Houle Chevrier Engineering Ltd.
180 Wescar Lane
R.R. 2
Carp, Ontario K0A 1L0
Tel.: (613) 836-1422
Fax: (613) 836-9731
www.hceng.ca

REPORT ON

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN EVALUATION

PROPOSED COMMERCIAL / INDUSTRIAL SUBDIVISON 3119 CARP ROAD, TOWNSHIP OF HUNTLEY OTTAWA, ONTARIO

Submitted to:

Mr. Greg LeBlanc
1963 Old Carp Road
Ottawa, Ontario
K0A 1L0

DISTRIBUTION:

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February 2014

Our ref: 11-037

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1.0 INTRODUCTION

1.1 Background

Houle Chevrier Engineering Ltd. (HCEL) was retained by Mr. Greg LeBlanc to conduct a hydrogeological investigation and terrain evaluation at the site of a proposed rural commercial/industrial development consisting of a maximum of twelve (12) lots in Carp (City of Ottawa), Ontario.

The proposed commercial/industrial lot development (hereafter referred to as 'the subject site') will be comprised of a 14.20 hectare (35.09 acre) parcel of land located on Concession 3 in the Township of Huntley, at 3119 Carp Road (refer to Site Location Plan, Figure 1).

The subject site is currently vacant and portions of it have been previously used for agricultural purposes. Some mature trees are situated on the western half of the site.

The proposed commercial/industrial development will consist of a maximum of twelve (12) lots serviced with on-site septic disposal systems and water supply wells. The proposed lots will be serviced by an internal roadway system and are to have a minimum lot size of approximately 0.7 hectares (1.7 acres) with an average lot size of 1.0 hectares (2.5 acres). It is understood from information provided by the developer that lot sizes will be tailored to meet customer demands; for example, if a prospective buyer has large space requirements then they could purchase two (2) lots as a single large lot. The proposed lot layout, showing the maximum of twelve (12) lots, is shown on the Site Plan, Figure 2.

1.2 Project Scope

The objectives of this investigation are as follows:

- To investigate the potential quantity and quality of groundwater available from drilled test wells on the subject site for potential water supply;
- To identify and characterize the shallow subsurface conditions on the subject site as they relate to the design of septic sewage disposal systems under the Ontario Building Code (OBC).
- To assess the potential for impact on the receiving aquifer(s) and any nearby surface water features from on-site septic disposal systems. This will include predictions on nitrate concentrations at the property boundaries; and

- To provide preliminary geotechnical engineering guidelines relative to the proposed site development.

1.3 Policy Overview

Based on available information provided to us, it is understood that the proposed development meets all existing municipal policies with respect to hydrogeological requirements. Based on a cursory review of the Carp River Watershed/Subwatershed Study, dated December 2004 and prepared by Robinson Consultants Inc., no significant restrictions were identified for the proposed development of the subject site. No PTTW records were identified in the vicinity of the site based on a review of Access Information Ontario.

1.4 Land Use in the Vicinity of the Site

Land use in the vicinity of the site consists of vacant undeveloped land, agricultural land, rural residential land use, commercial / light industrial (Carp airport and gravel pits). Specific land uses near the site boundaries are documented in the following table:

Site Boundary	Land Use
Southwest	• Combination of former gravel pits (now open water ponds) and undeveloped rural land along with some heavily treed areas. McGee Pit is located approximately 900 metres to the southwest of the site on the far side of William Mooney Road.
Northwest	• Access road to McGee Pit followed by Carp Airfields.
Northeast	• Cemetery, private residence and church followed by Carp Road, followed by: mixed land use, including rural residential, agricultural and commercial (e.g. general contractor, landscape supply company) along Carp Road.
Southeast	• Mixed land use, including: rural residential, commercial and agriculture land along Carp Road. A municipal landfill site, Waste Management's Ottawa Landfill, is located 5-km southeast of the site.

Potential impacts to groundwater quality from adjacent land within 500 metres of the subject site boundary are not anticipated. It is noted that the area encompassing the Carp Airfields does have a number of petroleum contaminated sites but it is understood that the area has undergone remediation and is closely monitored. No impacts have been identified in the sentinel wells located along the Carp Airfield property boundary. Ponds in former gravel pits southwest of the site may provide some additional recharge to the bedrock groundwater system

but are not expected to pose any groundwater contamination concerns. No impacts from the adjacent cemetery and agricultural land uses are anticipated.

No large scale water takings capable of causing adverse impacts to groundwater quantity were identified within 500 metres of the subject site boundary.

1.5 Overview of Local Geological Setting

1.5.1 Topography

Topographic mapping data provided indicates that elevations range from about 110 to 117 metres above sea level. Overall, the property is relatively flat with a regional slope downwards in a northeasterly direction towards the Carp River. The topographic high point of the property is the southwest corner of the property.

1.5.2 Drainage

There are no surface water features on the subject site, however, two ponds (former gravel pits) are located just west of the site. There is a potential swale (observed to be dry) centrally located on the western portion of the subject site which may drain westerly to the two ponds on the adjacent property.

Overall, the drainage of the subject site is assumed to be influenced by the natural topography of the site and is anticipated to be generally northeasterly towards the Carp River. Roadside drainage ditches have been constructed along the northwest boundary of the site.

Ontario Base Mapping indicates that there are no wetland features on the subject site which is consistent with field observations of the subject site.

1.5.3 Regional Surficial and Bedrock Geology

Surficial and bedrock geology maps of the Ottawa area (Urban Geology of the National Capital Region) indicate that the overburden generally consists of nearshore marine deposits consisting of sand and silt and Paleozoic bedrock. The overburden thickness is reported to range from 0 to 15 metres in thickness. Based on site observations during test pit operations, there were no areas of exposed bedrock observed at the subject site. Sand and gravel pit operations were observed west of the site.

Bedrock maps of the Ottawa area indicate that the bedrock below the subject site is mapped as the Middle Ordovician Verulam Formation of the Simcoe Group. The Verulam Formation gradationally overlies the Bobcaygeon Formation and consists of interbedded bioclastic to very-fine grained limestone and grey-green calcareous shale. The upper few metres of the Verulam Formation contain more abundant coarse-grained calcarenites (bio- and intraclastic grainstones and rudstones) which are locally mapped as a separate upper member (Derek K. Armstrong and J.E.P. Dodge, Ontario Geological Survey, 2007).

2.0 TERRAIN EVALUATION

2.1 Field Procedure

Test pits were advanced by HCEL from June 17 to 20, 2011. Eighteen (18) test pits, numbered 11-1 to 11-18, were advanced at the site. The field work was supervised throughout by a member of our engineering staff, who directed the excavating operations and logged the test pits.

The test pits were advanced using an excavator to depths ranging from about 0.3 to 3.2 metres below ground surface. The subsurface conditions encountered in the test pits were identified by visual and tactile examination of the materials exposed on the sides and bottom of the test pits and from the excavated materials. Groundwater levels were measured in five (5) temporary piezometers installed in the test pits. The test pits were backfilled with the excavated materials and tamped with the bucket of the excavator during backfilling.

Selected samples of the overburden deposits were returned to our office for further testing. Grain size and hydrometer testing was carried out on six (6) soil samples. The results of the grain size and hydrometer testing are presented in Appendix A following the Records of Test Pit sheets and are discussed in Section 2.3 of this report.

The locations of the test pits are shown on the Site Plan, Figure 2. Additional details on the soil samples can be found in the Record of Test Pit sheets provided in Appendix A.

A plan showing the interpreted overburden thickness is provided in the Interpreted Overburden Thickness Plan, Figure 3. Please note that the areas identified are approximate only and are based on the information collected from the test pits. Therefore, areas outside the locations of test pits may differ in overburden thickness than indicated on Figure 3.

2.2 Soil and Groundwater Conditions

2.2.1 General

Soil and groundwater conditions encountered during test pitting are described in the Record of Test Pit sheets provided in Appendix A. The test pit logs indicate the subsurface conditions at the specific test pit locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and may have been interpreted. Subsurface conditions at other than

the test pit locations may vary from the conditions encountered in the test pits. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgment and HCEL does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

An overview of the subsurface conditions, interpreted from the Records of Test Pits, is presented below.

2.2.2 Topsoil

Topsoil was encountered at ground surface in all of the eighteen (18) test pits. The topsoil consists of dark brown silty clay to silty sand with organic material. The topsoil ranged from about 0.1 to 0.2 metres in thickness and has an average thickness of about 0.1 metres.

2.2.3 Silty Clay to Clayey Silt, Silt

Deposits of silty clay to clayey silt with trace sand were encountered in test pits 11-1, 11-2, 11-4, 14, 11-15, 11-16, 11-17 and 11-18. The silty clay deposit was encountered underlying the topsoil in test pit 11-1 but was encountered overlain by a sand or silty sand deposit at the other test pit locations. The silty clay to clayey silt deposits ranged from about 0.3 to 1.4 metres in thickness with an average thickness of about 0.9 metres.

2.2.4 Silty Sand, Sand

Deposits of brown sand (fine to coarse) and silty sand with some to trace clay and gravel were encountered in all of test pits except for test pits 11-1 and 11-7. The silty sand / sand deposits were encountered directly beneath the topsoil. The silty sand / sand deposits at test pit 4 was noted to contain clay seams and cobbles with increasing depth. At some test pit locations the silty sand / sand deposits occur above and below the silty clay deposits. The silty sand / sand deposits range in thickness from about 0.2 to 2.3 metres with an average thickness of 1.35 metres.

2.2.5 Glacial Till

Deposits of glacial till were encountered in test pits 11-9 and 11-10. The glacial till consists of grey brown silty sand and sandy silt with trace to some clay, gravel, cobbles and boulders. The thickness of the glacial till deposits was approximately 1.2 metres at both test pit locations.

2.2.6 Inferred Bedrock

All of the test pits were terminated either on the inferred surface of the bedrock (as determined by practical refusal of the excavator) or practical refusal on boulders at depths ranging from about 0.3 to 3.2 metres below ground surface. Excavation refusal was encountered at an average depth of about 2.1 metres below ground surface in the eighteen (18) test pits.

2.2.7 Overburden Groundwater

Groundwater was observed to enter all of the test pits at depths generally ranging from 1 to 2 metres below ground surface. Water levels were measured in five (5) shallow monitoring wells using an electronic water level meter on June 30, 2011. Water levels ranged from 0.37 to 2.05 metres below the ground surface, averaging 1.1 metres below the ground surface.

As no significant overburden aquifer was encountered on the subject site (that is, 13 of 18 test pits were observed to be dry upon completion), it is our opinion that the bedrock aquifer is the receiving aquifer for septic system effluent.

It should be noted that the groundwater levels could vary during wet periods of the year, after periods of heavy precipitation and snow melt or during the dry summer months.

2.3 Grain Size and Hydrometer Testing

Soil samples from the terrain analysis were selected for grain size and hydrometer testing. The results of the grain size and hydrometer testing are presented following the Record of Test Pit sheets in Appendix A. The soil sample ID's, along with accompanying classification based on the results of the grain size and hydrometer testing, are summarized below:

Test Pit	Sample No.	Description
11-3	1	Sand, trace silt and some gravel

Test Pit	Sample No.	Description
11-4	4	Silty sand, some clay
11-6	2	Sand, some silt
11-13	2	Sand some silt, trace gravel
11-14	2	Sandy silt with clay
11-15	3	Silty clay and fine sand

2.4 Sewage Disposal Systems

This section discusses the results of the terrain evaluation as they relate to the feasibility of installing sewage disposal systems within the proposed developments and the resulting impacts on the groundwater environment.

It should be noted that it is our understanding that conventional septic disposal systems are being considered for waste water servicing on the subject site. In addition, developers of individual lots may consider the use of tertiary septic systems due to smaller space requirements for tertiary septic systems.

2.4.1 Septic Envelopes

The septic system envelope area (septic envelope) represents the area on a lot set aside for the construction of the leaching bed and is for the leaching bed only. It does not include that area required for the septic tank or the isolation/separation distances required by the Ontario Building Code (OBC).

The size of the septic envelope is a function of the percolation rate of the native soil in the vicinity of the septic envelope or the fill used for the construction of a septic bed and the daily effluent loading to the septic bed. The test pits indicate that the shallow subsurface at this site is characterized by deposits composed primarily of sand, silty sand, silty clay and glacial till. Based on our experience, the results of the grain size distribution analyses and the Ontario Building Code (2006) Supplemental Standard SB-6, the estimated ranges of percolation rates (t-times) for the native deposits are between 2 (fine to coarse sand) to over 50 minutes per centimetre (silty clay). No significant deposits of highly permeable native soil deposits were encountered on the site during the terrain evaluation.

In accordance with the OBC, for finer grained soils, such as sandy silt, silty clay and glacial till, the maximum loading rate ranges from 6 to 8 litres per square metre per day (L/m^2/day). The OBC also specifies that where a leaching bed is constructed in unsaturated soil having a percolation time of greater than 15 minutes per centimetre, any fill used in the construction of the leaching bed must have a percolation time not less than 75 percent of the percolation time of the unsaturated soil or leaching bed fill material. In view of the percolation time of the native sandy silt, silty clays and glacial till encountered over the subject site, a 15 metre sand mantle should be allowed for on some or all of the proposed lots.

At the time of the hydrogeological investigation, the daily design flow of the future commercial/industrial buildings on the subject site were unknown (buildings will be custom built to meet individual lot purchaser needs). As a conservative approach to calculating the maximum expected septic system envelope required to service a building, a septic system envelope size was calculated using a daily sewage flow of 3,500 litres. A daily design flow of 3,500 litres per day is suitable for a 46 employee factory/office (assuming 75 litres per employee per 8 hour shift) or for a warehouse with three (3) washrooms and four (4) loading bays (950 litres per water closet and 150 litres per loading bay). The septic envelope area required for a daily sewage flow of 3,500 litres and a conservative loading rate of 6 to 8 L/m^2/day for the sandy silt is about 440 to 585 m^2. This septic system envelope should be readily accommodated on the lot sizes that are proposed for this development (the minimum proposed lot size is 0.7 hectares).

Prior to establishing the actual septic envelope (leaching bed) location on any particular lot, test holes should be excavated to determine the actual subsurface conditions in the area of the proposed leaching bed. The design and construction of individual septic disposal systems on the proposed lots should be carried out in accordance with the requirements in the OBC.

2.4.2 Leaching Bed Design Considerations

The design of septic leaching beds involves a combination of a number of interrelated factors, including the volume of effluent discharged to the system, properties of the soil materials used in the construction of the leaching bed and the subsurface conditions in the area of the leaching bed. The construction of individual septic disposal systems within the proposed commercial subdivision should be carried out in accordance with the requirements in the OBC.

The design must ensure that the bottom of the absorption trenches is at least 0.9 metres above low permeability soils (such as sandy silt), bedrock, and at least 0.9 metres above the seasonally high groundwater table. Based on the soil conditions which were observed in the test pits, it is expected that some or all of the septic leaching beds at this site will be partially or fully raised.

In order to provide maximum protection to the subsurface groundwater supply aquifer due to the potential for shallow bedrock conditions (that is, less than 0.3 metres of native soil), it is recommended that a compacted clay seal with a minimum thickness of 150 millimetres be placed below the leaching bed and sand mantle on any lots where there is less than 0.3 metres of suitable native soil above the surface of the bedrock. A plan showing interpreted overburden thickness is provided on Figure 3. Please note that the identified overburden thickness areas are approximately only and is based on the information collected from the test pits. Therefore, a site specific investigation should be carried out on each lot for septic system design purposes to determine the thickness and type of overburden present in any areas proposed for installation of leaching beds.

The OBC requires that the upper 0.25 metres of unsaturated soil (soil mantle) underlying the leaching bed and extending at least 15 metres beyond the outer distribution pipes in any direction that effluent may migrate have a percolation time between 1 and 50 minutes per centimetre for Class IV leaching beds. The OBC also specifies that where a leaching bed is constructed in unsaturated soil having a percolation time of greater than 15 minutes per centimetre, any fill used in the construction of the leaching bed must have a percolation time not less than 75 percent of the percolation time of the unsaturated soil. Although it is considered that the lots on the site will require imported fill and a mantle, the thickness of unsaturated soil in the downgradient direction from the leaching bed should be investigated on a lot-specific basis to determine whether the 0.25 metre unsaturated depth requirement can be met with native soils. If necessary, imported sand fill should be used to augment the native soils.

2.4.3 Tertiary Septic Systems

Individual lot developers may consider the use of tertiary septic systems in order to minimize the area on lots required for waste water treatment and disposal. The disposal beds for tertiary treatment systems require a smaller area than those for conventional Class IV septic systems. Furthermore, the required separation distance between the underside of the crushed stone layer

in the disposal bed and low permeability soils, bedrock, or the seasonally high groundwater table is less than the required 0.9 metres for conventional septic systems.

2.5 Nitrate Impact Assessment on Groundwater

Calculations were carried out to assess the potential impact of nitrate-reduced septic effluent on the properties adjoining the subdivision using a nitrate dilution model in general accordance with MOE Procedure D-5-4. The Thornthwaite Water Balance method was used to estimate the net potential infiltration based on local climatic data available from Environment Canada for Carleton Place, Ontario.

The nitrate concentration at the site boundaries was calculated using the following information:

- A weighted average water surplus value of 390.7 millimetres was obtained for Carleton Place, Ontario and Ottawa Airport provided by Environment Canada for soils with a water holding capacity of 280 millimetres (silty clay), 150 millimetres (silty sand/sandy silt) and 100 millimetres (sand). A copy of the water surplus data and the weighted average water surplus calculation is provided in Appendix B. The weighted average calculation used the first layer of soil encountered below the topsoil from the test pit logs;

- A conservative infiltration factor of 0.50 was calculated using Table 2 of Section 4-62 of the MOE document titled "MOEE Hydrogeological Technical Requirements for Land Development Applications" dated April 1995.

    - A topography factor of 0.20 was used since the site has a rolling topography.

    - A soil factor of 0.20 based was chosen based on the existing overburden deposits (sand, silty sand, silty clay and glacial till underlying silty sand/silty clay topsoil).

    - A cover factor of 0.10 was chosen for this site since the subject site will eventually be predominately cleared of trees.

- The area for potential infiltration was calculated to be approximately 11.36 hectares. The area used in the calculation is based on the total site area minus the hard surfaced areas which were estimated to be approximately 30 percent of the total site area (includes roads and building roofs).

The nitrate dilution calculation was based on a volume of effluent of 1000 litres per day per lot (as per MOE Procedure D-5-4), an effluent nitrate concentration of 40 mg/L and the proposed development of 12 lots. The nitrate concentration at the site boundaries was calculated to be 6.7 mg/L (refer to the calculation in Appendix C).

The calculated nitrate concentration at the site boundary is below the acceptable nitrate impact requirement of 10 mg/L established by the MOE. The value is considered to be conservative since some or most of the water runoff from hard surfaced areas (paved parking areas, roofs, road, etc.) will be contained on the subject site and will infiltrate through native and imported soils. A recent Ontario Municipal Board (OMB) hearing concluded that water runoff from hard surfaced areas could be used for nitrate dilution.

It should be noted that due to the uncertainty regarding future site use (for example, the sizes and uses of commercial buildings on the subject site), that impacts of development of septic systems with flows outside those described in MOE Procedure D-5-4 have not been assessed. Procedure D-5-4 allows for a nitrate loading of 40 g/lot/day with a daily septic flow of 1,000 litres which assumed to be typical for a residence. As the proposed site use is to be commercial/light industrial, it is expected that the use of residential loading rates is an acceptable surrogate for the proposed site use, as the proposed site use tends to result in lower nutrient loading rates than residential use (e.g. light industrial and commercial sites are typically only occupied during business hours, 5 to 6 days a week with water fixtures commonly limited to washrooms and kitchenettes). A recommendation will be provided to assess any atypical waste water loading rates of any unusual commercial and light industrial site uses (for example, process water from manufacturing being directed to septic systems).

Background nitrate concentrations in the overburden were measured in water samples collected from test pits 11-4, 11-12 and 11-5. The nitrate concentrations were 0.86, 0.28 and <0.10 mg/L respectively. The highest overburden nitrate concentration of 0.86 mg/L was measured in test pit 11-4 which is located in the easternmost corner of the subject site. Adjacent land use surrounding the easternmost corner of the subject site is all agricultural land use (refer to aerial photograph provided in Site Plan, Figure 2). It is expected that the low nitrate concentration detected at this location is due to adjacent land use impacts. The source of the trace nitrate concentration measured in test pit 11-12 is possibly a result of historical use of the site as a cow pasture.

Background nitrate concentrations measured in the bedrock water samples from the test wells ranged from <0.10 to 2.78 mg/L. The maximum observed nitrate concentration of 2.78 mg/L was in the three (3) hour water sample from test well TW2. The nitrate concentration in the six (6) hour water sample from test well TW2 was reduced to <0.10 mg/L. Therefore, the measured

concentration of 2.78 mg/L in TW2 is not considered to be representative of the background nitrate concentrations available in the water supply at the subject site. The observed nitrate concentrations in TW1 were below the method of detection for the laboratory and are not of concern. The concentration of nitrates in test well TW3 ranged from 0.46 to 0.67 mg/L. The lowest concentration (0.46 mg/L) was observed at the end of the pumping test (six hour sample). The range of nitrate concentrations observed in test well TW3 is attributed to agricultural land use to the south and east of the subject site. Due to the long term agricultural use of the adjacent properties (since at least 1976 based on available aerial photographs), the current observed concentration is assumed to represent the steady state long term impact on the proposed water supply aquifer from adjacent agricultural land use. The background nitrate concentrations in the bedrock aquifer are not considered to be indicative of sensitive site conditions and, therefore, are not of concern.

3.0 GROUNDWATER SUPPLY INVESTIGATION

3.1 Field Procedures

A field investigation was carried out in accordance with the MOE August 1996 document "Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment" to determine the quantity and quality of groundwater available for domestic water supply. The MOE Procedure D-5-5 document indicates that a minimum of three (3) test wells are required for sites up to 15 hectares.

Three (3) new test wells (Test Wells TW1 to TW3) were drilled by Saunders Well Drilling under Well Contractor License No. 4879. The wells were completed between June 5 and 13, 2013. Copies of the MOE Water Well Records and the Certificates of Well Compliance (Well Grouting Inspections) are provided in Appendix D.

The locations of the test wells are shown on Figure 2. The locations of the new test wells were chosen to provide maximum coverage of the site and with the intent for future use as water supply wells on individual lots. MOE Water Well Records for the test wells are provided in Appendix D and the geographical references for the test wells are provided in the respective MOE Water Well Records.

3.1.1 Test Well Construction

Well grouting inspections were carried out by HCEL staff during the sealing of the well casings in the test wells. HCEL staff were not present for the remainder of the drilling of test wells.

Based on the well records provided by the well driller, the test wells were completed with 10.7 metre (34 feet) to 16.3 metre (53.5 feet) of steel casings. The depths of the test wells ranged from 48.5 to 78.6 metres below ground surface. The test wells were constructed using a nominal 159 millimetre inside diameter steel casing. The construction details of the test wells are summarized in the following table:

Test Well	Depth to Bedrock (m BGS)	Depth of Casing (m BGS)	Depth Water Found (m BGS)	Total Well Depth (m BGS)
TW1	14.8	16.3	42.7	48.8

Test Well	Depth to Bedrock (m BGS)	Depth of Casing (m BGS)	Depth Water Found (m BGS)	Total Well Depth (m BGS)
TW2	11.0	12.5	44.8	48.5
TW3	2.3	10.7	48.8 / 70.1	78.6

It should be noted that efforts were made to limit the total well depth to less than 61 metres (200 feet) due to concerns with heavy mineralization water at deep depths in the area. Test well TW1 was hydrofractured by the well driller to increase the well yield for the purposes of the hydrogeological investigation. Test well TW2 did not require any activity to increase the flow rate of the well. Test well TW3 was initially completed to a depth of approximately 50 metres and hydrofractured, however, the well driller determined that the well yield was insufficient for the purpose of inclusion in the hydrogeological investigation. The test well was subsequently deepened to 78.6 metres below ground surface and the lower portion (newly drilled/deepened section) was also hydrofractured to obtain the necessary well yield for inclusion in the hydrogeological investigation.

Additionally, it is noted that the reported depth to bedrock reported for test wells TW1 and TW2 are significantly deeper than the average depth to refusal reported in the test pits. The reported refusal depths for test pits may be due to refusal on boulders within the overburden. It is noted that the depth to bedrock reported for test well TW3 is more in line with the results of the test pits.

3.1.2 Pumping Tests

The pumping tests for the onsite test wells were conducted between June 18 and 20, 2013. A six (6) hour duration constant discharge rate pumping test was conducted in each test well. During the pumping tests, water level measurements were taken at regular intervals in the well being pumped using an electric water level tape and on a continuous basis using electronic data loggers. After the pump was shut off, water level data were measured in wells TW1 and TW2 until approximately 90 percent of the drawdown in water level had recovered. During the recovery of well TW3 the water level tape got stuck around the pump TW3 and only 61 percent of the recovered was captured for that well. Data from the electronic data loggers were

corrupted after the test when a computer hard drive crashed, thus only the manual water readings were considered for this analysis.

Specific details of the pumping test carried out on each test well are presented in Section 3.3. The water level measurements for the drawdown and recovery data for the pumping tests are provided in Appendix E.

Water level measurements were also taken from other onsite test wells (observation wells) during the pumping of test wells to determine potential interference effects between the test wells during pumping. Water level measurements taken in the observation wells are provided in Appendix F.

3.1.3 Water Sampling

Groundwater samples were collected from the test wells after three hours of pumping and again in the last hour of the pump tests (six hours) to characterize groundwater quality. Total chlorine tests were performed to ensure that chlorine levels were at 0.0 mg/L prior to sampling for bacteriological testing. The temperature, conductivity, total dissolved solids, pH, turbidity and total chlorine levels of the groundwater were measured at periodic intervals during the pumping tests and are summarized in Table 1.

The groundwater samples were collected and prepared/preserved in the field using established sampling protocols and submitted to Exova Canada Inc. (Exova) in Ottawa, Ontario for chemical, physical and bacteriological analyses as listed in the MOE guideline titled "Technical Guideline for Private Wells: Water Supply Assessment", dated August 1996. The results of the laboratory analyses are summarized in Table 2 and the laboratory certificates of analysis are provided in Appendix G. Additional testing of test wells TW1 and TW2 due to bacteriological exceedances are summarized in Tables 3 and 4 and the laboratory Certificates of Analysis are presented in Appendix H.

A supplemental water sample collected after six (6) hours of pumping from test well TW3 was submitted for analysis of herbicides/pesticides, petroleum hydrocarbons (PHC's) and volatile organic compounds (VOC's) due to historical agricultural land use. The results of this testing are provided in Table 5. The laboratory certificate of analysis for the supplementary sampling from test well TW3 is provided in Appendix I.

Water samples were collected from two (2) nearby private wells located on private lots adjacent to the subject site to characterize groundwater quality at established wells in nearby developments. The approximate locations of the private wells are provided on Figure 4, Private Well Location Plan. The groundwater samples were collected and prepared/preserved using established sampling protocols and submitted to Exova for chemical, physical and bacteriological analyses as listed in the MOE guideline titled "Technical Guideline for Private Wells: Water Supply Assessment", dated August 1996. The total chlorine levels of the groundwater were measured in the field and are summarized in Table 6. The results of the laboratory analyses are summarized in Table 7 and the laboratory certificates of analysis are provided in Appendix J.

3.2 Water Quality

3.2.1 General

The results of the chemical, physical and bacteriological analyses on the water samples from the test wells are summarized in Table 2. The water quality at the site is considered safe for consumption based on no health related exceedances detected in the final water samples from the onsite test wells. Some treatment, such as conventional water softeners, may be desired by business owners to reduce aesthetic objective and operational guideline related exceedances.

Initial exceedances of bacteriological parameters were identified in samples from test wells TW1 and TW2 but retest samples on July 22, 2013 (TW2) and August 19, 2013 (TW1) (refer to Tables 3 and 4) met all the applicable bacteriological maximum acceptable concentrations of the ODWS. Laboratory Certificates of Analysis for the retesting of the test wells can be found in Appendix H.

The results of the chemical, physical and bacteriological analyses on the water samples from the private offsite wells are summarized in Table 7. The water quality from private offsite wells in the vicinity of the site is considered safe for consumption based on no health related exceedances detected in the water samples from the offsite private wells.

3.2.2 Health Related Parameters - Onsite Test Wells

No health related exceedances of chemical parameters were encountered in any of the water samples collected from the onsite test wells. Total coliform bacteria exceeded the ODWS

maximum acceptable concentration in test wells TW1 and TW2 for the water samples collected during the six (6) hour pumping tests.

Due to the bacteriological exceedances in test wells TW1 and TW2, corrective actions were carried out on test wells TW1 and TW2 by the well driller to address the bacteriological exceedances. The corrective actions and subsequent resampling of the test wells are summarized in the following sections.

TW1 Corrective Actions

The following corrective actions for test well TW1 were carried out following the detection of a total coliform exceedance in the June 18, 2013 sample:

- The test well TW1 was chlorinated by the water well driller. The quantity and concentration of chlorine used by the well driller was not reported to us;
- After a minimum of 24 hours of contact time, TW1 was developed by the well driller until the odour of chlorine was non-detectable. The flow rate and duration of pumping were not reported to us;
- HCEL sampled the discharge hose of test well TW1 on August 19, 2013. The total chlorine concentration was confirmed by HCEL staff to be non-detectable as indicated by three (3) consecutive chlorine measurements taken approximately fifteen (15) minutes apart using a HACH Total Chlorine test kit (model CN-66T), and;
- Two (2) water samples were collected in laboratory supplied bottles by HCEL approximately fifteen (15) minutes apart and submitted to Exova for analysis of bacteriological parameters on August 19, 2013.

The results of the re-sampling for bacteriological parameters on August 19, 2013 of test well TW1 indicated that total coliform bacteria concentrations had been reduced to 0 ct/100 mL in both of the retest samples. In addition, the concentrations of E. coli., faecal streptococcus and faecal coliform bacteria were non-detectable. Low concentrations of Heterotrophic Plate Count (HPC) bacteria were detected; however, these are not considered to be a problem from a water quality perspective (HPC bacteria are commonly detected in water supply wells). Based on the absence of total coliform bacteria in the retest samples taken on August 19, 2013 from test well TW1, no further corrective actions for test well TW1 are required and the water is considered to be suitable for consumption.

TW2 Corrective Actions

The following corrective actions for test well TW2 were carried out following the detection of a total coliform exceedance in the June 19, 2013 sample:

- The test well TW2 was chlorinated by the water well driller. The quantity and concentration of chlorine used by the well driller was not reported to us;
- After a minimum of 24 hours of contact time, TW2 was developed by the well driller until the odour of chlorine was non-detectable. The flow rate and duration of pumping were not reported to us;
- HCEL sampled the discharge hose of test well TW2 on July 22, 2013. The total chlorine concentration was confirmed by HCEL staff to be non-detectable as indicated by three (3) consecutive chlorine measurements taken approximately fifteen (15) minutes apart using a HACH Total Chlorine test kit (model CN-66T), and;
- Two (2) water samples were collected in laboratory supplied bottles by HCEL approximately fifteen (15) minutes apart and submitted to Exova for analysis of bacteriological parameters on July 22, 2013.

The results of the re-sampling for bacteriological parameters on July 22, 2013 of test well TW2 indicated that total coliform bacteria concentrations had been reduced to 0 ct/100 mL in both of the retest samples. In addition, the concentrations of E. coli. and faecal coliform bacteria were non-detectable. Low concentrations of Heterotrophic Plate Count (HPC) bacteria and a single isolated faecal streptococcus bacteria were detected in the first retest sample; however, both types of bacteria were determined to be non-detectable in the second retest sample. The occurrence of the single isolated faecal streptococcus bacteria in the one sample is not considered to be representative of the water supply aquifer and does not exceed any health related limits of the ODWS. Based on the absence of total coliform bacteria in the retest samples taken on July 22, 2013 from test well TW2, no further corrective actions for test well TW2 are required and the water is considered to be suitable for consumption.

No health related exceedances of the ODWS were noted for any of the chemical parameters tested during the investigation. Based on the bacteriological retesting of test wells TW1 and TW2 and the initial bacteriological testing of TW3, the proposed bedrock water supply aquifer is suitable for consumption.

3.2.3 Aesthetic Objectives and Operational Guidelines - Onsite Test Wells

Aesthetic and operational related exceedances of the Ontario Drinking Water Standards (ODWS) were limited to hardness (all wells), turbidity (TW1 and TW2 3 hour sample only), hydrogen sulphide (TW1 and TW 2), iron (TW2 3 hour sample only), and organic nitrogen (TW3 6 hour sample only). These exceedances are discussed in the following sections:

Hardness

The concentrations of hardness in water samples obtained from all three (3) test wells ranged from 184 to 263 mg/L as $CaCO_3$, which exceed the operational guideline of 80 to 100 mg/L of $CaCO_3$ as specified in the ODWS.

Water having a hardness above 80 to 100 mg/L as $CaCO_3$ is often softened for domestic use. The MOE Procedure D-5-5 document states that water having a hardness value of greater than 300 mg/L is considered "very hard". The Ontario Ministry of the Environment publication entitled "Ontario Drinking Water Objectives", states that water with hardness in excess of 500 mg/L is considered to be unacceptable for most domestic purposes.

The concentrations of hardness in all the test wells are within the treatable limits provided in MOE Procedure D-5-5 document using conventional water softeners. Most water supply wells within rural eastern Ontario are equipped with water softeners.

Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water which may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium) could be considered as a means of keeping sodium concentrations in the water at background levels. Consideration could also be given to providing a bypass of the water softener for drinking water purposes.

Turbidity

The laboratory Certificates of Analysis indicate that the levels of turbidity in samples from test well TW1 (both the 3 and 6 hour samples) and the three (3) hour sample from TW2 exceeded the ODWS aesthetic objective. The six (6) hour water sample from test well TW2 was equal to the aesthetic objective of the ODWS and is considered to be acceptable.

Following corrective actions carried out on test well TW1 (to address bacteriological exceedances), a supplemental water sample was collected from test well TW1 on August 19, 2013 and submitted to Exova laboratory for turbidity analysis. The result of the turbidity analysis on the supplemental water sample collected from TW1 was 0.7 NTU (refer to the laboratory Certificate of Analysis is presented in Appendix H). Based on the August 19, 2013 water sample from TW1, the turbidity is considered to be acceptable.

The levels of turbidity measured in the field during the pumping tests (refer to Table 1) for these test wells was noted to decrease significantly during the six (6) pump test and levels will likely further decline with well use. It is noted that the field testing of turbidity for test well TW2 at six (6) hours showed an increase in turbidity after six (6) hours of pumping (refer to Table 1). However, this was not correlated with an increase in turbidity in the laboratory results for the six (6) hour water sample. The discrepancy between the field reading and the laboratory level for turbidity is unknown; however, it is our opinion that the turbidity measured by the laboratory is representative of the groundwater quality from the test well (based on the decreasing trend in turbidity concentrations in the field and laboratory results). Therefore, it is our opinion that the six (6) hour field measurement of turbidity for test well TW2 is an anomaly and the turbidity in all of the test wells on the site meets the aesthetic objective of the ODWS.

Hydrogen Sulphide

The concentration of hydrogen sulphide in test wells TW1 and TW2 exceeded the Ontario Drinking Water Standards (ODWS) aesthetic objective of 0.05 mg/L. The concentration of hydrogen sulphide in test well TW1 ranged from 0.23 to 0.75 mg/L and both samples from TW2 contained a hydrogen sulphide concentration of 0.11 mg/L.

Elevated concentrations of hydrogen sulphide are typically characterized by an unpleasant odour (rotten egg smell) and, when in present in association with iron, can produce black stains on laundered items and black deposits on pipes and fixtures.

The Ministry of Environment document entitled "Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines" indicates that low levels of hydrogen sulphide can be removed effectively from most well water by aeration. Hydrogen sulphide can also be effectively treated through the use of activated charcoal filters, chlorination, manganese greensand filters and other forms of oxidizing treatment. Due to the possible occurrence of both

hydrogen sulphide and organic nitrogen exceedances in future wells on the subject site, it is recommended that chlorination for treatment of hydrogen sulphide not be considered for the subject site. Based on the measured levels of hydrogen sulphide in TW1 and TW2, it is our opinion that the measured concentrations on the subject site are reasonably treatable using aeration and are not of concern.

Iron

The iron concentration was 0.58 mg/L in water sample (3 hour sample only) collected from test wells TW2. The iron concentration in the test well is above the aesthetic objective of 0.30 mg/L listed by the ODWS. The MOE Procedure D-5-5 document indicates that iron concentrations up to 5.0 mg/L are considered treatable by conventional water softeners. The iron concentration in the six (6) hour water sample from this well was below the ODWS aesthetic objective. The iron concentration in all of the test wells is well below the aesthetic objective of the ODWS and/or the treatable limit for water softeners provided by MOE Procedure D-5-5 and is not of concern.

Organic Nitrogen

The operational guideline (OG) for organic nitrogen was exceeded in the six (6) hour water sample collected from TW3. The concentration was 0.18 mg/L, compared to a guideline value of 0.15 mg/L. Organic nitrogen is calculated as the difference between the total Kjeldahl nitrogen and the ammonia nitrogen. Organic nitrogen compounds may react with chlorine and severely reduce its disinfectant power. Taste and odour problems are common with organic nitrogen levels greater than 0.15 mg/L. The operational guideline limit exceedance in test well TW3 for organic nitrogen is not considered to be a significant and does not preclude the proposed development of the subject site.

It is noted that chlorine disinfection is not required for the water supply aquifer at the subject site because all of the final bacteriological test results met the ODWS for bacteriological parameters. It is noted that other test wells on the subject site showed low levels of hydrogen sulphide which, if desired, can be treated with an oxidizing process, such as aeration or addition of hydrogen peroxide or chlorine. Due to the possible occurrence of both hydrogen sulphide and organic nitrogen exceedances in future wells on the subject site, it is recommended that chlorination for treatment of hydrogen sulphide not be considered for the subject site.

It is our opinion that the water quality available from the onsite test wells is representative of the water quality that new drinking water wells may encounter at the subject site and that the water available at the subject site is generally expected to meet the Ontario Drinking Water Standards and Procedure D-5-5, with the exception of the previously noted exceedances.

3.2.4 Additional Analytical Testing

To test for impacts of historical land use on the subject site (agricultural land use) and in the surrounding areas, additional water testing was carried out on test well TW3 after six (6) hours of pumping. The additional water samples were collected and submitted to Exova Ottawa laboratory for analysis of Herbicides, Pesticides, Petroleum Hydrocarbons (PHC's) and Volatile Organic Compounds (VOC's). The results of the additional water testing are summarized in Table 5 and the laboratory Certificates of Analysis are presented in Appendix I.

The results of the additional water testing indicate that the concentrations of herbicides, pesticides, PHC's and VOC's were all below the method of detection of the laboratory. No impacts from the historical land use on the subject site were detected in the additional analytical testing.

3.2.5 Private Offsite Wells

Water samples were collected on September 11, 2013 from two (2) private offsite wells in the vicinity of the subject site. The approximate locations of the private wells are indicated on the Private Well Location Plan, Figure 4. Both private wells serviced commercial/institutional buildings.

Interviews were conducted with building occupants at the time of sampling to obtain information regarding the well construction and the occupants perception of water quality and water quantity.

The results of total chlorine water testing carried out at the time of sampling of the private wells are provided in Table 6. The analytical results from the private wells are summarized in Table 7. Copies of the laboratory certificates of analysis for the private well sampling are provided in Appendix J.

None of the private well samples contained any health related exceedances of the ODWS. Operational guideline exceedances for hardness were noted for both of the private wells. The aesthetic objectives for total dissolved solids was exceeded in private well PW2. No other exceedances of the ODWS were noted for the private wells.

It is noted that the level of nitrate in private well PW2 was elevated at a concentration of about 9.6 mg/L and close to the maximum acceptable concentration for nitrates provided in the ODWS. A water well record was not available for PW2; however, it was noted that the building serviced by this well was likely an old farmhouse and the well was likely installed without proper well construction and grouting methods. The well may be exhibiting impacts from the onsite septic system or adjacent agricultural land use due to its construction. The owner of the private well has been notified of the elevated nitrate level and it was recommended that they investigate the source of nitrates, as it is beyond the scope of this hydrogeological investigation to determine the source of the elevated nitrates in the private offsite well. None of the test wells on the subject site or the other private well showed nitrate concentrations in this range and it is our opinion that the nitrate level in this private well is not representative of the water supply aquifer proposed for the subject site.

Hardness

The level of hardness in the water samples from the two (2) of the private wells ranged from 220 mg/L as $CaCO_3$ to 252 mg/L as $CaCO_3$, and exceeded the operational guideline for hardness of 80 to 100 mg/L of $CaCO_3$ as specified in the ODWS.

Water having a hardness above 80 to 100 mg/L as $CaCO_3$ is often softened for domestic use. The MOE Procedure D-5-5 document states that water having a hardness value more than 300 mg/l is considered "very hard" and the ODWS states that waters with hardness in excess of 500 mg/l is considered to be unacceptable for most domestic purposes. There is no upper treatable limit for hardness using a conventional water softener.

Water softening by conventional sodium ion exchange water softeners that use sodium chloride may introduce relatively high concentrations of sodium into the drinking water, which may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium) could be considered as a

means of keeping sodium concentrations in the water to a minimum. Consideration could also be given to providing a bypass of the water softener for drinking water purposes.

Total Dissolved Solids

The level of TDS in the water sample from private well PW2 was 647 mg/L which is above the ODWS aesthetic objective of 500 milligrams per litre. As per Table 3 in the Appendix of the MOE Guideline D-5-5, rationale must be provided that corrosion, encrustation or taste problems will not occur when there are exceedances of the ODWS for TDS.

To determine the corrosive nature of the groundwater, the Langelier Index (LI) was calculated for the sample obtained from the PW2. These values are based on the TDS, temperature, pH, alkalinity (as $CaCO_3$), and calcium in the sample. A copy of the calculation to determine the LI value is provided in Appendix J. The LI was calculated for a the range of temperatures between 6 and 12 degrees Celsius to assess the impact of temperature on the LI.

The LI was calculated to range from 0.28 to 0.37 for temperatures ranging from 6 to 12 degrees Celsius in private well PW2. Available information indicates that the desired range of LI to prevent corrosion and scaling between -0.5 and 0.5. Based on the range of LI values for the sample from this well, the groundwater from the private well is within the desired range; therefore, the degree of corrosion and scaling of plumbing should be acceptable. Based on our experience of conducting interviews at sites with TDS levels of less than 1,000 mg/L, no taste problems are expected. However, it is noted that taste preferences can be subjective and differ from individual to individual.

Resident Interviews

Interviews regarding well construction details and the occupants' perception of the quality and quantity of well water were carried out during the water sampling at the offsite locations. The results of the interviews are summarized in the following table:

Private Well ID	Private Well Homeowner Interview Comments
PW1	• Well was drilled on May 22, 1985 by Valley Drilling Ltd. and is 38.1 metres in depth; • Occasional sulphur smell; • No water treatment; • No water quantity issues reported; • No septic system problems were reported.
PW2	• No information about the well; • Water is not used for drinking (bottled water is provided by building owner); • Brown color when tap hasn't been used in a while; • No water treatment; • No water quantity issues were reported; • No septic system problems were reported.

Based on the results of the interviews carried out with the building occupants, the wells were reported to have no issues with respect to water quantity. Reported water quality issues were limited to occasional sulphur smell (one private wells) and brown water colour when not used for an extended period (one private well).

Based on the results of the offsite private wells, the water quality in the vicinity of the subject site is considered to be acceptable and no significant exceedances of the ODWS were identified.

3.2.6 Comparison between Onsite Test Wells and Private Wells

The following summary table provides a list of all aesthetic objective (AO) and operational guideline (OG) exceedances for both the onsite test wells and the private wells sampled during the course of this investigation:

Onsite Test Wells AO and OG Exceedances	Offsite Private Wells AO and OG Exceedances
Hardness	Hardness
Turbidity	-
Hydrogen Sulphide	-
Iron	-
Organic Nitrogen	-
-	Total Dissolved Solids

Both the onsite test wells and the offsite private wells had exceedances for hardness. The onsite test wells encountered exceedances for turbidity, hydrogen sulphide (test wells), iron (one test well only) and organic nitrogen (one test well only). The offsite private wells encountered exceedances of total dissolved solids (one private well only).

Based on the onsite and offsite water sample results and interviews with adjacent homeowners, water quality on the site appears to be from a different water bearing zone than offsite private well PW2, as evidenced by the elevated TDS and nitrate levels in the well. However, the occurrences of aesthetic objective and operational guideline exceedances may vary from well to well.

3.3 Water Quantity

Pumping tests were carried out on onsite test wells to determine the characteristics of the water supply aquifer. Water level measurements were taken using an electronic water level tape and electronic data loggers in the test well being pumped during the pumping and recovery portions of the pumping test; however, the electronic data logger data was not available for analysis and, as such, the electronic water level tape data was used for analysis of the pumping tests.

The drawdown and recovery data and graphs for the water levels in the test wells during pumping are provided in Appendix E. The drawdown data contained in Appendix E was measured with reference to the top of the well casings.

Please note that the discharge rate on the drawdown data and graph sheets for the pumping tests are listed as variable because the recovery period, where the discharge rate is zero, is included in the same data set as the drawdown data. However, the actual discharge rate during the pumping of the test wells was at a constant rate.

The specific details of the pumping tests carried out on the test wells are provided in the following table. All depths provided are in metres below ground surface (m BGS):

Parameter	TW1	TW2	TW3
Duration (minutes)	360	360	360

Parameter	TW1	TW2	TW3
Flow Rate (L/min)	18.9	30.3	22.7
Static Water Level (m BGS)	3.77	1.66	2.03
Well Depth (m BGS)	48.8	48.5	78.6
Available Drawdown (m)	45.0	46.8	76.6
Water Level at End of Pumping (m BGS)	42.12	8.13	16.84
Observed Drawdown at End of Pumping (m)	38.4	6.5	14.8
Drawdown Utilized (%)	85.3%	13.9 %	19.3 %
Specific Capacity (m^3/day•m)	0.708	6.7	2.2
Percent Recovery (18 hour)	100%	>98%	100%

As per MOE Procedure D-5-5, each of the test wells was pumped at a flow rate greater than 18.8 litres per minute over a minimum of 6 hours. The maximum drawdown observed at the end of pumping was 38.4 metres in test well TW1 which is equivalent to approximately 85.3 percent of the available drawdown in the test well. The drawdown utilized in the remaining test wells ranged from 13.9 to 19.3 percent. Based on these results, all of the onsite test wells are capable of supplying water at a rate greater than 18.8 litres per minute for a period greater than six (6) hours. This is considered sufficient for typical commercial use.

All three (3) of the test wells achieved greater than 98 percent recovery within about 18 hours after pumping ceased. Therefore, no concerns were identified with the 24 hour pumping/recovery cycles and the test well yields should be capable of meeting the peak demand of the proposed development.

Based on the results of the pump test drawdown and recovery data for the pumping test on each test well, the transmissivity was analyzed based on the Theis and Hantush methods using Aquifer Test Pro 4.0, a commercially available software program from Waterloo Hydrogeologic Inc. The results of the Aquifer Test Pro 4.0 analysis are provided in Appendix L. The results of the analysis are summarized in the following table:

Data Source	Transmissivity (m^2/day)		
	Theis Analysis		Hantush Analysis
	Drawdown	Recovery	Drawdown
TW1	0.196	0.238	0.166
TW2	4.73	2.59	1.68
TW3	0.869	0.825	0.491
Geometric Mean	0.84		

Note:
The geometric mean was calculated for the transmissivity values determined for the onsite test wells. The geometric mean, which is representative of a log-normal distribution, was calculated to provide a conservative interpretation of the transmissivity.

The shape of the drawdown curve for test wells generally matched the theoretical shape of the Hantush and Theis curves.

Based on the flow rates during the pumping tests (minimum of 18.9 litres per minute), the duration of the pumping tests (6 hours) and the drawdown observed in the water wells (maximum of 38 metres drawdown after 6 hours of pumping), there is more than sufficient quantities of water available in the local bedrock aquifer at the subject site for the proposed commercial/industrial development of the property. No concerns were identified for the long-term safe yield of the water supply aquifer.

3.4 Hydraulic Interference Effects

During the pumping of the onsite test wells, water level measurements were generally taken at one (1) hour intervals in the two (2) test wells that were not being pumped (observation wells). The water level measurements in observation wells, the radial distances between the pumping and observation wells and the pumping rates are provided in Appendix F.

The results of the water level measurements made at the bedrock observation wells during the pumping tests indicate that the drawdown in the observation wells was zero or levels slightly increased; the maximum increase was -0.02 metres (rise in water level). The radial distances between the observation wells and the pumping wells ranged from about 218 metres to 430 metres.

Based on the absence of any hydraulic interference effects during the pumping of the test wells on the other onsite test wells, any potential interference with on-site or off-site water wells is expected to be acceptable.

3.5 Interpreted Horizontal Groundwater Flow Directions

The horizontal groundwater flow directions in the bedrock aquifer were determined from the static water levels in the onsite test wells and the respective top of casing elevations for these locations. The water level measurements, top of casing elevations and the calculated water elevations for the test wells are provided in Table 8 following the text of this report. The interpreted horizontal groundwater flow direction for the bedrock aquifer is shown on Figure 5 - Interpreted Groundwater Flow Direction.

The groundwater flow direction in the bedrock is interpreted to flow northward across the site based on the water level measurements obtained on June 18, 2013.

3.6 Local Hydrogeology

A site cross-section was prepared based on the three (3) onsite test wells. Ground surface elevations for each of the test wells were measured by Houle Chevrier Engineering Ltd. The elevations are referenced to geodetic datum. The cross-section for the northeast-southwest direction (cross section A-A') is shown in Figure 6 - Interpreted Subsurface Section. The alignment of the cross section is shown on Figure 2 - Site Plan.

The cross-section, based on the onsite test wells, indicates that the depth of overburden ranges from about 2.3 to 14.8 metres and the bedrock surface elevations range from about 101.2 to 116.5 metres Above Mean Sea Level (AMSL). The test well casing depth elevations range from 99.6 to 108.4 metres AMSL and water bearing zones (depth water found) elevations ranges from 40.1 to 73.3 metres AMSL. The elevations of the bottom of the test wells ranged from 42.1 to 67.8 metres AMSL.

3.7 Ontario Ministry of Environment Water Well Records

The MOE Water Well Records for a 1.0 kilometre radius surrounding the centre of the subject site were obtained to determine the characteristics of existing private wells in the vicinity of the subject site. A total of sixty seven (67) well records were obtained and these records are

provided in Appendix M. Six (6) well records were for wells completed in the overburden; all of the remaining well records were for drilled wells completed in the bedrock.

A total of three (3) wells were excluded from the analysis due to incomplete information provided in the well record summary sheets.

The following table provides a summary of the well characteristics for the remaining sixty seven (67) water well records for depth to water found, static water levels, depth to bedrock and total well depth:

Parameter	10th Percentile	90th Percentile	Average / Geometric Mean
Depth Water Found (m)	18.3	68.6	39.8 / 32.8
Static Water Level (m)	1.9	7.9	5.4 / 4.6
Depth to Bedrock (m)	1.2	35.3	10.8 / 5.5
Total Well Depth (m)	24.3	74.4	48.6 / 43.8

The MOE Water Well Records for a 1.0 kilometre radius around the subject site indicate that water in existing private wells was encountered at shallower depths compared to that of the onsite test wells (i.e. geometric average of 32.8 metres below ground surface for the offsite private well records and geometric average of 53.5 metres below ground surface for the onsite test wells). This indicates that the majority of nearby private wells likely utilize more a shallow water bearing zone than the onsite test wells.

The MOE Water Well Records indicate that the existing private wells have shallower well completion depths than the onsite test wells (i.e. geometric average of 43.8 metres below ground surface for the offsite private well records and geometric average of 57.1 metres below ground surface for the onsite test wells). Again, this supports the assumption that nearby shallow wells utilize a more shallow water bearing zone than the onsite test wells. This could be due to the longer well casing length (10 metres minimum) selected for the test wells at this site. Somewhat longer casings would cut off shallow aquifer zones.

The depth to bedrock in existing private wells is slightly less that the depth to bedrock of the onsite test wells (i.e. geometric average of 5.5 metres below ground surface for the offsite well records and geometric average of 7.2 metres below ground surface for the onsite test wells).

4.0 GEOTECHNICAL CONSIDERATIONS

4.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the test pit information and the project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous uses or activities of this site or adjacent properties, and/or resulting from the introduction onto the site from materials from offsite sources are outside the terms of reference for this report and have not been investigated or addressed.

4.2 Commercial Buildings

4.2.1 Foundation Design

Based on the available test pit information, the subsurface conditions in the area of the proposed commercial/industrial development consist primarily of topsoil overlying deposits of silty sand, sand, silty clay, clayey silt, silt and glacial till, followed by bedrock.

Spread footings for the proposed buildings will likely be founded on or within native overburden deposits or bedrock. All topsoil, fill and disturbed material should be removed from the building footprint to expose native, undisturbed deposits or bedrock. No unusual constraints are expected in founding the proposed buildings on or within the native overburden deposits above the groundwater level. Excavation below the groundwater level within the sandy silt, silty sand, sand, sand and glacial till could result in disturbance to the subgrade surface. Groundwater lowering in advance of excavation using wells and/or well points will be required to prevent disturbance due to excavation below the groundwater level within the sandy silt, silty sand and sand. If the sandy silt, silty sand, sand, silty clay, clayey silt, silt and glacial till at founding level

become disturbed, it is recommended that the disturbed material be removed. If necessary, the grade could then be raised with engineered fill material, as discussed below.

The following allowable bearing pressure values may be used to size the spread footings for the structures

Subgrade Type	Preliminary Net Geotechnical Reaction at Serviceability Limit State (kilopascals)	Preliminary Factored Net Geotechnical Reaction at Ultimate Limit State (kilopascals)
Sand (above the groundwater table)	100	250
Silty Sand (above the groundwater level)	100	250
Silty Clay (above the groundwater level)	100	250
Glacial Till (above the groundwater level)	120	250
Engineered fill over native soils	150	300
Engineered fill over sound bedrock	300	1,000
Sound bedrock	Not Applicable	3,000

To reduce the potential for groundwater inflow into the basement sump pits (if applicable) in the long term, it is suggested that the spread footings for the proposed buildings be founded at least 0.15 metres above the seasonally high groundwater level.

Since raised septic leaching beds will likely be required over portions of the subject site, it is expected that the finished grade will be raised in some of the lots. In any areas where the proposed founding level is above the native soil or bedrock, imported granular material (engineered fill) should be used. The engineered fill should consist of granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular A or Granular B Type II engineered fill and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. To allow the spread of load beneath the footings, the engineered fill should extend horizontally a minimum of 300 millimetres beyond the edge of the footings and then down and out from this point at a slope of 1 horizontal to 1 vertical, or flatter. The excavations for the buildings should be sized to accommodate this fill placement. A detail showing the engineered fill requirements could be provided at a later date,

if required. Currently, OPSS documents allow recycled asphaltic concrete and Portland cement concrete to be used in Granular A and B Type II materials. Since the source(s) of recycled material cannot be determined and could contain contaminants, it is suggested that any granular materials used below founding level be composed of virgin material only, for environmental reasons.

The test pits completed as part of this investigation were loosely backfilled with the excavated material upon completion. Any test pits within building areas, roadways or parking areas should be subexcavated and backfilled with suitable, compacted material.

All exterior footings for heated buildings should be provided with at least 1.5 metres of earth cover for frost protection purposes. For unheated buildings and isolated piers the required earth cover is 1.8 metres. In areas where the required earth cover for foundations is not practicable, a combination of earth cover and extruded polystyrene insulation could be considered. Further details regarding the insulation of foundations could be provided on a lot by lot basis. The requirement for frost protection of footings which are on bedrock could be waived provided that the bedrock is considered to be non-frost susceptible. This would require inspection of the bedrock by qualified geotechnical personnel. Also, the depth of frost protection may be taken from finished grade to the underside of any engineered fill material used below footings since engineered fill material is considered to be non-frost susceptible.

Based on our experience, the bedrock surfaces may be irregular or stepped. As such, provision should be made for additional formwork and concrete for footings bearing on bedrock surfaces.

Provided that the excavations are above the seasonally high groundwater level, groundwater inflow from the native soils into excavations during construction should be handled by pumping from sumps within the excavations.

4.2.2 Bedrock Excavation

Some bedrock removal is considered possible for the development of this site. Small quantities of bedrock excavation could be carried out using hoe ramming equipment. In areas where the upper portion of the bedrock is weathered, bedrock removal could likely be carried out using large excavation equipment.

4.2.3 Foundation Wall Backfill and Drainage

To avoid frost adhesion and possible heaving, the foundations should be backfilled with imported, free-draining, non-frost susceptible granular material meeting OPSS Granular B Type I or II requirements. In areas where clean sand exist, the sands could be carefully separated, stockpiled, and tested for conformance with Granular B Type I prior to reuse.

Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks or other similar surfaces), the backfill should be placed in maximum 200 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment. Where future landscaped areas will exist next to the proposed structure and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value.

Where areas of hard surfacing (concrete, sidewalk, pavement, etc.) abut the proposed building, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible native materials to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from the bottom of the excavation or 1.5 metres below finished grade, whichever is less, to the underside of the granular base/subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

Perimeter foundation drainage is not considered necessary for slab on grade structures, provided that the floor slab level is above the finished exterior ground surface level.

4.2.4 Slab-on-Grade Support (Heated Areas Only)

To prevent long term settlement of the floor slabs, all fill material, former topsoil, organic, loose, wet or deleterious material should be removed from below the slab on grade.

The grade within the proposed buildings could be raised, where necessary, with granular material meeting OPSS requirements for Granular B Type I or II. The use of Granular B Type II is preferred under wet conditions. The granular base for the proposed slab on grades that support normal live loads should consist of at least 150 millimetres of OPSS Granular A.

OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A material. Since the source of recycled material cannot be determined, it is suggested that any granular materials used beneath the floor slabs be composed of virgin material (100 percent crushed rock) or native pit run material only for environmental reasons.

All imported granular materials placed below the proposed floor slabs should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level.

Where any interior areas of the buildings will be unheated, thermal protection for the subgrade will be required where less than 1.5 metres of non-frost susceptible fill cover will exist below the floor slab. Further details on the insulation requirements could be provided, if necessary.

Proper moisture protection with a vapour retarder should be used for any slab on grade where the floor will be covered by moisture sensitive flooring material or where moisture sensitive equipment, products or environments will exist. The "Guide for Concrete Floor and Slab Construction", ACI 302.1R-04 should be considered for the design and construction of vapour retarders below the floor slab.

4.3 Roadways

4.3.1 Subgrade Preparation

In preparation for roadway construction at this site, all surficial topsoil and any soft, wet or deleterious materials should be removed from the proposed roadways. Any sub-excavated areas could be filled with compacted earth borrow or well shattered and graded rock fill material. Similarly, should it be necessary to raise the roadway grades at this site, material which meets OPSS specifications for Select Subgrade Material, earth borrow or well shattered and graded rock fill material may be used. The Select Subgrade Material or earth borrow should be placed in maximum 300 millimetre thick lifts and compacted to at least 95 percent of the standard Proctor maximum dry density value using vibratory compaction equipment under dry conditions. It is noted, however, that the native deposits of silty clay, sandy silt, silty sand and glacial till and

most of the earth borrow materials in the area are sensitive to changes in moisture content, precipitation and frost heaving. As such, unless the earth material placement is planned during the dry period of the year (June to September), precipitation and/or freezing conditions may restrict or delay adequate compaction of these materials. Depending on the weather conditions, it may be necessary to allow earth fill materials to dry prior to compaction.

Rock fill should be placed in maximum 500 millimetre lifts and suitably compacted either with a large drum roller, the haulage and spreading equipment, or a combination of both. Prior to placing granular material for the roadway, the exposed subgrade should be heavily proof rolled and inspected and approved by geotechnical personnel. Any soft areas evident from the proof rolling should be sub-excavated and replaced with suitable earth borrow or rock fill approved by the geotechnical engineer.

The subgrade should be shaped and crowned to promote drainage of the roadway granular materials.

4.3.2 Pavement Structure

For the roadways within this industrial development, the minimum standard pavement structure should be used:

- 90 millimetres of hot mix asphaltic concrete (40 millimetres of Superpave 12.5, Traffic Level B over 50 millimetres of Superpave 19. Traffic Level B), over
- 150 millimetres of OPSS Granular A base, over
- 450 millimetres of OPSS Granular B Type II (50 or 100 millimetre minus crushed stone)

The above Granular B Type II subbase thickness could be reduced to 150 millimetres in areas where the subgrade material below the pavement consists of at least 0.5 metres of well shattered blast rock, intact bedrock or non-frost susceptible native sand. An assessment of the subgrade conditions could be made by the geotechnical engineer at the time of construction.

If the granular pavement materials are to be used by construction traffic, it may be necessary to increase the thickness of the Granular B Type II, install a woven geotextile separator between the roadway subgrade surface and the granular subbase material, or a combination of both, to

prevent pumping, contamination and disturbance to the subbase material. The contractor should be made responsible for construction access roadways.

The above pavement structure assumes that the fill materials are adequately compacted and that the roadway subgrade surface is prepared as described in this report. If the roadway subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thickness given above may not be adequate and it may be necessary to increase the thickness of the OPSS Granular B Type II subbase and/or to incorporate a woven geotextile separator between the roadway subgrade surface and the granular subbase material. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

4.3.3 Granular Material Placement

The pavement granular materials should be compacted in maximum 300 millimetre thick lifts to at least 98 percent of standard Proctor maximum dry density using suitable vibratory compaction equipment.

4.3.4 Transition Treatments

In areas where the new pavement structure will abut existing pavements, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter, to match the depths of the granular material(s) exposed in the existing pavement.

4.3.5 Pavement Drainage

The subgrade surface should be shaped and crowned to promote drainage of the roadway granular materials.

In order to provide drainage of the granular subbase, the granular materials should extend to the roadside ditches. The bottom of the ditches should be at least 0.3 metres below the bottom of the OPSS Granular B Type II Subbase material.

4.4 Construction Induced Vibration

Some of the construction operations (such as granular material compaction, bedrock excavation, etc.) will cause ground vibration on the site. The vibrations will attenuate with

distance from the source but may be felt at nearby structures. It is suggested therefore that the construction operations be planned to avoid any adverse effects of such vibrations on freshly placed (uncured) concrete and on existing dwellings.

4.5 Construction Considerations and Observations

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed development do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design.

The native soils at this site are sensitive to construction operations, ponded water and frost. The construction operations should, therefore, be carried out in a manner that will prevent disturbance of the subgrade surfaces.

Detailed investigations should be carried out for the structures and septic systems. The seismic Site Class and potential for liquefaction should be assessed on a lot by lot basis. All footing surfaces for the structures should be inspected by geotechnical personnel to ensure that a suitable subgrade has been reached and properly prepared. The subgrade surface for the roadway should also be inspected by geotechnical personnel. The placing and compaction of granular materials beneath the foundations and for the roadway subbase and base layers should be inspected to ensure that the materials used conform to the grading and compaction specifications.

5.0 CONCLUSIONS

The subject site is considered suitable for development based on the results of the hydrogeological assessment and terrain analysis. The quality and quantity of groundwater is sufficient to service commercial and/or industrial buildings based on the proposed development. The following provides conclusions regarding septic systems, soil types, water quality and quantity and impacts on the receiving and supply aquifers.

Some minor aesthetic and operational guideline exceedances were encountered in the test wells drilled at the subject site. A hardness exceedance was also observed in water samples collected from nearby private wells. Groundwater in the vicinity of the subject site is generally described as being hard. Some treatment, such as conventional softeners, may be desired by owners to reduce operational related exceedances due to hardness. The levels of iron encountered in the onsite test wells are considered to be reasonably treatable using a conventional water softener. Additional treatment, such as aeration may be required to treat minor aesthetic exceedances hydrogen sulphide. Based on sampling of nearby private wells, it is also possible that aesthetic exceedances of total dissolved solids may be encountered in wells drilled on the subject site.

No exceedances of the Ontario Drinking Water Standards (ODWS) health related criteria for bacteriological parameters were noted during the pumping tests of test well TW3 and for test wells TW1 and TW2 following corrective actions. No bacteriological exceedances of the ODWS were noted for nearby private wells. In addition, indicator species of bacteria such as faecal coliform and faecal streptococcus bacteria were determined to be absent in the final water samples for the onsite test wells and offsite private wells.

The pump tests indicated that the onsite test wells are capable of sustaining short term yields greater than 18.9 litres per minute while causing negligible effects on the observation wells utilized in the investigation.

The site is suitable for onsite sewage disposal using conventional and/or tertiary treatment septic disposal systems. The overburden across the site generally consists predominantly of sand, silty sand, sandy silt, silty clay and glacial till. In some areas, a compacted clay seal may be required above shallow depth bedrock and imported sand fill may need to be placed to meet

the minimum design requirements for onsite septic systems. The proposed lot sizes (i.e. minimum 0.7 hectares) are considered to be acceptable based on the nitrate dilution calculation.

Spread footings for the proposed buildings will likely be founded on or within native overburden deposits or bedrock. No unusual constraints are expected in founding the proposed buildings on or within the native overburden deposits above the groundwater table. The bearing pressures for sizing spread footing foundations at this site are similar to those used at other sites in the Ottawa area.

All exterior footings for heated parts of structures should be provided with at least 1.5 metres of earth cover. For unheated buildings and isolated piers, the required earth cover is 1.8 metres o. In areas where the required earth cover for foundations is not practicable a combination of earth cover and extruded polystyrene insulation could be considered.

All surficial topsoils and soft, wet or deleterious materials should be removed from the areas of proposed roadways. Should it be necessary to raise the grade of roadways and parking areas at this site, suitable material, such as select subgrade material, earth borrow or well shattered and graded rock fill material should be used and suitably compacted. If roadway subgrade materials are disturbed or wetted due to construction activities or precipitation, it may be necessary to increase the subbase material thickness and/or incorporate a woven geotextile separator between the roadway subgrade surface and granular subbase material.

6.0 RECOMMENDATIONS

The following provides recommendations regarding well construction specifications, water quality and septic system design:

6.1 Water Supply Recommendations

- All wells that are drilled in the future lots should be constructed in accordance with local MOE regulations (Ontario Reg. 903);
- Drinking water wells should be located so that they meet the minimum setback distances from septic systems, property lines and any other sources of contamination, as required in the Ontario Building Code and/or Ontario Reg. 903.
- Well casings should be extended at least 10.0 metres below ground surface. The entire annular space between the steel casing and the overburden/bedrock should be filled with a suitable cement or bentonite grout;
- In addition to the minimum recommended well casing lengths specified in the preceding recommendation, all well casings should be completed a minimum of 1.5 metres into sound, competent bedrock;
- Hydrofracturing was carried out on two (2) out of three (3) completed test wells in an effort to minimize the completed well depth and minimize the risk of encountering highly mineralized water at deeper depths. Hydrofracturing may be required for future wells constructed on the subject site in order to meet the minimum recommended water demand of 18.9 litres per minute at the depths investigated in this report;
- Water testing in the bedrock water supply aquifer has only been carried out in test wells completed at depths between 48.5 to 78.6 metres below ground surface. Wells completed at depths outside this range and/or with alternative well construction specifications may encounter water bearing zones with water quantity and quality differing from that of the test wells investigated in this report;
- Conventional water softeners may be desired by occupants to treat minor operational guideline exceedances of the ODWS such as hardness and minor aesthetic exceedances such as iron;
- Additional treatment such as carbon filters and/or aeration systems may be desired by occupants to treat minor aesthetic exceedances due to hydrogen sulphide; and,
- Chlorination systems to treat hydrogen sulphide exceedances are not recommended for this site.

6.2 Septic System Recommendations

- The proposed lots will be serviced by conventional septic disposal systems or tertiary treatment septic sewage disposal systems designed according to the Ontario Building

Code. A site specific investigation should be conducted on each lot for the design of the septic system;

- The nitrate impact assessment in this report assumed a maximum flow of 3,500 litres per day per lot. A professional engineer with experience in hydrogeological investigations should be retained to assess nitrate impacts if the septic flow from any of the proposed buildings constructed on the subject site exceeds 3,500 litres per day. It should be noted that a septic system daily design flow of 3,500 litres per day is anticipated to be more than sufficient for any of the anticipated commercial and/or industrial development potential for the subject site;

- In view of the percolation time of the native sand, sandy silt, silty sand, silty clay and glacial till of this site, a partially or fully raised septic leaching bed with a sand mantle should be allowed for on some or all of the proposed lots;

- Based on the shallow bedrock conditions which were observed in some of the test pits, it is expected that some of the septic leaching beds will require a compacted clay seal to be placed below the septic leaching bed and the sand mantle. A compacted clay seal with a minimum thickness of 150 millimetres should be placed below the leaching bed and sand mantle in any areas where there is less than 0.3 metres of suitable native soil overlying the bedrock;

- Based on the shallow soil conditions which were observed in some of the test pits, it is expected that some of the septic leaching beds at this site will be partially or fully raised; and,

- Any fill used in the construction of the leaching bed must have a percolation time not less than 75 percent of the percolation time of the unsaturated soil or leaching bed fill material.

6.3 Geotechnical Recommendations

- The native soils and bedrock at the site are considered suitable for the support of small industrial/commercial buildings on conventional spread footings;

- Site specific geotechnical investigations should be carried out as part of lot development; and,

- Roadways within the development should be constructed using a pavement structure composed of 90 millimetres of asphaltic concrete, 150 millimetres of OPSS Granular A and 450 millimetres of OPSS Granular B Type II.

7.0 LIMITATIONS OF REPORT

This report was prepared for Mr. Greg LeBlanc and is intended for the exclusive use of Mr. Greg LeBlanc. This report may not be relied upon by any other person or entity without the express written consent of Houle Chevrier Engineering Ltd. (HCEL) and Mr. Greg LeBlanc Nothing in this report is intended to provide a legal opinion.

The investigation undertaken by HCEL with respect to this report and any conclusions or recommendations made in this report reflect the best judgments of HCEL based on the site conditions observed during the investigations undertaken at the date(s) identified in the report and on the information available at the time the report was prepared. This report has been prepared for the application noted and it is based, in part, on visual observations made at the site, subsurface investigations at discrete locations and depths and laboratory analyses of specific chemical parameters and material during a specific time interval, all as described in the report. Unless otherwise stated, the findings contained in this report cannot be extrapolated or extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations on the site that were not investigated directly, or chemical parameters, materials or analysis which were not addressed.

Should new information become available during future work, including excavations, borings or other studies, HCEL should be requested to review the information and, if necessary, re-assess the conclusions presented herein.

7.1 STATEMENT OF QUALIFICATIONS

The Senior Environmental Scientist, Mr. James McEwen, was the principal project manager for the hydrogeological investigation. Mr. McEwen has a degree in Environmental Engineering and has been working on hydrogeological investigations in the Ottawa Region for more than 10 years.

The Senior Principal Engineer, Mr. Andrew Chevrier, was the senior engineering reviewer who provided the required professional oversight for the hydrogeological investigation. Mr. Chevrier has a Masters of Engineering, is a registered Professional Engineer in the Province of Ontario and has been carrying out hydrogeological investigations in the Ottawa Region for more than 20 years.

We trust that this report is sufficient for your requirements. If you have any questions concerning this information or if we can be of further assistance to you on this project, please call.

Yours truly,

HOULE CHEVRIER ENGINEERING LTD.

James McEwen, B.Sc., B.Eng.
Senior Environmental Scientist

Andrew Chevrier, M.Eng., P.Eng.
Principal

8.0 REFERENCES

Geological Survey of Canada. Urban Geology of the National Capital Region (http://gdr.ess.nrcan.gc.ca/website/_urbgeo_natcap/). November 5, 2007. (Refer to Appendix N for full Bibliography for this reference source).

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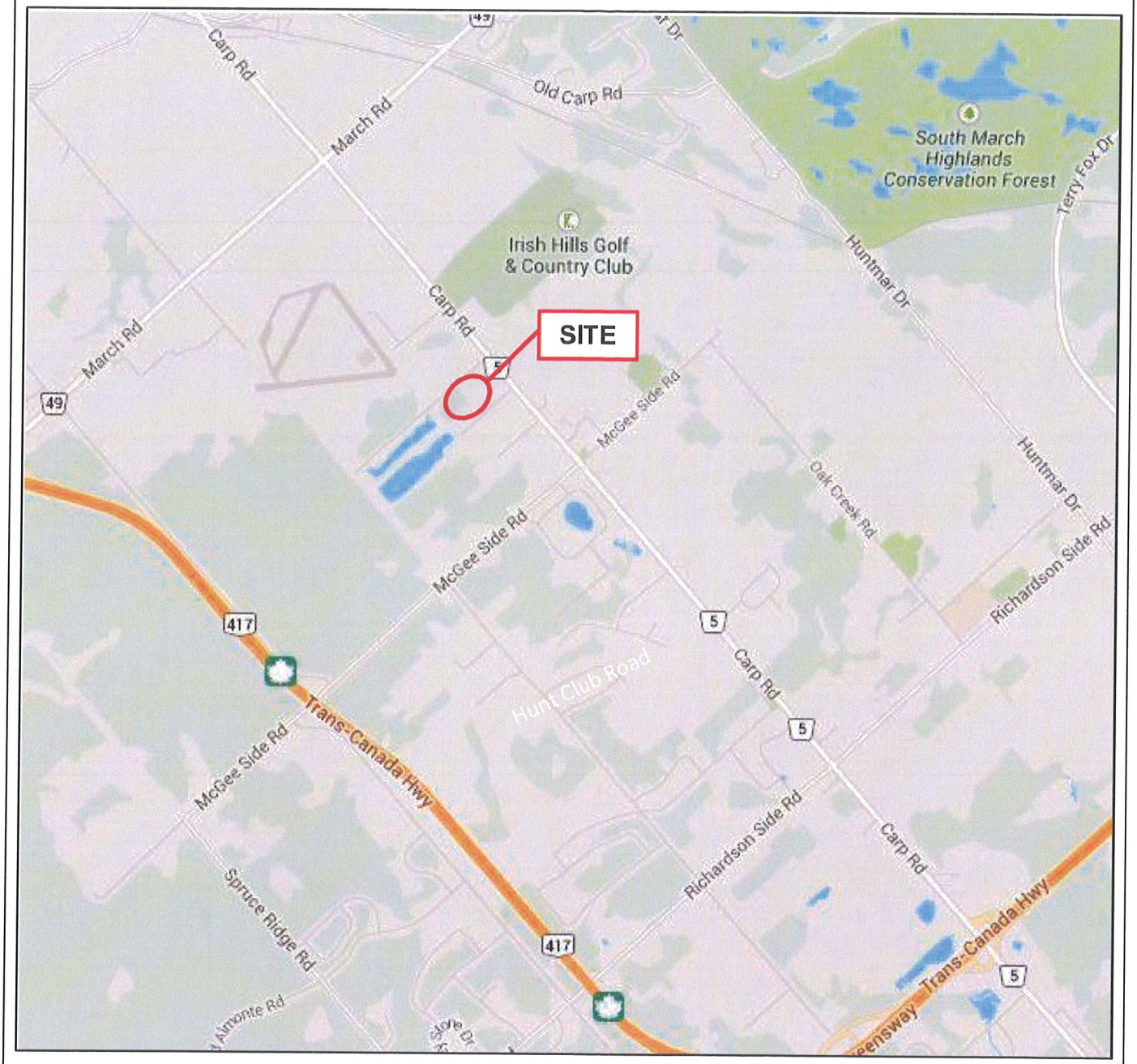
KEY PLAN	FIGURE 1



N.T.S

Houle Chevrier Engineering

Date: February 2014

Project: 11-037

LEGEND

TP11-1 — APPROXIMATE TESTPIT LOCATION IN PLAN, CURRENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD.

TW1 — APPROXIMATE TEST WELL LOCATION IN PLAN, CURRENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD.

A A — CROSS SECTION LOCATION

Client: Mr. Greg LeBlanc		Location: 3119 CARP ROAD CARP, ON	Revision: 0
Drawn by: AGSD	Approved by: A.F.C.	Project No.: 11-037	Approx. Scale: 1 : 4000
Houle Chevrier Engineering		Title: SITE PLAN	
		Date: February 2014	FIGURE 2

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LEGEND

TP11-1 — APPROXIMATE TESTPIT LOCATION IN PLAN, CURRENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD.

0.7m — INTERPRETED OVERBURDEN THICKNESS, m BASED ON REFUSAL DEPTHS IN TEST PITS

Client: Mr. Greg LeBlanc		Location: 3119 CARP ROAD CARP, ON	Revision: 0
Drawn by: AGSD	Approved by: A.F.C.	Project No.: 11-037	Approx. Scale: 1 : 4000
Houle Chevrier Engineering		Title: INTERPRETED OVERBURDEN THICKNESS	
		Date: February 2014	FIGURE 3

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Figure 4 - Private Well Location Plan

Houle Chevrier Engineering

Date: February 2014
Project: 11-037

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LEGEND

TW1 / 112.8 — APPROXIMATE TEST WELL LOCATION IN PLAN, CURRENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD. / WATER LEVEL IN METRES ASL

GROUNDWATER FLOW DIRECTION (APPROX.) - JUNE 18, 2013

114m — GROUNDWATER FLOW CONTOURS (APPROX.) - JUNE 18, 2013

Client: Mr. Greg LeBlanc		Location: 3119 CARP ROAD CARP, ON	Revision: 0
Drawn by: AGSD	Approved by: A.F.C.	Project No.: 11-037	Approx. Scale: 1 : 4000

Houle Chevrier Engineering

Title: INTERPRETED GROUNDWATER FLOW DIRECTION

Date: February 2014

FIGURE 5

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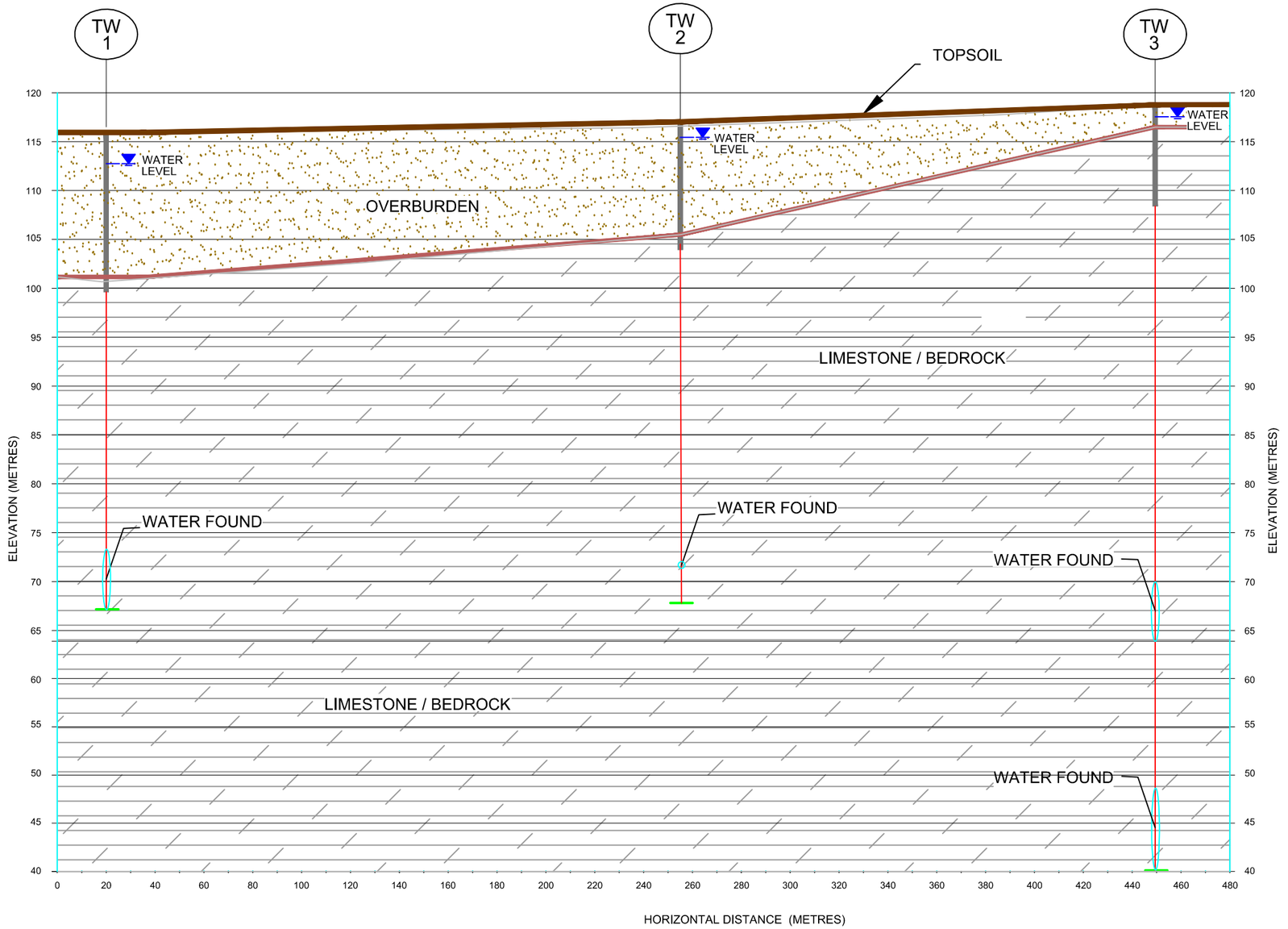


LEGEND

- SAND / SILTY SAND / SILTY CLAY
- LIMESTONE BEDROCK
- STATIC GROUNDWATER LEVEL
- TW1 — TEST WELL

NOTE: 8x VERTICAL EXAGGERRATION

Client: Mr. Greg LeBlanc		Location: 3119 CARP ROAD CARP, ON	Scales: Horizontal 1 : 2000 Vertical 1 : 500
Drawn by: D.J.R.	Approved by: A.F.C.	Project No.: 11-037	
Houle Chevrier Engineering	Title: INTERPRETED SUBSURFACE SECTION		
	Date: February 2014		FIGURE 6

Table 1 - Summary of Field Parameter Measurements - Test Wells

Test Well	Date	Time Since Start of Pumping (hrs:min)	Temperature (oC)	Conductivity (µS/cm)	Total Dissolved Solids (ppm)	pH	Turbidity (NTU)	Total Chlorine (mg/L)
TW1	18-Jun-13	1:00	12.8	615	302	7.88	41.63	0.0
		2:00	11.5	586	307	8.03	108.00	0.0
		3:00	11.0	615	298	8.05	27.31	0.0
		4:00	10.3	586	290	7.97	12.39	0.0
		5:00	10.4	588	307	7.88	11.49	0.0
		6:00	11.1	589	302	7.87	8.91	0.0
TW2	19-Jun-13	1:00	10.7	502	247	7.50	46.37	0.0
		2:00	10.5	477	236	7.77	26.61	0.0
		3:00	11.7	482	240	7.54	17.77	0.0
		4:00	11.9	485	250	7.80	10.88	0.0
		5:00	11.8	493	241	7.79	5.87	0.0
		6:00	11.1	472	234	7.81	14.41	0.0
TW3	20-Jun-13	1:00	10.4	508	256	7.46	14.09	0.0
		2:00	11.9	517	257	7.63	3.53	0.0
		3:00	12.5	517	257	7.70	3.53	0.0
		4:00	12.1	510	255	7.85	3.57	0.0
		5:00	12.1	520	251	7.80	3.57	0.0
		6:00	12.3	507	261	7.84	2.84	0.0

Table 2 - Summary of Analytical Results - Test Well Sampling

PARAMETER	UNITS	TW1 - 3Hr 2013-06-18	TW1 - 6Hr 2013-06-18	TW2 - 3Hr 2013-06-19	TW2 - 6Hr 2013-06-19	ONTARIO DRINKING WATER STANDARD	TYPE OF STANDARD
Total Coliforms	ct/100mL	**60**	**10**	**3**	**3**	0	MAC[1]
Escherichia Coli	ct/100mL	0	0	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	216	193	15	23	-	-
Faecal Coliforms	ct/100mL	0	0	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	0	0	-	-
Alkalinity as CaCO3	mg/L	250	247	191	189	30-500	OG[2]
Chloride	mg/L	34	35	32	32	250	AO[3]
Colour	TCU	2	<2	2	<2	5	AO
Conductivity	µS/cm	678	686	554	553	-	-
Dissolved Organic Carbon	mg/L	1.5	1.5	1.1	1.2	5.0	AO
Fluoride	mg/L	1.05	0.99	0.23	0.24	1.5	MAC
Hydrogen Sulphide	mg/L	**0.23**	**0.75**	**0.11**	**0.11**	0.05	AO
N-NH3 (Ammonia)	mg/L	0.3	0.32	0.08	0.09	-	-
N-NO2 (Nitrite)	mg/L	<0.10	<0.10	<0.10	<0.10	0.1[4]	MAC
N-NO3 (Nitrate)	mg/L	<0.10	<0.10	2.78	<0.10	10[4]	MAC
pH		8.19	8.16	8.09	8.06	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Sulphate	mg/L	60	61	60	60	500	AO
Tannin & Lignin	mg/L	<0.1	0.3	0.2	0.2	-	-
TDS (COND - CALC)	mg/L	441	446	360	359	500	AO
Total Kjeldahl Nitrogen	mg/L	0.4	0.42	0.17	<0.10	-	-
Turbidity	NTU	**12.2**	**5.9**	**15.5**	5	5	AO
Hardness as CaCO3	mg/L	**184**	**193**	**261**	**256**	80-100	OG
Ion Balance		1.04	1.03	0.95	0.97	-	-
Calcium	mg/L	39	41	65	63	-	-
Magnesium	mg/L	21	22	24	24	-	-
Potassium	mg/L	5	5	3	3	-	-
Sodium	mg/L	85	80	13	13	200[5]	AO
Iron	mg/L	0.19	0.08	**0.58**	0.24	0.3	AO
Manganese	mg/L	<0.01	<0.01	0.01	<0.01	0.05	AO
Organic Nitrogen(1)	mg/L	0.10	0.10	0.09	0.01	0.15	OG

NOTES:

1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. The total of Nitrate and Nitrite should not exceed 10 mg/litre
5. The aesthetic objective for sodium is 200 mg/litre. The local medical officer of health should be notified when the sodium concentration exceeds 20 mg/litre for persons on sodium restricted diets.
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

Table 2 (Continued) - Summary of Analytical Results - Test Well Sampling

PARAMETER	UNITS	TW3 - 3Hr 2013-06-20	TW3 - 6Hr 2013-06-20	ONTARIO DRINKING	TYPE OF STANDARD
Total Coliforms	ct/100mL	0	0	0	MAC(1)
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	2	6	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-
Alkalinity as CaCO3	mg/L	184	183	30-500	OG(2)
Chloride	mg/L	46	48	250	AO(3)
Colour	TCU	2	<2	5	AO
Conductivity	µS/cm	591	589	-	-
Dissolved Organic Carbon	mg/L	1.2	1.2	5.0	AO
Fluoride	mg/L	0.1	0.1	1.5	MAC
Hydrogen Sulphide	mg/L	<0.01	<0.01	0.05	AO
N-NH3 (Ammonia)	mg/L	<0.02	0.06	-	-
N-NO2 (Nitrite)	mg/L	<0.10	<0.10	0.1(4)	MAC
N-NO3 (Nitrate)	mg/L	0.67	0.46	10(4)	MAC
pH		7.94	7.95	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	-	-
Sulphate	mg/L	61	59	500	AO
Tannin & Lignin	mg/L	0.2	0.1	-	-
TDS (COND - CALC)	mg/L	384	383	500	AO
Total Kjeldahl Nitrogen	mg/L	0.17	0.24	-	-
Turbidity	NTU	2.8	2.7	5	AO
Hardness as CaCO3	mg/L	**263**	**261**	80-100	OG
Ion Balance		0.91	0.91	-	-
Calcium	mg/L	74	73	-	-
Magnesium	mg/L	19	19	-	-
Potassium	mg/L	2	2	-	-
Sodium	mg/L	10	11	200(5)	AO
Iron	mg/L	0.18	0.26	0.3	AO
Manganese	mg/L	<0.01	<0.01	0.05	AO
Organic Nitrogen(1)	mg/L	0.15	**0.18**	0.15	OG

NOTES:

1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. The total of Nitrate and Nitrite should not exceed 10 mg/litre
5. The aesthetic objective for sodium is 200 mg/litre. The local medical officer of health should be notified when the sodium concentration exceeds 20 mg/litre for persons on sodium restricted diets.
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

Table 3 - TW1 Additional Testing - August 19, 2013

PARAMETER	UNITS	TW1-R1	TW1-R2	ONTARIO DRINKING WATER STANDARD	TYPE OF STANDARD
Total Coliforms	ct/100mL	0	0	0	MAC[1]
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	4	7	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-
Turbidity	NTU	-	0.7	5	AO[2]

NOTES:

1. MAC = Maximum Acceptable Concentration
2. AO = Aesthetic Objective
3. '-' signifies no value provided in the ODWS guideline.

Table 4 - TW2 Bacteriological Retesting - July 22, 2013

PARAMETER	UNITS	TW1-R1	TW1-R2	ONTARIO DRINKING WATER STANDARD	TYPE OF STANDARD
Total Coliforms	ct/100mL	0	0	0	MAC[1]
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	4	7	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-

NOTES:

1. MAC = Maximum Acceptable Concentration
2. '-' signifies no value provided in the ODWS guideline.

Table 5 - Summary of Additional Analytical Results - TW3

GROUP	PARAMETER	UNITS	TW3 - 3Hr
Herbicide/Pesticide	Alachlor	ug/L	<1.0
	Atrazine	ug/L	<1.0
	Azinphos-methyl	ug/L	<2
	Bendiocarb	ug/L	<2
	Carbaryl	ug/L	<5
	Carbofuran	ug/L	<5
	Chlorpyrifos	ug/L	<1
	Cyanazine	ug/L	<1
	De-ethylated atrazine	ug/L	<1.0
	Diazinon	ug/L	<1
	Diclofop-methyl	ug/L	<1.0
	Dimethoate	ug/L	<2.5
	Malathion	ug/L	<5
	Metolachlor	ug/L	<1.0
	Metribuzin	ug/L	<5
	Parathion	ug/L	<1
	Phorate	ug/L	<1.0
	Prometryne	ug/L	<1.0
	Simazine	ug/L	<1
	Temephos	ug/L	<10
	Terbufos	ug/L	<1.0
	Triallate	ug/L	<1
	Trifluralin	ug/L	<1.0
Hydro-carbons	F1 (C6-C10	mg/L	<0.1
	F2 (C10-C16)	mg/L	<0.1
	F3 (C16-C34)	mg/L	<0.2
	F4 (C34-C50)	mg/L	<0.2
	1,1,1,2-tetrachloroethane	ug/L	<0.5
	1,1,1-trichloroethane	ug/L	<0.4
	1,1,2,2-tetrachloroethane	ug/L	<0.5
	1,1,2-trichloroethane	ug/L	<0.4
	1,1-dichloroethane	ug/L	<0.4
	1,1-dichloroethylene	ug/L	<0.5
	1,2-dibromoethane	ug/L	<0.2
	1,2-dichlorobenzene	ug/L	<0.4
	1,2-dichloroethane	ug/L	<0.2
	1,2-dichloropropane	ug/L	<0.5

GROUP	PARAMETER	UNITS	TW3 - 3Hr
VOCs	1,3,5-trimethylbenzene	ug/L	<0.3
	1,3-dichlorobenzene	ug/L	<0.4
	1,4-dichlorobenzene	ug/L	<0.4
	Benzene	ug/L	<0.5
	Bromodichloromethane	ug/L	<0.3
	Bromoform	ug/L	<0.4
	Bromomethane	ug/L	<0.5
	c-1,2-Dichloroethylene	ug/L	<0.4
	c-1,3-Dichloropropylene	ug/L	<0.2
	Carbon Tetrachloride	ug/L	<0.2
	Chloroethane	ug/L	<0.2
	Chloroform	ug/L	<0.5
	Chloromethane	ug/L	<0.2
	Dibromochloromethane	ug/L	<0.3
	Dichlorodifluoromethane	ug/L	<0.5
	Dichloromethane	ug/L	<4.0
	Ethylbenzene	ug/L	<0.5
	m/p-xylene	ug/L	<0.5
	Monochlorobenzene	ug/L	<0.2
	o-xylene	ug/L	<0.5
	Styrene	ug/L	<0.5
	t-1,2-Dichloroethylene	ug/L	<0.4
	t-1,3-Dichloropropylene	ug/L	<0.2
	Tetrachloroethylene	ug/L	<0.3
	Toluene 0.5	ug/L	<0.5
	Trichloroethylene	ug/L	<0.3
	Trichlorofluoromethane	ug/L	<0.5
	Vinyl Chloride	ug/L	<0.2
	Xylene; total	ug/L	<1.0

Table 6 - Summary of Total Chlorine Measurements - Private Wells

Private Well ID	Total Chlorine (mg/L)
PW1	0.0
PW2	0.0

Table 7 - Summary of Analytical Results - Private Wells

PARAMETER	UNITS	PW1	PW2	ONTARIO DRINKING WATER STANDARD	TYPE OF STANDARD
Total Coliforms	ct/100mL	0	0	0	MAC[1]
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	0	0	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-
Alkalinity as CaCO3	mg/L	156	227	30-500	OG[2]
Chloride	mg/L	44	127	250	AO[3]
Colour	TCU	2	2	5	AO
Conductivity	µS/cm	521	996	-	-
Dissolved Organic Carbon	mg/L	1.1	1.9	5.0	AO
Fluoride	mg/L	<0.10	<0.10	1.5	MAC
Hydrogen Sulphide	mg/L	<0.01	<0.01	0.05	AO
N-NH3 (Ammonia)	mg/L	0.05	0.05	-	-
N-NO2 (Nitrite)	mg/L	<0.10	<0.10	0.1[4]	MAC
N-NO3 (Nitrate)	mg/L	<0.10	9.57	10[4]	MAC
pH		7.82	7.75	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	-	-
Sulphate	mg/L	48	39	500	AO
Tannin & Lignin	mg/L	<0.1	<0.1	-	-
TDS (COND - CALC)	mg/L	339	**647**	500	AO
Total Kjeldahl Nitrogen	mg/L	<0.10	<0.10	-	-
Turbidity	NTU	2.7	0.2	5	AO
Hardness as CaCO3	mg/L	**252**	**220**	80-100	OG
Ion Balance		1.08	1.05	-	-
Calcium	mg/L	73	75	-	-
Magnesium	mg/L	17	8	-	-
Potassium	mg/L	2	1	-	-
Sodium	mg/L	16	131	200[5]	AO
Iron	mg/L	0.21	0.03	0.3	AO
Manganese	mg/L	0.02	<0.01	0.05	AO
Organic Nitrogen(1)	mg/L	0.05	0.05	0.15	OG

NOTES:

1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. The total of Nitrate and Nitrite should not exceed 10 mg/litre
5. The aesthetic objective for sodium is 200 mg/litre. The local medical officer of health should be notified when the sodium concentration exceeds 20 mg/litre for persons on sodium restricted diets.
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

Table 8 - Summary of Test Well Groundwater Elevations

Bedrock Test Well	Date of Measurement	Top of Casing Elevation (metres ASL)	Water Level (metres TOC)	Water Elevation (metres ASL)
TW1	18-Jun-13	116.52	3.77	112.75
	19-Jun-13		3.75	112.77
	20-Jun-13		3.75	112.77
TW2	18-Jun-13	117.09	1.66	115.43
	19-Jun-13		1.66	115.43
	20-Jun-13		1.65	115.44
TW3	18-Jun-13	119.54	2.00	117.54
	19-Jun-13		2.00	117.54
	20-Jun-13		2.03	117.51

Notes:

1. metres ASL = metres above sea level
2. metres BGS = metres below ground surface

APPENDIX A

RECORD OF TEST PIT SHEETS

PROJECT: 11-037

RECORD OF TEST PIT 11-1

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - +, Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) — Wp, W, Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Grey SILTY CLAY, occasional small sand pocket (weathered crust)		0.15	1				Backfilled with excavated material
1								
	Grey SILTY CLAY, trace small rounded gravel		1.52					20 mm diameter, 0.61 metres long slotted well screen
2	End of test pit Refusal on inferred bedrock or boulder		1.96					Groundwater conditions observed at 0.37 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-2

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown fine to medium SILTY SAND		0.25					
1	Very stiff, brown SILTY CLAY (weathered crust)		0.55					
	End of test pit Refusal on inferred bedrock or boulder		1.68					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-3

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) — Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08					
	Dark brown fine to coarse SAND, trace silt, some gravel			1				
	becoming lighter by 0.56 metres depth							
1								
2								
	End of test pit Refusal on inferred bedrock or boulder		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-4

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown fine SILTY SAND, trace organics		0.18	1				
	Grey brown SANDY SILT with clay		0.51	2				
	Grey SANDY SILT and CLAY		0.66	3				
1								
2	Grey, fine SILTY SAND, some clay with intervals of 0.15 metres silty clay seams, cobbles with depth		1.68	4				
3								
	End of test pit Refusal on inferred bedrock or boulder		3.20					
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-5

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Brown silty sand, trace topsoil and organics (TOPSOIL)							Backfilled with excavated material
			0.20					
1	Brown fine to medium SAND, some gravel and cobbles							
2								20 mm diameter, 0.61 metres long slotted well screen
	End of test pit Refusal on inferred bedrock or boulder		2.44					Groundwater conditions observed at 2.05 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-6

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Dark brown SILTY SAND, trace organics		0.05					
	Reddish brown fine SAND, trace organics and silt		0.23	1				
	Grey fine SAND, some silt		0.69	2				
1								
	Test pit terminated on inferred smooth surfaced bedrock		1.75					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-7

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Brown silty sand, TOPSOIL							
	Test pit terminated on inferred smooth surfaced bedrock		0.25					
1								
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-8

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Dark brown TOPSOIL							
	Brown fine SAND		0.20					
	Test pit terminated on inferred smooth surfaced bedrock		0.36					
1								
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-9

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown SILTY SAND, trace organics, small rootlets		0.05					
	Brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		0.20					
1								
	Test pit terminated on inferred smooth surfaced bedrock		1.37					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-10

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown SILTY SAND, trace organics		0.08					
	Grey brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		0.25					Backfilled with excavated material; 20 mm diameter, 0.61 metres long slotted well screen
1								
	End of test pit Refusal on inferred bedrock or boulder		1.47					Groundwater conditions observed at 1.33 metres below ground surface on June 30, 2011.
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-11

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) — Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Dark brown SILTY SAND, trace small rootlets		0.08					
	Reddish brown fine to medium SAND		0.30					
	Brown grey fine to medium SAND		0.77					
1	Grey SILTY SAND, trace small gravel, trace shells		1.00					
	Grey SILTY SAND, some clay, some gravel and shells		1.70					
2	Grey SAND		2.30					
	End of test pit Refusal on inferred bedrock or boulder		2.70					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-12

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Reddish brown fine SILTY SAND with trace organics turning brown grey by 0.3 metres depth		0.09	1				Backfilled with excavated material
1	Grey fine SILTY SAND to SANDY SILT, trace shells, trace small gravel		0.75	2				
	Brown grey fine to medium SAND		1.40	3				20 mm diameter, 0.61 metres long well screen
2	End of test pit Refusal on inferred bedrock or boulder		2.20					Groundwater conditions observed at 1.38 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-13

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Reddish brown fine to medium SAND, trace silt and organics		0.10	1				
	Brown fine to medium SAND, some silt, trace gravel		0.40	2				
1	Brown fine to medium SAND, trace silt		1.00	3				
	Grey SAND, occasional gravel with depth		1.20					
2								
	End of test pit Refusal on inferred bedrock or boulder		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-14

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08	1				
	Reddish brown fine to medium SAND, trace silt		0.48					
1	Grey brown fine to medium SAND		0.82	2				
	Grey brown SANDY SILT with clay		1.43					
	Grey SILTY SAND, some shells		1.77	3				
2	Grey brown fine to coarse SAND, trace silt		2.80					
	End of test pit Refusal on inferred bedrock or boulder							
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-15

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown grey fine SAND		0.15					
	Brown SILTY fine SAND, trace clay		0.53	1				
1	Grey fine silty SAND		1.09	2				
	Grey fine SILTY SAND, trace shells		1.35					
2	Grey SILTY CLAY and fine SAND		1.91	3				
	Grey fine SAND, some silt		2.44	4				
	End of test pit Refusal on inferred bedrock or boulder		2.74					
3								
4								

Backfilled with excavated material

20 mm diameter, 0.61 metres long slotted well screen

Groundwater conditions observed at 0.45 metres below ground surface on June 30, 2011.

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-16

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Dark brown to brown fine to medium SAND		0.10	1				
	Grey brown SILTY CLAY and fine SAND		0.81					
1	Brown grey SILTY CLAY (weathered crust)		1.04	2				
2	Grey SILTY CLAY, trace rounded gravel, trace shells		1.93					
	End of test pit Refusal on inferred bedrock or boulder		2.44					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-17

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Dark brown SILTY SAND, trace organics		0.10					
	Reddish brown fine to medium SAND becoming grey brown by 0.48 metres depth		0.24					
1	Brown grey SILTY SAND, some clay seams grey with shells by 1.83 metres depth		0.86					
2	Grey medium SAND		1.83					
	Grey SILTY CLAY		2.44					
3	End of test pit Refusal on inferred bedrock or boulder		2.97					
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

PROJECT: 11-037

RECORD OF TEST PIT 11-18

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.09					
	Dark brown SILTY SAND, trace rootlets		0.23					
	Brown fine to medium SAND, trace silt			1				
1	Brown fine to medium SAND		0.91	2				
	becoming grey by 1.09 metres depth							
2								
	Grey SILTY CLAY		2.29					
	End of test pit Refusal on inferred bedrock or boulder		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering Ltd.

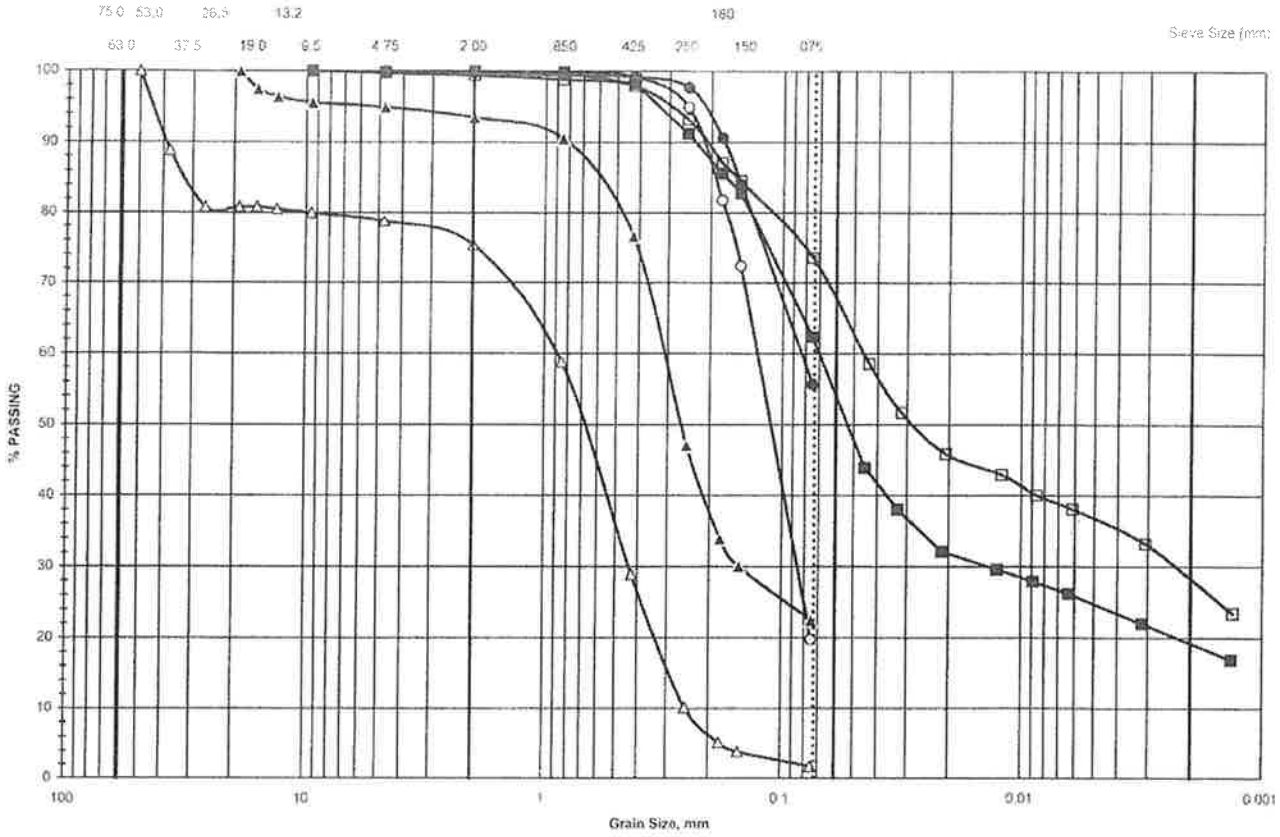
LOGGED: M.L.

CHECKED:

TESTPIT RECORD 2012 WITH LAB WC GINT 11-037 TP 1-18.GPJ 3/12/14

GRAIN SIZE ANALYSIS

FIGURE



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			
Modified M.I.T. Classification										

Test Pit	Sample	Depth (m)	Legend
11-3	1	0.61 - 0.91	△
11-4	4	2.44 - 3.05	■
11-6	2	0.91 - 1.22	○
11-13	2	0.50 0.70	▲
11-14	2	0.95 - 1.25	□
11-15	3	1.98 - 2.44	●

Houle Chevrier Engineering

Date: July 2011
Project : 11-037

APPENDIX B

ENVIRONMENT CANADA
WATER SURPLUS DATA

Test Pit No.	Silty Clay	Fine to Coarse Sand	Silty Sand
1	x		
2			x
3		x	
4			x
5		x	
6		x	
7			x
8		x	
9			x
10			x
11			x
12			x
13		x	
14		x	
15		x	
16		x	
17			x
18			x
Totals	**1**	**8**	**9**

Soil Type	Carleton Place Water Surplus (mm)	Ottawa Airport Water Suplus (mm)	Average Surplus (mm)
Silty Clay	368.9	312.4	340.7
Sand	433.0	372.2	402.6
Silty Sand	417	350.1*	383.6

* Silty Sand Water Suplus (water holding capacity estimated at 150 mm) for Carleton Place calculated as the average between Sand (water holding capcity of 100 mm) and Glacial Till (water holding capacity of 200 mm)

Weighted Water Suplus for 3119 Carp Road Site Based on Soil Types

$$Weighted\ Average\ Water\ Surplus =$$

$$\left[\frac{1}{18} * 340.7\right] + \left[\frac{8}{18} * 383.6\right] + \left[\frac{9}{18} * 402.6\right] = 390.7\ mm$$

Carleton Place - Silty Clay Water Surplus Data - 1985 to 1997

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Jan	0	0.4	0	53.4	27.5	52	2.9	0	75.6	0	160.4	78.7	15.2
Feb	0	7.4	0.6	31.8	10.1	69.4	108.8	0	0	38.9	16.8	105.2	91
Mar	64.3	99.4	144.1	95.5	137.9	80.2	102	146.6	160.4	108.2	35	122.7	100.5
Apr	23.3	0	44.9	66.7	5	70.7	89.7	100.2	177.8	80.1	28.8	115.6	86.9
May	0	57.5	5	0	29.1	27.6	0	1.1	0	39.1	0	1.8	6.6
Jun	0	5.2	0	0	0	0	0	0	43	14	0	0	0
Jul	0	29.7	0	0	0	0	0	0	0	0	0	0	11.9
Aug	0	7.3	0	0	0	0	0	0	0	0	6	0	0
Sep	0	66.3	0	0	0	0	0	0	0	0	0	0	8.1
Oct	0	54.1	0	0	0	0	0	8.8	44.8	0	120	0	16.8
Nov	0	37.3	54.9	27.1	0	17.6	0	99.6	99.8	57.3	76.8	2	70.5
Dec	0	14.3	80.1	22.8	0	84.7	0	24.2	33.3	54.9	0	94.6	7.2
Yearly Surplus	87.6	378.9	329.6	297.3	209.6	402.2	303.4	380.5	634.7	392.5	443.8	520.6	414.7

13 Year Average Silty Clay
368.8769

Carleton Place -Sand Water Surplus Data - 1985 to 1997

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Ave	
Jan	0	66.3	0	53.4	27.5	100.6	2.9	10.7	75.5	0	160.4	78.7	15.2	45.47692	
Feb	20.3	7.4	0.6	31.8	10.1	69.3	108.8	12.4	0	38.9	16.8	105.2	91	39.43077	
Mar	116	99.3	144	95.5	137.8	80.2	101.9	158.9	160.4	108.1	34.9	122.7	100.5	112.3231	
Apr	23.2	0	44.8	66.6	4.9	70.6	89.6	100.1	177.6	79.9	28.7	115.5	86.8	68.33077	
May	0	57.2	4.9	0	29	27.4	0	1	0	39	0	1.6	6.5	12.81538	
June	0	5	0	0	0	0	0	0	42.7	13.9	0	0	0	4.738462	
July	0	29.9	0	0	0	0	0	0	0	0	0	0	14.1	3.384615	
Aug	0	7.1	0	0	0	0	0	1.8	0	0	5.5	0	0	1.107692	
Sept	0	66.2	0	0	0	0	0	0	0	0	0	0	6.3	5.576923	
Oct	0	54	0	10.9	0	22.9	0	31.1	44.5	0	119.7	0	16.7	23.06154	
Nov	0	37.2	54.2	80.3	31.5	47.7	22.8	99.6	99.8	56.7	76.8	8.8	70.4	52.75385	
Dec	14.3	14.3	80.1	22.7	0	84.7	49.3	24.2	33.3	54.9	0	94.6	7.2	36.89231	
	173.8	443.9	328.6	361.2	240.8	503.4	375.3	439.8	633.8	391.4	442.8	527.1	414.7		405.8923

13 Year Average - Sand =

405.9

Carleton Place - Silty Sand Water Surplus Data - 1985 to 1997

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Ave	
Jan	0	42	0	53.4	27.5	93.4	2.9	10.7	75.5	0	160.4	78.7	15.2	43.05385	
Feb	0.3	7.4	0.6	31.8	10.1	69.3	108.8	12.4	0	38.9	16.8	105.2	91	37.89231	
Mar	116	99.3	144	95.5	137.8	80.2	101.9	158.9	160.4	108.1	34.9	122.7	100.5	112.3231	
Apr	23.2	0	44.8	66.6	4.9	70.6	89.6	100.1	177.6	79.9	28.7	115.5	86.8	68.33077	
May	0	57.2	4.9	0	29	27.4	0	1	0	39	0	1.6	6.5	12.81538	
June	0	5	0	0	0	0	0	0	42.7	13.9	0	0	0	4.738462	
July	0	29.9	0	0	0	0	0	0	0	0	0	0	14.1	3.384615	
Aug	0	7.1	0	0	0	0	0	1.8	0	0	5.5	0	0	1.107692	
Sept	0	66.2	0	0	0	0	0	0	0	0	0	0	6.3	5.576923	
Oct	0	54	0	0	0	0	0	31.1	44.5	0	119.7	0	16.7	20.46154	
Nov	0	37.2	54.2	49.5	0	40.7	0	99.6	99.8	56.7	76.8	4.6	70.4	45.34615	
Dec	0	14.3	80.1	22.7	0	84.7	26.8	24.2	33.3	54.9	0	94.6	7.2	34.06154	
	139.5	419.6	328.6	319.5	209.3	466.3	330	439.8	633.8	391.4	442.8	522.9	414.7		389.0923

13 Year Average - Silty Sand =
389.1

Environment Canada
Water Surplus Data
(1983-2002)

Soil Type: Sand
Water Holding Capacity: 100 millimetres

Year	Surplus (mm)
1983	471.7
1984	414.3
1985	308.1
1986	508.2
1987	285.9
1988	341.2
1989	253.5
1990	423.3
1991	355.2
1992	430.8
1993	530.4
1994	335.6
1995	327.6
1996	447.6
1997	341.4
1998	306.6
1999	344.4
2000	329.3
2001	306.7
2002	382.7
Avg. Surplus (mm) (1983-2003)	372.2

Environment Canada
Water Surplus Data
(1983-2002)

Soil Type: Silty Clay
Water Holding Capacity: 280 millimetres

Year	Surplus (mm)
1983	337.1
1984	386.7
1985	258.8
1986	460.4
1987	240.6
1988	287.3
1989	203.9
1990	353.9
1991	335.8
1992	308.7
1993	467.7
1994	335.6
1995	298.6
1996	374.3
1997	341.4
1998	223.8
1999	150.9
2000	329.3
2001	215.5
2002	338.6
Avg. Surplus (mm) (1983-2003)	312.4

APPENDIX C

NITRATE DILUTION CALCULATION

Nitrate Dilution Calculation - 3119 Carp Road

Nitrate Loading

Untreated Septic Systems

Number of lots with untreated septic systems =	12	lots
Nitrate loading from untreated septic system =	40	grams/lot/day
Total annual nitrate loading from untreated systems =	175200	grams/year

Treated Septic Systems

Number of lots with treated septic systems =	0	lots
Nitrate loading from treated septic system =	22.5	grams/lot/day
Total annual nitrate loading from treated systems =	0	grams/year

Total annual nitrate loading from all systems = 175200 grams/year

Dilution Volumes

Infiltration Factors

Topography factor =	0.2
Soil factor =	0.2
Cover factor =	0.1
Combined infiltration factor =	0.5

Precipitation Infiltration

Annual water surplus =	0.3907	metres/year
Annual infiltration (Water Surplus x Infiltration Factor) =	0.1954	metres/year

Infiltration Area

Total Site Area =	142003	square metres
Hard Surface Areas	30	percent (estimate)
Area available for infiltration (Site Area - Hard Surface Area) =	99402.1	square metres
Total Annual Volume of Infiltration (Infiltration x Area) =	19418	cubic metres/year
Total Annual Volume of Septic Effluent (1000 L/day/lot x 365 days) =	4380	cubic metres/year

Total Annual Volume Available for Dilution = 23798 cubic metres/year

Dilution Calculation

$$C_{Nitrate} = \frac{Mass}{Volume} = \frac{Annual\ Nitrate\ Loading(grams/year)}{Annual\ Dilution\ Volume(cubic\ metres/year)} = \frac{grams}{cubic\ metre} = \frac{mg}{L}$$

$$\mathbf{C_{Nitrate} = \frac{175200\ grams/year}{23798\ cubic\ metres/year} = 7.36\ mg/L}$$

APPENDIX D

ONSITE TEST WELL WATER WELL RECORDS AND CERTICATES OF WELL COMPLIANCE

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Be): A138240

Well Record

Regulation 903 Ontario Water Resources Act

Page ___ of ___

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT	K0A1L0	6137201962

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARLETON	CARP	Ontario	K0A1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	420964	5018977		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
RED	SAND			0	5
BROWN	SAND	[redacted]		5	14
GREY	SAND		OCCASIONAL LAYERS OF GREY CLAY	14	48½
GREY	LIMESTONE			✓ 48½	160

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	38½	BENTONITE SLURRY	.768
38½	48½	CEMENT GROUT	.150

Method of Construction

☐ Cable Tool ☐ Diamond ☒ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☒ Air percussion ☐ Other, specify ___

14.00

Well Use

☐ Public ☐ Commercial ☐ Not used ☒ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☒ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify ___

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	STEEL	.188	0 +2	53½
6	OPENHOLE		53½	160

Status of Well

☒ Water Supply ☐ Replacement Well ☒ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ___ ☐ Other, specify ___

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Water Details

Water found at Depth (m/ft)	Kind of Water: ☐ Fresh ☒ Untested ☐ Gas ☐ Other, specify	Hole Diameter Depth (m/ft) From	To	Diameter (cm/in)
140-160	FRACKED FRACTURED			
Water found at Depth (m/ft) ☐ Gas	Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify ___	53½	160	6
Water found at Depth (m/ft) ☐ Gas	Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify ___			

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify CLEARING

If pumping discontinued, give reason: ___

Pump intake set at (m/ft): 150

Pumping rate (l/min / GPM): 12

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 42.48

If flowing give rate (l/min / GPM): ___

Recommended pump depth (m/ft): 150

Recommended pump rate (l/min / GPM): 12

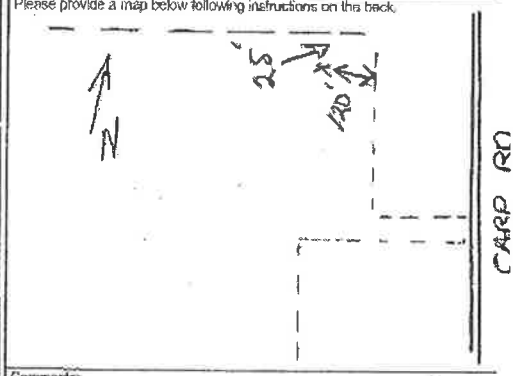
Well production (l/min / GPM): 12+

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	3.66		
1	11.60	1	32.48
2	15.68	2	26.41
3	18.93	3	21.75
4	21.64	4	17.77
5	24.07	5	14.59
10	31.64	10	7.24
15	36.29	15	6.08
20	38.56	20	4.99
25	39.93	25	4.69
30	40.98	30	4.50
40	41.88	40	4.39
50	42.30	50	4.22
60	42.48	60	4.09

Map of Well Location

Please provide a map below following instructions on the back.



Comments: ___

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6136235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
11517	Troy Saun	2013 06 05

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☒ Yes ☐ No	2013 06 05	Audit No. Z158243
	Date Work Completed: 2013 06 05	Received ___

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Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at [redacted]3119 CARP RD (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #1 160' DEEP
WELL TAG # A138240

I CERTIFY FURTHER that, I am aware of well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY 2013.

Troy Saunders / SAUNDERS WELL DRILLING LTD.
Well Driller / Company

The Engineer on behalf of the landowner set out above **CERTIFIES** that he/she has inspected the well and it was constructed in accordance with the specifications in 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P.Eng.
Engineer

Houle Chevrier Engineering Ltd.

LICENSED PROFESSIONAL ENGINEER
July 24/13
A. C. HOULE
PROVINCE OF ONTARIO

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Below): A 138241

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT.	K0A 1L0	6137201963

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA-CARELTON	CARP	Ontario	K0A 1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	442110	5011886 4		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
RED	SAND			0	6½
GREY	CLAY			6½	25½
GREY/RED	SAND	GRAVEL + STONES		25½	36
GREY	LIMESTONE			36	159

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	31	BENTONITE SLURRY	.256
31	41	CEMENT GROUT	.150

Method of Construction

☐ Cable Tool ☐ Diamond ☒ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☒ Air percussion ☐ Other, specify _____

MUD

Well Use

☐ Public ☐ Commercial ☐ Not used ☒ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☒ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify _____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	STEEL	.188	0+2	41
6	OPEN HOLE		41	159

Status of Well

☒ Water Supply ☐ Replacement Well ☒ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify _____ ☐ Other, specify _____

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth From	Depth To	Diameter (cm/in)
147 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify			
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	41	159	6
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify			

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify CLEARING

If pumping discontinued, give reason: —

Pump intake set at (m/ft): 155

Pumping rate (l/min / GPM): 6

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 57.18

If flowing give rate (l/min / GPM): —

Recommended pump depth (m/ft): 150

Recommended pump rate (l/min / GPM): 5

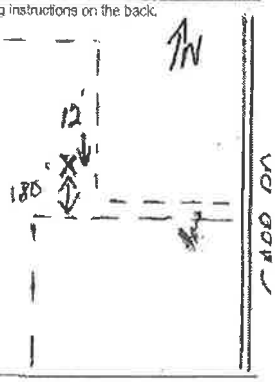
Well production (l/min / GPM): 7

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	5.0		
1	8.45	1	50.39
2	10.81	2	46.62
3	12.96	3	43.64
4	15.71	4	41.02
5	17.69	5	38.30
10	25.03	10	26.78
15	31.85	15	18.13
20	36.87	20	11.94
25	41.13	25	8.15
30	44.88	30	6.43
40	50.18	40	5.18
50	54.19	50	5.0
60	57.18	60	5.0

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A 1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
1517	Troy Saunders	2013 07 02

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☒ Yes ☐ No	2013 06 07	Audit No. Z 158245
	Date Work Completed: 2013 06 02	Received

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CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at 3119 CARP RD (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #2

WELL TAG# A138241

I CERTIFY FURTHER that, I am aware of well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY, 2013.

Troy Saunders / SAUNDERS WELL DRILLING LTD

Well Driller / Company

The Engineer on behalf of the landowner set out above **CERTIFIES** that he/she has inspected the well and it was constructed in accordance with the specifications in 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P.Eng.

Engineer

Houle Chevrier Engineering Ltd.

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Below): A138239

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT	K0A1L0	6137201963

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARELTON	CARP	Ontario	K0A 1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	421095.50	18561		

Overburden and Bedrock Material/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
RED	SAND			0	7½
GREY	LIMESTONE		FRACTURED	7½	9
GREY	LIMESTONE			9	258

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	24	BENTONITE SLURRY	.256
24	34	CEMENT GROUT	.150

Method of Construction

☐ Cable Tool ☐ Diamond
☒ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) MUD ☐ Driving
☐ Boring ☐ Digging
☒ Air percussion
☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☒ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	STEEL	.188	0 +2ft	34
6	OPEN HOLE		34	258

Status of Well

☒ Water Supply
☐ Replacement Well
☒ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Water Details

Water found at Depth	Kind of Water	Other, specify
160-180 (m/ft) ☐ Gas	☐ Fresh ☒ Untested	HYDROFRAC
230-258 (m/ft) ☐ Gas	☐ Fresh ☐ Untested	HYDROFRAC
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
34	258	6"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify CLEARING

If pumping discontinued, give reason:

Pump intake set at (m/ft): 230

Pumping rate (l/min / GPM): 4.5

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 71.45

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft): 248

Recommended pump rate (l/min / GPM): 4.5

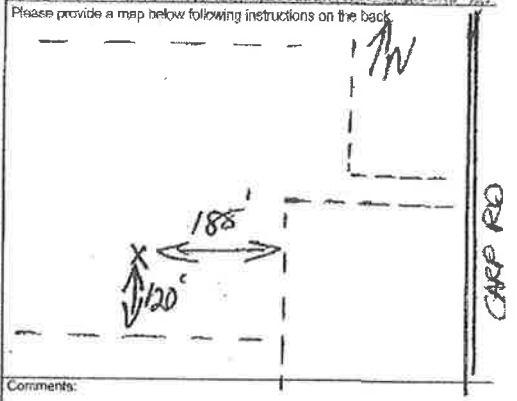
Well production (l/min / GPM): 4.5

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		10.58		
1		14.30	1	67.34
2		17.80	2	64.40
3		21.79	3	61.87
4		24.36	4	58.98
5		27.04	5	56.10
10		36.48	10	48.30
15		42.34	15	41.61
20		47.24	20	35.84
25		51.61	25	31.17
30		55.39	30	26.84
40		61.62	40	20.53
50		66.42	50	16.58
60		71.45	60	13.65

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6136235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
1517	Troy Saunders	2013/08/16

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☒ Yes ☐ No	2013/06/18	Audit No. Z158244
	Date Work Completed: 2013/06/18	Received

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CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at 3119 CARP RD. (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #3

WELL TAG# A138239

I CERTIFY FURTHER that, I am aware of well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY, 2013.

Troy Saunders / SAUNDERS WELL DRILLING

Well Driller / Company

The Engineer on behalf of the landowner set out above **CERTIFIES** that he/she has inspected the well and it was constructed in accordance with the specifications in 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P. Eng.

Engineer

Houle Chevrier Engineering Ltd.

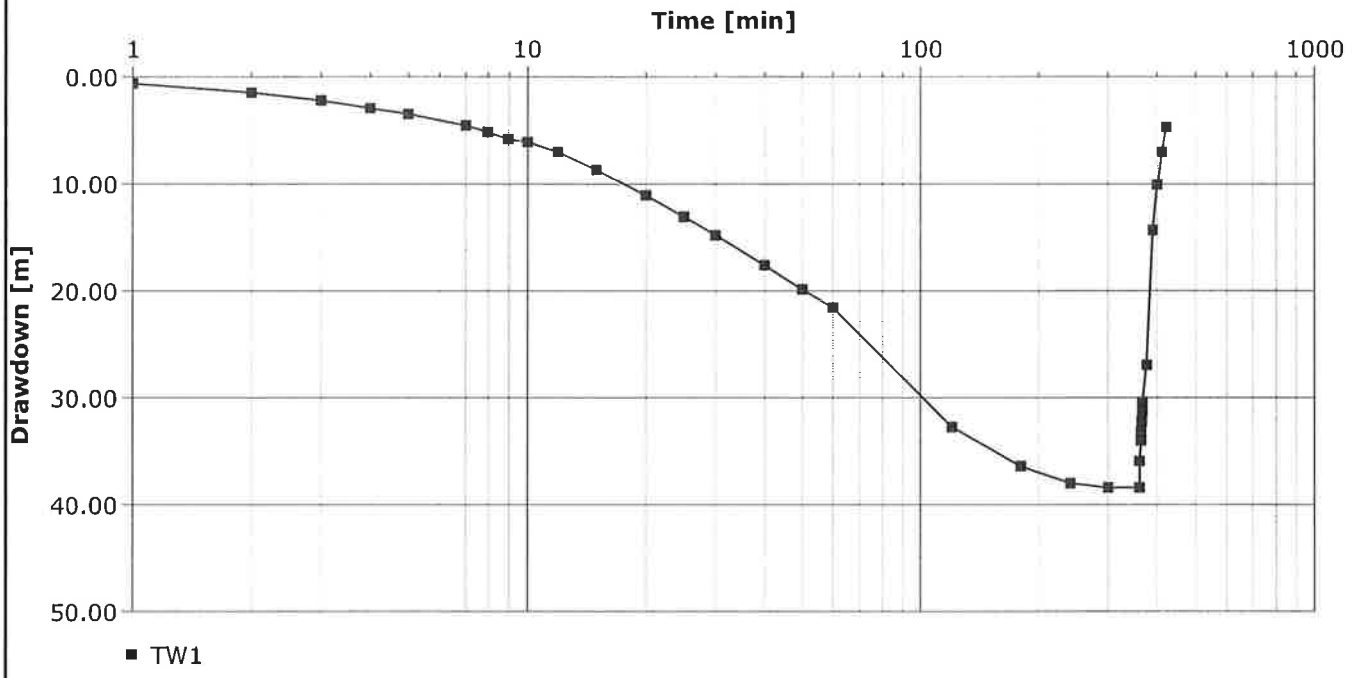
LICENSED PROFESSIONAL ENGINEER
July 24/13
A. C. HOULE
PROVINCE OF ONTARIO

APPENDIX E

TEST WELL DRAWDOWN AND RECOVERY MEASUREMENTS

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW1	Pumping Well: TW1
Test Conducted by: HCE Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Drawdown and recovery data	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 5 [U.S. gal/min]	



GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

Pumping Test - Water Level Data

Project: Hydrogeological Investigation

Number:

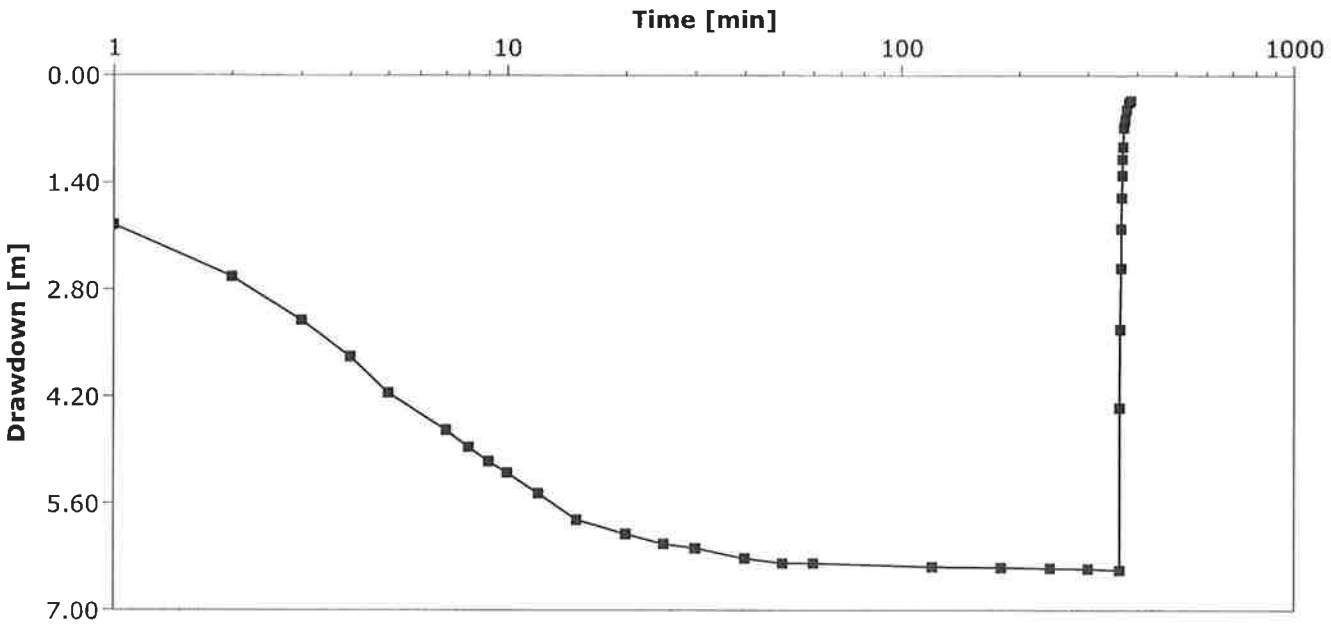
Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 1	Pumping Well: TW1
Test Conducted by: HCE Ltd.	Test Date: 6/18/2013	Discharge Rate: 5 [U.S. gal/min]
Observation Well: TW1	Static Water Level [m]: 3.70	Radial Distance to PW [m]: -

	Time [min]	Water Level [m]	Drawdown [m]
1	1	4.30	0.60
2	2	5.16	1.46
3	3	5.91	2.21
4	4	6.66	2.96
5	5	7.18	3.48
6	7	8.21	4.51
7	8	8.80	5.10
8	9	9.50	5.80
9	10	9.77	6.07
10	12	10.72	7.02
11	15	12.38	8.68
12	20	14.78	11.08
13	25	16.75	13.05
14	30	18.50	14.80
15	40	21.33	17.63
16	50	23.56	19.86
17	60	25.25	21.55
18	120	36.44	32.74
19	180	40.10	36.40
20	240	41.71	38.01
21	300	42.08	38.38
22	360	42.12	38.42

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Drawdown and recovery	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 8 [U.S. gal/min]	



GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

Pumping Test - Water Level Data

Project: Hydrogeological Investigation

Number:

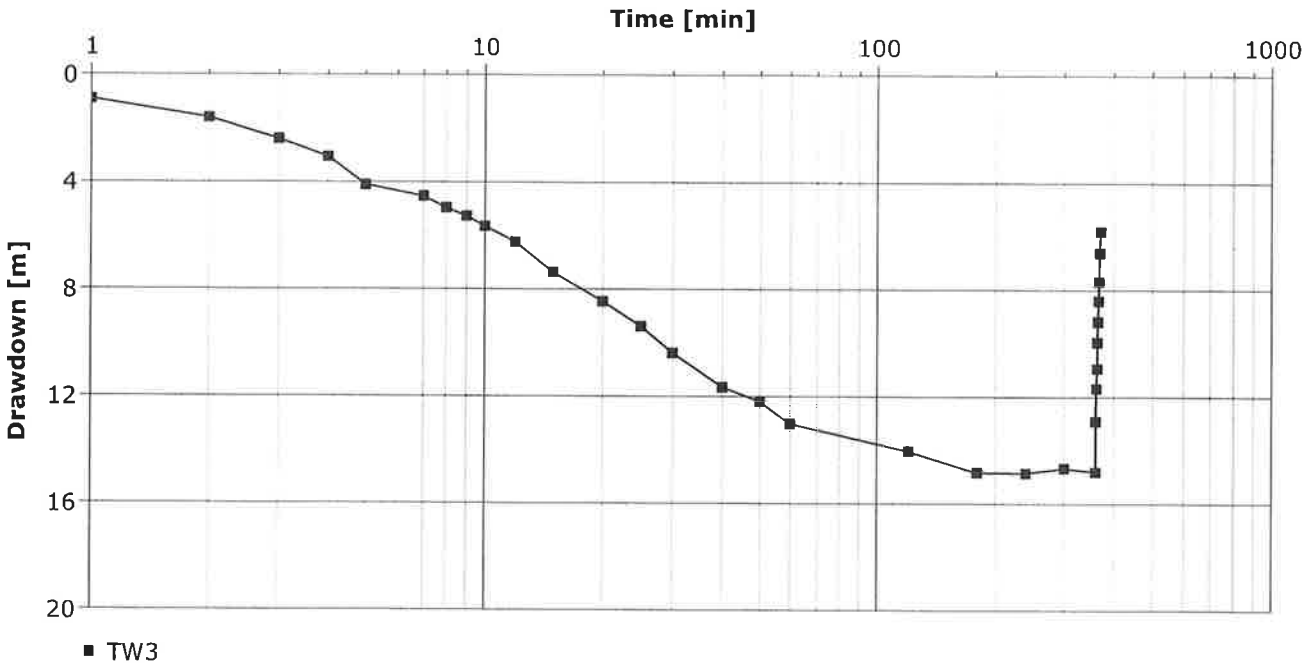
Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 2	Pumping Well: TW2
Test Conducted by: HCE Ltd.	Test Date: 6/19/2013	Discharge Rate: 8 [U.S. gal/min]
Observation Well: TW2	Static Water Level [m]: 1.65	Radial Distance to PW [m]: -

	Time [min]	Water Level [m]	Drawdown [m]
1	1	3.60	1.95
2	2	4.28	2.63
3	3	4.85	3.20
4	4	5.33	3.68
5	5	5.80	4.15
6	7	6.29	4.64
7	8	6.51	4.86
8	9	6.70	5.05
9	10	6.85	5.20
10	12	7.12	5.47
11	15	7.46	5.81
12	20	7.65	6.00
13	25	7.78	6.13
14	30	7.84	6.19
15	40	7.97	6.32
16	50	8.03	6.38
17	60	8.03	6.38
18	120	8.08	6.43
19	180	8.09	6.44
20	240	8.10	6.45
21	300	8.11	6.46
22	360	8.13	6.48

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Drawdown and recovery	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 6 [U.S. gal/min]	



GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

Pumping Test - Water Level Data

Project: Hydrogeological Investigation

Number:

Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 3	Pumping Well: TW3
Test Conducted by: HCE Ltd.	Test Date: 6/20/2013	Discharge Rate: 6 [U.S. gal/min]
Observation Well: TW3	Static Water Level [m]: 2.03	Radial Distance to PW [m]: -

	Time [min]	Water Level [m]	Drawdown [m]
1	1	2.93	0.90
2	2	3.64	1.61
3	3	4.43	2.40
4	4	5.10	3.07
5	5	6.13	4.10
6	7	6.56	4.53
7	8	6.98	4.95
8	9	7.31	5.28
9	10	7.68	5.65
10	12	8.26	6.23
11	15	9.38	7.35
12	20	10.49	8.46
13	25	11.42	9.39
14	30	12.40	10.37
15	40	13.68	11.65
16	50	14.21	12.18
17	60	15.05	13.02
18	120	16.07	14.04
19	180	16.85	14.82
20	240	16.89	14.86
21	300	16.70	14.67
22	360	16.84	14.81

APPENDIX F

OBSERVED INTERFERENCE EFFECTS

OBSERVATION WELLS

Pumping Interference Effects

Pumping of TW1 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW2	TW3
0 (Static Water Level)	1.66	2.00
1	1.66	2.00
2	1.66	2.00
3	1.66	1.99
4	1.65	1.99
5	1.65	1.99
6	1.65	1.99
Maximum Observed Drawdown	- 0.01 (rise in water level)	- 0.01 (rise in water level)

Pumping of TW2 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW1	TW3
0 (Static Water Level)	3.75	2.00
1	3.74	1.98
2	3.74	1.98
3	3.74	1.97
4	3.74	1.97
5	3.74	1.98
6	3.74	1.98
Maximum Observed Drawdown	- 0.01 (rise in water level)	- 0.02 (rise in water level)

Pumping of TW3 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW1	TW2
0 (Static Water Level)	3.75	1.65
1	3.75	1.64
2	3.75	1.64
3	3.75	1.64
4	3.75	1.64
5	3.75	1.63
6	3.75	1.63
Maximum Observed Drawdown	0.00	- 0.02 (rise in water level)

Radial Distances Between Wells

Pumping Well	Approximate Distance to Observation Well (m)		
	TW1	TW2	TW3
TW1	-	255	430
TW2	255	-	218
TW3	430	218	-

APPENDIX G

LABORATORY CERTIFICATES OF ANALYSES

PUMP TESTS

EXOVA OTTAWA

Certificate of Analysis

Exova

Client:	Houle Chevrier Engineering 180 Wescar Lane, R.R. #2 Carp, ON K0A 1L0	Report Number:	1311934
Attention:	Mr. James McEwen	Date Submitted:	2013-06-18
PO#:		Date Reported:	2013-06-21
Invoice to:	Houle Chevrier Engineering	Project:	11-037
		COC #:	152382

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Jennifer Mitchell 2013.06.21 12:43:16 -04'00'

Jennifer Mitchell
Laboratory Supervisor, Microbiology

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs(for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311934
Date Submitted: 2013-06-18
Date Reported: 2013-06-21
Project: 11-037
COC #: 152382

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1034388 Water 2013-06-18 TW1 - 3Hr	1034389 Water 2013-06-18 TW1 - 6Hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			216	193
	Total Coliforms	0	ct/100mL	MAC-0		60*	10*

Guideline = ODWSOG *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Digitally signed by Lorna Wilson
Date: 2013.06.24 10:14:53 -04'00'

APPROVAL: _____

Lorna Wilson
Laboratory Supervisor, Inorganics

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Exova (Mississauga) is accredited for specific parameters by:
SCC, Standards Council of Canada (to ISO 17025)

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.	
					1034386 Water 2013-06-18 TW1 - 3Hr	1034387 Water 2013-06-18 TW1 - 6Hr
Calculations	Hardness as CaCO3	1	mg/L	OG-100	184*	193*
	Ion Balance	0.01			1.04	1.03
	TDS (COND - CALC)	1	mg/L	AO-500	441	446
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	250	247
	Cl	1	mg/L	AO-250	34	35
	Colour	2	TCU	AO-5	2	<2
	Conductivity	5	uS/cm		678	686
	DOC	0.5	mg/L	AO-5	1.5	1.5
	F	0.10	mg/L	MAC-1.5	1.05	0.99
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	<0.10	<0.10
	pH	1.00		6.5-8.5	8.19	8.16
	S2-	0.01	mg/L	AO-0.05	0.23*	0.75*
	SO4	3	mg/L	AO-500	60	61
	Turbidity	0.1	NTU	MAC-1.0	12.2*	5.9*
Metals	Ca	1	mg/L		39	41
	Fe	0.03	mg/L	AO-0.3	0.19	0.08
	K	1	mg/L		5	5
	Mg	1	mg/L		21	22
	Mn	0.01	mg/L	AO-0.05	<0.01	<0.01
	Na	2	mg/L	AO-200	85	80
Nutrients	N-NH3	0.02	mg/L		0.30	0.32
	Phenols	0.001	mg/L		<0.001	<0.001
	Tannin & Lignin	0.1	mg/L		<0.1	0.3
	Total Kjeldahl Nitrogen	0.10	mg/L		0.40	0.42

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-06-21 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 252705 **Analysis Date** 2013-06-19 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	98	85-115
Run No 252709 **Analysis Date** 2013-06-19 **Method** C SM2120C			
Colour	<2 TCU	95	90-110
Run No 252719 **Analysis Date** 2013-06-19 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127
Run No 252755 **Analysis Date** 2013-06-19 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	120	80-120
N-NO3	<0.10 mg/L	83	80-120
Run No 252768 **Analysis Date** 2013-06-19 **Method** M SM3120B-3500C			
Ca	<1 mg/L	108	80-120

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
K	<1 mg/L	108	80-120
Mg	<1 mg/L	102	80-120
Na	<2 mg/L	107	80-120
Run No 252769 **Analysis Date** 2013-06-19 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	104	
Run No 252780 **Analysis Date** 2013-06-20 **Method** C SM5550B			
Tannin & Lignin	<0.1 mg/L	100	80-120
Run No 252784 **Analysis Date** 2013-06-20 **Method** SM 4110C			
Cl	<1 mg/L	99	90-110
SO4	<3 mg/L	105	90-110
Run No 252789 **Analysis Date** 2013-06-19 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	97	95-105
Conductivity	<5 uS/cm	100	95-105
F	<0.10 mg/L	101	90-110
pH	5.77	100	90-110
Run No 252870 **Analysis Date** 2013-06-21 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	105	77-123

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 252878 **Analysis Date** 2013-06-21 **Method** C SM5530D			
Phenols	<0.001 mg/L	106	73-127
Run No 252923 **Analysis Date** 2013-06-21 **Method** EPA 200.8			
Fe	<0.03 mg/L	111	88-112
Mn	<0.01 mg/L	102	91-109
Run No 252933 **Analysis Date** 2013-06-21 **Method** C SM5310C			
DOC	<0.5 mg/L	98	84-116

Guideline = ODWSOG *** = Guideline Exceedence**
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EXOVA OTTAWA

Certificate of Analysis

Exova

Client:	Houle Chevrier Engineering	Report Number:	1312115
	180 Wescar Lane, R.R. #2	Date Submitted:	2013-06-19
	Carp, ON	Date Reported:	2013-06-21
	K0A 1L0	Project:	11-037
Attention:	Mr. James McEwen	COC #:	37670
PO#:			
Invoice to:	Houle Chevrier Engineering		

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Jennifer Mitchell 2013.06.21 16:06:02 -04'00'

Jennifer Mitchell
Laboratory Supervisor, Microbiology

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CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs(for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312115
Date Submitted: 2013-06-19
Date Reported: 2013-06-21
Project: 11-037
COC #: 37670

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1034818 Water 2013-06-19 TW2 - 3Hr	1034819 Water 2013-06-19 TW2 - 6Hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			15	23
	Total Coliforms	0	ct/100mL	MAC-0		3*	3*

Guideline = ODWSOG *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Digitally signed by Lorna Wilson Date: 2013.06.26 16:34:50 -04'00'

Lorna Wilson
Laboratory Supervisor, Inorganics

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

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SCC, Standards Council of Canada (to ISO 17025)

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

				Lab I.D.	1034957	1034958
				Sample Matrix	Water	Water
				Sample Type		
				Sampling Date	2013-06-19	2013-06-19
				Sample I.D.	TW2-3hr	TW2-6hr
Group	**Analyte**	**MRL**	**Units**	**Guideline**		
Calculations	Hardness as CaCO3	1	mg/L	OG-100	261*	256*
	Ion Balance	0.01			0.95	0.97
	TDS (COND - CALC)	1	mg/L	AO-500	360	359
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	191	189
	Cl	1	mg/L	AO-250	32	32
	Colour	2	TCU	AO-5	2	<2
	Conductivity	5	uS/cm		554	553
	DOC	0.5	mg/L	AO-5	1.1	1.2
	F	0.10	mg/L	MAC-1.5	0.23	0.24
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	2.78	<0.10
	pH	1.00		6.5-8.5	8.09	8.06
	S2-	0.01	mg/L	AO-0.05	0.11*	0.11*
	SO4	3	mg/L	AO-500	60	60
	Turbidity	0.1	NTU	MAC-1.0	15.5*	5.0*
Metals	Ca	1	mg/L		65	63
	Fe	0.03	mg/L	AO-0.3	0.58*	0.24
	K	1	mg/L		3	3
	Mg	1	mg/L		24	24
	Mn	0.01	mg/L	AO-0.05	0.01	<0.01
	Na	2	mg/L	AO-200	13	13
Nutrients	N-NH3	0.02	mg/L		0.08	0.09
	Phenols	0.001	mg/L		<0.001	<0.001
	Tannin & Lignin	0.1	mg/L		0.2	0.2
	Total Kjeldahl Nitrogen	0.10	mg/L		0.17	<0.10

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-06-26 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 252780 **Analysis Date** 2013-06-20 **Method** C SM5550B			
Tannin & Lignin	<0.1 mg/L	100	80-120
Run No 252830 **Analysis Date** 2013-06-20 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127
Run No 252873 **Analysis Date** 2013-06-21 **Method** C SM2120C			
Colour	<2 TCU	100	90-110
Run No 252874 **Analysis Date** 2013-06-21 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	101	85-115
Run No 252915 **Analysis Date** 2013-06-21 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	110	80-120
N-NO3	<0.10 mg/L	92	80-120

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 252923 **Analysis Date** 2013-06-21 **Method** EPA 200.8			
Fe	<0.03 mg/L	111	88-112
Mn	<0.01 mg/L	102	91-109
Run No 252966 **Analysis Date** 2013-06-21 **Method** SM 4110C			
Cl	<1 mg/L	100	90-110
SO4	<3 mg/L	108	90-110
Run No 252976 **Analysis Date** 2013-06-21 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	99	95-105
Conductivity	<5 uS/cm	101	95-105
F	<0.10 mg/L	100	90-110
pH	5.92	100	90-110
Run No 253037 **Analysis Date** 2013-06-25 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	98	77-123
Run No 253111 **Analysis Date** 2013-06-25 **Method** M SM3120B-3500C			
Ca	<1 mg/L	100	80-120
K	<1 mg/L	111	80-120
Mg	<1 mg/L	96	80-120

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Na	<2 mg/L	106	80-120
Run No 253133 **Analysis Date** 2013-06-25 **Method** C SM5310C			
DOC	<0.5 mg/L	97	84-116
Run No 253151 **Analysis Date** 2013-06-26 **Method** C SM5530D			
Phenols	<0.001 mg/L	125	73-127
Run No 253199 **Analysis Date** 2013-06-26 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	104	

Guideline = ODWSOG *** = Guideline Exceedence**
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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312314
Date Submitted: 2013-06-21
Date Reported: 2013-06-24
Project: 11-037
COC #: 37746

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Dragana Dzeletovic 2013.06.24 11:53:17 -04'00'

Dragana Dzeletovic
Microbiology Laboratory Team Lead

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAF, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312314
Date Submitted: 2013-06-21
Date Reported: 2013-06-24
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035339 Water 2013-06-20 TW3-3hr	1035340 Water 2013-06-20 TW3-6hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			2	6
	Total Coliforms	0	ct/100mL	MAC-0		0	0

Guideline = ODWSOG *** = Guideline Exceedence**
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Methods references and/or additional QA/QC information available on request.

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Diana Cameron 2013.06.28 12:58:59 -04'00'

Diana Cameron
Team Leader, Inorganics

APPROVAL: Charlie Qu 2013.06.28 12:20:49 -04'00'

Charlie (Long) Qu
Laboratory Supervisor, Organics

Exova (Ottawa) is certified and accredited for specific parameters by:
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Exova (Mississauga) is accredited for specific parameters by:
SCC, Standards Council of Canada (to ISO 17025)

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
Calculations	Hardness as CaCO3	1	mg/L	OG-100		263*	261*
	Ion Balance	0.01				0.91	0.91
	TDS (COND - CALC)	1	mg/L	AO-500		384	383
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500		184	183
	Cl	1	mg/L	AO-250		46	48
	Colour	2	TCU	AO-5		2	<2
	Conductivity	5	uS/cm			591	589
	DOC	0.5	mg/L	AO-5		1.2	1.2
	F	0.10	mg/L	MAC-1.5		0.10	0.10
	N-NO2	0.10	mg/L	MAC-1.0		<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0		0.67	0.46
	pH	1.00		6.5-8.5		7.94	7.95
	S2-	0.01	mg/L	AO-0.05		<0.01	<0.01
	SO4	3	mg/L	AO-500		61	59
	Turbidity	0.1	NTU	MAC-1.0		2.8*	2.7*
Herbicide/Pesticide	Alachlor	1.0	ug/L	IMAC-5			<1.0
	Atrazine	1.0	ug/L				<1.0
	Azinphos-methyl	2	ug/L	MAC-20			<2
	Bendiocarb	2	ug/L	MAC-40			<2
	Carbaryl	5	ug/L	MAC-90			<5
	Carbofuran	5	ug/L	MAC-90			<5
	Chlorpyrifos	1	ug/L	MAC-90			<1
	Cyanazine	1	ug/L	IMAC-10			<1
	De-ethylated atrazine	1.0	ug/L				<1.0
	Diazinon	1	ug/L	MAC-20			<1
	Diclofop-methyl	1.0	ug/L	MAC-9			<1.0

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
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K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
Herbicide/Pesticide	Dimethoate	2.5	ug/L	IMAC-20			<2.5
	Malathion	5	ug/L	MAC-190			<5
	Metolachlor	1.0	ug/L	IMAC-50			<1.0
	Metribuzin	5	ug/L	MAC-80			<5
	Parathion	1	ug/L	MAC-50			<1
	Phorate	1.0	ug/L	IMAC-2			<1.0
	Prometryne	1.0	ug/L	IMAC-1			<1.0
	Simazine	1	ug/L	IMAC-10			<1
	Temephos	10	ug/L	IMAC-280			<10
	Terbufos	1.0	ug/L	IMAC-1			<1.0
	Triallate	1	ug/L	MAC-230			<1
	Trifluralin	1.0	ug/L	IMAC-45			<1.0
Hydrocarbons	F1 (C6-C10)	0.1	mg/L				<0.1
	F2 (C10-C16)	0.1	mg/L				<0.1
	F3 (C16-C34)	0.2	mg/L				<0.2
	F4 (C34-C50)	0.2	mg/L				<0.2
Metals	Ca	1	mg/L			74	73
	Fe	0.03	mg/L	AO-0.3		0.18	0.26
	K	1	mg/L			2	2
	Mg	1	mg/L			19	19
	Mn	0.01	mg/L	AO-0.05		<0.01	<0.01
	Na	2	mg/L	AO-200		10	11
Nutrients	N-NH3	0.02	mg/L			<0.02	0.06
	Phenols	0.001	mg/L			<0.001	<0.001
	Tannin & Lignin	0.1	mg/L			0.2	0.1
	Total Kjeldahl Nitrogen	0.10	mg/L			0.17	0.24

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Client: Houle Chevrier Engineering
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K0A 1L0
Attention: Mr. James McEwen
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Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	1,1,1,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,1-trichloroethane	0.4	ug/L				<0.4
	1,1,2,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,2-trichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethylene	0.5	ug/L	MAC-14			<0.5
	1,2-dibromoethane	0.2	ug/L				<0.2
	1,2-dichlorobenzene	0.4	ug/L	MAC-200			<0.4
	1,2-dichloroethane	0.2	ug/L	IMAC-5			<0.2
	1,2-dichloroethane-d4	1	%				102
	1,2-dichloropropane	0.5	ug/L				<0.5
	1,3,5-trimethylbenzene	0.3	ug/L				<0.3
	1,3-dichlorobenzene	0.4	ug/L				<0.4
	1,4-dichlorobenzene	0.4	ug/L	MAC-5			<0.4
	4-bromofluorobenzene	1	%				100
	Benzene	0.5	ug/L	MAC-5			<0.5
	Bromodichloromethane	0.3	ug/L				<0.3
	Bromoform	0.4	ug/L				<0.4
	Bromomethane	0.5	ug/L				<0.5
	c-1,2-Dichloroethylene	0.4	ug/L				<0.4
	c-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Carbon Tetrachloride	0.2	ug/L	MAC-5			<0.2
	Chloroethane	0.2	ug/L				<0.2
	Chloroform	0.5	ug/L				<0.5
	Chloromethane	0.2	ug/L				<0.2
	Dibromochloromethane	0.3	ug/L				<0.3

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	Dichlorodifluoromethane	0.5	ug/L				<0.5
	Dichloromethane	4.0	ug/L	MAC-50			<4.0
	Ethylbenzene	0.5	ug/L	AO-2.4			<0.5
	m/p-xylene	0.5	ug/L				<0.5
	Monochlorobenzene	0.2	ug/L	MAC-80			<0.2
	o-xylene	0.5	ug/L				<0.5
	Styrene	0.5	ug/L				<0.5
	t-1,2-Dichloroethylene	0.4	ug/L				<0.4
	t-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Tetrachloroethylene	0.3	ug/L	MAC-30			<0.3
	Toluene	0.5	ug/L	AO-24			<0.5
	Toluene-d8	1	%				103
	Trichloroethylene	0.3	ug/L	MAC-5			<0.3
	Trichlorofluoromethane	0.5	ug/L				<0.5
	Vinyl Chloride	0.2	ug/L	MAC-2			<0.2
	Xylene; total	1.0	ug/L	AO-300			<1.0

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APPENDIX H

LABORATORY CERTIFICATES OF ANALYSES

SUPPLEMENTAL TESTING OF TEST WELLS TW1 AND TW2

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317890
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: Craig Thompson 2013.08.28 16:40:50 -04'00'

Craig Thompson
Project Manager

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CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317890
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.		
					1051186 Water 2013-08-19 TW1-R1	1051187 Water 2013-08-19 TW1-R2	
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0	0	0	
	Faecal Coliforms	0	ct/100mL		0	0	
	Faecal Streptococcus	0	ct/100mL		0	0	
	Heterotrophic Plate Count	0	ct/1mL		4	7	
	Total Coliforms	0	ct/100mL	MAC-0	0	0	

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number:	1317896
Date Submitted:	2013-08-19
Date Reported:	2013-08-22
Project:	11-037
COC #:	160506

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: Craig Thompson 2013.08.28 16:43:24 -04'00'

Craig Thompson
Project Manager

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317896
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

				Lab I.D.	1051196
				Sample Matrix	Water
				Sample Type	
				Sampling Date	2013-08-19
				Sample I.D.	TW1 - R2
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
General Chemistry	Turbidity	0.1	NTU	MAC-1.0	0.7

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317896
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 256307 **Analysis Date** 2000-00-13 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127

Guideline = ODWSOG *** = Guideline Exceedence**
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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1315482
Date Submitted: 2013-07-22
Date Reported: 2013-07-25
Project: 11-037
COC #: 160501

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: Craig Thompson 2013.08.28 16:35:19 -04'00'

Craig Thompson
Project Manager

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1315482
Date Submitted: 2013-07-22
Date Reported: 2013-07-25
Project: 11-037
COC #: 160501

				Lab I.D.	1044356	1044357
				Sample Matrix	Water	Water
				Sample Type		
				Sampling Date	2013-07-22	2013-07-22
				Sample I.D.	TW2-R1	TW2-R2
Group	**Analyte**	**MRL**	**Units**	**Guideline**		
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0	0	0
	Faecal Coliforms	0	ct/100mL		0	0
	Faecal Streptococcus	0	ct/100mL		1	0
	Heterotrophic Plate Count	0	ct/1mL		2	0
	Total Coliforms	0	ct/100mL	MAC-0	0	0

Guideline = ODWSOG *** = Guideline Exceedence**
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APPENDIX I

LABORATORY CERTIFICATES OF ANALYSES

ADDITIONAL WATER TEST ANALYSIS
TEST WELL TW3

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
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Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Diana Cameron 2013.06.28 12:58:59 -04'00'

Diana Cameron
Team Leader, Inorganics

APPROVAL: Charlie Qu 2013.06.28 12:20:49 -04'00'

Charlie (Long) Qu
Laboratory Supervisor, Organics

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EXOVA OTTAWA

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Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.					
Calculations	Hardness as CaCO3	1	mg/L	OG-100	263*	261*
	Ion Balance	0.01			0.91	0.91
	TDS (COND - CALC)	1	mg/L	AO-500	384	383
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	184	183
	Cl	1	mg/L	AO-250	46	48
	Colour	2	TCU	AO-5	2	<2
	Conductivity	5	uS/cm		591	589
	DOC	0.5	mg/L	AO-5	1.2	1.2
	F	0.10	mg/L	MAC-1.5	0.10	0.10
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	0.67	0.46
	pH	1.00		6.5-8.5	7.94	7.95
	S2-	0.01	mg/L	AO-0.05	<0.01	<0.01
	SO4	3	mg/L	AO-500	61	59
	Turbidity	0.1	NTU	MAC-1.0	2.8*	2.7*
Herbicide/Pesticide	Alachlor	1.0	ug/L	IMAC-5		<1.0
	Atrazine	1.0	ug/L			<1.0
	Azinphos-methyl	2	ug/L	MAC-20		<2
	Bendiocarb	2	ug/L	MAC-40		<2
	Carbaryl	5	ug/L	MAC-90		<5
	Carbofuran	5	ug/L	MAC-90		<5
	Chlorpyrifos	1	ug/L	MAC-90		<1
	Cyanazine	1	ug/L	IMAC-10		<1
	De-ethylated atrazine	1.0	ug/L			<1.0
	Diazinon	1	ug/L	MAC-20		<1
	Diclofop-methyl	1.0	ug/L	MAC-9		<1.0

Guideline = ODWSOG *** = Guideline Exceedence**
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Attention: Mr. James McEwen
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Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.					
Herbicide/Pesticide	Dimethoate	2.5	ug/L	IMAC-20		<2.5
	Malathion	5	ug/L	MAC-190		<5
	Metolachlor	1.0	ug/L	IMAC-50		<1.0
	Metribuzin	5	ug/L	MAC-80		<5
	Parathion	1	ug/L	MAC-50		<1
	Phorate	1.0	ug/L	IMAC-2		<1.0
	Prometryne	1.0	ug/L	IMAC-1		<1.0
	Simazine	1	ug/L	IMAC-10		<1
	Temephos	10	ug/L	IMAC-280		<10
	Terbufos	1.0	ug/L	IMAC-1		<1.0
	Triallate	1	ug/L	MAC-230		<1
	Trifluralin	1.0	ug/L	IMAC-45		<1.0
Hydrocarbons	F1 (C6-C10)	0.1	mg/L			<0.1
	F2 (C10-C16)	0.1	mg/L			<0.1
	F3 (C16-C34)	0.2	mg/L			<0.2
	F4 (C34-C50)	0.2	mg/L			<0.2
Metals	Ca	1	mg/L		74	73
	Fe	0.03	mg/L	AO-0.3	0.18	0.26
	K	1	mg/L		2	2
	Mg	1	mg/L		19	19
	Mn	0.01	mg/L	AO-0.05	<0.01	<0.01
	Na	2	mg/L	AO-200	10	11
Nutrients	N-NH3	0.02	mg/L		<0.02	0.06
	Phenols	0.001	mg/L		<0.001	<0.001
	Tannin & Lignin	0.1	mg/L		0.2	0.1
	Total Kjeldahl Nitrogen	0.10	mg/L		0.17	0.24

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	1,1,1,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,1-trichloroethane	0.4	ug/L				<0.4
	1,1,2,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,2-trichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethylene	0.5	ug/L	MAC-14			<0.5
	1,2-dibromoethane	0.2	ug/L				<0.2
	1,2-dichlorobenzene	0.4	ug/L	MAC-200			<0.4
	1,2-dichloroethane	0.2	ug/L	IMAC-5			<0.2
	1,2-dichloroethane-d4	1	%				102
	1,2-dichloropropane	0.5	ug/L				<0.5
	1,3,5-trimethylbenzene	0.3	ug/L				<0.3
	1,3-dichlorobenzene	0.4	ug/L				<0.4
	1,4-dichlorobenzene	0.4	ug/L	MAC-5			<0.4
	4-bromofluorobenzene	1	%				100
	Benzene	0.5	ug/L	MAC-5			<0.5
	Bromodichloromethane	0.3	ug/L				<0.3
	Bromoform	0.4	ug/L				<0.4
	Bromomethane	0.5	ug/L				<0.5
	c-1,2-Dichloroethylene	0.4	ug/L				<0.4
	c-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Carbon Tetrachloride	0.2	ug/L	MAC-5			<0.2
	Chloroethane	0.2	ug/L				<0.2
	Chloroform	0.5	ug/L				<0.5
	Chloromethane	0.2	ug/L				<0.2
	Dibromochloromethane	0.3	ug/L				<0.3

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Report Number: 1312344
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Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	Dichlorodifluoromethane	0.5	ug/L				<0.5
	Dichloromethane	4.0	ug/L	MAC-50			<4.0
	Ethylbenzene	0.5	ug/L	AO-2.4			<0.5
	m/p-xylene	0.5	ug/L				<0.5
	Monochlorobenzene	0.2	ug/L	MAC-80			<0.2
	o-xylene	0.5	ug/L				<0.5
	Styrene	0.5	ug/L				<0.5
	t-1,2-Dichloroethylene	0.4	ug/L				<0.4
	t-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Tetrachloroethylene	0.3	ug/L	MAC-30			<0.3
	Toluene	0.5	ug/L	AO-24			<0.5
	Toluene-d8	1	%				103
	Trichloroethylene	0.3	ug/L	MAC-5			<0.3
	Trichlorofluoromethane	0.5	ug/L				<0.5
	Vinyl Chloride	0.2	ug/L	MAC-2			<0.2
	Xylene; total	1.0	ug/L	AO-300			<1.0

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APPENDIX J

LABORATORY CERTIFICATES OF ANALYSES

PRIVATE WELL SAMPLING

EXOVA OTTAWA

Certificate of Analysis

Exova

Client:	Houle Chevrier Engineering 180 Wescar Lane, R.R. #2 Carp, ON K0A 1L0	Report Number:	1319998
Attention:	Mr. James McEwen	Date Submitted:	2013-09-11
PO#:		Date Reported:	2013-09-16
Invoice to:	Houle Chevrier Engineering	Project:	11-037
		COC #:	160507

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Krista Quantrill 2013.09.16 08:55:13 -04'00'

Krista Quantrill
Laboratory Supervisor, Microbiology

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Exova (Mississauga) is accredited for specific parameters by:
SCC, Standards Council of Canada (to ISO 17025)

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1319998
Date Submitted: 2013-09-11
Date Reported: 2013-09-16
Project: 11-037
COC #: 160507

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1057265 Water 2013-09-11 PW 1	1057266 Water 2013-09-11 PW 2
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			0	0
	Total Coliforms	0	ct/100mL	MAC-0		0	0

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EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number:	1320010
Date Submitted:	2013-09-11
Date Reported:	2013-09-17
Project:	11-037
COC #:	160507

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Digitally signed by Lorna Wilson Date: 2013.09.17 13:10:41 -04'00'

Lorna Wilson
Laboratory Supervisor, Inorganics

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Exova (Mississauga) is accredited for specific parameters by:
SCC, Standards Council of Canada (to ISO 17025)

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1320010
Date Submitted: 2013-09-11
Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1057281 Water 2013-09-11 PW 1	1057282 Water 2013-09-11 PW 2
Calculations	Hardness as CaCO3	1	mg/L	OG-100		252*	220*
	Ion Balance	0.01				1.08	1.05
	TDS (COND - CALC)	1	mg/L	AO-500		339	647*
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500		156	227
	Cl	1	mg/L	AO-250		44	127
	Colour	2	TCU	AO-5		2	2
	Conductivity	5	uS/cm			521	996
	DOC	0.5	mg/L	AO-5		1.1	1.9
	F	0.10	mg/L	MAC-1.5		<0.10	<0.10
	N-NO2	0.10	mg/L	MAC-1.0		<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0		<0.10	9.57
	pH	1.00		6.5-8.5		7.82	7.75
	S2-	0.01	mg/L	AO-0.05		<0.01	<0.01
	SO4	3	mg/L	AO-500		48	39
	Turbidity	0.1	NTU	MAC-1.0		2.7*	0.2
Metals	Ca	1	mg/L			73	75
	Fe	0.03	mg/L	AO-0.3		0.21	0.03
	K	1	mg/L			2	1
	Mg	1	mg/L			17	8
	Mn	0.01	mg/L	AO-0.05		0.02	<0.01
	Na	2	mg/L	AO-200		16	131
Nutrients	N-NH3	0.02	mg/L			0.05	0.05
	Phenols	0.001	mg/L			<0.001	<0.001
	Tannin & Lignin	0.1	mg/L			<0.1	<0.1
	Total Kjeldahl Nitrogen	0.10	mg/L			<0.10	<0.10

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K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1320010
Date Submitted: 2013-09-11
Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-09-16 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 257516 **Analysis Date** 2013-09-12 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	95	85-115
Run No 257596 **Analysis Date** 2013-09-13 **Method** C SM2120C			
Colour	<2 TCU	105	90-110
Run No 257598 **Analysis Date** 2013-09-13 **Method** C SM5530D			
Phenols	<0.001 mg/L	92	73-127
Run No 257599 **Analysis Date** 2013-09-13 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	102	77-123
Run No 257603 **Analysis Date** 2013-09-13 **Method** C SM2130B			
Turbidity	<0.1 NTU	100	73-127
Run No 257604 **Analysis Date** 2013-09-13 **Method** C SM5550B			

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180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1320010
Date Submitted: 2013-09-11
Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Tannin & Lignin	<0.1 mg/L	96	80-120
Run No 257629 **Analysis Date** 2013-09-13 **Method** EPA 200.8			
Fe	<0.03 mg/L	110	88-112
Mn	<0.01 mg/L	103	91-109
Run No 257638 **Analysis Date** 2013-09-13 **Method** M SM3120B-3500C			
Ca	<1 mg/L	100	80-120
K	<1 mg/L	105	80-120
Mg	<1 mg/L	100	80-120
Na	<2 mg/L	110	80-120
Run No 257656 **Analysis Date** 2013-09-13 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	103	80-120
N-NO3	<0.10 mg/L	95	80-120
Run No 257670 **Analysis Date** 2013-09-13 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	101	95-105
Conductivity	<5 uS/cm	99	95-105
F	<0.10 mg/L	103	90-110
pH	5.82	100	90-110

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Report Number: 1320010
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Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 257676 **Analysis Date** 2013-09-13 **Method** SM 4110C			
Cl	<1 mg/L	101	90-110
SO4	<3 mg/L	105	90-110
Run No 257683 **Analysis Date** 2013-09-16 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	107	
Run No 257685 **Analysis Date** 2013-09-16 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	107	80-120
N-NO3	<0.10 mg/L	97	80-120
Run No 257702 **Analysis Date** 2013-09-16 **Method** C SM5310C			
DOC	<0.5 mg/L	102	84-116

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APPENDIX K

PW2 LANGELIER INDEX CALCULATIONS

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Langelier Index calculator (online calculator)

This calculator helps you determine the scaling potential of the water by using the Langelier Saturation Index

Give the values of your water analysis. All the fields with * are required.

Water Temperature (Fahrenheit or Celcius)	6	○ °F ◉ °C
pH	7.75	
TDS (mg/L):	647	
Ca (mg/L):	75	○ $CaCO_3$ ◉ Ca^{2+}
Alkalinity (mg/L as CaCO3):	227	
Langelier Index:	+0.28	Calculate Now! Reset

Saturation Index	Description	General Recommendation
-5	Severe Corrosion	Treatment Recommended
-3	Moderate Corrosion	Treatment Recommended
-2	Moderate Corrosion	Treatment May Be Needed
-1	Mild Corrosion	Treatment May Be Needed
-0.5	None- Mild Corrosion	Probably No Treatment
0	Near Balanced	No Treatment
0.5	Some Faint Coating	Probably No Treatment
1	Mild Scale Coating	Treatment May Be Needed
2	Mild to Moderate Coatings	Treatment May Be Needed
3	Moderate Scale Forming	Treatment Recommended
4	Severe Scale Forming	Treatment Recommended

Click here to get code

Please Note- SI Index is not a reliable means of evaluating corrosion potential, but it can be used as a guide.

Technical Resources

Calculators for Water Treatment
- Chlorine Metering Pump Calculator: CC 's per minute
- Chlorine Metering Pump Sizing
- Fixture Counts
- How to determine pump flow rate on systems with pressure tanks
- **Langelier Index**
- Metric Conversions
- Ozone Demand
- Rainfall
- Multi-Media Sand Filters
- Filter System Flow Rates (English)
- Filter System Flow Rates (Metric)

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Give the values of your water analysis. All the fields with * are required.

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pH	7.75	
TDS (mg/L):	647	
Ca (mg/L):	75	○ $CaCO_3$ ◉ Ca^{2+}
Alkalinity (mg/L as CaCO3):	227	
Langelier Index:	+0.37	Calculate Now! Reset

Saturation Index	Description	General Recommendation
-5	Severe Corrosion	Treatment Recommended
-3	Moderate Corrosion	Treatment Recommended
-2	Moderate Corrosion	Treatment May Be Needed
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-0.5	None- Mild Corrosion	Probably No Treatment
0	Near Balanced	No Treatment
0.5	Some Faint Coating	Probably No Treatment
1	Mild Scale Coating	Treatment May Be Needed
2	Mild to Moderate Coatings	Treatment May Be Needed
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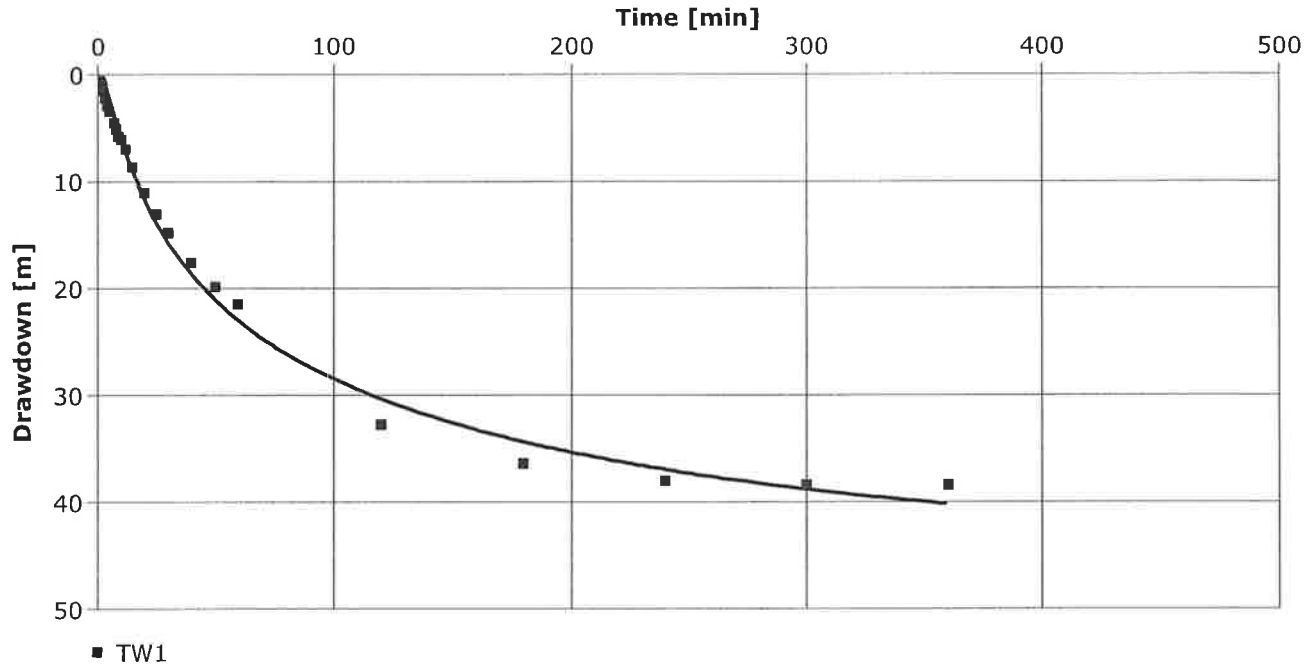
APPENDIX L

AQUIFER TEST PRO
THEIS ANALYSIS RESULTS

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 1	Pumping Well: TW1
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 5 [U.S. gal/min]	

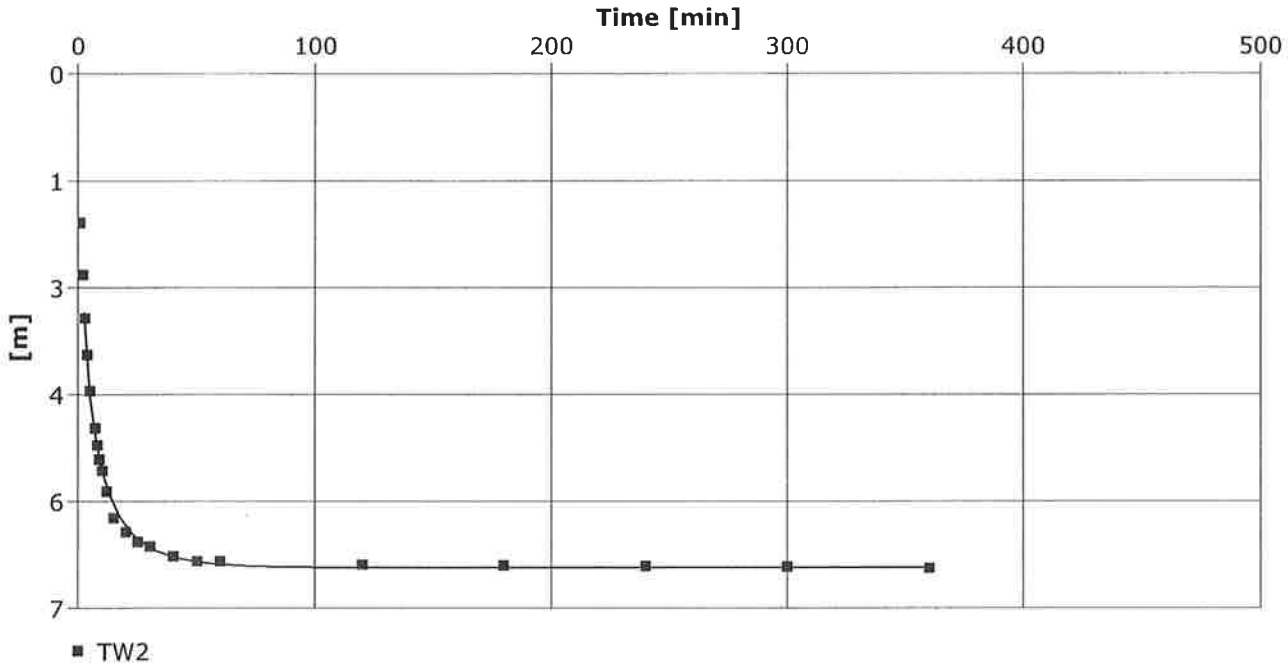


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]
TW1	1.66×10^{-1}		1.30×10^{3}	3.87×10^{-1}	

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 8 [U.S. gal/min]	

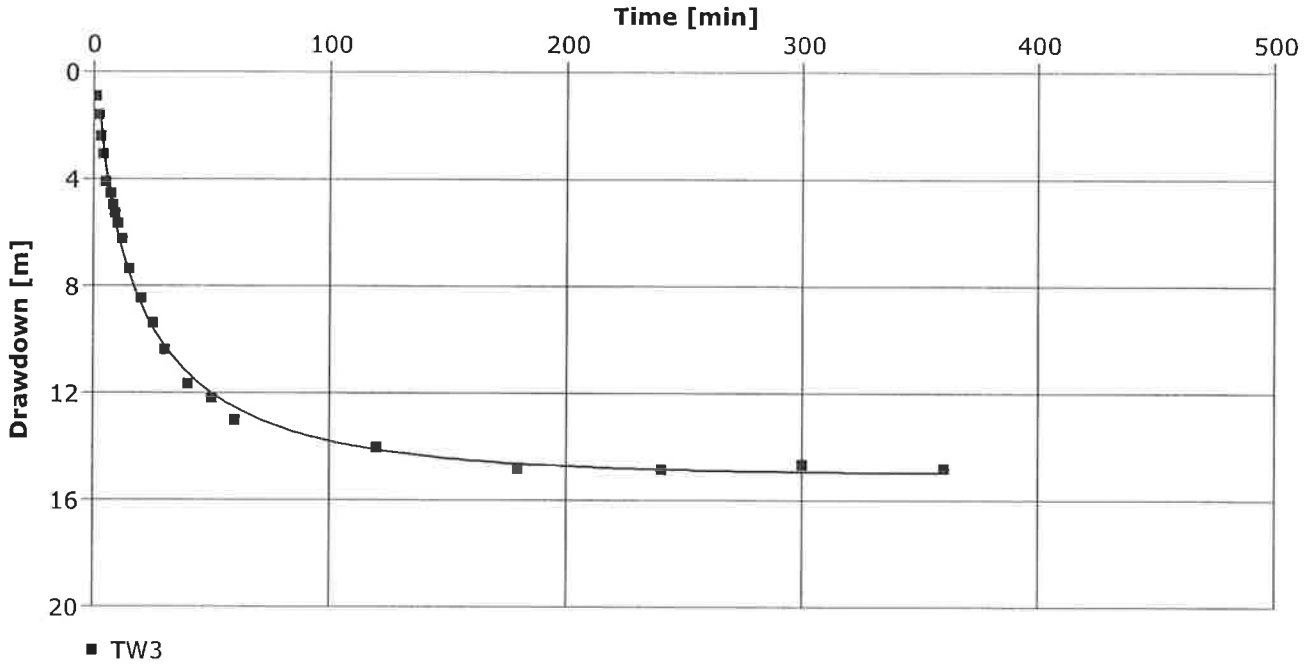


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW2	1.68×10^{0}		8.42×10^{1}	3.14×10^{-1}		

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 6 [U.S. gal/min]	

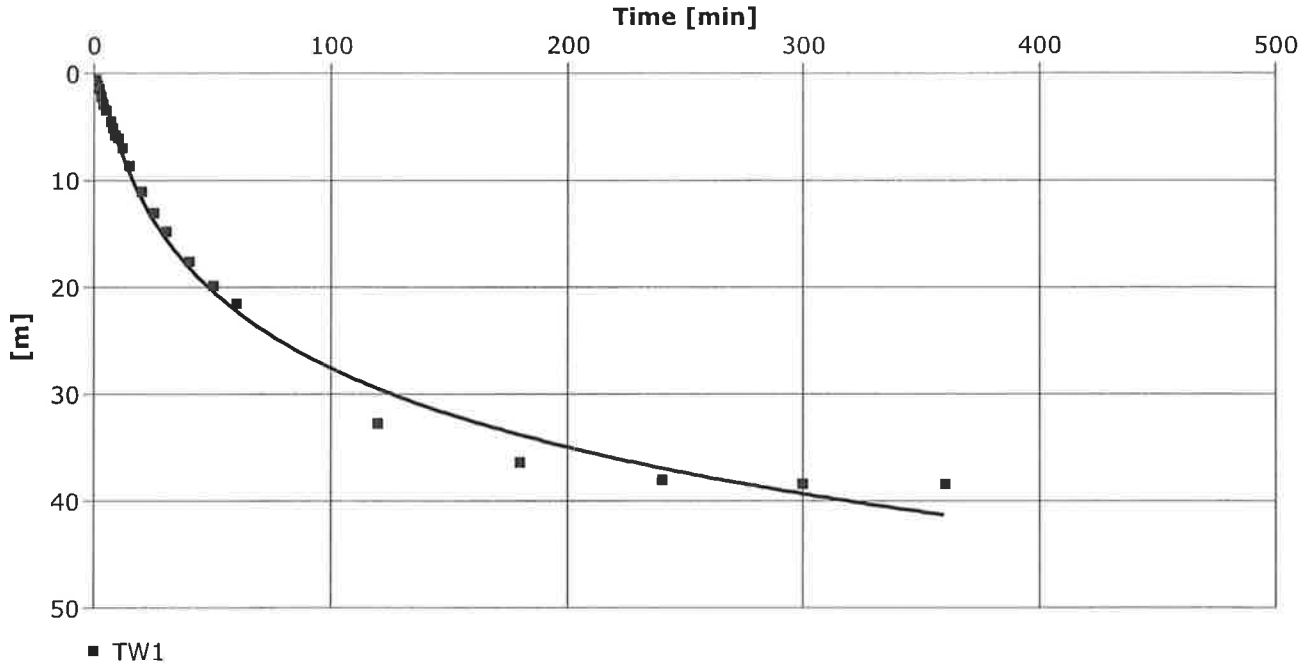


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW3	4.91×10^{-1}		2.08×10^{2}	2.66×10^{-1}		

GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 1	Pumping Well: TW1
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Theis Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 5 [U.S. gal/min]	

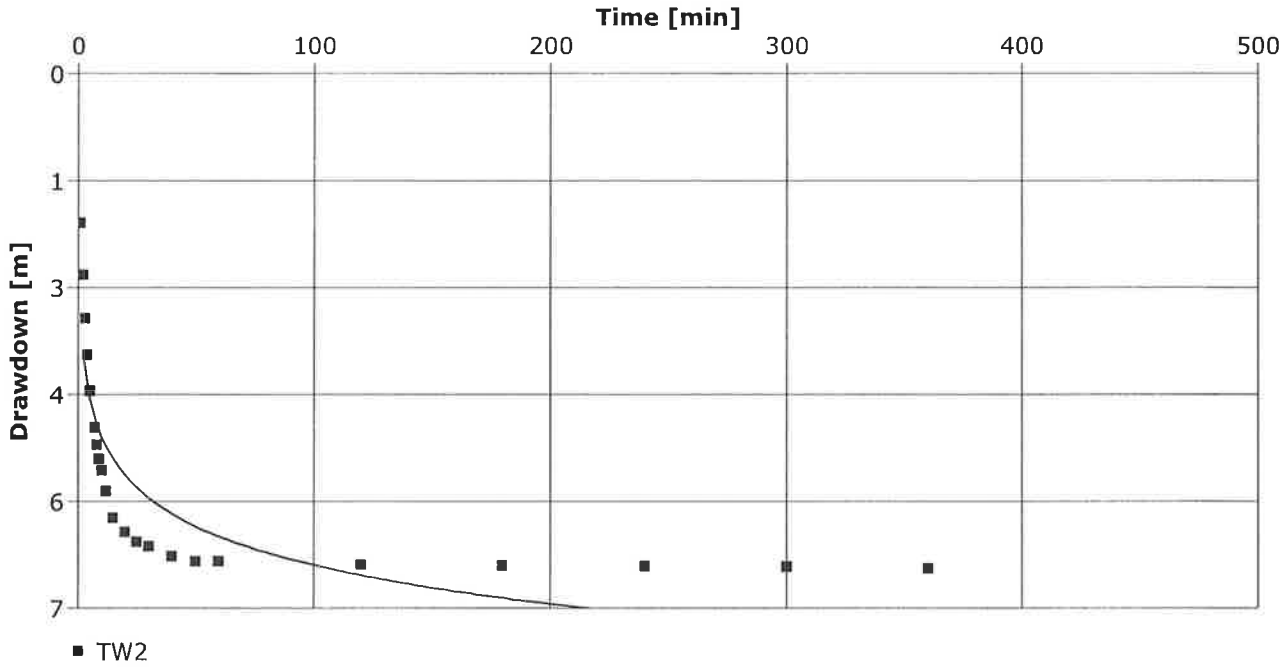


Calculation using Theis

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW1	1.96×10^{-1}		

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Theis Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 8 [U.S. gal/min]	

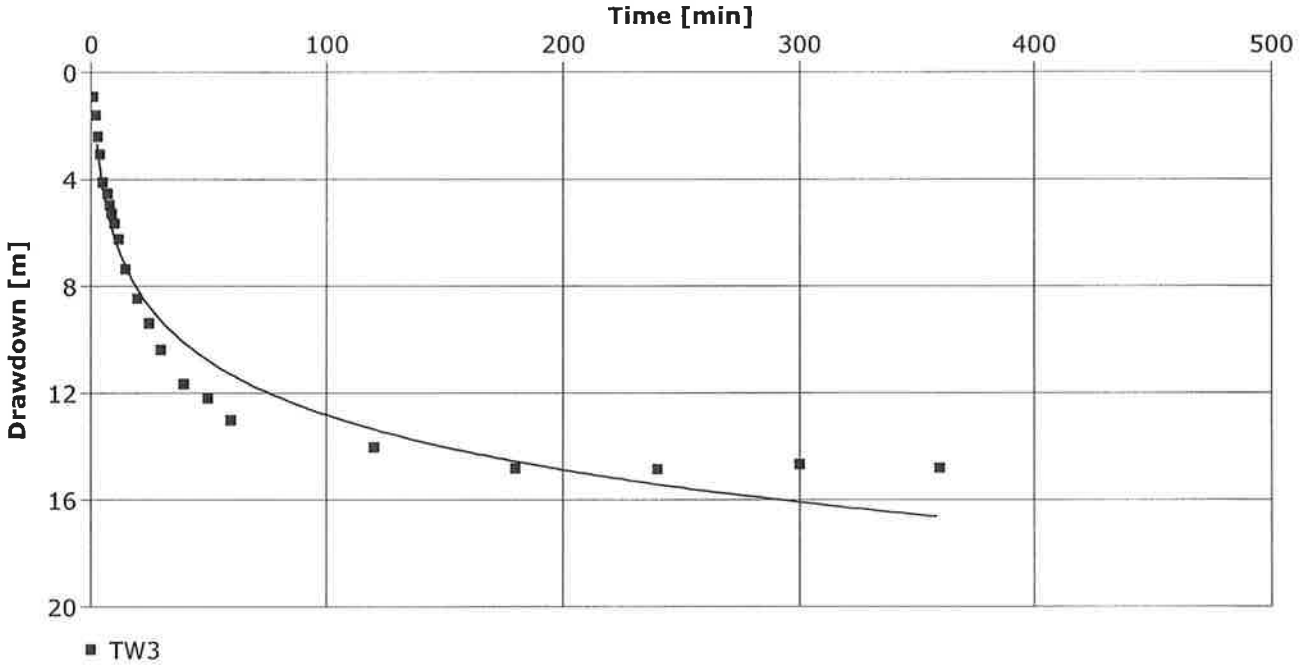


Calculation using Theis

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW2	4.73×10^{0}			

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Theis Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 6 [U.S. gal/min]	

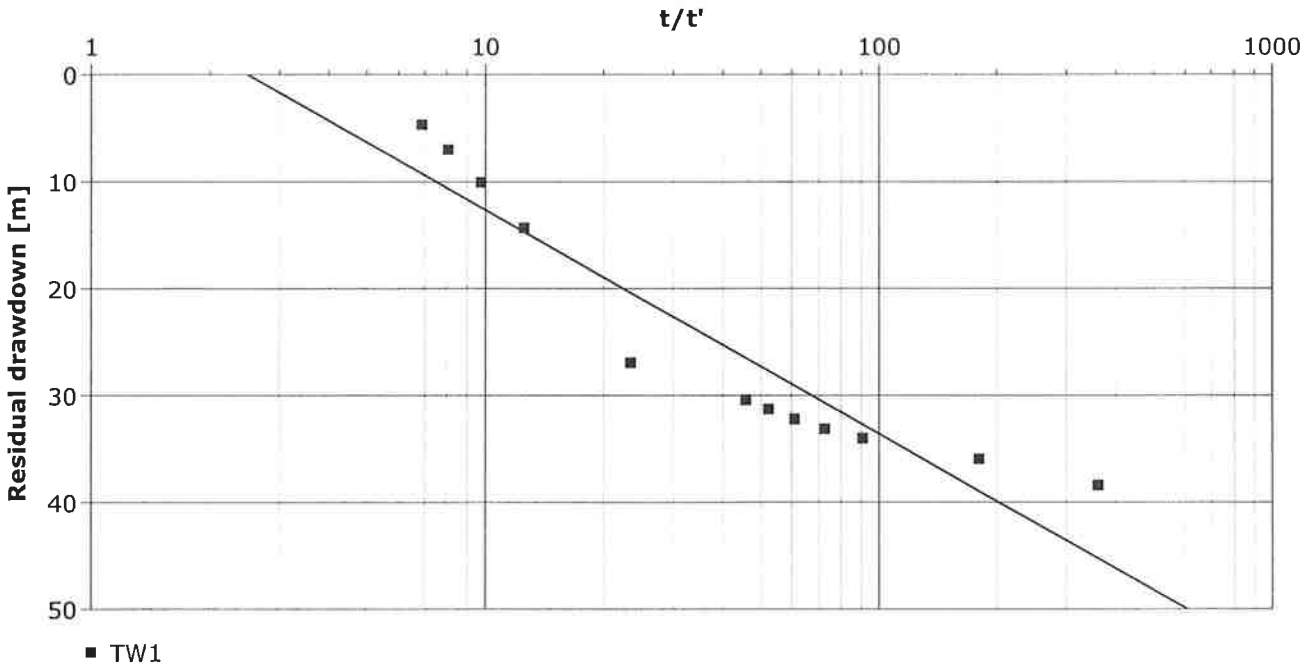


Calculation using Theis

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW3	8.69×10^{-1}			

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 1	Pumping Well: TW1
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 5 [U.S. gal/min]	

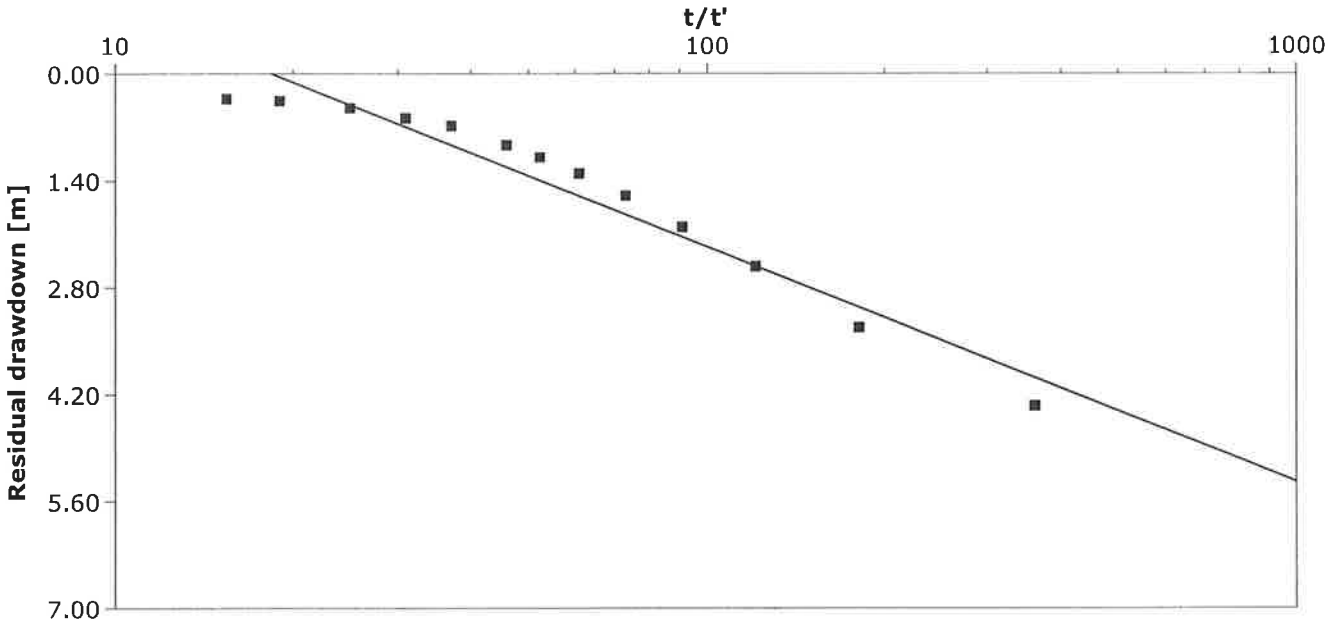


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW1	2.38×10^{-1}		

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report** K
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 8 [U.S. gal/min]	

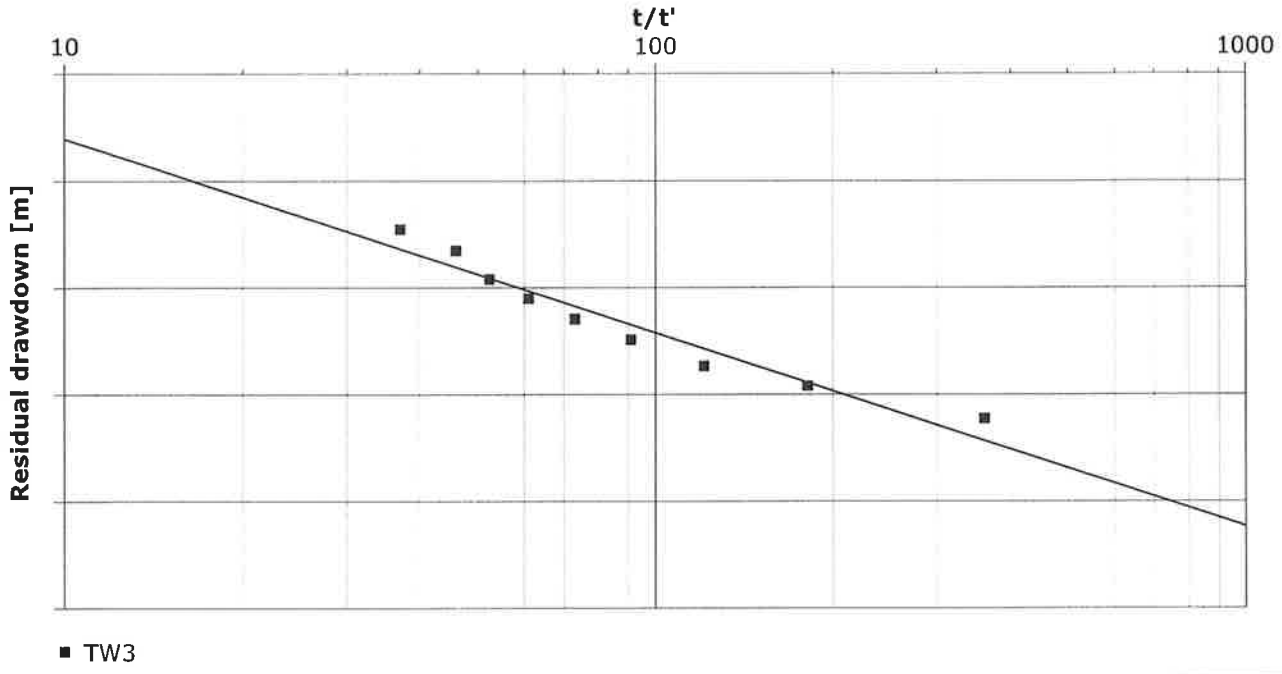


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW2	2.59×10^{0}		

GEMTEC Consulting Engineers and Geoscientists 191 Doak Road Fredericton, NB, Canada	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 6 [U.S. gal/min]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW3	8.25×10^{-1}		

APPENDIX M

ONTARIO MINISTRY OF ENVIRONMENT

WATER WELL RECORD SEARCH RESULTS

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 01(011)	18 421530 5018621[W]	1982/06 3504	06	FR 0125	026 / 120 020 / 0:30	DO		1517897 () BLUE CLAY 0008 BLCK GRNT 0128
HUNTLEY TOWNSHIP CON 02(010)	18 421930 5018421[W]	1980/10 3644	06	FR 0080	025 / 080 004 / 1:0	DO		1517377 () GREY CLAY STNS 0012 GREY LMSN SHLY 0084
HUNTLEY TOWNSHIP CON 02(010)	18 421951 5018122[W]	1960/03 4832	04 04	FR 0178	020 / 021 005 / 0:30	DO		1503064 () CLAY LOAM 0004 GREY LMSN 0180
HUNTLEY TOWNSHIP CON 02(010)	18 421891 5018222[W]	1962/04 4825	04 04	FR 0120	016 / 018 006 / 1:0	DO		1503065 () CLAY 0002 LMSN 0120
HUNTLEY TOWNSHIP CON 02(011)	18 421781 5018487[W]	1964/06 4806	06 06	FR 0105 FR 0071	020 / 090 008 / 1:0	DO		1503070 () LOAM 0004 GREY LMSN 0105
HUNTLEY TOWNSHIP CON 02(011)	18 421766 5018362[W]	1962/05 4825	04 04	FR 0125	020 / 055 006 / 1:30	DO		1503069 () PRDR 0070 LMSN 0130
HUNTLEY TOWNSHIP CON 02(011)	18 421721 5018422[W]	1961/05 4833	04 04	FR 0098	010 / 020 005 / 0:30	DO		1503068 () CLAY LOAM 0014 GREY LMSN 0100
HUNTLEY TOWNSHIP CON 02(011)	18 421921 5018437[W]	2007/08 1119	00	0340 0485	019 / 115 006 / 1:0	DO		7050820 (Z60149) A049703 SAND GRVL 0014 GREY LMSN 0500
HUNTLEY TOWNSHIP CON 02(011)	18 421830 5018321[W]	1977/08 1365	06 06	FR 0041	007 / 030 020 / 2:0	DO		1516282 () BRWN CSND BLDR 0021 WHIT SNDS CGRD 0050
HUNTLEY TOWNSHIP CON 02(011)	18 421726 5018881[W]	1988/11 3142	06 06	UK 0158 FR 0090	015 / 140 007 / 1:30	DO		1523034 (44875) BRWN SAND BLDR PCKD 0019 GREY LMSN HARD 0090 GREY LMSN SHLE PORS 0160
HUNTLEY TOWNSHIP CON 02(011)	18 421630 5018521[W]	1984/06 1558	06 06	SU 0155 SU 0250	020 / 060 015 / 1:0	ST		1519074 () BRWN SAND PCKD 0004 GREY SAND GRVL PCKD 0008 GREY LMSN SOFT 0012 GREY LMSN MGRD 0260
HUNTLEY TOWNSHIP CON 02(011)	18 421930 5018521[W]	1981/09 1558	06 06	SU 0290 FR 0030	020 / 125 005 / 1:0	DO		1517781 () BRWN SAND BLDR 0015 GREY LMSN 0250 BLCK LMSN 0298
HUNTLEY TOWNSHIP CON 02(011)	18 421630 5018521[W]	1980/10 1558	06 06	UK 0048 UK 0145	020 / 040 010 / 1:0	DO		1517526 () BRWN SAND STNS FILL 0004 BRWN CLAY BLDR SNDY 0013 GREY LMSN SOFT 0150
HUNTLEY TOWNSHIP CON 02(011)	18 421731 5018522[W]	1978/06 3644	06	FR 0060	020 / 050 006 / 1:0			1516579 () GREY HPAN GRVL 0010 GREY SHLE GRVL 0042 GREY LMSN 0064
HUNTLEY TOWNSHIP CON 02(011)	18 421943 5018748[W]	1974/07 1558	06 06	FR 0044 FR 0060	025 / 040 030 / 1:0	DO		1514247 () BRWN CLAY SAND PCKD 0006 GREY HPAN BLDR HPAN 0030 GREY LMSN FCRD 0033 GREY LMSN 0062
HUNTLEY TOWNSHIP CON 02(011)	18 421671 5018532[W]	1968/09 4806	06 06	FR 0063 FR 0129	010 / 129 006 / 1:0	DO		1512382 () SHLE 0010 GREY LMSN 0129

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 02(011)	18 421631 5018548[W]	1972/05 1558	06 06	FR 0090 FR 0138	020 / 075 007 / 1:0	DO		1511921 () BRWN SAND FILL 0003 BRWN SAND STNS 0009 GREY LMSN 0141
HUNTLEY TOWNSHIP CON 02(011)	18 421631 5018542[W]	1972/05 3644	05	FR 0139	022 / 070 005 / 1:0	DO		1511759 () GREY CLAY GRVL 0011 GREY LMSN 0139
HUNTLEY TOWNSHIP CON 02(011)	18 421851 5018392[W]	1969/07 4806	06	FR 0073 FR 0121	021 / 080 010 / 1:0	DO		1510511 () GREY SHLE 0009 GREY LMSN 0121
HUNTLEY TOWNSHIP CON 02(012)	18 421096 5018982[W]	2005/11 6574	40 35	FR 0026	021 / 021 022 / 1:0	CO	26 2	1536029 (Z28740) A035191 BRWN SAND 0016 GREY CLAY 0026 GREY GRVL 0029 GREY LMSN 0029
HUNTLEY TOWNSHIP CON 02(012)	18 421715 5019458[L]	1988/08 5222	06	FR 0163	/ 075 025 / 2:0	DO		1523175 (39009) BRWN CLAY SNDY PCKD 0018 GREY CLAY PCKD 0050 GREY CLAY SILT 0115 GREY SILT CLAY LYRD 0155 BRWN SAND GRVL CGVL 0165
HUNTLEY TOWNSHIP CON 02(012)	18 421715 5019458[L]	5222	06 06	SU 0190 FR 0145	/ 006 / 2:0	DO		1524583 (84304) BRWN SAND SLTY PCKD 0005 BRWN SAND PCKD 0015 GREY HPAN BLDR PCKD 0027 GREY SILT 0030 GREY LMSN HARD 0200
HUNTLEY TOWNSHIP CON 02(013)	18 420631 5019702[W]	1967/09 1503	05 05	SU 0198	050 / 058 010 / 1:0	DO		1503071 () CLAY 0110 MSND 0135 LMSN 0200
HUNTLEY TOWNSHIP CON 02(014)	18 420601 5019762[W]	1969/06 1802	06	SU 0165	032 / 165 025 / 1:0	IN IR		1510130 () BRWN MSND 0006 GREY MSND CLAY 0035 GREY CLAY 0100 GREY MSND 0112 GREY MSND GRVL 0131 GREY LMSN 0200
HUNTLEY TOWNSHIP CON 03(010)	18 421900 5017952[W]	2010/02 1119	06 06	0152 0186	012 / 056 020 / 1:0	DO		7141758 (Z108236) A093679 SAND GRVL BLDR 0017 GREY LMSN 0135 GREY LMSN SNDS 0160 GREY LMSN 0200
HUNTLEY TOWNSHIP CON 03(010)	18 421567 5017859[W]	2009/10 1119	06 06	0231	016 / 099 015 / 1:0	DO		7132598 (Z102713) A089342 SAND GRVL BLDR 0052 GREY LMSN 0240
HUNTLEY TOWNSHIP CON 03(010)	18 421530 5018021[W]	1984/09 3142	06 06	FR 0069	004 / 015 040 / 4:0	DO		1519233 () RED SAND PCKD 0006 BRWN SAND PCKD 0018 GREY SAND CLAY LOOS 0052 GREY SAND GRVL STNS 0063 GREY LMSN 0070
HUNTLEY TOWNSHIP CON 03(010)	18 421807 5018216[W]	1972/10 1558	06 06	FR 0124	025 / 075 010 / 1:0	DO		1512118 () GREY GRVL SAND 0015 GREY LMSN 0125
HUNTLEY TOWNSHIP CON 03(010)	18 421624 5018051[W]	2006/02 1558	06	0118 0060		DO		1536296 (Z39257) A035418 BRWN LOAM STNS PCKD 0004 BRWN SNDS 0023 GREY SNDS STNS 0044 GREY LMSN 0123
HUNTLEY TOWNSHIP CON 03(010)	18 421668 5017988[W]	2009/03 1558	06	0140	015 / 015 012 / 2:0	DO		7123248 (Z095326) A076799 BRWN LOAM ROCK FCRD 0004 BRWN CLAY PCKD 0014 BRWN SAND WBRG 0022 GREY TILL PCKD 0032 GREY LMSN MGRD 0140
HUNTLEY TOWNSHIP CON 03(010)	18 421755 5018048[W]	2009/10 1558	06	0110 0161	016 / 020 012 / 2:0	DO		7139851 (Z101735) A076883 BRWN HPAN BLDR 0008 GREY LMSN LYRD SOFT 0020 GREY LMSN MGRD 0162

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 03(011)	18 421371 5018322[W]	1959/12 4833	04 04	FR 0122	016 / 030 007 / 0:30	ST DO		1503123 () CLAY LOAM 0012 GREY LMSN 0124
HUNTLEY TOWNSHIP CON 03(011)	18 421419 5018710[W]	1972/10 3503	06 06	UK 0071	010 / 016 020 / 0:30	DO		1514608 () GREY SAND STNS 0029 GREY SHLE SAND 0080
HUNTLEY TOWNSHIP CON 03(011)	18 421431 5018662[W]	1962/05 4825	04 04	FR 0125	016 / 035 006 / 1:0	DO		1503125 () CLAY 0006 LMSN 0127
HUNTLEY TOWNSHIP CON 03(011)	18 421741 5018272[W]	1961/09 4833	04 04	FR 0100	020 / 025 005 / 0:30	ST DO		1503124 () CLAY LOAM 0007 GREY LMSN 0101
HUNTLEY TOWNSHIP CON 03(011)	18 421631 5018442[W]	1964/09 4806	06 06	FR 0108 FR 0071	023 / 090 006 / 1:0	DO		1503126 () SHLE 0012 GREY LMSN 0108
HUNTLEY TOWNSHIP CON 03(011)	18 421691 5018272[W]	1966/03 4824	04 04	FR 0080	015 / 050 003 / 1:0	DO		1503127 () GRVL 0010 LMSN 0081
HUNTLEY TOWNSHIP CON 03(011)	18 421581 5018292[W]	1969/05 4847	04 04	FR 0060	016 / 028 005 / 0:30	DO		1510221 () LOAM MSND 0008 GREY LMSN 0111
HUNTLEY TOWNSHIP CON 03(011)	18 420854 5018003[W]	5222	06 06	FR 0085 FR 0190	013 / 190 003 / 6:0	DO CO		1524588 (84306) BRWN LOAM PCKD 0001 BRWN CLAY SNDY PCKD 0003 GREY LMSN HARD 0200
HUNTLEY TOWNSHIP CON 03(011)	18 421532 5018171[W]	5222	06 06	FR 0030	010 / 030 006 / 6:0	CO	30 3	1524587 (84307) BRWN LOAM PCKD 0001 BRWN CLAY PCKD 0005 BRWN CLAY SNDY FSND 0012 BRWN MSND 0023 BRWN SAND SILT MGRD 0028 BRWN MSND 0037
HUNTLEY TOWNSHIP CON 03(011)	18 421089 5018090[L]	1983/09 3644	06 06	FR 0075	025 / 060 020 / 1:0	DO		1518611 () GREY CLAY 0006 GREY SNDS 0080
HUNTLEY TOWNSHIP CON 03(012)	18 421151 5018922[W]	1960/09 4833	04 04	FR 0094	012 / 014 003 / 0:30	PS		1503128 () CLAY LOAM 0036 GREY LMSN 0096
HUNTLEY TOWNSHIP CON 03(012)	18 420234 5018316[W]	1975/04 2801	05	FR 0003	003 / 008 010 / 4:0	PS	10 5	1514738 () RED SAND DRTY LOOS 0003 CSND FSND GRVL 0015 GREY CLAY SOFT 0022
HUNTLEY TOWNSHIP CON 03(012)	18 420185 5018212[W]	1975/04 2801						1514737 () RED SAND DRTY LOOS 0003 GREY CSND FSND LOOS 0011 GREY SAND SILT CLAY 0024 GREY CLAY SOFT 0061
HUNTLEY TOWNSHIP CON 03(012)	18 420686 5018556[L]	1985/05 1558	06 05	SU 0220	030 / 125 005 / 1:0	DO		1519713 () BRWN SAND 0005 GREY SAND GRVL WBRG 0023 GREY CLAY 0089 GREY LMSN 0225
HUNTLEY TOWNSHIP CON 03(012)	18 420152 5018314[W]	2005/06 6574	06	0148	019 / 051 001 / 1:0			1536026 (Z28727) A029175 BRWN SAND SILT PCKD 0027 BLUE CLAY WBRG 0086 GREY SAND GRVL DNSE 0090 GREY LMSN 0325

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 03(012)	18 421126 5018996[W]	1972/12 1558	06 06	SU 0080 SU 0187	010 / 050 015 / 2:0	IN		1512197 () BRWN GRVL SAND PCKD 0003 BRWN SAND PCKD 0018 GREY SAND PCKD 0032 GREY CLAY LOOS 0042 GREY SAND GRVL STNS 0047 BLCK LMSN 0188
HUNTLEY TOWNSHIP CON 03(012)	18 420686 5018556[L]	1986/10 5222	06 06	FR 0023	007 / 023 006 / 3:0	DO	23 3	1521050 (02025) BRWN FSND LOOS 0017 BRWN SAND CGVL 0026 GREY CLAY PCKD 0026
HUNTLEY TOWNSHIP CON 03(012)	18 421227 5018949[W]	1973/04 1836	06	SU 0256	015 / 100 008 / 1:0	DO		1513273 () YLLW SAND 0020 HPAN 0032 GREY LMSN 0260
HUNTLEY TOWNSHIP CON 03(012)	18 420489 5018547[W]	1975/04 2801	05	FR 0003	003 / 011 060 / 1:0			1514739 () RED SAND DRTY LOOS 0002 BRWN SAND LOOS 0018 SAND FGVL LOOS 0023 GREY FSND SILT CLAY 0025 GREY CLAY SOFT 0038
HUNTLEY TOWNSHIP CON 03(013)	18 420831 5019422[W]	1978/11 1558	06 06	FR 0145	040 / 055 025 / 1:0	DO		1516828 () BRWN CLAY BLDR 0021 GREY HPAN BLDR PCKD 0035 GREY LMSN SOFT 0145
HUNTLEY TOWNSHIP CON 03(013)	18 420813 5019053[W]	2005/09 6574	06 06	0090	019 / 035 / :0	MN PS	86 4	1535787 (Z28731) A029180 BLCK LOAM 0001 BRWN SAND 0015 BRWN SAND 0022 GREY GRVL 0027 GREY SILT 0035 GREY CLAY HARD 0048 BLUE CLAY WBRG 0072 GREY CLAY HARD 0082 GREY GRVL PCKD 0090
HUNTLEY TOWNSHIP CON 03(013)	18 420701 5019542[W]	1958/06 4832	05 04 03 03	SU 0183	028 / 045 003 / 3:0	DO		1503129 () PRDR 0140 HPAN 0152 LMSN 0187
HUNTLEY TOWNSHIP CON 03(013)	18 420436 5019162[W]	1975/02 1558	06 06	SU 0167	018 / 030 020 / 2:0	DO		1514573 () BRWN SAND SILT PCKD 0030 BLUE CLAY LOOS 0115 GREY SAND CLAY PCKD 0123 BLCK LMSN 0175
HUNTLEY TOWNSHIP CON 03(013)	18 420291 5019026[L]	1985/09 3142	06	FR 0024	006 / 015 020 / 1:0	DO		1520137 () GREY CLAY SAND PCKD 0020 GREY GRVL LOOS 0025
HUNTLEY TOWNSHIP CON 03(013)	18 420424 5019205[W]	2004/09 1119	02 06 02			NU	133 10 2 11	1535240 (Z19014) A018872 CLAY 0127 GREY LMSN 0144
HUNTLEY TOWNSHIP CON 03(013)	18 420930 5019321[W]	1981/11 4006	06 06	FR 0083 FR 0185	008 / 200 004 / 1:0	DO		1517689 () GREY CLAY PCKD 0015 GREY SILT STNS PCKD 0057 GREY SAND CMTD 0061 GREY TILL STNS PCKD 0079 GREY GRNT MGRD 0215
HUNTLEY TOWNSHIP CON 03(014)	18 420155 5019475[W]	2004/09 1119	06 02 02			NU	119 10 2 9	1535239 (Z19016) A018880 CLAY 0114 GREY LMSN 0129
HUNTLEY TOWNSHIP CON 03(015)	18 419327 5019365[W]	2009/06 1844						7127229 (M04486) A074638 BRWN LOAM 0000 GREY CSND GRVL 0006 GREY ROCK SAND GRVL 0008 GREY SAND GRVL ROCK 0009 GREY SILT CLAY SAND 0012

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP 02(012)	18 421372 5018928[W]	2007/05 6907						7049976 (Z50987) A017504
HUNTLEY TOWNSHIP 03(010)	18 421718 5018158[W]	2010/07 1558	06	0230	021 / 024 010 / 2:0	DO		7151500 (Z115581) A102298 BRWN LOAM 0002 BRWN SHLE SOFT 0018 GREY LMSN LYRD SOFT 0231
HUNTLEY TOWNSHIP ()	18 420944 5019366[W]	2006/07 7241	02				5 8	7035379 (Z51855) A046053 BRWN LOAM LOOS 0004 BRWN SAND SILT 0012 GREY CLAY SILT WBRG 0013
HUNTLEY TOWNSHIP ()	18 421630 5018027[W]	2010/10 1558						7156095 (Z115626) A102342
HUNTLEY TOWNSHIP ()	18 420326 5019172[W]	2006/07 1844	02				0 12	1536752 (Z50484) A045182 BRWN SAND FILL FGRD 0003 GREY SAND WBRG 0008 GREY SAND SLTY WBRG 0012
HUNTLEY TOWNSHIP ()	18 420301 5019145[W]	2008/07 1844						7120701 (M04547) A045182
OTTAWA CITY ()	18 420263 5019179[W]	2009/06 1844						7127228 (M04487)
RUSSELL TOWNSHIP CON 04(022)	18 420609 5018335[W]	2005/08 1414	06	FR 0072	025 / 034 004 / 1:0	DO		5606152 (Z27954) A021433 RED SHLE 0078

Notes:
1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code
7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDY		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Water Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial		
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX N

URBAN GEOLOGY OF THE NATIONAL CAPITAL REGION

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