GROUND-WATER RECONNAISSANCE

OF THE

NORTH LOUP DIVISION

OF THE

LOWER PLATTE RIVER BASIN

NEBRASKA

By
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and
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DEPARTMENT OF THE INTERIOR
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HYDROLOGIC INVESTIGATIONS ATLAS HA 12

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INTRODUCTION

The North Loup Division of the lower Platte River basin, an irrigation project proposed for development by the U. S. Bureau of Reclamation, is in central Valley County and in southwestern Greeley, northern Howard, northwestern Merrick, and southwestern Nance Counties, Nebr. (See fig. 1.) At the request of the Bureau of Reclamation, the Geological Survey made a study of the ground-water conditions and potentialities in the project area. This report embodies the results of that study.

Most of the fieldwork was done during the late summer of 1956 and the spring of 1957. All the irrigation wells in the area were visited and pertinent data on them were obtained, in part by visual inspection of the wells and in part by interviewing their owners or operators (table 4). Personnel of the Bureau of Reclamation assisted in making this inventory. The altitudes of the measuring points of the wells either were determined by surveyors of the Bureau of Reclamation or were estimated by the authors of this report from topographic maps of the Geological Survey. Water-level data collected during the inventory were used in mapping the depth to water and the configuration of the water table. (See pl. 1.) Chemical analyses of the water from 10 wells (table 1) were made in the Geological Survey's laboratory in Lincoln, Nebr.

This report is based not only on the information obtained specifically for this investigation but also on geologic and hydrologic data previously collected in the area. As part of the statewide program of geologic and ground-water studies made cooperatively by the U. S. Geological Survey and the Conservation and Survey Division of the University of Nebraska, 56 test holes had been drilled in or near the area. Copies of the logs of these test holes may be obtained from the Conservation and Survey Division of the University of Nebraska. Also as part of the Federal-State cooperative program, water-level measurements had been made at irregular intervals since 1934 in 2 wells in the area (table 3) and chemical analyses had been made of 14 ground-water samples (table 1) and of 1 sample of river water (table 2). As part of the program of the Interior Department for development of the Missouri River basin, water-level measurements were made at intervals in 68 wells in the area (table 3) and chemical analyses were made of 2 ground-water samples (table 1) and 11 samples of river water (table 2). Reports by Connor (1951), Miller (1951), Brown (1955), and Sniegocki (1955, 1959)--all prepared as part of the Missouri River basin development program--also contain pertinent information on the area described in this report.

This investigation was made under the supervision of G. H. Taylor, regional engineer in charge of ground-water investigations in the Missouri River basin. The quality-of-water phase of the investigation was under the supervision of P. C. Benedict, regional engineer, Quality of Water Branch.

SYSTEM FOR NUMBERING WELLS AND TEST HOLES

The well and test-hole numbers in this report indicate the location of each well and test hole according to the survey of the area by the Bureau of Land Management. The first segment of a number indicates the township, the second the range, and the third the section. The lowercase letters following the section number indicate the position of the well or test hole within the section. These letters are assigned in a counterclockwise direction beginning with "a" in the northeast quadrant. The first letter indicates the quarter section, or 160-acre tract; the second letter indicates the quarter-quarter section, or 40-acre tract. (See fig. 2.) When two or more wells or test holes are situated within the same tract, they are distinguished by numerals, beginning with 1, added after the lowercase letters.

GEOGRAPHY

Location and extent of area

The area described in this report includes about 350 square miles in east-central Nebraska. It consists of (1) the part of the upland in Valley County that is drained principally by Turtle, Dane, and Mira Creeks; (2) the North Loup River valley in Valley, Greeley, and Howard Counties; and (3) the Loup River valley in Howard, Merrick, and Nance Counties. (See fig. 1.) It is in the High Plains section of the Great Plains physiographic province, as described by Fenneman (1931, p. 11-25).

Topography and drainage

The drainage basins of Turtle, Dane, and Mira Creeks and intervening streams comprise about 250 square miles. About half this part of the report area is an elongate northwest-trending upland plain which ranges in altitude from 2,050 to 2,225 feet above mean sea level. The remainder is a highly dissected upland in which the highest ridges are about 150 feet higher than the general level of the upland plain and 250 to 300 feet higher than the flood plain of the North Loup River.

The valley floors of the North Loup and Loup Rivers are 2 to 3½ miles wide. The Recent flood plain in each is less than half a mile wide and is bordered by terraces which are separated in some places by scarps but more generally by gentle slopes. Of the two distinct terraces that can be recognized almost anywhere along these valleys, the higher is 30 to 50 feet above stream level and in some places is as much as 2 miles wide. Along the margins of the valleys, the higher terrace merges with the steep slope that separates the valley floor from the bordering uplands.

The North Loup flows at an altitude of about 2,100 feet where it enters Valley County and at an altitude of about 1,750 feet where it joins the Middle Loup to form the Loup River. The altitude of the Loup River where it leaves the area near Fullerton, Nance County, is about 1,620 feet.

Climate

According to records of the U. S. Weather Bureau, the climate of the area is characterized by wide variations in temperature, precipitation, and wind movement.

The mean annual temperature ranges from 48° to 50°F. Usually, on several days each summer the maximum temperature is 100°F or a little higher and on several days each winter the minimum is 0°F or below. The last killing frost normally occurs in early May and the first in early October.

The amount and distribution of precipitation differ greatly from year to year. The mean annual precipitation ranges from about 21 inches at the west end of the area to about 23 inches at the east end. The greater part of the precipitation occurs during thunderstorms in the period April through September. Lack of rain in late summer occasionally causes reduced crop yields, but because the soil, if properly cultivated, is highly retentive of moisture, total crop failures are rare.

The prevailing wind is from the south and southeast during the summer and from the northwest during the winter. The average wind velocity is 9 to 10 miles per hour.

Population

The first permanent settlers in the area arrived about 1870. Many others soon followed, homesteading all the valley land and a large part of the upland. By 1890 almost the entire area had been homesteaded. The present farm population is estimated to be about 6,000.

The principal cities and villages in or near the area and their population in 1950 are listed below in downstream order:

City or village	Population
Elyria..................	87
Ord.....................	2,239
North Loup..............	526
Scotia..................	474
Cotesfield..............	106
Elba....................	216
St. Paul................	1,676
Cushing.................	71
Palmer..................	434
Fullerton...............	1,520

Transportation

Cushing and Ord are on a branch line of the Chicago, Burlington & Quincy Railroad; all the other principal cities and villages, including Ord, are on a branch line of the Union Pacific Railroad. Elyria, Ord, North Loup, Scotia, Cotesfield, and Elba are on or within a mile or two of Nebraska Highway 11; St. Paul is on U. S. Highway 281 and Nebraska Highway 92; and Fullerton is on Nebraska Highway 14. Within the area described in this report, these highways are paved. Few, if any, places in the area are farther than a mile from the nearest graveled road, which generally is on a section line.

Agriculture

Agriculture is the chief industry. The principal crops are corn, wheat, and oats, most of which are fed on the farm to cattle and hogs. Both in the valleys and on level upland areas farms range in size from 160 to 320 acres, but on the rolling and rough upland areas, where most of the land is used for grazing, they are larger. Much of the terrace land in the North Loup River valley in Valley County and a small part of that in western Greeley County is irrigated with water diverted from the North Loup River. The cropland on the southwest side of the North Loup River and northwest of the center of T. 19 N., R. 14 W., is supplied irrigation water by the Taylor-Ord Canal; that on the northeast side of the river by the Burwell-Sumter Canal; and that on the west side of the river from the southern part of T. 19 N., R. 13 W., to the northwestern part of T. 17 N., R. 12 W., by the Ord-North Loup Canal. The construction of the diversion dams and canals was financed with funds made available by the Federal Emergency Administration of Public Works. The system is maintained by the North Loup River Public Power and Irrigation District, which was organized in 1936.

The use of ground water for irrigation in both upland and valley areas is increasing at a rapid rate; in the spring of 1957 there were 115 irrigation wells in the area. Of the 106 for which the date of installation is known, the first was drilled in 1920. Eight others are known to have been drilled before 1940, 35 were drilled in the 1940's, and 62 from 1950 through early 1957.

GEOLOGY

Summary of Tertiary and Quaternary geologic history

The retreat of the Late Cretaceous sea from the interior of the North American continent exposed to subaerial erosion the sediments that had accumulated in that sea. Throughout the following Tertiary period, streams draining high mountains to the west built a broad alluvial apron out from the eastern slopes of the mountains, but not until the Pliocene epoch of the Tertiary period did the alluvial apron extend far enough to bury the area described in this report. It is not certain that all the area was buried--the lack of deposits of Tertiary age in the eastern part of Nance County could indicate either that the eastward-thinning alluvial apron never reached that far or, if it did, that subsequent erosion removed it.

During the first half of the succeeding Pleistocene epoch of the Quaternary period, continental ice sheets twice advanced well into eastern Nebraska, almost reaching the area described in this report. The glaciers dammed the streams that were flowing eastward down the gentle slope of the alluvial apron, causing them to fill their valleys and, in places, to mantle the intervening uplands with the gravel and sand they could transport no farther. After both the glacial advances, silt and clay of fluvial and eolian origin were deposited over the sand and gravel, but then part, and in places all, of the Pleistocene sediments were removed by stream erosion. Although the later continental ice sheets did not advance near enough to the area to block drainageways, the regimen of the streams was so changed from time to time that valley filling repeatedly alternated with valley cutting. Wind-deposited silty clay (loess) is an important component of the mass of Pleistocene deposits.

The upland area that the Bureau of Reclamation proposes for irrigation is a topographic feature known locally as Mira Valley (also as Myra Valley). This broad valley appears to have been formed by a stream, possibly the ancestral North Loup River, that flowed southeast and east across Valley County in middle Pleistocene (Illinoian?) time. The valley areas that now are irrigated or are proposed for irrigation are stream-built terraces in a valley that was cut probably in late Pleistocene (Wisconsin) time.

Geologic formations of Tertiary and Quaternary age

The following description of the geologic formations of Tertiary and Quaternary age is based on reports by Condra and Reed (1943), Condra, Reed, and Gordon (1950), and Miller (1951) and on the logs of test holes drilled by the Conservation and Survey Division of the University of Nebraska in cooperation with the U. S. Geological Survey.

Tertiary system

Ogallala formation.--The Ogallala formation of the Pliocene series is the only formation of Tertiary age underlying the area. It consists of interbedded hard and soft layers of sandy gravel, sand, silt, and clay. Some layers are cemented by calcium carbonate, but others are relatively unconsolidated. The formation also contains minor amounts of marl, volcanic ash, and opaline sandstone resembling quartzite. Gradations, both laterally and vertically, from one lithologic type to another within short distances are characteristic of the formation. In general, the grain size of the Ogallala decreases eastward. Some beds in the Ogallala formation are so like some of the Quaternary deposits that it is not always possible to determine, when drilling, the exact depth at which the bit first enters the Ogallala formation. Generally, the first cemented bed encountered is considered to be the top of the Ogallala.

The greatest thickness of the Ogallala formation in the area described in this report is not known. Because the Ogallala was deposited on an uneven surface and was eroded deeply after it was deposited, its thickness varies considerably within short distances. An oil test (No. 1 Valla) drilled by the Shell Oil Co. in the NW¼NW¼NE¼ sec. 6, T. 19 N., R. 16 W., reached Cretaceous bedrock at a depth of 812 feet. If it is correct to assume that the thickness of the Quaternary deposits at this site is no more than 100 feet and that the Ogallala thins eastward, then the greatest thickness of the Ogallala in this area is approximately that at the test well--a little more than 700 feet. Cretaceous bedrock was reached at a depth of 495 feet in an oil test (No. 1 Williams) drilled by Henry Bredthauer in the center of the NW¼SW¼ sec. 29, T. 18 N., R. 13 W. Test holes drilled in Valley County as part of the Federal-State program did not completely penetrate the Tertiary rocks, but several drilled in the North Loup River and Loup River valleys downstream from Valley County did reach Cretaceous bedrock. One in Howard County (16-11-33aa) penetrated about 270 feet of material considered to be the Ogallala. East of Howard County the Ogallala apparently is discontinuous, as several test holes in or near the Loup River valley penetrated no material believed to be of Tertiary age.

Miller (1951) mapped numerous isolated exposures of the Ogallala formation in Valley County. The most conspicuous of these are along the North Loup River valley in the eastern part of the county, both near stream level and in high bluffs on the valley wall. The Ogallala is exposed also in ravines and along the bluffs bordering Mira Valley and in several places along the North Loup River valley in Greeley and Howard Counties. The exposures consist principally of cemented beds, which commonly are referred to as "mortar beds."

Quaternary system

A generalized section of Quaternary deposits recognized in east-central Nebraska west of the till border is given below:

Series	Stage	Formation or deposit
Recent		Alluvium, colluvium, dune sand, and loess
Recent and Pleistocene		Bignell loess
Pleistocene	Wisconsin	Unnamed deposits of sand and gravel, Peorian loess, and Todd Valley sand
	Illinoian	Loveland loess and Crete formation
	Yarmouth	Sappa formation, including Pearlette ash member
	Kansan	Grand Island formation
	Aftonian	Fullerton formation
	Nebraskan	Holdrege formation

Deposits corresponding to most of those listed in the table above have been identified tentatively in the report area. However, more test drilling must be done before the age relationships of all deposits of Quaternary age can be worked out in detail.

Holdrege formation.--When the advancing Nebraskan glacier dammed the eastward-flowing streams in Nebraska, it caused the streams to aggrade their valleys and the adjacent uplands with sand and gravel. This deposit has been named the Holdrege formation. In his mapping of Valley County, Miller (1951) did not identify any exposed sand and gravel as Holdrege, nor has the Nebraska Geological Survey definitely recognized it in test holes drilled in Valley County or elsewhere in the area described in this report. A concealed deposit of sand and gravel directly overlying the Ogallala in parts of Howard and Greeley Counties outside the report area has been identified as the Holdrege (Sniegocki, 1959), so it is not impossible that remnants of the formation are concealed beneath the upland surface of Valley County also.

Fullerton formation.--The Fullerton formation, of Aftonian age, is composed of fine sand, silt, and calcareous clay deposited during the waning phase of the Nebraskan glaciation. It is considered to be of aqueous and eolian origin. After its deposition it was subjected to deep weathering, soil development, and erosion; in places a layer of peat accumulated on its surface. The Fullerton is 20 feet thick in its type exposure 1 mile northwest of the town for which it was named, just outside the report area. As is true of the underlying Holdrege formation, its extent beneath the area is unknown.

Grand Island formation.--The advance of the Kansan ice sheet into Nebraska again resulted in the blocking of eastward-flowing streams and aggradation of their valleys and adjacent uplands. The sandy gravel thus deposited is the Grand Island formation. It is composed predominantly of particles of quartz and orthoclase feldspar; mica, quartzite, and chlorite are minor constituents. The thickness of the Grand Island ranges from less than 1 foot to about 20 feet in the exposures where it could be measured within the report area. On his geologic map of Valley County, Miller (1951) shows many isolated exposures of the Grand Island formation in ravines cut by streams into the sides of Mira Valley.

Sappa formation.--The Sappa formation, of Yarmouth age, is a gray to greenish-gray silty clay which conformably overlies the Grand Island formation in many places. Within the formation is a discontinuous layer known as the Pearlette ash member; it represents accumulations of volcanic ash in lakes and ponds. Like the Fullerton, the Sappa is of aqueous and eolian origin and was subjected to deep weathering, soil formation, and erosion soon after it was deposited. Like the underlying Grand Island formation, it is exposed in several of the ravines cut by streams into the sides of Mira Valley.

Crete(?) formation.--If, as has been suggested previously, Mira Valley was formed by a stream that flowed southeastward across Valley County in middle Pleistocene (Illinoian?) time, the deposit of sand and fine gravel that underlies that valley and rests unconformably on the Ogallala formation probably is the Crete formation, which was originally described by Condra, Reed, and Gordon (1947, p. 22). The presence of this deposit was revealed by the drilling of test holes 18-13-31cb, 18-15-14cb, 18-15-2dd, and 19-14-31bb, in which the thickness of the gravel ranged from 17 to 41 feet.

Loveland loess.--After the Crete(?) formation was deposited, the entire area was blanketed by wind-deposited clayey silt (loess), which in the then-existing valley areas was reworked by running water. It commonly is light pinkish brown to reddish brown, and its original surface, where preserved, is marked by a fossil soil. Although it probably underlies much of the upland part of Valley County, it is exposed only where streams have cut ravines through the overlying Peorian loess. Many such outcrops were mapped by Miller (1951). In parts of the report area the Loveland directly overlies the Ogallala formation, but elsewhere it rests on one or another of the earlier Pleistocene formations. The thickness of the Loveland in the report area probably is nowhere more than about 20 feet.

Todd Valley sand.--The North Loup and Loup Rivers probably have been flowing in their present valleys since early in the Wisconsin stage of glaciation. The depth to which they had cut their valleys before they partly refilled them with the Todd Valley sand (originally described by Lugn, 1934, p. 324, 349-350) is not known because later erosion in these valleys removed all, or nearly all, evidence of early Wisconsin deposition. Possibly detailed geologic studies would reveal the presence of loess-buried remnants of the Todd Valley sand along the valley walls above the general level of the higher terrace in the valleys.

Peorian loess.--Deposition of the Todd Valley sand in the valleys was followed by the deposition of another widespread layer of loess, the Peorian. Throughout the upland area this layer of wind-deposited yellowish-gray silt rests directly on the weathered Loveland loess, but in the valleys of the North Loup and Loup Rivers it was removed when the rivers later cut to a deeper level. The Peorian loess, as mapped by Miller (1951), also includes the Bignell loess (originally described by Schultz and Stout, 1945, p. 241). In the report area the Peorian loess (not including the Bignell) averages about 15 feet in thickness but in some places it is as much as 50 feet thick.

Deposits of middle and late Wisconsin and Recent age.--During the middle part of the Wisconsin stage of glaciation, the North Loup and Loup Rivers deepened their valleys, removing all, or nearly all, the previously deposited Wisconsin valley fill. They then partly refilled their valleys with sand and gravel, and another layer of loess, the Bignell, was deposited. Because the Bignell loess mantles the sand and gravel that underlies the principal terrace in the valleys, it can be readily identified there. In the upland area, however, where its deposition continued into Recent time, it can be distinguished from the underlying Peorian loess only where evidence of pre-Bignell soil development on the Peorian surface has not been completely removed. In late Wisconsin time, the North Loup and Loup Rivers deepened their valleys by cutting into and through the middle Wisconsin sand and gravel. As these deeper valleys were much narrower than the earlier ones, broad remnants of the middle Wisconsin sand and gravel were left intact. The narrower valleys were alluviated in late Wisconsin time, and in Recent time even narrower valleys were cut into the late Wisconsin deposits, remnants of which form the low terrace bordering the present flood plain. The valley fill underlying the flood plain probably is not more than 15 to 20 feet thick. It is not known how much of the valley fill beneath the flood plain is undisturbed late Wisconsin sand and gravel and how much was deposited in Recent time.

GROUND WATER

Below a surface known as the water table, the deposits of Tertiary and Quaternary age are saturated with water. It is water from these deposits that is brought to the surface when wells are pumped, and, in places where the water table is close to the land surface, it is this water that keeps vegetation green during periods of drought. Also, it is the natural discharge of this water into the North Loup and Loup Rivers that largely maintains their flow when there is little or no overland runoff. In the area described in this report, water moves freely through deposits of

Tertiary and of Quaternary age and from one to the other. Therefore, these saturated deposits are considered to form a single hydrologic unit which hereinafter is referred to as the "ground-water reservoir."

Depth to water table

The depth to water in wells, as measured during the field studies, ranged from 1 to 120 feet below the land surface. (See table 4.) It is estimated, however, that the water table is as much as 225 feet beneath some of the higher hills between Mira Valley and the North Loup River valley. In general, as shown by patterns on plate 1, the water table is less than 5 feet below the flood plain of the North Loup and Loup Rivers, and is 5 to 40 feet below the terraces bordering the flood plain. In much of the upland part of Valley County, including parts of Mira Valley, the depth to water exceeds 60 feet, but only in a relatively small part of the upland is the depth to water greater than 150 feet. The principal tributaries to the North Loup River in Valley County have cut their valleys to within 20 feet of the water table throughout much of their length.

Recharge

The water in the ground-water reservoir beneath the report area is derived in part by subsurface inflow from adjacent areas and in part by the infiltration of precipitation and irrigation water. Subsurface inflow occurs along the northwest, west, southwest, and south margins of the upland area in Valley County, the inflowing water entering from a west-southwest direction. (See pl. 1; the ground water is moving at right angles to the water-table contour lines.) Subsurface inflow to the report area occurs also along the northeast margin of the North Loup River valley in Valley County and along both sides of the North Loup River and Loup River valleys downstream from Valley County. Without additional information on the thickness and permeability of the ground-water reservoir along the margins of the area, it is impossible to compute the amount of recharge due to subsurface inflow. Because the areal extent of the area described in this report is small in relation to the length of the boundaries across which inflow occurs, inflow probably is the most significant source of recharge to the ground-water reservoir underlying the report area.

Sniegocki (1959), on the basis of records of stream discharge during periods of insignificant overland runoff, computed the average annual recharge from precipitation in the loess-mantled part of the Loup River drainage basin to be about $1\frac{1}{4}$ inches, or between 5 and 6 percent of the average annual precipitation. The amount of recharge from infiltrating precipitation undoubtedly varies widely from year to year. Generally, it is not directly related to the amount of precipitation because it is governed not only by the amount but also by the intensity and duration of the rainfall and by soil-moisture conditions, season of the year, and other factors. Under favorable conditions melting snow can be a source of considerable recharge. The hydrograph of well 15-9-9aa1, near Cushing, for the period 1949-51 shows a significant period of recharge in each of the 3 years. (See fig. 3.) The largest rise of the water level began in March 1949 and continued through July of that year. The early part of that rise was due to the melting of an unusually heavy snow cover, whereas the later part was due to infiltrating spring rains. If it is assumed that the specific yield of the material that became saturated is about 20 percent, the rise of nearly 2 feet would reflect recharge amounting to about $4\frac{1}{2}$ inches of water, or roughly 250 acre-feet per square mile, or 80 million gallons per square mile. The lesser rises in 1950 and 1951 were due largely to infiltrating spring rains.

In the irrigated parts of the area, seepage from the distribution system of canals and laterals and from water applied to cropland is an added source of recharge. No estimates have been made of recharge in the irrigated areas, but the 8- and 10-foot rises of the water level during the period 1934-56 in wells 19-14-6dc and 18-13-23dd, respectively, which are in irrigated parts of Valley County, suggest that infiltrating irrigation water locally is a source of significant recharge to the ground-water reservoir. (See table 3.)

Movement

In all parts of the report area, water in the ground-water reservoir is percolating slowly (at a rate estimated to average about 3 feet per day) toward either the North Loup River or the Loup River. (See pl. 1.) In the upland part of the area the movement is east-northeastward or eastward, whereas in the valleys of the North Loup and Loup Rivers ground water moves from the valley sides in a downstream direction toward the river. In the valleys, the average angle between the line of ground-water flow and the general course of the river is about 60°.

Discharge

Unless withdrawn through wells, or discharged by evapotranspiration in places where the water table is near the land surface (principally on the flood plain), all ground water percolating toward the rivers eventually enters them and is conveyed out of the area as surface flow. Because the natural flow in the North Loup and Loup Rivers within the report area is affected by diversions for irrigation, by ground-water withdrawals for irrigation, and by return flow from irrigated areas, the records of discharge at gaging stations in the area do not provide an adequate basis for computing the quantity of ground water being discharged as surface flow.

Of the 115 irrigation wells in the area in the spring of 1957 (table 4), about one-third were on the upland in Valley County and the others were in the valleys of the North Loup and Loup Rivers. Most of those on the upland are 300 to 400 feet deep, were drilled 200 feet or more into saturated material, and yield 600 to 1,000 gpm (gallons per minute), whereas most of those in the valleys are less than 200 feet deep, were drilled 60 to 150 feet into the zone of saturation, and yield 250 to 900 gpm. The water yielded by most wells on the upland is derived in large part, and by some is derived wholly, from the Ogallala formation; that yielded by wells in the valleys is derived either wholly from the deposits of Wisconsin age or partly from those deposits and partly from the underlying Ogallala formation. In 1956, about 8,000 acre-feet of water was pumped for irrigation.

Water pumped from wells supplies the residents of all towns in the area except Ord, which obtains water from the North Loup River. The villages of Elyria, Cotesfield, and Cushing do not have publicly owned water systems, each dwelling and business establishment being equipped with a privately owned well. Water for the village of North Loup is obtained from two wells (18-13-25cc1 and -25cc2). Well -25cc1 is south of the water tower and is used as a standby for emergencies; well -25cc2 is a block west of the railroad station. Scotia is supplied with water from 2 wells (17-12-4dc and -9ba) in the city hall, and Elba is supplied from 1 well (15-11-10bc) in the northwest corner of town. The city of Fullerton is supplied from 9 wells (16-6-11db1-9) which are connected by siphons in series of 3, with a pump to each series. Fullerton has 4 other wells not now in use.

In rural areas nearly all the water used for domestic purposes is obtained from wells. Stock ponds are frequented by cattle grazing the rough lands between Mira Valley and the valley of the North Loup River in Valley County, but elsewhere in the area water supplies for livestock are obtained from wells.

Several of the rural domestic and livestock wells were visited in obtaining water-level data needed for the construction of plate 1; pertinent data regarding these wells are included in table 4.

Where the capillary fringe (zone above the water table into which ground water rises by capillarity) is within the reach of plant roots, large quantities of ground water are transpired by plants; and where the capillary fringe extends up to or within a few inches of the land surface, ground water is evaporated also. The amount of ground water discharged by evaporation and transpiration (commonly referred to as evapotranspiration) is governed by such factors as temperature, wind movement, relative humidity, precipitation, and type of vegetation. According to data collected by the Conservation and Survey Division of the University of Nebraska, various types of vegetation common in northern Nebraska consumed 2 to 4 feet of ground water between July 9 and September 20, 1937, where the water table was 3 to 6 feet below the land surface. Thus, in the 14,000 acres of the report area in which the water table is less than 5 feet below the land surface, about 42,000 acre-feet of ground water would be discharged in a year if an average of 3 feet of ground water were transpired by plants growing there. Because the roots of some plants, among them alfalfa, penetrate to a depth of 20 feet or more, ground-water discharge by transpiration can be significant also in areas where the water table is deeper than 5 feet.

Chemical quality

By Lester R. Petri

Chemical analyses of ground water from deposits of Tertiary and Quaternary age are listed in table 1. The analyses indicate that the water is uniform both in type and in amount of mineralization. The water is of the calcium bicarbonate type and has moderate concentrations of dissolved minerals (specific conductance, 236 to 859 micromhos). The most highly mineralized water was from a well (18-13-25cc1) located between a large irrigation canal and the river, and the relatively high mineralization is probably the result of recharge by irrigation water that has been concentrated by evaporation and transpiration.

The ground water is of good quality for irrigation. Because the concentrations of dissolved minerals are moderate, high salinity in the soil is not likely to develop if drainage is adequate. The concentrations of sodium are low; therefore, the structure of the soil is not likely to deteriorate from use of the water for irrigation. Concentrations of boron are so low that even boron-sensitive crops should not be affected adversely by use of the water.

The water is of good quality for domestic use and most industrial uses except that it is hard and highly siliceous. Locally, the water from shallow deposits may contain enough iron to cause discoloration of fabrics, utensils, and fixtures and to impart an unpleasant taste. The nitrate content of a few samples was high enough to suggest that locally the water may not be safe for infant feeding. The temperature of the water ranged from 48° to 58°F.

The ground water is similar in type to the water in the North Loup River but has about twice as much mineral material (table 2). The greater mineral content probably is the result of the long period of contact of the ground water with the minerals in the rocks through which it has moved.

CONCLUSIONS

The observed productiveness of the water-bearing deposits and the present wide scattering of the irrigation wells indicate that small to moderately large supplies of ground water are obtainable in much, if not all, of the area described in this report. Because the average discharge of the wells in Valley County and in the western parts of Greeley and Howard Counties is somewhat greater than that of wells in the remainder of the area, it is believed that the capacity of the ground-water reservoir to yield water to individual wells decreases eastward. East of central Howard County the Ogallala formation apparently is too thin and its permeability is too low for it to yield much water; consequently, the deposits of Quaternary age are the principal source of the water discharged by wells in that part of the area. Because the Ogallala contains a high proportion of very fine grained material, wells tapping it are likely to yield silt and fine sand with the water unless they are properly designed and installed and are carefully developed by surging or other effective methods.

Water-level measurements made to date do not indicate that withdrawals of ground water have caused any significant lowering of the water table. However, if the rate of withdrawal were to be increased considerably, the water levels eventually would decline and pumping lifts would increase correspondingly. The establishment of a gravity irrigation system in the immediate vicinity of the wells would result in an increase in recharge to the ground-water reservoir and thus tend to offset any water-level decline caused by pumping. A close watch on water levels in wells would reveal at an early date if, in places, the water table is rising sufficiently to threaten waterlogging or is declining to the extent that pumping costs are increasing appreciably; remedial measures then could be taken. Because both the ground water and the surface water are highly suitable for use in irrigation, no water-quality problems are expected to occur unless the water table rises in places to a level high enough for the ground water to be raised by capillarity to the root zone or to the land surface.

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Table 1.--Chemical analyses of ground water in the North Loup Division of the lower Platte River basin

[Results in parts per million except as indicated]

Well	Depth (feet)	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Sodium-adsorption-ratio	Specific conductance (micromhos at 25°C)	pH
15-6-2bb	19	6- 2-51	49	46	1.4	33	3.8	6.1	5.0	115	11	2.5	0.2	12	.....	188	98	4	11	0.3	236	7.7
15-8-17dd	14	6- 2-51	48	35	....	66	9.6	16	6.1	249	42	3.0	.3	.9	.....	311	204	0	14	.5	450	7.7
15-9-5cc	150	9-11-56	55	61	.02	100	7.4	9.9	5.2	343	19	4.0	.2	6.8	0.07	380	280	0	7	.3	565	7.4
15-10-16aa	65	12- 1-43	53	.....	....	....	......	7.8		340	6.0	7.0	.....	9.6	.....	....	285	6	6	.2	539	7.9
15-11-9	46	11-30-43	53	.....	....	....	......	16		331	5.0	4.0	.....	1.0	.....	....	249	0	12	.4	511	7.6
15-11-10bc	79	11-30-43	.....	.....	<.02	81	13	16		327	11	4.0	.0	6.4	.04	....	256	0	12	.4	511	7.6
16-7-35ab	97	9-11-56	53	51	.01	98	17	14	7.4	356	24	7.5	.2	33	.08	428	315	23	9	.3	652	7.3
16-11-7cb	38	11-30-43	53	.....	....	....	......	22		390	10	8.0	.....	.0	.....	....	294	0	14	.6	620	7.6
16-11-8ab	185	11-30-43	54	.....	.02	89	11	19		347	9.3	5.0	.0	8.0	.06	....	267	0	13	.5	545	7.6
16-11-18bc	......	9-13-56	55	60	.15	88	8.4	7.7	4.9	317	14	3.0	.2	3.1	.04	341	254	0	6	.2	505	7.6
17-11-31ba	100	8-29-56	53	60	.01	98	12	7.8	7.5	361	13	4.0	.2	5.4	.05	388	292	0	5	.2	583	7.3
17-12-4dd	93	8-29-56	55	62	.08	105	14	14	6.9	384	33	2.5	.2	4.6	.08	435	318	3	9	.3	641	7.3
17-12-9ba	74	11-30-43	52	.....	<.02	102	15	23		390	28	7.0	.0	9.0	.06	....	316	0	14	.6	639	7.5
18-12-19ca	264	8-29-56	56	61	.03	90	9.6	12	6.5	326	25	3.0	.1	3.3	.04	376	264	0	9	.3	547	7.4
18-13-20db	100+	11-30-43	52	.....	....	....	......	20		395	35	5.0	.....	6.6	.....	....	330	6	11	.5	665	7.5
18-13-23dd	83	11- 6-36	.....	.....	....	81	15	25		322	27	5.0	.7	22	.....	....	264	0	16	.7	....	
18-13-25cc1	93	11-29-43	53	.....	<.05	122	22	47		444	77	20	.0	31	.07	....	395	31	21	1.0	859	7.5
18-13-33bc	257	8-28-56	55	63	.08	98	8.1	8.2	6.6	332	26	3.5	.2	2.9	.07	391	278	6	6	.2	562	7.3
18-13-36ad	125+	11-30-43	53	.....	.02	96	14	14		362	23	5.0	.0	.0	.07	....	297	0	9	.4	584	7.6
18-14-31ad	354	8-28-56	58	64	.02	100	13	11	6.5	369	29	4.0	.2	1.8	.06	415	305	2	7	.3	610	7.4
18-15-12bb	120	8-29-56	53	60	.01	93	12	7.9	6.3	329	26	2.5	.2	3.4	.06	377	280	10	6	.2	558	7.5
18-15-15dd	158	11-29-43	53	.....	....	....	......	4.6		318	10	10	.....	8.4	.....	....	282	21	3	.1	553	7.6
19-13-35cc2	85	11-29-43	54	.....	<.02	40	6.3	11		154	5.6	2.8	.0	16	.04	....	126	0	15	.4	277	7.6
19-14-8da	42	11-29-43	52	.....	....	....	......	33		385	12	9	.....	38	.....	....	300	0	19	.8	663	7.6
19-16-13db	305	8-28-56	56	60	.02	100	13	8.6	7.2	329	55	3.0	.1	.6	.09	416	301	31	6	.2	604	7.5
20-15-10da2	100	11-29-43	52	.....	.02	62	9.2	15		261	4.1	1.0	.1	5.6	.04	....	192	0	14	.5	409	7.7

Table 2.--Chemical analyses of water from the North Loup River near St. Paul, Nebr.

[Results in parts per million except as indicated]

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: Residue on evaporation at 180°C	Dissolved solids: Tons per acre-foot	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Sodium-adsorption-ratio	Specific conductance (micromhos at 25°C)	pH
1943																					
Dec. 1	....	......	....	....	......	....	......	126	5.0	2.0	.....	2.5	.....	....	.....	120	17	....	....	211	8.0
1947																					
Mar. 26	934	64	0.08	26	5.9	15		120	19	.0	0.4	2.8	0.11	174	0.24	89	0	27	0.7	237	8.2
May 8	762	49	.11	31	6.3	7.1		131	9.5	.0	.4	.5	.06	175	.24	103	0	13	.3	232	7.4
Aug. 25	329	50	.13	29	6.8	11		135	12	.0	.3	.9	.....	182	.25	100	0	20	.5	239	7.0
1948																					
July 29	2,110	40	.40	43	5.5	5.1		149	16	1.0	.3	.0	.06	208	.28	130	8	8	.2	255	7.5
1949																					
Mar. 5	3,250	35	.07	28	4.6	5.3		109	4.0	3.5	.3	1.0	.06	176	.24	89	0	11	.2	226	7.4
Mar. 6	2,650	33	.10	26	4.6	6.2		107	5.6	1.5	.3	1.1	.06	148	.20	84	0	14	.3	195	7.4
Oct. 6	730	53	.02	28	3.1	10		119	3.0	1.5	.4	1.5	.....	175	.24	83	0	21	.4	205	8.2
1955																					
Nov. 15	a750	64	.02	29	3.8	7.8	5.6	127	5.0	.5	.2	2.3	.03	180	.24	88	0	15	.4	217	7.6
1956																					
Jan. 9	a1,130	60	.04	24	4.1	7.4	5.3	112	4.0	.0	.2	1.4	.03	162	.22	77	0	16	.4	195	7.7
June 19	1,030	45	.02	26	5.1	6.8	8.2	114	10	.0	.2	2.4	.04	170	.23	86	0	13	.3	210	7.9
Aug. 20	476	53	.01	30	3.9	7.3	6.3	133	7.5	.0	.2	.7	.04	173	.24	91	0	14	.3	229	7.2

a Mean daily discharge.

Table 3.--Measurements of the water levels in wells, in feet below land surface

Greeley County

17-11-31ba

Date	Water level	Date	Water level
June 28, 1948	35.40	June 6, 1950	34.32
Sept. 30	35.52	July 13	34.32
Apr. 28, 1949	34.62	Aug. 15	34.15
June 2	34.52	Sept. 11	34.08
June 30	34.46	Oct. 5	34.03
Sept. 2	35.53	Nov. 3	34.03
Nov. 2	35.02	Jan. 5, 1951	33.88
Nov. 29	34.93	Mar. 7	33.89
Jan. 4, 1950	34.79	Apr. 26	33.81
Feb. 27	34.71	Nov. 29	33.49
Mar. 31	34.57	Apr. 17, 1952	33.26
May 2	34.41	Aug. 21, 1956	34.24

17-12-6dc

Date	Water level	Date	Water level
June 29, 1948	12.45	Mar. 31, 1950	13.58
Sept. 30	13.15	May 2	13.63
Apr. 28, 1949	12.41	June 6	13.51
June 2	12.72	Jan. 5, 1951	13.26
June 30	12.47	Dec. 4, 1952	13.07
Aug. 3	13.27	July 14, 1953	12.80
Sept. 2	12.84	Apr. 5, 1954	13.43
Nov. 2	13.29	Aug. 16	12.82
Jan. 4, 1950	13.60	Mar. 2, 1955	13.49
Feb. 27	13.76		

17-12-9bb1

Date	Water level	Date	Water level
Sept. 30, 1948	27.00	Sept. 11, 1950	18.62
Apr. 28, 1949	17.98	Oct. 5	18.56
June 2	22.89	Nov. 3	18.77
June 30	18.23	Jan. 5, 1951	18.60
Nov. 2	19.58	Mar. 7	18.24
Nov. 29	22.22	Apr. 26	17.60
Jan. 4, 1950	19.33	Nov. 29	17.90
Feb. 27	17.56	Dec. 4, 1952	19.65
Mar. 31	18.28	July 14, 1953	18.33
May 2	18.22	Apr. 5, 1954	18.75
June 6	18.36	Mar. 2, 1955	18.52
July 13	16.45		

17-12-26aa

Date	Water level	Date	Water level
June 28, 1948	23.65	Mar. 31, 1950	22.73
Sept. 30	25.99	May 2	22.74
Apr. 28, 1949	23.03	June 6	22.71
June 2	22.89	July 13	24.11
June 30	22.81	Aug. 15	22.52
Sept. 2	24.62	Sept. 11	22.28
Nov. 2	23.07	Oct. 5	22.11
Nov. 29	22.95	Nov. 3	22.02
Jan. 4, 1950	22.81	Jan. 5, 1951	21.99
Mar. 1	22.81	Aug. 22, 1956	23.85

Howard County

15-9-9aa1

Date	Water level	Date	Water level
May 21, 1948	a32.50	Feb. 28, 1951	a31.27
Oct. 1	a32.57	Mar. 30	a31.45
Dec. 31	a32.79	Apr. 30	a31.43
Jan. 31, 1949	a32.83	May 31	a31.37
Feb. 28	a32.89	June 30	a31.12
Mar. 21	a32.59	July 31	a30.99
Apr. 30	a31.91	Aug. 31	a31.02
May 31	a31.64	Sept. 30	a30.97
June 30	a31.25	Oct. 31	a31.12
July 28	a31.14	Nov. 30	a31.15
Aug. 31	a31.07	Dec. 31	a31.20
Sept. 30	a31.02	Jan. 31, 1952	a31.34
Oct. 31	a31.08	Feb. 29	a31.40
Nov. 30	a31.17	Mar. 31	a31.43
Dec. 31	a31.24	Apr. 30	a31.45
Jan. 31, 1950	a31.34	May 31	a31.41
Feb. 28	a31.44	June 30	a31.45
Mar. 31	a31.50	July 31	a31.55
Apr. 30	a31.55	Aug. 31	a31.70
May 31	a31.61	Sept. 23	a31.80
June 30	a31.68	Feb. 2, 1953	32.15
July 31	a31.29	Aug. 5	32.80
Aug. 31	a31.05	Apr. 2, 1954	33.62
Sept. 30	a31.01	Mar. 2, 1955	34.24
Oct. 31	a31.00	May 25	34.38
Nov. 30	a31.12	Apr. 17, 1956	35.27
Dec. 31	a31.18	Aug. 28	32.31
Jan. 31, 1951	a31.34	Mar. 21, 1957	35.48

Howard County--Continued

15-9-12cb

Date	Water level	Date	Water level
May 21, 1948	10.26	Mar. 30, 1950	7.72
Oct. 1	11.06	May 3	9.57
Apr. 26, 1949	8.91	June 5	9.53
June 2	8.51	July 7	9.77
June 30	8.27	Aug. 17	8.52
Aug. 3	9.21	Sept. 8	9.07
Sept. 27	9.71	Oct. 4	9.53
Nov. 7	9.72	Nov. 3	9.73
Dec. 5	9.88	Jan. 5, 1951	9.66
Jan. 10, 1950	10.09	Feb. 2, 1953	9.48
Feb. 9	9.68	Aug. 21, 1956	10.04
Feb. 27	9.47		

15-9-16dd

Date	Water level	Date	Water level
Sept. 14, 1950	14.60	Nov. 29, 1950	14.83
Oct. 2	14.58	Aug. 21, 1956	15.17
Oct. 31	14.93		

15-9-17cc

Date	Water level	Date	Water level
Sept. 14, 1950	3.11	Feb. 21, 1951	4.27
Oct. 2	3.34	Mar. 30	4.55
Oct. 31	3.65	Apr. 26	4.75
Jan. 4, 1951	3.87	May 28	4.55
Jan. 30	4.07	Aug. 21, 1956	4.31

15-9-17dd

Date	Water level	Date	Water level
Sept. 14, 1950	3.27	Oct. 23, 1951	3.66
Oct. 2	3.32	Nov. 23	3.77
Oct. 31	3.85	Dec. 26	3.90
July 26, 1951	2.97	Jan. 25, 1952	3.72
Aug. 24	3.38	Aug. 21, 1956	4.31
Sept. 25	3.60		

15-9-23bb

Date	Water level	Date	Water level
Oct. 2, 1950	4.23	July 26, 1951	3.48
Oct. 31	3.93	Aug. 24	3.49
Nov. 29	3.78	Sept. 25	3.75
Jan. 4, 1951	3.82	Oct. 23	3.51
Jan. 30	4.01	Nov. 23	3.54
Feb. 21	3.75	Dec. 26	3.60
Mar. 30	1.89	Jan. 25, 1952	3.33
Apr. 26	1.50	Aug. 21, 1956	5.13
May 28	1.92		

15-9-24aa1

Date	Water level	Date	Water level
Sept. 14, 1950	6.28	Nov. 29, 1950	7.13
Oct. 2	6.67	Aug. 21, 1956	7.34
Oct. 31	6.90		

15-9-24bb

Date	Water level	Date	Water level
Sept. 14, 1950	3.89	Nov. 29, 1950	4.57
Oct. 2	3.86	Aug. 21, 1956	4.42
Oct. 31	4.33		

15-10-12ca

Date	Water level	Date	Water level
June 28, 1948	65.65	Mar. 29, 1950	65.42
Oct. 1	66.59	May 3	65.15
Apr. 26, 1949	65.28	June 5	65.06
May 31	64.88	July 7	65.08
June 30	64.63	Aug. 17	65.14
Aug. 3	66.98	Sept. 8	65.65
Sept. 27	66.27	Oct. 4	65.34
Nov. 10	65.70	Nov. 3	65.38
Dec. 5	65.51	Jan. 5, 1951	65.22
Jan. 10, 1950	65.63	Sept. 24	66.12
Feb. 9	65.33	Feb. 2, 1953	65.78
Feb. 27	65.20	Sept. 2, 1956	66.28

15-10-19ab

Date	Water level	Date	Water level
Mar. 30, 1948	10.85	May 2, 1950	10.77
June 29	8.48	June 6	10.79
Sept. 30	11.14	Sept. 11	10.36
May 2, 1949	9.96	Oct. 25	10.66
June 30	9.88	Oct. 31	10.69
Sept. 2	11.53	Jan. 8, 1951	10.64
Nov. 9	11.24	Dec. 5, 1952	10.69
Dec. 6	11.24	Apr. 6, 1954	10.67
Jan. 4, 1950	11.25	Feb. 15, 1955	10.66
Feb. 9	11.13	Mar. 21, 1957	10.70

Howard County--Continued

15-10-34cb

Date	Water level	Date	Water level
June 29, 1948	19.60	June 6, 1950	17.94
Oct. 1	19.50	Aug. 17	14.72
Apr. 19, 1949	17.97	Sept. 11	15.46
May 31	17.74	Oct. 4	15.28
June 30	16.86	Oct. 31	15.43
Sept. 27	17.35	Jan. 8, 1951	15.91
Nov. 9	17.31	Mar. 16	16.34
Dec. 6	17.45	May 14	16.38
Jan. 4, 1950	17.61	Sept. 24	15.53
Feb. 9	17.74	Dec. 13	15.95
Mar. 30	17.77	Feb. 12, 1952	16.24
May 2	17.87		

16-11-7cc

Date	Water level	Date	Water level
Mar. 30, 1948	18.59	Mar. 30, 1950	18.50
June 29	18.65	May 2	18.51
Sept. 30	19.59	June 6	18.40
May 2, 1949	18.02	July 13	18.24
May 31	18.08	Aug. 17	18.05
June 30	18.01	Sept. 11	18.44
Sept. 2	19.36	Oct. 5	18.37
Nov. 2	19.24	Nov. 3	18.58
Nov. 29	16.31	Jan. 5, 1951	18.54
Jan. 4, 1950	19.12	Aug. 21, 1956	23.66

16-11-18cd

Date	Water level	Date	Water level
June 21, 1950	26.27	Jan. 5, 1951	26.02
Oct. 6	25.97	Aug. 21, 1956	26.32
Nov. 3	26.05		

16-11-19bb

Date	Water level	Date	Water level
June 22, 1950	40.23	Nov. 3, 1950	40.09
Sept. 11	40.71	Aug. 22, 1956	41.44
Oct. 6	40.09		

16-11-19cb1

Date	Water level	Date	Water level
Aug. 28, 1950	42.39	Apr. 25, 1952	a41.47
Sept. 28	41.74	May 28	a41.46
Oct. 6	41.63	June 26	a42.46
Oct. 25	41.68	July 22	a44.05
Nov. 3	42.22	Aug. 25	a43.90
Nov. 27	41.64	Sept. 16	a42.99
Dec. 31	a42.09	Oct. 31	a42.86
Jan. 31, 1951	a42.03	Nov. 30	a42.45
Feb. 28	a41.91	Dec. 31	a42.28
Mar. 30	a41.95	Jan. 31, 1953	a42.29
Apr. 30	a41.63	Feb. 28	a42.10
May 31	a40.56	Mar. 31	a41.99
June 30	a41.57	Apr. 30	a41.93
July 31	a46.41	May 31	a41.97
Aug. 31	a42.68	June 30	a43.89
Sept. 30	a42.20	July 31	a48.65
Oct. 31	a42.03	Aug. 31	a48.84
Nov. 30	a41.82	Sept. 8	a45.60
Dec. 25	a41.72	Apr. 5, 1954	42.39
Jan. 31, 1952	a41.62	Feb. 28, 1955	43.64
Feb. 26	a41.54	Mar. 21, 1957	46.30
Mar. 26	a41.50		

16-11-19cb2

Date	Water level	Date	Water level
June 22, 1950	33.28	May 5, 1952	32.36
Oct. 6	33.12	Aug. 22, 1956	33.19

16-11-32ab

Date	Water level	Date	Water level
Mar. 30, 1948	18.45	May 2, 1950	17.56
June 29	18.45	June 6	17.43
Sept. 30	17.58	July 13	17.13
May 2, 1949	17.12	Aug. 17	16.48
May 31	17.09	Sept. 11	16.51
June 30	16.75	Oct. 6	16.53
Aug. 3	18.56	Nov. 3	16.78
Sept. 2	17.74	Jan. 5, 1951	17.01
Nov. 2	17.56	Mar. 7	17.16
Nov. 29	17.63	May 14	17.00
Jan. 4, 1950	17.70	Feb. 15, 1952	16.87
Mar. 1	17.79	Apr. 10	16.56
Mar. 31	17.28	Aug. 21, 1956	23.74

Merrick County

15-6-12dd

Date	Water level	Date	Water level
Oct. 27, 1949	9.42	Oct. 6, 1955	13.50
Oct. 16, 1950	8.84	Nov. 6, 1956	14.43
June 13, 1955	12.49		

15-7-14bb

Date	Water level	Date	Water level
July 13, 1950	5.35	Oct. 3, 1950	5.34
Aug. 8	4.08	Oct. 30	5.59
Sept. 5	4.85	Nov. 27	5.84

15-7-14cc

Date	Water level	Date	Water level
Aug. 8, 1950	2.09	Jan. 30, 1951	3.55
Sept. 5	3.68	Feb. 21	3.53
Oct. 3	3.85	Mar. 30	1.44
Oct. 30	4.05	Apr. 26	1.41
Nov. 27	3.69	May 28	2.32
Jan. 4, 1951	3.51	June 15, 1955	4.60

15-7-19bb

Date	Water level	Date	Water level
Aug. 4, 1950	5.22	Oct. 31, 1950	9.10
Sept. 5	8.13	Nov. 29	9.63
Oct. 3	8.69		

15-8-17dd

Date	Water level	Date	Water level
Aug. 4, 1950	2.19	Apr. 26, 1951	2.15
Aug. 29	3.08	May 28	2.56
Oct. 2	2.84	July 26	3.51
Oct. 31	3.30	Aug. 24	3.36
Nov. 27	2.94	Sept. 25	3.26
Jan. 4, 1951	2.84	Oct. 23	3.02
Jan. 30	3.58	Nov. 23	2.87
Feb. 21	2.87	Dec. 26	2.56
Mar. 30	1.98	Jan. 25, 1952	2.67

15-8-18dd

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

15-8-22ad

Date	Water level	Date	Water level
Aug. 4, 1950	7.34	Oct. 3, 1950	8.83
Aug. 29	8.01	Nov. 29	9.48

15-8-22cc

Date	Water level	Date	Water level
Aug. 4, 1950	3.55	Oct. 30, 1950	6.07
Aug. 29	4.53	Nov. 29	6.06
Oct. 3	5.75		

15-8-22dd

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

15-8-25aa

Date	Water level	Date	Water level
Aug. 4, 1950	4.27	Oct. 31, 1950	6.48
Sept. 5	5.63	Nov. 27	6.52
Oct. 3	5.94	June 15, 1955	8.17

15-8-27dd

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

15-8-28bb

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

a Lowest stage for day; taken from recorder chart.

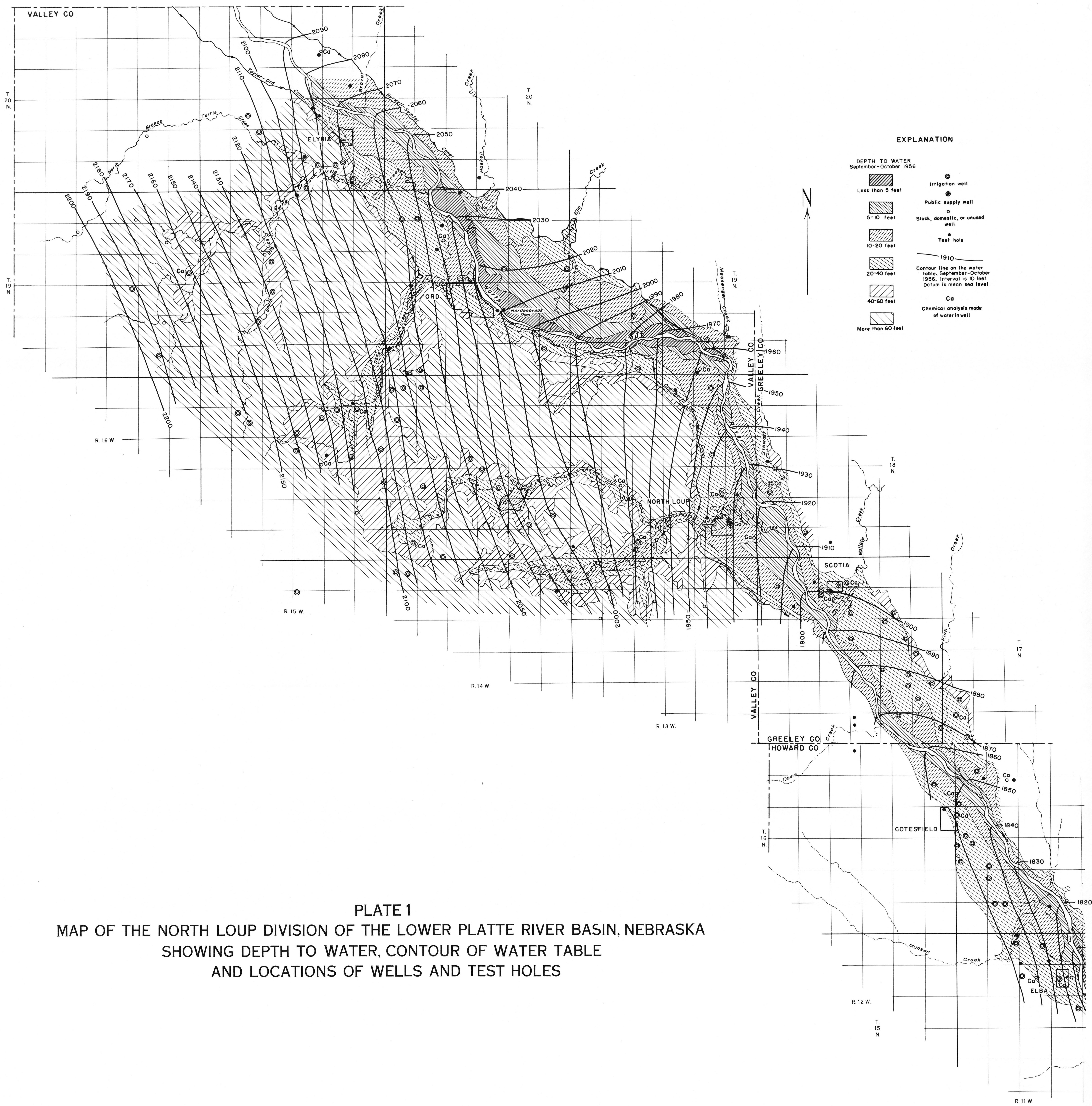

PLATE 1
MAP OF THE NORTH LOUP DIVISION OF THE LOWER PLATTE RIVER BASIN, NEBRASKA
SHOWING DEPTH TO WATER, CONTOUR OF WATER TABLE
AND LOCATIONS OF WELLS AND TEST HOLES

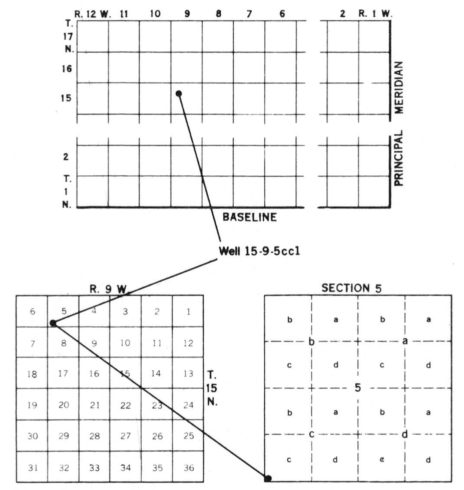

Figure 2. — Sketch illustrating system for numbering wells and test holes

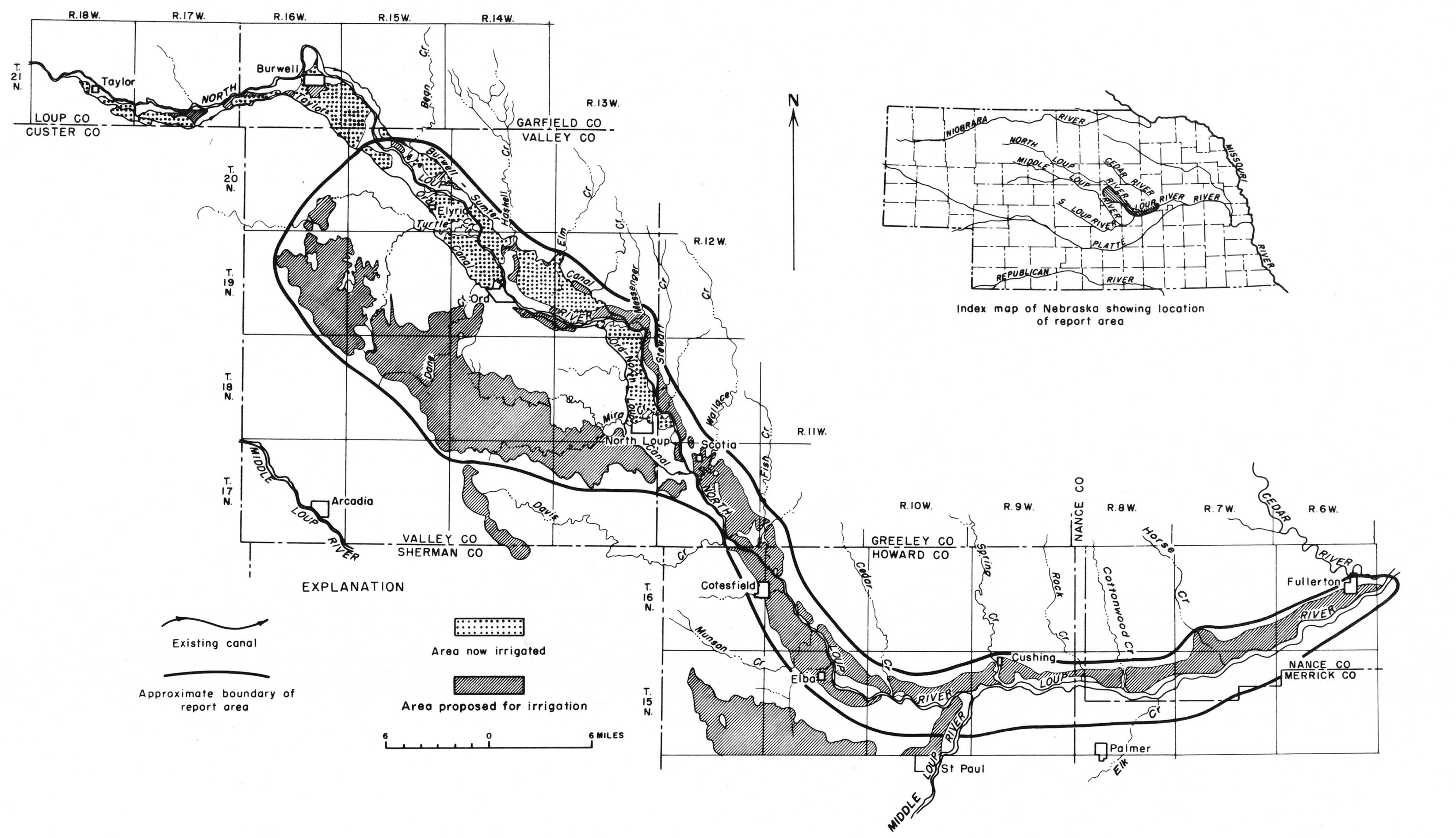

Figure 1. — Map of the North Loup Division of the lower Platte River basin, Nebraska, showing areas now irrigated and areas proposed for irrigation

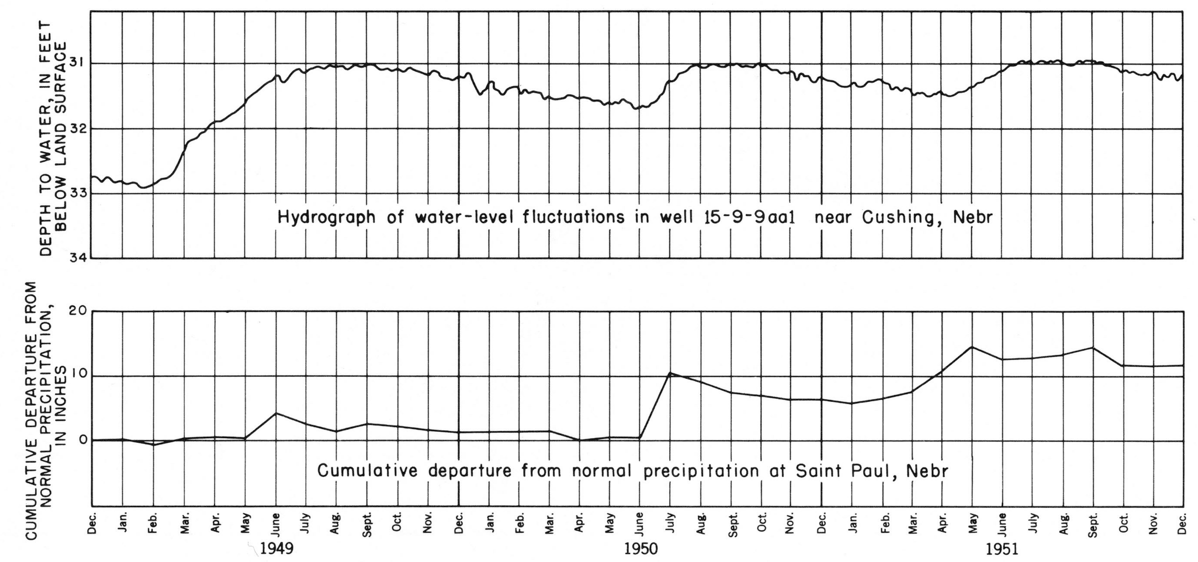

Figure 3. — Hydrograph of well 15-9-9aa1 and cumulative departure from normal monthly precipitation, 1949-51

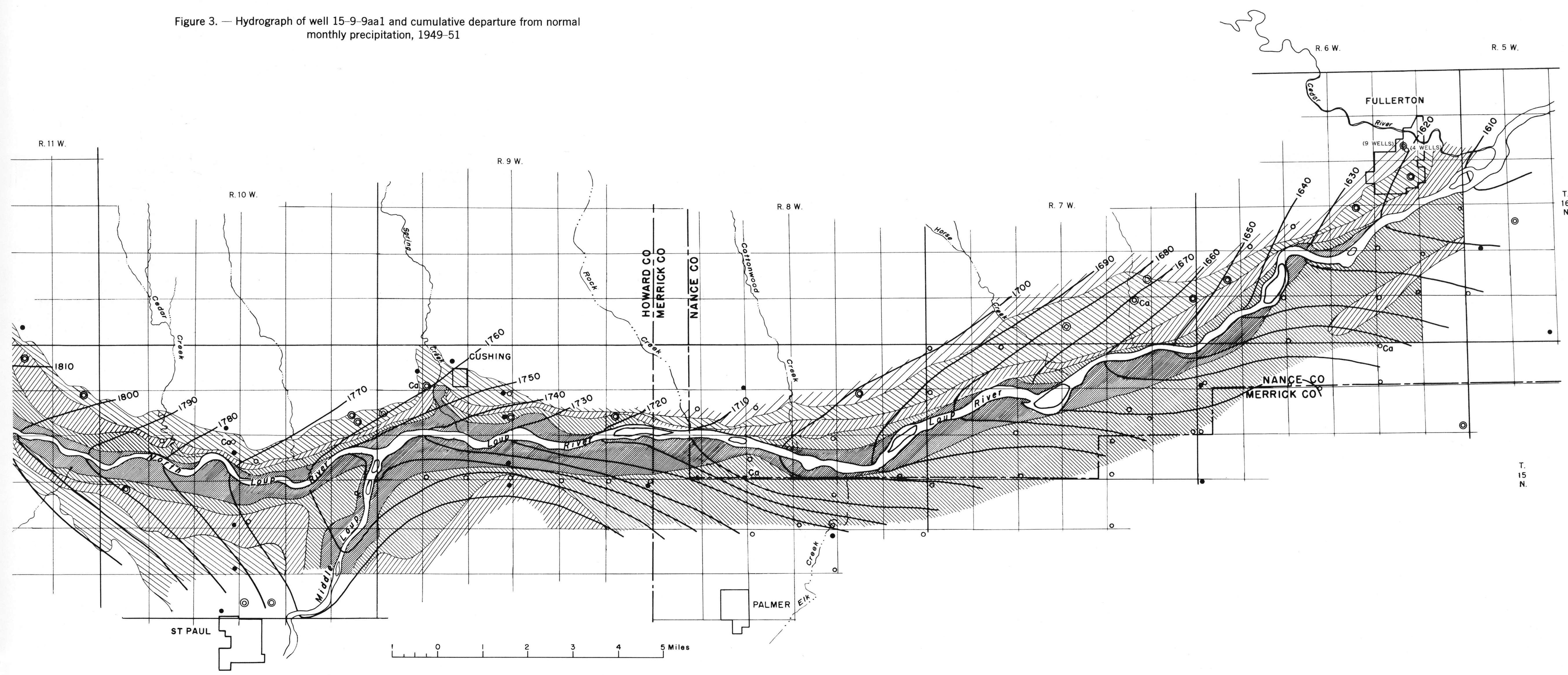

Table 3.--Measurements of the water levels in wells--Continued

Nance County

15-6-2bb

Date	Water level	Date	Water level
Sept. 22, 1949	4.28	Oct. 30, 1950	3.08
Nov. 4	4.08	Nov. 27	2.83
Nov. 30	4.05	Nov. 28	2.80
Jan. 5, 1950	4.26	Dec. 27	2.91
Feb. 6	4.14	Jan. 29, 1951	3.39
Mar. 3	2.48	Feb. 21	2.75
Mar. 28	1.07	Apr. 26	1.08
Apr. 28	2.35	May 28	1.65
May 24	2.18	July 26	2.50
June 23	3.21	Aug. 24	2.14
June 27	3.35	Sept. 25	2.29
July 28	1.78	Oct. 23	2.09
Aug. 28	2.25	Nov. 23	2.09
Sept. 5	3.01	Dec. 26	2.04
Oct. 4	1.96	Jan. 24, 1952	1.94
Oct. 25	2.99		

15-6-2cc

Date	Water level	Date	Water level
July 31, 1950	7.71	Oct. 30, 1950	7.33
Sept. 5	7.43	Nov. 27	7.51
Oct. 4	7.38		

15-6-4cc

Date	Water level	Date	Water level
Aug. 8, 1950	27.01	Oct. 30, 1950	26.63
Sept. 5	26.88	Nov. 27	26.57
Oct. 4	26.81		

15-6-7cc

Date	Water level	Date	Water level
Aug. 8, 1950	12.24	Oct. 30, 1950	12.25
Sept. 5	12.27	Nov. 27	12.23
Oct. 3	12.27		

15-7-6bb

Date	Water level	Date	Water level
Sept. 30, 1948	66.00	July 24, 1950	65.49
Apr. 26, 1949	64.33	Aug. 29	65.52
June 1	65.72	Oct. 2	65.48
July 1	65.78	Oct. 30	65.42
Aug. 8	65.61	Nov. 28	65.36
Sept. 21	65.54	Jan. 4, 1951	65.30
Nov. 7	65.51	Jan. 30	65.36
Dec. 2	65.49	Feb. 21	65.33
Jan. 10, 1950	65.50	Mar. 30	65.32
Feb. 9	65.47	Apr. 26	65.34
Mar. 3	65.44	May 28	65.35
Mar. 28	63.88	Aug. 12, 1952	65.16
Apr. 28	65.59	Nov. 21, 1955	65.99
May 24	65.53	Apr. 17, 1956	66.15
June 27	65.73	Sept. 6	66.28

15-7-8dd

Date	Water level	Date	Water level
Aug. 4, 1950	6.51	Aug. 24, 1951	7.95
Sept. 5	7.42	Sept. 25	8.24
Oct. 3	7.89	Oct. 23	8.47
Oct. 30	8.12	Nov. 23	8.72
Nov. 27	8.46	Dec. 26	9.02
Jan. 4, 1951	8.32	Jan. 25, 1952	9.09
July 26	7.70	Sept. 6, 1956	8.47

15-7-16cc

Date	Water level	Date	Water level
Aug. 4, 1950	2.41	Oct. 30, 1950	4.82
Aug. 9	1.50	Nov. 27	4.96
Sept. 5	4.10	Sept. 6, 1956	6.78
Oct. 3	4.16		

15-8-16cb

Date	Water level	Date	Water level
Aug. 4, 1950	3.59	Oct. 30, 1950	4.79
Aug. 29	4.37	Nov. 27	4.78
Oct. 2	4.76	Sept. 6, 1956	6.38

16-5-20bc

Date	Water level	Date	Water level
Sept. 21, 1949	7.05	May 24, 1950	7.33
Nov. 4	7.64	June 23	7.64
Dec. 2	8.82	July 25	3.61
Jan. 9, 1950	7.98	Aug. 25	5.84
Feb. 8	8.22	Oct. 5	6.41
Mar. 3	7.98	Nov. 1	6.92
Mar. 29	7.58	Nov. 28	7.22
Apr. 28	7.80		

16-5-30cc

Date	Water level	Date	Water level
July 31, 1950	1.32	Nov. 1, 1950	4.05
Aug. 29	2.92	Nov. 30	4.00
Oct. 5	3.21		

16-6-14ac

Date	Water level	Date	Water level
Oct. 10, 1947	27.35	June 22, 1950	26.85
Apr. 23, 1948	26.47	July 25	25.96
Sept. 29	26.60	Aug. 22	25.68
Apr. 26, 1949	25.68	Oct. 2	25.66
June 1	25.64	Nov. 1	25.76
July 1	25.24	Nov. 29	25.72
Aug. 8	25.99	Jan. 4, 1951	26.05
Sept. 21	26.02	Jan. 30	26.26
Nov. 7	25.93	Feb. 21	26.52
Dec. 5	26.14	Mar. 30	26.27
Jan. 10, 1950	26.58	Apr. 26	25.92
Feb. 9	26.78	May 28	25.97
Mar. 3	26.56	Nov. 5	26.11
Mar. 29	26.63	Sept. 3, 1956	26.21
May 23	26.67		

Nance County--Continued

16-6-22ab

Date	Water level	Date	Water level
Nov. 7, 1949	30.29	Oct. 2, 1950	30.72
Dec. 5	30.32	Oct. 30	30.59
Jan. 10, 1950	30.45	Nov. 28	30.71
Feb. 9	30.49	Jan. 4, 1951	30.87
Mar. 3	30.43	Jan. 30	30.86
Mar. 30	30.23	Feb. 21	30.84
Apr. 28	30.89	Mar. 30	30.60
May 23	30.76	Apr. 26	30.46
June 26	30.81	May 28	30.27
Aug. 18	31.05	Nov. 5	28.89
Aug. 29	33.11	Sept. 6, 1956	36.65

16-6-23cc

Date	Water level	Date	Water level
July 31, 1950	3.26	Oct. 30, 1950	4.72
Sept. 5	4.08	Nov. 27	4.90
Oct. 4	4.30	Sept. 6, 1956	6.44

16-6-24aa

Date	Water level	Date	Water level
June 5, 1950	1.13	Oct. 4, 1950	1.54
June 26	2.24	Nov. 1	2.12
July 31	.53	Nov. 30	1.88
Aug. 29	1.48		

16-6-32aa

Date	Water level	Date	Water level
Aug. 8, 1950	3.94	Oct. 30, 1950	5.13
Sept. 5	4.71	Nov. 27	5.34
Oct. 4	4.53	Sept. 6, 1956	6.76

16-6-33cc

Date	Water level	Date	Water level
Aug. 8, 1950	1.46	Oct. 30, 1950	3.68
Sept. 5	3.03	Nov. 27	3.77
Oct. 4	2.27	Sept. 6, 1956	7.10

16-6-35bb

Date	Water level	Date	Water level
July 31, 1950	4.94	Oct. 30, 1950	6.69
Sept. 5	6.28	Nov. 27	6.77
Oct. 4	5.89	Sept. 6, 1956	10.40

16-7-34cb

Date	Water level	Date	Water level
Sept. 30, 1948	29.02	July 24, 1950	27.25
Apr. 26, 1949	27.32	Aug. 29	26.74
June 1	27.12	Oct. 2	26.80
July 1	27.09	Oct. 30	26.60
Sept. 21	28.93	Nov. 28	26.71
Nov. 7	27.85	Jan. 4, 1951	26.79
Dec. 5	27.55	Jan. 30	26.76
Jan. 10, 1950	26.58	Feb. 21	26.76
Feb. 9	27.32	Mar. 30	26.75
Mar. 3	27.28	Apr. 26	26.81
Mar. 30	29.08	May 28	26.80
Apr. 28	29.08	Nov. 5	25.29
May 24	27.90	Sept. 6, 1956	33.39
June 23	27.63		

16-7-36aa

Date	Water level	Date	Water level
Sept. 30, 1948	22.52	June 26, 1950	21.62
Apr. 26, 1949	21.26	July 24	21.27
June 1	21.09	Aug. 29	21.30
July 1	20.98	Oct. 2	21.63
Aug. 8	21.42	Oct. 30	21.43
Sept. 21	21.68	Nov. 28	21.67
Nov. 7	21.83	Jan. 4, 1951	21.74
Dec. 5	21.87	Jan. 30	21.73
Jan. 10, 1950	21.92	Feb. 21	21.72
Feb. 9	21.96	Mar. 30	21.36
Mar. 3	21.88	Apr. 26	21.21
Mar. 30	21.70	May 28	21.19
Apr. 28	21.59	Nov. 5	19.99
May 24	21.51	Sept. 6, 1956	21.81

Valley County

18-13-2ac

Date	Water level	Date	Water level
June 30, 1948	10.26	May 2, 1950	11.34
Sept. 30	9.60	June 6	11.55
Apr. 29, 1949	10.33	July 13	11.03
June 2	10.17	Aug. 15	10.36
June 30	10.27	Sept. 11	10.51
Sept. 2	11.24	Oct. 5	10.43
Nov. 2	10.15	Nov. 1	10.50
Nov. 29	10.28	Jan. 5, 1951	11.06
Jan. 4, 1950	10.53	Sept. 19	11.07
Feb. 28	10.96	Aug. 21, 1956	16.57
Mar. 31	11.07		

18-13-23dd

Date	Water level	Date	Water level
Aug. 10, 1934	23.08	Oct. 17, 1941	18.39
Nov. 6	22.55	Nov. 11, 1942	12.41
Dec. 29	22.57	June 30, 1948	10.70
Feb. 21, 1935	22.60	Sept. 30	10.46
Apr. 16	22.60	Apr. 29, 1949	10.88
June 11	22.51	June 2	11.39
July 10	22.35	June 30	11.06
Sept. 11	22.74	Aug. 3	8.70
Oct. 16	22.56	Sept. 2	9.77
Nov. 20	22.40	Nov. 2	11.51
Dec. 22	22.41	Nov. 29	11.89
Jan. 12, 1936	22.41	Jan. 4, 1950	12.27
Mar. 24	22.48	Mar. 31	12.76
May 29	22.50	Aug. 15	11.16
Sept. 15	23.06	Sept. 11	11.16
Nov. 6	22.87	Oct. 5	11.72
Mar. 29, 1937	22.96	Nov. 1	12.17
June 12	23.03	Jan. 5, 1951	12.75
Oct. 12	23.37	Sept. 19	12.05
July 12, 1938	23.24	Dec. 4, 1952	10.90
Oct. 20	22.94	Apr. 5, 1954	12.51
June 2, 1939	22.38	Aug. 13	10.02
Nov. 27	18.83	Mar. 2, 1955	11.52
July 17, 1940	17.75	Aug. 21, 1956	13.18

Valley County--Continued

18-13-33bc

Date	Water level	Date	Water level
July 13, 1950	37.28	Jan. 5, 1951	37.25
Sept. 11	37.50	Sept. 19	36.17
Oct. 5	36.70	June 10, 1957	39.83
Nov. 1	36.95		

18-13-33cc

Date	Water level	Date	Water level
Nov. 14, 1955	16.11	July 11, 1956	15.66
May 18, 1956	15.31	Aug. 10	16.25
June 14	15.78	June 10, 1957	14.97

18-14-27aa

Date	Water level	Date	Water level
Aug. 17, 1955	10.59	July 11, 1956	7.36
Nov. 14	9.77	Aug. 9	10.73
May 10, 1956	10.64	June 10, 1957	7.09
June 14	11.20		

18-15-11ba

Date	Water level	Date	Water level
June 15, 1950	32.40	July 9, 1952	32.31
Oct. 26	31.59	Aug. 9, 1956	38.02
Sept. 19, 1951	31.35		

18-15-12bb

Date	Water level	Date	Water level
July 1, 1948	30.84	Aug. 15, 1950	29.19
Oct. 1	32.00	Oct. 26	29.42
Apr. 29, 1949	28.26	Sept. 19, 1951	30.75
June 2	28.56	Aug. 9, 1956	30.84
Feb. 28, 1950	30.12	May 24, 1957	33.75
June 6	29.22		

19-13-28bb

Date	Water level	Date	Water level
June 30, 1948	13.45	July 13, 1950	13.61
Sept. 30	14.58	Aug. 15	13.18
Apr. 29, 1949	12.29	Sept. 11	13.54
June 2	12.55	Sept. 28	13.65
June 30	12.71	Nov. 1	13.81
Sept. 30	13.62	Jan. 5, 1951	14.06
Nov. 2	13.53	Sept. 18	13.26
Nov. 29	13.89	Dec. 4, 1952	13.98
Jan. 4, 1950	13.99	July 14, 1953	13.86
Feb. 28	14.09	Mar. 23, 1954	14.21
Mar. 31	13.92	Aug. 13	14.79
May 2	13.93	Feb. 9, 1955	14.44
June 6	14.00	Aug. 20, 1956	14.03

19-13-33cc

Date	Water level	Date	Water level
June 28, 1948	34.20	Jan. 5, 1951	32.93
Sept. 30	33.35	Mar. 7	33.30
Jan. 4, 1950	33.30	Apr. 26	33.64
Feb. 28	33.61	July 10	33.60
Mar. 31	33.77	Sept. 19	33.02
May 2	33.83	Nov. 29	33.11
June 6	34.01	Feb. 15, 1952	33.52
July 13	33.62	Apr. 17	33.79
Aug. 15	33.26	July 22	35.76
Sept. 11	33.05	July 14, 1953	33.76
Oct. 5	32.83	Aug. 17, 1956	33.15
Nov. 1	32.75		

19-14-5cc

Date	Water level	Date	Water level
July 13, 1950	22.09	Jan. 5, 1951	22.41
Aug. 15	21.87	Sept. 18	22.11
Sept. 11	21.86	Aug. 9, 1956	21.85
Sept. 28	21.86	Apr. 9, 1957	23.07
Nov. 1	22.04		

19-14-6dc

Date	Water level	Date	Water level
Aug. 10, 1934	37.90	Nov. 11, 1942	30.78
Nov. 6	36.00	Mar. 27, 1948	29.23
Dec. 29	35.86	June 30	28.77
Feb. 20, 1935	35.77	Sept. 30	27.82
Apr. 15	35.71	Apr. 29, 1949	29.29
June 11	35.65	June 2	29.55
July 10	35.59	June 30	29.37
Aug. 9	36.06	Aug. 3	28.62
Sept. 11	35.77	Sept. 20	27.21
Oct. 16	35.62	Nov. 2	27.38
Nov. 20	35.56	Nov. 29	27.93
Dec. 22	35.57	Mar. 31, 1950	29.38
Jan. 12, 1936	35.55	May 2	29.72
Mar. 24	35.57	June 6	29.91
May 29	35.54	Aug. 15	29.31
July 15	35.80	Aug. 24	29.37
Sept. 15	36.35	Sept. 28	29.11
Nov. 6	36.12	Oct. 25	28.77
Mar. 29, 1937	35.96	Nov. 1	28.83
June 12	36.00	Nov. 27	28.93
Oct. 12	36.30	Dec. 29	29.29
July 12, 1938	36.29	Feb. 2, 1951	29.51
Oct. 20	36.42	Feb. 27	29.78
June 2, 1939	36.09	Apr. 26	29.44
Nov. 27	34.72	Mar. 23, 1954	27.75
Mar. 26, 1940	34.36	Mar. 2, 1955	28.68
July 17	33.06	Aug. 29, 1956	29.69
Oct. 29	32.94	Apr. 9, 1957	30.28
Oct. 16, 1941	32.99		

19-14-13da

Date	Water level	Date	Water level
June 30, 1948	21.50	July 13, 1950	21.89
Sept. 30	20.33	Aug. 15	22.32
Apr. 29, 1949	22.39	Sept. 11	21.95
June 2	21.88	Sept. 28	22.48
June 30	21.92	Nov. 1	22.86
Aug. 3	20.71	Jan. 5, 1951	23.35
Sept. 20	21.60	Mar. 7	23.72
Nov. 2	22.43	Apr. 26	23.93
Nov. 29	22.74	Sept. 18	21.65
Jan. 4, 1950	22.94	Nov. 29	22.40
Feb. 28	23.32	Feb. 15, 1952	23.02
Mar. 31	23.28	Apr. 17	23.24
May 2	23.44	July 14, 1953	21.26
June 6	23.51	Aug. 16, 1956	23.22

Valley County--Continued

19-14-15da

Date	Water level	Date	Water level
June 30, 1948	4.43	Mar. 31, 1950	5.25
Sept. 30	6.37	May 2	5.63
Apr. 29, 1949	4.96	June 6	5.71
June 2	5.57	July 13	4.75
June 30	5.43	Aug. 15	5.07
Sept. 26	6.04	Sept. 11	6.08
Nov. 2	6.41	Sept. 28	6.11
Nov. 29	6.42	Nov. 1	6.34
Jan. 4, 1950	6.54	Sept. 18, 1951	4.94
Feb. 28	5.99	Aug. 16, 1956	6.73

19-14-36bb

Date	Water level	Date	Water level
June 30, 1948	29.40	Nov. 29, 1949	29.93
Sept. 30	29.72	Jan. 4, 1950	29.73
Apr. 29, 1949	29.24	May 2	29.52
June 2	29.44	June 6	29.43
June 30	28.51	Oct. 5	29.36
Aug. 3	29.69	Nov. 1	29.61
Sept. 20	29.88	Sept. 18, 1951	29.77
Nov. 2	30.90	Aug. 21, 1956	34.22

19-15-25dd

Date	Water level	Date	Water level
June 14, 1955	16.99	Aug. 9, 1956	18.16
July 11, 1956	16.33	Apr. 9, 1957	17.95

20-15-29aa

Date	Water level	Date	Water level
July 13, 1950	66.53	Mar. 7, 1951	66.14
Aug. 15	66.24	Sept. 18	66.05
Sept. 11	66.38	Apr. 17, 1952	65.93
Sept. 28	66.33	Aug. 18, 1956	68.93
Nov. 1	66.28	Apr. 9, 1957	66.89
Jan. 5, 1951	65.98		

20-15-34aa

Date	Water level	Date	Water level
June 30, 1948	57.16	May 2, 1950	57.05
Sept. 30	57.00	June 6	57.01
Apr. 29, 1949	56.73	July 13	56.84
June 2	56.99	Aug. 15	56.41
June 30	56.85	Sept. 11	56.66
Sept. 2	57.37	Sept. 28	56.50
Nov. 2	58.00	Nov. 1	56.46
Nov. 29	58.00	Jan. 5, 1951	56.45
Jan. 4, 1950	55.15	Sept. 18	56.41
Feb. 28	57.29	Aug. 10, 1956	61.13
Mar. 31	57.24	Apr. 9, 1957	58.04

20-15-35ba

Date	Water level	Date	Water level
June 15, 1950	57.76	Nov. 29, 1951	61.74
Sept. 28	56.94	Feb. 15, 1952	62.21
Jan. 5, 1951	61.88	Apr. 17	62.75
Mar. 7	62.08	July 14, 1953	60.91
Apr. 26	62.33	Aug. 9, 1956	63.30
Sept. 18	61.12	Apr. 9, 1957	58.97

Table 4.--Records of wells and test holes

Well number: See text for explanation of well-numbering system.
Type of casing: C, concrete; N, none; P, iron or steel pipe; W, wood.
Type of pump: C, centrifugal; Cy, cylinder; N, none; T, turbine.
Type of power: D, diesel; E, electric; G, gasoline or tractor fuel; H, hand; N, none; P, propane; W, wind.
Measuring point: Ls, land surface; Tb, hole in base of turbine; Tc, top of casing.

Depth to water: Reported depths are given in whole numbers; all others are measured depths.
Use of water: D, domestic; I, irrigation; N, none; PS, public supply; S, stock.
Remarks: Ca, sample collected for chemical analysis; L, log obtainable from Conservation and Survey Division, University of Nebraska; O, observation of water-level fluctuations.

Well	Owner or user	Year drilled	Depth of well (feet)	Diameter of casing (inches)	Type of casing	Type of pump	Type of power	Measuring point			Static water level		Draw-down (feet)	Yield (gpm)	Use of water	Re-marks
								Description	Distance above or below (-) land surface (feet)	Altitude above mean sea level (feet)	Depth below measuring point (feet)	Date of measurement				
								Greeley County								
17-11-30db.....	Joe Pearson Est......	1948	108	18	P	T	G	Tb	1.0	1,920	42.66	8-21-56	66	250	I	
31ba.....	Phil Yuma...........	1947	100	18	P	T	E	Tb	.0	1,907	34.24	8-21-56	......	.....	I	Ca,O
31dd.....	F. M. Van Sike.......	1947	96	18	P	T	G	Tb	1.0	1,900	28.41	8-21-56	63	900	I	
12- 4dc.....	Village of Scotia....	1923	45	22	C	C	E	Ls	.0	....	23	11-30-43	17	125	PS	
4dd.....	Alfred W. Peterson...	1946	93	18	C	T	E	Tb	.0	1,932	30	8- 8-56	30	450	I	Ca
5dd.....	Univ. Nebraska and U. S. Geol. Survey.	1943	120	4	N	N	N	Ls	.0	1,909	6.7	10-31-43	......	.....	N	L
6dc.....	Wilber Fuss..........	1947	92	18	P	T	P	Tb	1.0	1,925	14.63	5- 2-50	......	1,200	I	O
8cb.....	Univ. Nebraska and U. S. Geol. Survey.	1943	100	4	N	N	N	Ls	.0	1,920	14.2	11- 8-43	......	.....	N	L
9ba.....	Village of Scotia....	1932	74	18	P	T	E	Ls	.0	1,925	23	6- 4-52	11	300	PS	Ca
9bb1....	E. E. Williams.......	1941	33	18	P	T	G	Tc	1.5	1,920	19.72	5- 2-50	......	200	I	O
9bb2....	Charles Vorhees......	....	82	....	....	T	E	Ls	.0	1,920	18	8-21-56	82	450	I	
10cc.....	Mrs. Elsie Sautter...	1955	119	18	....	T	E	Ls	.0	1,919	25	8- 8-56	......	450	I	
11cd.....	Dinsdale brothers....	1953	160	18	C	T	E	Tb	.0	1,960	59.03	8-22-56	141	700	I	
14bb.....	Mark Wagner..........	1954	162	18	C	T	E	Ls	.0	1,925	27	8- 8-56	43	400	I	
14da.....	A. Fred Lehn.........	1954	218	18	C	T	E	Ls	.0	1,940	39	8- 8-56	100	800	I	
15cb.....	C. F. White..........	1955	109	18	....	T	P	Ls	.0	1,909	21	8- 8-56	58	800	I	
23cb.....	L. V. Kokes..........	1951	185	18	P	T	P	Tb	.5	1,908	29.15	8-22-56	54	850	I	
23dd.....	Ben Sautter..........	1954	191	18	P	T	E	Ls	.0	1,912	35	8- 8-56	22	307	I	
24bb.....	C. W. Vorhees........	1954	161	18	....	T	E	Tb	1.0	1,948	60.23	8-24-56	61	750	I	
25ab.....	Roy Fillinger........	1950	190	18	P	T	E	Tb	.5	1,919	40.74	8-23-56	110	850	I	
25cb.....	Harry Ita............	1946	80	18	P	T	E	Ls	.0	1,893	20	8- 8-56	39	721	I	
26aa.....	Laverne Jess.........	1947	130	18	P	T	P	Tb	.5	1,902	24.35	8-22-56	......	.....	I	O
34bb.....	Univ. Nebraska and U. S. Geol. Survey.	1944	109	4	N	N	N	Ls	.0	2,023	Dry	8- 3-44	......	.....	N	L
34bc.....	.....do..............	1944	89	4	N	N	N	Ls	.0	1,900	24.1	8- 2-44	......	.....	N	L
35ab.....	Joy Jacobson.........	....	150	18	....	T	G	Ls	.0	1,890	21	8- 8-56	64	900	I	
36da.....	Kenneth R. Krebs.....	....	50	18	....	T	E	Ls	.0	1,892	23	8- 8-56	......	150	I	
18-12-18cd.....	Univ. Nebraska and U. S. Geol. Survey.	1943	130	4	N	N	N	Ls	.0	1,974	......	....	......	.....	N	L
19ab.....	W. H. Schudel........	1955	262	18	....	T	P	Tb	.5	1,978	47.54	8-24-56	70	1,000	I	
19ad.....	Carroll Thomas.......	1955	182	18	....	T	P	Tb	.5	1,965	35.81	8-24-56	65	950	I	
19ca.....	Alvena Kriewald......	1955	264	18	....	T	P	Tb	.5	1,952	27.02	8-24-56	46	1,100	I	Ca
19cd.....	Vernon Thomas........	1955	252	18	....	T	G	Tc	.5	1,940	16.57	8-24-56	39	1,000	I	
32ab.....	Clarence Thaler......	1949	182	18	....	T	G	Ls	.0	1,960	55	8- 8-56	75	650	I	
33ca.....	Univ. Nebraska and U. S. Geol. Survey.	1943	270	4	N	N	N	Ls	.0	1,960	......	....	......	.....	N	L
								Howard County								
15- 9- 5ac.....	Univ. Nebraska and U. S. Geol. Survey.	1944	109	4	N	N	N	Ls	0.0	1,805	42.7	8-28-44	......	.....	N	L
5cc.....	C. M. Anderson.......	1941	150	18	C	T	E	Ls	.0	1,795	34	8- 8-56	60	300	I	Ca
6da.....	Univ. Nebraska and U. S. Geol. Survey.	1944	79	4	N	N	N	Ls	.0	1,792	27.5	8-28-44	......	.....	N	L
7cb.....	George Anderson......	1944	165	18	....	T	E	Ls	.0	1,800	40	8- 8-56	......	800	I	
9aa1....	Wilber Edwards.......	1946	90	18	P	N	N	Tc	.4	1,781	32.71	8-28-56	......	.....	N	O
9aa2....	Univ. Nebraska and U. S. Geol. Survey.	1944	79	4	N	N	N	Ls	.0	1,781	33.5	8-30-44	......	.....	N	L
9da1....	.....do..............	1944	79	4	N	N	N	Ls	.0	1,743	6.1	8-28-44	......	.....	N	L
9da2....	Wilber Edwards.......	1953	80	18	P	T	E	Ls	.0	1,739	6	8- 8-56	40	600	I	
12cb.....	Clarence Baker.......	1920	35	48	P	T	G	Tc	.0	1,731	10.04	8-21-56	......	.....	I	O
16da.....	Univ. Nebraska and U. S. Geol. Survey.	1944	39	4	N	N	N	Ls	.0	1,760	11.7	8-30-44	......	.....	N	L
16dd.....	U. S. Geol. Survey...	1950	28	3/4	P	N	N	Tc	2.5	1,780	17.67	8-21-56	......	.....	N	O
17cc.....	.....do..............	1950	25	3/4	P	N	N	Tc	2.0	1,765	6.31	8-21-56	......	.....	N	O
17dd.....	.....do..............	1950	21	3/4	P	N	N	Tc	2.5	1,773	6.81	8-21-56	......	.....	N	O
21aa.....	Univ. Nebraska and U. S. Geol. Survey.	1944	59	4	N	N	N	Ls	.0	1,785	18.9	8-30-44	......	.....	N	L
23bb.....	U. S. Geol. Survey...	1950	21	3/4	P	N	N	Tc	2.5	1,764	7.63	8-21-56	......	.....	N	O
24aa1....	.....do..............	1950	15	3/4	P	N	N	Tc	2.0	1,740	9.34	8-21-56	......	.....	N	O
24aa2....	Univ. Nebraska and U. S. Geol. Survey.	1951	180	4	N	N	N	Ls	.0	1,738	4.98	7-20-51	......	.....	N	L
24bb.....	U. S. Geol. Survey...	1950	21	3/4	P	N	N	Tc	2.0	1,752	6.42	8-21-56	......	.....	N	O
10- 9dc.....	Univ. Nebraska and U. S. Geol. Survey.	1943	140	4	N	N	N	Ls	.0	1,845	......	....	......	.....	N	L
12ca.....	Carl Hanson..........	1948	183	18	P	T	E	Tb	.5	1,833	66.78	9- 2-56	......	400	I	O
12db.....	J. B. Glass..........	1946	160	18	....	T	E	Ls	.0	1,830	67	8- 8-56	......	400	I	
15ca.....	Harold Rasmusson.....	....	80	2	P	Cy	E	Tc	-4.7	1,800	31.85	9- 2-56	......	.....	D,S	
16aa.....	Pauline Arterburn....	....	65	3	P	Cy	W	Ls	.0	1,825	50	12- 1-43	......	.....	D,S	Ca
16ad.....	Univ. Nebraska and U. S. Geol. Survey.	1944	139	4	N	N	N	Ls	.0	1,800	28.9	7-18-44	......	.....	N	L
17ba.....	Carl Anderson........	....	80	2	P	Cy	W	Tc	3.0	1,820	34.00	8-24-56	......	.....	D,S	
19ab.....	C. L. Southard.......	1947	82	18	....	T	G	Tb	1.0	1,802	11.77	5- 2-50	72	765	I	O
21dd.....	Univ. Nebraska and U. S. Geol. Survey.	1944	84	4	N	N	N	Ls	.0	1,792	19	7-21-44	......	.....	N	L
22cc.....	G. W. Caudill........	1947	96	4	P	Cy	W	Tc	2.0	1,790	21.80	8-31-56	......	.....	S	
28dd.....	Univ. Nebraska and U. S. Geol. Survey.	1944	139	4	N	N	N	Ls	.0	1,810	......	....	......	.....	N	L
33dc.....	.....do..............	1944	139	4	N	N	N	Ls	.0	1,819	22.4	7-21-44	......	.....	N	L
34cb.....	Stanley Luanski......	1948	......	18	P	T	.....	Tb	.5	1,803	18.37	5- 2-50	......	.....	I	O
34db.....	....	....	79	18	P	T	E	Tb	.0	1,795	21.07	5- 2-52	......	.....	I	
11- 2bd.....	Richard Spilinek.....	1955	207	18	P	T	P	Tb	1.0	1,830	16.31	8-31-56	164	450	I	
4ac.....	Mrs. Dagmar Peterson.	1955	212	18	P	T	E	Tb	.5	1,860	38.86	8-21-56	71	800	I	
4cc.....	Univ. Nebraska and U. S. Geol. Survey.	1947	100	4	N	N	N	Ls	.0	1,880	37.0	11- 8-47	......	.....	N	L
4dd.....	.....do..............	1947	150	4	N	N	N	Ls	.0	1,855	28.4	11- 8-47	......	.....	N	L
5aa.....	.....do..............	1947	370	4	N	N	N	Ls	.0	1,866	22.1	6-11-47	......	.....	N	L
5ad.....	James L. Vlack.......	1955	76	18	....	T	E	Tb	.5	1,872	25.73	8-31-56	......	450	I	
9.......	J. R. Wibbels........	....	46	6	P	Cy	W	Ls	.0	....	20	11-30-43	......	.....	D,S	Ca
9bc.....	Lester Jacobsen......	1954	256	18	C	T	P	Tb	1.0	1,893	44.57	8-21-56	140	493	I	
10ac.....	Richard Spilinek.....	....	53	6	P	N	N	Tc	1.0	1,846	34.52	8-21-56	......	.....	D,S	
10bc.....	Village of Elba......	1936	79	8	P	T	E	Ls	.0	1,860	35	5- 6-52	19	350	PS	Ca
12ab.....	George D. Spilinek, Sr.	1956	324	15	P	T	P	Tb	1.0	1,835	34.14	8-28-56	......	1,250	I	
15ad.....	Esther Spilinek......	1953	186	18	P	T	G	Tb	1.0	1,863	49.31	8-28-56	127	400	I	
16-11- 6dc.....	Ray Stevens..........	1953	150	18	P	T	E	Tb	.5	1,890	34.92	8-21-56	32	357	I	
7aa.....	Univ. Nebraska and U. S. Geol. Survey.	1943	84	4	N	N	N	Ls	.0	1,891	41.0	11- 8-43	......	.....	N	L
7cb.....	James Szwanek........	....	38	4	P	Cy	W	Ls	.0	1,868	17	11-30-43	......	.....	D,S	Ca
7cc.....	Emil Lind............	1936	90	18	....	T	G	Tb	.0	1,872	23.66	8-21-56	34	400	I	O
8aa.....	Univ. Nebraska and U. S. Geol. Survey.	1943	430	4	N	N	N	Ls	.0	2,066	......	....	......	.....	N	L
8ab.....	Vurnon Keep..........	1936	185	2	P	Cy	W	Ls	.0	2,035	180	....	......	.....	D,S	Ca
18bc.....	Jess Parker..........	....	......	....	....	T	G	Tb	.0	1,884	29.76	6-22-50	......	.....	I	Ca
											29.64	10- 5-50				
											36.55	8-21-56				
18cd.....	Stanley Tucker.......	1946	......	18	P	T	G	Tb	.0	1,873	26.32	8-21-56	......	.....	I	O
19ab.....	R. J. Rasmessen......	1948	96	18	P	T	G	Tb	.0	1,879	26.59	9-11-50	......	700	I	
											26.55	10- 6-50				
											27.03	8-21-56				
19bb.....	Bill Wells...........	1948	150	18	P	T	G	Tb	1.0	1,899	42.44	8-22-56	......	800	I	O
19cb1....	Ray Parker...........	1947	96	18	P	N	N	Tc	-.5	1,905	45.80	3-21-57	......	.....	N	O
19cb2....	.....do..............	1948	165	18	P	T	G	Tb	1.0	1,886	34.19	8-22-56	......	900	I	O
20cc.....	Haggert & Hanish.....	1953	199	18	P	T	E	Ls	.0	1,875	30	8- 8-56	70	650	I	
27dc.....	Mrs. Mary Augustyn...	1922	90	3	P	Cy	H	Tc	.5	1,886	65.10	8-22-56	......	.....	S	

Table 4.--Records of wells and test holes--Continued

Well	Owner or user	Year drilled	Depth of well (feet)	Diameter of casing (inches)	Type of casing	Type of pump	Type of power	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Measuring point: Altitude above mean sea level (feet)	Static water level: Depth below measuring point (feet)	Static water level: Date of measurement	Drawdown (feet)	Yield (gpm)	Use of water	Remarks
Howard County--Continued																
16-11-29bc.....	Corbin Springer......	1945	87	18	P	T	G	Ls	0.0	1,877	28.28	8-21-56	......	650	I	
32ab.....	Mr. Gerdes...........	....	80	24	P	T	G	Tb	1.0	1,868	24.74	8-21-56	......	.....	I	O
32bb.....	Mrs. Mary Linsey.....	1940	85	18	P	T	G	Tc	-1.0	1,876	20.33 20.93	10- 6-50 8-22-56	......	600	I	
33aa.....	Univ. Nebraska and U. S. Geol. Survey.	1947	300	4	N	N	N	Ls	.0	1,828	7.6	6- 9-47	......	.....	N	L
35ca.....	.....do.............	1943	203	4	N	N	N	Ls	.0	1,853	33.3	10-31-43	......	.....	N	L
12- 4aa.....	.....do.............	1944	89	4	N	N	N	Ls	.0	2,023	Dry	8- 2-44	......	.....	N	L
12bd.....	H. Blanchard.........	1954	144	18	C	T	E	Tb	.5	1,880	20.86	8-24-56	80	400	I	
13ab.....	Univ. Nebraska and U. S. Geol. Survey.	1947	100	4	N	N	N	Ls	.0	1,895	37.0	11- 8-47	......	.....	N	L
Merrick County																
15- 6- 9ab.....	....	....	50	2 1/2	P	Cy	W	Tc	0.0	1,721	39.92 40.58	4-13-50 10-12-50	......	.....	S	
12dd.....	....	1949	31	18	P	C	G	Tc	.0	1,670	9.42	10-27-49	......	350	I	O
19bb.....	Univ. Nebraska and U. S. Geol. Survey.	1951	230	4	N	N	N	Ls	.0	1,760	42.7	7- -51	......	.....	N	L
7-14bb.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	2.0	1,691	7.35	7-13-50	......	.....	N	O
14cc.....	.....do.............	1950	16	3/4	P	N	N	Tc	.5	1,704	2.59	8- 8-50	......	.....	N	O
19bb.....	.....do.............	1950	16	3/4	P	N	N	Tc	2.0	1,717	7.22	8- 4-50	......	.....	N	O
23cc.....	....	....	25	4	P	Cy	H	Tc	2.0	1,755	20.85 17.42	9-30-49 10-17-50	......	.....	D	
8-17dd.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	1.0	1,713	3.19	8- 4-50	......	.....	N	Ca,O
18dd.....	.....do.............	1950	21	3/4	P	N	N	Tc	3.0	1,736	16.31	10- 2-50	......	.....	N	O
22ad.....	.....do.............	1950	14	3/4	P	N	N	Tc	2.5	1,726	9.84	8- 4-50	......	.....	N	O
22cc.....	.....do.............	1950	14	3/4	P	N	N	Tc	2.5	1,732	6.05	8- 4-50	......	.....	N	O
22dd.....	.....do.............	1950	16	3/4	P	N	N	Tc	2.0	1,732	9.54	8- 4-50	......	.....	N	O
25aa.....	.....do.............	1950	20	3/4	P	N	N	Tc	1.5	1,724	5.77	8- 4-50	......	.....	N	O
27aa.....	Univ. Nebraska and U. S. Geol. Survey.	1932	25	4	N	N	N	Ls	.0	1,733	5.0	6-22-32	......	.....	N	L
27dd.....	U. S. Geol. Survey...	1950	21	3/4	P	N	N	Tc	1.5	1,740	2.87	8- 4-50	......	.....	N	O
28bb.....	.....do.............	1950	17	3/4	P	N	N	Tc	3.0	1,739	7.97	8- 3-50	......	.....	N	O
Nance County																
15- 6- 2bb.....	U. S. Geol. Survey...	1951	19	3/4	P	N	N	Tc	1.0	1,663	2.65	5-28-51	......	.....	N	Ca,O
2cc.....	.....do.............	1950	21	3/4	P	N	N	Tc	4.0	1,686	11.71	7-31-50	......	.....	N	O
4cc.....	.....do.............	1950	37	3/4	P	N	N	Tc	2.0	....	29.01	8- 8-50	......	.....	N	O
6cc1....	....	....	9	....	....	Cy	W	Tc	.0	1,681	7.12 7.23	9-29-40 10-17-50	......	.....	D,S	
6cc2....	Univ. Nebraska and U. S. Geol. Survey.	1951	100	4	N	N	N	Ls	.0	1,680	8.39	7-18-51	......	.....	N	L
7cc.....	U. S. Geol. Survey...	1950	30	3/4	P	N	N	Tc	3.0	....	15.24	8- 8-50	......	.....	N	O
7- 5ab.....	J. H. Russell........	1907	50	3	P	Cy	E	Tc	2.5	1,720	33.60	9- 4-56	......	.....	D,S	
6bb.....	Dinsdale brothers....	....	81	3	P	Cy	W	Tb	2.0	1,770	68.28	9- 6-56	......	.....	D	O
7bb.....	H. W. Weems..........	1951	44	10	P	Cy	W	Tc	3.0	1,719	34.69	9- 7-56	......	.....	S	
8dd.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	1.0	1,691	9.47	9- 6-56	......	.....	N	O
11bd.....	James Santin.........	....	11	6	P	Cy	W	Tc	.5	1,676	5.30 6.20 7.61	6-13-50 10-17-50 9- 6-56	......	.....	S	
11da.....	....	....	13	4	P	Cy	H	Tb	1.0	1,685	8.45 7.53	9-23-49 10-17-50	......	.....	D,S	
12dd.....	U. S. Geol. Survey...	1951	24	3/4	P	N	N	Tc	3.0	1,706	16.90	9- 6-56	......	.....	N	
16cc.....	.....do.............	1950	14	3/4	P	N	N	Tc	2.5	1,705	9.28	9- 6-56	......	.....	N	O
8- 5dd.....	Univ. Nebraska and U. S. Geol. Survey.	1932	155	4	N	N	N	Ls	.0	1,813	......	....	......	.....	N	L
7ad.....	Fred Schenck.........	....	70	3	P	Cy	W	Tc	.5	1,768	53.80	9- 7-56	......	.....	D,S	
9bc.....	Ken A. Tibbets.......	1952	90	3	P	Cy	W	Tc	2.5	1,777	67.70	9- 6-56	......	.....	D,S	
11ba.....	Frank V. Forbes......	1954	68	18	C	T	G	Tb	1.0	1,738	44.21	9- 8-56	19	.....	I	
13cd.....	....	....	100	4	P	Cy	H	Tc	1.0	1,720	24.80 23.74	4-13-50 10-17-50	......	.....	D	
15aa.....	Frank V. Forbes......	1932	50	14	C	Cy	E	Tc	-7.0	1,709	9.35	9- 8-56	......	.....	D,S	
16cb.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	1.5	1,711	7.88	9- 6-56	......	.....	N	O
16- 5-19cd.....	Univ. Nebraska and U. S. Geol. Survey.	1946	120	4	N	N	N	Ls	.0	1,629	9.4	9- 5-46	......	.....	N	L
20bc.....	Walter Prosaski.....	1937	18	6	P	C	G	Tc	.0	1,624	7.05	9-21-49	......	.....	I	O
30cc.....	U. S. Geol. Survey..	1950	14	3/4	P	N	N	Tc	2.0	1,635	3.32	7-31-50	......	.....	N	O
32dd.....	Univ. Nebraska and U. S. Geol. Survey.	1932	41	4	N	N	N	Ls	.0	1,640	5.0	7- 1-32	......	.....	N	L
6-11db1-9..	City of Fullerton....	(1)	(2)	(3)	....	....	.....	......	....	....	......	....	......	(4)	PS	
11db10-13	.....do.............	....	......	....	....	....	.....	......	....	....	......	....	......	.....	N	
14ac.....	C. A. Aldrich........	....	51	10	....	T	G	Tc	.5	1,643	26.71	9- 3-56	17	125	I	O
20cc.....	Louie Zimmer.........	....	62	4	P	Cy	W	Tc	1.5	1,706	57.60	9- 3-56	......	.....	S	
21bc.....	Roy Badb.............	....	67	6	W	Cy	W	Tc	1.5	1,698	62.15	9- 4-56	......	.....	S	
22ab.....	....	1949	63	18	P	T	E	Tb	.0	1,658	36.65	9- 6-56	......	.....	I	O
23cc.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	3.0	1,632	9.44	9- 6-56	......	.....	N	O
24aa.....	Joe Lesiak...........	....	8	1 1/4	P	Cy	W	Tc	.5	1,617	1.63	6- 5-50	......	.....	S	O
25bb.....	....	....	19	6	P	Cy	W	Tc	1.0	1,635	9.16 9.20	2-17-47 3-29-47	......	.....	S	
26dd.....	Joe Shotkoski........	1943	15	6	P	Cy	W	Tc	.1	1,641	6.35 5.64	4-21-50 10-17-50	......	.....	S	
30db.....	Mike Usendoski.......	1955	40	18	C	T	E	Tb	1.0	1,669	23.10	9- 6-56	10	800	I	
32aa.....	U. S. Geol. Survey...	1950	14	3/4	P	N	N	Tc	2.0	1,645	8.76	9- 6-56	......	.....	N	O
33cc.....	.....do.............	1950	14	3/4	P	N	N	Tc	1.5	1,668	8.60	9- 6-56	......	.....	N	O
35bb.....	.....do.............	1950	14	3/4	P	....	.....	Tc	2.0	1,649	12.40	9- 6-56	......	.....	N	O
7-26da.....	Donald Cunningham....	1955	156	18	P	T	E	Tb	1.0	1,718	37.31	9- 7-56	112	225	I	
34cb.....	R. H. Brooks.........	1948	58	18	P	T	E	Tb	.5	1,709	33.89	9- 6-56	20	600	I	O
35ab.....	E. H. Held...........	1955	97	18	P	T	E	Tb	.5	1,698	32.72	9- 6-56	27	250	I	Ca
36aa.....	Mr. Russell..........	1934	33	18	P	C	G	Tc	.5	1,674	22.31	9- 6-56	......	.....	I	O
Valley County																
17-13- 6cc.....	Lenard Wells.........	....	76	4	P	Cy	W	Tc	2.0	2,037	15.78	9-12-56	......	.....	S	
7dd.....	Clarence Fox.........	....	140	4	P	Cy	W	Tc	1.0	2,090	77.50	8-17-56	......	.....	D,S	
9ac.....	Riley Brannon........	....	160	4	P	Cy	W	Tc	2.0	2,075	108.60	8-29-56	......	.....	S	
11ca.....	W. J. Boomer.........	....	141	4	P	Cy	W	Tc	.5	2,055	112.09	8-17-56	......	.....	S	
14- 1ad.....	Univ. Nebraska and U. S. Geol. Survey.	1943	150	4	N	N	N	Ls	.0	2,049	23.7	10- 9-43	......	.....	N	L
6ac.....	O. C. Lamsman........	1954	360	18	C	T	G	Tb	1.0	2,152	53.35	6-10-57	88	900	I	
6bd.....	Harry H. Foth and son.	1954	320	18	C	T	G	Tb	1.0	2,160	52.58	6-10-57	149	1,000	I	
12ab.....	Univ. Nebraska and U. S. Geol. Survey.	1943	130	4	N	N	N	Ls	.0	2,060	24.6	10- 9-43	......	.....	N	L
15-10bb.....	Armin Lueck..........	1954	328	18	P	T	D	Tb	1.0	....	104.94	5-24-57	......	600	I	
18-13- 2ac.....	Stanley Rutar........	1947	100	18	P	T	P	Tb	1.0	1,970	17.57	8-21-56	......	750	I	O
3ca.....	Univ. Nebraska and U. S. Geol. Survey..	1943	130	4	N	N	N	Ls	.0	2,013	31.2	10- 2-43	......	.....	N	L
14db.....	Ign Porkraka.........	....	120	18	C	T	P	Tb	2.0	1,961	21.45	8-17-56	......	.....	I	
20db.....	Aubrey Davis.........	....	100	....	....	Cy	H	Ls	.0	....	......	....	......	.....	D,S	Ca
23dd.....	W. T. Hutchins.......	1930	83	24	C	T	P	Tc	1.7	1,950	14.88	8-21-56	......	.....	I	Ca,O
24cd.....	Univ. Nebraska and U. S. Geol. Survey.	1943	150	4	N	N	N	Ls	.0	1,959	......	....	......	.....	N	L
25cc1....	Village of North Loup.	1914	93	10	P	T	E	Tc	.0	1,957	12	9-10-56	49	150	PS	Ca
25cc2....	.....do.............	1951	85	12	P	T	E	Ls	.0	1,957	10	7-10-52	34	250	PS	

1 The oldest was drilled in 1904 and the others were drilled as the demand for water increased.

2 Depths range from 34 to 187 feet.

3 Diameters range from 10 to 144 inches.

4 Combined yield of all wells is about 600 gpm.

Table 4.--Records of wells and test holes--Continued

Well	Owner or user	Year drilled	Depth of well (feet)	Diameter of casing (inches)	Type of casing	Type of pump	Type of power	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Measuring point: Altitude above mean sea level (feet)	Static water level: Depth below measuring point (feet)	Static water level: Date of measurement	Drawdown (feet)	Yield (gpm)	Use of water	Remarks
Valley County--Continued																
18-13-26ca.....	Univ. Nebraska and U. S. Geol. Survey.	1943	150	4	N	N	N	Ls	0.0	1,972	11.2	10-14-43	......	.....	N	L
31cb.....	.....do.............	1943	120	4	N	N	N	Ls	.0	2,069	46.8	10- 9-43	......	.....	N	L
33bc.....	W. W. Vogeler........	1949	257	18	P	T	G	Tb	1.0	2,020	38.83	6-10-57	85	350	I	Ca,O
33cb.....	Roy Cox.............	1957	315	18	C	T	G	Tb	1.0	....	24.76	6-10-57	115	1,100	I	
33cc.....	U. S. Bur. Reclamation.	1955	22	1	P	N	N	Tc	1.5	2,008	17.75	8-10-56	......	.....	N	O
36ad.....	Everett Hornicher....	1923	125	3	P	Cy	W	Ls	.0	1,955	......	....	......	.....	D,S	Ca
14- 5bc.....	John L. Koll.........	1955	338	18	C	T	G	Tb	1.0	2,170	109.27	8-14-56	64	1,000	I	
6ac.....	Anton Kluna..........	1954	319	18	....	T	G	Tb	1.0	2,150	77.54	6- 6-57	76	1,000	I	
6bc.....	Eldon Lange..........	1954	297	18	P	T	G	Tb	1.0	2,130	69.36	6- 6-57	......	700	I	
7bd.....	Alfred Burson........	1954	208	18	P	T	G	Tb	1.0	2,160	74.65	6- 6-57	50	1,000	I	
16da.....	.....do.............	1955	318	18	C	T	G	Tb	.5	2,105	49.24	6-10-57	85	700	I	
20cb.....	E. J. Lange..........	1955	340	18	C	T	G	Tb	1.0	2,128	38.94	6- 6-57	......	700	I	
22bb.....	Lloyd Geweke.........	1954	337	18	....	T	G	Tb	.0	2,110	75.63	8-10-56	150	850	I	
22db.....	George Clement.......	1954	303	18	C	T	P	Tb	.5	2,070	37.89	8-10-56	121	1,035	I	
25ca.....	Arvin Bredthauer.....	1956	323	18	C	T	G	Tc	.5	2,090	78.82	8-20-56	77	800	I	
26dc.....	Henry G. Lange.......	1955	371	18	....	T	G	Tb	1.0	2,092	69.96	6-10-57	88	825	I	
27aa.....	U. S. Bur. Reclamation.	1955	17	1	P	N	N	Tc	1.0	2,053	11.73	8- 9-56	......	.....	N	O
31ad.....	Harold Koelling......	1956	354	28	C	T	G	Tb	1.0	2,120	27.44	6-10-57	112	1,100	I	Ca
32dd.....	Elsie and George Bremer.	1956	327	18	C	T	G	Tb	1.0	2,155	84.19	6-10-57	213	550	I	
35cc.....	William Koelling.....	1955	390	22	C	T	G	Tb	.0	2,110	59.72	6-10-57	143	800	I	
18-15- 2dd.....	Univ. Nebraska and U. S. Geol. Survey.	1943	122	4	N	N	N	Ls	.0	2,120	12.2	10- 5-43	......	.....	N	L
4aa.....	Harold Burson........	....	123	4	P	Cy	W	Tc	1.5	2,215	83.50	9-12-56	......	.....	D,S	
8bb.....	Eldon Maresh.........	1955	338	18	P	T	G	Tb	.0	2,260	95.41	5-23-57	198	800	I	
8db.....	Johnson brothers.....	1954	327	18	C	T	G	Tb	.5	2,280	120.26	5-23-57	70	1,000	I	
10ad.....	Joe Bonne............	1954	200	18	C	T	P	Tb	.0	2,167	41	8-15-56	45	1,000	I	
10cc.....	.....do.............	1957	400	18	C	T	G	Tb	2.0	2,200	59.22	5-23-57	152	1,100	I	
11ba.....	William Hansen.......	1949	150	18	P	T	G	Tb	.5	2,159	38.52	8- 9-56	......	1,000	I	O
12bb.....	Emil Kokes...........	1948	120	18	P	T	G	Tb	1.0	2,140	31.84	8- 9-56	......	450	I	Ca,O
13ad.....	E. J. Lange..........	1954	247	18	C	T	G	Tb	1.0	2,159	59.29	6- 6-57	175	400	I	
14cb.....	Univ. Nebraska and U. S. Geol. Survey.	1943	180	4	N	N	N	Ls	.0	2,174	39.2	10- 5-43	......	.....	N	L
14da.....	Chester F. Travis....	1954	300	18	....	T	P	Tb	2.0	2,160	47.23	5-24-57	74	660	I	
15bc.....	O. A. Kellsian.......	1954	336	18	....	T	P	Tb	2.0	2,236	93.95	5-23-57	100	700	I	
15dd.....	Chas. M. King........	1936	158	3	P	Cy	W	Ls	.0	....	......	....	......	.....	D,S	Ca
24ad.....	Irving King..........	1955	350	18	P	T	G	Tb	1.0	2,185	81.28	6- 6-57	200	700	I	
25bc.....	Archie Mason.........	1923	280	4	P	Cy	W	Tc	.5	2,190	70.88	9-12-56	......	.....	D,S	
19-13-25cc.....	Univ. Nebraska and U. S. Geol. Survey.	1943	300	4	N	N	N	Ls	.0	1,996	16.0	10-16-43	......	.....	N	L
26cd.....	Neola Shoemaker......	....	55	18	P	T	E	Tb	1.0	1,980	9.96 12.72	9-18-51 8-20-56	......	.....	I	
28bb.....	William Peterson.....	1947	98	18	P	T	P	Tb	.0	2,006	14.03	8-20-56	......	700	I	O
31db.....	....	....	123	3	P	N	N	Tc	3.0	2,045	57.56 57.46 58.26	1- 5-51 9-19-51 8-17-56	......	.....	N	
33cc.....	I. D. Fish...........	1938	119	18	P	T	P	Tb	.0	2,010	33.15	8-17-56	......	500	I	O
35cc1....	Univ. Nebraska and U. S. Geol. Survey.	1943	80	4	N	N	N	Ls	.0	1,987	9.0	10- 2-43	......	.....	N	L
35cc2....	Mrs. Lydia Kokes.....	....	85	3	P	Cy	W	Tc	.0	....	20	11-29-43	......	.....	D,S	Ca
14- 4ba.....	Univ. Nebraska and U. S. Geol. Survey.	1943	100	4	N	N	N	Ls	.0	2,071	26.7	9-15-43	......	.....	N	L
5cc.....	Ed Zikmund...........	1935	......	18	P	T	G	Tb	1.0	2,079	22.85	8- 9-56	......	.....	I	O
6dc.....	Chas. Verzal.........	1931	97	24	C	T	G	Tc	-.4	2,085	29.29	8-29-56	9	.....	I	O
8aa.....	Univ. Nebraska and U. S. Geol. Survey.	1943	110	4	N	N	N	Ls	.0	2,047	13.6	9-14-43	......	.....	N	L
8da.....	Henry Benn...........	....	42	3	P	Cy	W	Ls	.0	....	......	....	......	.....	D,S	Ca
8dc.....	Univ. Nebraska and U. S. Geol. Survey.	1943	90	4	N	N	N	Ls	.0	2,058	13.1	9-13-43	......	.....	N	L
13da.....	William Sack.........	1947	134	18	P	T	G	Tb	.5	2,040	23.72	8-16-56	......	.....	I	O
15da.....	Victor Kerchal.......	1948	96	18	P	T	P	Tb	.5	2,030	7.23	8-16-56	40	750	I	O
19aa.....	Univ. Nebraska and U. S. Geol. Survey.	1943	360	4	N	N	N	Ls	.0	2,090	33.1	9-13-43	......	.....	N	L
22dc.....	.....do.............	1943	70	4	N	N	N	Ls	.0	2,015	5.8	9-30-43	......	.....	N	L
31bb.....	.....do.............	1943	190	4	N	N	N	Ls	.0	2,098	14.7	10- 5-43	......	.....	N	L
31dd.....	H. H. Koll...........	1955	298	18	C	T	G	Tb	.5	2,127	60.93	8-20-56	151	700	I	
32cc.....	F. H. Kuehl..........	1955	347	18	P	T	G	Tb	.5	2,130	63.96	8-20-56	100	850	I	
36bb.....	Edward Penas.........	1947	155	18	P	T	G	Tb	1.0	2,033	35.22	8-21-56	40	900	I	O
15- 3bb.....	Univ. Nebraska and U. S. Geol. Survey.	1943	120	4	N	N	N	Ls	.0	2,152	......	....	......	.....	N	L
16bd.....	Ray Grabowski........	1955	316	18	P	T	P	Tb	1.0	2,200	78.21	5-23-57	90	850	I	
21bd.....	Rudolph Kokes........	1955	330	18	P	T	P	......	1.0	2,180	54.17	4-16-57	70	.....	I	
25dd.....	U. S. Bur. Reclamation.	1955	22	1	P	N	N	Tc	1.0	2,100	17.99	6-14-55	......	.....	N	O
29ad.....	E. D. Zabloudil......	1954	180	18	C	T	P	......	.5	2,183	43.01	5-23-57	67	900	I	
16- 3dd.....	L. Kvetensky.........	....	160	4	P	Cy	W	Tc	1.0	2,295	121.98	8-16-56	......	.....	D,S	
9bc.....	Frank Kirkac.........	....	122	4	P	Cy	W	Tc	1.0	2,320	117.00	8-28-56	......	.....	S	
11da.....	Frank Zardina........	....	87	4	P	Cy	W	Tc	2.0	2,230	60.60	9-11-56	......	.....	D,S	
13db.....	Wm. J. Beran, Sr.....	1955	305	18	P	T	P	Tb	.5	2,220	57.90 54.64	8-11-56 4-16-57	150	500	I	Ca
22aa.....	Fjl Benda............	1956	270	18	P	T	P	Tb	1.0	2,290	95.77 94.98	8-11-56 4-16-57	60	.....	I	
26aa.....	George Zureck........	....	153	4	P	Cy	W	Tc	.5	2,275	93.00	9-11-56	......	.....	S	
35ac.....	Rudolph Krahulik.....	1955	405	18	P	T	P	Tb	1.0	2,285	94.83 89.04	8-11-56 4-16-57	60	1,000	I	
20-14-34cb.....	Univ. Nebraska and U. S. Geol. Survey.	1943	98	4	N	N	N	Ls	.0	2,142	......	....	......	.....	N	L
15-10da1....	.....do.............	1943	106	4	N	N	N	Ls	.0	2,116	11.6	9-23-43	......	.....	N	L
10da2....	Frank James..........	1905	100	4	P	Cy	W	Tc	.0	....	20	11-29-43	......	.....	D,S	Ca
14da.....	Univ. Nebraska and U. S. Geol. Survey.	1943	130	4	N	N	N	Ls	.0	2,102	......	....	......	.....	N	L
20db.....	Steve Kapustka.......	1954	152	18	C	T	P	Tb	.5	2,205	81.63 80.00	8-24-56 4-16-57	23	850	I	
22ac.....	Univ. Nebraska and U. S. Geol. Survey.	1943	50	4	N	N	N	Ls	.0	2,130	30.4	10-16-43	......	.....	N	L
22da.....	.....do.............	1943	123	4	N	N	N	Ls	.0	2,111	19.6	10-16-43	......	.....	N	L
27cd.....	.....do.............	1943	107	4	N	N	N	Ls	.0	2,138	40.8	9-20-43	......	.....	N	L
29aa.....	Louie Greenwoldt.....	1936	130	24	C	T	G	Tb	1.0	2,188	69.93	8-18-56	......	.....	I	O
34aa.....	Joe Michalski........	1945	122	18	P	T	G	Tb	.0	2,140	61.13	8-10-56	......	600	I	O
34cd.....	Antone Welniak.......	1954	210	18	C	T	P	Tb	.5	2,145	54.75 53.13	8-10-56 4- 9-57	35	900	I	
35ab.....	Floyd Wozniak........	1948	122	18	C	T	G	Tb	.0	2,153	63.75 64.62	8-10-56 4- 9-57	......	650	I	
35ba.....	Stanley Colka Est....	1946	134	18	P	T	G	Tb	1.0	2,140	64.30	8- 9-56	10	660	I	O
16-26ba.....	Raymond Osentowski...	1953	140	4	P	Cy	W	Tc	2.5	2,255	93.28	8-28-56	......	.....	S	