CERTIFICATION OF WATER QUANTITY AND QUALITY FOR THE NORTH LOT OF A RURAL SUBDIVISION AT 33257 RICHARDS Avenue IN THE DISTRICT OF MISSION

(District of Mission Subdivision Application S91-075 and File PRF 15-40)

Prepared for

MR. R. (BOB) AND MRS. KAREN KNAPP
33257 Richards Avenue,
MISSION, B.C. V2V 5X4

Prepared by

PACIFIC HYDROLOGY CONSULTANTS LTD.
204 - 1929 West Broadway
VANCOUVER, B.C. V6J 1Z3

May 25, 1992

E. LIVINGSTON, P. Eng.
A. BADRY

PACIFIC HYDROLOGY CONSULTANTS LTD.

CONSULTING GROUNDWATER GEOLOGISTS

204 - 1929 WEST BROADWAY
VANCOUVER, B.C. V6J 1Z3
TELEPHONE: (604) 738-9232

May 25, 1992

Mr. R. (Bob) and Mrs. Karen Knapp
33257 Richards Avenue,
MISSION, B.C. V2V 5X4

Subject: **Certification of Water Quantity and Quality for the North Lot of a Rural Subdivision at 33257 Richards Avenue in the District of Mission**
District of Mission Subdivision Application S91-075 and File PRF 15-40

Dear Sir:

This letter-report is further to several telephone discussions between Mr. Bob Knapp and Ed Livingston, P. Eng. of Pacific Hydrology Consultants Ltd., to onsite discussions between Mr. Bob Knapp and Ed Livingston during a preliminary site investigation on March 3 and to later discussions onsite on May 14, about groundwater conditions in the subject area and about procedures for constructing and pump testing a dug well on the North Lot to be created by the subdivision of a parcel of land at 33257 Richards Avenue in the District of Mission.

1.0 INTRODUCTION

The purpose of this letter is to present information which confirms that the new dug well constructed on the North Lot of the proposed subdivision of Lot 13, S.W. ¼ of Section 4, Township 18, Plan 35599, New Westminster District, will "...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 under District of Mission

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Bylaw No. 2203-1990. This letter also discusses the quality of groundwater yielded by the Well 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 Knapp Subdivision is shown on Figure 1 in Appendix A and the local topography, subdivision layout and well locations are shown on Figure 2, a draft plan prepared by D.G. Fenning, B.C.L.S.; as shown on the draft plan, access to the North Lot is by a panhandle off Richards Avenue. We understand that the proposed disposal field for the new Lot will be located more than 30 m (100 ft) south of the Well.

The subject Knapp Well is 4.1 m (13.5 ft) deep below ground level; the top of the concrete casing projects 0.73 m (2.4 ft) above ground. We understand that the Well was excavated through about one-half metre (1½ ft) of loam soil, over 1.8 m (6 ft) of brown stony silt, over 1.8 m (6 ft) of sand and gravel resting on bedrock; 0.91 m (36") diameter concrete casing, perforated for the bottom 1.8 m (6 ft), was then set in the hole and surrounded by drain rock to a depth of 1.8 m (6 ft). The upper part of the hole was backfilled with excavated soil which was separated from the underlying drain rock by a sheet of plastic.

The closest well to the subject Well is a dug well about 3 m (10 ft) deep which supplies the existing Knapp Residence and which can be supplemented, if required by water from a buried pipeline from a spring that supplies a neighbour across Richards Avenue. The old Knapp Well on the South Lot is more than 200 metres (660 ft) from the new Well.

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2.0 HYDROGEOLOGY

The proposed Knapp Subdivision is located on the north side of Richards Avenue, on the lower slope of an unnamed Mountain which forms the east side of the Steelhead Valley. According to Geological Survey of Canada Map 1485A, **Surficial Geology Mission, British Columbia,** the surficial cover in the area of the proposed Subdivision is "Lodgment and minor flow till: **Sf,** sandy till and substratified drift 2 to 10 m thick".

The sediments reported to have been encountered in the excavation of the subject Well can probably be classified as substratified drift. The Well is located in an obvious area of groundwater discharge, as shown by the type of local vegetation and by the near-surface static water level of the Well. Before the digging of the subject Well, another hole had been dug east of the well; this first excavation did not encounter the sand and gravel present in the subject Well so it was abandoned as a well and a small pond was dug at that location. The pond has gradually been filling with groundwater.

3.0 WELL CAPACITY

To assess whether the capacity of the subject Well on the North Lot of the proposed Knapp Subdivision satisfies District of Mission Bylaw 2203-1990, the Well was pump tested by the Owner, according to instructions by Pacific Hydrology and under Pacific Hydrology's supervision, using a syphon created by disconnecting the pipe from the spring and discharging the water down slope near the old Knapp Well. The flow rate during the test was determined by timing the filling of a container of known volume. Since the flow rate was less than 9 L/min (1.98 igpm) because of the small diameter of

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the syphon pipe, and in order to show that the Well complies with Bylaw 2203-1990, the Owner carried out a second test using a small contractor's pump with a control valve. During this test, the Well was pumped at 13.9 L/min (3.1 igpm) for 100 minutes, followed by pumping at 12.9 L/min (2.84 igpm) for 140 minutes, over a total of four hours. The data collected during the capacity tests, along with standard straight-line plots of the data, are attached in Appendix B.

The subject Well was tested using a constant-rate procedure. The testing, which started at 11:50 a.m. on May 12, was carried out with the syphon discharging initially at a rate of 7.76 litres per minute (1.7 igpm); the rate gradually declined to 7.33 L/min (1.6 igpm) by 25 minutes after the start and, finally, to 7.14 L/min (1.57 igpm) by 610 minutes, following which the rate remained constant to the end of the test at 2650 minutes (44.2 hrs). At the final rate, at the end of 2650 minutes of syphoning, the total drawdown in the Well was 1.43 m (4.69 ft) and increasing at a rate about 0.008 m (0.025 ft) per hour, as shown on Figure 3 (Page B - 6). The recovery of the water level was observed on a fairly regular basis for 24 hours after pumping was terminated, by which time the residual drawdown was 0.190 m (0.625 ft) and, as shown on the plot of the recovery data (Figure 5, Page B - 8), complete recovery to the pre-pumping static water level will occur; this response confirms that recharge conditions are satisfactory. The satisfactory recharge conditions are also shown by the supplementary test in which complete recovery can also be projected (Figure 6, Page B - 9).

Although the pumping water level did not reach stability during the 44.2-hour test, the long-term capacity of the subject Well is at least as high as the syphon rate. Capacity testing of the dug well on the North Lot of the proposed Knapp Subdivision, therefore, has clearly shown that the capacity of the Well satisfies the minimum quantity requirement specified in District of Mission Bylaw 2203-1990. Because the Well is located in the groundwater discharge zone, we expect that even in very dry summers there will be little reduction in well capacity.

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4.0 GROUNDWATER QUALITY

Appendix C contains a certificate of analysis from Canadian Lysozyme Inc. (C.L.I.) dated May 12, 1992 and identified as Certificate Number 2532. The results presented by C.L.I. show that the water from the subject Knapp Well satisfies B.C. Ministry of Health's Drinking Water Standards for all parameters checked, including bacteriological.

The groundwater represented by the C.L.I. analysis is a very soft complex calcium & sodium/bicarbonate + chloride type water with low mineralization; the complex groundwater type is a reflection of the location of the Well in the groundwater discharge zone. The water is of generally excellent quality for domestic consumption.

5.0 HYDROGEOLOGIC IMPACT ASSESSMENT

Because of its position in the groundwater flow system, and in consideration of the distance to other wells, use of the subject Well on the North Lot of the Knapp Subdivision is unlikely to have any impact on existing drilled and/or dug wells, or on the source aquifers in the area, either in the short or long term.

The near-surface sediments encountered in the excavation for the subject well show that conditions for proper operation of wastewater drain fields are suitable for treatment of the effluent in the soil before it reaches the water table; therefore, there is no risk to the well water source from properly constructed and maintained disposal facilities. The planned site for the disposal field is "downstream" from the well and outside of the groundwater discharge zone.

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6.0 SUMMARY AND CONCLUSIONS

1. The proposed Knapp rural Subdivision, at 33257 Richards Avenue in the District of Mission, is located in a groundwater discharge zone near the base of the south-facing slope of an unnamed Mountain which forms the east side of the Steelhead Valley.

2. Excavating to construct a dug well on the North Lot to be created by the Knapp Subdivision, encountered a thin cover of surficial sediments, best classified as substratified drift, as shown on Geological Survey of Canada Map 1485A of the surficial geology; the dug well encountered a local permeable zone of sand and gravel above the rock.

3. Capacity testing confirms that the recently constructed dug well, which is to be used as the source of domestic water for the North Lot of the proposed Knapp Subdivision of Lot 13, Section 4, Township 18, Plan 35599, 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.

4. A chemical analysis carried out by Canadian Lysozyme Inc. shows that the groundwater from the subject Well on the North Lot of the proposed Knapp Subdivision meets B.C. Ministry of Health's drinking water quality standards for all parameters checked, including bacteriological, and is of generally good quality for domestic consumption.

5. Under the prevailing circumstances, the new dug well on the North Lot of the proposed Knapp Subdivision will not have any negative impacts on other existing drilled and/or dug wells in the area or on the source aquifers.

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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 new dug well on the North Lot of the proposed Subdivision at 33257 Richards Avenue. Please call if we can be of further assistance with this matter.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.

E. Livingston

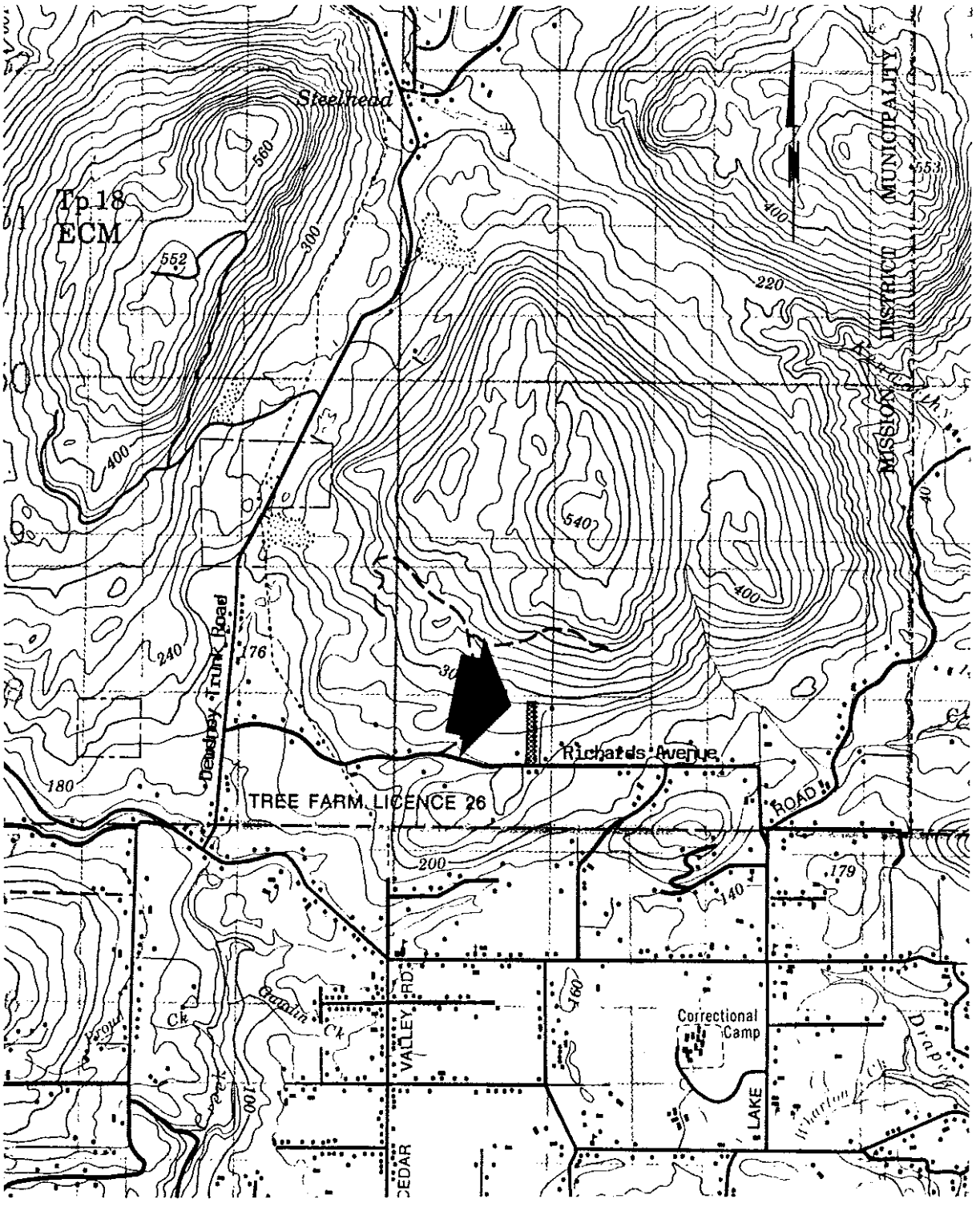
E. Livingston, P. Eng.

Attachments

APPENDIX A

AREA LOCATION MAP AND SUBDIVISION PLAN

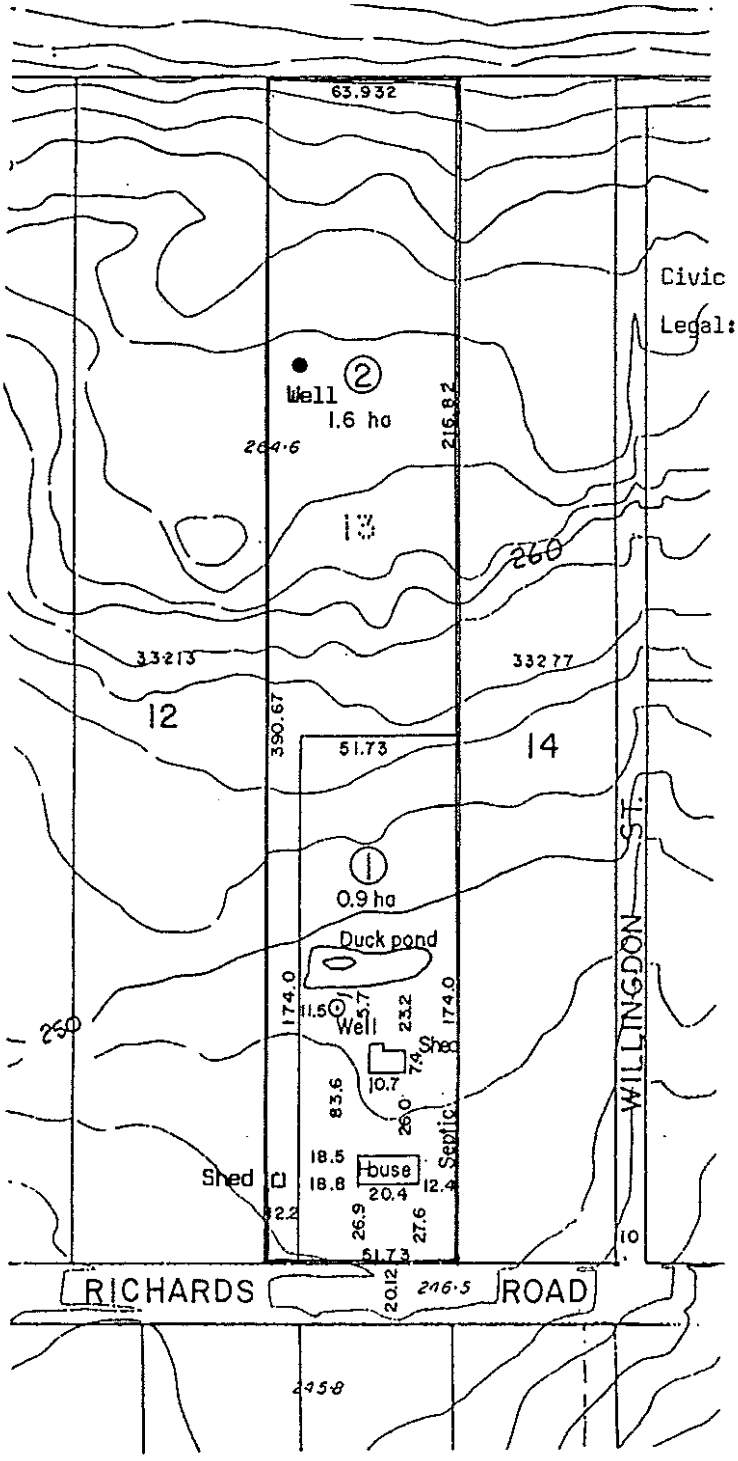
FIGURE 1	AREA LOCATION MAP - PROPOSED KNAPP SUBDIVISION ON RICHARDS AVENUE, MISSION



Notes:

1. The base map is 1:50,000 scale topographic map N.T.S. 92G/1, **Mission**, enlarged to a scale of approximately 1:39,000; contour interval is 20 metres.
2. ▮ indicates location of proposed Knapp Subdivision on Richards Avenue.

FIGURE 2	DRAFT PLAN OF PROPOSED KNAPP SUBDIVISION ON RICHARDS AVENUE, DISTRICT OF MISSION



Civic adress: 33257 Richards Ave.

Legal: Lot 13, S.W.¼, Sec. 4, Tp. 18, N.W.D., Plan 35599

Note: Duck Pond is manmade.

Notes:

1. The base map is a 1:2500 scale plan by D.G. Fenning, B.C.L.S., (File 9112257), dated 12th of December, 1991; contour interval is two metres.
2. ⊙ ● indicates respective locations of existing and new dug wells.

APPENDIX B

PUMPING TEST DATA AND PLOTS

PUMP TEST - DRAWDOWN DATA

Project: BOB & KAREN KNAPP

Location: 33257 Richards Avenue
Mission, B.C.

Well: Dug on Lot 2

Datum: Top of concrete cover

Elevation of Datum: 2.4 ft agl

Static Water Level: 3.79 ft

Well Depth: 13.5 ft bgl

TIME	ELAPSED TIME t(min)	DISTANCE TO WATER (ft)	DRAWDOWN (ft)	TIME TO FILL 22 LITRES (sec)	PUMPING RATE (L/min)	REMARKS
05/12/92						
11:50		3.79				Static level; start.
11:51	1	3.96	0.17	170	7.76	
11:52	2	4.04	0.25	170	7.76	
11:53	3	4.10	0.31	170	7.76	
11:54	4	4.13	0.34	170	7.76	
11:55	5	4.16	0.37	170	7.76	
11:56	6	4.19	0.40	170	7.76	
11:57	7	4.22	0.43			
11:58	8	4.24	0.45			
11:59	9	4.28	0.49			
12:00	10	4.31	0.52			
12:02	12	4.35	0.56	170	7.76	
12:04	14	4.41	0.62	170	7.76	
12:06	16	4.48	0.69	170	7.76	
12:08	18	4.52	0.73			
12:10	20	4.57	0.78			
12:15	25	4.70	0.91	180	7.33	
12:20	30	4.82	1.03			
12:25	35	4.95	1.16			
12:30	40	5.06	1.27			
12:35	45	5.17	1.38	180	7.33	
12:40	50	5.28	1.49			
12:50	60	5.47	1.68			
13:00	70	5.65	1.86	180	7.33	
13:20	90	5.96	2.17			
13:40	110	6.24	2.45			
14:00	130	6.48	2.69	180	7.33	
14:30	160	6.74	2.95			
15:00	190	6.98	3.19	180	7.33	
15:30	220	7.13	3.34	180	7.33	

PUMP TEST - DRAWDOWN DATA

Project: BOB & KAREN KNAPP

Static Water Level: 3.79 ft Well: Dug on Lot 2

TIME	ELAPSED TIME t(min)	DISTANCE TO WATER (ft)	DRAWDOWN (ft)	TIME TO FILL 22 LITRES (sec)	PUMPING RATE (L/min)	REMARKS
05/12/92						
16:00	250	7.31	3.52	180	7.33	
17:00	310	7.51	3.72			
18:00	370	7.66	3.87			
20:00	490	7.67	3.88			
22:00	610	7.72	3.93	185	7.14	
24:00	730	7.77	3.98	185	7.14	
05/13/92						
08:00	1,210	8.06	4.27	185	7.14	
12:00	1,450	8.17	4.38			
16:00	1,690	8.27	4.48			
20:00	1,930	8.35	4.56			
24:00	2,170	8.42	4.63	185	7.14	
05/14/92						
08:00	2,650	8.48	4.69			Stop pump.

PUMP TEST - RECOVERY DATA

Project: BOB & KAREN KNAPP

Location: 33257 Richards Avenue
Mission, B.C.

Well: Dug on Lot 2

Datum: Top of concrete cover

Elevation of Datum: 2.4 ft agl

Static Water Level: 3.79 ft

Final Drawdown: 4.69 ft

TIME	ELAPSED TIME SINCE PUMPING STARTED t(min)	ELAPSED TIME SINCE PUMPING STOPPED t'(min)	RATIO (t/t')	DISTANCE TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	REMARKS
05/14/92						
08:00	2650	0		8.48	4.69	Stop pump.
09:00	2710	60	45.2	6.92	3.13	
10:00	2770	120	23.1	6.01	2.22	
11:00	2830	180	15.7	5.44	1.65	
12:00	2890	240	12.0	5.06	1.27	
13:00	2950	300	9.8	4.88	1.09	
14:00	3010	360	8.4	4.76	0.97	
15:00	3070	420	7.3	4.67	0.88	
16:00	3130	480	6.5	4.60	0.81	
20:00	3370	720	4.7	4.52	0.73	
24:00	3610	960	3.8	4.50	0.71	
05/15/92						
08:00	4090	1440	2.8	4.42	0.63	

SUPPLEMENTARY PUMP TEST - DRAWDOWN DATA

Project: BOB & KAREN KNAPP

Location: 33257 Richards Avenue
Mission, B.C.

Well: Dug on Lot 2

Datum: Top of concrete cover

Elevation of Datum: 2.4 ft agl

Static Water Level: 4.42 ft

Well Depth: 13.5 ft bgl

TIME	ELAPSED TIME t(min)	DISTANCE TO WATER (ft)	DRAWDOWN (ft)	TIME TO FILL 22 LITRES (sec)	PUMPING RATE (L/min)	REMARKS
15/05/92						
09:00	0	4.42		95	13.9	Static level;
09:01	1	4.51	0.09			start.
09:02	2	4.63	0.21			
09:03	3	4.67	0.25			
09:04	4	4.70	0.28			
09:05	5	4.75	0.33			
09:06	6	4.82	0.40			
09:07	7	4.88	0.46			
09:08	8	4.93	0.51			
09:09	9	4.98	0.56			
09:10	10	5.06	0.64			
09:12	12	5.13	0.71			
09:14	14	5.23	0.81			
09:16	16	5.33	0.91			
09:18	18	5.46	1.04			
09:20	20	5.58	1.16			
09:25	25	5.83	1.41			
09:30	30	6.10	1.68			
09:35	35	6.31	1.89			
09:40	40	6.54	2.12			
09:50	50	6.90	2.48			
10:00	60	7.21	2.79			
10:20	80	7.82	3.40			
10:40	100	8.25	3.83	102	12.9	
11:00	120	8.66	4.24			
11:30	150	9.16	4.74			
12:00	180	9.54	5.12			
12:30	210	9.83	5.41			
13:00	240	10.02	5.60			Stop pump.

SUPPLEMENTARY PUMP TEST - RECOVERY DATA

Project: BOB & KAREN KNAPP

Location: 33257 Richards Avenue
Mission, B.C.

Well: Dug on Lot 2

Datum: Top of concrete cover

Elevation of Datum: 2.4 ft agl

Static Water Level: 4.42 ft

Final Drawdown: 4.69 ft

TIME	ELAPSED TIME SINCE PUMPING STARTED t(min)	ELAPSED TIME SINCE PUMPING STOPPED t'(min)	RATIO (t/t')	DISTANCE TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	REMARKS
05/15/92						
13:00	240	0		10.02	5.60	Stop pump.
14:00	300	60	5.0	8.00	3.58	
15:00	360	120	3.0	6.69	2.27	
16:00	420	180	2.3	5.85	1.43	
17:00	480	240	2.0	5.35	0.93	
19:00	600	360	1.7	4.91	0.49	
21:00	720	480	1.5	4.71	0.29	
23:00	840	600	1.4	4.63	0.21	
05/16/92						
08:00	1380	1140	1.2	4.54	0.12	
12:00	1620	1380	1.2	4.50	0.08	
16:00	1860	1620	1.1	4.42	0.00	

FIGURE 3. KNAPP DUG WELL DRAWDOWN PLOT

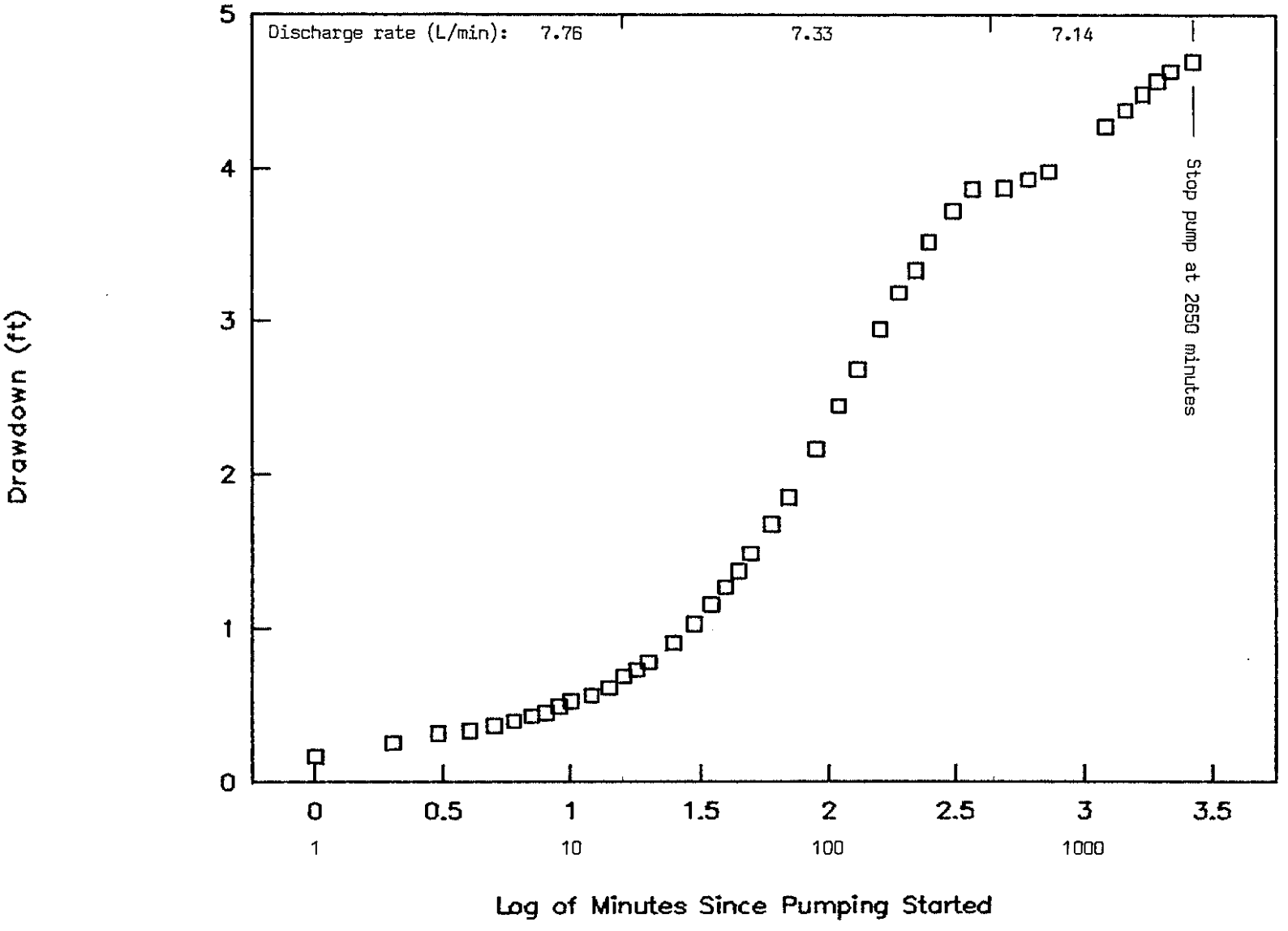


FIGURE 4. KNAPP WELL DRAWDOWN PLOT 2

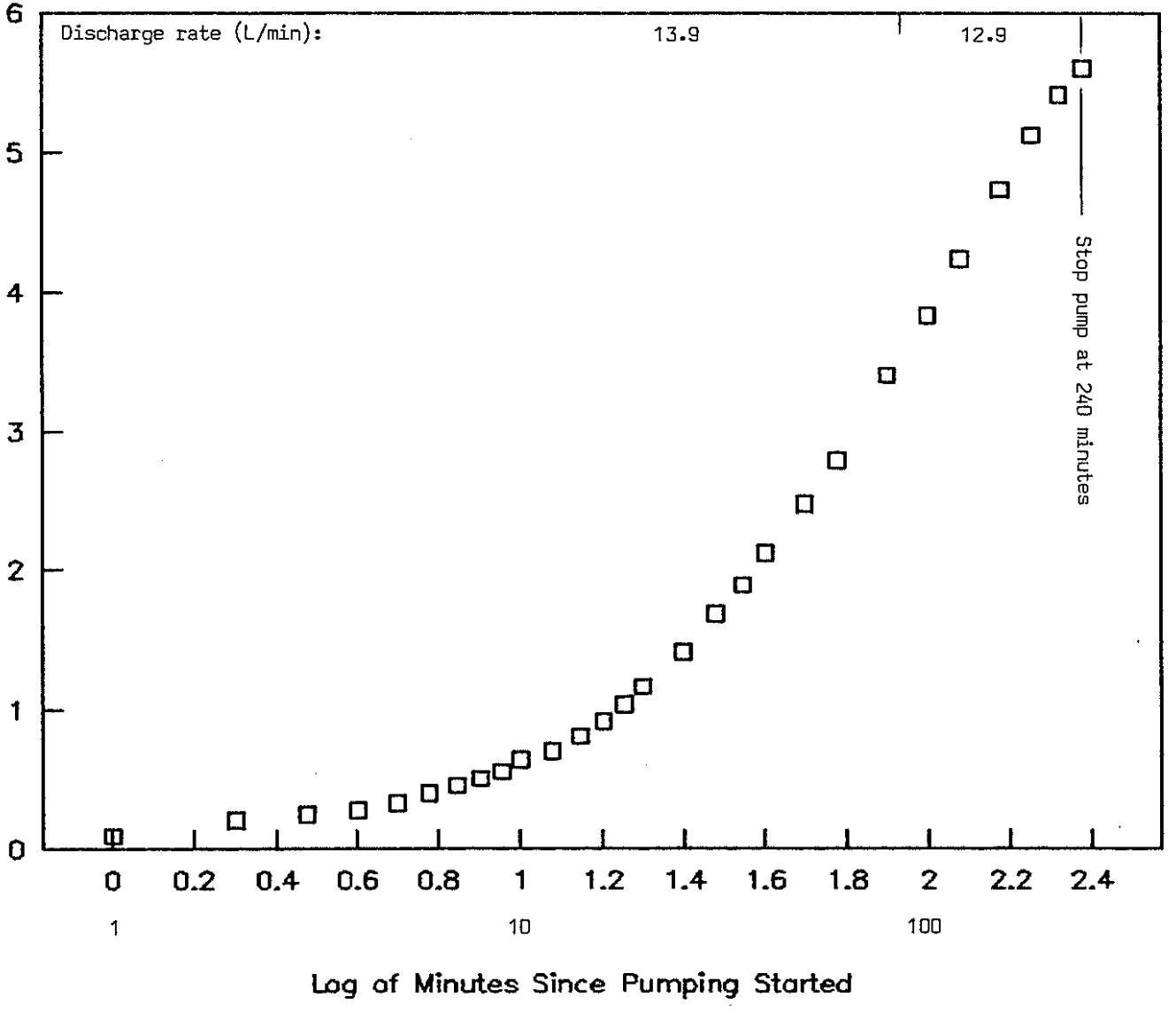


FIGURE 5. KNAPP DUG WELL RECOVERY PLOT

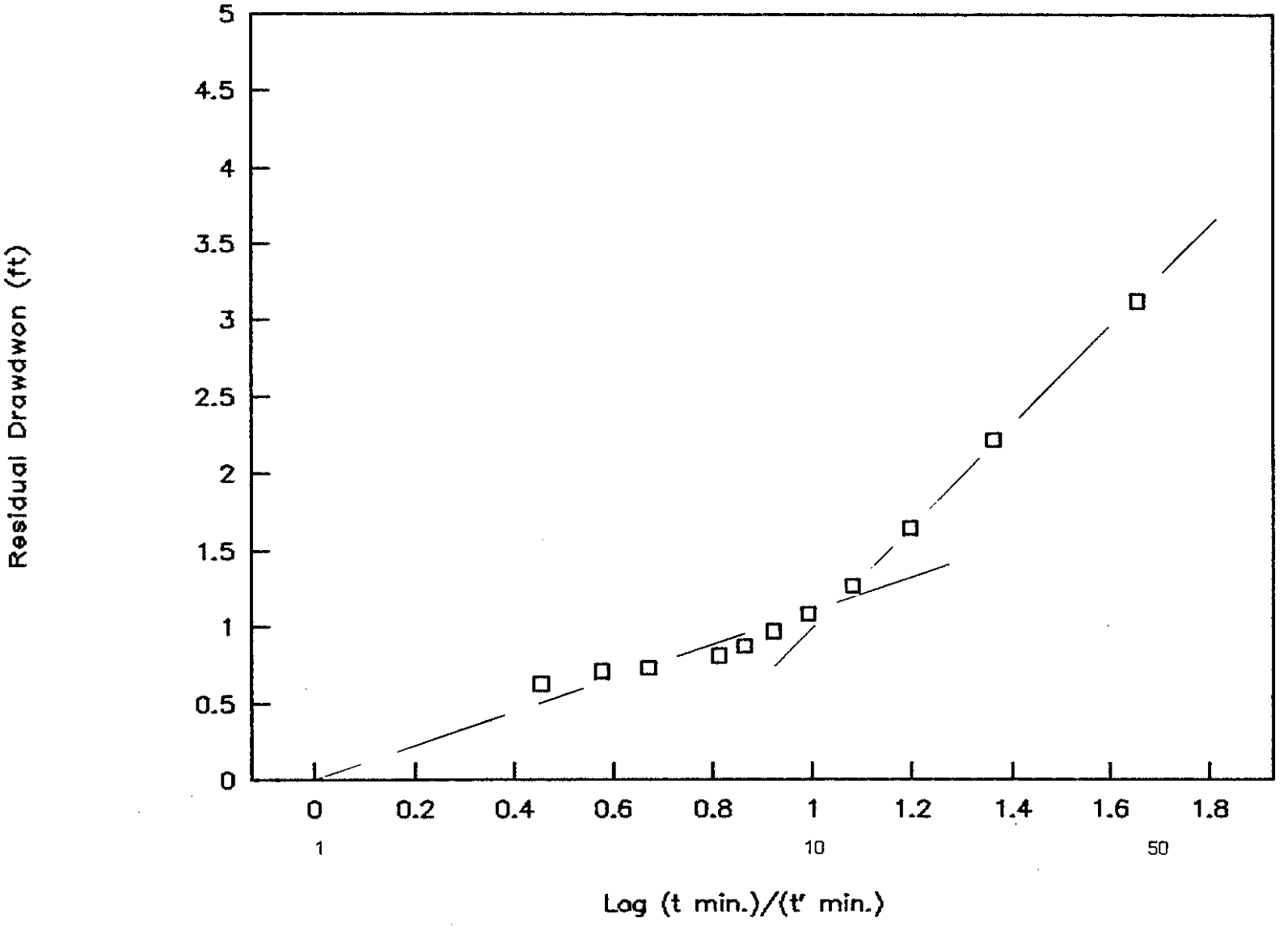
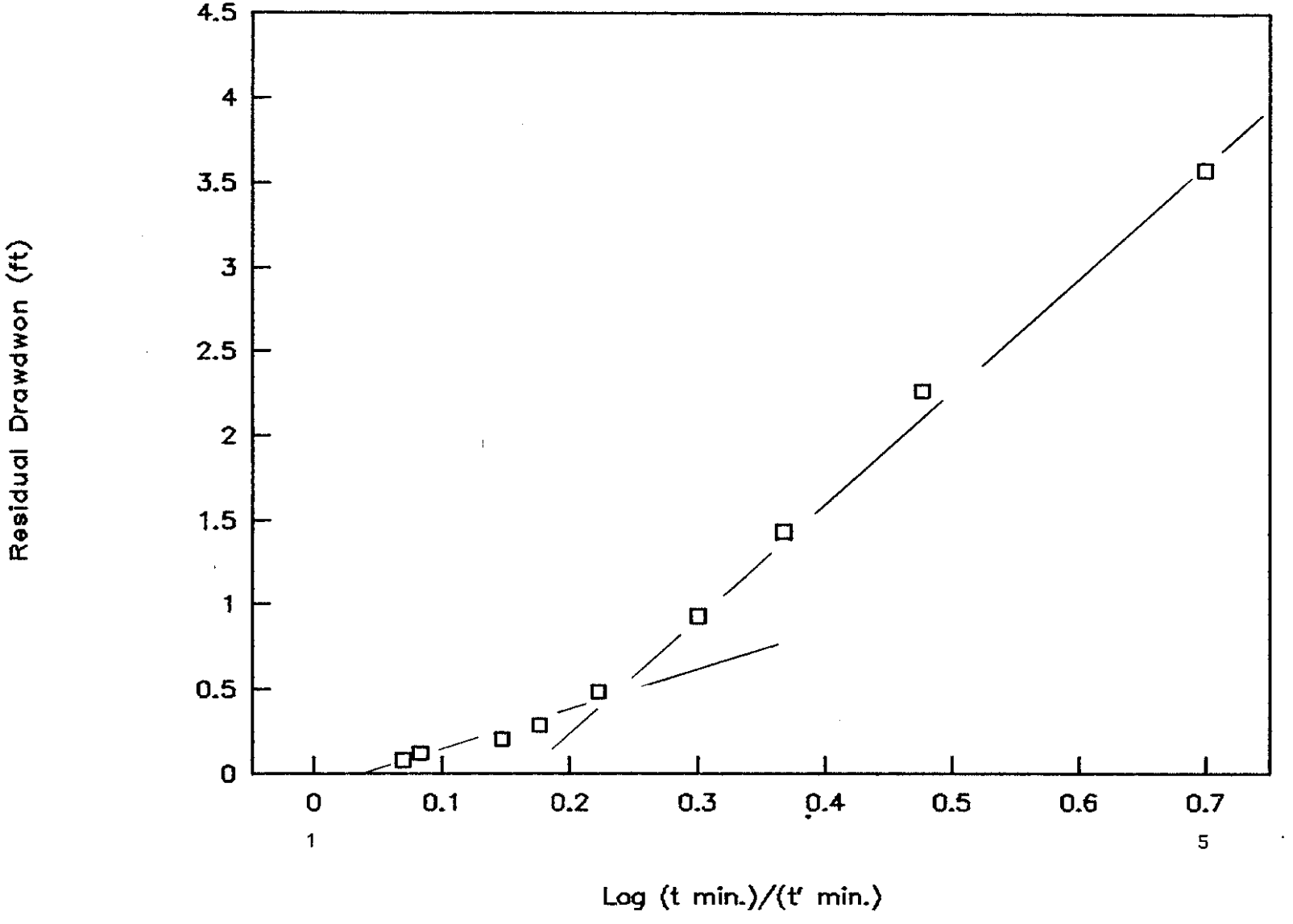


FIGURE 6. KNAPP WELL RECOVERY PLOT 2



APPENDIX C

WATER QUALITY CERTIFICATE

CANADIAN LYSOZYME INC.
31212 Peardonville Road
Abbotsford, B.C. V2S 6W6

CERTIFICATE OF ANALYSIS

CUSTOMER: Bob & Karen Knapp
33257 Richards Ave.
Mission, B.C. V2V 5X4

CERTIFICATE NO.: 2532
DATE SUBMITTED: May 12, 1992
P.O. NO.:

We hereby certify that the sample(s) submitted have been tested, and the results are as follows:

Sample Identification

Water - received in glass jar

Total Coliform (MPN)	<1.1 Coliform/100mls
Fecal Coliform (MPN)	<1.1 Coliform/100mls
pH	7.55
Total Alkalinity (as $CaCO_3$)	44.5mg/l
Total Hardness (as $CaCO_3$)	31.3mg/l
Filterable Solids	85.0mg/l

Anions

Chloride	7.70mg/l
Sulfate	2.77mg/l
Nitrate	1.03mg/l
Fluoride	<0.05mg/l
Nitrite	<0.05mg/l

Dated: May 22, 1992

Quality Control: Angela Hess

mg/l = milligrams per litre

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WARRANTY AND LIMITS OF LIABILITY - Our warranty is limited to the accuracy of analyses of samples as received. We assume no responsibility for the purposes for which the client uses the test results, nor liability for any other warranties, express or implied, including warranties of fitness for particular purpose or for merchantability made by the client. These terms and conditions shall supersede any conflicting terms and conditions stated on any purchase order, or other order of work submitted by the client.

CANADIAN LYSOZYME INC.
31212 Peardonville Road
Abbotsford, B.C. V2S 5W6

Customer: Bob & Karen Knapp
33257 Richards Ave.
Mission, B.C. V2V 5X4

Date: May 22, 1992
Certificate: 2532
Page: two of two

We hereby certify that we have tested the samples submitted and report as follows:

SAMPLE IDENTIFICATION		DETECTION LIMIT	RESULTS
Aluminum	Al	0.15 ppm	<0.15 ppm
Antimony	Sb	0.15	<0.15
Arsenic	As	0.30	<0.30
Barium	Ba	0.001	0.003
Beryllium	Be	0.003	<0.003
Bismuth	Bi	0.5	<0.5
Boron	B	0.01	<0.01
Cadmium	Cd	0.025	<0.025
Calcium	Ca	0.01	11.1
Chromium	Cr	0.03	<0.03
Cobalt	Co	0.02	<0.02
Copper	Cu	0.015	<0.015
Iron	Fe	0.030	0.033
Lead	Pb	0.08	0.08
Magnesium	Mg	0.001	0.88
Manganese	Mn	0.003	0.021
Molybdenum	Mo	0.04	<0.04
Nickel	Ni	0.025	<0.025
Phosphorus	PO_4	0.4	<0.4
Potassium	K	0.01	1.45
Silicon	SiO_2	0.08	13.7
Silver	Ag	0.03	<0.03
Sodium	Na	0.1	11.4
Strontium	Sr	0.001	0.086
Tin	Sn	0.03	<0.03
Titanium	Ti	0.006	<0.006
Vanadium	V	0.01	<0.01
Zinc	Zn	0.015	<0.015

ppm = parts per million

Telephones: (604) 852-5940 • (604) 534-8596 • Fax: (604) 852-8751