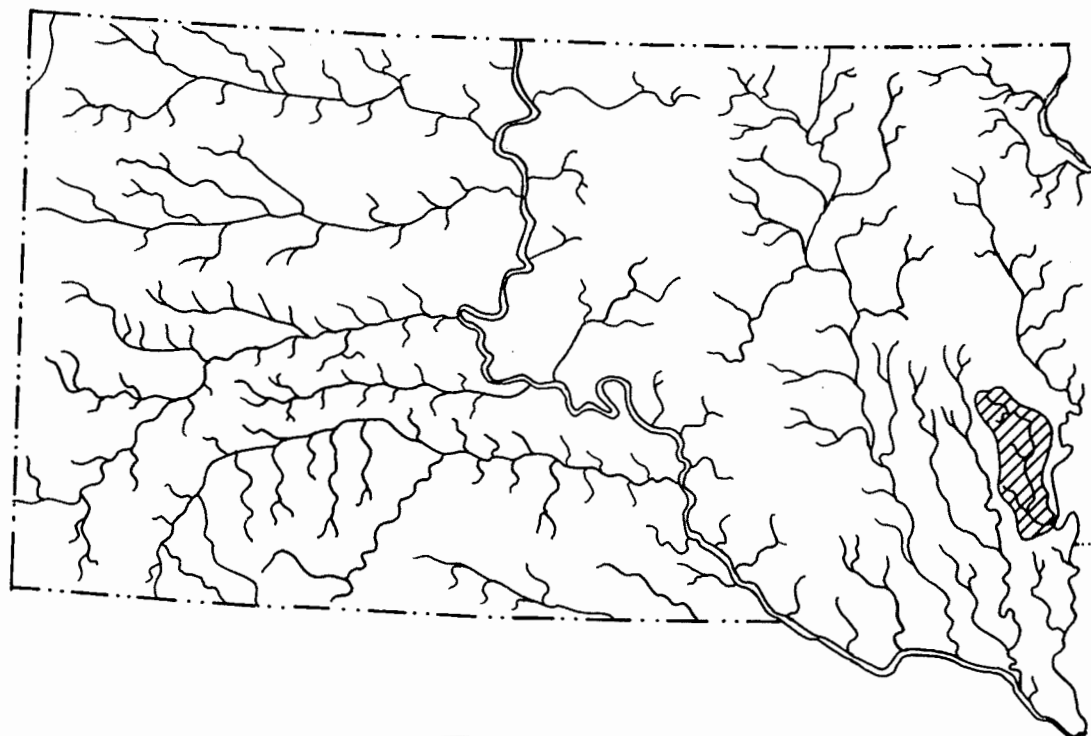


SOUTH DAKOTA STATE GEOLOGICAL SURVEY
AND
SOUTH DAKOTA STATE WATER RESOURCES COMMISSION

WATER RESOURCES REPORT NO. 3

BASIC HYDROGEOLOGIC DATA,
SKUNK CREEK-LAKE MADISON DRAINAGE
BASIN, SOUTH DAKOTA



BY
D.G. ADOLPHSON AND M.J. ELLIS
U.S. GEOLOGICAL SURVEY

VERMILLION, SOUTH DAKOTA
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INTRODUCTION

Data contained in the following tables were collected by the Ground Water Branch, U. S. Geological Survey, the South Dakota State Geological Survey, and the South Dakota State Water Resources Commission, in connection with their investigation of the geology and hydrology of the glacial drift in selected drainage basins in eastern South Dakota. The interpretive report by M. J. Ellis and D. G. Adolphson describes the hydrogeology of the Skunk Creek-Lake Madison drainage basin and will be published as U. S. Geological Survey Hydrologic Atlas No. 195.

Data-collection points (well, test holes, and surface-water gaging stations) are located in accordance with the United States Bureau of Land Management's system of land subdivision. The first numeral of a point designation indicates the township, the second the range, and the third the section in which the point is situated. Lowercase letters after the section number indicate location within the section; the first letter denotes the 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. The letters a, b, c, and d are assigned in a counterclockwise direction, beginning in the northeast corner of each tract. The number of lowercase letters indicates the accuracy of the point location; if the point can be located within a 10-acre tract, three lowercase letters are shown in the point number. For example, data collection point 105-51-23add (a test hole) is in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$, section 23, T. 105 N., R. 51 W. (See fig. 1.) If two or more points are situated within the same tract, consecutive numbers, beginning with 1, are added as suffixes to designate the order in which the points are described.

The locations of data-collection points are shown on Plate 1, which also has an index showing the tables and page numbers in the report that contain information on the data-collection points.

Data contained in the 6 tables of this report are useful for predicting subsurface, hydrologic, and water quality conditions in the drainage basin. The tables, however, will be more useful if they are examined together with U. S. Geological Survey Hydrologic Atlas No. 195.

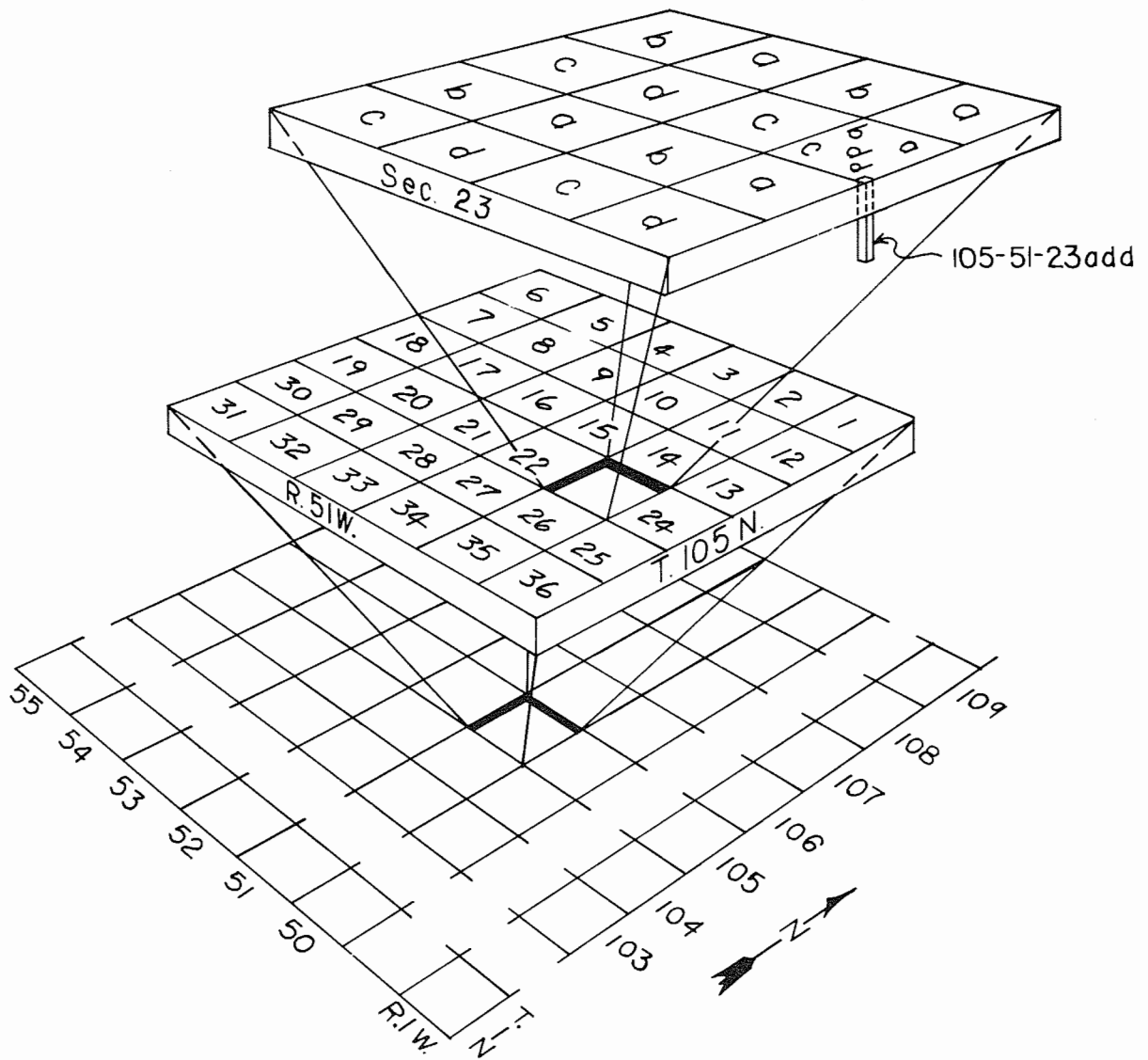


Figure I. Sketch showing data collection point location system

A section (Appendix I) on the suitability of water for irrigation is included in this report to aid readers who are actual or potential water users in the area. Appendix I consists primarily of two tabulations--one on the relative tolerances of many of the crops grown in the area to total dissolved solids; the other is a general classification of irrigation waters. This appendix should be used in conjunction with Table 3 on the chemical analyses of water.

The following glossary is included in this report to aid the reader in understanding the hydrologic and geologic terms with which he may be unfamiliar.

GLOSSARY

Definitions of Terms

Terms listed include those published by American Geological Institute (AGI) and U. S. Geological Survey Water Supply Paper 1541-A (WSP 1541-A).

Acre-foot.--a unit for measuring the volume of water; the quantity of water required to cover 1 acre to a depth of 1 foot; equals 43,560 cubic feet or 324,851 gallons (WSP 1541-A).

Annual discharge.--total volume (acre-feet) of flow in a stream for a water year (WSP 1541-A).

Aquifer.--a formation, group of formations, or part of a formation that is water-bearing (AGI).

Aquifer test.--a means for determining the hydrologic properties of an aquifer. Conducted by pumping a well at a constant rate while measuring drawdown and recovery in the pumped well and in observation wells.

Base flow.--sustained or fair weather flow in most streams--base flow is composed largely of ground water discharged into stream channels (WSP 1541-A).

Cfs.--abbreviation of cubic feet per second.

Coefficient of permeability.--the number of gallons of water per day that will pass through a cross-sectional area of 1 square foot of material under unit hydraulic gradient at a temperature of 60°F. (AGI).

Coefficient of transmissibility.--the rate of flow of water, in gallons per day, at the prevailing water temperature and under a unit hydraulic gradient through each vertical strip of the aquifer 1 foot wide having a height equal to the thickness of the aquifer (AGI).

Cubic feet per second.--a unit expressing rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, flowing water an average velocity of 1 foot per second (WSP 1541-A).

Drainage basin.--the area drained by a river system (a stream and its tributaries).

Drawdown.--lowering of the water table or piezometric surface by pumping or by artesian flow (AGI).

Glacial drift.--rock material, such as boulders, till, gravel, sand, and clay, transported by a glacier and deposited by or from the ice or by or in water derived from the melting of the ice (AGI).

Gpd.--abbreviation of gallons per day.

Gpm.--abbreviation of gallons per minute.

Ground water.--water in the ground that is in the zone of saturation, from which wells, springs, and ground-water runoff are supplied (WSP 1541-A).

Hydrology.--the science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground (WSP 1541-A).

Moraine.--glacial drift, deposited chiefly by direct glacial action; commonly has constructional topography independent of control by the surface on which it lies (AGI).

Nonequilibrium formula.--a formula commonly used to determine transmissibility and storage coefficients from aquifer-test data; developed by C. V. Theis (1935).

Observation well.--a well in which water levels are measured periodically.

Outwash.--stratified drift deposited by meltwater streams beyond the glacier margin.

Parts per million (ppm).--is a unit for expressing the concentration by weight of a chemical constituent, usually as milligrams of constituent per kilogram of solution or as grams of constituent per million grams of solution.

Porosity.--the ratio of total pore space in a rock or soil to total volume of the material; usually expressed as a percentage.

Ppm.--abbreviation of parts per million.

Quartzite.--a metamorphosed sandstone composed of grains of quartz that are tightly cemented by silica.

Recovery.--difference between observed water level in a well after pumping has stopped and lowest level reached during pumping.

Sorting.--in a descriptive sense indicates the degree of similarity, in respect to some particular characteristic, of the component parts of a material (AGI).

Specific gravity.--ratio of the mass of a body to the mass of an equal volume of water at 4°C (AGI).

Specific retention.--as applied to a rock or soil, it is the ratio of (1) the volume of water which, after being saturated, it will retain against the pull of gravity to (2) its own volume. It is stated as a percentage (AGI).

Specific yield.--the ratio of the volume of water that will drain by gravity from a saturated rock to the total volume of the rock; stated as a percentage.

Surface water.--water on the earth's surface, such as river, lakes, and ponds.

Test hole.--an uncased hole drilled, augered, etc., to obtain geologic and hydrologic data of an area.

Till.--an unstratified, unsorted glacial deposit.

Water table.--the upper surface of the zone of saturation except where that surface is formed by an impermeable barrier (AGI).

Water-table condition.--conditions under which the water in an aquifer is not confined by overlying, relatively impermeable strata. Under these conditions, water can be obtained from storage in the aquifer by gravity drainage--that is, by lowering the water level, as in a pumped well.

Water year.--as used by the U. S. Geol. Survey, the period from October 1 through September 30. The water year is designated by the calendar year in which it ends. Thus, the year ended September 30, 1959, is called the "1959 water year." (WSP 1541-A).

Zone of saturation.--the zone in which the rocks are saturated with water under hydrostatic pressure.

Table 2.--Surface-water records -- Skunk Creek-Lake Madison drainage basin.

Data in the following table have been compiled from: (1) U. S. Geol. Survey Water-Supply Paper 1209, 1239, 1279, 1309, 1339, 1389, 1439, 1509, 1559, 1629, and 1709; (2) U. S. Geol. Survey Surface Water Records of North and South Dakota for 1961 and 1962; and (3) File data, Surface Water Branch, U. S. Geol. Survey, Pierre, South Dakota.

Data from gaging station, collection point 15, on Skunk Creek near Sioux Falls, in NW $\frac{1}{4}$ NW $\frac{1}{4}$, sec. 23, T. 101 N., R. 50 W., on left bank at downstream side of bridge on U. S. Highway 16, 600 feet upstream from nearest tributary, 2 $\frac{1}{2}$ miles upstream from mouth, and 4 miles west of Sioux Falls.

<u>Water year</u>	<u>Annual discharge (acre-feet)</u>	<u>Water year</u>	<u>Annual discharge (acre-feet)</u>
1949	48,650	1956	9,850
1950	15,110	1957	77,720
1951	90,800	1958	10,420
1952	95,230	1959	6,710
1953	40,160	1960	80,080
1954	29,120	1961	12,780
1955	8,240	1962	95,980
	Average discharge, 1948-1962		44,480

Skunk Creek, collection point 15.

Nov. 8, 1962 Base Flow 9.79 cfs (cubic feet per second)

Supplemental measurements

West Branch Skunk Creek, collection point 45, 2 $\frac{1}{2}$ miles north and $\frac{1}{4}$ mile east of Hartford.

Nov. 8, 1962 Base Flow 0.81 cfs

Skunk Creek, collection point 81, 8 $\frac{3}{4}$ miles north and 3 $\frac{1}{4}$ miles east of Hartford.

Nov. 8, 1962 Base Flow 4.44 cfs

Table 3.--Chemical analyses of water
[Concentrations of dissolved constituents, dissolved solids, and hardness given in parts per million]

Data Coll- ection point number	Location number	Source ¹	Date of Collection	Depth of well (feet)	Temp- erature (°F)	Silica (SiO ₂) (P)	Iron (Fe) (Co)	Ca- cium (Ca)	Mag- ne- sium (Mg)	Sod- ium (Na)	Po- tas- sium (K)	Bicar- bonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl) (F)	Fluo- ride (F)	Bor- on (B)	Dis- solved solids (total dissolved solids) (180°C)	Hardness Cal- cium equiv- alent	Hardness non- cal- cium equiv- alent	Specific conduc- tance (micro- mhos/cm at 25°C)	pH	Sodium absorp- tion ratio		
14	101-50-13ccc	O ²	8/28/54	172	53	15	0.91	102	35	12	4.6	346	130	3.0	0.5	0.4	0.41	486	398	115	742	7.4	0.3	
15	101-50-23bba	S	5/31/60	---	---	9.5	.02	124	52	23	7.7	320	291	3.6	.2	2.3	.08	719	525	263	973	7.8	.4	
16	101-51-24bbe	H	12/8/61	120	49	28	.25	146	58	25	5.2	413	306	1.1	.8	.6	.19	820	604	265	1,120	7.0	.4	
33	101-50-7aab	O	9/28/60	43	54	18	.01	75	29	9.7	6.6	306	90	2.2	.5	.0	.11	379	308	57	612	7.9	.2	
36	101-50-3ccc	O	12/8/61	39	48	23	10	84	32	19	1.6	427	39	1.9	.4	3.1	.10	414	342	0	706	7.4	.4	
541	102-51-22be	H	10/ /57	152	---	---	.1	185	62	33	6.3	427	433	4.0	.3	.0	---	3,1040	717	---	4,1,300	7.4	.5	
543	102-52-16aa	H ²	10/ /57	432	---	---	.2	220	87	38	6.6	408	656	7.0	.5	.0	---	3,1,340	912	---	4,1,760	7.3	.5	
544	102-50-3add	H	10/ /57	258	---	---	.8	437	140	55	10.0	356	1,440	8.0	.9	.4	---	2,170	1,680	---	4,2,950	7.5	.5	
47	102-51-3add	O	9/27/60	26	56	23	.8	60	27	6.6	2.2	265	51	4.4	.8	.2	.19	382	260	43	477	7.5	.2	
50	103-51-35cdc	O	12/11/58	62	---	---	3.0	1.3	96	29	9.9	3.5	380	67	1.7	.3	.1	.06	425	360	48	661	7.1	.2
52	103-51-33add	O	9/26/60	37	54	28	.01	49	28	7.2	1.6	270	20	.0	.6	1.3	.04	269	236	15	460	7.7	.2	
75	103-50-18cda	O	12/7/61	24	50	26	.08	107	36	13	1.6	360	124	19	.4	4.9	.08	542	415	120	830	7.0	.3	
76	103-52-14bcc	H	12/7/61	13	40	19	.35	167	69	24	8.7	322	463	6.0	.3	.5	.09	985	699	435	1,260	7.1	.4	
80	103-50-7acd	O	9/26/60	48	54	22	2.8	90	20	7.4	8.3	212	155	2.0	.2	.0	.15	423	306	132	602	7.6	.2	
82	103-51-10cdc	H	12/7/61	13	46	26	.02	159	68	26	4.2	487	210	40	.6	77	.11	910	676	277	1,270	7.5	.4	
92	104-51-26bd	H	11/ /55	26	---	---	.2	136	55	21	1.6	378	230	38	.3	5.0	---	2,790	567	---	4,1,050	7.2	.5	
95	104-50-20add	H	12/6/61	30	47	31	.74	86	39	17	1.6	346	83	5.2	.6	40	.09	478	373	89	725	7.4	.4	
101	104-52-8add	H	12/7/61	50	42	23	6.4	343	142	64	12	454	1,130	5.9	.4	26	.43	2,130	1,440	1,070	2,300	7.2	.7	
102	104-50-9aba	O	12/6/61	28	46	30	.18	114	39	15	3.4	320	111	32	.4	53	.07	632	444	182	899	7.2	.3	
5118	105-51-23acc	O	-----	57	46	30	.03	83	36	15	5.6	323	103	3.2	.3	16	.06	465	355	90	707	7.2	.3	
137	105-51-14bbb	O	9/30/60	88	55	23	.03	81	48	8.1	14	392	112	1.8	.3	.1	.11	495	401	80	752	7.9	.2	
140	105-51-18aaa	O	12/6/61	35	46	33	5.6	133	48	28	9.0	481	156	11	.4	26	.43	700	528	134	1,040	7.1	.5	
151	105-51-18aaa	L	12/6/61	---	33	29	.11	142	127	85	32	288	750	30	.2	1.9	.25	1,470	876	640	1,770	7.5	1.3	
174	105-51-652	L	12/6/61	---	33	2.2	.07	103	88	100	22	155	570	84	.2	.0	.23	1,150	619	492	1,500	7.0	1.7	
184	106-52-15ccb	H	12/7/61	80	42	25	15	95	45	24	3.3	327	194	4.7	.7	.0	.30	586	420	152	860	7.1	.5	
5193	106-52-8caa	O	10/ /60	40	---	---	1.4	362	98	104	14	334	799	303	.4	.1	---	2,180	1,320	---	4,2,500	7.3	1.3	
5194	106-52-7cbb	O	10/ /60	30	---	---	1.2	216	72	97	11	334	666	43	.5	.4	---	3,440	840	---	4,1,840	7.6	1.5	
5198	106-52-bda	O	10/ /60	30	---	---	.3	80	27	156	9.4	283	278	83	.4	1.0	---	2,792	311	---	4,1,080	8.2	3.8	
200	106-53	L	12/6/61	---	33	16	.07	115	62	50	18	201	475	5.1	.1	1.2	.10	910	542	377	1,170	7.0	.9	
204	106-53-7bbc	O	12/6/61	16	48	22	.12	69	29	18	4.3	261	106	5.5	.4	7.2	.09	395	293	79	608	7.3	.5	
210	106-53-2aaa	H	12/17/61	18	47	30	5.0	259	200	75	3.8	341	708	117	.6	526	.20	2,350	1,470	1,190	2,700	6.9	.9	

¹Source: L, lake; H, moraine deposits; O, outwash deposits; S, stream.

²Well completed in bedrock, but most water obtained from glacial drift.

³Dissolved solids reported - methods of determination unknown.

⁴Extrapolated value.

⁵Analysis by South Dakota Dept. of Health, Pierre, South Dakota.

Table 4.--Selected physical properties of unconsolidated materials

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Test hole no. ^a	Location	Laboratory sample no.	Depth or interval sampled (ft)	Specific gravity	Specific retention (%)	Porosity (%)	Specific yield (%)	Coefficient of permeability (gpd/ft ²)	Material
13	101-50-23aad	14	20					5,480	Sand, some gravel, clean.
	do.	15	25					740	do.
	do.	16	30					1,190	do.
	do.	17	40					4,490	Gravel, fine to coarse.
	do.	18	50					5,260	do.
	do.	19	55					6,260	do.
	do.	20	57					1,610	do.
20	101-50-15cbc	7	9-10					3,270	Gravel, fine to medium, clean.
	do.	8	15					650	Sand, fine to medium.
	do.	9	25					3,020	Sand and gravel, medium.
	do.	10	30					5,470	Sand, very coarse, and medium gravel.
22	101-50-15bbb	11	5					3,770	Gravel, medium to fine, loose.
	do.	12	10					14,800	Gravel, fine to medium, some pebbles.
	do.	13	15					5,180	do.
104	104-50-4dccc	61SD1	10-20	2.68	9.0	38.8	29.8	24	Gravel, fine.
	do.	61SD2	30-40	2.68	4.3	31.7	27.4	180	Gravel, coarse.
119	105-51-23bda	62SD1	2-53	2.68	5.3	30.6	25.3	260	Composite sample, see log p. 44.
120	105-51-23bdb	62SD2	2-59	2.68	5.0	30.6	25.6	190	Composite sample, see log p. 44.

^aData on samples from test holes 13, 20, and 22 are from Rothrock and Otton (1947, p. 33); data on samples from test holes 104, 119, and 120 determined by U. S. Geological Survey Hydrologic Laboratory, Denver, Colorado

Table 5.--Aquifer-test data

The hydraulic characteristics of an aquifer must be determined to predict the effects of withdrawal of water from it. Three aquifer tests, or controlled pumping tests, were made on wells in the outwash deposits to determine the aquifer characteristics. Computation of the results of the tests is based on drawdown and recovery measurements in observation wells using the Theis (1935, p. 519-524) nonequilibrium formula and methods outlined by Wenzel (1942, p. 87-89).

In September, 1944 (Rothrock and Otton, 1947, unpublished basic data) two aquifer tests of short duration were made to determine the hydraulic characteristics of the southern outwash deposits. In the first test, well 10 (101-50-24bdd) was pumped at an average rate of 61 gpm (gallons per minute) for 12 hours. The calculated T (coefficient of transmissibility) values, based on drawdown measurements, range from about 100,000 to 109,000 gpd per ft., and average about 105,000 gpd per ft. The average saturated thickness of the outwash deposits in the area of the test is about 30 feet; therefore, the field coefficient of permeability is about 3,500 gpd per sq. ft. The following tabulation lists drawdowns in the pumped well and in the observation wells.

Well no.	Well depth (ft)	Distance from pump (ft)	Altitude, water level	Total drawdown (ft)
Pumped well 10	35	0	-----	-----
Observation well A	15	25	1,408.37	0.14
Observation well B	15	50	1,408.46	.13
Observation well C	10	100	1,409.27	.00

The second test was on well 28 (101-50-9dad), which was pumped at an average rate of 57 gpm for 6 hours. The values for T, based on drawdown measurements, average about 37,000 gpd per ft. The saturated outwash deposits in the area of the test are about 11 feet thick; therefore, the field coefficient of permeability is about 3,400 gpd per sq. ft. The following tabulation lists drawdowns in the pumped well and observation wells:

Well no.	Well depth (ft)	Distance from pump (ft)	Altitude, water level	Total drawdown (ft)
Pumped well 28	17	0	-----	-----
Observation well A	10	25	1,437.83	0.38
Observation well B	10	65	1,437.83	.05

The period of pumping for the tests on wells 10 and 28 were too short to obtain an accurate determination for the values of S (coefficient of storage).

During the period October 23-25, 1962, a test was made of the northern outwash deposits penetrated by irrigation well 118 (105-51-23bdd). The well was pumped at a rate of 640 gpm for 25 hours. The calculated values for T average about 150,000 gpd per ft., and those for S about 0.13. The magnitude of S indicates that water in the aquifer is under water-table conditions; this is confirmed by logs of materials penetrated during the test drilling and the drilling of the production well. The aquifer in the test area is about 40 feet thick; therefore, the coefficient of permeability is about 3,750 gpd per sq. ft. The following tabulation lists drawdowns:

Well no.	Well depth (ft)	Distance from pump (ft)	Depth to water (ft)	Total drawdown (ft)
Pumped well 118	50	0	20.26	8.23
Observation well 119	52	50	20.38	2.56
Observation well 120	49	100	21.19	1.77

Data from the aquifer tests indicate that the coefficients of transmissibility and permeability of the outwash deposits differ greatly in the Skunk Creek-Lake Madison drainage basin.

Table 6.--Logs of test holes and observation wells

Altitude of land surface in feet above mean sea level was determined by spirit leveling (L), reported in files and publications (R), or estimated from topographic map (T). Depth to water level is given in feet below land surface. Logs listed include those published by Rothrock and Otton (1947), [reproduced as originally published] and records of test holes drilled by the South Dakota Geological Survey (SDGS), the South Dakota Water Resources Commission (SDWRC), the U. S. Geological Survey (USGS), and the U. S. Bureau of Reclamation (USBR).

MINNEHAHA COUNTY

Test hole 1 (101-50-25dbb). Altitude, 1,412 feet (R). Well 186 of Rothrock and Otton (1947, p. 68).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and clay, sandy.....	8	8
Gravel, fine to medium, clean.....	6	14
Clay, gray, with a few small pebbles.....	5	19
Sand, coarse, with gravel.....	6	25
Clay, gray, with small pebbles (glacial till)	22	47
Clay, dark-gray, quartzite pebbles near base	23	70
Quartzite.....	inches	70+

Test hole 2 (101-50-25aac). Altitude, 1,411 feet (R). Well 185 of Rothrock and Otton (1947, p. 68).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black, clay, sandy.....	8	8
Same, grading into medium clean gravel.....	2	10
Gravel, clean.....	20	30
Sand, medium, clean, small amounts of gravel	26	56
Clay balls, tough, silty; grades into clay, sticky, gray.....	2	58

MINNEHAHA COUNTY--Continued

Test hole 3 (101-50-25bad). Altitude, 1,419 feet (R). Well 184 of Rotarock and Otton (1947, p. 68).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and loam.....	3	3
Sand and gravel, fine reddish.....	2	5
Gravel, medium, red-brown.....	5	10
Sand, fine, well sorted.....	5	15
Gravel and sand.....	25	40
Sand, medium, coarse, clean.....	7	47
Clay, dark-gray, stiff.....	1	48

Test hole 4 (101-50-25bbb). Altitude, 1,428 feet (T). Depth to water, 12 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, coarse, and fine gravel.....	5	7
Sand, medium to coarse.....	7	14
Sand, medium.....	23	37
Till.....	12	49

Test hole 5 (101-50-26aaa). Altitude, 1,428 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Till, tan.....	5	9

Test hole 6 (101-50-24ccc). Altitude, 1,428 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium to coarse.....	2	4
Boulder.....	--	4+

MINNEHAHA COUNTY--Continued

Test hole 7 (101-50-24dda). Altitude, 1,411 feet (R). Well 183 of Rothrock and Otton (1947, p. 67).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and clay.....	4	4
Gravel, brown, dirty.....	1	5
Gravel, fine to medium, clean.....	32	37
Clay, tough, gray.....	0.5	37.5

Test hole 8 (101-50-24dbd). Altitude, 1,413 feet (R). Well 182 of Rothrock and Otton (1947, p. 67).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, gray, clayey.....	6	6
Gravel, fine, clean.....	4	10
Sand, coarse, and gravel.....	10	20
Gravel, fine to coarse, some pebbles up to 4 inches in width.....	5	25
Sand, medium, small shale fragments.....	6	31
Clay, brown.....	1	32
Clay, stiff, with small pebbles.....	6	38

Test hole 9 (101-50-23dda). Altitude, 1,420 feet (R). Well 178 of Rothrock and Otton (1947, p. 66).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and loam.....	3	3
Gravel and silt, rust-brown.....	2	5
Sand and gravel, medium.....	25	30
Sand, medium, clean.....	5	35
Sand, fine, brown, and gravel.....	10	45
Sand, coarse, gravel.....	9	54
Clay, gray, stiff.....	inches	54+

Test hole 10 (101-50-24bdd). Altitude, 1,415 feet (R). Well 181 of Rothrock and Otton (1947, p. 67).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and loam.....	5	5

MINNEHAHA COUNTY--Continued

Test hole 10 (101-50-24bdd) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand and gravel.....	25	30
Gravel, fine.....	5	35
Sand, gray, medium.....	5	40
No sample.....	2	42
Clay, gray.....	1	43
Sand, poorly sorted.....	9	52
Clay, gray, sticky.....	1	53
Quartzite.....	inches	53+

Test hole 11 (101-50-24cbb). Altitude, 1,422 feet (R). Well 180 of Rothrock and Otton (1947, p. 66).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
No sample.....	10	10
Sand and gravel, clean.....	5	15
Gravel, clean.....	12	27
Clay, dark-gray.....	inches	27+

Test hole 12 (101-50-23daa). Altitude, 1,425 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, coarse, and coarse gravel; unsorted...	16	18
Sand, medium to coarse.....	47	65
Sand, and coarse gravel.....	2	67
Till.....	1	68

Test hole 13 (101-50-23aad). Altitude, 1,432 feet (R). Well 177 of Rothrock and Otton (1947, p. 66).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
No sample.....	10	10
Gravel, fine to medium, clean.....	5	15
Sand with some gravel, clean.....	15	30
Gravel, fine to coarse, wood fragments.....	27	57
Clay, gray, stiff.....	inches	57+

MINNEHAHA COUNTY--Continued

Test hole 17 (101-50-13ccc2). Altitude, 1,429 feet (T). Depth to water 8.5 feet (measured Sept. 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, coarse, and coarse gravel; unsorted...	3	6
Sand, medium, and fine gravel.....	12	18
Till, dark-gray.....	14	32
Boulder.....	--	32+

Test hole 18 (101-50-13ccc1). Altitude, 1,429 feet (T). Well 171 of Rothrock and Otton (1947, p. 68).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel and silty clay, mixed.....	12	12
Clay, blue.....	30	42
Quartzite, hard.....	142	184

Test hole 19 (101-50-15ccc). Altitude, 1,456 feet (T). Depth to water 24 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, sandy.....	4	4
Till, gray, gravelly.....	5	9
Till, brown.....	5	14
Sand, fine to medium, silty.....	15	29
Sand, medium to coarse.....	5	34
Sand, medium.....	10	44
Till, tan.....	15	59

Test hole 20 (101-50-15cbc). Altitude, 1,440 feet (T). Well 174 of Rothrock and Otton (1947, p. 66).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and loam.....	3	3
Sand and gravel, rust-colored.....	2	5
Gravel, fine to medium, clean.....	5	10
Sand, fine to medium, gray.....	5	15
No sample.....	5	20
Clay, dark-gray.....	3	23

MINNEHAHA COUNTY--Continued

Test hole 20 (101-50-15cbc) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, small gravel pebbles.....	1	24
Sand and gravel, medium.....	1	25
Sand, very coarse, and medium gravel.....	5	30
No sample.....	2	32
Quartzite.....	inches	32+

Test hole 21 (101-50-16daa). Altitude, 1,454 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, coarse, and coarse gravel; unsorted...	17	18
Till, brown.....	14	32

Test hole 22 (101-50-15bbb). Altitude, 1,436 feet (R). Well 173 of Rothrock and Otton (1947, p. 65).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and loam.....	4	4
Gravel, medium to fine, loose.....	1	5
Gravel and sand.....	5	10
Gravel, fine to medium, some pebbles.....	8	18
Clay, silty, buff, sticky.....	2	20
Quartzite.....	inches	20+

Test hole 23 (101-50-16aaa). Altitude, 1,447 feet (T). Depth to water, 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, tan, medium sand, and fine gravel.....	4	4
Sand, coarse, and fine gravel.....	14	18
Till, tan.....	4	22
Quartzite.....	--	22+

MINNEHAHA COUNTY--Continued

Test hole 24 (101-50-10ddc). Altitude, 1,435 feet (T). Well 164 of Rothrock and Otton (1947, p. 65).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, dark.....	1	4
Clay, brown.....	6	10
Sand, coarse, with clay balls.....	7	17
Sand, incoherent, medium and coarse.....	20.5	37.5
Quartzite.....	1.5	39

Test hole 25 (101-50-10dcd2). Altitude, 1,435 feet (T). Well 163 of Rothrock and Otton (1947, p. 65).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, dark.....	2	2
Clay, yellow.....	14	16
Gravel, coarse, and sand.....	3	19
Quartzite.....	inches	19+

Test hole 26 (101-50-9ddd). Altitude, 1,447 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, fine to medium.....	2	3
Sand, medium to coarse, and fine to coarse gravel.....	6	9
Sand, medium to coarse, and fine gravel.....	9	18
Boulder.....	--	18+

Test hole 27 (101-50-10dcd1). Altitude, 1,435 feet (T). Well 162 of Rothrock and Otton (1947, p. 64).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, dark.....	2	2
Clay, yellow.....	12	14
Clay, brown and yellow.....	8	22
Clay, sandy at top.....	14	36
Boulders.....	1	37

MINNEHAHA COUNTY--Continued

Test hole 27 (101-50-10dcd1) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, gray, gritty at base.....	7.5	44.5
Clay; rotten rock.....	2.5	47
Quartzite.....	inches	47+

Test hole 28 (101-50-9dad). Altitude, 1,443 feet (R). Well 160 of Rothrock and Otton (1947, p. 64).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and clay, brown, silty.....	6	6
Gravel, coarse.....	11	17
Quartzite.....	inches	17+

Test hole 29 (101-50-9add1). Altitude, 1,443 feet (R). Well 159 of Rothrock and Otton (1947, p. 64).

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil and clay, brown, silty.....	3	3
Sand and fine gravel, reddish.....	2	5
Sand, medium, and fine gravel.....	5	10
Gravel, fine, clean.....	8	18
Clay, brown, silty, with small pebbles.....	inches	18+

Test hole 30 (101-50-9add2). Altitude, 1,447 feet (T). Depth to water 3.4 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, coarse, and fine gravel.....	4	5
Till, dark-gray.....	13	18
Boulder.....	--	18+

MINNEHAHA COUNTY--Continued

Test hole 31 (101-50-9bbc). Altitude, 1,490 feet (T). Depth to water 25 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, gray.....	4	4
Clay, gray, silty.....	5	9
Sand, medium, silty.....	5	14
Clay, sandy.....	5	19
Till, tan.....	6	25
Quartzite.....	--	25+

Observation well 32 (101-50-7aaa). Altitude, 1,454 feet (T). Observation well S-27 of SDWRC. Drilled by SDWRC. Water levels given in table 2.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loam.....	12	12
Gravel, coarse.....	7	19
Clay, blue.....	26	45

Test hole 33 (101-50-7aab). Altitude, 1,473 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	6	6
Gravel, very coarse.....	3	9
Gravel, medium to coarse.....	3	12
Sand, medium to coarse.....	24	36
Clay, gray, silty.....	10	46
Till.....	7	53

Test hole 34 (101-50-7baa). Altitude, 1,470 feet (T). Depth to water 32.1 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, fine, silty, clayey.....	5	8
Sand, and coarse gravel.....	2	10
Clay, contains silt and fine sand.....	7	17
Sand, medium, and coarse gravel.....	35	52
Clay, gray (till).....	5	57

MINNEHAHA COUNTY--Continued

Test hole 35 (101-50-3ccd). Altitude, 1,445 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Clay, tan-gray, silty.....	10	14
Clay, gray, silty.....	5	19
Sand, medium, silty.....	5	24

Test hole 37 (101-50-6ddd). Altitude, 1,473 feet (T). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Clay, sandy.....	6	8
Sand, fine, clayey.....	6	14
Till, gray.....	15	29

Test hole 38 (102-50-19dbb). Altitude, 1,480 feet (T). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	9	9
Sand, medium.....	5	14
Sand, medium to coarse.....	10	24
Till.....	10	34

Test hole 39 (102-50-19cbb). Altitude, 1,499 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, fine to medium, clayey.....	6	9
Gravel, coarse.....	1	10
Till.....	4	14
Boulder.....	--	14+

MINNEHAHA COUNTY--Continued

Test hole 40 (102-51-24acd). Altitude, 1,500 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Gravel, sandy.....	1	4
Till, brown.....	8	12
Till, gray.....	5	17

Test hole 42 (102-51-24aaa). Altitude, 1,500 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Top soil.....	5	5
Boulder.....	--	5+

Test hole 46 (102-51-10aaa). Altitude, 1,519 feet (T). Depth to water 4.3 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand and gravel, reddish-brown, clayey.....	5	8
Sand, coarse, and coarse gravel, clayey.....	4	12
Gravel, coarse.....	3	15

Test hole 47 (102-51-3add). Altitude, 1,512 feet (T). Depth to water 4.7 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Gravel, coarse.....	2	6
Sand, brown, silty.....	17	23
Till, brown.....	3	26
Boulder.....	--	26+

MINNEHAHA COUNTY--Continued

Test hole 48 (102-51-3abb). Altitude, 1,540 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, coarse, and gravel.....	7	8
Sand, medium to coarse.....	12	20
Clay, gray, silty, sand (till).....	22	42

Test hole 49 (103-51-35dcd). Altitude, 1,514 feet (L). Depth to water 12.0 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Clay, sandy.....	7	10
Gravel and coarse sand.....	1	11
Sand, coarse.....	3	14
Clay and silt, sandy.....	11	25

Observation well 50 (103-51-35cdc). Altitude, 1,510 feet (L). Observation well S-26 of SDWRC. Drilled by SDWRC. Water levels given in table 2.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loam.....	8	8
Gravel.....	1	9
Sand, fine.....	19	28
Clay, yellow.....	14	42
Sand, fine.....	20	62
Quartzite.....	--	62+

Test hole 51 (103-51-35ccc). Altitude, 1,540 feet (L). Depth to water 25.1 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, coarse, and fine gravel.....	5	7
Sand, fine to medium, and fine gravel.....	8	15

MINNEHAHA COUNTY--Continued

Test hole 51 (103-51-35ccc) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, very fine, brown, clayey.....	11	26
Silt, gray, fine sand.....	9	35
Clay, gray, silty.....	18	53
Till, gray.....	4	57

Test hole 52 (103-51-33ddd). Altitude, 1,534 feet (L). Depth to water
9.4 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, coarse, and coarse gravel.....	5	7
Clay, brown, silty.....	3	10
Gravel, coarse.....	1	11
Silt, brown, sandy.....	4	15
Till, brown.....	22	37

Test hole 53 (103-50-35dab). Altitude, 1,607 feet (L). Drilled by
USBR,

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Sand, brown, silty, moist.....	21	22
Till, brown; moist.....	8	30

Test hole 54 (103-50-34daa). Altitude, 1,576 feet (L). Depth to water
11 feet (reported October 4, 1961). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, dark-brown, silty.....	6	6
Silt, brown, clayey.....	9	15

MINNEHAHA COUNTY--Continued

Test hole 55 (103-51-36bcd). Altitude, 1,512 feet (L). Depth to water 6.3 feet (reported January 5, 1962). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, black, silty.....	1	1
Sand, coarse, brown.....	2	3
Gravel, sandy.....	8.5	11.5
Sand, coarse, gray.....	3.5	15
Gravel, sandy.....	6.5	21.5
Silt, gray.....	5.5	27
Till, brown.....	3	30

Test hole 56 (103-51-36bcc). Altitude, 1,508 feet (L). Depth to water 6.5 feet (reported October 4, 1961). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium to coarse, brown.....	8	8

Test hole 57 (103-51-35adc). Altitude, 1,508 feet (L). Depth to water 4.2 feet (reported January 9, 1962). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, black.....	4.2	4.2
Sand, silty.....	9.4	13.6
Sand, fine to coarse, gray-green, gravelly..	6.9	20.5
Quartzite, pink to reddish.....	8.5	29

Test hole 58 (103-51-34add). Altitude, 1,542 feet (T). Depth to water 40.1 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, fine to medium.....	2	3
Gravel, coarse.....	2	5
Sand, medium to coarse.....	3	8
Sand, very fine, clayey.....	32	40
Till, gray.....	9	49

MINNEHAHA COUNTY--Continued

Test hole 59 (103-51-34acc). Altitude, 1,540 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, fine to coarse.....	5	7

Test hole 60 (103-51-33bdd). Altitude, 1,530 feet (L). Depth to water 4.5 feet (reported January 9, 1962). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, black, sandy.....	3.9	3.9
Gravel, fine to coarse, brown, sandy.....	8.7	12.6
Clay, gray.....	5.4	18
Till, brown.....	7	25

Test hole 61 (103-51-33bcc). Altitude, 1,545 feet (L). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, brown, silty.....	2	3
Sand and gravel, brown.....	5	8
Till, brown, moist.....	10	18
Sand, brown, silty; moist.....	6.6	24.6

Test hole 62 (103-51-32aad). Altitude, 1,530 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Gravel, very coarse.....	3	6

Test hole 63 (103-51-28ccc). Altitude, 1,550 feet (T). Depth to water 13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	9	9
Sand, medium to coarse, silty.....	5	14

MINNEHAHA COUNTY--Continued

Test hole 63 (103-51-28ccc) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel, fine to coarse.....	3	17
Boulder.....	--	17+

Test hole 64 (103-51-30ddd). Altitude, 1,612 feet (L). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, light brown, silty and sandy.....	15	15

Test hole 65 (103-51-28cbb). Altitude, 1,559 feet (T). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, fine to medium, and coarse gravel.....	4	5
Sand, coarse, and fine to medium gravel.....	5	10
Till.....	17	27

Test hole 66 (103-51-28bbb). Altitude, 1,563 feet (T). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, very coarse.....	2	4
Boulder.....	--	4+

Test hole 67 (103-51-29aaa). Altitude, 1,563 feet (T). Depth to water 4.7 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Clay, gravelly (till?).....	2	3
Clay, sandy.....	2	5
Clay, gravelly.....	3	8
Clay, sandy.....	19	27

MINNEHAHA COUNTY--Continued

Test hole 68 (103-51-20ccc). Altitude, 1,554 feet (T). Depth to water 19 feet (reported summer 1958).. Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, gray to tan.....	7	9
Till, dark-gray.....	5	14
Clay, dark-gray.....	5	19
Sand, clayey.....	5	24
Gravel, fine.....	1	25
Quartzite.....	--	25+

Test hole 69 (103-52-21cbb). Altitude, 1,768 feet (L). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, brown, silty.....	6	7
Till, brown; moist.....	18	25

Test hole 70 (103-52-21caa). Altitude, 1,726 feet (T). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Till, brown, silty and sandy.....	14	15

Test hole 71 (103-52-20cab). Altitude, 1,756 feet (L). Drilled by USBR.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Clay, tan and gray, silty.....	5.8	6.8
Till, brown, becoming gray at 23 feet; moist	18.2	25

MINNEHAHA COUNTY--Continued

Test hole 72 (103-50-19aaa). Altitude, 1,534 feet (T). Depth to water 4 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, medium to coarse, silty.....	6	9
Sand, medium.....	5	14
Sand, medium to coarse.....	10	24
Till, brown.....	15	39

Test hole 73 (103-50-19bba). Altitude, 1,520 feet (T). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, and medium sand, silty.....	8	8
Sand, medium to coarse.....	8	16
Till.....	23	39

Test hole 74 (103-50-17ccc). Altitude, 1,534 feet (T). Depth to water 10 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, clayey.....	7	9
Sand, medium, silty.....	5	14
Sand, medium to coarse.....	14	28
Till, tan.....	6	34

Test hole 77 (103-50-18bab). Altitude, 1,532 feet (L). Depth to water 4.0 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Sand, fine to medium.....	7	8
Sand, fine to medium, and fine gravel.....	6	14
Gravel, fine to medium, and coarse sand.....	6	20
Gravel, fine to coarse.....	6	26
Sand, medium to coarse, clayey.....	9	35
Gravel, medium to coarse, sandy.....	2	37
Till, brown, sandy.....	1	38

MINNEHAHA COUNTY--Continued

Test hole 77 (103-50-18bab). Continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown, silty and sandy.....	20	58
Till, gray.....	8	66

Test hole 78 (103-51-14bba). Altitude, 1,545 feet (T). Depth to water

5.3 feet (measured October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, brown, clayey.....	24	26

Test hole 79 (103-50-8ccc). Altitude, 1,532 feet (L). Depth to water

8.0 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium to coarse, brown.....	10	12
Sand, coarse, and fine to medium gravel.....	39	51
Till.....	1	52

Test hole 80 (103-50-7dcd). Altitude, 1,528 feet (L). Depth to water

5.0 feet (measured September 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, medium to coarse, and fine gravel.....	12	13
Sand, and coarse gravel.....	1	14
Sand, medium to coarse, and fine to medium gravel.....	10	24
Coarse sand and gravel.....	12	36
Till.....	12	48

MINNEHAHA COUNTY--Continued

Test hole 83 (103-50-8bbb). Altitude, 1,537 feet (T). Depth to water 22 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, clay, silty.....	2	2
Sand, medium, silty.....	17	19
Sand, medium.....	5	24
Sand, fine, clayey.....	15	39
Sand, fine to medium.....	6	45
Sand, medium to coarse.....	4	49
Till, tannish-brown.....	5	54

Test hole 84 (103-50-7aaa). Altitude, 1,537 feet (T). Depth to water 7 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, medium to coarse, and fine gravel.....	6	9
Sand, fine to medium.....	10	19
Sand, coarse, and fine gravel.....	10	29
Till, tan.....	10	39

Test hole 85 (103-50-6ccd). Altitude, 1,540 feet (T). Depth to water 5 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium, silty.....	12	14
Sand, medium to coarse.....	6	20
Sand, coarse, and fine gravel.....	4	24
Till, tan.....	5	29

Test hole 86 (103-52-3ccb). Depth to water 7.4 feet (measured October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	12	12
Sand and gravel, clayey.....	31	43
Till, dark-gray.....	2	45

MINNEHAHA COUNTY--Continued

Test hole 87 (103-50-5abb). Altitude, 1,558 (T). Depth to water 17 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Clay, tan, sandy.....	6	10
Sand, coarse.....	2	12
Medium sand and gravel.....	2	14
Sand, medium to coarse, silty.....	10	24
Sand, coarse.....	5	29
Till, tan.....	5	34
Till, brown.....	5	39

Test hole 88 (103-50-5bbb). Altitude, 1,545 (T). Depth to water 7 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	4	4
Sand, silty.....	5	9
Sand, medium to coarse, silty.....	5	14
Sand, coarse, and fine gravel.....	10	24
Till, tan.....	5	29

Test hole 89 (104-50-31cdd). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium, and fine gravel.....	2	4
Sand, medium.....	10	14
Sand, medium to coarse.....	5	19
Sand, coarse.....	5	24
Sand, medium to coarse.....	19	43

Test hole 90 (104-50-29aaa). Altitude, 1,555 feet (L). Depth to water 13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2

MINNEHAHA COUNTY--Continued

Test hole 90 (104-50-29aaa) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium.....	2	4
Sand, medium to coarse.....	10	14
Sand, coarse.....	5	19
Sand, medium to coarse.....	13	32
Till, gray.....	22	54

Test hole 91 (104-50-29bab). Altitude, 1,551 feet (L). Depth to water
8 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Clay, tannish-gray.....	2	4
Sand, fine, silty.....	5	9
Sand, fine to medium, silty.....	5	14
Sand, medium to coarse.....	6	20
Boulder.....	--	20+

Test hole 93 (104-50-21ccc). Altitude, 1,562 feet (L). Depth to water
8.5 feet (measured October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, fine to coarse.....	14	15
Sand, coarse, and fine gravel.....	10	25
Till, gray.....	2	27

Test hole 94 (104-50-20dcc). Altitude, 1,550 feet (L). Depth to water
11.1 feet (measured October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, dirty.....	10	11
Gravel, fine.....	3	15
Gravel, coarse.....	20	35
Till, gray.....	2	37

MINNEHAHA COUNTY--Continued

Observation well 96 (104-50-20aaa). Altitude, 1,550 (T). Well S-23 of SDWRC. Drilled by SDWRC. Water levels given in table 2.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loam.....	8	8
Sand, coarse.....	10	18
Gravel, coarse.....	5	23
Clay, gray.....	7	30

Test hole 97 (104-50-16cda). Altitude, 1,562 (T). Depth to water 6.6 feet (measured June 13, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Gravel, fine.....	2	3
Sand, fine to medium, pebbly.....	12	15
Sand, fine to medium, and fine gravel.....	10	25
Gravel, fine to medium.....	3	28
Till, gray, contains layers of sand and gravel.....	51	79
Quartzite.....	--	79+

Test hole 98 (104-50-16caa). Altitude, 1,562 (T). Depth to water 7.2 feet (measured June 13, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Sand, fine to coarse, and some pebbles.....	16	17
Sand, fine to coarse, and fine gravel.....	8	25
Gravel, fine to medium, and coarse sand.....	2	27
Till, grayish-green, contains layers of coarse gravel.....	43	70
Coarse sand and gravel.....	12	82
Quartzite.....	--	82+

Test hole 99 (104-50-16aab). Altitude, 1,570 (T). Depth to water 17 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay and sand.....	4	4

MINNEHAHA COUNTY--Continued

Test hole 99 (104-50-16aab) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, silty.....	5	9
Sand, medium to coarse, silty.....	23	32
Till, tan.....	2	34
Till, brownish-gray.....	5	39

Test hole 100 (104-50-16bba). Altitude, 1,560 (T). Depth to water 7 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	4	4
Gravel, coarse.....	5	9
Sand, medium to coarse.....	5	14
Sand, medium, and fine gravel.....	5	19
Sand, coarse.....	9	28
Till, tan.....	6	34

Test hole 103 (104-50-9bba). Altitude, 1,575 (T). Depth to water 15.5 feet (measured October 20, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, coarse.....	8	10
Gravel, fine to medium.....	35	45
Till, brownish-gray.....	10	55

Test hole 104 (104-50-4dcc). Altitude, 1,568 (T). Depth to water 8.4 feet (measured October 20, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, fine.....	18	20
Gravel, medium.....	10	30
Gravel, coarse.....	10	40
Gravel, medium.....	25	65
Till, gray.....	2	67

MOODY COUNTY

Test hole 105 (105-50-34ccc2). Altitude, 1,580 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Sand, fine to coarse, pebbly.....	4	5
Sand, fine to medium.....	5	10
Gravel, fine.....	25	35
Till, gray.....	18	53
Quartzite.....	--	53+

Test hole 106 (105-50-33ddc). Altitude, 1,574 feet (L). Depth to water 8 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Sand, silty.....	5	9
Sand, coarse, and medium gravel.....	7	16
Till, gray.....	13	29

Test hole 107 (105-50-33cdd). Altitude, 1,565 feet (L). Depth to water 12 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, medium to coarse.....	3	4
Sand, medium, and coarse gravel.....	5	9
Gravel, fine to coarse.....	5	14
Sand, coarse, and medium gravel.....	5	19
Sand, coarse, and fine gravel.....	25	44
Sand, medium to coarse.....	7	51
Till.....	5	56

Test hole 108 (105-50-34ccc1). Altitude, 1,575 feet (T). Depth to water about 8 feet (estimated June 13, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1

MOODY COUNTY--Continued

Test hole 108 (105-50-34ccc1) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine to medium, reddish-brown, some small pebbles.....	4	5
Sand, fine to coarse, reddish-brown, and fine to coarse gravel.....	5	10
Sand, fine to medium.....	2	12
Sand, fine to coarse, and fine gravel.....	23	35
Sand, fine, brown, clayey.....	12	47
Till, brown.....	5	52
Quartzite.....	--	52+

Test hole 109 (105-50-33baa). Altitude, 1,579 feet (T). Depth to water
14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium.....	2	4
Sand, medium to coarse.....	10	14
Sand, medium, and fine gravel.....	6	20
Till, greenish-gray.....	4	24
Till, grayish-green.....	5	29
Till, grayish-tan.....	5	34

LAKE COUNTY

Test hole 110 (105-52-36baa). Depth to water 5.1 feet (measured
October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse, and fine gravel.....	15	15
Sand and gravel, clayey.....	13	28
Clay, gray.....	4	32

MOODY COUNTY

Test hole 111 (105-50-28ccc). Altitude, 1,573 feet (T). Depth to water 13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	5	5
Sand, fine.....	4	9
Sand, medium to coarse.....	18	27
Boulder.....	--	27+

Test hole 112 (105-50-30aad). Altitude, 1,582 feet (T). Depth to water 5 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium.....	4	4
Sand, medium to coarse.....	5	9
Sand, coarse.....	15	24
Sand, medium.....	26	50
Till.....	24	74

LAKE COUNTY

Test hole 113 (105-51-27aad). Altitude, 1,586 feet (L). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	9	9
Sand, gray, silty.....	15	24
Till.....	10	34

Test hole 114 (105-51-24ccb). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	9	9
Sand, medium, silty.....	5	14
Sand, coarse.....	15	29
No sample.....	20	49
Sand, coarse.....	15	64
Sand, medium.....	5	69
Sand, coarse.....	5	74

LAKE COUNTY--Continued

Test hole 115 (105-51-22dad). Altitude, 1,602 feet (L). Depth to water 29 feet (summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse.....	4	4
Sand, coarse, and fine gravel.....	5	9
Sand, medium to coarse.....	5	14
Sand, medium.....	5	19
Gravel, medium.....	5	24
Gravel, medium to coarse.....	5	29
Sand, coarse.....	25	54
No sample (till?).....	18	72

Test hole 116 (105-51-21cbb). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, brownish-gray.....	7	9
Till, bluish-gray.....	5	14

Test hole 117 (105-51-23add). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Sand, fine to coarse, reddish-brown, clayey, some pebbles.....	14	15
Till, dark-gray, sandy.....	12	27

Observation well 119 (105-51-23bda). Observation well for aquifer test.

Depth to water 20.53, 18.62, and 18.28 feet (measured June 12, 1962;

September 4, 1962; and October 17, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Sand, fine to coarse.....	10	12
Gravel, fine to coarse.....	40	52

LAKE COUNTY--Continued

Observation well 120 (105-51-23bdb). Observation well for aquifer test.

Depth to water 19.38, 17.76, and 19.08 feet (measured June 12, 1962;

September 4, 1962; and October 17, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Sand, fine to medium.....	15	17
Gravel, fine to coarse.....	32	49

Test hole 121 (105-51-23aaa). Altitude, 1,590 feet (L). Depth to water

13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	4	4
Clay, sandy.....	5	9
Gravel.....	5	14
Till, gray.....	10	24
No sample (till?).....	15	39

Test hole 122 (105-51-23baa). Altitude, 1,591 feet (L). Depth to water

5.7 feet (measured October 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Silt, sandy.....	10	12
Sand, fine to medium, silty.....	8	20
Clay, silty, sandy.....	7	27
Clay.....	3	30
Sand, fine to medium, silty.....	3	33
Sand, medium to coarse, and fine to medium gravel.....	27	60
Clay and silt, sandy.....	5	65
Till.....	1	66

Test hole 123 (105-51-23bbb). Altitude, 1,589 feet (L). Depth to water

8.2 feet (measured October 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1

LAKE COUNTY--Continued

Test hole 123 (105-51-23bbb) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse, and fine gravel.....	10	11
Clay, gray.....	6	17
Clay, gray, sandy.....	6	23
Sand, medium to coarse.....	39	62
Till, dark-gray.....	5	67

Test hole 124 (105-51-22bbb). Altitude, 1,607 feet (L). Depth to water
29 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, medium.....	2	4
Sand, coarse, and fine gravel.....	15	19
Gravel, medium to coarse.....	5	24
Gravel, medium.....	5	29
Sand, medium to coarse.....	5	34
Sand, coarse.....	20	54
Sand, medium.....	3	57

Test hole 125 (105-51-15dcc). Altitude, 1,599 feet (L). Drilled by
USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Sand, medium to coarse, and fine gravel.....	67	68
Sand, medium to coarse, and fine to medium gravel.....	19	87
Sand, fine, silty.....	20	107
Silt, sandy.....	8	115
Till.....	2	117

Test hole 126 (105-51-16cdd). Altitude, 1,613 feet (L). Drilled by
USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse, and fine to medium gravel.....	13	13
Clay.....	7	20

LAKE COUNTY--Continued

Test hole 126 (105-51-16cdd) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine to coarse, and fine gravel.....	15	35
Clay, sandy.....	4	39
Sand, fine to medium.....	8	47
Sand, medium to coarse, and medium to coarse gravel.....	13	60
Till.....	7	67

Test hole 127 (105-51-17ddd). Altitude, 1,592 feet (L). Drilled by
USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine, silty.....	9	9
Sand, fine.....	5	14
Sand, medium.....	5	19
Till.....	10	29

Test hole 128 (105-51-17cdd). Altitude, 1,596 feet (L). Drilled by
USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Clay, brown.....	12	13
Clay, dark-gray.....	9	22

Test hole 129 (105-51-18dcc). Altitude, 1,607 feet (L). Depth to water
14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	4	4
Sand, silty.....	25	29
Till, gray.....	15	44

LAKE COUNTY--Continued

Test hole 130 (105-52-15cdc). Depth to water 5.5 feet (measured October 25, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, coarse, brown.....	5	7
Sand, coarse, and fine gravel, clayey.....	17	24
Till, gray.....	4	28

Test hole 131 (105-51-14cbb). Altitude, 1,606 feet (L). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	4	4
Till, tan-gray.....	5	9
Till, brown.....	5	14

Test hole 132 (105-51-17dad). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	4	4
Sand, coarse.....	13	17
Till, bluish-gray.....	7	24

Test hole 133 (105-51-18daa). Depth to water 16 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine.....	4	4
Sand, coarse.....	5	9
Sand, medium; dirty.....	5	14
Clay, sandy.....	5	19

LAKE COUNTY--Continued

Test hole 134 (105-51-14add). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till.....	19	19

Test hole 135 (105-51-14bcc). Altitude, 1,600 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Silt, brown, sandy.....	18	18
Boulder.....	--	18+

Test hole 136 (105-52-14add). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, yellow.....	4	4
Till, tan.....	5	9
Till, brownish-gray.....	5	14

Test hole 137 (105-51-14bbb). Altitude, 1,599 feet (L). Depth to water 3.5 feet (measured October 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Clay, black, sandy.....	5	7
Sand, fine to coarse, gray.....	9	16
Sand, coarse, and coarse gravel.....	7	23
Sand, medium to coarse.....	19	42
Clay, sandy.....	3	45
Sand.....	18	63
Clay, silty, sandy.....	20	83
Clay, (till).....	5	88

Test hole 138 (105-51-16aaa). Depth to water 27.38 feet (measured June 12, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine to coarse, and fine gravel.....	20	20

LAKE COUNTY--Continued

Test hole 138 (105-51-16aaa) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse, and fine to coarse gravel.....	5	25
Till, light-gray.....	5	30
Till, buff.....	2	32

Test hole 139 (105-51-16bbb). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Gravel, fine.....	3	4
Sand, medium to coarse.....	10	14
Sand, coarse.....	17	31
Till.....	8	39

Test hole 141 (105-52-13abb). Depth to water 3.5 feet (measured October 20, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, gray.....	15	17

Test hole 142 (105-51-8cdd). Depth to water 12 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, silty.....	4	4
Gravel, coarse, silty.....	5	9
Sand, coarse, and fine gravel.....	5	14
Sand, coarse, silty.....	5	19
Sand, coarse.....	5	24
Till, gray.....	10	34

LAKE COUNTY--Continued

Test hole 143 (105-51-7ddd). Altitude, 1,628 feet (L). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, sandy.....	4	4
Clay, gray, sandy.....	5	9
Clay.....	5	14
Till, gray.....	5	19

Test hole 144 (105-52-12cdd). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel, fine to coarse.....	4	4
Gravel, coarse, clayey.....	5	9
No sample.....	5	14
Sand, coarse.....	5	19
Till, gray.....	15	34

Test hole 145 (105-51-11ccb). Altitude, 1,604 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Sand, fine to medium, clayey.....	7	9
Sand, medium to coarse, and fine gravel.....	39	48
Sand, coarse, and fine to medium gravel.....	22	70
Sand, fine to medium, clayey.....	12	82
Till.....	5	87

Test hole 146 (105-51-11bcc). Altitude, 1,613 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Sand, medium to coarse.....	8	11
Till, gray.....	21	32

LAKE COUNTY--Continued

Test hole 147 (105-51-9daa). Depth to water 19 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Gravel, medium.....	1	4
Sand, medium to coarse.....	5	9
Sand, medium.....	5	14
Sand, fine; dirty.....	10	24
Till.....	10	34

Test hole 148 (105-51-8daa). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine, and fine gravel.....	4	4
Gravel, medium.....	5	9
Sand, coarse, and fine gravel.....	20	29
Gravel, medium.....	5	34
No sample.....	5	39
Till, gray.....	5	44

Test hole 149 (105-51-7add). Altitude, 1,648 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Till, brown.....	26	27

Test hole 150 (105-52-11bcc). Depth to water 4.9 feet (measured October 20, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, brownish-gray.....	15	17

Test hole 152 (105-52-12bbb). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown, gravelly.....	4	4

LAKE COUNTY--Continued

Test hole 152 (105-52-12bbb) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	10	14
Till, brownish-gray.....	5	19

Test hole 153 (105-51-5ddd). Depth to water 10.6 feet (measured October 1960). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay and silt, brown, sandy.....	12	12
Sand, medium to coarse, and fine to medium gravel.....	23	35
Sand, fine to medium.....	20	55
Clay, sandy (till).....	5	60
Till.....	10	70

Test hole 154 (105-51-5cdd). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, fine.....	2	4
Gravel, fine to very coarse.....	10	14
Sand, coarse.....	15	29
Gravel, coarse.....	4	33

Test hole 155 (105-51-5ccc). Altitude, 1,623 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine, and fine gravel.....	7	7
Clay, with thin layers of sand and gravel...	10	17
Sand, fine to coarse, and fine gravel.....	10	27
Boulder.....	--	27+

Test hole 156 (105-52-1dda). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Till.....	2	4

LAKE COUNTY--Continued

Test hole 156 (105-52-1dda), continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine.....	10	14
Till.....	10	24
Till, brownish-gray.....	5	29

Test hole 157 (105-52-3ddd). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, gray.....	2	2
Till, grayish-brown.....	17	19

Test hole 158 (105-52-4ddd). Depth to water 17 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	9	9
Till, grayish-brown.....	25	34

Test hole 159 (105-51-5dad). Depth to water 8 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, fine.....	19	19
Till.....	15	34

Test hole 160 (105-52-2daa). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel, fine.....	4	4
Sand, medium to coarse, and pebbles.....	5	9
Gravel, medium.....	7	16
Till, sandy.....	3	19
Till, gray.....	5	24

LAKE COUNTY--Continued

Test hole 161 (105-51-46bb). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, brown.....	26	28

Test hole 162 (105-52-4add). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	1	1
Clay.....	1	2
Clay, yellowish-brown, sandy.....	2	4
Clay, sandy.....	5	9
Till, light-tan.....	5	14
Till, gray, sandy.....	5	19
Sand, coarse.....	5	24
Sand, medium to coarse.....	53	77
Till (?).	17	94

Test hole 163 (105-51-5bbb). Altitude, 1,620 feet (L). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium to coarse, and fine gravel.....	32	32
Sand, fine to medium, dark-gray, clayey, silty.....	16	48
Clay, sandy (till).....	9	57

Test hole 164 (105-52-1bbb). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium.....	4	4
Sand, medium to coarse.....	5	9
Sand, coarse, and fine gravel.....	6	15
Till, brownish-gray.....	4	19
Till, gray.....	5	24

LAKE COUNTY--Continued

Test hole 165 (106-51-32bcc). Altitude, 1,618 feet (L). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	3	3
Gravel, coarse.....	1	4
Gravel.....	5	9
Till, brown.....	5	14
Till, gray.....	5	19
Till, bluish-gray.....	5	24

Test hole 166 (106-51-32baa). Altitude, 1,670 feet (L). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	14	14

Test hole 167 (106-52-26ccc). Depth to water 14 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand and gravel.....	4	4
Sand, medium to coarse.....	5	9
Sand, medium.....	3	12
Till, bluish-gray.....	7	19

Test hole 168 (106-52-26add). Depth to water 32 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till.....	6	6
Sand, fine.....	3	9
Till, brown.....	5	14
Clay, sandy.....	5	19
Sand, fine, gray, clayey.....	30	49
Till.....	5	54

LAKE COUNTY--Continued

Test hole 169 (106-52-28add). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	14	14

Test hole 170 (106-52-27bbb). Depth to water 17 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, medium.....	4	4
Sand, tan.....	5	9
Till.....	15	24

Test hole 171 (106-52-21cbb). Depth to water 6.0 feet (measured October 20, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Till, brown.....	13	15
Till, gray.....	2	17

Test hole 172 (106-52-20add). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	14	14
Till, gray.....	15	29

Test hole 173 (106-52-23aad). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Till.....	3	4
Till, brown.....	5	9
Till, brownish-gray.....	10	19

LAKE COUNTY--Continued

Test hole 175 (106-52-22bcb). Depth to water 23 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand, coarse, and fine gravel.....	14	14
Gravel, fine.....	10	24
No sample.....	5	29
Sand, coarse.....	44	73

Test hole 176 (106-52-21abb1). Depth to water 33 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Sand and coarse gravel.....	4	4
Sand, coarse, and fine gravel.....	5	9
Gravel, fine.....	2	11
Clay, bluish-gray.....	8	19
Gravel, fine, silty.....	5	24
No sample.....	15	39
Sand, coarse.....	30	69

Test hole 177 (106-52-21abb2). Depth to water 8.8 feet (measured October 19, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Gravel, coarse.....	11	12
Gravel, medium.....	48	60
Clay, grayish-brown (till).....	2	62

Test hole 178 (106-52-19aaa). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, tan.....	19	19
Till, gray.....	5	24

LAKE COUNTY--Continued

Test hole 179 (106-53-21aad). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, tan.....	14	14
Till, bluish-gray.....	15	29

Test hole 180 (106-52-16caa). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, coarse.....	5	7
Gravel, fine.....	5	12
Gravel, coarse.....	5	17
Gravel, fine.....	30	47

Test hole 181 (106-52-16cbb). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, tan.....	14	14

Test hole 182 (106-52-18add). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, tan.....	9	9

Test hole 183 (106-53-13add). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brownish-gray.....	9	9
Till, gray.....	5	14

Test hole 185 (106-52-16add). Depth to water 22 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loess.....	4	4
Till.....	10	14
Till, sandy.....	5	19
Till.....	5	24

LAKE COUNTY--Continued

Test hole 186 (106-62-16abb). Depth to water 17.2 feet (measured October 19, 1962). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	2	2
Gravel, fine to coarse.....	13	15
Gravel, fine.....	5	20
Gravel, coarse.....	5	25
Gravel, fine.....	10	35
Gravel, medium.....	10	45
Till, gray.....	3	48

Observation well 187 (106-52-8ddd). Well S-21 of SDWRC. Drilled by SDWRC. Water levels given in table 2.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel, coarse.....	4	4
Loam, gravelly.....	4	8
Gravel, coarse.....	8	16
Clay, gray.....	6	22
Gravel.....	2	24
Clay.....	6	30

Test hole 188 (106-52-7ddd). Depth to water 14 to 19 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loam, black.....	1	1
Clay, brown.....	3	4
Clay, sandy.....	15	19
Till, bluish-gray.....	--	19

Test hole 189 (106-53-12ddd). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, tan.....	9	9
Till, brown.....	10	19
Till, gray.....	5	24

LAKE COUNTY--Continued

Test hole 190 (106-53-12dda). Depth to water 23 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, brownish-gray.....	4	4
Gravel, fine, and pebbles.....	5	9
Gravel, fine.....	5	14
Gravel, medium, and till, blue.....	12	26
No sample (till?).....	23	49

Test hole 191 (106-53-11ddd). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loess.....	4	4
Sand, medium.....	5	9
Clay, sandy.....	5	14
Till, tan.....	10	24

Test hole 192 (106-52-9cbb). Depth to water 23 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Clay, brownish-gray.....	2	4
Clay, silty.....	5	9
Gravel, coarse.....	5	14
Gravel.....	5	19
Gravel, fine.....	5	24
Sand, medium to coarse.....	8	32
Till, gray.....	12	44

Test hole 195 (106-53-12daa). Depth to water 21 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Clay, gravelly.....	2	4
Gravel, medium to coarse.....	10	14

LAKE COUNTY--Continued

Test hole 195 (106-53-12daa) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Gravel, fine to medium.....	5	19
Sand, coarse.....	5	24
Gravel.....	2	26
Till, bluish-gray.....	3	29
No sample (till?).....	15	44

Test hole 196 (106-52-9bbc). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Till, brown.....	14	14

Test hole 197 (106-52-7acc). Depth to water (reported summer 1958).

Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	4	4
Gravel, coarse.....	5	9
Gravel.....	5	14
Gravel, coarse.....	15	29
Till, bluish-gray.....	10	39

Test hole 199 (106-53-11add). Depth to water 13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, gray.....	4	4
Gravel, clayey.....	5	9
Sand, coarse.....	5	14
Gravel, fine.....	15	29
No sample.....	5	34
Sand, fine to coarse.....	5	39
Sand, medium to coarse.....	5	44
Sand, coarse, and pebbles.....	20	64
No sample (till?).....	15	79

LAKE COUNTY--Continued

Test hole 201 (106-53-11aaa). Depth to water 22 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Loess.....	6	6
Till, tan.....	13	19
Till, bluish-gray.....	5	24

Test hole 202 (106-53-10aab). Depth to water 13 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	2	2
Clay, gray.....	2	4
Sand, clayey.....	5	9
Clay, sandy.....	5	14
Till.....	10	24

Test hole 203 (106-53-8bbb). Depth to water 9.9 feet (measured October 26, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Gravel, coarse, and cobbles.....	3	4
Sand and gravel, clayey.....	16	20
Till, gray.....	4	24

Test hole 205 (106-53-3ccc). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, yellow.....	9	9
Clay, gray.....	10	19

Test hole 206 (106-53-5ddd). Depth to water 5.2 feet (measured October 26, 1961). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, black.....	4	4

LAKE COUNTY--Continued

Test hole 206 (106-83-6dad) continued.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Clay, brown, sandy.....	20	24
Boulder.....	--	24+

Test hole 207 (106-82-6abb). Drilled by USGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil.....	1	1
Clay, brown, sandy.....	19	20

Test hole 208 (106-82-6bcc). Depth to water 9 feet (reported summer 1958). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	4	4
Sand, medium, and fine gravel.....	5	9
Sand, coarse.....	5	14
Till.....	10	24

Test hole 209 (106-82-6bbb). Drilled by SDGS.

<u>Material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Soil, black.....	4	4
Till, yellowish-gray.....	5	9
Till, tan.....	5	14

APPENDIX I

Suitability of the Water for Irrigation Use

When water is evaluated for a particular use, several chemical characteristics must be considered; some characteristics may be satisfactory, whereas others may be unsatisfactory. The most important characteristic that determines the suitability of water for irrigation in the Skunk Creek-Lake Madison drainage basin is the specific conductance indicating the total dissolved-solids content.

"Nearly all irrigation waters that have been used successfully for a considerable time have conductivity values (specific conductance) of less than 2,250 micromhos per centimeter (equivalent to a dissolved-solids content of about 1,500 ppm). Waters of higher conductivity are used occasionally, but crop production, except in unusual situations, has not been satisfactory". (U. S. Salinity Laboratory Staff, 1954, p. 70).

The relative tolerances of many common crops to total dissolved solids are shown in the following tabulation (U. S. Salinity Laboratory Staff, 1954, p. 67).

Relative tolerance of crop plants to total dissolved solids ^{1/}

Tolerant	Moderately Tolerant	Sensitive
Fruit Crops		
	Grape Cantaloupe	Pear Apple Prune Plum Almond Apricot Peach Strawberry
Vegetable Crops		
Garden beets Kale Asparagus Spinach	Tomato Broccoli Cabbage Bell pepper Cauliflower Lettuce Sweet corn Potato Carrot Onion Peas Squash Cucumber	Radish Celery Green beans
Field Crops		
Barley (grain) Sugar beet Rape	Rye (grain) Wheat (grain) Oats (grain) Sorghum (grain) Corn (field) Flax Sunflower Castor beans	Field beans

Tolerant	Moderately Tolerant	Sensitive
Forage Crops		
Aibali Sacaton Saltgrass Canada wild rye Western wheat grass Barley (hay) Birdsfoot trefoil	White sweet clover Yellow sweet clover Perennial rye grass Strawberry clover Dallis grass Sudan grass Alfalfa Rye (hay) Wheat (hay) Oats (hay) Orchard grass Blue grama Reed canary Bightrefoil Smooth brome Tall meadow oatgrass Sour clover	White Dutch clover Meadow foxtail Alsike clover Ladino clover

1/ Under each of the types of crops the most tolerant crops are listed at the top of each column.

Other characteristics of irrigation water that are objectionable are the content of individual chemicals that might be toxic to crops, and the chemical changes that may take place in the soil after the water has been applied.

The following tabulation shows five quality classifications and limiting factors (Scofield, 1935) for irrigation water.

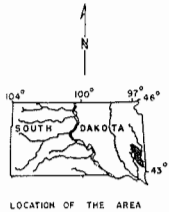
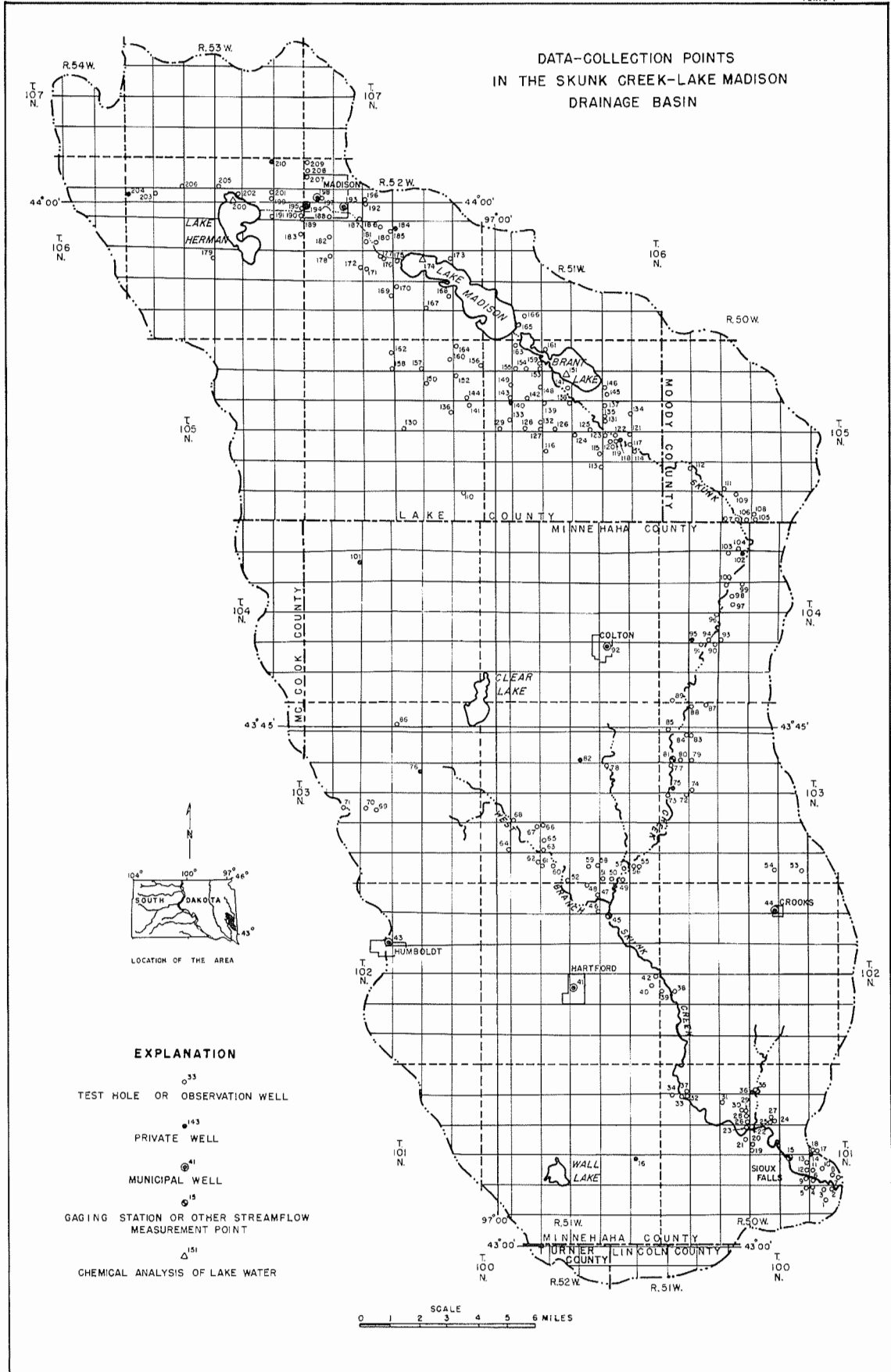
Classes of irrigation water and permissible limits of constituents

Class of water	Total dissolved solids		Sodium, per cent	Boron, Ppm			Concentration, Ppm	
	Electrical conductances, $K \times 10^6, 25^\circ C$	Ppm		Fruit trees	Vines and cereals	Vegetables	Chloride (Cl)	Sulfate (SO_4)
1. Excellent less than	250	175	20	0.33	0.67	1.0	142	192
2. Good	250-750	175-525	20-40	0.33-0.67	0.67-1.33	1.0-2.0	142-248	192-336
3. Permissible	750-2,000	525-1,400	40-60	0.67-1.00	1.33-2.00	2.0-3.0	248-426	336-576
4. Doubtful	2,000-3,000	1,400-2,100	60-80	1.00-1.25	2.00-2.50	3.0-3.75	426-709	576-961
5. Unsuitable, more than	3,000	2,100	80	1.25	2.50	3.75	709	961

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DATA-COLLECTION POINTS
 IN THE SKUNK CREEK-LAKE MADISON
 DRAINAGE BASIN



LOCATION OF THE AREA

EXPLANATION

- ³³
TEST HOLE OR OBSERVATION WELL
- ⁴³
PRIVATE WELL
- ⊙⁴¹
MUNICIPAL WELL
- ⊖¹⁵
GAGING STATION OR OTHER STREAMFLOW MEASUREMENT POINT
- △¹⁵¹
CHEMICAL ANALYSIS OF LAKE WATER

