File: 92 B/14

Aug. 8, 1980

DRILLING, CONSTRUCTION AND TESTING OF OBSERVATION WELL WR 258-80 CONTRACT NO. 67 GALIANO ISLAND, B.C.

INTRODUCTION

The following is a report on the drilling, construction and aquifer testing of Observation Well WR 258-80, located on a road right-of-way at the intersection of Winstanley and Shopland Road, Southern Galiano Island, (Figures 1, 2). This well was drilled as part of the 1979-80 Observation Well Network expansion program (see file 92 B/14 [71], Feb. 7, 1980). The drilling and testing program began on March 17, 1980 and was completed on March 20, 1980 at a total cost of $3,186.00 less supervisory costs. The purpose of the well is to monitor the long-term water level fluctuations in an area where increasing development is occurring; to provide information on the amount of recharge to the aquifer, and the effects of groundwater withdrawal upon the aquifer.

WELL DRILLING

Ken's Drilling was retained by the Groundwater Section to carry out the drilling, construction, and testing of the observation well. The well was drilled by the air rotary method. A 20-foot length of 6-inch diameter surface casing was first installed, followed by drilling uncased in bedrock, to a depth of 300 feet. The lithologic log, driller's log of the well and final well completion are shown in Appendix A. Samples of the rock cuttings were taken every ten feet.

Five major water-bearing fractures were encountered: the first one at 50 feet (yield of 3 gpm), the second one at 150 feet (yield of 20 gpm), the third at 190 feet (slight increase in yield), the fourth at 195 feet (no increase in yield) and the fifth at 265 feet (no increase in yield). At the completion of well drilling, the water level in the well was measured and found to be approximately 25 feet below ground level.

WELL COMPLETION

Construction details of the well are shown in Appendix A. A 20-foot length of 6-inch diameter surface casing was set to a depth of 19 feet below ground, and a 1 foot stick-up. The remainder of the well is uncased to a depth of 300 feet below ground. A short duration flow

test was carried out during drilling, which indicated a yield of approximately 20 Igpm. At the completion of drilling, water in the well was flushed out with compressed air, until it appeared clear. A sanitary cement seal was completed around the surface casing to a depth of approximately 1.5 feet below ground level.

PUMPING TEST

An 8-hour constant rate pumping test at an average rate of 18 USgpm was conducted on March 18, 1980, using a submersible pump, set at an intake depth of 190 feet from ground level. One hundred feet of one inch diameter discharge hose was utilized to convey the pumped water away from the well. The pumping rate was measured with a flow meter and checked with a five-gallon drum and a stopwatch. Drawdown and recovery data is tabulated in Appendix B, and the results are graphically illustrated in Figure 3 and 4. The data was analyzed by the Cooper and Jacob (1946) straight line method.

PUMP TEST ANALYSIS

Figure 3 shows the time-drawdown relationship for the 8-hour pumping test. From this relationship the average "apparent" transmissivity of the fractured bedrock was calculated to be 147 USgpd per foot. This value compared favourably with the calculated average value from the Residual-Drawdown vs. t/t' ratio graph (Figure 4) of 159 USgpd per foot. From these two figures, the overall average "apparent" transmissivity of the water-bearing fractured bedrock zone is 153 USgpd per foot. Figure 3 also shows a slight decrease of the slope of the graph at approximately 65 minutes after the start of pumping. This decrease suggests that a more fractured bedrock zone had been encountered during pumping. Using an average pumping rate of 18 USgpm and a drawdown of approximately 71 ft. after 480 minutes of pumping, the Specific Capacity of the well was calculated to be 0.25 USgpm/ft. of drawdown. Utilizing 70% of the available drawdown of approximately 265 feet, the estimated theoretical safe well yield for short term pumping is approximately 46 USgpm. Performance of the well at pumping rates greater than 18 USgpm would also be expected to be less (i.e., the specific capacity would be expected to decrease with increased pumping rates).

HYDROCHEMISTRY

During the pumping test, a sample of the water was tested for quality using a Hach Test Kit. The results of the analysis is as follows:

Iron, Fe	- 0.4 mg/L	Specific Conductance	- 305 µmho/cm.
Chloride	- 15 mg/L	Temperature	- 10°C
Hardness, $CaCO_3$	- 68 mg/L	pH	- 8.0

The well was sampled for laboratory analysis on April 11, 1980 several weeks after the completion of the pumping test. The results of the laboratory analyses are found in Appendix C.

Marc Zubel.

Marc Zubel
Geological Engineer
Groundwater
Hydrology Section
Inventory & Engineering Branch

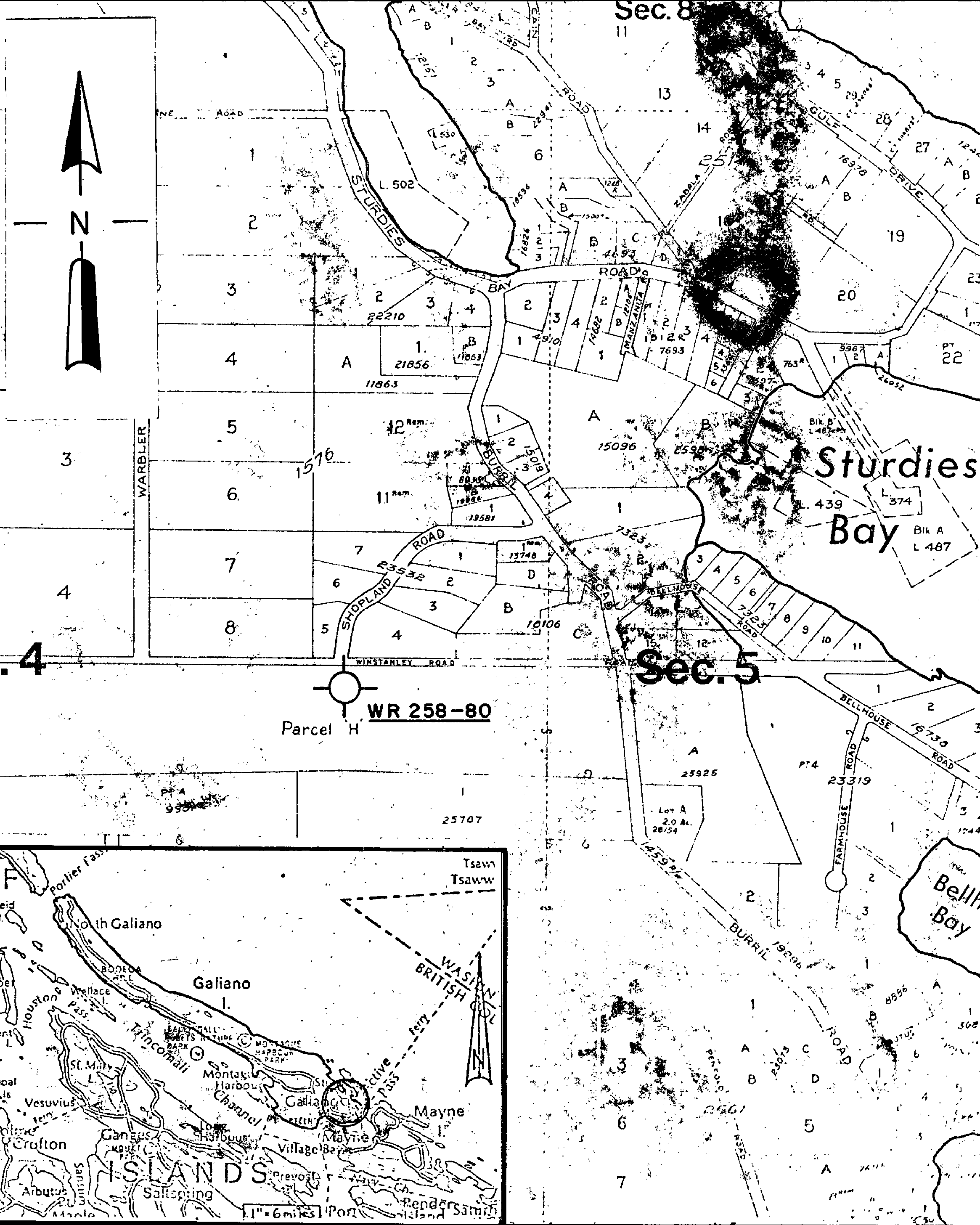
References:

Cooper, H.H. Jr. and Jacob, C.E. 1946. A generalized Graphical Method of Evaluating Formation Constants and Summarizing Well Field History. Trans. Am. Geophys, Union, Vol. 27 (4), August.

MZ/jm

Attachs.

LIST OF FIGURES



Sec. 8
N
STURDIES BAY ROAD
L. 502
ZABALA ROAD
GULF DRIVE
MANZANITA
WARBLER
BURRIL ROAD
SHOPLAND ROAD
BELLHOUSE ROAD
WINSTANLEY ROAD
FARMHOUSE ROAD
Sturdies Bay
L. 439
L 374
Blk A L 487
Sec. 5
WR 258-80
Parcel H
Bellhouse Bay
North Galiano
Galiano I.
Porlier Pass
Houston Pass
Wallace I.
Trincomali Channel
Montague Harbour
Galiano
Active Pass
Mayne I.
Mayne
Village Bay
Vesuvius
Crofton
Ganges
Long Harbour
ISLANDS
Saltspring
Prevost
Arbutus
Tsawwassen
WASHINGTON
BRITISH COLUMBIA
Ferry
1" = 6 miles
Port
Pender Island

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

TO ACCOMPANY REPORT ON
GALIANO ISLAND
OBSERVATION WELL WR 258–80
CONTRACT 67

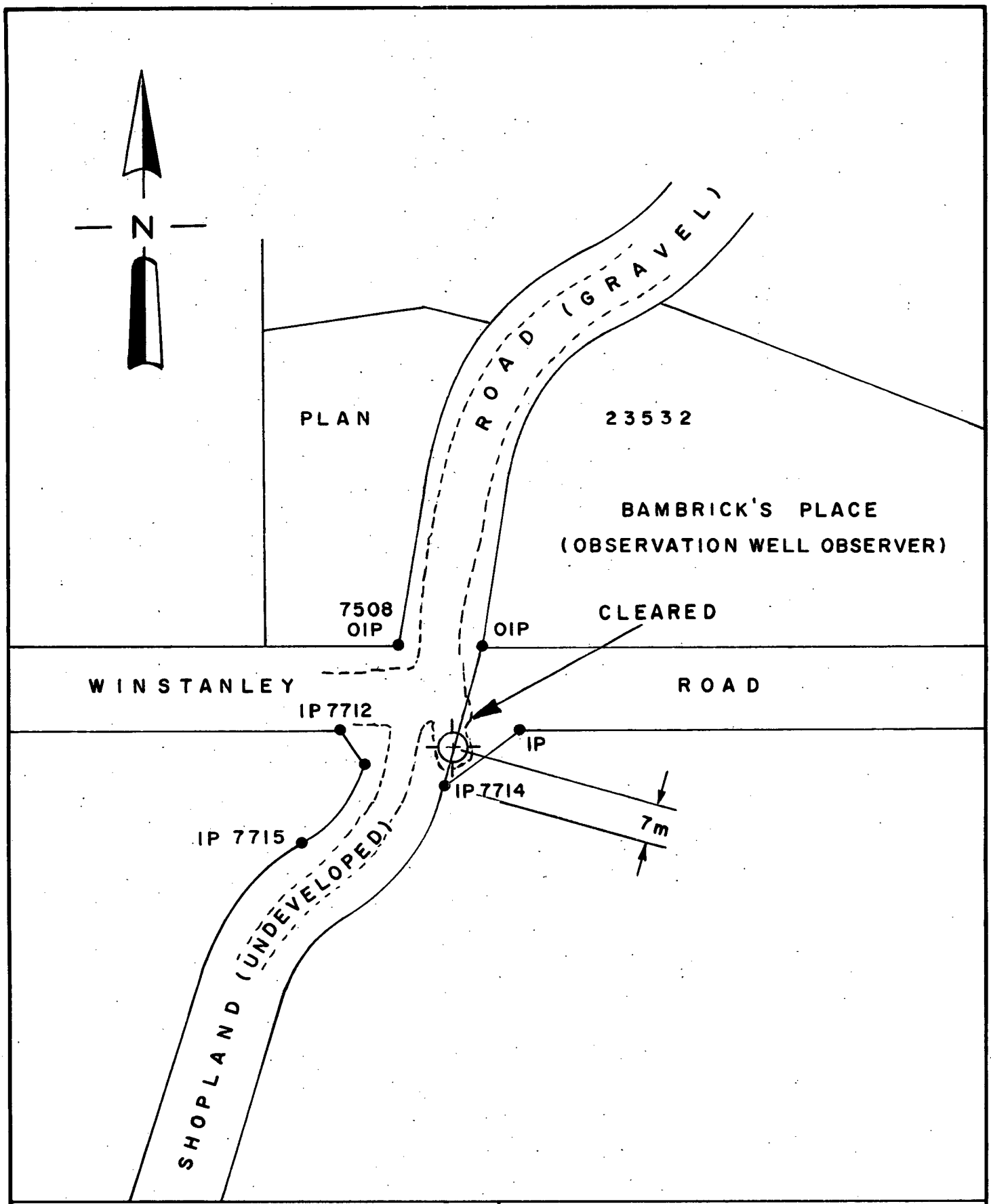
SCALE: 1.5"= 1,000'
1 cm = 80 m

DATE
MAY 1980

M. ZUBEL ENGINEER

FILE No. 92 B/14 DWG. No. FIGURE 1

bcil 6660 wrs



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TO ACCOMPANY REPORT ON
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CONTRACT 67

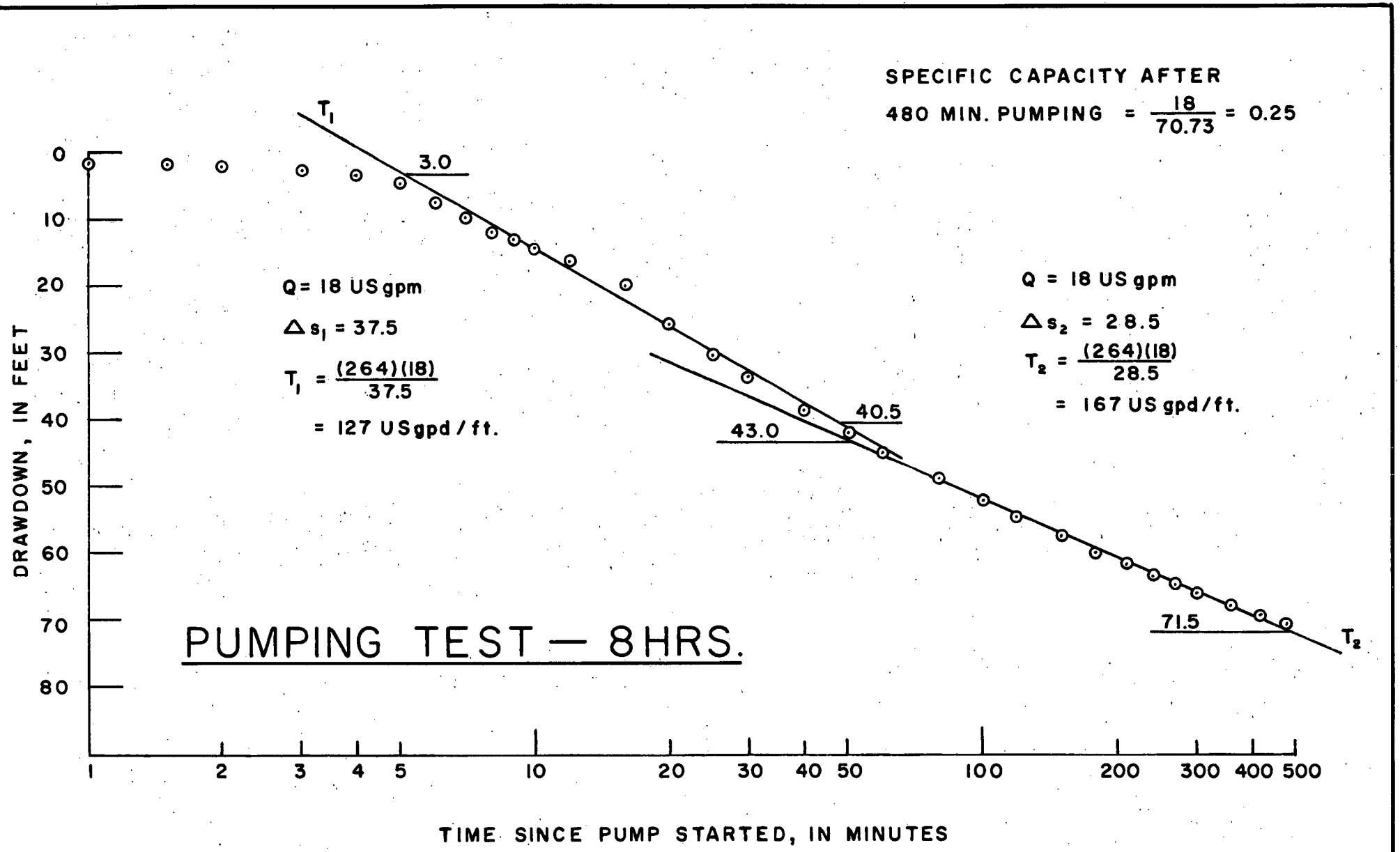
SCALE: 1 : 1250

DATE: MAY 1980

M. ZUBEL ENGINEER

FILE No. 92 B/14 DWG. No. FIGURE 2

bcil 6660 wrs



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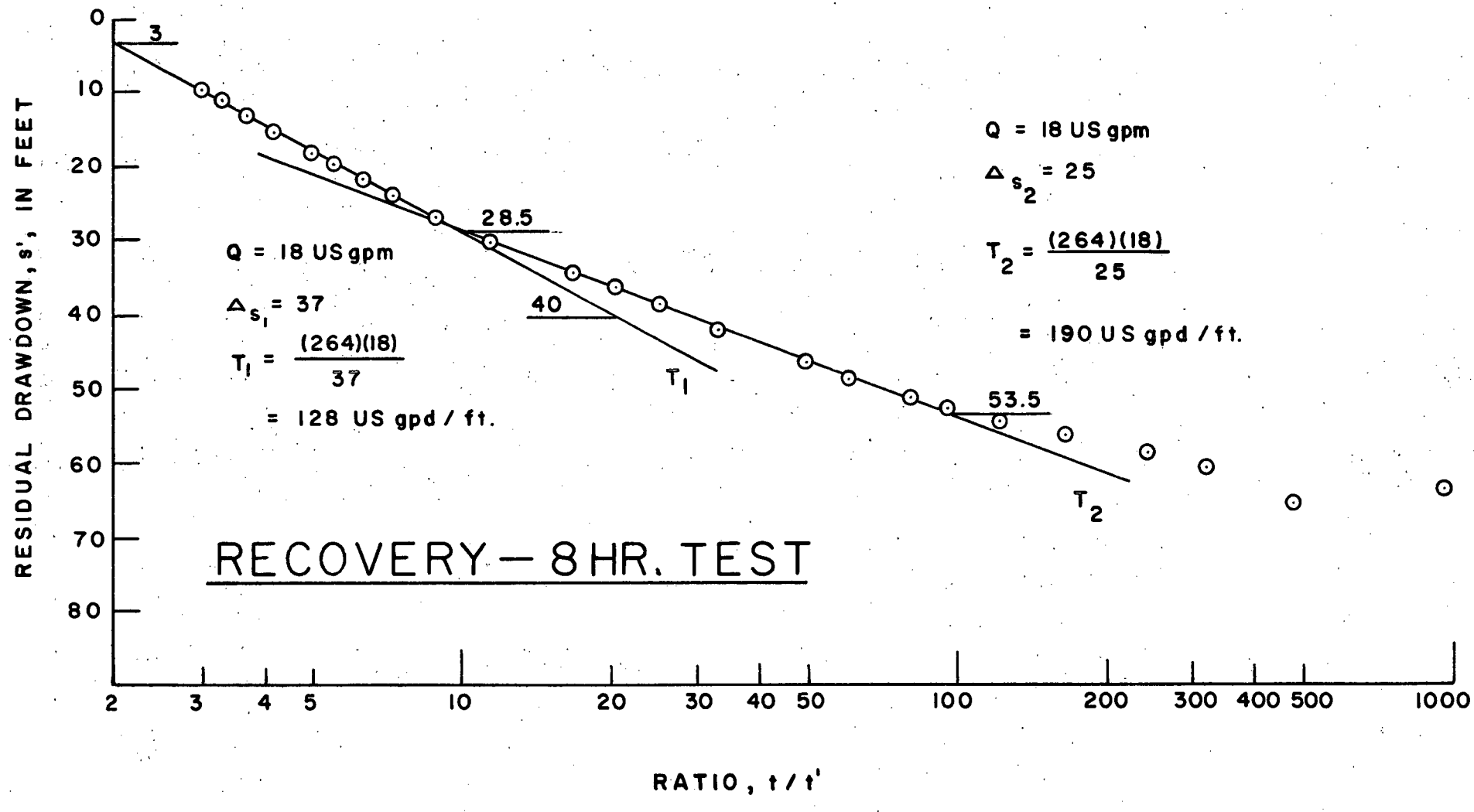
SCALE: VERT. 1" = 20'
HOR. LOG SCALE

DATE
MAY 1980

M. ZUBEL ENGINEER

FILE No. 92 B/14 DWG. No. FIGURE 3

bcil 6661 wrs



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CONTRACT 67

SCALE: VERT. 1" = 20'
HOR. LOG SCALE

DATE
MAY 1980

M. ZUBEL ENGINEER

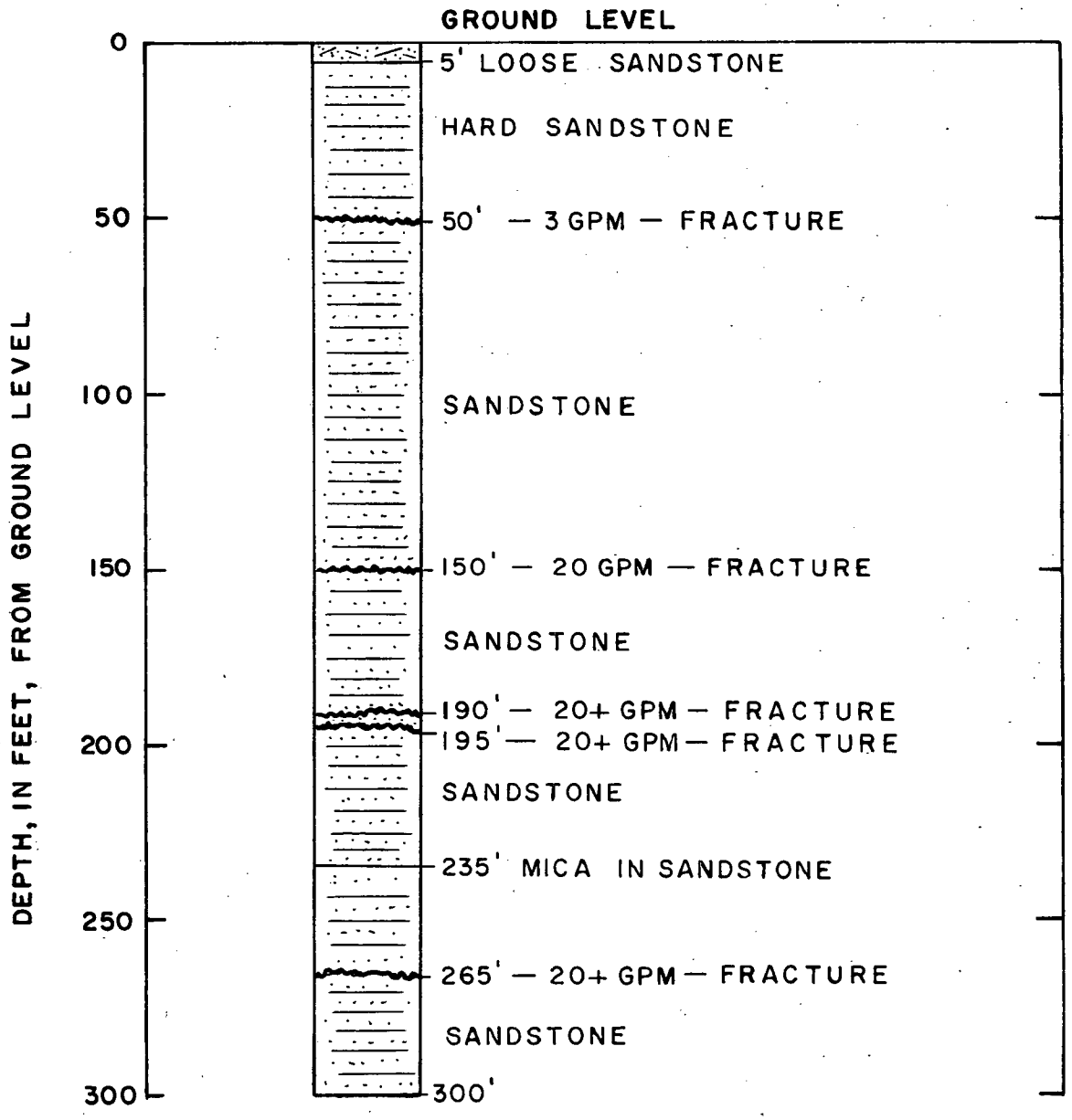
FILE No. 92 B/14 DWG. No. FIGURE 4

bcil 6661 wrs

APPENDIX A

1. Lithological Log
2. Driller's Log
3. Construction Detail

LITHOLOGICAL LOG



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CONTRACT 67

SCALE: VERT. 1 "= 50'
HOR. N/A

DATE
MAY 1980

M. ZUBEL ENGINEER

FILE No. 92 B/14 DWG. No. APPENDIX A

bcil 6660 wrs

Ken's Drilling Ltd.
P.O. BOX 487
BRENTWOOD BAY, B.C.
V0S 1A0
TELEPHONE 652-4406

WELL LOG

OWNER B.C. GOV'T. MINISTRY OF ENVIRN.
ADDRESS PARLIAMENT BUILDINGS. / 780 BLANCHARD.

INVOICE

20' FEET CASING @ $ _____
300 FEET WELL HOLE @ $ _____

_____

TOTAL $ _____

DATE BEGUN MARCH 17/80.
DATE COMPLETED MARCH 18/80
APPROX. YIELD 20+ GALLONS PER MINUTE
PUMPING WATER LEVEL 190 FEET FROM SURFACE
CASING USED 20'
BOTTOM OF CASING 19' FEET FROM SURFACE
STICK-UP ABOVE GROUND 1' FEET

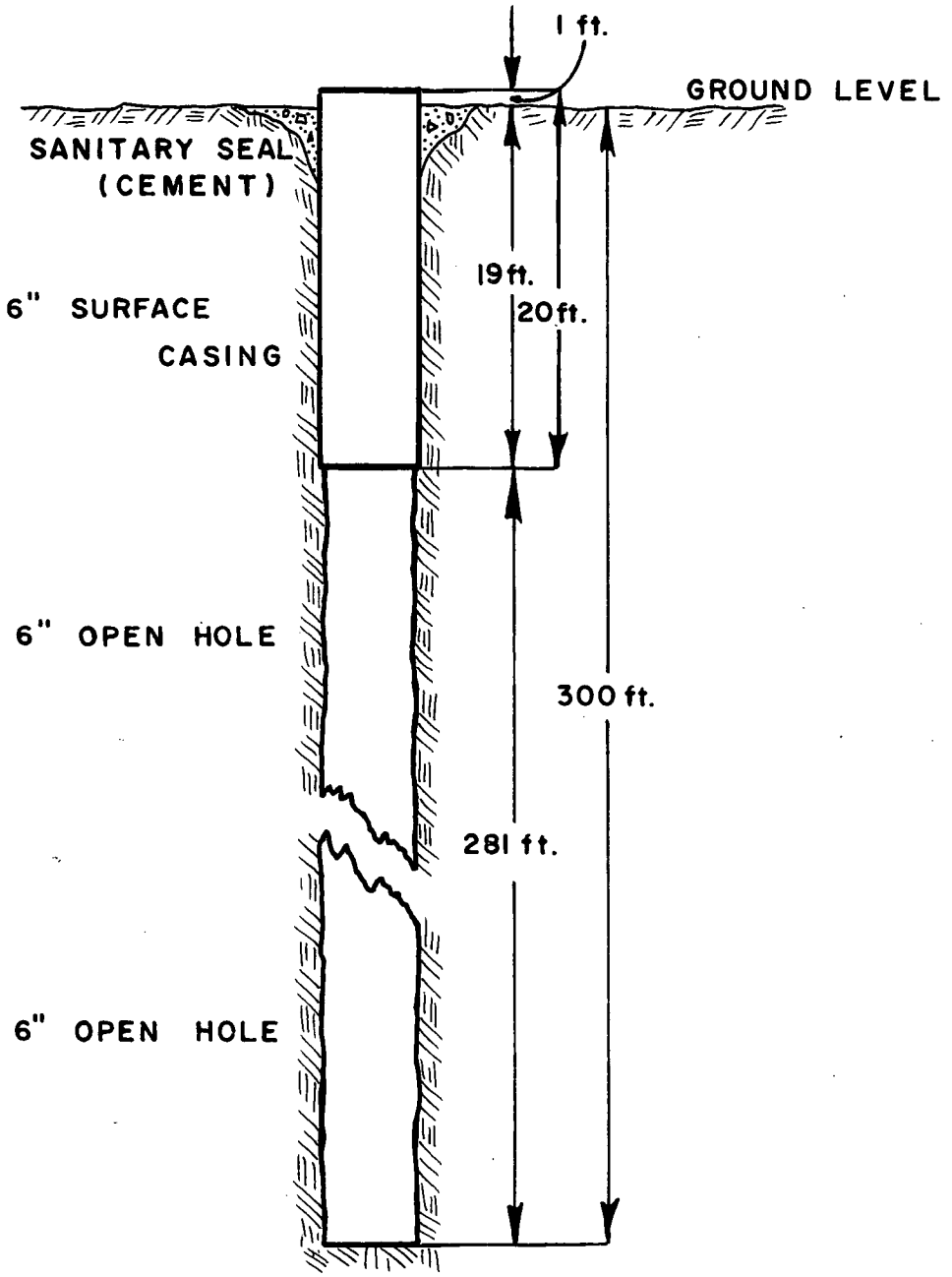
DRILLER: Ken Patterson.

DEPTH	MATERIAL
0'	SANDSTONE LOOSE'
5'	GOOD HARD SANDSTONE
	CASING SET @ (20') 19'
25'	SANDSTONE
50'	NO CHANGE FRACT. - 36 GPM
75'	NO CHANGE
100	NO CHANGE.
125'	" "
150'	FRACT - 20 GPM.
175'	NO CHANGE
190	FRACT. SLIGHT INCREASE
195	FRACT - NO CHANGE IN FLOW. SMALL SCALE PATCH.
200	NO CHANGE
225	NO CHANGE
235	MICA - IN THE SANDSTONE.
250	NO CHANGE.
265	FRACT. NO CHANGE
275	NO CHANGE
300'	NO CHANGE
	T.D. @ 300'
	YIELD 20+ GPM

APPENDIX A

WR 258-80

CONSTRUCTION DETAIL



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

TO ACCOMPANY REPORT ON
GALIANO ISLAND
OBSERVATION WELL WR 258-80
CONTRACT 67

SCALE: VERT. AS SHOWN
HOR. N/A

DATE
MAY 1980

M. ZUBEL ENGINEER

FILE No. 92B/14 DWG. No. APPENDIX A

bcil 6660 wrs

APPENDIX B

1 Drawdown Data

2 Recovery Data

APPENDIX B

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 258

GALIANO ISLAND Date MARCH 18, 1980

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 7.96m) 26.12'	Depth to water in well from top of casing in metres	U.S.gals. per min. discharge from well	NOTE: TOP OF CASING 0.5 m (1.64 ft.) ABOVE GROUND LEVEL
1:00 PM	0	26.12	0	7.96	20	U.S.
	1/2	26.90	0.78	8.20		
	1	27.36	1.24	8.34		
	1 1/2	27.66	1.54	8.43		
	2	27.95	1.83	8.52		
	3	28.61	2.49	8.72		
	4	29.10	2.98	8.87		
	5	30.58	4.46	9.32		
	6	33.63	7.51	10.25		
	7	35.66	9.54	10.87		
	8	37.60	11.48	11.46		
	9	39.07	12.95	11.91		
1:10	10	40.22	14.10	12.26		
	12	42.22	16.10	12.87		
	16	45.93	19.81	14.00		
1:20	20	51.48	25.36	15.69		
	25	56.30	30.18	17.10		ADJUST RATE SLIGHTLY
1:30	30	59.58	33.46	18.16		
	40	64.57	38.45	19.68		
	50	68.11	41.99	20.76		
2:00	60	71.13	45.01	21.68		
	80	74.97	48.85	22.85	≈18	ADJUST RATE —
	100	78.18	52.06	23.83		VALVE OPEN ALL
3:00	120	80.77	54.65	24.62	≈18	THE WAY: < 20 G.P.M.
	150	83.66	57.54	25.50		HACH KIT TESTS:
4:00	180	86.02	59.90	26.22		10° C
	210	88.06	61.94	26.84		305 COND.
5:00	240	89.57	63.45	27.30		25 Na Cl
	270	91.01	64.89	27.74		Fe 0.4
6:00	300	92.29	66.17	28.13		PH 8.0
7:00	360	94.03	67.91	28.66		HARDNESS 4
8:00	420	95.41	69.29	29.08		
9:00	480	96.85	70.73	29.52		

APPENDIX B

RECOVERY READINGS IN WELL NO. 258 AFTER "CONSTANT RATE" PUMPING TEST

GALIANO ISLAND Date MARCH 18/80

Time	Time (t) since start of pumping in mins.	Time (t') since Pumping stopped in mins.	Value of t / t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static = 7.96 ~~m~~) 26.12'	Depth to water in well from top of casing in metres
9:00 P.M.	480	0		96.85	70.73	29.52
	480½	½	961	90.03	63.91	27.44
	481	1	481	91.40	65.28	27.86
	481½	1½	321	86.48	60.36	26.36
	482	2	241	85.10	58.98	25.94
	483	3	161	82.78	56.66	25.23
	484	4	121	80.84	54.72	24.64
	485	5	97	79.13	53.01	24.12
	486	6	81	77.95	51.83	23.76
	488	8	61	75.07	48.95	22.88
	490	10	49	72.93	46.81	22.23
	495	15	33	68.67	42.55	20.93
	500	20	25	65.19	39.07	19.87
	505	25	20.2	62.80	36.68	19.14
	510	30	17.0	60.96	34.84	18.58
	525	45	11.7	56.17	30.05	17.12
10:00 P.M.	540	60	9.0	52.85	26.73	16.11
	555	75	7.4	50.13	24.01	15.28
	570	90	6.3	47.97	21.85	14.62
	585	105	5.6	46.13	20.01	14.06
11:00 P.M.	600	120	5.0	44.46	18.34	13.55
	630	150	4.2	41.57	15.45	12.67
12:00 P.M.	660	180	3.7	39.37	13.25	12.00
	690	210	3.3	37.40	11.28	11.40
1:00 A.M.	720	240	3.0	35.70	9.58	10.88
	750	270	2.8	—	—	—
2:00 A.M.	780	300	2.6	—	—	—
8:00 A.M.	1140	660	1.7	28.44	2.32	8.67

APPENDIX C

1 Water Quality Analysis

WATER QUALITY REPORT FOR SAMPLE 004181W

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

FOR SITE: 1401490 GALIANO ISLAND 300 FEET

SAMPLING DATE(S): APR 1/80 1300 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH:91.4
SAMPLED BY: W.I.B. - HYDROLOGY
DATE RECEIVED BY LABORATORY: APR 03/80

0040101	PH	6.5 REL UNIT	0071701	RES:FILT.105C	108. MG/L
0110101	SPECIFIC CONDUC	119. UMHO/CM	0300101	COMP.DIL.COND.	124. UMHO/CM
1010101	ALKALINITY:PHNL	L 0.5 MG/L	1020101	ALKALINITY:TOT	39.6 MG/L
1041702	CHLORIDE:DISSOL	8.0 MG/L	1061701	FLUORIDE:DISSOL	L 0.10 MG/L
1070002	HARDNES.T:CACO3	41.6 MG/L	1081703	NITROGN:AMMONIA	0.024 MG/L
1091703	NITROGN:NO2 NO3	0.14 MG/L	1120003	NITROGN:ORGANIC	0.13 MG/L
1130101	NITROGN:KJELDAH	0.15 MG/L	1191703	PHOSPHORUS :TOT DISSOLVED	0.007 MG/L
1201702	SILICA:REACTIVE	20.0 MG/L	1211701	SULPHATE:DISSOL	5.6 MG/L
2541802	CALCIUM DISSOLVED	11.4 MG/L	2570309	IRON TOTAL	0.2 MG/L
2591801	MAGNESIUM DISSOLVED	3.2 MG/L	2600309	MANGANESE TOTAL	L 0.02 MG/L
2641703	POTASSIUM DISSOLVED	0.4 MG/L	2651703	SODIUM DISSOLVED	8.4 MG/L

THE APPROXIMATE COST OF THE ABOVE TESTS IS $ 62.30

THERE IS NO CHARGE FOR THE FOLLOWING TESTS

257D	IRON	E	260D	MANGANESE	E

SAMPLE NO. 004181W CONTINUED ON NEXT PAGE.

WATER QUALITY REPORT FOR SAMPLE 004181W

REMARKS:

FOR ENVIRONMENTAL LABORATORY

1. Observation Well WR 258-60
Galiano Island (south)
Site location

2. Observation Well WR 258-60
Galiano Island (south)
Ken's Drilling setting up

3. Observation Well WR 258-60
Galiano Island (south)
Drilling in progress

4. Observation Well WR 258-60
Galiano Island (south)
Sandstone cuttings and slight flow
from water-bearing fractures.

5. Observation Well WR 258-60
Galiano Island (south)
Pumpint test equipment set-up.

6. Observation Well WR 258-60
Galiano Island (south)
Pumping test flow meter and water level indicator