

6/28/81

GROUNDWATER DEVELOPMENT

ARBUTUS RIDGE

(HATCH POINT, B.C.)

FOR

CRC CANADIAN RETIREMENT CORPORATION

AND

APLIN & MARTIN ENGINEERING LTD.

DOMESTIC WELL NO. 6

W.L. Brown, P. Eng.

May, 1990

## 1.0 INTRODUCTION

- 1.1 Location - Domestic Well 6 is located in the west central area of Arbutus Ridge Estates approximately 60 m (200 feet) north of Hutchinson Road and 280 m (900 feet) west of Ratcliffe Road. Domestic Well No. 6 lies approximately 175 m (575 feet) southeast of Domestic Well 5 and 303 m (995 feet) southeast of Domestic Well 4. Please see Well Location Map Fig. 1 in pocket.
- 1.2 Drilling and Testing - This well was constructed and tested during February and March 1990.

## 2.0 GEOLOGY

- 2.1 Bedrock - Domestic Well 6 was drilled to a depth of 108.2 m (355 feet) or to approximately sea level without encountering the bedrock that was found in Domestic Wells 1 and 2.
- 2.2 Unconsolidated Sediments - Domestic Well 6 encountered artesian sand and gravel aquifers that are capped by 84 metres (275 feet) of relatively impervious gravels, sands, silts, and clays. The static water level in the screened intervals was approximately 45 m (148 feet) below present ground surface at an elevation of 63 m (208 feet). The screened intervals in Domestic Wells 4, 5 and 6 are all in the same geologic setting so that all three wells affect each other during pumping.

## 3.0 CONSTRUCTION

Domestic WELL 6 was drilled by an air rotary rig. Reference to the well log will show that this well is cased with 203 mm (8-inch) diameter steel casing and that the screen assembly consists of two 203 mm (8-inch) telescopic diameter stainless steel well screens capped and separated by 178 mm (7-inch) diameter steel pipe. A 178 mm (7-inch) diameter pump sump bottoms the screen assembly. The well screens have 10 and 20/1000 inch slot openings.

The screened water-bearing zones were developed by air blowing.

#### 4.0 PUMP TESTING

This well was tested at a pumping rate of 175 Igpm (211 U.S. gpm) for the first 1350 minutes of the test and at a rate of 158 Igpm (190 U.S. gpm) for the remainder of the test. The well was pumped for a total of 4350 minutes (72.5 hours). Two Hundred Fifty (250) minutes of recovery measurements were taken after the pump had been shut off. Please see attached pump test data for details.

#### 5.0 PUMP TEST ANALYSIS

Reference to Fig. 2, the semi-log plot of water level drawdown during pumping will show that the cones of influence around this well encountered water-bearing zones with a transmissivity value of approximately 7000 and 3200 U.S. gpd/ft.

The lower value of 3200 U.S. gpd/ft is judged to be the effective transmissivity for productivity analysis.

#### 6.0 PRODUCTIVE CAPACITY

##### 6.1 General Statement

The productive capacities of Domestic Wells 4 and 5 are recalculated in this section using the data obtained from the pump testing of Domestic Well 6 because all three wells affect each other when they are being pumped.

Please see Figures 3, 4 and 5, the distance - drawdown charts used to calculate the interference between these wells.

##### 6.2 Domestic Well 4 - the productive capacity of this well is calculated as follows:

Depth to Top of Screen	94.5 metres	310 feet
Static Water Level	19.9	65
Total Available Drawdown	<u>74.6</u>	<u>245</u>

Specific Capacity 0.26 (51/199) U.S. gpm/foot of drawdown.

Interference from Domestic Wells 5 and 6 (Fig. 5)  
 $20 + 16 = 36$  feet

Productive Capacity at 70% of Total Available  
Drawdown  
 $0.7(245-36)0.26 = \underline{38 \text{ U.S. gpm or } 32 \text{ Igpm}}$

6.3 Domestic Well 5 - Calculated as above:

Depth to Top of Screen	104.5 metres	343 feet
Static Water Level	39.9	131
Total Available Drawdown	<u>64.6</u>	<u>212</u>

Specific Capacity 1.6 U.S. gpm/foot of drawdown.

Interference from Domestic Wells 4 and 6 (Fig. 4)  
 $20 + 19 = 39$  feet

Productive Capacity at 70% of Total Available  
Drawdown  
 $0.7(212-39)1.6 = \underline{194 \text{ U.S. gpm or } 162 \text{ Igpm}}$

It is generally believed that the velocity of water through a well screen should not exceed 0.1 feet per second to prevent turbulent flow and the danger that such flow will move sand. A flow of 174 U.S. gpm will produce an entrance velocity of 0.1 feet per second and increasing the flow to 194 U.S. gpm will increase the entrance velocity of the water through the screen to 0.11 feet per second. Experience has shown that this slight increase in velocity will not make Domestic Well 5 a "sand pumper."

6.4 Domestic Well 6 - calculated as above:

Depth to Top of Screen	84.1 metres	276 feet
Static Water Level	45.1	148
Total Available Drawdown	<u>39.0</u>	<u>128</u>

Specific Capacity 1.7 (190/113) U.S. gpm/foot of drawdown.

Interference from Domestic Wells 4 and 5 (Fig. 3)  
 $15 + 17 = 32$  feet

Productive Capacity at 70% of Total Available Drawdown  
 $0.7(128-32)1.7 = \underline{114 \text{ U.S. gpm or } 95 \text{ Igpm}}$

## 7.0 WATER QUALITY

Samples of water were collected prior to the end of each pump test. These were sent to a commercial laboratory for chemical analyses. These show that the groundwater from this well is potable and meets the Canadian and British Columbia drinking water guidelines for all parameters analysed. Please see the chemist's report attached.

## 8.0 RECOMMENDATIONS AND CONCLUSIONS

8.1 Based upon presently available information the safe productive potential of Domestic Well 6 is 114 U.S. gpm, 95 Igpm, or 620 m<sup>3</sup>/day including interference from wells 4 and 5.

8.2 The total proven capacity of the Arbutus Ridge Estates Domestic Well Field is now as follows when all wells are being pumped:

Domestic Well 1	66 US gpm	55 I gpm	360 m <sup>3</sup> /day
Domestic Well 2	55 US gpm	46 I gpm	300 m <sup>3</sup> /day
Domestic Well 3	35 US gpm	29 I gpm	190 m <sup>3</sup> /day
Domestic Well 4	38 US gpm	32 I gpm	207 m <sup>3</sup> /day
Domestic Well 5	194 US gpm	162 I gpm	1057 m <sup>3</sup> /day
Domestic Well 6	114 US gpm	95 I gpm	621 m <sup>3</sup> /day
Total Productive Capacity	<u>502</u> US gpm	<u>419</u> I gpm	<u>3735</u> m <sup>3</sup> /day

8.3 If more groundwater is needed, more wells can be located south of Domestic Well 6. Also the deep bedrock channel indicated by the results of Domestic Well 4 drilling should be explored to determine the type and productivity of those sediments filling the channel.

8.4 It is important to note that the aquifer discovered in Domestic Wells 4, 5 and 6 is hydrogeologically separated from the aquifer developed in Domestic Wells Nos. 1, 2 and 3. These two sets of wells should not affect the productive potentials of each other.

8.5 These wells should NOT be

overpumped  
vibrated  
raw-hided  
sealed and put under vacuum

8.6 The new concrete cribbings that will be constructed around these new domestic wells will change the datum of the measuring point from that used on the well logs and pump tests attached to this and previous reports. The relationship between the original ground surface and the new top of cribbings should be established and recorded.

8.7 The pumps set in the pump sumps should be "shrouded" to ensure that the motors are properly cooled.

8.8 Water level measurements should be made and recorded in all wells during the first five years of operation. These records should be reviewed by the writer once a year with a view to increasing the safe productive potential of the well field.

8.9 When all the pumps are installed in all the wells the well field should be "tuned" to produce the maximum total safe production without dewatering the well screens.



## CHEMICAL ANALYSIS REPORT

Date: April 11, 1990  
File No. 1003B  
Report On: Water Analysis  
Report To: Brown Erdman & Turner Ltd.  
207 - 132 West 15th Street  
North Vancouver, B. C.  
V7M 1R5

DATE OF SUBMISSION: Mar. 26/90

### SAMPLE IDENTIFICATION

Labelled as shown in RESULTS section.

### METHODOLOGY

Analysed in accordance with "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, 1985.

### RESULTS OF ANALYSIS


Results are presented in the table(s) attached.

### REMARKS

The water as represented by the sample "Arbutus Ridge DW #6 can be characterized as moderate with respect to dissolved mineralization.

The water sample met Canadian and British Columbia drinking water guidelines for all parameters analysed.

ASL ANALYTICAL SERVICE LABORATORIES LTD.

  
Barbara Szczachor, B.Sc.  
Supervisor  
Water Quality Laboratory

  
Nelida Parreno, B.Sc.



BS/NP/dmc

analytical service laboratories ltd.

CONSULTING CHEMISTS & ANALYSTS  
1650 Pandora Street  
Vancouver, B.C. • V5L 1L6  
Fax (604) 253-6700 • Tel. (604) 253-4188

## RESULTS OF ANALYSIS

File No. 1003B  
Page 2 of 2

Arbutus  
Ridge  
DW #6  
Mar 23/90

Drinking \*1  
Water  
Guidelines

Physical Tests

pH		7.83	6.5-8.5
Conductivity		145.	-
Colour		<5.0	15.
Turbidity	NTU	<0.1	5.
Suspended Solids		<1.0	-
Dissolved Solids		120.	500.
Total Hardness	CaCO <sub>3</sub>	60.6	- *2

Anions

Alkalinity	CaCO <sub>3</sub>	70.2	-
Sulfate	SO <sub>4</sub>	3.3	500.
Chloride	Cl	3.2	250.
Fluoride	F	0.06	1.5
Silicate	SiO <sub>2</sub>	21.1	-
NO <sub>3</sub> /NO <sub>2</sub>	N	0.092	10.0

Total Metals

Iron	T Fe	<0.03	0.30
Manganese	T Mn	<0.005	0.05

Dissolved Metals

Arsenic	D As	0.0031	0.05
Barium	D Ba	<0.010	1.0
Cadmium	D Cd	<0.0002	0.005
Chromium	D Cr	<0.015	0.05
Copper	D Cu	<0.010	1.0
Iron	D Fe	<0.03	-
Lead	D Pb	<0.001	0.05
Manganese	D Mn	<0.005	-
Zinc	D Zn	<0.005	5.0
Calcium	D Ca	15.5	-
Magnesium	D Mg	5.20	-
Potassium	D K	0.76	-
Sodium	D Na	6.52	- *3

Other Tests

Coliform Total	ND	-
Fecal	ND	-

&lt; = Less than      T = Total      D = Dissolved

NO<sub>3</sub>/NO<sub>2</sub> = Nitrate/nitrite nitrogen

ND = Not Detected

Results expressed as milligrams per litre except for pH, Conductivity ( $\mu$ mhos/cm), Colour (CU), Turbidity (NTU), and Coliform Bacteria (colonies/100 ml).

\*1 "Maximum acceptable concentration" as published by Health &amp; Welfare Canada, 1985

\*2 Maximum level not established - water supplies with a hardness exceeding 200 mg/L are considered poor but will be tolerated. Not a health consideration

\*3 Maximum level not established - of concern to consumers with sodium restricted diet. Levels exceeding 20 mg/L may be of concern in this circumstance.





HATCH POINT  
DOMESTIC WELL NO. 6  
(Test Well "D")

Depth below ground surface		Description
Metres	Feet	
0 - 47.5	0 - 156	Silt and gravel
47.5 - 55.8	156 - 183	Sand and gravel some silt
55.8 - 70.1	183 - 230	Sand and gravel, bits of wood
70.1 - 73.5	230 - 241	Sand and gravel with silt beds
73.5 - 76.8	241 - 252	Silt and clay, grey
76.8 - 83.8	252 - 275	Sand and gravel with silt
83.8 - 90.2	275 - 296	Sand and gravel, brown <u>water-bearing</u>
90.2 - 93.9	296 - 308	Silt, grey
93.9 - 98.1	308 - 322	Sand, fine, with silt interbed
98.1 - 104.2	322 - 342	Sand, fine to medium with silt, <u>water-bearing</u>
104.2 - 108.2	342 - 355 T.D.	Clay, silty, grey

Construction Details	Depth Below Ground	
	Metres	Feet
203 mm (8-inch) diameter casing	+0.80 - 82.9	+2.6 - 272
178 mm (7-inch) diameter riser	82.9 - 84.1	272 - 276
203 mm (8-inch) telescopic diameter screen 10 slot	84.1 - 90.2	276 - 296
178 mm (7-inch) diameter blank	90.2 - 101.1	296 - 332
203 mm (8-inch) telescopic diameter screen 20 slot	101.2 - 104.2	332 - 342
178 mm (7-inch) diameter sump	104.2 - 107.3	342 - 352





**ARBUTUS RIDGE**  
**DOMESTIC WELL NO. 6**

Date: March 20-23, 1990

Discharge Rate:

Day 1 - 211 U.S. gpm	Days 2 & 3 - 190 U.S. gpm
- 175 Igpm	- 158 Igpm
- 1145 m <sup>3</sup> /day	- 1034 m <sup>3</sup> /day

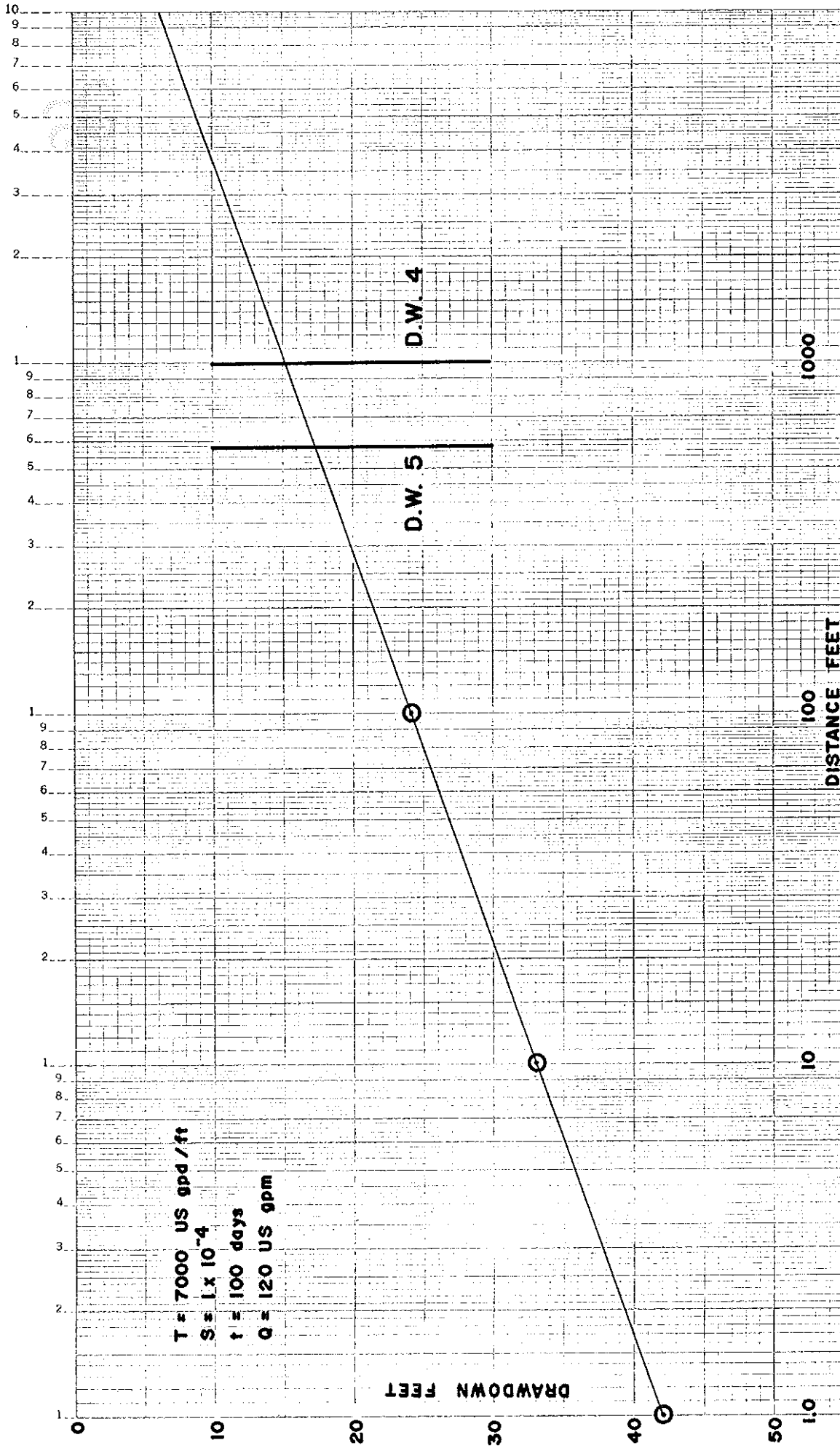
Time of Day hr/min.	Elapsed Time Minutes	Depth to Water Metres	Comments
Mar. 20/90			
1750	100.0	72.574	Water temp. 9.6° C
1815	125.0	72.919	
1840	150.0	73.180	
1930	200.0	73.655	Slightly slow - increased
2020	250.0	74.380	
2110	300.0	74.658	
2200	350.0	74.945	
2250	400.0	75.202	
2340	450.0	75.362	211 U.S. gpm
Mar. 21/90			
0030	500.0	75.494	New Observer
0120	550.0	75.708	
0210	600.0	76.066	
0300	650.0	76.202	
0350	700.0	76.356	
0440	750.0	76.442	Slightly low - increased
0530	800.0	76.758	
0620	850.0	76.872	
0710	900.0	76.993	
0800	950.0	77.112	New Observer
0850	1000.0	77.190	211 U.S. gpm
0940	1050.0	77.300	Water temp. 9.6° C
1030	1100.0	77.386	
1120	1150.0	77.443	
1210	1200.0	77.765	
1300	1250.0	77.856	
1350	1300.0	77.907	Decreasing rate






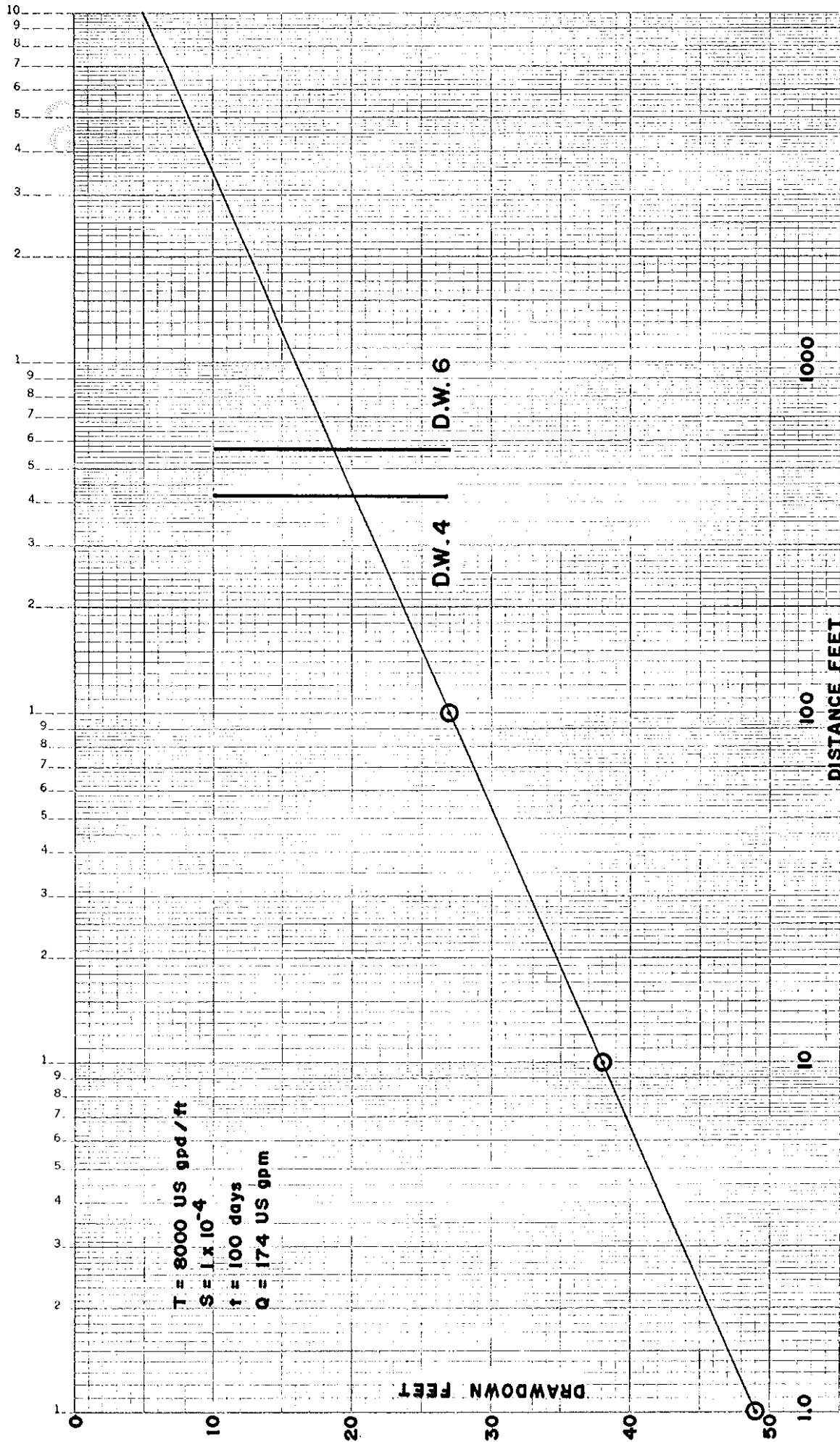





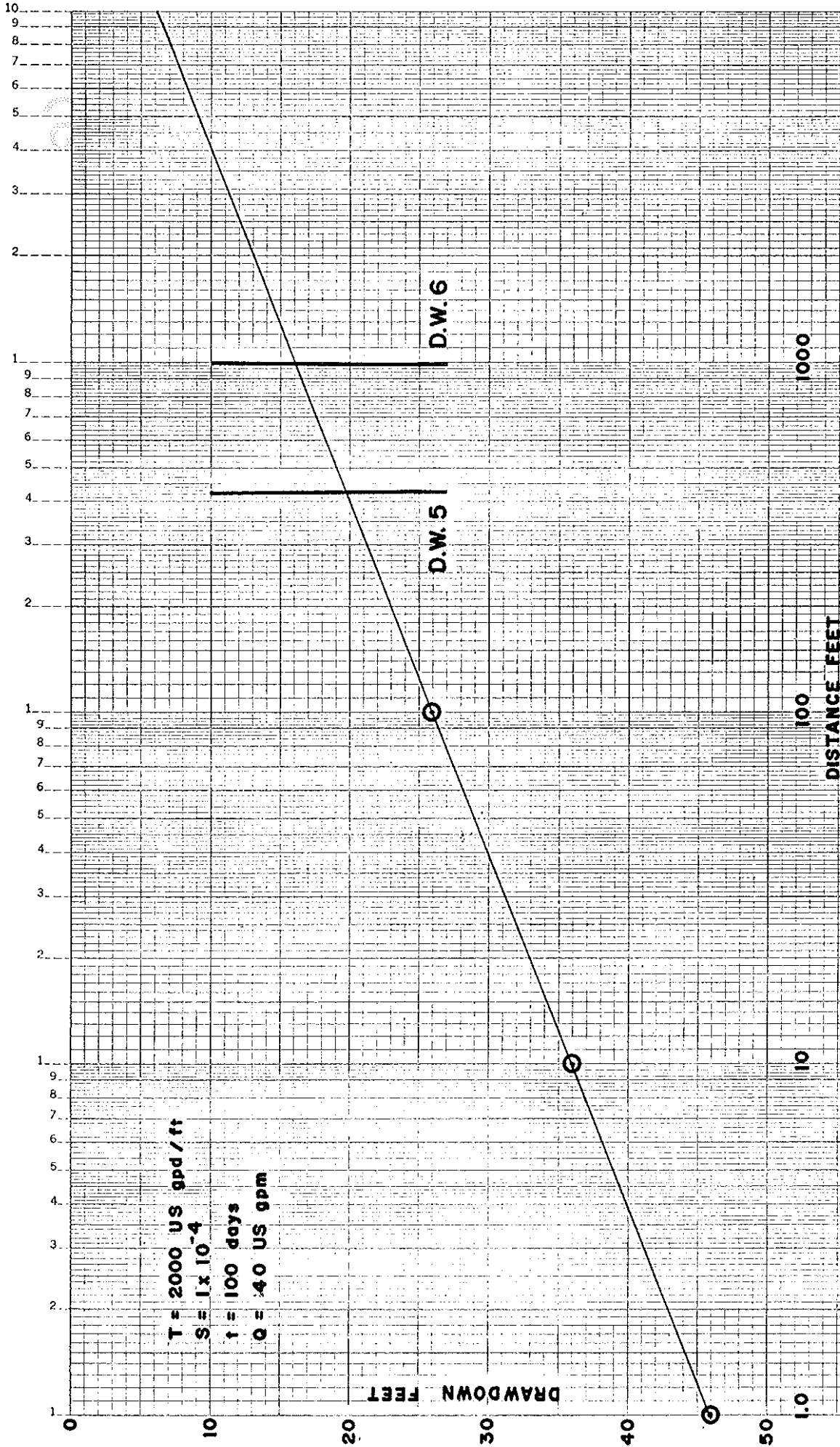


CRC CANADIAN RETIREMENT CORPORATION ARBUTUS RIDGE (HATCH POINT, B.C.)	DISTANCE - DRAWDOWN DOMESTIC WELLS 4, 5 & 6 (FROM 6)	 BROWN, ERDMAN & ASSOCIATES LTD. INTERNATIONAL GROUNDWATER CONSULTANTS NORTH VANCOUVER, BRITISH COLUMBIA
	WLB MAY 1990 FIG 3	





	<b>BROWN, ERDMAN &amp; ASSOCIATES LTD.</b> INTERNATIONAL GROUNDWATER CONSULTANTS <small>NORTH VANCOUVER, BRITISH COLUMBIA</small>
<b>CRC</b> CANADIAN RETIREMENT CORPORATION	<b>DISTANCE - DRAWDOWN</b> <b>DOMESTIC WELLS</b> <b>4, 6 &amp; 5 (FROM 5)</b>
ARBUTUS RIDGE (HATCH POINT, B.C.)	<b>WLB</b> <b>MAY 1990</b> <b>FIG. 4</b>



CRC CANADIAN RETIREMENT CORPORATION ARBUTUS RIDGE (HATCH POINT, B.C.)	DISTANCE - DRAWDOWN DOMESTIC WELLS 5, 6 & 4 (FROM 4)	BROWN, ERDMAN & ASSOCIATES LTD. INTERNATIONAL GROUNDWATER CONSULTANTS NORTH VANCOUVER, BRITISH COLUMBIA	WLB	MAY 1990	FIG 5
			(Empty space for additional notes or signatures)		

TV 4 5P10

--60--

TD 162 m  
RATING  
55 l gpm



CLAY

NO. 1 (3)  
DOMESTIC WELL 1  
TEST WELL 3

LITHOLOGY

SCALES:  
HORIZONTAL - NO SCALE  
VERTICAL - 1:500

CRC  
CANADIAN  
RETIREMENT  
CORPORATION



BROWN, ERIDMAN & ASSOCIATES LTD.  
INTERNATIONAL GROUNDWATER CONSULTANTS  
NORTH VANCOUVER BRITISH COLUMBIA

ARBUTUS RIDGE  
(HATCH POINT B.C.)  
DOMESTIC WELL LOGS

DATE

WLB

1990-06-05

PROJECT

85-377

FIGURE NO.

6



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98.1 - 104.2	322 - 342	Sand, fine to medium with silt, <u>water-bearing</u>
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**Construction Details**

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	Metres	Feet
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**RESULTS OF ANALYSIS**

File No. 1003B  
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Ridge  
DW #6  
Mar 23/90

Drinking \*1  
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Physical Tests

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Colour		<5.0	15.
Turbidity	NTU	<0.1	5.
Suspended Solids		<1.0	-
Dissolved Solids		120.	500.
Total Hardness	CaCO3	60.6	- *2

Anions

Alkalinity	CaCO3	70.2	-
Sulfate	SO4	3.3	500.
Chloride	Cl	3.2	250.
Fluoride	F	0.06	1.5
Silicate	SiO2	21.1	-
NO3/NO2	N	0.092	10.0

Total Metals

Iron	T Fe	<0.03	0.30
Manganese	T Mn	<0.005	0.05

Dissolved Metals

Arsenic	D As	0.0031	0.05
Barium	D Ba	<0.010	1.0
Cadmium	D Cd	<0.0002	0.005
Chromium	D Cr	<0.015	0.05
Copper	D Cu	<0.010	1.0
Iron	D Fe	<0.03	-
Lead	D Pb	<0.001	0.05
Manganese	D Mn	<0.005	-
Zinc	D Zn	<0.005	5.0
Calcium	D Ca	15.5	-
Magnesium	D Mg	5.20	-
Potassium	D K	0.76	-
Sodium	D Na	6.52	- *3

Other Tests

Coliform	Total	ND	-
	Fecal	ND	-

< = Less than      T = Total      D = Dissolved

NO3/NO2 = Nitrate/nitrite nitrogen

ND = Not Detected

Results expressed as milligrams per litre except for pH, Conductivity ( $\mu$ mhos/cm), Colour (CU), Turbidity (NTU), and Coliform Bacteria (colonies/100 ml).

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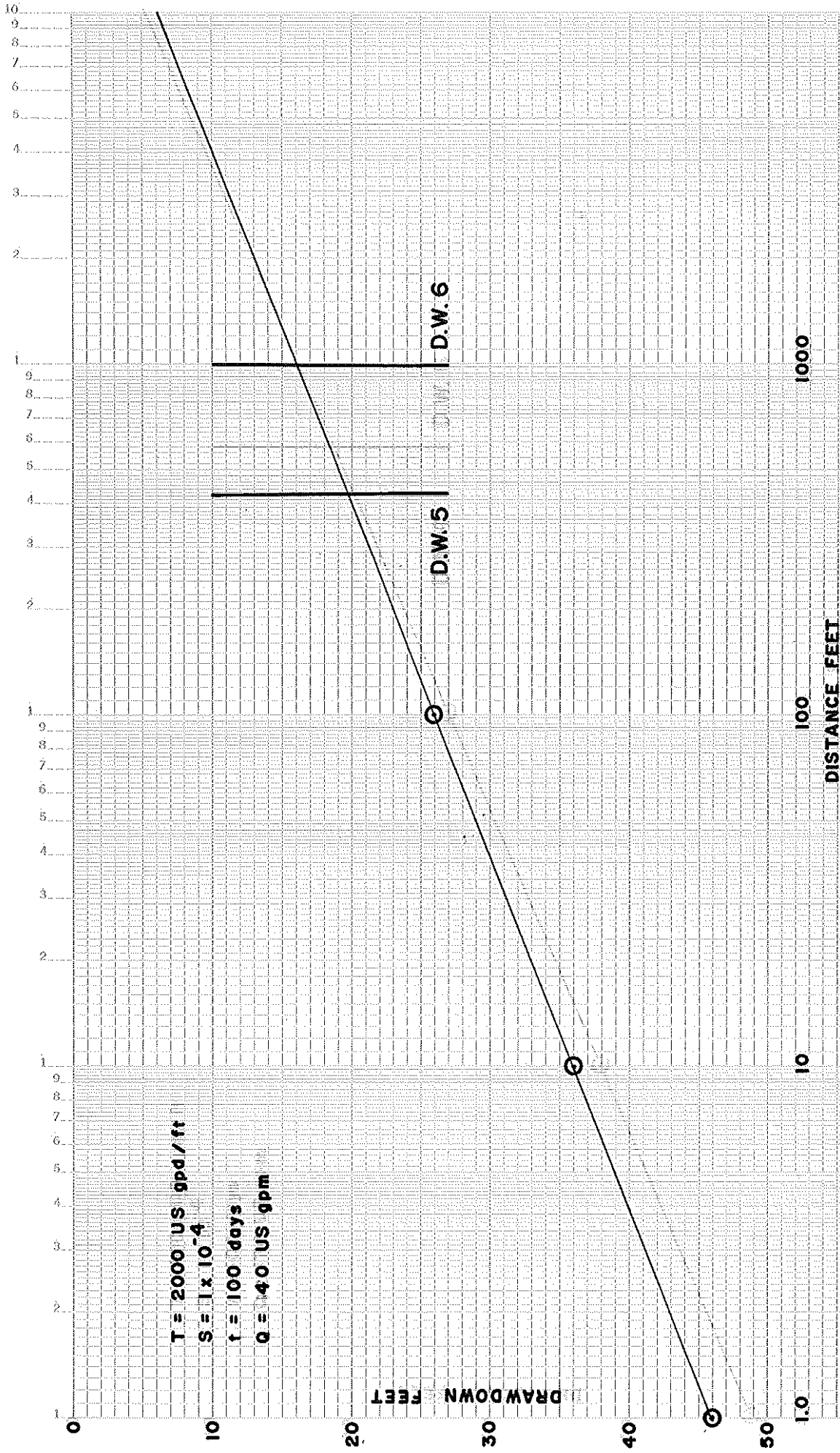












<p><b>CRC</b> CANADIAN RETIREMENT CORPORATION ARBUTUS RIDGE (HATCH POINT, B.C.)</p>	<p><b>DISTANCE - DRAWDOWN</b> <b>DOMESTIC WELLS</b> <b>5, 6 &amp; 4 (FROM 4)</b></p>	<p><b>BROWN ERDMAN &amp; ASSOCIATES LTD.</b> INTERNATIONAL GROUNDWATER CONSULTANTS NORTH VANCOUVER, BRITISH COLUMBIA</p> <p>WLB      MAY 1990      FIG 5</p>
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