

STATE OF SOUTH DAKOTA
Richard Kneip, Governor

DEPARTMENT OF NATURAL RESOURCE DEVELOPMENT
Vern W. Butler, Secretary

GEOLOGICAL SURVEY
Duncan J. McGregor, State Geologist

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GROUND-WATER STUDY FOR THE CITY OF ABERDEEN

by

Merlin J. Tipton

Science Center
University of South Dakota
Vermillion, South Dakota
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GROUND-WATER STUDY FOR THE CITY OF ABERDEEN

At the request of Aberdeen city officials, a ground-water study of the area around Aberdeen was conducted during the week of September 22 to 27, 1975. The purpose of the survey was to determine if a sufficient amount of good quality ground water could be obtained from either the Elm or Middle James aquifer (Koch et al., 1973) to supplement or replace the present source of surface water.

Resource studies recently completed in Brown County (Koch et al., 1973) show the presence of two shallow aquifers which could possibly supply the amount of water required by the city of Aberdeen. The aquifers extend from north to south through the central part of the County and when combined range in width from 3 miles to more than 25 miles (fig. 1).

The Middle James aquifer may yield as much as 1,000 gallons per minute to properly constructed wells at depths ranging from 60 to 200 feet. Water in the aquifer occurs under artesian conditions, and water levels in wells tapping the aquifer range from flowing to 32 feet below land surface. Aquifer thickness range from 2 to 70 feet.

The Middle James aquifer yields water that is predominantly of sodium bicarbonate and sodium sulfate types, with specific conductances ranging from 679 to 5,690 and averaging 2,407 μ mhos/cm (micromhos per centimeter).

The Elm aquifer overlies the western part of the Middle James aquifer (fig. 1) and in some of the areas

where both aquifers occur they are hydraulically connected. The aquifer may yield as much as 1,000 gallons per minute to properly constructed wells at depths ranging from 15 to 100 feet. Aquifer thickness ranges from 2 to 80 feet. Water in the aquifer may be under water-table or artesian conditions, and water levels in wells tapping the aquifer range from 4 to 50 feet below land surface.

Water in the Elm aquifer is predominantly of sodium, calcium, sulfate, bicarbonate types with specific conductances ranging from 246 to 5,900 μ mhos/cm and averaging 2,017 μ mhos/cm. Hardness ranges from about 80 to 3,300 and averages about 860 mg/l or 50 grains per gallon.

Test holes showing saturated thickness of sand and gravel, which were drilled for the Brown County resource study (Koch, 1976) as well as additional test holes (app. A) which were drilled during this investigation, are shown in figure 2 for an area of 432 square miles around Aberdeen. Several tests to the north of Aberdeen show saturated thicknesses of more than 50 feet which should be capable of producing large quantities of water.

Figure 3 shows the total dissolved solids or specific conductance of water samples from the Elm and Middle James aquifer for the same area around Aberdeen as that shown in figure 2. Three areas of very poor quality water show up from these analysis: one area 2 miles northeast of Aberdeen, another area 5 to 6 miles north of Aberdeen around Alkali Lake,

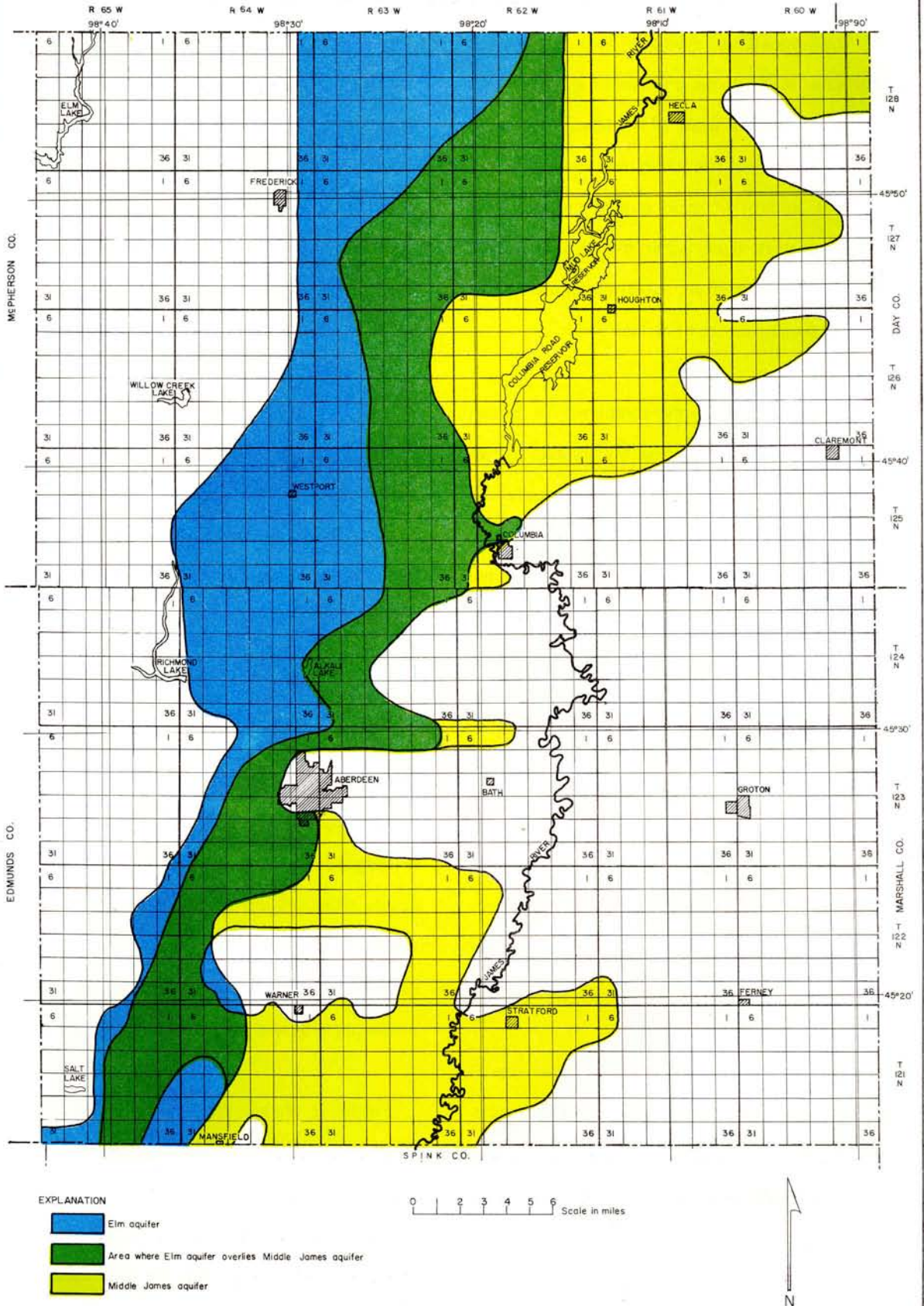
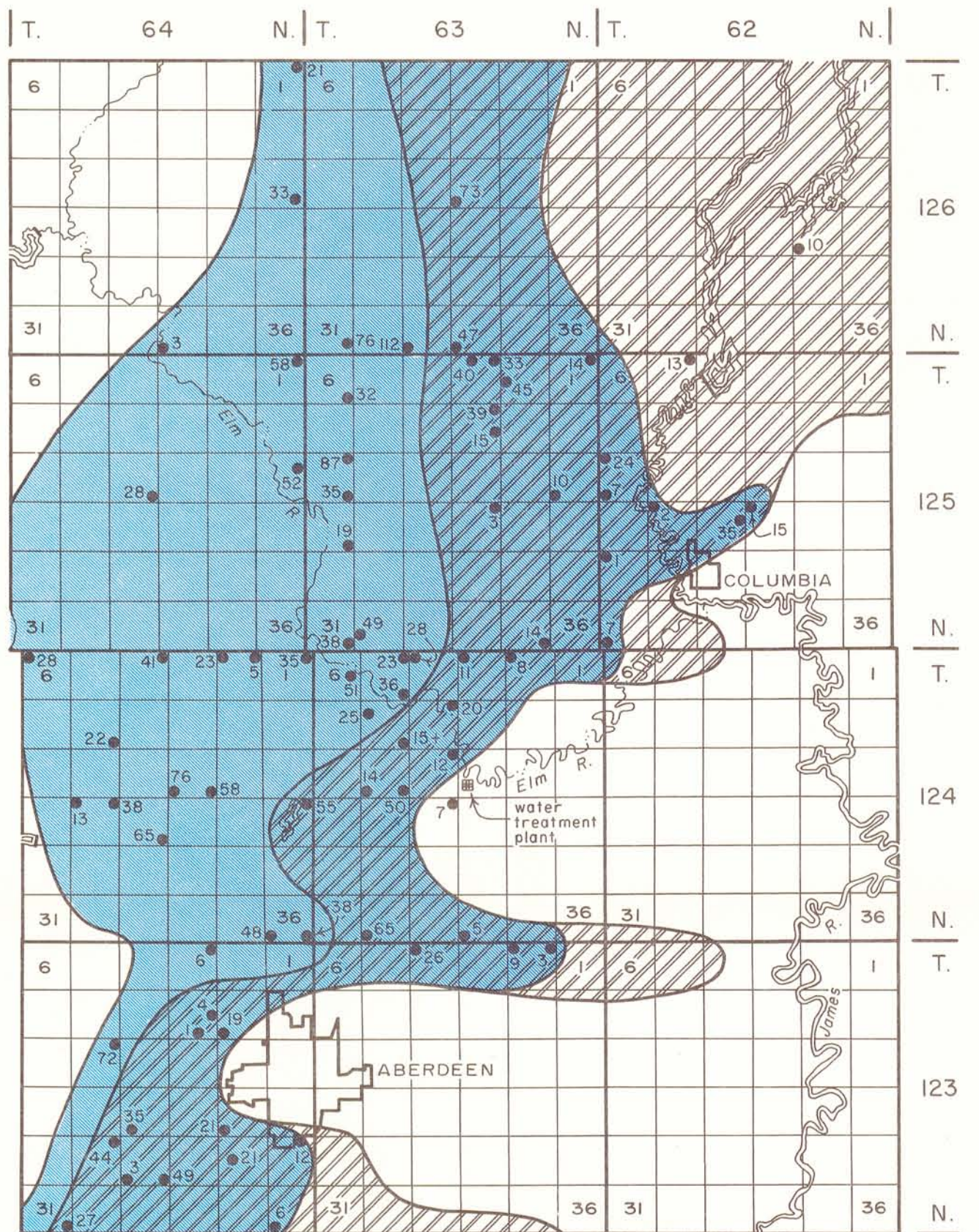


Figure 1. Map of Brown County showing locations of the Middle James and Elm aquifers. (modified from Koch, et al, 1973)



0 1 2 3 4 5 6 12 18 miles



Elm aquifer

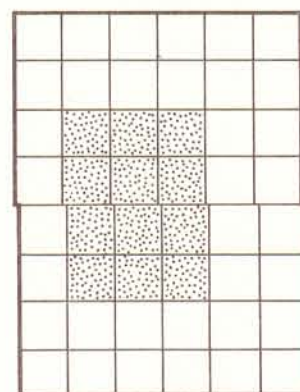


Middle James aquifer



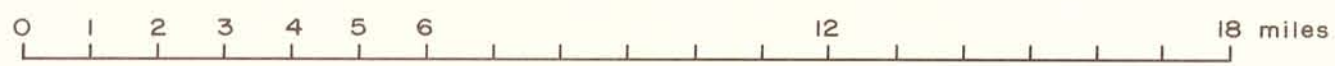
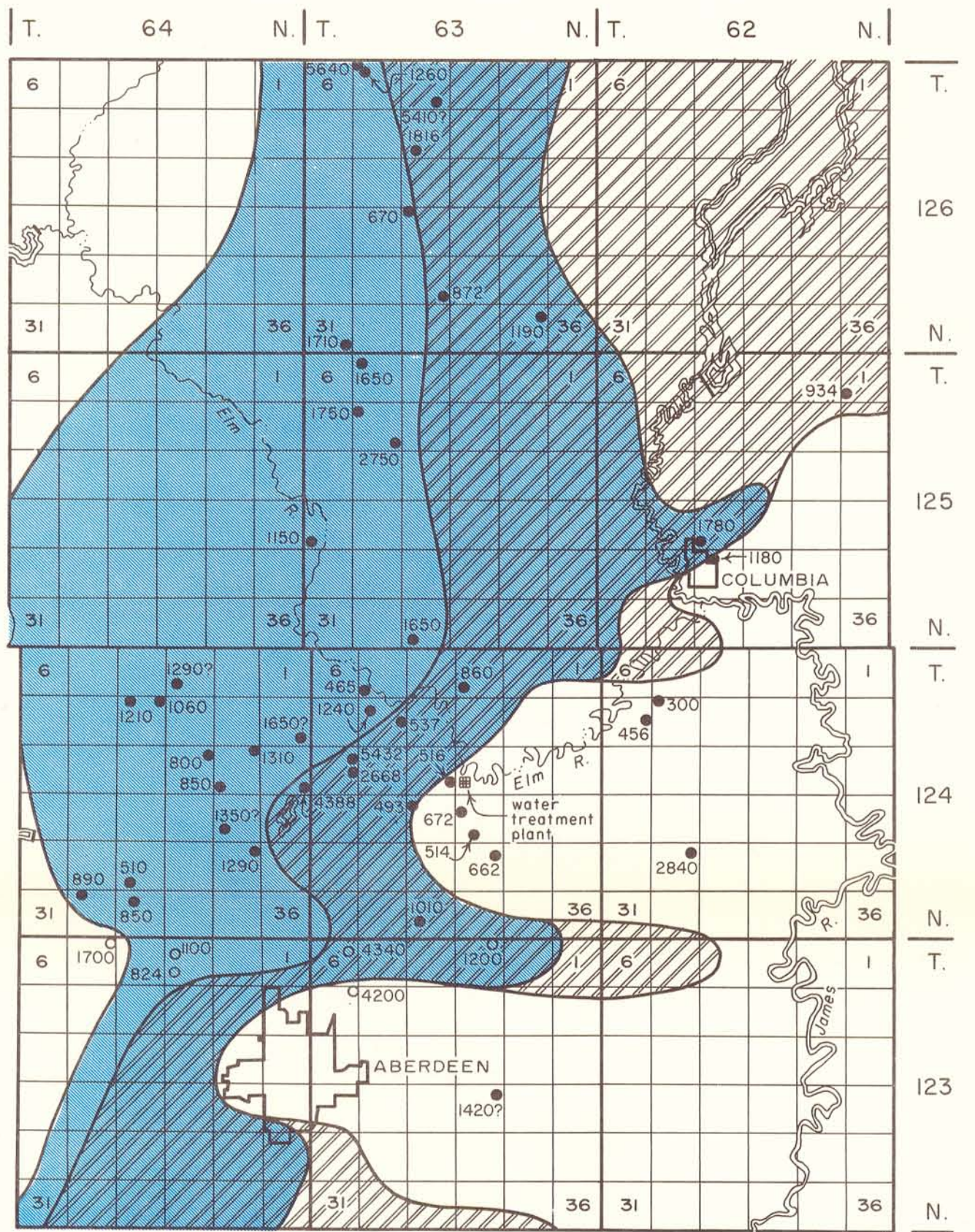
Area where the Elm and Middle James aquifers overlap

39● Test hole, number is thickness of saturated sand and gravel, in feet.



Index map — Brown Co.

Figure 2. Shallow ground water supplies in the Aberdeen area showing thickness of saturated sand and gravel (modified from Koch, et al, 1973).



Elm aquifer



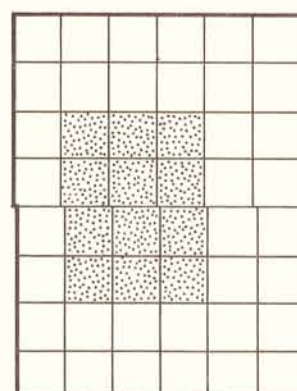
Middle James aquifer



Area where the Elm and Middle James aquifers overlap

800● Total dissolved solids

1700○ Specific conductance



Index map—Brown Co.

Figure 3. Shallow ground water supplies in the Aberdeen area showing Total Dissolved Solids and Specific Conductance of water samples from the Elm and Middle James aquifers (modified from Koch, et al, 1973).

and the third area 19 to 20 miles straight north of Aberdeen. All three areas have total solids or specific conductances between 4,000 to 5,000 parts per million or micromhos per centimeter respectively. These three areas should be avoided in future water development for the city of Aberdeen. Complete analyses of water samples in this area are given in Bulletin 25 and in table 1. Table 1 contains the analyses of the waters collected in connection with this report.

To determine the quantity and quality of ground water available to the city of Aberdeen several aquifer tests should be conducted. The first test should be in the vicinity of SE¼ section 31, Township 125 North, Range 63 West or the NE¼ section 6, Township 124 North, Range 63 West. At these locations approximately 40 to 50 feet of saturated aquifer material should be encountered. An initial test hole at this location is recommended to confirm the previous findings and, if confirmed, a fairly large production well should be installed. The production well should be capable of pumping a minimum of 500 gallons per minute. Observation wells should be installed at distances of 30, 60, and 120 feet from the production well. The aquifer test should be conducted for a minimum of 72 hours and possibly longer depending on the aquifer's response to high-capacity pumping.

Water quality samples should be collected at the beginning, half way through, and just prior to ending the aquifer test. These should be analyzed for all the elements relevant to a city water supply.

If the first aquifer test proves successful--that is, if the aquifer yields a sufficient quantity of water of acceptable quality, and dependent upon the results of the data from this first test, an additional three to five tests will be recommended.

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 consulted regarding the biological and chemical suitability of the water.

REFERENCES LISTED

- Koch, N. C., Bradford, W., and Leap, D. I., 1973, Major aquifers and sand and gravel resources in Brown County, South Dakota: South Dakota Geol. Survey, Inf. Pamph. 4, 8 p.
- Koch, N. C., and Bradford, W., 1976, Geology and water resources of Brown County, South Dakota: South Dakota Geol. Survey, Rept. Inv. 25, 53 p.

APPENDIX A

Test holes drilled in the Aberdeen area

Test Hole 1

Location: NE NE NE NE sec. 5, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 2
Till, oxidized, light-brown	2-16
Sand, coarse to very coarse, clayey, saturated, subangular to subrounded	16-18
Gravel, fine, with very coarse sand, water, subangular, clean	18-25
Sand, medium-coarse, clean, gray, water, subrounded to subangular	25-41
Till, unoxidized, hard	41-50

* * * *

Test Hole 2

Location: SE SE SE SE sec. 5, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 1
Till, oxidized, light- to dark-brown, moist	1- 8
Sand, medium to coarse, water at 8 feet, sand is subrounded, clean	8-17
Cobbles, estimate 2 to 3 inches diameter	17-23
Sand, fine to medium, slightly dirty and clayey, subrounded, saturated	23-44
Till, unoxidized, hard	44-50

* * * *

Test Hole 3

Location: SE SE SW NE sec. 6, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, brown, dry	0- 1
Sand, coarse, subrounded, dry, silty	1- 4
Gravel, medium to coarse, dry, subrounded, moist at 9 feet, water at 14 feet	4-33
Gravel, coarse to very coarse, unknown size, estimate 1- to 1½-inch cobbles, water	33-35
Gravel, medium to coarse, water, subrounded	35-48
Sand, medium to coarse, subrounded, water	48-65
Till, unoxidized, sandy, hard	65-80

* * * *

Test Hole 4

Location: NW NW SW NW sec. 8, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 1
Sand, fine to very fine, dry	1- 7

Test Hole 4 -- continued.

Gravel, fine to very coarse sand, becomes saturated at 12 feet, dark-brown and silty	7-25
Gravel, fine to medium, silty brown, subrounded, saturated	25-32
Gravel, medium to coarse, unknown size, estimate ½- to 1-inch diameter pebbles, saturated	32-37
Clay, unoxidized, gray	37-50

* * * *

Test Hole 5

Location: SE SE SE SE sec. 8, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 2
Sand, fine, dry, silty	2- 4
Gravel, very coarse to boulders, impossible drilling, bit twisted off, abandoned hole	4-25

* * * *

Test Hole 6

Location: NE NE NE NE sec. 9, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 2
Sand, medium to coarse, clean, dry, subangular, saturated at 8 feet	2-11
Sand, coarse to very coarse, clean, water, subrounded	11-22
Gravel, unknown size, estimate, medium, water	22-28
Till, unoxidized, sandy at first but not from 30 to 35 feet, gray, hard	28-35

* * * *

Test Hole 7

Location: NE NE NE NE sec. 16, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black	0- 2
Sand, medium to coarse, very clayey, saturated at 9 feet, subangular, water at 11 feet	2-14
Sand, medium to coarse, silty and clayey, subangular to subrounded, saturated	14-21
Till, unoxidized, unsorted, gray, hard	21-25

* * * *

Test Hole 8
 Location: NE NE NE NE sec. 21, T. 124 N., R. 63 W.

Description	Depth Feet
Topsoil, black	0- 2
Sand, medium to very coarse, moist, water at 13 feet, subrounded	2-13
Sand, very coarse, subrounded to subangular, some till but very little	13-20
Till, unoxidized, hard	20-25

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Test Hole 9
 Location: SE SE SE SE sec. 6, T. 125 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 2
Till, oxidized, light-brown, moist	2-24
Till, unoxidized, moist	24-42
Sand, medium to coarse, subrounded, water	42-65
Gravel, fine to medium, water, clean, gray, subrounded, subangular	65-74
Till, unoxidized, hard	74-80

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Test Hole 10
 Location: NE NE NE NE sec. 18, T. 125 N., R. 63 W.

Description	Depth Feet
Topsoil	0- 1
Till, oxidized, moist	1- 16
Till, unoxidized, moist, black	16- 24
Sand, medium to coarse, saturated, subrounded	24-103
Clay or till?	103-110

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Test Hole 11
 Location: SE SE SE SE sec. 18, T. 125 N., R. 63 W.

Description	Depth Feet
Topsoil	0- 1
Till, oxidized, moist	1-22
Till, unoxidized, black, moist	22-32
Sand, fine to medium, some clay, subrounded, saturated	32-46
Sand, fine, wet, subrounded	46-51
Sand, fine to medium, wet, subrounded	51-67
Clay or till	67-75

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Test Hole 12
 Location: SE SE SE SE sec. 19, T. 125 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 1
Till, oxidized, light- to dark-brown, moist	1-16
Till, unoxidized, gray, moist	16-39
Sand, fine to medium, saturated, gray	39-51
Clay, unoxidized, gray	51-60

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Test Hole 13
 Location: SE SE SE SE sec. 34, T. 125 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 1
Till, brown, unoxidized, moist	1-17
Clay, very sandy, coarse, light-brown, saturated, subangular grains	17-23
Sand, subrounded, fine to medium, water, brown	23-31
Sand, subangular, subrounded, fine to medium, saturated, gray	31-74
Clayey sand, medium, unoxidized	74-80

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Test Hole 14
 Location: NE SE SE SE sec. 31, T. 126 N., R. 63 W.

Description	Depth Feet
Topsoil, black, dry	0- 2
Till, oxidized, light- to dark-brown, moist	2- 22
Till, unoxidized, moist, gray	22- 36
Sand, medium to coarse, subrounded to subangular, saturated, clean	36- 61
Gravel, estimate medium size, water, clean	61- 69
Sand, fine to coarse, subrounded, subangular, saturated, clean	69-113
Till, unoxidized, gray, hard	113-120

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TABLE 1. Chemical analyses of water samples in the Aberdeen area

Location	Depth to Water	Chloride	Total Hardness	Sulfate	Calcium	Alkalinity	Total Iron	Magnesium	Total Solids	Manganese	Nitrate	Sodium
SE SW SE SW 9-122-63	36	660	950	500	185	280?	12 ?	120	2820?	2.15	3.0	350
NW NW NE NW 15-122-63	65?	210	440	350	95	360	0.95	50	1430	1.40	12	270
NE NE NE SE 22-123-63	40	80	570	370	105	360	0.30	75	1420?	0.15	3	130
NW NW NW NW 16-123-64		390	70	150	15	450	2.2	8	1548	0.45	0	500
SE SE 16-124-63	20?	10	435	80	125	260	0.1	30	516	0.05	1.5	10
NE SE NE 18-124-63	15-18	960	4020	1750?	1300	320	2.0	190	5432?	0.2	0.5	200
SE SE SE NE 18-124-63	?	785	90	380	20	540	0.2	10	2668	0.1	0.5	860
NW NW 22-124-63	8-12	20	600	190	200	230	0.1	25	672	0.2	0.5	10
SE SW SE SW 3-124-64	30	40	480	250	110	480	0.30	50	1290?	0.15	3.0	145
NE NE NE NE 9-124-64	26	40	510	250	115	460	0.1	55	1060	0.7	8	120
NW NE NW NW 9-124-64	50	60	510	320	115	450	0.3	55	1210	0.55	4	170
SW SW SW SE 12-124-64	40	80	540	450	115	440	12 ?	60	1650?	0.45	1	225
SE SE SE SE 13-124-64	18	255	3360	2200	640	565	8	430	4388	0.15	0.5	510
NE NE NE NE 14-124-64	30	120	530	250	90	520	0.1	75	1310	0.55	16	210
SW SW SW SW 14-124-64	36	110	462	130	70	320	0.1	70	850	0.25	0.5	75
NE SE SE NE 15-124-64	35	60	405	130	80	360	0.1	50	800	0.5	6.0	80
NW NE SE SE 23-124-64	30	120	455	250	100	440	0.3	50	1350?	0.35	4	190
NE SE NE NE 26-124-64	30	80	610	580	115	290	0.1	80	1290	0.75	2	180
SW SW SE SW 28-124-64	18	20	270	20	70	320	0.1	25	510	0.15	1	25
NE NW NW NE 32-124-64	22	40	360	170	60	400	0.1	50	890	0.2	1	120

SE SW SE SE 4-126-63	30	900	1860?	950	220	540	0.1	320	5410?	2.05	55	440
NW NW NW NW 5-126-63 ¹	30	100	460	325	70	310	0.30	70	1260	0.35	0.5	150
NW NW NW NW 5-126-63 ²	32	620	1850?	1550	210	600	0.30	320	5640	0.1	120	570
SW 9-126-63	40	149	870	780	150	432	0.2	120	1816	0.2	11	230
NW NW NE NW 21-126-63	23	30	300	100	70	340	0.95	30	670	0.5	3.0	80
SE 28-126-63 ¹	80	39	560	440	130	452	16.0	57	872	0.2	3	100
SE 28-126-63 ²	40	41	560	420	130	448	2.0	57	924	0.1	1.5	100
NE SE NE NE 35-126-63	?	50	470	250	105	380	0.95	50	1190	0.95	2.0	120