

SASKATCHEWAN WATER CORPORATION

GEOLOGY OF THE RIDGE CREEK IRRIGATION
PROJECT

Report 0122-003

March 23, 1989

E. A. Christiansen Consulting Ltd.

CONSULTING GEOLOGIST

BOX 3087
SASKATOON, SASKATCHEWAN, CANADA
S7K 3S9

PHONE 374-6700

March 31, 1989

Saskatchewan Water Corporation
Victoria Place
111 Fairford Street East
Moose Jaw, Saskatchewan
S6H 7X5

Attention: Mr. Harvey Fjeld

Dear Mr. Fjeld:

Enclosed are 10 copies of Report 0122-003 on the "Geology of the Ridge Creek Irrigation Project". A draft copy was sent to TJ/Pedocan Land Consultants. Their suggestions are included in this final copy.

If you have any queries about the report, please call me.

Sincerely yours,


E.A. Christiansen



ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN		
CERTIFICATE OF AUTHORIZATION		
E.A. CHRISTIANSEN CONSULTING LTD.		
NUMBER 505		
PERMISSION TO CONSULT HELD BY:		
DISCIPLINE	SASK. REG. No.	SIGNATURE
<i>Geology</i>	<i>2917</i>	<i>EAC</i>

INTRODUCTION

The purpose of this investigation was to provide a geological framework for the study on suitability of soil for irrigation being conducted in the Ridge Creek area by TJ/Pedocan Land Consultants. The information includes an information sheet supplied by W.A. Meneley Consultants Ltd., seven testholes, the location of which was determined by EAC and TJ/Pedocan, and an inventory of wells and springs which was done along the three cross sections by TJ/Pedocan. Based on this information, an information sheet (Drawing 0122-003-01) and three cross sections were drawn (Drawings 0122-003-02, 03, 04). Wells from the information sheet and from the TJ/Pedocan inventory, which are located along the cross sections, were drawn in the sections along with electrical conductivity, chloride, and SAR values. An index of cross section logs, wells, and water analyses appears in Appendix A, copies of the testhole logs produced in this study appear in Appendix B, and carbonate, soil salinity, and mechanical analyses appear on Appendix C.

GEOLOGY

Stratigraphy

Both bedrock and drift were investigated in this study. Although the Judith River Formation and the lower part of the Bearpaw Formation are shown in the cross sections, the Demaine and Ardkenneth Members of the Bearpaw Formation were the base of exploration for the test drilling program. For the purpose of this report, discussion of the bedrock

sediments will be confined in ascending order to the Demaine, Beechy, Ardkeneth, and Snakebite Members of the Bearpaw Formation (Drawing 0122-003-02, 03, 04) and drift. Stratigraphic nomenclature is taken from Whitaker (1970) and E.A. Christiansen Consulting Ltd. (1986).

The Demaine Member, which is composed of up to 50 feet of gray, noncalcareous silty sand, was penetrated in four testholes (Appendix B, SWC Ridge Creek Nos. 2, 3, 4, 6) (Drawings 0122-003-02-04). The Demaine Member was drilled because of its potential for causing soil salinity in the lowland north of Tugaska (Drawing 0122-003-03).

The Beechy Member, which is up to 60 feet thick, lies between the Demaine and the overlying Ardkeneth Members of the Bearpaw Formation. The Beechy Member is composed of gray, noncalcareous, marine clay loam (Appendix B, SWC Ridge Creek No. 4).

The Ardkeneth Member was penetrated in six of the seven testholes (Appendix B, SWC Ridge Creek Nos. 1-3, 5-7) (Drawings 0122-003-02-04). The member is up to 150 feet thick and is composed of fine to medium gray, noncalcareous "salt and pepper" sand which becomes finer grained and siltier with depth. The fining downward sequence is typical of prograding deltas. Exposures of the Ardkeneth Member are common in the central part of the area where the member is covered with less than 10 feet of drift.

The Snakebite Member is preserved in downfaulted blocks in the southern and western parts of the Ridge Creek area. This downfaulting or collapse will be discussed below. The Snakebite Member is up to 400 feet thick in major collapses (Drawings 0122-003-02) and is composed of gray, noncalcareous, marine clay (Appendix B, testhole No. 1).

Drift in the Ridge Creek area includes till, glaciolacustrine silts and clays, and glaciofluvial sands and gravels. Till range from 0 in the central part of the area to over 300 feet in the southern part of the Ridge Creek area (Drawing 0122-003-03). In the central part of the Ridge Creek area the soils are formed in glaciolacustrine silts and clays. Glaciofluvial sands and gravels occur in a subglacial valley east of Tugaske (Drawing 0122-003-01, Appendix B, testhole 6) and between Tugaske and Bridgeford in Section 3, Township 23, Range 3.

Locally, the glaciolacustrine deposits near Tugaske are overlain by less than two feet of loess derived, presumably, from the outwash areas to the north and west of the Ridge Creek area. Alluvium occurs in all depressional areas. In the Qu'Appelle Valley, the Qu'Appelle Alluvium is up to 85 feet thick and is composed of postglacial organic poorly sorted gravels, sands, silts, and clays.

Structure

The structure in the Ridge Creek area is governed by the process of collapse which is the result of dissolution of Devonian salt. The monocline dipping southwest between Tugaske and Bridgeford represents

the edge of salt dissolution (Drawings 0122-003-01-04). West of this structure, the hills and depressions in the seismic map represent a karst topography indicating partial dissolution of salt in this area. Northeast of the monocline (Drawing 0122-003-01), where collapse has not occurred, the Ardkeneth Member is at the surface. Southwest of this monocline, the elevation of the Ardkeneth Member is a function of the depth of collapse as a result of the dissolution of Devonian salt.

GROUNDWATER

To relate the quality of the groundwater to the geology in the cross sections (Drawing 0122-003-02-04), an inventory of wells along these cross sections was done (TJ/Pedocan Land Consultants, 1989). From this inventory, electrical conductivity, chloride, and SAR were selected and their values were recorded in Appendix A and Drawings 0122-003-02-04. Where samples or geophysical logs are not available, the aquifers are inferred.

Groundwater occurs in the Judith River Formation, in the Demaine and Ardkeneth Members on the Bearpaw Formation, and in Drift (Appendix A, Drawings 0122-003-02-04). One well is in the Judith River Formation (Drawing 0122-003-03, well 50), the water from which is not potable. Only one well also occurs in the Demaine Member which is considered to be a marginal aquifer because of the high silt content.

The Ardkeneth Member is the most extensive aquifer in the Ridge Creek area. Of the 16 wells and 2 springs samples along the cross sections (Appendix A), 13 are in the Ardkeneth Member. The Ardkeneth aquifer is not only extensive but contains good quality water (951 ± 373 uS/cm from 11 wells and one spring). Because the sand in the Ardkeneth Member becomes more silty with depth, most of the wells are in the upper part of this aquifer. Going deeper into the aquifer for more available drawdown is offset by decreasing permeability.

Where the Ardkeneth aquifer is missing or at considerable depth, shallow drift wells are common (Drawing 0122-003-02-04). These are mainly low capacity seepage wells. The subglacial valley east of Tugaske (Drawing 0122-003-01) contains 65 feet of glacial sand and gravel (Appendix B, SWC Ridge Creek No. 6) which is in contact with the Ardkeneth Member (Drawing 0122-003-02, log 14).

Most of the groundwater recharge into the Ardkeneth Member occurs where the member is at or near surface east, west, and north of Tugaske. This recharge eventually discharges through springs along the escarpment north and east from Tugaske and through springs and seeps along the Ridge Creek lowlands in the Darmody artesian basin to the west (Maddox, 1932; Lebedin, 1987). Groundwater also discharges from the Ardkeneth Member into the subglacial valley east of Tugaske, particularly from the east which is the reason that the permeable upper part of the member is dry in well 15 (Drawing 0122-003-02).

SOIL SALINITY

Soil salinity occurs where the Ardkeneth Member discharges through the Snakebite Member west of testhole 6 (Drawing 0122-003-02) or through drift along the foot of the escarpment north and east of Tugaske (Drawing 0122-003-03, south of testhole 47). The saline soil, north of the fringe of saline soils caused by the Ardkeneth Member are thought to be the result of discharge from the Demaine Member through the overlying drift. If additional water through irrigation is added to the recharge area in the central part of the Ridge Creek area, the resulting increase in discharge will accelerate the process of soil salinization.

LITERATURE CITED

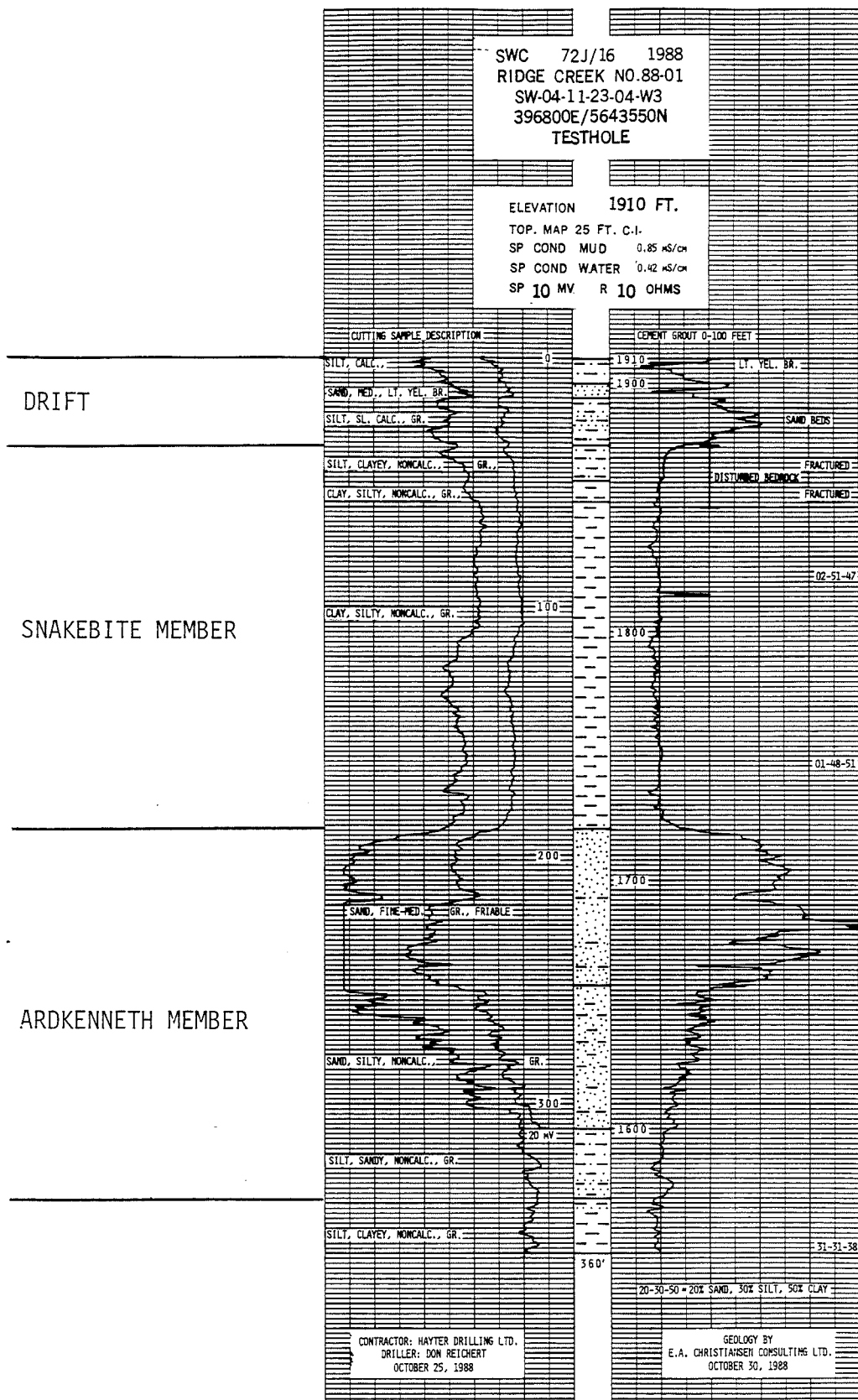
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- TJ/Pedocan Land Consultants, 1989. Soil Survey and land evaluation. Technical Report 82-54 for Saskatchewan Water Corporation (in preparation).
- Whitaker, S.H. 1970. Geology and groundwater resources of the Swift Current area (72J), Saskatchewan. Saskatchewan Research Council, Geology Division, Map. No. 11.

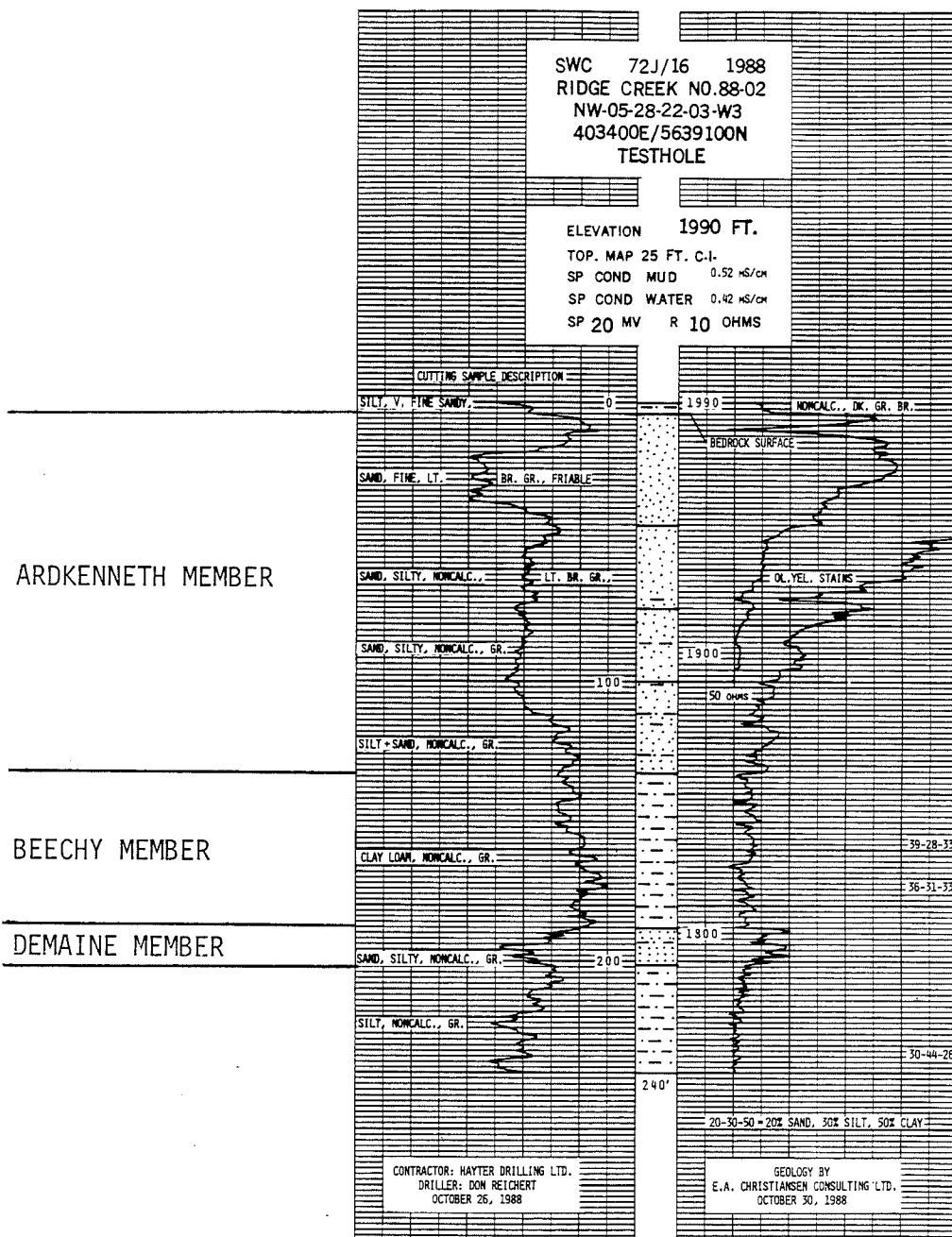
APPENDIX A. INDEX OF CROSS SECTIONS, LOGS, WELLS, AND WATER ANALYSES.

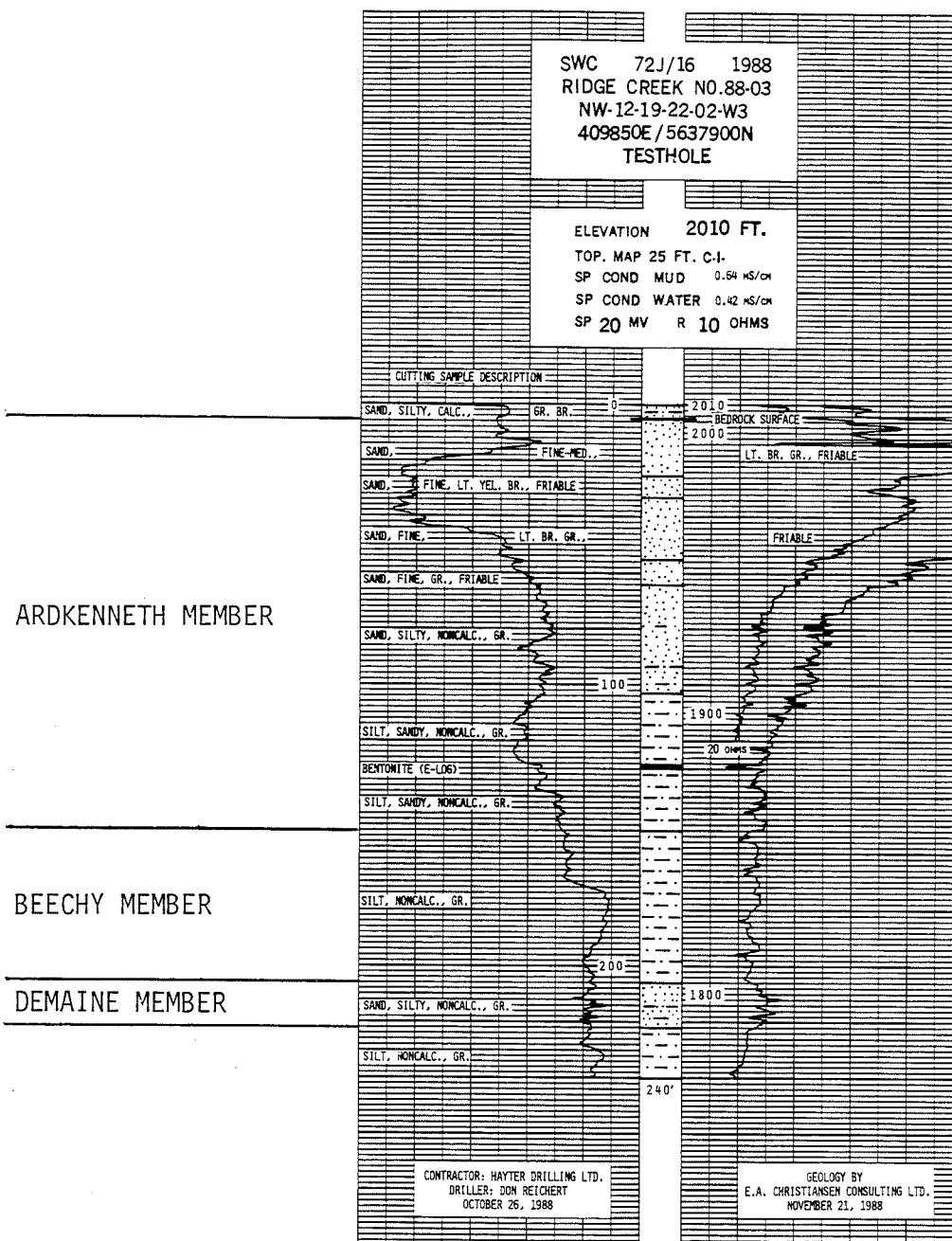
No	Name	Location (W3)	Well Depth (feet)	Static water level(feet)	EC=uS/cm	Cl mg/L	SAR	Aquifer
1		SE-02-03-22-04	435	27				Ardkenneth
2	HB Bridgeford	12-02-22-04						
3		NE-14-12-22-04	460					Ardkenneth
4		NW-16-07-22-03	140	0				Ardkenneth
5	Bryan, Doug	NW-14-08-22-03	spring		3150	216	178	Ardkenneth
6	SWC Ridge Creek 88-07	SE-03-17-22-03						
7	Wilson, Agnes	NE-16-08-22-03	50	45				Ardkenneth
8	Combes, Edgar	SE-16-04-22-03	160	8	720	16	83	Ardkenneth
9	FFIB Cave, Stanley	SE-14-34-21-03	400	10	1180	26	71	Ardkenneth
10	Donnelly, Janet	SW-04-02-22-03	250	8				Ardkenneth
11	Sheridan, Gladys	NW-04-01-22-03	70	30				Drift
12	SWC Ridge Creek 88-05	NW-12-06-22-02						
13	FFIB Foulston, Roy	NE-14-05-22-02	150	39	522	2	5	Ardkenneth
14	SWC Ridge Creek 88-06	NW-15-05-22-02						
15	FFIB Foulston, Terry	NW-13-03-22-02	220	73	1080	76	33	Demaine
16	Foulston, Albert	SE-01-10-22-02	?	?				?
17	Maunder, A.T.	NE-11-02-22-02	?	?				?
18	SRC Eyebrow	NW-13-36-21-02						
19		NW-36-21-02	40	33				Ardkenneth
20		SW-05-31-21-01	60	30				Ardkenneth
21		SW-32-21-01	90	50				Ardkenneth
22		NW-34-21-01	50	40				Drift
23		SE-02-22-01	38	23				Drift
24	SWC Huron Colony	NW-13-01-22-01	170	17				Demaine
25	FFIB Howard, W.	SE-10-03-21-01	281	273				Drift
26		SE-01-09-21-01	30	16				Drift
27		NW-08-21-01	22	18				Drift
28	FFIB Webb, R.C.	NW-05-18-21-01	99	25				Drift
29		SE-09-14-21-02	55	30				Drift
30	Gurney, Greg	NW-13-15-21-02	126	45				Ardkenneth
31		NE-13-16-21-02	60	20				Drift
32		NW-02-20-21-02	90	52				Ardkenneth
33		SE-19-21-02	25	20				Drift
34		NW-19-21-02	45	6				Drift
35		SE-01-25-21-03	37	21				Drift
36		NW-12-30-21-02	40	7				Drift
37		SW-31-21-02	38	34				Drift
38		NW-16-36-21-03	40	30				Drift
39	Dolman, Howard	NW-13-06-22-02	200	28.5	669	8	15	Ardkenneth
40	Wilson, Robert	NW-05-07-22-02	167	25.6	919	18	29	Ardkenneth
41	White, Blaine	SE-08-13-22-03	40	20				Drift
42	White, Donald	SW-01-24-22-03	40.3	16.7	1440	24	15	Ardkenneth
43	SWC Ridge Creek 88-03	NW-12-19-22-02						
44	Brown, Dennis	SE-09-25-22-03	spring	0	1020	20	17	Ardkenneth
45		SW-13-30-22-02	65	40				Ardkenneth
46	White, Don	NE-16-31-22-02	15.1	5.9	39200	540	259	Drift
47	White, Blain	SW-04-05-23-02	9.8	6.6	41200	560	277	Drift
48	SWC Ridge Creek 88-04	SW-04-05-23-02						
49		NE-06-23-02	18	10				Drift
49	FFIB Laybourne, J.R.	SE-01-13-23-03	18	15	1370	82	4	Drift
50	FFIB Gallagher, G.J.	SW-12-14-23-03	438	20	12340	4200	353	Judith River

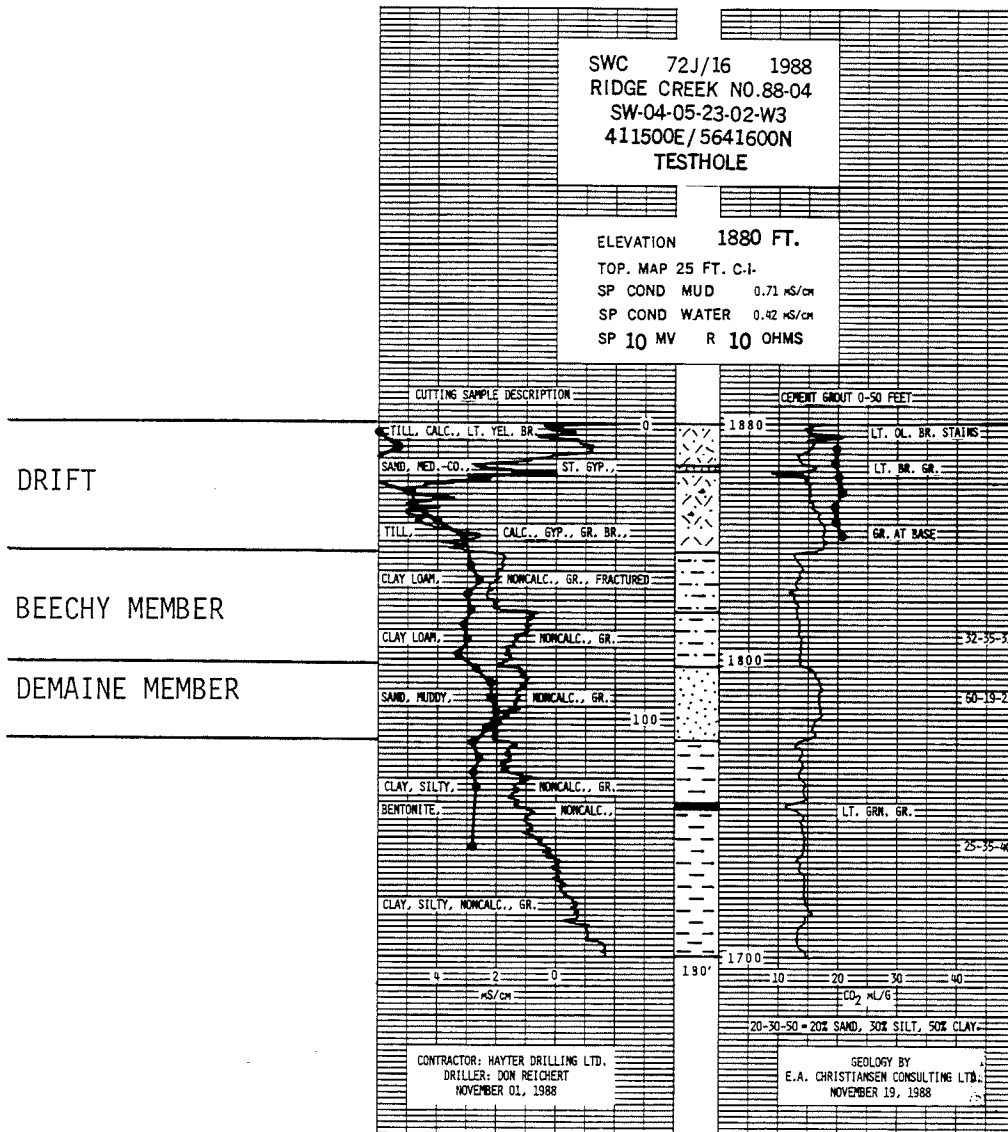
No	Name	Location (W3)	Well Depth (feet)	Static water level(feet)	EC=uS/cm	Cl mg/L	SAR	Aquifer
51	SRC Bridgeford	SE-07-21-23-03						
52	PFRA Qu'appelle Dam							
53	HB Elbow #1	01-34-23-04						
54	FFIB Foul, Dennis	SW-02-17-22-02	170	39				Ardkenneth
55	Foulston, Murray	NW-14-08-22-02	40	35				Drift
56	Mackenzie, J.&K.	NE-15-18-22-02	50	46				Ardkenneth
57	Foulston, Ivan	NE-14-18-22-02	45	35				Ardkenneth
58	Brown, Dennis	NW-04-25-22-03	38	15.4	780	12	13	Ardkenneth
59	Wilson, Agnes	SE-01-27-22-03	100	85				Ardkenneth
60	SWC Ridge Creek 88-02	NW-05-28-22-03						
61	Oram, Mark	NE-16-29-22-03	79.4	64.9	1070	58	13	Ardkenneth
62	Immel, Doug	NE-09-30-22-03	81	48.2	730	30	4	Ardkenneth
63	Colwell, Joe	NW-13-30-22-03	82	35				Ardkenneth
64	King, C.&A.	NE-08-36-22-04	124	25	1780	134	78	Ardkenneth
	King, C.&A.	NE-08-36-22-04	28.2	10.5				Drift
65	FFIB Byan, Sid	NW-13-31-22-03	100	35				Drift
66	Deleted							
67	Wandler, George	SE-05-07-23-03	100	9	579	2	6	Ardkenneth
68		SE-12-23-04	15	10				Drift
69		NW-04-12-23-04	16	14				Drift
70	SWC Ridge Creek 88-01	SW-04-11-23-04						
71	King, Earl & Murray	NE-08-10-23-04	25	23				Drift
72		SW-12-10-23-04	25	24				Drift
		SW-12-10-23-04	190	30				?
73		NE-03-15-23-04	50	25				Drift
74		SW-12-09-22-02	28	18				Drift
75		NE-09-01-23-04	155	40				Ardkenneth
76		NE-24-22-03	59	54				Ardkenneth

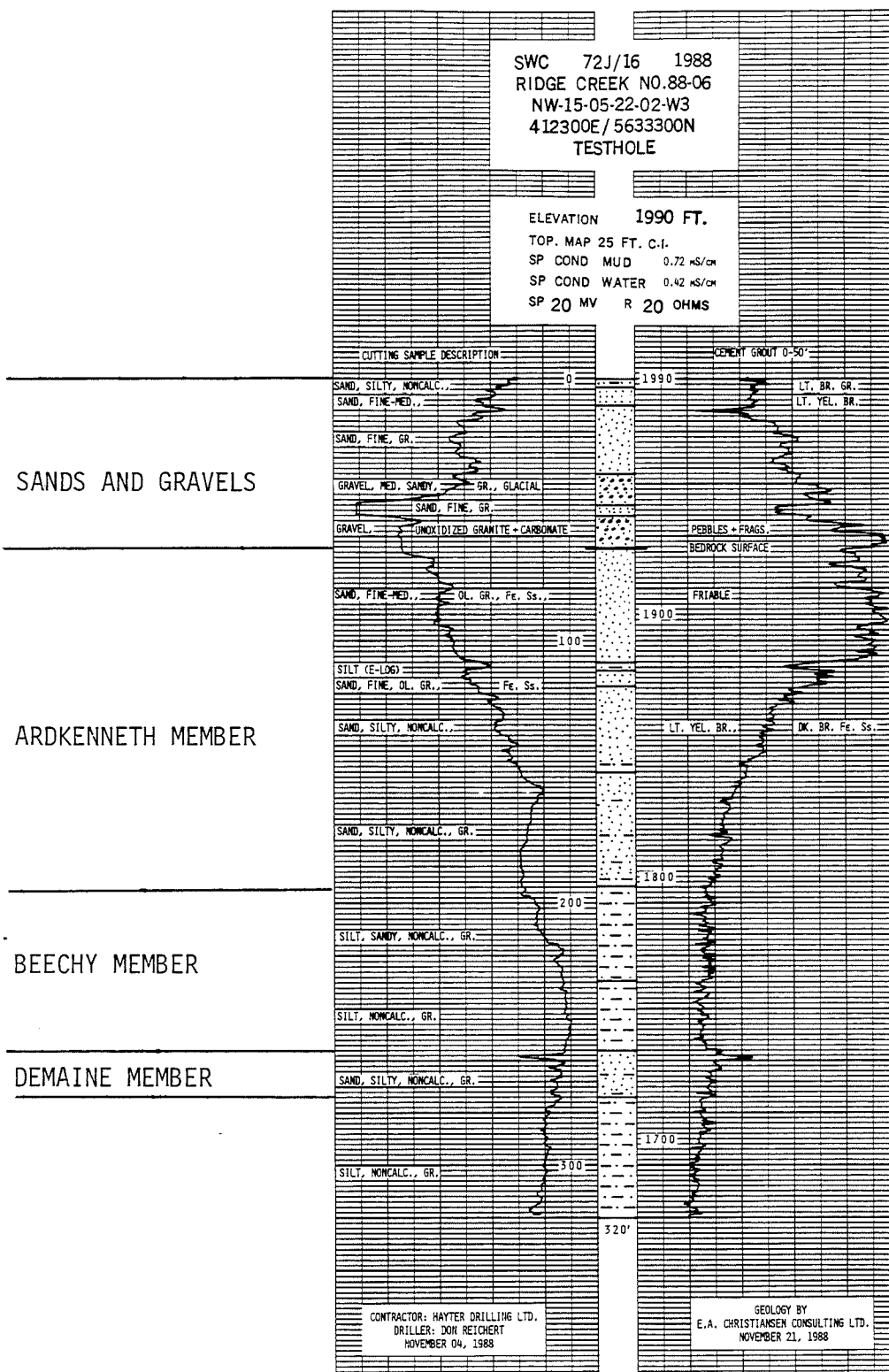
APPENDIX B. TESTHOLE LOGS



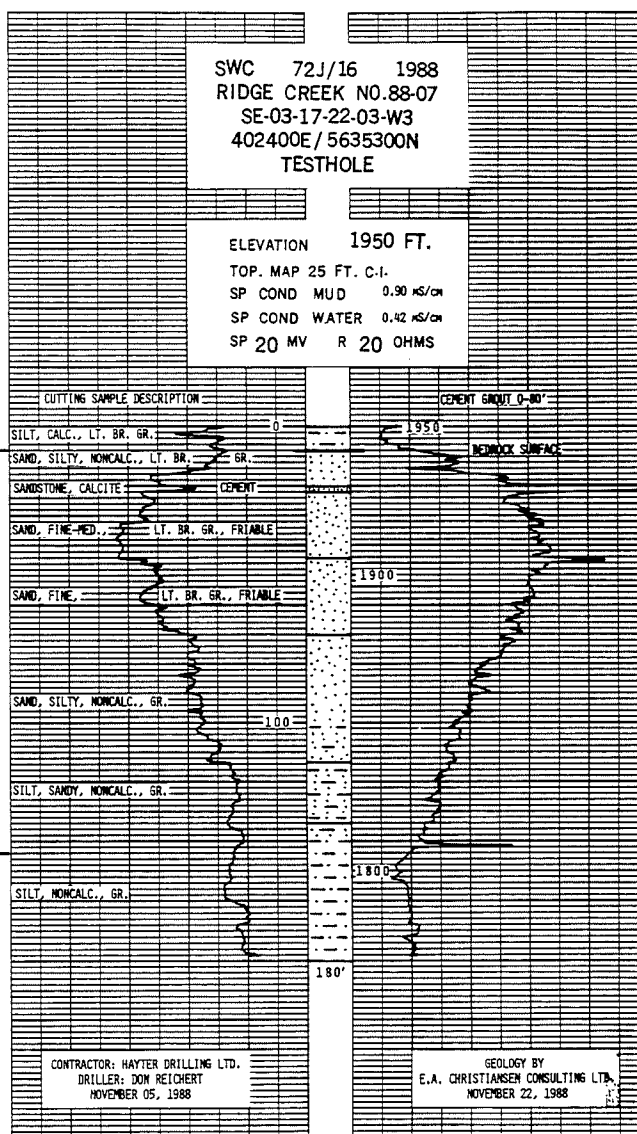








ARDKENNETH MEMBER



APPENDIX C. CARBONATE, SOIL SALINITY, AND MECHANICAL ANALYSES.

SASKATCHEWAN SOIL TESTING LABORATORY

Date: 01-12-88

SPECIAL ANALYSIS

Page: 1 of 1

#CHRISTNSN*I8-07478/07513

CHRISTIANSEN CONSULTING

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*****
|                               |                               | |
| Lab Number | Client Identification | CO2 EQUIV |
|                               |                               | ml/gm |
*****
| I8-07478   | BRDGFRDTGSK88-04 5-10 | 19.83 |
-----
| I8-07479   | BRDGFRDTGSK88-04 10-15 | 19.28 |
-----
| I8-07480   | BRDGFRDTGSK88-04 15-20 | 20.20 |
-----
| I8-07481   | BRDGFRDTGSK88-04 20-25 | 20.95 |
-----
| I8-07482   | BRDGFRDTGSK88-04 25-30 | 19.46 |
-----
| I8-07483   | BRDGFRDTGSK88-04 30-35 | 19.46 |
-----
| I8-07484   | BRDGFRDTGSK88-04 35-40 | 20.95 |
-----
| I8-07502   | BRDGFRDTGSK88-055-10  | 3.89 |
-----
| I8-07503   | BRDGFRDTGSK88-0510-15 | 23.17 |
-----
| I8-07504   | BRDGFRDTGSK88-0515-20 | 19.46 |
-----
| I8-07505   | BRDGFRDTGSK88-0520-25 | 20.20 |
-----
| I8-07506   | BRDGFRDTGSK88-0525-30 | 20.39 |
-----
| I8-07507   | BRDGFRDTGSK88-0530-35 | 21.32 |
-----
| I8-07508   | BRDGFRDTGSK88-0535-40 | 23.54 |
-----
| I8-07509   | BRDGFRDTGSK88-0540-45 | 15.94 |
-----
| I8-07510   | BRDGFRDTGSK88-0545-50 | 21.13 |
-----
| I8-07511   | BRDGFRDTGSK88-0550-55 | 22.43 |
-----
| I8-07512   | BRDGFRDTGSK88-0555-60 | 23.17 |
-----
| I8-07513   | BRDGFRDTGSK88-0560-65 | 23.17 |
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Comment:

End

SASKATCHEWAN SOIL TESTING LABORATORY

Date: 01-12-88

FERTILITY ANALYSIS

Page: 1 of 2

CHRISTNSN*I8-07477/07517

CHRISTIANSEN CONSULTING

Lab Number	Client Identification	pH	Conduct
			ms/cm

I8-07477	BRDGFRDTGSK88-04 0-5	8.0	6.0
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I8-07478	BRDGFRDTGSK88-04 5-10	8.3	5.3
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I8-07479	BRDGFRDTGSK88-04 10-15	8.1	6.7
----------	------------------------	-----	-----

I8-07480	BRDGFRDTGSK88-04 15-20	8.0	6.6
----------	------------------------	-----	-----

I8-07481	BRDGFRDTGSK88-04 20-25	8.1	4.9
----------	------------------------	-----	-----

I8-07482	BRDGFRDTGSK88-04 25-30	8.1	4.4
----------	------------------------	-----	-----

I8-07483	BRDGFRDTGSK88-04 30-35	8.0	4.0
----------	------------------------	-----	-----

I8-07484	BRDGFRDTGSK88-04 35-40	8.1	3.1
----------	------------------------	-----	-----

I8-07485	BRDGFRDTGSK88-04 45-50	8.5	2.9
----------	------------------------	-----	-----

I8-07486	BRDGFRDTGSK88-04 50-55	8.7	2.6
----------	------------------------	-----	-----

I8-07487	BRDGFRDTGSK88-04 55-60	8.6	3.0
----------	------------------------	-----	-----

I8-07488	BRDGFRDTGSK88-04 60-65	8.5	2.9
----------	------------------------	-----	-----

I8-07489	BRDGFRDTGSK88-04 65-70	8.5	3.1
----------	------------------------	-----	-----

I8-07490	BRDGFRDTGSK88-04 70-75	8.7	3.0
----------	------------------------	-----	-----

I8-07491	BRDGFRDTGSK88-04 75-80	8.4	3.3
----------	------------------------	-----	-----

I8-07492	BRDGFRDTGSK88-04 80-85	8.6	2.7
----------	------------------------	-----	-----

I8-07493	BRDGFRDTGSK88-04 85-90	8.9	2.2
----------	------------------------	-----	-----

I8-07494	BRDGFRDTGSK88-04 90-95	8.8	2.2
----------	------------------------	-----	-----

I8-07495	BRDGFRDTGSK88-04 95-100	8.9	2.0
----------	-------------------------	-----	-----

I8-07496	BRDGFRDTGSK88-04100-105	8.8	2.3
----------	-------------------------	-----	-----

I8-07497	BRDGFRDTGSK88-04105-110	8.7	2.8
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I8-07498	BRDGFRDTGSK88-04110-115	8.7	2.6
----------	-------------------------	-----	-----

I8-07499	BRDGFRDTGSK88-04115-120	8.7	2.8
----------	-------------------------	-----	-----

I8-07500	BRDGFRDTGSK88-04120-125	8.7	2.7
----------	-------------------------	-----	-----

I8-07501	BRDGFRDTGSK88-04140-145	8.7	2.8
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Comment:

SASKATCHEWAN SOIL TESTING LABORATORY

Date: 01-12-88

FERTILITY ANALYSIS

Page: 2 of 2

CHRISTNSN*I8-07477/07517

CHRISTIANSEN CONSULTING

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*****
|                               |           |           | |
| Lab Number | Client Identification | pH | Conduct |
|           |           |           |           |
|           |           |           |           |
*****
| I8-07502   | BRDGFRDTGSK88-055-10 | 7.4 | 2.8 |
|-----|
| I8-07503   | BRDGFRDTGSK88-0510-15 | 7.9 | 1.8 |
|-----|
| I8-07504   | BRDGFRDTGSK88-0515-20 | 8.0 | 1.1 |
|-----|
| I8-07505   | BRDGFRDTGSK88-0520-25 | 8.0 | 1.1 |
|-----|
| I8-07506   | BRDGFRDTGSK88-0525-30 | 8.1 | 0.9 |
|-----|
| I8-07507   | BRDGFRDTGSK88-0530-35 | 8.1 | 0.8 |
|-----|
| I8-07508   | BRDGFRDTGSK88-0535-40 | 8.3 | 0.6 |
|-----|
| I8-07509   | BRDGFRDTGSK88-0540-45 | 8.3 | 0.7 |
|-----|
| I8-07510   | BRDGFRDTGSK88-0545-50 | 8.4 | 0.7 |
|-----|
| I8-07511   | BRDGFRDTGSK88-0550-55 | 8.3 | 0.6 |
|-----|
| I8-07512   | BRDGFRDTGSK88-0555-60 | 8.6 | 0.7 |
|-----|
| I8-07513   | BRDGFRDTGSK88-0560-65 | 8.4 | 0.9 |
|-----|
| I8-07514   | BRDGFRDTGSK88-05145-150 | 8.3 | 2.0 |
|-----|
| I8-07515   | BRDGFRDTGSK88-05325-330 | 8.3 | 1.2 |
|-----|
| I8-07516   | BRDGFRDTGSK88-05370-375 | 8.3 | 2.0 |
|-----|
| I8-07517   | BRDGFRDTGSK88-05395-400 | 8.5 | 2.3 |
|-----|

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Comment:

End

SASKATCHEWAN SOIL TESTING LABORATORY

Date: 18-11-88
 CHRISTNSN*I8-05569/05574

MECHANICAL ANALYSIS
 CHRISTIANSEN CONSULTING

Page: 1 of 1

Lab Number	Client Identification	Sand	Silt	Clay		
		percent	percent	percent		

I8-05569	B-T 88-01 85-90	2.0	51.1	46.9		
I8-05570	B-T 88-01 160-165	1.1	47.8	51.1		
I8-05571	B-T 88-01 355-360	30.9	31.3	37.8		
I8-05572	B-T 88-02 155-160	39.3	28.1	32.6		
I8-05573	B-T 88-02 170-175	35.8	31.1	33.0		
I8-05574	B-T 88-02 230-235	29.4	44.3	26.3		

Comment:

End

SASKATCHEWAN SOIL TESTING LABORATORY

Date: 01-12-88

MECHANICAL ANALYSIS

Page: 1 of 1

\$CHRISTNSN*I8-07490/07517

CHRISTIANSEN CONSULTING

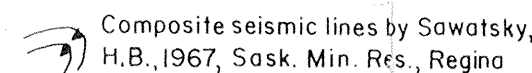
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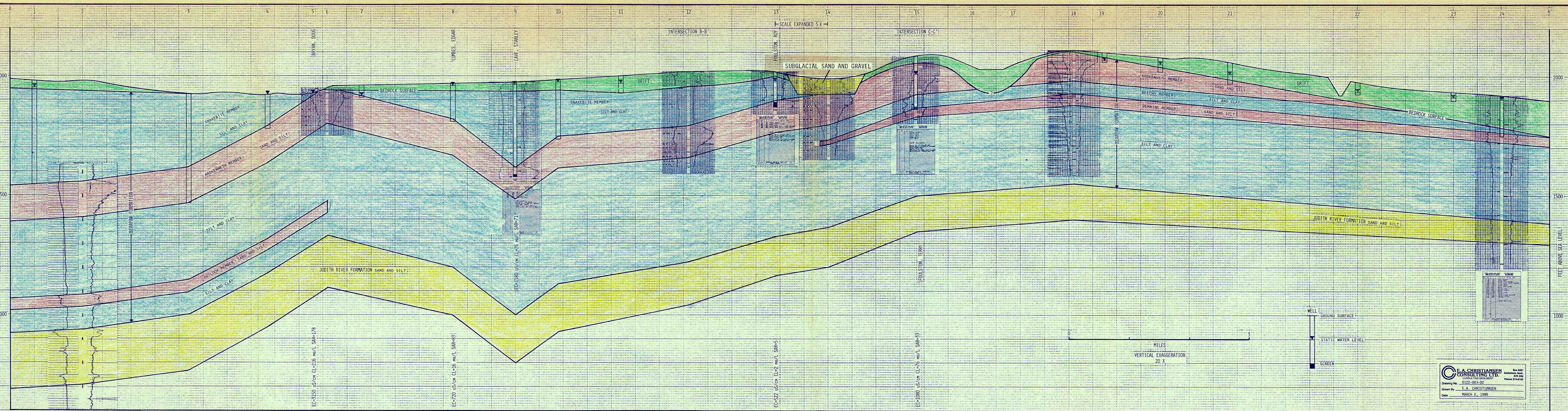
*****
|                               |                               | | | |
| Lab Number | Client Identification | Sand | Silt | Clay |
|            |                     | percent | percent | percent |
*****
| I8-07490   | BRDGFRTGSK88-04 70-75 | 32.0 | 34.5 | 33.4 |
|-----|-----|-----|-----|-----|
| I8-07494   | BRDGFRTGSK88-04 90-95 | 59.9 | 19.3 | 20.8 |
|-----|-----|-----|-----|-----|
| I8-07501   | BRDGFRTGSK88-04140-145| 24.5 | 35.2 | 40.3 |
|-----|-----|-----|-----|-----|
| I8-07505   | BRDGFRTGSK88-0520-25 | 50.1 | 27.9 | 22.1 |
|-----|-----|-----|-----|-----|
| I8-07511   | BRDGFRTGSK88-0550-55 | 52.2 | 27.0 | 20.8 |
|-----|-----|-----|-----|-----|
| I8-07514   | BRDGFRTGSK88-05145-150| 1.6 | 43.6 | 54.9 |
|-----|-----|-----|-----|-----|
| I8-07515   | BRDGFRTGSK88-05325-330| 65.1 | 19.0 | 15.9 |
|-----|-----|-----|-----|-----|
| I8-07516   | BRDGFRTGSK88-05370-375| 51.7 | 24.3 | 24.0 |
|-----|-----|-----|-----|-----|
| I8-07517   | BRDGFRTGSK88-05395-400| 31.5 | 31.1 | 37.3 |
|-----|-----|-----|-----|-----|

```

Comment:

End





DRAWING 0122-003-02. CROSS SECTION A-A', RIDGE CREEK IRRIGATION PROJECT.

E.A. CHRISTIANSEN
CONSULTING LTD.
CONSULTING GEOLOGIST
0122-003-02
Drawn By E.A. CHRISTIANSEN
Date MARCH 2, 1989

Box 2087
Saskatoon, Sask.
S7N 1S8
Phone: 374-4700

