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by

ASSAD BARARI
1970

GROUND-WATER STUDY

in the

LITTLE WHITE RIVER VALLEY

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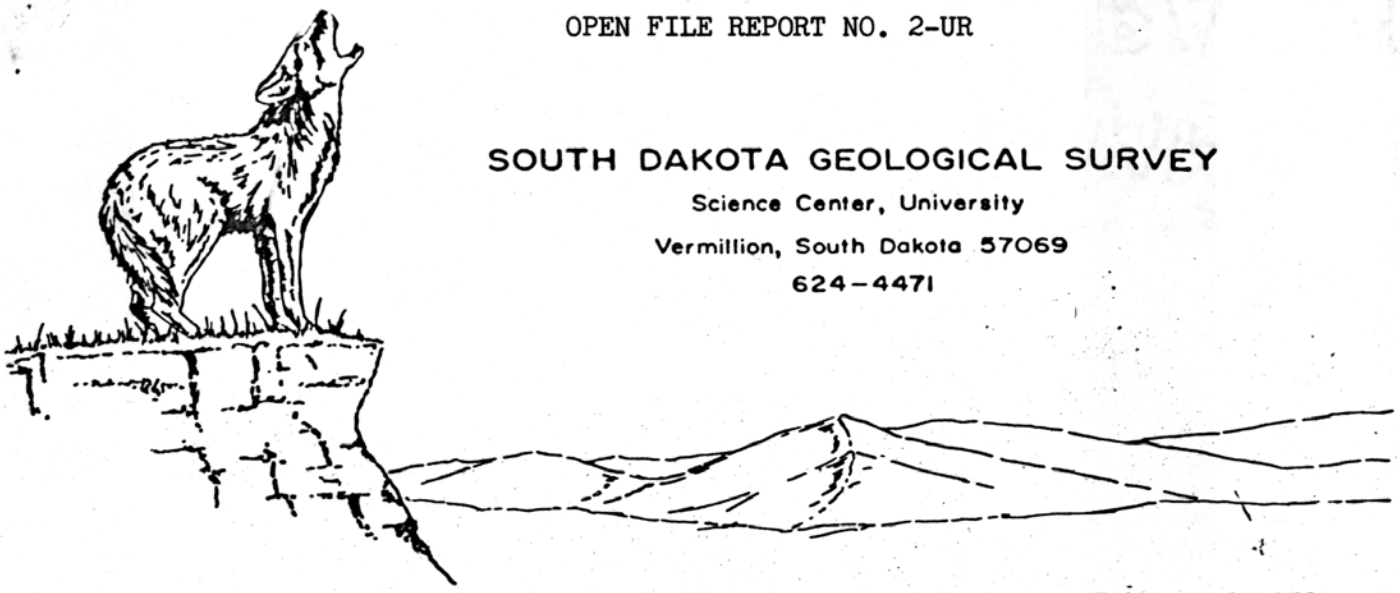

SOUTH DAKOTA GEOLOGICAL SURVEY
Science Center, University
Vermillion, South Dakota 57069
624-4471

February 6, 1970

Mr. Howard North, Director
Lyman-Jones Water Development Association
P. O. Box 1
Murdo, South Dakota

Dear Mr. North:

At the request of the Lyman-Jones Water Development Association the South Dakota Geological Survey conducted a ground-water study in the Little White River Valley from the mouth of the river upstream to the City of White River. Included in this survey were: (1) a review of the geology as mapped by the South Dakota Geological Survey (Agnew, 1957); (2) electrical resistivity investigations at 25 stations conducted by Bruno Petsch; (3) supervised drilling of 20 test holes by Ferguson-Meador and Associates in the area; and (4) collection and analysis of 11 water samples.

The Little White River has formed a valley approximately 180 feet deep and one-half to a mile wide in the study area. The river has deposited alluvial sediments in the valley which vary from less than a foot to 21 feet thick (Test Hole 5, App. 1). In the study area, these alluvial sediments consist of sand ranging in size from fine to coarse and in some locations clay and sand are mixed together. The thickest alluvial deposit is at the junction of the Little White River Valley and the White River Valley. These deposits are mostly coarse to very coarse sand and approximately 15 feet of these deposits are water saturated. There is locally thicker and coarser material from the junction of the two valleys toward the White River. Twenty-three feet of alluvium ranging in size from medium sand to gravel was penetrated by Test Hole No. 3. The water saturated thickness of the material was 16 feet in this hole. Sediments in this area were deposited by both rivers.

Water in the alluvial deposits in these valleys is hydrologically connected to the respective streams flowing in the valleys. Since water in the White River has more dissolved chemicals than water in the Little White River, water from alluvium in the valley of the White River is poorer in quality. Compare Sample W_1 (from alluvium in the White River Valley) with Samples W_4, W_5, and W_{10} (from alluvium in the Little White River Valley). There are some wells in the Little White River Valley which are getting an inferior quality water from the Pierre Shale; compare Samples W_6, W_7, and W_8 (from the Pierre Shale) with Samples W_4, W_5, and W_{11} (from alluvium in the Little White River).

It is recommended that the Lyman-Jones Water Development Association do additional testing in the area outlined on the Data Map (fig. 2). This testing should include drilling a few additional test holes in the recommended area on Figure 2. The results of these test holes should provide information on size, sortment, and clay content of the sediments. Based on the data to be gathered from these additional test holes and in consideration of the distance from the White River, the best site for construction of a well for an aquifer test could then be decided.

A well for an aquifer test should be installed by a qualified driller north of the bridge. Several observation wells should be drilled in the area and an extensive aquifer test should be conducted for a minimum of 72 hours and probably, because of the special connection between the aquifers, for a longer period. The drawdown in the observation wells should be measured during the pump test to calculate the hydraulic properties of the aquifer. Water samples should be collected for chemical analysis during the aquifer test to find out the chemical changes of the quality of water and also to find the effect of the induced recharge for an extensive period. In the event that the quality of water is not satisfactory by the end of the aquifer test, another aquifer test should be run in the southeast of the recommended area.

The results of the aquifer test(s) will afford a basis for deciding if the area will provide the required quantity and quality of water, determine the proper spacing of production wells, and obtain data for design of the wells.

Before a permanent well is drilled the Lyman-Jones Water Development Association should consult with the South Dakota Water Resources Commission to obtain water rights and a permit to drill a municipal well, and with the South Dakota Department of Health to determine biological and chemical suitability of the water.

For your information a generalized geologic map, data map, the results of chemical analyses of water, the logs of the test holes, a map showing resistivity stations, and resistivity readings are enclosed.

Sincerely,

Assad Barari

Assad Barari
Research Geologist

For the State Geologist

AB:mk
Encls:
Fig. 1. Geologic Map of the Little White River Study Area
Fig. 2. Data Map of the Little White River Study Area
Fig. 3. Map Showing Location of Resistivity Stations
Table 1. Chemical Analyses of Water from the Little White River Study Area
Table 2. Resistivity Readings
Appendix 1. Logs of Test Holes in the Little White River Area

Table 1.–CHEMICAL ANALYSES OF WATER FROM THE LITTLE WHITE RIVER STUDY AREA

Sample	Source	Parts Per Million											
		Calcium	Sodium	Magnesium	Chloride	Sulfate	Iron	Manganese	Nitrogen	Fluoride	pH	Hardness $CaCO_3$	Total Solids
A		—	—	50	250	500[1]	0.3	0.005[1]	10.0	0.9-1.7[2]	–	—	1000[1]
W1	WA	80	215	18	16	404	0.4	1.2	1.0	0.4		274	900
W2	TA	72	35	19	1	132	2	4.4		4.0		259	418
W3	R	29	22	14	0.4	56	2.6	0	0.4	0.6		128	268
W4	TA	58	41	17	8	50	3.2	1.8	1.2	0.6		217	416
W5	TA	59	80	21	5	126	2.2	1.2	0.4	0.8		233	524
W6	WP	321	156	26	321	736		0.2	40.0	0.6		910	1800
W7	WP	103	200	22	28	460			0.7	0.4		346	1014
W8	WP	582	440	65	32	2358			3.5	1.2		1718	3948
W9	R	18	19	20	0.4	32			0.6	0.4		206	270
W10	WA	36	16	13	0	24	1	1.8	1	0.6		142	256
W11	WA	27	23	14	0	36	0.3			0.6		123	226

[1] Modified for South Dakota by the Department of Health (written communication, Water Sanitation Section, March 20, 1968).
[2] 1.2 is optimum for South Dakota.

Source: WA, existing well in alluvium; TA, test hole in alluvium; R, Little White River; WP, existing well in Pierre Shale.

Samples were analyzed by the South Dakota Chemical Laboratory.

LOCATION OF WATER SAMPLES
(for map location, see Figure 2)

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

W1. SW¼SW¼NW¼ sec. 8, T. 4 S., R. 29 E., Road Side Park well.

W2. NW¼NW¼NW¼NE¼ sec. 9, T. 43 N., R. 28 W., Test Hole No. 2, water was collected from depth of 14 feet.

Location of water samples – continued.

W3. SE¼NE¼ sec. 9, T. 43 N., R. 28 W., water from Little White River.

W4. SE¼NW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W., Test Hole No. 9.

W5. SE¼SW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W., Test Hole No. 10.

W6. SE¼SW¼NW¼ sec. 5, T. 42 N., R. 28 W., Larry Hutchinson well.

W7. SE¼NE¼SW¼NW¼ sec. 24, T. 42 N., R. 29 W., Knife well, 47 feet deep.

W8. SW¼SW¼NE¼SW¼ sec. 23, T. 42 N., R. 29 W., Joseph Larvie well, 48 feet deep.

W9. SW¼SW¼SW¼NW¼ sec. 23, T. 42 N., R. 29 W., Little White River water.

W10. NE¼NE¼NE¼SW¼ sec. 34, T. 42 N., R. 29 W., White River City Well No. 2.

W11. SE¼NE¼SE¼SW¼ sec. 34, T. 42 N., R. 29 W., White River City Well No. 1.

Table 2.–RESISTIVITY READINGS[1]
(for map location, see Figure 3)

Resistivity Station Number	Electrode Spacing in Feet																		
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76
1[2]	421	363	374	300	268	355	201	118											
2[2]	352	371	328	272	390	377	151	159	139	164									
3	3284	2817	1210	308	304	275	246	254	234	220	217	183	170	142	130	184	167	154	134
4	1578	1836	1698	412	358	304	277	115	197	175	164	152	130	124	110				
5	1918	1590	1610	339	405	369	344	294	273	246	228	200	193	179	180				
6	16600	13590	6900	798	944	815	865	632	479	364	297	272	218	204	169				
7	4000	2802	1654	635	533	451	397	331	297	261	235	201	178	163	151				
8	483	547	528	45100	35300	28300	21100	160	110	797	0	339	0	302	229				
9	960	480	400	363	298	301	0	255	235	203	185	172	146	134	123				
10	1000	750	587	445	319	237	188	161	135	0	112	108	109	094	084				
11	362	189	202	231	251	259	282	287	295	309	311	308	303	294	273	261	273	231	
12	1000+	842	595	550	472	510	520	496	479	447	424	392	382	351	330	305	293	264	
13	4050	26700	1750	1250	1010	781	612	534	410	327	276	403	416	337	347	316	291	239	
14	5650	4170	3900	2930	1340	1010	839	670	526	446	374	309	260	219	186	172	145	141	
15	183	174	147	150	153	167	169	189	187	294	250	200	243	189	186	179	158	150	
16	4000	329	271	245	203	172	151	134	119	104	096	094	086	086	077	074	079	077	
17	788	276	174	179	137	151	171	084	130	137	114	100	098	111	077	068	051	068	
18	64300	37300	966	876	151	308	362	323	274	257	214	211	201	187	156	150	138	232	
19	697	638	572	531	457	383	328	273	227	209	193	167	159	142	134	126	114	105	
20	672	689	613	486	366	299	244	205	167	155	148	133	123	113	106	108	103	097	
21	373	287	234	187	172	124	118	129	139	129	125	118	117	103	109	104	099	090	
22	15300	934	594	420	312	255	237	204	195	175	164	162	145	126	127	125	128	108	
23	1360	744	682	617	437	435	376	309	303	212	189	176	165	157	137	119	114	120	
24	387	253	194	155	127	114	105	106	101	094	097	089	089	084	084	084	086	081	
25	746	417	324	309	303	238	204	171	155	123	114	126	104	102	098	097	097	088	
26	17100	20600	21500	18600	15500	12300	959	77	497	362	297	239	194	149	138	131	019	004	

[1] All readings are in Ohm-centimeters, Wenner arrangement of electrode spacing.
[2] Electrode spacing for Stations 1 and 2 is 5, 10, 15, 20 etc. feet (adjustment of instrument and training of crew).

APPENDIX 1

LOGS OF TEST HOLES IN THE LITTLE WHITE RIVER AREA
(for location, see Figure 2)

Test Hole No. 1
Location: SE¼SE¼SW¼SE¼ sec. 4, T. 43 N., R. 28 W.
Surface elevation: 1785[1] feet
Depth to water: 10 feet

0- 1	Topsoil
1-12	Clay, yellowish-brown
12-20	Clay and gravel
20-25	Gravel
25-28	Shale, dark-gray

* * *

Test Hole No. 2
Location: NW¼NW¼NW¼NE¼ sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1782 feet
Depth to water: 6 feet

0- 1	Topsoil
1- 4	Sand, light-brown, medium
4-20	Sand, coarse to very coarse
20-25	Sand and gravel
26-28	Clay

* * *

Test Hole No. 3
Location: SW¼SE¼NW¼NE¼ sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1782 feet
Water table: 7 feet

0- 1	Topsoil
1- 7	Sand, medium
7-14	Sand, medium to coarse
14-23	Sand and gravel
23-24	Shale, gray

* * *

Test Hole No. 4
Location: NE¼NE¼SE¼NW¼ sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1783 feet
Water table: 7 feet

0- 4	Clay
4- 8	Sand, gray, medium-fine
8-18	Sand, medium
18-21	Sand, coarse, some pebbles
21-25	Shale, gray

* * *

[1] Elevations for the test holes are taken from U. S. Geological Survey 7½ minute, 10 feet contour interval map and should not be considered as an exact elevation of the test hole location.

Test Hole No. 5
Location: SE¼NE¼SW¼NE¼ sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1791 feet
Depth to water: 6 feet

0- 8	Sand, light-brown, grading to gray, coarse, well-sorted
8-18	Sand, coarse
18-21	Sand, coarse to very coarse, some clay
21-26	Clay, gray

* * *

Test Hole No. 6
Location: SE¼SE¼SE¼NE¼ sec. 9, T. 43 N., R. 28 W.
Surface elevation: 1799 feet
Depth to water: 6 feet

0- 1	Topsoil
1- 5	Sand, medium
5-18	Sand, gray, medium, little clay
18-23	Shale

* * *

Test Hole No. 7
Location: NW¼NE¼NW¼NW¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1794 feet
Depth to water: 4 feet

0- 2	Topsoil
2- 4	Sand, fine, silty
4- 9	Sand, brown, medium to coarse
9-27	Clay, dark-gray (shale)

* * *

Test Hole No. 8
Location: SW¼NE¼NE¼NW¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1794 feet
Depth to water: 4 feet

0- 2	Topsoil
2- 4	Sand, brown, fine to medium
4-12	Sand, brown changing to gray, medium
12-18	Clay, dark-gray (shale)

* * *

Test Hole No. 9
Location: SE¼NW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1795 feet
Depth to water: 4 feet

0- 2	Topsoil
2- 7	Sand, fine, some clay

Test Hole No. 9 – continued.

7-15	Sand, gray, medium to coarse
15-23	Clay, gray

* * *

Test Hole No. 10
Location: SE¼SW¼SW¼NE¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1798 feet
Depth to water: 6 feet

0- 1	Topsoil
1- 7	Sand, some clay
7-15	Sand, medium to coarse, well sorted
15-17	Clay, gray

* * *

Test Hole No. 11
Location: SE¼NE¼NW¼SE¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1802 feet
Depth to water: 6 feet

0- 1	Topsoil
1- 5	Sand, brown, medium to coarse
5-17	Sand, gray, some pebbles
17-18	Shale

* * *

Test Hole No. 12
Location: SW¼NW¼SE¼SE¼ sec. 15, T. 43 N., R. 28 W.
Surface elevation: 1805 feet
Depth to water: 7 feet

0- 1	Topsoil
1- 4	Sand, brown, fine
4- 8	Sand, medium
8-17½	Sand, medium, little clay
17½-23	Clay, dark-gray (shale)

* * *

Test Hole No. 13
Location: SE¼SE¼NW¼NE¼ sec. 22, T. 43 N., R. 28 W.
Surface elevation: 1813 feet
Depth to water: 8 feet

0- 1	Topsoil
1- 7	Sand, brown, fine
7- 8	Sand, medium
8-19½	Clay, gray, soft drilling
19½-21	Shale

* * *

Test Hole No. 14
Location: NE¼SE¼NW¼NE¼ sec. 22, T. 43 N., R. 28 W.
Surface elevation: 1814 feet
Depth to water: 7 feet

0- 1	Topsoil
1- 4	Sand, brown, fine
4- 6	Sand, medium, some clay
6-12	Sand, medium to coarse
12-15	Sand, some clay
15-18	Clay, gray, (shale)

* * *

Test Hole No. 15
Location: SW¼NE¼NW¼NW¼ sec. 27, T. 43 N., R. 28 W.
Surface elevation: 1822 feet
Depth to water: 5 feet

0- 1	Topsoil
1- 4	Sand, fine, some clay
4-13	Sand, medium to coarse
13-16	Clay, dark-gray

* * *

Test Hole No. 16
Location: SW¼NW¼SE¼NE¼ sec. 28, T. 43 N., R. 28 W.
Surface elevation: 1823 feet
Depth to water: 8 feet

0- 1	Topsoil
1- 5	Sand, fine
5- 8	Sand, medium
8-12	Sand, coarse
12-13	Clay, gray
13-19	Sand and gravel
19-21	Shale

* * *

Test Hole No. 17
Location: SW¼SE¼SW¼NW¼ sec. 5, T. 42 N., R. 28 W.
Surface elevation: 1862 feet
Depth to water: 3 feet

0- 2	Sand, brown, medium
2- 5	Sand, coarse
5- 9	Sand, gray, some pebbles
9-12	Shale

* * *

Test Hole No. 18
Location: NE¼SW¼NE¼SW¼ sec. 5, T. 42 N., R. 28 W.
Surface elevation: 1875 feet
Depth to water: dry hole

Test Hole No. 18 – continued.

0- 1	Topsoil
1- 4	Clay, brown
4- 8	Shale, gray

* * *

Test Hole No. 19
Location: SE¼NE¼SW¼NW¼ sec. 24, T. 42 N., R. 29 W.
Surface elevation: not measured
Depth to water: 7 feet

0- 9	Sand, tan, medium coarse
9-11	Shale, gray

* * *

Test Hole No. 20
Location: NE¼NE¼NE¼SW¼ sec. 34, T. 42 N., R. 29 W.
Surface elevation: not measured
Depth to water: 9 feet

0- 5	Clay and sand, (built up area)
5-20	Sand, coarse
20-23	Shale, gray

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