STATE OF SOUTH DAKOTA
William J. Janklow, Governor

DEPARTMENT OF WATER AND NATURAL RESOURCES
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GEOLOGICAL SURVEY
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PUMP TEST FOR THE HANSON RURAL WATER SYSTEM

by

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PUMP TEST FOR THE HANSON RURAL WATER SYSTEM

In June, 1979, the Hanson Rural Water System hired Huron Drilling Inc. to drill test holes and construct a pump test well. Huron Drilling under the direction of Bartlett and West Consulting Engineers drilled six test holes in the area. Four of these holes were electrically logged by the South Dakota Geological Survey. Four observation wells and a production well were constructed in the NW¼ of Section 28, Township 101 North, Range 55 West. The top of the aquifer at the production well site was approximately 135 feet and the bottom approximately 198 feet below the land surface. The 10-inch well equipped with 25 feet of screen was gravel packed.

At the request of the Office of Water Rights the South Dakota Geological Survey drilled 11 test holes in the area. Four observation wells were constructed outside the Hanson Rural Water System to monitor the water levels. The logs of these test holes along with the log of an observation well drilled in 1977 by the South Dakota Geological Survey are in Appendix A. Figure 1 shows the location of all the observation wells and the production wells in the area.

At the request of the Hanson Rural Water System the South Dakota Geological Survey supervised a pump test conducted in the NW¼ of Section 28, Township 101 North, Range 55 West located approximately three miles southeast of Bridgewater, South Dakota.

On August 6, 1979, at 5 p.m. the pump test started and continued for 72 hours. The flow meter indicated that 2,585,755

gallons of water were pumped for an average flow rate of 598 gallons per minute.

The recovery was measured in all the test holes and observation wells in the area. By September 18, all wells were recovered within 1.5 feet of the original levels.

Theis and Jacob Methods were used to calculate the transmissivity and the storage coefficient of the aquifer. Based on the data the value of 37,500 gallons/day/foot and storage coefficient of 3.0×10^{-4} are reasonable. Based on these values a well pumping 270 gallons a minute continuously for one year will have a drawdown of approximately five feet at a distance of one mile from the production well. The same well will have a drawdown of less than seven feet after five years in a well at a distance of one mile from the production well. Because of boundary conditions and rapid change in thickness of the aquifer very conservative values were chosen for T and S. Based on values of T = 20,000 gal/day/ft and a $S = 2.0 \times 10^{-4}$, a well pumping 270 gallons a minute continuously for a year will have a drawdown of approximately nine feet at a distance of one mile from the production well and the same well after pumping for five years will have a drawdown of less than 12 feet at a distance of one mile.

It should be noted that all figures are based on no recharge and in actuality the drawdown will be less than the above figures.

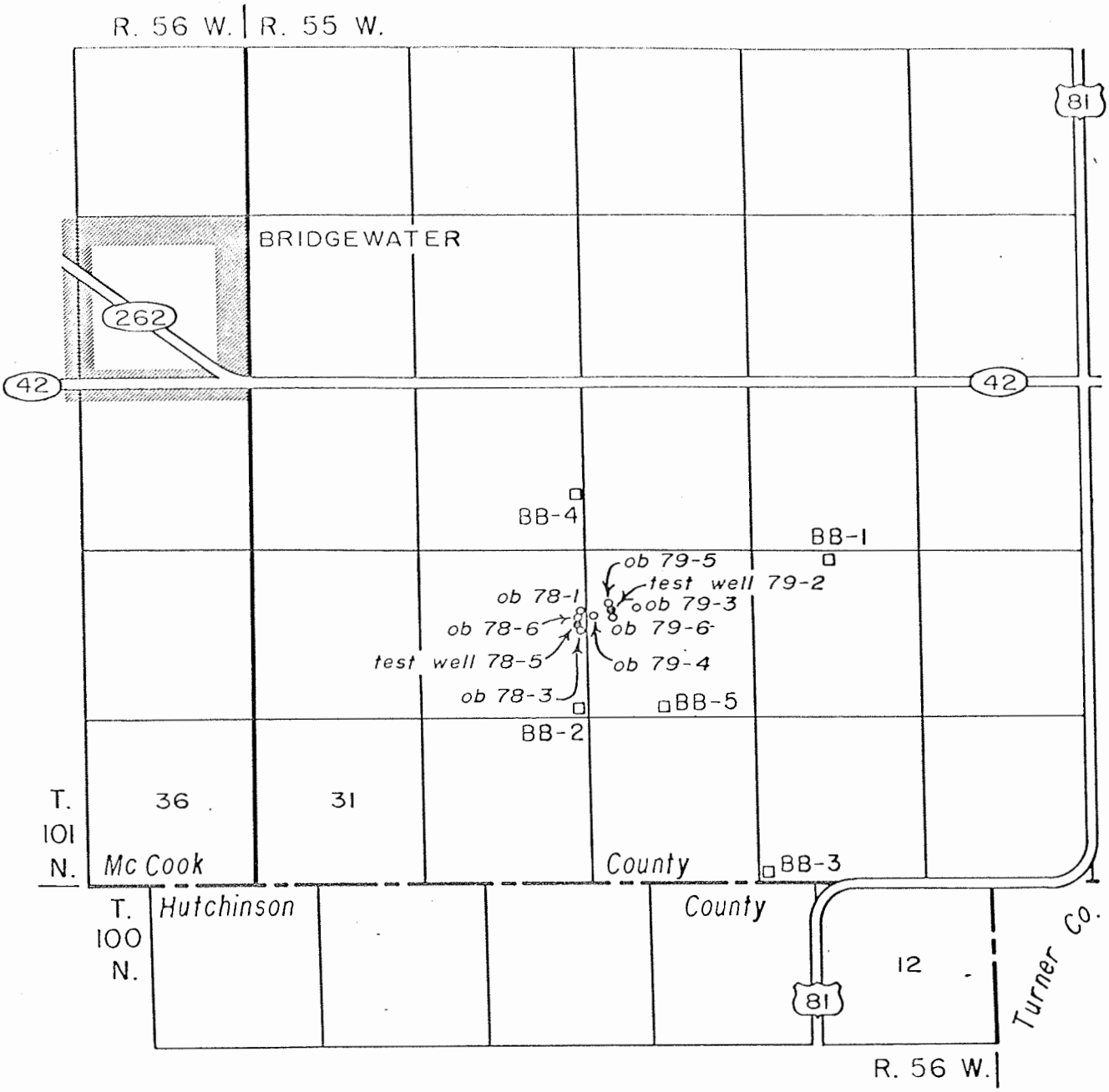
Figure 3, which was prepared after the field work of 1977, shows that the size of the aquifer is at least 64,800 acre feet. Assuming a porosity of 20 percent, the water in storage

in the aquifer is 12,960 acre feet. The Hanson Rural Water System is asking for 435.5 acre feet a year. This means that the Rural Water System is asking for approximately 3.4 percent a year of the water stored in the aquifer. The recent drilling in the area shows that the aquifer is more extensive than shown on Figure 3. (See the log of observation well BB-3 in Appendix A.)

Before the pump test nine water samples were collected from private wells in the area. The results of chemical analses of water samples are in Table 1. Another set of water samples was collected at the end of the pumping period. The samples in Table 1 are designated by a number which refers to the location of the sampling point (see fig. 2), and a letter A or B. The letter A designates the sample was collected before the test and the letter B designates the sample was collected near the end of the pumping period. Sample W-79-9A was collected at the start and W-79-9B was collected at the end of the test from the production well.

Table 1 shows that the total solids in the production well had a slight increase from 830 to 840 parts per million during the test and a decrease of hardness from 83 to 79 parts per million. These changes are very small and could be attributed to the measuring error. However, some change of quality might be seen after a long period of pumping.

This report was prepared by Assad Barari in September, 1979.



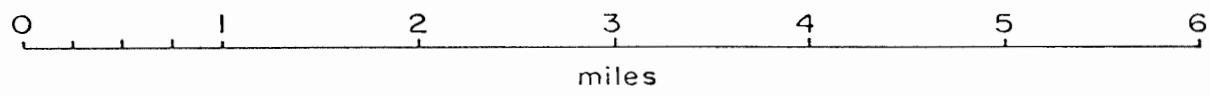
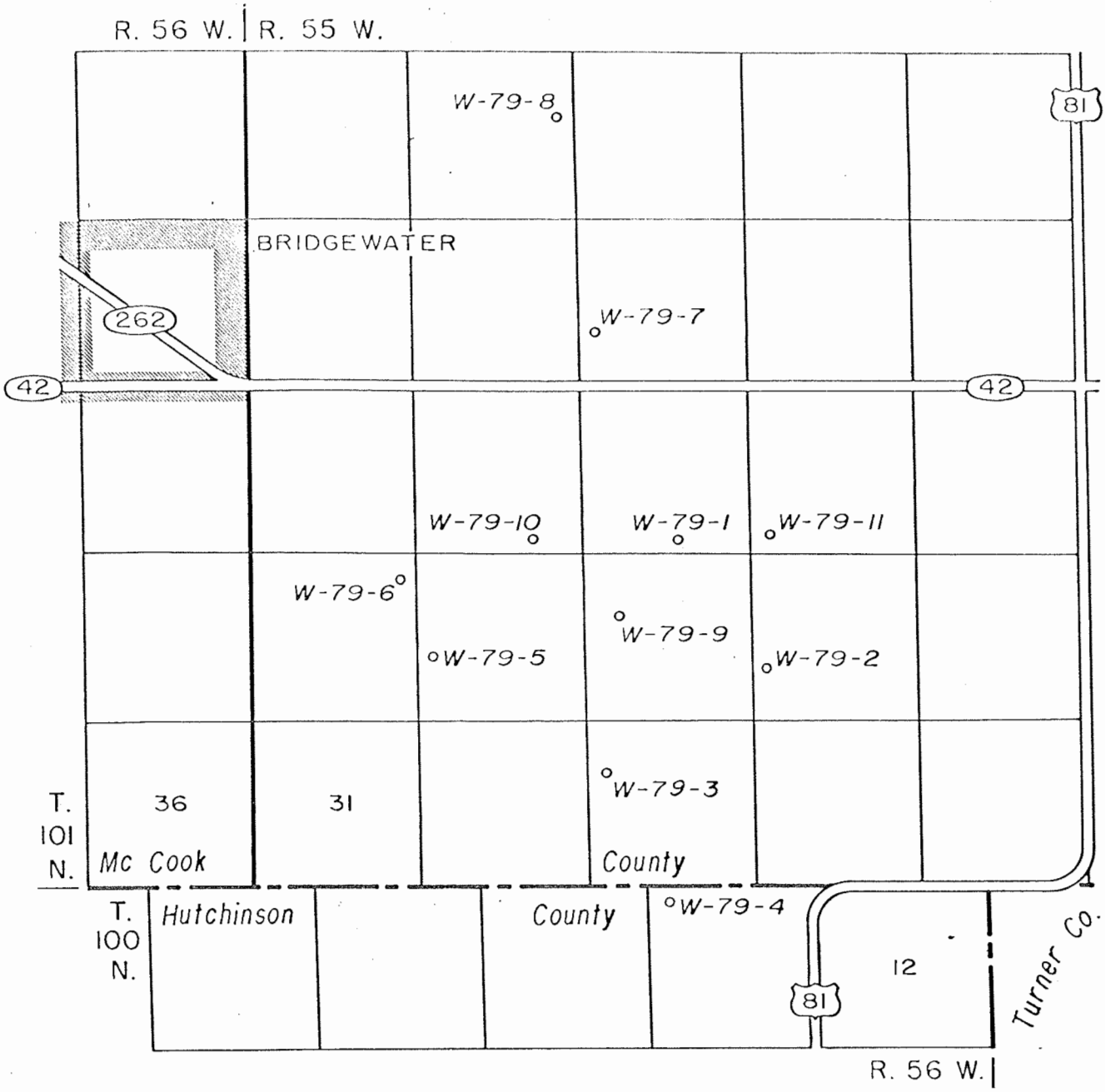
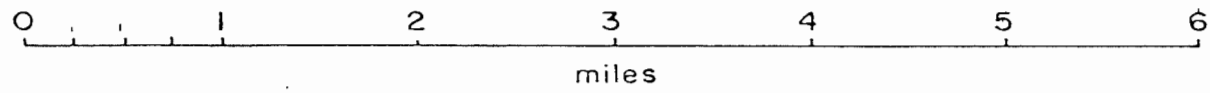


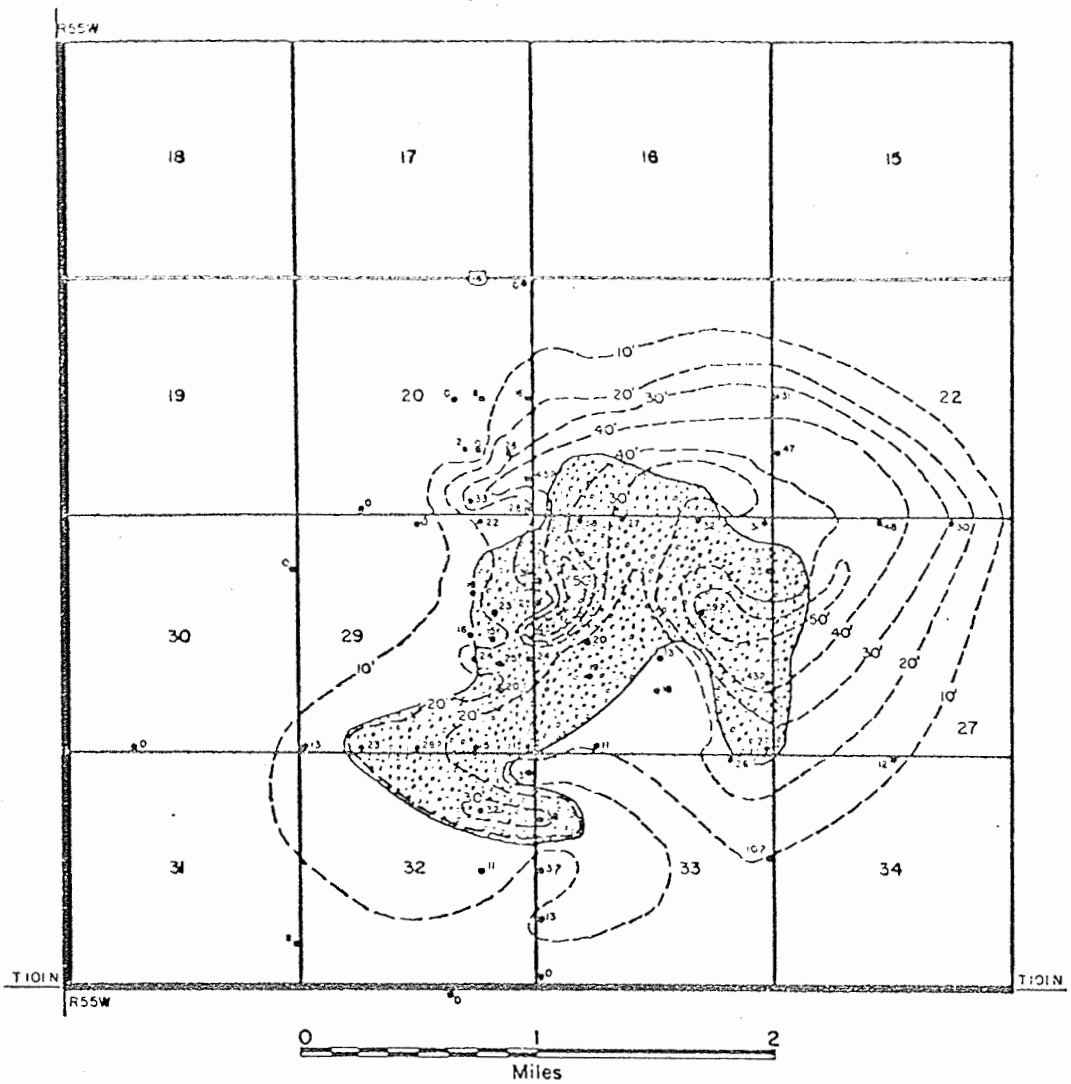
Figure 1. Map showing the location of the pump test wells and observation wells in the area of the Hanson Rural Water Study.





W-79-8 Water sample

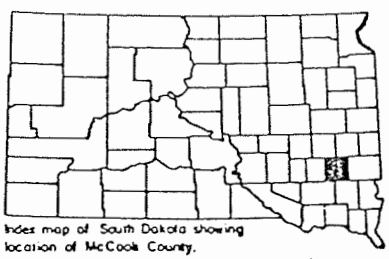
Figure 2. Map showing the location of water samples collected at the beginning and end of the 1979 Hanson Rural Water Pump Test.



Recommended area

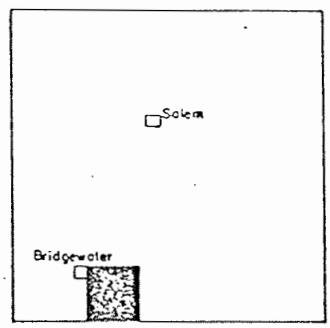
Lines indicating areas of equal thickness of saturated sand and gravel. Contour interval — 10 feet

46• Test hole, number indicates thickness of saturated sand and gravel.



Index map of South Dakota showing location of McCook County.

N



Index map of McCook Co. showing location of this figure.

FIGURE 3

Map showing thickness of saturated sand and gravel

TABLE 1. Chemical analyses of water samples collected at the beginning and end of the Hanson Rural Water pump test.

(For map location, see fig. 2)

Sample	Parts Per Million											Conductivity Mmhos
	Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrate Nitrogen	Fluoride	Hardness $CaCO_3$	Total Solids	
S	---	---	---	250[2]	250[2]	0.3[2]	0.05[2]	10.0[1]	2[1]	----	500[2]	----
W-79- 1A	160	310	39	16	350	3.25	0.05*	----	0.32	559	1250	1750
W-79- 1B	150	306	36	16	350	0.05*	0.05*	----	0.32	522	1270	1750
W-79- 2A	92	282	29	16	210	1.45	0.22	----	0.38	348	1090	1450
W-79- 3A	60	200	13	20	25*	6.0	0.22	----	0.38	203	770	960
W-79- 3B	65	200	13	28	25*	2.30	0.05	----	0.38	215	760	960
W-79- 4A	36	231	12	30	35	2.20	0.05*	----	0.35	139	800	1100
W-79- 4B	38	231	12	28	35	2.70	0.05*	----	0.35	144	830	1100
W-79- 5A	94	140	23	14	190	1.8	0.15	----	0.46	329	790	1100
W-79- 5B	94	134	22	15	190	3.7	0.18	----	0.46	325	820	1080
W-79- 6A	34	188	9	22	25*	1.70	0.05*	----	0.45	122	820	940
W-79- 6B	33	192	9	26	25*	0.06	0.05*	----	0.52	120	840	930
W-79- 7A	100	300	31	16	460	2.60	0.45	0.5*	0.38	376	1480	1740
W-79- 7B	93	302	31	16	445	0.15	0.05*	1.2	0.36	359	1490	1710
W-79- 8A	210	420	210	88	1580	1.50	1.50	25+	0.41	1386	3080	3150
W-79- 9A	20	220	8	18	25	0.75	0.05*	0.5*	0.42	83	830	890
W-79- 9B	20	220	7	18	25*	0.78	0.05*	0.5*	0.42	79	840	950
W-79-10B	30	210	11	18	25*	1.60	0.05*	0.5*	0.41	120	890	1000
W-79-11A	137	323	51	21	750	0.25	0.05*	0.5*	0.30	551	1710	2200

Sample S

[1]National Interim Primary Drinking Water Regulations, December 24, 1975 (enforceable limits)

[2]Proposed National Secondary Drinking Water Regulations, March 31, 1977, (recommended limits)

*Less than

Designation of water sample collection

A - collected prior to the test
B - collected at the end of the test

Location of water samples collected at the beginning and end of Hanson Rural Water 1979 pump test.

For map location, see figure 2.

W-79- 1 SW¼SE¼ sec. 21, T. 101 N., R. 55 W., Gordon Wollman, 150 feet deep.

W-79- 2 SW¼ sec. 27, T. 101 N., R. 55 W., Clifford Wollman, 155 feet deep.

W-79- 3 SW¼NW¼ sec. 33, T. 101 N., R. 55 W., Paul Hofer, 160? feet deep.

W-79- 4 NW¼NW¼NW¼ sec. 11, T. 100 N., R. 56 W., Larry Hofer, 125 feet deep.

W-79- 5 NW¼SW¼ sec. 29, T. 101 N., R. 55 W., William Rinehart, 140 to 150 feet deep.

W-79- 6 NE¼NE¼ sec. 30, T. 101 N., R. 55 W., Mikael Hofer, 145 to 150 feet deep.

W-79- 7 SW¼ sec. 16, T. 101 N., R. 55 W., Roger Hofer, 132 feet deep. Water level in the old well was 54 feet before the pump test and at the end of the test. Water samples were collected from the well next to the barn.

W-79- 8 SE¼NE¼ sec. 8, T. 101 N., R. 55 W., Roger Hofer, 252 feet deep.

W-79- 9 NW¼ sec. 28, T. 101 N., R. 55 W., Pump test well, 195 feet deep.

W-79-10 SE¼SE¼ sec. 20, T. 101 N., R. 55 W., Jacob Hofer (Dennis Hofer), 145 feet deep.

W-79-11 SW¼SW¼ sec. 22, T. 101 N., R. 55 W., Harold Hofer, new well, 147 feet deep.

APPENDIX A

Logs of test holes and observation wells
drilled by the South Dakota Geological Survey

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-20 aaaa

Location NE¼NE¼NE¼NE¼ Section: 20 T. 101 N R. 55 W

Test Hole: 79-1 Well: Land Owner:

County: McCook Date: 7-17-79 Elevation: 1439 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
24	Clay, yellowish-brown, sandy, silty, pebbly (till)	2- 26
198	Clay, gray, sandy, pebbly (till)	26-224
	Very hard rock, quartzite	224
	Total depth - 224 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-29 dddd

Location SE¼SE¼SE¼SE¼ Section: 29 T. 101 N R. 55 W

Test Hole: 79-2 Well: BB-2 Land Owner:

County: McCook Date: 7-18-79 Elevation: 1438 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Jared Aldern

Thickness	Lithologic Description	From - to Feet
1	Soil	0- 1
15	Clay, brown, silty, pebbly (till)	1- 16
126	Clay, gray, silty, pebbly (till)	16-142
10	Sand, silty	142-152
8	Gravel, fine to medium, well rounded	152-160
29	Clay, gray, silty, sandy, gravelly (till)	160-189
	Quartzite	189
	Observation well (BB-2)	
	Casing - 150 feet of plastic pipe and 4 feet of sand point.	
	Total depth - 189 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-34 cccc

Location SW¼SW¼SW¼SW¼ Section: 34 T. 101 N R. 55 W

Test Hole: 79-3 Well: BB-3 Land Owner:

County: McCook Date: 7-18-79 Elevation: 1438 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
1	Soil	0- 1
20	Clay, yellowish-brown, silty, sandy (till)	1- 21
42	Clay, grayish-brown, silty, sandy (till)	21- 63
12	Sand, fine, gravel, silty	63- 75
77	Clay, brownish-gray, silty, pebbly (till)	75-152
16	Sand, fine to coarse, some gravel, silty	152-168
18	Clay, brownish-gray, sandy, pebbly	168-186
	Observation Well (BB-3)	
	Casing - 160 feet of plastic pipe and 4 feet of sand point.	
	Total depth - 186 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-33 aaaa

Location NE¼NE¼NE¼NE¼ Section: 33 T. 101 N R. 55 W

Test Hole: 79-4 Well: Land Owner:

County: McCook Date: 7-19-79 Elevation: 1444 T

E-Log: Yes Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Jared Aldern

Thickness	Lithologic Description	From - to Feet
1	Soil	0- 1
5	Clay, brown, silty, pebbly	1- 6
3	Sand, fine to gravel, well rounded	6- 9
11	Clay, brown, silty	9- 20
29	Clay, gray, very silty, pebbly (till)	20- 49
106	Clay, gray, silty, sandy (till)	49-155
17	Sand and gravel, silty	155-172
26	Clay, gray, sandy, pebbly (till)	172-198
	Quartzite	198
	Total depth - 198 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-20 dadd

Location SE¼SE¼NE¼SE¼ Section: 20 T. 101 N R. 55 W

Test Hole: 79-5 Well: BB-4 Land Owner:

County: McCook Date: 7-19-79 Elevation: 1445 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
1	Soil	0- 1
20	Clay, yellowish-brown	1- 21
51	Clay, gray, sandy, silty, pebbly (till)	21- 72
3	Sand, medium to coarse, some gravel	72- 75
80	Clay, gray, sandy (till)	75-155
3	Sand, coarse, some gravel	155-158
17	Sand, medium to coarse, silty	158-175
20	Sand, coarse, some gravel, silty	175-195
21	Clay, gray, silty, sandy (till)	195-216
	Observation well (BB-4)	
	Casing - 162 feet of plastic pipe and 4 feet of sand point	
	Total depth - 216 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-30 addd

Location SE¼SE¼SE¼NE¼ Section: 30 T. 101 N R. 55 W

Test Hole: 79-6 Well: Land Owner:

County: McCook Date: 7-20-79 Elevation: 1436 T

E-Log: Yes Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Jared Aldern

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
32	Clay, brown, silty	2- 34
31	Clay, gray, sandy, pebbly (till)	34- 65
61	Clay, gray, very silty, pebbly (till)	65-126
9	Clay?	126-135
65	Clay, gray, silty, gravelly (till)	135-200
	Quartzite	200
	Total depth - 200 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-56-25 dddd

Location SE¼SE¼SE¼SE¼ Section: 25 T. 101 N R. 56 W

Test Hole: 79-7 Well: Land Owner:

County: McCook Date: 7-23-79 Elevation: 1425 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
17	Clay, yellow, sandy, pebbly	2- 19
141	Clay, gray, sandy	19-160
20	Clay?, sand?, silty	160-180
47	Clay, brown, silty	180-227
	Total depth - 227 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-30 dddd

Location SE¼SE¼SE¼SE¼ Section: 30 T. 101 N R. 55 W

Test Hole: 79-8 Well: Land Owner:

County: McCook Date: 7-25-79 Elevation: 1434 T

E-Log: Yes Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
29	Clay, yellowish-brown, silty	2- 31
99	Clay, silty, pebbly (till)	31-130
12	Sand, silty?	130-142
48	Clay, sandy (till)	142-190
10	Clay?, sandy (till?)	190-200
3	Clay, sandy (till)	200-203
	Total depth - 203 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-28 dccc

Location SW¼SW¼SW¼SE¼ Section: 28 T. 101 N R. 55 W

Test Hole: 79-9 Well: BB-5 Land Owner:

County: McCook Date: 7-26-79 Elevation: 1441 T

E-Log: Yes Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Jared Aldern

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
22	Clay, brown, silty	2- 24
118	Clay, gray, pebbly (till)	24-142
13	Sand, fine, some gravel	142-155
7	Clay?, pebbly	155-162
12	Sand, fine to medium	162-174
25	Clay, gray, gravelly (till)	174-199
	Quartzite	199
	Observation Well (BB-5)	
	Casing - 168 feet of plastic pipe and 5 feet of sand point	
	Total depth - 199 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-33 bccc

Location SW¼SW¼SW¼NW¼ Section: 33 T. 101 N R. 55 W

Test Hole: 79-10 Well: Land Owner:

County: McCook Date: 7-25-79 Elevation: 1433 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Bo Garrison

Rotary: Combination Auger: Driller: Bo Garrison

Thickness	Lithologic Description	From - to Feet
2	Soil	0- 2
23	Clay, brown, sandy (till)	2- 25
105	Clay, gray, sandy (till)	25-130
12	Sand?	130-142?
55	Clay, gray, pebbly (till)	142?-197
	Quartzite	197
	Total depth - 197 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY Location 101-55-27 aabb

Location NW¼NW¼NE¼NE¼ Section: 27 T. 101 N R. 55 W

Test Hole: R-60-77 Well: BB-1 Land Owner:

County: McCook Date: 8-24-77 Elevation: 1450 T

E-Log: No Samples: No Drilling Company: SD Geological Survey

Project: Hanson Rural Water Study Geologist: Carl Cripe

Rotary: Yes Auger: Driller:

Thickness	Lithologic Description	From - to Feet
2	Topsoil, black	0- 2
15	Clay, yellow-brown, silty, pebbly (till)	2- 17
35	Clay, gray, silty, pebbly (till)	17- 52
17	Clay, gray, silty, gravelly (till)	52- 69
9	Clay, gray, silty, pebbly (till)	69- 78
1	Gravel	78- 79
3	Clay, gray, silty, pebbly (till)	79- 82
12	Gravel, clayey	82- 94
70	Clay, gray, silty, gravelly (till)	94-164
30	Gravel, medium to coarse	164-194
64	Clay, gray, silty, gravelly (till)	194-258
	Quartzite	258
	Observation well (BB-1)	
	Observation well (SDGS) length of pipe 168? feet	
	Water Quality - 2000 ppm TDS	
	Total depth - 258 feet	