Edinburgh Group Limited

Final Report

Project Name
Level II Groundwater Supply Assessment
Proposed Cottage Lot Development
Ocean Pond Property
Newfoundland and Labrador

Project Number
SJN-00215494-A0

Prepared By:

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Date Submitted
August 2015

EXECUTIVE SUMMARY

Exp Services Ltd. (**exp**) completed a Level II Groundwater Supply Assessment (GSA) for the Proposed Cottage Lot Development – Ocean Pond Property. The proposed development is located on the south side of the Trans-Canada Highway (TCH), approximately 10.5 km east of Whitbourne, Newfoundland and Labrador. The site is located approximately 7.2 km southwest from the TCH-Ocean Pond access-road intersection. Access is via an existing gravel road through the cottage-developed area of Ocean Pond. Ocean Pond has been developed historically as summer cottages. The development proposes 106 cottage lots (Lot 1 to Lot 37 and Lot 43 to Lot 111), approximately 4542 m^2 in size, over approximately 48.6 hectares (excluding road rights-of-way) of presently-wooded land. Note that Lot 38 to Lot 42 are not being developed due to existing water/bog conditions.

The testing incorporated a five-test dug-well program, which incorporated recovery-testing protocols at each dug well site.

The recovery rate tests indicated conservative values of water in storage during winter conditions ranging from 500 litres to 1000 litres, with short-term yields of 5 Lpm to 7 Lpm; recovering in 1.5 hours to 3.5 hours. These values meet the volume and yield requirements during the time of testing. However, the extent of decline in the water table during low summer conditions is unknown, as is its impact on yield and volume available.

Dug-well contractors are not licensed in the Province, however, Service NL provides the document "Before You Construct Your Dug Well…", which provides details for dug-well construction.

Water quality from the aquifer should meet potable guidelines, given the 55 parameters tested. Iron and manganese, in localized situations, may exceed the aesthetic limits. Depending upon homeowner preference, this may require treatment. Sub-divisions generally are noted for the use of a wide variety of potential contaminants which are more likely to enter the shallow groundwater flow system which is being utilized for both water supply and septic field treatment. Home owners should be advised to sample their raw water for at least an RCAp+MS and bacteria annually as part of normal maintenance practice.

Total coliform bacteria were noted at low concentrations in two wells. Fecal and e-coli bacteria were not detected in any of the samples. The influence of low winter temperatures on these results is unknown.

The impact of climate change on these conclusions is presently unknown.

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1 INTRODUCTION

A Level I Groundwater Supply Assessment was undertaken in January 2014 by **exp** Services Inc. (**exp**) on property identified as the Proposed Cottage Lot Development – Ocean Pond Property. The proposed development is located on the south side of the Trans-Canada Highway (TCH), approximately 10.5 km east of Whitbourne, Newfoundland and Labrador; hereafter referred to as the "Site". The Site is located approximately 7.2 km southwest from the TCH-Ocean Pond access-road intersection. Access is via an existing gravel road through the cottage-developed area of Ocean Pond. Ocean Pond has been developed historically as summer cottages. The development proposes 106 cottage lots (Lot 1 to Lot 37 and Lot 43 to Lot 111), approximately 4542 m^2 in size, over approximately 48.6 hectares (excluding road rights-of-way) of presently-wooded land. Note that Lot 38 to Lot 42 are not being developed due to existing water/bog conditions. Refer to *Figure 1: Test Pit and Dug Well Location Plan* for details.

While the Level I study noted the potential for acceptable yields from the underlying bedrock, the intention is that water supplies for individual lots will be provided through dug wells. This was agreed to by Newfoundland Department of Environment and Conservation. A 38-test-pit program was completed during the period January 09 to 20, 2015 to assess the suitability of on-site overburden materials for septic fields, and to construct five preliminary dug wells for hydraulic and water quality testing.

This report summarizes the results of the Level II GSA program. The Level I study was reported in January 2014 by **exp**. The septic field suitability study was reported on by **exp** on June 11, 2015. It is assumed the reader is familiar with both reports.

2 PROPOSED COTTAGE LOT DEVELOPMENT

The development proposes 106 cottage lots, each approximately 4542 m^2 in size, over approximately 48.6 hectares of presently-wooded land. It is planned as a strip development, following the shorelines of Ocean Pond. Lots will be developed for use as cottages, though some may have a year-round usage. The area is not presently serviced with water or sanitary sewer.

The surrounding property is essentially virgin and undeveloped. The nearest existing development is a gravel cottage access road located approximately 500 m northeast of the Site. There are approximately 12 cottages along the last 500 m of this road fronting onto Western Gull Pond; though none occur within a 500 m radius of the property. Future access to the proposed development will be by way of an extension to this existing road. Note that a rough access road to the proposed cottage lot locations was completed during the winter of 2014.

It is understood that each lot will be serviced by its own septic system. It is assumed they will be designed according to provincial requirements. This does, however, imply the use of groundwater in both the overburden and shallow bedrock for treatment. It will therefore be critical in the location and design of the dug wells to ensure maximum separation distance between wells and septic fields; with the latter being hydraulic down-gradient of the wells on both the primary, as well as adjacent properties.

It is understood that the cottage lot development will be serviced by roadside, and in some cases, backlot ditching, potentially reducing the rate of infiltration and recharge to the aquifer. Further, open-loop groundwater source heat pump systems are not permitted in un-serviced development.

3 FIELD PROGRAM

A 38-test-pit program was designed to provide coverage of the total area. Each test pit was instrumented by a monitor well prior to infilling. Groundwater water table levels were monitored once per week during the period February 09, 2015 to April 24, 2015.

Five additional test pits were completed as dug wells, with locations and identifiers presented on *Figure 1: Test Pit and Dug Well Location Plan*. The wells were not logged either manually or through geophysics. However, test pits adjacent each well were logged by **exp** personnel, as summarized in *Table 3-1: Test Pit Data at Dug Well Locations*; logs are provided in Appendix A.

Table 3-1:
Test Pit Data at Dug Well Locations

DUG WELL	ADJACENT TEST PIT	TOTAL DEPTH (m)	TERMINATED IN	GROUNDWATER ENCOUNTERED AT (m)
Well 1	TP 21	2.7	Glacial Till	1.2
Well 2	TP 17	4.8	Bedrock (presumed)	n/e
Well 3	TP 39	2.4	Glacial Till	n/e
Well 4	TP 23	5.0	Glacial Till	4.5
Well 5	TP 06	4.0	Glacial Till	3.8

Notes:
n/e not encountered

It is understood the dug wells were constructed within test pits (approximately 3 m x 3 m square at the top and 2 m x 2 m square at the base) excavated by a *CAT 336E* excavator. The base of the excavation was covered with a rock mattress approximately 0.75 m to 1 m deep. The grain size, origin, and composition of the granulars are unknown. The casing was comprised of 600 mm diameter ribbed plastic culvert pipe. Water was allowed to inflow up through the base of the pipe, with a few holes drilled in the side walls of two wells. The test pits were then backfilled with excavated native till material.

Given the large well diameter, encompassing not only the casing but also rock infill, the normal groundwater testing protocols to determine safe yield are not viable. No specific hydraulic testing or analysis protocols were designated by NLDEC.

Hydraulic testing comprised pumping the well dry a number of times at varying rates (Well 1 – 72 L/m; Well 2 – 31 L/m; Well 3 – 60 L/m; Well 4 – 63 L/m; Well 5 – 62 L/m) and then recording water level rise during the last recovery period. Pump

test/recovery data for each well location is provided in Appendix B. Note that water levels in adjacent test pit stand pipes were not measured during the dug well pumping/recovery process.

Water samples were collected for an RCAp plus metal scan (field filtered) and microbiological analysis following construction of dug wells, and submitted to Maxxam Analytics, an accredited testing laboratory for analysis. Note that surface water samples were collected from Ocean Pond and Interior Pond (no name) for analysis. Water chemical and microbiological analyses are included in Appendix C.

4 HYDROLOGICAL SETTING

4.1 Hydrological Region

The proposed development lies within a setting similar to a Lowland Hydrological Region – Homoclinal Flank Hydrological District. This District is characterized by gently undulating, bedrock-controlled topography. It comprises a thin overburden, underlain by a variety of arenaceous and argillaceous bedded sedimentary rock, which dip steeply (30 degrees to 40 degrees) westward in proximity to the SNOWS synclinal axis and the adjacent Parkland anticlinal axis. This potentially creates a series of aquifers and aquitards. The ground surface is covered by a dominant boreal softwood forest and localized wetlands. Given the bedrock lithology, development of preferential flow pathways resulting from karst dissolution processes are not expected.

The northeast-southwest orientation of the proposed development trends parallel to bedding strike and topographic relief.

4.2 Hydrostratigraphic Units

Five hydrostratigraphic Units (HUs) are expected to control water flow within this setting, including:

1. Gibbett Hill (bedrock) HU;
2. Structural HU (Snows Pond Syncline; Parkland Anticline);
3. Till HU;
4. Soil HU; and
5. Organic HU, forming wetlands in localized depressions.

Given the utilization of dug wells, the first two HUs are not of importance in the following discussion.

4.3 Groundwater Flow Field:

A conceptual (not numerical) model of the flow field was developed for the site.

Interflow within the Soil and Organic HUs, coupled with water table (at times perched) conditions in the Till HU are expected to exert a major control over the shallow groundwater flow system and therefore ground/surface water interaction (GWSI). This layer ranged from 0.3 m to 2.1 m thick (average 0.8 m) as encountered at the surface at all test pits.

Given the absence of a detailed groundwater assessment at this site, the conceptual model is expected to see primary control on the shape of the flow field exerted by topographic constraints. This should result in development of a 'Local" groundwater flow system, with recharge over topographic highs and discharge in the adjacent lowlands.

The static water levels in monitored test pits ranged from 0.26 m to 5.86 m below ground surface during winter conditions. Where bedrock was encountered at four test pits, only two encountered groundwater providing a thin saturated zone of 0.1 m to 0.6 m. However, the five dug wells noted much greater saturated thickness ranging from 1.66 m to 3.82 m; averaging 2.89 m. It is expected that, during summer low head conditions, the water table may drop to within the shallow bedrock.

5 AQUIFER CHARACTERISTICS

5.1 Lithology

The primary aquifer which will supply potable groundwater to the development is the Till HU.

It is described as a dense, dark grey unit extending to depths ranging from 2.0 m to 6.8 m below ground surface. Where bedrock was encountered at four test pits, the depth of overburden ranged from 2.6 m to 4.8 m.

While it exhibits a variable composition, it is generally described geotechnically as a silty gravelly Sand to a Sand and Gravel, with traces of some silt and occasional cobbles and boulders.

Particle size analyses were completed on 16 representative Till samples, with the following results:

Gravel:	22.4 percent to 48.4 percent	(average 34.5 percent)
Sand:	36.0 percent to 55.0 percent	(average 46.8 percent)
Silt:	9.2 percent to 25.5 percent	(average 18.7 percent).

Gradation Curves are presented in Appendix A.

The natural moisture content of the samples tested ranged from 5.6 percent to 11.5 percent, with an average of 8.7 percent.

Perculation tests in 12 test pits resulted in time values for the water level to drop 2.5 cm (1 inch) ranging from 3 minutes to 60 minutes, averaging 24.5 minutes.

Hydrometer analyses were not undertaken. Straight line extrapolation to the D_{10} value for 13 grain size analyses indicated 10 percent finer than values ranging between 0.006 mm to 0.055 mm, averaging 0.025 mm. Using the Hazen method with a C value of 150 indicates a permeability for the Till HU ranging between 4.5×10^{-3} and 5.4×10^{-5} cm/sec, averaging 9.4×10^{-4} cm/sec.

5.2 Hydrogeology - Yield

No airlift or step testing was undertaken. Drawdown during pumping was not recorded, just recovery after dewatering the well. Water levels in adjacent monitor wells during the testing period were not recorded.

The data associated with the recovery tests undertaken on each of the five dug wells are provided in Appendix B. The data is summarized in *Table 5-1: Summary of Recovery Tests.*

Table 5-1 Summary of Recovery Tests

WELL ID	STATIC WATER LEVEL (m)	TOTAL DEPTH TEST PIT (m)	SATURATED THICKNESS (m)	PUMPING RATE (Lpm)	APPROX. VOLUME WATER REMOVED (L)	FINAL PUMPING LEVEL (m)	TIME TO RECOVER TO STATIC (min)	INFLOW RATE (Lpm)
Well 1	2.41	5.46	3.05	72.0	862	5.21	145	6.0
Well 2	4.18	5.84	1.66	30.9	570	5.59	94	6.1
Well 3	2.23	6.05	3.82	60.1	1079	6.05	207	5.2
Well 4	2.05	5.39	3.34	63.3	945	5.34	141	6.7
Well 5	3.76	6.29	2.53	62.4	715	5.73	140	5.1

The approximate volume of water removed accounts only for the water within the casing, not in the granular pack under and around the casing. Therefore, the calculated inflow rates are conservative. The data suggests well yields ranging from 5.1 Lpm to 6.7 Lpm under winter, high water table conditions.

5.3 Hydrogeochemistry

A total of five inorganic water chemical analyses were collected during this investigation, following the installation of dug wells, Well No. 1 to Well No. 5. The results are provided in Appendix C.

Each sample was analyzed for 55 inorganic ions, metals, and calculated analytes by *Maxxam Analytical* laboratories, a CALA accredited facility. While no duplicate samples were collected for QA/QC, all ion balance errors were =/< 5%, (except for Well 5 at 6.06%). The chemistries are accepted as valid for interpretation.

A review of the water chemistry indicated:

1) The water chemistry within the Till HU appears relatively consistent over the site at the wells tested. Generally it can be characterized as a fresh (TDS 23 – 40 mg/L), soft (hardness as $CaCO_3$ 6.3 to 11 mg/L), corrosive (at 4^0 C), with minor alkalinity (5.6 to 11 mg/L), and a slightly acidic to neutral pH range of 6.1 to 7.1.

2) The chemical signature for the water was usually a sodium-chloride type water, except Well No. 1 which was a mixed sodium-bicarbonate/chloride-type water. These are generally indicative of shallow groundwater with a similar typing to rainwater.

3) The water was non-coloured, except for a relatively-high reading (19 TCU) at Well No. 3. With exception of the latter, it suggests minimal influence of near-surface waters, wetland drainage, or grubbings in the backfill around the casing.

4) The water exhibited low turbidity (0.71 NTU to 4.4 NTU), suggesting minimal influence of sidewalls due to well construction. It was expected that larger concentrations would be encountered, given the loose backfill positioned around the outer well casing.

5) Silica, as an indicator of deeper groundwater flow, ranged between 4.1 mg/L and 11 mg/L, suggesting the influence of bedrock groundwater.

6) Sulfate, as indicator for the influence of surface wetlands and natural mineralization, exhibited a relatively-low concentration range from 2.4 mg/L to 3.0 mg/L; more indicative of shallow water table conditions.

7) Nutrients, as exemplified by the indicators of total organic carbon (1.9 to 6.8), nitrate+nitrite (as N) (<0.05 mg/L), ammonia (as N) (0.062 to 0.13 mg/L), and orthophosphate (P) (<0.01 to 0.011 mg/L) were at low levels. However, the

higher TOC and presence of ammonia suggest influence of Soil HU and/or grubbings within the fill placed around the well casing.

8) Three dissolved indicator trace metals noted variable concentrations of iron (<50 µg/L to 320 µg/L), manganese (35 µg/L to 310 µg/L), and aluminium (89 µg/L to 620 µg/L). Six were continuously detectable as dissolved concentrations, including:

aluminum	(89 µg/L to 620 µg/L)
barium	(2.0 µg/L to 11 µg/L)
cadmium	(0.013 µg/L to 0.026 µg/L)
copper	(2.3 µg/L to 8.6 µg/L)
manganese	(21 µg/L to 310 ug/L)
strontium	(8.7 µg/L to 16 µg/L).

Whether these metals are associated with bedrock groundwater and/or the coarse rock-fill placed under the casing, is unknown.

9) Total coliform, fecal coliform and E-Coli bacteria where analyzed following construction of each dug well. All wells recorded non-detectable concentrations of Fecal and E-Coli bacteria. Total coliform bacteria were detected at low concentrations in Well No. 3 (6 CFU/100ml), and Well 5 (9 CFU/100 ml). The influence of low winter temperatures on these results is unknown.

5.4 Water Quality

Of the 55 parameters analyzed for, five exhibited sporadic exceedances to aesthetic concentrations within the Guidelines for Canadian Drinking Water Quality (October 2014). These included:

Iron:	Well No. 3	320 µg/L
Manganese:	Well No. 2	0.062 µg/L; Well No.3 310 µg/L
Colour:	Well No. 3	19 TCU
pH:	Well No. 1	6.36; Well No. 3 6.12, and Well No. 5 6.44.

5.5 Surface Water Quality

In addition to analysis completed on well water samples, inorganic water chemistry and microbiological analyses were completed on the surface waters of Ocean Pond and Inner Pond (no name).

Total coliform, fecal coliform and E-Coli bacteria where analyzed at four surface water locations (as indicated on Figure 1), with the following results:

OP1-01: (May 14/15)	Total Coliform – 22 CFU/100 ml; Fecal Coliform - < 1 CFU/100 ml; E. coli - < 1 CFU/100 ml
OP1-02: (May 14/15)	Total Coliform – > 200 CFU/100 ml; Fecal Coliform - 27 CFU/100 ml; E. coli - 27 CFU/100 ml
OP1-02: (June 1/15)	Total Coliform – > 200 CFU/100 ml; Fecal Coliform - < 1 CFU/100 ml; E. coli - < 1 CFU/100 ml
IP1-01: (May 14/15)	Total Coliform – > 200 CFU/100 ml; Fecal Coliform - < 1 CFU/100 ml; E. coli - < 1 CFU/100 ml
IP1-02: (May 14/15)	Total Coliform – > 200 CFU/100 ml; Fecal Coliform - < 1 CFU/100 ml; E. coli - < 1 CFU/100 ml

Note that the fecal coliform and E-coli values were elevated for the OP1-02 surface water sample dated May 14/15. This location, OP1-02, was resampled on June 1/15 with the fecal coliform and the E.coli values less than the laboratory detection limits. Total coliform values may result from naturally occurring vegetation and animal faeces occurring in surface waters.

There were no noted metals exceedances of the Guidelines for Canadian Drinking Water Quality (October 2014) for surface water samples analysed.

6 COTTAGE-LOT REQUIREMENTS

6.1 Yield

The provincial requirements for developments serviced by individual private wells require a minimum quantity of 340 litres per person per day for a normal domestic four-person house, without a groundwater source heat pump system. With a consistent 24-hour pumping rate, this would equate to 0.94 Lpm.

The guidelines further note the consultant must address the issue of whether the groundwater withdrawals in the proposed development and other existing or planned developments in the area will exceed the long-term safe yield of the aquifer, or significantly decrease flow to sensitive watercourses. The method and level-of-effort required to undertake that assessment is left open in terms of understanding: a) the impact of multiple well pumping during breakfast and supper, b) applicable annual

recharge rates, c) extent of reduced infiltration expected through development and drainage, and d) impact of a changing climate.

However, the Province guidelines indicate:

> *"A groundwater assessment is NOT intended to provide a guarantee that future home owners will have an adequate supply of potable water but, rather, is to provide a qualified opinion of the likelihood of obtaining an adequate supply of potable water".*

To assess the potential for the proposed development to meet the above requirements, two approaches were used, the results of which are summarized below:

1) *Well Yield:* The recovery rate tests indicated conservative values of water in storage during winter ranging from 500 litres to 1000 litres, with short-term yields of 5 Lpm to 7 Lpm; recovering in 1.5 hours to 3.5 hours. These values meet the volume and yield requirements during the time of testing. However, the extent of decline in the water table during low summer conditions is unknown, as is its impact on yield and volume available.

2) *Recharge Rate:* Assuming an average annual groundwater recharge rate of 0.1 m/year to 0.4 m/year spread over the 48.6 hectare surface, translates to a potential recharge volume of 48 600 m^3 to 194 400 m^3. Assuming 10% to 20% loss by reduced infiltration with normal development land use (roads, roofs, driveways, etc.) leaves an average annual recharge volume of approximately 38 900 m^3 to 175 000 m^3. The proposed cabin lot development accommodates 106 homes plus green space area which, at 340 L/person/day (four persons per household), equates to a demand of approximately 144 m^3/day. This accounts for approximately 31 % (at 0.1 m/year) to 8 % (at 0.4 m/year) of the replenishable resource. The impact of climate change on recharge rate is unknown.

3) *Flow System:* Given the variability in topographic relief and incised drainage network an analytical flow system analysis could not be undertaken.

6.2 Water Quality

As noted in Section 5.4, the groundwater quality, for the most part, meets potable guidelines. Iron and manganese, in localized situations, may exceed the aesthetic limits. Depending upon homeowner preference, this may require treatment. The influence of climate change is unknown.

A typical sub-division development is noted for use of a wide variety of potential contaminants associated with not only septic field discharge but also roof drainage, lawn-care products, fuel oil tanks, road wash run-off, pet feces, etc. The greatest

potential for these compounds to be present is in the shallow groundwater flow system. Since the overburden geology serves as a type of treatment for removing near-surface contamination, those homes removing all or part of the overburden for basement excavation and/or landscaping are more at risk. Home owners should be advised to consider having a sample of their raw water collected and analyzed for an RCAp+MS plus microbiological sample as part of normal maintenance practice.

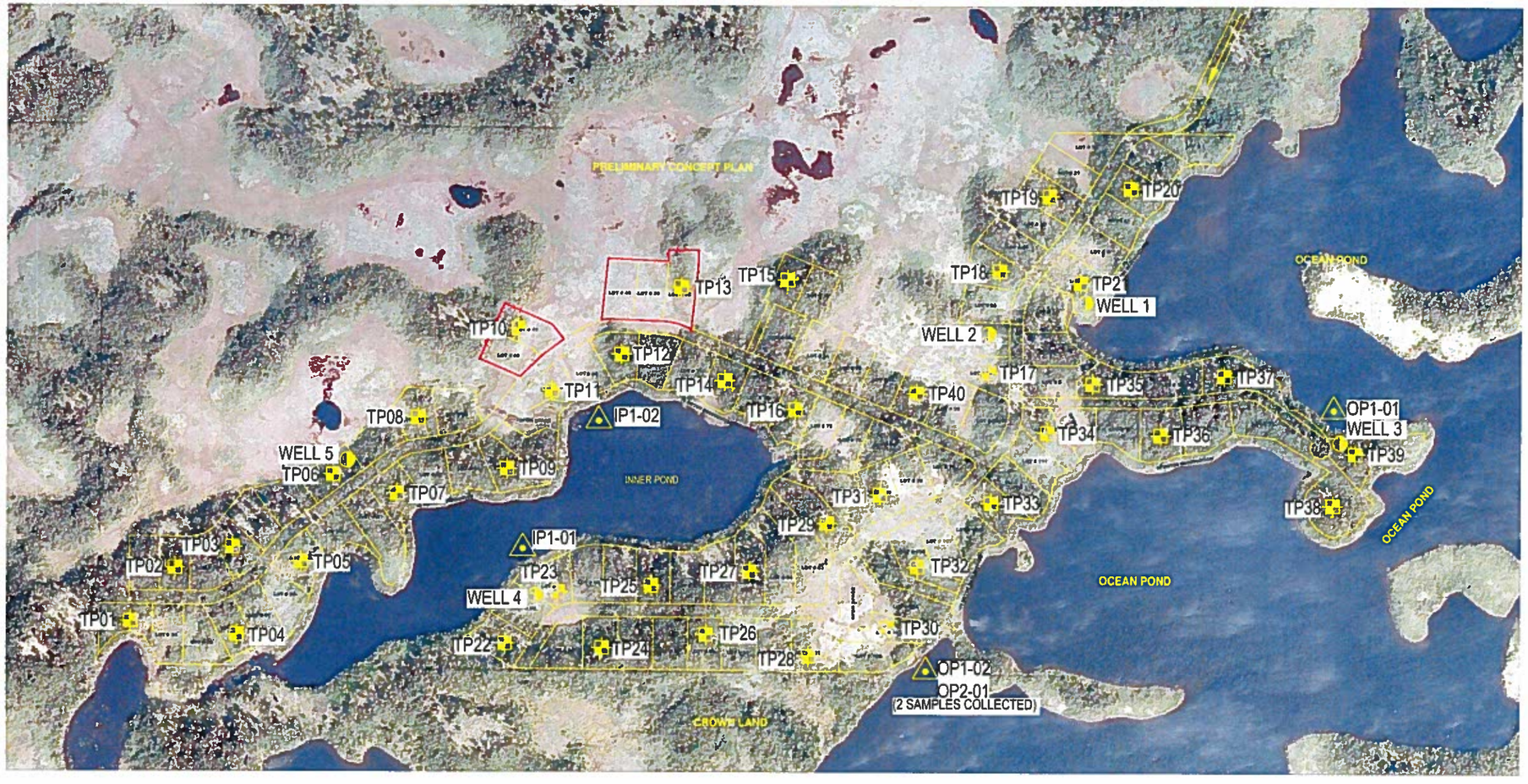
7 DUG WELL CONSTRUCTION

Service NL provides the document *"Before You Construct Your Dug Well..."* on its website. This document provides information pertaining to location of wells, well construction and details, disinfecting new wells, maintenance, and design. A copy of the document is attached in Appendix D.

FILE:

MODEL: %MODELNAME

NOTES:
-TEST PITS TP10 AND TP13 NOT EXCAVATED.
-LOT No.38, LOT No.39, LOT No.40, LOT No.41 AND LOT No.42 WILL NOT BE DEVELOPED DUE TO EXISTING SURFACE WATER/BOG CONDITIONS (NOTED AS RED LINES ON SKETCH BELOW).



0m 100m 200m 300m 400m 500m 600m 700m 800m 900m 1000m

PLOTTED BY: %USER DATE: %DATE TIME: %TIME

No.	Issue	Date

No.	Revision	Ckd. By	Date

LEGEND

- TEST PIT LOCATION
- WELL (DUG) AND WELL WATER SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION

Const. North

Drawn By: R.J.B.

Dwg. Standards Ckd. By: R.J.B.

Designed By: W.G.M.

Date Printed: 09-JUL-2015

Dwg. Design Ckd. By: W.G.M.

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Project Title
LEVEL II GROUND WATER SUPPLY ASSESSMENT
PROPOSED CABIN LOT DEVELOPMENT
OCEAN POND PROPERTY

Dwg. Title
TEST PIT AND DUG WELL LOCATION PLAN

Project No. SJN-00215494-A0

Dwg. No. **FIGURE 1** Rev. No.

Scale 1:7,500
This drawing is not to be scaled

APPENDIX A

Symbols and Terms Used on the Borehole, Test Pit, and Monitor Well Records

Test Pit Records

Gradation Curves

SYMBOLS AND TERMS USED ON THE BOREHOLE, TEST PIT, AND MONITOR WELL RECORDS

SOIL DESCRIPTION

Behavioural properties (i.e. plasticity, permeability) take precedence over particle gradation in describing soils.

Terminology describing soil structure:

Desiccated	-	having visible signs of weathering by oxidation clay minerals, shrinkage, cracks, etc.
Fissured	-	having cracks, and hence a blocky structure
Varved	-	composed of regular alternating layers of silt and clay
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay
Well-graded	-	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Uniformly-graded	-	predominantly of one grain size.

Terminology used for describing soil strata based upon proportion of individual particle sizes present:

Trace, or occasional	-	less than 10%
Some	-	10% to 20%
Adjective (e.g. silty or sandy)	-	20% to 35%
And (e.g. silt and sand)	-	35% to 50%

The standard terminology to describe cohesionless soils include the relative density, as determined by laboratory test or by the Standard Penetration Test N-value: the number of blows of 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2-inch (50.8 mm) O.D. split-spoon sampler 1 foot (305 mm) into the soil. On the records, where complete sampler penetration is not achieved and an N-value cannot be reported, the total number of blows are shown over actual penetration in millimetres (eg. 75/180).

Relative Density	N-value	Relative Density %
Very Loose	<4	<15
Loose	4 - 10	15 - 35
Compact	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very Dense	>50	>85

The standard terminology to describe cohesive soils include the consistency, which is based on undrained shear strength as measured by in situ vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength		N-value
		kPa	
Very Soft	< 0.25	< 12.5	< 2
Soft	0.25 to 0.5	12.5 to 25	2 to 4
Firm	0.5 to 1.0	25 to 50	4 to 8
Stiff	1.0 to 2.0	50 to 100	8 to 15
Very Stiff	2.0 to 4.0	100 to 200	15 to 30
Hard	> 4.0	> 200	> 30

SAMPLES

SS Split-spoon sample (obtained by performing the Standard Penetration Test)
AS Auger sample
ST Shelby tube or thin-wall tube
PS Piston sample
BK Bulk sample
WS Wash sample
RC Rock core
AXT, BXL, etc.
Rock core samples obtained with the use of standard diamond drilling bits.

OTHER TESTS

G Specific Gravity
H Hydrometer Analysis
S Sieve Analysis
MC Moisture Content
y Unit Weight
C Consolidation
CD Consolidated drained triaxial
CU Consolidated undrained triaxial with pore pressure measurements
UU Unconsolidated undrained triaxial
RCC Rock Core Compression
DS Direct Shear
P Field Permeability
TPH Total Petroleum Hydrocarbons (ppm)
ND Below Detection Limit

ROCK DESCRIPTION

The description of rock is based on the rock quality designation (RQD).

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. In most cases, RQD is run on NXL core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from normal in situ fractures.

RQD	Rock Quality
90 to 100	excellent quality
75 to 90	good quality
50 to 75	fair quality
25 to 50	poor quality
< 25	very poor quality

CLASSIFICATION OF ROCK WITH REGARD TO STRENGTH

STRENGTH		FIELD IDENTIFICATION METHOD	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (MPa)
Grade	Classification		
RO	Extremely weak	Indented by thumbnail	< 1
R1	Very weak	Crumbles under firm blows of geological hammer; can be peeled with a pocket-knife	1 - 5
R2	Weak rock	Can be peeled by a pocket-knife with difficulty; shallow indentations made by a firm blow with point of geological hammer	5 - 25
R3	Medium strong	Cannot be scraped or peeled with a pocket-knife; specimen can be fractured with a single firm blow of geological hammer	25 - 50
R4	Strong	Specimen requires more than one blow of geological hammer to fracture	50 - 100
R5	Very strong	Specimen requires many blows of geological hammer to fracture	100 - 250
R6	Extremely strong	Specimen can be chipped by geological hammer	> 250

STRATA PLOT


Asphalt


Concrete


Organics


Fill


Cobbles & Boulders


Gravel

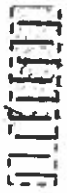

Sand


Silt


Clay


Igneous Bedrock


Sedimentary Bedrock


Metamorphic Bedrock

WATER LEVEL MEASUREMENT


Borehole, Standpipe or Monitor Well (at time of drilling)


Borehole, Standpipe or Monitor Well (static conditions)

WELL CONSTRUCTION


Flush-mounted Well-head Enclosure


End/Top Cap


Solid PVC Pipe


Slotted PVC Pipe


Bentonite


Cave-in

TEST PIT RECORD

CLIENT Edinburgh Group Limited
PROJECT No. SJN-215494-A0
LOCATION Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL
TEST PIT No. TP06
DATES (dd-mm-yy): DUG 16-01-15 WATER LEVEL 16-01-15
DATUM Geodetic

DEPTH (m)	ELEV. (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES OTHER TESTS
0	95.70						
		ORGANICS: Trees, shrub, and rootmat on loose to compact dark brown to reddish brown ORGANICS; some oxidized till with occasional cobbles and boulders; moist to dry.					
	95.0						
1		**TILL:** Dense dark grey gravelly, silty SAND; occasional cobbles and boulders; dry to wet.					
2					BK	1	
3							
4	91.7			▼			
		End of Test Pit.					

Undrained Shear Strength, kPa: 20 40 60 80

Water Content & Atterberg Limits: W_P W W_L

10 20 30 40 50 60 70 80 90

NOTES:
1. Groundwater encountered at 3.8 m.
2. Test Pit terminated at 4.0 m in Till.

5 6 7 8

exp Services Inc.
60 Pippy Place, Suite 200
St. John's, NL, A1B4H7
Tel 7095792027 Fax 7095797115

Technologist: R. Hayes
Reviewed By: W. Melendy
Contractor: Contour Atlantic Ltd.
Equipment: CAT 336E Excavator

△ Unconfined Compression Test
▼ Water Level at Time of Drilling/Excavation
▽ Static Water Level

TEST PIT RECORD

CLIENT Edinburgh Group Limited
PROJECT No. SJN-215494-A0
LOCATION Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL
TEST PIT No. TP17
DATES (dd-mm-yy): DUG 09-01-15 WATER LEVEL 09-01-15
DATUM Geodetic

DEPTH (m)	ELEV. (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES OTHER TESTS
0	90.18						
		ORGANICS: Trees, shrub, and rootmat on loose to compact dark brown to reddish brown ORGANICS; some oxidized till with occasional cobbles and boulders; moist to dry.					
	89.6	**TILL:** Dense dark grey gravelly SAND; some silt; occasional cobbles and boulders; broken rock at depth; dry.					
1							
2					BK	1	
3							
4							
	85.4	End of Test Pit.					
5		**NOTES:** 1. Groundwater not encountered. 2. Test Pit terminated at 4.8 m on probable Bedrock.					
6							
7							
8							

Undrained Shear Strength, kPa
20 40 60 80

Water Content & Atterberg Limits W_p W W_l

10 20 30 40 50 60 70 80 90

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Technologist: R. Hayes
Reviewed By: W. Melendy
Contractor: Contour Atlantic Ltd.
Equipment: CAT 336E Excavator

△ Unconfined Compression Test
Water Level at Time of Drilling/Excavation
Static Water Level

TEST PIT RECORD

CLIENT Edinburgh Group Limited
PROJECT No. SJN-215494-A0
LOCATION Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL
TEST PIT No. TP21
DATES (dd-mm-yy): DUG 12-01-15 WATER LEVEL 12-01-15
DATUM Geodetic

DEPTH (m)	ELEV. (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES OTHER TESTS
0	82.57						
		ORGANICS: Trees, shrub, and rootmat on loose to compact dark brown to reddish brown ORGANICS; some oxidized till with occasional cobbles and boulders; dry.					
	82.1	**TILL:** Dense dark grey gravelly, silty SAND; occasional cobbles and boulders; dry to wet.		▼	BK	1	
	79.9	End of Test Pit.					

NOTES:
1. Groundwater encountered at 1.2 m.
2. Test Pit terminated at 2.7 m in Till.

Undrained Shear Strength, kPa: 20 40 60 80
Water Content & Atterberg Limits: W_p W W_l: 10 20 30 40 50 60 70 80 90

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Technologist: R. Hayes
Reviewed By: W. Melendy
Contractor: Contour Atlantic Ltd.
Equipment: CAT 336E Excavator

△ Unconfined Compression Test
▼ Water Level at Time of Drilling/Excavation
▽ Static Water Level

TEST PIT RECORD

CLIENT Edinburgh Group Limited
PROJECT No. SJN-215494-A0
LOCATION Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL
TEST PIT No. TP23
DATES (dd-mm-yy): DUG 15-01-15 WATER LEVEL 15-01-15
DATUM Geodetic

DEPTH (m)	ELEV. (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES OTHER TESTS
0	94.10						
		ORGANICS: Shrub, and rootmat on loose to compact dark brown to reddish brown ORGANICS; some oxidized till with occasional cobbles and boulders; dry.					
	93.4						
1		**TILL:** Dense dark grey silty, gravelly SAND (SM); occasional cobbles and boulders; dry to wet.					
2							
					BK	1	S,M
3							
4				▼			
5	89.1	End of Test Pit.					
6							
7							
8							

Undrained Shear Strength, kPa
20 40 60 80
Water Content & Atterberg Limits W_p W W_l
10 20 30 40 50 60 70 80 90

NOTES:
1. Groundwater encountered at 4.5 m.
2. Test Pit terminated at 5.0 m in Till.

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Tel 7095792027 Fax 7095797115

Technologist: R. Hayes
Reviewed By: W. Melendy
Contractor: Contour Atlantic Ltd.
Equipment: CAT 336E Excavator

△ Unconfined Compression Test
▼ Water Level at Time of Drilling/Excavation
▽ Static Water Level

TEST PIT RECORD

CLIENT Edinburgh Group Limited
PROJECT No. SJN-215494-A0
LOCATION Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL
TEST PIT No. TP39
DATES (dd-mm-yy): DUG 12-01-15 WATER LEVEL 12-01-15
DATUM Geodetic

DEPTH (m)	ELEV. (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES OTHER TESTS
0	83.17						
		ORGANICS: Trees, shrub, and rootmat on loose to compact dark brown to reddish brown ORGANICS; some oxidized till with occasional cobbles and boulders; dry.					
	82.6						
1		**TILL:** Dense grey gravelly SAND; some silt; occasional cobbles and boulders; dry.			BK	1	
2	80.8						
		End of Test Pit.					
3		**NOTES:** 1. Groundwater not encountered. 2. Test Pit terminated at 2.4 m in Till.					
4							
5							
6							
7							
8							

Undrained Shear Strength, kPa
20 40 60 80

Water Content & Atterberg Limits W_p W W_l

10 20 30 40 50 60 70 80 90

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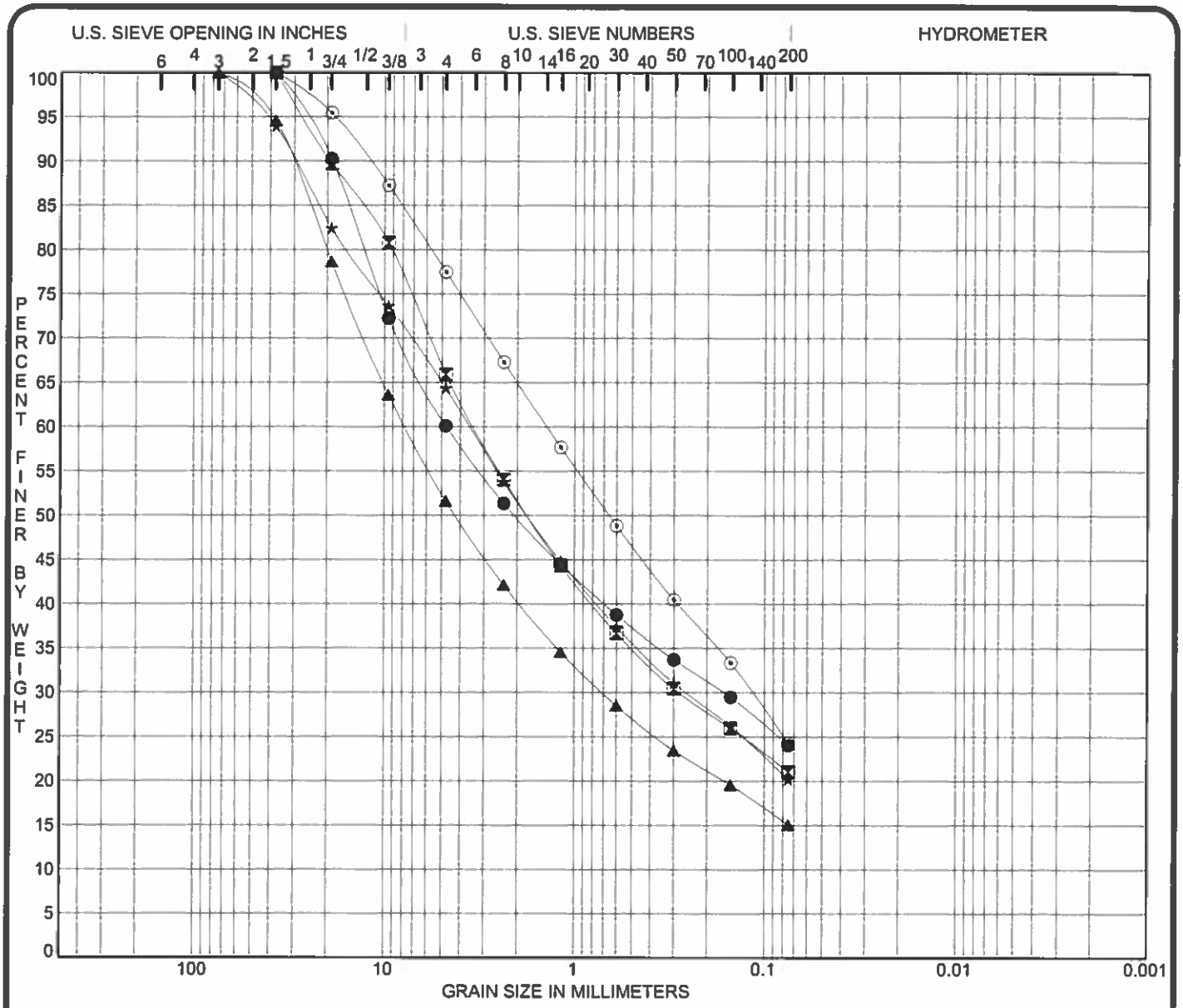
Technologist: R. Hayes
Reviewed By: W. Melendy
Contractor: Contour Atlantic Ltd.
Equipment: CAT 336E Excavator

△ Unconfined Compression Test
Water Level at Time of Drilling/Excavation
Static Water Level



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Location	Depth (m)	Classification (USCS)	MC%	LL	PL	PI	Cc	Cu
●	TP02	2.0	Silty GRAVEL and SAND (GM)	8.6					
⧗	TP05	2.0	Gravelly, silty SAND (SM)	8.6					
▲	TP08	1.6	GRAVEL and SAND; some silt (GM)	11.5					
★	TP12	3.1	Silty SAND and GRAVEL (SM)	8.2					
⊙	TP15	3.2	Silty, gravelly SAND (SM)	9.1					

	Location	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP02	2.0	37.50	4.72	0.163		39.9	36.0	24.1	
⧗	TP05	2.0	37.50	3.36	0.281		34.1	44.8	21.1	
▲	TP08	1.6	75.00	7.72	0.708		48.4	36.5	15.1	
★	TP12	3.1	75.00	3.56	0.258		35.6	44.2	20.2	
⊙	TP15	3.2	37.50	1.39	0.116		22.6	53.2	24.2	

PROJECT **Edinburgh Group Limited - Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL**

JOB NO. **SJN-215494-A0**

DATE **03-02-15**

GRADATION CURVES

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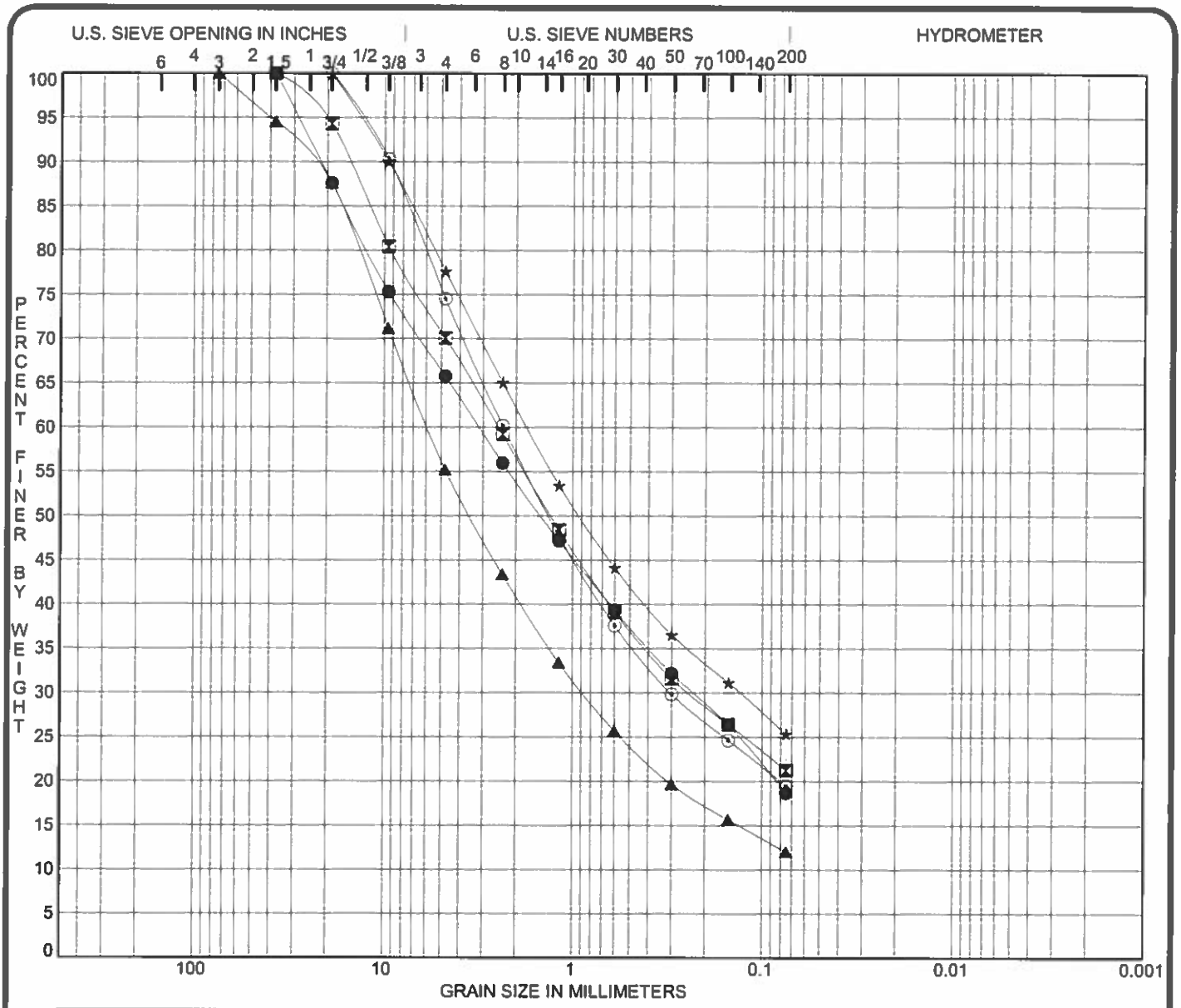
St. John's, NL



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Location	Depth (m)	Classification (USCS)	MC%	LL	PL	PI	Cc	Cu
●	TP16	1.8	Gravelly SAND; some silt (SM)	11.4					
⧗	TP18	2.7	Gravelly, silty SAND (SM)	8.3					
▲	TP20	1.1	GRAVEL and SAND; some silt (GW-GM)	5.8				2.56	115.0
★	TP23	2.6	Silty, gravelly SAND (SM)	9.1					
⊙	TP24	2.2	Gravelly SAND; some silt (SM)	8.4					

	Location	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP16	1.8	37.50	3.15	0.231		34.3	47.0	18.7	
⧗	TP18	2.7	37.50	2.48	0.242		30.0	48.8	21.3	
▲	TP20	1.1	75.00	5.86	0.875		44.8	43.1	12.0	
★	TP23	2.6	19.00	1.75	0.131		22.4	52.2	25.3	
⊙	TP24	2.2	19.00	2.34	0.304		25.5	55.0	19.5	

PROJECT **Edinburgh Group Limited - Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL**

JOB NO. **SJN-215494-A0**

DATE **03-02-15**

GRADATION CURVES

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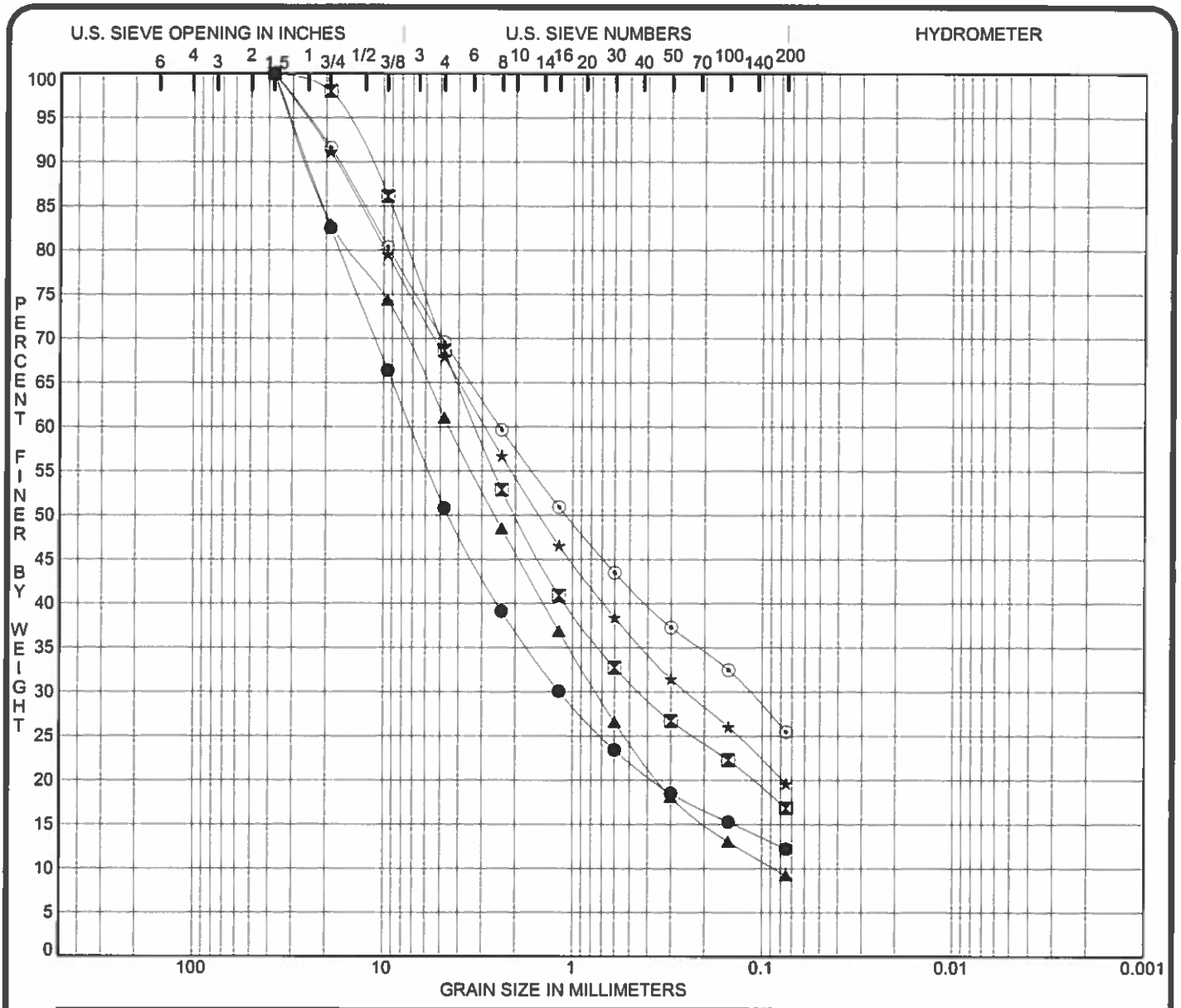

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Location	Depth (m)	Classification (USCS)	MC%	LL	PL	PI	Cc	Cu
●	TP27	2.0	GRAVEL and SAND; some silt (GM)	6.5				4.22	157.4
⧗	TP30	1.2	Gravelly SAND; some silt (SM)	11.1					
▲	TP31	1.8	SAND and GRAVEL; trace silt (SW-SM)	6.3				1.45	51.9
★	TP34	3.3	Gravelly SAND; some silt (SM)	11.1					
⊙	TP37	1.9	Gravelly, silty SAND (SM)	8.9					

	Location	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP27	2.0	37.50	7.15	1.171		49.2	38.6	12.2	
⧗	TP30	1.2	37.50	3.24	0.438		31.4	51.7	16.9	
▲	TP31	1.8	37.50	4.49	0.751	0.0865	39.0	51.8	9.2	
★	TP34	3.3	37.50	2.90	0.249		32.1	48.2	19.6	
⊙	TP37	1.9	37.50	2.42	0.117		30.4	44.1	25.5	

PROJECT **Edinburgh Group Limited - Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL**

JOB NO. **SJN-215494-A0**

DATE **03-02-15**

GRADATION CURVES

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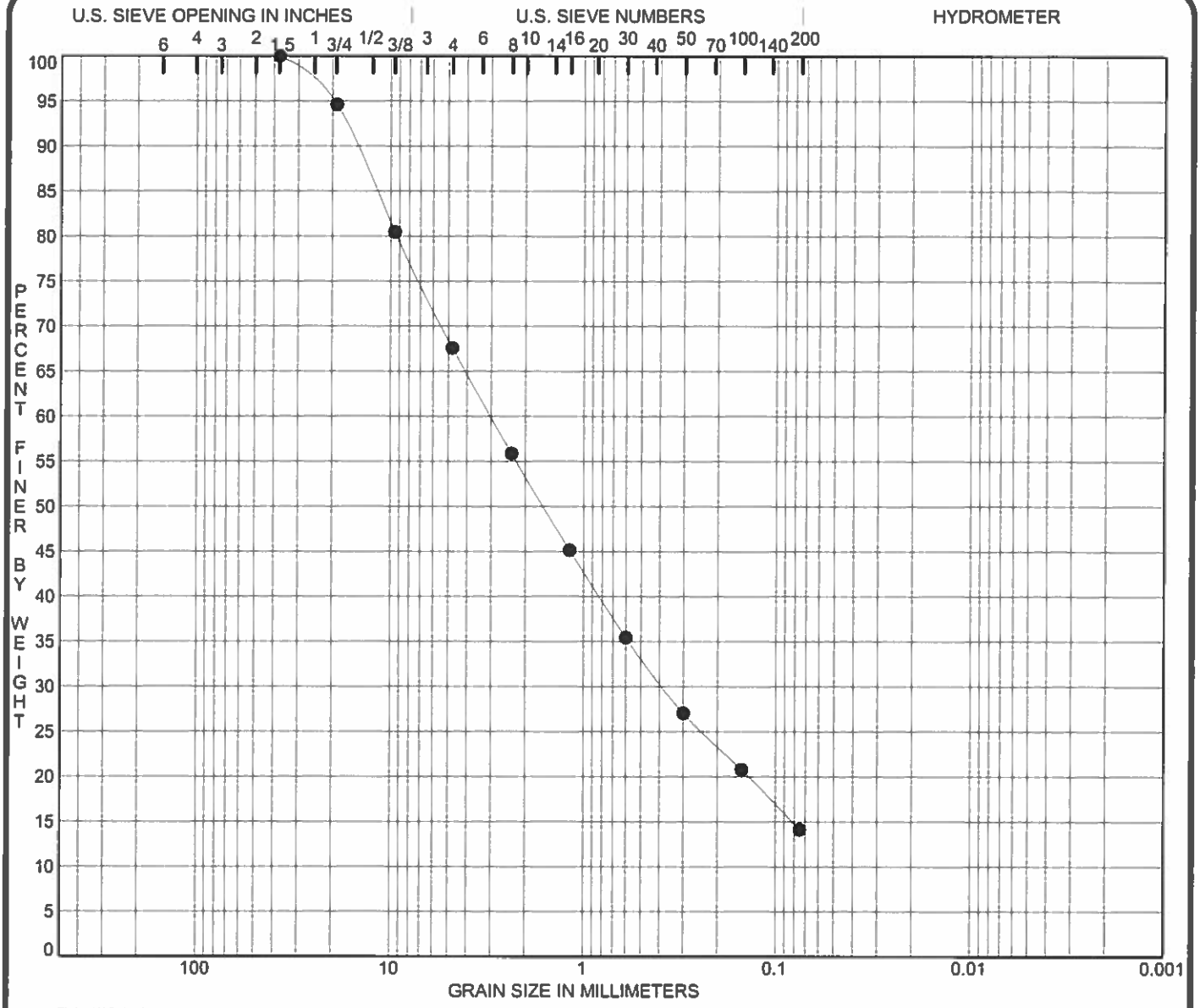

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Location	Depth (m)	Classification (USCS)	MC%	LL	PL	PI	Cc	Cu
●	TP38	1.6	Gravelly SAND; some silt (SM)	5.6					

	Location	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP38	1.6	37.50	3.02	0.383		32.4	53.4	14.1	

PROJECT Edinburgh Group Limited - Engineering Study - Proposed Cottage Lot Development, Ocean Pond, NL

JOB NO. SJN-215494-A0

DATE 03-02-15

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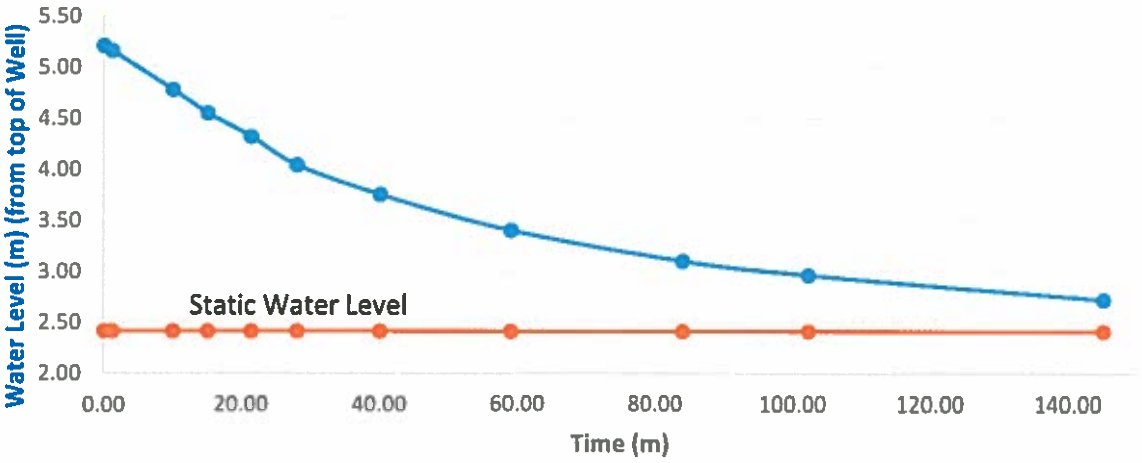
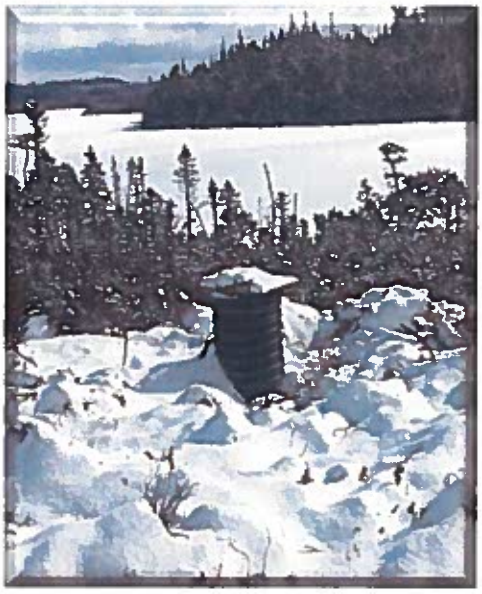
APPENDIX B

Pump Test /Recovery Data

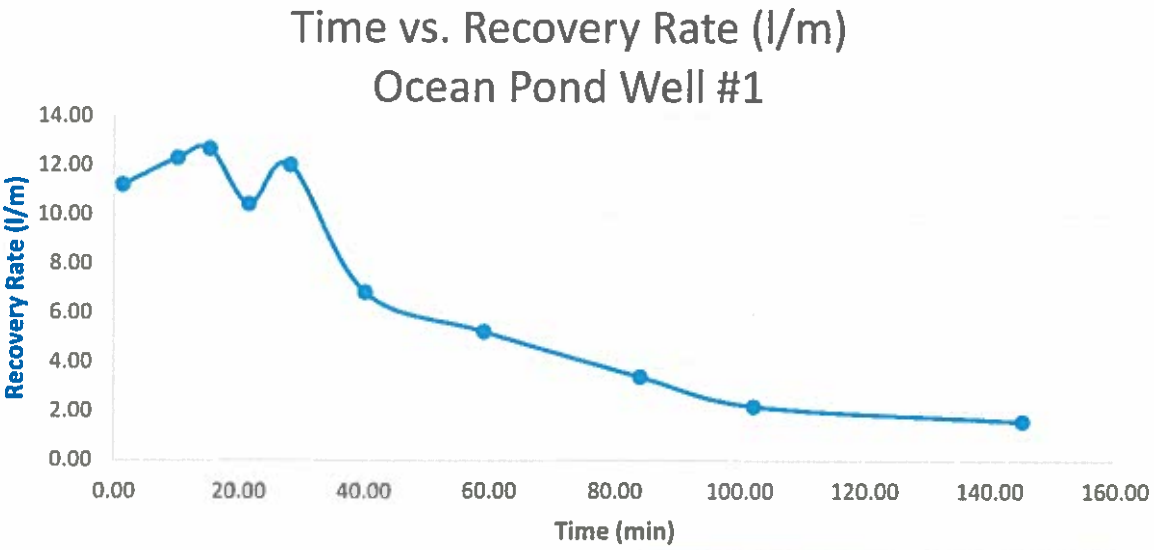
Time vs. Water Level (m)
Ocean Pond Well #1



Time (Min)	Depth to Water (m)
0.00	5.21
1.26	5.16
10.01	4.78
15.15	4.55
21.40	4.32
28.00	4.04
40.05	3.75
59.02	3.40
84.00	3.10
102.16	2.96
145.10	2.72



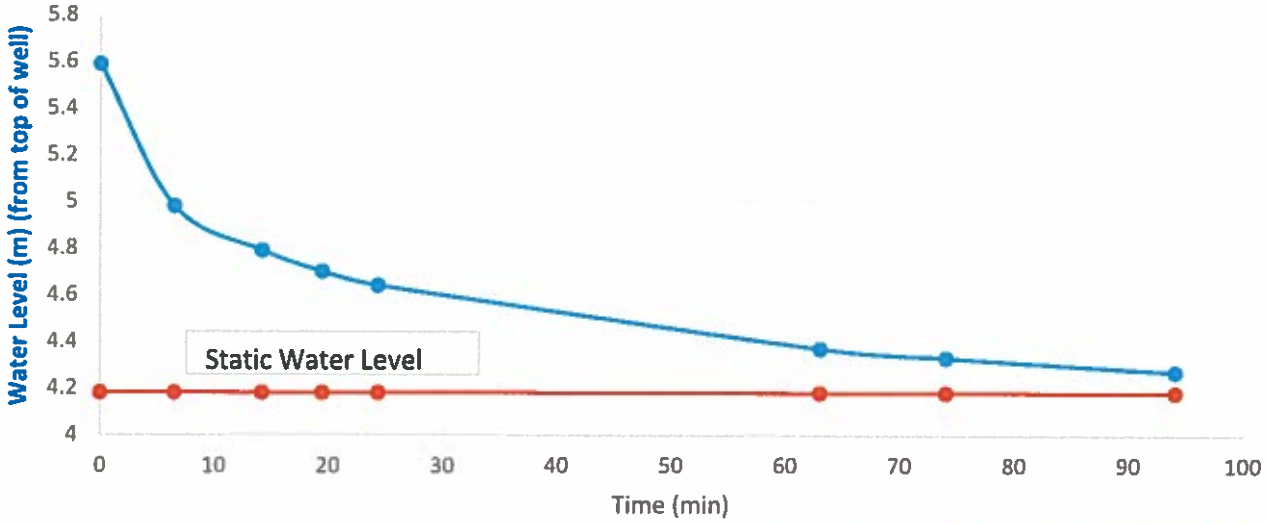
January 26th, 2015
Static Water Level - 2.41m
Depth of Well 5.46m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 862L
Well pump-out rate - 72 l/m



Time (Min)	Recovery Rate (l/m)
0.00	0.00
1.26	11.21
10.01	12.30
15.15	12.68
21.40	10.43
28.00	12.02
40.05	6.82
59.02	5.23
84.00	3.40
102.16	2.19

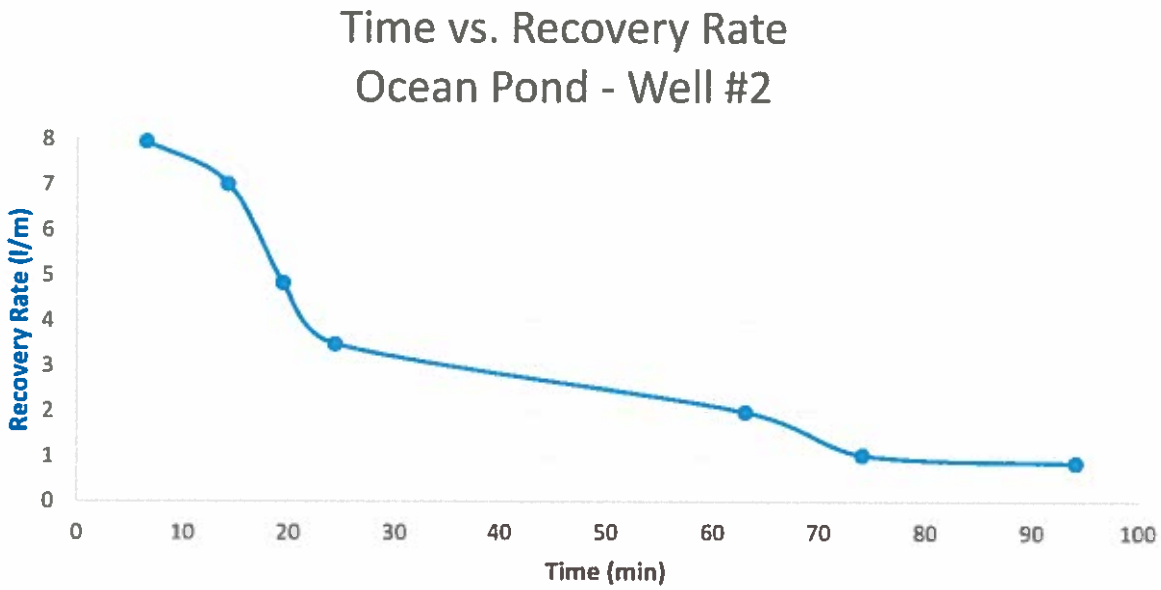
January 26th, 2015
Static Water Level - 2.41m
Depth of Well 5.46m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 862L
Well pump-out rate - 72 l/m

Time vs. Water Level (m)
(from top of well casing)
Ocean Pond Well #2



Time (Min)	Depth to Water (m)
0	5.59
6.53	4.98
14.2	4.79
19.48	4.7
24.37	4.64
63.01	4.37
74.01	4.33
94.1	4.27

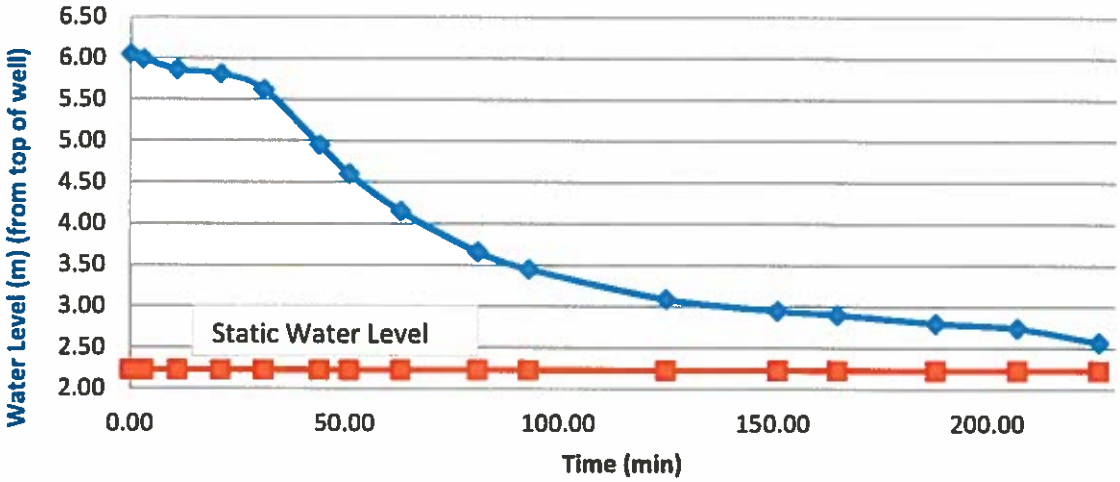
January 26th, 2015
Static Water Level - 4.18m
Depth of Well 5.84m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 470.3L
Well pump-out rate - 30.9 l/m



Time (Min)	Recovery Rate (l/m)
0	0
6.53	7.95
14.2	7.02
19.48	4.83
24.37	3.48
63.01	1.98
74.01	1.03
94.1	0.85

January 26th, 2015
Static Water Level - 4.18m
Depth of Well 5.84m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 470.3L
Well pump-out rate - 30.9 l/m

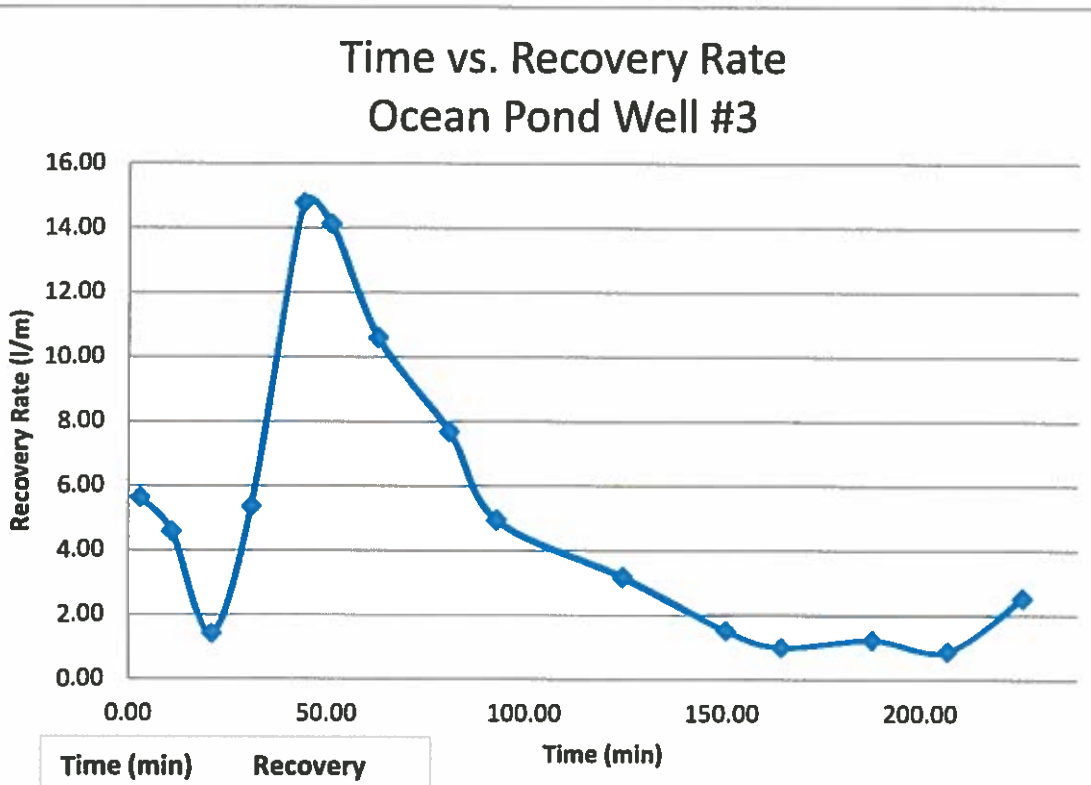
Time vs. Water Level (m)
(from top of well casing)
Ocean Pond Well #3



Time (min)	Water Level (m) (from top of well casing)
0.00	6.05
3.00	5.99
11.00	5.86
21.00	5.81
31.00	5.62
44.00	4.95
51.00	4.60
63.00	4.15
81.00	3.66
93.00	3.45
125.00	3.09
151.00	2.95
165.00	2.90
188.00	2.80
207.00	2.74

February 7, 2015
Static Water Level - 2.23m
Depth of Well 6.05m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 1,079.5L
Well pump-out rate - 60.1 l/min

Note: At 31 minutes, holes were drilled to perforate bottom of well casing.
- Large inflow of water noted.

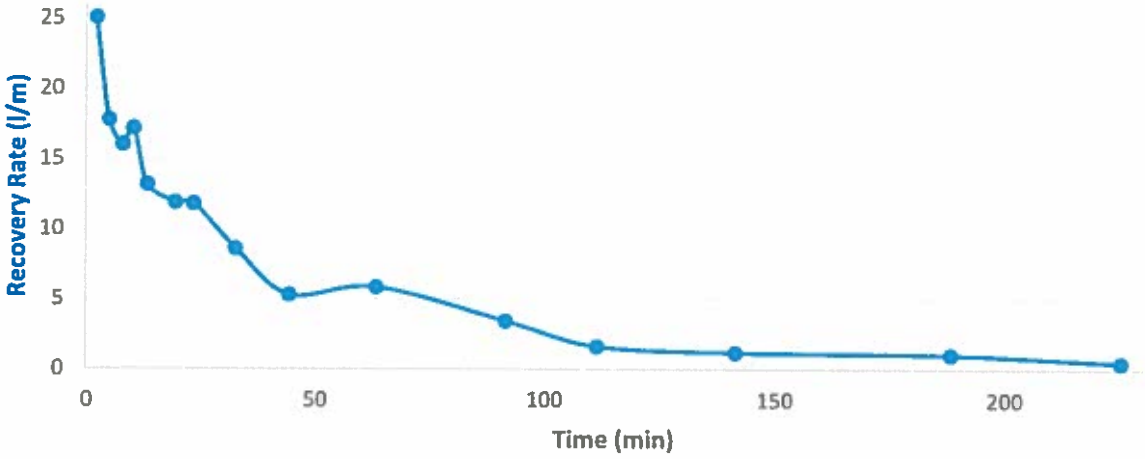


Time (min)	Recovery Rate (l/min)
0.00	0.00
3.00	5.65
11.00	4.59
21.00	1.41
31.00	5.37
44.00	14.78
51.00	14.13
63.00	10.59
81.00	7.69
93.00	4.95
125.00	3.18
151.00	1.52
165.00	1.01
188.00	1.23
207.00	0.89

February 7, 2015
Static Water Level - 2.23m
Depth of Well 6.05m
Measurements taken from top of well casing.
Volume of water in 600Ø well - 1,079.5L
Well pump-out rate - 60.1 l/min

Note: At 31 minutes, holes were drilled to perforate bottom of well casing.
- Large inflow of water noted.

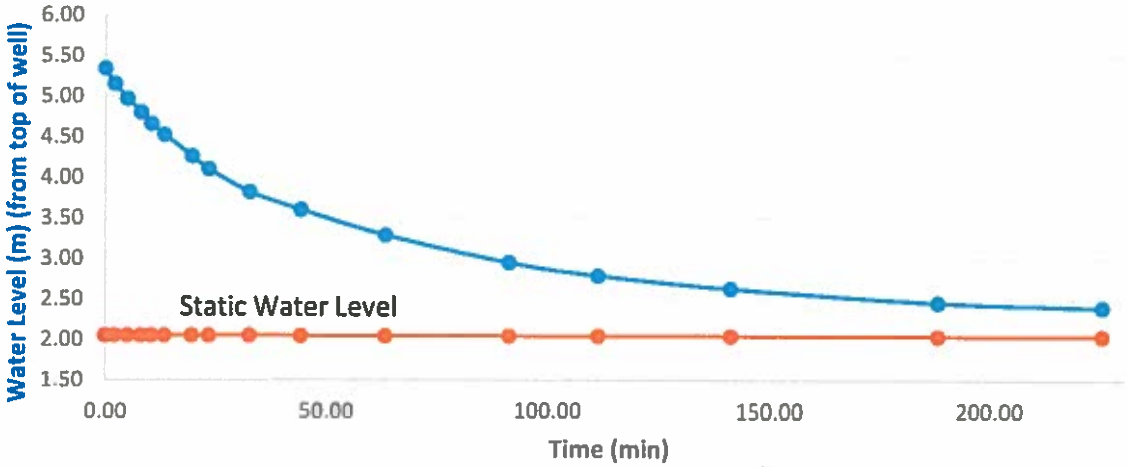
Time vs. Recovery Rate
Ocean Pond Well #4



Time (min)	Recovery Rate (l/min)
2.14	25.09
5.00	17.79
8.00	16.01
10.30	17.20
13.30	13.19
19.47	11.91
23.30	11.81
32.50	8.60
44.20	5.31
63.20	5.85
91.20	3.43
111.20	1.62
141.20	1.19

February 7th, 2015
Static Water Level - 2.045m
Depth of Well - 5.39m
Pump out Rate - 63.3 l/m
Volume of Water - 945.3 litres

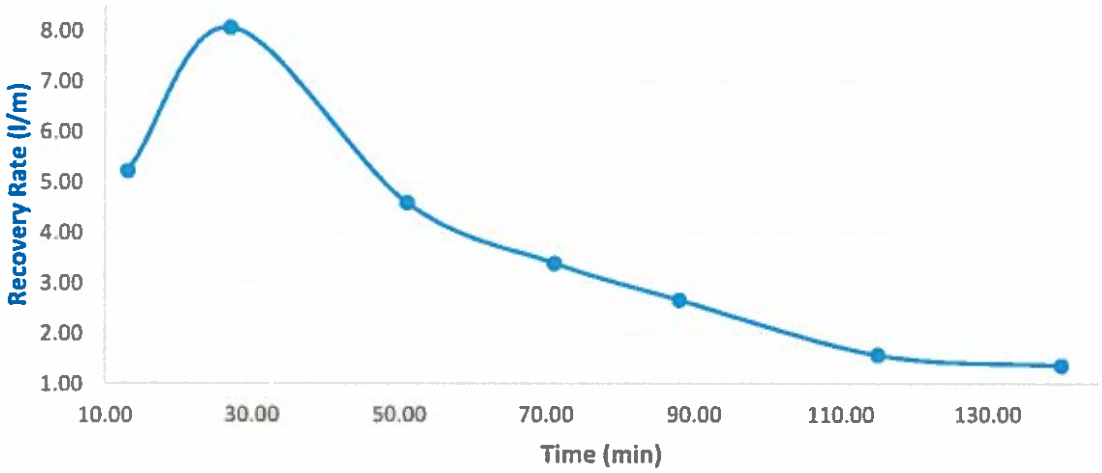
Time vs. Water Level (m)
(from top of well casing)
Ocean Pond Well #4



Time (min)	Water Level (m) (from top of well casing)
0.00	5.34
2.14	5.15
5.00	4.97
8.00	4.80
10.30	4.66
13.30	4.52
19.47	4.26
23.30	4.10
32.50	3.82
44.2	3.60
63.20	3.29
91.20	2.95
111.20	2.79
141.20	2.63

February 7th, 2015
Static Water Level - 2.045m
Depth of Well - 5.39m
Pump out Rate - 63.3 l/m
Volume of Water - 945.3 litres

Time vs. Recovery Rate (l/m)
Ocean Pond Well #5

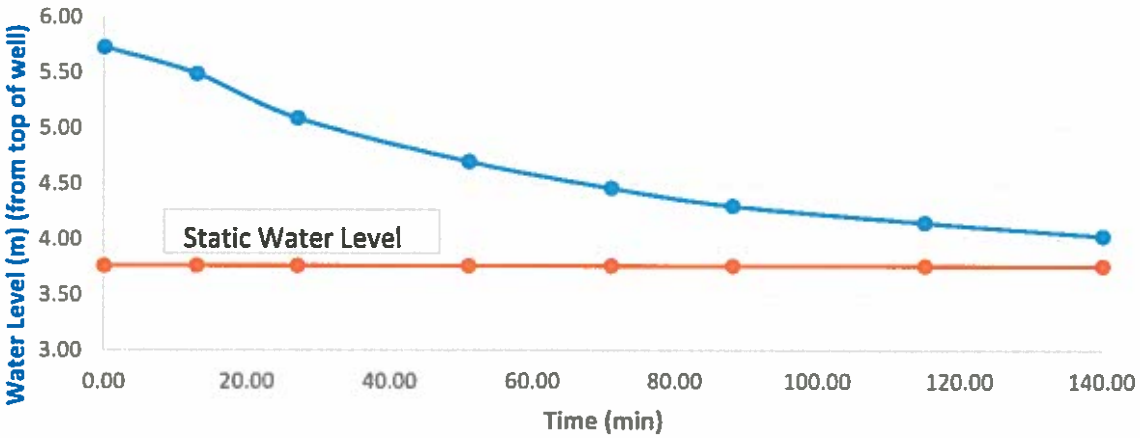


Time (min)	Recovery Rate (l/m)
0.00	0.00
13.00	5.22
27.00	8.07
51.00	4.59
71.00	3.39
88.00	2.66
115.00	1.57
140.00	1.36

February 7th, 2015
Static Water Level - 3.76m
Depth of Well - 6.29m
Pump out Rate - 62.4 l/m
Volume of Water - 715 litres

Note: Very large flow encountered in the bottom of this well. Pumped continuously, for 40 minutes, at level 5.73 metres, but could not drop level below 5.73 metres.

Time vs. Water Level
Ocean Pond Well #5



Time (min)	Water Level (m) (from top of well casing)
0.00	5.73
13.00	5.49
27.00	5.09
51.00	4.70
71.00	4.46
88.00	4.30
115.00	4.15
140.00	4.03

February 7th, 2015
Static Water Level - 3.76m
Depth of Well - 6.29m
Pump out Rate - 62.4 l/m
Volume of Water - 715 litres

Note: Very large flow encountered in the bottom of this well. Pumped continuously, for 40 minutes, at level 5.73 metres, but could not drop level below 5.73 metres.

APPENDIX C

Water Chemical and
Microbiological Analytical Results

Maxxam
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Success Through Science®

Your Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Your C.O.C. #: B 143111

Attention:Bill Melendy

exp Services Inc
60 Pippy Pl
Suite 200
St. John's, NL
A1B 4H7

Incoming Data/Product (Procedure #5)
Supplied by: Maxxam
Project No: SJN-215494-AO
Reveiwed by: SM & FCB
Date Reviewed: May 29/15

Report Date: 2015/05/25
Report #: R3439931
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B590907
Received: 2015/05/15, 09:46

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Carbonate, Bicarbonate and Hydroxide (1)	4	N/A	2015/05/22	N/A	SM 22 4500-CO2 D
Carbonate, Bicarbonate and Hydroxide (1)	5	N/A	2015/05/24	N/A	SM 22 4500-CO2 D
Alkalinity (1)	9	N/A	2015/05/22	ATL SOP 00013	EPA 310.2 R1974 m
Chloride (1)	9	N/A	2015/05/22	ATL SOP 00014	SM 22 4500-Cl- E m
Colour (1)	9	N/A	2015/05/21	ATL SOP 00020	SM 22 2120C m
Conductance - water (1)	4	N/A	2015/05/21	ATL SOP 00004	SM 22 2510B m
Conductance - water (1)	5	N/A	2015/05/24	ATL SOP 00004	SM 22 2510B m
Hardness (calculated as CaCO3) (1)	9	N/A	2015/05/25	ATL SOP 00048	SM 22 2340 B
Metals Water Diss. MS (as rec'd) (1)	9	N/A	2015/05/22	ATL SOP 00058	EPA 6020A R1 m
Ion Balance (% Difference) (1)	9	N/A	2015/05/25		Auto Calc.
Anion and Cation Sum (1)	9	N/A	2015/05/25		Auto Calc.
Nitrogen Ammonia - water (1)	6	N/A	2015/05/21	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen Ammonia - water (1)	3	N/A	2015/05/22	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite (1)	9	N/A	2015/05/22	ATL SOP 00016	USGS SOPINCF0452.2 m
Nitrogen - Nitrite (1)	9	N/A	2015/05/21	ATL SOP 00017	SM 22 4500-NO2- B m
Nitrogen - Nitrate (as N) (1)	9	N/A	2015/05/22	ATL SOP 00018	ASTM D3867
pH (1, 2)	4	N/A	2015/05/22	ATL SOP 00003	SM 22 4500-H+ B m
pH (1, 2)	5	N/A	2015/05/24	ATL SOP 00003	SM 22 4500-H+ B m
Phosphorus - ortho (1)	9	N/A	2015/05/22	ATL SOP 00021	EPA 365.2 m
Sat. pH and Langelier Index (@ 20C) (1)	9	N/A	2015/05/25	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C) (1)	9	N/A	2015/05/25	ATL SOP 00049	Auto Calc.
Reactive Silica (1)	9	N/A	2015/05/22	ATL SOP 00022	EPA 366.0 m
Sulphate (1)	9	N/A	2015/05/22	ATL SOP 00023	EPA 375.4 R1978 m
Total Dissolved Solids (TDS calc) (1)	9	N/A	2015/05/25		Auto Calc.
Organic carbon - Total (TOC) (1, 3)	9	N/A	2015/05/22	ATL SOP 00037	SM 22 5310C m
Turbidity (1)	9	N/A	2015/05/25	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

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Your Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Your C.O.C. #: B 143111

Attention:Bill Melendy

exp Services Inc
60 Pippy Pl
Suite 200
St. John's, NL
A1B 4H7

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(1) This test was performed by Maxxam Bedford
(2) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(3) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Rachael Mansfield
25 May 2015 16:02:36 -03:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Avery Withrow, Project Manager
Email: AWithrow@maxxam.ca
Phone# (902)420-0203 Ext:233

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B590907
Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY759		AGY760	AGY761	AGY762	AGY762	AGY763		
Sampling Date		2015/05/14		2015/05/14	2015/05/14	2015/05/14	2015/05/14	2015/05/14		
COC Number		B 143111		B 143111	B 143111	B 143111	B 143111	B 143111		
	Units	WELL #1	QC Batch	WELL #2	WELL #3	WELL #4	WELL #4 Lab-Dup	WELL #5	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	0.480	4030814	0.470	0.560	0.480		0.350	N/A	4030814
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	11	4030810	8.8	6.4	9.3		5.6	1.0	4030810
Calculated TDS	mg/L	36	4030820	36	40	38		23	1.0	4030820
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	4030810	ND	ND	ND		ND	1.0	4030810
Cation Sum	me/L	0.440	4030814	0.440	0.560	0.450		0.310	N/A	4030814
Hardness (CaCO3)	mg/L	10	4030812	7.4	11	7.7		6.3	1.0	4030812
Ion Balance (% Difference)	%	4.35	4030813	3.30	0.00	3.23		6.06	N/A	4030813
Langelier Index (@ 20C)	N/A	-3.57	4030818	-3.02	-4.11	-3.34		-4.03		4030818
Langelier Index (@ 4C)	N/A	-3.82	4030819	-3.27	-4.36	-3.60		-4.28		4030819
Nitrate (N)	mg/L	ND	4030815	ND	ND	ND		ND	0.050	4030815
Saturation pH (@ 20C)	N/A	9.93	4030818	10.1	10.2	10.0		10.5		4030818
Saturation pH (@ 4C)	N/A	10.2	4030819	10.4	10.5	10.3		10.7		4030819
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L	11	4031482	8.8	6.4	9.3		5.6	5.0	4031482
Dissolved Chloride (Cl)	mg/L	7.3	4031485	8.4	13	8.8		5.7	1.0	4031485
Colour	TCU	ND	4031501	ND	19	ND		ND	5.0	4031501
Nitrate + Nitrite	mg/L	ND	4031535	ND	ND	ND		ND	0.050	4031535
Nitrite (N)	mg/L	ND	4031536	ND	ND	ND		ND	0.010	4031536
Nitrogen (Ammonia Nitrogen)	mg/L	0.13	4030955	0.075	0.17	0.062		0.076	0.050	4030955
Total Organic Carbon (C)	mg/L	1.9	4032925	1.9	6.8	3.5		1.9	0.50	4032925
Orthophosphate (P)	mg/L	ND	4031504	ND	ND	0.011		ND	0.010	4031504
pH	pH	6.36	4035267	7.08	6.12	6.66		6.44	N/A	4029090
Reactive Silica (SiO2)	mg/L	10	4031499	9.8	7.8	11		4.1	0.50	4031499
Dissolved Sulphate (SO4)	mg/L	2.8	4031496	3.0	2.9	2.4		3.7	2.0	4031496
Turbidity	NTU	2.7	4036003	4.4	4.1	1.6	1.6	0.71	0.10	4036003
Conductivity	uS/cm	44	4035269	48	64	48		35	1.0	4029102
Metals										
Dissolved Aluminum (Al)	ug/L	94	4032736	89	620	95		130	5.0	4032736
Dissolved Antimony (Sb)	ug/L	ND	4032736	ND	ND	ND		ND	1.0	4032736
Dissolved Arsenic (As)	ug/L	ND	4032736	ND	ND	ND		ND	1.0	4032736
Dissolved Barium (Ba)	ug/L	4.6	4032736	3.2	11	2.0		6.5	1.0	4032736

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not detected

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Maxxam Job #: B590907
Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY759		AGY760	AGY761	AGY762	AGY762	AGY763		
Sampling Date		2015/05/14		2015/05/14	2015/05/14	2015/05/14	2015/05/14	2015/05/14		
COC Number		B 143111		B 143111	B 143111	B 143111	B 143111	B 143111		
	Units	WELL #1	QC Batch	WELL #2	WELL #3	WELL #4	WELL #4 Lab-Dup	WELL #5	RDL	QC Batch
Dissolved Beryllium (Be)	ug/L	ND	4032736	ND	ND	ND		ND	1.0	4032736
Dissolved Bismuth (Bi)	ug/L	ND	4032736	ND	ND	ND		ND	2.0	4032736
Dissolved Boron (B)	ug/L	ND	4032736	ND	ND	ND		ND	50	4032736
Dissolved Cadmium (Cd)	ug/L	0.013	4032736	0.019	0.026	0.024		0.023	0.010	4032736
Dissolved Calcium (Ca)	ug/L	2200	4032736	1800	1800	2100		1200	100	4032736
Dissolved Chromium (Cr)	ug/L	ND	4032736	ND	ND	ND		ND	1.0	4032736
Dissolved Cobalt (Co)	ug/L	ND	4032736	ND	4.0	ND		ND	0.40	4032736
Dissolved Copper (Cu)	ug/L	6.3	4032736	2.3	8.6	5.1		3.0	2.0	4032736
Dissolved Iron (Fe)	ug/L	ND	4032736	ND	320	ND		ND	50	4032736
Dissolved Lead (Pb)	ug/L	ND	4032736	ND	ND	ND		ND	0.50	4032736
Dissolved Magnesium (Mg)	ug/L	1200	4032736	710	1500	580		810	100	4032736
Dissolved Manganese (Mn)	ug/L	35	4032736	62	310	21		41	2.0	4032736
Dissolved Molybdenum (Mo)	ug/L	ND	4032736	ND	ND	ND		ND	2.0	4032736
Dissolved Nickel (Ni)	ug/L	ND	4032736	ND	ND	ND		ND	2.0	4032736
Dissolved Phosphorus (P)	ug/L	110	4032736	ND	ND	ND		ND	100	4032736
Dissolved Potassium (K)	ug/L	290	4032736	520	660	360		620	100	4032736
Dissolved Selenium (Se)	ug/L	ND	4032736	ND	ND	ND		ND	1.0	4032736
Dissolved Silver (Ag)	ug/L	ND	4032736	ND	ND	ND		ND	0.10	4032736
Dissolved Sodium (Na)	ug/L	5100	4032736	6400	7200	6400		3700	100	4032736
Dissolved Strontium (Sr)	ug/L	9.6	4032736	8.7	16	9.8		10	2.0	4032736
Dissolved Thallium (Tl)	ug/L	ND	4032736	ND	ND	ND		ND	0.10	4032736
Dissolved Tin (Sn)	ug/L	ND	4032736	ND	ND	ND		ND	2.0	4032736
Dissolved Titanium (Ti)	ug/L	6.1	4032736	6.5	9.9	3.1		ND	2.0	4032736
Dissolved Uranium (U)	ug/L	ND	4032736	ND	ND	ND		ND	0.10	4032736
Dissolved Vanadium (V)	ug/L	ND	4032736	ND	ND	ND		ND	2.0	4032736
Dissolved Zinc (Zn)	ug/L	ND	4032736	ND	15	ND		5.4	5.0	4032736

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Maxxam Job #: B590907
Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY764	AGY764		AGY765	AGY765	AGY766		
Sampling Date		2015/05/14	2015/05/14		2015/05/14	2015/05/14	2015/05/14		
COC Number		B 143111	B 143111		B 143111	B 143111	B 143111		
	Units	OP1-01	OP1-01 Lab-Dup	QC Batch	OP1-02	OP1-02 Lab-Dup	IP1-01	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	0.210		4030814	0.200		0.210	N/A	4030814
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	ND		4030810	ND		ND	1.0	4030810
Calculated TDS	mg/L	16		4030820	15		16	1.0	4030820
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND		4030810	ND		ND	1.0	4030810
Cation Sum	me/L	0.320		4030814	0.320		0.340	N/A	4030814
Hardness (CaCO3)	mg/L	5.6		4030812	5.7		7.0	1.0	4030812
Ion Balance (% Difference)	%	20.8		4030813	23.1		23.6	N/A	4030813
Langelier Index (@ 20C)	N/A	NC		4030818	NC		NC		4030818
Langelier Index (@ 4C)	N/A	NC		4030819	NC		NC		4030819
Nitrate (N)	mg/L	ND		4030815	ND		ND	0.050	4030815
Saturation pH (@ 20C)	N/A	NC		4030818	NC		NC		4030818
Saturation pH (@ 4C)	N/A	NC		4030819	NC		NC		4030819
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	ND		4031482	ND		ND	5.0	4031482
Dissolved Chloride (Cl)	mg/L	7.6		4031485	7.1		7.4	1.0	4031485
Colour	TCU	25		4031501	48		48	5.0	4031501
Nitrate + Nitrite	mg/L	ND		4031535	ND		ND	0.050	4031535
Nitrite (N)	mg/L	ND		4031536	ND		ND	0.010	4031536
Nitrogen (Ammonia Nitrogen)	mg/L	0.17		4030955	0.17		0.077	0.050	4030955
Total Organic Carbon (C)	mg/L	3.5	3.6	4032925	5.0		4.7	0.50	4032925
Orthophosphate (P)	mg/L	ND		4031504	ND		ND	0.010	4031504
pH	pH	6.50		4035267	6.29	6.28	6.54	N/A	4035267
Reactive Silica (SiO2)	mg/L	1.5		4031499	1.7		1.9	0.50	4031499
Dissolved Sulphate (SO4)	mg/L	ND		4031496	ND		ND	2.0	4031496
Turbidity	NTU	0.72		4036003	1.0		1.3	0.10	4036040
Conductivity	uS/cm	34		4035269	33	33	33	1.0	4035269
Metals									
Dissolved Aluminum (Al)	ug/L	61		4032736	75		78	5.0	4032736
Dissolved Antimony (Sb)	ug/L	ND		4032736	ND		ND	1.0	4032736
Dissolved Arsenic (As)	ug/L	ND		4032736	ND		ND	1.0	4032736
Dissolved Barium (Ba)	ug/L	1.8		4032736	1.6		1.1	1.0	4032736

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not detected

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Maxxam Job #: B590907
Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY764	AGY764		AGY765	AGY765	AGY766		
Sampling Date		2015/05/14	2015/05/14		2015/05/14	2015/05/14	2015/05/14		
COC Number		B 143111	B 143111		B 143111	B 143111	B 143111		
	Units	OP1-01	OP1-01 Lab-Dup	QC Batch	OP1-02	OP1-02 Lab-Dup	IP1-01	RDL	QC Batch
Dissolved Beryllium (Be)	ug/L	ND		4032736	ND		ND	1.0	4032736
Dissolved Bismuth (Bi)	ug/L	ND		4032736	ND		ND	2.0	4032736
Dissolved Boron (B)	ug/L	ND		4032736	ND		ND	50	4032736
Dissolved Cadmium (Cd)	ug/L	ND		4032736	ND		ND	0.010	4032736
Dissolved Calcium (Ca)	ug/L	1200		4032736	1200		1600	100	4032736
Dissolved Chromium (Cr)	ug/L	ND		4032736	ND		ND	1.0	4032736
Dissolved Cobalt (Co)	ug/L	ND		4032736	ND		ND	0.40	4032736
Dissolved Copper (Cu)	ug/L	3.3		4032736	2.7		4.2	2.0	4032736
Dissolved Iron (Fe)	ug/L	ND		4032736	95		100	50	4032736
Dissolved Lead (Pb)	ug/L	ND		4032736	ND		ND	0.50	4032736
Dissolved Magnesium (Mg)	ug/L	630		4032736	660		760	100	4032736
Dissolved Manganese (Mn)	ug/L	9.8		4032736	19		35	2.0	4032736
Dissolved Molybdenum (Mo)	ug/L	ND		4032736	ND		ND	2.0	4032736
Dissolved Nickel (Ni)	ug/L	ND		4032736	ND		ND	2.0	4032736
Dissolved Phosphorus (P)	ug/L	ND		4032736	ND		ND	100	4032736
Dissolved Potassium (K)	ug/L	270		4032736	230		290	100	4032736
Dissolved Selenium (Se)	ug/L	ND		4032736	ND		ND	1.0	4032736
Dissolved Silver (Ag)	ug/L	ND		4032736	ND		ND	0.10	4032736
Dissolved Sodium (Na)	ug/L	4400		4032736	4200		4200	100	4032736
Dissolved Strontium (Sr)	ug/L	6.4		4032736	6.0		6.2	2.0	4032736
Dissolved Thallium (Tl)	ug/L	ND		4032736	ND		ND	0.10	4032736
Dissolved Tin (Sn)	ug/L	ND		4032736	ND		ND	2.0	4032736
Dissolved Titanium (Ti)	ug/L	ND		4032736	ND		2.5	2.0	4032736
Dissolved Uranium (U)	ug/L	ND		4032736	ND		ND	0.10	4032736
Dissolved Vanadium (V)	ug/L	ND		4032736	ND		ND	2.0	4032736
Dissolved Zinc (Zn)	ug/L	ND		4032736	ND		ND	5.0	4032736

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
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Maxxam Job #: B590907
Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY767	AGY767		
Sampling Date		2015/05/14	2015/05/14		
COC Number		B 143111	B 143111		
	Units	IP1-02	IP1-02 Lab-Dup	RDL	QC Batch
Calculated Parameters					
Anion Sum	me/L	0.210		N/A	4030814
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	ND		1.0	4030810
Calculated TDS	mg/L	16		1.0	4030820
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND		1.0	4030810
Cation Sum	me/L	0.330		N/A	4030814
Hardness (CaCO3)	mg/L	6.6		1.0	4030812
Ion Balance (% Difference)	%	22.2		N/A	4030813
Langelier Index (@ 20C)	N/A	NC			4030818
Langelier Index (@ 4C)	N/A	NC			4030819
Nitrate (N)	mg/L	ND		0.050	4030815
Saturation pH (@ 20C)	N/A	NC			4030818
Saturation pH (@ 4C)	N/A	NC			4030819
Inorganics					
Total Alkalinity (Total as CaCO3)	mg/L	ND	5.0	5.0	4031482
Dissolved Chloride (Cl)	mg/L	7.4	7.5	1.0	4031485
Colour	TCU	49	48	25	4031501
Nitrate + Nitrite	mg/L	ND	ND	0.050	4031535
Nitrite (N)	mg/L	ND	ND	0.010	4031536
Nitrogen (Ammonia Nitrogen)	mg/L	0.085		0.050	4030955
Total Organic Carbon (C)	mg/L	4.9		0.50	4032925
Orthophosphate (P)	mg/L	ND	ND	0.010	4031504
pH	pH	6.50		N/A	4035267
Reactive Silica (SiO2)	mg/L	1.8	1.8	0.50	4031499
Dissolved Sulphate (SO4)	mg/L	ND	ND	2.0	4031496
Turbidity	NTU	0.82		0.10	4036040
Conductivity	uS/cm	33		1.0	4035269
Metals					
Dissolved Aluminum (Al)	ug/L	89		5.0	4032736
Dissolved Antimony (Sb)	ug/L	ND		1.0	4032736
Dissolved Arsenic (As)	ug/L	ND		1.0	4032736
Dissolved Barium (Ba)	ug/L	1.1		1.0	4032736
Dissolved Beryllium (Be)	ug/L	ND		1.0	4032736

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

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Report Date: 2015/05/25

exp Services Inc
Client Project #: SJN-00215494-AO
Site Location: ENVIRO SERVICES
Sampler Initials: RH

AT. RCAP-MS DISSOLVED (FIELDFILT) IN W

Maxxam ID		AGY767	AGY767		
Sampling Date		2015/05/14	2015/05/14		
COC Number		B 143111	B 143111		
	Units	IP1-02	IP1-02 Lab-Dup	RDL	QC Batch
Dissolved Bismuth (Bi)	ug/L	ND		2.0	4032736
Dissolved Boron (B)	ug/L	ND		50	4032736
Dissolved Cadmium (Cd)	ug/L	ND		0.010	4032736
Dissolved Calcium (Ca)	ug/L	1400		100	4032736
Dissolved Chromium (Cr)	ug/L	ND		1.0	4032736
Dissolved Cobalt (Co)	ug/L	ND		0.40	4032736
Dissolved Copper (Cu)	ug/L	2.7		2.0	4032736
Dissolved Iron (Fe)	ug/L	120		50	4032736
Dissolved Lead (Pb)	ug/L	ND		0.50	4032736
Dissolved Magnesium (Mg)	ug/L	730		100	4032736
Dissolved Manganese (Mn)	ug/L	33		2.0	4032736
Dissolved Molybdenum (Mo)	ug/L	ND		2.0	4032736
Dissolved Nickel (Ni)	ug/L	ND		2.0	4032736
Dissolved Phosphorus (P)	ug/L	ND		100	4032736
Dissolved Potassium (K)	ug/L	300		100	4032736
Dissolved Selenium (Se)	ug/L	ND		1.0	4032736
Dissolved Silver (Ag)	ug/L	ND		0.10	4032736
Dissolved Sodium (Na)	ug/L	4000		100	4032736
Dissolved Strontium (Sr)	ug/L	6.0		2.0	4032736
Dissolved Thallium (Tl)	ug/L	ND		0.10	4032736
Dissolved Tin (Sn)	ug/L	ND		2.0	4032736
Dissolved Titanium (Ti)	ug/L	2.5		2.0	4032736
Dissolved Uranium (U)	ug/L	ND		0.10	4032736
Dissolved Vanadium (V)	ug/L	ND		2.0	4032736
Dissolved Zinc (Zn)	ug/L	ND		5.0	4032736

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	0.9°C

Sample AGY763-01 : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample AGY764-01 : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample AGY765-01 : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample AGY766-01 : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample AGY767-01 : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
4029090	KMC	Spiked Blank	pH	2015/05/22		100	%	N/A
4029090	KMC	RPD	pH	2015/05/22	0.94		%	N/A
4029102	KMC	Spiked Blank	Conductivity	2015/05/21		103	%	80 - 120
4029102	KMC	Method Blank	Conductivity	2015/05/21	1.2, RDL=1.0		uS/cm	
4029102	KMC	RPD	Conductivity	2015/05/21	0.0014		%	25
4030955	ARS	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2015/05/22		99	%	80 - 120
4030955	ARS	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2015/05/21		99	%	80 - 120
4030955	ARS	Method Blank	Nitrogen (Ammonia Nitrogen)	2015/05/21	ND, RDL=0.050		mg/L	
4030955	ARS	RPD	Nitrogen (Ammonia Nitrogen)	2015/05/22	NC		%	25
4031482	MCN	Matrix Spike [AGY767-01]	Total Alkalinity (Total as CaCO3)	2015/05/22		104	%	80 - 120
4031482	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2015/05/22		102	%	80 - 120
4031482	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2015/05/22	ND, RDL=5.0		mg/L	
4031482	MCN	RPD [AGY767-01]	Total Alkalinity (Total as CaCO3)	2015/05/22	NC		%	25
4031485	MCN	Matrix Spike [AGY767-01]	Dissolved Chloride (Cl)	2015/05/22		104	%	80 - 120
4031485	MCN	QC Standard	Dissolved Chloride (Cl)	2015/05/22		104	%	80 - 120
4031485	MCN	Spiked Blank	Dissolved Chloride (Cl)	2015/05/22		107	%	80 - 120
4031485	MCN	Method Blank	Dissolved Chloride (Cl)	2015/05/22	ND, RDL=1.0		mg/L	
4031485	MCN	RPD [AGY767-01]	Dissolved Chloride (Cl)	2015/05/22	1.5		%	25
4031496	ARS	Matrix Spike [AGY767-01]	Dissolved Sulphate (SO4)	2015/05/22		94	%	80 - 120
4031496	ARS	Spiked Blank	Dissolved Sulphate (SO4)	2015/05/22		92	%	80 - 120
4031496	ARS	Method Blank	Dissolved Sulphate (SO4)	2015/05/22	ND, RDL=2.0		mg/L	
4031496	ARS	RPD [AGY767-01]	Dissolved Sulphate (SO4)	2015/05/22	NC		%	25
4031499	ARS	Matrix Spike [AGY767-01]	Reactive Silica (SiO2)	2015/05/22		97	%	80 - 120
4031499	ARS	Spiked Blank	Reactive Silica (SiO2)	2015/05/22		102	%	80 - 120
4031499	ARS	Method Blank	Reactive Silica (SiO2)	2015/05/22	ND, RDL=0.50		mg/L	
4031499	ARS	RPD [AGY767-01]	Reactive Silica (SiO2)	2015/05/22	NC		%	25
4031501	NRG	Spiked Blank	Colour	2015/05/21		98	%	80 - 120
4031501	NRG	Method Blank	Colour	2015/05/21	ND, RDL=5.0		TCU	
4031501	NRG	RPD [AGY767-01]	Colour	2015/05/21	NC		%	25
4031504	MCN	Matrix Spike [AGY767-01]	Orthophosphate (P)	2015/05/22		99	%	80 - 120
4031504	MCN	Spiked Blank	Orthophosphate (P)	2015/05/22		104	%	80 - 120
4031504	MCN	Method Blank	Orthophosphate (P)	2015/05/22	ND, RDL=0.010		mg/L	
4031504	MCN	RPD [AGY767-01]	Orthophosphate (P)	2015/05/22	NC		%	25
4031535	ARS	Matrix Spike [AGY767-01]	Nitrate + Nitrite	2015/05/22		97	%	80 - 120
4031535	ARS	Spiked Blank	Nitrate + Nitrite	2015/05/22		102	%	80 - 120
4031535	ARS	Method Blank	Nitrate + Nitrite	2015/05/22	ND, RDL=0.050		mg/L	
4031535	ARS	RPD [AGY767-01]	Nitrate + Nitrite	2015/05/22	NC		%	25
4031536	NRG	Matrix Spike [AGY767-01]	Nitrite (N)	2015/05/21		101	%	80 - 120
4031536	NRG	Spiked Blank	Nitrite (N)	2015/05/21		103	%	80 - 120
4031536	NRG	Method Blank	Nitrite (N)	2015/05/21	ND, RDL=0.010		mg/L	
4031536	NRG	RPD [AGY767-01]	Nitrite (N)	2015/05/21	NC		%	25

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
4032736	MLB	Matrix Spike	Dissolved Aluminum (Al)	2015/05/22		106	%	80 - 120
			Dissolved Antimony (Sb)	2015/05/22		106	%	80 - 120
			Dissolved Arsenic (As)	2015/05/22		100	%	80 - 120
			Dissolved Barium (Ba)	2015/05/22		NC	%	80 - 120
			Dissolved Beryllium (Be)	2015/05/22		100	%	80 - 120
			Dissolved Bismuth (Bi)	2015/05/22		99	%	80 - 120
			Dissolved Boron (B)	2015/05/22		96	%	80 - 120
			Dissolved Cadmium (Cd)	2015/05/22		99	%	80 - 120
			Dissolved Calcium (Ca)	2015/05/22		NC	%	80 - 120
			Dissolved Chromium (Cr)	2015/05/22		97	%	80 - 120
			Dissolved Cobalt (Co)	2015/05/22		96	%	80 - 120
			Dissolved Copper (Cu)	2015/05/22		95	%	80 - 120
			Dissolved Iron (Fe)	2015/05/22		104	%	80 - 120
			Dissolved Lead (Pb)	2015/05/22		98	%	80 - 120
			Dissolved Magnesium (Mg)	2015/05/22		NC	%	80 - 120
			Dissolved Manganese (Mn)	2015/05/22		NC	%	80 - 120
			Dissolved Molybdenum (Mo)	2015/05/22		104	%	80 - 120
			Dissolved Nickel (Ni)	2015/05/22		96	%	80 - 120
			Dissolved Phosphorus (P)	2015/05/22		110	%	80 - 120
			Dissolved Potassium (K)	2015/05/22		104	%	80 - 120
			Dissolved Selenium (Se)	2015/05/22		100	%	80 - 120
			Dissolved Silver (Ag)	2015/05/22		102	%	80 - 120
			Dissolved Sodium (Na)	2015/05/22		NC	%	80 - 120
			Dissolved Strontium (Sr)	2015/05/22		NC	%	80 - 120
			Dissolved Thallium (Tl)	2015/05/22		102	%	80 - 120
			Dissolved Tin (Sn)	2015/05/22		106	%	80 - 120
			Dissolved Titanium (Ti)	2015/05/22		102	%	80 - 120
			Dissolved Uranium (U)	2015/05/22		109	%	80 - 120
			Dissolved Vanadium (V)	2015/05/22		100	%	80 - 120
			Dissolved Zinc (Zn)	2015/05/22		98	%	80 - 120
4032736	MLB	Spiked Blank	Dissolved Aluminum (Al)	2015/05/22		106	%	80 - 120
			Dissolved Antimony (Sb)	2015/05/22		101	%	80 - 120
			Dissolved Arsenic (As)	2015/05/22		99	%	80 - 120
			Dissolved Barium (Ba)	2015/05/22		97	%	80 - 120
			Dissolved Beryllium (Be)	2015/05/22		98	%	80 - 120
			Dissolved Bismuth (Bi)	2015/05/22		103	%	80 - 120
			Dissolved Boron (B)	2015/05/22		95	%	80 - 120
			Dissolved Cadmium (Cd)	2015/05/22		99	%	80 - 120
			Dissolved Calcium (Ca)	2015/05/22		97	%	80 - 120
			Dissolved Chromium (Cr)	2015/05/22		98	%	80 - 120
			Dissolved Cobalt (Co)	2015/05/22		97	%	80 - 120
			Dissolved Copper (Cu)	2015/05/22		99	%	80 - 120
			Dissolved Iron (Fe)	2015/05/22		105	%	80 - 120
			Dissolved Lead (Pb)	2015/05/22		100	%	80 - 120
			Dissolved Magnesium (Mg)	2015/05/22		108	%	80 - 120
			Dissolved Manganese (Mn)	2015/05/22		103	%	80 - 120
			Dissolved Molybdenum (Mo)	2015/05/22		99	%	80 - 120
			Dissolved Nickel (Ni)	2015/05/22		99	%	80 - 120
			Dissolved Phosphorus (P)	2015/05/22		110	%	80 - 120
			Dissolved Potassium (K)	2015/05/22		106	%	80 - 120
			Dissolved Selenium (Se)	2015/05/22		99	%	80 - 120
			Dissolved Silver (Ag)	2015/05/22		103	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
			Dissolved Sodium (Na)	2015/05/22		107	%	80 - 120
			Dissolved Strontium (Sr)	2015/05/22		102	%	80 - 120
			Dissolved Thallium (Tl)	2015/05/22		103	%	80 - 120
			Dissolved Tin (Sn)	2015/05/22		103	%	80 - 120
			Dissolved Titanium (Ti)	2015/05/22		101	%	80 - 120
			Dissolved Uranium (U)	2015/05/22		108	%	80 - 120
			Dissolved Vanadium (V)	2015/05/22		98	%	80 - 120
			Dissolved Zinc (Zn)	2015/05/22		100	%	80 - 120
4032736	MLB	Method Blank	Dissolved Aluminum (Al)	2015/05/22	ND, RDL=5.0		ug/L	
			Dissolved Antimony (Sb)	2015/05/22	ND, RDL=1.0		ug/L	
			Dissolved Arsenic (As)	2015/05/22	ND, RDL=1.0		ug/L	
			Dissolved Barium (Ba)	2015/05/22	ND, RDL=1.0		ug/L	
			Dissolved Beryllium (Be)	2015/05/22	ND, RDL=1.0		ug/L	
			Dissolved Bismuth (Bi)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Boron (B)	2015/05/22	ND, RDL=50		ug/L	
			Dissolved Cadmium (Cd)	2015/05/22	ND, RDL=0.010		ug/L	
			Dissolved Calcium (Ca)	2015/05/22	ND, RDL=100		ug/L	
			Dissolved Chromium (Cr)	2015/05/22	ND, RDL=1.0		ug/L	
			Dissolved Cobalt (Co)	2015/05/22	ND, RDL=0.40		ug/L	
			Dissolved Copper (Cu)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Iron (Fe)	2015/05/22	ND, RDL=50		ug/L	
			Dissolved Lead (Pb)	2015/05/22	ND, RDL=0.50		ug/L	
			Dissolved Magnesium (Mg)	2015/05/22	ND, RDL=100		ug/L	
			Dissolved Manganese (Mn)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Molybdenum (Mo)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Nickel (Ni)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Phosphorus (P)	2015/05/22	ND, RDL=100		ug/L	
			Dissolved Potassium (K)	2015/05/22	ND, RDL=100		ug/L	
			Dissolved Selenium (Se)	2015/05/22	ND, RDL=1.0		ug/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
			Dissolved Silver (Ag)	2015/05/22	ND, RDL=0.10		ug/L	
			Dissolved Sodium (Na)	2015/05/22	ND, RDL=100		ug/L	
			Dissolved Strontium (Sr)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Thallium (Tl)	2015/05/22	ND, RDL=0.10		ug/L	
			Dissolved Tin (Sn)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Titanium (Ti)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Uranium (U)	2015/05/22	ND, RDL=0.10		ug/L	
			Dissolved Vanadium (V)	2015/05/22	ND, RDL=2.0		ug/L	
			Dissolved Zinc (Zn)	2015/05/22	ND, RDL=5.0		ug/L	
4032736	MLB	RPD	Dissolved Aluminum (Al)	2015/05/22	NC		%	20
			Dissolved Antimony (Sb)	2015/05/22	NC		%	20
			Dissolved Arsenic (As)	2015/05/22	NC		%	20
			Dissolved Barium (Ba)	2015/05/22	0.51		%	20
			Dissolved Beryllium (Be)	2015/05/22	NC		%	20
			Dissolved Bismuth (Bi)	2015/05/22	NC		%	20
			Dissolved Boron (B)	2015/05/22	NC		%	20
			Dissolved Cadmium (Cd)	2015/05/22	5.6		%	20
			Dissolved Calcium (Ca)	2015/05/22	0.10		%	20
			Dissolved Chromium (Cr)	2015/05/22	NC		%	20
			Dissolved Cobalt (Co)	2015/05/22	NC		%	20
			Dissolved Copper (Cu)	2015/05/22	NC		%	20
			Dissolved Iron (Fe)	2015/05/22	NC		%	20
			Dissolved Lead (Pb)	2015/05/22	NC		%	20
			Dissolved Magnesium (Mg)	2015/05/22	0.67		%	20
			Dissolved Manganese (Mn)	2015/05/22	1.6		%	20
			Dissolved Molybdenum (Mo)	2015/05/22	NC		%	20
			Dissolved Nickel (Ni)	2015/05/22	NC		%	20
			Dissolved Phosphorus (P)	2015/05/22	NC		%	20
			Dissolved Potassium (K)	2015/05/22	0.77		%	20
			Dissolved Selenium (Se)	2015/05/22	NC		%	20
			Dissolved Silver (Ag)	2015/05/22	NC		%	20
			Dissolved Sodium (Na)	2015/05/22	0.96		%	20
			Dissolved Strontium (Sr)	2015/05/22	0.21		%	20
			Dissolved Thallium (Tl)	2015/05/22	NC		%	20
			Dissolved Tin (Sn)	2015/05/22	NC		%	20
			Dissolved Titanium (Ti)	2015/05/22	NC		%	20
			Dissolved Uranium (U)	2015/05/22	NC		%	20
			Dissolved Vanadium (V)	2015/05/22	NC		%	20
			Dissolved Zinc (Zn)	2015/05/22	NC		%	20
4032925	MCY	Matrix Spike [AGY765-01]	Total Organic Carbon (C)	2015/05/22		NC	%	80 - 120
4032925	MCY	Spiked Blank	Total Organic Carbon (C)	2015/05/22		98	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
4032925	MCY	Method Blank	Total Organic Carbon (C)	2015/05/22	ND, RDL=0.50		mg/L	
4032925	MCY	RPD [AGY764-01]	Total Organic Carbon (C)	2015/05/22	1.4		%	20
4035267	KMC	QC Standard	pH	2015/05/24		100	%	97 - 103
4035267	KMC	RPD [AGY765-01]	pH	2015/05/24	0.17		%	N/A
4035269	KMC	Spiked Blank	Conductivity	2015/05/24		101	%	80 - 120
4035269	KMC	Method Blank	Conductivity	2015/05/24	ND, RDL=1.0		uS/cm	
4035269	KMC	RPD [AGY765-01]	Conductivity	2015/05/24	0.59		%	25
4036003	KSR	QC Standard	Turbidity	2015/05/25		101	%	80 - 120
4036003	KSR	Method Blank	Turbidity	2015/05/25	ND, RDL=0.10		NTU	
4036003	KSR	RPD [AGY762-01]	Turbidity	2015/05/25	2.5		%	25
4036040	KSR	QC Standard	Turbidity	2015/05/25		95	%	80 - 120
4036040	KSR	Method Blank	Turbidity	2015/05/25	ND, RDL=0.10		NTU	
4036040	KSR	RPD	Turbidity	2015/05/25	8.3		%	25

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Mike MacGillivray, Scientific Specialist (Inorganics)

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 49-55 Elizabeth Ave, Suite 101A, St.John's, NL, Canada A1A 1W9 Tel: 709-754-0203 Toll Free: 888-492-7227 Fax: 709-754-8612 www.maxxamanalytics.com

Maxxam Analytics

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 — Tel: 902-420-0203 — Fax: 902-420-8612 — Toll Free: 1-800-565-7227
49 Elizabeth Ave., St John's, NL A1A 1W9 — Tel: 709 754-0203 — Fax: 709 754 8612 — Toll Free: 1-888-402 7227
99 Esplanade Sydney, NS B1P 1A1 — Tel: 902-567-1255 — Fax: 902 539 6504 — Toll Free: 1-888 535-7770
www.maxxamanalytics.com — E-mail: Clientservicesbedford@maxxamanalytics.com

MAXXAM Chain of Custody Record

COC #: B 143111 — Page ____ of ____

This column for lab use only:
Client Code #
Maxxam Job #: B590907

Cooler ID	Seal Present	Seal Intact	Temp 1	Temp 2	Temp 3	Average Temp
			0.9	0.6		
			1	0		
			AW 2015/05/15			

Integrity: YES / NO — Integrity / Checked by: AW
Labelled by — Location / Bin #

INVOICE INFORMATION:
Company Name: EXP SERVICES
Contact Name: M. HELENDY
Address: 6 CRIPPY PLACE.
ST. JOHN'S NL Postal Code A1B 4H7
Email:
Ph: 579-2027 Fax: 579-7115

REPORT INFORMATION (if differs from invoice):
Company Name: SAME
Contact Name: C/C R. HAYES
Address:
Postal Code
Email:
Ph: Fax:

PO #
Project # / Phase #: STJ-00215494-A0
Project Name / Site Location: ENVIRO SERVICES
Quote
Site #
Task Order #
Sampled by: ROD HAYES

TURNAROUND TIME
Standard ☑
10 day ☐
If RUSH Specify Date:
Pre-schedule rush work
Charge for # Jars used but not submitted

Guideline Requirements / Detection Limits / Special Instructions

*Specify Matrix: Surface/Salt/Ground/Tapwater/Sewage/Effluent/Potable/NonPotable/Tissue/Soil/Sludge/Metal/Seawater

Field Sample Identification	Matrix*	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAP-30 Choose Total or Diss Metals	RCAP-MS Choose Total or Diss Metals	Metals Water: Total Digest (Default Method) for well water/surface water	Metals Water: Dissolved for ground water	Metals Water: Mercury	Metals Soil: Metals & Mercury Default Available Digest Method	Metals Soil: Metals Total Digest - for Ocean sediments (HNO3-HF-HClO4)	Metals Soil: Mercury Low level by Cold Vapour AA	Metals Soil: Selenium (low level) Field for CCME Reference Conditions, Agriculture	Metals Soil: Hot Water soluble Boron required for CCME Agriculture	Hydrocarbons: RBCA Hydrocarbons (BTEX, C6-C32)	Hydrocarbons: Hydrocarbons Soil (Potable), NS Fuel Oil, Soil Policy Low Level BTEX, C6-C32	Hydrocarbons: NB Potable Water BTEX, VPH, Low level T.E.H.	Hydrocarbons: TPH Fractionation	Hydrocarbons: PAH's	Hydrocarbons: PAH's with Acridine, Quinoline
1 WELL #1	H2O	MAY14/15	1-250	✓		✓		✓												
2 WELL #2	"	"	"	✓		✓		✓												
3 WELL #3	"	"	"	✓		✓		✓												
4 WELL #4	"	"	"	✓		✓		✓												
5 WELL #5	"	"	"	✓		✓		✓												
6 ~~OP1-01~~ OP1-01	"	"	"	✓		✓		✓												
7 OP1-02	"	"	"	✓		✓		✓												
8 IP1-01	"	"	"	✓		✓		✓												
9 IP1-02	"	"	"	✓		✓		✓												
10																				

SHIPPED FROM
14-05-2015
MAXXAM NL

B590907

2015 MAY 15 9:16

RELINQUISHED BY: (Signature/Print)	Date	Time	RECEIVED BY: (Signature/Print)	Date	Time
ROD HAYES	MAY 14/15	1:52 PM	2015/05/14 1:55pm SARA MASON		

White: Maxxam — Yellow: Mail — Pink: Client

AIL FCD 00149 / Revision 10

Registered to ISO 9001:2008
ISO/IEC 17025:2005 Accredited
CALA-Food and Environmental Scope (No.2709)

petroforma LABORATORIES

Results of Microbiological Analyses

Customer: Cyril Pumphrey
EXP Services
60 Pippy Place, Suite 200
St. John's, NL
A1B 4H7
(709) 579-2027 (P)
(709) 579-7115 (F)

Sample: Water - 9 sample(s)
Date Received: 14-May-15
Date Started: 14-May-15
Date Reported: 28-May-15
Project No: 11048
Report ID: 44333

Sample Description	Water	Water	Water	Water
Sample ID (Date/Code)	Well #1, May 14/15 @ 10:15 AM	Well #2, May 14/15 @ 10:30 AM	Well #3, May 14/15 @ 7:30 AM	Well #4, May 14/15 @ 8:15 AM
Lab Refer. No.	M-77301-08	M-77302-08	M-77303-08	M-77304-08
Bacteriological Analyses				
Total Coliform (MF)	<1 CFU/100ml	<1 CFU/100ml	6 CFU/100ml	<1 CFU/100ml
Fecal Coliform (MF)	<1 CFU/100ml	<1 CFU/100ml	<1 CFU/100ml	<1 CFU/100ml
E. coli (MF)	<1 CFU/100ml	<1 CFU/100ml	<1 CFU/100ml	<1 CFU/100ml

Incoming Data/Product (Procedure #5)
Supplied by: Petroforma
Project No: SJW-215494-A0
Reveiwed by: SM
Date Reviewed: May 28/2015

Comments: The above analyses were conducted according to protocols indicated. The above results, which refer to the sample(s) tested only, are for your information and will be held in the strictest of confidence by this firm. For the list of test methods, please refer to the attached 'Appendix - References for Microbiological Analyses'. The arrival temperature was 1.5°C. Please see the attached Guidelines for Canadian Drinking Water Quality.

Technical Reviewer: Lana Cameron / [signature]
(Print Name/Signature)

Senior Reviewer: Stacey Penney / [signature] Date: May 28/15.
(Print Name/Signature)

222 Logy Bay Road St. John's, NL A1A 5C6 Canada

Results of Microbiological Analyses

Testing Facility
petroforma Laboratories
422 Logy Bay Road
St. John's, Newfoundland
A1A 5C6
Tel: (709) 726-9345
Fax: (709) 237-0741

Customer: Cyril Pumphrey
EXP Services
60 Pippy Place, Suite 200
St. John's, NL
A1B 4H7
(709) 579-2027 (P)
(709) 579-7115 (F)

Sample: Water - 9 sample(s)
Date Received: 14-May-15
Date Started: 14-May-15
Date Reported: 28-May-15
Project No: 11048
Report ID: 44333

Sample Description	Water	Water	Water	Water
Sample ID (Date/Code)	Well #5, May 14/15 @ 9:20 AM	OP1-01, May 14/15 @ 7:45 AM	OP1-02, May 14/15 @ 9:00 AM	IP1-01, May 14/15 @ 8:25 AM
Lab Refer. No.	M-77305-08	M-77306-08	M-77307-08	M-77308-08
Bacteriological Analyses				
Total Coliform (MF)	9 CFU/100ml	22 CFU/100ml	>200 CFU/100ml	>200 CFU/100ml
Fecal Coliform (MF)	<1 CFU/100ml	<1 CFU/100ml	27 CFU/100ml	<1 CFU/100ml
E. coli (MF)	<1 CFU/100ml	<1 CFU/100ml	27 CFU/100ml	<1 CFU/100ml

Comments: The above analyses were conducted according to protocols indicated. The above results, which refer to the sample(s) tested only, are for your information and will be held in the strictest of confidence by this firm. For a list of test methods, please refer to the attached 'Appendix - References for Microbiological Analyses'. The arrival temperature was 1.5°C. Please see the attached Guidelines for Canadian Drinking Water Quality.

Technical Reviewer: Lana Cameron / [signature]
(Print Name/Signature)

Senior Reviewer: Stacey Penney / [signature] Date: May 28/15.
(Print Name/Signature)

Results of Microbiological Analyses

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Tel: (709) 726-9345
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60 Pippy Place, Suite 200
St. John's, NL
A1B 4H7
(709) 579-2027 (P)
(709) 579-7115 (F)

Sample: Water - 9 sample(s)
Date Received: 14-May-15
Date Started: 14-May-15
Date Reported: 28-May-15
Project No: 11048
Report ID: 44333

Sample Description	Water			
Sample ID (Date/Code)	IP1-02, May 14/15 @ 9:45 AM			
Lab Refer. No.	M-77309-08			
Bacteriological Analyses				
Total Coliform (MF)	>200 CFU/100ml			
Fecal Coliform (MF)	<1 CFU/100ml			
E. coli (MF)	<1 CFU/100ml			

Comments: The above analyses were conducted according to protocols indicated. The above results, which refer to the sample(s) tested only, are for your information and will be held in the strictest of confidence by this firm. For a list of test methods, please refer to the attached 'Appendix - References for Microbiological Analyses'. The arrival temperature was 1.5°C. Please see the attached Guidelines for Canadian Drinking Water Quality.

Technical Reviewer: Lana Cameron / LCameron
(Print Name/Signature)

Senior Reviewer: Stacy Penney / SPenney Date: May 28/15
(Print Name/Signature)

Tables

Table 1. Microbiological Parameters

In general, the highest priority guidelines are those dealing with microbiological contaminants, such as bacteria, protozoa and viruses. As a result of challenges with routine analysis of harmful microorganisms that could potentially be present in inadequately treated drinking water, the microbiological guidelines focus on indicators (*E.coli*, total coliforms) and treatment goals. The use of a multi-barrier approach that includes source water protection, adequate treatment, including disinfection, and a well maintained distribution system can reduce microorganisms to levels that have not been associated with illness, as well as meet the guidelines outlined below.

Parameter (approved)	Guideline	Common sources	Health considerations	Applying the guideline
Enteric protozoa: *Giardia* and *Cryptosporidium* (2012)	Treatment goal: Minimum 3 log removal and/or inactivation of cysts and oocysts	Human and animal faeces	*Giardia* and *Cryptosporidium* are commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea). Less common health effects vary. *Giardia* infections may include prolonged gastrointestinal upset, malaise and malabsorption. *Cryptosporidium* infections, in immunocompromised individuals, can occur outside the gastrointestinal tract including in the lungs, middle ear, and pancreas.	Monitoring for *Cryptosporidium* and *Giardia* in source waters will provide valuable information for a risk-based assessment of treatment requirements. Depending on the source water quality, a greater log removal and/or inactivation may be required.
Enteric viruses (2011)	Treatment goal: Minimum 4 log reduction (removal and/or inactivation) of enteric viruses	Human faeces	Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); less common health effects can include respiratory symptoms, central nervous system infections, liver infections and muscular syndromes.	Routine monitoring for viruses is not practical; characterize source water to determine if greater than a 4 log removal or inactivation is necessary.
Escherichia coli (*E.coli*) (2012)	MAC: None detectable per 100 mL	Human and animal faeces	The presence of *E. coli* indicates recent faecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses; pathogens in human and animal faeces pose the most immediate danger to public health.	*E. coli* is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. *E. coli* monitoring should be used, in conjunction with other indicators, as part of a multi-barrier approach to producing drinking water of an acceptable quality.

			Health considerations	
Total coliforms (2012)	MAC of none detectable/100 mL in water leaving a treatment plant and in non-disinfected groundwater leaving the well	Human and animal faeces; naturally occurring in water, soil and vegetation	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	Total coliforms should be monitored in the distribution system because they are used to indicate changes in water quality. In water leaving a treatment plant, total coliforms should be measured in conjunction with other indicators to assess water quality; the presence of total coliforms indicates a serious breach in treatment. In a distribution and storage system, detection of total coliforms can indicate regrowth of the bacteria in biofilms or intrusion of untreated water. In non-disinfected groundwater, the presence of total coliforms may indicate that the system is vulnerable to contamination, or it may be a sign of bacterial regrowth.
Turbidity (2012)	Treatment limits for individual filters or units: - Conventional and direct filtration: ≤ 0.3 NTU[1] - slow sand and diatomaceous earth filtration: ≤ 1.0 NTU[2] - membrane filtration: ≤ 0.1 NTU[3]	Naturally occurring particles: *Inorganic*: clays, silts, metal precipitates *Organic*: decomposed plant & animal debris, microorganisms	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	Guidelines apply to individual filter turbidity for systems using surface water or groundwater under the direct influence of surface water. The decision to exempt a waterworks from filtration should be made by the appropriate authority based on site-specific considerations, including historical and ongoing monitoring data. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less. For systems that use groundwater, turbidity should generally be below 1.0 NTU.

[1] in at least 95% of measurements either per filter cycle or per month; never to exceed 1.0 NTU.
[2] in at least 95% of measurements either per filter cycle or per month; never to exceed 3.0 NTU.
[3] in at least 99% of measurements per operational filter period or per month. Measurements greater than 0.1 NTU for a period greater than 15 minutes from an individual membrane unit should immediately trigger an investigation of the membrane unit integrity.

petroforma LABORATORIES

APPENDIX
References for Microbiological Analyses

Test Title	CALA Accredited Methods
Total Coliforms (MF) and/or Fecal Coliforms (MF)	9222. Membrane filter technique for members of the coliform group. 2005. Standard Methods For The Examination of Water and Wastewater. 21st Edition.
Fecal Coliforms (A-1 MPN Method)	9221E. Fecal Coliform Procedure.2. Fecal Coliform Direct Test (A-1 Medium) 2005 Standard Methods for the Examination of Water and Wastewater. 21st Edition.
Total Coliforms and E.coli (Colilert Method)	AOAC Official Method 991.15. Determination of Total Coliforms and E.coli using the (Colilert) Method
Standard Plate Count	***Determination of Aerobic Colony Count in Foods. MFHPB –18. October, 2001. Compendium of Analytical Methods: Volume 2.***
Total Coliforms (MPN Method), Fecal Coliforms (MPN Method), and/or E.coli (MPN Method)	***Enumeration of Coliforms, Fecal Coliforms and of E. coli in Foods Using The MPN Method. MFHPB –19. April 2002. Compendium of Analytical Methods: Volume 2.***
Salmonella Species	***Isolation and Identification of Salmonella from Foods and Environmental Samples. MFHPB-20. March 2009. Compendium of Analytical Methods: Volume 2.***
Staphylococcus aureus Coagulase (+)	***Enumeration of Staphylococcus aureus in Foods. MFHPB –21. September, 2005. Compendium of Analytical Methods: Volume 2.***
Listeria monocytogenes	***Isolation of Listeria monocytogenes and other Listeria spp. from foods and environmental samples. MFHPB-30. February 2011. Compendium of Analytical Methods Volume 2.***
Standard Plate Count (Petrifilm)	***Enumeration of Total Aerobic Bacteria in Food Products and Food Ingredients using 3M Petrifilm Aerobic Count Plates. MFHPB-33. February 2001. Compendium of Analytical Methods: Volume 2.***
Total Coliforms and E.coli (Petrifilm)	***Enumeration of E.coli and Coliforms in Food Products and Food Ingredients using 3M Petrifilm E. coli Count Plates. MFHPB-34. February 2001. Compendium of Analytical Methods: Volume 2. Supplement to the Method MFHPB-34. January, 2006. Compendium of Analytical Methods: Volume 2***
Enterobacteriacese species (Petrifilm)	***Enumeration of Enterobacteriacese species in Food and Environmental Samples using 3M Petrifilm Enterobacteriacese Count Plates (modified to add shrimp testing). MFLP-09. June 2007. Compendium of Analytical Methods: Volume 3.***
Listeria monocytogenes enumeration	***Enumeration of Listeria monocytogenes species in Foods. MFLP-74. April 2002. Compendium of Analytical Methods: Volume 3. Supplement to the Method MFLP-74. April, 2004. Compendium of Analytical Methods: Volume 3***

Non-Accredited Methods

1. pH
2. Salt Content
3. Enumeration of *Enterococcus* species: Colony Count Technique
4. *Vibrio* Detection (Presence/Absence)(MPN Method)
5. Anaerobes Sporulative/Anaerobes Vegetative
6. Yeasts and Molds

Legend for symbols:

<	Less than the lowest detection limit for the test
>	Greater than the highest detection limit for the test
MPN	Most Probable Number (testing conducted using the MPN test tube method)
CFU	Colony Forming Unit
Negative	Not detected
MF	Membrane filtration
%	Percent
g	Gram
ml	Millilitre

Registered to ISO 9001:2008
ISO/IEC 17025:2005 Accredited
CALA-Food and Environmental Scope (No.2709)

petroforma LABORATORIES

Results of Microbiological Analyses

Customer: Cyril Pumphrey
EXP Services
60 Pippy Place, Suite 200
St. John's, NL
A1B 4H7
(709) 579-2027 (P)
(709) 579-7115 (F)

Sample: Water - 1 sample(s)
Date Received: 01-Jun-15
Date Started: 01-Jun-15
Date Reported: 08-Jun-15
Project No: 11048
Report ID: 44517

Sample Description	Water — OP2-01 June 1st/15			
Sample ID (Date/Code)	#1 Ocean Pond, June 01/15 @ 10:00 AM			
Lab Refer. No.	M-78000-08			
Bacteriological Analyses				
Total Coliform (MF)	>200 CFU/100ml			
Fecal Coliform (MF)	2 CFU/100ml			
E. coli (MF)	2 CFU/100ml			

Incoming Data/Product (Procedure #
Supplied by: Petroforma
Project No: SJN-215404-A0
Reveiwed by: SM
Date Reviewed: June 8/2015

Comments: The above analyses were conducted according to protocols indicated. The above results, which refer to the sample(s) tested only, are for your information and will be held in the strictest of confidence by this firm. For the list of test methods, please refer to the attached 'Appendix - References for Microbiological Analyses'. The arrival temperature was 17.3°C which was reflective of the temperature upon collection. Please see the attached Guidelines for Canadian Drinking Water Quality.

Technical Reviewer: Suzette Winter
(Print Name/Signature)

Senior Reviewer: Stacey Penney
(Print Name/Signature)

Date: June 8/15

Tables

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petroforma LABORATORIES

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Listeria monocytogenes enumeration	***Enumeration of Listeria monocytogenes species in Foods. MFLP-74. April 2002. Compendium of Analytical Methods: Volume 3. Supplement to the Method MFLP-74. April, 2004. Compendium of Analytical Methods: Volume 3***

Non-Accredited Methods

1. pH
2. Salt Content
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Legend for symbols:

<	Less than the lowest detection limit for the test
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MPN	Most Probable Number (testing conducted using the MPN test tube method)
CFU	Colony Forming Unit
Negative	Not detected
MF	Membrane filtration
%	Percent
g	Gram
ml	Millilitre

APPENDIX D

Dug Well Construction Recommendations

A Note About Well Liners/Casings

There are several different types of well liners on the market, such as concrete, PVC plastic, or steel. Please note that a galvanized steel liner may only be used in wells with a low water level, or in combination with an inner PVC or concrete liner, to prevent its contact with the water. If the steel liner does contact the water, it will rust over time and could put harmful metals into the well water.

Disinfecting A Newly Dug Well

A newly dug well will likely contain bacteria. Before you use the water for drinking, you should disinfect the well to kill the bacteria:

Step 1) Clean the inside of the well liner with a stiff brush or broom and a bleach solution of 15 mL (½ US oz.) household bleach in 25 L (6.5 US gal.) of water. (For safety reasons, it is not recommended to descend into a pumped out well.)

Step 2) Add unscented household bleach to the well in the amount as shown in the table on the following page, and mix well by connecting a garden hose to a nearby tap and washing down the inside of the well.

Depth of Water in New Dug Well	Bleach to Add to New Dug Well (90 cm Diameter)
1.0 m (3 feet)	3.2 L (7 US pints)
3.0 m (10 feet)	9.8 L (2.5 US gal.)
5.0 m (16 feet)	16.5 L (4.5 US gal.)

Step 3) Open the taps in the house, until you can smell the chlorine on the water, then close them. If you cannot smell the chlorine, add more bleach to the well.

Step 4) Let the bleach sit in the system for at least 12 hours.

Step 5) Run water through the outside hose away from grass, bushes, ponds and rivers, until the chlorine smell is gone. Then open the indoor taps until the chlorine is flushed out.

Step 6) Obtain a sterile bottle from the local Government Service Centre or the Public Health Lab in St. John's. Wait 10-14 days before taking a water sample from your tap for testing. Follow the instructions given on the sample bottle form when taking and submitting the sample.

Looking After Your Dug Well

If your dug well is properly constructed and lies in a good location, it can give you clean, safe drinking water for many years. You should inspect your well on a regular basis to ensure that the cover is secure, the vent screen is clear and intact, and that there is no ponding of water around the well liner.

You should also have the water tested for bacteria at least once a year, or after several months without use, just to ensure its safety. If there are bacteria in the sample, you will be told how to disinfect your well with household bleach.

Finally, you may want to test the water for any chemical problems, such as lead or arsenic. This can be done at a private lab for a fee. Check the yellow pages in the telephone directory under "Laboratories - Chemical & Analytical" for the lab nearest you. If you need help with these lab results, contact one of the offices listed on the back of this brochure.

Designing Your Dug Well

The most important thing to keep in mind when designing a well is that it must keep rain or runoff from putting bacteria into your well water. The drawing on the front page is an example of a properly constructed dug well. A dug well should meet all of these standards:

- the dug well should be at least 3.6 metres (12 feet) deep
- the space from the bottom of the well up to the liner bottom should be lined with rock, or small boulders
- a water-tight liner is needed for a depth of at least 3 metres (10 feet) with the liner reaching at least 50 centimetres (20 inches) above the surface of the ground
- an overlapping, water-tight cover with a screened vent is needed (wooden covers should not be used as they harbour bacteria-carrying insects.)
- the ground around the dug well should be sloped to direct surface water away from the well
- dip buckets are not recommended as they can allow dirt and bacteria to enter a well
- where the discharge line connection is made below ground, the connection should be made water-tight with a strong, non-toxic sealing material
- the water service line should be about 1.5 metres (4 or 5 feet) below the surface to protect it from frost

For More Information

For more information, please contact an Environmental Health Officer at the nearest **Government Service Centre**:

Regional Government Service Centre Locations:

Happy Valley-Goose Bay
Corner Brook
Grand Falls-Windsor
Gander
Clarenville
Harbour Grace
St. John's

or, a regional Environmental Health Manager:

Regional Health and Community Services & Integrated Health Board Locations:

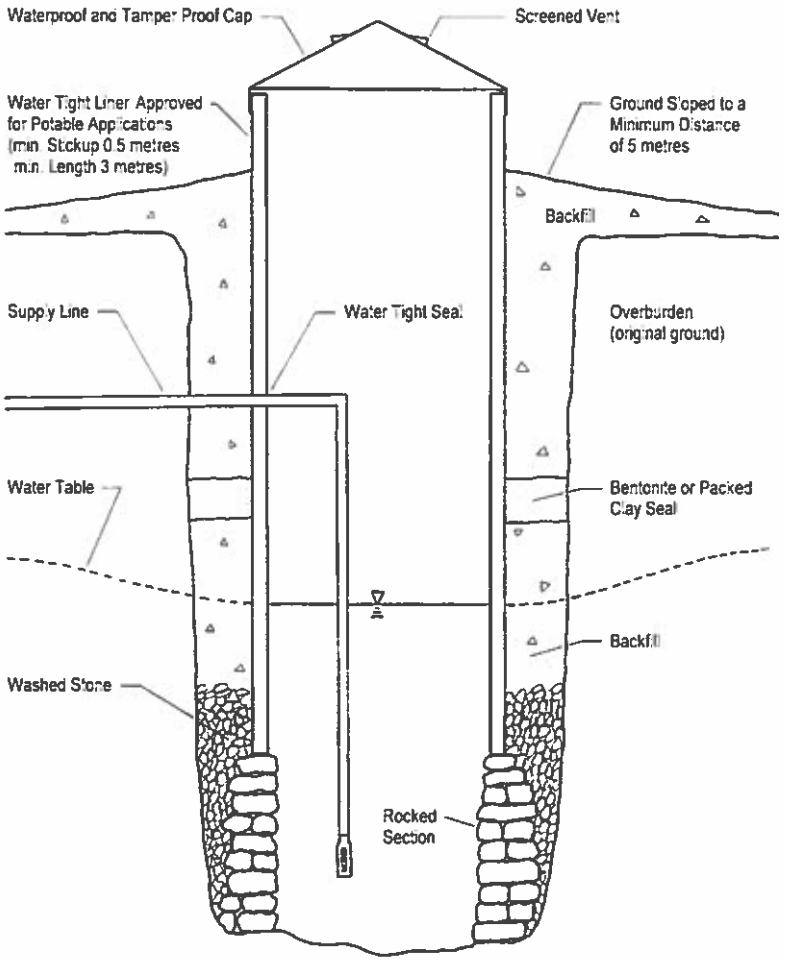
Happy Valley-Goose Bay
St. Anthony
Corner Brook
Gander
Holyrood
St. John's

Partnering for Health

Department of Health and Community Services
Department of Government Services and Lands
Department of Environment
Regional Health and Community Services Boards
April 2003

The Sanitary Dug Well

Properly Constructed Dug Well



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR