STATE OF SOUTH DAKOTA
Richard Kneip, Governor

DEPARTMENT OF NATURAL RESOURCE DEVELOPMENT
Vern W. Butler, Secretary

GEOLOGICAL SURVEY
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GROUND-WATER STUDY FOR THE CLAY RURAL WATER SYSTEM

by

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GROUND WATER STUDY FOR

CLAY RURAL WATER SYSTEM

At the request of Clay Rural Water System, the South Dakota Geological Survey conducted a ground water study in part of northern Clay County. This study was started on May 17 and was completed on June 4, 1976. The purpose of the investigation was to assist the Rural Water System in locating a water supply.

Included in the study were: 1) drilling of 12 test holes, 2) constructing an observation well in each test hole, 3) surveying the elevation of observation wells, and 4) collection and analysis of 19 water samples.

The project was financed by South Dakota Geological Survey and the Clay Rural Water System.

Figure 1 is a data map showing the location of observation wells in the area. The logs for these holes are in Appendix A. Aquifer material was penetrated by all test holes. In some test holes in the valley (lowground) the upper part of the aquifer is separated from the lower part. Test Hole 10 for example, had a 6 foot layer of clay from 41 to 47 feet (Figure 2 shows the summary of the logs below the water level). Where the upper and lower gravel was separated by a clay layer, observation wells were constructed in both gravel layer to check the quality of water.

Figure 1 also shows the location of water samples collected in the area. The results of chemical analysis of water samples are in Table 1. Samples 1 through 12 are collected from observation wells. The observation wells (1 through 4) located on high ground could not be pumped satisfactorily enough to clean the drilling fluid. Therefore, the water samples from these observation wells may not be representative samples. The quality of water in the vicinity of Test Hole 1 and 2 is expected to be similar to W-13, W-14, W-15 and W-16, which were collected from private wells. These water samples are generally high in iron and manganese. The average hardness for these samples (W-13 thru W-16) is 369 parts per million (ppm) which is approximately 21 grains.

It was mentioned previously that locally in the valley, the upper part of the aquifer is separated from the lower part by a less permeable material. Water from the upper gravel contains less dissolved chemicals than the lower gravel (compare W-11 and W-10 in Table 1). Samples W-17 and W-9 were collected from a private well and an observation well, both of which were drilled to the upper part of gravel. These samples have lower hardness and total solids than W-7, which was collected from an observation well which penetrated to the lower part of the aquifer.

An oral report of the results of this study was given to the Clay Rural Water System Board of Directors on July 14, 1976. It was indicated that the lowest hardness and total solids were in samples collected from W-11, a test hole which penetrated the upper gravel in the valley. If agreement could be obtained from the owners of land in this location, additional test holes should be drilled. The second priority was the area in the valley between Test Hole 9 and 7. It was also recommended that if the Rural Water System should decide to develop wells in this area, a few test holes should be drilled in the area after the agreements have been reached with the owners of the lands. These holes should be drilled in the upper part of the aquifer. If the thickness and particle size of the deposits is satisfactory, a pump test well should be constructed. A pump test should be conducted by a hydrologist or a qualified engineer, and should be at least 72 hours in length. Water samples should be collected during the test and analyzed for chemical content. The results of these tests should provide a basis for determining if the quality and quantity of water is satisfactory.

Before a permanent well is drilled, the Division of Water Rights should be contacted to obtain water rights and the South Dakota Environmental Protection Agency should be contacted to determine the biological and chemical suitability of the water.

Report prepared by Assad Barari

September, 1976

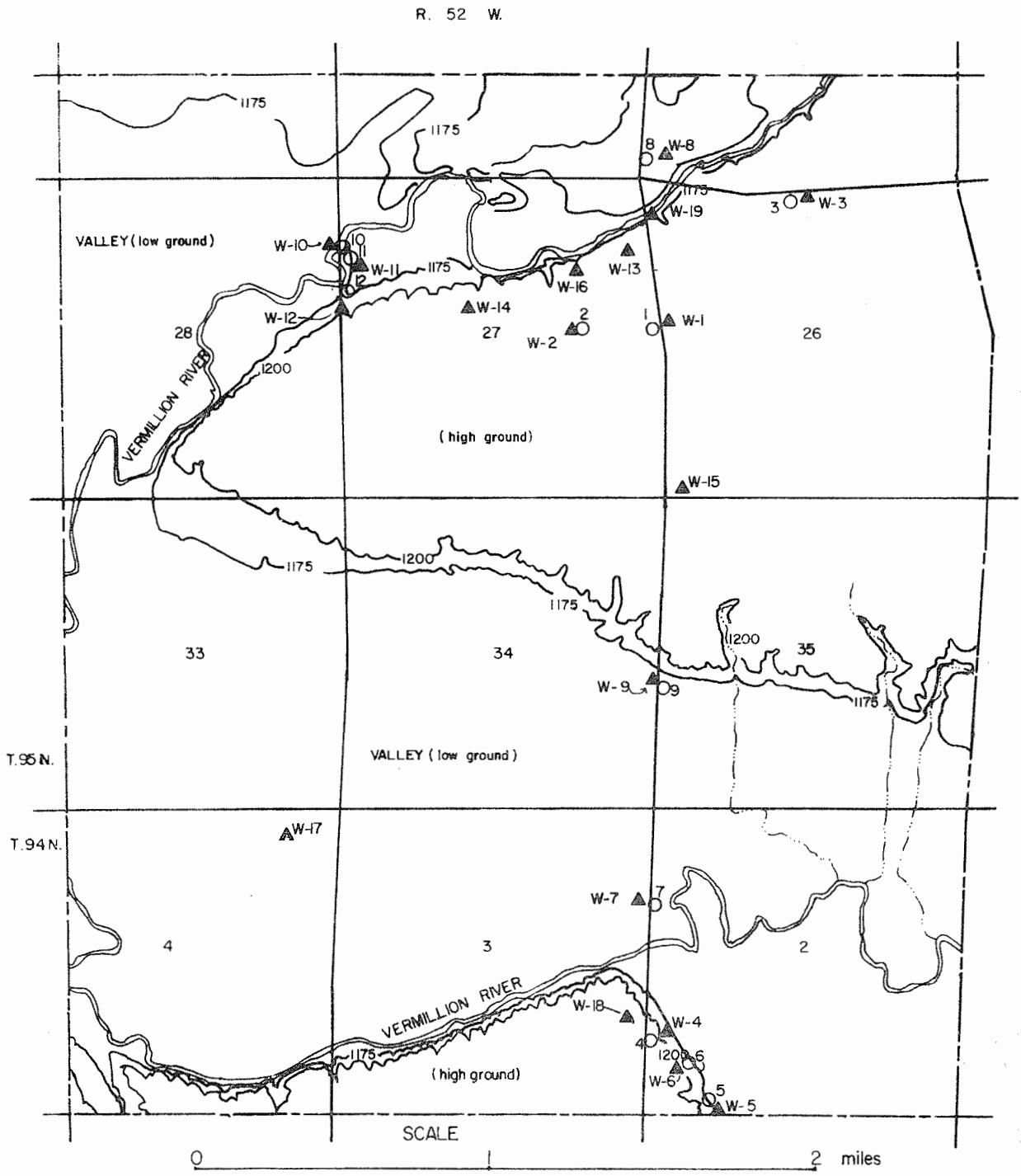

Figure 1 -- Data map showing the location of observation wells and water samples for Clay rural water system.

Explanation

○7 Observation well, number refers to logs in appendix A.

▲W-9 Water sample, number refers to water sample in table 1.

N

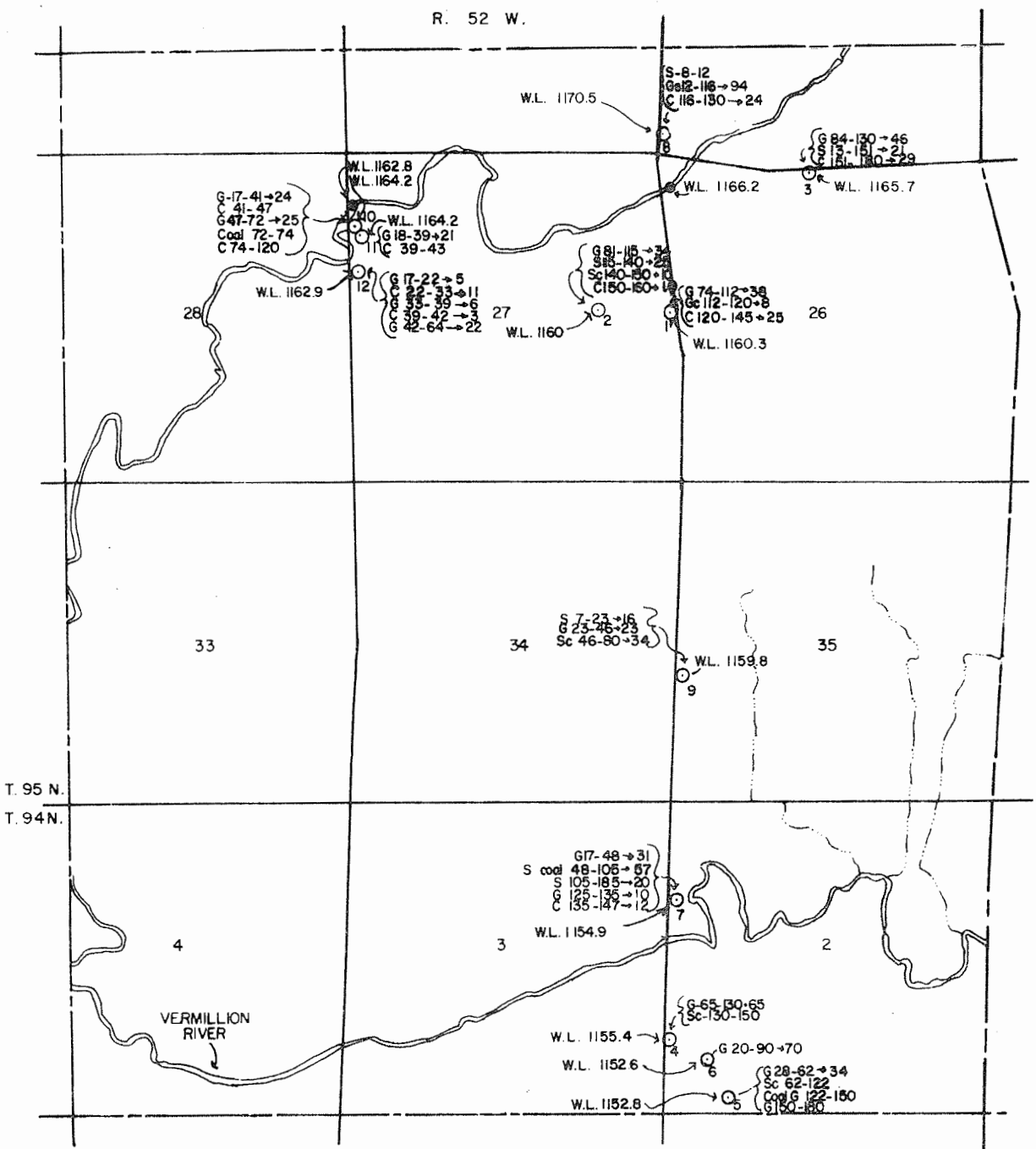

Figure 2 -- Map showing the summary of logs below the water level for Clay rural water system.

EXPLANATION

Water level in feet above mean sea level W.L. 1154.9

Observation well ⊙7

Number refers to logs in app. A

G 17-48 31 Gravel from 17 to 48 feet = 31 feet.

Gc Gravel with clay

S Sand

Sc Sand and clay

C Clay

Coal G Coal and gravel

N

TABLE 1. Chemical analyses of water samples for Clay Rural Water System
(For location, see fig. 1)

Sample	Depth	Parts per million										Hardness in Grains
		Calcium	Sodium	Magnesium	Chlorides	Sulfate	Iron	Manganese	Nitrate Nitrogen	Total Solids	Hardness[2] $CaCO_3$	
A		---	--	---	250	500[1]	0.3	0.05	10.0	1000[1]	----	----
W- 1	120	88	20	32	8	230	5.0	1.3	< 0.5	704	351	20.6
W- 2	110	125	40	52	8	370	20	10	< 0.5	2360	525	30.9
W- 3	140	240	50	59	10	400	20	10	< 0.5	2996	840	49.4
W- 4	120	190	90	210	9	1375	3.2	2.5	5	4236	1336	78.6
W- 5	90	150	40	60	7	360	15	10	< 0.5	916	620	36.5
W- 6	60	80	70	52	11	320	< 0.5	1.1	< 0.5	648	413	24.3
W- 7	130	90	10	53	7	340	2.5	0.9	< 0.5	720	442	26.0
W- 8	50	80	0	53	8	230	6.0	1.3	< 0.5	636	417	24.5
W- 9	40	60	0	22	8	110	0.8	0.8	< 0.5	448	240	14.1
W-10	80	80	0	51	10	220	2.0	0.6	< 0.5	636	409	24.1
W-11	34	39	0	20	10	50	0.9	0.5	< 0.5	274	179	10.5
W-12	53	75	20	32	5	210	1.5	0.7	< 0.5	525	318	18.7
W-13	85?	100	30	42	5	243	<0.05	0.4	< 0.5	790	430	25.3
W-14	90	85	15	42	7	210	8.0	0.9	< 0.5	760	385	22.6
W-15	100	93	15	39	6	184	3.5	1.1	< 0.5	670	390	22.9
W-16	80	60	25	30	4	85	3.0	0.7	< 0.5	520	270	15.9
W-17	15	70	30	37	6	92	<0.05	1.6	7	570	325	19.1
W-18	60?	90	10	43	5	340	1.5	1.2	< 0.5	796	401	23.6
W-19	River	95	80	66	10	430	0.4	2.0	< 0.5	1100	510	30.0

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

All samples were analyzed by the South Dakota Geological Survey

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

[2]To convert to grains, divide parts per million by 17

APPENDIX A

LOGS OF TEST HOLES FOR

CLAY RURAL WATER SYSTEM

95 52 27 addd

SOUTH DAKOTA GEOLOGICAL SURVEY

Location SE¼SE¼SE¼NE¼ Section: 27 T. 95 N. ~~S.~~ R. 52 E. W.

Well: _____ Test Hole: C1 01 Land Owner: _____

County: Clay Date: 5-17-76 Elevation: top of pipe 1234.3 (~~A~~, I, ~~P~~)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	1.5	Topsoil, brown to black	0-1.5
	11.5	Clay, brown to gray-green, unsorted, till	1.5-13
	9	Clay, oxidized, sandy to fine gravel, brown, till	13-22
	.5	Small rock	22-22.5
	7.5	Clay, oxidized, but some unweathered, sandy and	
		gravelly, till	22.5-30
	33	Clay, weathered, sandy with intermittent gravel	
		stringers, coal fragments, till	30-63
	5	Clay, unoxidized, very few gravel or sand	
		stringers, till	63-68
	27	Cobbles, gravel, medium to coarse, clean, subangular	
		to angular	68-95
	17	Gravel, coarse to medium, sub angular, cobbles,	
		some clay, unoxidized	95-112
	8	Gravel, fine, very clayey, gray, subrounded to sub-	
		angular; sand, medium to coarse	112-120
	25	Clay, unoxidized, gray	120-145
		T.D. 145'	
		Obs. Well - 120' pipe (50' slot - 5' sand point)	

95 52 27 dccc

SOUTH DAKOTA GEOLOGICAL SURVEY

Location SW¼SW¼SW¼SE¼ Section: 27 T. 95 N. ~~S~~ R. 52 ~~E~~ W.

Well: _____ Test Hole: Cl 02 Land Owner: _____

County: Clay Date: 5-18-76 Elevation: 1235.3 (~~XXX~~ ', ~~XX~~)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	4	Topsoil, black, sandy (medium)	0-4
	25	Clay, brown, oxidized, sandy, silty, pebbles (till)	4-29
	40.5	Clay, gray unoxidized, sandy, silty, pebbles; (till)	
		sand stringer 35-40	29-69.5
	7.5	Gravel and clay, coarse gravel	69.5-77
	4	Clay, gravelly (till)	77-81
	34	Gravel, fairly coarse, some clay, coal fragments	81-115
	25	Sand, very coarse; gravel, fine to medium and	
		unoxidized clay	115-140
	10	Sand, medium to coarse, more clay, shale pebbles	140-150
	10	Clay, oxidized?, black, humus-like organic matter	150-160
		T.D. 160'	
		Water level - 75.3 feet	
		110 feet pipe (50' slotted and 5' sand point-total 115')	

95 52 27 baba

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NE¼NW¼NE¼NW¼ Section: 26 T. 95 N. X S. R. 52 X E. W.

Well: _____ Test Hole: C1 03 Land Owner: _____

County: Clay Date: 5-18-76 Elevation: 1240.5 (A, I, T)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	1	Topsoil, black, sandy	0-1
	10	Clay, oxidized, dark brown, unsorted (till)	1-11
	6	Clay, oxidized, light grown, unsorted (till)	11-17
	12	Clay, sandy, unoxidized, gray, unsorted (till)	17-29
	10	Clay, weathered, blue gray, unsorted (till)	29-39
	2	Gravel stringer, medium, subangular, clayey	39-41
	6	Clay, unoxidized, blue-gray, unsorted (till)	41-47
	8	Gravel, fine to medium, subrounded	47-55
	10	Gravel, very clayey, subrounded to subangular; sand,	
		gray, coarse	55-65
	19	Clay, unoxidized, gray, intermittent gravel stringers,	
		very thin (till)	65-84
	21	Gravel, very coarse to cobbles, clean, subrounded to	
		subangular, difficult drilling	84-105
	5	Gravel, medium to coarse, clayey, subrounded	105-110
	20	Gravel, very coarse to small cobbles, clean, difficult	
		to drill	110-130
	21	Sand, very coarse, clean, subangular to subrounded	130-151
	9	Clay, sandy, fine to coarse, traces of bituminous coal	151-160
	10	Clayey silt with large chunks of coal, some medium sand	160-170
	10	Clay, unoxidized, some sand (trace) lots of coal fragments	170-180

T.D. - 180' Water level - 74.8 feet

140' pipe (50' slotted) plus 5' sand point = 145 feet

94 52 2 ccbb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼NW¼SW¼SW¼ Section: 2 T. 94 N. ~~X~~ R. 52 ~~X~~ W.

Well: _____ Test Hole: C1 04 Land Owner: _____

County: Clay Date: 5-20-76 Elevation: 1213.1-top of pipe (A, I, ~~X~~)

E Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	5	Clay, brown oxidized, sandy, silty, some gravel (till)	0-5
	17	Clay, brown, oxidized; coarse sand and some gravel	5-22
	23	Clay, brown oxidized; sandy, silty, pebbles and	
		cobbles (till)	22-45
	10	Clay, unoxidized, gray; sandy, silty, pebbles,	
		cobbles (till)	45-55
	10	Clay, oxidized and some gray unoxidized high % gravel	
		and sand (pea size) (gravelly till)	55-65
	8	Gravel, oxidized, pea size and larger, some clay	65-73
	12	Gravel, oxidized, very coarse, some clay (possible	
		pebbles and cobbles at 78-82)	73-85
	32	Gravel, oxidized, medium to coarse; sand, oxidized,	
		very coarse, some clay, pebbles (8+mm)	85-117
	8	Pebbles (8+mm); gravel, very coarse, coal fragments	117-125
	5	Gravel, coarse to very coarse; coal fragments,	
		increase in clay %	125-130
	20	Sand, medium to coarse, high clay %	130-150
		T.D. 150' Water level 57.7 feet	
		120' pipe (50' slotted) plus 5' sand point = 125 feet	

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼SE¼SW¼SW¼ Section: 2 T. 94 N. ~~X~~ R. 52 ~~X~~ W.

Well: _____ Test Hole: C1 05 Land Owner: _____

County: Clay Date: 5-24-76 Elevation: top of pipe 1178.(9~~X~~, I, ~~X~~)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil, black	0-2
	6	Clayey silts, lite brown to gray	2-8
	4	Clay, oxidized, unsorted, lite brown	8-12
	16	Clay, oxidized, unsorted, lite brown to gray,	
		bentonite, sand, gravel lenses	12-28
	4	Gravel, medium to fine, subangular, clean	28-32
	30	Gravel, medium to coarse, clean, subrounded to	
		subangular	32-62
	28	Sand, medium to coarse, subangular, clayey and silty,	
		lite brown	62-90
	32	Sand, fine to very fine, clayey and silty, subrounded	
		to subangular, large amounts of fragments bituminous coal	90-122
	28	Coal, intermittent layers unknown thickness plugging	
		screen, gravel and fine sand, intermittent layers	122-150
	30	Gravel, coarse, tough drilling, screen plugged	
		with coal	150-180
		Water level - 26.1 feet T.D. 180'	
		90' pipe (60' slotted) plus 3' sand point = 93'	

94 52 2 ccbd

SOUTH DAKOTA GEOLOGICAL SURVEY

Location SE¼NW¼SW¼SW¼ Section: 2 T. 94 N. ~~S.~~ R. 52 ~~E.~~ W.

Well: _____ Test Hole: C1 06 Land Owner: _____

County: Clay Date: _____ Elevation: 1172.7-pipetop (~~A~~, I, ~~T~~)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	5	Topsoil, black, sandy, silty, pebbly	0-5
	10	Clay, brown oxidized, sandy, silty, pebbly, some	
		black sandy soil	5-15
	12	Sand, oxidized, coarse; gravel, medium; pebbles	
		(pebble layer 27-30	15-27
	38	Gravel, rounded, pea size; some sand good pebble	
		layer at 54'	27-65
	25	Sand, fairly coarse to medium; gravel, fine; coal	
		fragments at 72 (lot of coal fragments)	65-90
		T.D. 90'	
		Water level 20.1 feet	
		60' pipe (30' slotted) plus 5' sand point = 65 feet	

94 52 2bccb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼SW¼SW¼NW¼ Section: 2 T. 94 N. ~~XXX~~ S. R. 52 ~~XX~~ E. W.

Well: _____ Test Hole: C1 07 Land Owner: _____

County: Clay Date: 5-25-76 Elevation: 1162.5 pipetop (~~X~~ A, I, ~~X~~ T)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil, black	0-2
	15	Silt, black, to lite gray, organic	2-17
	31	Gravel, outwash, medium to coarse shell fragments	
		(bivalves), clean, subrounded	17-48
	32	Sand, medium to coarse, subrounded to subangular,	
		clean, traces of bituminous coal	48-80
	25	Sand, fine to coarse, large amounts of bituminous coal	80-105
	20	Sand, medium to very coarse, no coal	105-125
	10	Gravel, medium to coarse subrounded, clean	125-135
	12	Clay, unoxidized; boulder, very hard drilling,	
		granite chips (till)	135-147
		T.D. 147'	
		Water Level 7.6 feet	
		130' pipe (20' slotted) plus 5' sand point = 135 feet	

95 52 26 bbbb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼NW¼NW¼NW¼ Section: 26 T. 95 N. ~~X~~ R. 52 ~~X~~ W.

Well: _____ Test Hole: C1 08 Land Owner: _____

County: Clay Date: 5-27-76 Elevation: 1178.2 pipetop (~~X~~, I, ~~X~~)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil, black, sandy, silty	0-2
	10	Sand, oxidized, brown, fine to medium	2-12
	13	Gravel, oxidized, pea size and coarser, medium to	12-25
		coarse; pebbles (2-3 cm)	
	8	Sand, medium to coarse; gravel, pea size; some	
		pebbles (1-2 cm)	25-33
	7	Gravel, well rounded, pebbly; sand medium to coarse	33-40
	29	Sand, medium to coarse, gravelly, pebbly, (coal	
		fragments at 65')	40-69
	47	Sand, coarse to very coarse; gravel, fine to medium	
		(lot of coal fragments)	69-116
	14	Clay, sandy, silty, pebbles (till)	116-130
		T.D. 130' Water level - 7.7 feet	
		50' pipe (35 slotted) + 4' sand point = 54 feet	

95 52 35 cbbb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼NW¼NW¼SW¼ Section: 35 T. 95 N. ~~X~~ R. 52 ~~X~~ W.

Well: _____ Test Hole: Cl 09 Land Owner: _____

County: Clay Date: 5-27-76 Elevation: 1164.6 pipetop (A, I, T)

E-Log: _____ Samples: _____ Drilling Company: ~~SDGS~~

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	1	Topsoil, black	0-1
	5	Sand, fine to medium, silty, green, subrounded	1-6
	6	Sand, fine to medium, clean, subrounded	6-12
	11	Sand, medium to very coarse, clean, subrounded to	
		subangular	12-23
	23	Gravel, fine to medium, subrounded, clean	23-46
	21	Sand, fine to medium, clayey, silty, gray, sub-	
		angular to subrounded	46-67
	13	Sand, fine, clayey, silty, thin intermittent	
		bituminous coal layers	67-80
		T.D. 80' Water level - 6.8 feet	
		40' pipe + 3' sand point = 43 feet	

95 52 27 bbcb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼SW¼NW¼NW¼ Section: 27 T. 95 N. ~~S.~~ R. 52 ~~E.~~ W.

Well: _____ Test Hole: C1 10 Land Owner: _____

County: Clay Date: 6-4-76 Elevation: 1176.8 pipetop (A, I, T)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil	0-2
	10	Silt, dark brown, soft	2-12
	5	Silt, black, soft	12-17
	24	Gravel, fine to medium (coal fragments)	17-41
	6	Clay, gray, silty, pebbly (till)	41-47
	25	Gravel, fine to coarse sand	47-72
	2	Coal (possibility) hard drill	72-74
	50	Sand, very coarse and gravelly (till) may be	
		alluvium, very clayey	74-120
		Water level - 13 feet	
		80' pipe (20' slotted) + 3' sand point = 83 feet	

95 52 27 bbcc

SOUTH DAKOTA GEOLOGICAL SURVEY

Location SW¼SW¼NW¼NW¼ Section: 27 T. 95 N. ~~S.~~ R. 52 ~~W.~~ W.

Well: _____ Test Hole: Cl 11 Land Owner: _____

County: Clay Date: 6-3-76 Elevation: 1179.0 pipetop (A, I, T)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil	0-2
	10	Silt, dark brown, soft	2-12
	6	Silt, black, soft	12-18
	21	Gravel, fine to medium, some coal	18-39
	4	Clay, silty, gray, somewhat sandy, (till or alluvium)	39-43
		T.D. 43'	
		Water level 14.8 feet	
		37.5' pipe + 3' sand point = 40.5 feet	

95 52 27 bcbb

SOUTH DAKOTA GEOLOGICAL SURVEY

Location NW¼NW¼SW¼NW¼ Section: 27 T. 95 N. ~~X~~ S. R. 52 ~~X~~ E. W.

Well: _____ Test Hole: Cl 12 Land Owner: _____

County: Clay Date: 6-4-76 Elevation: 1176.4 pipetop (A, I, T)

E-Log: _____ Samples: _____ Drilling Company: SDGS

Source of Data: _____

Geologic Unit	Thickness	Lithologic Description	From - to Feet
	2	Topsoil	0-2
	3	Silt, dark brown, soft	2-5
	7	Silt, yellow, soft	5-12
	10	Gravel, fine to sand, coarse	12-22
	11	Very sandy till or alluvium clay	22-33
	6	Gravel, fine to medium	33-39
	3	Clay, possibly alluvium	39-42
	22	Gravel, fine to medium	42-64
		Rock	64
		T.D. 64' Water level 17 feet	
		53' pipe (20' slotted) + 3' sand point = 56 feet	