CERTIFICATION OF WATER QUANTITY AND QUALITY FOR A TWO LOT RURAL SUBDIVISION AT 29710 DEWDNEY TRUNK ROAD IN THE DISTRICT OF MISSION

(District of Mission Subdivision Application S90-69 and File PRF 15-40)

Prepared for

Mr. J. Charron
21486 Exeter Avenue
MAPLE RIDGE, B.C. V3Z 1A7

Prepared by

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SEPTEMBER 17, 1991

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September 17, 1991

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MAPLE RIDGE, B.C. V3Z 1A7

Subject: **Certification of Water Quantity and Quality for a Two Lot Rural Subdivision at 29710 Dewdney Trunk Road in the District of Mission**
District of Mission Subdivision Application S90-69 and File PRF 15-40

Dear Sir:

This letter-report is further to several discussions between Mr. Joe Charron, Property Owner, and Ed Livingston, P. Eng., and/or Ann Badry, Hydrogeologist, of Pacific Hydrology Consultants Ltd., both on the telephone and at Pacific Hydrology's Office, concerning groundwater conditions on the subject Property at 29710 Dewdney Trunk Road and about procedures for evaluating the capacities of dug wells; it is also further to discussions between Charron, Badry and Livingston during a site visit of June 8 to the subject Property at 29710 Dewdney Trunk Road, located southeast of the intersection of Dewdney Trunk with Carr Street, while preliminary pumping of Wells "A" and "B" was under way.

1.0 INTRODUCTION

The purpose of this letter is to present information which confirms that dug wells constructed on Lots A and B of the proposed Charron/Pasquill Subdivision of Lot 1, NW¼ of Section 14, Township 15, Plan 2929, New Westminster District, will "...provide a quantity of water not

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less than 2500 litres per day per parcel and provide a sustained yield of 9 litres per minute for a minimum of four hours", as required under District of Mission Bylaw 2203-1990. This letter also discusses the quality of groundwater yielded by the Wells and provides the required hydrogeologic impact assessment with respect to:

(i) Impact of each proposed well on neighbour wells both within and adjacent to the proposed subdivision, and

(ii) Long term impact of the proposed wells on the source aquifer.

The topographic setting of the proposed Charron/Pasquill Subdivision is shown on Figure 1 in Appendix A and the subdivision layout is shown on Figure 2, prepared from a sketch plan provided by the Owner; access to both lots will be off Dewdney Trunk Road. As shown on Figure 2:

1. The wastewater drain fields for the houses on both lots of the proposed Charron/Pasquill Subdivision are located more than 30 m (100 ft) in a downslope direction from the Wells.

2. There are two Wells - Well "A" and Well "C" - on the western Lot A.

According to the Property Owner, Mr. J. Charron, the Wells were all excavated by a backhoe through about a metre of loose soil and weathered sediment and then into about one metre of till, below which there was gravel containing water. 150 mm (6") diameter PVC casing was set in each dug hole, with the casing surrounded by drain rock in the lower half; the upper half of each excavation was backfilled with excavated material, which was compacted after placement to create a surface seal. The three Wells, identified as Wells "A", "B" and "C", have respective total depths below the tops of the PVC casings of 4.9, 4.8 and 4.9 m (16.0, 15.6 and 16.1 ft).

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2.0 HYDROGEOLOGY

The subject Charron/Pasquill Subdivision is located on the south side of Dewdney Trunk Road, near the base of the southeast-facing slope of Blue Mountain. According to Geological Survey of Canada Map 1485A, **Surficial Geology Mission British Columbia,** the Subdivision is underlain by "Vashon Drift: **Va,** lodgment till with sandy loam matrix up to 10 m thick, overlain in many places by gravelly ablation till up to 3 m thick."

The sediments reported to have been encountered in the excavations for the dug wells on the subject Property are consistent with the description of the surficial geology given above. The Wells are located in the discharge zone of the groundwater flow regime, as shown by the topographic location and by the presence of springs and natural ponds along Carr Street north of the Property. Inspite of the location of the Wells in the groundwater discharge zone, the capacities of individual wells are limited by the low permeability of the till underlying the area. The number of more permeable patches of sediments intersected by a particular dug well excavation and the depth of the well are also factors which control the capacity of any particular well.

3.0 WELL CAPACITY

3.1 Pump Test Procedures

To assess whether the capacity of the subject Wells on the proposed Charron/Pasquill Subdivision satisfy District of Mission Bylaw 2203-1990, the Wells were pump tested by Murrays Pump Service, with assistance by the Property Owner, according to instructions by Pacific

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Hydrology and under Pacific Hydrology's supervision. A contractor's pump was first used to rapidly dewater the water in storage in the well casing, and in the drain rock surrounding the casing, followed by constant-drawdown pumping with the pumping water level maintained by a piston pump. The discharge water from the test was conveyed through polyethylene pipe downslope away from the immediate vicinity of the Wells. The pumping rate during the test was determined by timing the filling of a container of known volume. the data collected during the pumping test, along with standard straight line plots on semi-logarithmic graph paper, are attached in Appendix B.

Well "A" (Lot A) and Well "B" (Lot B) were tested simultaneously. Preliminary evaluation of the test data showed that the capacity of Well "A" on Lot A was not sufficient to meet the District of Mission Bylaw 2203-1990 requirements so Well "C", also located on Lot A, was tested to see whether it either had sufficient capacity to meet the District's requirements individually or in conjunction with Well "A".

Because of problems in regulating very low pumping rates on low capacity dug wells, Mr. Murray Robinson of Murray's Pump Service suggested using a constant-drawdown method of pump testing instead of the more common constant-rate method. To accomplish this, a small electric piston pump, powered by a gasoline generator, was utilized according to the following testing procedure:

1. Pumping was started at an high rate using a centrifugal contractor's pump. This pumping was continued until the drawdown approached the limit imposed by the depth of the Well, arbitrarily determined to be a pumping water level about 0.9 m (3 ft) above the bottom.

2. The high rate pumping was stopped and pumping with the piston pump was started as soon as practical. The position of the suction pipe for the piston pump is arbitrarily fixed at a specific depth selected as a practical level for satisfactory operation of the well.

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3. Pumping was continued at the rate imposed by the position of the suction pipe. The pumping rate was measured occasionally and pumping was continued at constant-drawdown to the end of the test.

4. Following the termination of pumping, the recovery of the water level was measured in the usual way.

3.2 Well Capacity Analysis

Because a constant drawdown is maintained using the piston pump, instead of a plot of drawdown versus log of time since pumping started, the data are analyzed by plotting pumping rate versus log of time since pumping started, with a standard plot prepared from the "pump-down" data. The pumping test data and plots of the data from the testing of the Charron/Pasquill Wells are included in Appendix B attached to this letter.

Well "A"

The first stage of the testing of Well "A" began at 10:02 a.m. on August 24 by pumping for 28 minutes at a rate of 147 L/min. (32.4 igpm), during which the pumping water level was drawn down to 4.01 m (13.15 ft); as shown by Figure 3 (Page B - 7), drawdown was still continuing when the contractor's pump was stopped to replace it with the piston pump. The piston pump was started at 138 minutes after the initial start of pumping and pumping continued to the end of the 1358 minutes of pumping at a fairly stable pumping rate of 1.58 to 1.56 L/min (0.348 to 0.343 igpm), which maintained a constant pumping water level of 4.0 m (13.00 ft). The final rate of 1.56 L/min represents 2246 litres per day, somewhat below the Bylaw requirement of 2500 litres per day. By the elapse of 1520 minutes after pumping was terminated, the residual drawdown was still 1.195 m (3.92 ft).

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Well "B"

For the testing of Well "B", the water level was initially pumped down, starting at 10:53 a.m. on August 24, at a rate of 136 L/min (30 igpm) for 25 minutes. Then, again, starting at 08:30 a.m. on August 25, the water level was similarly pumped down in the first thirty minutes, following which the piston pump was installed and the rate adjusted to achieve a stable pumping water level of 4.0 m (13.00 ft). As shown on the plot of the elapsed time versus pumping rate for this Well (Figure 7, Page B - 11), the rate was declining very slowly toward equilibrium when testing was terminated at 1530 minutes after the intial start. The final pumping rate of 3.1 L/min (0.68 igpm) represents 4464 litres per day, almost double the Bylaw Requirement.

The recovery of the water level following the termination of the pumping of Well "B" was slow but the recovery data plot (Figure 8, Page B - 12) shows that complete recovery to the pre-pumping static water level would occur.

Well "C"

As mentioned previously, because Well "A" was shown by the testing to have a capacity less than the Mission Bylaw requirement, a second dug well on Lot A was tested. This dug well, Well "C", was constructed at the same time as Wells "A" and "B". As shown on Figure 2 in Appendix A, Well "C" is located 22.0 m (72 ft) west of Well "A". The same test procedure was used as for Wells "A" and "B". The initial pumping, which only lasted nine minutes for Well "C", was at a rate of 264 L/min (58 igpm). The piston pump was then started at a rate of 28.1 L/min but this rate decreased to 2.00 L/min (0.44 igpm) at 49 minutes and, finally to 1.20 L/min (0.264 igpm) at 1429 minutes (23.8 hours). The plot of pumping rate versus log of time since pumping started (Figure 9, Page B - 13) shows that the pumping rate

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was still decreasing at the end of the test period. The final rate of 1.20 L/min (0.264 igpm) represents 1728 litres/day which, as in the case of Well "A", is substantially less than the Bylaw requirement. The water level in Well "A" was observed during the pumping of Well "C" and no interference effect was detected.

The plot of the recovery data for Well "C" (Figure 10, Page B - 14) again shows that recovery of the water level is slow, with a residual drawdown of 0.17 m (0.55 ft) at 3870 minutes following the termination of pumping, but that complete recovery will occur

3.3 Well Capacity Summary

To summarize, the pumping tests of the dug wells on the proposed Charron/Pasquill Subdivision shows:

1. Well "B" on Lot B clearly meets the requirments of District of Mission Bylaw 2203-1990, with sufficient water stored in the well casing and drain rock surrounding the casing to supply the requirement of 9 L/min for four hours.

2. Neither Well "A" or "C" on Lot A can individually satisfy the Bylaw 2203-1990 requirements but the combined capacity of the two Wells would be sufficient. If such a course of action is to be followed, the pumping installation must obviously be designed to include the two Wells. Alternatively, one or other of the Wells could be deepened.

4.0 GROUNDWATER QUALITY

Appendix C contains certificates of analysis for water samples collected from Wells "A" and "B" at the time of preliminary pumping carried out in June. The Norwest Labs' Certificates for Wells "A" and "B" are respectively dated July 26 and August 2, 1991 and identified as Water Sample Numbers 91-3166 and 91-3167.

The results presented by Norwest show that the groundwaters from Wells "A" and "B" on the proposed Charron/Pasquill Subdivision satisfy B.C. Ministry of Health's Drinking Water Standards for all parameters checked, including bacteriological. The groundwaters represented by the Norwest analyses are both complex type waters, reflecting changes due to ion exchange along the path of flow. The groundwater from Well "A" may be classed as a sodium + calcium/chloride + bicarbonate type water; that from Well "B" may be classed as a calcium + sodium/bicarbonate & chloride type water. The waters are both very soft but moderately mineralized and they are generally of good quality for domestic uses. There is little doubt that the quality of water from Well "C" on Lot A would be similar.

5.0 HYDROGEOLOGIC IMPACT ASSESSMENT

In the prevailing situation, use of the subject Wells on the proposed Charron/Pasquill Subdivision is unlikely to have any negative impacts on existing drilled and/or dug wells or on the source aquifers in the area. We draw this conclusion because the capacity of any particular dug well is controlled partly by the number of water-bearing lenses intersected by the excavation for the particular dug well. As shown by the lack of interference between Wells "A" and "C" during the pump testing of Well "C", even closely spaced low capacity dug wells are unlikely to interfere with each other under the prevailing hydrogeologic conditions. Nor is there likely to be any long-term impact to the source aquifer.

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6.0 SUMMARY AND CONCLUSIONS

1. The Wells on the two Lots of the proposed Charron/Pasquill rural Subdivision, at 29710 Dewdney Trunk Road in the western part of the District of Mission, is located in a groundwater discharge area near the base of a southeast-facing mountain slope.

2. Well "B" on the east lot of the proposed Charron/Pasquill Subdivision of Lot 1, of N.W. ¼ Section 14, Township 15, Plan 2929, New Westminster District, can clearly "...provide a quantity of water not less than 2500 litres per day per parcel and provide a sustained yield of 9 litres per minute for a minimum of four hours", as required by District of Mission Bylaw No. 2203-1990. Neither the capacity of Well "A" or Well "C", both on Lot A, is sufficient to satisfy the requirements defined by Bylaw 2203-1990, but the combined capacities of the two Wells does satisfy the Bylaw requirements; a dual-pumping installation would be required with the the most satisfactory method of operation likely to be alternating the use of the Wells on a daily basis.

3. Chemical analyses carried out by Norwest Labs show that the groundwaters from the subject Wells "A" and "B" on respective Lots A and B of the proposed Charron/Pasquill Subdivision meet B.C. Ministry of Health's drinking water quality standards for all parameters checked, confirming that the Wells yield potable water.

4. All things considered, use of the dug wells on the proposed Charron/Pasquill Subdivision are unlikely to have any negative impacts on other existing drilled and/or dug wells in the area, or on the source aquifers, either in the short or long term.

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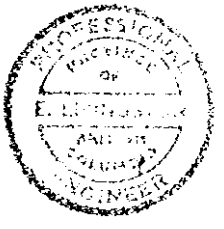
We trust that this letter will satisfy District of Mission regarding the required certification of water quantity and quality from the dug wells proposed as water supply sources for the proposed Charron/Pasquill Subdivision. Please call if we can be of further assistance with this matter.

Yours truly

PACIFIC HYDROLOGY CONSULTANTS LTD.

E. Livingston

E. Livingston, P. Eng.

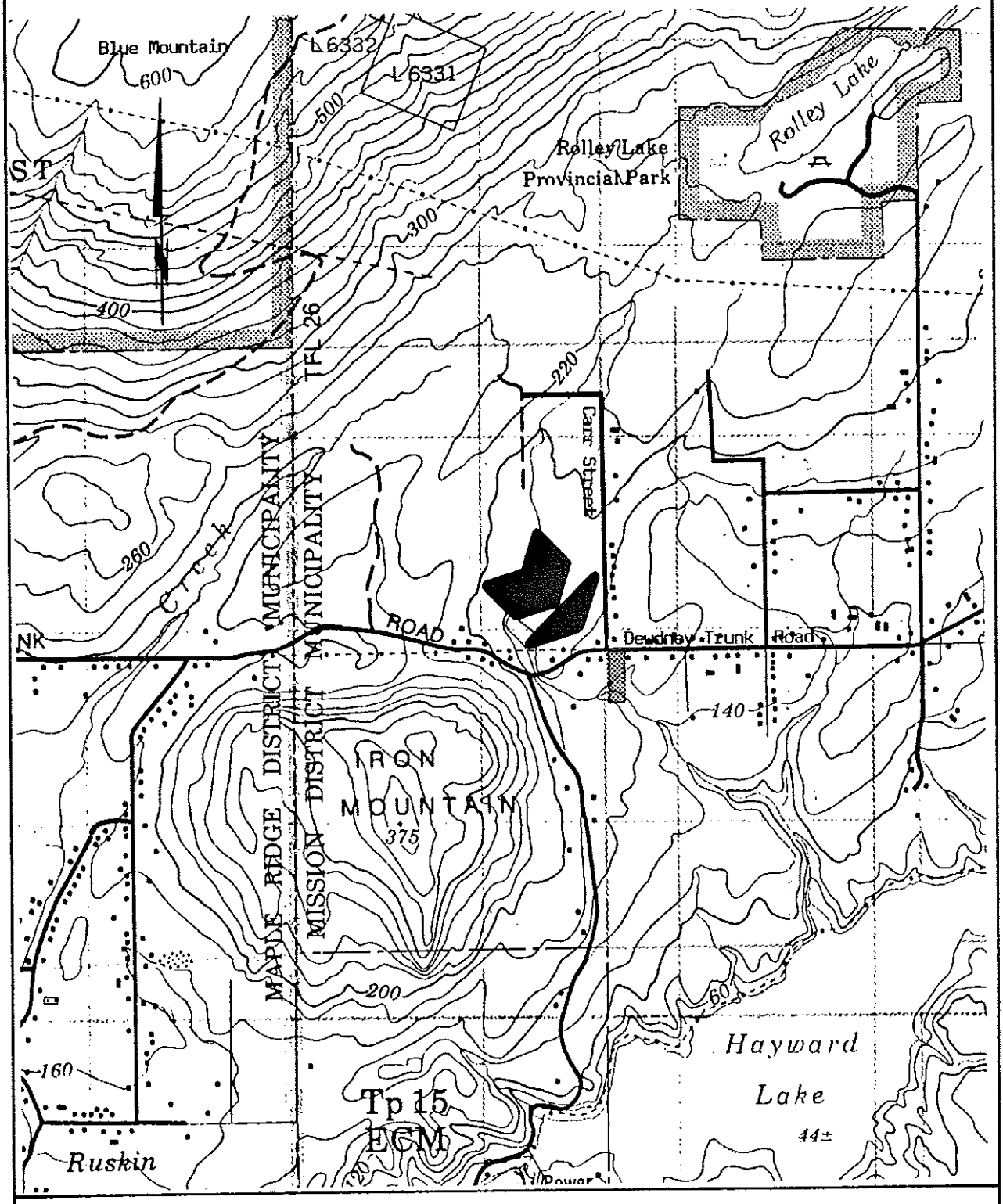


Attachments

APPENDIX A

AREA LOCATION MAP AND SUBDIVISION PLAN

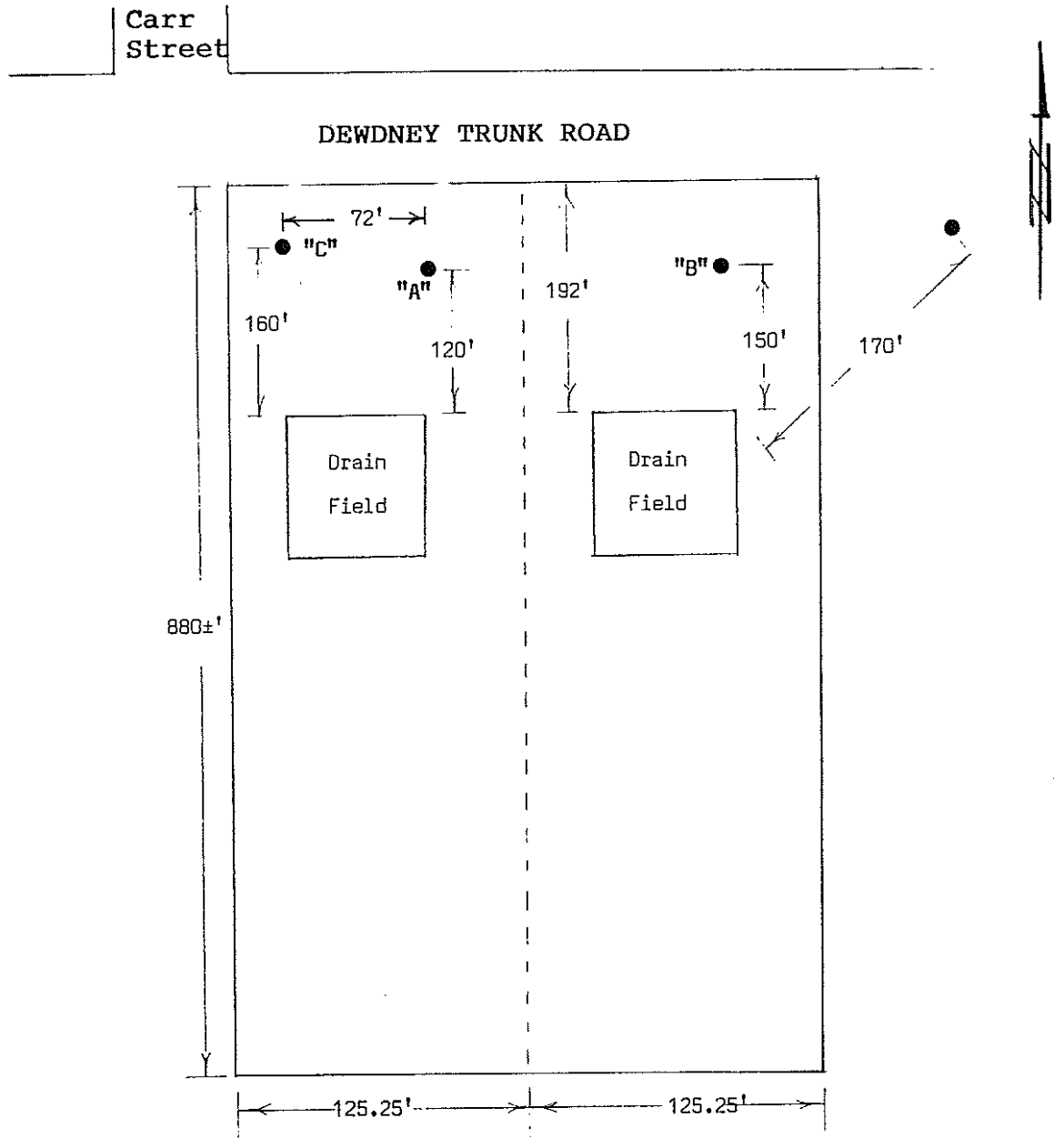
FIGURE 1	AREA LOCATION MAP - PROPOSED CHARRON/PASQUILL SUBDIVISION AT 29710 DEWDNEY TRUNK ROAD



Notes:

1. The base map is 1:50,000 scale topographic map N.T.S. 92G/1, **Mission**, enlarged to a scale of approximately 1:30,000; contour interval is 20 metres.
2. ▶▶ indicates location of proposed Charron/Pasquill Subdivision.

FIGURE 2	LOT LAYOUT AND WATER WELL LOCATIONS ON PROPOSED CHARRON/PASQUILL SUBDIVISION



Notes:

1. Property description: Lot 1, NW¼ of Section 14, Township 15, Plan 2929, New Westminster District, at 29710 Dewdney Trunk Road, Mission.
2. The sketch is not to scale; approximate (unsurveyed) distances are as shown.
3. ● approximate (unsurveyed) location of a dug well, as identified.

APPENDIX B

PUMPING TEST DATA AND PLOTS

PUMP TEST – DRAWDOWN DATA

24/25	August	1991
DAY	MONTH	YEAR

CONTRACTOR Murray's Pump Service

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Location 29710 Dewdney Trunk Road

Well "A" on Lot A

Pumping Rate (Q) See below

Datum Point Top of 6" diameter PVC well casing

Elevation of Datum Point 0.3 m (1 ft) above grade

Static Water Level 6.50 ft (1.98 m)

Screen Location n/a - 16.00 ft deep dug well

TIME		ELAPSED TIME	DISTANCE TO WATER	DRAWDOWN (ft)	SECONDS TO FILL 22 LITRES	PUMPING RATE	PUMPING RATE	REMARKS
HR.	MIN.	t (MIN.)				(L/min)	(igpm)	
10	02		6.50					Static level; start.
10	03	1	6.85	0.35				
10	04	2	6.90	0.48				
10	06	4	7.50	1.00	9	146.7	32.3	
10	08	5	8.02	1.52				
10	11	9	8.61	2.11				
10	14	12	9.17	2.67				
10	18	16	10.35	3.85				
10	22	20	11.43	4.93	9	146.7	32.3	
10	27	25	12.74	6.24				
10	30	28	13.15	6.65				Stop pump to install
								restrictor.
12	20	138	13.00	6.50	830	1.59	0.35	Start piston pump
								with level at
								13 ft
16	37	395	13.00	6.50	835	1.58	0.35	
18	30	508	13.00	6.50	839	1.57	0.35	
20	30	628	13.00	6.50	841	1.57	0.35	
25/08	23	1341	13.00	6.50	847	1.56	0.34	
08	40	1358	13.00	6.50				Stop pump.

PUMP TEST — RECOVERY DATA

25/26	August	1991
DAY	MONTH	YEAR

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Well "A" on Lot A

Datum Point Top of 6" diameter PVC casing Elevation of Datum Point 0.3 m (1 ft) above grade

Static Water Level 6.50 ft (1.98 m) Total Drawdown 6.50 ft (1.98 m)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	DISTANCE TO WATER	RESIDUAL DRAWDOWN (ft)		REMARKS
HR.	MIN.	t (min.)	t' (min.)					
25/08	40	1358			13.00	6.50		Stop pump.
08	55	1373	15	91.5	12.90	6.40		
09	20	1398	40	35.0	12.80	6.30		
09	45	1423	65	21.9	12.72	6.22		
10	15	1453	95	15.3	12.65	6.15		
13	28	1646	288	5.7	12.33	5.83		
13	58	1676	318	5.3	12.28	5.78		
14	28	1706	348	4.9	12.23	5.73		
15	01	1739	381	4.6	12.15	5.65		
15	32	1770	412	4.3	12.10	5.60		
16	01	1799	441	4.1	12.05	5.55		
16	29	1827	469	3.9	12.00	5.50		
17	00	1858	500	3.7	11.94	5.44		
17	31	1889	531	3.6	11.90	5.40		
20	32	2070	712	2.9	11.63	5.13		
26/10	00	2878	1520	1.9	10.42	3.92		

PUMP TEST – DRAWDOWN DATA

25/26	Aug	1991
DAY	MONTH	YEAR

CONTRACTOR Murray's Pump Service

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Location 29610 Dewdney Trunk Road

Well Well "B" on Lot B

Pumping Rate (Q) See below

Datum Point Top of 6" diameter PVC casing

Elevation of Datum Point 0.26 m (0.84 ft) above grade

Static Water Level 5.40 ft (1.65 m)

Screen Location n/a - 15.6 ft deep dug well

TIME		ELAPSED TIME	DISTANCE TO WATER	DRAWDOWN (ft)	SECONDS TO FILL 22 LITRES	PUMPING RATE	PUMPING RATE	REMARKS
HR.	MIN.	t (MIN.)				(L/min)	(igpm)	
10	53		5.40					Static level; start.
10	54	1	7.25	1.85	9	146.7	32.3	
10	55	2	7.78	2.38				
10	57	4	8.73	3.33				
10	59	6	9.33	3.93				
11	02	9	9.68	4.28				
11	05	12	10.45	5.05				
11	09	16	11.35	5.95				
11	13	20	12.10	6.70				
11	18	25	13.10	7.70				Stop pump.
25/08	30		5.84	0.44				Start pump at a rate
								about 30 gpm.
09	00	30	13.00	7.60	60	22.0	4.84	Start piston pump.
09	35	65	13.00	7.60	262	5.04	1.11	
09	50	80	13.00	7.60	263	5.02	1.10	
10	25	115	13.00	7.60	268	4.92	1.08	
13	35	305	13.00	7.60	355	3.72	0.82	
14	06	340	13.00	7.60	363	3.64	0.80	
14	31	365	13.00	7.60	367	3.60	0.79	
15	04	398	13.00	7.60	380	3.47	0.76	
15	35	425	13.00	7.60	393	3.36	0.74	
16	03	463	13.00	7.60	394	3.35	0.74	
16	31	481	13.00	7.60	394	3.35	0.74	
17	03	513	13.00	7.60	397	3.32	0.73	
17	32	542	13.00	7.60	399	3.31	0.73	
20	34	724	13.00	7.60	414	3.19	0.70	
26/10	00	1530	13.00	7.60	430	3.07	0.68	Stop pump.

PUMP TEST – RECOVERY DATA

26/27	Aug.	1991
DAY	MONTH	YEAR

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Well "B" on Lot B

Datum Point Top of PVC casing

Elevation of Datum Point 0.26 m (0.84 ft) above grade

Static Water Level 5.40 ft (1.65 m)

Total Drawdown 7.60 ft (2.32 m)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	DISTANCE TO WATER	RESIDUAL DRAWDOWN (ft)		REMARKS
HR.	MIN.	t (min.)	t' (min.)					
10	00	1530	0		13.00	7.60		Stop pump.
10	15	1545	15	103	12.90	7.50		
10	30	1560	30	52	12.82	7.42		
10	45	1575	45	35	12.76	7.36		
11	45	1635	105	15.6	12.52	7.12		
12	45	1695	165	10.3	12.28	6.88		
15	00	1830	300	6.1	11.74	6.34		
17	45	1995	465	4.3	11.14	5.74		
19	59	2089	559	3.7	10.68	5.28		
27/07	05	2795	1265	2.2	9.41	4.01		

PUMP TEST -- DRAWDOWN DATA

3/4	Sept.	1991
DAY	MONTH	YEAR

CONTRACTOR Murray's Pump Service

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Location 29610 Dewdney Trunk Road

Well "C" on Lot A

Pumping Rate (Q) See below

Datum Point Top of 6" diameter PVC casing

Elevation of Datum Point 1.20 ft above grade

Static Water Level 2.90 ft (0.88 m)

Screen Location n/a - 16.10 ft deep dug well

TIME HR.	TIME MIN.	ELAPSED TIME t (MIN.)	DISTANCE TO WATER	DRAWDOWN (ft)	SECONDS TO FILL 22 LITRES	PUMPING RATE (L/min)	PUMPING RATE (igpm)	REMARKS
15	41							
15	42	2	11.18	8.28	5	264	58	
15	44	3	12.52	9.62				
15	50	9	11.73	8.83				Install piston pump.
15	55	14	12.11	9.21	47	17.2	10.3	
16	11	30	13.00	10.10				
16	19	38	13.00	10.10				
16	30	49	13.00	10.10	660	2.00	4.4 0.44	
04/08	00	979	13.00	10.10	900	1.47	3.2 0.32	
15	30	1429	13.00	10.10	1100	1.20	2.6 0.26	Stop pump.

PUMP TEST – RECOVERY DATA

4-7	Sept.	1991
DAY	MONTH	YEAR

PROJECT Charron/Pasquill - District of Mission Sub. Application S90-69

Well "C" on Lot A

Datum Point Top of 6" diameter PVC casing Elevation of Datum Point 1.20 ft above grade

Static Water Level 2.90 ft (0.88 m) Total Drawdown 10.10 ft (3.08 m)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	DISTANCE TO WATER	RESIDUAL DRAWDOWN		REMARKS
HR.	MIN.	t (min.)	t' (min.)			(ft)		
15	30	1429			13.00	10.10		Stop pump.
15	37	1436	7	205.1	12.97	10.07		
15	42	1441	12	120.1	12.92	10.02		
15	49	1448	19	76.2	12.88	9.98		
16	00	1459	30	48.6	12.85	9.95		
18	30	1609	180	8.9	12.58	9.68		
21	00	1759	330	5.3	12.13	9.23		
05/08	00	2419	990	2.4	10.05	7.15		
12	00	2659	1230	2.2	9.92	7.02		
17	00	2959	1530	1.93	9.45	6.55		
21	00	3199	1770	1.81	8.49	5.59		
06/08	00	3859	2430	1.59	5.57	2.67		
16	30	4369	2940	1.49	3.70	0.80		
07/08	00	5299	3870	1.37	3.45	0.55		
14	30	5689	4260	1.34	3.45	0.55		

Figure 3. Semi-logarithmic Plot of Drawdown During Pump Down of Charron Well "A"

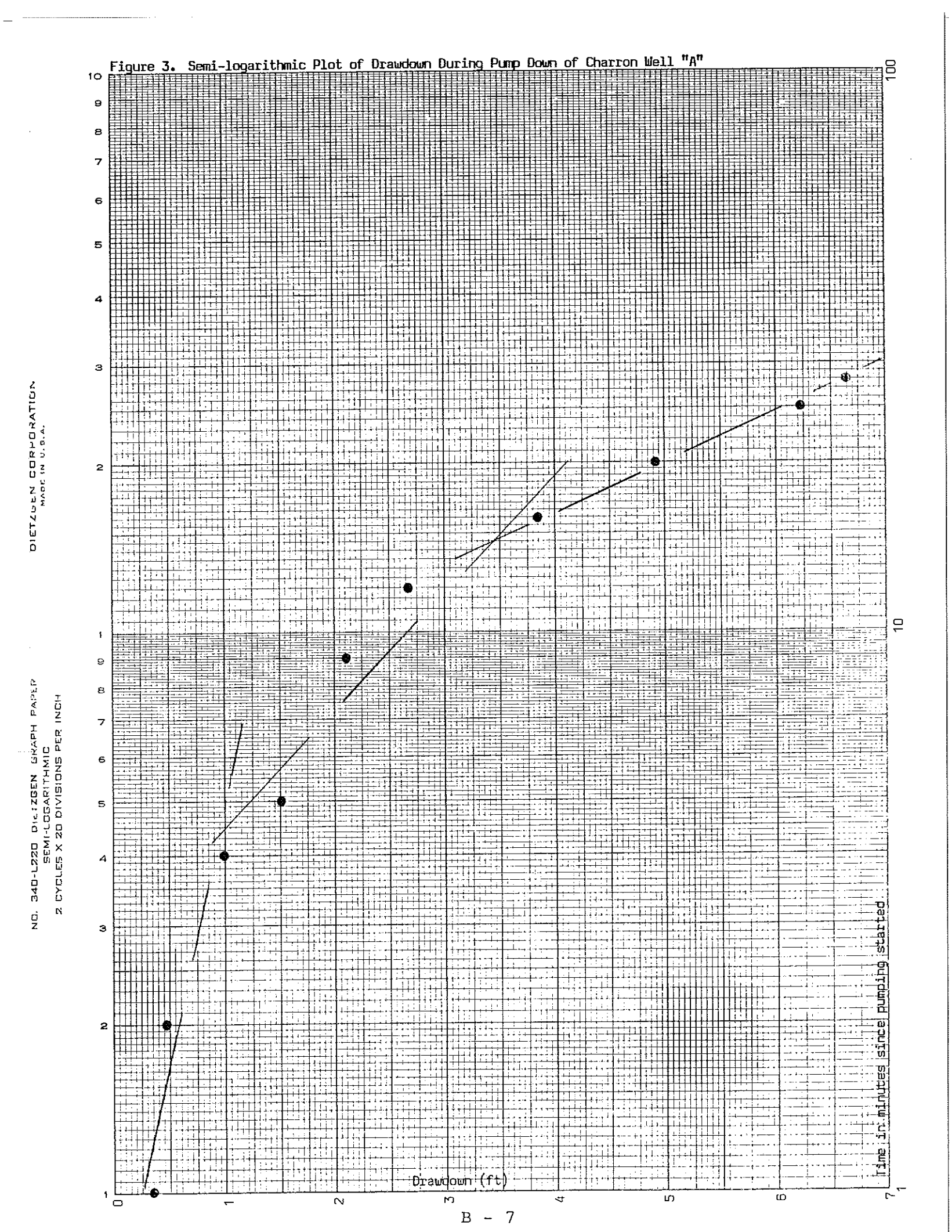
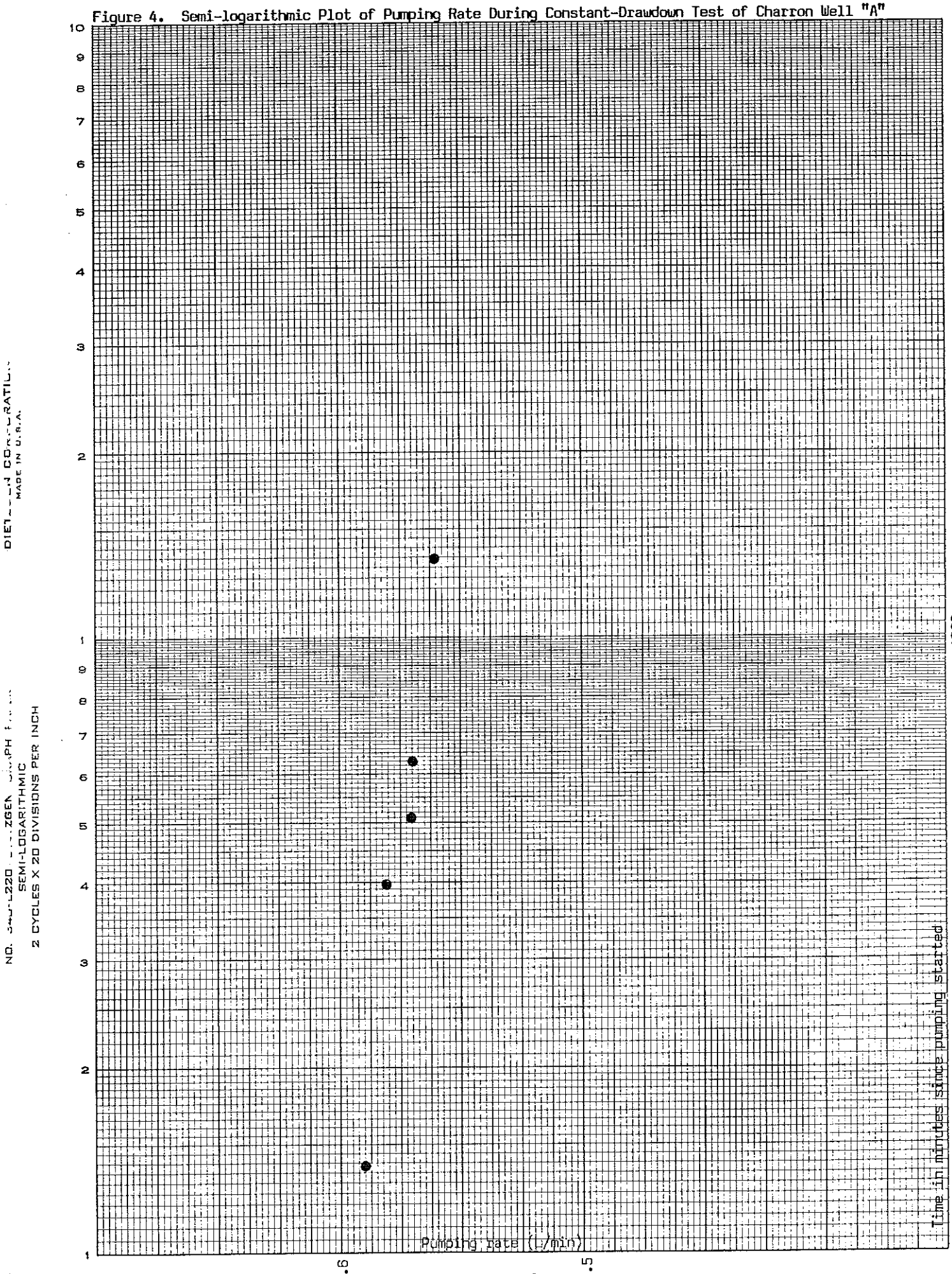
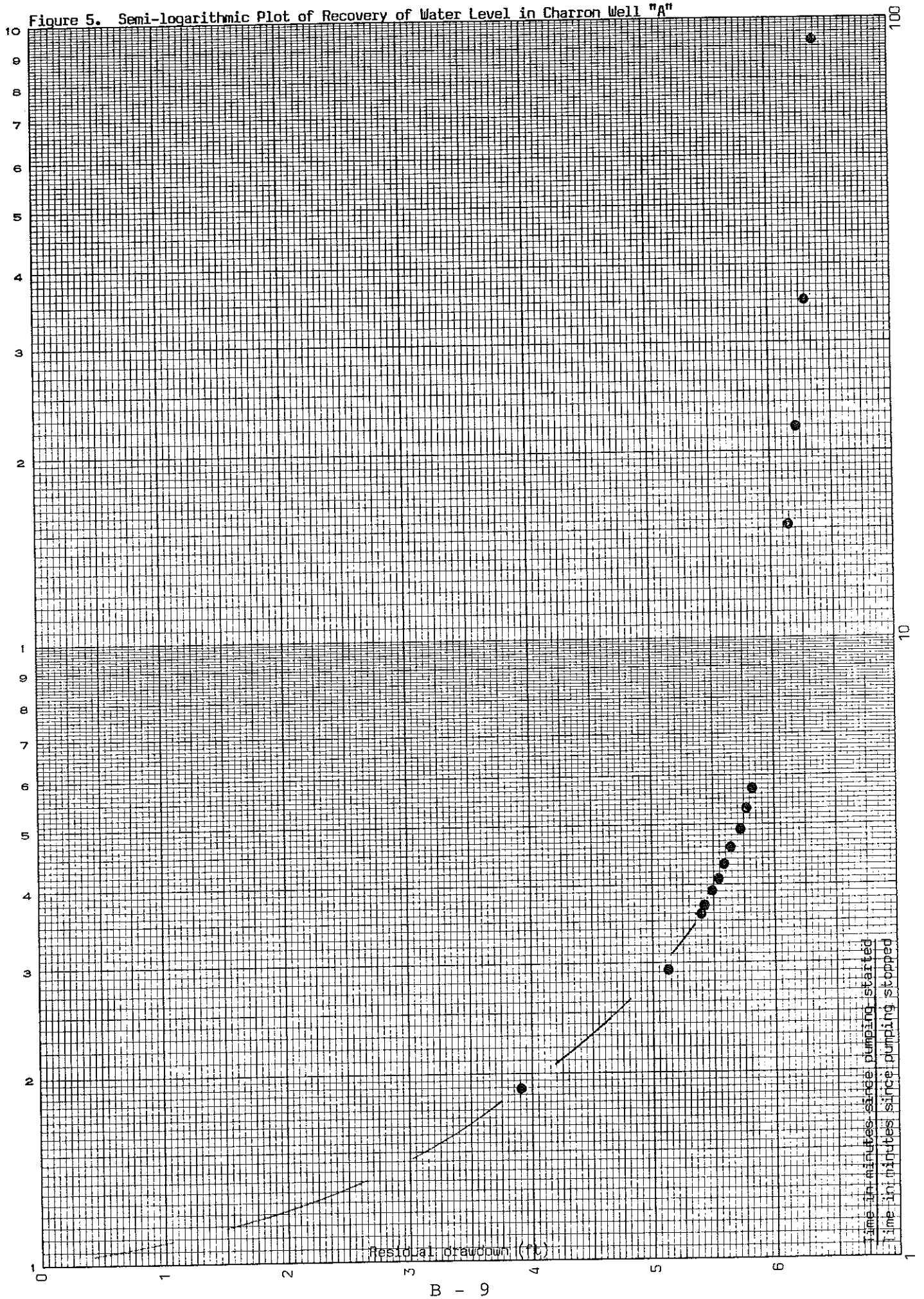


Figure 4. Semi-logarithmic Plot of Pumping Rate During Constant-Drawdown Test of Charron Well "A"



SEMI-LOGARITHMIC
2 CYCLES X 20 DIVISIONS PER INCH
MADE IN U.S.A.

Figure 5. Semi-logarithmic Plot of Recovery of Water Level in Charron Well "A"



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MADE IN U.S.A.

NO. 340-L22D DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 20 DIVISIONS PER INCH

Figure 6. Semi-logarithmic Plot of Drawdown During Pump Down of Charron Well "B"

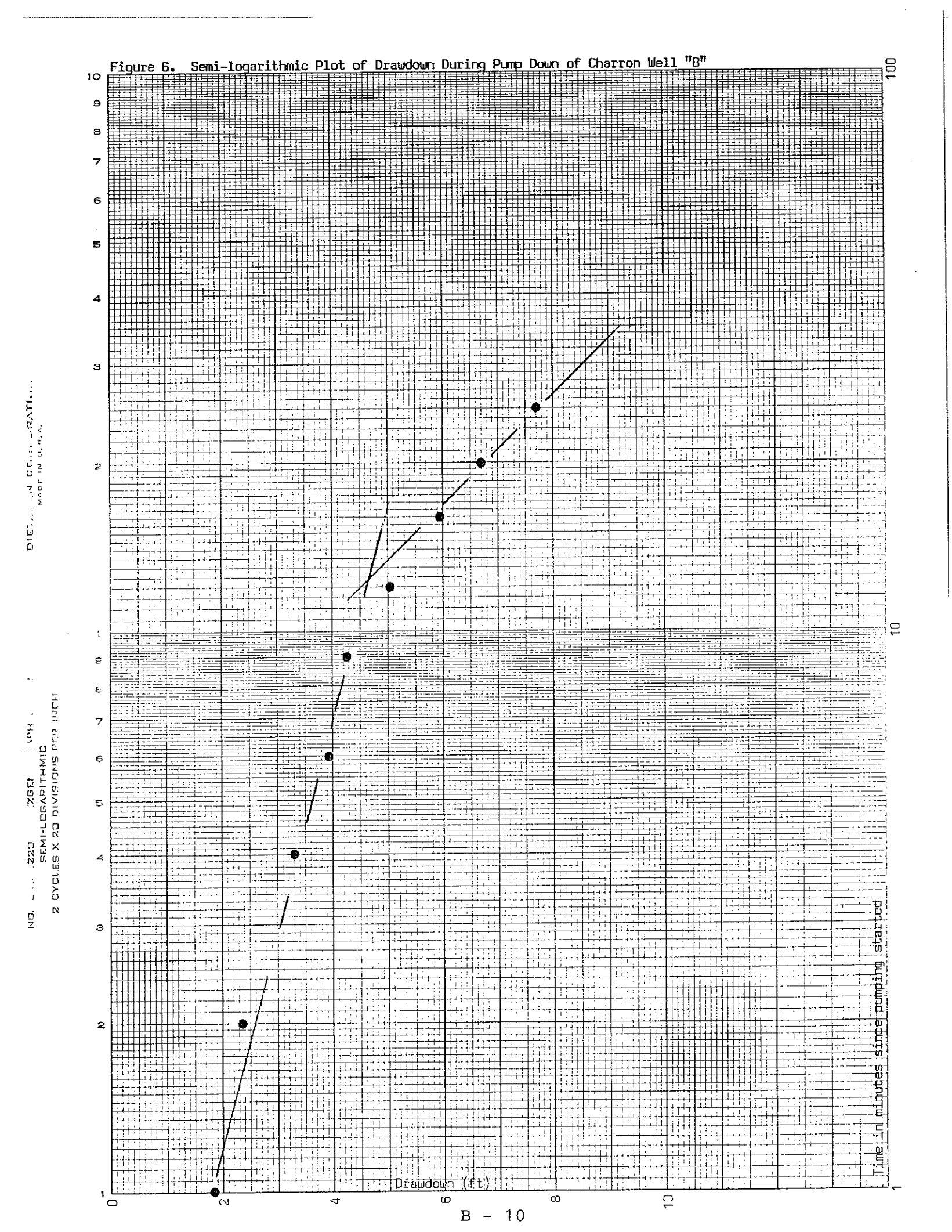


Figure 7. Semi-logarithmic Plot of Pumping Rate During Constant-Drawdown Test of Charron Well "B"

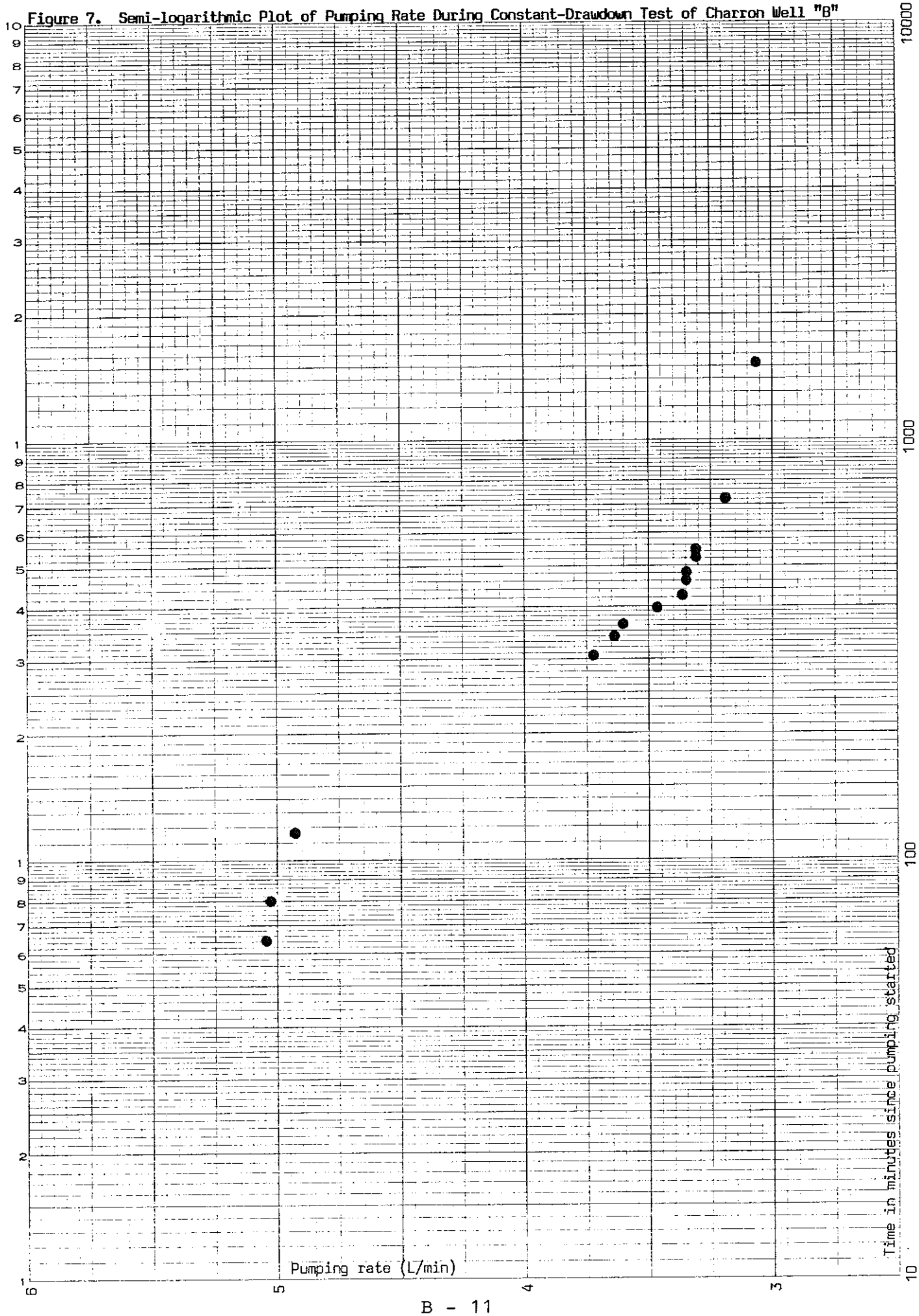


Figure 8. Semi-logarithmic Plot of Recovery of Water in Charron Well "B"

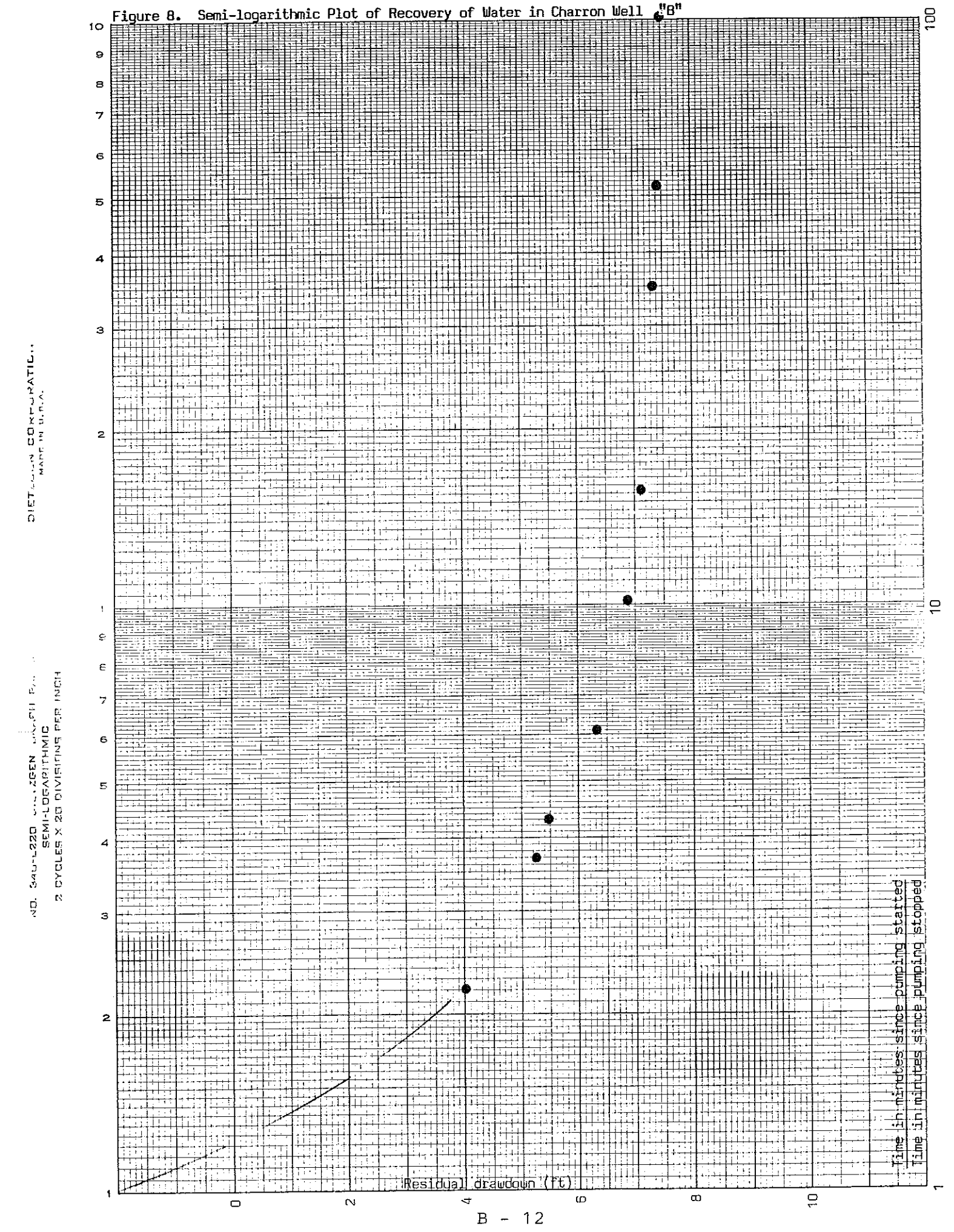


Figure 9. Semi-logarithmic Plot of Pumping Rate During Constant-Drawdown Test of Charron Well "C"

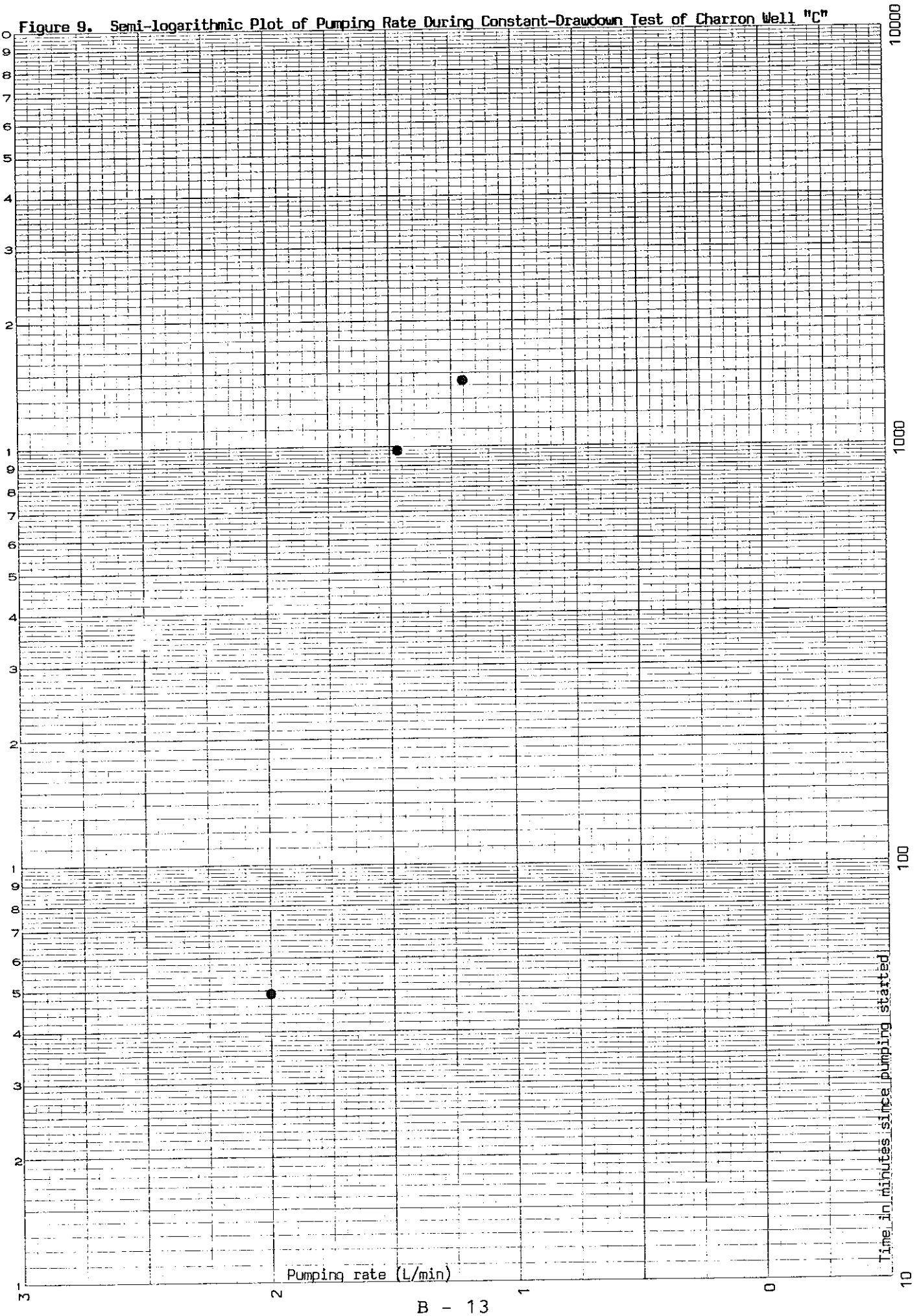
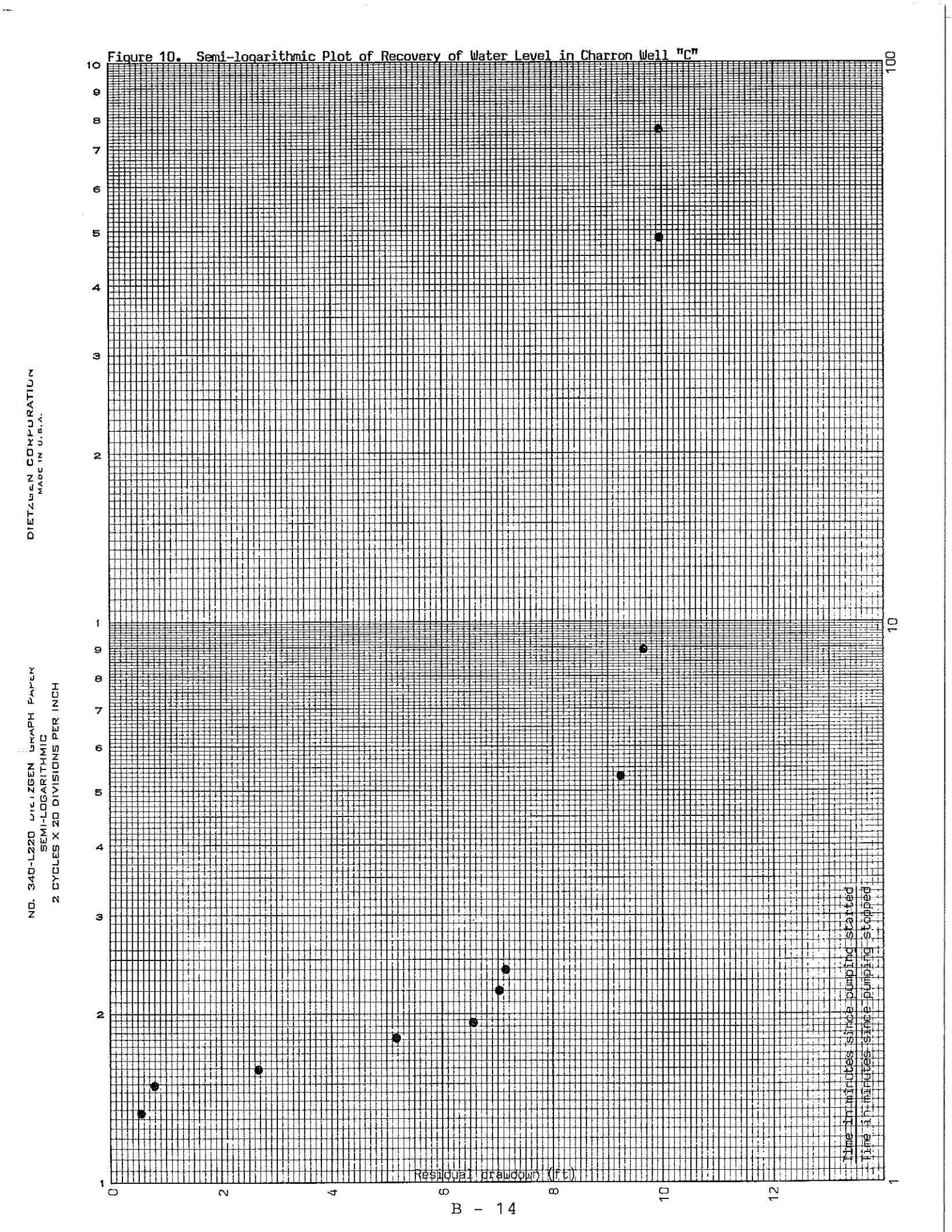


Figure 10. Semi-logarithmic Plot of Recovery of Water Level in Charron Well "C"



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MADE IN U.S.A.

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SEMI-LOGARITHMIC
2 CYCLES X 20 DIVISIONS PER INCH

APPENDIX C

WATER QUALITY CERTIFICATES

Norwest Labs

"We Solve Problems"

203 - 20771 Langley By-Pass
Langley, B.C. V3A 5E8
Phone (604) 530-4344
Fax (604) 534-9996

Date: July 26, 1991

Work Order No.: 2889

Source of Sample:

Domestic Well Water from Well "A" - West Lot
29710 Dewdney

CERTIFICATION OF POTABILITY

Norwest Soil Research Inc. certifies that the above mentioned water sample number 91-3166 supplied by J. Charron meets the chemical and bacteriological requirements specified by the 1989 Guidelines for Canadian Drinking Water Quality for the constituents tested.

Sincerely,

Dr. Thomas F. Guthrie, P.Ag.
Laboratory Manager

TELEPHONE (604) 530-4344
FACSIMILE (604) 534-9996

NORWEST LABS

"Keeping B.C. Growing"

WATER ANALYSIS REPORT

W.O. NUMBER : 2889
LAB. NUMBER : 913166

SAMPLE RECEIVED : 06-12-1991
ANALYSIS COMPLETED : 07-26-1991
SAMPLE RETAINED FOR 30 DAYS

SAMPLE SUBMITTED BY :

J. CHARRON
21486 - EXETER AVENUE
MAPLE RIDGE, B.C. V3Z 1A7

SAMPLE IDENTIFICATION : WELL "A", WEST LOT - 29710 DEWDNEY

ANALYTICAL RESULTS			GUIDELINES FOR DRINKING WATER
pH	7.09		pH values between 6.5 & 8.5 considered acceptable
Electrical Conductivity	0.11	ms/cm	Values above 1.0 ms/cm indicate increasing salt content
Total Dissolved Solids	100	mg/l	Objective level 500 mg/l; higher values indicate high salts
Total Suspended Solids	11	mg/l	Values above 250 mg/l indicate increasing levels of sediment
Ammonium-N	0.0	mg/l	Acceptable values below 0.5 mg/l; objective level below 0.01 mg/l
Potassium	1.2	mg/l	No acceptable level set; values normally in the 0.5 to 10 mg/l range
Calcium	4.1	mg/l	Below 200 mg/l acceptable; objective level below 75 mg/l
Magnesium	1.4	mg/l	Below 150 mg/l acceptable; objective level below 50 mg/l
Sodium	6.6	mg/l	Below 300 mg/l acceptable; over 20 mg/l high for low sodium diets
Iron	0.00	mg/l	Above 0.3 mg/l may cause staining & deposits; objective limit 0.05 mg/l
Copper	0.00	mg/l	Below 1.0 mg/l acceptable; objective limit below 0.01 mg/l
Zinc	0.00	mg/l	Below 5.0 mg/l acceptable; objective limit below 1.0 mg/l
Manganese	0.06	mg/l	Below 0.05 mg/l acceptable; objective limit below 0.01 mg/l
Phosphate-P	0.0	mg/l	No acceptable limit set; below 0.2 mg/l desirable
Sulphate-S	0.5	mg/l	Below 500 mg/l acceptable; objective limit below 250 mg/l
Nitrate-N	0.4	mg/l	Below 10 mg/l acceptable; high values may indicate contamination
Chloride	12.0	mg/l	Below 250 mg/l acceptable
Fluoride	0.69	mg/l	Values up to 1.2 mg/l desirable; under 1.5 mg/l acceptable
Boron	0.02	mg/l	Below 5.0 mg/l acceptable
Carbonate	0	mg/l	Presence indicates alkaline water
Bicarbonate	12	mg/l	Presence indicates mildly alkaline water
Hardness (CaCO3 equiv)	16	mg/l	Soft waters are less than 75 mg/l; hard waters above 150 mg/l
Total coliforms	0/100ml		Above 2/100 ml unacceptable
Fecal coliforms	0/100ml		Greater than 0/100ml unacceptable

Results quoted as zero indicate concentrations below the following detection limits:
Less than 0.01 mg/l Fe, Cu, Zn, Mn, B
Less than 0.05 mg/l Na, Ca, Mg, K, PO4-P, NH4-N, NO3-N
Less than 0.10 mg/l Cl, Fl, SO4-S; Less than 1 mg/l TDS, TSS, carbonate & bicarbonate

Norwest Labs

"We Solve Problems"

203 - 20771 Langley By-Pass
Langley, B.C. V3A 5E8
Phone (604) 530-4344
Fax (604) 534-9996

Date: August 2, 1991

Work Order No.: 2889

Source of Sample:

Domestic Well Water from Well "B" East Lot - 29710 Dewdney

CERTIFICATION OF POTABILITY

Norwest Soil Research Inc. certifies that the above mentioned water sample number 91-3167 supplied by J. Charron meets the chemical and bacteriological requirements specified by the 1989 Guidelines for Canadian Drinking Water Quality for the constituents tested.

Sincerely,

Thomas F. Guthrie

Dr. Thomas F. Guthrie, P.Ag.
Laboratory Manager

TELEPHONE (604) 530-4344
FACSIMILE (604) 534-9996

NORWEST LABS

"Keeping B.C. Growing"

WATER ANALYSIS REPORT

W.O. NUMBER : 2889
LAB. NUMBER : 913167

SAMPLE RECEIVED : 06-12-1991
ANALYSIS COMPLETED : 08-02-1991
SAMPLE RETAINED FOR 30 DAYS

SAMPLE SUBMITTED BY :

J. CHARRON
21486 - EXETER AVENUE
MAPLE RIDGE, B.C. V3Z 1A7

SAMPLE IDENTIFICATION : WELL "B" EAST LOT - 29710 DEWDNEY

ANALYTICAL RESULTS			GUIDELINES FOR DRINKING WATER
pH	7.05		pH values between 6.5 & 8.5 considered acceptable
Electrical Conductivity	0.13	ms/cm	Values above 1.0 ms/cm indicate increasing salt content
Total Dissolved Solids	103	mg/l	Objective level 500 mg/l; higher values indicate high salts
Total Suspended Solids	15	mg/l	Values above 250 mg/l indicate increasing levels of sediment
Ammonium-N	0.0	mg/l	Acceptable values below 0.5 mg/l; objective level below 0.05 mg/l
Potassium	0.8	mg/l	No acceptable level set; values normally in the 0.5 to 10 mg/l range
Calcium	9.1	mg/l	Below 200 mg/l acceptable; objective level below 75 mg/l
Magnesium	2.2	mg/l	Below 150 mg/l acceptable; objective level below 50 mg/l
Sodium	8.9	mg/l	Below 300 mg/l acceptable; over 20 mg/l high for low sodium diets
Iron	0.00	mg/l	Above 0.3 mg/l may cause staining & deposits; objective limit 0.05 mg/l
Copper	0.00	mg/l	Below 1.0 mg/l acceptable; objective limit below 0.05 mg/l
Zinc	0.00	mg/l	Below 5.0 mg/l acceptable; objective limit below 1.0 mg/l
Manganese	0.04	mg/l	Below 0.05 mg/l acceptable; objective limit below 0.01 mg/l
Phosphate-P	0.0	mg/l	No acceptable limit set; below 0.2 mg/l desirable
Sulphate-S	0.3	mg/l	Below 500 mg/l acceptable; objective limit below 250 mg/l
Nitrate-N	0.5	mg/l	Below 10 mg/l acceptable; high values may indicate contamination
Chloride	16.7	mg/l	Below 250 mg/l acceptable
Fluoride	0.70	mg/l	Values up to 1.2 mg/l desirable; under 1.5 mg/l acceptable
Boron	0.06	mg/l	Below 5.0 mg/l acceptable
Carbonate	0	mg/l	Presence indicates alkaline water
Bicarbonate	29	mg/l	Presence indicates mildly alkaline water
Hardness (CaCO3 equiv)	32	mg/l	Soft waters are less than 75 mg/l; hard waters above 150 mg/l
Total coliforms	0/100ml		Above 2/100 ml unacceptable
Fecal coliforms	0/100ml		Greater than 0/100ml unacceptable

Results quoted as zero indicate concentrations below the following detection limits:
Less than 0.01 mg/l Fe, Cu, In, Mn, P
Less than 0.05 mg/l Na, Ca, Mg, K, PO4-P, NH4-N, NO3-N
Less than 0.10 mg/l Cl, Fl, SO4-S; Less than 1 mg/l TDS, TSS, carbonate & bicarbonate