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Consulting Services

June 4, 2001

Reference No. QE 01-401

Theo Nibourg
RR# 2
Yarker,
Ontario K0K 3N0

Dear Theo

Re: Alexander Island: Hydrogeology Report

Quinte-Eco Consultants is pleased to provide you with the attached Draft Hydrogeology Report for you're Alexander Island property. This report details our findings and includes recommendations.

Thank you for the opportunity to be of service. If you have any questions or require any clarification please do not hesitate to contact me on (613) 967-6432.

Yours truly,

QUINTE-ECO CONSULTANTS INC.



Deirdre Johnson BSc MEnvSt

HYDROGEOLOGY REPORT
June 2001

ALEXANDER ISLAND

**THE ISLAND LYING BETWEEN
LAKE ONTARIO AN PLEASANT BAY
AND
LYING IN FRONT OF
LOT 33, CONSESSION 2,
TOWNSHIP OF HILLIER,
MUNICIPALITY OF THE COUNTY OF PRINCE EDWARD**

**Quinte-Eco Consultants
(QE01-401)**

June 2001

1.0 INTRODUCTION

Quinte-Eco Consultants Inc. (QEC) is pleased to provide this Hydrogeology Report which outlines the methods of servicing the site with private well and subsurface sewage disposal systems. This report has been written to satisfy the requirements of the County of Prince Edward with respect to deleting the 'H' symbol suffixed to the CT-4-H Zone.

Alexander Island is described as the island lying between Lake Ontario and Pleasant Bay and lying in front of Lot 33, Concession 2, Township of Hillier, Municipality of the County of Prince Edward (see Figure 1).

In the first five years, the development is expected to be as follows:

- 40 units with full housekeeping facilities each accommodating 2 persons
- Dining Room Facilities with 100 seats
- Bar and Cocktail lounge with 100 seats
- 10 full-time equivalent Non Resident staff

In addition, a garden and lawn irrigation system will be established.

Two well were previously installed on the site by Chalk Well Drilling:

Well #1: - originally drilled to 9.1 m (30')
- advanced to 15.2 m (50') on January 15, 2001
- estimated pumping rate 109 L/min (24 gallons/min)
- 69 m (225') from a surface water source (Lake Ontario)
- depth to water table 5.5 m (18')

Well #2: - drilled to 12.2 m (40') on October 04, 2000
- estimated pumping rate 15.9 L/min (3.5 gallons/min)
- 30 m (95') from a surface water source (Pleasant Bay)
- depth to water table 7.0 m (23')

On May 01, 2001, two monitoring wells were drilled by GET Drilling Ltd. to determine the groundwater flow on the property:

Well #3: - drilled to 9.1 m (30') on May 1, 2001.
- 148 m (487') from a surface water source (Lake Ontario).
- depth to water table 8.5 m (28')

Well #4: - drilled to 4 m (13') on May 1, 2001.
- depth to water table 2.4 m (8')

Appendix A contains Well Logs.

It should be noted that given the proximity of the wells to a surface water source (less than 100 m) and that the wells are drawing water from formations less than 15 m from the ground surface, the groundwater could be considered by the Ministry of the Environment (MOE) to be under the direct influence of surface water.

2.0 METHODOLOGY

2.1 Groundwater Flow Direction

On May 3, 2001, Wells 1, 3 and 4 were surveyed. The groundwater flow was calculated by measuring the ground elevation at each well above a datum and the static water depth in each well above the datum.

2.2 Aquifer Testing - Groundwater Quantity

On May 16, 2001 Well #1 was developed at approximately 57 L/min for 64 min (approximately 15 well volumes).

On May 17, 2001 a pumping test was performed on Well #1 using a 1/3 hp submersible pump powered by a portable generator. Well # 1 was pumped at a rate between 50 and 52 L/min for 360 min. Water was discharged approximately 20 m downgradient from the well in an area which drained away from the well. Drawdown was measured at various intervals over this period. Once pumping ceased, the recovery of the well was also monitored for 140 min. Drawdown and recovery was also measured for an observation well (Well #3) 108 m from the pumping well (Well #1).

Field Data is summarised in Appendix B.

2.3 Aquifer Testing - Groundwater Quality

Turbidity readings were taken throughout the pumping test from Well #1 using an EST (Engineered Systems and Designs) Model 800 Turbidity Meter. Two sets of water samples were also collected - $t=175$ min (Sample QE401-01) and $t = 355$ min (Sample QE401-02). Sample bottles were filled directly from the discharge hose. The samples were taken in the prepackaged set of Subdivision Well Water criteria bottles (1 x 500ml, 2 x 200 ml, 1 x 125 ml, 2 x 60 ml, 1 x 45 ml) provided by Environment Technology Laboratories (ETRL). Samples were placed in a cooler and sent under Chain of Custody Protocol to ETRL in Kingston, Ontario. A Subdivision Water Quality analysis was undertaken for each sample.

3.0 RESULTS AND DISCUSSION

3.1 Groundwater Flow Direction

Groundwater flow in the vicinity of the development appears to be in a south-easterly direction towards Lake Ontario (i.e. from Well #3 and 4 towards Well #1 (see Table 1 and Figure 2). The flow was estimated to be in the order of 10^{-10} m/s.

Table 1: Well Elevation and Static Water Elevation

Well #	Ground Elevation (above datum) (m)	Static Water Depth (below ground) (m)	Static Water Depth (above datum) (m)
1	10.32	1.83	8.50
3	12.07	2.21	8.84
4	10.00	1.20	8.80

3.2 Aquifer Test: Groundwater Quantity

The aquifer test data for the pumping well (Well #1) was plotted using the Theis and Jacob straight-line methods for drawdown phase and Jacob straight-line method for the recovery phase. In order to eliminate the effect of water coming from the well casing rather than the aquifer, the transmissivity was estimated after it stabilised at 200 min (drawdown). Transmissivity was calculated during the recovery using data from 6 to 140 min. Aquifer storativity could not be determined from this data.

The observation well (Well #3) was affected by the pumping of Well #1 after 30 min. However, the total drawdown of Well #3 after 6 hours was only 0.41 m. It is concluded that after 6 hours the pumping rate had not significantly affected Well #3 and therefore data could not reliably be used to determine the transmissivity and storativity of the aquifer.

At Well #1, the transmissivity (T) of the aquifer is estimated to be moderate (calculated T ranged from 3.3 to 3.8 m²/day) - see calculations in Appendix B.

The volume of groundwater removed during the testing was approximately 18,000 L. Well #1 recovered to 95% of its original static level in 120 minutes. During this time drawdown at the observation well (Well #3) was measured to be 0.41 m, indicating only a slight impact on the observation well. Well #2 recovered to 93% original static level in 140 minutes. It is estimated that this well would recover to 95% of its original static level in 220 minutes.

3.3 Suitability of Aquifer to Supply Development

Based on the drawdown data it is predicted that Well #1 could not sustain repeated pumping at the test pumping rate (50 L/min or 72,000 L/day) for more than 6 hours. It should be noted that the Well Log for Well #1 indicated that the pumping rate for this well could be 109 L/min (24 gallons/min). Given the information derived from the aquifer test, this rate of 109 L/min calculated over a 2 hour period, could not be maintained over a longer period of time

The water requirement over the next five years is projected to be approximately 40,000 L/day (28 L/min) - see Table 2. This amount is considerably lower than the pumping rate used in the aquifer test. It is expected this rate, could be maintained for a duration of over 6 hours. Since this rate is less than 50,000 L/day, a Permit to Take Water will not be required.

Table 2: Expected Daily Volume of Water Required by the Development (First 5 Years)

Area	Number of persons/seats	Daily Volume per person/seat (Litres/day)	Daily Volume (Litres/day)
Unit with full housekeeping facilities	80	225	18000
Dining Room Facilities	100	125	12500
Bar and Cocktail Lounge	100	70	7000
Full-time equivalent Non Resident staff	10	40	400
Garden and Lawn Irrigation (estimated)			2100
		TOTAL	40000

3.4 Aquifer Test: Groundwater Quality

Since the daily volume of water required over the next 5 year will be approximately 40,000 L/day (see Table 2) Ontario Regulation 459/00 "Drinking Water Protection" does not apply, and consequently the Ontario Drinking Water Standards do not apply. However, given that the water will be supplying guests to the proposed development, it is recommended that these standards be used as a baseline for the water quality.

Table 3 (Chemical Physical Parameters) and 4 (Microbiological Parameters) outlines the results from the analysis of water taken at t=175 min (Sample QE401-01) and t = 355 min (Sample QE401-02).

Results indicate that although the water is generally good, there are a number of parameters which exceed the Ontario Drinking Water Standards (turbidity, colour, total organic carbon (TOC), organic nitrogen (TKN - ammonia), sodium (sample 2 only), hardness, iron (sample 1 only) and methane (sample 2 only).

Table 3: Chemical/Physical Parameters

Parameter	Units	MDL	ODWS		Sample 1	Sample 2
			Objective	Type		
Nitrite (N)	mg/L	0.05	1.0	MAC	<0.05	<0.05
Nitrate (N)	mg/L	0.05	10.0	MAC	0.14	0.22
pH	pH units	-	6.5-8.5	OG	7.41	7.45
Conductivity	uS/cm	1	-	-	592	602
Alkalinity	mg/L	3	30-500	OG	256	272
Calcium	mg/L	0.5	-	-	77.1	73.3
Potassium	mg/L	0.04	-	-	2.0	2.2
Chloride	mg/L	1.0	250	AO	5.2	4.8
Fluoride	mg/L	0.1	1.5	MAC	0.4	0.3
Turbidity	NTU	0.2	1.0	MAC	2.6	2.7
Colour	TCU	2	5	AO	31	32
Sodium	mg/L	0.5	200, 20	AO	18.8	24.9
Aluminum	mg/L	0.05	0.10	OG	<0.05	<0.05
TOC*	mg/L	1	5	AO	11	15
Phenols	mg/L	0.001	-	-	0.015	0.015
Sulfide	mg/L	0.01	0.05	AO	<0.01	0.01
Hardness	mg/L	1	80-100	AO	229	231
Iron	mg/L	0.05	0.3	AO	0.31	0.29
Manganese	mg/L		0.05	AO	0.04	0.04
TKN	mg/L	0.1	-	-	0.5	0.5
Ammonia (N)	mg/L	0.05	-	-	0.28	0.33
Organic N	mg/L		0.15	OG	0.22	0.17
Tannins & Lignins	mg/L		-	-	0.4	0.4
Magnesium	mg/L	0.5	-	-	8.9	9.3
Methane	L/m3	0.2	3L/m3	AO	2.3	4.7

Bolded - exceeds ODWS objective

MDL is the Method Detection Limit

AO = Aesthetic Objective

MAC = Maximum Acceptable Concentration

OG = Operational Guide Line

mg/L = milligrams per litre (parts per million)

* Total Organic Carbon - in this sample all TOC was in the form of Dissolved Organic Carbon (DOC) which has an objective of 5 mg/L

The following notes describe the individual parameters¹:

- The elevated colour measurement is probably due to the presence of organic materials (i.e. elevated DOC), tannins, iron and/or manganese in the water.
- Elevated TOC (DOC) may cause disinfection by-products when water is treated with chlorine.
- Turbidity caused by the presence of suspended tiny particles that scatter light and make drinking water appear cloudy. It can interfere with disinfection and the maintenance of residual chlorine.
- Organic nitrogen produces taste and odour problems in water.
- Sodium levels of over 20 mg/L are not recommended for persons on a sodium restricted diet.
- The measured hardness is due to the presence of calcium carbonate (Limestone bedrock). Water with a hardness of between 200 and 500 mg/L is considered poor but tolerable.
- The concentration of iron is at the objective. It may cause a brownish colour to laundered good, plumbing fixtures and the water itself. It may also produce a bitter, astringent taste in water and beverages.
- Methane may cause mechanical damage by causing water hammer. If allowed to accumulate in confined areas (such as hot water tanks) the potential for explosive combustion exists.

Table 4: Microbial Parameters

Parameter	Units	ODWS		Sample 1	Sample 2
		Objective	Type		
Total Coliform	CFU/100mL	0	MAC	0	1
E.coli	CFU/100mL	0	MAC	0	0
Background	CFU/100mL	200	MAC	167	70
Fecal Streptococci	CFU/100mL	-	-	0	0
Fecal Coliform	CFU/100mL	0	MAC	0	0

There is a potential for microbial contamination as background colony analysis indicates the possibility of fecal contamination (e.g. E. coli).

Although the Ontario Regulation 459/00 and consequently the Ontario Drinking Water Standards do not apply, given the proximity of Well #1 to a surface water source and the quality of the water, both filtration and disinfectant units should be installed.

Use of a water softener will reduce the hardness. However, given the concentration of sodium is above 20 mg/L, a sodium chloride based water softener should not be used for drinking or cooking water.

An aeration tank should be installed to reduce the concentration of dissolved methane in the water.

¹ Adapted from Ontario Ministry of the Environment "Ontario Drinking Water Standards" August 2000.

3.5 Subsurface Sewage Disposal Systems

The expected daily volume of water entering a subsurface sewage disposal system is approximately 38,000 L (see Table 2). Since the average daily flow is greater than 10,000 L/day, Section 53 of Ontario Water Resources Act (OWRA) will apply. Therefore an application to the Ministry of the Environment (MOE) for a Certificate of Approval (Sewage) will be required.

A Class IV septic system with pretreatment will be required for the site. Final disposal of the effluent could be either surface or subsurface disposal.

Disposal of final effluent would be via a raised leaching bed to native soils. Sub-surface disposal would require phosphorous and/or nitrogen pretreatment. Since it is likely that sub-surface disposal will eventually discharge to surface water (in general, Lake Ontario and Pleasant Bay form the property boundaries) pre-treatment will be required to reduce phosphorous. If sub-surface disposal is also upgradient of the groundwater well, pre-treatment to reduce nitrogen will be required.

Surface disposal to either Lake Ontario or Pleasant Bay would require phosphorous pretreatment and disinfection of the final effluent. In this case treated water could be reused to irrigate gardens and lawns.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the data collected between May 1 and 17, 2001, the following conclusions and recommendations are offered by Quinte-Eco Consultants Inc.

Groundwater flow in the vicinity of the proposed development appears to be in a south-easterly direction towards Lake Ontario at a rate of approximately 10^{-10} m/s. It is suspected that groundwater closer to Pleasant Bay will be flowing towards this bay (ie. in a northerly direction).

Well #1 could not sustain repeated pumping at the test pumping rate (50 L/min or 72,000 L/day) for over 6 hours. However, given that the water use over the next five years is estimated to be approximately 40,000 L/day (28 L/min), it is expected this rate, could be maintained for a duration of over 6 hours.

At an estimated rate of less than 50,000 L/day, a Permit to Take Water will not be required. Ontario Regulation 459/00 "Drinking Water Protection" will also not apply, and consequently the Ontario Drinking Water Standards do not apply. However, given the nature of the proposed development, it is recommended that these standards be used as a baseline for the water quality.

Results indicate that the water quality is generally good, however, there are a number of parameters which exceed the Ontario Drinking Water Standards (turbidity, colour, total organic carbon (TOC), organic nitrogen (TKN - ammonia), sodium, hardness, iron and methane). The background microbial count also exceeds the objective.

It is recommended that prior to using the well for drinking water purposes, water samples be collected and analysed following full development of the well. If the analysis is unchanged, then given the proximity of the Well #1 to Lake Ontario and the quality of the water, raw water should be filtered and disinfected prior to using it as a drinking water source. Options for treatment should be considered following the repeat analysis.

A water softener will reduce the hardness. However, given the concentration of sodium is above 20 mg/L, sodium chloride based water softeners should not be used for drinking or cooking water.

An aeration tank should be installed to reduce the concentration of dissolved methane in the water.

Since the average daily wastewater flow is greater than 10,000 L/day Section 53 of Ontario Water Resources Act (OWRA) will apply. Therefore an application to the Ministry of the Environment (MOE) for a Certificate of Approval (Sewage) will be required.

A Class IV septic system with pretreatment will be required for the site. The nature of the pretreatment will depend on the location of the tile bed and the type of disposal (surface or subsurface).

DISCLAIMER

The purpose of this hydrogeological study at Alexander Island is to provide the County of Prince Edward with methods for servicing this site with private well and subsurface sewage disposal systems..

QEC does not assume responsibility for the discovery and elimination of hazards that could possibly cause accident, injuries or damage nor for identifying or testing of intermediate products or products of decomposition beyond the terms of reference described in this report. Compliance with submitted recommendations and/or suggestions in no way assures elimination of hazards or the fulfilment of a property owner's obligation under any local, provincial, or federal laws, or any modifications or changes thereto. It is the responsibility of the property owner or occupier to notify authorities of any conditions that are in violation of current legal standards.

QEC has prepared this report at the request of Mr. Theo Nibourg on behalf of Nibourg Development, RR #2 Yarker, Ontario. QEC is responsible for the accuracy of the report's contents, subject to what is stated elsewhere in this Disclaimer, but recommends the report be used only for the purpose intended by the client, when the report was prepared. The report may be unsuitable for other uses, and the client bears all responsibility for such uses. No changes to the form or content of the report may be made without QEC's expressed written approval.

This report reflects conditions as tested on May 3 to 17, 2001, the monitoring period. Changes or modifications to procedures and/or facilities made after this period are not included.

All of which is respectfully submitted,
QUINTE-ECO CONSULTANTS INC.

Deirdre Johnson, B.Sc. M.Env.St

Ronald E. Carter, M.Sc., C.Eng.
SE/REC/a

June 2001

Alexander Island: Hydrogeology Report

QE 01-401

Appendix A

Well Logs

Print only in spaces provided.
 Mark correct box with a checkmark, where applicable.

WELL #1

County or District Prince Edward	Township/Borough/City/Town/Village Hillier	Con block tract survey, etc. II	Lot 35
Owner's surname NIBOURG DEVELOPMENT	First Name	Address R. R. # 3, Consecon, Ontario	
		Date completed	15 01 01 day month year

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)					
General colour	Most common material	Other materials	General description	Depth - feet	
				From	To
				0	30
	Well previously drilled				
	Well deepened				
Grey	Limestone		Hard	30	50

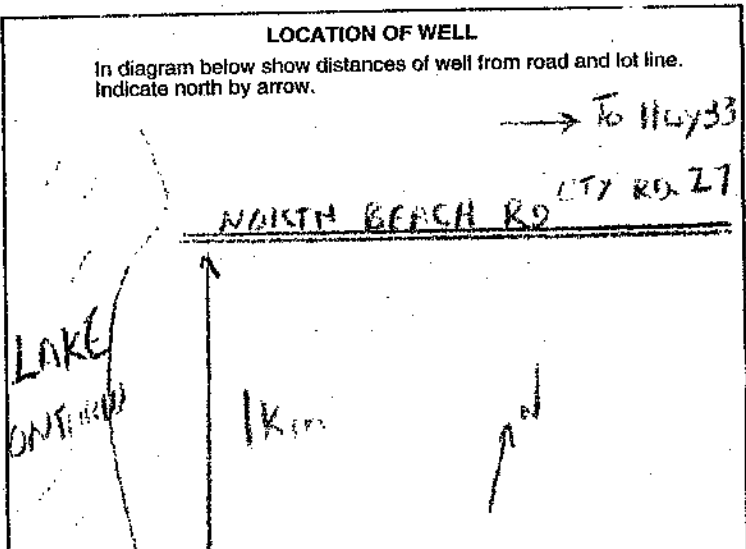
WATER RECORD	
Water found at - feet	Kind of water
18	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input checked="" type="checkbox"/> Untested <input type="checkbox"/> Minerals <input type="checkbox"/> Gas
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Gas
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Gas
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Gas
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Gas

CASING & OPEN HOLE RECORD				
Inside diam inches	Material	Well thickness inches	Depth - feet	
			From	To
5 7/8	<input type="checkbox"/> Steel <input type="checkbox"/> Galvanized <input checked="" type="checkbox"/> Concrete <input type="checkbox"/> Open hole <input type="checkbox"/> Plastic		30	50
	<input type="checkbox"/> Steel <input type="checkbox"/> Galvanized <input type="checkbox"/> Concrete <input type="checkbox"/> Open hole <input type="checkbox"/> Plastic			
	<input type="checkbox"/> Steel <input type="checkbox"/> Galvanized <input type="checkbox"/> Concrete <input type="checkbox"/> Open hole <input type="checkbox"/> Plastic			
	<input type="checkbox"/> Steel <input type="checkbox"/> Galvanized <input type="checkbox"/> Concrete <input type="checkbox"/> Open hole <input type="checkbox"/> Plastic			

SCREEN	Sizes of opening (Slot No.)	Diameter	Length
		Inches	feet
	Material and type	Depth at top of screen	
			feet

PLUGGING & SEALING RECORD		
<input type="checkbox"/> Annular space		<input type="checkbox"/> Abandonment
Depth set at - feet		Material and type (Cement grout, bentonite, etc.)
From	To	

PUMPING TEST	Pumping test method	Pumping rate	Duration of pumping	
	<input type="checkbox"/> Pump <input checked="" type="checkbox"/> Bailor	24 GPM	2 Hours	0 Mins
	Static level	Water level end of pumping	Water levels during <input checked="" type="checkbox"/> Pumping <input type="checkbox"/> Recovery	
	8 feet	43 feet	15 minutes: 43 feet	30 minutes: 43 feet
			45 minutes: 43 feet	60 minutes: 43 feet
	If flowing give rate	Pump intake set at	Water at end of last	
	GPM	feet	<input type="checkbox"/> Clear <input checked="" type="checkbox"/> Cloudy	
	Recommended pump type	Recommended pump setting	Recommended pump rate	
	<input type="checkbox"/> Shallow <input checked="" type="checkbox"/> Deep	47 feet	24 GPM	



FINAL STATUS OF WELL		
<input checked="" type="checkbox"/> Water supply	<input type="checkbox"/> Abandoned, insufficient supply	<input type="checkbox"/> Unfinished
<input type="checkbox"/> Observation well	<input type="checkbox"/> Abandoned, poor quality	<input type="checkbox"/> Replacement well
<input type="checkbox"/> Test hole	<input type="checkbox"/> Abandoned (Other)	
<input type="checkbox"/> Recharge well	<input type="checkbox"/> Dewatering	

WATER USE		
<input type="checkbox"/> Domestic	<input checked="" type="checkbox"/> Commercial	<input type="checkbox"/> Not use
<input type="checkbox"/> Stock	<input type="checkbox"/> Municipal	<input type="checkbox"/> Other
<input type="checkbox"/> Irrigation	<input type="checkbox"/> Public supply	

Appendix B

Aquifer Test Data

Groundwater Flow Direction

Groundwater flow appears to be from Well #3 and 4 towards Well #1 (see Table 1).

Table 1: Well Elevation and Static water Elevation

Well #	Ground Elevation (above datum) (m)	Depth (below ground) (m)	Static Water Depth (above datum) (m)
1	10.32	1.83	8.50
3	12.07	2.21	8.84
4	10.00	1.20	8.80

Assume: limestone $k = 10^{-7}$ m/s; $\Delta h = 8.82 - 8.50 = 0.32$ m; $\Delta l = 95$ m

$$\begin{aligned} \text{Flow (q)} &= \frac{k \Delta h}{\Delta l} \\ &= \frac{10^{-7} * 0.32}{95} = 3.4 \times 10^{-10} \text{ m/s} \end{aligned}$$

Pumping Rate (Discharge) $Q = 50$ L/min = 72 m³/day

Aquifer Test Sheet: Drawdown

Quinte -Eco Consultants

Date: 17 May 2001

Project Name: Alexander Island
Well No.: 1

Project No.: QE01-401
Test No.: 1

Static Water Level (SWL): 2.16 m
Depth of Water: 13.39 m
Volume of Water: 233 L

Date Well Developed: 16 May 2001
(see Development Sheet)
Volume Developed: 3600 L

1 gallon = 4.55 L
1ft³ = 28.3 L
1ft = 0.3048 m

How Q measured: 1/3 HP Submersible Pump
How WL measured: Tape
Diameter of Pumping Well: 0.149 m
Distance from Pumping Well: -
Measuring Pt for WL: Top of Casing (0.30 m above ground)
Elevation of Measuring Pt: 4.70 m (above reference point)

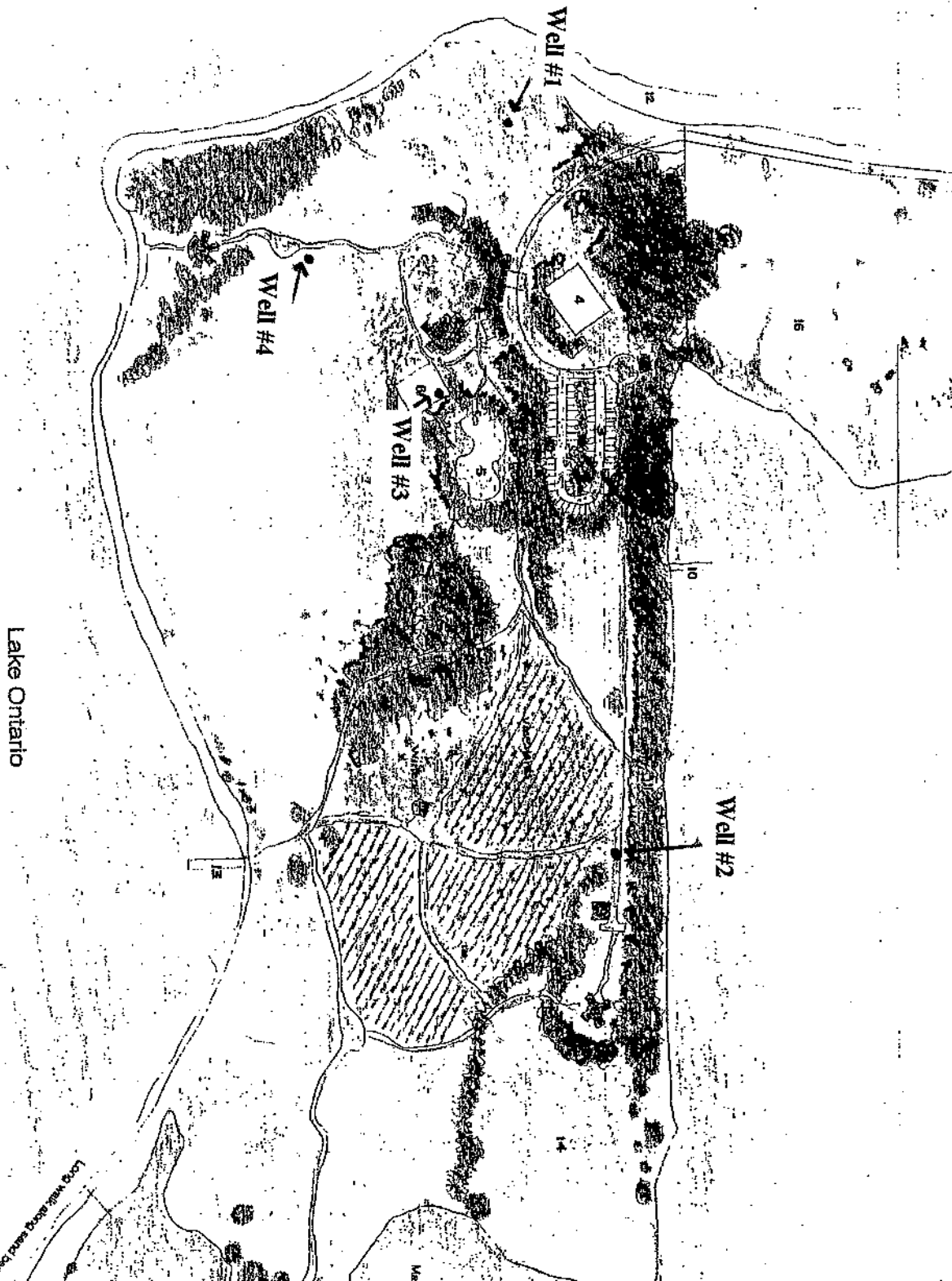
Depth of Intake: 12.3 m
Pump On: 09:20
Pump Off: 15:20
Duration: 360 min/6 hr
Pump Rate: 50 L/min

t (min)	Reading (m)	Drawdown (m)	Comments
0	2.16	0.00	
1	2.92	0.76	
2	3.25	1.09	
3	3.43	1.27	
4	3.64	1.48	
5	3.81	1.65	Turbidity 4.0
6	3.94	1.78	
7	4.01	1.85	
8	4.18	2.02	
9	4.29	2.13	
10	4.42	2.26	
12	4.61	2.45	
14	4.74	2.58	
16	4.99	2.83	
18	5.06	2.90	
20	5.21	3.05	
25	5.41	3.25	Turbidity 3.3
30	5.60	3.44	Turbidity 2.7, slight H ₂ S taste
35	5.94	3.78	Turbidity 1.5
40	5.97	3.81	
45	6.22	4.06	
50	6.35	4.19	
55	6.48	4.32	
60	6.56	4.40	
70	6.72	4.56	
80	6.86	4.70	
90	6.76	4.60	Turbidity 18
100	6.82	4.66	Turbidity 98
150	8.80	6.64	Turbidity 3.4, Water sample QE401-01 collected
200	9.99	7.83	
250	10.18	8.02	Turbidity 0.9
300	10.52	8.36	
360	10.94	8.78	Turbidity 0.7, Water sample QE401-02 collected

Name :

Deirdre Johnson

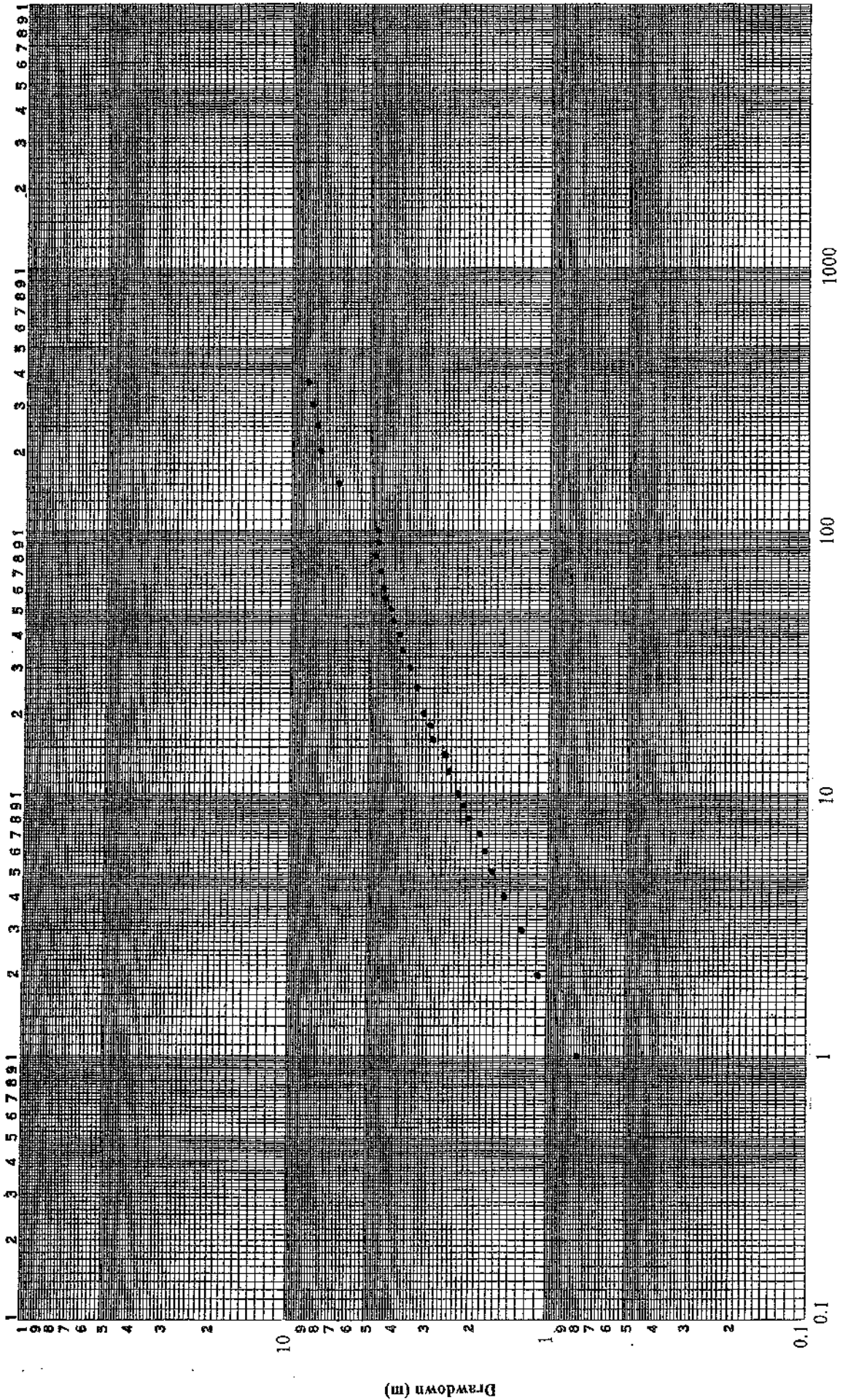
Figure 2: Approximate Location of Wells



PLEASANT BAY LODGE,
ALEXANDER ISLAND

Scale 1:3000

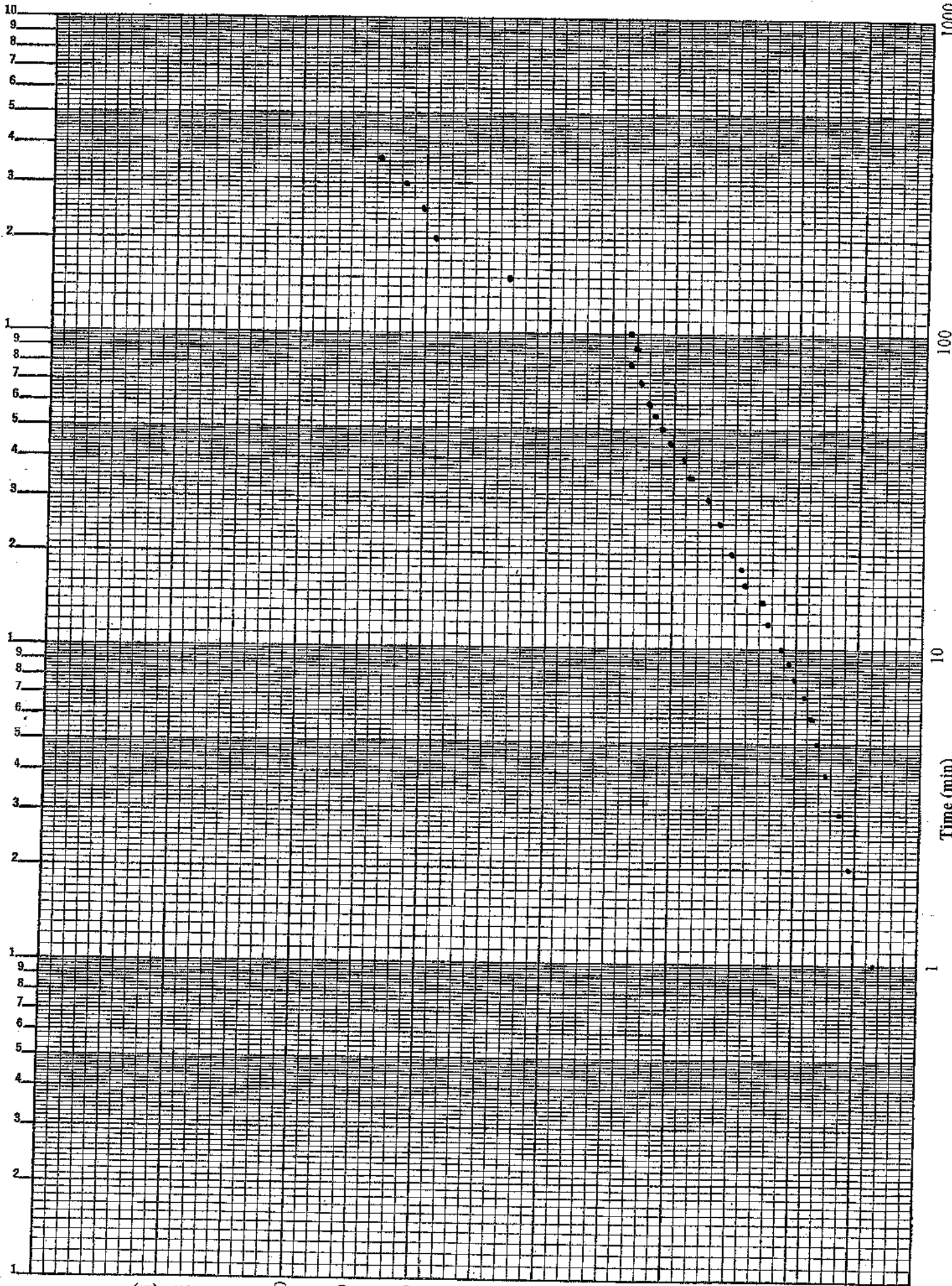
Well #1 Drawdown - Theis Analysis



Time (min)

Drawdown (m)

Well #1 Drawdown - Jacob An. Dis



Aquifer Test Sheet: Recovery

Quinte-Eco Consultants

Date: 17 May 2001

Project Name: Alexander Island
Well No.: 1

Project No.: QE01-401
Test No.: 1

1ft = 0.3048 m

How WL measured: Tape

Measuring Pt for WL: Top of Casing (0.30 m above ground)

Elevation of Measuring Pt: 4.70 m (above reference p Recovery Time: _____

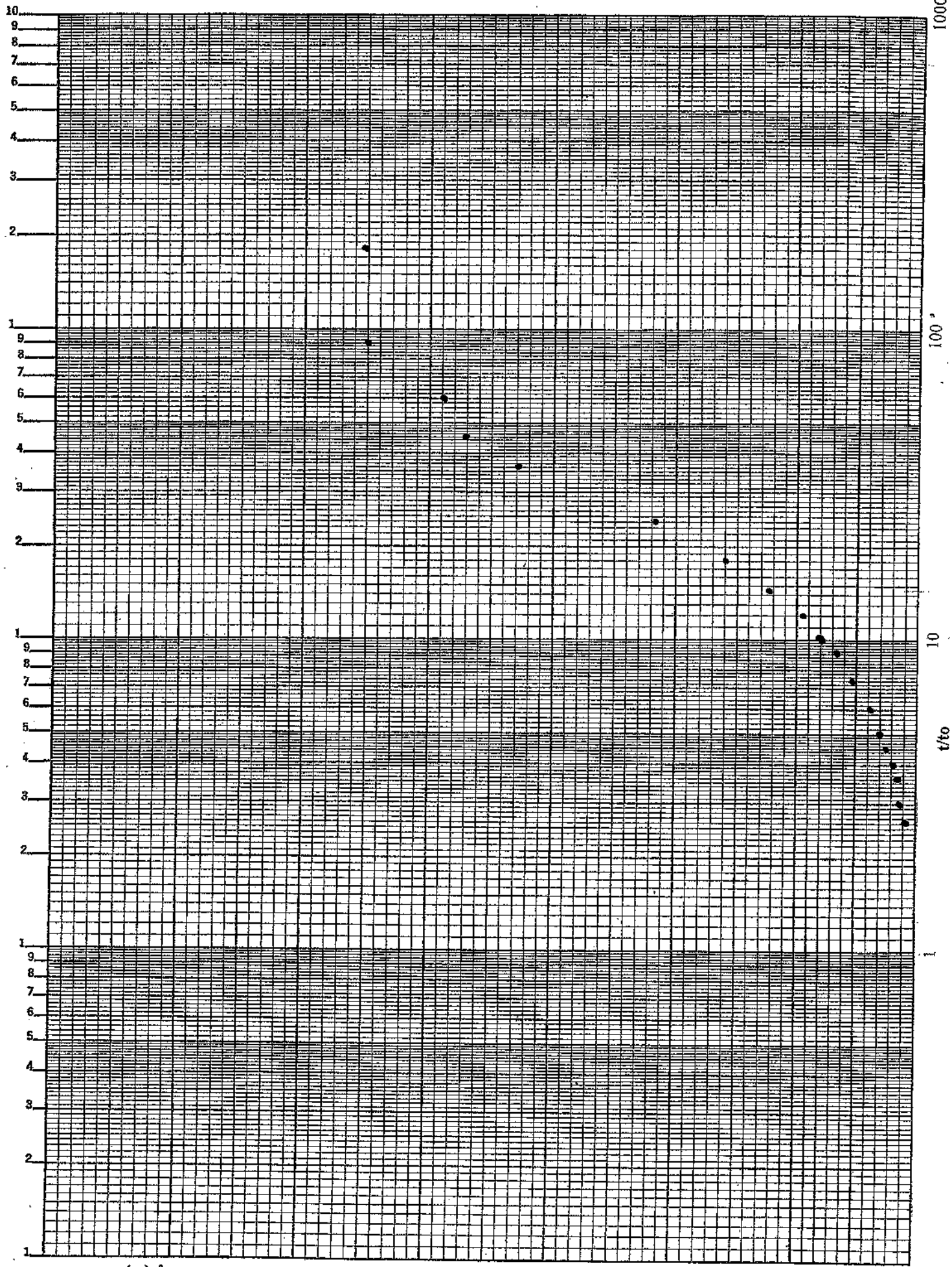
Depth at t_0 (e.g. 360 min): 10.94 m

Static water level (SWL): 2.16 m

t (min)	t' (min)	Reading from top of Well Casing (m)	t_0/t'	Recovery (Distance below SWL) (m)	Comments
360	0	8.78	0	6.62	t_0
362	2	6.67	180.0	4.51	
364	4	6.66	90.0	4.50	
366	6	6.05	60.0	3.89	
368	8	5.87	45.0	3.71	
370	10	5.45	36.0	3.29	
375	15	4.33	24.0	2.17	
380	20	3.76	18.0	1.60	
385	25	3.39	14.4	1.23	
390	30	3.10	12.0	0.94	
395	35	2.95	10.3	0.79	
400	40	2.83	9.0	0.67	
410	50	2.68	7.2	0.52	
420	60	2.55	6.0	0.39	
430	70	2.46	5.1	0.30	
440	80	2.41	4.5	0.25	
450	90	2.35	4.0	0.19	
460	100	2.32	3.6	0.16	
480	120	2.27	3.0	0.11	
500	140	2.25	2.6	0.09	Test Finished - 99% Recovery

Name: Deirdre Johnson

Well #1 Recovery - Jacob Analys



Aquifer Test Sheet: Drawdown

Quinte-Eco Consultants

Date: 17 May 2001

Project Name: Alexander Island
Well No.: 3 (Observation Well)

Project No.: QE01-401
Test No.: 1

Static Water Level (SWL): 3.26 m
Depth of Water: m
Volume of Water: L

Date Well Developed: 16 May 2001
(see Development Sheet)
Volume Developed: 3600 L

How Q measured: -

Depth of Intake: -

How WL measured: Tape

Pump On: 09:20

Diameter of Pumping Well: -

Pump Off: 15:20

Distance from Pumping Well: 108 m

Duration: 360 min/6 hr

Measuring Pt for WL: Top of Casing (1.04 m above ground) Pump Rate: 49 - 52 L/min

Elevation of Measuring Pt: 7.84 m (above reference point)

t (min)	Reading (m)	Drawdown (m)	Comments
0	3.26	0.00	
1	3.26	0.00	
2	3.26	0.00	
3	3.26	0.00	
4	3.26	0.00	
5	3.26	0.00	
6	3.26	0.00	
7	3.26	0.00	
8	3.26	0.00	
9	3.26	0.00	
10	3.26	0.00	
12	3.26	0.00	
14	3.26	0.00	
16	3.26	0.00	
18	3.26	0.00	
20	3.26	0.00	
30	3.27	0.01	
40	3.30	0.04	
50	3.39	0.13	
55	3.43	0.17	
60	3.43	0.17	
70	3.43	0.17	
80	3.44	0.18	
90	3.44	0.18	
100	3.51	0.25	
150	3.56	0.30	
200	3.60	0.34	
250	3.64	0.38	
300	3.65	0.39	
360	3.67	0.41	

Name : Deirdre Johnson

Aquifer Test Sheet: Recovery

Quinte-Eco Consultants

Date: 17 May 2001

Project Name: Alexander Island
Well No.: 3 (Observation Well)

Project No.: QE01-401
Test No.: 1

How WL measured: Tape
Elevation of Measuring Pt: 7.84 m (above reference pt)

Measuring Pt for WL:
Top of Casing (1.04 m above ground)
Recovery Time: Well #1 Recovered

Depth at t_0 (e.g. 360 min): 3.67 m
Static water level (SWL): 3.26 m

t (min)	t' (min)	Reading from top of Well Casing (m)	t_0/t'	Recovery (Distance below SWL) (m)	Comments
360	0	-	0	0	t_0
362	2	3.67	180.0	0.41	
364	4	3.65	90.0	0.39	
366	6	3.65	60.0	0.39	
368	8	3.64	45.0	0.38	
370	10	3.68	36.0	0.42	
375	15	3.66	24.0	0.40	
380	20	3.66	18.0	0.40	
385	25	3.66	14.4	0.40	
390	30	3.66	12.0	0.40	
395	35	3.65	10.3	0.39	
400	40	3.63	9.0	0.37	
410	50	3.62	7.2	0.36	
420	60	3.61	6.0	0.35	
430	70	3.59	5.1	0.33	
440	80	3.55	4.5	0.29	
450	90	3.55	4.0	0.29	
460	100	3.52	3.6	0.26	
480	120	3.51	3.0	0.25	
500	140	3.49	2.6	0.23	Test Finished

Name : Deirdre Johnson

Aquifer Drawdown (Well #1)

After 200 min

Theis

Match Point - $W(u) = 1; 1/u = 10$
 $h-h_0 = 1.5 \text{ m}; t = 0.85 \text{ min}$

$$T = \frac{Q * W(u)}{4\pi (h-h_0)}$$

$$T = \frac{72 * 1}{4\pi (1.5)} = 3.8 \text{ m}^2/\text{day}$$

Jacob straight-line

$$\Delta(h_0-h) = 4.0$$

$$t_0 = 23 \text{ min}$$

$$T = \frac{2.3Q}{4\pi \Delta(h_0-h)}$$

$$T = \frac{2.3*72}{4\pi (4.0)} = 3.3 \text{ m}^2/\text{day}$$

Aquifer Recovery (Well #1)

From 4 to 140 min

Jacob straight-line

$$\Delta(h_0-h) = 3.75$$

$$T = \frac{2.3Q}{4\pi (h_0-h)}$$

$$T = \frac{2.3*72}{4\pi (3.75)} = 3.5 \text{ m}^2/\text{day}$$

June 2001

Alexander Island: Hydrogeology Report

QE 01-401

Appendix C

Laboratory Results

ENVIRONMENTAL TECHNOLOGY RESEARCH LABORATORIES INC133 Dalton Ave. Kingston, Ont. K7K 6C2 Tel: (613) 544-2001 Fax: (613) 544-2770 email: env1@kingston.net

ETRL Record #:	01-2087 revised report
Contact:	D. Johnson
Client:	Quinte Eco Consultants
Source:	Water
Chain of Custody #:	9352
Sample Matrix:	Water
Date Submitted:	23-May-01
Date Reported:	31-May-01

PARAMETER	Method Reference	Units	MDL	ODWS		Date Tested	Sample 1
				Obj.	Type		
Ammonia (N)	SM4500	mg/L	0.05	-	-	23-May-01	0.28
Nitrite (N)	SM4110	mg/L	0.05	1.0	MAC	23-May-01	<0.05
Nitrate (N)	SM4110	mg/L	0.05	10.0	MAC	23-May-01	0.14
pH	SM4300H+	pH units	-	6.5-8.5	OG	23-May-01	7.41
Conductivity	SM2513	uS/cm	1	-	-	23-May-01	592
Alkalinity	SM2320	mg/L	3	30-500	OG	24-May-01	256
Calcium*	EPA215.1	mg/L	1	-	-	31-May-01	77.1
Potassium*	EPA200.7	mg/L	1.0	-	-	31-May-01	2.0
Chloride	SM4110	mg/L	1.0	250	AO	23-May-01	5.2
Fluoride	SM4500FD	mg/L	0.1	1.5	MAC	23-May-01	0.4
Turbidity	SM2130B	NTU	0.2	1.0	MAC	23-May-01	2.6
Colour	SM2120A	TCU	2	5	AO	23-May-01	31
Sodium*	EPA200.7	mg/L	1.0	200, 20	AO	31-May-01	18.8
Aluminum*	EPA200.7	mg/L	0.05	0.10	OG	31-May-01	<0.05
TOC*	SM5310	mg/L	1	5	AO	25-May-01	11
Phenols*	SM5530	mg/L	0.001	-	-	25-May-01	0.015
Sulfide	SM4500-S ²⁻	mg/L	0.01	0.05	AO	23-May-01	<0.01
Hardness*	calculation	mg/L	1	80-100	AO	31-May-01	229
Iron*	EPA200.7	mg/L	0.01	0.3	AO	31-May-01	0.31
Manganese*	EPA200.7	mg/L	0.01	0.05	AO	31-May-01	0.04
TKN	E3199A.1	mg/L	0.1	-	-	24-May-01	0.5
Tannins & Lignins	HACH	mg/L	0.1	-	-	24-May-01	0.4
Magnesium*	EPA200.7	mg/L	1.0	-	-	31-May-01	8.9
Methane*	GC-FID	L/m3	0.2	3L/m3	AO	30-May-01	2.3

MDL is the Method Detection Limit

AO = Aesthetic Objective

IMAC = Interim Maximum Acceptable Concentration

MAC = Maximum Acceptable Concentration

OG = Operational Guide Line

mg/L = milligrams per litre (parts per million)

* Analysis performed by Areco Canada (Division of ETRL Inc)

Sample 1 = QE-401-01

CERTIFIED BY,



Richard Hombek, Ph.D.
President

ENVIRONMENTAL TECHNOLOGY RESEARCH LABORATORIES INC133 Dalton Ave. Kingston, Ont K7K 6C2 Tel: (613) 544-2001 Fax: (613) 544-2770 email: ertl@kingston.net

ETRL Record #:	01-2087 revised report
Contact:	D. Johnson
Client:	Quinte Eco Consultants
Source:	Water
Chain of Custody #:	9352
Sample Matrix:	Water
Date Submitted:	23-May-01
Date Reported:	31-May-01

PARAMETER	Method Reference	Units	MDL	ODWS		Date Tested	Sample 2
				Obj.	Type		
Ammonia (N)	SM4500	mg/L	0.05	-	-	28-May-01	0.33
Nitrite (N)	SM4110	mg/L	0.05	1.0	MAC	23-May-01	<0.05
Nitrate (N)	SM4110	mg/L	0.05	10.0	MAC	23-May-01	0.22
pH	SM4300H+	pH units	-	6.5-8.5	OG	23-May-01	7.45
Conductivity	SM2513	uS/cm	1	-	-	23-May-01	602
Alkalinity	SM2320	mg/L	3	30-500	OG	24-May-01	272
Calcium*	EPA215.1	mg/L	1	-	-	31-May-01	73.3
Potassium*	EPA200.7	mg/L	1.0	-	-	31-May-01	2.2
Chloride	SM4110	mg/L	1.0	250	AO	23-May-01	4.8
Fluoride	SM4500FD	mg/L	0.1	1.5	MAC	23-May-01	0.3
Turbidity	SM2130B	NTU	0.2	1.0	MAC	23-May-01	2.7
Colour	SM2120A	TCU	2	5	AO	23-May-01	32
Sodium*	EPA200.7	mg/L	1.0	200, 20	AO	31-May-01	24.9
Aluminum*	EPA200.7	mg/L	0.05	0.10	OG	31-May-01	<0.05
TOC*	SM5310	mg/L	1	5	AO	25-May-01	15
Phenols*	SM5530	mg/L	0.001	-	-	25-May-01	0.015
Sulfide	SM4500-S ²	mg/L	0.01	0.05	AO	23-May-01	0.01
Hardness*	calculation	mg/L	1	80-100	AO	31-May-01	231
Iron*	EPA200.7	mg/L	0.01	0.3	AO	31-May-01	0.29
Manganese*	EPA200.7	mg/L	0.01	0.05	AO	31-May-01	0.04
TKN	E3198A.1	mg/L	0.1	-	-	24-May-01	0.5
Tannins & Lignins	HACH	mg/L	0.1	-	-	24-May-01	0.4
Magnesium*	EPA200.7	mg/L	1.0	-	-	31-May-01	9.3
Methane*	GC-FID	L/m3	0.2	3L/m3	AO	30-May-01	4.7

MDL is the Method Detection Limit

AO = Aesthetic Objective

IMAC = Interim Maximum Acceptable Concentration

MAC = Maximum Acceptable Concentration

OG = Operational Guide Line

mg/L = milligrams per litre (parts per million)

* Analysis performed by Areco Canada (Division of ETRL Inc)

Sample 2 = QE-401-02

CERTIFIED BY,



Richard Hombek, Ph.D.
President

ENVIRONMENTAL TECHNOLOGY RESEARCH LABORATORIES INC133 Dalton Ave. Kingston, Ont K7K 6C2 Tel: (613) 544-2001 Fax: (613) 544-2770 email: ertl@kingston.net

ETRL Record #:	01-2087 revised report
Contact:	D. Johnson
Client:	Quinte Eco Consultants
Source:	Water
Chain of Custody #:	9352
Sample Matrix:	Water
Date Submitted:	23-May-01
Date Reported:	31-May-01

Method: Membrane Filtration							
PARAMETER	Method Reference	Units	ODWS		Date Tested	Sample 1	Sample 2
			Obj.	Type			
Total Coliform	SM9222B	CFU/100mL	0	MAC	23-May-01	0	1
E. coli	SM9222D	CFU/100mL	0	MAC	23-May-01	0	0
Background	SM9222B	CFU/100mL	0	MAC	23-May-01	167	70
Fecal Streptococci	SM9230C	CFU/100mL	-	-	23-May-01	0	0
Fecal Coliform	SM9222D	CFU/100mL	0	MAC	23-May-01	0	0

Sample 1 = QE-401-01

Sample 2 = QE-401-02

CERTIFIED BY,



for Richard Hombek, Ph.D.
President