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H Y D R O G E O L O G Y

CAMPBELL HEIGHTS

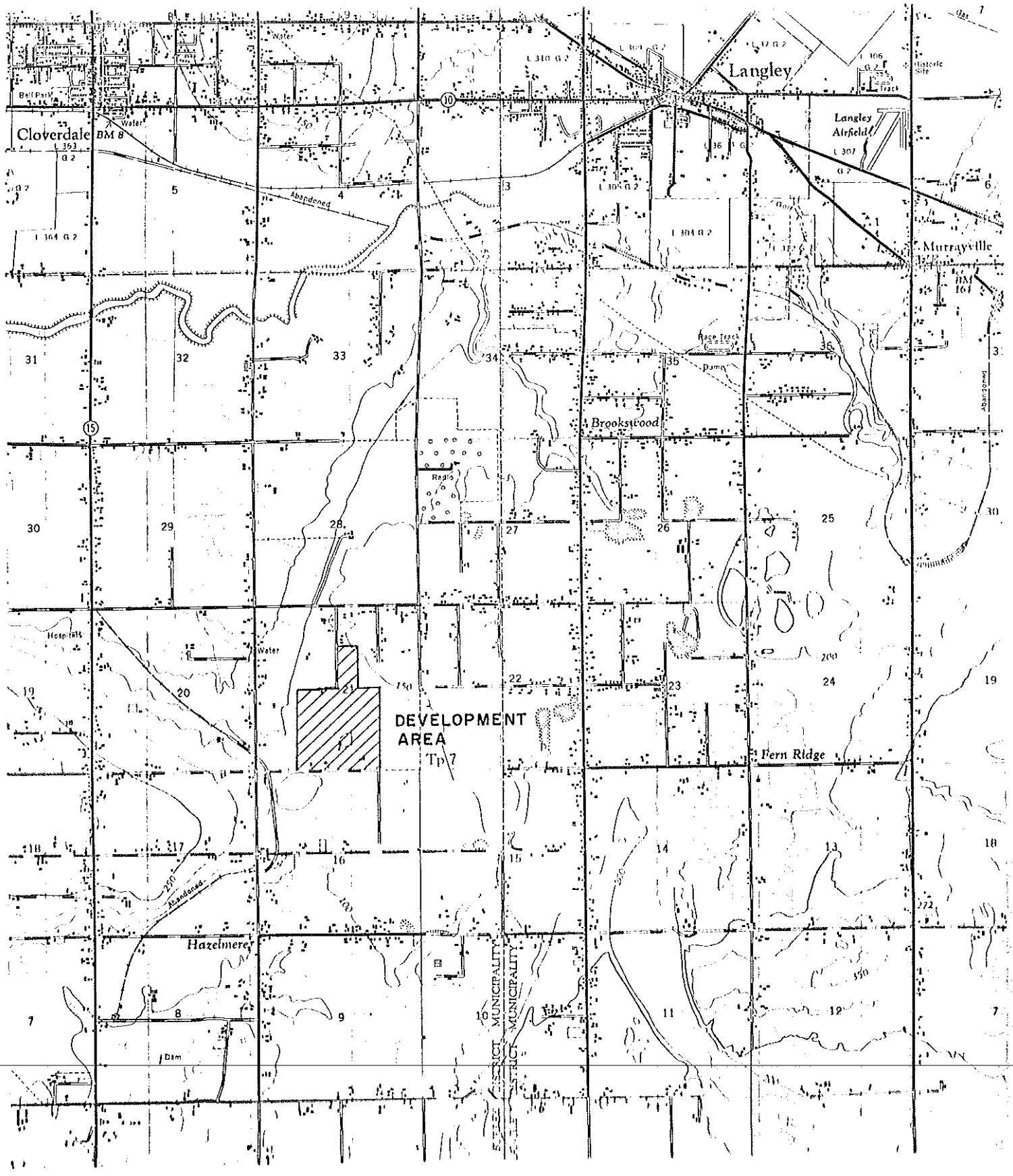
FOR

BRITISH COLUMBIA BUILDING CORPORATION

W. L. BROWN, P. ENG.

APRIL 1980

80-166



B. C. DEVELOPMENT CORPORATION

CAMPBELL HEIGHTS

REGIONAL LOCATION PLAN

1.0 INTRODUCTION

The hydrogeology of the Campbell Heights Industrial Campus was studied to establish the presence of a potable water-bearing zone and the suitability of the site for on-site ground disposal of sewage effluent.

The water demand of the proposed industry is 300 US gpm. 70% to 95% of this water can be returned to the ground. If any harmful chemicals are added to the water as it passes through the process they will be removed prior to discharge. At this time we believe that no harmful chemicals will be added to the water. The plant will produce 30,000 gallons per day of sewage effluent and the surrounding houses will produce 30,000 gallons per day. The domestic potable water demand for the houses is estimated to be 50,000 gallons per day or 35 gpm.

Two groundwater test wells were drilled close to the intersection of 188th and 28th Avenue to depths of 550 and 78 feet. Ten test pits were dug and examined and 8 percolation tests were run. Eight piezometer holes were drilled to establish the slope of the water table. Locations of the test wells, test pits, percolation tests and piezometers are shown on Drawing No. 1.

2.0 R E S U L T S

2.1 GROUNDWATER TEST HOLES

Groundwater Test Hole No. 1 was drilled to a total depth of 550 feet to test for deep water-bearing zones. A fine grained sand zone was encountered between depths of 496 and 520 feet (please see log of well in Appendix). A screen was set, developed (cleaned) and the well was pump tested. Although the well was blown at rates up to 50 gpm it could only be pumped at a rate of 8 gpm for a period of 200 minutes or 3.3 hours.

Groundwater Test Hole No. 2 was drilled near Test Hole No. 1 to a depth of 78 feet. Fifteen feet of well screen was set between depths of 50 and 65 feet. The screens were developed and the well was pump tested at a constant rate of 50 US gpm. The water level stabilized at a depth of 37 feet below the top of the casing after only 18 minutes of pumping. The transmissivity (a field measurement of permeability) was calculated from the drawdown and recovery water level measurements to be 18,000 US gallons per day per foot which is a standard value for a relatively highly permeable sand and gravel. Results of this pump test show that properly designed production wells should have safe productive capacities of 100 US gpm.

2.2 PERCOLATION HOLES

The locations of the 8 percolation test holes are shown on Location Map Drawing 1. These were standard percolation tests made in 18-inch deep square holes with one foot sides in accordance with requirements of Division 5 - Site Investigation on page 5 of the Health Act, B.C. Reg. 577/75. Examination of the results show that the design percolation rate for the site should be 5 minutes per inch.

2.3 TEST PITS

The locations of the ten test pits are shown on Drawing 1 and the logs of these pits are included in Appendix II at the end of the report. In general the pits showed dry sand with some pebbles below a silty loam top soil. The pits were dug to depths of six to seven feet below ground surface. The bottom of all test pits were dry except the following:

Test Pit No.	Depth (Feet)	Depth to Water (Feet)
4	7.0	7.0
7	6.5	6.5
8	7.0	7.0

2.4 PIEZOMETERS

The locations of the eight piezometers that were installed to measure the depth to and slope of the Water Table are shown on the Location Map Drawing No. 1. The piezometers ranged from 17 to 34 feet in depth and consisted of 2-inch diameter rigid plastic pipe with the bottom three feet perforated.

This 2-inch diameter pipe was centred in a 6-inch diameter hole and sand packed with F-9 Monterey filter sand capped with a Bentonite seal. This method of construction ensures that the static water level of the groundwater (Water Table) is correctly measured.

Please see Appendix I for the water levels measured in the piezometers on March 31, 1980.

3.0 HYDROGEOLOGY

3.1 DESCRIPTION

The subject site is underlain by sands and gravels that are 65 feet thick where the test wells were drilled. These sands and gravels overlie fine grained sediments of sands, silts and clays. This fine grained non-productive sequence extends at least to a depth of 550 feet (total depth of Test Well No. 1) beneath the site.

elev. -400 B.S.L

The Water Table in the upper sands and gravels ranges from five to almost 25 feet below ground surface except in the extreme southwest corner of the site where springs occur on a terrace area that is five to ten feet lower than the general area of the site. As can be seen on the Water Table Map Drawing 2 a spring line occurs to the west of the site close to the 100 foot contour.

The Water Table slopes to the west at a rate of one foot vertically to 80 feet horizontally (gradient of 0.0125). This gradient steepens to 1 in 40 in the southwestern part of the site in response to a line of springs draining the area. Using the Water Table gradient and the transmissivity of the water-bearing sands and gravels it can be calculated

3.1 DESCRIPTION continued ...

that approximately one million gallons of groundwater flows beneath the site each day. This is approximately seven times the estimated amount of water that will be used by the plant and homes. It is estimated that the houses will use 35 gpm and the plant will use 65 gpm (22% of 300 gpm) for a total of 100 gpm.

Reference to the Regional Location Map will show that the spring waters that issue along the edge of the terrace to the west of the site flow, via ditches, to pump chambers from which this water is lifted into the Nicomekl River.

3.2 RECHARGE

The subject site lies between the White Rock and Langley weather stations. The average annual precipitation at White Rock is almost 40-inches while that at Langley is almost 60-inches. It therefore appears reasonable to use an average annual precipitation for the site of 50-inches. The flat topographic surface of the site coupled with the relatively high permeability of the sands and gravels indicates that some 60% of the precipitation that falls on the area will infiltrate into

3.2 RECHARGE continued ...

into the ground and recharge the aquifers. Therefore the following quantities of direct recharge onto the area will be:

ON WHOLE CAMPBELL UPLAND OF 10 SQUARE MILES

$10 \times 50 \times 0.6 \times 14.5 \times 10^6$ (1 inch of water on one square mile)

$= 4{,}350 \times 10^6$ Imp gallons/year

= 8,300 Imp gallons per minute

ON CAMPBELL UPLAND IN SURREY OF 3 SQUARE MILES

$4{,}350 \times 10^6 \times 3/10 = 1{,}305$ Imp gallons/year

= 2,500 Imp gallons/minute

ON SUBJECT SITE OF 160 ACRES

$\frac{160}{640} \times 50 \times 0.6 \times 14.5 \times 10^6 = 110 \times 10^6$ Imp gallons per year

= 210 Imp gallons/minute

3.2 RECHARGE continued ...

Thus a very large amount of groundwater is available in the Campbell Upland sand and gravel terrace in Langley and Surrey. Langley is estimated to be removing 1/20th of this amount in the Brookswood area but since that area is on septic tank the actual withdrawal would be approximately 1/100th (80% return) of the average annual recharge. We expect that slightly less than one-half of the average annual recharge that falls directly onto the subject site or 100 gpm will be withdrawn from the groundwater reserves beneath the site.

3.3 PLANT WATER DISPOSAL

The clean process water from the plant can be disposed of in several ways. The exact method to be used will depend upon calculations to be made during the detail design stage of this project. Possible disposal systems would include:

- Storage in Golf Course lakes for use as irrigation water
- Spray irrigation
- Subsurface ground disposal
- Injection wells

3.3 PLANT WATER DISPOSAL continued ...

Injection wells should each be capable of receiving approximately 50 gpm of influent water. Therefore six such wells would be required. Injection wells must be very carefully designed and the water being injected into the wells must be clear, clean and free of all gases. Calculations indicate that a ground disposal bed consisting of 8,000 lineal feet of drain pipe in an area of 80,000 square feet or two acres will dispose of 300 gpm of clean water and impress a mound of less than 5 feet onto the water table. Ample area is available in the eastern part of the site so that the mound would not cause instability of the front of the terrace. Since the water would be clean, spray irrigation of field crops or greens and fairways would appear to be a relatively easy method of disposal. Perhaps a combination of ground disposal during the winter, storage in golf course lakes during the spring and irrigation during the summer and fall would turn out to be the most effective and efficient method for plant process water disposal.

3.4 SEWAGE EFFLUENT WATER DISPOSAL

It is estimated that 30,000 gpd of sewage effluent will be generated by the plant and that another 30,000 gpd will be generated by houses. A percolation rate of 5 minutes per inch will require an area of 2.8 acres for the disposal of 60,000 gpd of effluent with a BOD of 20 mg/l and a Suspended Solids of 30 mg/l. This area can probably be reduced if the effluent is polished to a 5/5 or 10/10 level. Ample area is available in the northeastern part of the site to construct drain fields that will be over 1,500 feet from the top edge of the terrace and over 2,100 feet from the spring line along the toe of the terrace slope.

4.0 WATER QUALITY

A sample of water was analyzed for the chemical constituents by a commercial laboratory Can Test Ltd. The results are not presently available in report form. However, the verbal results are shown on Appendix III.

The water is potable and soft with a very low content of total dissolved solids.

5.0 C O N C L U S I O N S

5.1 The main features of the Campbell Heights Campus site hydrogeology are:

5.1.1 Highly permeable sands and gravels 65 feet thick underlie the site.

5.1.2 The area is situated near the western edge of an ancient raised river delta terrace that totals 10 square miles in areal extent.

5.1.3 The surface topography is essentially flat and at an elevation that varies between 140 and 145 feet A.S.L.

5.1.4 The water table is six or more feet below ground surface except in the extreme south-western part of the site where springs issue from a small secondary terrace that lies five to ten feet below the main terrace area.

5.1 continued ...

5.1.5 A spring line is present along the toe of the main terrace slope at an elevation of approximately 100 feet A.S.L.

5.1.6 This spring water flows towards and is pumped into the Nicomekl River.

5.2 The sewage effluent from the plant and houses can be disposed of in beds located over 1,500 feet from the top of the terrace slope and over 2,100 feet from the spring line.

5.3 The plant process clean water can be disposed of in several ways. The way or combination of ways to be used should await the detailed design stage of the project.

5.4 Four water wells approximately 65 feet deep should be capable of supplying the fresh water requirements of the plant and homes.

5.0 C O N C L U S I O N S continued ...

5.5 The quality of the groundwater is potable and excellent.

5.6 Based upon data and information presently available to us we conclude that the ground disposal of a total of 60,000 gallons per day of polished effluent into this site will not cause a deterioration of the groundwater resource nor cause instability of the terrace front.

A P P E N D I X I

WATER LEVEL ELEVATIONS

Well Or Piezometer	Elevation Top of Pipe	Depth To Water	Elevation Water Table
W.W. #1	145	-	-
W.W. #2	145	17.6	127.4
Piez. 1	145	24.8	120.2
Piez. 2	146	12.4	133.6
Piez. 3	145	18.2	126.8
Piez. 4	148	9.2	138.8
Piez. 5	145	6.6	138.4
Piez. 6	145	9.9	135.1
Piez. 7	145	15.3	129.7
Piez. 8	146	11.9	134.1

Water levels measured on March 31, 1980.

A P P E N D I X II

TEST PITS

Number	Depth (Feet)	Description
T.P. 1	0 -1.5	silty loam top soil brown
	1.5-4.5	sandy clay brown
	4.5-6.0	sand fine to coarse grained grey DRY
T.P. 2	0 -1.0	silty loam top soil brown
	1.0-6.0	sand grey DRY
T.P. 3	0 -0.5	silty loam top soil brown
	0.5-6.0	sand clayey
	6.0-6.5	sand fine to coarse grained grey DRY
T.P. 4	0 -1.0	silty loam top soil brown
	1.0-7.0	sand fine to medium grained some clay stringers
		water at 7 feet

... /continued.

APPENDIX II continued ...
TEST PITS
Page 2

Number	Depth (Feet)	Description
T.P. 5	0 -1.0	silty loam top soil brown
	1.0-4.5	sand fine to medium grained brown
	4.5-6.5	sand fine to coarse grained some pebbles, grey DRY
T.P. 6	0 -1.5	silty loam top soil brown
	1.5-4.0	sand fine to medium grained brown
	4.0-7.0	sand fine to coarse grained some pebbles DRY
T.P. 7	0 -1.5	silty loam top soil brown
	1.5-4.5	sand fine to medium grained some pebbles brown
	4.5-6.5	sand fine to coarse grained grey some pebbles
		water at 6.5 feet
T.P. 8	0 -1.0	silty loam top soil brown
	1.0-4.5	sand fine to coarse grained brown
	4.5-7.0	sand fine to coarse grained and gravel
		water level at 7 feet

... /continued.

APPENDIX II continued ...
TEST PITS
Page 3

Number	Depth (Feet)	Description
T.P. 9	0 -2.0	silty loam top soil brown
	2.0-4.5	sand fine to coarse grained some pebbles
	4.5-7.5	sand fine to coarse gravel some pebbles grey DRY
T.P. 10	0 -1.0	silty loam top soil brown
	1.0-5.0	sand fine to coarse gravel brown
	5.0-8.0	sand fine to coarse grained and gravel DRY

A P P E N D I X III

B.C.D.C. CAMPBELL HEIGHTS

SHALLOW AQUIFER

WATER QUALITY

(Phoned Report From Can Test Ltd.)

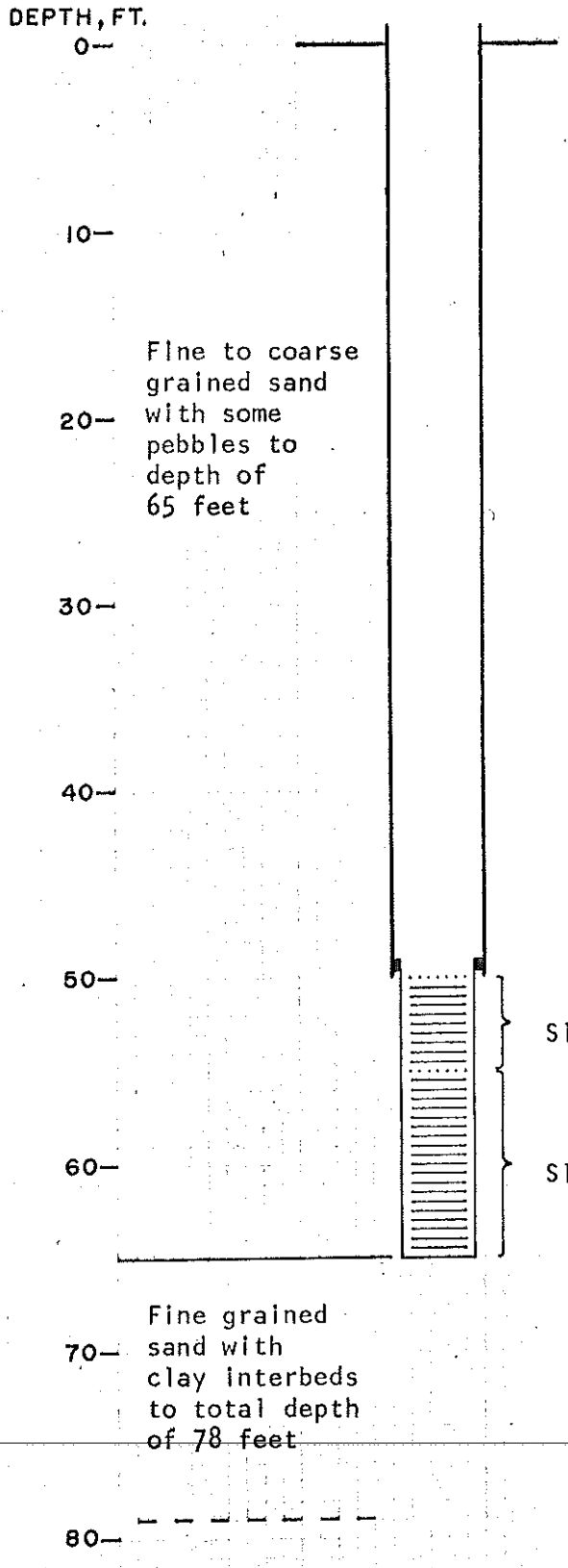
Constituent		mg/l
Ph		8.2
Conductivity		153
Color		5
Turbidity		.45
Total Dissolved Solids		135
Total Suspended Solids	<	0.5
Bicarbonate		75
Chloride		4.5
Sulphate		5.5
Nitrate/Nitrite		.002
Phosphate		.07
Fluoride		.084
Silica		21.3
Hardness		64.7
Calcium		18.5
Magnesium		4.5
Sodium		2.5
Potassium		1.02
Iron		.032
Cadmium	<	.001
Copper		.004
Lead	<	.001
Total Iron		.22
Total Manganese		.066

APPENDIX IV

LOG OF TEST HOLE NO. 2

Elevation Top of Pipe - 145 Feet.

Depth (Feet)	Description
0-1	Top soil brown silty loam
1-55	Sand fine to coarse grained some pebbles Water-bearing below 15 feet
55-65	Sand, medium to coarse grained, Water-bearing
65-80	Sand, fine to medium grained, with few clay stringers, Water-bearing
80-240	Sand, fine grained, silty with clay
240-245	Clay, pebbly
245-390	Clay
390-420	Sand, fine gravel, silty
420-496	Clay, silty
496-520	Sand fine grained, Water-bearing
520-550	Clay, silty. Total Depth.



- Well casing 8 inch I.D. to depth of 50 feet
- Stainless steel well screen 8 inch nominal diameter with neoprene packer between depths of 50 and 65 feet

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LOG OF TEST WELL 2

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DRAWING NO.
80-166
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