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Geologic and Ground-Water Reconnaissance of the Loup River Drainage Basin Nebraska

R. T. Sniegocki

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By R. T. SNIEGOCKI

With a section on CHEMICAL QUALITY OF THE WATER

By R. H. LANGFORD

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By R. T. Sniegocki

ABSTRACT

The Loup River and its tributaries drain an area of about 15,230 square miles in central Nebraska. The upper three-fifths of the drainage basin is in the Sand Hills region of Nebraska, and the lower two-fifths is in the loess plains and hills region. An eastward-thinning wedge of semiconsolidated and unconsolidated deposits of Tertiary and Quaternary age underlies the surficial dune sand and loess. These deposits, which are recharged by infiltrating precipitation, contain a tremendous volume of water—at least 400 million acre-feet—and annually discharge about 1.7 million acre-feet into streams. Although wells supply nearly all the water used in the area for municipal, rural domestic, and livestock requirements, and some of the water used for irrigation, the withdrawals are small compared to the yield that the ground-water reservoir is capable of sustaining. Moreover, it seems unlikely that withdrawals ever will equal the potential for ground-water development except, perhaps, locally. The U.S. Bureau of Reclamation has prepared plans for greater utilization of the surface-water resources of the basin—overland runoff and ground-water discharge into streams—for generation of hydroelectric power and irrigation of farmland both within the basin and in the adjacent lower Platte River valley.

The chemical characteristics of the ground and surface water are uniform. The water is of the calcium bicarbonate type, generally contains less than about 500 parts per million of dissolved solids, and is suitable for irrigation and most domestic uses.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

The investigation of the Loup River drainage basin in Nebraska had a twofold objective: one to summarize available pertinent geologic and hydrologic information, and the other to collect enough field data on the occurrence, present use, and chemical quality of the ground water that general conclusions could be drawn about the potential for additional ground-water development in the area.

The locations of all wells having a large discharge were recorded. From water-level measurements made in some of these and in selected other wells and from information obtained from topographic maps, the general configuration of the water table was depicted by means of contour lines. Data obtained by test drilling were used in constructing a cross section of the rocks of Tertiary and Quaternary age in the southeastern part of the drainage basin. Chemical analyses of samples collected from streams and representative wells provide an index to the chemical quality of water supplies throughout the area.

The investigation was made as part of the program of the Department of the Interior for development of the Missouri River basin. The fieldwork was done in 1952 under the general supervision of G. H. Taylor, regional engineer, and under the direct supervision of C. F. Keech, district engineer, both of the Ground Water Branch. The study of the chemical quality of the water was made under the supervision of P. C. Benedict, regional engineer, Quality of Water Branch.

PREVIOUS INVESTIGATIONS

Several reports dealing specifically with the geology or groundwater resources, or both, describe areas that extend into, or are completely within, the Loup River drainage basin. (See fig. 1.). The earliest of these was written by Darton (1898), who described both the bedrock and mantling deposits and discussed the occurrence of ground water in an area that includes Dawson, Buffalo, and Hall Counties. Lugn and Wenzel (1938) described in greater detail the deposits of Quaternary age and presented a water-table contour map for a somewhat larger part of the Loup River drainage basin; their report, like Darton's, was written without benefit of information from test drilling.

Several reports prepared as part of the program for the development of the Missouri River basin deal specifically with the geology and water resources of parts of the Loup River drainage basin (fig. 1.) One, by Miller (1951), describes the exposed rocks in Valley County but mentions only briefly the occurrence of ground water. Another, by Connor (1951), gives chemical analyses of samples collected from the principal streams in the Loup River drainage basin and discusses the geochemical relationships and salinity characteristics of the water. A third report, by Brown (1955), describes groundwater resources of the lower Middle Loup River valley and the upland in east-central Sherman County and west-central Howard County. A fourth, by Sniegocki (1955), describes ground water in the Prairie Creek unit, which is a triangular area bounded by the Loup and Platte Rivers and the east edge of Hall and Howard Counties. A fifth, by Schreurs (1956), describes the geology and groundwater resources of Buffalo County and small parts of Hall, Howard, Sherman, Custer, and Dawson Counties. The reports by Sniegocki and Schreurs contain much information based on test drilling by the

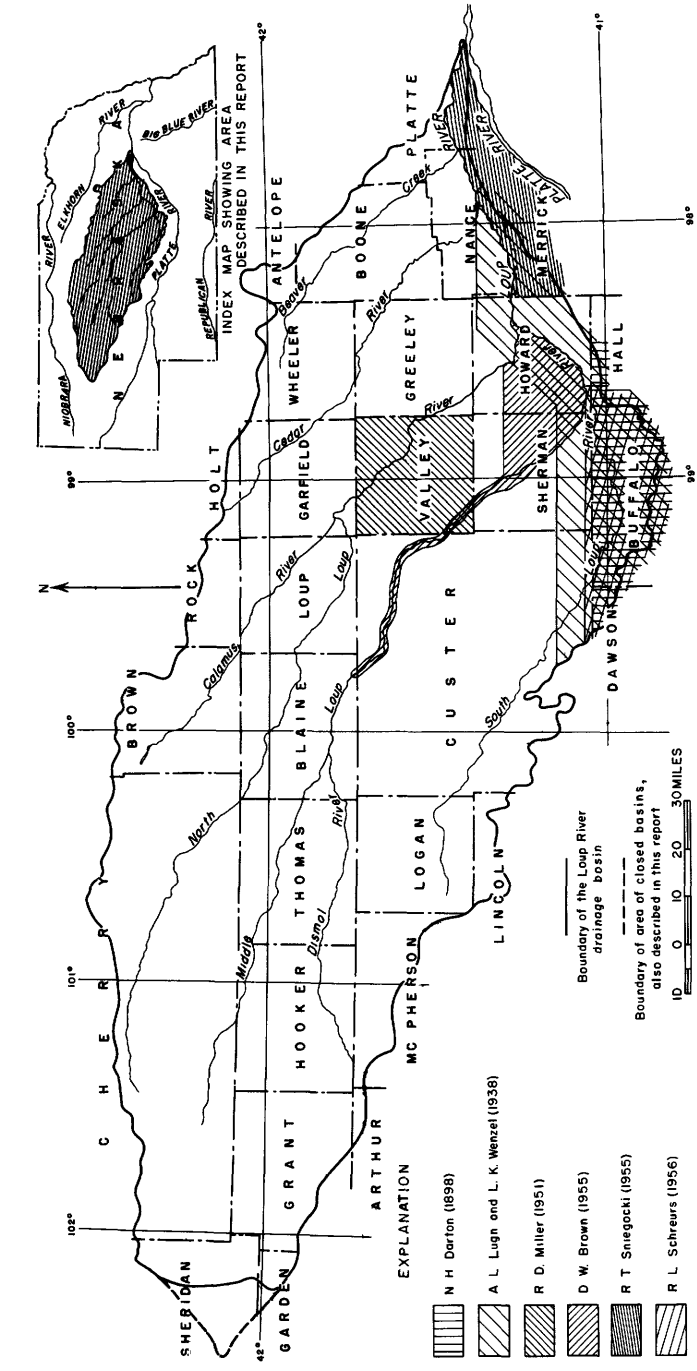

FIGURE 1.—Map showing extent of area described in this report and in previous reports.

Conservation and Survey Division of the University of Nebraska in cooperation with the U.S. Geological Survey.

The relation of the lakes to the ground-water reservoir in the Sand Hills region, much of which lies within the Loup River drainage basin, was discussed by Condra (1932). Other papers (Lugn, 1935; Condra, 1936, 1944, 1945, 1947; Condra and Reed, 1936; and Condra, Reed, and Gordon, 1947) discuss the geology, ground-water storage, and problems relating to land and water conservation in areas larger than, but including, the Loup River drainage basin. Geographic, geologic, and hydrologic data in the files of Federal and State agencies, private organizations, and individuals were compiled and analyzed in reports by the Nebraska State Planning Board (1936, 1941), together with firsthand information gathered by members of the board's staff. These publications contain much of the background material used in preparing this report.

As part of the program of geologic and ground-water studies made in Nebraska by the Conservation and Survey Division of the University of Nebraska in cooperation with the U.S. Geological Survey, 147 test holes had been drilled in the southeastern part of the Loup River drainage basin before this investigation was made. The logs of these test holes are summarized in table 8. Also, the Speltz, Cunningham, and Mevis Oil Exploration Co. had drilled 52 test holes in or near the Loup River drainage basin in 1941. The logs of 27 of these were presented by Schreurs (1956) and are summarized in table 9. The logs of the other 25 are reproduced in table 10, together with the logs of 8 wells drilled for the Chicago, Burlington & Quincy Railroad. Information from the logs of these test holes and well has contributed much to the understanding of the geology of the Loup River drainage basin.

Also as part of the State-Federal program of geologic and ground-water studies, many measurements of the water level in selected wells have been made during the past 17 years. (See table 11.) These records of water-table fluctuations are an index to the magnitude of changes in ground-water storage.

As part of the program for development of the Missouri River basin, the U.S. Geological Survey has prepared topographic quadrangle maps for about two-thirds of the Loup River drainage basin. In addition to portraying the topography, the quadrangle maps show the location of flowing wells, the altitude of the water surface of lakes, and the altitude of the land surface at livestock wells. The location of flowing wells and the contour lines depicting the configuration of the water table in the upper part of the Loup River drainage basin, as shown on plate 1 of this report, are based, in part, on data obtained from the quadrangle maps.

ACKNOWLEDGMENTS

Many persons supplied data that otherwise could not have been obtained readily, if at all. E. C. Reed and V. C. Dreeszen of the Conservation and Survey Division, University of Nebraska, made available their files of pertinent geologic and hydrologic data and assisted in interpretation of the data. County agricultural extension agents and local personnel of the U.S. Bureau of Reclamation and U.S. Soil Conservation Service supplied information on the location and characteristics of irrigation wells; and city and town officials furnished information on municipal water-supply systems. Farmers permitted the measurement of their wells and supplied many data that could not have been obtained readily by inspection of the wells.

SYSTEM USED IN NUMBERING WELLS AND TEST HOLES

All wells and test holes referred to in this report have been assigned numbers indicating their location within the land subdivisions surveyed by the U.S. Bureau of Land Management. The first numeral within the number indicates the township, the second the range, and the third the section in which the well or test hole is located. The lowercase letters (a, b, c, d) following the section number designate the quarter section and the quarter-quarter section. The letters are assigned in a counterclockwise direction beginning with "a" in the northeast quadrant. If two or more wells or test holes within the same quarter-quarter section are listed, they are distinguished by adding consecutive numerals after the lowercase letters. An uppercase letter "A" at the beginning of a well number indicates that the well is east of the principal meridian. The system used in numbering is illustrated in figure 2.

GEOGRAPHY

LOCATION, EXTENT, AND CLIMATE OF THE AREA

The Loup River drainage basin is in central Nebraska and includes all, or parts, of 30 counties. (See figs. 1 and 3.) It comprises about 15,230 square miles, or about one-fifth of the area of the State. It is about 275 miles long and in its central part is about 85 miles wide. On the northwest it is bordered by the drainage basin of the Niobrara River, on the northeast by the drainage basin of the Elkhorn River, and on the southwest and southeast by the drainage basin of the Platte River. Also described in this report is a triangular area of closed basins, which is about 155 square miles in extent and adjoins the west end of the Loup River drainage basin.

The climate of the Loup River drainage basin grades from semiarid at the west end, where the mean annual precipitation is about 18 inches,

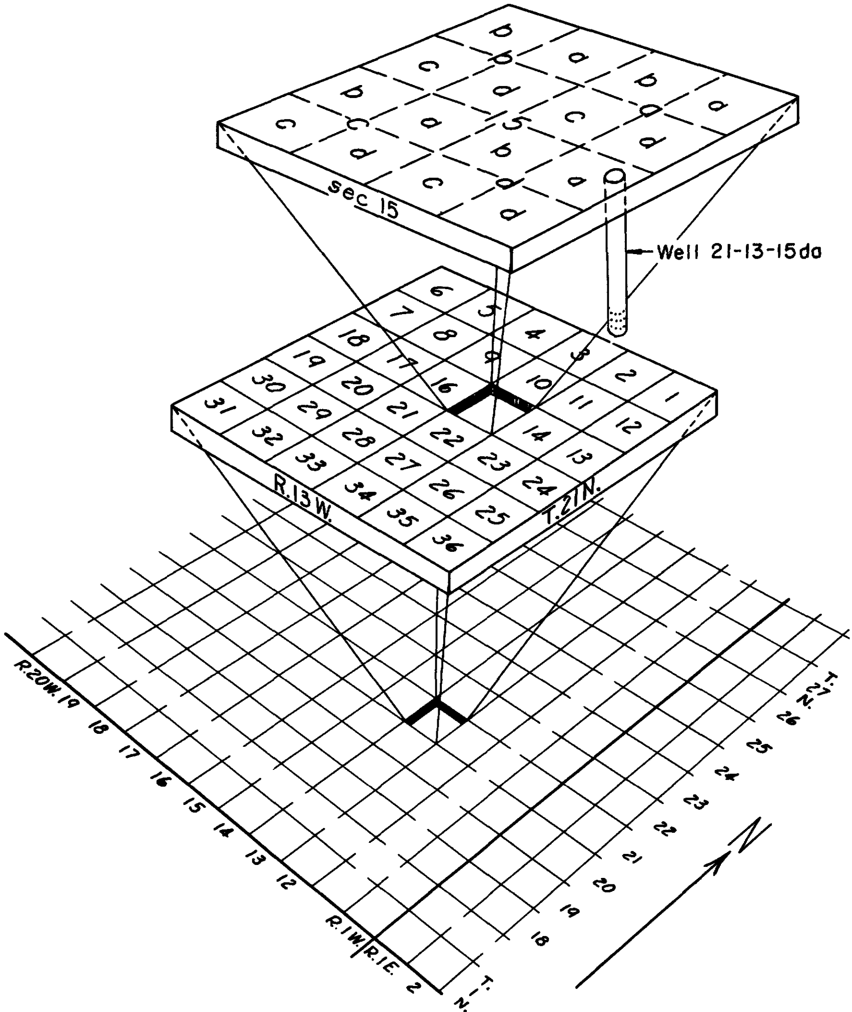

FIGURE 2.—Diagram of system used in numbering wells and test holes.

to subhumid at the east end, where the precipitation is about 26 inches. Precipitation records for selected stations in the basin are shown by graphs in figures 4 to 6. About 80 percent of the precipitation falls in the period April through September. (See fig. 7.) At Genoa, where records have been kept since 1876, precipitation of 2 inches or more within 24 hours occurs on an average of every 1.2 years. The maximum recorded rainfall in a 24-hour period was 12 inches at both Greeley and Loup City on June 5, 1896.

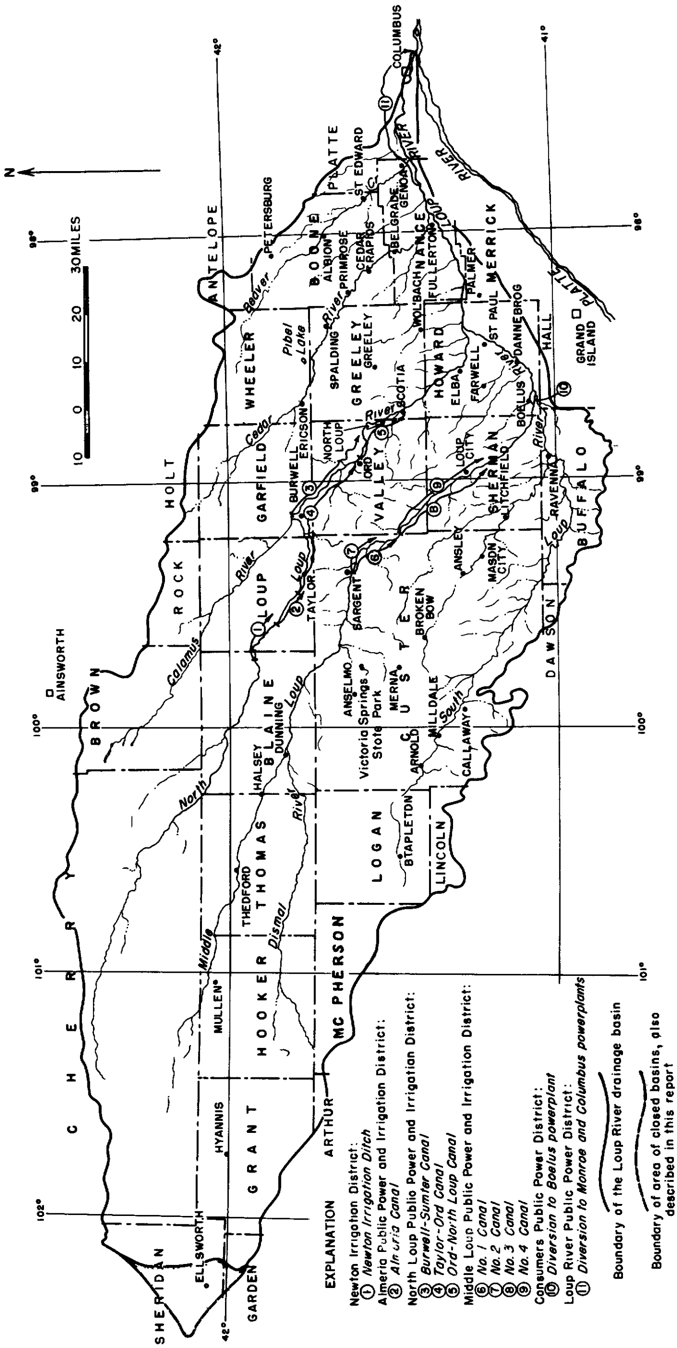

FIGURE 3.—Map showing location of principal towns and canals in the Loup River drainage basin.

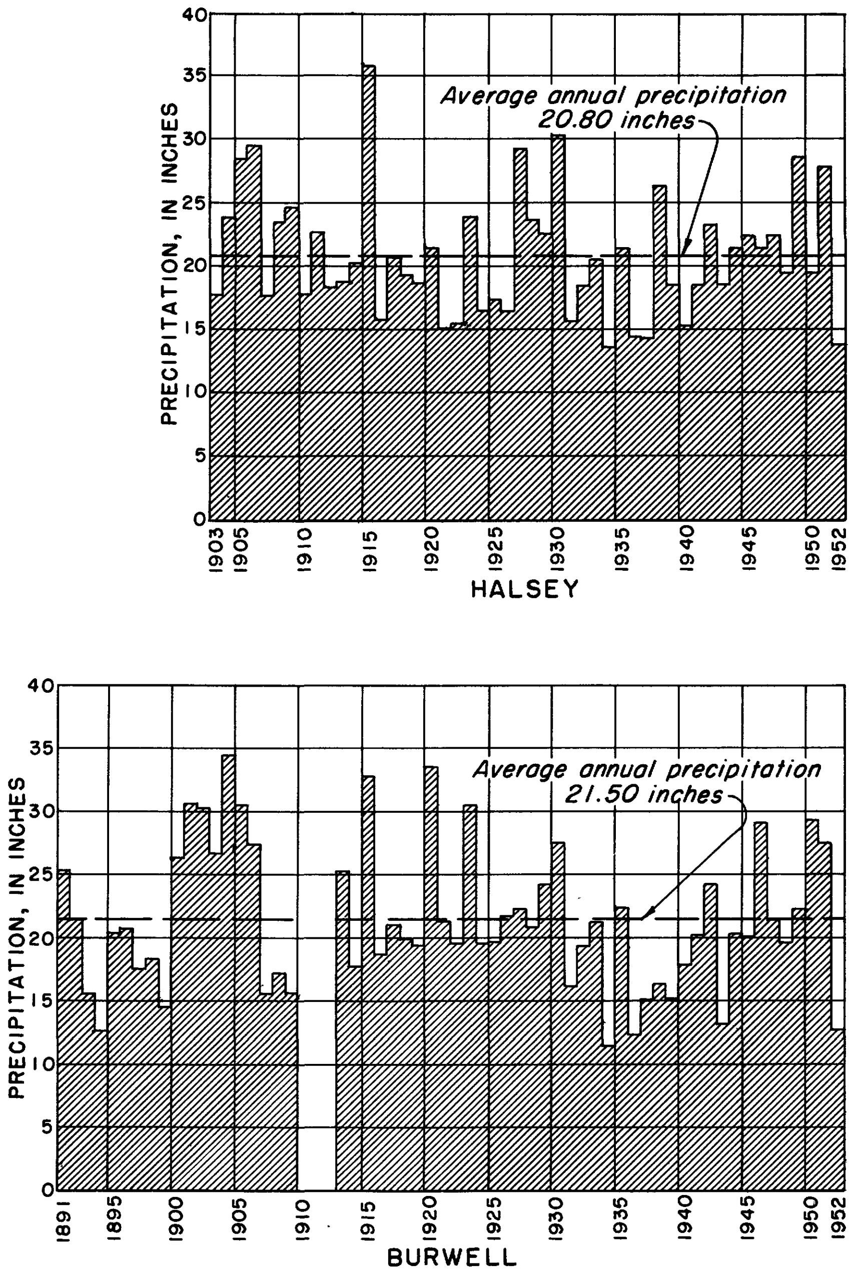

FIGURE 4.—Annual precipitation at Halsey, Nebr., 1903–52, and at Burwell, Nebr., 1891–1952.

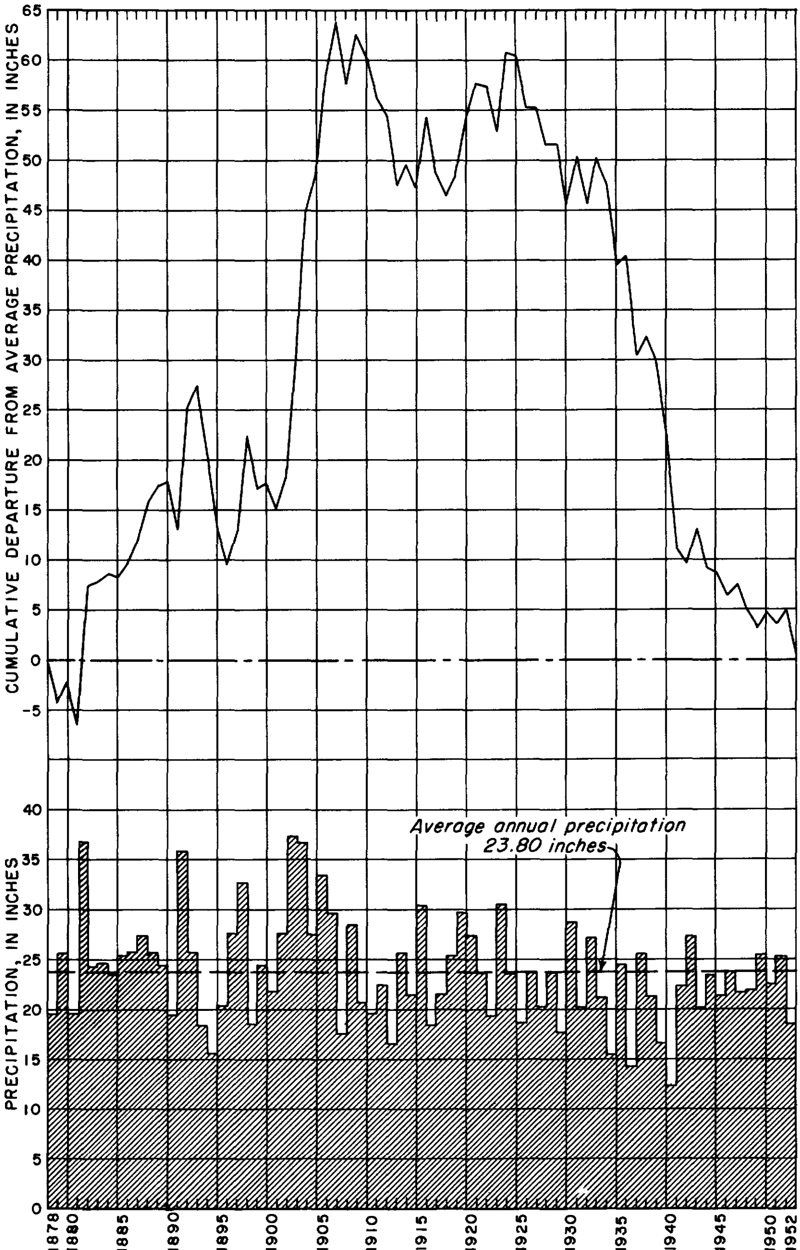

FIGURE 5—Annual precipitation and cumulative departure from average annual precipitation at Ravenna, Nebr., 1878–1952.

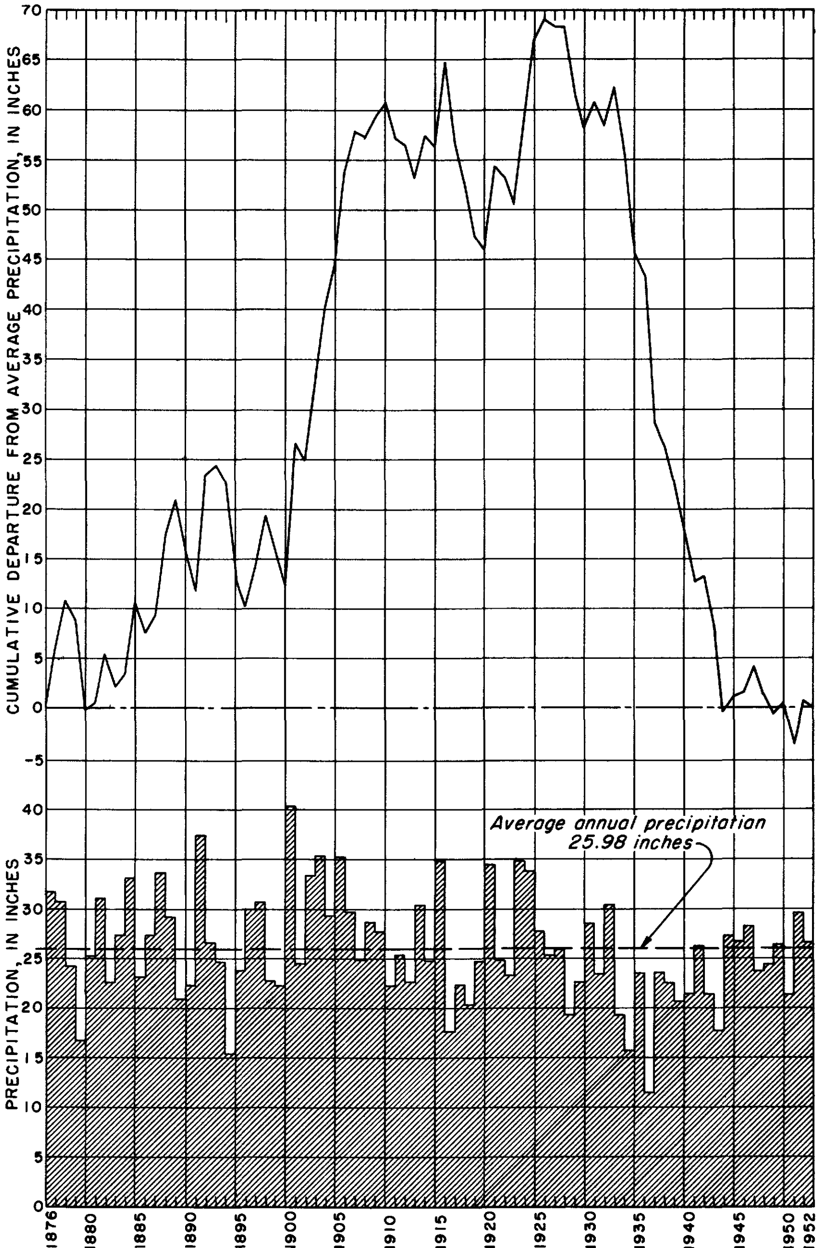

FIGURE 6.—Annual precipitation and cumulative departure from average annual precipitation at Genoa, Nebr., 1876–1952.

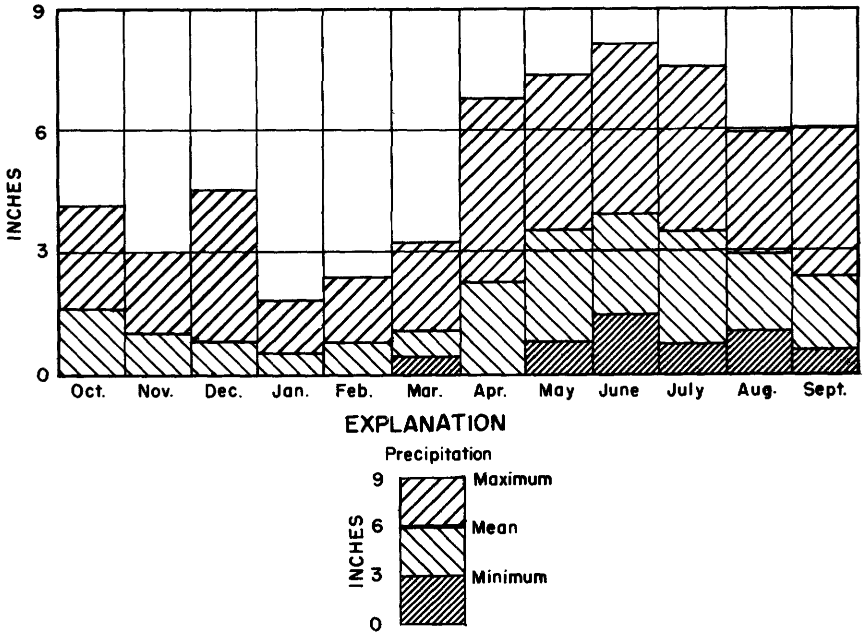

FIGURE 7.—Minimum, average, and maximum monthly precipitation in the Loup River drainage basin, 1900–38. From Nebraska State Planning Board, 1941.

Precipitation in the Sand Hills part and in the loess plains and hills part of the Loup River drainage basin during water years 1948–52 is given in table 1.

TABLE 1.—*Precipitation in the Loup River drainage basin, 1948–52*

Water year	Precipitation			
	Sand Hills part of the basin		Loess plains and hills part of the basin	
	Weighted average (inches)	Total volume (millions of acre-feet)	Weighted average (inches)	Total volume (millions of acre feet)
1948	19. 38	8. 9	22. 72	8. 0
1949	24. 86	11. 4	25. 65	9. 1
1950	23. 98	11. 0	24. 36	8. 6
1951	27. 24	12. 5	27. 80	9. 8
1952	16. 60	7. 6	17. 77	6. 3

The average annual temperature at Halsey is 48° F and at Loup City is 49°F. The average daily minimum and maximum temperatures are 33.9°F and 62.2°F at Halsey, and 35.9°F and 62.1°F at Loup City.

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The lowest and the highest temperatures recorded at Halsey are −34°F and 108°F, and at Loup City −39°F and 110°F. Temperatures of 0° F or below are recorded on 15 to 30 days each winter and of 100° F or above on 7 to 15 days each summer. The average length of the growing season ranges from 145 days in the western part of the basin to 160 days in the eastern part.

The evaporation rate is not recorded at any of the climatological stations of the U.S. Weather Bureau in the Loup River drainage basin, but it is estimated from a partial record kept at the Valentine Migratory Waterfowl Refuge, a few miles north of the basin boundry, that evaporation from a free water surface is about 50 inches per year. Actual water loss—evaporation plus plant transpiration—from the drainage basin of the Middle Loup and North Loup Rivers above St. Paul averaged about 19.5 inches per year during the period 1929–33 (Williams and others, 1940). This figure was obtained by subtracting measured runoff from precipitation.

TOPOGRAPHY AND DRAINAGE

The northwestern three-fifths of the Loup River drainage basin is within the Sand Hills region of Nebraska. This part of the basin consists of sand dunes and intervening sand-floored valleys. Viewed from the air, the landscape appears to be similar to the surface of a billowy sea. At some places the dunes are alined in nearly parallel windrows (fig. 8) and at others they are arranged haphazardly (fig. 9). Generally the dunes are steepest on their east side, indicating that they were formed by westerly winds. The land surface in this part of the basin is mostly sod covered, but the tops of many of the dunes have been hollowed out by wind action (fig. 9). The craterlike hollows of bare sand commonly are referred to as "blowouts." There are hundreds of small lakes and marshes in the Sand Hills region. During periods of prolonged drought the larger and deeper lakes become smaller and shallower, and the smaller and shallower lakes and marshes may disappear entirely. Conversely, during a succession of years of above-average precipitation, new lakes and marshes may appear where lakes and marshes formerly had been and the lakes already in existence increase in size and depth.

The remaining two-fifths of the basin once was a fairly smooth constructional plain but now is being dissected by the headward erosion of streams (fig. 10). Because the plain is the top surface of a thick layer of wind-deposited dust, or loess, this part of the basin is called the loess plains and hills region. Although some fairly extensive upland flats remain, most of this part of the basin is character-

FIGURE 8.—Oblique aerial view to the west near Dunning, Blaine County, showing the confluence of the Dismal (left) and Middle Loup (right) Rivers and the windrow dune topography. Photograph by H. E. Skibitzke.

FIGURE 9.—Oblique aerial view to the south near Ellsworth, Sheridan County, showing blowout development in the Sand Hills region. Photograph by H. E. Skibitzke.

FIGURE 10.—Oblique aerial view to the southeast near Milldale, Custer County, showing dissection of the formerly continuous loess plain. Photograph by H. E. Skibitzke.

ized by smooth hills and valleys or, where erosion is more active, by sharp ravines and ridges.

The general slope of the Loup River drainage basin is southeastward; the streams have an average gradient of 7.5 feet per mile. The tops of the highest hills at the west end of the area are about 4,300 feet above sea level and the altitude of the Loup River where it flows into the Platte River is 1,415 feet above sea level. Relief along any line transverse to the regional slope is less than about 600 feet.

The principal streams in the Loup River drainage basin have their origin in the Sand Hills part of the basin. The South Loup River heads in Logan County and flows southeastward to north-central Buffalo County, where it veers northeastward and flows into the Middle Loup River near Boelus in Howard County. The Middle Loup heads in southwestern Cherry County and flows southeastward to Boelus, there veering northeastward and joining the North Loup River near St. Paul to form the northeastward-flowing Loup River. The Dismal River, which rises in eastern Grant County, flows into the Middle Loup at Dunning in southwestern Blaine County. Both the North Loup River, which rises in west-central Cherry County, and the Calamus River, which rises in western Brown County, flow southeastward—the Calamus flowing into the North Loup at Burwell. The Cedar River and Beaver Creek rise in southwestern Holt County and central Wheeler County, respectively, and flow southeastward, both entering the Loup River in Nance County. In Platte County the Loup River arcs southeastward and enters the Platte River near Columbus. The Loup River and the lower reaches of its principal tributaries flow in broad, nearly flat valleys.

Stream and canal discharge has been or is measured at the gaging stations shown in figure 11; the discharge measurements are summarized in table 2. The discharge of streams in the Loup River drainage basin in 1952 is represented by the width of the streams in figure 12.

The discharge measurements made at the gaging stations Middle Loup River at Seneca, Middle Loup River at Dunning, Dismal River near Gem, and Dismal River at Dunning indicate that the rate of flow of streams in the Sand Hills part of the basin is remarkably uniform. During the 3 water years 1950–52, the variation in annual discharge at these stations was 6, 6, 2, and 4 percent, respectively, of the average annual discharge during the same period. Because only about 9 percent of the Sand Hills part of the basin contributes direct overland runoff to the streams, most of the discharge of streams in this part of the Loup River drainage basin is water that reaches the streams by subterranean routes. In the loess plains and hills part of the basin,

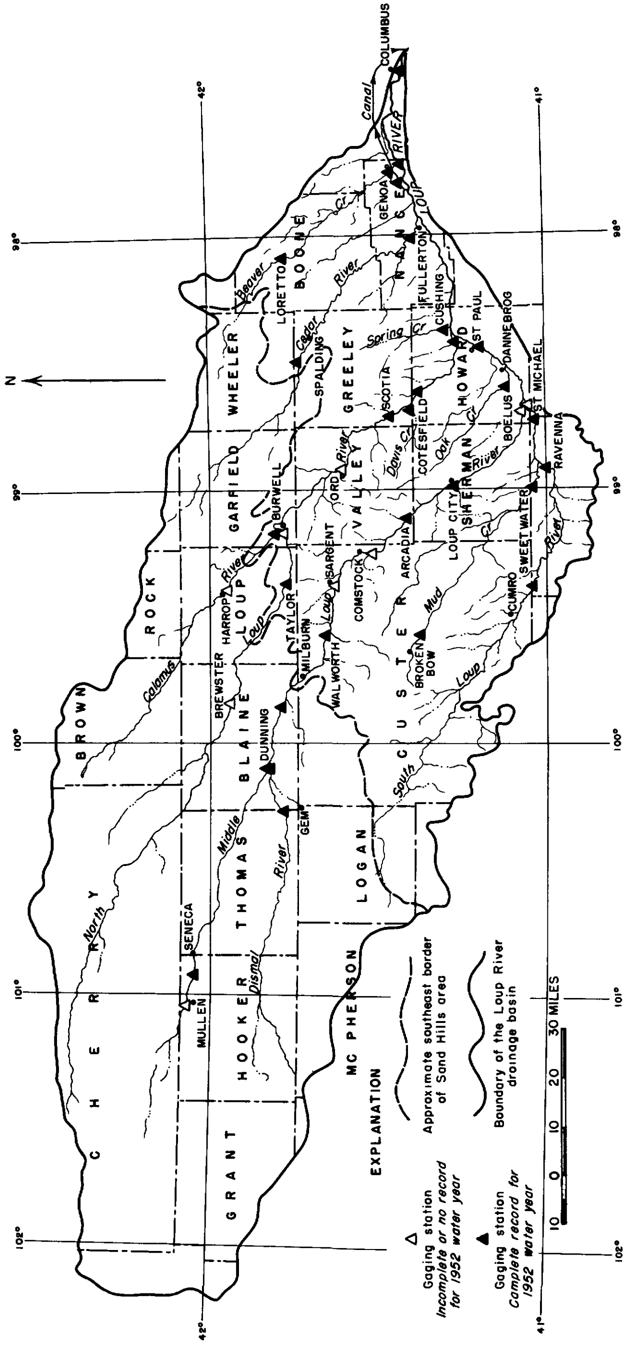

FIGURE 11.—Map showing location of stream-gaging stations in the Loup River drainage basin.

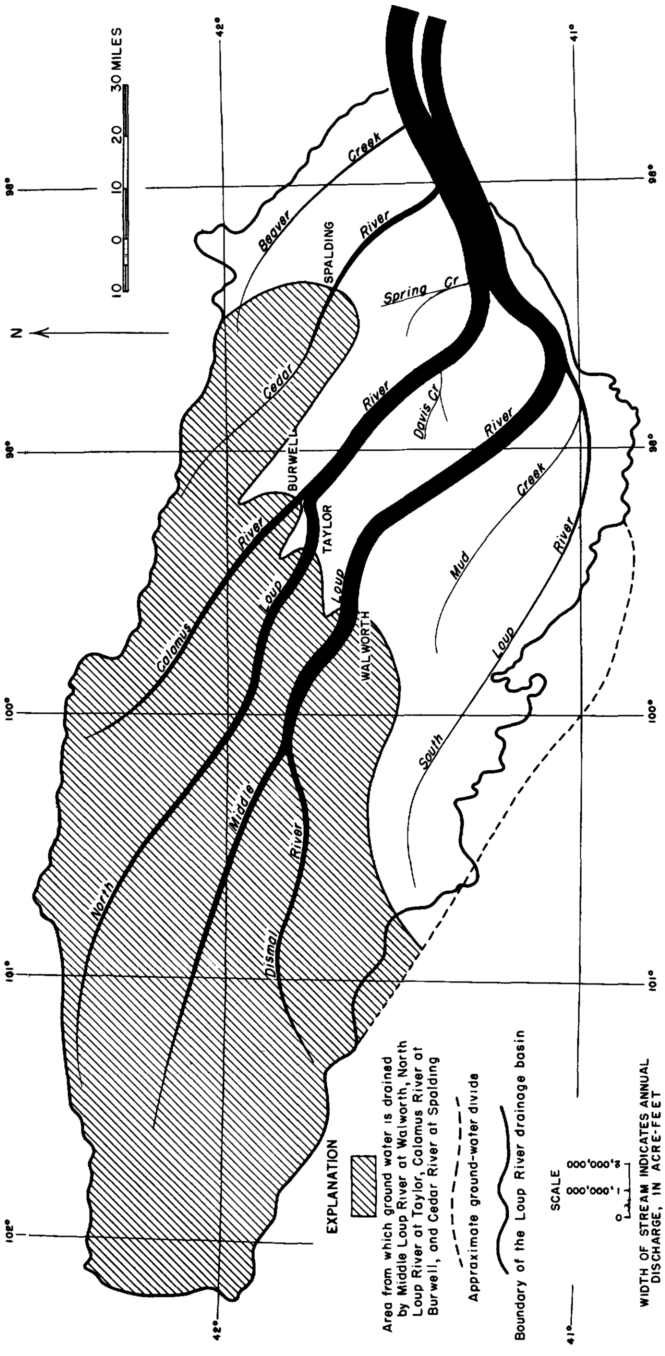

FIGURE 12.—Map showing discharge of streams in the Loup River drainage basin in 1952.

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*

[Annual discharge values rounded according to standard practice]

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Middle Loup River near Mullen													
1946–47	8,420	8,150	7,870	8,420	6,890	8,360	8,930	8,050	11,600	7,810	7,380	7,680	99,560
1947–48	8,080	7,900	8,250	8,170	7,440	8,240	7,890	8,130	7,710	7,860	8,040	7,470	95,180
Middle Loup River near Seneca													
1947–48	------	------	------	------	------	------	3,760	11,020	11,290	11,340	11,470	10,210	------
1948–49	11,620	11,090	11,980	12,440	11,970	14,560	14,110	14,250	12,340	11,750	10,650	10,740	147,500
1949–50	11,150	10,770	11,870	11,790	11,140	12,440	12,010	12,240	10,940	11,300	12,000	12,640	140,300
1950–51	12,300	11,220	11,720	11,670	11,310	11,370	11,010	14,140	13,230	13,260	12,410	14,660	148,300
1951–52	11,440	11,820	11,350	11,010	12,340	12,680	14,140	13,300	11,670	11,650	11,680	11,920	145,000
Middle Loup River at Dunning													
1944–45	------	------	------	------	------	------	------	------	------	------	------	13,570	------
1945–46	24,420	23,200	22,880	26,010	23,680	25,520	23,190	22,890	20,520	20,090	21,360	22,890	276,600
1946–47	26,800	23,380	25,070	23,940	20,770	24,640	24,380	22,940	26,890	22,200	20,950	21,620	283,600
1947–48	22,800	21,640	22,280	24,600	21,280	23,830	22,670	21,710	20,350	22,180	22,020	21,520	266,900
1948–49	22,910	23,610	23,560	19,800	23,640	29,340	25,640	24,940	22,970	22,060	21,410	22,000	281,900
1949–50	21,480	22,880	20,640	21,400	21,420	25,460	22,040	23,350	20,490	21,850	21,810	21,230	264,000
1950–51	21,280	22,820	24,160	22,810	23,990	23,200	19,850	25,100	24,200	23,360	22,540	23,720	277,000
1951–52	23,880	22,930	23,830	23,370	23,270	26,860	25,760	25,130	21,150	21,490	22,390	20,440	280,500
Dismal River near Gem													
1946–47	16,700	16,060	15,660	17,040	15,380	16,400	16,930	15,880	16,720	16,000	16,090	16,280	195,100
1947–48	16,640	15,660	16,980	15,180	13,400	17,110	15,880	16,820	16,000	15,440	15,480	15,910	190,500
1948–49	16,460	15,840	16,760	16,600	16,660	17,520	17,550	16,600	16,150	15,840	16,710	15,520	198,200
1949–50	16,880	16,960	16,940	15,470	16,440	17,790	16,720	17,490	16,010	18,590	17,430	17,890	204,600
1950–51	18,050	16,880	17,930	16,940	17,380	16,820	16,260	19,030	17,520	17,860	16,420	16,890	208,000
1951–52	16,860	16,390	17,660	18,720	17,670	19,670	17,010	17,210	15,880	16,230	16,670	16,060	206,000

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Dismal River at Dunning													
1945–46	19,500	20,270	19,690	20,150	19,760	20,280	18,150	18,090	16,340	16,520	17,880	16,950	223,600
1946–47	19,560	18,490	17,910	20,970	19,340	19,030	19,470	18,200	21,850	18,560	17,520	18,080	229,000
1947–48	18,410	18,430	19,480	17,760	15,760	20,080	18,190	19,890	18,110	18,480	18,330	18,600	221,500
1948–49	18,780	18,160	19,600	19,740	19,540	20,620	20,760	19,460	18,600	18,040	18,880	18,860	231,000
1949–50	19,010	18,270	18,400	17,120	18,100	19,860	19,140	18,550	17,230	20,070	17,930	19,010	222,700
1950–51	19,870	18,420	20,030	18,860	19,430	18,770	18,150	21,420	19,540	19,680	17,950	19,080	231,200
1951–52	18,220	18,090	19,840	20,470	19,500	21,680	19,120	19,200	18,060	18,200	18,730	18,070	229,200
Middle Loup River near Milburn													
1951–52	51,690	48,460	43,110	50,640	49,690	54,390	56,400	50,610	44,640	42,330	45,670	44,090	581,700
Middle Loup River at Walworth													
1940–41	47,470	50,870	38,950	44,500	57,880	42,630	43,720	49,170	43,030	44,330	44,010	46,030	552,600
1941–42	------	------	------	------	------	------	------	------	------	------	------	------	------
1942–43	------	------	------	------	------	------	------	------	------	------	43,010	45,270	------
1943–44	53,150	46,990	48,330	51,390	47,210	61,040	51,090	49,510	48,150	46,500	43,440	42,610	589,400
1944–45	47,670	51,900	42,330	43,140	46,430	52,620	48,220	54,200	50,020	44,380	43,570	48,720	573,200
1945–46	46,000	43,450	40,600	52,600	51,470	56,630	45,080	45,790	40,200	37,620	41,880	45,450	546,800
1946–47	53,960	46,300	44,210	44,410	41,000	53,130	48,450	48,700	73,290	43,950	43,300	43,840	584,500
1947–48	47,770	47,300	49,150	44,350	51,150	51,340	50,330	45,880	44,640	44,050	42,930	42,160	561,000
1948–49	43,330	43,560	40,560	38,440	46,430	62,200	59,480	57,680	51,770	43,180	45,310	46,630	578,600
1949–50	49,300	49,260	41,480	38,700	52,280	56,050	53,900	50,270	42,010	49,530	48,980	47,120	578,900
1950–51	48,910	49,200	49,160	44,390	50,130	51,490	51,960	62,970	55,190	50,180	51,650	50,890	616,000
1951–52	53,850	46,110	43,800	56,910	56,150	56,840	56,780	55,020	44,600	44,100	45,610	43,590	603,400

Middle Loup River at Sargent

1936-37	-----	-----	-----	43,120	50,690	61,120	51,070	50,790	42,300	44,420	40,180	45,890	-----
1937-38	51,120	42,660	42,810	43,380	43,250	58,010	56,620	58,810	50,570	48,770	44,260	47,690	588,000
1938-39	50,320	45,670	47,190	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Middle Loup River near Comstock

1936-37	-----	-----	-----	41,300	49,840	66,240	53,550	49,710	45,250	43,070	-----	-----	-----

Middle Loup River at Arcadia

1936-37	-----	-----	-----	-----	-----	-----	-----	-----	-----	44,190	43,450	45,290	-----
1937-38	53,860	40,270	40,870	48,480	44,670	68,190	69,300	70,400	53,960	48,780	41,000	43,300	623,100
1938-39	45,240	44,780	55,160	56,140	25,100	63,690	45,660	50,260	50,770	33,370	32,990	33,120	536,300
1939-40	46,620	49,910	46,930	35,140	53,970	63,560	48,270	38,060	42,970	25,840	29,180	31,840	512,300
1940-41	42,890	53,030	49,120	63,660	58,380	48,070	33,310	39,670	36,440	32,360	27,110	48,270	532,300
1941-42	54,980	45,370	48,300	48,880	53,490	64,160	60,860	59,850	53,610	34,540	37,140	46,010	607,200
1942-43	53,890	58,490	49,590	38,860	48,410	57,330	56,150	43,940	47,710	37,750	30,850	40,730	563,700
1943-44	53,830	49,090	46,530	52,540	56,100	67,490	66,440	63,010	47,530	40,120	30,140	42,720	615,500
1944-45	51,260	49,240	44,450	46,510	50,700	57,180	55,080	55,620	52,240	39,890	38,450	38,510	579,100
1945-46	46,100	45,060	41,930	52,580	49,060	63,540	42,770	39,770	34,590	29,470	28,830	39,390	513,100
1946-47	66,340	49,740	45,940	47,420	45,000	60,600	56,340	47,150	110.200	45,050	29,070	39,460	642,300
1947-48	44,620	50,130	46,170	43,460	51,170	56,340	50,160	36,670	40,520	36,870	44,890	31,680	532,700
1948-49	42,880	48,110	40,030	45,100	47,700	79,810	66,990	59,800	52,710	34,570	34,270	46,990	599,000
1949-50	51,880	52,190	46,760	43,890	50,520	57,820	56,350	54,080	36,840	55,440	48,120	46,730	600,600
1950-51	55,620	47,080	45,910	42,480	51,790	54,260	52,180	70,680	51,820	56,210	49,580	53,880	631,500
1951-52	53,680	49,850	45,320	56,030	56,260	70,710	64,690	61,350	33,010	29,860	30,710	36,170	587,600

Middle Loup River at Loup City

1936-37	-----	-----	-----	40,990	51,550	68,720	58,160	53,800	51,890	45,600	44,880	53,910	-----
1937-38	54,110	47,540	42,380	49,300	47,180	78,260	81,950	-----	-----	-----	-----	-----	-----
1948-49	-----	-----	-----	-----	-----	-----	-----	-----	35,090	33,500	33,680	44,580	-----
1949-50	51,300	52,350	45,130	41,710	50,840	60,990	57,870	57,560	37,670	55,240	49,500	43,640	603,800
1950-51	55,450	47,800	44,240	46,370	51,040	53,750	58,740	71,540	53,090	62,520	48,070	59,670	652,300
1951-52	60,830	48,470	46,450	61,530	62,620	74,400	64,260	68,820	33,680	27,420	34,860	35,070	618,400

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Boelus power canal near Boelus													
1951–52	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	25,630	28,540	----------
Middle Loup River at Boelus													
1936–37	----------	----------	----------	22,290	55,520	105,900	51,610	50,650	57,290	49,200	38,430	46,960	----------
1937–38	50,160	43,420	42,460	51,150	49,820	73,770	61,110	68,310	45,600	50,930	35,980	43,050	615,800
1951–52	----------	----------	----------	----------	----------	----------	----------	----------	----------	3,410	6,700	7,230	----------
South Loup River near Cumro													
1945–46	----------	----------	----------	----------	----------	----------	----------	----------	10,680	7,720	5,600	7,650	----------
1946–47	19,670	10,340	9,230	8,330	10,590	10,470	10,950	8,830	35,110	12,830	7,440	7,190	151,000
1947–48	7,620	8,590	9,540	9,760	12,130	16,930	8,920	7,710	8,620	11,620	8,670	6,180	116,300
1948–49	7,240	8,140	8,970	6,850	8,870	14,410	14,530	11,910	12,010	7,740	6,560	11,820	119,000
1949–50	8,580	8,810	8,140	7,540	10,120	12,080	10,440	11,370	8,500	10,030	8,110	7,850	111,600
1950–51	8,830	8,700	8,290	8,710	9,040	9,890	10,050	23,080	13,570	10,560	9,000	9,420	129,100
1951–52	9,550	9,060	8,360	10,190	11,820	13,110	10,660	9,770	7,230	6,340	6,770	6,200	109,100
South Loup River at Ravenna													
1940–41	7,380	10,460	16,470	14,580	16,670	17,530	16,280	18,000	16,120	9,570	4,440	9,000	156,500
1941–42	8,830	8,730	8,380	9,630	11,350	14,710	10,190	14,240	29,840	9,690	7,870	26,190	159,600
1942–43	9,780	10,170	11,310	8,190	9,800	11,380	14,110	9,760	38,340	16,050	6,380	6,050	151,300
1943–44	7,830	8,720	8,150	9,620	10,780	13,110	20,280	22,560	14,290	9,860	6,510	6,160	137,900
1944–45	8,310	8,680	7,980	8,880	12,080	9,740	11,560	17,470	46,120	9,810	10,290	7,300	158,200
1945–46	9,220	9,250	7,240	10,590	10,670	14,190	9,800	10,580	11,670	8,200	4,650	9,300	115,400
1946–47	28,430	14,000	10,650	10,200	14,100	14,280	14,230	10,140	93,980	18,960	7,410	7,190	243,600
1947–48	8,090	9,790	10,460	8,700	12,420	27,670	11,010	9,350	17,470	17,700	14,540	5,930	153,100
1948–49	7,500	9,360	8,450	7,800	10,770	23,130	19,350	15,590	26,120	8,180	6,980	18,960	162,200
1949–50	9,730	10,080	8,780	7,540	12,690	15,200	13,290	15,960	10,530	15,630	9,300	9,850	138,600
1950–51	10,560	10,810	10,900	9,150	11,350	12,510	13,950	30,370	19,640	14,370	11,100	11,190	165,900
1951–52	10,900	11,050	9,430	9,850	14,710	19,090	14,290	13,300	8,300	6,610	5,750	5,220	128,500

Mud Creek near Broken Bow													
1949-50	42	50	46	41	64	100	93	113	73	596	355	70	1,640
1950-51	69	69	74	75	70	87	108	291	189	606	142	99	1,880
1951-52	81	86	105	87	107	220	143	126	59	45	44	25	1,130
Mud Creek near Sweetwater													
1945-46											440	1,650	
1946-47	9,480	1,710	1,680	1,830	4,100	2,270	2,230	2,080	59,620	4,600	1,580	1,340	92,520
1947-48	1,230	1,640	1,640	2,430	5,890	18,920	2,360	1,880	5,300	5,230	6,800	996	54,320
1948-49	1,110	1,320	1,380	1,590	3,990	4,270	3,050	2,860	6,340	2,210	891	3,430	32,440
1949-50	1,370	1,400	1,370	1,120	2,360	2,760	2,500	4,200	3,370	11,720	7,820	2,300	42,290
1950-51	3,160	2,030	1,670	1,760	1,990	2,280	2,800	5,640	5,510	6,970	4,070	2,510	40,390
1951-52	2,070	2,060	1,850	2,730	3,400	5,050	2,780	2,350	1,570	1,120	873	851	26,700
South Loup River at St. Michael													
1943-44	8,800	10,440	9,900	10,120	12,510	15,060	26,370	32,380	17,850	12,300	7,440	7,830	171,000
1944-45	9,220	11,350	8,940	10,450	14,600	12,590	13,340	20,490	66,270	17,010	11,570	8,000	203,800
1945-46	9,810	10,430	8,370	11,540	11,800	15,600	10,610	12,110	16,160	9,090	4,880	11,560	132,000
1946-47	38,070	16,160	12,420	12,000	18,220	18,050	17,310	12,340	163,100	24,090	9,080	8,520	349,400
1947-48	8,940	11,720	12,090	11,840	21,820	46,910	13,100	11,480	25,870	23,160	23,670	7,040	217,600
1948-49	8,580	10,950	10,610	8,910	15,070	29,000	23,240	20,380	31,570	9,890	7,650	22,040	197,900
1949-50	11,460	11,420	10,620	9,650	17,160	19,020	15,150	20,780	15,900	25,760	16,360	12,380	185,700
1950-51	14,100	12,230	10,700	10,620	12,970	14,330	17,880	34,570	26,240	25,190	16,070	13,590	208,500
1951-52	12,950	12,750	11,500	12,240	17,970	26,460	18,290	16,250	9,750	8,530	6,460	6,280	159,400
Oak Creek near Dannebrog													
1949-50	64	66	70	60	348	480	130	1,390	1,220	8,370	579	91	12,870
1950-51	182	92	130	87	133	179	1,180	2,830	1,600	2,510	238	538	9,700
1951-52	104	120	74	172	290	699	258	233	53	319	23	8.5	2,350

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Middle Loup River at St. Paul													
1927–28												56,300	
1928–29	70,100	80,900	29,900	33,800	41,300	128,000	91,000	127,100	102,000	76,900	53,900	60,700	896,000
1929–30	61,500	44,400	29,900	43,900	134,000	83,000	107,000	124,000	155,000	45,100	86,100	77,400	991,000
1930–31	103,000	78,000	75,000	90,400	89,400	89,200	72,600	70,100	53,400	47,100	47,200	46,300	862,000
1931–32	71,300	60,700	97,800	58,000	82,800	94,700	66,000	90,400	179,000	78,700	81,200	60,100	1,021,000
1932–33	68,900	50,600	45,400	68,200	50,600	100,000	75,000	89,200	48,000	69,500	78,700	63,100	807,000
1933–34	62,800	68,970	78,700	64,560	61,090	66,410	69,130	57,470	52,370	44,540	52,890	59,290	738,200
1934–35	78,030	80,730	43,530	46,600	84,580	72,550	94,530	131,000	163,000	89,400	92,030	82,080	1,058,000
1935–36	84,670	83,370	62,180	42,370	48,800	182,700	69,050	64,650	54,580	35,770	41,150	48,480	817,800
1936–37	50,880	48,460	49,560	18,140	57,230	144,600	66,400	71,880	81,960	52,310	45,640	71,950	759,000
1937–38	68,560	41,660	47,110	54,190	58,770	90,390	65,550	134,400	84,620	109,500	38,110	50,480	843,300
1938–39	54,930	57,220	92,160	74,400	41,970	80,350	64,470	62,020	74,880	41,390	34,500	31,310	709,600
1939–40	50,410	62,880	62,810	35,540	65,410	95,810	54,600	50,460	95,740	23,400	28,950	39,010	665,000
1940–41	61,020	54,460	48,710	63,510	78,920	91,240	79,290	83,120	76,050	41,870	27,140	53,900	759,200
1941–42	54,570	44,850	55,740	53,210	51,030	93,080	64,430	86,720	118,700	37,620	53,390	94,900	808,200
1942–43	65,610	76,890	41,880	39,230	58,550	74,160	69,440	52,190	111,200	81,800	35,710	55,310	762,000
1943–44	57,880	61,400	53,630	61,980	85,610	95,070	118,800	105,300	85,510	56,430	37,160	52,350	871,100
1944–45	63,510	61,690	48,610	63,790	60,520	64,810	74,980	92,790	134,500	57,420	52,140	47,080	821,800
1945–46	58,360	53,840	40,580	74,120	71,920	77,240	55,280	56,540	70,090	43,110	30,040	58,480	689,600
1946–47	109,900	67,520	58,200	60,990	65,360	83,350	84,000	59,630	292,300	72,870	35,900	47,380	1,037,000
1947–48	54,660	67,880	65,470	62,580	92,070	151,300	61,450	51,360	96,140	69,330	82,810	39,390	894,500
1948–49	51,710	61,980	52,660	48,160	59,940	125,200	94,600	79,520	118,900	45,460	42,690	70,420	851,200
1949–50	66,630	59,880	49,720	42,860	66,510	88,940	75,850	92,290	56,950	109,900	77,300	58,870	845,700
1950–51	73,570	58,810	56,020	56,560	76,740	77,280	82,410	122,100	98,280	83,970	69,710	77,230	932,700
1951–52	72,600	72,030	43,610	68,720	86,420	97,190	76,890	81,370	40,340	39,550	36,160	39,450	754,300
North Loup River at Brewster													
1944–45												10,720	
1945–46	21,170	20,240	18,190	22,180	20,830	27,670	19,540	20,350	17,000	15,220	16,810	20,360	239,600
1946–47	24,130	23,590	23,710	22,410	19,540	23,540	27,130	19,980	27,860	19,790	17,080	18,900	267,700
1947–48	18,730	21,650	23,080	19,140	22,470	20,310	20,060	20,430	19,740	18,620	17,690	17,290	239,200
1948–49	19,380	20,690	19,470	18,130	22,870	37,920	29,420	28,950	27,190	19,950	19,100	19,380	282,400
1949–50	23,050	21,940	19,790	22,470	25,240	26,580	25,590	28,350	21,340	22,140	21,380	22,410	280,300
1950–51	23,060	22,610	22,450	20,760	23,230	24,710	24,230	35,070	44,530	29,380	30,310	31,510	331,800

North Loup River at Taylor

1936-37			27,050	20,340	25,790	32,420	26,920	25,620	26,280	19,590	18,180	22,600	
1937-38	26,510	29,140	26,290	22,630	28,230	38,140	39,550	38,040	26,150	25,150	20,920	24,470	345,200
1938-39	23,720	26,100	29,610	29,810	22,310	31,970	25,920	24,080	27,050	16,190	17,300	17,620	291,700
1939-40	21,380	26,250	25,100	24,760	32,980	35,480	24,070	18,420	16,930	9,050	10,740	11,890	257,000
1940-41	18,150	24,730	29,100	45,370	26,720	31,660	30,520	23,880	18,150	15,100	11,540	17,030	292,000
1941-42	25,060	24,950	25,040	31,270	26,930	32,040	30,480	48,090	28,890	16,550	16,830	26,330	332,500
1942-43	25,770	27,950	25,390	26,770	32,210	33,020	29,590	22,400	24,940	13,520	9,670	18,580	289,800
1943-44	20,760	27,200	26,720	29,400	32,420	37,030	38,540	35,880	38,590	22,320	12,580	17,840	339,300
1944-45	24,210	28,340	28,580	30,820	26,840	31,940	35,200	26,660	33,910	22,920	18,370	18,980	326,800
1945-46	24,460	29,940	25,380	29,710	28,600	38,770	25,380	24,080	17,460	13,860	10,650	20,840	289,100
1946-47	35,430	32,030	29,570	29,490	24,930	35,170	37,090	26,500	40,850	23,550	11,860	18,510	345,000
1947-48	21,450	25,240	28,980	24,020	28,620	29,040	27,130	21,110	21,010	14,660	20,200	15,190	276,600
1948-49	19,840	25,580	23,580	22,830	27,150	46,040	39,430	34,670	29,240	19,590	18,470	22,030	328,500
1949-50	26,940	28,980	25,250	25,750	31,950	34,250	34,520	37,510	24,030	26,110	27,460	26,890	349,600
1950-51	28,710	26,950	29,030	25,280	32,130	29,180	31,340	41,310	51,210	35,180	32,130	39,590	402,000
1951-52	32,960	32,180	29,140	36,420	38,520	42,510	43,280	39,790	21,930	13,910	17,740	15,900	364,300

North Loup River at Burwell

1936-37			45,800	34,340	42,670	54,380	43,890	45,080	40,070	34,550	35,350	39,330	
1937-38	44,090	42,150	40,400	35,180	34,250	55,480	59,190	60,010	45,420	40,710	36,400	39,020	532,300

Calamus River near Harrop

1931-32						16,300	13,500	13,600	15,100				

Calamus River near Burwell

1940-41	14,840	14,970	15,790	15,100	12,840	15,830	15,530	15,520	14,830	13,330	12,650	14,750	176,000
1941-42	16,230	15,390	14,570	14,820	14,650	17,750	16,720	19,110	15,590	14,790	14,160	16,010	189,800
1942-43	16,920	16,800	15,690	14,240	15,680	21,450	17,220	16,530	18,140	14,740	14,440	14,780	196,600
1943-44	15,780	15,740	15,350	16,390	15,320	17,830	18,170	17,990	18,680	15,470	14,180	14,170	195,100
1944-45	15,780	14,900	15,030	16,400	15,870	16,640	16,400	16,070	16,790	15,170	14,640	14,430	188,100
1945-46	15,460	15,430	15,190	17,080	14,940	17,690	14,490	15,380	13,440	13,660	13,310	14,680	180,800
1946-47	18,190	16,850	16,200	16,470	15,590	16,680	16,820	15,000	21,640	15,500	15,390	14,630	199,000
1947-48	15,720	15,840	16,880	15,980	16,440	16,350	15,630	15,700	15,210	13,960	14,870	13,960	186,500
1948-49	15,130	17,010	15,830	14,420	16,280	22,530	22,150	18,750	19,460	15,980	17,080	16,410	211,000
1949-50	17,550	16,970	16,770	15,450	15,220	20,760	21,290	20,970	18,250	18,370	18,490	18,810	218,900
1950-51	18,670	17,930	16,400	17,840	16,560	18,780	19,920	26,380	22,940	19,450	22,850	23,390	241,100
1951-52	22,440	21,060	20,740	23,550	22,560	25,000	23,520	23,810	17,990	17,810	18,460	16,870	253,800

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
North Loup River at Ord													
1936-37			43,430	33,080	43,180	57,020	47,050	48,490	40,590	39,060	37,480	43,450	
1937-38	46,210	41,860	39,770	38,400	39,070	63,970	57,880	64,580	48,020	43,080	37,460	43,600	563,900
1951-52										29,100	39,680	34,640	
North Loup River at Scotia													
1936-37			46,510	32,820	43,090	62,410	47,250	47,060	43,750	39,810	35,390	40,990	
1937-38	46,610	42,040	40,140	41,550	42,130	69,730	58,520	71,100	54,790	50,230	38,990	44,820	600,600
1938-39	43,650	42,810	50,990	58,190	32,360	59,270	49,230	45,950	51,490	25,380	30,080	36,260	525,700
1939-40	38,190	52,000	45,990	34,830	46,900	64,710	45,690	37,930	46,870	18,470	20,450	20,450	472,500
1940-41	35,300	41,040	50,960	49,650	50,110	64,840	54,880	42,670	42,180	24,090	14,410	38,370	508,500
1941-42	56,130	49,030	49,260	39,190	28,850	46,070	52,780	82,440	72,250	27,890	25,480	54,340	583,700
1942-43	47,480	47,630	45,160	38,140	48,950	50,530	54,720	41,120	53,080	34,010	14,500	38,740	514,100
1943-44	33,920	43,140	42,080	50,620	52,050	56,320	66,660	80,460	66,310	37,350	20,760	34,700	584,400
1944-45	46,600	48,700	43,200	53,410	50,990	58,590	56,430	75,970	66,240	47,150	30,570	33,710	611,600
1945-46	45,090	47,610	33,560	54,030	52,420	62,170	41,550	42,750	38,450	25,670	15,250	42,980	501,500
1946-47	68,580	57,720	48,750	51,330	54,110	59,320	59,800	45,730	124,600	41,870	18,750	35,200	665,800
1947-48	42,060	52,180	60,300	47,420	65,970	69,510	47,870	38,420	59,040	34,510	50,130	28,960	596,400
1948-49	41,560	53,250	47,600	46,990	48,810	89,570	77,970	60,010	63,570	34,510	32,110	44,800	640,800
1949-50	53,520	52,730	45,760	42,350	55,320	77,990	64,350	73,110	44,970	96,220	55,450	47,380	709,200
1950-51	59,020	52,610	54,870	49,490	55,070	59,210	65,130	81,830	85,390	66,950	66,450	73,720	769,700
1951-52	65,120	58,970	50,570	60,620	78,450	70,510	73,770	76,010	37,420	25,190	33,320	34,490	664,400
Davis Creek near Cotesfield													
1948-49									1,300	116	209	137	
1949-50	86	136	122	65	375	831	311	520	137	4,060	307	100	7,050
1950-51	235	145	184	114	218	294	268	857	1,050	1,330	1,050	1,110	6,860
1951-52	180	188	178	205	119	842	238	203	108	135	43	26	2,460
North Loup River near Cotesfield													
1950-51	60,120	55,570	54,510	49,770	55,150	60,070	64,650	83,170	85,730	70,450	77,500	72,380	789,100
1951-52	65,580	59,380	51,850	59,590	79,680	77,550	73,710	75,750	38,470	24,750	37,180	34,620	678,100

North Loup River near St. Paul

1927–28	----	----	----	----	----	----	----	----	----	----	----	46,900	----
1928–29	57,400	65,500	43,000	43,000	41,600	104,000	75,000	79,300	70,200	57,900	42,600	46,700	726,000
1929–30	55,700	40,600	26,600	40,600	85,500	60,800	88,700	84,200	80,300	43,000	67,000	52,400	725,000
1930–31	66,400	61,900	57,400	67,000	80,000	70,700	61,900	56,000	45,500	43,200	43,200	43,300	696,000
1931–32	51,500	52,400	74,400	41,700	81,700	58,800	57,900	68,900	119,000	48,700	46,500	43,900	745,000
1932–33	54,500	46,400	39,500	52,700	38,400	64,600	61,300	75,600	39,400	53,800	51,400	47,700	625,000
1933–34	45,700	53,040	50,640	46,120	42,760	48,410	47,210	43,240	36,080	30,260	38,660	48,350	530,500
1934–35	48,880	47,940	33,910	39,230	69,980	55,040	93,720	89,690	95,390	50,750	40,650	41,760	706,900
1935–36	47,600	49,770	49,470	37,400	42,310	159,200	52,700	59,160	39,160	28,810	33,240	36,330	635,200
1936–37	42,500	44,920	42,390	32,630	41,870	78,830	48,580	52,110	43,540	40,960	36,290	41,170	545,800
1937–38	43,100	38,480	35,150	45,170	45,810	71,800	51,290	63,320	46,650	49,980	27,590	39,260	557,600
1938–39	41,650	46,450	53,900	63,360	36,090	57,640	51,890	43,660	47,260	23,960	24,840	29,060	519,800
1939–40	34,950	48,540	46,640	31,810	58,030	67,900	46,850	39,800	57,500	15,490	17,780	19,420	484,700
1940–41	35,020	40,680	46,970	45,880	60,310	67,950	60,400	50,040	50,440	25,420	13,600	42,150	538,900
1941–42	46,920	48,400	50,520	49,220	33,500	65,980	55,390	91,600	77,740	28,810	30,290	58,240	636,600
1942–43	45,350	48,830	43,580	35,620	51,130	55,420	49,510	35,450	57,050	41,590	14,680	39,720	517,900
1943–44	37,100	46,810	47,380	53,200	56,130	62,090	74,340	86,210	71,760	40,650	23,660	38,720	638,000
1944–45	48,300	48,550	39,130	51,130	57,020	63,730	54,670	71,800	77,080	57,310	33,170	32,980	634,900
1945–46	47,440	50,200	37,350	54,640	50,610	60,260	41,740	47,720	40,640	25,280	14,610	45,540	516,000
1946–47	71,740	59,080	51,850	46,650	56,830	65,360	64,660	46,000	149,700	44,460	17,660	34,620	708,600
1947–48	43,870	53,730	61,070	45,060	70,330	85,530	50,540	39,150	72,360	39,760	70,170	27,730	659,300
1948–49	40,830	50,780	44,110	39,790	44,350	104,600	79,490	64,160	69,310	36,700	32,660	44,210	651,000
1949–50	52,460	50,020	46,170	40,700	55,600	87,690	63,750	75,230	44,620	103,000	55,450	48,300	723,000
1950–51	61,400	56,750	54,910	47,800	57,600	65,680	65,440	85,300	83,600	75,180	84,970	78,610	817,200
1951–52	65,060	60,390	53,570	60,750	78,150	86,910	73,690	76,170	40,270	27,120	35,750	35,250	693,100

Spring Creek at Cushing

1948–49	----	----	----	----	----	----	----	----	2,340	458	545	384	----
1949–50	254	264	246	247	733	1,310	426	1,100	380	8,320	865	263	14,410
1950–51	582	329	330	269	295	598	1,880	2,170	2,010	1,280	2,610	1,710	14,060
1951–52	500	421	318	467	889	839	600	977	481	408	182	133	6,220

Cedar River near Spalding

1944–45	----	----	----	----	----	5,650	8,170	8,500	9,760	8,470	6,760	5,950	----
1945–46	7,580	7,210	5,170	6,510	6,100	7,320	6,180	7,170	7,250	6,650	6,620	7,570	81,330
1946–47	11,240	10,270	7,870	6,100	7,440	8,770	10,890	7,340	30,940	8,980	6,420	6,480	122,700
1947–48	7,330	7,820	7,820	7,380	8,980	8,590	7,550	7,420	7,790	6,910	6,450	6,720	90,760
1948–49	6,480	6,790	7,480	5,610	6,020	11,350	17,700	11,000	10,640	6,770	6,750	7,170	103,800
1949–50	7,460	7,540	7,690	5,190	6,700	10,930	10,610	12,360	11,060	19,940	11,300	10,450	121,200
1950–51	12,040	7,920	8,280	7,960	7,840	11,810	13,260	21,640	12,790	11,370	15,690	15,540	146,100
1951–52	12,470	10,160	9,720	10,030	17,730	15,840	14,040	12,820	8,060	8,080	7,700	6,810	133,500

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Cedar River near Fullerton													
1931-32	11,300	11,500	14,800	9,530	12,100	18,500	13,000	12,200	20,100	------	------	------	------
1940-41	10,130	9,650	10,460	11,310	13,330	15,060	15,530	14,300	17,610	9,030	6,660	11,380	144,400
1941-42	11,340	10,240	8,010	10,170	8,300	14,270	10,640	12,300	13,410	7,920	7,900	10,270	124,800
1942-43	8,860	9,690	9,370	8,690	23,210	10,690	11,940	17,420	40,920	14,460	7,160	8,730	171,100
1943-44	9,290	10,070	9,230	11,070	13,750	12,330	18,530	21,810	18,800	12,100	9,650	9,810	156,400
1944-45	10,530	11,060	10,840	12,180	10,730	14,850	13,070	15,520	19,230	12,710	8,900	8,030	147,600
1945-46	10,060	10,160	8,070	11,920	13,150	13,880	10,480	18,600	18,890	10,880	8,760	12,950	147,800
1946-47	18,240	15,760	10,140	10,640	14,380	15,290	17,210	20,660	85,470	18,370	9,060	9,220	244,400
1947-48	10,440	12,270	12,300	11,840	38,310	18,300	11,690	11,270	21,700	16,080	20,180	8,770	193,200
1948-49	9,950	11,350	11,210	8,430	8,930	20,340	26,260	17,600	20,240	11,070	10,290	11,370	167,000
1949-50	11,760	11,320	9,030	8,780	11,370	21,290	16,920	20,540	18,940	84,830	20,700	14,520	250,000
1950-51	16,820	13,830	12,210	11,890	11,560	19,910	22,040	30,300	25,280	20,410	24,660	24,900	233,800
1951-52	17,500	16,200	13,040	15,270	26,490	26,300	19,700	19,730	12,920	11,370	12,000	10,270	200,800
Loup River power canal near Genoa													
1936-37	------	------	5,800	7,340	4,610	6,790	7,520	8,330	11,660	23,570	22,620	21,000	------
1937-38	33,440	32,830	27,030	29,630	31,600	38,570	37,430	39,460	31,770	39,900	42,260	39,270	423,200
1938-39	35,250	30,220	29,380	36,170	25,670	31,090	31,940	48,800	46,270	44,000	53,140	59,160	471,100
1939-40	65,180	81,580	52,320	49,950	51,000	57,130	82,010	92,310	79,700	42,100	52,050	55,000	760,300
1940-41	91,320	85,160	77,230	77,780	92,180	108,500	138,700	111,400	120,600	54,870	42,840	104,700	1,105,000
1941-42	122,400	106,800	79,860	61,930	52,680	100,200	116,500	115,100	131,000	71,180	71,470	105,900	1,135,000
1942-43	108,400	106,200	89,040	81,030	97,510	68,740	98,900	96,210	105,500	92,350	48,940	83,920	1,077,000
1943-44	95,170	110,600	77,160	83,310	74,890	94,510	156,400	125,700	130,800	94,100	57,850	87,930	1,188,000
1944-45	109,100	102,800	38,640	81,020	60,320	110,500	130,500	117,500	137,400	107,300	83,120	76,900	1,155,000
1945-46	107,400	101,300	62,570	106,000	85,750	140,900	103,400	104,800	94,690	75,070	48,680	108,800	1,139,000
1946-47	149,900	138,100	84,730	85,240	87,020	107,200	134,300	119,700	126,900	123,900	55,120	84,810	1,297,000
1947-48	105,200	117,400	72,290	32,020	39,950	88,320	117,000	97,350	118,400	104,000	130,000	71,620	1,094,000
1948-49	101,500	98,490	78,390	79,110	85,510	121,200	160,700	160,300	154,700	93,240	80,410	114,600	1,328,000
1949-50	126,600	125,100	46,650	71,540	103,200	92,030	145,700	159,400	112,400	122,500	123,200	117,800	1,346,000
1950-51	132,600	84,040	76,400	93,560	79,850	71,240	136,400	152,000	153,600	141,600	136,700	157,100	1,415,000
1951-52	156,300	73,640	64,960	97,900	75,960	70,530	116,700	143,600	87,280	71,830	75,280	76,460	1,110,000

Loup River near Genoa

1927-28	----	----	----	----	----	----	----	----	----	----	----	116,000	----
1928-29	140,000	171,000	86,100	89,200	97,200	303,000	261,000	240,000	200,000	162,000	106,000	139,000	1,990,000
1929-30	148,000	92,200	57,800	92,200	244,000	173,000	227,000	269,000	252,000	105,000	165,000	152,000	1,980,000
1930-31	185,000	176,000	147,000	180,000	188,000	174,000	161,000	153,000	140,000	110,000	95,900	90,400	1,800,000
1931-32	----	----	----	----	----	22,100	21,200	20,400	20,100	----	----	----	----
1943-44	2,460	8,070	23,430	48,620	91,720	63,370	51,390	87,390	44,450	10,800	5,440	3,590	440,700
1944-45	3,280	10,580	56,460	43,930	79,520	49,910	14,030	50,260	115,800	28,240	6,080	6,450	464,500
1945-46	3,020	14,100	14,110	20,110	35,800	18,940	4,790	17,450	42,990	4,590	2,530	12,480	190,900
1946-47	57,460	11,420	40,420	18,100	49,540	68,500	31,540	9,570	438,200	21,580	7,310	5,160	758,800
1947-48	3,790	18,890	54,290	78,840	174,000	207,100	5,640	3,290	76,080	22,690	60,940	4,990	710,500
1948-49	3,390	28,630	30,990	14,110	21,620	162,600	57,500	14,880	85,130	3,130	3,050	14,460	439,500
1949-50	3,790	3,320	47,790	19,280	17,990	130,700	9,500	33,900	17,340	281,300	37,000	5,940	607,800
1950-51	22,580	43,120	43,350	18,080	60,030	107,000	40,010	96,920	71,940	35,100	31,440	15,820	585,400
1951-52	5,030	77,300	33,390	31,870	129,100	159,100	81,020	36,730	5,040	3,460	6,860	1,820	570,700

Beaver Creek at Loretto

1944-45	2,800	2,590	2,510	3,260	3,200	4,620	4,930	7,530	13,140	3,620	2,180	2,060	52,440
1945-46	2,550	2,800	2,500	2,830	2,670	4,850	2,990	4,460	2,720	1,780	1,910	2,390	34,450
1946-47	3,450	4,240	3,280	3,240	4,870	4,380	6,470	3,690	13,830	2,720	1,760	1,770	53,700
1947-48	2,420	3,200	3,380	3,200	7,180	5,670	3,480	3,100	3,240	3,740	4,660	2,090	45,360
1948-49	2,520	3,140	3,760	3,090	3,460	13,770	11,850	6,620	6,680	2,670	2,210	2,620	62,390
1949-50	2,950	3,030	3,020	2,360	3,140	8,930	4,860	6,210	12,270	19,800	5,070	3,660	75,300
1950-51	4,970	3,510	3,610	2,940	3,430	11,590	9,000	10,710	6,020	6,410	9,340	6,720	78,250
1951-52	3,890	4,220	4,300	4,400	7,530	8,430	9,490	9,210	3,400	2,780	4,260	2,490	64,400

Beaver Creek at Genoa

1940-41	2,710	2,830	4,270	4,400	9,300	8,840	9,760	8,340	9,300	4,610	2,440	7,470	74,270
1941-42	4,150	4,380	4,670	4,540	4,400	9,280	5,050	6,350	24,720	5,670	6,410	10,640	90,260
1942-43	4,010	4,290	4,600	4,170	11,700	5,450	6,140	6,180	26,950	7,650	3,090	2,760	86,990
1943-44	3,500	3,850	3,650	4,420	5,510	6,950	11,970	24,920	12,370	6,670	7,420	4,840	96,070
1944-45	4,160	4,410	4,360	4,680	5,440	9,250	6,840	7,920	19,260	10,730	3,980	3,010	84,040
1945-46	3,870	4,130	3,430	3,570	3,740	6,770	4,760	7,200	8,780	3,010	2,670	4,670	56,600
1946-47	8,630	6,640	5,360	4,860	8,100	9,690	9,430	10,040	40,500	6,030	2,930	3,020	115,200
1947-48	3,590	4,740	4,540	4,860	22,520	17,840	5,580	5,320	8,550	10,560	10,950	3,510	102,600
1948-49	3,710	4,580	4,970	4,340	4,590	19,690	16,490	11,650	19,100	5,960	7,090	5,390	107,600
1949-50	4,730	4,730	4,550	3,860	4,780	17,400	7,380	9,570	28,250	76,720	12,190	5,590	179,800
1950-51	7,080	5,430	5,490	5,490	5,060	24,430	14,790	15,810	11,930	10,260	20,160	12,800	138,700
1951-52	7,040	6,780	6,190	5,730	10,080	13,800	12,810	11,730	6,890	5,350	8,470	4,660	99,530

TABLE 2.—*Monthly and annual discharge, in acre-feet, of streams in the Loup River drainage basin, Nebraska*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Loup River at Columbus													
1900–01	--------	--------	--------	--------	--------	--------	193,626	144,250	206,300	98,934	84,668	169,765	--------
1901–02	137,716	138,842	--------	--------	--------	--------	143,385	198,334	193,375	348,530	293,115	191,487	--------
1902–03	185,116	143,859	--------	--------	--------	--------	239,623	251,177	189,699	211,180	330,373	164,410	--------
1903–04	171,919	203,544	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1905–06	--------	--------	--------	--------	--------	--------	--------	282,000	172,000	171,000	192,000	155,000	--------
1906–07	202,000	165,000	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1911–12	--------	--------	--------	--------	--------	--------	564,000	319,000	226,000	124,000	137,000	165,000	--------
1912–13	151,000	161,000	--------	--------	--------	--------	259,000	267,000	167,000	136,000	121,000	121,000	--------
1913–14	134,000	156,900	--------	--------	--------	--------	151,000	192,000	--------	--------	--------	--------	--------
1914–15	136,000	129,000	114,000	139,000	133,000	172,000	338,000	212,000	374,000	338,000	291,000	267,000	2,643,000
1930–31	--------	--------	--------	--------	--------	170,000	162,000	154,000	132,000	111,000	95,300	94,000	918,000
1933–34	138,300	150,800	176,800	116,800	122,500	148,100	163,400	111,800	112,100	76,000	97,680	139,000	1,553,000
1934–35	154,300	143,200	93,120	91,670	180,700	150,600	266,100	292,100	450,500	172,900	146,100	153,200	2,294,000
1935–36	123,200	151,100	131,200	83,220	87,810	419,700	143,900	184,300	114,900	66,290	85,170	99,650	1,690,000
1936–37	120,600	128,800	150,500	50,040	109,700	169,400	130,700	160,300	188,700	134,600	78,940	136,500	1,559,000
1937–38	106,600	98,020	79,760	73,370	75,250	192,300	122,000	190,700	150,300	139,900	44,500	107,600	1,380,000
1938–39	85,860	93,940	124,400	119,200	62,700	192,200	119,400	145,000	114,000	53,880	29,610	10,660	1,151,000
1939–40	25,460	31,900	54,890	34,290	74,680	197,300	53,610	23,640	117,100	5,120	6,950	4,510	629,400
1940–41	13,790	32,030	33,610	59,520	117,400	94,130	34,300	47,320	69,230	34,350	4,990	15,640	556,300
1941–42	15,220	17,040	30,330	56,040	61,410	120,300	23,750	78,830	137,900	18,170	16,870	79,180	655,000
1942–43	11,530	13,500	17,620	9,100	68,640	66,320	53,180	18,350	176,500	60,290	6,170	7,510	508,700
1943–44	6,630	12,060	29,890	53,910	107,100	72,370	82,990	138,900	59,150	31,750	19,850	13,360	628,000
1944–45	9,980	25,750	52,240	52,820	77,850	57,020	27,380	62,930	140,900	59,350	14,250	11,040	591,500
1945–46	9,620	23,410	29,790	23,820	59,750	29,690	13,490	37,310	77,230	9,360	6,790	22,930	343,200
1946–47	83,590	31,700	43,980	25,600	59,420	78,200	50,680	29,710	488,270	42,630	12,930	10,460	957,200
1947–48	10,140	25,400	54,900	82,020	189,100	233,200	18,330	14,810	82,420	38,200	68,000	10,210	826,700
1948–49	9,130	27,440	58,940	15,650	27,510	205,500	88,270	37,820	102,700	14,070	13,130	23,220	603,400
1949–50	11,460	11,860	54,290	23,580	25,050	139,900	19,620	55,710	46,920	343,700	61,390	14,780	808,300
1950–51	26,130	49,900	50,900	23,460	77,160	138,900	62,670	104,200	98,100	50,650	62,810	40,610	785,500
1951–52	16,670	79,820	44,690	38,170	134,800	163,700	94,410	60,490	14,650	15,190	19,830	8,930	691,400

however, about 87 percent of the surface contributes direct overland runoff to stream discharge. This runoff, consisting of rainfall and snowmelt, reaches the streams at irregular intervals and produces a less uniform rate of discharge. For example, during the 3 water years 1950–52, the variation in annual discharge of Oak Creek near Dannebrog, Davis Creek near Cotesfield, and Spring Creek at Cushing was 126, 84, and 177 percent, respectively, of the average annual discharge during the same period. Stream discharge at most other stations in the loess plains and hills part of the basin has a wide variation because the discharge is derived largely from overland runoff and, in addition, is regulated or is affected by electric-power developments, surface diversions and ground-water withdrawals for irrigation, and return flow from irrigated areas.

The sum of the discharges of Middle Loup River at Walworth, North Loup River at Taylor, Calamus River near Burwell, and Cedar River near Spalding is virtually equal to total runoff from the Sand Hills part of the Loup River drainage basin. (See fig. 12.) Similarly, the sum of the discharges of the Loup River power canal near Genoa and Loup River at Columbus is virtually equal to total runoff from the basin. Runoff from the loess plains and hills part of the area is determined by computing the difference between total runoff from the Sand Hills part of the basin and total runoff from the entire basin. As shown in table 3, the runoff from the loess plains and hills part of the basin is less than from the Sand Hills part, even though precipitation on the loess plains and hills part is greater. Doubtless the greater moisture-storing capacity of the cultivated loessial soils and consequent greater water loss through evapotranspiration accounts for the smaller proportion of precipitation reaching the streams by either overland or subterranean routes.

TABLE 3.—*Runoff from the Sand Hills part and the loess plains and hills part of the Loup River drainage basin*

Water year	Runoff							
	Sand Hills part of the basin				Loess plains and hills part of the basin			
	Acre-feet	Feet	Inches	Percent of precipitation	Acre-feet	Feet	Inches	Percent of precipitation
1948	1,115,000	0.202	2.42	12.5	805,900	0.190	2.28	10.0
1949	1,221,000	.227	2.72	10.9	710,100	.167	2.01	7.8
1950	1,268,000	.241	2.90	12.1	886,600	.209	2.51	10.3
1951	1,405,000	.273	3.28	12.0	794,800	.187	2.25	8.1
1952	1,355,000	.263	3.16	19.0	446,400	.105	1.26	7.1

NATURAL VEGETATION

Except where cultivated crops are grown, native grass is the predominant vegetation. The main grasses are known locally as needle grass, bunch grass, long-leaved reed grass, and blowout grass. The grasses grow luxuriantly in the valleys where they are amply supplied with moisture, but on the higher sandhills they are thin and interspersed with small woody plants, such as the wildrose, sandcherry, soapweed, wild licorice, and prickly pear.

Trees, such as green ash, boxelder, cottonwood, willow, and hackberry, and shrubs, such as choke cherry and wild plum, thrive along the streams. Cottonwoods have been planted in many of the hay flats. The Nebraska National Forest (Bessey Division), which was established in 1902, lies between the Middle Loup and Dismal Rivers near their confluence. It is a typical sand-dune area that has been planted to conifers. The dark patches at the top of figure 8 are planted areas in the forest.

POPULATION

The population of the Loup River drainage basin is not known but probably is about 120,000. Broken Bow, with a population of 3,400 is the largest town; and Ord and Albion have populations greater than 2,000. Fullerton, St. Paul, Ravenna, Loup City, Burwell, and Genoa are the only other towns having more than 1,000 residents. The density of the rural population ranges from about 16 per square mile at the lower end of the basin to 1 per square mile at the upper end.

AGRICULTURE AND INDUSTRY

Livestock raising and general farming are the chief sources of income in the Loup River drainage basin. Milling of grain and generation of electricity are the only industries of economic importance.

In the Sand Hills part of the basin nearly all the land is used as pasture for beef cattle or for growing wild hay. The average size of ranches is about 2,000 acres. In the lower part of the basin, about half the land is cultivated and half is used for pasture or for growing hay. Corn is the principal crop, although oats, alfalfa, and wheat also are economically important. Hogs and beef cattle are the principal livestock in this part of the basin and are about of equal economic value. About three-fourths of the corn and other grain is fed to livestock on the farm where grown. The average size of farms in this part of the basin is about 320 acres.

Water is diverted from the Middle and North Loup Rivers for irrigation of valley lands. The Middle Loup Public Power and Irrigation District provides for irrigation of land on both sides of the stream, from a few miles southeast of Sargent and continuing downstream for about 40 miles to a point about 8 miles southeast of Loup City. The Almeria Public Power and Irrigation District diverts water from the North Loup River near the Blaine-Loup County line for irrigation of valley land within Loup County. The North Loup Public Power and Irrigation District irrigates land on both sides of the stream from about 17 miles west of Burwell to near Scotia—a distance of about 45 miles. In many places, water for irrigation is pumped directly from streams. The U.S. Bureau of Reclamation has proposed construction of several reservoirs and irrigation of considerably more land, some of which is upland. In addition, it proposed diversion of water out of the Loup River drainage basin to irrigate land in the Platte River valley.

In 1952, when this reconnaissance was made, there were 352 irrigation wells in the Loup River drainage basin. Most of them were in the valleys and some were within the areas supplied by diverted river water.

In southwestern Howard County, water is diverted from the Middle Loup River into a canal which carries water to the Boelus powerplant and then discharges it into the South Loup River just above the point where the South Loup enters the Middle Loup. In eastern Nance County, about 6 miles southwest of Genoa, the Loup River Public Power District diverts water from the Loup River for generation of electricity at its powerplants near Monroe and near Columbus. There are onstream powerplants near Callaway on the South Loup River, near Sargent on the Middle Loup River, near Ericson, Spalding, and Fullerton on the Cedar River, and near St. Edward on Beaver Creek. The Bureau of Reclamation has made studies of several possible sites for additional hydroelectric powerplants.

GEOLOGY

Almost anywhere in the westernmost part of the Loup River drainage basin a hole drilled to bedrock of Cretaceous age would penetrate first the unconsolidated deposits of Quaternary age and then, in the order named, the following semiconsolidated deposits of Tertiary age: the Ogallala formation (Pliocene), the Hemingford group of Lugn (1938) and the Arikaree group (Miocene), and the White River group (Oligocene). At the lower end of the drainage basin, where the Loup River enters the Platte River valley, a hole drilled to bedrock would penetrate only deposits of Quaternary age before reaching strata of Cretaceous age. Obviously, therefore, the deposits of Tertiary age pinch out somewhere between the upper and lower ends of the basin. The combined thickness of the deposits of Quaternary and

Tertiary age at points where penetrated by test drilling is shown in figure 13.

The surface of the rocks of Cretaceous age is a buried peneplain which was produced by stream erosion early in the Tertiary period. Evidence obtained by drilling exploratory test holes and wells, data for which are on file in the offices of the Conservation and Survey Division of the University of Nebraska, indicates that this surface is 2,410 feet above sea level at its highest known point near the upper end of the Loup River drainage basin and that it may be as high as 2,862 feet in western Cherry County outside the basin. Although the surface is lowest, below 1,300 feet, at the extreme lower end of the Loup River drainage basin, it does not slope uniformly southeastward; test drilling has shown it to be almost as low at some points in eastern Cherry County as it is at the lower end of the drainage basin. (See fig. 13.)

The Cretaceous and older strata are warped into several broad flexures. (See fig. 14.) The axis of one anticline, the Siouxana arch, extends northeastward from central Hooker County; and the axis of another, the Chadron-Cambridge arch, crosses the drainage basin from northwestern McPherson County to central Sheridan County. Several synclinal axes extend into the drainage basin; one enters in central Buffalo County and disappears in southeastern Thomas County; another extends southeastward into the drainage basin for a short distance in east-central Cherry County; and a third crosses the lower end of the drainage basin.

Throughout nearly the entire Loup River drainage basin, the buried peneplain transects strata of only the marine Pierre shale of Late Cretaceous age (fig. 14). The maximum thickness of this formation within the basin is not known but possibly is as much as 2,000 feet in the western part. East of a north-northeastward-trending line through western Nance County, peneplanation completely removed the Pierre shale and exposed older formations, also of marine origin and of Late Cretaceous age. The formations thus truncated within the Loup River drainage basin include the Niobrara formation, which underlies the Pierre shale and is about 200 feet thick, the Carlile shale, about 150 feet thick, and possibly older Late Cretaceous strata. The importance of the Cretaceous formations as potential sources of water supply is considered negligible not only because ample supplies of ground water can be obtained from younger rocks, but also because the Cretaceous formations probably would not yield large supplies of water of good quality.

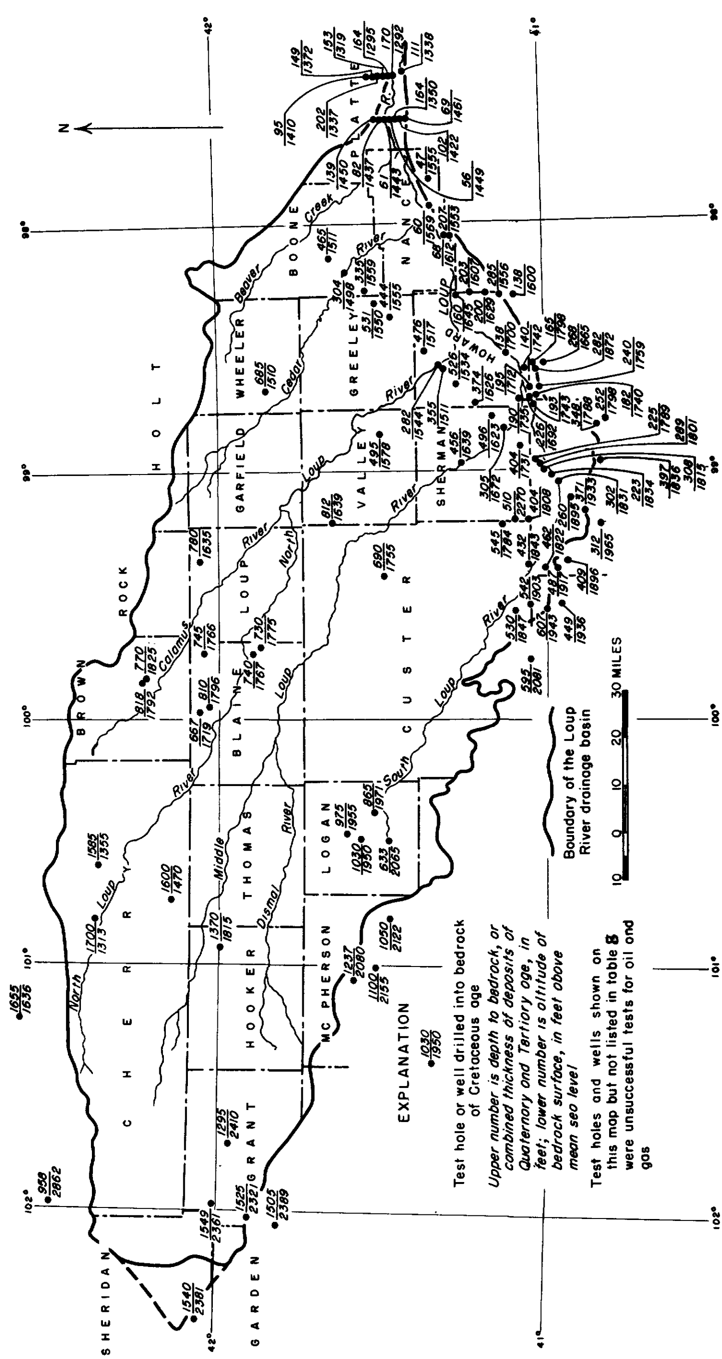

FIGURE 13.—Map showing depth to, and altitude of, the Cretaceous bedrock surface in the Loup River drainage basin.

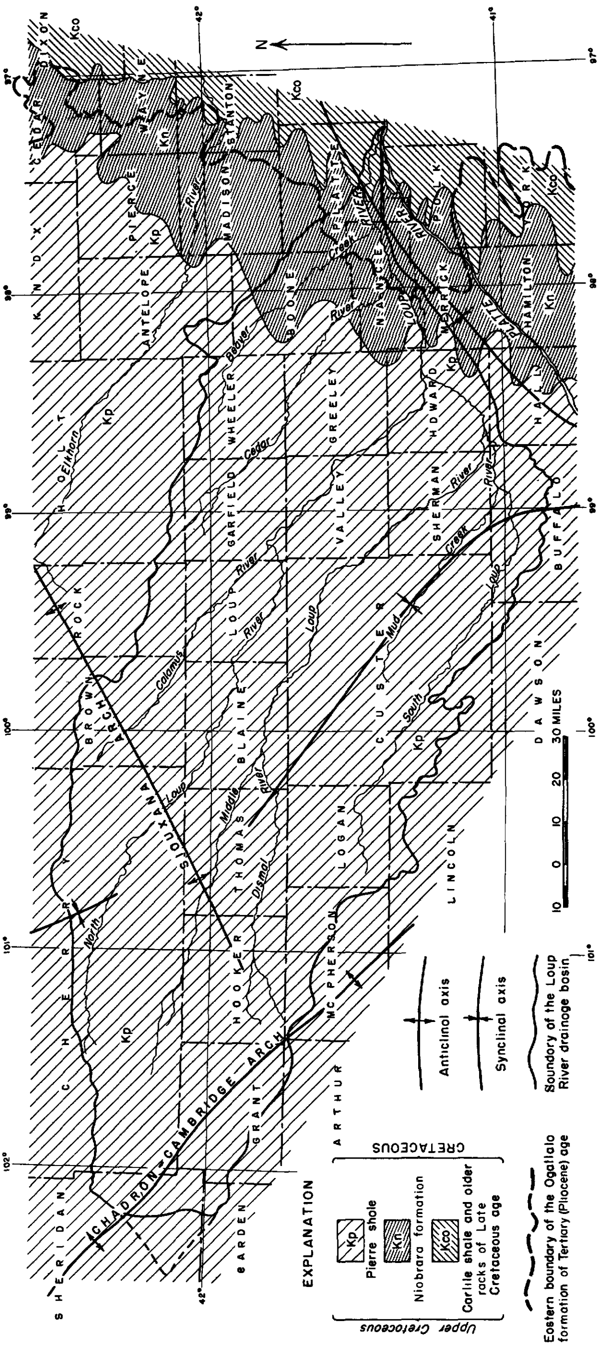

FIGURE 14.—Subsurface geologic map of the Cretaceous bedrock in the Loup River drainage basin, showing also the areal extent of the Ogallala formation of Tertiary (Pliocene) age.

TERTIARY SYSTEM

The eastward-thinning wedge of Tertiary deposits consists of rock fragments that were derived from the higher slopes and mountain ranges to the west and carried into the basin by the wind and by streams. Where these deposits are exposed outside the Loup River drainage basin, they have been subdivided, in ascending order, into the following formations: the Chadron formation and Brule clay of the White River group; the Gering, Monroe Creek, and Harrison sandstones of the Arikaree group; the Marsland and Sheep Creek formations (the Hemingford group of Lugn, 1938) ; and the Ogallala formation (the Ogallala group, as used by the Nebraska Geological Survey).

The Chadron formation of the White River group is composed principally of greenish to buff clay and silt; locally, at its base, it contains sandstone that was deposited in stream channels. Where exposed in Sioux and Dawes Counties, Nebr., the Chadron is as much as 100 feet thick, but its maximum thickness within the Loup River drainage basin is not known. Because the Brule clay rests on Cretaceous bedrock along the Niobrara River valley in northeastern Cherry County and northwestern Brown County, it is assumed that the Chadron formation thins eastward and disappears along a sinuous line somewhere west of Thomas County. The Brule clay, the younger formation of the White River group, is composed of pink sandy clay and channel sandstone in its lower part and of pink massive silty clay and thin layers of volcanic ash and sand in its upper part. The maximum thickness of the formation in Nebraska is about 600 feet, but within the Loup River drainage basin it probably is much less. The formation wedges out about halfway between the west and east ends of the basin, or somewhat east of the border of the Chadron formation. The White River group is of Oligocene age.

Streams flowing on the surface of the Brule clay excavated valleys and then filled them with deposits of both flat-bedded and crossbedded gray sand. Not only were the valleys completely filled but the divides between them eventually were buried beneath massive deposits of gray medium-fine sand. These deposits, now referred to as the Gering sandstone of the Arikaree group, were buried in turn by the Monroe Creek sandstone. The Monroe Creek consists in its lower part of massively bedded gray medium-grained sandstone containing "pipy" concretions and in its upper part of pinkish to buff sandy silt and thin layers of cemented concretions and scattered large concretions. Overlying the Monroe Creek are deposits of gray fine sand, the Harrison sandstone, which also contains "pipy" concretions in its lower part. West of the Loup River drainage basin, where these formations of the Arikaree group are exposed, their aggregate thickness is between 400 and 500 feet. Because they thin to a featheredge in or near western Cherry and Grant Counties, only the westernmost part of the basin is underlain by the Arikaree group. This group is of early Miocene age.

After another period of erosion by streams, sedimentation was renewed. Beds of buff to reddish-brown and gray sand, the Marsland formation, were the first to be deposited, and these were followed by beds of the Sheep Creek formation, which consists of pinkish- to greenish-gray sandy clay and sand, volcanic ash, and pinkish- and brownish-gray clay. The Marsland and Sheep Creek formations have a combined thickness of about 500 feet where they crop out west of the basin, but their maximum thickness within the basin possibly is less. These two units wedge out to the east also, probably along a line fairly close to the featheredge of the Arikaree group. The Marsland and Sheep Creek are of late Miocene age.

Again deposition was interrupted, and streams draining the newly formed constructional plain eroded broad valleys into its surface. Later, the streams began to aggrade their valleys, eventually filling them with sand and burying even the intervalley uplands with layers of gravel, sand, silt, clay, and volcanic ash. Some of the layers later became indurated, forming so-called mortar beds. This mass of deposits, the Ogallala formation, referred to as the Ogallala group by the Nebraska Geological Survey, is about 400 feet thick at the west end of the basin. There it has been subdivided locally into the Valentine formation (Barbour and Cook, 1917) and the overlying Ash Hollow formation (Engelmann, 1876; Lugn, 1938). The Ogallala formation extends much farther east than do the older Tertiary deposits, reaching almost to the east end of the basin before it pinches out. (See fig. 14.) In the eastern part of the basin the deposits of the Ogallala generally are finer grained than in the west and have been referred to by Condra, Reed, and Gordon (1947) as the Seward formation. The Ogallala is of Pliocene age.

During the period of erosion that followed, the once fairly smooth surface of the Ogallala formation, as well as the surface of the truncated Cretaceous strata beyond the outer margin of the Ogallala, was incised by streams. A profile of the surface thus produced is shown on plate 2.

QUATERNARY SYSTEM

When the first of the Pleistocene continental glaciers (the Nebraskan ice sheet) invaded eastern Nebraska, the streams draining the land surface were dammed in their lower reaches by the ice. Ponding of water along the ice margin caused the streams to drop their loads of sediment and aggrade the lower reaches of their valleys. These deposits which consist principally of sand and gravel and which have a maximum thickness of 170 feet or more, are referred to as the Holdrege formation. During the succeeding Aftonian interglacial stage, wind- and water-transported fine sand, silt, and clay accumulated in the valleys to a depth of 40 feet or a little more. These deposits, known as the Fullerton formation, completely mantled the Holdrege, lapping up onto the valley sides and extending farther upstream.

The second, or Kansan, ice sheet also invaded Nebraska, similarly damming drainage courses and causing the streams to aggrade their valleys to an even higher level with sand and gravel, now referred to as the Grand Island formation. The Sappa formation, which was deposited during the Yarmouth interglacial stage that followed, is similar to the Fullerton formation except that in some localities it contains a distinctive layer of volcanic ash—the Pearlette ash member. The Sappa is related to the Grand Island formation as is the Fullerton to the Holdrege.

Although the third continental ice sheet (Illinoian) did not reach Nebraska, the concurrent climatic change resulted in the deposition of a layer of sand and gravel, the Crete formation, in the valleys. The Crete generally is thinner than either the Holdrege or the Grand Island formation but is somewhat more extensive. After deposition of the Crete formation, the entire eastern part of the basin was buried beneath a 100-foot mantle of wind-deposited pinkish-brown silt and fine sand known as the Loveland loess. Possibly some of the sand that mantles the Ogallala formation in the Sand Hills part of the basin was deposited at the same time as was the Loveland, but, according to E. C. Reed (oral communication, 1957), the bulk of the dune sand may have accumulated concurrently with deposition of the later Peorian and Bignell loesses.

The fourth sheet of glacial ice (Wisconsin) barely invaded northeastern Nebraska. During this stage of glaciation, in which the ice sheet melted back and readvanced several times, the Todd Valley sand was deposited in valleys cut into the surface of the Loveland loess and the Peorian loess was deposited as another mantle over the eastern part of Nebraska. A fossil soil within the Peorian loess, similar to the fossil soil at the top of both the Loveland loess and the Peorian loess, is proof that deposition of the Peorian was interrupted at least once. The deposits which the Conservation and Survey Division of the University of Nebraska refers to as late Wisconsin sand and gravel may have been laid down during one such interruption. Another layer of loess, the Bignell, was deposited in late Wisconsin and Recent time in scattered parts of the basin; it consists largely of reworked Peorian loess.

Because the dune sand in the Sand Hills region grades into the loess layer in the loess plains and hills region, the two must have been deposited at about the same time; the wind dropped the heavier sand first and carried the lighter silt and clay particles farther southeast. The dune sand on the south side of the Loup River in southeastern Howard County and in Merrick, Nance, and Platte Counties probably was derived from the sand and gravel deposits exposed along the Loup River.

Recent deposits in the Loup River drainage basin consist of surficial materials that have been reworked by wind and running water since the Wisconsin glacier melted back the last time. Only by their position can they be distinguished from the Pleistocene deposits from which they were derived.

GROUND WATER

The semiconsolidated deposits of Tertiary age, except for the relatively impermeable formations of the White River group, together with the unconsolidated deposits of Quaternary age constitute a tremendous ground-water reservoir. Because little subsurface information is available for much of the basin, the amount of water stored in the reservoir cannot be determined accurately. A conservative estimate—400 million acre-feet or 20 times the average annual precipitation—is obtained by assuming that the average thickness of saturated material is not less than 300 feet and that the average porosity of the material is 15 percent. Because the supply of ground water is distributed fairly uniformly, wells of moderately large to large discharge can be drilled almost everywhere in the basin. In some places in the loess plains and hills part of the basin, however, it is generally impossible to obtain a supply much greater than enough for domestic and livestock needs. In much of this part of the basin the Pleistocene deposits are the only likely source of ground-water supply because the underlying Tertiary rocks are too fine grained to yield water freely.

If the water in a well does not rise above the level at which it is struck—that is, stands at the same level as the top of the zone of saturation—the water is under water-table conditions. On the other hand, if the water in a well stands higher than the top of the zone of saturation, perhaps even flowing from the well at the land surface, the water is artesian. Artesian water is confined under pressure below a relatively impervious layer. In many places in the Loup River drainage basin, both artesian and nonartesian conditions exist within the ground-water reservoir, and in such places it is possible to have a shallow well that taps nonartesian water or a deeper well that taps artesian water. In some places even the water in the uppermost part of the zone of saturation is artesian. Although most wells in the Loup River drainage basin tap water that is under water-table conditions or confined under only slight artesian head, flowing wells are common in parts of Grant, Cherry, and Brown Counties (pl. 1); none of them were visited during the investigation. Two of several flowing wells observed in T. 24 N., Rs. 14 and 15 W., Garfield County, had a flow of about 40 gpm (gallons per minute). Local residents reported that these wells tap saturated gravel overlain by blue clay 80 feet thick. Several other artesian wells are near Pibel Lake in Wheeler County; the flow from these wells is small and unsteady.

The top of the zone of saturation is within 250 feet of the land surface in all or nearly all the basin. In the Sand Hills part of the basin the water table is only a few feet below the floor of most of the closed basins; and in most of those basins occupied by lakes, the water table is continuous with the lake surface. In all the valleys where streamflow is perennial, the water table is continuous with the surface of the stream. Usually it is not possible to determine readily whether the water surface in any given well is at the same level as the top of the zone of saturation.

NATURAL RECHARGE AND DISCHARGE

Most of the sediments that constitute the ground-water reservoir were laid down by water and so were saturated when first deposited. However, the water that originally occupied the pore spaces has long since percolated out and has been replaced by infiltrating precipitation. Precipitation is the only significant source of recharge to the ground-water reservoir beneath the basin. Underflow is the source of some recharge along the south boundary of the drainage basin from McPherson County to Buffalo County, but the amount is small compared to the total received from precipitation.

The capacity of the soil to hold and to transmit water downward determines how much of the precipitation will pass through the soil and recharge the underlying reservoir. Because sandy soils generally hold less water and are much more permeable than loessial soils, the proportion of rainfall reaching the zone of saturation in the Sand Hills part of the basin is somewhat greater than in the loess plains and hills part. Direct determinations of the amount of recharge to an aquifer ordinarily are not possible without conducting highly complex and detailed studies; however, if discharge from a ground-water reservoir for a given period is assumed to balance recharge to the reservoir during that period, the amount of recharge may be determined indirectly by measuring the discharge.

In the Sand Hills part of the basin, ground water is discharged principally by seepage into streams and by evapotranspiration. The amount of streamflow originating as ground-water discharge in the Sand Hills region during water years 1948–52 indicates that the average annual rate of recharge is about 2.9 inches, plus whatever ground water is discharged by evaporation and transpiration. Because water evaporated from the myriad of lakes in the Sand Hills region is replaced by seepage from the ground-water reservoir and because the water table is so close to the land surface in many places that hay meadows are subirrigated, ground-water discharge by evapotranspiration may equal or exceed that by seepage into streams. Tolstead (1942) reported that the water table in a wet meadow in Cherry County fell 2.78 feet from June 30 to September 1, 1938, as the result of evapotranspiration losses. Accordingly, the average annual recharge in the Sand Hills parts of the basin is estimated to be at least 5 inches per year.

During November, runoff from the loess plains and hills part of the basin consists almost wholly of ground-water discharge because, during that month, overland runoff generally is negligible, evapotranspiration losses are slight, and freezing is not a factor in reducing streamflow. Based on records of stream discharge during water years 1948–52, the average runoff during November is about 38,000 acre-feet. If this rate of ground-water contribution to streamflow remains constant throughout the year, ground-water discharge from the loess plains and hills part of the basin averages about 450,000 acre-feet per year. To produce this amount of discharge from the ground-water reservoir, recharge necessarily would average 1.2 inches per year.

In addition to the direct discharge of ground water into streams and lakes, a very small amount of water issues from springs and seeps not immediately adjacent to streams. Among the best known of these are the springs in Victoria Spring State Park in Custer County and the springs at the north end of Pibel Lake in Wheeler County. At both places the water table is shallow and the springs are of the simple gravity type. When visited in July 1952, the two springs in Victoria Springs State Park had a combined flow of about 1 gpm.

ARTIFICIAL RECHARGE AND DISCHARGE

The hydrologic regimen of the Loup River drainage basin has been modified locally by withdrawal of ground water through wells, irrigation of valley lands with water diverted from streams, impoundment of water behind dams, and diversion from streams for generation of electric power. Some such developments reduce the supply of ground water available for use, whereas others increase the available supply of ground water.

Throughout the rural part of the drainage basin, water for drinking, cooking, laundering, and sanitary use is obtained from wells. On the basis of the number of rural residents and a reasonable assumption of per capita use, about 3,500 acre-feet of ground water is estimated to be pumped each year for these purposes. Although a part of the water is used consumptively, a part of it infiltrates to the zone of saturation and is available for reuse.

Livestock drink water from streams, from natural and artificial ponds, and from watering tanks or troughs filled with water pumped from wells. An estimated 14,000 acre-feet of ground water is pumped each year for this purpose. Probably most of the water is used consumptively, although some overflows the water tanks and troughs and infiltrates again to the undergound reservoir.

According to information obtained from a reconnaissance of the Loup River drainage basin and to data supplied by employees of the U.S. Soil Conservation Service, county agricultural extension agents, and residents of the basins, 352 irrigation wells had been drilled in the Loup River drainage basin by 1952 (fig. 15). The locations of these

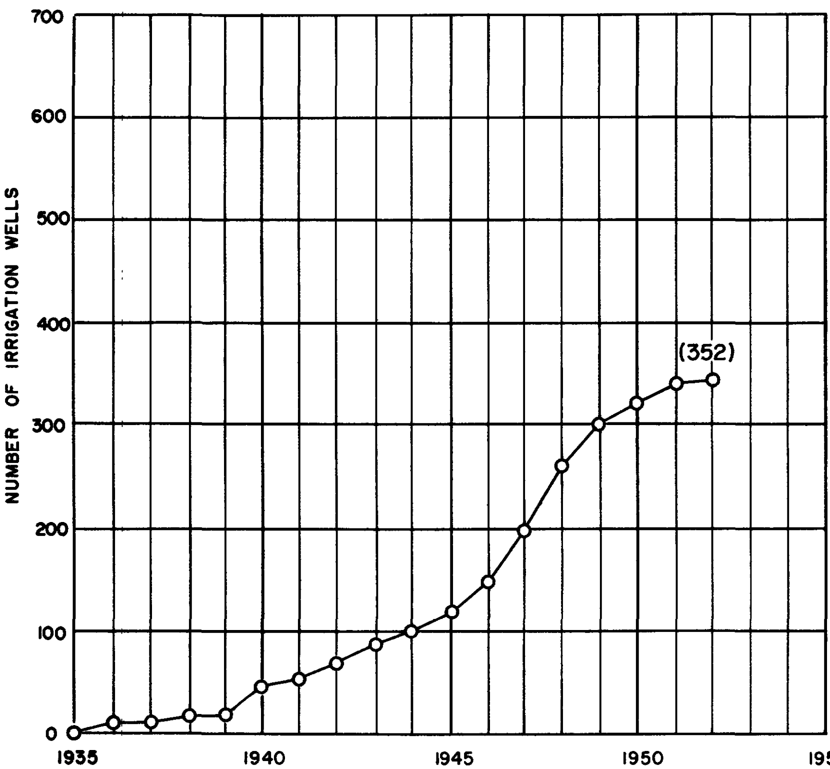

FIGURE 15.—Cumulative number of irrigation wells drilled in the Loup River drainage basin, 1935–52.

wells are shown on plate 1, and pertinent data on 115 of them, selected at random, are given in table 12. Most of the wells are in the valleys because there the pumping lift is not very great and most of the land is topographically suitable for irrigation. Available information indicates that the amount of land irrigated from a single well ranges from 20 to 260 acres and averages about 85 acres. Accordingly, about 30,000 acres in the basin is irrigated with water pumped from wells. The discharge from irrigation wells ranges from 200 to 1,800 gpm and averages about 830 gpm. In an average growing season irrigation wells are pumped a total of about 3 weeks and, thus, about 27,500 acre-feet of ground water per year is used for irrigation. How much of the applied irrigation water infiltrates below the reach of roots and rejoins the zone of saturation is not known but is estimated to be at least a tenth.

About 48,500 acres of land in the valleys of the Middle and North Loup Rivers is irrigated from the principal canals. Of the water diverted into these canals—a reported 115,700 acre-feet in the water year that ended September 30, 1952—probably as much as 40 percent evaporates or is utilized by crops, and the remainder eventually returns to the rivers. Although some of the return flow takes place by overland runoff, most of it returns by subsurface percolation.

The number of acres irrigated with water pumped from streams is not known. In Boone County surface water is pumped at 32 locations (fig. 16) to irrigate an aggregate of about 2,000 acres.

Ord, in Valley County, is the only town in the Loup River drainage basin that uses surface water for its public supply. All other towns having public-supply systems obtain water from wells, and the total pumpage is about 4,000 acre-feet per year. Data on all municipal wells are included in table 12, and additional information on selected municipal water supplies is given in table 4. The Chicago, Burlington & Quincy Railroad and local creameries are the principal industrial users of ground water not supplied from the municipal systems. An estimated 1,000 acre-feet of water per year is pumped for use by these industries.

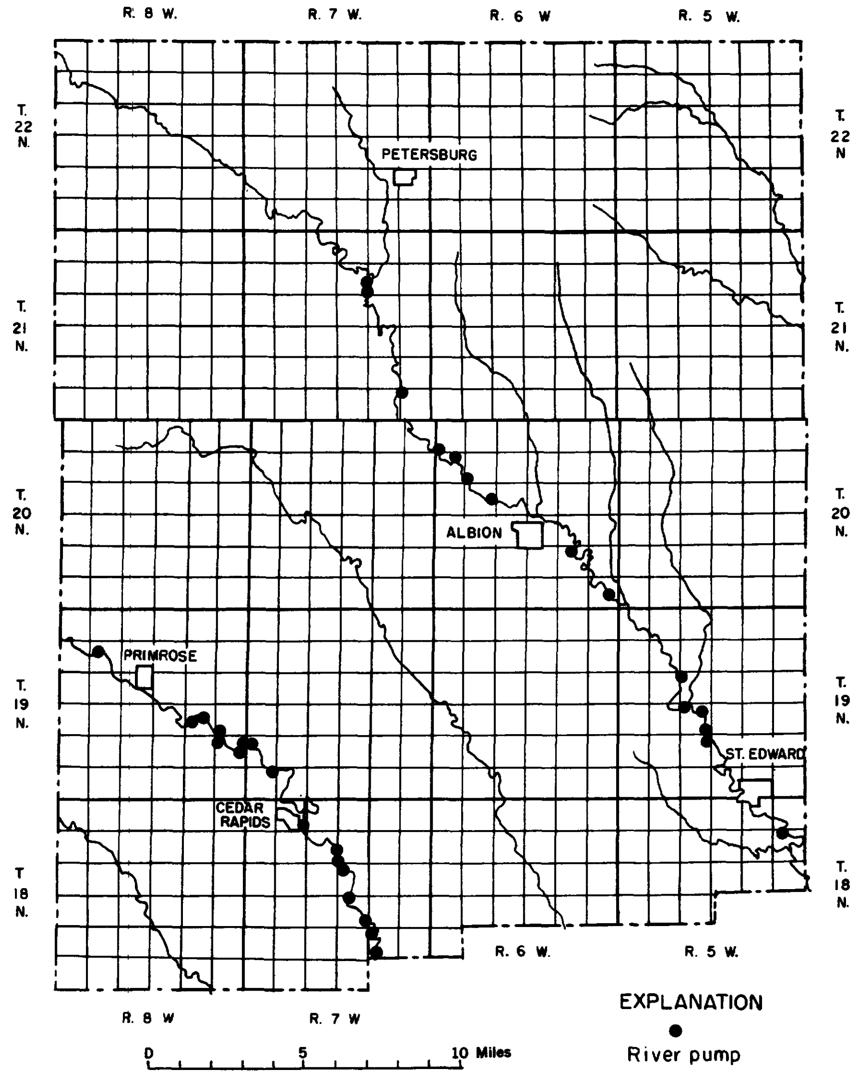

FIGURE 16.—Map of Boone County showing the locations at the Cedar River (lower left) and Beaver Creek (center) where surface water is pumped for irrigation.

TABLE 4.—*Data on selected municipal water supplies in the Loup River drainage basin*

City or town	Number of wells	Storage capacity (gallons)	Average daily pumpage (gallons)	Remarks
Boone County				
Albion	2	67,000	200,000	Water treated for taste and odor; chlorinated occasionally.
Cedar Rapids	7	------------	60,000	All wells interconnected to one piston pump. Information obtained for only one well.
Petersburg	2	------------	50,000	One well reserved for standby purposes. Both wells in firehouse.
Primrose	1	25,000	25,000	Well in building north of the town hall.
St. Edward	1	------------	50,000	Well in City Water Supply Building. Drawdown 18 feet after well is pumped 3 hours at 300 gpm.
Custer County				
Anselmo	2	50,000	75,000	Information obtained for only one well; other well is 50 feet east and is reserved for standby use.
Ansley	3	90,000	50,000	Drawdown in well 15-18-4dc is 15 feet when discharge is 300 gpm.
Arnold	2	80,000	200,000	Information obtained for only one well; other well is 50 feet south.
Broken Bow	5	350,000	400,000	
Callaway	2	50,000	200,000	Wells in city park, about 20 feet apart.
Mason City	1	30,000	25,000	
Merna	2	60,000	60,000	Information obtained for only one well. Other well is about 15 feet south.
Grant City				
Hyannis	2	90,000	180,000	
Greeley County				
Greeley	2	50,000	50,000	Wells pumped alternately.
Scotia	1	18,000	42,000	Well west of Community Building. Air-pressure storage tanks used.
Spalding	2	110,000	100,000	
Wolbach	2	43,000	43,000	Information obtained for only one well.
Hooker County				
Mullen	3	40,000	300,000	Water sample collected from well 24-32-20ab (city well 2). Well 24-32-20bd owned by Chicago, Burlington & Quincy Railroad and leased to town.
Howard County				
Boelus	1	------------	7,000	
Dannebrog	1	50,000	25,000	Occasionally water has an odor.
Elba	1	35,000	12,000	Drawdown 19 feet when well was test-pumped at 350 gpm.
Farwell	1	25,000	20,000	New well of larger capacity being constructed.
Logan County				
Stapleton	1	50,000	50,000	New well to be constructed.

TABLE 4.—*Data on selected municipal water supplies in the Loup River drainage basin*—Continued

City or town	Number of wells	Storage capacity (gallons)	Average daily pumpage (gallons)	Remarks
Merrick County				
Palmer	2		75,000	Information obtained for only one well; other well is 5 blocks east and is reserved for standby use.
Nance County				
Belgrade	1		120,000	
Fullerton	9		235,000	Information obtained for only one well.
Genoa	2		125,000	
Sherman County				
Litchfield	2	50,000	50,000	Information obtained for only one well; other well is in same city block.
Thomas County				
Thedford	1	9,000	100,000	
Valley County				
North Loup	2	60,000	45,000	Well 18-13-26dd reserved for standby use.
Wheeler County				
Ericson	1	33,000	45,000	

Apparently the canals conveying water from the Middle Loup River to the Boelus powerplant and from the Loup River to the powerplants at Monroe and Columbus are not sources of appreciable recharge to the ground-water reservoir. Unlike the irrigation canals, the power canals carry water the year round, and they have become effectively sealed by the settling of silt and clay. Hydrographs of the water level in two wells close to Lake Babcock, a regulatory reservoir near the Columbus powerplant, show that seepage from the reservoir caused a large rise of the water table when the canals first carried water in 1937 but that within a few years the water table began to decline and in 1952 was not appreciably higher than before the canal became operative. (See fig. 17.)

MOVEMENT

Once water infiltrates to the zone of saturation its direction of movement becomes nearly horizontal. Unless intercepted by a discharging well, the water continues its lateral movement until dis-

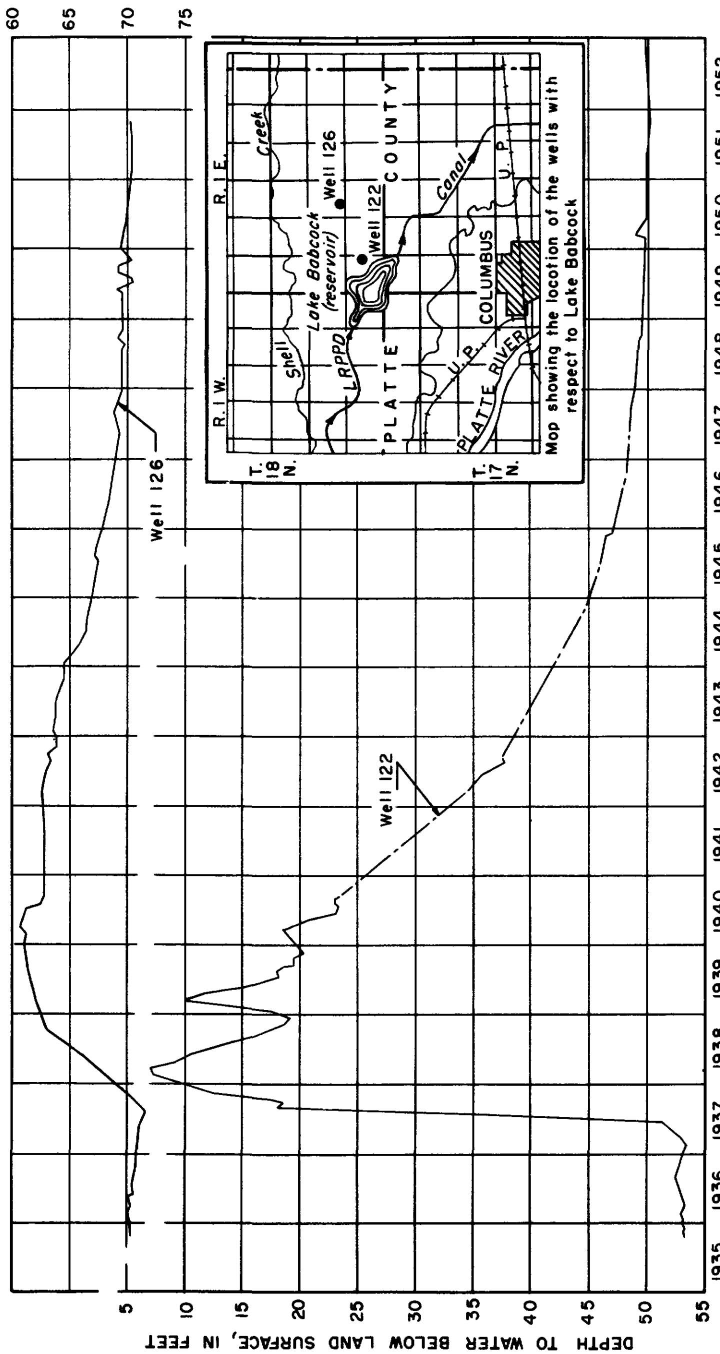

FIGURE 17.—Hydrographs for wells 122 (A18–1–31ad) and 126 (A18–1–28cd) of the Loup River Public Power District.

charged by natural processes. The rate of movement is governed by the permeability of the material through which the water moves and by the steepness of the hydraulic gradient. As the permeability of water-bearing material in the Loup River drainage basin has not been determined, the rate of ground-water movement is unknown. However, the average rate of movement is estimated to be no more than a few feet per day.

The steepness of the hydraulic gradient and the direction of ground-water movement in the Loup River drainage basin can be determined from plate 1, which shows the configuration of the water table. The hydraulic gradient ranges from about 6 to 40 feet per mile and averages a little less than 9 feet per mile. The general direction of ground-water movement in the western part of the basin is eastward and in the eastern part is southeastward. However, because ground water discharges into the streams, the direction of natural ground-water movement locally may be southwest, south, southeast, east, northeast, or north. In the triangular area adjoining the west end of the Loup River drainage basin, ground water moves westward and northwestward toward a tributary of the Niobrara River.

Pumping a well creates a steeper than natural hydraulic gradient toward the well on all sides, diverting ground water from its normal path, and causing it to percolate toward the well at an accelerated rate. When a well is pumped, the steepness of the hydraulic gradient toward it and the area in which water is diverted from its normal path are governed by the capacity of the aquifer to transmit water and by the rate at which water is discharged from the well.

WATER-LEVEL FLUCTUATIONS

Fluctuations of the water levels in wells reflect changes in the amount of ground water in storage. During periods of rising water level the increment to storage exceeds discharge from storage, and during periods of falling water level the reverse is true. Unlike that of water stored in a surface reservoir, the surface of stored ground water may rise in some parts of an area and at the same time fall in other parts. Therefore, significant net changes in ground-water storage are impossible to detect unless water-level changes are recorded at points scattered somewhat uniformly throughout the area.

As part of the State-Federal program of ground-water studies in Nebraska, water-level measurements have been made at irregular intervals in 18 wells in the Loup River drainage basin since the late 1930's. Measurements have been made in an additional 17 wells as part of the Missouri River basin development program, which began in 1946. The measurements made in all these wells are reproduced in table 11. Although the measurements show that seasonal fluctuations have occurred, they do not indicate any significant upward or downward trends in water levels during the period of record.

CHEMICAL QUALITY OF THE WATER

By Russell H. Langford

As part of the investigation of the ground-water resources of the Loup River drainage basin, studies were made to determine the chemical quality of the water and to evaluate the suitability of the water for irrigation and for domestic use. Some chemical quality data were available as a result of previous investigations in the area (Brown, 1955; Connor, 1951; Schreurs, 1956; and Sniegocki, 1955). An additional 20 samples were collected and analyzed in 1952 to augment data obtained during the previous investigations. The locations of wells, springs, streams, and lakes for which data are available are shown on figure 18, and the chemical analyses of the water are given in tables 5 and 6.

The chemical analyses were made by methods usually used in water chemistry (Am. Public Health Assoc., 1955). Concentrations of dissolved constituents are given in parts per million; a part per million is a unit for expressing concentration by weight, usually as grams of constituent per million grams of solution. Concentrations of iron and manganese in analyses of ground water represent the amounts of these constituents both in solution and in suspension at the time the sample was collected, except when footnoted "in solution when analyzed." Concentrations of iron in analyses of surface water represent the amounts of iron in solution at time of analysis. In tables 5 and 6, concentrations of dissolved solids represent residue on evaporation at 180°C, and specific conductance values are expressed in reciprocal ohms per centimeter times 10^6 and are referred to as micromhos at 25°C.

CHEMICAL CHARACTERISTICS OF THE WATER

The streams in the Loup River basin are fed by ground water, and the chemical quality of the water in the streams during periods of relatively low flow (table 5) is similar to the quality of the ground water (table 6). Because the chemical characteristics of both surface and ground waters in the Loup River drainage basin are uniform, no attempt was made to correlate the type of water with the water-bearing source. However, all samples of ground water are probably from sands and gravels of either Pleistocene or Tertiary age. Almost with-

TABLE 5.—*Chemical analyses of water from streams during periods of low flow and from lakes in the Loup River drainage basin*

[Results in parts per million except as indicated]

Location	Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C)	pH
Frye Lake, 1 mile northeast of Hyannis	*1952* Sept. 10	------	21	0.08	28	33	53	36	[1] 410	19	7.5	1.4	2.2	0.28	438	206	0	31	654	8.5
Middle Loup River at Dunning	do	[2] 347	57	.27	23	3.5	7.8	5.8	106	4.0	.5	.2	1.2	.03	160	72	0	18	188	8.1
Dismal River at Dunning	do	294	54	.25	22	2.2	7.2	4.8	96	2.0	1.0	.2	.8	.01	148	64	0	18	170	7.8
South Loup River at Pleasanton	*1950* Oct. 24	------	46	.10	55	7.9	10	7.3	224	15	3.5	.0	3.0	.00	278	170	0	11	373	8.0
Mud Creek at Ravenna	Oct. 28	------	50	.10	95	18	15	13	390	30	7.0	.2	1.3	.10	428	310	0	9	611	8.0
South Loup River at St. Michael	*1949* Sept. 22	[2] 168	46	.02	59	8.9	17		238	17	3.4	.2	3.8	------	284	184	0	17	394	7.5
Middle Loup River at St. Paul	Oct. 6	906	51	.02	34	4.2	14		144	8.0	2.5	.4	1.7	------	197	103	0	23	253	7.7
North Loup River near Burwell	*1952* Sept. 9	276	58	.14	26	3.9	8.5	6.0	117	4.0	1.0	.3	1.1	.02	170	81	0	17	204	7.9
Calamus River near Burwell	do	[2] 267	51	.10	18	2.2	6.6	4.4	83	2.0	1.0	.2	.9	.01	130	54	0	20	144	7.7
North Loup River near St. Paul	*1949* Oct. 6	730	53	.02	28	3.1	10		119	3.0	1.5	.4	1.5	------	175	83	0	21	205	8.2
Cedar River near Spalding	*1947* Aug. 27	42	47	.13	26	6.8	5.4		117	7.4	.0	.2	.7	.14	165	93	0	11	204	8.2
Beaver Creek at Loretto	*1949* Sept. 27	39	38	.08	31	5.4	7.6		136	1.6	1.4	.2	.8	------	158	100	0	14	274	7.7

[1] Includes equivalent of 13 ppm of carbonate (CO_3).
[2] Daily mean discharge.

TABLE 6.—*Chemical analyses of ground water in the Loup River drainage basin*

[Results in parts per million except as indicated]

Well or test hole	County	Depth of well (feet)	Date of collection	Temperature (° F)	Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25° C)	pH
11-16-35ad	Buffalo	183	9- 6-50		50	0.08		81	9.2	7.6	5.7	292	0	11	6.5	0.0	3.0	0.10	330	240	1	6	464	7.5
12-13-20cb	do	207	8-31-50		50	.05		64	8.4	9.6	8.0	236	0	12	2.0	.1	8.9	.00	314	194	0	9	403	7.4
14-5dd	do	235	8-30-50		54	.03	[1]0.05	88	12	10	6.1	332	0	18	4.0	.0	1.9	.00	374	268	0	7	515	7.5
15-25cb	do	96	8- 9-50		50	.05		71	11	11	6.2	276	0	21	4.0	.0	.6	.00	334	222	0	9	440	7.4
16-35ad2	do	119	9-12-50		48	.92	[1].06	89	13	11	6.6	332	0	19	9.0	.0	.5		400	276	4	8	522	7.5
13-11-6bd	Howard	80	10- 9-49	54	44	2.7		60	10	16	4.8	234	6	8.0	11	.2	2.9	.30	304	191	0	15	416	8.2
11dbl	do	85	2- 2-50	54	52	.32	[1].39	124	15	12	9.1	396	0	72	13	.1	2.7	.30	516	371	46	6	722	7.7
12-29abl	do	31.5	11-10-49	56	45	.05	[1].07	92	8.5	11	4.7	226	15	32	12	.2	34	.17	388	265	55	8	527	8.5
13-5dd	Sherman	35	10- 9-49	56	40	5.0		55	9.2	7.9	5.2	212	0	11	10	.1	7.0	.30	270	176	2	9	368	8.0
13cc	do	78	9- 1-49	55	46	.02		114	10	5.0	11	341	18	1.0	16	.2	20	.30	436	326	16	3	621	8.3
17-36bc	Custer	126	10-27-50		43	4.0		100	10	12	7.5	326	0	18	25	.0	.4	.00	402	292	25	8	583	7.7
14-10-3ca2	Howard	55	12- 1-43	55				88	16	32		300	0	50	13	.0	49	.09	396	286	40	20	628	7.5
30ba	do	32	10-18-49	55	41	.08		200	47	40	24	313	18	182	49	.3	314	.10	[2]1,070	693	406	11	1,450	8.3
11-6bal	do	115	8-15-49	54	58	.04	[1].08	36	9.4	9.4	7.4	181	0	4.0	3.2	.2	.8	.30	228	129	0	13	303	8.0
14-3cc2	Sherman	38	10- 9-49	53	41	.92		81	14	13	17	209	15	74	18	.3	8.9	.23	422	260	64	9	555	8.4
15- 6-2bb	Nance	18.5	6- 2-51	49	46	1.4		33	3.8	6.1	5.0	115	0	11	2.5	.2	12	.05	188	98	4	11	236	7.7
8-17dd	Merrick	14.0	6- 2-51	48	35			66	9.6	16	6.1	249	0	42	3.0	.3	.9	.09	311	204	0	14	450	7.7
27dd	do	21.0	6- 2-51	50	43			47	6.4	6.4	5.0	180	0	16	1.5	.3	1.1	.06	227	144	0	9	307	7.5
11-10bc	Howard	79	11-30-43					81	13	16		327	0	11	4	.0	6.4	.04	292	256	0	12	511	7.6
13-27ab	Sherman	150	7-21-49		58	.05	[1].05	40	13	12	11	174	0	18	24	.2	3.2	.44	282	154	11	13	378	8.1
14-18bd1	do	116	10-18-49	55	53	2.8	[1].05	59	15	22	12	239	0	54	17	.2	.6	.30	368	209	13	18	505	7.8
18-9bal	Custer	100	9- 9-52	55	57	.26	.00	63	8.0	9.0	6.3	230	0	16	3.0	.1	6.5	.05	286	190	1	9	405	7.6
23-11bal	do	194	9- 9-52	54	50	.11	.00	44	4.6	9.3	6.6	172	0	2.0	2.0	.2	8.4	.03	214	129	0	13	303	7.6
16- 3-5aa	Merrick	14.0	6- 4-51	49	30			20	3.4	9.4	4.8	86	0	19	.5	.2	2.2	.11	132	64	0	23	183	6.9
7dd	do	10.6	6- 4-51	50	28			30	6.1	20	2.2	104	0	26	3.0	.3	35	.02	218	100	15	30	297	6.8
5-21cc	Nance	14.0	6- 2-51	49	17			49	4.7	4.4	5.2	184	0	5.0	1.0	.3	1.9	.08	188	142	0	6	293	7.8
16-12bc	Sherman	124	8-29-49	54	44	.32		90	11	12	10	348	0	8.0	7.0	.2	3.3	.20	367	270	0	8	551	8.0
A17- 1-20bc	Platte	100	2-20-51	54	35	.32	.11	87	14	35	17	314	0	73	29	.3	1.4		474	273	16	21	690	7.4
17- 1-27ad	do	13.5	6- 4-51	50	29	1.9		40	5.8	13	14	148	0	41	7.0	.2	2.8	.10	239	124	3	17	332	7.0
4-24cal	Nance	30	12-29-49	54	36	.23	[1].05	91	13	23	11	331	0	54	7.5	.6	13	.20	428	281	10	15	608	7.3
36aa	do	11.0	6- 4-51	50	26	5.5		51	7.5	17	9.3	186	0	43	6.5	.3	3.5	.05	267	158	5	18	389	7.0

12-9ba	Greeley	73	11-30-43	52	----	----	----	102	15	23		390	0	28	7	.0	9.0	.06	376	316	0	14	639	7.5
16-26ba	Valley	81	10-17-49	55	50	.09	[1] .04	60	7.9	17	12	212	5	27	16	.2	1.1	.30	332	182	0	16	429	8.2
20-32ad2	Custer	165	9- 9-52	55	55	.14	.12	65	8.8	8.9	7.0	239	0	20	4.0	.2	6.8	.04	290	198	2	9	424	7.4
25-28aa [3]	do	140	9- 9-52	56	58	.39	.01	40	4.4	10	6.2	159	0	3.0	2.0	.2	7.9	.03	212	118	0	15	285	7.7
18-13-25cc	Valley	93	11-29-43	53	----	----	----	122	22	47		444	0	77	20	.0	31	.07	538	395	31	21	859	7.5
17-2db	Custer	180	10-17-49	52	52	.01	[1] .08	54	9.1	10	5.6	215	8	4.0	4.0	.3	3.8	.18	276	173	0	11	369	8.3
21-32dc2	do	180	9-11-52	56	51	.40	.00	59	4.6	11	7.8	219	0	4.0	3.0	.2	7.3	.05	256	166	0	12	375	7.6
28-35cd	Logan	153	9- 9-52	57	57	.02	.00	25	3.5	7.7	4.7	110	0	3.0	1.5	.1	3.7	.02	162	77	0	17	196	7.4
19-17-9ca	Custer	170	8-26-49	52	45	.17	----	39	5.0	6.5	6.5	160	0	.4	1.4	.1	4.6	.20	207	118	0	10	262	8.0
18-3dd1	do	90	7- 7-50	53	35	.08	[1] .04	48	8.6	9.6	9.0	165	0	11	13	.1	34	.19	274	156	21	11	366	7.1
20-5cb	do	112	8-25-49	54	48	.44	----	46	6.0	10	8.6	198	0	1.0	2.2	.5	.8	.30	242	140	0	13	316	8.1
9aa	do	80	8-25-49	54	49	.25	----	61	8.8	10	15	230	14	5.6	2.4	.5	2.8	.20	302	188	0	10	400	8.4
21-20aa	do	(4)	9-11-52	54	54	.26	----	44	5.1	8.7	8.8	185	0	2.0	1.5	.3	.3	.02	218	131	0	12	302	7.7
22-16cb2	do	150	9-11-52	----	57	.32	.25	45	4.5	9.2	10	191	0	2.0	2.0	.3	.5	.04	226	131	0	12	309	7.7
20- 6-22ba1	Boone	98	9- 8-52	54	50	.09	.21	74	10	13	9.0	275	0	18	15	.2	.4	.04	324	226	0	11	499	7.3
19-31cb	Custer	110	8-24-49	54	49	.23	----	60	8.3	10	9.0	214	18	1.4	2.0	.2	1.1	.20	279	184	0	10	376	8.5
34ab	do	122	8-25-49	53	54	.67	----	49	8.1	12	9.5	230	0	3.0	2.4	.2	1.5	.30	254	156	0	13	354	8.0
20-30aa	do	77	8-25-49	54	48	.02	----	32	4.8	4.8	5.6	127	0	4.0	1.5	.4	5.3	.30	186	100	0	9	226	8.1
21-10bc	do	30	8-24-49	54	38	.03	----	97	16	28	16	136	6	63	44	.3	176	.23	672	308	187	16	796	8.3
21-11-25dd	Wheeler	97	9- 8-52	54	55	1.0	----	26	3.6	6.2	5.8	119	0	1.0	.5	.2	.3	.02	162	80	0	13	194	7.5
16-23bd3	Garfield	78	11-29-43	47	----	----	----	70	15	26		233	0	29	13	.1	65	----	333	236	45	19	522	7.5
22- 7-25bd2	Boone	126	9- 8-52	54	45	.18	.04	69	8.8	10	9.3	265	0	15	6.5	.2	1.3	.03	292	208	0	9	450	7.3
23-28-9ca	Thomas	----	9-10-52	----	58	.17	.00	27	2.3	8.0	6.8	101	0	6.0	2.5	.1	7.9	.03	178	77	0	17	204	7.3
38-6ad	Grant	160	9-10-52	----	55	.32	.01	36	5.8	15	9.7	126	0	21	10	.3	25	.06	242	114	11	20	326	7.3
24-15-15dd	Garfield	140	9- 9-52	53	51	.18	----	15	2.3	6.7	2.8	77	0	1.0	.5	.2	.5	.03	118	47	0	22	127	7.3
32-20ab	Hooker	180	9-10-52	----	55	.17	.00	24	2.9	6.6	5.0	93	0	3.0	3.5	.2	7.2	.03	162	72	0	16	190	7.6

…n solution when analyzed.
…alculated.
[3] Analysis represents mixture of water from municipal wells 28aa1 and 28aa2.
[4] Spring.

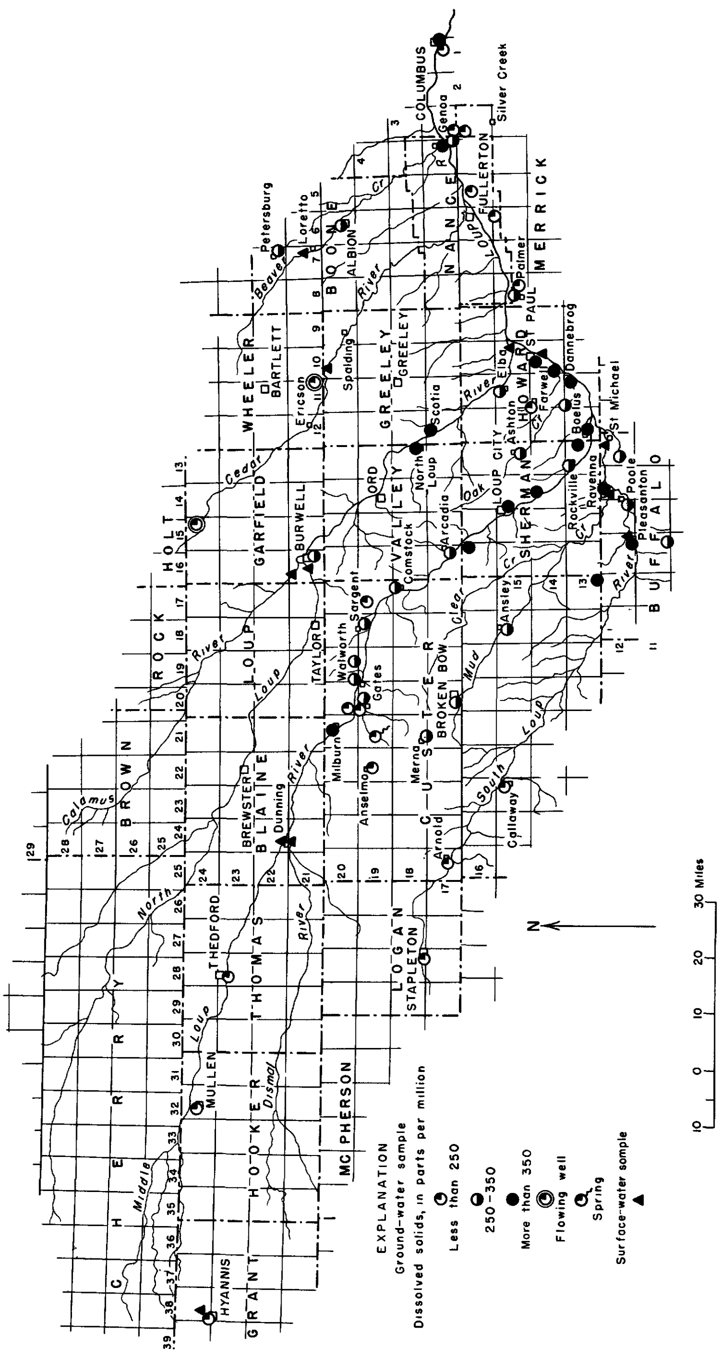

FIGURE 18.—Map of the Loup River drainage basin showing the location of sampling points and the concentration of dissolved solids in the ground water.

out exception, the analyses show that the water is of the calcium bicarbonate type and has high concentrations of silica and low concentrations of sodium (table 7).

TABLE 7.—*Maximum, minimum, and average concentrations of some of the constituents of ground and surface water*[1]

[Concentrations are given in parts per million, except as indicated]

Constituent	Maximum	Minimum	Average
Silica (SiO_2)	58	17	47
Bicarbonate and carbonate as HCO_3	444	77	218
Boron (B)	.44	.00	.12
Dissolved solids	538	118	280
Hardness as $CaCO_3$	395	47	176
Percent sodium	31	3	14
Specific conductance (micromhos at 25°C)	859	127	391

[1] The analyses of water from wells 20–21–10bc and 14–10–30ba were omitted from this tabulation because the water probably was contaminated. They are plotted on figure 19, however.

The similarity in the chemical characteristics of the surface and ground waters can be seen more clearly in figure 19, in which the water is classified according to type. The plots represent the percentage concentrations of the various groups of ions in the water. Percentages were calculated from concentrations in equivalents per million and were based on the sum of either the cations or the anions. The ions are grouped into the strong bases—sodium and potassium; the weak bases—calcium and magnesium; the strong acids—sulfate, chloride, fluoride, and nitrate; and the weak acids—carbonate and bicarbonate. Nearly all the analyses plotted in the shaded part of the figure. The position of the shaded area in the left part of the diamond illustrates that most water in the area is of the calcium bicarbonate type. About two-thirds of the points plotted in the lower part of the shaded area. Most of the points in the upper part of the shaded area represent water from wells in the bottom lands of the lower Middle Loup and lower Loup River valleys.

The analyses of three samples did not conform with the majority. Water from wells 20–21–10bc and 14–10–30ba contained high percentages of chloride and nitrate (fig. 19), perhaps as a result of contamination of the water by surface drainage. The plot representing the sample from Frye Lake near Hyannis shows the effect of concentration by evaporation of the lake water, a phenomenon that is discussed by F. H. Rainwater (Bradley, 1956) in connection with similar lakes in southern Sheridan County, Nebr.

The water in the Sand Hills part of the basin generally is softer than that in the southeastern part of the basin, except in the area south of the Loup River between St. Paul and Columbus where samples were collected from shallow wells in June 1951 after a period of heavy precipitation. Rainwater states that water from these shallow wells probably was diluted by recharge from the precipitation (Sniegocki, 1955).

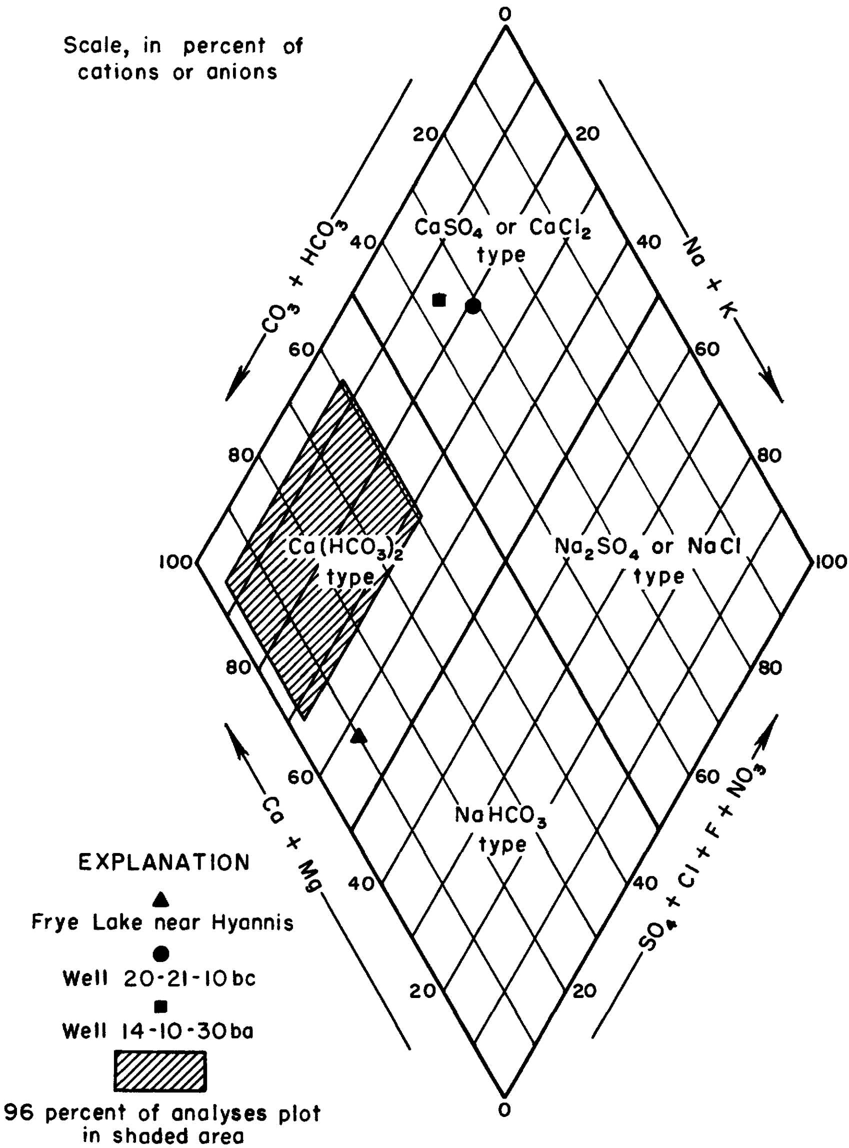

FIGURE 19.—Chemical classification of waters in the Loup River drainage basin.

Generally, the concentration of dissolved solids increases in the direction of ground-water movement, which is southeastward. (See fig. 18.) The increase in concentration, however, does not result from proportional increases in each of the constituents. The relations of cations and alkalinity to total concentrations are shown in figure 20. In this illustration, total concentration is considered to be the sum of the equivalents per million of all the ionized constituents. Alkalinity is caused principally by carbonates and bicarbonates, although in the Loup River drainage basin water contains appreciable silica which may contribute to the alkalinity. In figure 20 the alkalinity is plotted as carbonate plus bicarbonate. The plots of alkalinity have been ad-

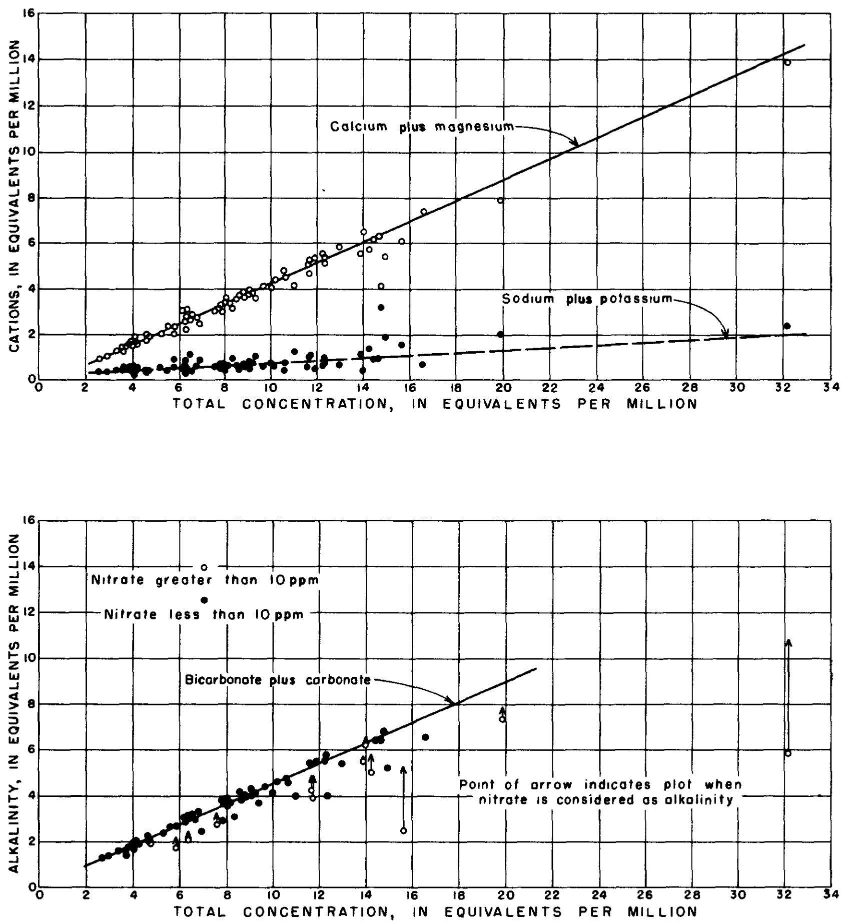

FIGURE 20.—Relation of cations and alkalinity to total concentration, Loup River drainage basin.

justed for those analyses that show a nitrate concentration greater than 10 ppm. (See arrows, fig. 20.) Rainwater (Sniegocki, 1955) explains this method for adjusting the alkalinity when nitrate concentration is high. The slopes of the curves in figure 20 show that an increase in total concentration is due mainly to an increase in calcium and magnesium salts rather than in sodium and potassium salts. The slopes of the calcium plus magnesium curve and the alkalinity curve are each about 0.45. This fact indicates that about 90 percent of the total ionic concentration consists of alkaline salts of calcium and magnesium and that calcium plus magnesium and alkalinity increase in stoichiometric proportion. Thus, the increase in concentration of ground water in transit can be attributed principally to the solution of calcium and magnesium carbonates. The slope of the sodium plus potassium curve in figure 20 indicates that sodium and potassium salts are less abundant soluble constituents of the water-bearing sources.

The percentage by weight of silica in the dissolved solids decreases in the general direction of ground-water movement. Water in the Sand Hills part of the basin had appreciably higher silica concentrations than water in the loess plains and hills part of the basin. Connor (1951, p. 9) states, "A noticeable downward trend in the percentage of silica in ground water sampled between Dunning and St. Paul was also observed in the surface water."

SUITABILITY OF THE WATER FOR IRRIGATION

The rating of water for irrigation depends not only on the dissolved constituents in the water but also on the drainage characteristics of the land, the permeability of the soil, the expected reactions in the soil solution, the amount of water to be applied, and the type of crops to be grown.

Wilcox (1948) rates water for irrigation with respect to the total concentration and percent sodium, assuming "average conditions as related to soil, permeability, drainage, quantity of water used, climate, and crops." Water sampled in the Loup River drainage basin, when classified by the method described by Wilcox, rates excellent to good, with the exception of ground water in the vicinity of three wells, which rates good to permissible.

Eaton (1950) discusses the effect on the soil of high concentrations of carbonates and bicarbonates in irrigation water. He defines "residual sodium carbonate" as the residue of carbonate paired with sodium in equivalents per million after evaporation and plant uptake of water have resulted in the precipitation of calcium and magnesium carbonates. Thus, even though an irrigation water initially has a low percent sodium, if carbonate and bicarbonate exceed calcium and magnesium, the percent sodium and the pH could increase as the water is subjected to evaporation and plant uptake. Wilcox (1952, p. 3) states that waters having more than 2.5 epm (equivalents per million) of residual sodium carbonate are not suitable for irrigation, waters having 1.25 to 2.5 epm are marginal, and those having less than 1.25 epm are probably safe. About 60 percent of the water sampled had some residual sodium carbonate; however, the maximum was only 0.52 epm except for the sample from Frye Lake near Hyannis, which had 2.30 epm.

Boron is toxic to many plants. Wilcox (1952, p. 3) states, "In a general way, if the boron concentration * * * is less than 1 part per million no serious injury will occur even to the more sensitive plants." The highest boron concentration in water sampled was 0.44 ppm, which is well below the limit for the more sensitive crops.

Both surface and ground water in the Loup River drainage basin should not present any serious problems if used for irrigation, providing that drainage is adequate.

SUITABILITY OF THE WATER FOR DOMESTIC USE

The United States Public Health Service (1946) has set standards for the chemical characteristics of drinking and culinary water used on public and other carriers subject to Federal quarantine regulations. These standards are useful in evaluating the suitability of water for domestic use and are shown, in part, below:

Constituent	*Recommended maximum concentration (ppm)*
Iron and manganese	0.3
Magnesium	125
Sulfate	250
Chloride	250
Fluoride	[1] 1.5
Dissolved solids	[2] 500

[1] Maximum allowable.
[2] 1,000 ppm permitted when water of better quality is not available.

Except for excess iron in some samples, most of the water is satisfactory according to the above standards.

Although a limit on the concentration of nitrate is not included in the standards, nitrate when present in high concentrations may be an indication of contamination of ground water. A limit of 44 ppm has been recommended for water used in infant feeding (Maxcy, 1950). Water from two wells used for domestic purposes in the area contained nitrate greatly in excess of 44 ppm and should not be used for drinking.

Generally, water having a hardness of less than about 60 ppm is considered to be soft, whereas that having a hardness of more than

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about 200 ppm is considered to be very hard. Softening is desirable for most uses of very hard water. In the report area the degree of hardness of the water ranged from soft in the Sand Hills part of the basin to very hard in the southeastern part of the basin.

CONCLUSIONS

Evidence indicates that large quantities of water feasibly could be pumped from wells in the Sand Hills part of the basin. However, barring a progressive decrease in precipitation or a general change in the agricultural economy of that part of the Loup River drainage basin, ground-water withdrawals there are not likely to increase substantially. Because high production of hay would no longer be possible if the water table were lowered below the reach of meadow grasses, a wide-spread lowering of the water table, such as would attend large-scale pumping from the ground-water reservoir, would adversely affect the feed supply required for cattle raising. At present, therefore, the ground-water resources of the Sand Hills probably could not be utilized to better advantage within that part of the basin; only if the ground water now discharged into streams could not be used effectively outside the Sand Hills would development of ground water within the Sand Hills seem economically advantageous.

In 1952 not all the loess plains and hills part of the basin had been test drilled; and, until it is, its ground-water potential will remain unknown. However, the test drilling already done shows that, although the yielding capacity of the ground-water reservoir is not uniform, at least some extensive tracts are underlain by material capable of yielding large quantities of water to wells. Exploratory test drilling should be done at the site of each proposed large-discharge well to determine whether the aquifer at that point is sufficiently thick and permeable to transmit the desired quantity of water.

Even if the ground-water resources of the loess plains and hills part of the basin were eventually developed to the maximum capacity of the reservoir to yield on a sustained basis, the supply of surface water probably would not be reduced to less than about 70 percent of the present supply. As pointed out by the U.S. Bureau of Reclamation (1951), there exist many opportunities to use the available surface water to irrigate farmland and generate hydroelectric power within the Loup River drainage basin and also to supplement the supply in water-short areas in the Platte River valley in Buffalo County and eastward.

The chemical characteristics of the water in the Loup River drainage basin are very uniform. Analyses of samples collected during 1943–52 indicate that the water is of the calcium bicarbonate type and has a high silica content and a low percent sodium. In general, the concentration of dissolved salts in the ground water increases in the direction of ground-water movement. Calcium and magnesium bicarbonates account for about 90 percent of the increase in the ionized constituents. Water in the Sand Hills part of the basin is softer and has higher concentrations of silica than water in the southeastern part.

The water is suitable for irrigation because of its low concentration of dissolved solids, boron, and sodium and low residual sodium carbonate. Although in some parts of the basin the ground water is very hard and locally has a high iron or nitrate content, it is considered to be suitable for most domestic uses.

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BASIC DATA

Table 8.—*Summary of published logs of test holes drilled in the Loup River drainage basin by the Conservation and Survey Division, University of Nebraska, in cooperation with the U. S. Geological Survey*

[Logs obtainable from Conserv. and Survey Division, Univ. Nebraska]

Test hole	Altitude of land surface (feet)	Water surface			Thickness of saturated Pleistocene deposits penetrated (feet)	Top of Ogallala formation		Thickness of Ogallala formation penetrated (feet)	Depth of test hole (feet)
		Date of measurement	Depth below land surface (feet)	Altitude (feet)		Depth below land surface (feet)	Altitude (feet)		
BOONE COUNTY									
18- 8- 8bc	1,894	May 19, 1947	40.4	1,853.6	167	207	1,687	128	340
19- 7- 5aa	1,976	May 21, 1947	181	1,795	249	430	1,546	35	500
8-24bc	1,802	May 9, 1947	9.0	1,793.0	103	112	1,690	182	320
27cc	1,879	May 12, 1947	79.7	1,799.3	118	198	1,681	162	360
21- 7-23ca	1,821	Nov. 1, 1944	8	1,813	86	94	1,727	15	109
23cb	1,868	do	22	1,846	18	....	....	0	40
23db	1,800	do	2.4	1,797.6	51.6	54	1,746	85	139
24cb	1,832	Oct. 31, 1944	39	1,793	100	....	....	0	139
BUFFALO COUNTY									
11-16-15da	2,155	July 17, 1947	30.3	2,124.7	47.7	78	2,077	182	310
31da	2,304	do	143.1	2,160.9	0	138	2,166	233	400
12-15-12ba	2,014	July 8, 1947	6.4	2,007.6	61.6	68	1,946	157	270
14ab	2,090	July 10, 1947	72.0	2,018.0	55.0	127	1,963	162	360
22ab	2,123	July 11, 1947	91.8	2,031.2	20.2	112	2,011	196	340
28bd	2,057	July 15, 1947	6.3	2,050.7	40.7	47	2,010	176	260
31dd	2,133	July 14, 1947	66.1	2,066.9	73.9	140	1,993	162	330
18- 5ab	2,218	Sept. 14, 1948	8.6	2,209.4	62.4	71	2,147	269	340
17dd	2,284	Sept. 13, 1948	32.6	2,251.4	42.4	75	2,209	387	480
32ad	2,404	Sept. 10, 1948	127.8	2,276.2	33.2	161	2,243	326	510
CUSTER COUNTY									

13-19-31dc	2,445	Sept. 17, 1948	101.7	2,343.3	15.3	117	2,328	343	560
21-32cc	2,676	Oct. 6, 1948	210.4	2,465.6	107.6	318	2,358	277	645
GARFIELD COUNTY									
21-16-11dd	2,177	Sept. 26, 1943	23.7	2,153.3	32.3	56	2,121	81	137
14da	2,143	.....do	6.6	2,136.4	8.4	15	2,128	135	150
28aa	2,186	Oct. 23, 1943	13.6	2,172.4	106.4+	....	....	0	120
GREELEY COUNTY									
17- 9- 5cd	1,997	May 26, 1947	102.2	1,894.8	18	120	1,877	224	460
10-23ca	1,954	May 27, 1947	78.9	1,875.1	0	67	1,887	63	130
12- 5dd	1,909	Oct. 31, 1943	6.7	1,902.3	48.3	55	1,854	65	120
8cb	1,936	Nov. 8, 1943	14.2	1,921.8	55.8	70	1,866	30	100
34bb	2,023	Aug. 3, 1944	Dry	1,914.0-	0	99	1,924	10	109
34bc	1,900	Aug. 2, 1944	24.1	1,875.9	4.9	29	1,871	60	89
18- 9-23cc	2,081	May 23, 1947	184.9	1,896.1	141	326	1,756	205	540
12-18cd	1,974	Oct. 31, 1943	30.8	1,943.2	0	26	1,948	104	130
33ca	1,960	Oct. 23, 1943	41.6	1,918.4	66.4	108	1,852	162	270
20-10- 5ba	1,980	Nov. 9, 1944	24.6	1,955.4	74.4	....	....	0	99
5bd	1,932	.....do	6.8	1,925.2	55.2	62	1,870	37	99
5cb	1,935	.....do	9	1,926	44	53	1,882	46	99
HALL COUNTY									
12-12- 2ab	1,997	Aug. 19, 1944	Dry	1,928.0	....	....	....	....	69
HOWARD COUNTY									
13- 9- 1aa	1,841	July 25, 1951	23.2	1,817.8	....	....	....	....	300
24aa	1,805	July 24, 1951	3.0	1,802.0	....	....	....	....	175
10- 7cc	1,837	July 6, 1931	4.8	1,832.2	....	....	....	....	134
19ab	1,881	Aug. 5, 1944	4.9	1,876.1	37.1	42	1,839	67	109
29ab	1,890	July 15, 1931	12.2	1,877.8	....	....	....	....	167

Table 8.—*Summary of published logs of test holes drilled in the Loup River drainage basin by the Conservation and Survey Division, University of Nebraska, in cooperation with the U. S. Geological Survey*—Continued

Test hole	Altitude of land surface (feet)	Water surface: Date of measurement	Water surface: Depth below land surface (feet)	Water surface: Altitude (feet)	Thickness of saturated Pleistocene deposits penetrated (feet)	Top of Ogallala formation: Depth below land surface (feet)	Top of Ogallala formation: Altitude (feet)	Thickness of Ogallala formation penetrated (feet)	Depth of test hole (feet)
HOWARD COUNTY—Continued									
13-10-32dd	1,931	Aug. 5, 1944	23.3	1,907.7	75.7	99	1,832	40	139
11- 4cc	1,929	....	....	....	0	94	1,835	45	139
8da	1,901	Aug. 8, 1944	35.2	1,865.8	31.8	67	1,834	72	139
8dd	1,914	Aug. 10, 1944	47.5	1,866.5	45.5	93	1,821	26	119
12bc	1,838	Aug. 5, 1944	10.1	1,827.9	20.9	31	1,807	107	139
12-24ca	....	Aug. 12, 1944	20.4	....	28.6+	49+	....	0	49
25ba	1,923	.....do	37.7	1,885.3	0	19	1,904	90	109
25db	1,900	.....do	20.8	1,879.2	0	19	1,881	80	99
36aa	1,900	Aug. 16, 1944	9.2	1,890.8	19.8	29	1,871	40	69
36dd	1,904	.....do	.0	....	0	71	1,833	28?	99
14-10- 4cd	1,814	July 24, 1944	22.1	1,791.9	15.9	38	1,776	66	104
9da	1,797	July 25, 1944	8.2	1,788.8	7.8	16	1,781	123	139
22aa	1,799	July 26, 1944	5.3	1,793.7	37.7	43	1,756	96	139
26ab	1,845	July 27, 1944	21.5	1,823.5	28.5	50	1,795	69	119
12- 6da	2,000	June 25, 1947	24.1	1,975.9	86.9	111	1,889	263	430
15- 9- 5ac	1,799	Aug. 28, 1944	42.7	1,756.3	23.3	66	1,733	43	109
6da	1,782	.....do	27.5	1,754.5	0	27	1,755	52	79
9aa	1,785	Aug. 30, 1944	33.5	1,751.5	13.5	47	1,738	32	79
9da	1,743	Aug. 28, 1944	6.1	1,736.9	30.9	37	1,706	42	79
16da	1,764	Aug. 30, 1944	11.7	1,752.3	4.3	16	1,748	23	39
21aa	1,788	.....do	18.9	1,769.1	23.1	42	1,746	17	59
24aa	1,738	July 20, 1951	5.0	1,733.0	29.0	34	1,704	146	180
10- 9dc	1,845	Oct. 31, 1943	61.6	1,783.4	0	58	1,787	82	140
16ad	1,800	July 18, 1944	28.9	1,771.1	3.1	32	1,768	107	139

21dd	1,792	July 21, 1944	....	....	....	54	1,738	30	84
28dd	1,810	.....do......	25	1,785	45	70	1,740	69	139
33dc	1,819	.....do......	22.4	1,796.6	29.6	52	1,767	87	139
11- 4cc	1,888	Nov. 8, 1947	37.0	1,843.0	40.0	77	1,803	23	100
4dd	1,855	.....do......	28.4	1,826.6	52.6	81	1,774	69	150
5aa	1,866	June 11, 1947	22.1	1,843.9	46.9	69	1,797	286	370
12-14dd	2,060	June 24, 1947	144.5	1,915.5	0	139	1,921	387	560
16-10-18bb	1,993	June 3, 1947	100.4	1,892.6	0	83	1,910	393	490
11- 7aa	1,891	Nov. 8, 1943	41.0	1,850.0	0	28	1,863	56	84
8aa	....	....	....	....	....	104	....	326	430
33aa	1,826	June 9, 1947	7.6	1,818.4	5.4	13	1,813	269	300
35ca	1,853	Oct. 31, 1943	33.3	1,819.7	12.7	46	1,807	157	203
12- 4aa	2,023	Aug. 2, 1944	Dry	1,934.0-	0	19	2,004	70	89
13ab	1,895	Nov. 8, 1947	37.0	1,858.0	0	37	1,858	63	100

MERRICK COUNTY

14- 8- 6bb	1,810	July 20, 1951	12.4	1,797.6	59.6	72	1,738	131	230
19bb	1,829	.....do......	12.8	1,816.2	105.2	118	1,711	82	240
15- 6-19bb	1,760	July 18, 1951	42	1,718.0	....	....	....	....	230

NANCE COUNTY

15- 6- 6cc	1,680	July 18, 1951	8.4	1,671.6	....	....	....	....	100
16- 4-19bc	1,602	July 26, 1951	5.5	1,596.5	....	....	....	....	80
5-19cd	1,629	Sept. 5, 1946	9.4	1,619.6	51.1	....	....	0	120

PLATTE COUNTY

17- 1- 2cc1	1,463	July 8, 1942	4.3	1,458.7	50.7	....	....	0	55
2cc2	1,472	.....do......	12.0	1,460.0	141	....	....	0	160
14cc	1,462	.....do......	11.0	1,451.0	159	....	....	0	175
15aa	1,459	.....do......	2.9	1,456.1	161.1	....	....	0	180
27dd	1,449	July 6, 1942	4.3	1,444.7	106.7	....	....	0	130
2- 6dd	1,504	July 20, 1942	4.2	1,499.8	56.9	....	....	0	99

Table 8.—*Summary of published logs of test holes drilled in the Loup River drainage basin by the Conservation and Survey Division, University of Nebraska, in cooperation with the U. S. Geological Survey*—Continued

Test hole	Altitude of land surface (feet)	Water surface			Thickness of saturated Pleistocene deposits penetrated (feet)	Top of Ogallala formation		Thickness of Ogallala formation penetrated (feet)	Depth of test hole (feet)
		Date of measurement	Depth below land surface (feet)	Altitude (feet)		Depth below land surface (feet)	Altitude (feet)		
PLATTE COUNTY—Continued									
17- 2- 7dd	1,505	July 20, 1942	5.8	1,499.2	50.2	....	....	0	90
18dd	1,514	.....do	12.5	1,501.5	151.5	....	....	0	170
19dd	1,524	.....do	20.4	1,503.6	81.6	....	....	0	130
31aa	1,530	.....do	15.6	1,514.4	53.4	....	....	0	100
18- 1-23bc	1,505	July 8, 1942	7.3	1,497.7	87.7	....	....	0	110
27dd	1,521	.....do	49.5	1,471.5	99.5	....	....	0	160
35cc	1,539	.....do	74.6	1,464.4	127.4	....	....	0	230
2-29cc	1,589	July 20, 1942	62.4	1,526.6	76.6	....	....	0	150
31dd	1,519	.....do	13.2	1,505.8	68.8	....	....	0	100
SHERMAN COUNTY									
13-13- 5ab	2,086	....	....	....	....	59	2,027	40	99
5ca	1,977	July 1, 1947	8.1	1,968.9	8.9	17	1,960	288	320
5cb1	1,979	Aug. 2, 1944	10.7	1,968.3	22.3	33	1,946	26	59
5cb2	1,973	Sept. 2, 1944	6.7	1,966.3	27.3	34	1,939	45	79
7ab	1,969	Sept. 7, 1944	4.8	1,964.2	42.2	47	1,922	2	49
7ca	1,987	.....do	18.7	1,968.3	73.3	92	1,895	7	99
7cc	2,096	.....do	100+	1,996-	....	....	....	0	129
24da	1,982	Sept. 25, 1944	26.4	1,955.6	8	34	1,948	83	117
26da	1,951	.....do	15	1,936	50	65	1,887	28	93
34aa	2,048	....	....	....	....	104	1,944	30	120
14-23cc	2,135	Sept. 17, 1947	133.5	2,001.5	11.5	145	1,990	259	420
15-28cd	2,087	Oct. 24, 1944	28.2	2,058.8	62.8	91	1,996	8	99

28da	2,076	Oct. 24, 1944	23.6	2,052.4	58.4	82	1,994	4	86
32ad	2,096	.....do	30.8	2,065.2	69.2	100	1,996	9	109
14-13-22dd	2,119	July 1, 1947	133.0	1,986	31.0	164	1,955	332	510
14- 2cd	2,081	Sept. 9, 1944	....	....	....	102	1,979	37	139
6ab	2,069	Sept. 23, 1944	21.3	2,047.7	4.7	26	2,043	33	59
10ac	2,026	Sept. 7, 1944	7.7	2,018.3	34.3	42	1,984	27	69
16aa	2,009	.....do	3.8	2,005.2	30.2	34	1,975	45	79
17da	2,033	Sept. 23, 1944	11	2,022.0	37.0	48	1,985	21	69
16-21cc	2,173	Oct. 23, 1944	49.5	2,123.5	73.5	123	2,050	16	139
23ca	2,161	.....do	44.3	2,116.7	52.7	97	2,064	12	109
23cc	2,149	.....do	33.2	2,115.8	69.8	103	2,046	10	113
28bc	2,166	.....do	....	....	....	87	2,079	2	89
36ab	2,129	.....do	43.8	2,085.2	20.2+	....	....	0	64
36cc	2,099	.....do	17.7	2,081.3	50.3	68	2,031	1	69
15-13-34aa	2,033	Oct. 2, 1944	31.8	2,001.2	34.2	66	1,967	39	105
36bb	2,023	.....do	22	2,001	17+	....	....	0	39
14-28bb	2,077	Sept. 23, 1944	36.7	2,040.3	33.3	70	2,007	19	89
29db	2,042	.....do	6.7	2,035.3	27.3	34	2,008	25	59
32cb	2,043	.....do	6.1	2,036.9	70.9	77	1,966	42	119
15-12aa	2,094	Oct. 7, 1944	29.4	2,064.6	31.6	61	2,033	13	74
12cc	2,069	.....do	1	2,068	46	47	2,022	52	99
14cd	2,093	Oct. 2, 1944	18.9	2,074.1	48.1	67	2,026	72	139
16-15- 5bb	2,139	Oct. 12, 1944	12.7	2,126.3	33.3	46	2,093	43	89
16dd	2,120	Oct. 7, 1944	16	2,104	47	63	2,057	1	64
28bb	2,105	Oct. 10, 1944	10.2	2,094.8	51.8	62	2,043	77	139
29dc	2,124	.....do	17.5	2,106.5	22.5	40	2,084	54	94
16-16-12aa	2,125	Oct. 12, 1944	1.7	2,123.3	37.3	....	....	0	39
12cd	2,166	.....do	31.3	2,134.7	13.7	45	2,121	44	89

VALLEY COUNTY

17-14- 1ad	2,049	Oct. 9, 1943	23.7	2,025.3	26.3	50	1,999	100	150
12ab	2,060	.....do	24.6	2,035.4	25.4	50	2,010	80	130

Table 8.—*Summary of published logs of test holes drilled in the Loup River drainage basin by the Conservation and Survey Division, University of Nebraska, in cooperation with the U. S. Geological Survey*—Continued

Test hole	Altitude of land surface (feet)	Water surface			Thickness of saturated Pleistocene deposits penetrated (feet)	Top of Ogallala formation		Thickness of Ogallala formation penetrated (feet)	Depth of test hole (feet)
		Date of measurement	Depth below land surface (feet)	Altitude (feet)		Depth below land surface (feet)	Altitude (feet)		
VALLEY COUNTY—Continued									
18-13- 3ca	2,013	Oct. 2, 1943	31.2	1,981.8	18.8	50	1,963	80	130
24cd	1,959	Oct. 14, 1943	11	1,948	41.8	53	1,906	97	150
26ca	1,972	.....do	11.2	1,960.8	50.8	62	1,910	88	150
31cb	2,069	Oct. 9, 1943	46.8	2,022.2	8.2	55	2,014	65	120
15- 2dd	2,120	Oct. 5, 1943	12.2	2,107.8	50.8	63	2,057	60	123
14cb	2,174	.....do	39.2	2,134.8	53.8	93	2,081	87	180
19-13-25cc	1,996	Oct. 16, 1943	16.0	1,980.0	42.0	58	1,938	242	300
35cc	1,987	Oct. 2, 1943	9.0	1,978.0	71.0	....	....	0	80
14- 4ba	2,071	Sept. 15, 1943	26.7	2,044.3	55.3	82	1,989	18	100
8aa	2,047	Sept. 14, 1943	13.6	2,033.4	73.4	87	1,960	23	110
8dc	2,058	Sept. 13, 1943	13.1	2,044.9	29.9	43	2,013	47	90
19aa	2,090	.....do	33.1	2,056.9	16.9	50	2,040	310	360
22dc	2,015	Sept. 30, 1943	5.8	2,009.2	64.2	....	....	0	70
31bb	2,098	Oct. 5, 1943	14.7	2,083.3	73.3	88	2,010	102	190
15- 3bb	2,152	Sept. 20, 1943	15	2,137	99	114	2,038	6	120
20-14-34cb	2,142	Sept. 18, 1943	75	2,067	22	97	2,045	1	98
15-10da	2,116	Sept. 23, 1943	11.6	2,104.4	45.4	57	2,059	49	106
14da	2,102	Sept. 25, 1943	10	2,092	27	37	2,065	93	130
22ac	2,130	Oct. 16, 1943	30.4	2,099.6	19.6	....	....	0	50
22da	2,111	.....do	19.6	2,091.4	30.4	50	2,061	73	123
27cd	2,138	Sept. 20, 1943	40.8	2,097.2	66.2	....	....	0	107
WHEELER COUNTY									
21-10-32dc	1,993	Nov. 8, 1944	31.7	1,961.3	107.3	....	....	0	139

Table 9.—*Summary of published logs of test holes drilled in the Loup River drainage basin by the Spelts, Cunningham, and Mevis Oil Exploration Co.*

[Logs from Schreurs (1956)]

Test hole	Altitude of land surface (feet)	Thickness of Pleistocene deposits (feet)	Altitude of top of Ogallala formation (feet)	Thickness of Ogallala formation (feet)	Thickness of Cretaceous rocks penetrated (feet)	Depth of test hole (feet)
BUFFALO COUNTY						
12-13- 1cc	1,936	115	1,821	78	379	572
HALL COUNTY						
12-11- 5dd	1,963	155	1,808	10	315	480
21bb	1,933	205	1,728	63	143	411
12- 3bb	1,907	88	1,819	107	......	......
6ab	1,920	62	1,858	166	227	455
8bb	1,922	128	1,794	54	295	477
12dd	1,963	176	1,787	109	192	477
15bb	1,999	180	1,819	60	272	512
HOWARD COUNTY						
13-11-30dd	1,895	83	1,812	77	220	380
32cc	1,922	105	1,817	50	673	828
33bb	1,882	75	1,807	65	210	350
12-20dd	1,925	93	1,832	97	690	880
26bb	1,893	25	1,868	135	285	445
26cc	1,916	75	1,841	103	319	422
31bb	1,930	62	1,868	123	315	500
31cd	1,931	62	1,869	113	345	520
34bb	1,906	57	1,849	98	285	440
35aa	1,892	39	1,853	141	265	445
SHERMAN COUNTY						
13-13-19dd	2,074	153	1,921	177	286	616
20aa	1,968	67	1,901	155	308	530
22ca	1,946	72	1,874	130	288	490
24cc	1,934	20	1,914	165	314	499
24dd	1,941	38	1,903	162	510	710
29dd	2,056	148	1,908	167	303	618
35dd	2,063	154	1,909	156	338	648
14-24cc	2,100	106	1,994	256	308	670
25dd	2,110	135	1,975	237	318	690

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*

Material	Thickness (feet)	Depth (feet)
GRANT COUNTY		
Well 23-39- 6ab		
[Chicago, Burlington & Quincy Railroad Co. 12-in. diameter well 1 at Hyannis. Drilled in 1922]		
Sand, fine	63	63
Sand, coarse	2	65
Sand, coarse; contains clay	5	70
Sand, coarse	6	76
Sand, fine	11	87
Sand, coarse	5	92
Sand, fine	3.3	95.3
Well 24-36-20bc		
[Chicago, Burlington & Quincy Railroad Co. well at Whitman. Drilled in 1918]		
Quicksand, water-bearing	118	118
HALL COUNTY		
Test hole 12- 9- 5bb		
[Surface altitude, 1,865 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	2	2
Clay	6	8
Sand and gravel	72	80
Clay, yellow	14	94
Caliche	6	100
Clay, yellow	37	137
Shale, blue to gray	8	145
Shale, dark-gray	93	238
Lime, chalky, shaly, speckled light-gray	7	245
Test hole 12-10- 4ab		
[Surface altitude, 1,906 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil, sandy	3	3
Clay, yellow	3	6
Sand and gravel	97	103
Caliche	37	140
Gravel	5	145
Clay, yellow	11	156
Shale, blue to gray	168	324
Lime, chalky, shaly, speckled light-gray	16	340

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)
HALL COUNTY—Continued		
Test hole 12-10- 7bb		
[Surface altitude, 1,924 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Sand	5	5
Clay, buff to yellow	12	17
Sand and gravel	126	143
Caliche; contains sand	22	165
Clay, yellow; contains dark streaks	35	200
Shale, blue to gray	50	250
Shale, dark-gray to black	52	302
Shale, dark-gray to black; contains fossil fragments	49	351
Lime, light-gray; contains some gray to buff, shaly chalky lime	19	370
Test hole 12-10-11dd		
[Surface altitude, 1,870 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	2	2
Sand	3	5
Clay, yellow	13	18
Sand and gravel	52	70
Clay, blue	40	110
Clay, yellow	5	115
Caliche	17	132
Clay, yellow	18	150
Shale, blue to gray	10	160
Shale, dark-gray	86	246
Lime, chalky, shaly, speckled light-gray	24	270
Test hole 12-10-18aa		
[Surface altitude, 1,906 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Sand, fine	7	7
Clay, sandy, yellow	15	22
Sand and gravel	15	37
Clay, blue	13	50
Sand and gravel	50	100
Clay, green	7	107
Caliche	8	115
Sand and gravel	70	185
Clay, yellow	25	210
Shale, blue to gray	60	270
Shale, dark-gray to black	38	308
Lime, chalky, shaly, speckled light-gray	12	320

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

HALL COUNTY—Continued

Test hole 12-11-13bb

[Surface altitude, 1,916 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Soil	5	5
Sand and gravel	83	88
Clay, yellow	22	110
Sand and gravel	24	134
Caliche	21	155
Sand and gravel	13	168
Clay, sandy, yellow	92	260
Shale, blue to gray	20	280
Shale, dark-gray	91	371
Lime, chalky, shaly, speckled light-gray	29	400

Test hole 12-11-14cc

[Surface altitude, 1,911 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Soil	1	1
Clay	30	31
Sand and gravel	39	70
Caliche; contains sand	135	205
Gravel	15	220
Clay, sandy, yellow to light-gray	82	302
Shale, blue to gray	57	359
Lime, chalky, shaly, speckled light-gray	12	371

Test hole 12-12-32bb

[Surface altitude, 1,924 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Soil	3	3
Sand	35	38
Gravel; contains clay	17	55
Clay, sticky, yellow	107	162
Shale, sticky, blue	28	190
Shale, gray	110	300
Shale, dark-gray to black	30	330
Hard streak, probably dolomitic lime	100	430
Shale, dark-gray to black	43	473
Lime, chalky, shaly, light-gray	7	480
Lime, chalky, shaly, speckled light-gray	20	500

HOOKER COUNTY

Well 24-32-20ab

[Chicago, Burlington & Quincy Railroad Co. 6-in diameter well at Mullen. Depth to water, 96 ft. Drilled in 1938]

Material	Thickness (feet)	Depth (feet)
Old well pit	12	12
Clay, hard; contains gypsum and sandstone	96	108
Sand, fine	56	164
Sand and gravel, coarse	12	176

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)
HOWARD COUNTY		
Test hole 13-10- 7dc		
[Surface altitude, 1,839 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	1	1
Sand and gravel	42	43
Caliche; contains green sandy clay	67	110
Clay, yellow	42	152
Shale, blue to gray	115	267
Hard streak	4	271
Shale, gray; contains hard streak at 274.5 ft	15	286
Hard streak	1	287
Shale, gray	59	346
Lime, chalky, shaly, speckled light-gray	34	380
Test hole 13-10-16aa		
[Surface altitude, 1,891 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Sand and gravel	100	100
Clay, yellow	24	124
Caliche, sandy	56	180
Clay, yellow	13	193
Shale, blue to gray	19	212
Shale, dark-gray	28	240
Shale, dark-gray to black	135	375
Lime, chalky, shaly, speckled light-gray	15	390
Test hole 13-10-25aa		
[Surface altitude, 1,891 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	4	4
Clay, sandy	13	17
Sand and gravel	141	158
Caliche	9	167
Clay, blue	11	178
Clay, yellow	2	180
Shale, blue to gray	10	190
Shale, dark-gray	33	223
Hard streaks	1	224
Lime, chalky, shaly, speckled light-gray	86	310

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Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)

HOWARD COUNTY—Continued

Test hole 13-10-31dd

[Surface altitude, 1,924 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Sand, fine	27	27
Clay, yellow	17	44
Sand and gravel	46	90
Clay	5	95
Sand and gravel	21	116
Clay, green	4	120
Caliche, sandy	40	160
Sand and gravel	5	165
Caliche	15	180
Shale, blue to gray	60	240
Shale, gray to black	115	355
Lime, chalky, shaly, speckled light-gray	25	380
Lime, shalky, speckled light-gray; contains more shale than above	50	430
Lime, chalky, shaly, speckled dark-gray	120	550
Lime, chalky, shaly, speckled light-gray; contains streaks of dark-gray shale	160	710
Lime, chalky, shaly, speckled light-gray	68	778
Shale, sticky, waxy, black	16	794

Test hole 13-10-32aa

[Surface altitude, 1,933 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Sand, fine	22	22
Clay, buff to yellow	15	37
Sand and gravel	93	130
Caliche; contains sand	72	202
Shale, blue to gray	58	260
Shale, dark-gray to black	36	296
Hard streak	44	340
Shale, dark-gray; contains fossil shell fragments	28	368
Lime, chalky, shaly, speckled light-gray to buff	12	380

Test hole 13-11- 3cc

[Surface altitude, 1,944 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Soil	2	2
Clay, yellow	124	126
Sand and gravel	4	130
Caliche	8	138
Clay, yellow	68	206
Caliche	29	235
Clay, yellow	11	246
Shale, blue to gray	199	445
Lime, chalky, shaly, speckled light-gray	15	460

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)

HOWARD COUNTY—Continued

Test hole 13-11-18aa

[Surface altitude, 1,965.6 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Soil	5	5
Clay, yellow	99	104
Clay and caliche	161	265
Clay, yellow	25	290
Shale, light-gray; contains hard streaks	50	340
Shale, dark-gray	5	345
Shale, black	55	400
Shale, dark-gray; contains chalk	20	420
Chalk; contains some dark-gray shale	50	470
Shale, dark-gray, and chalk	16	486
Shale, limy, speckled light-gray	24	510

Test hole 13-11-19dd

[Surface altitude, 1,917 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Clay	25	25
Clay, sandy	45	70
Clay, sandy; contains caliche	22	92
Clay, chalky, green and white	13	105
Sandstone and caliche	60	165
Clay, sticky, yellow; contains white caliche	35	200
Clay, blue and yellow	20	220
Shale, light bluish-gray	80	300
Shale, dark-gray	75	375
Lime, chalky, shaly, light-gray	25	400
Lime, chalky, shaly, speckled light-gray	22	422
Lime, chalky, shaly, speckled, darker than above	55	477
Shale, calcareous, speckled light-gray	223	700
Shale, calcareous, speckled gray	12	712
Shale, calcareous, speckled gray; contains fossil fragments	71	783
Shale, calcareous, speckled, more chalky, gray	9	792
Shale, argillaceous, black	13	805

Test hole 13-11-22bb

[Surface altitude, 1,989 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Material	Thickness (feet)	Depth (feet)
Soil	4	4
Clay, yellow	126	130
Caliche; contains clay	50	180
Shale, sandy, hard, green	45	225
Caliche; contains light-colored shale	6	231
Clay, yellow	9	240
Shale, gray	90	330
Shale, light-gray; contains streaks of chalk	20	350
Shale, dark-gray to black	40	390
Shale, gray; contains light-colored streaks	30	420
Shale, gray; contains streaks of chalk	35	455
Shale, dark-gray	55	510
Shale, dark-gray; contains chalk	5	515
Shale, limy, speckled light-gray	35	550

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)
HOWARD COUNTY—Continued		
Test hole 13-11-34ad		
[Surface altitude, 1,900 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Sand and very coarse gravel	100	100
Caliche, tan to light-green	55	155
Shale, blue to gray	45	200
Shale, dark-gray; contains many fossil shells	125	325
Lime, chalky, shaly, speckled light-gray	25	350
Test hole 13-11-34bb		
[Surface altitude, 1,881 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	2	2
Sand, fine, buff to gray	73	75
Sandstone, hard; contains lenses of lime and shale	30	105
Gravel; contains clay	2	107
Sand, fine	20	127
Caliche	43	170
Shale, gray	12	182
Shale, dark-gray to black	66	248
Shale, dark-gray; contains hard streaks	2	250
Shale, dark-gray; contains shell fragments	55	305
Shale, black; contains some chalk	5	310
Shale, dark-gray	20	330
Shale, chalky, limy, speckled white, light-gray	30	360
Test hole 13-11-35dd		
[Surface altitude, 1,953 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Sand and gravel	188	188
Clay, gray	14	202
Clay, yellow	13	215
Shale, dark-gray	182	397
Lime, chalky, shaly, speckled light-gray	33	430
Test hole 13-12-13cc		
[Surface altitude, 2,000 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	3	3
Clay, sticky, grayish-buff	92	95
Clay; contains caliche	90	185
Sandstone; contains caliche	76	261
Sandstone, quartzitic, hard	6	267
Clay, sticky, hard, white; contains caliche streaks	55	322
Shale, sticky, gray	28	350
Shale, dark-gray to black	153	503
Lime, chalky, shaly, speckled light-gray	47	550

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)

SHERMAN COUNTY

Test hole 13-13- 4cc

[Surface altitude, 1,989 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Sand	50	50
Sand and gravel	20	70
Sand and porous caliche	20	90
Sand, fine, light	20	110
Sand and gravel	10	120
Caliche, porous, buff	120	240
Clay; contains buff porous caliche	40	280
Clay, buff	30	310
Sand, coarse, clear	5	315
Shale, light-gray	25	340
Shale, medium-gray	20	360
Shale, dark-gray	62	422
Shale, black	22	444
Shale, black; contains a few thin buff streaks	110	554
Lime, chalky, shaly, speckled grayish-buff	31	585

Test hole 13-13- 6cc

[Surface altitude, 1,995 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Soil	3	3
Clay, sandy	24	27
Sand, gray	58	85
Caliche, hard; contains cemented sand	205	290
Clay, yellow	27	317
Shale, blue to gray	73	390
Shale, black	176	566
Lime, shaly, chalky, speckled light-gray to buff	16	582

Test hole 13-13-12dd

[Surface altitude, 2,068 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]

Soil	5	5
Clay, silty, buff to brown	145	150
Clay, silty, buff; contains weathered chalky clay	50	200
Clay, chalky	150	350
Shale, calcareous, greenish-buff	40	390
Shale, calcareous, gray and buff	30	420
Shale, light-gray; contains bands of dark-gray shale	40	460
Shale, argillaceous, dark-gray	10	470
Shale, buff and dark-gray	20	490
Shale, light-gray	32	522
Shale, dark-gray to black	11	533
Shale, dark-gray to black; contains fragments of fossils	111	644

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)
SHERMAN COUNTY—Continued		
Test hole 13-13-14cc		
[Surface altitude, 1,954 ft. Drilled by Spelts, Cunningham, and Mevis Oil Exploration Co. in 1941]		
Soil	3	3
Sand	9	12
Clay, sandy	23	35
Clay and caliche	30	65
Sand	13	78
Sandstone and caliche	77	155
Sand	33	188
Sand and caliche	27	215
Clay and caliche	30	245
Clay, yellow and gray	20	265
Clay, blue and yellow	10	275
Shale, sticky, bluish-gray	25	300
Shale, light bluish-gray	10	310
Shale, bluish-gray	30	340
Shale, dark-gray to black	135	475
Lime, chalky, shaly, light-gray	15	490
Lime, chalky, shaly, speckled light-gray	30	520
THOMAS COUNTY		
Well 23-28- 9cb		
[Chicago, Burlington & Quincy Railroad Co. well at Thedford. Depth to water, 8 ft; water-level drawdown, 8 ft. Drilled in 1927]		
Soil, sandy	1	1
Soil, black	1	2
Sand and gravel, dry	10	12
Sand and gravel, water-bearing	18	30
Clay, yellow	.5	30.5
Sand and gravel, water-bearing	11.5	42
Well 24-30-19ab1		
[Chicago, Burlington & Quincy Railroad Co. well 50 ft west of storage tank at Seneca. Drilled in 1945]		
Sand, fine	20	20
Gravel, fine	7	27
Sand, fine	41	68
Sandstone	12	80
Sandstone, soft	100	180
Sand, firm; contains some water	6	186
Sandstone, soft	50	236
Sand, fine; contains some water	4	240
Sandstone, soft	20	260
Sand, fine, water-bearing	60	320
Sand, fine	87	407
Sand and some fine gravel	17	424

Table 10.—*Previously unpublished logs of test holes and wells in the Loup River drainage basin*—Continued

Material	Thickness (feet)	Depth (feet)
THOMAS COUNTY—Continued		
Well 24-30-19ab2		
[Chicago, Burlington & Quincy Railroad Co. well at Seneca. Drilled in 1918]		
Sand, fine	9	9
Vegetation, rotted	.5	9.5
Gravel, coarse, clean	12	21.5
Clay, light-yellow	.5	22
Clay, heavy, greenish-yellow	.3	22.3
Well 24-30-19ab3		
[Chicago, Burlington & Quincy Railroad Co. well at Seneca. Depth to water, 10.4 ft. Drilled in 1921]		
Sand, fine	7.8	7.8
Vegetation, rotted	.5	8.3
Sand and gravel, coarse, clean	12	20.3
Clay, light-yellow	.5	20.8
Clay, heavy, greenish-yellow	.7	21.5
Sand and gravel	1.4	22.9
Sandstone	5	27.9
Sand and gravel, coarse	7	34.9
Sandstone, hard	.5	35.4
Sand, fine	.5	35.9
Sand and gravel	4.5	40.4
Well 24-30-19ab4		
[Chicago, Burlington & Quincy Railroad Co. well at Seneca. Depth to water, 9.5 ft]		
Sand, fine	9	9
Vegetation, rotted	.5	9.5
Gravel, coarse, clean	12	21.5
Clay, light-yellow	.5	22
Clay, heavy, greenish-yellow	.3	22.3
Sand, fine	.5	22.8
Sandstone, soft	3	25.8
Sand and gravel, coarse	6	31.8
Sand, fine	6.5	38.3
Sandstone	.5	38.8
Sand, coarse	1	39.8
Sand, very fine	48.6	88.4
Sandstone	.5	88.9
Sand, very fine	35.2	124.1
Sandstone	.8	124.9
Sand, very fine	24.3	149.2

Table 11.—*Measurements of the water level in wells, in feet below land surface*

Date	Water level	Date	Water level	Date	Water level
BLAINE COUNTY					
22-24-33ca					
Jan. 7, 1935......	3.64	Sept. 28, 1944.....	4.90	Mar. 25, 1948......	3.20
Feb. 27, 1935......	3.57	Oct. 29, 1944.....	4.50	May 1, 1948......	3.88
Apr. 20, 1935......	3.27	Nov. 28, 1944.....	4.14	May 26, 1948......	4.28
June 8, 1935......	2.44	Dec. 29, 1944.....	4.12	June 3, 1948......	4.27
July 15, 1935......	3.87	Jan. 29, 1945.....	4.20	June 16, 1948......	4.55
Aug. 16, 1935......	4.79	Feb. 26, 1945.....	3.80	June 30, 1948......	3.92
Sept. 16, 1935......	4.39	Mar. 29, 1945.....	3.80	July 13, 1948......	4.46
Oct. 23, 1935......	4.17	Apr. 28, 1945.....	3.38	July 27, 1948......	4.55
Nov. 26, 1935......	3.83	May 29, 1945.....	3.80	Aug. 11, 1948......	4.13
Dec. 30, 1935......	3.69	June 28, 1945.....	3.28	Aug. 24, 1948......	4.39
Jan. 18, 1936......	3.62	July 28, 1945.....	4.31	Sept. 2, 1948......	4.72
Mar. 27, 1936......	3.12	Aug. 17, 1945.....	4.54	Sept. 21, 1948......	4.86
June 3, 1936......	3.50	Aug. 29, 1945.....	4.46	Oct. 5, 1948......	4.83
July 21, 1936......	4.96	Sept. 28, 1945.....	4.60	Oct. 19, 1948......	4.76
Aug. 26, 1936......	5.02	Oct. 29, 1945.....	4.43	Oct. 21, 1948......	4.73
Nov. 24, 1936......	4.10	Jan. 8, 1946.....	3.81	Nov. 2, 1948......	4.54
Apr. 2, 1937......	3.80	Jan. 29, 1946.....	3.77	Apr. 4, 1949......	1.17
June 17, 1937......	3.71	Feb. 27, 1946.....	3.60	May 13, 1949......	2.55
Aug. 10, 1937......	5.12	Mar. 29, 1946.....	3.12	May 17, 1949......	2.44
Oct. 15, 1937......	4.57	Apr. 4, 1946.....	3.39	May 31, 1949......	1.16
June 24, 1938......	3.59	Apr. 26, 1946.....	3.91	June 8, 1949......	1.27
Oct. 24, 1938......	4.15	Apr. 29, 1946.....	3.58	June 13, 1949......	1.96
June 9, 1939......	3.07	May 14, 1946.....	4.05	June 28, 1949......	3.13
Dec. 2, 1939......	4.06	May 22, 1946.....	4.10	July 15, 1949......	3.68
Apr. 2, 1940......	3.37	June 3, 1946.....	4.04	July 28, 1949......	4.21
July 23, 1940......	3.70	June 24, 1946.....	4.67	Aug. 9, 1949......	4.64
Nov. 4, 1940......	4.44	July 2, 1946.....	5.00	Aug. 23, 1949......	4.34
Oct. 21, 1941......	4.18	Aug. 4, 1946.....	5.60	Sept. 7, 1949......	3.85
Aug. 25, 1942......	4.80	Aug. 15, 1946.....	5.49	Sept. 16, 1949......	3.84
Aug. 29, 1942......	4.80	Sept. 1, 1946.....	2.30	Sept. 19, 1949......	4.03
Sept. 28, 1942......	4.08	Oct. 1, 1946.....	4.42	Oct. 5, 1949......	4.21
Oct. 29, 1942......	4.08	Oct. 14, 1946.....	2.36	Oct. 18, 1949......	3.62
Nov. 2, 1942......	4.02	Oct. 30, 1946.....	3.67	Nov. 15, 1949......	3.40
Nov. 29, 1942......	3.95	Dec. 3, 1946.....	3.08	Nov. 24, 1949......	3.52
Dec. 29, 1942......	3.83	Dec. 24, 1946.....	3.38	Nov. 30, 1949......	3.52
Jan. 29, 1943......	3.78	Jan. 11, 1947.....	3.22	Dec. 14, 1949......	3.46
Feb. 26, 1943......	3.57	Feb. 20, 1947.....	3.00	Dec. 28, 1949......	3.47
Mar. 29, 1943......	3.49	Apr. 1, 1947.....	3.23	Jan. 11, 1950......	3.43
Apr. 28, 1943......	4.48	Apr. 24, 1947.....	3.03	Jan. 23, 1950......	3.31
May 29, 1943......	3.94	May 6, 1947.....	3.40	Feb. 6, 1950......	3.22
June 28, 1943......	4.50	June 2, 1947.....	3.48	Feb. 23, 1950......	2.89
July 29, 1943......	4.60	July 1, 1947.....	2.74	Mar. 8, 1950......	1.04
Aug. 29, 1943......	4.70	Aug. 26, 1947.....	4.68	Apr. 4, 1950......	2.30
Sept. 28, 1943......	4.81	Aug. 29, 1947.....	4.82	May 4, 1950......	2.89
Oct. 29, 1943......	4.53	Sept. 3, 1947.....	4.76	June 15, 1950......	2.68
Nov. 28, 1943......	4.19	Sept. 9, 1947.....	4.80	July 12, 1950......	4.24
Dec. 29, 1943......	4.11	Sept. 15, 1947.....	4.39	Aug. 14, 1950......	4.06
Jan. 29, 1944......	3.90	Sept. 29, 1947.....	4.54	Aug. 23, 1950......	4.27
Feb. 27, 1944......	3.92	Oct. 7, 1947.....	4.58	Sept. 6, 1950......	4.00
Mar. 29, 1944......	3.20	Oct. 14, 1947.....	4.58	Sept. 20, 1950......	3.58
Apr. 28, 1944......	2.69	Oct. 28, 1947.....	4.39	Oct. 6, 1950......	3.69
May 29, 1944......	3.39	Nov. 13, 1947.....	3.01	Oct. 16, 1950......	3.91
June 28, 1944......	3.90	Dec. 3, 1947.....	3.64	Oct. 18, 1950......	3.96
July 29, 1944......	4.96	Dec. 23, 1947.....	3.55	Nov. 16, 1950......	3.89
Aug. 17, 1944......	4.95	Jan. 6, 1948.....	3.50	Dec. 13, 1950......	3.66
Aug. 29, 1944......	4.78	Feb. 19, 1948.....	3.45	Dec. 18, 1950......	3.59

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

BLAINE COUNTY—Continued

22-24-33ca—Continued

Date	Water level	Date	Water level	Date	Water level
Dec. 26, 1950.....	3.64	July 25, 1951.....	3.55	Apr. 2, 1952.....	3.08
Jan. 25, 1951.....	3.73	Aug. 8, 1951.....	6.97	Apr. 16, 1952.....	3.35
Feb. 2, 1951.....	3.87	Aug. 22, 1951.....	4.21	Apr. 29, 1952.....	3.40
Feb. 7, 1951.....	3.72	Sept. 4, 1951.....	3.28	May 12, 1952.....	3.48
Feb. 19, 1951.....	3.44	Sept. 6, 1951.....	3.80	May 28, 1952.....	2.16
Feb. 22, 1951.....	3.45	Sept. 20, 1951.....	3.97	June 12, 1952.....	3.56
Mar. 7, 1951.....	3.13	Oct. 2, 1951.....	4.15	June 26, 1952.....	4.16
Mar. 13, 1951.....	3.35	Oct. 16, 1951.....	4.32	July 9, 1952.....	4.62
Mar. 22, 1951.....	3.32	Oct. 30, 1951.....	4.12	July 23, 1952.....	4.93
Apr. 3, 1951.....	3.20	Oct. 31, 1951.....	4.10	Aug. 5, 1952.....	4.88
Apr. 17, 1951.....	3.34	Nov. 14, 1951.....	4.07	Aug. 19, 1952.....	4.85
Apr. 18, 1951.....	3.40	Nov. 28, 1951.....	4.07	Sept. 17, 1952.....	5.25
Apr. 25, 1951.....	2.80	Dec. 12, 1951.....	4.03	Sept. 23, 1952.....	5.27
Apr. 26, 1951.....	3.03	Dec. 27, 1951.....	3.83	Oct. 2, 1952.....	5.05
May 2, 1951.....	2.95	Jan. 9, 1952.....	3.69	Oct. 15, 1952.....	4.90
May 22, 1951.....	1.55	Jan. 23, 1952.....	3.32	Oct. 28, 1952.....	4.70
May 23, 1951.....	1.81	Feb. 4, 1952.....	3.10	Nov. 12, 1952.....	4.60
May 29, 1951.....	2.47	Feb. 20, 1952.....	3.22	Nov. 25, 1952.....	4.45
June 10, 1951.....	2.20	Mar. 5, 1952.....	3.48	Dec. 12, 1952.....	4.34
June 28, 1951.....	2.81	Mar. 17, 1952.....	2.60	Dec. 24, 1952.....	4.28
July 10, 1951.....	3.13				

BOONE COUNTY

18- 7- 4ca

Date	Water level	Date	Water level	Date	Water level
Mar. 26, 1937.....	14.33	Sept. 28, 1948.....	14.39	May 29, 1950.....	13.18
June 10, 1937.....	14.75	Apr. 28, 1949.....	12.79	June 21, 1950.....	13.31
Oct. 10, 1937.....	14.84	June 8, 1949.....	12.65	July 24, 1950.....	10.82
July 10, 1938.....	14.69	July 5, 1949.....	13.03	Aug. 21, 1950.....	14.33
Oct. 14, 1938.....	15.16	Aug. 4, 1949.....	13.83	Oct. 23, 1950.....	13.35
May 26, 1939.....	15.00	Sept. 20, 1949.....	13.66	Dec. 29, 1950.....	13.44
Nov. 24, 1939.....	15.08	Nov. 1, 1949.....	13.89	Feb. 19, 1951.....	13.40
Mar. 23, 1940.....	14.64	Nov. 30, 1949.....	14.02	May 8, 1951.....	12.81
July 13, 1940.....	14.88	Jan. 5, 1950.....	13.94	Aug. 13, 1951.....	12.66
Oct. 26, 1940.....	15.17	Feb. 6, 1950.....	13.79	Dec. 27, 1951.....	12.78
Oct. 14, 1941.....	14.99	Feb. 27, 1950.....	13.27	Aug. 12, 1952.....	11.88
Oct. 31, 1942.....	15.02	Mar. 30, 1950.....	13.43	Oct. 28, 1952.....	13.25
Apr. 22, 1948.....	14.38	Apr. 27, 1950.....	13.73		

18- 7- 5ad

Date	Water level	Date	Water level	Date	Water level
Feb. 14, 1935.....	5.79	Nov. 8, 1936.....	5.93	Sept. 29, 1948.....	5.82
Apr. 12, 1935.....	5.69	Mar. 26, 1937.....	5.20	Apr. 28, 1949.....	4.35
May 29, 1935.....	5.30	June 10, 1937.....	6.05	June 8, 1949.....	4.43
July 8, 1935.....	5.76	Oct. 10, 1937.....	5.95	July 5, 1949.....	4.87
Aug. 6, 1935.....	6.33	July 10, 1938.....	5.63	Aug. 4, 1949.....	5.49
Sept. 9, 1935.....	5.84	Oct. 14, 1938.....	6.11	Sept. 20, 1949.....	5.13
Oct. 12, 1935.....	6.20	May 26, 1939.....	6.00	Nov. 1, 1949.....	4.96
Nov. 18, 1935.....	5.96	Nov. 24, 1939.....	5.94	Nov. 30, 1949.....	5.04
Dec. 20, 1935.....	5.98	Mar. 23, 1940.....	5.42	Jan. 5, 1950.....	4.76
Jan. 9, 1936.....	5.82	July 13, 1940.....	5.69	Feb. 3, 1950.....	4.28
Mar. 21, 1936.....	5.39	Oct. 26, 1940.....	6.11	Feb. 27, 1950.....	4.29
May 26, 1936.....	5.92	Oct. 14, 1941.....	5.77	Mar. 30, 1950.....	3.24
July 11, 1936.....	5.86	Oct. 31, 1942.....	6.04	Apr. 27, 1950.....	4.77
Aug. 19, 1936.....	6.14	Apr. 22, 1948.....	5.70	May 29, 1950.....	4.21

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
		BOONE COUNTY—Continued			
		18- 7- 5ad—Continued			
June 21, 1950......	4.66	Dec. 29, 1950....	4.31	Aug. 13, 1951.....	3.93
July 26, 1950......	2.14	Feb. 19, 1951....	4.47	Dec. 27, 1951.....	3.16
Aug. 21, 1950......	4.51	May 8, 1951....	3.40	Oct. 28, 1952.....	3.75
Oct. 23, 1950......	5.74				
		21- 7-26ca			
Mar. 26, 1937.....	17.69	Oct. 30, 1942....	18.31	Apr. 26, 1950.....	16.30
June 9, 1937.....	18.45	Apr. 21, 1948....	17.20	May 23, 1950.....	16.13
Oct. 10, 1937.....	20.76	Sept. 29, 1948....	19.72	June 22, 1950.....	16.30
July 10, 1938.....	19.69	Apr. 27, 1949....	14.89	July 25, 1950.....	14.26
Oct. 14, 1938.....	21.07	Nov. 4, 1949....	14.97	Aug. 22, 1950.....	14.13
May 26, 1939......	18.96	Dec. 5, 1949....	16.92	Oct. 24, 1950.....	14.92
Nov. 23, 1939......	19.95	Jan. 10, 1950....	16.96	Jan. 2, 1951.....	15.27
Mar. 23, 1940......	18.83	Feb. 9, 1950....	16.82	Feb. 20, 1951.....	15.53
July 13, 1940......	Dry	Mar. 2, 1950....	16.81	May 4, 1951.....	14.51
Oct. 26, 1940......	Dry	Mar. 28, 1950....	16.27	Dec. 27, 1951.....	14.27
Oct. 14, 1941......	Dry				
		CHERRY COUNTY			
		25-31-18ac			
Jan. 15, 1948......	98.67	July 14, 1948....	102.26	Sept. 7, 1948.....	102.43
May 26, 1948......	102.05	July 28, 1948....	102.18	Sept. 21, 1948.....	102.49
June 15, 1948......	102.22	Aug. 11, 1948....	102.27	Oct. 19, 1948.....	102.66
July 1, 1948......	102.26	Aug. 24, 1948....	102.28		
		25-31-31bb			
Jan. 5, 1948......	148.87	Aug. 11, 1948....	149.55	Sept. 20, 1948.....	149.65
July 1, 1948......	149.54	Aug. 24, 1948....	149.56	Oct. 7, 1948.....	149.40
July 28, 1948......	149.48	Sept. 7, 1948....	149.34	Oct. 19, 1948.....	149.56
		GRANT COUNTY			
		24-36-30bb			
Jan. 5, 1935......	4.61	Oct. 24, 1938....	5.64	Mar. 25, 1948.....	5.04
Feb. 26, 1935......	4.40	June 9, 1939....	4.93	June 30, 1948.....	5.54
Apr. 20, 1935......	4.14	Dec. 2, 1939....	5.85	Sept. 2, 1948.....	6.18
June 8, 1935......	3.59	Apr. 2, 1940....	5.46	Oct. 19, 1948.....	6.06
July 15, 1935......	4.38	July 22, 1940....	6.62	May 13, 1949.....	4.87
Aug. 15, 1935......	5.07	Nov. 4, 1940....	6.48	June 8, 1949.....	4.36
Sept. 16, 1935......	5.03	Oct. 21, 1941....	6.44	July 15, 1949.....	5.41
Oct. 23, 1935......	5.05	Nov. 13, 1942....	5.76	Sept. 16, 1949.....	5.55
Nov. 26, 1935......	4.85	Apr. 4, 1946....	5.17	Nov. 25, 1949.....	5.36
Dec. 30, 1935......	4.70	May 22, 1946....	5.25	Jan. 23, 1950.....	5.12
Jan. 18, 1936......	4.63	June 24, 1946....	5.48	Apr. 3, 1950.....	4.70
Mar. 27, 1936......	4.20	Aug. 15, 1946....	6.28	Aug. 14, 1950.....	4.25
June 3, 1936......	4.44	Sept. 2, 1946....	6.15	Oct. 16, 1950.....	4.95
Aug. 27, 1936......	5.73	Oct. 14, 1946....	5.84	Dec. 18, 1950.....	4.81
Nov. 24, 1936......	5.38	Dec. 24, 1946....	5.59	Feb. 19, 1951.....	4.65
Apr. 2, 1937......	3.68	Jan. 11, 1947....	5.47	Apr. 17, 1951.....	4.51
June 17, 1937......	5.02	Apr. 24, 1947....	5.15	June 7, 1951.....	4.10
Aug. 10, 1937......	5.88	Aug. 23, 1947....	5.97	Sept. 4, 1951.....	4.30
Oct. 15, 1937......	5.80	Oct. 28, 1947....	5.90	June 30, 1952.....	4.38
June 24, 1938......	4.86				

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
GRANT COUNTY—Continued					
24-40-36bb					
Jan. 5, 1935......	12.80	Oct. 24, 1938.....	13.38	Aug. 29, 1947.....	13.99
Feb. 26, 1935......	12.84	June 9, 1939.....	12.97	Oct. 28, 1947.....	14.02
Apr. 20, 1935......	12.71	Dec. 2, 1939.....	13.84	Mar. 25, 1948.....	13.85
June 8, 1935......	12.32	Apr. 2, 1940.....	13.76	June 30, 1948.....	13.89
July 15, 1935......	12.41	July 22, 1940.....	14.10	Sept. 2, 1948.....	14.18
Aug. 15, 1935......	12.62	Nov. 4, 1940.....	13.27	Oct. 19, 1948.....	14.26
Sept. 16, 1935......	12.87	Oct. 21, 1941.....	13.31	May 13, 1949.....	13.52
Oct. 23, 1935......	12.86	Nov. 13, 1942.....	13.27	June 8, 1949.....	13.48
Nov. 26, 1935......	12.90	Aug. 17, 1944.....	13.53	July 14, 1949.....	13.42
Dec. 30, 1935......	12.91	Aug. 17, 1945.....	13.70	Sept. 16, 1949.....	13.85
Jan. 18, 1936......	12.91	Apr. 4, 1946.....	13.82	Nov. 25, 1949.....	13.87
Mar. 27, 1936......	12.78	Apr. 26, 1946.....	13.94	Jan. 23, 1950.....	13.85
June 3, 1936......	12.81	May 22, 1946.....	13.89	Apr. 3, 1950.....	13.88
July 21, 1936......	13.10	June 24, 1946.....	13.95	Aug. 14, 1950.....	14.06
Aug. 27, 1936......	13.29	Aug. 15, 1946.....	14.08	Oct. 16, 1950.....	14.12
Nov. 24, 1936......	13.37	Aug. 28, 1946.....	13.83	Dec. 18, 1950.....	14.17
Apr. 2, 1937......	13.30	Sept. 2, 1946.....	13.88	Feb. 19, 1951.....	13.21
June 17, 1937......	13.38	Oct. 14, 1946.....	14.01	Apr. 17, 1951.....	14.19
Aug. 10, 1937......	13.69	Dec. 24, 1946.....	14.08	June 7, 1951.....	13.90
Oct. 15, 1937......	13.26	Jan. 11, 1947.....	14.02	June 30, 1952.....	12.79
June 24, 1938......	12.98	Apr. 24, 1947.....	14.05		
GREELEY COUNTY					
17-10-10cb					
Nov. 15, 1935......	14.67	July 12, 1938....	15.40	Apr. 28, 1949......	14.27
Dec. 23, 1935......	14.62	Oct. 20, 1938....	16.08	May 29, 1950......	14.10
Jan. 12, 1936......	14.56	June 3, 1939....	15.62	June 21, 1950......	14.06
Mar. 24, 1936......	14.28	Nov. 27, 1939....	16.29	July 24, 1950......	13.34
Nov. 6, 1936......	15.22	Mar. 27, 1940....	16.25	Aug. 21, 1950......	13.11
Mar. 29, 1937......	15.09	July 17, 1940....	16.09	Oct. 23, 1950......	13.72
June 13, 1937......	15.04	Oct. 29, 1940....	16.72	Dec. 29, 1950......	13.49
Aug. 8, 1937......	15.46	Oct. 17, 1941....	16.96	Feb. 19, 1951......	13.70
Oct. 12, 1937......	15.84	Oct. 31, 1942....	17.17	May 8, 1951......	13.65
20- 9-20cc					
Feb. 21, 1935......	1.85	Aug. 8, 1937.....	3.00	Sept. 20, 1949......	2.81
Apr. 16, 1935......	2.11	Oct. 12, 1937.....	2.58	Nov. 1, 1949......	2.43
June 3, 1935......	2.11	July 12, 1938.....	2.47	Nov. 30, 1949......	2.32
July 11, 1935......	2.35	Oct. 20, 1938.....	2.53	Jan. 5, 1950......	2.14
Aug. 9, 1935......	3.27	June 3, 1939.....	2.18	Feb. 6, 1950......	1.63
Sept. 11, 1935......	2.55	Nov. 27, 1939.....	2.18	Feb. 27, 1950......	1.85
Oct. 16, 1935......	2.67	Mar. 27, 1940.....	1.81	Mar. 30, 1950......	1.35
Nov. 20, 1935......	1.30	July 17, 1940.....	3.06	Apr. 27, 1950......	2.03
Dec. 23, 1935......	2.19	Oct. 29, 1940.....	2.03	May 29, 1950......	1.44
Jan. 12, 1936......	1.71	Oct. 17, 1941.....	2.20	June 21, 1950......	1.80
Mar. 24, 1936......	1.78	Oct. 31, 1942.....	2.04	July 24, 1950......	1.40
May 30, 1936......	2.60	Apr. 22, 1948.....	2.24	Aug. 21, 1950......	1.88
July 16, 1936......	3.26	Sept. 29, 1948.....	2.78	Oct. 23, 1950......	2.04
Sept. 14, 1936......	3.11	Apr. 28, 1949.....	1.93	Dec. 29, 1950......	1.63
Nov. 6, 1936......	2.47	June 8, 1949.....	1.79	Feb. 19, 1951......	1.60
Mar. 29, 1937......	1.80	July 5, 1949...	2.22	May 8, 1951......	1.78
June 13, 1937......	2.59	Aug. 3, 1949.....	3.35	Aug. 12, 1952......	2.64

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
		GREELEY COUNTY—Continued			
		20- 9-20db			
Nov. 6, 1936......	9.97	Oct. 17, 1941.....	9.26	Feb. 27, 1950.....	9.02
Mar. 29, 1937......	7.50	Apr. 22, 1948.....	8.80	Mar. 30, 1950.....	7.52
June 12, 1937......	8.24	Sept. 29, 1948.....	9.15	Apr. 27, 1950.....	8.36
Aug. 8, 1937......	8.77	Apr. 29, 1949.....	7.56	May 29, 1950.....	8.65
Oct. 12, 1937......	9.13	June 8, 1949.....	8.07	June 21, 1950.....	8.37
July 12, 1938......	8.44	July 5, 1949.....	7.79	July 24, 1950.....	6.85
Oct. 20, 1938......	8.98	Aug. 4, 1949.....	9.04	Aug. 21, 1950.....	7.88
June 2, 1939......	7.72	Sept. 22, 1949.....	8.97	Oct. 23, 1950.....	8.26
Nov. 27, 1939......	9.37	Nov. 1, 1949.....	9.10	Dec. 29, 1950.....	8.43
Mar. 27, 1940......	7.88	Nov. 30, 1949.....	9.17	Feb. 19, 1951.....	8.47
July 17, 1940......	9.12	Jan. 5, 1950.....	9.11	May 8, 1951.....	7.54
Oct. 29, 1940......	9.02	Feb. 6, 1950.....	9.06	Aug. 12, 1952.....	9.84
		HOOKER COUNTY			
		24-31-17cd			
May 24, 1948......	15.40	Sept. 20, 1948.....	15.29	Oct. 16, 1950.....	15.28
July 1, 1948......	15.33	Oct. 11, 1948.....	15.26	Dec. 18, 1950.....	15.32
July 14, 1948......	15.30	Oct. 22, 1948.....	15.32	Feb. 19, 1951.....	15.26
July 27, 1948......	15.32	Sept. 19, 1949.....	15.34	Apr. 17, 1951.....	15.12
Aug. 10, 1948......	15.32	Aug. 14, 1950.....	15.33	Sept. 4, 1951.....	15.46
Aug. 23, 1948......	15.30	Oct. 4, 1950.....	15.31	June 30, 1952.....	14.80
Sept. 6, 1948......	15.28				
		24-31-18cb			
May 26, 1948......	32.68	Sept. 6, 1948.....	32.73	Oct. 16, 1950.....	32.62
June 15, 1948......	32.71	Sept. 20, 1948.....	32.66	Dec. 18, 1950.....	32.66
July 1, 1948......	32.69	Oct. 11, 1948.....	32.62	Feb. 19, 1951.....	32.64
July 14, 1948......	32.68	Oct. 19, 1948.....	32.75	Apr. 17, 1951.....	32.52
July 27, 1948......	32.68	Aug. 14, 1950.....	32.67	Sept. 4, 1951.....	32.71
Aug. 10, 1948......	32.67	Oct. 5, 1950.....	32.51	June 30, 1952.....	33.26
Aug. 23, 1948......	32.68				
		24-31-18dd			
May 24, 1948......	16.30	Aug. 10, 1948.....	16.97	Oct. 11, 1948.....	16.97
July 1, 1948......	16.95	Aug. 23, 1948.....	16.92	Oct. 19, 1948.....	17.05
July 14, 1948......	16.95	Sept. 6, 1948.....	16.98	Sept. 19, 1949.....	17.11
July 27, 1948......	16.98	Sept. 20, 1948.....	17.00	Oct. 5, 1950.....	17.09
		24-31-21aa			
May 24, 1948......	4.80	Sept. 20, 1948.....	4.88	Oct. 16, 1950.....	4.91
July 1, 1948......	4.85	Oct. 11, 1948.....	4.84	Dec. 18, 1950.....	4.88
July 14, 1948......	4.86	Oct. 19, 1948.....	4.86	Feb. 19, 1951.....	4.83
July 27, 1948......	4.89	Sept. 19, 1949.....	4.97	Apr. 17, 1951.....	4.71
Aug. 11, 1948......	4.89	Aug. 14, 1950.....	4.82	Sept. 4, 1951.....	4.40
Aug. 23, 1948......	4.87	Oct. 4, 1950.....	4.90	June 30, 1952.....	4.19
Sept. 6, 1948......	4.87				

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
HOOKER COUNTY—Continued					
24-35-23dd					
Jan. 5, 1935......	11.70	Oct. 24, 1938.....	16.20	Aug. 29, 1947.....	20.49
Feb. 26, 1935......	12.17	June 9, 1939.....	16.83	Oct. 28, 1947.....	20.51
Apr. 20, 1935......	12.53	Dec. 2, 1939.....	17.25	Mar. 25, 1948.....	20.40
June 8, 1935......	.19	Apr. 2, 1940.....	17.72	June 30, 1948.....	20.73
July 15, 1935......	5.62	July 22, 1940.....	17.91	Sept. 2, 1948.....	20.72
Aug. 15, 1935......	8.84	Nov. 4, 1940.....	17.18	Oct. 19, 1948.....	20.84
Sept. 16, 1935......	10.11	Oct. 21, 1941.....	18.93	May 13, 1949.....	20.87
Oct. 23, 1935......	10.98	Nov. 13, 1942.....	15.74	June 8, 1949.....	19.70
Nov. 26, 1935......	11.53	Aug. 17, 1944.....	18.94	July 15, 1949.....	19.21
Dec. 30, 1935......	11.97	Aug. 17, 1945.....	19.50	Sept. 16, 1949.....	20.02
Jan. 18, 1936......	12.18	Apr. 4, 1946.....	19.55	Nov. 23, 1949.....	20.46
Mar. 27, 1936......	12.79	Apr. 28, 1946.....	20.00	Jan. 23, 1950.....	20.55
June 3, 1936......	9.56	May 22, 1946.....	19.98	Apr. 3, 1950.....	20.61
July 21, 1936......	11.82	June 24, 1946.....	20.17	Aug. 14, 1950.....	20.42
Aug. 27, 1936......	12.49	Aug. 15, 1946.....	20.07	Oct. 16, 1950.....	20.63
Nov. 24, 1936......	13.35	Sept. 2, 1946.....	20.10	Dec. 18, 1950.....	20.61
Apr. 2, 1937......	14.19	Oct. 14, 1946.....	20.16	Feb. 19, 1951.....	19.70
June 17, 1937......	14.60	Dec. 24, 1946.....	20.28	Apr. 17, 1951.....	19.90
Aug. 10, 1937......	14.87	Jan. 11, 1947.....	20.26	Sept. 4, 1951.....	10.30
Oct. 15, 1937......	15.14	Apr. 24, 1947.....	20.46	June 30, 1952.....	6.70
June 24, 1938......	15.61				
LOUP COUNTY					
21-18-22aa					
Oct. 15, 1935......	4.78	July 12, 1938.....	4.82	Oct. 5, 1950.....	4.20
Nov. 20, 1935......	4.47	Oct. 20, 1938.....	4.89	Nov. 1, 1950.....	4.06
Dec. 22, 1935......	4.33	June 2, 1939.....	4.50	Jan. 5, 1951.....	3.98
Jan. 11, 1936......	4.16	Nov. 25, 1939.....	4.62	Mar. 7, 1951.....	3.67
Mar. 23, 1936......	3.79	Mar. 26, 1940.....	4.17	Apr. 26, 1951.....	3.73
May 29, 1936......	4.24	July 16, 1940.....	5.31	July 10, 1951.....	4.15
July 15, 1936......	5.25	Oct. 28, 1940.....	4.77	Sept. 21, 1951.....	3.96
Sept. 15, 1936......	5.14	Oct. 16, 1941.....	4.59	Nov. 29, 1951.....	4.08
Nov. 5, 1936......	4.67	Nov. 11, 1942.....	4.67	Feb. 15, 1952.....	3.54
Mar. 28, 1937......	3.97	Mar. 27, 1948.....	3.93	Apr. 15, 1952.....	3.81
June 12, 1937......	4.50	Aug. 24, 1950.....	4.50	July 22, 1952.....	5.04
Oct. 11, 1937......	4.88				
21-18-27ba					
Aug. 31, 1950......	5.08	Mar. 7, 1951.....	3.39	Nov. 29, 1951.....	3.60
Oct. 5, 1950......	5.12	Apr. 26, 1951.....	3.63	Feb. 15, 1952.....	4.22
Nov. 1, 1950......	1.43	July 10, 1951.....	3.13	Apr. 15, 1952.....	4.63
Jan. 5, 1951......	2.52	Sept. 21, 1951.....	2.98	July 22, 1952.....	5.20
MERRICK COUNTY					
15- 8-17dd					
Aug. 4, 1950......	2.19	Oct. 2, 1950.....	2.84	Nov. 27, 1950.....	2.94
Aug. 29, 1950......	3.08	Oct. 31, 1950.....	3.30	Jan. 4, 1951.....	2.84

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

MERRICK COUNTY—Continued

15- 8-27dd

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

16- 3- 5aa

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

16- 3- 7dd

Date	Water level	Date	Water level	Date	Water level
Aug. 11, 1947	4.45	Sept. 2, 1949	4.85	Jan. 31, 1951	5.29
Sept. 4, 1947	4.94	Nov. 7, 1949	4.01	Feb. 21, 1951	5.25
Nov. 11, 1947	4.97	Jan. 11, 1950	5.07	Mar. 26, 1951	3.99
Jan. 13, 1948	4.40	Mar. 10, 1950	4.59	Apr. 26, 1951	3.08
Mar. 18, 1948	3.67	May 4, 1950	4.15	May 28, 1951	3.34
May 8, 1948	2.94	May 26, 1950	3.68	July 26, 1951	3.57
July 13, 1948	3.75	June 23, 1950	4.23	Aug. 24, 1951	3.90
Sept. 2, 1948	4.20	Aug. 3, 1950	4.33	Sept. 25, 1951	4.14
Nov. 2, 1948	4.89	Aug. 23, 1950	4.39	Oct. 23, 1951	3.79
Jan. 4, 1949	3.86	Oct. 9, 1950	4.66	Nov. 23, 1951	4.02
May 8, 1949	3.49	Nov. 2, 1950	4.95	Dec. 27, 1951	4.00
Apr. 15, 1949	.79	Nov. 30, 1950	4.98	Jan. 24, 1952	3.72
July 12, 1949	3.58	Jan. 5, 1951	5.19	May 29, 1952	1.12

NANCE COUNTY

15- 6- 2bb

Date	Water level	Date	Water level	Date	Water level
Nov. 4, 1949	4.08	July 28, 1950	1.78	Feb. 21, 1951	2.75
Nov. 29, 1949	4.05	July 31, 1950	1.89	Apr. 26, 1951	1.08
Jan. 6, 1950	4.26	Aug. 28, 1950	2.25	May 28, 1951	1.65
Feb. 6, 1950	4.14	Sept. 5, 1950	3.01	July 26, 1951	2.50
Mar. 3, 1950	2.48	Oct. 4, 1950	1.96	Aug. 24, 1951	2.14
Mar. 28, 1950	1.07	Oct. 25, 1950	2.99	Sept. 25, 1951	2.29
Apr. 12, 1950	2.09	Oct. 30, 1950	3.08	Oct. 23, 1951	2.09
Apr. 28, 1950	2.35	Nov. 27, 1950	2.83	Nov. 23, 1951	2.09
May 24, 1950	2.18	Nov. 28, 1950	2.80	Dec. 26, 1951	2.04
June 23, 1950	3.21	Dec. 27, 1950	2.91	Jan. 24, 1952	1.94
June 27, 1950	3.35	Jan. 31, 1951	3.39		

16- 5-21cc

Date	Water level	Date	Water level	Date	Water level
Aug. 1, 1950	6.09	Jan. 30, 1951	8.22	Sept. 25, 1951	7.41
Aug. 28, 1950	6.70	Feb. 21, 1951	8.26	Oct. 23, 1951	7.76
Oct. 5, 1950	7.07	Mar. 30, 1951	7.97	Nov. 23, 1951	7.94
Nov. 1, 1950	7.36	Apr. 26, 1951	7.52	Dec. 26, 1951	8.18
Nov. 30, 1950	7.81	May 28, 1951	7.54	Jan. 24, 1952	8.12
Jan. 4, 1951	8.11	Aug. 24, 1951	7.20		

17- 4-36aa

Date	Water level	Date	Water level	Date	Water level
Nov. 6, 1935	5.80	Jan. 27, 1936	5.50	Apr. 26, 1949	2.93
Nov. 19, 1935	5.90	Feb. 26, 1936	5.30	June 6, 1949	2.73
Dec. 4, 1935	5.70	Mar. 25, 1936	4.90	July 6, 1949	2.57
Dec. 17, 1935	5.40	June 15, 1936	5.50	Aug. 8, 1949	4.47
Dec. 30, 1935	5.50	May 18, 1948	4.11	Sept. 21, 1949	4.35
Jan. 13, 1936	5.40	Sept. 28, 1948	5.15	Nov. 4, 1949	4.63

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
NANCE COUNTY—Continued					
17- 4-36aa—Continued					
Dec. 2, 1949......	4.85	Apr. 12, 1950....	3.60	Aug. 25, 1950....	4.66
Jan. 10, 1950......	4.89	Apr. 24, 1950....	4.06	Oct. 6, 1950....	5.11
Feb. 8, 1950......	4.77	May 24, 1950....	3.84	Nov. 2, 1950....	5.21
Mar. 3, 1950......	4.24	June 23, 1950....	4.39	Nov. 28, 1950....	5.17
Mar. 29, 1950......	3.48	July 26, 1950....	3.12	Nov. 20, 1952....	5.14
PLATTE COUNTY					
A18- 1-28cd					
Nov. 1, 1935.....	69.80	June 26, 1940.....	60.40	Feb. 28, 1946....	68.00
Nov. 13, 1935.....	69.40	July 20, 1940.....	61.70	Mar. 28, 1946....	68.10
Dec. 2, 1935.....	69.50	Aug. 14, 1940.....	62.20	Apr. 30, 1946....	68.30
Dec. 16, 1935.....	70.20	Mar. 18, 1942.....	62.20	May 27, 1946....	68.30
Dec. 28, 1935.....	69.50	Apr. 13, 1942.....	62.20	June 28, 1946....	68.10
Jan. 15, 1936.....	69.60	May 20, 1942.....	62.40	July 27, 1946....	68.40
Jan. 31, 1936.....	69.50	June 11, 1942.....	62.40	Aug. 28, 1946....	68.50
Mar. 16, 1936.....	69.50	July 21, 1942.....	62.70	Sept. 27, 1946....	68.70
Apr. 2, 1936.....	69.70	Aug. 19, 1942.....	63.10	Oct. 28, 1946....	68.80
June 16, 1936.....	69.80	Sept. 29, 1942.....	62.80	Dec. 27, 1946....	68.80
Oct. 9, 1936.....	69.84	Oct. 23, 1942.....	63.20	Jan. 27, 1947....	69.10
Feb. 5, 1937.....	70.25	Nov. 20, 1942.....	63.30	June 26, 1947....	69.00
Feb. 25, 1937.....	70.39	Dec. 16, 1942.....	63.50	Aug. 27, 1947....	68.90
Apr. 10, 1937.....	70.51	Jan. 6, 1943.....	63.40	Sept. 26, 1947....	69.00
June 11, 1937.....	70.60	Feb. 8, 1943.....	63.30	Nov. 29, 1947....	69.20
July 30, 1937.....	70.73	Mar. 16, 1943.....	63.70	Dec. 30, 1947....	69.30
Oct. 5, 1937.....	70.17	Apr. 22, 1943.....	64.00	Jan. 28, 1948....	69.30
Nov. 30, 1937.....	69.00	May 28, 1943.....	64.10	Mar. 29, 1948....	69.30
Jan. 3, 1938.....	68.35	June 28, 1943.....	64.20	Apr. 28, 1948....	69.40
Feb. 9, 1938.....	67.35	Aug. 28, 1943.....	64.40	May 28, 1948....	69.40
Mar. 23, 1938.....	66.35	Sept. 28, 1943.....	64.70	July 31, 1948....	69.50
Apr. 26, 1938.....	65.58	Oct. 28, 1943.....	64.70	Aug. 28, 1948....	69.60
May 25, 1938.....	64.95	Nov. 27, 1943.....	65.00	Oct. 30, 1948....	69.40
June 15, 1938.....	64.50	Dec. 28, 1943.....	65.10	Nov. 30, 1948....	69.60
July 19, 1938.....	63.80	Feb. 28, 1944.....	65.90	Jan. 29, 1949....	69.70
Aug. 11, 1938.....	63.37	Mar. 28, 1944.....	66.10	Feb. 26, 1949....	69.70
Sept. 7, 1938.....	62.95	Apr. 28, 1944.....	66.20	Mar. 31, 1949....	69.80
Oct. 11, 1938.....	62.50	May 27, 1944.....	66.30	Apr. 29, 1949....	69.49
Nov. 25, 1938.....	62.06	June 28, 1944.....	66.40	May 28, 1949....	69.40
Dec. 14, 1938.....	61.95	Aug. 28, 1944.....	66.50	June 30, 1949....	70.50
Jan. 19, 1939.....	61.64	Sept. 28, 1944.....	66.60	July 30, 1949....	70.50
Feb. 14, 1939.....	61.47	Oct. 28, 1944.....	66.70	Aug. 29, 1949....	69.50
Mar. 9, 1939.....	61.36	Nov. 28, 1944.....	66.80	Sept. 30, 1949....	69.50
Apr. 10, 1939.....	61.20	Dec. 28, 1944.....	66.90	Oct. 31, 1949....	70.50
May 17, 1939.....	60.91	Jan. 27, 1945.....	67.10	Dec. 28, 1949....	69.70
June 7, 1939.....	61.01	Feb. 28, 1945.....	67.20	Jan. 28, 1950....	69.80
July 14, 1939.....	60.73	Mar. 28, 1945.....	67.20	Feb. 28, 1950....	69.90
Aug. 22, 1939.....	60.62	Apr. 28, 1945.....	67.40	Mar. 21, 1950....	69.90
Sept. 12, 1939.....	60.58	May 28, 1945.....	67.40	May 27, 1950....	70.00
Oct. 17, 1939.....	60.47	June 28, 1945.....	67.60	June 29, 1950....	70.00
Nov. 14, 1939.....	60.46	July 27, 1945.....	67.40	July 31, 1950....	70.10
Dec. 19, 1939.....	60.50	Aug. 28, 1945.....	67.40	Aug. 29, 1950....	70.10
Feb. 21, 1940.....	60.50	Sept. 29, 1945.....	67.70	Sept. 30, 1950....	70.00
Mar. 27, 1940.....	60.30	Oct. 29, 1945.....	67.70	Oct. 25, 1950....	69.88
Apr. 24, 1940.....	60.30	Nov. 28, 1945.....	67.80	Oct. 30, 1950....	70.10
May 24, 1940.....	60.50	Jan. 28, 1946.....	67.90	Nov. 28, 1950....	69.96

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

PLATTE COUNTY—Continued

A18- 1-28cd—Continued

Date	Water level	Date	Water level	Date	Water level
Dec. 27, 1950......	69.98	July 26, 1951.....	70.21	Feb. 25, 1952.....	70.36
Jan. 29, 1951......	69.76	Sept. 25, 1951.....	70.32	Mar. 24, 1952.....	70.45
Feb. 21, 1951......	70.08	Oct. 23, 1951.....	70.31	May 2, 1952.....	70.44
Mar. 26, 1951......	69.99	Nov. 23, 1951.....	70.34	May 29, 1952.....	70.32
Apr. 26, 1951......	70.09	Dec. 24, 1951.....	70.26	Oct. 20, 1952.....	70.18
July 3, 1951......	70.27	Jan. 24, 1952.....	70.32		

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

SHERIDAN COUNTY

24-41-34da

Date	Water level	Date	Water level	Date	Water level
Dec. 18, 1934......	6.78	Oct. 24, 1938.....	7.98	June 6, 1947.....	8.04
Jan. 5, 1935......	6.72	June 9, 1939.....	7.30	Aug. 29, 1947.....	8.59
Feb. 26, 1935......	6.56	Dec. 2, 1939.....	8.68	Oct. 28, 1947.....	8.68
Apr. 20, 1935......	6.25	Apr. 2, 1940.....	8.17	Mar. 25, 1948.....	7.93
June 8, 1935......	5.52	July 22, 1940.....	9.09	June 30, 1948.....	7.53
July 15, 1935......	6.00	Nov. 4, 1940.....	9.35	Sept. 2, 1948.....	8.73
Aug. 15, 1935......	6.64	Oct. 21, 1941.....	9.37	Oct. 19, 1948.....	8.77
Sept. 16, 1935......	6.83	Nov. 13, 1942.....	8.25	May 13, 1949.....	7.66
Oct. 23, 1935......	7.00	Aug. 17, 1944.....	8.30	June 8, 1949.....	7.52
Nov. 26, 1935......	6.87	Aug. 17, 1945.....	8.17	July 15, 1949.....	7.98
Dec. 30, 1935......	6.77	Mar. 1, 1946.....	8.10	Sept. 16, 1949.....	8.34
Jan. 18, 1936......	6.73	Mar. 22, 1946.....	9.88	Nov. 25, 1949.....	8.19
Mar. 27, 1936......	6.38	Apr. 4, 1946.....	7.85	Jan. 23, 1950.....	8.09
June 3, 1936......	6.41	May 14, 1946.....	8.03	Apr. 3, 1950.....	7.31
July 21, 1936......	7.53	Aug. 15, 1946.....	8.94	Aug. 14, 1950.....	8.36
Aug. 27, 1936......	7.92	Sept. 2, 1946.....	8.85	Oct. 16, 1950.....	8.41
Nov. 24, 1936......	7.81	Oct. 14, 1946.....	8.54	Dec. 18, 1950.....	8.36
Apr. 2, 1937......	7.29	Nov. 15, 1946.....	8.44	Feb. 19, 1951.....	8.29
June 17, 1937......	7.59	Dec. 18, 1946.....	8.41	Apr. 17, 1951.....	8.24
Aug. 10, 1937......	8.47	Jan. 21, 1947.....	8.35	June 7, 1951.....	7.78
Oct. 15, 1937......	8.53	Feb. 19, 1947.....	8.24	Sept. 4, 1951.....	7.21
June 24, 1938......	7.23	Apr. 29, 1947.....	8.03	June 30, 1952.....	6.80

24-42-27ba

Date	Water level	Date	Water level	Date	Water level
Mar. 28, 1946......	12.50	Nov. 15, 1946.....	13.12	Aug. 29, 1947.....	13.10
Apr. 4, 1946......	12.19	Dec. 18, 1946.....	13.23	Oct. 28, 1947.....	12.99
May 14, 1946......	12.33	Jan. 21, 1947.....	13.27	June 30, 1948.....	12.94
June 24, 1946......	12.38	Feb. 20, 1947.....	13.26	Sept. 2, 1948.....	13.05
Aug. 15, 1946......	12.37	Apr. 29, 1947.....	13.21	Oct. 19, 1948.....	13.01
Oct. 14, 1946......	13.13	June 6, 1947.....	13.18	May 13, 1949.....	12.94

Table 11.—*Measurements of the water level in wells, in feet below land surface*—Con.

Date	Water level	Date	Water level	Date	Water level
SHERIDAN COUNTY—Continued					
24-42-27ba—Continued					
June 8, 1949	12.52	Aug. 14, 1950	13.24	Apr. 17, 1951	13.45
July 15, 1949	12.84	Oct. 16, 1950	13.28	June 7, 1951	13.40
Nov. 25, 1949	13.05	Dec. 18, 1950	13.34	Sept. 4, 1951	13.02
Jan. 23, 1950	13.07	Feb. 19, 1951	13.30	June 30, 1952	12.71
Apr. 3, 1950	13.12				
24-43-15da					
May 22, 1940	7.36	Oct. 19, 1946	6.78	June 8, 1949	5.66
July 22, 1940	7.90	Nov. 15, 1946	6.66	July 15, 1949	6.32
Nov. 4, 1940	8.08	Dec. 18, 1946	6.64	Sept. 16, 1949	6.53
Oct. 20, 1941	7.86	Jan. 21, 1947	6.70	Nov. 25, 1949	6.35
Nov. 13, 1942	6.23	Feb. 20, 1947	6.78	Jan. 23, 1950	6.39
Aug. 17, 1944	6.95	Apr. 29, 1947	6.70	Apr. 3, 1950	6.14
Aug. 17, 1945	6.52	June 6, 1947	6.52	Aug. 14, 1950	6.68
Mar. 1, 1946	6.26	Aug. 29, 1947	6.96	Oct. 16, 1950	6.73
Mar. 22, 1946	6.01	Oct. 28, 1947	6.82	Dec. 18, 1950	6.73
Apr. 4, 1946	5.97	Mar. 25, 1948	6.45	Feb. 19, 1951	6.74
May 14, 1946	6.16	June 30, 1948	6.78	Apr. 17, 1951	6.76
June 24, 1946	6.35	Sept. 2, 1948	7.14	June 7, 1951	6.75
Aug. 15, 1946	6.94	Oct. 19, 1948	7.01	Sept. 4, 1951	6.58
Sept. 2, 1946	7.00	May 13, 1949	5.78	June 30, 1952	6.41
24-44-14da					
Apr. 4, 1946	4.05	Aug. 29, 1947	6.09	Apr. 3, 1950	3.80
May 14, 1946	4.42	Oct. 28, 1947	5.51	Aug. 14, 1950	5.79
Aug. 15, 1946	6.18	June 30, 1948	5.13	Oct. 16, 1950	5.18
Oct. 14, 1946	5.26	Sept. 2, 1948	6.05	Dec. 18, 1950	4.77
Nov. 15, 1946	4.86	Oct. 19, 1948	5.68	Feb. 19, 1951	4.54
Dec. 18, 1946	4.76	May 11, 1949	3.94	Apr. 17, 1951	4.33
Jan. 21, 1947	4.73	July 15, 1949	4.62	June 7, 1951	4.42
Feb. 20, 1947	4.42	Sept. 16, 1949	5.24	Sept. 5, 1951	3.71
Apr. 29, 1947	4.31	Nov. 25, 1949	4.66	June 30, 1952	4.77
June 6, 1947	4.09	Jan. 23, 1950	4.49		
24-44-18bb					
Apr. 4, 1946	4.30	Aug. 29, 1947	4.71	Apr. 3, 1950	4.49
May 14, 1946	4.25	Oct. 28, 1947	4.72	Aug. 14, 1950	5.33
Aug. 15, 1946	5.50	June 30, 1948	4.79	Oct. 16, 1950	5.23
Oct. 14, 1946	5.13	Sept. 2, 1948	5.31	Dec. 18, 1950	5.24
Nov. 15, 1946	5.04	Oct. 19, 1948	5.19	Feb. 19, 1951	5.20
Dec. 18, 1946	5.03	May 11, 1949	3.80	Apr. 17, 1951	5.19
Jan. 21, 1947	5.04	July 15, 1949	4.11	June 21, 1951	4.93
Feb. 20, 1947	4.87	Sept. 16, 1949	4.77	Sept. 5, 1951	4.41
Apr. 29, 1947	4.78	Nov. 25, 1949	4.73	June 30, 1952	4.61
June 6, 1947	4.54	Jan. 23, 1950	4.74		
24-45- 8dd					
Nov. 26, 1935	3.06	July 21, 1936	4.25	Oct. 15, 1937	3.15
Dec. 30, 1935	2.91	Aug. 27, 1936	4.50	June 10, 1938	2.22
Jan. 18, 1936	2.83	Nov. 24, 1936	3.72	June 24, 1938	2.45
Mar. 27, 1936	2.40	Apr. 2, 1937	2.92	Oct. 24, 1938	3.22
June 3, 1936	2.36	Aug. 10, 1937	4.13	June 9, 1939	2.67

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Table 11.—*Measurements of the water level in wells, in feet below land surface*—*Con.*

Date	Water level	Date	Water level	Date	Water level
SHERIDAN COUNTY—Continued					
24-45- 8dd—Continued					
Dec. 2, 1939......	3.98	Nov. 15, 1946....	1.91	July 12, 1949.....	0.97
Apr. 2, 1940......	3.36	Dec. 18, 1946....	2.04	Sept. 13, 1949.....	2.15
July 22, 1940......	4.65	Jan. 21, 1947....	2.00	Nov. 23, 1949.....	1.94
Nov. 4, 1940......	3.97	Apr. 29, 1947....	1.75	Aug. 14, 1950.....	2.95
Oct. 21, 1941......	4.23	June 6, 1947....	1.35	Oct. 16, 1950.....	2.75
Nov. 15, 1942......	1.85	Aug. 29, 1947....	3.00	Dec. 18, 1950.....	2.42
May 14, 1946......	.96	Oct. 28, 1947....	2.34	Feb. 19, 1951.....	2.32
June 24, 1946......	1.47	Sept. 2, 1948....	3.28	Apr. 17, 1951.....	2.18
Aug. 15, 1946......	3.29	Oct. 19, 1948....	2.91	Sept. 5, 1951.....	.88
Sept. 2, 1946......	2.20	May 11, 1949....	1.13	June 30, 1952.....	1.77
Oct. 14, 1946......	2.23				
24-46-10cb					
Apr. 4, 1946......	2.26	June 6, 1947....	6.82	Nov. 23, 1949.....	6.03
May 14, 1946......	6.15	Aug. 29, 1947....	7.04	Jan. 24, 1950.....	5.90
June 24, 1946......	6.69	Oct. 28, 1947....	6.97	Apr. 5, 1950.....	5.75
Aug. 15, 1946......	7.35	Mar. 25, 1948....	6.32	Aug. 14, 1950.....	6.35
Oct. 14, 1946......	7.31	July 1, 1948....	6.46	Oct. 16, 1950.....	6.33
Nov. 15, 1946......	7.12	Sept. 2, 1948....	6.90	Dec. 18, 1950.....	6.30
Dec. 18, 1946......	7.00	Oct. 19, 1948....	6.86	Feb. 19, 1951.....	6.29
Jan. 21, 1947......	6.97	May 11, 1949....	5.92	Apr. 18, 1951.....	6.18
Feb. 20, 1947......	6.92	July 14, 1949....	5.67	Sept. 5, 1951.....	6.39
Apr. 29, 1947......	6.75	Sept. 13, 1949....	6.14	June 30, 1952.....	5.72
THOMAS COUNTY					
24-30-20ab					
Dec. 19, 1934......	2.52	June 24, 1938....	2.65	Apr. 24, 1947.....	2.83
Jan. 7, 1935......	2.60	Oct. 24, 1938....	2.78	Aug. 29, 1947.....	2.57
Feb. 26, 1935......	2.55	June 9, 1939....	2.60	Oct. 28, 1947.....	2.73
Apr. 20, 1935......	2.46	Dec. 2, 1939....	2.66	Mar. 25, 1948.....	2.67
June 8, 1935......	2.52	Apr. 2, 1940....	2.46	June 30, 1948.....	2.92
July 15, 1935......	2.87	July 23, 1940....	2.90	Sept. 2, 1948.....	2.95
Aug. 15, 1935......	3.07	Nov. 4, 1940....	2.56	Oct. 19, 1948.....	2.78
Sept. 16, 1935......	2.75	Oct. 21, 1941....	2.79	July 15, 1949.....	2.91
Oct. 23, 1935......	2.94	Nov. 12, 1942....	2.68	Sept. 16, 1949.....	2.84
Nov. 26, 1935......	2.70	Aug. 17, 1944....	2.89	Nov. 23, 1949.....	2.76
Dec. 30, 1935......	2.48	Aug. 17, 1945....	2.90	Jan. 23, 1950.....	2.54
Jan. 18, 1936......	2.54	Apr. 4, 1946....	2.71	Apr. 3, 1950.....	2.55
Mar. 27, 1936......	2.33	Apr. 26, 1946....	3.12	Aug. 14, 1950.....	2.68
June 3, 1936......	2.56	May 22, 1946....	2.87	Oct. 16, 1950.....	2.77
July 21, 1936......	3.01	June 24, 1946....	3.04	Dec. 18, 1950.....	2.57
Aug. 26, 1936......	3.02	Aug. 15, 1946....	3.04	Feb. 19, 1951.....	2.51
Nov. 24, 1936......	2.54	Sept. 2, 1946....	2.86	Apr. 17, 1951.....	2.87
Apr. 2, 1937......	2.38	Oct. 14, 1946....	2.70	June 7, 1951.....	2.42
June 17, 1937......	2.71	Dec. 24, 1946....	2.64	Sept. 4, 1951.....	1.57
Aug. 10, 1937......	2.92	Jan. 11, 1947....	2.52	June 30, 1952.....	2.74
Oct. 15, 1937......	2.83				

Table 12.—*Record of wells and springs in Loup River basin*

Well number: See text for explanation of well-numbering system.
Type of well: B, bored; Dn, driven; Dr, drilled; Du, dug; J, jetted; Sp, spring.
Depth of well: Measured depths are given in feet and tenths below land surface; reported depths are given in feet only.
Type of casing: C, concrete; GI, galvanized iron; I, iron; P, pipe; S, steel.
Type of pump: C, centrifugal; Cy, cylinder; N, none; P, piston; T, turbine.
Type of power: D, diesel; E, electric; F, natural flow; G, stationary gasoline engine; H, hand; N, none; T, tractor; W, wind.
Use of water: D, domestic; I, irrigation; In, industrial; N, none; O, observation of water-level fluctuations; P, public supply; R, railroad; S, stock.
Measuring point: Epb, edge of pump base; Hpb, hole in pump base; Ldp, lower edge of discharge pipe; Ls, land surface; Tca, top of casing; Tpi, top of pipe; Tpl, top of platform.
Depth to water: Measured depths are given in feet and hundredths; reported depths are given in feet only.

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Distance above or below (-) land surface	Measuring point: Altitude above mean sea level (feet)	Depth to water level below measuring point (feet)	Date of measurement
	BLAINE COUNTY													
22-24-33ca	University of Nebraska	1934	Dn	12.7	1	P	N	N	O	Tpi	1.4	2,615	5.13	12-16-34
	BOONE COUNTY													
18- 5- 6cd	....	....	Dr	177.0	3	P	Cy	H	S	Tca	2.0	1,840	140.75	5-20-52
12cc	Fay Smith	1944	Dr	65.0	18	GI	T	E	I	Hpb	.5	1,660	13.15	1- 2-51
7- 4ca	University of Nebraska	1936	Dn	22.3	1	P	N	N	O	Tpi	2.9	1,767	16.34	12-29-50
5ad	.....do	1935	Dn	14.3	1	P	N	N	O	Tpi	1.7	1,758	6.01	12-29-50
5ca	City of Cedar Rapids	1926	Dr	90.0	3	S	P	E	P	Ls	0	....	15	5-28-52
14bb	A. Kleffner	1944	Dr	250	18	GI	T	G	I	Hpb	0	1,800	57.10	12-29-50
19- 5- 4ac	C. Choat	1945	Dr	142.0	22	C	T	T	I	Hpb	0	1,753	64.44	1- 2-51
6aa	Carl Olson	1946	Dr	....	18	....	T	T	I	Hpb	.5	1,746	42.08	1- 2-51
7cd	R. C. Maricle	1943	Dr	147.0	18	GI	T	E	I	Hpb	1.0	1,755	45.73	1- 2-51
16db	Elmer Choat	1944	Dr	129.0	22	C	T	T	I	Hpb	0	1,695	23.87	1- 2-51

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point			Depth to water level below measuring point (feet)	Date of measurement
										Description	Distance above or below (-) land surface	Altitude above mean sea level (feet)		
	BOONE COUNTY—Continued													
19- 5 27dc	Louis Gasper	1945	Dr	65.0	18	GI	T	T	I	Hpb	0.5	1,674	14.07	1- 2-51
28cd	Lawrence Bryan	1945	Dr	147.0	18	GI	T	E	I	Hpb	1.0	1,709	34.04	1- 2-51
35cd	City of St. Edward	……	Dr	110	30	C	T	E	P	Ls	0	……	20	5-22-52
7- 13aa	Henry Vette	1949	Dr	179.0	18	GI	T	G	I	Hpb	0	1,848	86.52	5-21-52
24ba	Roy Bert	……	Dr	194.0	3	P	N	N	N	Ls	0	……	168.95	5-20-52
30aa	Roy Green	1941	Dr	98.0	18	GI	T	T	I	Hpb	:.5	1,791	24.39	12-29-50
31cc	Wm. Brown	1941	Dr	96.0	18	GI	T	G	I	Hpb	0	1,812	36.41	12-29-50
8- 9bb	H. Curring	1945	Dr	160.0	18	GI	T	T	I	Hpb	0	1,893	68.99	12-29-50
14db	John West	1943	Dr	100.0	24	GI	T	T	I	Hpb	.5	1,819	25.88	12-29-50
16aa	City of Primrose	……	Dr	60	6	S	T	E	P	Ls	0	1,824	20	5-28-52
16cc	C. J. Dresch, Jr.	1944	Dr	165	18	GI	T	G	I	Hpb	0	1,856	44.45	12-29-50
20- 5-20bd	……	……	Dr	112.0	2	P	N	N	N	Tpi	2.0	1,776	65.59	5-26-52
6- 6dc	……	……	Dr	78.0	3	P	Cy	W	S	Tpi	4.0	1,836	71.13	1- 2-51
22ba1	City of Albion	1935	Dr	98	18	C	T	E	P	Ls	0	……	14	5-22-52
22ba2	....do	1946	Dr	99	18	S	T	D	P	Ls	0	……	14	5-22-52
23bb	W. W. Redler	1947	Dr	100.0	22	GI	T	T	I	Hpb	0	1,763	30.44	1- 2-51
35ba	Lawrence Thompson	1943	Dr	154.0	18	GI	T	E	I	Hpb	1.0	1,773	50.65	1- 2-51
21- 6- 8aa	……	……	Dr	198.0	3	P	Cy	H	N	Tpi	2.0	2,031	169.25	5-26-52
7-26ca	University of Nebraska	1936	Dr	24.2	3	GI	N	N	O	Tca	1.9	1,827	17.17	1- 2-51
22- 7-25bd2	City of Petersburg	1925	Dr	126	8	S	T	E	P	Ls	0	1,898	50	5-26-52

BUFFALO COUNTY

11-16-35ad	Ray Cruise	1947	Dr	183	18	S	T	G	I	Hpb	1.0	2,287	153.66	8-27-51
12-13-20cb	Irvin Urwiller	1950	Dr	207	18	....	T	G	I	Hpb	.5	2,031	26.01	8-20-51
14- 5dd	City of Ravenna	1940	....	235	18	C	T	E	P	....	....	....	45	7-15-40
15-25cb	Bert Standage	1945	....	96	3	....	Cy	E	D	Epb	.5	2,039	16.80	8-10-50
16-35ad1	Raymond Hand	1935	Du	24.0	12	GI	Cy	H	N	Tpl	0	2,080	6.42	8-27-51
35ad2	Village of Pleasanton	....	....	119	18	S	T	E	P	....	....	....	....	....

CHERRY COUNTY

25-31-18ac	U. S. Bur. Reclamation	1948	Dr	139.0	1¼	I	N	N	O	Tpi	0	3,204	102.66	10-19-48
31bb	.....do	1948	Dr	163.0	1¼	I	N	N	O	Tpi	....	3,223	149.56	10-19-48

CUSTER COUNTY

13-17-36bc	A. W. Tatum	....	....	126	3	P	Cy	W	D,S	Tpi	1.0	2,288	110.17	10-27-50
19-15ba	G. L. Morgan	1948	Dr	....	18	....	T	T	I	Ls	0	....	90	8- 6-52
14-17- 2cb	Ross Douglas	....	Dr	81.0	18	....	T	T	I	Hpb	0	....	28.66	8- 5-52
5bb	City of Mason City	1947	Dr	162	10	....	T	E	P	Ls	0	2,257	40	8- 7-52
15-17- 1ad	Glen Smith	1940	Dr	122	24	GI	T	T	I	Hpb	0	2,222	21.48	11- 6-50
12ab	Maurice Lowry	1936	Du	100	24	GI	T	T	I	Ls	0	....	20	8- 5-52
34aa	Otha Lovitt	....	Dr	120.0	18	GI	T	T	I	Hpb	1.0	....	36.11	8- 5-52
18- 4ba	C. I. Sherbeck	....	Dr	102	18	GI	T	E	I	Ls	0	....	35	8- 7-52
4dc	City of Ansley	1938	Dr	140	10	S	T	E	P	Ls	0	2,304	25	8- 7-52
7da	E. A. Nelson	1947	Dr	100	....	....	T	T	I	Hpb	0	2,355	51.84	8- 7-52
9ba1	City of Ansley	1946	Dr	100	8	S	T	E	P	Ls	0	2,304	25	8- 7-52
9ba2	.....do	1948	Dr	110	8	S	T	E	P	Ls	0	2,304	25	8- 7-52
14bb	Raymond Shepardson	1946	Dr	125	....	....	T	T	I	Ls	0	....	30	8- 7-52
14ca	Melvin Clinger	1950	Dr	95	18	S	T	T	I	Ls	0	....	30	8- 7-52
15cc	Matthew Reed	....	Dr	....	18	....	T	T	I	Hpb	0	....	29.56	8- 7-52
35ca	Frank Reed	....	Dr	....	18	GI	T	T	I	Hpb	0	....	36.38	8- 7-52
22- 8bb	Harlan Van Cleave	1945	Dr	135	18	GI	T	G	I	Ls	0	....	27	8- 6-52
31da	Ralph Benjamin	1951	Dr	180	18	GI	T	G	I	Ls	0	2,647	115	8- 2-52
23-11ba1	City of Callaway	1921	Dr	194	10	P	T	E	P	Ls	0	2,552	11	8- 6-52
11ba2	.....do	1904	Dr	190	4	P	T	E	P	Ls	0	2,552	11	8- 6-52

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Distance above or below (-) land surface	Measuring point: Altitude above mean sea level (feet)	Depth to water level below measuring point (feet)	Date of measurement
	CUSTER COUNTY—Continued													
15-23-13bc	Roy Bryson	....	......	....	....	....	T	T	I	Hpb	0	2,566	30.22	8-13-52
24-14bc	Henry Bonde	....	Dr	186.0	18	GI	T	G	I	Hpb	0	2,714	122.35	8- 6-52
16-17- 2ab	Arthur Armstrong	1940	Dr	200	18	GI	T	G	I	Ls	0	....	80	7-29-52
5cb	Hubert Mills	1951	Dr	....	18	GI	T	E	I	Ls	0	....	15	7-24-52
9ac	Ralph Porter	1944	Dr	83	18	GI	T	T	I	Ls	0	....	35	7-23-52
9dc	A. J. Pester	1938	Dr	83	20	GI	T	E	I	Ls	0	....	40	7-23-52
26ad	Fred Mills	1940	Dr	....	18	GI	T	T	I	Ls	0	....	35	8- 5-52
18- 2ab	Jess Casteel	1936	Du	120	24	GI	T	G	I	Ldp	4.8	....	28.12	7-24-52
2dd	Alpha Casteel	1943	Dr	86.0	18	S	T	T	I	Ls	0	....	14.70	7-24-52
3ba	Marshall Casteel	1938	Dr	113.0	24	GI	T	T	I	Hpb	1.0	2,327	11.20	7-24-52
19- 6ab	Leonard Anderson	1949	Dr	126	18	GI	T	G	I	Hpb	0	....	31.5	8- 1-52
8da	Bill Gunther	1938	Dr	125	....	....	T	G	I	Ls	0	....	45	8- 1-52
20aa	O. H. Talbot	1940	Dr	....	18	GI	T	G	I	Hpb	0	....	43.02	8- 7-52
20-10dc	Arthur Haumont	....	Dr	....	24	GI	T	T	I	Hpb	0	....	29.22	8- 1-52
23-17dc	Johnson	1952	Dr	208.0	18	S	....	....	I	Tca	0	....	22.86	8- 6-52
17-17-25dc	Donald Holeman	1945	Dr	120	20	GI	T	G	I	Hpb	0	....	47.82	7-30-52
25dd	.....do	1948	Dr	120	20	GI	T	G	I	Ls	0	....	48	7-30-52
26db	Gerald Pierson	1951	Dr	225	18	GI	T	G	I	Ls	0	....	80	7-30-52
31cc	Miles Lee	....	......	130	....	....	T	E	I	Ls	0	....	19	2-23-49
36cc	G. F. Dean	1940	Dr	197	18	GI	T	T	I	Ls	0	....	80	7-29-52

36dd	.....do	1946	Dr	205	18	GI	T	G	I	Ls	0	...	80	7-29-52
18-21cc	Donald Samp	1948	Dr	200	18	I	T	E	I	Ls	0	...	11	7-29-52
27cb	Charles Brown	1948	Dr	207	18	S	T	E	I	Ls	0	2,332	11	7-29-52
36cb	Rex Cooley	1940	Dr	...	18	...	T	E	I	Ls	0	...	29	7-29-52
20-32ad1	City of Broken Bow	1940	Dr	140	10	S	T	E	P	Ls	0	...	16	7-22-52
32ad2	.....do	1935	Dr	165	8	S	T	E	P	Ls	0	2,475	16	7-22-52
33cb1	.....do	1940	Dr	156	12	S	T	E	P	Ls	0	2,470	30	7-22-52
33cb2	.....do	1949	Dr	140	18	GI	T	E	P	Ls	0	2,480	33	7-22-52
33cc1	Charles Sargent	...	Dr	145	18	GI	T	E	I	Ls	0	2,480	30	7-22-52
33cc2	City of Broken Bow	1932	Dr	161	8	S	T	E	P	Ls	0	2,475	24	7-22-52
21-13db	Merritt Winchester	1947	Dr	125	18	GI	T	G	I	Ls	0	...	75	7-31-52
24- 7ca	Lawrence Wahl	...	Dr	175.0	18	GI	T	G	I	Hpb	0	2,787	114.95	7-31-52
30ca	Robert Shaw	1949	Dr	...	18	GI	T	T	I	Ls	0	...	20	7-31-52
25-28aa1	City of Arnold	1928	Dr	140	6	S	T	E	P	Ls	0	2,700	12	7-23-52
28aa2	.....do	...	Dr	140	4	S	C	E	P	Ls	0	2,700	12	7-23-52
18-17- 2db	City of Comstock	1927	Dr	180	8	GI	T	E	P	...	...	...	30	10-17-49
18-15ab	Clive Tobias	1947	Dr	174	18	GI	T	G	I	Ls	0	2,457	108	7-21-52
21-32dc2	City of Merna	...	Dr	180	12	GI	T	E	P	Ls	0	2,659	120	7-22-52
22-33bc	Cecil Jacquot	1938	Dr	220	14	S	T	E	I	Ls	0	2,742	140	7-22-52
19-17- 9ca	P. E. Probert	1948	Dr	170	18	GI	T	G	I	Hpb	1.0	2,336	69.69	11- 1-50
18- 3dd1	City of Sargent	1936	Dr	90	24	GI	T	E	P	Ls	0	...	12.14	2- 8-50
3dd2	.....do	1936	Dr	90	24	C	T	E	P	Ls	0	...	14.15	2- 8-50
31dc	Floyd Slagle	1947	Dr	130	18	GI	T	G	I	Ls	0	...	105	7-30-52
19-28da	Berent Ottun	1952	Dr	128	18	GI	T	T	I	Ls	0	...	91	7-30-52
33cb	Milton Collins	1945	Dr	162	18	GI	T	G	I	Ls	0	...	96	7-30-52
20- 5cb	John Jacobsen	1942	Dr	112	18	GI	T	G	I	Tpl	1.0	2,448	16.96	11- 2-50
9aa	Oscar Swick	1948	Dr	80	18	GI	T	G	I	Hpb	0	2,427	16.52	11- 2-50
21-15dc	...	...	Dr	155	18	GI	T	T	I	Hpb	0	2,567	39.12	7-17-52
16cd	Carl Knoell	1940	Dr	110	24	F	T	G	I	Ls	0	2,531	20	7-22-52
17ab	Charles Sargent	...	...	140	16	GI	T	T	I	Ls	0	2,550	22	7-17-52
20aa	Victoria Springs State Park	...	Sp	...	...		...	...	...	...	...	...	...	...
22aa	Harold Kepler	1952	Dr	160	18	GI	T	T	I	Ls	0	2,565	38	7-17-52
22-16cb2	City of Anselmo	1927	Dr	150	4	GI	T	E	P	Ls	0	2,605	30	7-17-52
16db	Frank Lewis	1950	Dr	130	18	GI	T	T	I	Hpb	0	2,600	29.77	7-21-52

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Distance above or below (-) land surface	Measuring point: Altitude above mean sea level (feet)	Depth to water level below measuring point (feet)	Date of measurement
	CUSTER COUNTY—Continued													
1[illegible]-22-17ad	Chicago, Burlington & Quincy Railroad	1927	Dr	100	6	P	Cy	D	R	Ls	0	2,606	30	7-17-52
17dd	Dominic Rolli	....	Dr	135	18	GI	T	E	I	Hpb	0	2,613	22.9	7-21-52
20ac	Frank Lewis	1950	Dr	130	18	GI	T	T	I	Ls	0	2,612	23	7-21-52
21ab	.....do	1950	Dr	130	18	GI	T	T	I	Hpb	0	2,596	33.95	7-17-52
22bc	James Lindly	....	Dr	137	24	GI	T	E	I	Ls	0	2,596	35	7-17-52
20-19-31cb	E. E. Stone	1949	Dr	110	18	GI	T	T	I	Tpl	1.0	2,409	33.08	11- 2-50
34ab	Ray Johnson	1948	Dr	122	18	GI	T	G	I	Hpb	0	2,399	52.68	11-12-50
20-30aa	Ted Holmes	1948	Dr	77	18	GI	T	G	I	Tpl	0	2,446	32.27	10-10-50
21-10bc	A. C. Turner	1949	Dr	30	6	GI	Cy	W	D	Tca	1.0	2,478	22.09	10-30-50
	GARFIELD COUNTY													
21-13-32cd	George Lavbildoil	....	.....	191	18	GI	T	G	I	Hpb	0	....	119.40	10-26-50
15-19aa	Henry Bonzoll	....	.....	......	....	....	T	G	I	Hpb	1.0	....	16.04	10-25-50
20dd	Charles Meyer	....	.....	......	....	....	T	T	I	Tca	1.0	....	26.26	10-25-50
16-11dd	M. L. Kenselmeyer	1948	Dr	55	18	GI	T	G	I	Tca	1.0	....	25.00	10-24-50
12cc	.....do	1949	Dr	80	18	GI	T	G	I	Hpb	2.0	....	38.75	10-24-50
13ad	Emma Janicek	1944	Dr	......	18	GI	T	G	I	Hpb	0	....	48.49	10-24-50
14cb	Frank Smalik	1949	Dr	154	18	GI	T	G	I	Hpb	2.0	....	25.82	10-24-50
15da	Lawrence Fransen	1949	Dr	64	18	GI	T	T	I	Tca	0	....	9.03	10- 5-50
21dc	Elsie Donner	1949	Dr	71	18	GI	T	G	I	Hpb	1.0	....	6.19	10-25-50
23bd1	City of Burwell	1929	Dr	50	30	S	T	E	P	Ls	0	2,176	18	8-18-52

23bd2	.....do........	1936	Dr	50	30	S	T	E	P	Ls	0	2,176	18	8-18-52
23bd3	.....do........	....	Dr	78	24	C	T	E	P	Ls	0	....	35	11-29-43
24-15-15dd	....	1952	Dr	140	1¼	....	....	F	....	....	....	....	....	....

GRANT COUNTY

23-38- 5bd	City of Hyannis........	1947	Dr	120	....	....	T	E	P	Ls	0	....	15	8-19-52
6ad	.....do........	1932	Dr	160	....	....	T	E	P	Ls	0	....	30	8-19-52
24-36-30bb	U. S. Geol. Survey........	1934	Dn	15.4	1	P	N	N	O	Tpi	1.2	3,600	5.91	12-18-34
40-36bb	.....do........	1934	Dn	20.9	1	P	N	N	O	Tpi	4.2	3,840	13.87	12-18-34

GREELEY COUNTY

17- 9-31ba	City of Wolbach........	....	Dr	90	....	C	T	E	P	Ls	0	....	50	6- 2-52
10-10cb	U. S. Geol. Survey........	1935	B	20.0	3	GI	N	N	O	Tca	.9	....	14.39	12-29-50
12- 9ba	City of Scotia........	1932	Dr	73	36	S	T	E	P	Ls	0	1,940	23	6- 4-52
18-11-12ac	Town of Greeley........	1938	Dr	255	10	S	T	E	P	Ls	0	....	32	6- 4-52
12db	.....do........	1943	Dr	255	10	S	T	E	P	Ls	0	....	32	6- 4-52
31cc	Conrad Hermsmeyer........	1941	Dr	220	18	GI	T	D	I	Hpb	0	2,025	65.45	6- 4-52
19- 9-12db	....	....	....	....	....	....	T	G	I	Hpb	0	1,878	37.58	12-29-50
20- 9-20cc	U. S. Geol. Survey........	1935	Dn	16.3	1	P	N	N	O	Tpi	1.4	1,882	3.03	12-29-50
20db	.....do........	1936	B	19.5	3	GI	N	N	O	Tca	2.2	1,883	10.63	12-29-50
21bd	City of Spalding........	1946	Dr	150	24	S	T	E	P	Ls	0	....	18	6- 3-52
21ca	.....do........	....	Dr	120	24	S	T	E	P	Ls	0	....	25	6- 3-52
30ca	Alvin Gilray........	1947	Dr	168.0	18	GI	T	G	I	Hpb	2.0	1,962	68.98	12-29-50
34aa	E. Haggerty........	1943	Dr	158.0	24	GI	T	G	I	Hpb	.5	1,882	32.79	12-29-50
10-14ab	Albert Glaser........	1944	Dr	90.0	18	GI	T	G	I	Hpb	.5	1,921	10.00	12-29-50

HOOKER COUNTY

24-31-17cd	U. S. Bur. Reclamation........	....	Dr	20.9	1¼	I	N	N	O	Tpi	0.9	3,010	16.92	12-18-50
18cb	.....do........	....	Dr	41.6	1¼	I	N	N	O	Tpi	1.0	3,050	33.66	12-18-50
18dd	.....do........	....	Dr	21	1¼	I	N	N	O	Tpi	1.0	3,030	18.09	10- 5-50
21aa	.....do........	....	Dr	11.6	1¼	I	N	N	O	Tpi	2.2	2,990	7.08	12-18-50
32-20ab	City of Mullen........	1934	Dr	180	8	P	T	E	P	Ls	0	....	40	8-19-52

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point			Depth to water level below measuring point (feet)	Date of measurement
										Description	Distance above or below (-) land surface (feet)	Altitude above mean sea level (feet)		
						HOOKER COUNTY—Continued								
20ad	.....do.........	1949	Dr	180	8	P	T	E	P	Ls	0	....	40	8-19-52
20bd	.....do.........	1915	Dr	180	8	P	T	E	P	Ls	0	....	40	8-19-52
35-23dd	University of Nebraska.........	1934	Dn	22.6	1	P	N	N	O	Tpi	1.8	3,440	13.34	12-18-34
						HOWARD COUNTY								
13-11- 6bd	J. C. Peterson.........	1900	Dr	80	6	GI	Cy	W	D,S	Tpl	1.0	1,955	49.61	10-13-50
11ac	City of Dannebrog.........	1939	Dr	54	18	C	T	E	P	Ls	0	....	30	5- 6-52
11db1	.....do.........	1934	Dr	85	18	GI	T	E	P	Ls	2.2	....	19.00	2- 2-50
12-29ab1	City of Boelus.........	1935	Dr	31.5	12	GI	T	E	P	Hpb	1.0	....	10.24	11-10-49
29ab2	.....do.........	1934	Dr	31.5	18	S	T	E	P	Hpb	0	....	9.02	5- 6-52
14- 9- 3bb	George Zuehelke.........	1950	Dr	106	18	GI	T	T	I	Hpb	0	1,850	11.47	4-30-52
3cb	Ray Bahensky.........	1949	Dr	107	18	GI	T	T	I	Hpb	0	1,855	14.36	4-30-52
10- 3ca1	City of St. Paul.........	1948	Dr	50	18	S	C	E	P	Ls	....	....	14	5- 8-52
3ca2	.....do.........	....	Dr	55	28	S	T	E	P	Ls	....	....	12	12- 1-43
30ba	Ivan McCrackin.........	1935	Dr	32	4	GI	Cy	W	D	Tca	.5	1,853	14.88	4- 3-50
11- 3bc	....	....	....	....	2	P	N	N	N	Tpi	-4.0	1,992	106.88	4- 5-52
6ba1	Chicago, Burlington & Quincy Railroad.........	1937	Dr	115	12	GI	T	E	R	Hpb	2.0	....	32.81	8-15-49
6ba2	City of Farwell.........	1938	Dr	142	8	S	T	E	P	Ls	0	....	29	5- 6-52
27ba	U. S. Bur. Reclamation.........	1952	J	31	$\frac{3}{4}$	P	N	N	N	Tpi	1.5	1,910	16.65	4- 5-52
12- 1aa	....	....	....	31	5	GI	N	N	N	Tca	1.0	1,960	20.71	4- 6-52

12dd	U. S. Bur. Reclamation	1952	J	......	$\frac{3}{4}$	P	N	N	N	Tpi	1.2	1,935	8.30	4- 7-52
15-10-34db	......	......	Dr	79.0	18	GI	T	E	I	Hpb	0	1,795	21.07	5- 2-52
11- 5cc	Joseph Zavitka	......	......	85	5	GI	Cy	H	D,S	Tca	0	1,906	32.34	4- 6-52
10ac	R. Spilinek	......	......	53	6	GI	N	N	N	Tca	1.0	1,845	33.03	4- 6-52
10bc	City of Elba	1936	Dr	79	8	S	T	E	P	......	......	......	28	11-30-43
15ba	Elba Cemetery	......	......	83	5	GI	Cy	H	D,S	Tca	1.0	1,893	66.29	4- 5-52
27aa	A. S. Naprstek	......	......	120	6	GI	Cy	W	S	Hpb	0	1,922	67.90	4- 5-52
12-33aa	......	......	Du	32	60	......	N	N	S	Tpi	0	1,993	30.68	4- 7-52
16- 9-10ad	Cyril Havlik	......	Dr	260	3	S	Cy	H	N	Tpi	4.0	2,000	175.35	5- 2-52
10-21cc	......	......	Dr	101	8	GI	N	N	S	Tca	1.0	1,970	90.20	5- 2-52
11-19cb1	Ray Parker	1947	Dr	96	18	GI	N	N	I	Tca	0	1,905	41.59	12-29-50
19cb2	......	......	Dr	95	18	GI	T	T	I	Hpb	0	1,880	33.36	5- 5-52

LOGAN COUNTY

18-28-35cd	City of Stapleton	1938	Dr	153	8	P	T	E	P	Ls	0	2,890	18	8-13-52

LOUP COUNTY

21-17-32dc	Louis Bohy	......	......	......	18	......	T	G	I	Hpb	0.5	......	23.74	8-30-50
18-18cd	Arthur Coleman	1945	Dr	131	18	GI	T	G	I	Hpb	1.0	......	15.36	8-29-51
20bd	Charles Ford	1946	Dr	115	18	GI	T	G	I	Hpb	.5	......	28.79	11- 1-50
22aa	University of Nebraska	1935	Dn	15.2	1	P	N	N	O	Tpi	.8	......	4.86	11- 1-50
26cc	......	......	......	......	18	GI	T	G	I	Hpb	0	......	25.91	11- 1-50
27ba	North Loup Public Power and Irrigation District	......	Dn	6.3	$1\frac{1}{4}$	GI	N	N	O	Tpi	1.0	......	5.12	10- 5-50
35ba	Lester Stekel	......	......	......	......	......	......	G	I	Hpb	0	......	33.59	9-24-51
19- 4bc	Wm. Strong	1930	Dr	22.0	$1\frac{1}{4}$	P	N	N	N	Tpi	1.5	......	10.41	1-17-51
13db	S. Ferguson	1945	Dr	132.0	18	GI	T	G	I	Hpb	1.0	......	17.79	11- 1-50
22-20-24db	Oscar Anderson	1945	Dr	......	18	GI	T	G	I	Hpb	1.0	......	19.80	1-17-51

MERRICK COUNTY

15- 8-17dd	U. S. Geol. Survey	1950	J	14.0	$\frac{3}{4}$	GI	N	N	O	Tpi	1.0	1,718	3.84	1- 4-51
27dd	.....do	1950	J	21.0	$\frac{3}{4}$	GI	N	N	O	Tpi	1.5	1,740	4.55	11-29-50

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Measuring point: Altitude above mean sea level (feet)	Depth to water level below measuring point (feet)	Date of measurement
						MERRICK COUNTY—Continued								
15- 8-32cd	City of Palmer	1952	Dr	95	18	GI	T	E	P	Ls	0	....	20	1- 9-53
16- 3- 5aa	U. S. Geol. Survey	1950	J	14.0	¾	GI	N	N	O	Tpi	1.0	1,566	5.75	11-30-50
7dd	.....do	1947	Dr	10.6	1¼	GI	N	N	O	Tpi	1.0	....	2.12	5-29-52
						NANCE COUNTY								
15- 6- 2bb	U. S. Geol. Survey	1951	J	18.5	¾	GI	N	N	O	Tpi	1.0	1,663	3.83	11-27-50
16- 5-21cc	.....do	1950	J	14.0	¾	GI	N	N	O	Tpi	1.5	....	9.61	1- 4-51
6-11db	City of Fullerton	1904	Du	50	18	C	C	E	P	Ls	0	....	25	5-14-52
7- 6aa	....	....	Dr	191.0	3	P	N	N	N	Tca	4.0	1,900	145.04	5-13-52
14ca	....	....	Dr	270.0	3	P	Cy	H	N	Tca	0	1,840	123.44	5-13-52
17- 4-24ca1	City of Genoa	1947	Dr	30	18	GI	T	E	P	Ls	0	....	20	5-14-52
24ca2	.....do	1950	Du	40	18	S	T	E	P	Ls	0	....	20	5-14-52
36aa	Loup River Public Power District	1935	Dn	11.0	1¼	P	N	N	O	Tpi	2.0	1,557	7.17	11-28-50
5-20bb	....	....	Dr	78.0	3	P	N	N	N	Tca	2.0	1,680	14.44	5-12-52
6- 3ad	....	....	Dr	154.0	3	P	N	N	N	Tca	2.0	1,800	89.95	5-12-52
7- 1dc	City of Belgrade	....	Du	40.5	14	S	T	E	P	Ls	0	....	10	5-14-52
8-15bb	....	....	Dr,Dn	74.0	3	P	Cy	W	N	Tca	0	1,795	17.64	5-12-52
18- 4-19ab	Homer Petersen	1935	Dr	42.0	4	GI	Cy	H	S	Tpl	1.5	1,635	12.34	1- 2-51
5-33da	....	....	Dr	164.0	3	P	N	N	N	Tca	2.0	1,800	146.22	5-12-52

PLATTE COUNTY

A17- 1-20bc	City of Columbus	1941	Dr	100	24	...	T	E	P	Ls	...	...	16.00	11- 7-41
A18- 1-28cd	Loup River Public Power District	1935	Dr	98.6	2	P	N	N	O	Tpi	0.5	1,512	70.82	5-29-52
31ad	.....do	1935	Dr	84.0	2	P	N	N	N	Tpi	...	1,507	56.3	11-14-35
17- 1-27ad	.....do	1935	Dn,B	13.5	1¼	P	N	N	O	Tpi	3.0	...	8.52	9-27-49

SHERIDAN COUNTY

24-41-34da	U. S. Geol. Survey	1934	Dn	13.2	1	P	N	N	O	Tpi	1.0	3,876	9.36	12-18-50
42-27ba	.....do	1946	Dr	18.2	1¼	P	N	N	O	Tpi	1.0	3,922	14.34	12-18-50
43-15da	University of Nebraska	1940	Dn	21	1¼	P	N	N	O	Tpi	1.8	3,917	8.55	6- 7-51
44-14da	.....do	1946	Dn	10.8	1¼	P	N	N	O	Tpi	1.5	3,879	5.92	6- 7-51
18bb	.....do	1946	Dn	12.3	1¼	P	N	N	O	Tpi	1.0	3,881	5.93	6- 7-51
45- 8dd	.....do	1935	Dn	11.5	1	P	N	N	O	Tpi	2.0	3,878	4.42	12-18-50
46-10cb	U. S. Geol. Survey	1946	Dn	12	1¼	P	N	N	O	Tpi	1.0	3,905	7.30	12-18-50
25-45-32ad	J. Herrian	1930	Dr	79	4	...	N	N	N	Tca	1.3	...	34.42	12-18-50

SHERMAN COUNTY

13-13- 5dd	Rockville Ball Club	...	...	35	...	...	...	...	...	Tpi	3.0	...	26.61	10- 9-49
13cc	John Siefert	1935	...	78	4	...	Cy	W	S	Hpb	0	1,995	53.59	11- 7-50
14-14- 3cc2	Bill Coutan	...	...	38	4	GI	Cy	W	S	Hpb	0	...	11.15	10- 9-49
15-26aa	...	...	Dr	139	5	GI	N	N	N	Tca	1.0	2,190	109.63	6- 5-52
16-28ac2	City of Litchfield	1949	Dr	109	14	S	T	E	P	Ls	0	...	44	6- 5-52
28db	Chicago, Burlington & Quincy Railroad	1908	Dr	...	...	...	Cy	G	R	Ls	...	...	45	6- 5-52
15-13-27ab	City of Ashton	...	Dr	150	12	GI	T	E	P	...	...	...	...	
14-18bd1	City of Loup City	1922	Dr	116	18	C	T	E	P	...	...	...	13.00	10-18-49
16- 7aa	M. Reiter	...	Dr	...	...	GI	T	T	I	Epb	.5	2,218	27.05	11- 6-50
7ab	Darrel Packer	...	Dr	...	...	...	...	...	I	...	...	...	...	
16-14-28aa	Earl Keeler	1947	Dr	160	18	S	T	G	I	Hpb	1.0	2,160	85.42	6-11-52
16-12bc	Edward Chotkoski	1948	Dr	124	18	GI	T	T	I	Hpb	2.0	2,186	37.35	11- 7-50
21aa	...	...	Dr	213.0	3	P	N	N	N	Tca	0	2,392	199.13	6- 5-52

Table 12.—*Record of wells and springs in Loup River basin*—Continued

Well	Owner or user	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Measuring point: Altitude above mean sea level (feet)	Depth to water level below measuring point (feet)	Date of measurement
	THOMAS COUNTY													
23-28- 9ca	City of Thedford	1942	Dr	....	....	....	T	E	P	Ls	0	....	15	8-19-52
24-30-20ab	University of Nebraska	1934	Dn	12.6	1	P	N	N	O	Tpi	2.5	2,950	4.92	6- 7-51
	VALLEY COUNTY													
17-16-26ba	City of Arcadia	1936	Dr	81	12	GI	T	E	P	....	....	....	7	10-17-49
30bc	Les Bly	1946	Dr	180	18	GI	T	T	I	Ls	0	....	64	7-30-52
18-13-25cc	City of North Loup	....	Dr	93	10	I	T	E	P	Ls	0	1,957	20	11-29-43
26dd	.....do	1914	Dr	87	12	S	T	E	P	Ls	0	1,957	10	7-10-52
33bc	W. N. Vogeler	1949	Dr	257	18	GI	T	G	I	Hpb	1.0	2,020	36	7- 9-52
15-11ba	William Hansen	1949	Dr	150	18	GI	T	G	I	Hpb	.5	2,156	32.81	7- 9-52
12bb	Emil Kokes	1948	Dr	120	18	GI	T	G	I	Hpb	1.0	2,145	31.84	7- 1-48
19-14- 6dc	Archie Gewęke	1940	Dr	98	30	C	T	T	I	Ls	....	2,085	36	7- 8-52
36ba	Edward Penas	1947	Dr	155	18	GI	T	T	I	Ls	0	2,030	33	7- 9-52
20-15-35ab	Floyd Wozniak	1948	Dr	122.0	18	C	T	G	I	Hpb	0	2,153	61.45	7- 8-52
	WHEELER COUNTY													
21-11-25dd	State of Nebraska	....	......	97	2	P	N	F	N	....	....	....	....	
12-23bb	City of Ericson	1937	Dr	87	6	S	T	E	P	Ls	0	....	5	11- 7-52

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