STATE OF SOUTH DAKOTA
Richard Kneip, Governor

SOUTH DAKOTA GEOLOGICAL SURVEY
Duncan J. McGregor, State Geologist

Special Report 54

GROUND-WATER INVESTIGATION FOR THE CITY OF SPENCER, SOUTH DAKOTA

by

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CONTENTS

INTRODUCTION

PRESENT INVESTIGATION

This report contains the results of a special ground-water investigation conducted by the South Dakota Geological Survey in June 1970, in and around the city of Spencer, McCook County, South Dakota (fig. 1). This report is the 54th in a continuing series of investigations to assist the cities in locating their future water supplies.

Spencer now obtains its water from a 130 feet deep well within the city limits. The fractured Sioux Quartzite yields water to the well.

Included in the survey of the Spencer area was: (1) mapping of the geology of the area, (2) drilling of 27 auger and 4 rotary test holes, (3) a well inventory, and (4) collection and analysis of 12 water samples.

As a result of this study, a sand and gravel deposit was found northwest of the city. This deposit may produce enough water to supply the city. A pump test in the sand and gravel is recommended before the construction of a permanent city well.

The cooperation of the residents of Spencer especially the officials, Mayor G. H. Lindekogel, Jr. and City Auditor Don Bruns is appreciated. The assistance of the State Chemical Laboratory in analyzing some of the water samples is also acknowledged.

The project was financed by the South Dakota Geological Survey and the city of Spencer.

LOCATION AND EXTENT OF AREA

The city of Spencer is located in southeast South Dakota in McCook County which is in the James Basin, a part of the Central Lowlands physiographic province (fig. 1).

TOPOGRAPHY AND DRAINAGE

Topography of the Spencer area ranges from a gently-sloping surface of glacial outwash along Wolf Creek to an undulating surface developed on glacial till (fig. 2). Wolf Creek is the principal drainage in the area and is a tributary of the James River.

GENERAL GEOLOGY

SURFICIAL DEPOSITS

Surficial deposits of the Spencer area are chiefly the results of glaciation late in the Pleistocene Epoch of geologic time. Glacial deposits are collectively termed drift which is divisible into two broad lithologic groups: till and outwash.

Till, commonly called "boulder clay," "blue clay," or "gumbo" consists of a heterogeneous mixture of boulder, pebbles, and sand in a matrix of clay deposited directly by the ice. Figure 2 is a geologic map of the Spencer area showing the distribution of surficial deposits in the area.

Outwash material is a more homogeneous deposit, consisting primarily of sand and gravel with minor amounts of silt and clay which was deposited by melt water streams issuing from a glacier. Because the distribution of alluvium (a mixture of sand and clay deposited by the present stream) is limited in areal extent and thickness, figure 2 shows surface outwash and alluvium as one unit. Buried outwash is present with its most extensive distribution found in the northwest part of the study area.

EXPOSED AND SUBSURFACE BEDROCK

Sioux Quartzite of Precambrian age underlies the glacial drift in the study area, and is exposed southwest of the city (fig. 2). In test hole 3, (fig. 3 and app. A) located approximately 1½ miles northwest of the city, the quartzite was encountered at a depth of 240 feet below the land surface.

OCCURRENCE OF GROUND WATER

PRINCIPLES OF OCCURRENCE

Ground water is defined as water contained in the openings within rocks or sediments below the water table. Practically all open spaces in the rocks that lie below the water table are filled with water; it is called the zone of saturation. The water table is the upper surface of the zone of saturation and is in equilibrium with atmospheric pressure. Rocks and soil that lie above the water table are in the zone of aeration because some of the open spaces in this zone are filled with water; the remaining portion contains air. Water in this zone is either held by molecular attraction, returned to the atmosphere by plant use, or is moving downward toward the zone of saturation. Water within the ground above the saturated zone moves downward under the influence of gravity, whereas in the saturated zone, it moves in a direction determined by the hydraulic head.

Contrary to popular belief, ground water does not occur in "veins" that crisscross the land at random. Instead it can be shown that water is found nearly everywhere beneath the surface, but at varying depths.

Nearly all ground water is derived from precipitation in the form of rain, snow, or ice. This water either evaporates, percolates directly downward to the water table and becomes ground water, or drains off as surface water. Surface water either evaporates, escapes to the ocean by streams, or percolates downward into the rocks.

Recharge is the addition of water to an aquifer (a deposit having structures that permit appreciable water to move through it under ordinary field conditions). Recharge to the aquifer is accomplished in four main ways: (1) by downward percolation of precipitation from the ground surface, (2) by downward percolation from surface bodies of water, (3) by lateral movement of ground water into the area, and (4) by artifical recharge, which takes place from excess irrigation, seepage from canals, and water purposely applied to augment ground-water supplies.

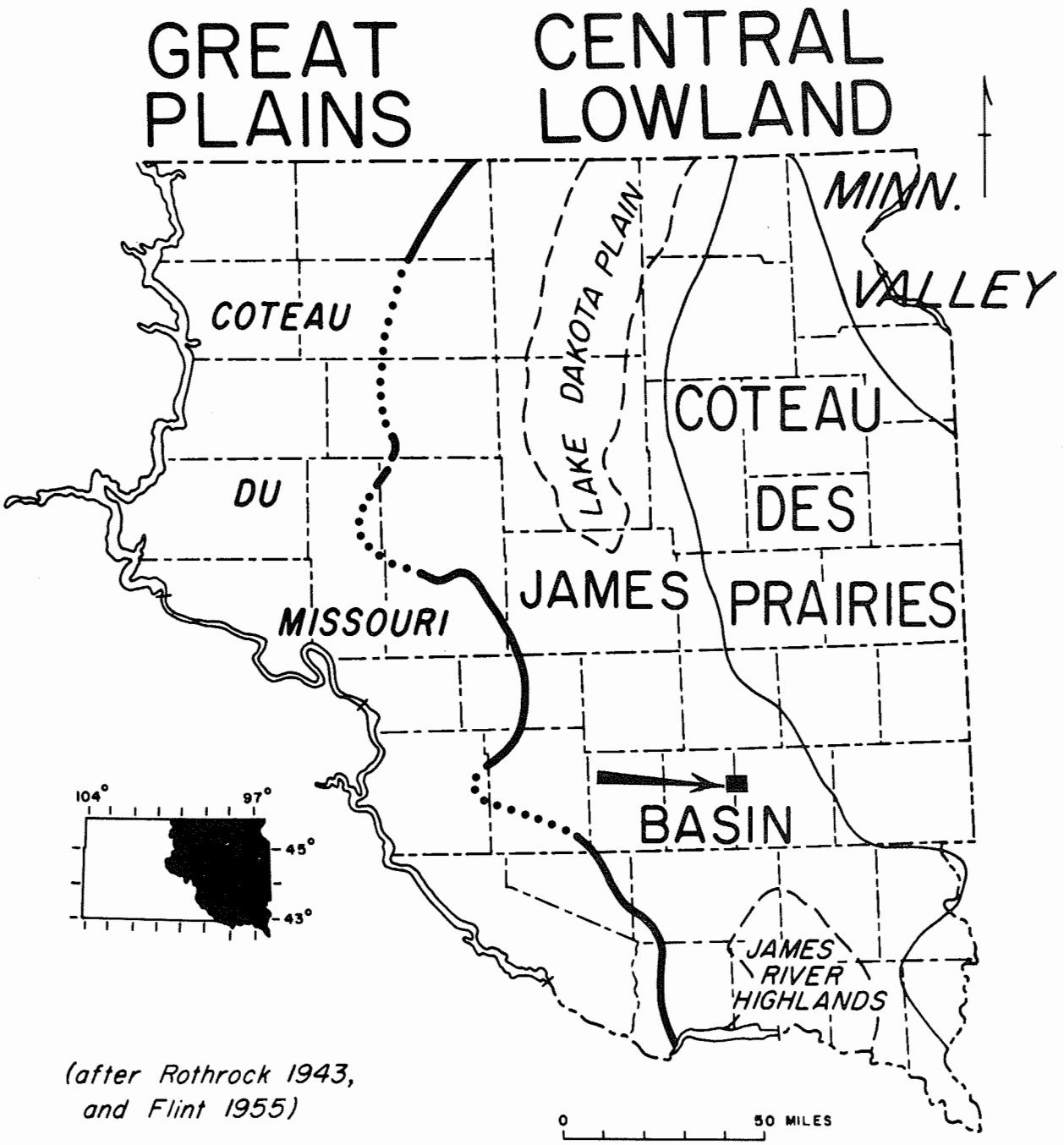
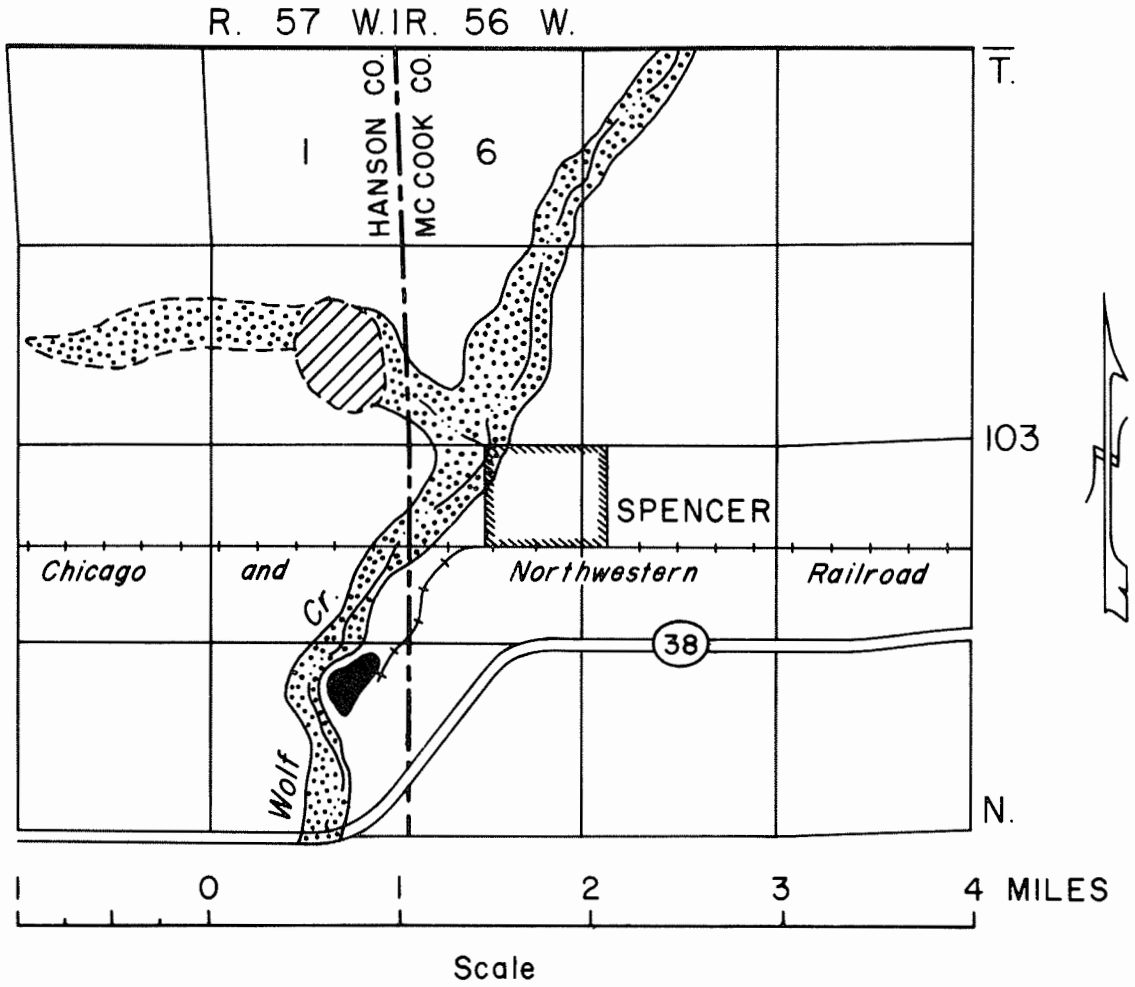


Figure 1. Map of eastern South Dakota showing the major physiographic divisions and location of the Spencer area.



EXPLANATION

Quaternary

Alluvium and outwash

Till

Precambrian

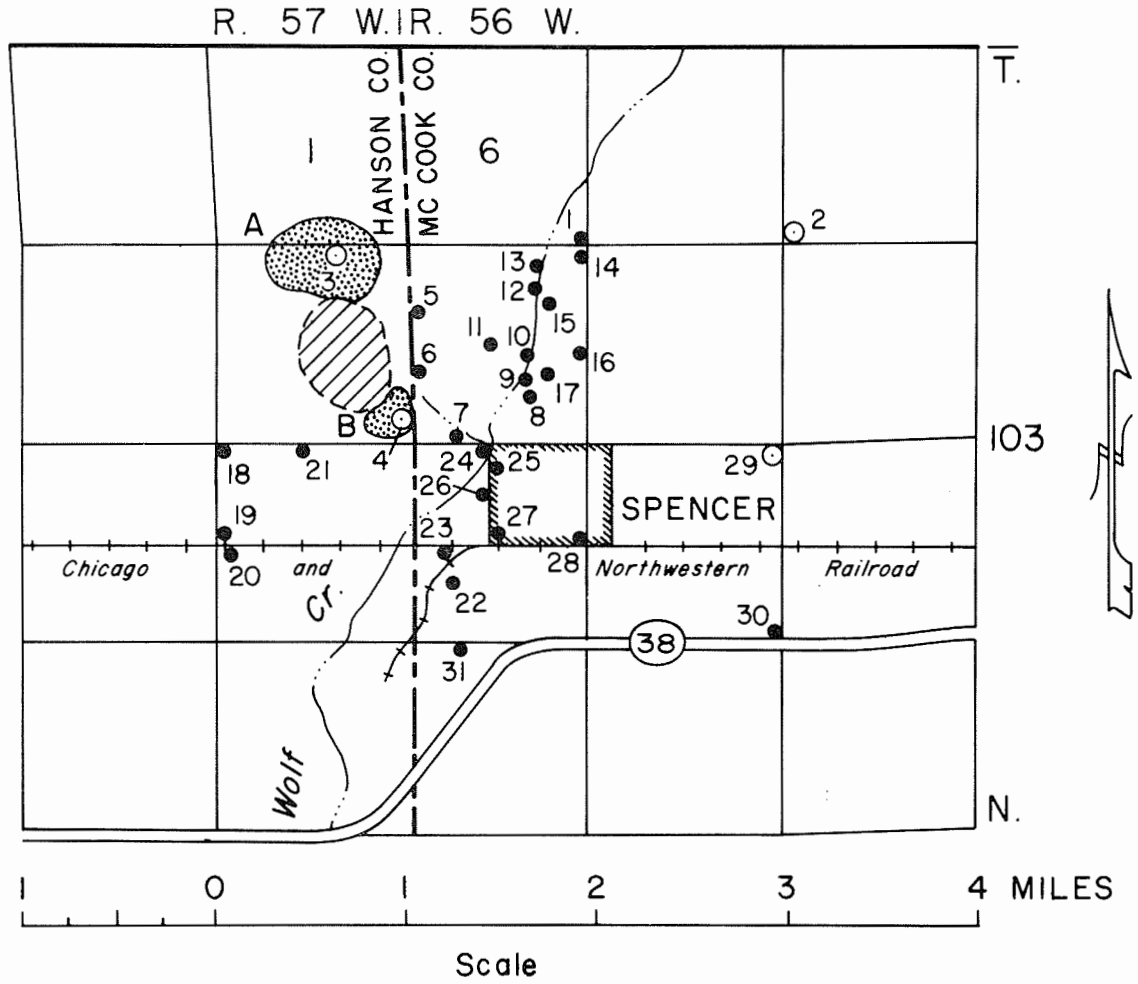
Sioux Quartzite

Intermittent lake

Intermittent stream

by A. Barari drafted by D. W. Johnson

Figure 2. Generalized geologic map of the Spencer area.



LEGEND

- Rotary test hole (3)
- Auger test hole (25)

Numbers refer to test holes listed in Appendix A.

- Recommended areas A and B.
- Intermittent lake
- Intermittent stream

by A. Barari drafted by D. W. Johnson

Figure 3. Map showing location of rotary and auger test holes in the Spencer area.

Discharge of ground water from an aquifer is accomplished in four ways: (1) by evaporation and transpiration by plants, (2) by seepage upward or laterally into surface bodies of water, (3) by lateral movement of ground water out of the area, and (4) by pumping from wells, which constitutes the major artificial discharge of ground water.

Porosity of a rock or soil is a measure of the contained open pore spaces, and it is expressed as the percentage of void spaces to the total volume of the rock. Porosity of a sedimentary deposit depends chiefly on (1) the shape and arrangement of its constituent particles, (2) the degree of sorting of its particles, (3) the cementation and compaction to which it has been subjected since its deposition, (4) the removal of mineral matter through solution by percolating waters, and (5) the fracturing of the rock, resulting in joints and other openings. Thus, the size of the material has little or no effect on porosity if all other factors are equal.

Permeability of a rock is its capacity for transmitting a fluid. Water will pass through a material with interconnected pores, but will not pass through material with unconnected pores, even if the latter material has a higher porosity. Therefore, permeability and porosity are not synonymous terms.

GROUND WATER IN GLACIAL DEPOSITS

It was stated earlier that glacial deposits are divided into till and outwash. Till does not yield water readily because of its highly unsorted nature and the predominance of silt and clay. Locally there may occur some lenses of sand and/or gravel within the till which provide an adequate supply of water for a farm well, but considering the till as a unit, it cannot function as a source of water for municipalities.

Outwash, a highly permeable deposit, may make an aquifer, if it is extensive and located below the water table. Results of test hole drilling and well inventory from the area (app. A, B, and fig. 3) indicate that the most extensive and thickest buried outwash is located 1½ miles northwest of the city (test hole 3, app. A).

GROUND WATER IN BEDROCK

Sioux Quartzite is a hard, massive, pink siliceous rock which is bedded and jointed. This rock yields water to some wells from fractures or joints, lenses of porous sand, or deposits or "granite wash."

QUALITY OF GROUND WATER

Ground water always contains dissolved chemical substances in various amounts. The dissolved chemicals are derived from: (1) the atmosphere as water vapor condenses and falls, (2) the soil and underlying deposits as the water moves downward to water table, and (3) the rocks below the water table. In general, the more chemical substances that a water contains, the poorer its quality.

Table 1 shows the chemical quality of water samples collected in the Spencer area (for map location, see fig. 4). Samples W-1 through W-7 and W-10 through W-11 were collected from wells yielding water from buried outwash. The water samples from buried outwash are within the limits set by the South Dakota Department of Health except for the following chemicals: (1) excluding sample W-2 these samples have high concentration of sulfate and total solids, (2) generally these samples have high concentration of manganese and low concentration of fluoride, and (3) samples W-2, W-3, and W-7 have higher iron than the limits.

Samples W-8 and W-9 were collected from test holes drilled through alluvium into the surface and shallow outwash deposits. These water samples are very high in dissolved chemicals, especially iron, sulfate, hardness, and total solids; consequently, this source is not recommended for the city water supply.

Sample W-12 was collected from the city well which yields water from the Sioux Quartzite. Except for high sulfate, iron, manganese the remaining measured chemicals are within the limits set by the South Dakota Department of Health. Table 2 shows the significance of some chemical and physical properties of drinking water.

DISCUSSION AND RECOMMENDATIONS

There are two potential sources of water for the city of Spencer in the study area. These sources are: (1) the deeper buried outwash deposit and (2) the Sioux Quartzite.

1. The deeper buried deposit located northwest of the city is the most extensive sand and gravel deposit in the study area. Following is a discussion of two locations of this deposit:

Location A: The thickest sand and gravel deposits were penetrated at this location. The log of test hole 3 located 1½ miles northwest of the city indicates that sand and gravel is more than 30 feet thick (app. A. and fig. 3). This location has the best chance of producing significant quantity of water. Chemical quality of water from this location is expected to be comparable to samples W-5 and W-6. Water from this location has higher sulfate, manganese, total solids, and less fluoride than the recommended limits. The water is comparable to the present city well (table 1).

Location B: Test hole 4 approximately half a mile northwest of the city penetrated gravel layers at depths of 80-84, 116-122, and 151-168 feet. Water sample W-7 (table 1) was collected from a well a short distance south of test hole 4. Analyses of the water sample from this well revealed less hardness than the water collected from location A and the present city well. The water has higher sulfate, iron, manganese, and total solids than the recommended limits. Exact depth of this well is not known; therefore, it is not clear which sand and gravel deposit is producing the water. Additional testing is required to determine if this location will produce the desired quantity of water for the town.

Should the city decide to test the potential of

Table 1. Chemical analyses of water samples from the Spencer area

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chlorides	Sulfate	Iron	Manganese	Nitrate Nitrogen	Fluoride	pH	Hardness $CaCO_3$	Total Solids
A		----	----	----	250	500[1]	0.3	0.05	10.0	0.9-1.7[2]	----	----	1000[1]
W- 1	B	202	244	29	43	872	0.0	0.2	0.4	0.6		624	1458
W- 2	B	69		17	100	280	1.6	0.13	5	0.5	8.3	210	966
W- 3	B	200		30	99	800	10	2.3	4.5	0.92	7.8	640	1550
W- 4	B	64	280	24	42	668		0.23	1.0	0.4		261	1320
W- 5	B	192	200	63	46	800			1.3	0.6		739	1610
W- 6	B	223		54.8	44.7	750	0.3	2.15	0.62		7.4	780	1529
W- 7	B	71.9		11.0	52.5	681	1.84	0.46	1.88		7.5	224	1381
W- 8	S	593	900	324	24	3754	2.8	0.0	1.1	0.9		2814	6254
W- 9	S	290	340	205	317	1458	2.5			0.4		1570	3268
W-10	B	149		24	34	820	0.0	0.07	7	0.66	8.1	470	1470
W-11	B	162		13	128	850	0.24	0.11	5	0.69	7.8	458	1600
W-12	Q	200		60	42	800	0.2	1.5			7.3	850	1391

Source: B, buried outwash and sand lenses; S, surface outwash, Q, quartzite.

A. Drinking water standards, U. S. Public Health Service (1962).

Samples W-2, W-3, W-8, W-9, and W-10 were analyzed by the South Dakota Geological Survey. All other samples were analyzed by the South Dakota Chemical Laboratory.

[1]Modified for South Dakota by the Department of Health (written communication, Water Sanitation Section, September 24, 1968).

[2]1.2 is optimum for South Dakota

Location of water samples from the Spencer area
(For map location see fig. 4.)

W- 1. NE¼SW¼SW¼SW¼ sec. 2, T. 103 N., R. 57 W., D. Brown, 105 feet deep, water level 22 feet.

W- 2. SW¼NE¼SE¼SE¼ sec. 2, T. 103 N., R. 57 W., K. Steichen, 148 feet deep, water level 90 feet.

W- 3. NE¼NW¼SW¼SW¼ sec. 6, T. 103 N., R. 56 W., D. Wise, 250 feet deep.

W- 4. NE¼SE¼NW¼SW¼ sec. 4, T. 103 N., R. 56 W., C. Zahrndt, 150 feet deep, water level 75 feet.

W. 5. NW¼SE¼SE¼SE¼ sec. 12, T. 103 N., R. 57 W., Mrs. S. Hofer, 120 feet deep, water level 80 feet.

W- 6. SW¼NE¼NE¼ sec. 12, T. 103 N., R. 57 W., E. Delgen, 225 feet deep.

W- 7- SE¼SE¼SE¼ sec. 12, T. 103 N., R. 57 W., Mrs. S. Hofer, 80? feet deep.

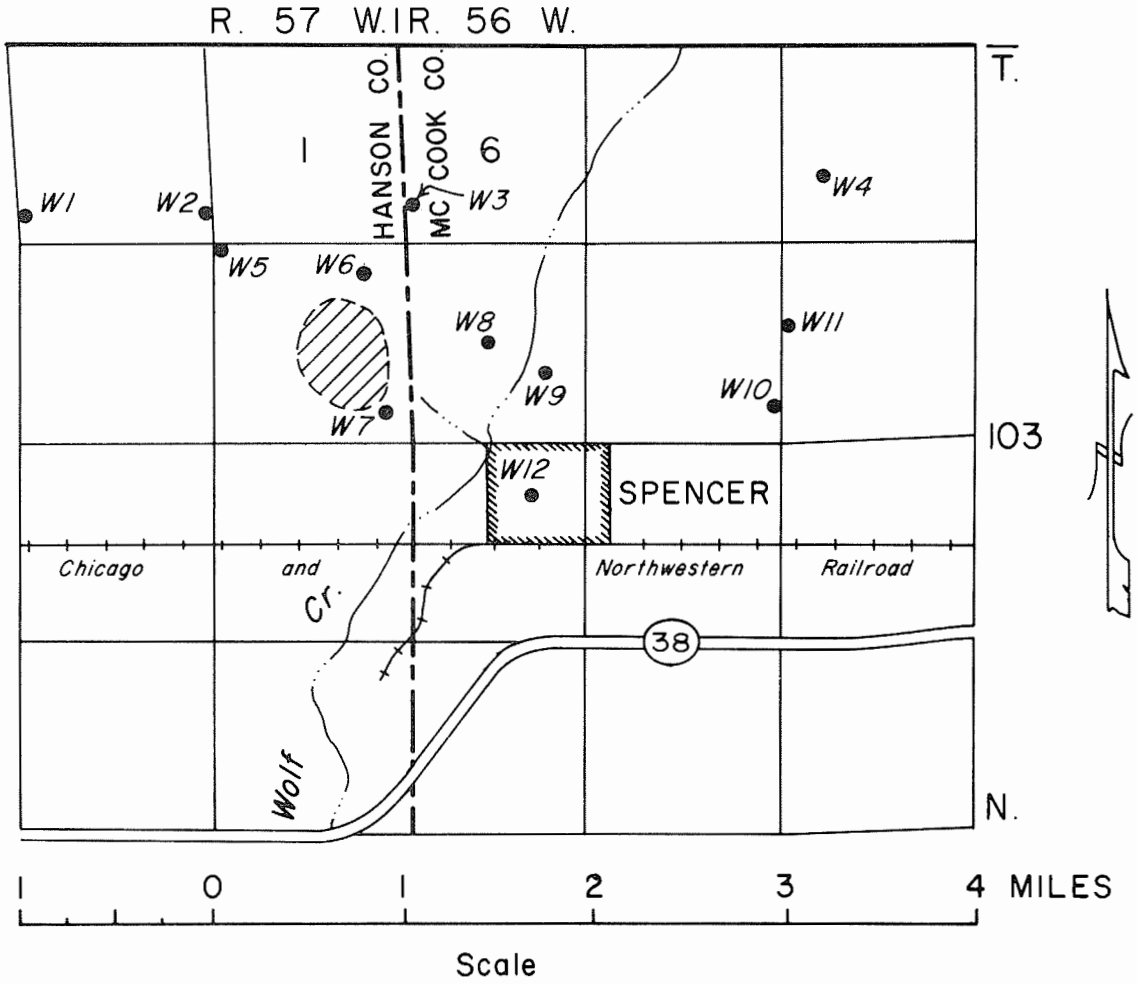
W- 8. NW¼NW¼NW¼SE¼ sec. 7, T. 103 N., R. 56 W., test hole 11; sample from 30 feet below the land surface; water level 8 feet.

W- 9. NW¼NW¼NE¼SE¼ sec. 7, T. 103 N., R. 56 W., test hole 17, sample from 25 feet below the land surface.

W-10. SW¼NE¼SE¼SE¼ sec. 8, T. 103 N., R. 56 W., W. Townsend.

W-11. SW¼SW¼SW¼NW¼ sec. 9, T. 103 N., R. 56 W., A. Kreutzfelt, 200 feet deep, water level 112 feet.

W-12. NE¼ sec. 18, T. 103 N., R. 56 W., city well, 130 feet deep.



LEGEND

W8● Location of water samples, *(numbers refer to water samples in Table 1).*

Intermittent lake

Intermittent stream

by A. Barari

drafted by D. W. Johnson

Figure 4. Map showing location of water samples collected in the Spencer area.

Table 2.--Significance of some chemical and physical properties of drinking water.

Chemical Constituents	Significance	Recommended Limits (ppm)[1]
Calcium (Ca) and Magnesium (Mg)	Cause most of the carbonate hardness and scale-forming properties of water by combining with carbonate and bicarbonate present in the water. Seldom can be tasted except in extreme concentrations.	Ca–None Mg–None
Sodium (Na)	Large amounts in combination with chloride will give water a salty taste. Large amounts will limit water for irrigation and industrial use.	None
Chloride (Cl)	Large amounts in combination with sodium give water a salty taste. Large quantities will also increase corrosiveness of water.	250
Sulfate (SO_4)	Large amounts of sulfate in combination with other ions give a bitter taste to water and may act as a laxative to those not used to drinking it. Sulfates of calcium and magnesium will form hard scale. U. S. Public Health Service recommends 250 ppm maximum concentration.	500[2]
Iron (Fe) and Manganese (Mn)	In excess will stain fabrics, utensils, and fixtures and produce objectionable coloration in the water. Both constituents in excess are particularly objectionable.	Fe–0.3 Mn–0.05
Nitrate Nitrogen (N)	In excess may be injurious when used in infant feeding. The U. S. Public Health Service regards 45 ppm as the safe limit of nitrate (NO_3) or 10 ppm nitrate nitrogen (N).	10
Fluoride (F)	Reduces incidence of tooth decay when optimum fluoride content is present in water consumed by children during period of tooth calcification. Excessive fluoride in water may cause mottling of enamel.	0.9-1.7[3]
pH	A measure of the hydrogen ion concentration; pH of 7.0 indicates a neutral solution, pH values lower than 7.0 indicate acidity, pH values higher than 7.0 indicate alkalinity. Alkalinity tends to aid encrustation and acidity tends to aid corrosion.	None
Hardness	Hardness equivalent to carbonate and bicarbonate is called carbonate hardness. Hardness in excess of this amount is noncarbonate hardness. Hardness in water consumes soap and forms soap curd. Will also cause scale in boilers, water heaters, and pipes. Water containing 0-60 ppm hardness considered soft; 61-120 ppm moderately hard; 121-180 ppm hard, and more than 180 ppm very hard. Good drinking water can be very hard.	None
Total Solids	Total of all dissolved constituents. U. S. Public Health Department recommends 500 ppm maximum concentration. Water containing more than 1000 ppm dissolved solids may have a noticeable taste; it may also be unsuitable for irrigation and certain industrial uses.	1000[2]

Modified from Jorgensen (1966).
[1](ppm) parts per million.
[2]Modified for South Dakota by the South Dakota Department of Health (written communcation, Water Sanitation Section, September 24, 1968.
[3]1.2 is optimum for South Dakota.

sand and gravel deposits in location A, (where the chance of producing significant water for the town is greater) or in location B (where the distance to the town is shorter), it is recommended that a test well be drilled for the purpose of conducting a pump test before the construction of the final well. The pump test should be conducted by a qualified engineer or hydrologist and carried out for a minimum of 72 hours. The South Dakota Geological Survey will provide technical assistance and supervise the conduction of the test. The results of the pump test will afford a basis for deciding if the area will produce the desired quantity and quality of water, determine the proper spacing of production wells, and obtain data for design of the wells.

2. The Sioux Quartzite, which underlies the entire area, will transmit water if there are joints present in the rock. Where the rock is jointed, water will move through the rock; if no joints are present, the rock is practically impermeable to water. For this reason it is possible that two wells a few hundred feet apart, drilled to the same depth into quartzite, will produce a different quantity and quality of water. One well could produce significant quantity of water and the other could produce very little if any water. If should be also noted that the cost of a well in Sioux Quartzite is high. Sample W-12 (table 1) was collected from the city well which produce water from the Sioux Quartzite. This water has higher sulfate manganese and total solids than the recommended limits set by the State Department of Health.

Before a permanent well is drilled, the city officials should consult with the State Water Resources Commission with regard to obtaining water rights and a permit to drill a city well and the State Department of Health with regard to the biological and chemical suitability of water.

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Jorgensen, D. G., 1966, Ground-water supply for the city of Lake Norden: S. Dak. Geol. Survey Special Report 34, 27 p., 6 figs.

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APPENDIX A

Logs of test holes in the Spencer area
(For map location see fig. 3.)

Test Hole 1
Location: SE¼SE¼SE¼SE¼ sec. 6, T. 103 N., R. 56 W.
Depth to water: ?

0 - ½	Topsoil, black
½- 1½	Gravel, coarse, reddish-brown, sand and silt, some boulders present
1½- 3	Sand, very coarse, poorly sorted
3 - 4	Boulders, hard rock
	(Moved twice and found the same material)

* * * *

Test Hole 2 (Rotary Test Hole)
Location: SW¼SW¼SW¼SW¼ sec. 4, T. 103 N., R. 56 W.
Depth to water: not measured

0- 2	Topsoil
2- 7	Clay, brown, sandy
7- 11	Sand and gravel
11- 14	Clay, brown
14- 23	Clay, gray, sandy
23- 27	Sand and gravel
27- 55	Clay, gray, sandy
55- 60	Sand and gravel layers
60-140	Clay, gray, sandy
140-155	Sand, with clay layers
155-178	Clay, gray, sandy
178-185	Sand and gravel, some clay
185-204	Clay, gray, gravelly
204-	Quartzite

* * * *

Test Hole 3 (Rotary Test Hole)
Location: NE¼NW¼NW¼NE¼ sec. 12, T. 103 N., R. 57 W.
Depth to water: not measured

0- 3	Topsoil, black
3- 17	Clay, yellowish-brown
17- 31	Clay, gray
31- 39	Sand and gravel
39-122	Clay, gray, gravelly
122-207	Gravel, some clay stringers
207-240	Gravel, coarse
240-	Quartzite

* * * *

Test Hole 4 (Rotary Test Hole)
Location: NE¼SE¼SE¼SE¼ sec. 12, T. 103 N., R. 57 W.
Depth to water: not measured

0- 2	Topsoil, black
2- 10	Clay, yellow
10- 15	Clay, yellowish-gray
15- 20	Sand and gravel, some clay
20- 80	Clay, gray

Test Hole 4 -- continued.

80- 84	Sand and gravel
84-116	Clay, gray
116-122	Sand and gravel
122-151	Clay and sand?
151-168	Gravel
168-	Quartzite

* * * *

Test Hole 5
Location: NW¼NW¼SW¼NW¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 17 feet

0 - 1½	Topsoil, dark brown, loose
1½- 3	Clay, medium brown, some very fine sand
3 - 11	Clay, yellow brown, soft
11 - 21	Clay, yellow brown, slightly sandy
21 - 27	Clay, brown, sandy
27 - 37	Clay, gray-brown, sand
37 - 56	Clay, gray, sandy
56 - 85	Clay, gray, more compact

* * * *

Test Hole 6
Location: SW¼SW¼NW¼SW¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 6 feet

0- 1	Topsoil, black
1- 6	Silt, black, compact, some pebbles and sand
6- 10	Sand, brown, fine to medium, some clay
10- 12	Gravel?
12- 18	Clay, reddish-brown, sandy
18-125	Clay, some fine sand, pebbles, soft (till)
125-130	Clay, gray, pebbles or gravel

* * * *

Test Hole 7
Location: SE¼SE¼SW¼SW¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 8 feet

0- 1	Topsoil, black
1- 8	Sand, brown, medium, dirty
8- 11	Sand, brown, coarse with scattered pea-size gravel
11-107	Till, gray, unoxidized
107-108	Gravel, medium
108-112	Sand, yellow, fine
112-	Quartzite

* * * *

Test Hole 8
Location: NE¼SW¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 6½ feet

0- 12	Silt, brownish-gray
12- 20	Silt, gray
20- 26	Gravel, well sorted with very coarse sand
34- 35	Gravel, very well sorted, pea-size, very clean
35-108	Till, gray

Test Hole 9
Location: SE¼SE¼NW¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 7 feet

0- 2	Topsoil, black, loose
2- 8	Silt, black, white streaks, some fine sand, compact
8- 20	Clay, gray, soft
20- 22	Clay, gray, medium to coarse sand, soft
22- 28	Gravel, gray, pea-size coarse sand, some gray clay
28- 29	Clay, gray, pebbly, (till)

* * * *

Test Hole 10
Location: SE¼NE¼NW¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 6 feet

0- 2	Topsoil, black
2- 11	Silt, black
11- 16	Gravel, gray to black, pea-size coarse sand, well sorted
16- 17	Gravel, medium size
17- 18	Till, gray
18- 24	Silt, gray, some very fine sand
24- 55	Till, gray

* * * *

Test Hole 11
Location: NW¼NW¼NW¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 8 feet

0- 1	Topsoil, black
1- 10	Silt, black to brown
10- 18	Silt, slightly sandy silt
18- 23	Sand, gray, very coarse
23- 37	Gravel, brown, pea-size, fairly clean
37- 40	Till, gray

* * * *

Test Hole 12
Location: SE¼NW¼NE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 7 feet

0 - 1½	Topsoil, black
1½- 11	Silt, black, some fine sand, compact
11 - 12	Sand, brown, fine to medium, some clay and rocks
12 - 13	Gravel, brown, clean
13 - 14	Clay, gray, some fine sand, pebbles, soft
14 - 50	Clay, gray, compact, pebbly, (till)

* * * *

Test Hole 13
Location: SE¼NE¼NW¼NE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 7 feet

0- 1	Topsoil, black
1- 3	Silt, black, compact
3- 7	Silt, light brown, some very fine sand
7- 11	Clay, yellow-brown, fine sand, much clay
11- 59	Clay, gray, pebbly, compact

Test Hole 14
Location: SE¼NE¼NE¼NE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 10 feet

0- 1	Topsoil, black
1- 8	Silt, brown, silty till, some sand
8- 10	Sand, very fine, clay present
10- 12	Sand, medium, saturated, clay present
12- 14	Gravel, with coarse sand
14- 37	Till, gray unoxidized
37- 80	Till, gray, gravelly
80-119	Till, gray, gravelly
119-	Quartzite

* * * *

Test Hole 15
Location: NW¼NW¼SE¼NE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 12 feet

0 - ½	Topsoil, black
½- 12	Silt, black, compact
12 - 13	Clay, yellow-gray, some fine sand, soft
13 - 16	Clay, brown, some pebbles
16 - 22	Clay, yellow-gray, soft
22 - 27	Clay, gray, lots of large sand and pea-size gravel
27 - 65	Clay, gray, pebble, compact, dry

* * * *

Test Hole 16
Location: SE¼NE¼NE¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 7 feet

0- 2	Topsoil, black, some sand
2- 7	Sand, yellow-gray, fine, some clay
7- 18	Clay, yellow-brown, fine sand
18- 27	Clay, medium-brown, not much sand
27-100	Clay, gray, mostly clay, some fine sand
100-119	Clay, gray, compact, pebbly, (till)

* * * *

Test Hole 17
Location: NW¼NW¼NE¼SE¼ sec. 7, T. 103 N., R. 56 W.
Depth to water: 7 feet

0- 2	Topsoil, black
2- 12	Silt, brown, white streaks
12- 17	Clay, gray-green
17- 25	Sand, grayish-green, coarse, some clay
25- 32	Clay, gray, pebbly, (till)

* * * *

Test Hole 18
Location: NW¼NW¼NW¼NW¼ sec. 13, T. 103 N., R. 57 W.
Depth to water: not measured

0- 2	Topsoil, black, dry
2- 21	Clay, yellow-brown to brown, pebbly, compact, (till)
21- 23	Clay, gray-brown, pebbly, compact, (till)

Test Hole 18 -- continued.

23- 69	Clay, gray, pebbly, compact, (till)
69- 72	Gravel?

* * * *

Test Hole 19
Location: SE¼SW¼SW¼NW¼ sec. 13, T. 103 N., R. 57 W.
Depth to water: ?

0- 1	Topsoil, black
1- 3	Silt, gray
3- 8	Till, yellow
8- 62	Till, gray
62-	Quartzite

* * * *

Test Hole 20
Location: NW¼NW¼NW¼SW¼ sec. 12, T. 103 N., R. 57 W.
Depth to water: 27 feet

0- 2	Topsoil, brown, loose
2- 18	Clay, yellow-brown, pebbly, compact, (till)
18- 23	Clay, brown, pebbly, compact, (till)
23- 27	Clay, gray, pebbly, compact, (till)
27- 37	Clay, gray, pea-size gravel, soft, (till)
37-135	Clay, gray, pea-size gravel to sandy, compact
135-137	Gravel?

* * * *

Test Hole 21
Location: NE¼NE¼NE¼NW¼ sec. 13, T. 103 N., R. 57 W.
Depth to water: 30 feet

0- 1	Topsoil, brown, loose
1- 3	Clay, yellow-brown, loose
3- 17	Clay, yellow-brown, compact, pebbly
17- 18	Clay, gray-green, pebbly, (till)
18- 32	Clay, gray, pebbly, (till)
32- 43	Clay, gray
43- 80	Clay, gray, with much very fine sand
80- 81	Gravel?
81-	Quartzite?

* * * *

Test Hole 22
Location: NW¼SE¼NW¼SW¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: not measured

0 - 3½	Topsoil, brown, loose
3½- 5	Clay, brown, pebbly, more compact
5 - 12	Clay, yellow-brown, soft, pebbly, some fine sand, (till)
12 - 28	Clay, gray, pebbly, compact, (till)
28 -	Quartzite

* * * *

Test Hole 23
Location: NE¼NE¼NW¼SW¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: 7 feet

Test Hole 23 -- continued.

0- 3	Topsoil, brown, loose
3- 5	Clay, yellow-brown, some medium to fine sand
5- 8	Clay, brown, much coarse sand or pea-size gravel
8- 31	Clay, gray, pebbly, compact, (till)
31- 45	Clay, gray, medium to coarse sand, some rocks
45- 46	Sand?
46-	Quartzite

* * * *

Test Hole 24
Location: NE¼NE¼NE¼NW¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: 6 feet

0- 13	Silt, dark brown shading into near black
13- 30	Clay, gray, much clay with some coarse sand and pea-size gravel
30- 52	Clay, slightly sandy
52-122	Clay, gray, (till), pebbly, compact
122-137	Gravel, sand to medium gravel, some rock up to 1 inch in diameter

* * * *

Test Hole 25
Location: SW¼NW¼NW¼NE¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: ?

0- 2	Topsoil, black
2- 3	Silt, black, some very fine sand
3- 6	Clay, gray-brown, some fine sand, some pebbles, (till)
6- 8	Clay, brown, much fine sand
8- 13	Clay, brown, some fine sand, wet
13- 16	Clay, dark brown, some fine to medium sand
16- 92	Clay, gray, compact, pebbly, (till)
92- 94	Sand, brown, fine, pebbles

* * * *

Test Hole 26
Location: SE¼SE¼NE¼NW¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: 65 feet

0- 1	Till, brown, clay with much large gravel
1- 8	Clay, yellow-brown, (till), pebbly
8- 75	Clay, gray, very compact, (till)
75-	Quartzite

* * * *

Test Hole 27
Location: SW¼SW¼SW¼NE¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: 13 feet

0- 2	Topsoil, black
2- 13	Till, yellow
13- 15	Till, yellow-brown, saturated and sandy
15- 23	Till, brown, saturated
23- 24	Till, brown, saturated
24- 59	Till, gray, unoxidized
59-	Quartzite

* * * *

Test Hole 28
Location: SE¼SE¼SE¼NE¼ sec. 18, T. 103 N., R. 56 W.
Depth to water: 20 feet

0- 1	Topsoil, brown, powdery, a little fine sand, (till?)
1- 17	Clay, brown, pebbly, (till)
17- 26	Clay, medium brown, some very fine sand
26- 44	Clay, gray, compact, pebbly, some fine sand
44- 51	Gravel, clean, (very little clay), coarse sand to pea-size
51- 92	Clay, gray, compact, pebbly, (till)
92-	Quartzite

* * * *

Test Hole 29
Location: NE¼NE¼NE¼NE¼ sec. 17, T. 103 N., R. 56 W.
Depth to water: not measured

0- 1	Topsoil
1- 2	Clay, yellowish-brown
2- 17	Clay, brown
17- 37	Clay, gray
37- 38	Gravel
38-136	Clay, gray
136-142	Gravel
142-	Quartzite

* * * *

Test Hole 30
Location: SE¼SE¼SE¼SE¼ sec. 17, T. 103 N., R. 56 W.
Depth to water: 38 feet

0- 2	Topsoil, brown, loose
2- 25	Clay, yellow-brown, loose, pebbly
25- 35	Clay, gray-brown, very pebbly, (till)
35- 43	Clay, gray, pebbly, (till)
43- 51	Sand, gray, medium to coarse
51- 60	Sand, gray, coarse, some gravel
60-134	Clay, gray, compact
134-	Quartzite

* * * *

Test Hole 31
Location: NW¼NW¼NE¼NW¼ sec. 19, T. 103 N., R. 56 W.
Depth to water: 8 feet

0 - 2½	Topsoil, brown
2½- 6	Clay, yellow-brown, pebbly, compact, (till)
6 - 8	Clay, brown, much coarse sand or pea-size gravel
8 - 11	Gravel, red-brown, medium to coarse sand, much clay
11 - 32	Clay, gray, compact, pebbly, (till)
32 - 35	Sand, probably coarse
35-	Quartzite

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APPENDIX B

Well Records in the Spencer area

Source: O, outwash and sand lenses; Q, quartzite

Use: D, domestic; S, stock

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Schneider, L.	SE¼SW¼NW¼SW¼ sec. 3, T. 104 N., R. 57 W.	260	12	O	D,S
Schneider, L.	SE¼SW¼NW¼SW¼ sec. 3, T. 104 N., R. 57 W.	365	12	O	D,S
Schroeder, B.	NE¼SE¼SW¼SE¼ sec. 9, T. 104 N., R. 57 W.	332	20	O	D,S
Muller, L.	NW¼SE¼SE¼SE¼ sec. 15, T. 104 N., R. 57 W.	350	20	O	D,S
Klinkhammer, W.	SE¼NW¼NE¼NW¼ sec. 16, T. 104 N., R. 57 W.	350			D,S
Klinkhammer, C.	SE¼NE¼NE¼SE¼ sec. 17, T. 104 N., R. 57 W.	360			D,S
Stevenson, G.	SE¼SE¼SE¼SE¼ sec. 20, T. 104 N., R. 57 W.	75	40	O	D,S
Beatch, F.	SE¼NE¼NW¼NE¼ sec. 20, T. 104 N., R. 57 W.	374	15	O	D,S
Kunkel, L.	SW¼NE¼NE¼NE¼ sec. 21, T. 104 N., R. 57 W.	300		O	D,S
Kunkel, H.	NW¼SE¼SW¼SW¼ sec. 22, T. 104 N., R. 57 W.	342	25		D,S
Kaufman, M.	SW¼NE¼NE¼NE¼ sec. 22, T. 104 N., R. 57 W.	365		Q	D,S
Scheuren, A.	SW¼NE¼SE¼NE¼ sec. 23, T. 104 N., R. 57 W.	520			D,S
Bartscher, H.	NE¼SW¼SW¼SE¼ sec. 26, T. 104 N., R. 57 W.				D
Richards, W.	NW¼ sec. 26, T. 104 N., R. 57 W.	120		O	D,S
Bowling, T.	NE¼SW¼SW¼NW¼ sec. 27, T. 104 N., R. 57 W.	180			S
Tysdal, F.	NW¼SE¼SW¼SE¼ sec. 27, T. 104 N., R. 57 W.	325	20		D,S
Bowling, T.	NE¼SW¼SW¼NW¼ sec. 27, T. 104 N., R. 57 W.	500	18		D,S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Roster, L.	SE¼NW¼NW¼SW¼ sec. 27, T. 104 N., R. 57 W.	446	22		D,S
Lahr, J.	NE¼SW¼SE¼SE¼ sec. 29, T. 104 N., R. 57 W.	278		Q	S
Roster, L.	SW¼SE¼NE¼NE¼ sec. 32, T. 104 N., R. 57 W.	380	50		S
Gannon, G.	SW¼NE¼NE¼SE¼ sec. 32, T. 104 N., R. 57 W.	300	50	O	S
Little, J.	SW¼NW¼SW¼ sec. 34, T. 104 N., R. 57 W.	180		O	D,S
Vanderhamm, H.	NE¼SE¼SW¼SE¼ sec. 34, T. 104 N., R. 57 W.	300	240	O	D,S
McDaniel, G.	NW¼SE¼SE¼SW¼ sec. 14, T. 104 N., R. 56 W.	115	60	Q	S
Dorale, E.	SE¼NE¼SE¼SW¼ sec. 18, T. 104 N., R. 56 W.		10		S
Roesler, E.	SW¼SE¼SE¼NE¼ sec. 19, T. 104 N., R. 56 W.	164	4	Q	S
McDaniel, G.	NE¼ sec. 20, T. 104 N., R. 56 W.	100		Q	S
Dorale, W.	NE¼SW¼SW¼SE¼ sec. 20 T. 104 N., R. 56 W.	22			D,S
McDaniel, G.	NW¼SW¼SE¼SW¼ sec. 21, T. 104 N., R. 56 W.	120	75	Q	D,S
McDaniel, G.	SW¼NW¼NE¼NE¼ sec. 22, T. 104 N., R. 56 W.	104	60	Q	S
Rabenhorst, R.	NW¼SW¼SW¼SE¼ sec. 23, T. 104 N., R. 56 W.	120	100	O	D,S
Keefe, C.	SW¼SW¼NW¼ sec. 23, T. 104 N., R. 56 W.	150	120		D,S
Brown, R.	SE¼NW¼NW¼SW¼ sec. 26, T. 104 N., R. 56 W.	180		Q	D,S
Jensen, R.	NW¼SW¼SW¼SE¼ sec. 27, T. 104 N., R. 56 W.			Q	D,S
Wier, H.	SW¼NE¼SE¼NE¼ sec. 27, T. 104 N., R. 56 W.	162			D,S
Dorale, D.	SE¼SW¼NW¼NW¼ sec. 28, T. 104 N., R. 56 W.	54		O	
Roesler, P.	NE¼SW¼NW¼SW¼ sec. 28, T. 104 N., R. 56 W.	145			

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Koepke, C.	NE¼SW¼SW¼SE¼ sec. 29, T. 104 N., R. 56 W.	90			D,S
Tillotson, A.	NW¼SE¼SW¼ sec. 30, T. 104 N., R. 56 W.	225	26	O	S
Tillotson, A.	NW¼SE¼SE¼SW¼ sec. 30, T. 104 N., R. 56 W.	289	10	O	D,S
Strong, O.	NW¼NW¼SE¼SE¼ sec. 30, T. 104 N., R. 56 W.	220	10	Q	D,S
Eilts, E.	SW¼SE¼NE¼SW¼ sec. 31, T. 104 N., R. 56 W.	375		O	D,S
Vinz, H.	SW¼SE¼NE¼NW¼ sec. 32, T. 104 N., R. 56 W.	186		Q	D,S
Carey, L.	NE¼NW¼SW¼NW¼ sec. 33, T. 104 N., R. 56 W.	169	30		D,S
Uphoff, H.	SE¼SW¼NW¼SW¼ sec. 34, T. 104 N., R. 56 W.	100			D,S
Strong, C.	SE¼SW¼NW¼SW¼ sec. 34, T. 104 N., R. 56 W.				D,S
Uphoff, H.	SE¼SW¼NW¼SW¼ sec. 34, T. 104 N., R. 56 W.	100			D,S
Uphoff, H.	NE¼SW¼SE¼SW¼ sec. 35, T. 104 N., R. 56 W.	90			D,S
Schultz, J.	NE¼SW¼SE¼SW¼ sec. 1, T. 103 N., R. 57 W.	165	4		D,S
Brown, D.	NE¼SW¼SW¼SW¼ sec. 2, T. 103 N., R. 57 W.	105	22	O	D,S
Steichen, K.	SW¼NE¼SE¼SE¼ sec. 2, T. 103 N., R. 57 W.	148	90	O	D,S
Steinnete, M.	NE¼SW¼SW¼SW¼ sec. 3, T. 103 N., R. 57 W.	194		O	D,S
Vanderhamm, D.	SW¼NW¼NW¼NE¼ sec. 3, T. 103 N., R. 57 W.	290	8	O	D,S
Lewis, D.	SE¼NE¼NW¼NW¼ sec. 10 T. 103 N., R. 57 W.	178		Q	D,S
Schneider, C.	NW¼NE¼SE¼NE¼ sec. 10, T. 103 N., R. 57 W.			O	D,S
Papendick, N.	NW¼SW¼SW¼SE¼ sec. 11, T. 103 N., R. 57 W.	200	50	O	D,S
Dexheimer, H.	SE¼NE¼NW¼NW¼ sec. 11 T. 103 N., R. 57 W.	400		Q	D,S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Hofer, S.	NW¼SE¼SE¼SE¼ sec. 12, T. 103 N., R. 57 W.	120	6	O	S
Hofer, S.	NW¼SE¼SE¼SE¼ sec. 12, T. 103 N., R. 57 W.	120	80	O	S
Hofer, S.	SE¼NW¼NW¼NW¼ sec. 12, T. 103 N., R. 57 W.	120	8	O	D,S
Hairar, J.	NE¼SW¼SW¼SW¼ sec. 13, T. 103 N., R. 57 W.	80		Q	D,S
Schulz, C.	SW¼NW¼NE¼NE¼ sec. 14, T. 103 N., R. 57 W.	65		O	S
Burkhart, W.	NW¼NE¼SE¼SE¼ sec. 15, T. 103 N., R. 57 W.	40		Q	D,S
Dunn, B.	NW¼SE¼SE¼SE¼ sec. 21, T. 103 N., R. 57 W.			Q	D,S
Carey, E.	NW¼NE¼SE¼NE¼ sec. 21, T. 103 N., R. 57 W.	50		Q	D,S
Weber, A.	SE¼NW¼SE¼SE¼ sec. 22, T. 103 N., R. 57 W.				S
Baldwin, J.	NE¼SW¼SE¼SW¼ sec. 22, T. 103 N., R. 57 W.	60		Q	S
Hairar, L.	SE¼NW¼NW¼NW¼ sec. 23, T. 103 N., R. 57 W.			Q	D,S
Kobernusz, C.	NE¼SE¼SW¼SE¼ sec. 23, T. 103 N., R. 57 W.			Q	S
Schumacher, W.	NW¼SE¼NE¼NE¼ sec. 23, T. 103 N., R. 57 W.	90		Q	D,S
Yost, L.	SW¼NE¼NW¼NW¼ sec. 24, T. 103 N., R. 57 W.	120		Q	D,S
Thelen, J.	NW¼SW¼SE¼SE¼ sec. 26, T. 103 N., R. 57 W.				D,S
Kobernusz, R.	SW¼NE¼NE¼NE¼ sec. 26, T. 103 N., R. 57 W.			Q	S
Thelen, J.	SE¼SE¼SE¼SE¼ sec. 27, T. 103 N., R. 57 W.	75		Q	S
Twedt, F.	SE¼NW¼NE¼NW¼ sec. 34, T. 103 N., R. 57 W.	64			D,S
Heronimus, H.	NE¼SW¼SE¼ sec. 34, T. 103 N., R. 57 W.	100	30	Q	S
Assmus, E.	SE¼NW¼NW¼NW¼ sec. 35, T. 103 N., R. 57 W.	123		Q	S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Huber, C.	NE¼SW¼SW¼SE¼ sec. 35, T. 103 N., R. 57 W.	110		Q	S
Cummings, L.	SW¼SE¼NE¼NE¼ sec. 36, T. 103 N., R. 57 W.	75		Q	S
Vinz, W.	SW¼SE¼NE¼NE¼ sec. 2, T. 103 N., R. 56 W.	100		Q	D,S
Roesler, R.	SW¼NW¼NE¼NE¼ sec. 3, T. 103 N., R. 56 W.	110	50	Q	D,S
Zahrndt, C.	NE¼SE¼NW¼SW¼ sec. 4, T. 103 N., R. 56 W.	150	75	O	D,S
Bailey, V.	NE¼SW¼SW¼NW¼ sec. 5, T. 103 N., R. 56 W.				D,S
Eilts, D.	SW¼NE¼NW¼NE¼ sec. 6, T. 103 N., R. 56 W.	150	20		D,S
Eilts, M.	SW¼NW¼NW¼NW¼ sec. 6, T. 103 N., R. 56 W.	165	20		D,S
Wise, D.	NE¼NW¼SW¼SW¼ sec. 6, T. 103 N., R. 56 W.	250		O	S
Vinz, V.	NW¼SE¼SW¼SW¼ sec. 8, T. 103 N., R. 56 W.	205			S
Townsend, W.	SW¼NE¼SE¼SE¼ sec. 8, T. 103 N., R. 56 W.			Q	D,S
Kellogg, H.	NE¼NW¼SW¼NW¼ sec. 8, T. 103 N., R. 56 W.	145			D,S
Vinz, V.	NW¼SE¼SW¼SW¼ sec. 8, T. 103 N., R. 56 W.			O	D
Zahrndt, C.	SW¼NW¼ sec. 9, T. 103 N., R. 56 W.	200			
Kreutzfeldt, A.	SW¼SW¼SW¼NW¼ sec. 9, T. 103 N., R. 56 W.	200	112	O	D,S
Kobernusz, C.	NW¼NW¼SE¼SW¼ sec. 10, T. 103 N., R. 56 W.		53		D,S
Krueger, E.	NE¼SW¼SE¼SW¼ sec. 11, T. 103 N., R. 56 W.	150	16		D,S
Brands, A.	NE¼SW¼NW¼NW¼ sec. 11, T. 103 N., R. 56 W.	152	80	O	D,S
Paulsen, H.	SW¼NE¼SE¼SE¼ sec. 11, T. 103 N., R. 56 W.	180	40		D,S
Nelson, R.	SE¼NW¼NW¼NE¼ sec. 14, T. 103 N., R. 56 W.				D,S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Kobernusz, H.	NW¼SE¼SW¼SW¼ sec. 15, T. 103 N., R. 56 W.	280		Q	D,S
Gross, J.	NW¼SE¼NE¼NE¼ sec. 15, T. 103 N., R. 56 W.	150			D,S
Gabel, A.	NE¼SE¼SW¼SW¼ sec. 17, T. 103 N., R. 56 W.				D,S
Tuschen, L.	NE¼SW¼SW¼SE¼ sec. 17, T. 103 N., R. 56 W.	100	80	O	D,S
Nafziger,	NE¼SW¼NW¼SE¼ sec. 18, T. 103 N., R. 56 W.	30			D,S
Nafziger,	NE¼SW¼NW¼SE¼ sec. 18, T. 103 N., R. 56 W.	100			D,S
Bartholow, D.	SE¼SE¼SE¼SE¼ sec. 18, T. 103 N., R. 56 W.	206	15	Q	D
Burnham, G.	SE¼NE¼SW¼NE¼ sec. 19, T. 103 N., R. 56 W.	150		Q	D,S
Eggars, W.	NE¼SW¼SE¼SE¼ sec. 20, T. 103 N., R. 56 W.	86			D,S
Wise, L.	NW¼SE¼SW¼SW¼ sec. 20, T. 103 N., R. 56 W.	200		Q	D,S
Hofer, D.	NE¼SW¼SW¼SW¼ sec. 21, T. 103 N., R. 56 W.	100		Q	S
Vanderlugt, H.	NW¼NW¼NW¼NW¼ sec. 22, T. 103 N., R. 56 W.	232		Q	D,S
Forster, H.	SE¼NE¼NW¼NW¼ sec. 23, T. 103 N., R. 56 W.	184	40		D,S
Uphoff, E.	NW¼SE¼SE¼NE¼ sec. 26, T. 103 N., R. 56 W.	300			D
Haupt, H.	SE¼NW¼NW¼NE¼ sec. 27, T. 103 N., R. 56 W.	140		Q	D,S
Ruud, L.	SW¼SE¼SW¼ sec. 27, T. 103 N., R. 56 W.	280		O	D,S
Haupt, H.	SE¼NW¼NW¼NE¼ sec. 27, T. 103 N., R. 56 W.	140		Q	D,S
Matthaei, F.	NW¼SW¼SW¼SE¼ sec. 28, T. 103 N., R. 56 W.	100			D,S
Heitzman, C.	SE¼NW¼NW¼NW¼ sec. 30, T. 103 N., R. 56 W.	90		Q	S
Lang, E.	NW¼NE¼SE¼SE¼ sec. 30, T. 103 N., R. 56 W.	190		Q	S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Kayser, L.	NE¼SE¼NE¼NE¼ sec. 31, T. 103 N., R. 56 W.	170?		Q	S
Bentien, H.	NE¼SW¼SW¼NW¼ sec. 31, T. 103 N., R. 56 W.	60		Q	D,S
Kehrman, B.	SE¼NE¼SW¼NW¼ sec. 32, T. 103 N., R. 56 W.	107	37	Q	D,S
Hamaker, C.	NW¼SW¼SW¼SE¼ sec. 33, T. 103 N., R. 56 W.	130		Q	S
Lienemann, C.	SW¼NE¼SE¼NE¼ sec. 33, T. 103 N., R. 56 W.	130	65	O	D,S
Hamaker, M.	SW¼NE¼NW¼NE¼ sec. 34, T. 103 N., R. 56 W.	180	150	Q	D,S
Schimmel, F.	NE¼NE¼NE¼NE¼ sec. 35, T. 103 N., R. 56 W.			Q	D,S
Haupt,	SE¼SW¼SW¼NW¼ sec. 35, T. 103 N., R. 56 W.	135		Q	D,S
Lentz, L.	SW¼SE¼SE¼NE¼ sec. 1, T. 102 N., R. 57 W.	90		Q	D,S
Kayser, N.	NE¼NE¼SW¼NW¼ sec. 1, T. 102 N., R. 57 W.	30			S
Dorele, D.	NW¼SE¼SE¼SE¼ sec. 3, T. 102 N., R. 57 W.				D,S
Lehrman, D.	SE¼SW¼SW¼NW¼ sec. 2, T. 102 N., R. 56 W.	107		Q	S
Newman, E.	SW¼SE¼SE¼NE¼ sec. 2, T. 102 N., R. 56 W.			O	D,S
Heiberger, C.	NE¼SE¼SE¼SW¼ sec. 2, T. 102 N., R. 56 W.	141	83	Q	D,S
Krier, B.	NE¼NE¼NE¼SE¼ sec. 3, T. 102 N., R. 56 W.	128	40	Q	D,S
Zelmer, H.	NW¼SE¼SE¼SE¼ sec. 4, T. 102 N., R. 56 W.	230		Q	D,S
Fatchett, K.	SW¼NE¼SW¼SW¼ sec. 6, T. 102 N., R. 56 W.	100		O	D,S
Uphoff, W.	NE¼SE¼NW¼NW¼ sec. 6, T. 102 N., R. 56 W.	122		Q	D,S
Tegels, A.	SE¼NW¼NE¼NE¼ sec. 7, T. 102 N., R. 56 W.	32		Q	S

Name	Location	Depth of Well (feet)	Depth of Water (feet)	Source	Use
Kressman, J.	NE¼NE¼NE¼NE¼ sec. 10, T. 102 N., R. 56 W.	108		Q	S
Schallenkamp, L.	SW¼NE¼NE¼NE¼ sec. 11, T. 102 N., R. 56 W.	135		O	S
Bunger, K.	SE¼NW¼NW¼NW¼ sec. 12, T. 102 N., R. 56 W.	148		Q	S