

926-6-65

PRODUCTION WELL COMPLETION REPORT

DL1605, BOWEN ISLAND

FOR

THOMPSON BERWICK PRATT & PARTNERS

BY

H. W. REED, P.ENG.

OCTOBER 7, 1980

80-183

## INTRODUCTION

The subject well was drilled during August 1980 and is located on the north end of Bowen Island adjacent to the east boundary of Lot 1605 on Smugglers Cove. An extended pumping test was run following construction to evaluate the productive capacity of the well at 5 lgpm.

## WELL CONSTRUCTION

The drilling site was chosen to intercept bedrock fractures which were located by an examination of air photos, geological reports and a site reconnaissance.

Drilling was carried out by an air rotary drilling rig. An eight inch diameter hole was drilled and cased into bedrock to a depth of 14 feet and a six inch diameter casing was telescoped inside and drilled to a depth of 20 feet to provide a surface seal. Below the casings a six inch diameter hole was drilled in bedrock to a total depth of 300 feet.

The completed hole was developed (cleaned) for 9 hours by surging and blowing using air lift from the drilling rig. The well produced at a rate of 30 gallons per minute during this operation.

The driller's interpretation of the bedrock lithology is shown on the attached log. Water-bearing fractures were noted between depths of 75 and 242 feet.

## AQUIFER TESTING

A test pump was installed in the well on August 27 and the discharge rate initially set at 39 lgpm. This rate was reduced by increments in an attempt to stabilize the pumping level near the maximum available drawdown level. The production was cut to 8.3 lgpm by this procedure and the level was nearing pump suction at 270 feet after 3500 minutes of the test. Because the discharge rate could not be controlled accurately with the pump used, the test was interrupted and a smaller pump was substituted. Testing resumed at a rate of 7.3 lgpm. After 3500 minutes the pumping level was again nearing pump suction and the rate was reduced to 5.3 lgpm for the final 2500 minutes of the test. The level recovered over this final step to a depth of 125 feet where stabilization almost took place.

Total pumping time was 9350 minutes (6.5 days) over the two intervals of testing. Pumping level reaction time to the last two rate changes was very slow so that complete stabilization would have required many more days of continuous discharge.

## AQUIFER PARAMETERS

### 1. Transmissivity

The attached drawdown plot was used to calculate the transmissivity of the aquifer for a discharge rate of 7.3 l gpm. Allowing for uncontrollable minor rate fluctuations, this transmissivity value was 58.3 Imperial gallons per day per foot width of aquifer.

### 2. Storativity

Observation well drawdown data needed for calculation of storativity is not available for the subject well but experience with similar wells on Bowen Island and elsewhere indicates that a value of  $1 \times 10^{-4}$  (dimensionless) is reasonable.

### 3. Specific Capacity

Experience dictates that a specific capacity of 0.029 l gpm/ft is a conservative estimate which is compatible with the transmissivity of 58.3 l gpd/foot.

### AQUIFER YIELD

The water-bearing fractures in a bedrock well will produce up to a maximum amount when the artesian head is lowered to the level of those fractures. Pumping in excess of that amount will cause an increased rate of lowering of the pumping level that may be noted at 2500 minutes on the drawdown plot. The aquifer test data shows that fractures in the subject well below the 220 foot depth do not produce a significant additional increase in well capacity. The maximum available drawdown is therefore governed by this effective boundary.

The well yield is calculated using the aquifer parameters above as follows:

Pumping level	220 feet
Static water level	<u>16 feet</u>
Maximum Available Drawdown	<u>204 feet</u>

$$\begin{aligned}\text{Well Yield} &= 0.035 \text{ USgpm per foot} \times 204 \text{ feet} \\ &= 7.14 \text{ USgpm or } 5.95 \text{ l gpm}\end{aligned}$$

Based upon our experience with fractured bedrock wells on Bowen Island we do not expect seasonal water table fluctuations to have a significant effect on this well. However, since the well did not stabilize after extended pumping it is prudent to include a safety factor in the final rating. We therefore conclude that

AQUIFER YIELD continued ...

the subject well is capable of a sustained yield of 5.0 l gpm which allows a safety factor of 16% over the calculated well yield of 5.95 l gpm.

Using a transmissivity of 58.3 l gpd/foot, a storativity of  $1 \times 10^{-4}$ , a continuous discharge of 5 l gpm and a period of drought or no recharge of 100 days it can be calculated that the water level in the well will drop to between 205 and 210 feet below ground surface. This is 10 to 15 feet above the 220 foot level in the well where the lowest effective fractures are apparently present. These stringent conditions of no recharge for 100 days on the north coast of Bowen Island and of continuous discharge for 100 days show that the rating of the well at 5 l gpm should be conservative.

The well head is 150 feet above sea level and the well is located an estimated 500 feet from the sea coast so that salt water encroachment will not take place with a pumping level at a depth of 210 feet below ground surface. The cone of influence, during pumping, around this well is steep and rises above the 150 foot depth to sea level within five feet of the well.

#### CHEMICAL QUALITY

Water samples were collected at the end of the pumping test and were submitted to a commercial laboratory for inorganic chemical and coliform testing. The results of these analyses are attached. These show that the water meets the Canadian Drinking Water Standards for the parameters tested.

#### FURTHER DRILLING

The air photos have been examined to select an area for a second well on the property which may be needed for later stages of the project. Some promising bedrock fracture traces were noted approximately 1800 feet to the west of the subject well at a proposed drill site shown on the attached sketch. A field examination of the area will be required to determine the best relationship of a new well with respect to the fracture traces. Present access to the area is poor and some road work will be necessary.

### CONCLUSIONS AND RECOMMENDATIONS

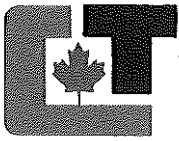
1. Based upon the results of the 6.5 day pump test we conclude that the subject well should be capable of a sustained yield of 5 lqpm.
  
2. A submersible pump is recommended for permanent installation in the well and should be set at a depth of 280 feet to take advantage of maximum available drawdown. The pump should be capable of delivering 8.3 lqpm against a head of at least 220 feet plus the system pressure at ground surface.
  
3. Water level and production records should be kept when the well is put into service. A 3/4 inch plastic pipe installed in the well with the permanent pump will permit water levels to be monitored with a sounding probe. If good records are kept it may be possible to reassess the rating of this well after a period of constant demand with a view to reducing the safety factor.



DRILLER'S WELL LOG

DL1605  
BOWEN ISLAND  
80-183

<u>Depth, Feet</u>	<u>Description</u>
0- 6	Brown sandy soil and boulders
6- 35	Black shale
35- 44	Green granite
44- 48	Black shale
48- 55	Green granite
55- 75	Black shale
75- 82	Fractured shale, water-bearing
82-105	Black shale with quartz veins, water-bearing
105-145	Fractured green granite, water-bearing
145-160	Granite
160-205	Fractured black shale with quartz veins, water-bearing
205-242	Hard fractured gray shale, water-bearing
242-285	Fractured green granite
285-300	Hard fractured black shale with quartz veins



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**REPORTED TO** BROWN, ERDMAN & ASSOCIATES LTD.  
1409 BEWICKE AVENUE  
NORTH VANCOUVER, B.C.

**W/O NO.** W-800905-004  
**DATE** OCTOBER 1, 1980  
**P.O.**

**FILE NO:** 7757D

**ATTENTION** MR. BILL BROWN, MR. DICK ERDMAN  
**SAMPLE TYPE** WATER  
**PREPARATION** FILTERED 0.45 MICRONS

We have reported the sample of water submitted by you on September 5, 1980 and report as follows:

SAMPLE IDENTIFICATION:

The samples were submitted in plastic bottles, one pre-sterilized container labelled:

BOWEN ISLAND  
MORSE PROPERTY  
SEPT. 4/80  
TEMP. 9.5°C  
TOTAL TIME PUMPING 6000 MIN.

METHOD OF TESTING:

The analyses were carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater (14th Edition)" published by the American Public Health Association, 1975.

RESULTS OF TESTING:

(on the following page)

CAN TEST LTD.

Judi M. Mitchell, B.Sc.,  
Chemist

/cs

SAMPLE #  
CLIENT SAMPLE I.D.

1  
MORSE PROP.

**PHYSICAL TESTS**

pH		8.45
Conductivity (micromhos/cm)		207.
Colour [Pt-Co scale] (CU)		< 5.
Turbidity (JTU)		1.0
Hardness (mg/L)		57.0

**SOLIDS (mg/L)**

Total Suspended		< 0.5
Total Dissolved		196.

**DISSOLVED ANIONS (mg/L)**

Alkalinity: Bicarbonate	HCO <sub>3</sub>	86.5
Alkalinity: Carbonate	CO <sub>3</sub>	2.40
Alkalinity: Hydroxide	OH	Nil
Chlorides	Cl	5.24
Sulfates	SO <sub>4</sub>	17.5
Nitrates and Nitrites	N	0.46
Ortho Phosphates	o-PO <sub>4</sub>	0.10
Fluorides	F	1.00
Silica	SiO <sub>2</sub>	35.7

**DISSOLVED METALS (mg/L)**

Cadmium	Cd	< 0.001
Calcium	Ca	20.0
Copper	Cu	0.011
Iron	Fe	0.14
Lead	Pb	< 0.001
Magnesium	Mg	1.50
Manganese	Mn	0.030
Potassium	K	0.22
Sodium	Na	25.0
Zinc	Zn	< 0.015

**TOTAL METALS (mg/L)**

Iron	Fe	0.19
Manganese	Mn	0.041

**COLIFORM BACTERIA (MPN/100 ml)**

Presumptive		4.5
Confirmed		< 2.0
Fecal		< 2.0

mg/L - milligrams per liter

MPN - Most Probable Number

REMARKS:

The water represented by the sample submitted can be characterized as moderate with respect to hardness and dissolved mineralization.

For the chemical and bacteriological parameters tested, the sample met the limits set by "Guidelines for Canadian Drinking Water Quality, 1978", published by authority of Health and Welfare, Canada.

WELL OWNER D L 1605

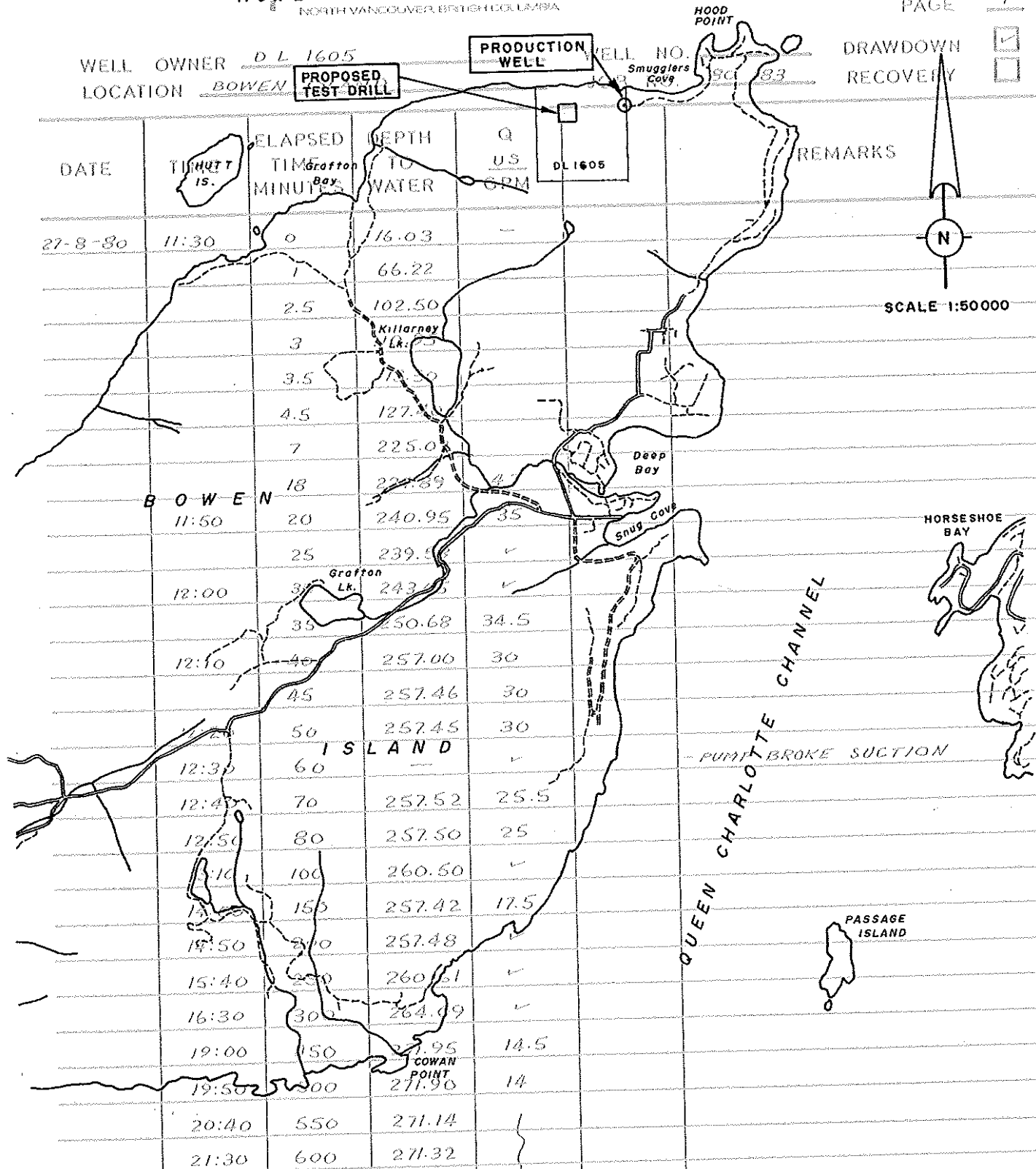
LOCATION BOWEN

**PROPOSED TEST DRILL**

**PRODUCTION WELL**

WELL NO. DL1605

DRAWDOWN   
 RECOVERY



DATE	TIME	ELAPSED TIME TO MINUTE	DEPTH TO WATER	Q US GPM	REMARKS
27-8-80	11:30	0	16.03	-	
		1	66.22		
		2.5	102.50		
		3	115.50		
		3.5	127.50		
		4.5	127.50		
		7	225.00		
		18	227.89	4	
	<b>BOWEN</b>	20	240.95	35	
	11:50	25	239.50	✓	
		30	243.45	✓	
	12:00	35	250.68	34.5	
		40	257.00	30	
	12:10	45	257.46	30	
		50	257.45	30	
		60	257.52	✓	
	12:30	70	257.52	25.5	
	12:40	80	257.50	25	
	13:10	100	260.50	✓	
	13:50	150	257.42	17.5	
	14:50	200	257.48	✓	
	15:40	250	260.51	✓	
	16:30	300	264.09	✓	
	19:00	350	267.95	14.5	
	19:50	400	271.90	14	
		550	271.14		
		600	271.32		
		650	272.50		
		750	272.50	19.5	
28-8-80	00:00	850	272.50	✓	
	01:40	1000	271.57	12.5	
	04:10	1050	271.86	✓	

THOMPSON BERWICK PRATT & PARTNERS

BOWEN ISLAND LOCATION SKETCH

BROWN, ERDMAN & ASSOCIATES LTD.  
 23-9-80 HWR 80-183



DATE	TIME	ELAPSED TIME MINUTES	DEPTH TO WATER	Q GPM	REMARKS
28-8-80	06:40	1150	272.62	12	
	08:20	1250	271.83	11.5	
	09:10	1300	271.88		
	10:00	1350	271.93		
	10:50	1400	271.97		
	11:40	1450	273.03		
	12:30	1500	272.10	11	
	15:15		-		- PUMP AT SUCTION. REDUCED
	15:20	1670	242.10	9	FLOW TO 9 GPM
	15:25	1675	229.58		
	15:30	1680	223.05		
	15:35	1685	216.32		
	16:07	1717	206.60		
	16:16	1726	208.91	10	- INCREASED TO 10 GPM AT 16:15
	16:20	1730	208.32		
	16:25	1735	208.00		
	16:30	1740	207.63		
	16:35	1745	207.59		
	16:40	1750	207.43		
	16:50	1760	206.93		
	16:55	1765	206.66		
	17:00	1770	206.48		
	17:30	1800	205.26		
	18:20	1850	204.20		
	19:10	1900	203.51		
	20:00	1950	202.90		
	21:40	2050	203.01		
	22:30	2100	203.47		
	23:20	2150	203.92		
29-8-80	00:10	2200	204.67		
	01:00	2250	205.79		
	01:50	2300	206.32		
	02:40	2350	207.59		
	03:30	2400	208.87		
	04:20	2450	209.04		





DATE	TIME	ELAPSED TIME MINUTES	DEPTH TO WATER	Q GPM	REMARKS
30-8-80	08:00	0	70.00	—	- PUMPED MAXIMUM FOR 2 HOURS
	10:20	140	238.35	8.8	
	12:00	240	190.60		
	12:50	290	186.08		
	14:30	390	186.95		
	15:20	440	188.59		
	17:00	540	191.25		
	18:40	640	194.05		
	20:20	740	195.85		
	22:00	840	198.20		
	23:40	940	202.16		
31-8-80	01:20	1040	203.91		
	03:00	1140	205.32		
	06:20	1340	207.48		
	08:00	1440	208.57		
	09:40	1540	209.33		
	11:20	1640	207.57		
	13:00	1740	210.91		
	15:30	1890	213.86		
	16:20	1940	215.92		
	18:00	2040	218.58		
	18:50	2090	219.16		
	19:40	2140	219.87		
	20:30	2190	220.25		
	22:10	2290	220.78		
1-9-80	00:40	2440	221.80		
	02:20	2540	223.60		
	04:00	2640	225.48		
	05:40	2740	227.97		
	07:20	2840	229.62		
	08:10	2890	231.32		
	09:00	2940	231.52		
	09:50	2990	231.67		
	10:40	3040	239.49		
	11:30	3090	240.87	8.8	





DATE	TIME	ELAPSED TIME MINUTES	DEPTH TO WATER	Q GPM	REMARKS
1-9-80	13:10	3190	243.66	8.8	
	14:00	3240	243.42	8.8	
	14:50	3290	252.48	8.5	
	15:40	3340	256.82		
	16:30	3390	258.44		
	17:20	3440	261.93		
	18:10	3490	266.45	8.5	
	19:00	3540	268.93	6.	- REDUCED FLOW TO 6 GPM
	20:40	3640	198.03		
	22:20	3740	177.38		
2-9-80	00:00	3840	169.15		
	01:40	3940	163.56		
	03:20	4040	158.79		
	06:40	4240	148.03		
	07:30	4290	145.34		
	08:20	4340	142.84		
	09:10	4390	140.56	6.	
	10:50	4490	136.90		
	12:40	4600	134.30	6.4	
	14:20	4700	132.06		
	16:00	4800	130.69		
	19:20	5000	129.12		
	21:00	5100	128.15		
	22:40	5200	127.17		
3-9-80	00:20	5300	126.86		
	02:00	5400	126.57		
	03:40	5500	126.10		
	05:20	5600	125.85		
	07:00	5700	126.45		
	08:40	5800	125.95		
	10:20	5900	125.00		
	12:00	6000	123.49	6.4	9.5 °C - END PUMPING
		RECOVERY			
	12:05	5	102.92	-	
	12:10	10	101.68	-	

