93B/16-10

Province of British Columbia
Ministry of Environment
Inventory & Engineering Branch

CONSTRUCTION OF AN OBSERVATION WELL WR260-80 IN THE RED BLUFF AREA - QUESNEL, B. C.

CONTRACT NO. 69

W.S. Hodge
Technician
Groundwater
Hydrology Section

Victoria, B.C. June 1980

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CONSTRUCTION OF AN OBSERVATION WELL WR 260-80 IN THE RED BLUFF AREA - QUESNEL, B. C.

CONTRACT NO. 69

1. INTRODUCTION

One 6-inch diameter observation well was drilled and completed to a depth of 245 feet in the Red Bluff area southeast of Quesnel. The well was drilled by Industrial Drillers Ltd. of Prince George in March 1980. Total contract costs for well construction and testing were $6,872.50.

The Red Bluff area is southeast of Quesnel and was chosen as a high priority area for establishment of an observation well on the recommendations of Choy (1978). The Red Bluff area is dependent on groundwater for its' water supply. A location plan showing well density in Red Bluff has been shown in Figure 1. Figure 2 shows the site plan in greater detail.

Construction of an observation well at Red Bluff was required to monitor water level fluctuation and long term effects of groundwater extraction in the area.

An automatic water level recorder and protective housing were installed on the well head. This equipment should remain in place for a minimum of 5 years.

2. WELL CONSTRUCTION AND RESULTS OF TESTING

Drilling was carried out using the air-rotary method. Ten feet of ten-inch diameter surface casing was installed and the annular space grouted. The lithological log, water well record, and results of the sieve analysis are shown in Appendix A. The aquifer transmissivity has been calculated from the recovery data and is shown in Appendix B. Drawdown data has also been plotted and shown in Appendix B.

The drill log shows the major aquifer zone starts at 225 feet below ground surface. A .020 inch slot well screen was set between 237 and 245 feet opposite coarse sand and gravel. The grain size analysis indicates this zone could be screened using a minimum slot size of .040 inch and larger (in theory possibly up to .150 inch slot). A .020 inch slot screen was however, considered adequate for observation well purposes. (Note the photograph showing the aquifer samples collected between 221 and 247 feet below ground surface.)

The well was developed using compressed air. The flow rate fluctuated due to the very deep static water level and the subsequent high lift required during pumping. The maximum recorded flow rate during development of this well was approximately 20 USgpm. The well was surged periodically by "rawhiding". (The air control valve was closed, then quickly opened, thus forcing water outward through the screen openings.) The water cleared and was visably free of sand and other fine particles after approximately 3 hours of development.

The well was pump tested at a near constant rate of 32 USgpm for 320 minutes (5.3 hours). The 3 horsepower submersible pump used was only able to lift a maximum of 32 USgpm from a distance of 216 feet. Pumping the well at this rate resulted in stabilization being reached after approximately 10 minutes. Water level began to rise slightly 10 minutes after pumping began, indicating that the well was being developed by this pumping. (Note the time-drawdown curve plot Appendix B.) Water level declined slightly after the 150 minute period of pumping and remained stable until the end of the test. Considering the well was pumped at a constant rate of 32 USgpm, resulting in a drawdown of 3 feet, the specific capacity of the well is 10.6 USgpm/ft. of drawdown. If 70 percent of the available drawdown is used during pumping, the well could in theory be pumped at a rate of 150 USgpm.

Recovery data has been plotted and is shown in Appendix B. Unfortunately, an observation well was not obtained in the area while this well was being pumped. The water level data does not, therefore, fully reflect the hydraulic characteristics of this aquifer. This data can be used only for limited calculations of the aquifer capabilities. This data does, however, allow transmissivity of the aquifer to be determined. A T. value of 48,918 USgpd/ft. has been calculated. This value suggests the well yield may be adequate for industrial, irrigation or municipal purposes. Recovery to the original pre-pumping water level was however, slow particularly considering the well was completed in permeable, unconsolidated material. The well recovered approximately 66 percent of the total drawdown, 60 minutes after pumping had stopped. The water level at this point was 217.5 feet below the point of reference. It took over 17 hours to recover to very near the initial static water level. This information clearly suggests the aquifer is well confined and the recharge rate is slow. It is probable that the principal factors controlling recharge to this aquifer are as follows:

a) Topography - The Red Bluff area is elevated and relatively flat with few surrounding hills to generate recharge to the aquifer.

b) Soil Permeability - This is a confined aquifer, located beneath 200 feet of till and clay. The low permeability of the confining layer may limit leakage to the aquifer and hence aquifer recharge.

c) Groundwater Movement - The hydrostatic pressure is low within this aquifer with the piezometric level rising only about 25 feet above the top of the aquifer. Groundwater movement in this area may be relatively slow. The highly mineralized, poor quality water within this aquifer also suggests groundwater movement is very slow.

3. GEOLOGY

Surficial and bedrock geology in the Quesnel area has been mapped by Tipper (1959, 1969). Glacial drift, lake deposits, and recent alluvium in the major river valleys cover most of the Quesnel map area. The depth of unconsolidated material averages 25-50 feet commonly and ranges up to 600-700 feet. Three distinct till sheets have been identified near Diamond Island, south of Quesnel, indicating three different glacial events in the area.

The GSC 762 foot deep testhole located in Figure 1, has been drilled in the Red Bluff area. This testhole is located 1/2 mile southwest of the observation well (Y1 #44 in Figure 1). The geologic log shows carbonaceous shale with coal stringers encountered at 170 feet deep. This bedrock belongs to the Tertiary Age Fraser River Formation (Australian Member). This is a narrow belt of weakly lithified clastic sediments along the present Fraser River extending from Prince George to 38 km south of Quesnel according to Graham (1978).

The geologic log of the observation well with an interpretation of origin of the materials is as follows:

Depth (feet)	Material	Possible Origin
0 - 15	Till	Glacial
15 - 21	Sand and gravel	Glacial outwash
21 - 190	Till	Glacial
190 - 221	Clay	Lacustrine
221 - 247	Sand and gravel	Glacial outwash

This well did not reach bedrock, however it is expected that bedrock will be found here in the 250 foot depth range. One nearby well drilled at the Red Bluff school encountered bedrock at a depth of 232 feet.

4. HYDROGEOLOGY

The Red Bluff area has been largely subdivided in the past as is evident in the number of subdivisions existing within this area.

Groundwater is the only domestic water source in Red Bluff and the majority of residents have had individual water wells constructed. There are 220 wells on file within the Red Bluff area. Approximately 60 percent of these wells are reported as being drilled, while the remaining 40 percent are recorded as being "dug". Well depths range from an 8-foot dug well to a 762-foot testhole drilled by the Geological Survey of Canada.

The majority of residents obtain water from a shallow aquifer located generally less than 100 feet below ground surface. This aquifer appears to be extensive and has been generally used for domestic water requirements for many years. Review of drill log data and discussions with local residents indicate the aquifer probably varies in thickness from a few inches to possibly a number of feet. The highest yield recorded from a well known to be constructed in this aquifer is one rated at approximately 20 gpm.

Below normal precipitation has occurred over northern B.C. during the past four years. As a result, water levels in shallow aquifers are declining. This has been noticeable in wells located in Red Bluff, and depletion of this shallow aquifer may eventually occur. The shallow depth to, and nature of aquifer materials make this aquifer susceptible to pollution from sources such as septic tank effluent and possibly contaminants such as accidental gasoline or oil spills. Depth to this aquifer does vary however, and in some places the overlying till or clay would likely prevent this problem from occurring. There have been numerous reports of residents constructing new wells or deepening (or planning on deepening) existing wells throughout the Red Bluff area.

The shallow aquifer was encountered at the drill site at a depth of between 15 and 21 feet below ground surface. This aquifer material consists of coarse sand and gravel. The gravels range in size from 1/4 inch diameter to possibly as great as a few inches in diameter (cobble size). This zone was not screened or tested. The principal objective of this project was to construct an observation well to monitor the deeper aquifer known to exist in Red Bluff.

Approximately 200 feet of till and clay separate the upper and lower aquifers at the drill site. The lower aquifer was intercepted at 221 feet and drilling continued to a depth of 245 feet. At this point, drilling was stopped and the well screen was installed.

Numerous domestic wells are located 3/4 to 1 mile distance to the east and up to 1/2 mile north of the drill site. These wells are generally less than 100 feet deep and are constructed in a number of thin sand and/or gravel aquifers. There may be a slight possibility that a connection between one or more of these aquifers, and the deeper aquifer intercepted at the drill site exists. This possibility however, is believed to be remote.

Well logs of deeper wells drilled in the vicinity of the observation well indicate the aquifer extends at least in a north-south direction. This is shown in that the Red Bluff school well (Z1Z-X11-Y1#2) intercepts the same aquifer, as does the Kinnie well (Z1Z-X11-Y1,#45), 800 feet to the north. The extent of this aquifer beyond these points is at present unknown. A high capacity well drilled for South-Hill Developments Ltd. is of interest and should be mentioned. The well is approximately 1.5 miles northeast of the drilling site. Geology is very similar to that seen at the drilling site and the aquifer capabilities also appear very similar. No evidence is presently available suggesting there is a connection between these aquifers, however this possibility does exist.

5. HYDROCHEMISTRY

A water sample was collected and submitted for complete chemical analyses during pumping of the well. The analysis (Appendix C) indicates the groundwater is very hard (1080 mg/L) and highly mineralized (TDS=2246 mg/L). A total iron content of 20 ppm was recorded even though the well was pumped for a considerable length of time. The majority of iron is probably in the ferric or dissolved state. The well water, when first pumped, was clear and colourless. After a few hours, deposits of rust-coloured material were noted at the bottom of the container. An iron content of 20 ppm exceeds the recommended drinking water standard

by greater than 60 times. Iron bearing water such as this also promotes the growth of iron bacteria. This water is clearly not potable and if considered for domestic use it must then be treated. Treatment of water of this quality may however, be very costly and is therefore not recommended at this time.

Better water quality is noted within the shallow aquifer. This can probably be attributed to a faster moving groundwater flow system or younger aged water. Water quality of this shallow flow system is reported to be relatively hard, mineralized water (a Hach test was performed on a shallow well, 42 feet deep, approximately 700 feet north of the drilling site. The results are as follows: Conductivity - 980 µmhos/cm. iron - 1.1 mg/L, hardness - 564 mg/L, pH-7.8 alkalinity - 684 mg/L. This analysis is believed to be representative of the quality of groundwater expected within the shallow aquifer.

6. CONCLUSIONS AND RECOMMENDATIONS

Pump test results have shown this well may be capable of yielding up to 150 USgpm. Recovery data and poor water quality suggest the aquifer could be part of an older confined groundwater system.

Although the pump test conducted was suitable for observation well purposes, a test at a higher pumping rate would be necessary to more clearly define the hydraulic characteristics of this aquifer.

Further water quality testing of wells completed in this deeper flow system is recommended. Sampling of a number of wells in the Red Bluff area may assist in confirming the connection between the observation well and other deep high capacity wells. Many wells that could be sampled for water quality have been noted.

A water level recorder float, specifically designed for deep water monitoring, should be installed in this well as soon as possible. This float should improve the water level fluctuation response and hopefully result in obtaining more accurate hydrograph records.

As many of the residents in Red Bluff obtain water from the shallow aquifer, it is also recommended that an observation well be established to monitor this aquifer. A suitable abandoned well may be available for this purpose. Hydrograph records from a well such as this would assist in determining whether this aquifer is being mined.

W. S Hodge

W.S. Hodge, Technician
Groundwater
Hydrology Section

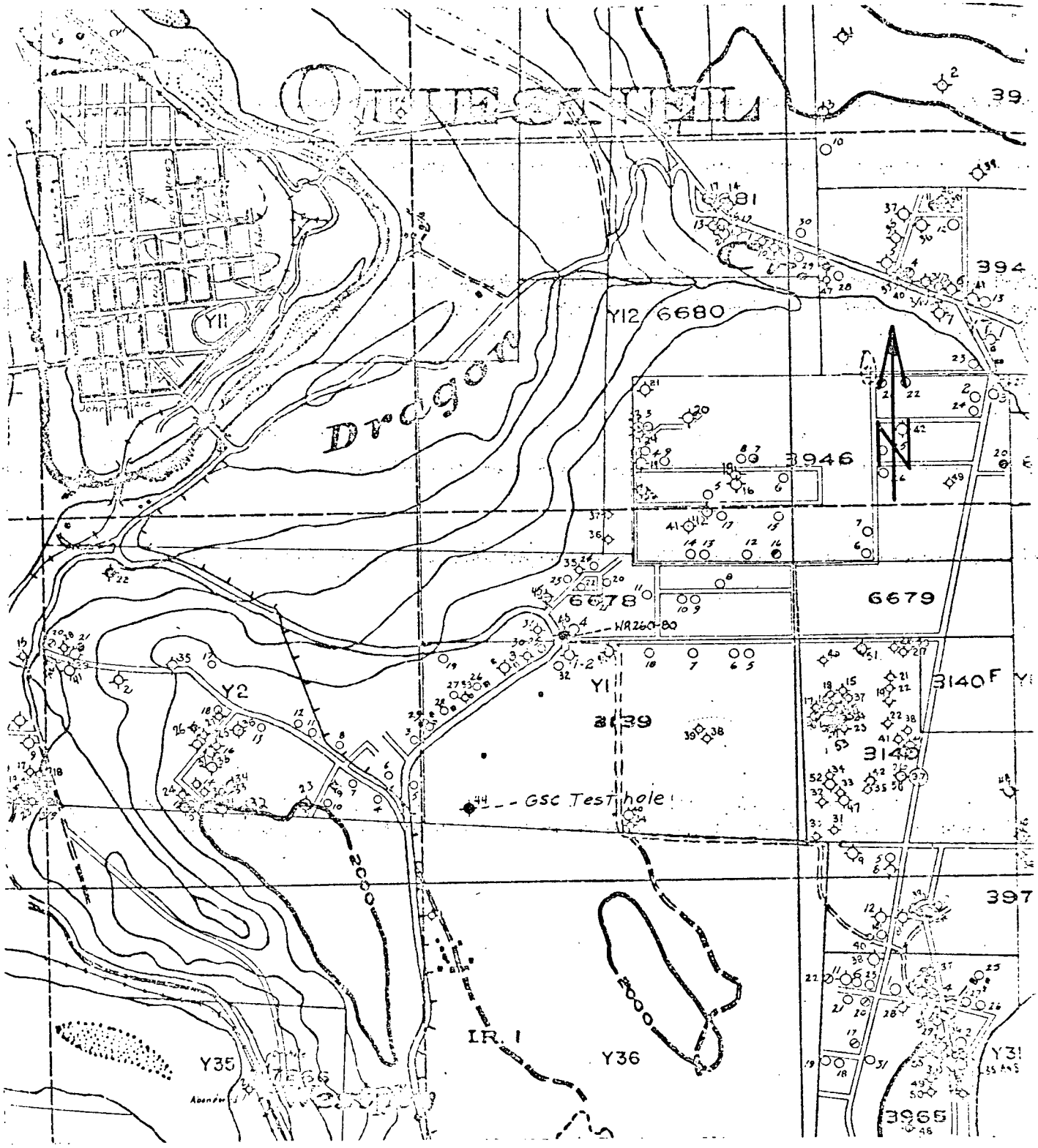
7. REFERENCES

Tipper, H.W. (1959), Geology Quesnel, Map 12-1959, Geological Survey of Canada.

Tipper, H.W. (1969), Surficial Geology Quesnel, Map 1290A, Geological Survey of Canada.

Graham, P.S.W. (1978), Preliminary Results of Drilling in the Coal Bearing Fraser River Formation, Quesnel, B.C., Institute of Sedimentary and Petroleum Geologists, Calgary.

Choy, H.H. (1978), Preliminary Proposal and Cost Estimates for Observation Well Network Program 1978. File 0183613-B, Groundwater Section, Hydrology Division, Water Investigations Branch, Ministry of the Environment.



Location Plan Showing Well Density

Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Quesnel (Red Bluff)
Observation Well, Contract No. 69

SCALE: VERT. 1" = 1900'
HOR.

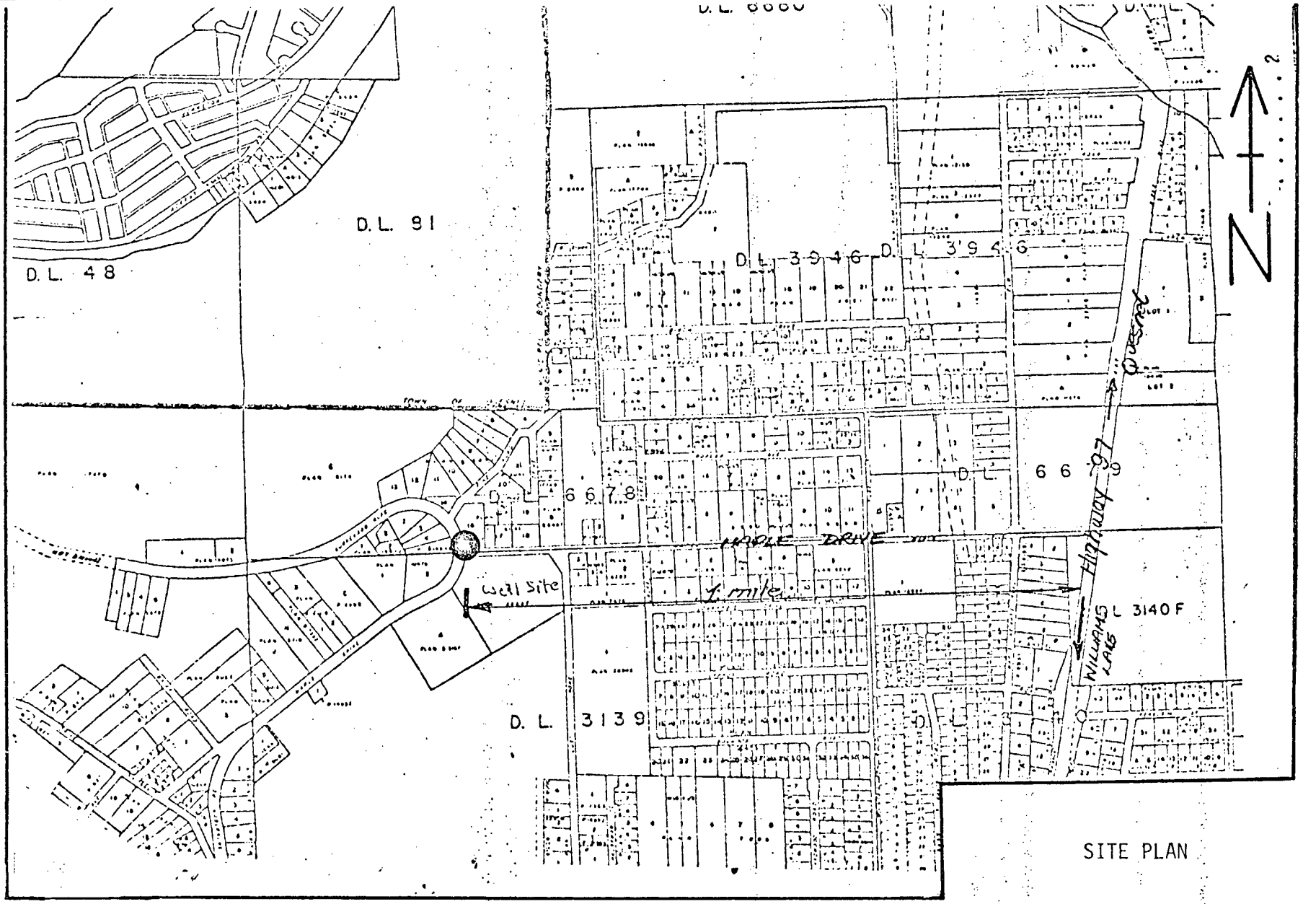
DATE March 1980

D. A. Lowen ENGINEER

FILE No.

DWG. No. Figure 1

bcil 6660 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Quesnel (Red Bluff) Observation Well Contract No. 69

SCALE: VERT. 1" = 1200 ft.
HOR.

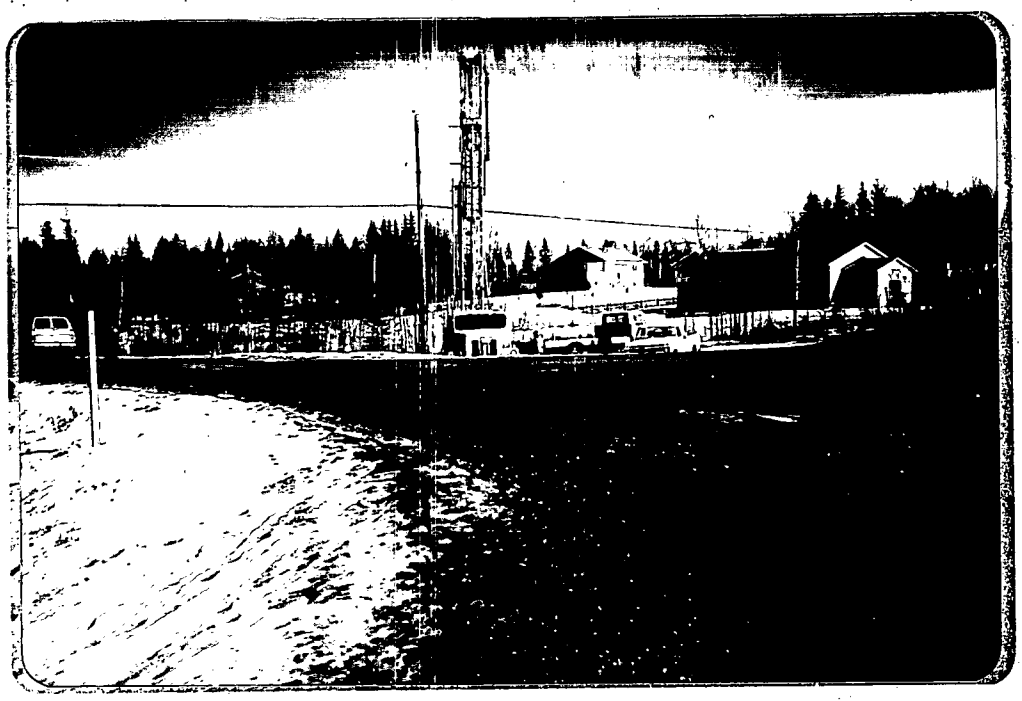
DATE: March 1980

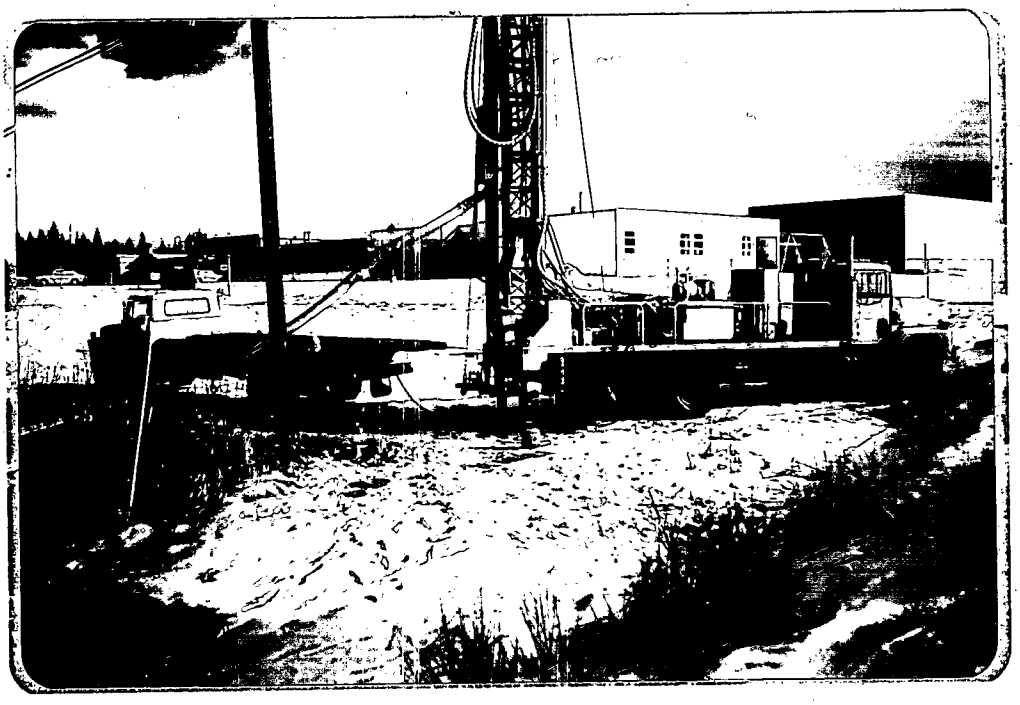
D. A. Lowen ENGINEER

FILE No. DWG. No. Figure 2

Quesnel (Red Bluff) Observation Well

WR 260-80 - Contract No. 69





Photographs showing Air rotary rig in action

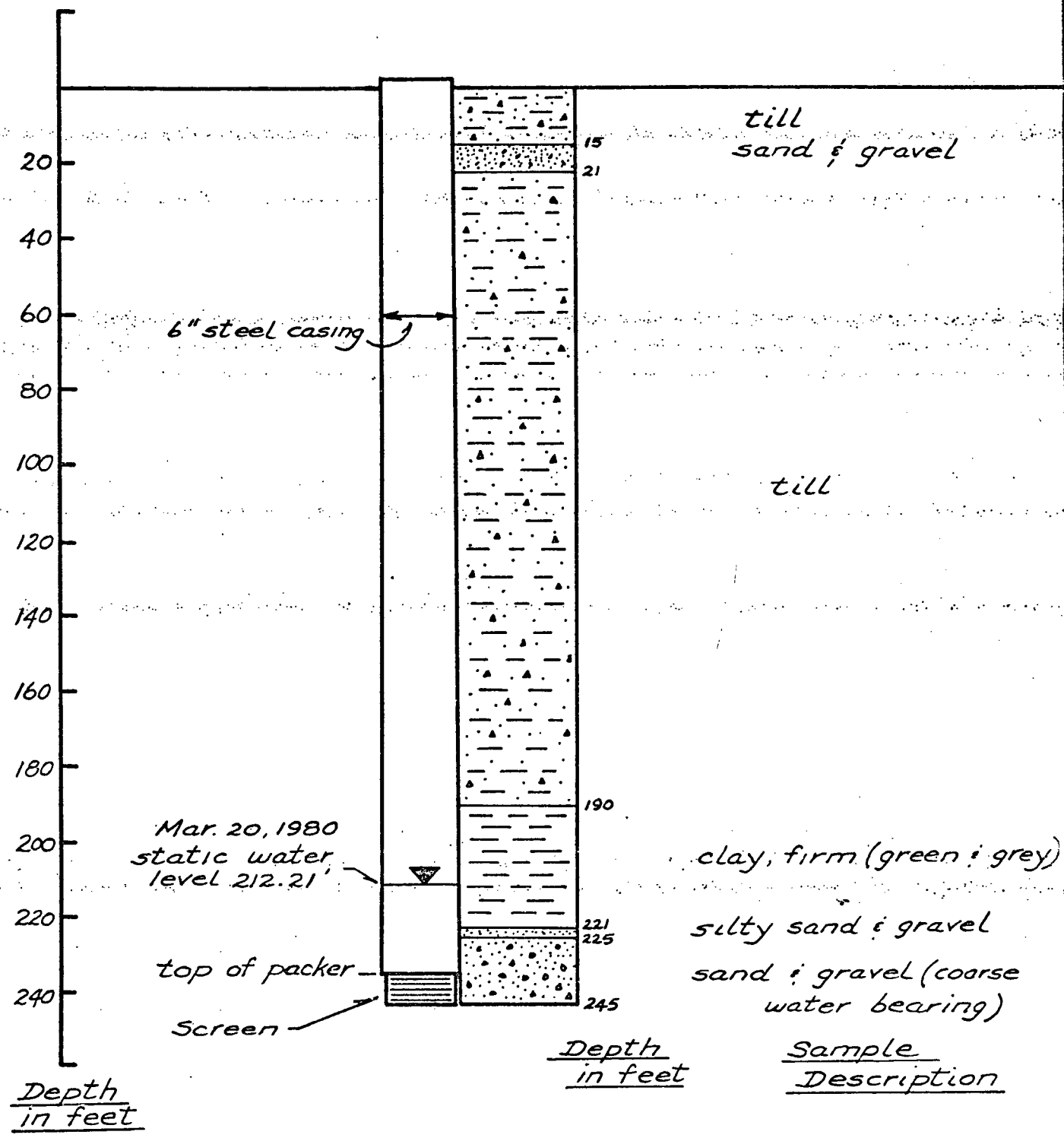
Quesnel (Red Bluff) Observation Well

WR-260-80 - Contract No. 69

Photograph showing location and appearance of aquifer material between 221 feet and 247 feet below top of well casing.

APPENDIX A

Well Design and Geology,
Sieve Analysis, Well Log



Quesnel Observation Well WR260-80

Well Design & Geology

Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Quesnel (Red Bluff) Observation Well Contract No. 69

SCALE: VERT. 1" = 40'
HOR. NTS

DATE
March 1980

D. A. Lowen ENGINEER

FILE No.

DWG. No. Appendix A

bcil 6660 wrs

WR260-80

WATER WELL RECORD

DEPT. OF ENVIRONMENT, WATER RESOURCES SERVICE, WATER INVESTIGATIONS BRANCH VICTORIA, BRITISH COLUMBIA

WELL NO. Z

LEGAL DESCRIPTION: LOT * (HIGHWAY RIGHT OF WAY) SEC. ____ TP. ____ R. ____ D.L. 6678 LAND DISTRICT CARIBOO PLAN 6678

DESCRIPTIVE LOCATION CORNER MAPLEDRIVE & BORREGARD - 1 MILE WEST OF HWY 97 LICENCE NO. ____ DATE ____

Z 12 X 11 Y 1 NO. 46

NAT. TOPO. SHEET NO. 4

OWNER'S NAME MINISTRY OF ENVIRONMENT ADDRESS 780 BLANCHARD AVE VICTORIA B.C.

DRILLER'S NAME INDUSTRIAL DRILLERS LTD ADDRESS HAMEL RD RR2 PRINCE GEORGE DATE COMPLETED MAR 20 1980

DEPTH 245.25 ELEVATION OF ground level ☐ ESTIMATED ☐ SURVEYED CASING DIAM. 6" LENGTH 247.8' VAN-2H9

METHOD OF CONSTRUCTION AIR ROTARY CASING DIAM ____ LENGTH ____

SCREEN LOCATION 237-245.25 SCREEN ☐ SIZE 020" LENGTH 8' TYPE JOHNSON S.S.

SANITARY SEAL YES ☐ NO ☐ SCREEN ☐ SIZE ____ LENGTH ____ TYPE ____

PERFORATED CASING ☐ LENGTH ____ PERFORATIONS FROM ____ TO ____

GRAVEL PACK ☐ LENGTH ____ DIAM. ____ SIZE GRAVEL, ETC. ____

DISTANCE TO WATER 212.21 ☐ ESTIMATED WATER LEVEL

FROM GROUND LEVEL ☐ MEASURED ELEVATION ____ ARTESIAN PRESSURE ____

DATE OF WATER LEVEL MEASUREMENT MAR 20/80 WATER USE OBSERVATION WELL

PRODUCTION TEST SUMMARY

DATE MAR 20/80

TEST BY INDUSTRIAL DRILLERS LTD

BAIL TEST ☐ PUMP TEST ☒ DURATION OF TEST 6 hrs

RATE 27 igpm DRAWDOWN 3.21

WATER LEVEL AT COMPLETION OF TEST 219.74

AVAILABLE DRAWDOWN 25 SPECIFIC CAPACITY ____

PERMEABILITY ____ STORAGE COEFF. ____

TRANSMISSIVITY ____

RECOMMENDED PUMPING RATE ____

RECOMMENDED PUMP SETTING ____

CHEMISTRY

TEST BY ENVIRONMENTAL LABORATORY DATE MAR 25/80

TOTAL DISSOLVED SOLIDS 2240 mg/l TEMPERATURE 42.2 °F pH 5.8 SILICA (SiO_2) 33.5 mg/l

CONDUCTANCE ____ µmhos/cm AT 25°C TOTAL IRON (Fe) 15 mg/l TOTAL HARDNESS ($CaCO_3$) 1080 mg/l

TOTAL ALKALINITY ($CaCO_3$) 38.6 mg/l PHEN. ALKALINITY ($CaCO_3$) ____ mg/l MANGANESE (Mn) 3 mg/l

COLOUR ____ ODOUR ____ TURBIDITY ____

ANIONS	mg/l	epm	CATIONS	mg/l	epm
CARBONATE (CO_3)			CALCIUM (Ca)	203	
BICARBONATE (HCO_3)			MAGNESIUM (Mg)	140	
SULPHATE (SO_4)	1376		SODIUM (Na)	150	
CHLORIDE (Cl)	1.6		POTASSIUM (K)	12.3	
NO_2 + NO_3 (NITROGEN)	3		IRON (DISSOLVED)		
• TKN. (NITROGEN)	20.02				
PHOSPHORUS (P)	.004				

• TKN = TOTAL KJELDAHL NITROGEN CHEMISTRY SITE NO. AA401492

NO_2 = NITRITE NO_3 = NITRATE

CHEMISTRY FIELD TESTS

TEST BY W. HOXIE DATE MAR 20 1980 EQUIPMENT USED HACH KIT & COND. METER

Temp 42.2°F IRON 5.0 +++

HARDNESS 1026 mg/L PH 5.6

CONTRACT # 69

CONTENTS OF FOLDER

☒ DRILL LOG ☐ PUMP TEST DATA ☒ CHEMICAL ANALYSIS

☐ SIEVE ANALYSIS ☐ GEOPHYSICAL LOGS ☐ REPORT

OTHER OBSERVATION WELL WR260-80 - An automatic water level recorder was installed MAR 21/80 - see enclosed memorandum for details

SOURCES OF INFORMATION ____

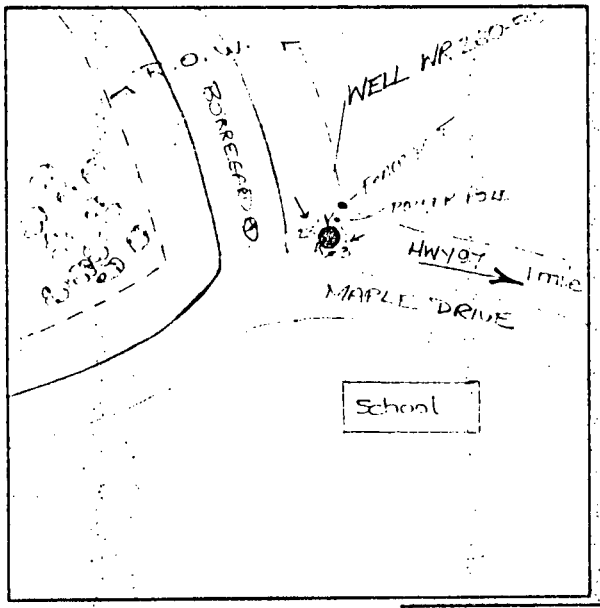
LITHOLOGY

FROM	TO	DESCRIPTION
0	15'	TILL
15'	21	SAND & GRAVEL
21	190	TILL
190	221	CLAY, FRM. (GREEN, GREY)
221	225	SILTY SAND & GRAVEL
225	247'	SAND & GRAVEL (COARSE) WATER BEARING.

Appendix A

NORTH

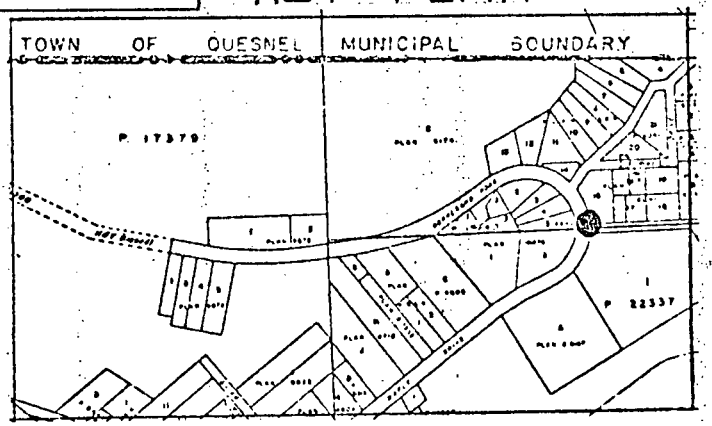
WEST



EAST

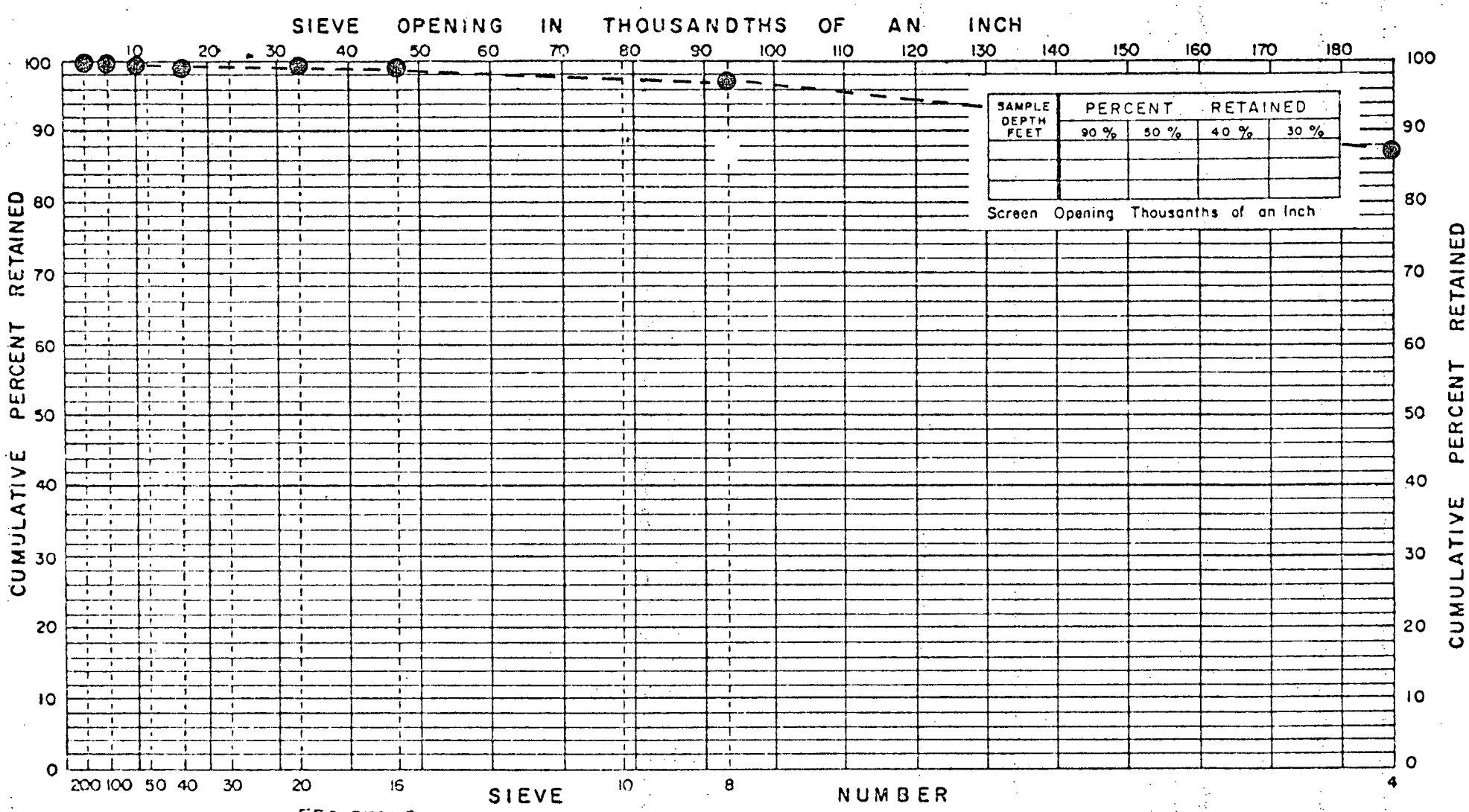
SOUTH

KEY PLAN



CARD BY W. Hodge DATE Mar 25/80

ADDITIONAL DATA ADDED BY _____



550 grams

SAMPLE DEPTH 243-246 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		480.0	87.2
8		533.1	96.9
16		543.1	98.7
20		544.8	99.0
40		547.5	99.5
60		548.6	99.7
100		549.4	99.8
200		549.8	99.9
PAN		550.0	100.0

Percent of sample not sieved 1/2" or over 1 %

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

Percent of sample not sieved 1/2" or over %

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
GROUNDWATER DIVISION

SIEVE ANALYSIS

PROJECT: Contract 69

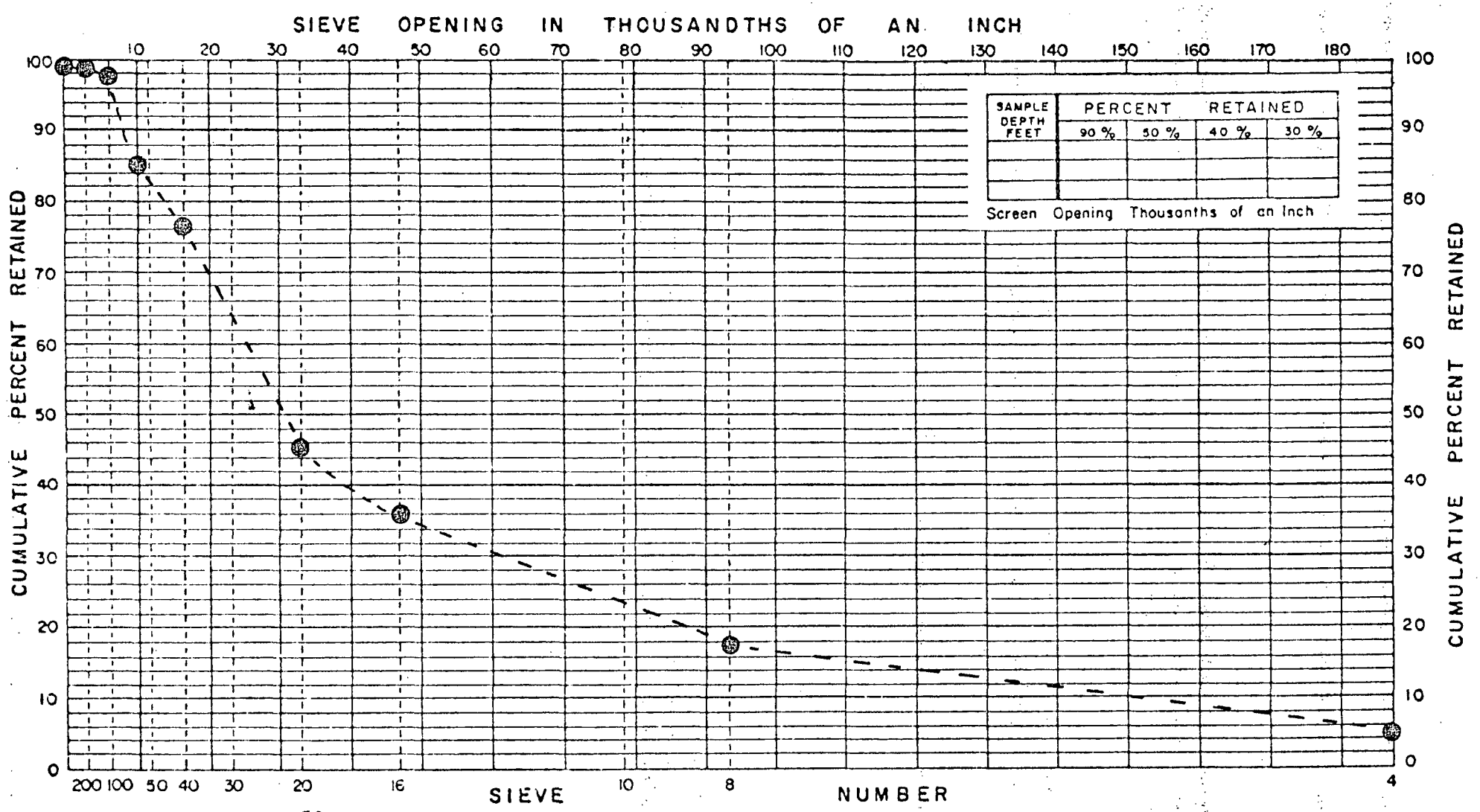
LOCATION: Red Bluff Area, Quesnel, B. C.

WELL No. WR 260-80

SAMPLED BY: W. Hodge

SIEVE ANALYSIS BY: W. Hodge

DATE: March 1980



395.8 grams

SAMPLE DEPTH 241-243 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		19.6	4.9
8		69.6	17.6
16		142.6	36.0
20		179.9	45.4
40		301.9	76.3
60		336.2	84.9
100		385.0	97.3
200		390.9	98.7
PAN		392.1	99.1

Percent of sample not sieved 1/2" or over 0 %

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

Percent of sample not sieved 1/2" or over %

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
GROUNDWATER DIVISION

SIEVE ANALYSIS

PROJECT: Contract 69

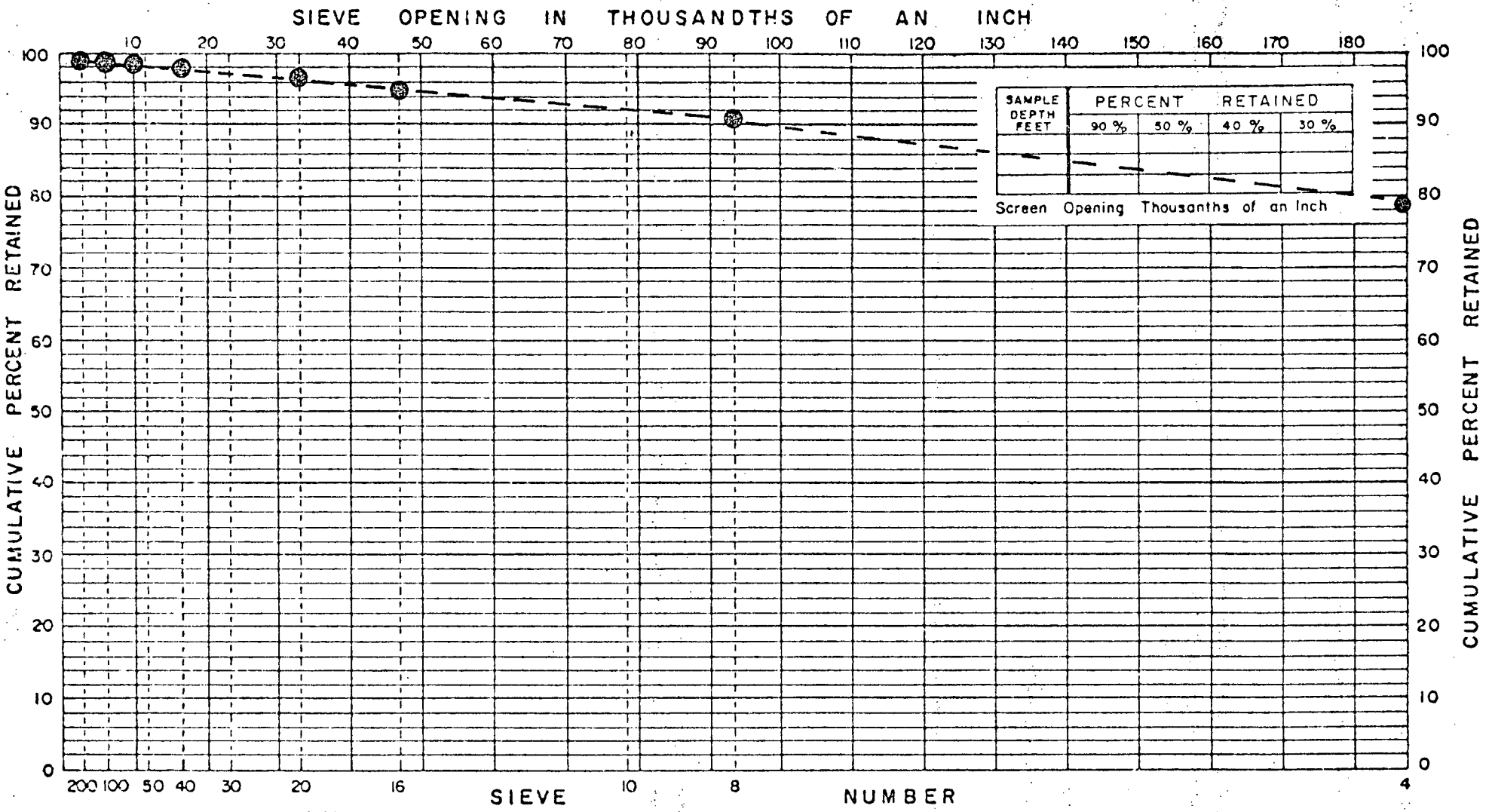
LOCATION: Red Bluff Area, Quesnel, B. C.

WELL No. WR 260-80

SAMPLED BY: W. Hodge

SIEVE ANALYSIS BY: W. Hodge

DATE: March 1980



446.2 grams

SAMPLE DEPTH 225-241 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		348.7	78.1
8		403.2	90.4
16		423.6	94.9
20		429.9	96.3
40		436.3	97.8
60		438.2	98.2
100		439.1	98.4
200		439.7	98.5
PAN		440.0	98.6

Percent of sample not sieved 1/2" or over 5 %

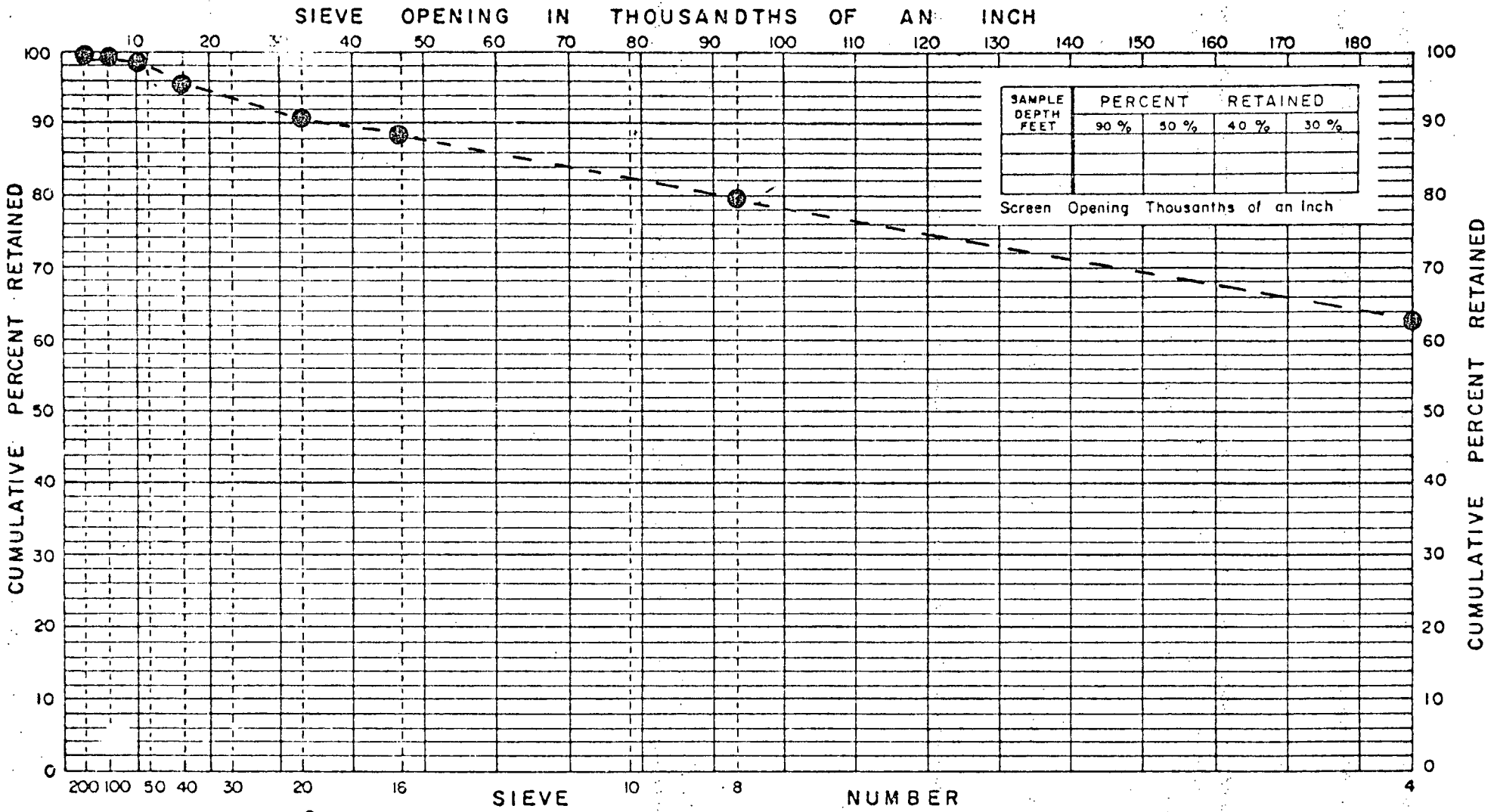
SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

Percent of sample not sieved 1/2" or over ____ %

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
GROUNDWATER DIVISION

SIEVE ANALYSIS

PROJECT: Contract No. 69
LOCATION: Red Bluff - Quesnel
WELL No. WR 260-80
SAMPLED BY: W. Hodge
SIEVE ANALYSIS BY: W. Hodge
DATE: April 1980



481.5 grams

SAMPLE DEPTH 246-247 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		297.6	62.4
8		383.2	79.5
16		424.4	88.1
20		435.7	90.5
40		461.6	95.9
60		475.0	98.5
100		478.4	99.2
200		480.0	99.6
PAN		480.6	99.7

Percent of sample not sieved 1/2" or over 3 %

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

Percent of sample not sieved 1/2" or over %

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
GROUNDWATER DIVISION

SIEVE ANALYSIS

PROJECT: Contract No. 69
LOCATION: Red Bluff - Quesnel
WELL No. WR 260-80
SAMPLED BY: W. Hodge
SIEVE ANALYSIS BY: W. Hodge
DATE: April 1980

APPENDIX B

Drawdown and Recovery Data

Time Drawdown Curve, Residual Drawdown Curve

PUMP TEST - OBSERVATION WELL WR 260-80
Quesnel (Red Bluff)
March, 1980

DRAWDOWN DATA:

TIME	MINS. SINCE START	DEPTH TO WATER (FT.)	DRAWDOWN (FT.)	PUMPING RATE (Igpm)	REMARKS
4:45	t=o	216.53			S.W.L.
	1/2	220.10	3.57		
	1.0	220.00	3.47		
	1.1/2	220.10	3.57		
	2.0	220.10	3.57		3 hp. submersible pump
	2.1/2	220.10	3.57		
	3.0	219.90	3.37		
	3.1/2	219.90	3.37		
	4.0	219.95	3.42		
	4.1/2	219.95	3.42		
	5.0	219.85	3.32		
	6.0	219.80	3.27		
	7.0	219.80	3.27		
	8.0	219.78	3.25		
	9.0	219.77	3.24		
4:55	10.0	219.77	3.24	26.6 Igpm	(32 USgpm)
	12.0	219.77	3.24		
	14.0	219.77	3.24		
	16.0	219.76	3.23		
	18.0	219.75	3.22		
5:05	20.0	219.75	3.22		
	25.0	219.75	3.22		
	30.0	219.73	3.20		
	35.0	219.71	3.18		42.2° F.
5:25	40.0	219.70	3.17		
	45.0	219.70	3.17		
	50.0	219.69	3.16		
	55.0	219.70	3.17		
5:45	60.0	219.69	3.16		
	70.0	219.68	3.15		
6:05	80.0	219.68	3.15		

TIME	MINS. SINCE START	DEPTH TO WATER (FT.)	DRAWDOWN (FT.)	PUMPING RATE (Igpm)	REMARKS
6:15	90.0	219.68	3.15		
6:25	100.0	219.68	3.15		
6:50	125.0	219.65	3.12		
7:15	150.0	219.66	3.13	25 - 26 Igpm	(31 USgpm)
7:40	175.0	219.77	3.24		
8:05	200.0	219.75	3.22		
8:35	230.0	219.76	3.23		
9:05	260.0	219.75	3.22*		*Taken @ 9:26 p.m.
9:35	290.0	219.76	3.23		
10:05	320.0	219.74	3.21		

Hach Results:

Iron - 5.0^{++} mg/L

PH. - 5.6

Conductivity - 2150 µm/cm

Hardness - 1026 mg/L

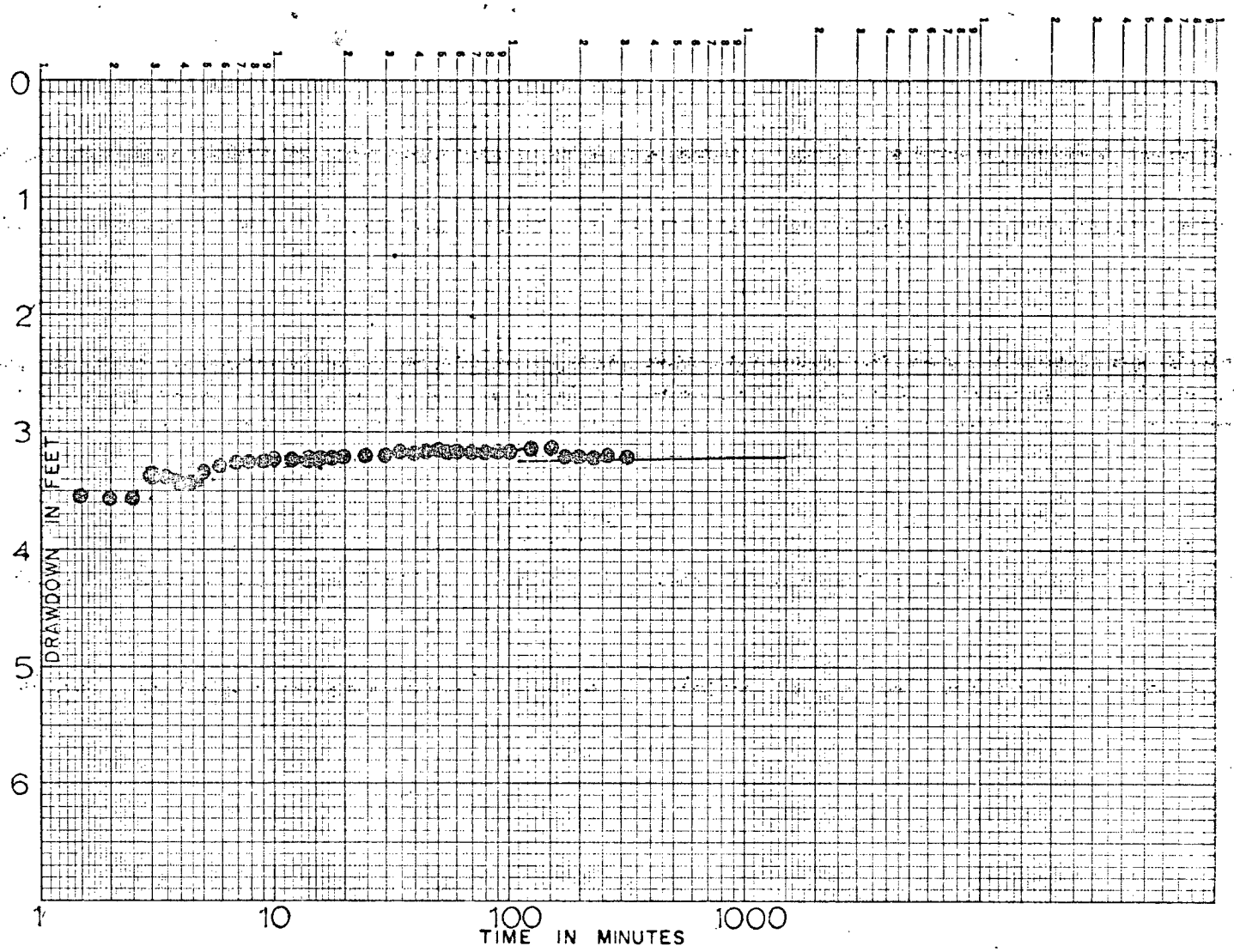
Appendix B

PUMP TEST - OBSERVATION WELL WR 260-80
Quesnel (Red Bluff)
March, 1980

RECOVERY DATA

TIME	MINS. SINCE STOP	DEPTH TO WATER (FT.)	DRAWDOWN (FT.)	REMARKS
10:05	0	219.74		orig. S.W.L. = 216.53'
10:05½	1/2	218.10	1.57	
10:06	1.0	217.80	1.27	
10:06½	1.1/2	217.80	1.27	
10:07	2.0	217.78	1.25	
10:07½	2.1/2			missed
10:08	3.0	217.65	1.12	
10:08½	3.1/2	217.65	1.12	
10:09	4.0			missed
10:09½	4.1/2	217.70	1.17	
10:10	5.0			
10:11	6.0	217.70	1.17	
10:12	7.0	217.67	1.14	
10:13	8.0	217.68	1.15	
10:14	9.0			missed
10:15	10.0	217.64	1.11	
10:20	15.0	217.60	1.07	
10:25	20.0	217.60	1.07	
10:30	25.0	217.58	1.05	
10:35	30.0	217.53	1.0	
10:45	40	217.50	0.97	
10:55	50	217.50	0.97	
11:05	60	217.50	0.97	

8:30 a.m. 21/III/80		ft.	217.35	0.82	before pump pulled
3:30 p.m. 21/III/80	4.600m	15.08	216.39	0.14	
9:00 a.m. 22/III/80	4.382m	14.37	215.68		196.21 correction for tape to p.t. readings,
10:40 a.m. 23/III/80	4.229m ↑ tape	13.87	215.09		g.L. to pointer 5.1 feet g.L. to p.t. ref.4.3 feet



TIME DRAWDOWN CURVE

DATA FROM WELL No. 260-80 (PUMPED, OBSERVATION)

$T = \frac{264 \times Q}{\Delta s} =$ _____ USGPD/AQ.FT.

$S = \frac{0.3 T t_o}{r^2 \times 1.44 \times 10^3} =$ _____

DATE: _____

ISWL: _____ Ft. Below Datum

Q: 31.5 USGPM

Δs: _____ Ft./CYCLE

r: _____ FEET

t_o: _____ MINUTES

PUMPING TEST OF _____ AQUIFER

Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Quesnel (Red Bluff) Observation Well Contract No. 69

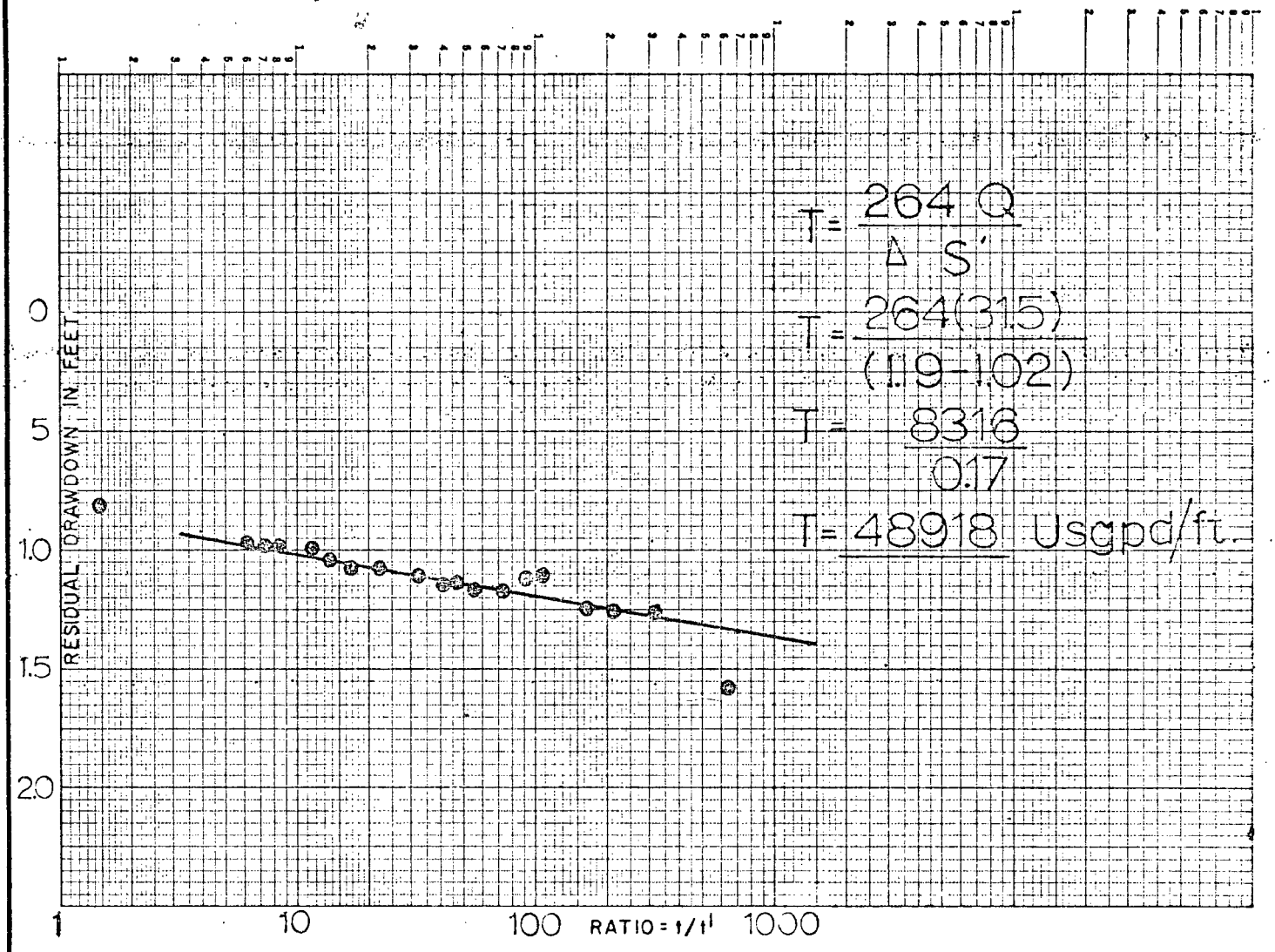
SCALE: VERT. 1" = 1.5'
HOR.

DATE March 1980

D. A. Lowen ENGINEER

FILE No.

DWG. No. Appendix B



RESIDUAL DRAWDOWN CURVE

DATA FROM WELL No. 260-80 (PUMPED, OBSERVATION)

$T = \frac{264 \times Q}{\Delta s'} = \frac{48{,}918}{}$ USGPD/~~AQ~~.FT.

DATE: MAR.80

ISWL: _____ Ft. Below Datum

FSWL: _____ Ft Below Datum

Q: 31.5 USGPM

Δs': .17 Ft./CYCLE

PUMPING TEST OF _____ AQUIFER

Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Quesnel (Red Bluff) Observation Well Contract No. 69

SCALE: VERT. 1" = 1.5'
HOR.

DATE March 1980

D. A. Lowen ENGINEER

FILE No. DWG. No. Appendix B

APPENDIX C

Observation Well Chemical Analysis,
Water Level Recorder Installation Specifications

MINISTRY OF THE ENVIRONMENT

WATER QUALITY REPORT FOR SAMPLE 003894W

TO: W.I.B.- HYDROLOGY
SUITE 1-345 QUEBEC ST
VICTORIA BC V8V 1X5

FOR SITE: 1401492 OBS WELL 260-80 QUESNEL

SAMPLING DATE(S): MAR 25/80 1200 HRS

SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH:73.1
SAMPLED BY: W.I.B. - HYDROLOGY
DATE RECEIVED BY LABORATORY: MAR 27/80

0040101	PH	5.8 REL UNIT	0071701	RES:FILT.105C	2246. MG/L
0110101	SPECIFIC CONDUC	2370. UMHO/CM	1010101	ALKALINITY:PHNL	L 0.5 MG/L
1020101	ALKALINITY:TOT	38.6 MG/L	1041702	CHLORIDE:DISSOL	1.6 MG/L
1061701	FLUORIDE:DISSOL	0.23 MG/L	1070002	HARDNES.T:CACO3	1080.* MG/L
1091703	NITROGN:NO2 NO3	L 0.02 MG/L	1130102	NITROGN:KJELDAH	3. MG/L
1191703	PHOSPHORUS :TOT DISSOLVED	0.004 MG/L	1201702	SILICA:REACTIVE	33.5 MG/L
1211701	SULPHATE:DISSOL	1376.* MG/L	2541802	CALCIUM DISSOLVED	203. MG/L
2570209	IRON TOTAL	20. MG/L	2591801	MAGNESIUM DISSOLVED	140.* MG/L
2600209	MANGANESE TOTAL	3.* MG/L	2641703	POTASSIUM DISSOLVED	12.3 MG/L
2651703	SODIUM DISSOLVED	150. MG/L			

THE APPROXIMATE COST OF THE ABOVE TESTS IS $ 59.80

THERE IS NO CHARGE FOR THE FOLLOWING TESTS

0300101	COMP.DIL.COND.	N UMHO/CM	2570	IRON	E
2600	MANGANESE	E			

SAMPLE NO. 003894W CONTINUED ON NEXT PAGE.

MINISTRY OF THE ENVIRONMENT

WATER QUALITY REPORT FOR SAMPLE 003894W

REMARKS:

FOR ENVIRONMENTAL LABORATORY

FIELD TEST RESULTS

0040102	PH	5.6 REL UNIT	0110102	SPECIFIC CONDUC	2150. UMHO/CM
0130101	TEMP. SAMPLING	42.2 DEG.C			

MEMORANDUM

To: File

Date: March 28, 1980

File: 0183613-B-260

Re: Quesnel (Red Bluff) Observation Well
WR 260-80, Site AA401492

Background Information:

It was recommended in 1977 that the Quesnel area be included in the proposal for expansion of the observation well network (Choy, 1977). An attempt to locate a suitable abandoned drilled well in the Quesnel area was made in June 1978, but proved unsuccessful. The Red Bluff area, southwest of Quesnel was chosen as a high priority area for establishment of a monitor well, because of the high density of water wells throughout this area. People in this area rely entirely on the groundwater resource for their domestic water supplies.

The purpose of this well was to monitor water level fluctuation and effects of groundwater extraction in the Red Bluff area and determine if groundwater mining may be taking over the long term. Water wells are consistantly being deepened within the Red Bluff area because of the declining water table. The deeper aquifer is more reliable and will be used more frequently as the growth of Red Bluff continues.

On February 28, 1980, Contract No. 69, drilling and construction of an observation well at Quesnel was awarded to Industrial Drillers Ltd. of Prince George. Drilling was begun on March 18, 1980 and completed on March 19, 1980 using an air rotary drill rig. The well is completed in coarse sand and gravel and screened between 236 feet and 245 feet using 8 feet of .020" slot screen (note attached drill log).

Well Location:

The well is located on the road allowance at the corner of Maple Drive and Borregard Road approximately 1 mile west of Highway 97 in Red Bluff (note: attached photographs). This drilling site was allocated to our Section by the Ministry of Transportation and Highways in Quesnel. The application for permission to construct Works within Corwn Lands has been completed and is attached to this memorandum. Mr. Tracy Cooper, Engineering Assistant, Ministry of Transportation and Highways in Quesnel assisted our staff in locating a suitable drilling site. As stipulated in the application form, water levels will be monitored for a minimum of 5 years.

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The legal location is:

Cariboo Land District, Plan 6678
Coordinates Z12-X11-Y1 #46
Well Location Map Sheet 4
N.T.S. - 93 B-16

Well Drilling Specifications:

Depth	-	247' (from top of casing)
Diameter	-	6"
Aquifer	-	coarse sand and gravel
Screen Location	-	236' - 245'
Well Yield*	-	125 Igpm
Well Drilling	-	Industrial Drillers Ltd. - Prince George
Static Water Level	-	217.21 (from recorder stand pointer)
Drilling Method	-	air rotary
Drilling Time	-	approximately 9 hours March 18 - March 19
Drilling Cost	-	$6,872.50

* The well was pumped at a rate of 26.6 Igpm for a period of 5.3 hours (320 minutes) resulting in approximately 3 feet of drawdown. The water level stabilized after less than ½ hour of pumping at this rate. Using these figures, a specific capacity of 8.8 Igpm/ft. of drawdown can be calculated. (Considering 70 percent of the available drawdown is utilized during pumping, the well could theoretically by pumped at around 125 Igpm). If a properly designed screen were installed in this aquifer, the specific capacity and subsequent yield may be considerably greater. The well was intended for water level monitoring only, however, and the screen installed was adequate for this purpose.

Equipment on Site:

Metric Recorder - RG-48 (1:2 Gears metric)
Weight Drive Clock - CG-21
Steel Recorder Housing - 18" X 24" X 24"
6" diameter threaded ripple welded to casing
Weight Drive Pipe
1 - 18 lb. Clock Weight
26 oz. of Counterweight
1 - 5" diameter float
1 - 15 metre graduated tape
195 ft. of fishing line (special rubber coated fly fishing line)
1 recorder stand W/GE pulley
1 bottle of ink
5 year supply of metric recorder charts (F-4) stamped "on" and "off"
2 cable clips
1 master lock and 2 keys (#3753)

The recorder installation was painted dark green upon completion. Reference to ground level has been shown with an arrow on the well casing.

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Observer Name and Particulars:

Ted Melanson (teacher)
774 Pine Road
Quesnel, B.C.
V2J 3S5
Phone - Home 747-1484

Observer Instructions:

Mr. Melanson has agreed to change the hydrograph monthly at no charge (at the end of each month). The necessary forms and charts have been left with him along with verbal and written instructions on how to change the hydrograph and accurately read the metric tape. Mr. Melanson is a Junior High school teacher and is very familiar with the metric system. He appears very interested in the groundwater resource of Red Bluff and should prove to be an excellent observer.

Ground Level Datum:

Casing stick-up from tape pointer to ground level (note: arrow on casing in photograph showing ground level reference) - 1.55 metres (5.1 feet).

Distance to water level from tape pointer = 66.20 metres (217.21 feet).

Tape reading = 4.600 metres.

Correction factor to be applied to tape reading is therefore + 60.05 metres.

Deep Water Level Monitoring Problems:

A static water level of over 60 metres (200 feet) may be difficult to monitor accurately. Several sources of error can contribute to inaccuracy in the record. With a depth to water of over 200 feet float lag and line shift may contribute to inaccuracy. A deep well float may have to be installed in place of the regular float. Water level records of this well should be studied closely for error and alterations made if necessary.

W. S. Hodge

W.S. Hodge
Technician
Groundwater Section
Hydrology Division
Water Investigations Branch

WSH/hw

Attachs.