PROJECT NUMBER G709102

SUITABILITY OF A WATER WELL PROPOSED TO SUPPLY A GREENHOUSE AT CAMPBELL VALLEY FARM LTD. AT 22950 - 16TH AVENUE, LANGLEY, B.C.

Prepared for:

GREAT WALL CANADIAN VENTURES LTD.
895 East 58th Avenue
VANCOUVER, B.C. V5X 1W6

Prepared by:

PACIFIC HYDROLOGY CONSULTANTS LTD.
201 - 1537 West 8th Avenue
VANCOUVER, B.C. V6J 1T5

SEPTEMBER 9, 1999

PACIFIC HYDROLOGY CONSULTANTS LTD. Consulting Hydrogeologists

Suite 201, 1537 West 8th Avenue, VANCOUVER, B.C. V6J 1T5
Telephone: (604) 730-6990 Facsimile: (604) 730-6931

September 9, 1999 Project No. G709102

Great Wall Canadian Ventures Ltd.
895 East 58th Avenue
VANCOUVER, B.C. V5X 1W6

Attention: Michelle Wu
Manager

Subject: **Suitability of a Water Well Proposed to Supply a Greenhouse at Campbell Valley Farm Ltd. at 22950 - 16th Avenue, Langley**

Dear Ms. Wu:

1.0 INTRODUCTION

This letter is further to a telephone discussion on August 20, 1999 between you (M. Wu), of Great Wall Canadian Ventures Ltd., and Ann Badry, P. Geo., of Pacific Hydrology Consultants Ltd. (PHCL) and, in particular, to a meeting with Ed Livingston, P. Eng., and Mark Bolton, both of PHCL, at PHCL's office on August 23, about obtaining a permit for a greenhouse operation at Campbell Valley Farm at 22950 - 16th Avenue in Langley. From these discussions, and from documents which you presented at the meeting, we understand the following:

1. District of Langley requires assurance, before issuing a permit, that the water supply for the proposed greenhouse facility is adequate with respect to quantity and quality and that the rate of groundwater withdrawal will not impact other area water well users.

2. The owner proposes to use a well, located near the middle of the lot, to supply the greenhouse. The owner estimates that the greenhouse will require a maximum of 68,140±5 litres (15,000 imperial gallons) per day on a warm summer day.

3. A well, believed to be the existing well which is being proposed to supply the greenhouse facility, was constructed by Columbia Water Wells in 1976; the property owner at that time was John Jacobs. The driller's log and other information about the well are included in the attachments to this letter. Driller's records for several other nearby wells are on file with Groundwater Section of B.C. Environment but there is no record for a second well located near the east boundary of the subject property. We have not been able to obtain any information about the second well but we understand that there are no plans to use it.

Included in the attachments to this letter are area and well/site locations plans.

. . . /2

2.0 PUMPING TEST

2.1 Test Procedure and Results

The well proposed to serve the greenhouse was tested for capacity on July 22, 1999 by Union Pumps, with pumping continued at a constant rate of 1.89 *l*ps (25 igpm) for 240 minutes. The data from this pumping test, which were provided to PHCL for analysis, are attached to this letter. Also attached are plots of the drawdown of the water level in the well during pumping and the recovery of the water level after pumping stopped (Figures 3 and 4); the pumping test data have been plotted using standard straight-line methods for analyzing such data.

The drawdown data plot (Figure 3) shows that the water level in the well was still drawing down at the end of the test, 240 minutes after the start, but the rate of drawdown during the last 60 minutes was decreasing, with an indication of approximate stability. At the end of pumping, the final drawdown was 3 m (10 ft), which is only about 16% of the total available drawdown. Figure 4, the plot of the recovery data, in which residual drawdown is plotted vs log of the ratio, time in minutes since pumping started/time in minutes since pumping stopped, shows that the water level had recovered by 82% within two hours, with full recovery indicated by the trend of the data plot.

2.2 Well Capacity Rating

The capacity of the subject Campbell Valley Farm Ltd. well is clearly greater than the test-pumping rate of 1.89 *l*ps (25 igpm) which utilized only a small percentage of the available drawdown; however, because of the prevailing hydrogeologic conditions, the well should not be pumped at a rate greater than 1.89 *l*ps without first test pumping the well at a higher rate to ensure that the well and aquifer can sustain higher rates of withdrawal.

3.0 GEOLOGY AND HYDROGEOLOGY

Examination of the records for ten wells at properties with street addresses close to the subject well, indicate that the aquifer supplying water to the Campbell Valley Farm well is part of a mass of ice contact deposits. Ice contact deposits, which are made up of an heterogenous mixture of various sediments of glacial origin and which consist of sediments with various grain sizes and permeability, were deposited by or in contact with ice at the end of a glacial event. The aquifers are masses or patches of permeable sand and gravel enclosed in less permeable sediments. For instance, the depths of the ten wells vary from 39.3 to 134.1 m (129 to 440 ft). Under these

conditions, it is essential to keep a record of the water level in the greenhouse supply well, observing and recording the level at more or less regular intervals.

4.0 WATER QUALITY

Water samples for chemical and bacteriological analyses were taken at the end of the four hour pumping test carried out in July 1999 and submitted to Norwest Labs. The laboratory report with the results, along with a table comparing the constituents with the **Guidelines for Canadian Drinking Water Quality** (**GCDWQ**, Health Canada, Sixth Edition, 1996), are attached to this letter. The groundwater represented by the Norwest Analysis is a moderately mineralized and rather soft water which is quite high in sodium. The water should be suitable for the intended use as a source of irrigation water. The analysis showed a high total coliform bacteria count but it is most unlikely that an aquifer under the prevailing conditions would contain coliform bacteria. No faecal coliform were detected. The second sample for a recheck of bacteria, which was collected on September 3 and submitted to Analytical Service Laboratories Ltd. (ASL), also showed total coliform but at a much reduced level. If coliform bacteria persist, after thorough disinfection and resampling, assurance that the water is safe for drinking can be achieved by ultraviolet treatment or some other form of purification. We do not, however, recommend such treatment without first carrying out further disinfection and resampling. As shown by the driller's litholog, the aquifer from which the well withdraws water is naturally protected by overlying sediments of low permeability which extend to a depth of 36.0 m (118 ft).

5.0 CONCLUSIONS AND RECOMMENDATIONS

From our understanding of conditions and the results of the pumping test of the existing Campbell Valley Farm Ltd. Well, which is proposed as a source of water for a greenhouse facility, and taking into account the fact that the pumping rate during the test was considerably greater than the maximum estimated greenhouse requirement, it is our opinion that the well is a satisfactory source of water for the greenhouse operation and that use of the well for the intended purpose will not impact existing well water users. However, having said this, from our present understanding of the situation as outlined in this letter, we make the following recommendations:

1. If the well is to be used for domestic consumption, disinfect the well and resample the water for coliform bacteria. Consider ultraviolet or other treatment only if coliform bacteria persist.
2. Equip the well with a ¾" (19 mm) diameter PVC measuring tube, which extends at least to the top of the pump, and an electric water level indicator which displays the water level in the well at all times.

3. Equip the well with a totalizing water meter and an hour meter to show the running time of the pump.
4. Read the water meter and water level indicator about once each week and record the data on a simple spreadsheet. These data will record and indicate the ongoing condition of the well, the pump and, possibly, also the aquifer.
5. About once each year, review the data to detect any changes.
6. Be aware of any irrigation or commercial wells which may be installed in the immediate vicinity.

6.0 CLOSURE

This letter presents our evaulation of information provided by others.

We trust that the letter contains the information required by District of Langley. However, please do not hesitate to call the undersigned or Ann Badry for further discussion.

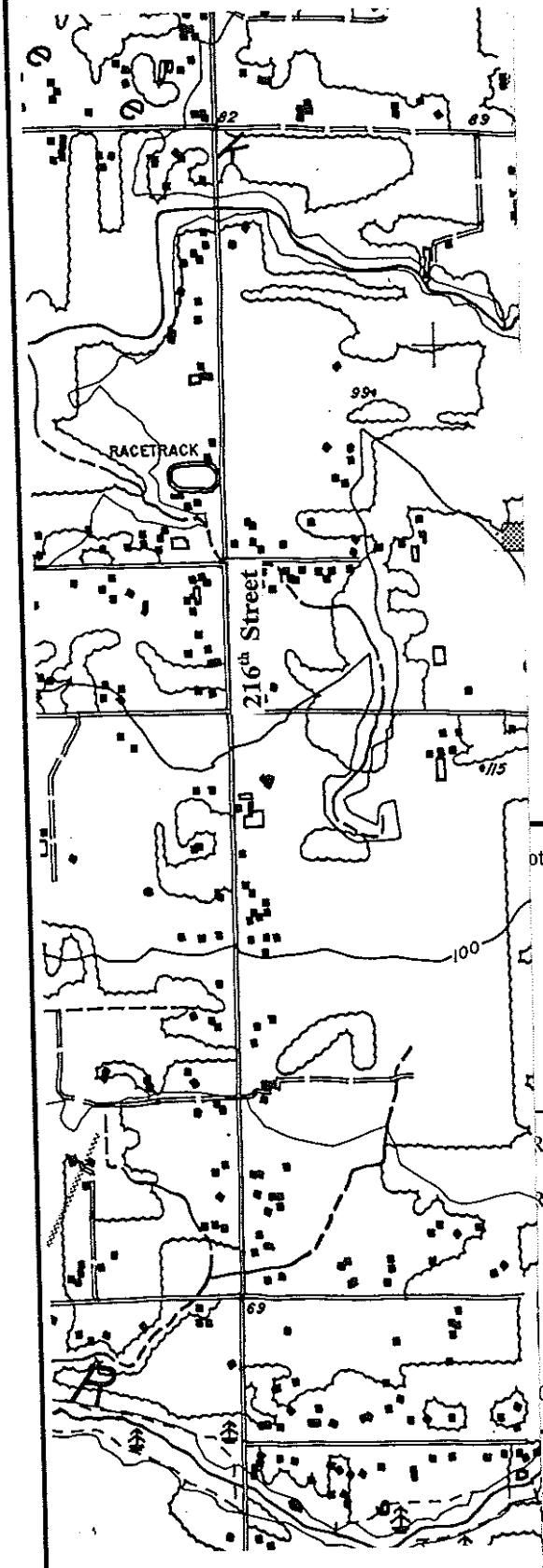
Yours truly,
PACIFIC HYDROLOGY CONSULTANTS LTD.

Ed Livingston per JB

Ed Livingston, P. Eng.
Associate Consultant

Attachments - *Area and Well/Site Location Maps*
Litholog and Well Construction Details
Pumping Test Data and Plots
Chemical Quality Table and Laboratory Reports

ATTACHMENTS



otes:

The base map is prepared from B.C. Ministry of Crown Lands, Surveys and Resource Mapping Branch, TRIM Maps 92G.007 and 92G.008, of 1:20,000 scale and with a 20 metre contour interval.

denotes approximate locations of Chu's Farm (B.C.) Ltd. and Campbell Valley Farm Ltd. proposed greenhouse facilities; for site layout and approximate well locations, see Figure 2 for the respective projects.

ROJECT NO.: G709101/G709102

ROJECT:

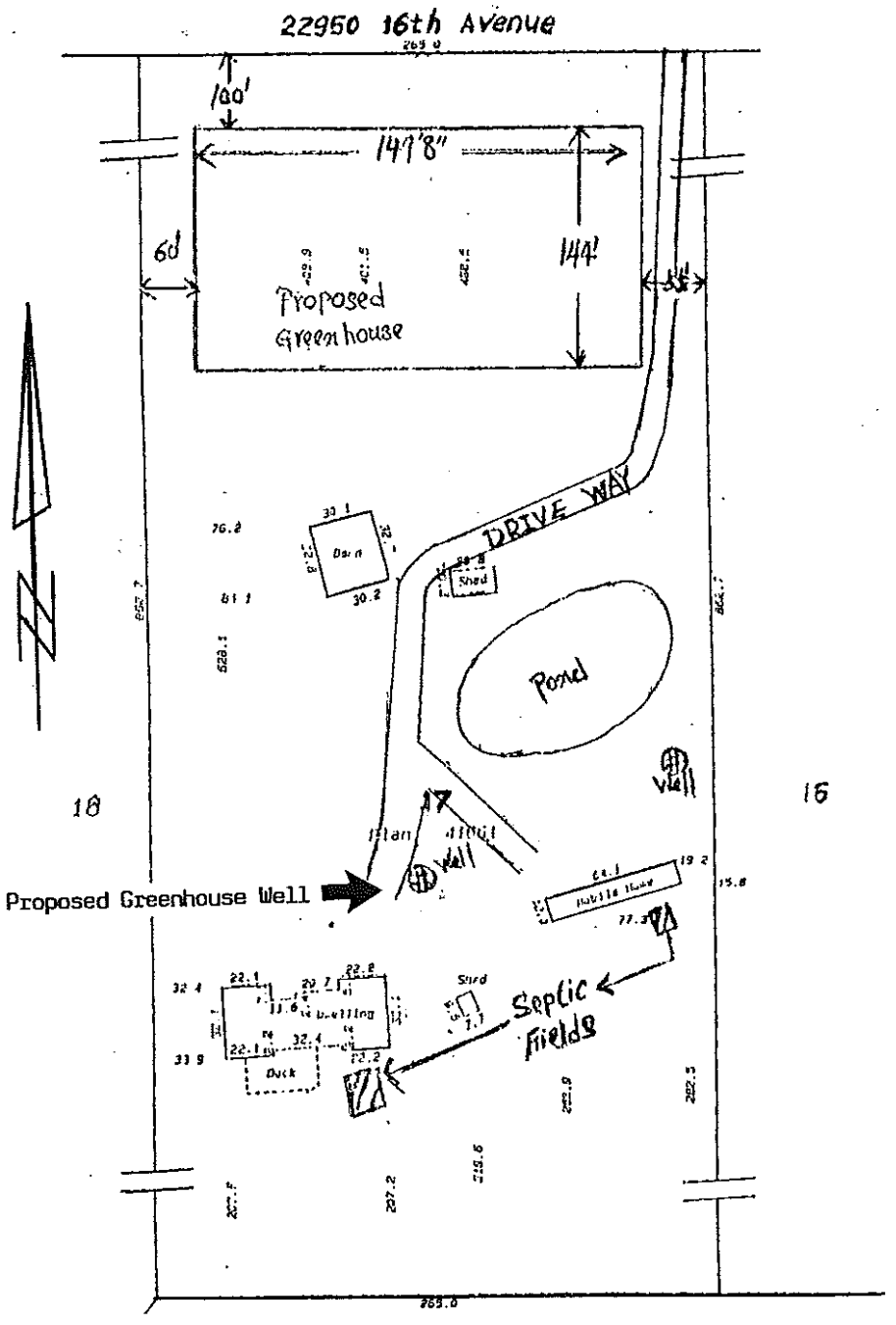
GREAT WALL CANADIAN VENTURES LTD.
CHU'S FARM (B.C.) LTD.
AND CAMPBELL VALLEY FARM LTD.

OCATION: District of Langley

ACIFIC HYDROLOGY CONSULTANTS LTD.
ONSULTING HYDROGEOLOGISTS

REA LOCATIONS OF PROPOSED GREENHOUSES

ATE:	DRAWN BY:	FIGURE:
09/09/1999	ab	1



Notes:

1. The base map is a survey plan by G.R. Williams Land Surveying Ltd.; the approximate reduced scale of the plan is 1:1,060.
2. ⊕ denotes approximate locations of onsite wells, with proposed greenhouse well, as identified.
3. Legal property description: Lot 17, Township 10, Section 8, N.W.D., Plan 41661; for area location, see Figure 1.

PROJECT NO.: G709102 PROJECT: **GREAT WALL CANADIAN VENTURES LTD.** **CAMPBELL VALLEY FARM LTD.** LOCATION: 22950 - 16th Avenue, Langley	**PACIFIC HYDROLOGY CONSULTANTS LTD.** *CONSULTING HYDROGEOLOGISTS* **SITE LAYOUT AND WELL LOCATIONS**	
	DATE: 09/09/99	DRAWN BY: ab
		FIGURE: 2

WTN 35697

WATER SUPPLY WELL AT CAMPBELL VALLEY FARM

Location: 22950 - 16th Avenue, Langley, B.C. (former owner, John Jacobs).

Legal description: Lot 17, Township 10, Section 8, New Westminster District, Plan 41661.

Contractor: Columbia Water Wells Ltd.

Date of installation: September 15, 1976.

Driller's litholog:

0.0 - 0.6 m (0 - 2 ft)	topsoil
0.6 - 24.4 m (2 - 80 ft)	stoney clay with some small boulders
24.4 - 36.0 m (80 - 118 ft)	sandy clay with stones
36.0 - 39.3 m (118 - 129 ft)	coarse silty gravel.

Completed depth: 38.9 m (127.5 ft)

Diameter: 150 mm (6") diameter.

Static water level: 15.2 m (50 ft) reported by the driller at the time of well completion in September 1976; 18.5 m (60.7 ft) at the time of the pumping test on July 22, 1999.

Well completion: The well is completed with a 1.5 m (5 ft) long well screen assembly containing 1.2 m (4 ft) of 0.5 mm (0.020") slot Johnson stainless steel well screen, with the assembly set from 37.3 to 38.9 m (122.5 to 127.5 ft).

Well performance: Constant-rate pumping for 4 hours at 1.89 *l*ps (25 igpm) on July 22, 1999 caused maximum drawdown of 3.0 m (10.0 ft), for a specific capacity of 0.63 *l*ps/m (2.5 igpm/ft).

Well capacity: The capacity of the Campbell Valley Farm well is greater than the test pumping rate of 1.89 *l*ps (25 igpm) which utilized only about 16% of the available drawdown. However, due to the hydrogeologic conditions, the well should not be pumped at a rate greater than 1.89 *l*ps without first confirming that the well and aquifer can sustain higher rate pumping.

PUMPING TEST - DRAWDOWN DATA

Project: **Campbell Valley Farm Ltd. Water Supply Well**

Location: 22950 - 16th Avenue, Langley, B.C.

Static Water Level: 60.70 ft (18.50 m)
Datum: Top of well casing
Well Completion: Well screen assembly set from 122.50 to 127.50 ft (37.3 to 38.9 m)

DATE (m/d/yr) & TIME (hr:min:sec)	ELAPSED TIME t(min)	DISTANCE TO WATER (ft)	DRAWDOWN (ft)	PUMPING RATE (igpm)	PUMPING RATE (lps)	REMARKS
07/22/99						
	0.0	60.70	0.00			Static level; start pump.
	1.0	64.10	3.40	25	1.89	
	2.0	65.70	5.00			
	3.0	65.90	5.20			
	4.0	65.95	5.25			
	5.0	66.10	5.40			
	6.0	66.20	5.50			
	7.0	66.35	5.65	25	1.89	
	8.0	66.35	5.65			
	9.0	66.40	5.70			
	10.0	66.50	5.80			
	15.0	66.85	6.15			
	20.0	67.10	6.40			
	25.0	67.40	6.70			
	30.0	67.70	7.00	25	1.89	Discharge water clear.
	45.0	68.25	7.55			
	60.0	68.70	8.00			Discharge water clear.
	75.0	69.00	8.30			
	90.0	69.25	8.55			
	105.0	69.50	8.80			
	120.0	69.70	9.00	25	1.89	
	150.0	70.15	9.45			
	180.0	70.40	9.70	25	1.89	Discharge water clear with yellow tinge.
	210.0	70.65	9.95			
	240.0	70.70	10.00	25	1.89	Stop pump.

PUMPING TEST - RECOVERY DATA

Project: **Campbell Valley Farm Ltd. Water Supply Well**

Location: 22950 - 16th Avenue, Langley, B.C.

Static Water Level: 60.7 ft (18.5 m)
Datum: Top of well casing
Final Drawdown: 10.0 ft (3.0 m)

DATE (m/d/yr) & TIME (hr:min:sec)	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
07/22/99						
	240.0	0.0		70.70	10.00	Stop pump.
	241.0	1.0	241.0	66.50	5.80	
	242.0	2.0	121.0	66.15	5.45	
	243.0	3.0	81.0	66.00	5.30	
	244.0	4.0	61.0	65.80	5.10	
	245.0	5.0	49.0	65.70	5.00	
	246.0	6.0	41.0	65.60	4.90	
	247.0	7.0	35.3	65.50	4.80	
	248.0	8.0	31.0	65.40	4.70	
	249.0	9.0	27.7	65.34	4.64	
	250.0	10.0	25.0	65.25	4.55	
	255.0	15.0	17.0	64.95	4.25	
	270.0	30.0	9.0	64.20	3.50	
	285.0	45.0	6.3	63.70	3.00	
	300.0	60.0	5.0	63.40	2.70	
	315.0	75.0	4.2	63.10	2.40	
	330.0	90.0	3.7	62.90	2.20	
	345.0	105.0	3.3	62.70	2.00	
	360.0	120.0	3.0	62.50	1.80	

Figure 3. Time-Drawdown Plot for July 1999 Pumping Test of Campbell Valley Farm Well at 22950 - 16th Avenue, Langley

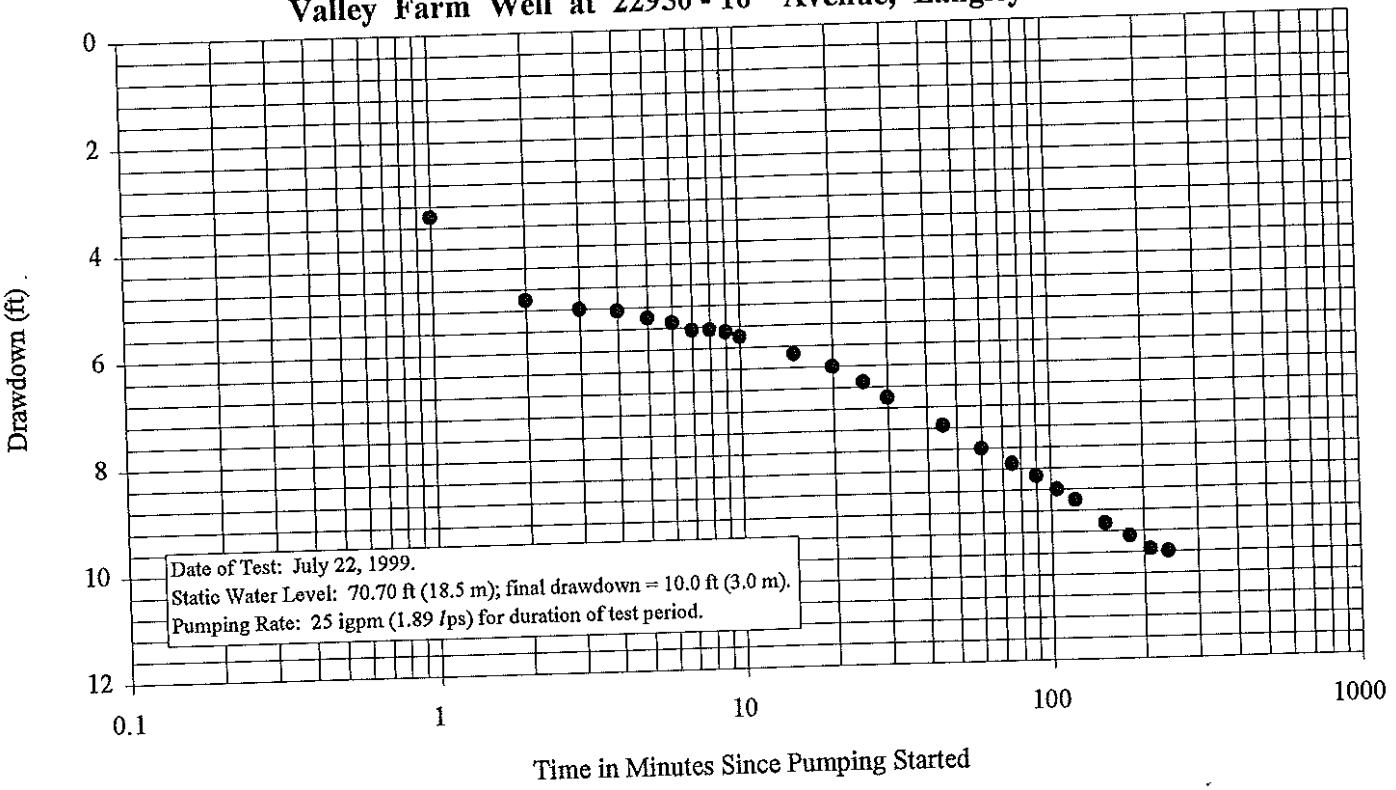


Figure 4. Time-Recovery Plot for July 1999 Pumping Test of Campbell Valley Farm Well at 22950 - 16th Avenue, Langley

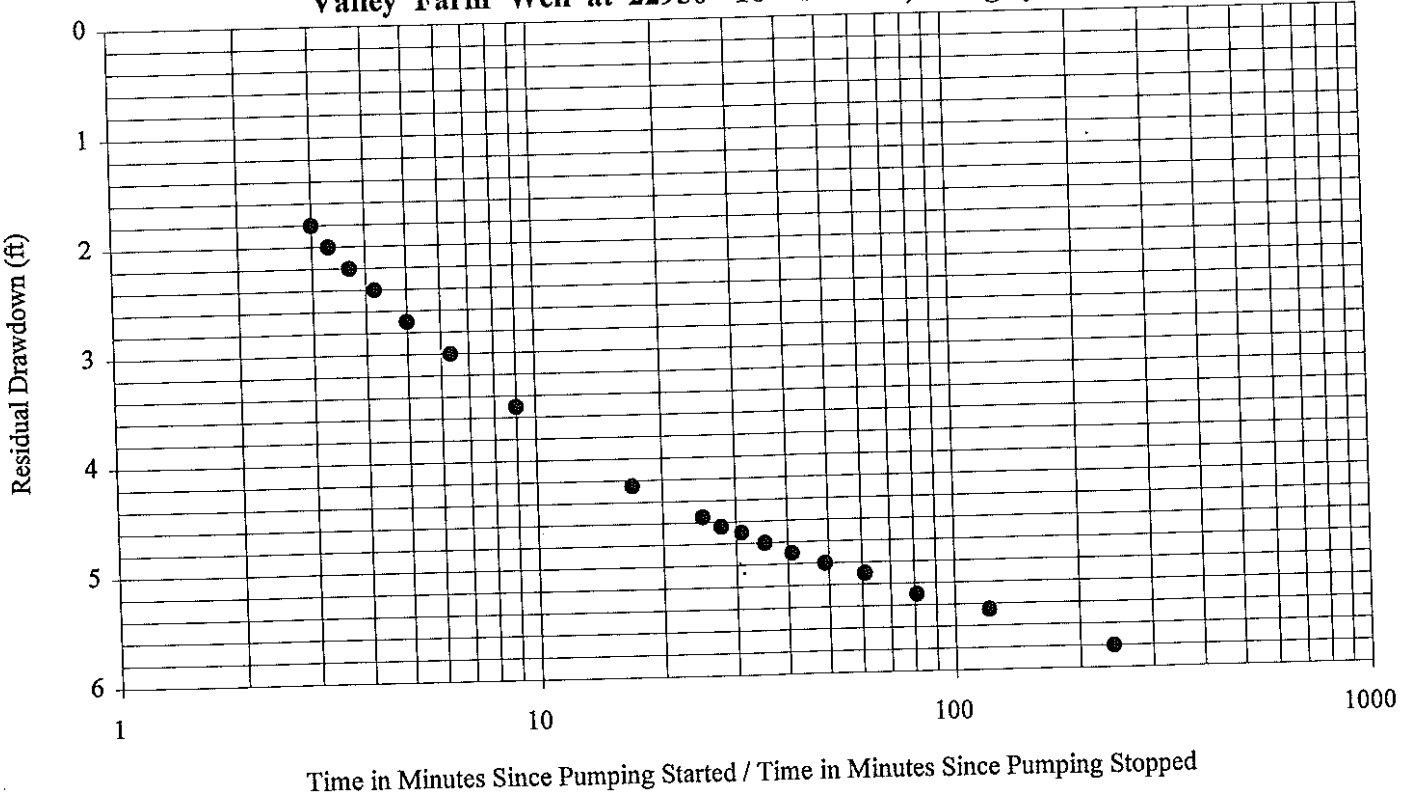


Table 1. Chemical Quality of Groundwater from Campbell Valley Farm Well and Comparison to Drinking Water Quality Limits

Parameter		Campbell Valley Farm Well		Drinking Water Limit (3)
		July 1999 (1)	September 1999 (2)	
Physical Tests				
Colour (CU)		35	-	15.
Total Dissolved Solids (mg/*l*)		387	-	500
Total Hardness (mg/*l*)	$CaCO_3$	53.9	-	-
pH		8.35	-	6.5 - 8.5
Turbidity (NTU)		4	-	1/5 (4)
Dissolved Anions (mg/*l*)				
Alkalinity	$CaCO_3$	285	-	-
calculated	HCO_3	347.5	-	-
Chloride	Cl	18.9	-	250.
Fluoride	F	<0.5	-	1.5
Sulphate	SO_4	<0.5	-	500.
Nutrients (mg/*l*)				
Nitrate (NO_3)	N	<0.05	-	10.
Nitrite (NO_2)	N	<0.5	-	1.0
Total Metals (mg/*l*)				
Aluminum	Al	0.18	-	-
Arsenic	As	<0.02	-	0.025
Barium	Ba	0.015	-	1.0
Cadmium	Cd	<0.0005	-	0.005
Chromium	Cr	<0.001	-	0.05
Copper	Cu	0.003	-	1.0
Iron	Fe	0.208	-	0.3
Lead	Pb	<0.005	-	0.01
Manganese	Mn	0.0421	-	0.05
Sodium	Na	136	-	200.
Uranium	U	<0.06	-	0.10
Zinc	Zn	0.003	-	5.0
Bacteriological				
Faecal Coliform (colony counts/100 m*l*s)		<1	<1	0
Total Coliform (colony counts/100 m*l*s)		>200.5	27	- (5)

Sources of Information and Notes:

1. Norwest Labs Work Order 46112; dated July 29, 1999 for a sample collected on July 22, 1999.
2. Analytical Service Laboratories Ltd. File K9284 dated September 8, 1999 for a sample collected on September 3, 1999.
3. Maximum acceptable concentration as specified in **Guidelines for Canadian Drinking Water Quality (GCDWQ**, Health Canada, Sixth Edition, 1996), which have been adopted by B.C. Ministry of Health as the basis for assessing water potability.
4. At the point of consumption, as per **GCDWQ**, a turbidity of 5 NTU is permitted, but maximum acceptable source turbidity is 1 NTU, with some relaxation permitted for groundwater sources.
5. No sample should contain more than 10 total coliform organisms per 100 m*l*, none of which should be faecal, and no consecutive samples should be positive.

NORWEST LABS

Langley	Ph (604) 514-3322	FAX (604) 514-3323
Edmonton	Ph (403) 438-5522	FAX (403) 438-0396
Calgary	Ph (403) 291-2022	FAX (403) 291-2021
Lethbridge	Ph (403) 329-9266	FAX (403) 327-8527
Winnipeg	Ph (204) 982-8630	FAX (204) 275-6019

Work Order Number: 46112
Date Issued: July 29, 1999

ANALYSIS FAILURE SHEET

Sample Id: **CAMPBELL VALLEY FARM**

Your water sample failed to qualify for a potability certificate for the following reason (s):

Total Coliforms High
Colour High

If you have any questions concerning your analysis please contact the laboratory manager. High coliform count require treatment of the well with bleach (procedure is included) followed by a repeat coliform test ($25.00 charge). A water purifier may be required if any of the chemicals exceed the guidelines, which are shown on the attached Water Analysis Report.

Sincerely,

John Davidson, Dipl. T., C.P.H.I. (C)
Supervisor, Inorganics Lab

NORWEST LABS

Surrey	Ph (604) 514-3322	FAX (604) 514-3323
Edmonton	Ph (403) 438-5522	FAX (403) 438-0396
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Lethbridge	Ph (403) 329-9266	FAX (403) 327-8527
Winnipeg	Ph (204) 982-8630	FAX (204) 275-6019

Name : UNION PUMPS
Address : BOX 3446, 23191 FRASER HWY.
LANGLEY
BC
V3A 4R8
Attention: Saul Hock
Phone : 604 533-3727
Fax : 604 533-4358

WO (Surrey) : 46112
Quote No. :
WO (Other) :
PO Num :
Project : CAMPBELL VALLEY FARM
Date Sampled : Jul 22, 1999
Date Received : Jul 22, 1999
Date Reported : Jul 29, 1999

ANALYTICAL REPORT

46112-1 CAMPBELL VALLEY FARM

M99

Analyte	Result	Detection Limit	Units	Guidelines / Recommendations
				Drinking Water
Total Coliforms	>200.5	1	MPN/100 mL	Below 1/100 mL acceptable. Conditional pass 10 / 100mL.
Standard Plate Count	100	1	cfu/mL	Below 500 CFU/mL acceptable
Fecal Coliforms	<1	1	MPN/100 mL	Below 1/100 mL acceptable

46112-1 CAMPBELL VALLEY FARM

W99-Water Potability

Analyte	Result	Detection Limit	Units	Guidelines / Recommendations
				Drinking Water
pH	8.35			pH values between 6.5 & 8.5 considered acceptable
Colour	35	5	TCU	Aesthetic limit 15 TCU
Turbidity	4	1	NTU	Below 5 NTU acceptable at point of use.
Total Dissolved Solids	387	1	mg/L	Objective level 500 mg/L; higher values indicate high salts
Hardness (CaCO3 equiv)	53.9	1	mg CaCO3/L	Soft waters are less than 75 mg/L; hard waters are above 150
Chloride	18.9	0.1	mg/L	Aesthetic limit 250 mg/L
Fluoride	<0.5	0.5	mg/L	Values up to 1.2 mg/L desirable; under 1.5 mg/L acceptable
Nitrite-N	<0.5	0.5	mg/L	
Nitrate-N	<0.05	0.05	mg/L	Below 10 mg/L acceptable; objective level below 1.0 mg/L
Sulfate	<0.5	0.5	mg/L	
Aluminum	0.18	0.01	mg/L	
Arsenic	<0.02	0.02	mg/L	Below 0.025 mg/L acceptable
Barium	0.015	0.0005	mg/L	Below 1 mg/L acceptable
Cadmium	<0.0005	0.0005	mg/L	Below 0.005 mg/L acceptable
Chromium	<0.001	0.001	mg/L	Below 0.05 mg/L acceptable
Copper	0.003	0.002	mg/L	Aesthetic limit 1.0 mg/L; objective below 0.01 mg/L
Iron	0.208	0.003	mg/L	>0.3 mg/L may cause staining; objective level below 0.05 mg/L
Lead	<0.005	0.005	mg/L	Below 0.01 mg/L acceptable
Manganese	0.0421	0.0005	mg/L	Aesthetic limit 0.05 mg/L; objective below 0.01 mg/L
Sodium	136	0.05	mg/L	Aesthetic limit 200 mg/L; below 20 mg/L for low sodium diets
Uranium	<0.06	0.06	mg/L	Below 0.1 mg/L acceptable
Zinc	0.003	0.001	mg/L	Aesthetic limit 5.0 mg/L; objective below 1.0 mg/L
Total Alkalinity	285	5	mg CaCO3/L	

Approved By:

John Davidson, Dipl. T., C.P.H.I. (C)
Supervisor, Inorganics Lab

Accredited By: CANADIAN ASSOCIATION FOR ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL)
For specific tests registered with the Association

988 Triumph Street, Vancouver, BC Canada V5L 1K5

analytical
service
laboratories
ltd.

FAX: (604) 253-6700 TEL: (604) 253-4188

CHEMICAL ANALYSIS REPORT

Date: September 8, 1999

ASL File No. K9284

Report On: GW Canadian Ven. Ltd.
Water Analysis

Report To: **Cash Customer**
1988 Triumph Street
Vancouver, BC
V5L 1K5

Received: September 7, 1999

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Miles Gropen, B.Sc. - Project Chemist
Sarena McHugh, B.Sc. - Project Chemist

Appendix 1 - REGULATORY CRITERIA

File No. K9284

Health Canada

Guidelines for Canadian Drinking Water Quality, Sixth Ed., 1996.
All limits are Maximum Acceptable Concentration (MAC) unless otherwise indicated.
Limits expressed as milligrams per litre except pH, Turbidity, Colour, and Coliform Bacteria.

	Upper Limit	Notes
Bacteriological Tests		
Coliform Bacteria - Fecal	0	
Coliform Bacteria - Total	-	1

1 No sample should contain more than 10 organisms per 100mL and no consecutive samples should be positive (MAC).

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

End of Report