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Hydrogeological Investigation & Terrain Analysis
Proposed Residential Subdivision
Lot 3, Concession 8
Beckwith Township, Ontario

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Submitted to:

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Beckwith Township, Ontario

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1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists (GEMTEC) was retained by Cameron and June Young to conduct a hydrogeological investigation and terrain evaluation at the site of a proposed residential subdivision (Lot 3, Concession 8) in Beckwith Township, Ontario. The location of the subject property is indicated in the Site Plan, Figure 1.

Based on the information provided to us, the proposed residential development (hereafter referred to as 'the subject site') will be comprised of 11 residential lots. The proposed lots will be serviced by an internal roadway system. The total property area to be developed is about 9.7 hectares. The majority of the subject site is currently vacant and has been previously used for agricultural purposes. Residential properties with private services are located along 9th Line Road, situated on the northern, eastern and southern borders of the site. In addition, there is currently one residential property located on the subject site. Based on a review of aerial photographs, the site appears to be agricultural or vacant land.

The proposed layout of the development is shown on the Young Concept Plan, prepared by ZanderPlan Inc., and provided in Appendix A.

1.1 Objectives of Investigation

The objectives of this investigation are as follows:

- To review available background information to assist in characterization of subsurface conditions in the vicinity of the subject site and develop a hydrogeological conceptual model;
- 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;
- To investigate the potential quantity and quality of groundwater available from drilled test wells on the subject site for potential domestic supply; and,
- To assess the long-term impacts on groundwater supply from existing developments on drilled water supply wells in the vicinity of the subject site.

Following a review of available background information and analysis of the results of the field investigation, conclusions and recommendations for the proposed residential development of the subject site are provided.

2.0 REVIEW OF BACKGROUND INFORMATION

2.1 Land Use

The majority of the subject site is currently vacant undeveloped land and was previously used for agricultural purposes. Land use in the vicinity of the site consists of vacant undeveloped land, mature trees and residential properties on private services (Detailed Site Plan, Figure 2). Specific land uses near the subject site boundaries are documented in Table 2.1.

Table 2.1 – Summary of Land Use in Study Area

Site Boundary	Existing Land Use
North	• Residential properties and vacant/agricultural lands
East	• Residential properties, mature trees
South	• Residential properties and vacant/agricultural lands
West	• Mississippi Lake

Potential impacts to groundwater quality from adjacent lands within 500 metres of the subject site boundary are limited to those associated with residential septic systems and agricultural land use based on past and present land use.

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

2.2 Topography

Topographic mapping data indicates that elevations range from about 135 to 147 metres above sea level (Figure 3: Topography and Drainage). Overall, the property is relatively flat with a regional slope to the west, towards Mississippi Lake. A local topographic high is located in the eastern portion of the property at 9th Line Road.

2.3 Drainage

The drainage of the subject site is influenced by the natural topography of the site and is anticipated to be generally west towards Mississippi Lake (Figure 3).

2.4 Regional Surficial and Bedrock Geology

Surficial and bedrock geology maps of the Carleton Place area (Ontario Geologic Survey) indicate that the overburden generally consists of Precambrian bedrock with areas thinly veneered by up to 2 metres of unconsolidated Quaternary sediments (Figure 4). Based on site observations made during the course of the field investigation, no areas of exposed bedrock were noted at the ground surface. The thickness of the overburden on the site is indicated to range from 0 to 3 metres based on OGS drift thickness mapping. The bedrock is mapped as sandstone of the Nepean Formation (Potsdam Group) overlying Precambrian metasedimentary and metavolcanic bedrock (Figure 5).

2.5 Environmental Considerations

The subject site is located within a 'highly vulnerable aquifer' as identified in the Mississippi-Rideau Source Protection Plan Report, 2013. Highly vulnerable aquifers are characterized as being susceptible to contamination from sources at the surface. In addition, the site is located within a significant groundwater recharge area as identified in the Mississippi-Rideau August 4, 2011 Assessment Report. To note, the proposed subdivision is not located within any Wellhead Protection Areas and is located outside of the Carlton Place Intake Protection Zone (refer to Appendix B).

The proposed residential subdivision is located approximately 7.0 kilometres southwest of the special overlay area of a known volatile organic compound (VOC) plume (refer to Appendix B). The mapped VOC plume originates in Carleton Place (Lake Avenue and Beckwith Street) extends to the east. The subject site is located upgradient of the special overlay area and groundwater flow is away from the subject site.

The proposed residential subdivision is consistent with the adjacent land use and is considered to be a low impact development. The hydrogeological investigation presented herein will discuss the environmental impacts and aquifer vulnerability.

2.6 Ontario Ministry of Environment, Conservation and Parks Water Well Records

The Ministry of the Environment, Conservation and Parks (MECP) Water Well Records for existing private wells in the surrounding development were obtained to determine the characteristics of existing private wells in the vicinity of the subject site (1 kilometre radius - east of Mississippi Lake). A total of 73 well records were reviewed from the MECP online water well record mapping resource. All of the drinking water well records were for wells completed in bedrock.

Table 2.2 provides a summary of the well characteristics for the 73 water well records for depth to water found, static water levels, depth to bedrock, depth into bedrock and total well depth. The MECP Water Well Records are summarized in Appendix C.

Table 2.2 – Summary of Water Well Records Search Results

Parameter	10th Percentile	90th Percentile	Average / Geometric Mean
Depth Water Found[1] (m)	9.2	52.2	26.0 / 20.6
Static Water Level (m)	1.0	6.4	3.7 / 2.6
Depth to Bedrock (m)	0.0	8.1	3.1 / 0.4
Total Well Depth (m)	11.3	61.0	29.3 / 23.7

Notes. 1. Depth water found as reported by well technician (refers to water bearing fractures encountered at the time of drilling).

Based on the offsite MECP Water Well Records, the subject site and adjacent lands are characterized by wells with an average overburden thickness of 3.1 metres and completed to an average depth of 29.3 metres. Groundwater was encountered at an average depth of 26.0 metres.

3.0 TERRAIN EVALUATION

3.1 Field Procedure

A total of 15 test pits numbered 18-1 to 18-15, inclusive, were advanced at the site on March 1, 2018 using a hydraulic mini excavator operated by Lakeside Excavation. The test pits were advanced to a depth of up to 2.6 metres below surface grade or until practical refusal on inferred bedrock was encountered. The subsurface conditions in the test pits were identified by visual and tactile examination of the materials exposed on the sides and bottom of the test pits. The short-term groundwater condition within the open test pits was observed upon completion of excavating.

Following the completion of the test pit excavation, the soil samples were returned to our laboratory for examination by an environmental engineer/geoscientist. Descriptions of the subsurface conditions logged in the test pits are provided on the Record of Test Pit sheets appended (Appendix D). Selected samples were submitted for moisture content and grain size distribution testing. The results of the laboratory classification tests on the soil samples are provided in Appendix D.

The locations of the test pits are shown on the Detailed Plan, Figure 2. The ground surface elevations at the test pit locations were determined using our Trimble R10 GPS survey instrument. The elevations are referenced to geodetic datum. All field work was observed by a member of our engineering staff.

3.2 Soil and Groundwater Conditions

3.2.1 General

As previously indicated, the soil and groundwater conditions identified in the test pits are given on the Record of Test Pit sheets in Appendix D. The logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the method of excavation, the recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at other than the test 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 or on adjacent properties.

The groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. These conditions may vary seasonally or as a consequence of construction activities in the area.

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 judgement and GEMTEC does not guarantee descriptions as exact but infers accuracy to the extent that is common in current geotechnical practice.

The following presents an overview of the subsurface conditions encountered in the test pits advanced during this investigation.

3.2.2 Topsoil

A surficial layer of topsoil was encountered at all of the test pit locations. The topsoil is generally composed of brown sand, some silt, trace gravel with varying amounts of organic material. The topsoil layer has a thickness ranging between 0.1 to 0.4 metres.

3.2.3 Silt and Sand

Below the top soil in test pit 18-1, native deposits of brown silty sand, trace gravel with organic material were encountered overlying native deposits of grey brown sandy silt, trace clay. The silt and sand deposits were encountered at 0.3 metres below ground surface. Test pit 18-1 was terminated within the silt and sand layer at 1.9 metres below ground surface.

3.2.4 Sand

Native deposits of brown sand, trace silt and gravel were encountered below the top soil layer in test pit 18-2 at a depth of 0.3 metres below ground surface with a thickness of 1.1 metres.

One grain size distribution test was undertaken on a sample of sand recovered from test pit 18-2 and the results of this testing are provided in Appendix D. The select sample of sand is comprised

of 1% gravel, 96% sand and 3% silt and clay sized particles. The moisture content of this material is 5%.

3.2.5 Glacial Till

Native deposits of glacial till comprised of grey brown silty sand, some clay and trace gravel were encountered underlying the topsoil deposits in test pits 18-3, 18-4, 18-5 and underlying the sand deposits in test pit 18-2. The glacial till in these test pits was encountered at depths ranging between 0.9 and 2.2 metres below ground surface. All of the above test pits were terminated within the glacial till layer at depths ranging between 1.8 and 2.6 metres below ground surface.

Native deposits of glacial till comprised of brown silty clayey sand, trace gravel, followed by glacial till composed of grey brown sand, some silt and gravel trace clay, were encountered underlying the topsoil deposit in test pits 18-7 to 18-10. The glacial till in these test pits was encountered at depths ranging between 0.2 and 0.3 metres below ground surface. Test pits 18-7 to 18-9 were terminated within the glacial till layer at depths ranging between 1.5 and 2.6 metres below ground surface. The glacial till in test pit 18-10 is 1.0 metre thick.

Native deposits of glacial till comprised of brown sandy clayey silt and trace gravel, followed by glacial till composed of grey brown sand, some silt and gravel trace clay, were encountered underlying the topsoil deposit in test pits 18-13. The glacial till in this test pit was encountered at a depth of 0.3 metres below ground surface and has a thickness of 1.0 metre.

Grain size distribution testing was undertaken on four representative samples of glacial till from test pits 18-3, 18-8 and 18-13 and the results of this testing are provided in Appendix D. The glacial till is comprised of 1 to 16% gravel, 31 to 59% sand and 25 to 67% silt and clay sized particles. The moisture content of the glacial till ranges between 22 and 31%.

3.2.6 Silty Clay

Native deposits of weathered grey brown silty clay, some sand were encountered underlying the top soil layer in test pit 18-6. The weathered silty clay was encountered at a depth of 0.3 metres below ground surface and was terminated within the silty clay layer at a depth of 1.8 metres below ground surface.

3.2.7 Sand and Gravel

Native deposits of red brown sand, some gravel, trace silt were encountered underlying the topsoil layer in test pits 18-11 and 18-15 at a depth of 0.3 metres below ground surface with a thickness of 2.3 and 0.5 metres respectively. Native deposits of brown sand and gravel, trace silt were encountered underlying the topsoil layer in test pit 18-14 and underlying the red brown sand, some gravel, trace silt layer in test pit 18-15. The brown sand and gravel was encountered at 0.3 and 0.8 metres below ground surface, respectively and the thickness of this layer was 0.6 and 1.7 metres, respectively.

One (1) grain size distribution test was undertaken on a sample of sand and gravel recovered from test pit 18-14 and the results of this testing are provided in Appendix D. The select sample of sand and gravel is comprised of 36% gravel, 57% sand, 7% silt and clay sized particles. The moisture content of this material is 17%.

3.2.8 Bedrock

Excavator refusal on inferred bedrock was noted in test pits 18-10, and 18-12 to 18-15 at depths ranging between 0.3 and 2.5 metres below ground surface. It should be noted that the type and quality of bedrock was not confirmed by bedrock coring.

3.2.9 Groundwater Conditions

Groundwater seepage was observed in several test pits advanced on March 2, 2018. Groundwater conditions were only observed for the short period of time when the test pits were open. The observed groundwater conditions are summarized in Table 3.1.

Table 3.1 – Observed Groundwater Conditions on March 2, 2018

Test Pit	Groundwater Depth Below Ground Surface (metres)	Groundwater Elevation Below Ground Surface (metres, Geodetic Datum)
18-1	-	-
18-2	-	-
18-3	1.4	139.4
18-4	1.1	138.2
18-5	1.2	137.6
18-6	1.5	137.0
18-7	1.5	136.4
18-8	1.1	136.5
18-9	0.3	135.5
18-10	-	-
18-11	-	-
18-12	-	-
18-13	0.2	139.0

Test Pit	Groundwater Depth Below Ground Surface (metres)	Groundwater Elevation Below Ground Surface (metres, Geodetic Datum)
18-14	1.0	140.1
18-15	-	-

Based on the topography in the vicinity of the subject site, any shallow groundwater is expected to flow west, towards Mississippi Lake.

4.0 HYDROGEOLOGICAL CONCEPTUAL MODEL

4.1 Background Information

Based on the results of the review of MECP water well records, land use observations and available geology maps, the local hydrogeology on the subject site and adjacent lands are characterized by thinly veneered quaternary sediments consisting of silty clay, sands and glacial till.

The overburden thickness varies across the subject site, ranging from 0.3 to 3.1 metres based on test well and test pit information (Figure 6). With the exception of overburden soils in the vicinity of TP18-12, the overburden thickness is greater than 1.0 metres in thickness which reduces surficial impacts to the bedrock water supply aquifer.

The site-specific geology findings are consistent with the findings of the available background information.

4.2 Hydrogeological Conceptual Model

The framework for the hydrogeological conceptual model for the subject site is summarized in Table 4.1 below.

A hydrogeological cross-section (Figure 7) across the subject site was prepared based information from onsite test wells and 15 test pits. Please note that the boundaries between zones indicated on the cross-section have been interpreted based on available information. Ground surface elevations for each of the test wells and test pits were measured by GEMTEC staff using a Trimble R10 global positioning system. The elevations are referenced to geodetic datum.

Table 4.1 – Framework of Hydrogeological Conceptual Model

Stratigraphic Unit	Generalized Composition	Thickness
Overburden	• Topsoil; • Localized shallow bedrock (0.3 metres; northwestern portion of the site) • Deposits of silty clay, sand, sand and gravel (north to northeastern portion of the site, locally discontinuous); • Deposits of glacial till (south to southwestern portion of the site)	• 0.3 to 3.1 metres
Bedrock	• Sandstone / Limestone • Granite	• 4.3 to 7.3 metres • > 11.6 metres
Mississippi Lake	• Surface water body located adjacent to subject site	-

The bedrock surface elevation ranges from about 135.1 to 142.0 metres Above Mean Sea Level (AMSL) and the base of the well casings range from 125.9 to 131.9 metres AMSL. The elevation of the water bearing zones (depth water found) ranges from 122.0 to 128.2 metres AMSL and the elevation of the bottom of test wells ranged from 119.83 to 124.9 metres AMSL.

The cross-section, based on the onsite test well water well records and test pit information, indicates that the total thickness of the overburden ranges from approximately 0.3 to 3.1 metres and generally consists of thinly veneered quaternary sediments (silty clay, glacial till and sands and gravels). The average overburden thickness across the subject site, based on test pit and test well data is 1.9 metres. It is noted that only five of the 15 test pits were terminated on inferred bedrock, the remaining test pits encountered groundwater and could not be advanced further. The surface topography slopes west, towards Mississippi Lake.

It is our assessment that the hydrogeological cross section is consistent with available background information and the site-specific geology from the field investigation on the subject site. Due to the variable overburden thickness (0.3 to 3.0 metres) above the bedrock at the subject site, the bedrock aquifer is not completely isolated and therefore measures should be implemented in the design of septic systems to add additional protection above the bedrock. However, it is noted that the water supply aquifer (granite) is overlain by the sandstone/limestone bedrock aquifer which ranges in thickness from 4.3 to 7.3 metres.

5.0 IMPACT ASSESSMENT

The impact on groundwater and surface water resources due to wastewater treatment and disposal by individual onsite sewage disposal systems on the subject site are assessed in the following sections.

5.1 Sewage Disposal Systems

This section discusses the results of the terrain evaluation as they relate to the feasibility of installing sewage disposal systems on the subject site for onsite wastewater treatment and disposal.

It should be noted that the following information is provided for general guidance purposes only and that all septic systems installed on the subject site should be designed on a lot by lot basis using a lot specific investigation involving test holes to determine the actual subsurface conditions at the location of the proposed septic system. In all cases, the septic system design must conform to the Ontario Building Code (OBC) requirements.

5.1.1 Class IV Septic Sewage Disposal Systems

This section discusses the results of the terrain evaluation as they relate to the feasibility of installing Class IV septic sewage disposal systems on the subject site.

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 system 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 septic envelope sizes were estimated for the purposes of preparing a Conceptual Lot Development Plan (Appendix A). The conservative average septic system envelope required to service a single-family dwelling at this site; which was calculated using a conservative design flow of 3,500 litres/day and a conservative loading rate of 4 litres/m^2/day. The septic envelope area required under this scenario is 875 m^2 (0.088 hectares). This septic system envelope should be readily accommodated on the lot sizes that are proposed (minimum 0.60 hectares), as demonstrated in the Conceptual Lot Development Plan (Appendix A).

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 septic leaching bed design must ensure that the bottom of the absorption trenches is at least 0.9 metres above low permeability soils (such as silty clay), bedrock, and the seasonally high

groundwater table. Based on the soil conditions which were observed in the test pits and boreholes, it is expected that some or all of the septic leaching beds at this site will be partially or fully raised.

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.

5.1.2 Tertiary Septic Systems

Approved septic disposal systems that meet the OBC requirements for tertiary treatment could also be considered for this development in place of conventional Class IV septic systems. The disposal beds for tertiary treatment systems require a smaller area than 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. Some tertiary treatment systems are also effective in reducing contaminants, such as nitrate, prior to disposal to the leaching bed.

5.2 Groundwater Impacts

The potential risk to groundwater resources on and off the subject site was assessed in accordance with Ministry of Environment Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment. To evaluate the groundwater impacts, the Three-Step Assessment Process outlining in MECP D-5-4 was followed.

5.2.1 Three-Step Assessment: Step 1 - Lot Size Considerations

Lot sizes of 1.0 hectares or larger are assumed to be sufficient for attenuative processes to reduce nitrate-nitrogen to acceptable concentrations in groundwater below adjacent properties. The proposed lot sizes of 0.6 hectares (minimum) does not meet this consideration.

5.2.2 Three-Step Assessment: Step 2 – Isolation

Where proposed lot sizes are less than 1.0 hectares, the risk of sewage effluent contamination must be assessed for the proposed subdivision. As per Procedure D-5-4, it is required to:

- Evaluate the most probable groundwater receiver for sewage effluent; and,
- Define the most probable lower hydraulic or physical boundary of the groundwater receiving the sewage effluent.

Based on the hydrogeological conceptual model and as per the isolation requirements of MECP Procedure D-5-4, the groundwater receiver for the septic effluent is upper sandstone/limestone bedrock aquifer and the septic effluent may not be fully isolated from the water supply aquifer.

The result of the hydrogeological conceptual model indicates that the thin surficial overburden deposits across the site generally do not meet the above requirements for isolation.

5.2.3 Three-Step Assessment: Step 3 - Nitrate Dilution Calculations

Where it cannot be demonstrated that the effluent is hydrogeologically isolated from the water supply aquifer and the proposed lot sizes are less than 1.0 hectares, the risk of individual on-site septic systems will be assessed using nitrate-nitrogen contaminant loading. The maximum allowable concentration of nitrate in the groundwater at the boundaries of the subject property is 10 milligrams per litre as per MECP Procedure D-5-4, dated August 1996.

The nitrate concentration at the site boundaries was calculated using the information in Table 5.1, below.

Table 5.1 Nitrate Dilution Assumptions

Parameters	Nitrate Dilution Calcs
Lot Area	88,250.5 m^2
Infiltration Area *Lot area – 10% for hard surfaces (e.g. roof, driveways)*	79,425.5 m^2
Water Holding Capacity[1]	75 mm *Shallow rooted crops/urban lawns, fine sandy loam*
Annual Water Surplus[2]	381 mm/year
Topography Factor (TF)	0.1 *Hilly Land*
Soil Factor (SF)	0.4 *Open Sandy Loam*
Cover Factor (CF)	0.1 *Cultivated Land*
Infiltration Factor[3] (TF + SF + CF)	0.60

1. Water holding capacity of soils (WHC) based on information obtained from Table 3.1 of the Ministry of Environment Stormwater Management Planning and Design Manual, dated March 2003.
2. Annual water surplus based on Environment Canada Water Surplus Datasheets (Appendix E) for weather station Carleton Place-Appleton (1984-2006).
3. Infiltration factors based on information provided in MOEE, 1995.

The predictive assessment is conducted using a mass balance calculation to determine the sewage loading for nitrate at the property boundary (see equation below).

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

The nitrate dilution calculations are provided in Appendix E and summarized in Table 5.2 below.

Table 5.2 Nitrate Dilution Calculations

Parameters	Nitrate Dilution Calcs
Number of Lots	11
Annual Nitrate Loading	160,600 grams/year *(11 lots x 40grams/lot/day *365 days/year)*
Annual Dilution Volume	19,670 m^3/year *[(surplus 0.381 m/year * infiltration factor 0.65 * infiltration area 79,425.5 m^{2-})* *+ (septic flows of 1 m^3/lot/day * 11 lots * 365 days/year)*
Nitrate Concentration at Property Boundary	7.2 mg/L

Based on the above information, the weighted average nitrate concentration at the site boundaries was calculated to be 7.2 mg/L (refer to the calculation in Appendix E). The nitrate impact assessment, using conservative assumptions, meets the acceptable nitrate impact requirement of 10 mg/L established by the MECP.

5.2.4 Background Nitrate Conditions

To further evaluate the potential risk of septic effluent on the water supply aquifer, the background water quality was assessed. Groundwater samples (PW1, PW2 and PW3) were collected from three (3) private wells on December 27, 2017 and February 19, 2018 and submitted for 'subdivision package' parameters. Private wells PW1 and PW3 are located directly adjacent to the subject site and PW2 is currently located within the subject site (refer to Figure 2 for private well locations). The nitrate concentrations were reported to be <0.1, 1.0 and 0.2 mg/L for PW1, PW2 and PW3 respectively. It is noted that PW1 and PW3 are completed at similar depths to the onsite test well and based on information provided to us, PW2 is a shallow on-site well with a depth of approximately 6.0 metres. No MECP WWR is available for PW2 and the increased nitrate may be due to poor well installation (e.g. grouting procedure and depth of casing unknown).

Groundwater samples were collected from standpipe piezometers installed in three shallow test pits (TP 18-3, 18-9 and 18-13) on March 2, 2018 in order to determine nitrate concentrations in the shallow subsurface. The location of the test pits is provided on Figure 2 and the nitrate concentrations are summarized in Table 5.1 below.

Table 5.1 – Summary of Groundwater Quality from Test Pits

Groundwater Quality	Units	Guideline/ Standard[1]	TP 18-3	TP 18-9	TP 18-13
Nitrate as N	mg/L	10	<0.1	<0.1	<0.1
Nitrite as N	mg/L	1.0	<0.05	<0.05	<0.05
Ammonia as N	mg/L	-	0.07	0.11	0.11
Total Phosphorous (TP)	mg/L	-	0.10	1.18	0.71
Total Kjeldahl Nitrogen (TKN)	mg/L	-	0.4	1.1	0.9

1. Ontario Drinking Water Standards

The groundwater samples collected from piezometers installed in test pits TP18-3, 18-9 and 18-13, reported non-detectable concentrations of nitrate and nitrite. In addition to the nitrate and nitrite sampling, total phosphorous, total kjeldahl nitrogen and ammonia were analyzed in order to assess phosphorous loading to Mississippi Lake (discussed in section 5.3 below).

It has been determined that, through dilution of the nitrate stemming from the proposed septic systems, the proposed 11 residential lots can be established while maintaining a nitrate concentration within the groundwater at the property boundary of less than 10 mg/L. Therefore, the proposed subdivision meets the requirements of the Three-Step Assessment Process as outlined in MECP D-5-4.

5.2.5 Aquifer Vulnerability

The nitrate levels in all onsite test wells ranged from the method detection limit of the laboratory (<0.10 mg/L) to 0.2 mg/L. The subject site and surrounding area were historically used for agricultural purposes and given the low concentrations of nitrate detected, the bedrock water supply aquifer does not appear to be significantly impacted from the agricultural use.

Possible off-site impacts from the proposed subdivision include those associated with septic system effluent. However, nitrate dilution calculations carried out as part of this investigation have shown that nitrate concentrations are expected to be less than the limit of 10 milligrams per litre at the site boundaries, as established by the MECP.

Surficial geological mapping and on-site test pits indicate that the site is underlain by approximately 0.3 to 3.05-metre-thick, thinly veneered, unconsolidated sediments and therefore, the site is classified as hydrogeologically sensitive. The proposed residential development is not

anticipated to negatively impact the groundwater aquifer, based on the calculated nitrate concentration of 7.2 mg/L at the property boundary. In order to minimize the potential risk to groundwater resources from the septic system, a clay liner, extended well casing and increased separation distances between the well and septic are recommended.

5.3 Surface Water Impacts

Based on the hydrogeological conceptual model, the septic effluent receiver is the shallow bedrock aquifer; however, given the sloping topography towards Mississippi Lake, the shallow groundwater system may also discharge to Mississippi Lake. Provided the on-site septic systems are constructed in accordance with the Ontario Building Code, municipal requirements and appropriate surface water setbacks, adverse water quality impacts to surface water are not anticipated.

Nevertheless, in order to assess the impacts from phosphorous loading to Mississippi Lake, a mass loading analysis was completed to estimate the phosphorous loading to Mississippi Lake. Mississippi Lake is part of the Mississippi River system and for the purposes of assessing surface water impacts, will be considered a flow through system (i.e. river). The following equation is used to solve the downstream phosphorous concentration from the proposed 11 lots on Mississippi Lake:

$$C_T = \frac{C_R Q_R + C_p Q_p}{Q_T}$$

where, C_T is the calculated concentration of phosphorous in Mississippi River at the downstream boundary; Q_T is the discharge of the Mississippi River; C_R is the concentration of phosphorus upstream in the Mississippi River; Q_R is the discharge upstream; C_P is the concertation of phosphorus in septic effluent; Q_P is the septic effluent discharge rate.

- Q_R = 32 m^3/s (average daily flow from Mississippi River at Ferguson Falls gauging station 02KF001, 1982 to 2015; https://wateroffice.ec.gc.ca/index_e.html);
- C_R = 0.0260 mg of phosphorous per litre (maximum phosphorous concentration measured in Mississippi Lake based on available data between 1975-2011, Mississippi Lake Association, 2015);
    - Noted to be downstream locations; however, the maximum available concentration was utilized as a conservative estimate.
- Q_P = 1.3 x 10^{-4} m^3/s (11,000 litres per day; 1,000 litres per day per lot);
    - Conservative estimate assumes direct septic effluent into Mississippi Lake.

- C_P = 165 mg/L (15 mg/L per lot, 11 lots total; concentration of phosphate recommended to assess potential impact of sewage effluent as outlined in MECP D-5-4); and,

- Q_T = Sum of Q_R and Q_P

The daily septic effluent volumes of 1.3 x 10^{-4} m^3/s (1,000 litres per day per septic system) are considered to be negligible in comparison to Mississippi River daily flow volumes of 32 m^3/s. It is noted that the average daily inflow (Mississippi River at Ferguson Falls 02KF001) and outflow (Mississippi Lake at Appleton 02KF006) from Mississippi Lake are both approximately 32 m^3/s.

The calculated downstream concentration of phosphorus is 0.0267 mg/L, which corresponds to an increase in phosphorous of 0.0007 mg/L. The background phosphorous concentrations in the overburden groundwater were measured to be 0.10 to 1.18 mg/L (Table 5.1), which is lower than the estimated phosphorous septic loading of 15 mg/L. It is noted that the calculations are extremely conservative and are provided to demonstrate that the proposed Mississippi Lake surface water will not be negatively impacted by the proposed development.

6.0 GROUNDWATER SUPPLY

A groundwater supply investigation was carried out in accordance with the MECP 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 results of the groundwater supply investigation are summarized in the following sections.

6.1 Test Well Construction

The MECP Procedure D-5-5 document indicates that a minimum of three (3) test wells are required for sites up to 15 hectares, with the Site under investigation being 9.7 hectares. Three (3) new test wells (TW1, TW2 and TW3) were drilled by Air Rock Drilling Co. Ltd. under Well Contractor License No. 1119. The wells were completed on July 10 and 11, 2018; copies of the MECP Water Well Records and the Certificates of Well Compliance (Well Grouting Inspections) are provided in Appendix F.

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 (Figure 2). The geographical references for the test wells are provided in the respective MECP Water Well Records.

Well grouting inspections were carried out by GEMTEC staff during the sealing of the well casings in all test wells. The test wells were constructed using a nominal 159 millimetre inside diameter steel casing. The construction details of the test wells are summarized in Table 6.1.

Table 6.1 – Summary of Test Well Construction Details

Test Well	Depth to Bedrock (m BGS)	Depth of Well Casing (m BGS)	Depth Water Found (m BGS)	Total Well Depth (m BGS)
TW 1	2.4	12.2	15.8 & 17.1	19.2
TW 2	3.0	12.2	16.1 & 16.8	18.3
TW 3	1.5	12.2	15.2 & 16.1	18.3

Notes: m BGS - Metres Below Ground Surface

6.2 Pumping Tests Field Procedure

The pumping tests for the onsite test wells were conducted between August 7 and August 9, 2018. A six (6) hour duration constant discharge rate pumping test was conducted in each test well. The pump discharge was directed to the ground surface at a distance ranging from 5 to 10 metres from the test wells and in a manner such that the flow of water on the ground surface was directed away from the test wells.

6.2.1 Water Level Measurements

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 was collected until a minimum of 95 percent of the drawdown in water level had recovered in the test wells or two hours had passed. The water level measurements for the drawdown and recovery data for the pumping tests are provided in Appendix F. The drawdown data was measured with reference to the top of the well casings.

Water level measurements were also taken from other onsite test wells (observation wells) during the pumping of each of the 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 G.

6.2.2 Flow Rate Measurements

The wells were pumped using a 1.5 HP electric submersible pump and portable generator supplied by Air Rock. The flow rate of the pump discharge hose was constantly monitored using a timed-volume method. Multiple flow measurements were taken within the first hour of the pumping test and then at 60 to 120-minute intervals throughout the remainder of the pumping test to ensure that the discharge rate maintained a constant flow rate (i.e. within 5%). A summary of the flow rate from the pumping tests of the test wells is provided in Table 6.2:

Table 6.2 – Pump Test Flow Rates

	Flow Rate (Litres per minute)		
Time (min)	TW 1	TW 2	TW 3
0-360	30.3	37.8	37.8

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.

6.2.3 Groundwater Sampling

Total chlorine tests were conducted in the field 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, colour and total chlorine levels of the groundwater were measured at periodic intervals during the pumping tests and are summarized in Appendix H. The field equipment used during the pumping test is calibrated monthly by GEMTEC and the details of field equipment are provided in Table 6.3:

Table 6.3 – Field Equipment Overview

Field Parameters	Manufacturer	Model No.
Total Chlorine	Hach	CN-60
pH, temperature, TDS and Conductivity	Hanna	HI 98129
Turbidity	Hanna	HI 98703
Colour	Hanna	DR 890

Groundwater samples for laboratory analysis were collected from the test wells after three (3) and six (6) hours of pumping.

The groundwater samples were collected in laboratory supplied bottles and prepared/preserved in the field in accordance with the industry standard sampling, handling and preservation

procedures required by the laboratory. All water samples, including samples for metal analysis, were unfiltered. The groundwater samples were subsequently submitted to AGAT laboratories in Ottawa, Ontario for chemical, physical and bacteriological analyses as listed in the MECP guideline titled “Technical Guideline for Private Wells: Water Supply Assessment”, dated August 1996.

6.3 Test Well Water Quality

The results of the chemical, physical and bacteriological analyses on the water samples from the test wells are summarized in in Appendix H and the laboratory results from Paracel Laboratories is provided in Appendix I.

6.3.1.1 Bacteriological Parameters

Total chlorine measurements made at regular intervals during the pumping test confirmed that total chlorine concentrations in the well water was non-detectable at the time of bacteriological sampling.

The proposed water supply aquifer, based on water samples collected from the onsite test wells, contains total coliform maximum acceptable concentration exceedances of the Ontario Drinking Water Standards (ODWS). Test well TW2 initially had elevated fecal and total coliforms detected (59 CFU/100mL and confluent, respectively) in the 3-hour pumping test sample. The water sample collected at the end of the pumping test (6-hour sample) reported non-detectable fecal and total coliform concentrations. Following well chlorination and additional well development, the fecal coliform remained non-detectable and the total coliform was reported to be 3 CFU/100mL.

Although the total coliform concentration in TW2 exceeds the ODWS maximum acceptable concentration of 0 CFU/100mL, the total coliform concentrations detected meet the MECP Procedure D-5-5 limit of less than 6 counts per 100 mL for Total Coliform bacteria. In addition, the concentration of other bacteria indicator species such as e.coli and fecal coliform (with the exception of TW2 3-hour sample, pre-chlorination) were determined to be non-detectable in all of the water samples.

Based on the bacteriological testing, the water is suitable for consumption.

6.3.1.2 Other Health Related Parameters

No other maximum acceptable concentration limits of the ODWS were exceeded (with the exception of total and fecal coliform in TW2 noted above) in the three and six-hour water samples collected from the onsite test wells. This includes fluoride, nitrate, nitrite and heavy metals.

6.3.2 Operational Guideline Exceedances

Operational related exceedances of the Ontario Drinking Water Standards (ODWS) were detected for hardness (all test wells) and organic nitrogen (TW1 and TW3) and are discussed in the following section:

Hardness

The concentration of hardness in water samples obtained from all three test wells ranged from 284 to 401 mg/L as $CaCO_3$ and was higher than the operational guideline of 80 to 100 mg/L of $CaCO_3$ as specified in the ODWS.

Water having a hardness level above 80 to 100 mg/L as CaCO3 is often softened for domestic use. The MECP Procedure D-5-5 document states that water having a hardness value more than 300 mg/L is considered "very hard". The Ontario Ministry of the Environment publication entitled "Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines", states that water 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 specified in MECP Procedure D-5-5.

The concentrations of hardness in all the test wells are below the reported threshold of 500 mg/L as CaCO3 as specified in the Technical Support Document for the ODWS. The concentration of hardness observed in the test wells is considered to be reasonably treatable using a conventional water softener. 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 that 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 (for example, a bypass of the softener to the cold-water kitchen tap).

Organic Nitrogen

The organic nitrogen concentration (total kjeldahl nitrogen – ammonia) exceeded the operational guideline of 0.15 mg/L for Ontario Drinking Water Standards (ODWS) in all test wells. The organic nitrogen ranged from 0 to 0.4 mg/L which slightly exceeds the ODWS. It is noted that the organic nitrogen decreased from 0.4 to 0 and 0.3 to 0.2 mg/L during TW1 and TW3 pumping tests.

The ODWS indicates that levels of organic nitrogen in excess of 0.15 mg/L may be caused by septic tank or sewage effluent contamination and is typically associated with Dissolved Organic

Carbon (DOC) contribution of 0.6 mg/L. Organic nitrogen can react with chlorine and severely reduce its disinfectant power; in addition, taste and odour problems may also occur. It is not expected that chlorination will be utilized by homeowners in the residential subdivision and, as such, no concerns with the operational objective exceedance for organic nitrogen were identified.

6.3.3 Aesthetic Objective Exceedances

Aesthetic objective exceedances of the Ontario Drinking Water Standards (ODWS) were detected for iron and colour. These exceedances are discussed in the following sections:

Iron

The iron levels in samples recovered from the on-site test wells ranged from 0.3 to 1.0 milligrams per litre. Samples recovered from test wells TW 1 and TW 2 exceed the ODWS aesthetic objective for iron of 0.3 milligrams per litre. Elevated levels of iron may cause staining to plumbing fixtures and laundry. However, the iron level is well within the maximum reasonably treatable limits (5.0 mg/L) provided in Table 3 of the Appendix in the MECP Guideline D-5-5.

Colour

The analytical laboratory results for colour (true colour unit - TCU) exceeded the ODWS aesthetic objective at all test well locations (TW 1, TW 2 and TW3). The colour in samples from these test wells ranged from 10 to 50 TCU. The highest levels were generally noted in TW1 which has the highest iron concentrations. The elevated colour parameter may be the result of high iron concentrations, which can precipitate out of solution and increase the colour levels. Generally, the test wells with the highest iron concentrations were associated with higher colour.

Water having a faint yellow/brown colour can be caused by organic materials and contributed to by iron and manganese. Colour is not generally considered a health issue and the aesthetic objective is set by appearance. However, the laboratory-measured colour in samples from all three test wells exceeded the treatability limit of 7 TCU. Upon resampling of TW2 on September 6, 2018 the field measured colour at the time of sample collection was 0 TCU and the corresponding laboratory measured colour was 10 TCU.

Given the absence of any elevated organic substances (e.g. dissolved organic carbon, nitrate, nitrite, tannins and lignins and organic nitrogen) exceeding the ODWS and the elevated iron levels, which exceed the ODWS aesthetic objective, the colour is likely the result of elevated iron concentrations and can be treated using manganese greensand treatment systems. As stated in Table 3 of the Appendix in the MECP Guideline D-5-5, higher iron-related colour (exceeding the maximum concentration considered reasonably treatable limit of 7 TCU) may be removed by manganese greensand treatment.

6.4 Offsite Private Well Water Quality

The water quality from three adjacent properties were assessed to determine the background water quality (Figure 2). Table 6.4 provides a list of maximum acceptable concentration (MAC), aesthetic objectives (AO) and operational guidelines (OG) exceedances for both onsite test wells and the offsite test wells.

Table 6.4 – Comparison of Onsite and Offsite (Neighbouring Properties) Well Water Quality

Onsite Test Wells MAC, AO and OG Exceedances	Offsite Test Wells AO and OG Exceedances
Organic Nitrogen = 0 – **0.4** mg/L	Organic Nitrogen = **0.2** mg/L
Total Hardness (as $CaCO_3$) = **284 – 401** mg/L	Total Hardness (as $CaCO_3$) = **244 – 349** mg/L
Iron = 0.3 – **1.0** mg/L	Iron = <0.1 – **0.424** mg/L
Fecal coliform (TW2 = **59** CFU/100mL[1]) and Total coliform (TW2 = **3** CFU/1mL[2])	Fecal Coliform = Not-Detected Total Coliform = Not-detected
Total Dissolved Solids = 310 – 472 mg/L	Total Dissolves Solids = 404-**836** mg/L
Colour = **10 – 50** TCU[2]	Colour = <2 TCU

Notes: **Bolded** values exceed the ODWQS.

1. Fecal coliform of 59 CFU/100mL measured during 3-hour pumping test sample. Fecal coliform subsequently decreased to non-detectable concentrations in the 6-hour pumping test sample, as well as resampling on September 8, 2018.
2. Review of the water quality data and field measured colour indicates that the colour is iron-related and higher iron-related colour can be removed by manganese greensand treatment.

The total dissolved solids (TDS) concentrations in the offsite private wells were measured to be 404 to 836 mg/L, which exceeds the ODWS aesthetic objective of 500 milligrams per litre. Elevated levels of TDS can lead to problems associated with encrustation and corrosion.

To determine the corrosive nature of the groundwater, the Langelier Saturation Index (LSI) was calculated for PW2 and PW3, which exceeded the ODWS for TDS. These values are based on the TDS, temperature, pH, alkalinity, and calcium observed in the sample. The LSI was calculated to be 0.02 and 0.14 (PW2 and PW3) using an estimated groundwater temperature of 10°C. This indicates that the water is slightly scale forming and corrosive. In our experience, the palatability of water with a TDS concentration of that measured should not be an issue.

As per the “Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines”, TDS levels in excess of 500 mg/L may result in excessive hardness, taste, mineral deposition or corrosion. According to the “Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Total Dissolved Solids (TDS)”, published by Health Canada (1991), TDS levels between 600 and 900 mg/L are considered to be ‘fair’. At levels above 1,200 mg/L, the palatability of drinking water is ‘unacceptable’. The palatability of the drinking water is expected to be acceptable, although some taste problems may occur as the palatability is classified as ‘fair’.

Based on the onsite and offsite test well water quality, water quality on the site is generally similar to offsite test wells. The occurrence of aesthetic objectives and operational guidelines may vary; the water quality is within maximum treatability limits as specified in the Ontario Drinking Water Quality Standards, Objectives and Guidelines.

6.5 Impact from Mississippi Lake

The groundwater chemistry of the private wells sampled, all located within 65 to 200 metres from Mississippi Lake, do not have any significant elevated surface water indicators such as total coliform, e.coli, fecal coliform, ammonia, dissolved organic carbon, colour, phenols, tannin and lignin, total kjeldahl nitrogen or organic nitrogen. Based on the available water well records, the private wells have likely been in operation for greater than 20 years and have minimum O.Reg 903 casing lengths of approximately 6.0 metres below ground surface.

The newly drilled test wells generally have similar water quality to the private wells sampled, with no significant elevated surface water indicators, with the exception of colour. The elevated colour is attributed to the elevated iron and manganese concentrations, which were generally reported to be greater in on-site test wells. Furthermore, the test wells have minimum well casing lengths of 12.2 metres below ground surface, to further reduce the risk of potential surface water impacts.

6.6 Pumping Test Analysis

6.6.1 Pump Test Analysis Overview

The drawdown and recovery water level data from the three (3) pumping tests conducted on the onsite test wells TW 1 to TW3, inclusive, are provided in Appendix G. The details of the pumping tests carried out on the test wells are provided in Table 6.5. All depths provided are in metres below ground surface (m BGS).

Table 6.5 – Pumping Tests Details

Parameter	TW 1	TW 2	TW 3
Duration (minutes)	390	390	390
Flow Rate (litres per minute)	30.3	37.8	37.8
Static Water Level (m BGS)	6.91	3.09	2.17
Well Depth (m BGS)	19.2	18.3	18.3
Available Drawdown (m)	15.3	15.2	16.1
Water Level at End of Pumping (m BGS)	11.36	6.39	15.93
Observed Drawdown at End of Pumping (m)	4.45	3.30	13.76
Percent Drawdown Utilized (%)	29.0	21.7	85.5

As per MECP Procedure D-5-5, each of the test wells was pumped at a flow rate greater than 18.8 litres per minute for 6 hours. The maximum drawdown observed at the end of pumping, at rates of 30.3 to 37.8 litres per minute, was 15.9 metres in test well TW 3 which is equivalent to approximately 85 percent of the available drawdown in the test well. The drawdown utilized in the remaining test wells ranged from 22 to 29 percent. Based on these results, all of the onsite test wells are capable of supplying water at a rate significantly greater than 18.8 litres per minute for a period greater than six (6) hours. This is considered more than sufficient for typical domestic use.

6.6.2 Transmissivity Analysis

The transmissivity of the water supply aquifer was estimated from the pump test drawdown and recovery data using Aqtesolv version 4.5, a commercially available software program from HydroSOLVE Inc. An analysis of the pump test and recovery data was carried out using the Cooper-Jacob method of analysis and Theis recovery method of analysis. The results of the Aqtesolv 4.5 analysis are provided in Appendix J.

6.6.2.1 Pumping Test TW 1

Test well TW 1 was pumped at a constant rate of 30.3 L/min for 385 minutes. The drawdown in the pumped well increased to approximately 3.8 m after 60 minutes of pumping and then gradually increased to 4.5 metres until approximately 385 minutes after pumping started. The water level in the test well recovered 95% within approximately 13 hours after the pump was shut off (Appendix G).

The specific capacity of the well at the time of maximum drawdown was 6.7 L/min/m. An aquifer transmissivity of 7.4 and 7.8 m^2/day was estimated using the drawdown and recovery data, respectively (Appendix J). Observation well data from TW2 and TW3 displayed minimal drawdown of 0.24 and 0.23 metres respectively and aquifer parameters could not be evaluated using drawdown and recovery data from the observation wells.

6.6.2.2 Pumping Test TW 2

Test well TW 2 was pumped at a constant rate of 37.8 L/min for 385 minutes. The drawdown in the pumped well increased to approximately 2.7 m after 60 minutes of pumping and then gradually increased to 3.3 metres until approximately 385 minutes after pumping started. The water level in the test well recovered 95% within approximately 13 hours after the pump was shut off (Appendix G).

The specific capacity of the well at the time of maximum drawdown was 11.5 L/min/m. An aquifer transmissivity of 15 and 12 m^2/day was estimated using the drawdown and recovery data, respectively (Appendix J). Observation well data from TW1 and TW3 displayed minimal drawdown of 0.22 and 0.34 metres respectively and aquifer parameters could not be evaluated using drawdown and recovery data from the observation wells.

6.6.2.3 Pumping Test TW 3

Test well TW 1 was pumped at a constant rate of 37.8 L/min for 390 minutes. The drawdown in the pumped well increased to approximately 13.7 m after 120 minutes of pumping and then the drawdown remained consistent at 13.8 metres until approximately 390 minutes after pumping started. It is noted that discharge measurements collected at regular intervals throughout the pumping test recorded measured flows of approximately 37.8 litres per minute (i.e. 10 US gallons per minute). The water level in the test well recovered 95% within approximately 10 hours after the pump was shut off (Appendix G).

The specific capacity of the well at the time of maximum drawdown was 2.7 L/min/m. An aquifer transmissivity of 1.4 and 5.8 m^2/day was estimated using the drawdown and recovery data, respectively (Appendix J). Observation well data from TW1 and TW2 displayed minimal drawdown of 0.31 and 0.08 metres respectively and aquifer parameters could not be evaluated using drawdown and recovery data from the observation wells.

6.7 Hydraulic Interference Effects

During the pumping of the onsite test wells, manual water level measurements were taken at one to two-hour intervals in the two test wells that were not being pumped (bedrock observation wells) on the site. In addition, continuous water level loggers, recording at 15 second intervals, were installed in all test wells. The water level measurements in the observation wells are reported in Appendix G and discussed below.

6.7.1 Bedrock Observation Wells

The change in water level measurements in bedrock monitoring wells (test wells not being pumped) during the pumping tests for test wells TW 1, TW 2, and TW 3 ranged from 0.08 metres to 0.34 metres. The water level increased and decreased in the observation wells throughout the pumping tests. Given the minor water level fluctuations observed during the pumping tests (maximum of 0.34 metres), the observed water level fluctuations (both increases and decreases) may be associated with natural water level fluctuations and not with pumping.

6.7.2 Computer Model Simulations

A well interference simulation was developed using Aqtesolv version 4.5. One scenario was developed and the well simulation output is provided in Appendix K for discussion purposes. A discussion of each simulation and the parameters used in its development are provided in the following sections.

No estimates of the storativity are available, however typical values for confined aquifers range from 5×10^{-5} to 5×10^{-3} (Todd, 1980).

6.7.2.1 Scenario 1 (Figure K1 - Appendix K)

Scenario 1 is provided to illustrate the maximum drawdown using the unified aquifer parameters identified in Table 6.7. Furthermore, the average storativity for a confined aquifer was used (Todd, 1980). The following parameter values were utilized in the model:

- Number of pumping wells = 11 wells;
- Individual well pumping rate = 18.9 litres per minute;
- Duration of pumping = 120 minutes;
- Analysis model = Theis
- Aquifer thickness = 6.0 metres;
- Aquifer transmissivity = 6.6 m^2/day (geometric mean based on TW1, TW2 and TW3); and,
- Storativity coefficient = 5×10^{-5} (conservative estimate of storativity).

The results of Scenario 1 simulation indicate that the maximum drawdown within the site, localized at the individual pumping wells is approximately 4.25 to 4.50 metres. The maximum drawdown

between wells is 1.1 metres. The drawdown decreases to less than 0.05 metres at the property boundary. Based on the results of the well interference simulation, the interference between drinking water wells and neighbouring properties is considered to be acceptable.

6.8 Long Term Well Yields

The British Columbia Ministry of the Environment (2012) estimates the long-term well yield by first determining the well's specific capacity after 100 days of pumping (theoretical drawdown without recharge). The assessment was carried out using the following data:

- Time (t) - 100 days;
- Pumping Rate (Q) - 27 m^3/day (based on peak flow of 18.75 litres per minute);
- Transmissivity (T) – 6.6 m^2/day (geometric mean based on TW1, TW2 and TW3);
- Distance (r) - 0.078 metres (based on radius of open hole test well);
- Storativity (S) – 5 x 10^{-5} (conservative estimate of storativity for a confined aquifer - Todd, 1980); and,
- Maximum Available Drawdown (D) – 15.5 metres (geometric mean based on TW1, TW2 and TW3).

First, the drawdown in the aquifer after 100 days of pumping is calculated using the Modified Nonequilibrium Equation (Groundwater and Wells 2nd Ed., Driscoll, 1986):

$$s = \frac{0.183 \cdot Q}{T} \cdot Log \frac{2.25 \cdot T \cdot t}{r^2 \cdot S}$$

The specific capacity after 100 days (SC) is calculated using the pumping flow rate (Q) and estimated drawdown after 100 days (s):

$$SC = \frac{Q}{s}$$

The safe well yield (Q_{safe}) can then be estimated by multiplying the specific capacity after 100 days of pumping (SC) by the maximum available drawdown (D) by a safety factor of 0.7:

$$Q_{safe} = 0.7 \times SC_{100} \times D_{available}$$

Using this approach, the safe well yield was calculated for the average scenario based on unified transmissivity values. The safe well yield was calculated to be approximately 28 litres per minute of continuous pumping for 100 days. This is 1.5 times more than the peak pumping rates of MECP Procedure D-5-5 of 18.9 litres per minute for a period of 2 hours.

7.0 CONCLUSIONS

Based on the results of the hydrogeological investigation, the following conclusions and professional opinions are provided:

- The site geology generally consists of thinly veneered unconsolidated quaternary sediments, consisting of silty clay, sand and gravels and/or glacial till. The subject site overburden thickness ranges from approximately 0.3 to 3.1 metres. The site is considered to be hydrogeologically sensitive and protective measures are recommended to minimize potential impacts to the water supply aquifer.

- Some areas of thin overburden will require augmentation of native soils to meet the minimum overburden thickness required for onsite septic systems. The proposed lot sizes are considered to be acceptable based on the proposed conceptual lot development plan as well as the nitrate dilution calculations.

- The water quality available from drilled wells on the subject site is safe for consumption based on the absence of health-related exceedances; however, groundwater treatment for aesthetic parameters will likely be required.
    - To note, despite the initial detection of fecal coliform bacteria, two subsequent samples were non-detectable indicating that the fecal coliform bacteria were likely associated with the well construction. Furthermore, following the initial detection of total coliform in TW2 (confluent), two subsequent samples were less than 6 CFU/100mL and meets MECP Procedure D-5-5 for acceptable drinking water quality.
    - To note, colour exceeds the maximum concentration considered reasonably treatable; however, the nature of the constituents casing excessive colour has been determined to be elevated iron and manganese concentrations and can be removed by manganese greensand treatment.

- The quality of the groundwater meets the Ministry of the Environment, Conservation and Parks Regulations, Standards, Guidelines and Objectives with the exception of hardness, total dissolved solids, colour, organic nitrogen, sodium and iron.

    - The levels of hardness and iron are considered to be reasonably treatable using a conventional water softener and/or manganese greensand filter.

    - The levels of colour reported exceed the ODWS aesthetic objective of 5 TCU and the maximum acceptable reasonably treatable limit of 7 TCU; however, the colour is considered to be iron-related and can be treated using manganese greensand filters.

- The levels of sodium remain well below the 200 mg/L aesthetic objective; however, several wells exceed the 20 mg/L warning limit for persons on sodium restricted diets.

- The organic nitrogen concentration (total kjeldahl nitrogen – ammonia) was found to range from 0 to 0.4 mg/L which exceeds the operational guideline of 0.15 mg/L for Ontario Drinking Water Standards (ODWS). Organic nitrogen can react with chlorine and severely reduce its disinfectant power; in addition, taste and odour problems may also occur. It is not expected that ongoing chlorination will be utilized by homeowners in the residential subdivision and, as such, no concerns with the operational objective exceedance for organic nitrogen were identified.

- The total dissolved solids concentrations measured in two neighbouring private wells exceed the ODWS aesthetic objective of 500 mg/L. Elevated levels of TDS can lead to problems associated with encrustation and corrosion. The Langelier Saturation Index (LSI) indicates the groundwater is slightly scale forming and corrosive. In our experience, the palatability of water with a TDS concentration of that measured should not be an issue. According to the "Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Total Dissolved Solids (TDS)", published by Health Canada (1991), TDS levels between 600 and 900 mg/L are considered to be 'fair'.

- The water quality from nearby private wells are similar to the water quality found in the proposed subdivision. No significant impacts from septic systems, Mississippi Lake or surrounding land use have been identified based on the water quality results.

- The surface water assessment demonstrates that Mississippi Lake will not be negatively impacted by the proposed development. Additional protective measures (increased separation distance between septic systems and surface water bodies (i.e. Mississippi Lake) are recommended.

- The water quality determined in the course of this investigation is representative of long-term water quality from which future lot owners are likely to obtain from their wells constructed in accordance with the well construction recommendations.

- The quantity of groundwater available from the proposed water supply aquifer is more than sufficient for the proposed development and will sustain repeated pumping at the test rate and duration at 24-hour intervals over the long term.

- Interference between drinking water wells is expected to be negligible under typical usage for residential developments.

- No negative impacts to the bedrock aquifer are anticipated based on nitrate dilution calculations which demonstrate that offsite nitrate impacts are less than 10 mg/L.

- The test well construction is typical of wells which will be used in the development in the future.

- The well yields determined in the course of the investigation are representative of the yields which residents of the development are likely to obtain from their wells in the long term.

8.0 RECOMMENDATIONS

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

8.1 Well Construction Recommendations

- All wells that are drilled in the subdivision should be constructed in accordance with local and MECP regulations, including, but not limited to, Ontario Reg. 903.

- Drinking water wells should be located so that they meet and preferably exceed 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.

    - Drinking water wells should be located in general accordance with the Conceptual Lot Development Plan, prepared by GEMTEC (Appendix A).

- Well casings should be extended at least 12.2 metres (40 feet) below ground surface and completed in competent bedrock. This is consistent with Beckwith Township well casing requirements. 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 3.0 metres into sound, competent bedrock;

- A well grouting certification inspection should be conducted during the installation and grouting of the well casing for all future wells installed on the subject site. The well grouting

certification inspection should be conducted under the supervision of a professional engineer or professional geoscientist.

- It is recommended that newly drilled water wells be developed by the well driller for a minimum of one (1) hour of pumping following completion of the well drilling. This well development can be carried in conjunction with the one (1) hour pumping test that is required for the MECP Water Well Record.

- It is recommended that newly drilled water wells be chlorinated by the well driller following completion of the well drilling and pumping.

8.2 Well Ownership Recommendations

- It is recommended that the property owners construct, maintain and test their drinking water well in accordance with the Ministry of the Environment and Climate Change document "Water Supply Wells - Requirements and Best Management Practices, Revised April 2015".

- For all newly drilled wells, it is recommended that a raw water sample be collected and analyzed for potability requirements (E. Coli. and total coliform bacteria).

    - If any bacteriological exceedances of the Ontario Drinking Water Standards (ODWS) are noted in the sampling, then it is recommended that the homeowner take remedial actions (such as chlorination of the well to eliminate bacteria) and retest a raw water sample to confirm that the remedial actions were effective.

- It is recommended that homeowners be informed that hardness levels may exceed the ODWS operational guideline for hardness. Conventional water softeners may be desired by homeowners to treat minor aesthetic objective and operational guideline exceedances of the ODWS such as hardness. On heating, hard water has a tendency to form scale deposits and can form excessive scum with regular soaps.

- It is recommended that homeowners be informed that 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.

- It is recommended that homeowners be informed that neighbouring private wells encountered total dissolved solids concentrations exceeding the ODWS aesthetic objective of 500 mg/L. Elevated levels of TDS can lead to problems associated with encrustation and corrosion. The Langelier Saturation Index (LSI) indicates the groundwater is slightly scale forming and corrosive. In our experience, the palatability of water with a TDS concentration of that measured should not be an issue. According to the "Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Total Dissolved Solids (TDS)", published by Health Canada (1991), TDS levels between 600 and 900 mg/L are considered to be 'fair'.

8.3 Septic System Construction Recommendations

- Septic systems should be located in general accordance with the Conceptual Lot Development Plan, prepared by GEMTEC (Appendix A).

- In areas where shallow bedrock is present (i.e. bedrock at less than 2.0 metres below ground surface), it is recommended that a minimum 150-millimetre-thick silty clay seal be placed between the bedrock and the imported septic sand.
    - Lots 4, 5, 6 and 7 based on the Conceptual Lot Development Plan, prepared by GEMTEC (Appendix A)

- It is recommended that the separation distance between the well and septic should be increased from 15 metres to 30 metres;

- It is recommended that the separation distance between septic systems and surface water (Mississippi Lake) should be increases from 30 metres to 60 metres, as demonstrated on the Conceptual Lot Development Plan, prepared by GEMTEC (Appendix A);

- The proposed lots will be serviced by conventional 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;

- Advanced treatment septic systems could be considered for the proposed development and/or individual property owners. Any advanced treatment septic systems should be designed according to the Ontario Building Code. A site-specific investigation should be conducted on each lot for the design of the septic system; and,

- It is recommended that if property owners choose to install advanced treatment septic systems, then it will be required to enter a maintenance agreement with authorized agents of the system manufacturer for the service life of the system.

8.4 Septic Ownership Recommendations

- It is recommended that the property owners construct, maintain and check their onsite septic system in accordance with the Ontario Building Code.

9.0 LIMITATIONS OF REPORT

This report was prepared for Cameron and June Young and is intended for the exclusive use of Cameron and June Young. This report may not be relied upon by any other person or entity without the express written consent of GEMTEC and Cameron and June Young. Nothing in this report is intended to provide a legal opinion.

The investigation undertaken by GEMTEC with respect to this report and any conclusions or recommendations made in this report reflect the best judgments of GEMTEC 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, GEMTEC should be requested to review the information and, if necessary, re-assess the conclusions presented herein.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

A. Paznekas

Andrius Paznekas, M.Sc.
Hydrogeologist

Shaun Pelkey, M.Sc.E., P.Eng.
Principal, Environmental Engineer

10.0 REFERENCES

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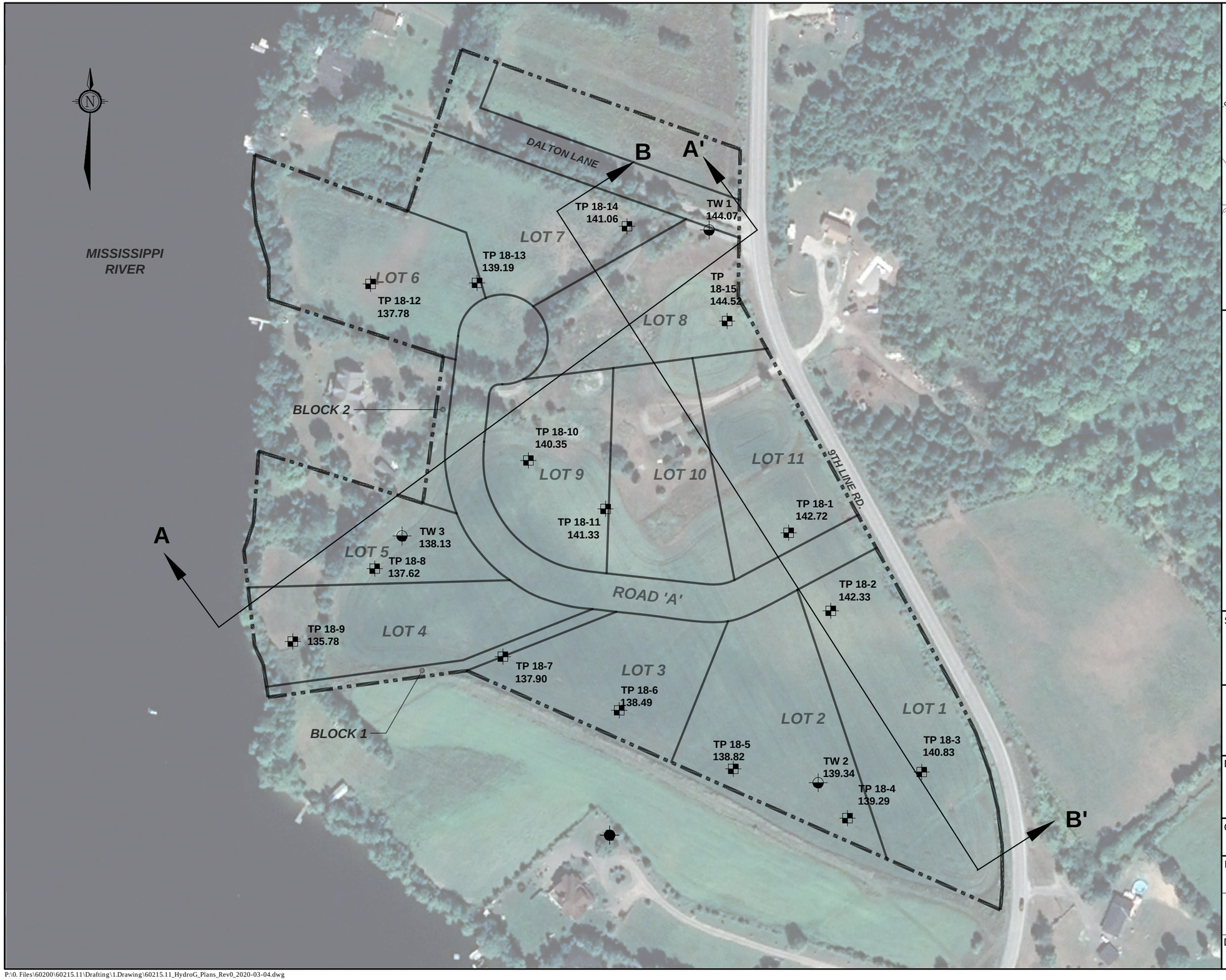
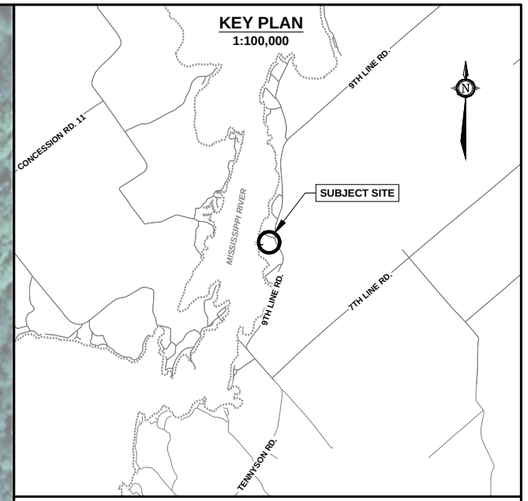


KEY PLAN
1:100,000



LEGEND

- SUBJECT SITE
- TEST PIT LOCATION IN PLAN (current investigation by GEMTEC)
- TEST WELL LOCATION IN PLAN (current investigation by GEMTEC)
- WELL LOCATION IN PLAN (Adjacent property)
- A — A' CROSS SECTION LOCATION IN PLAN (current investigation by GEMTEC)
- TP/TW # — TEST PIT/TEST WELL ID
- XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

Scale 1:2000

0 40 80 120m

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Drawing: DETAILED SITE PLAN

Client: ZANDER PLAN INC.

Project: 60215.11

HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C.

Chkd by: A.P.

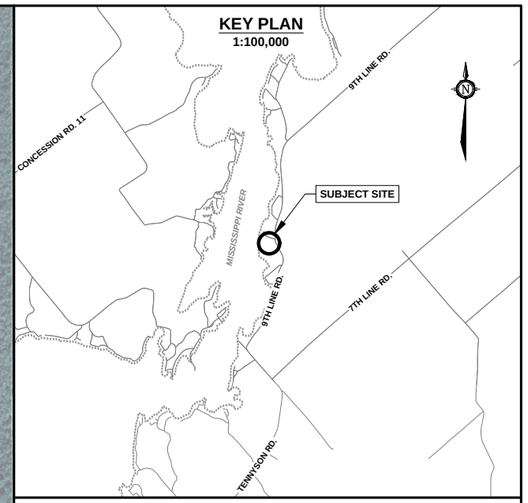
Date: MARCH 2020

Rev.: 0

FIGURE 1

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg

KEY PLAN
1:100,000



LEGEND

- SUBJECT SITE
- STUDY AREA 500m AROUND SUBJECT SITE
- 11 — LOT NUMBER
- MECP WELL LOCATION

Scale 1:7500

0 150 300 450m

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Drawing: ENVIRONMENTAL FEATURES

Client: ZANDER PLAN INC.

Project: 60215.11

HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C.

Chkd by: A.P.

Date: MARCH 2020

Rev.: 0

FIGURE 2

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg

KEY PLAN
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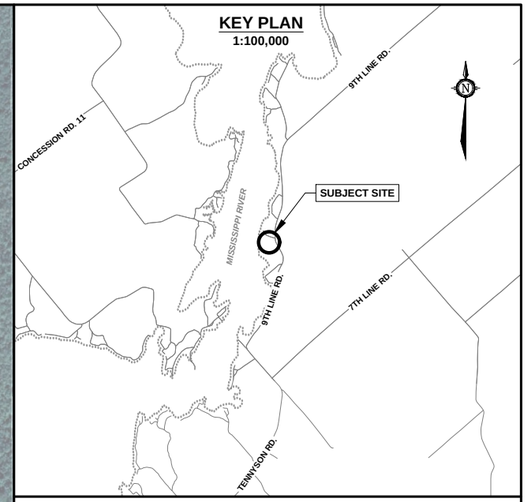

LEGEND

- SUBJECT SITE
- STUDY AREA 500m AROUND SUBJECT SITE
- 11 — LOT NUMBER
- 100 — CONTOUR INTERVAL, IN METRES

Scale 1:7500

0 150 300 450m

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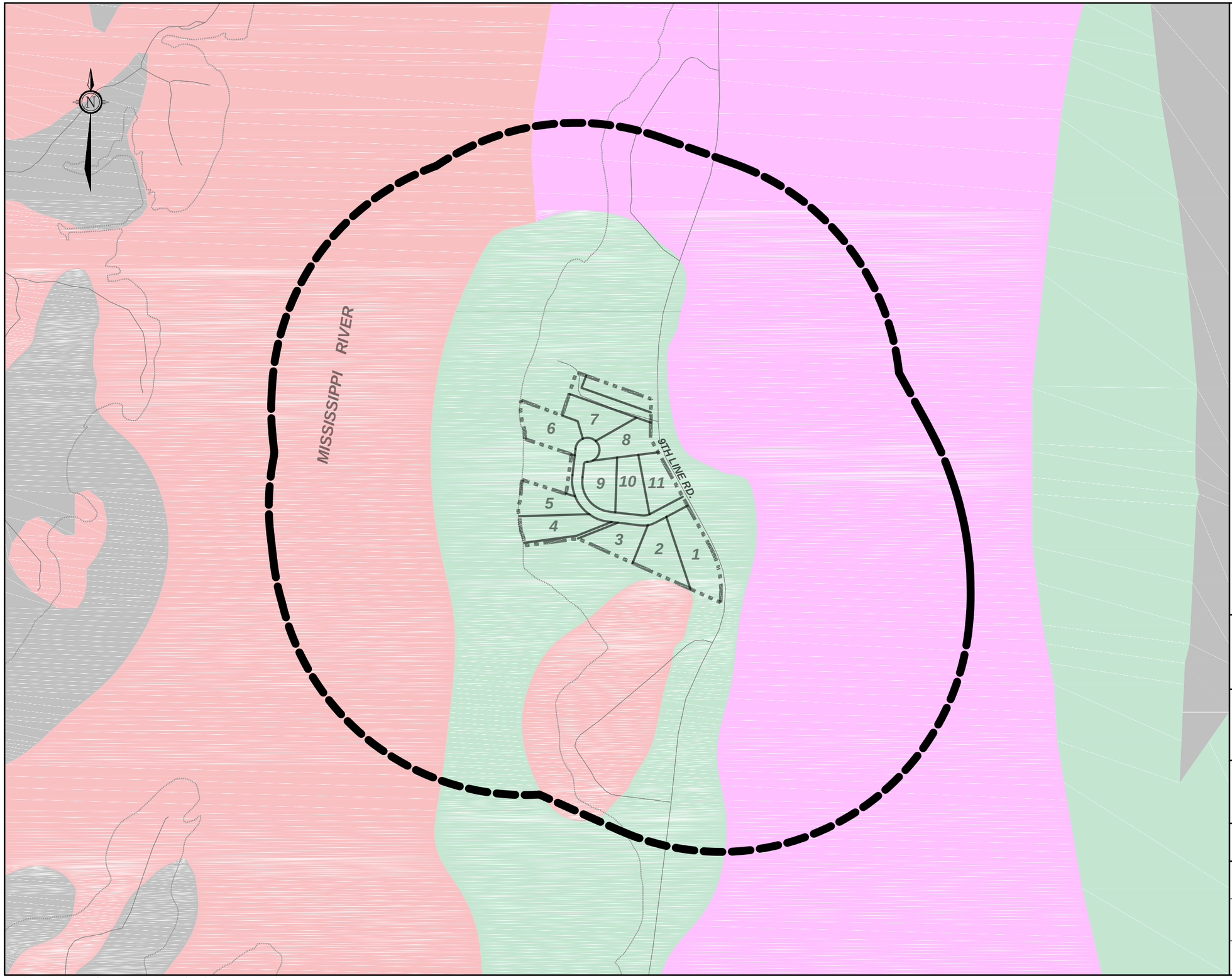
Drawing: TOPOGRAPHY AND DRAINAGE

Client: ZANDER PLAN INC.

Project		HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS LOT 3, CONCESSION 8 BECKWITH TOWNSHIP, ONTARIO
60215.11		
Drwn by: P.C.	Chkd by: A.P.	
Date: MARCH 2020	Rev.: 0	**FIGURE 3**

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg



LEGEND

- SUBJECT SITE
- STUDY AREA 500m AROUND SUBJECT SITE
- 11 LOT NUMBER
- WATER BODIES
- Organic Deposits
- Precambrian bedrock
- Till
- Paleozoic bedrock

Scale 1:7500

0 150 300 450m

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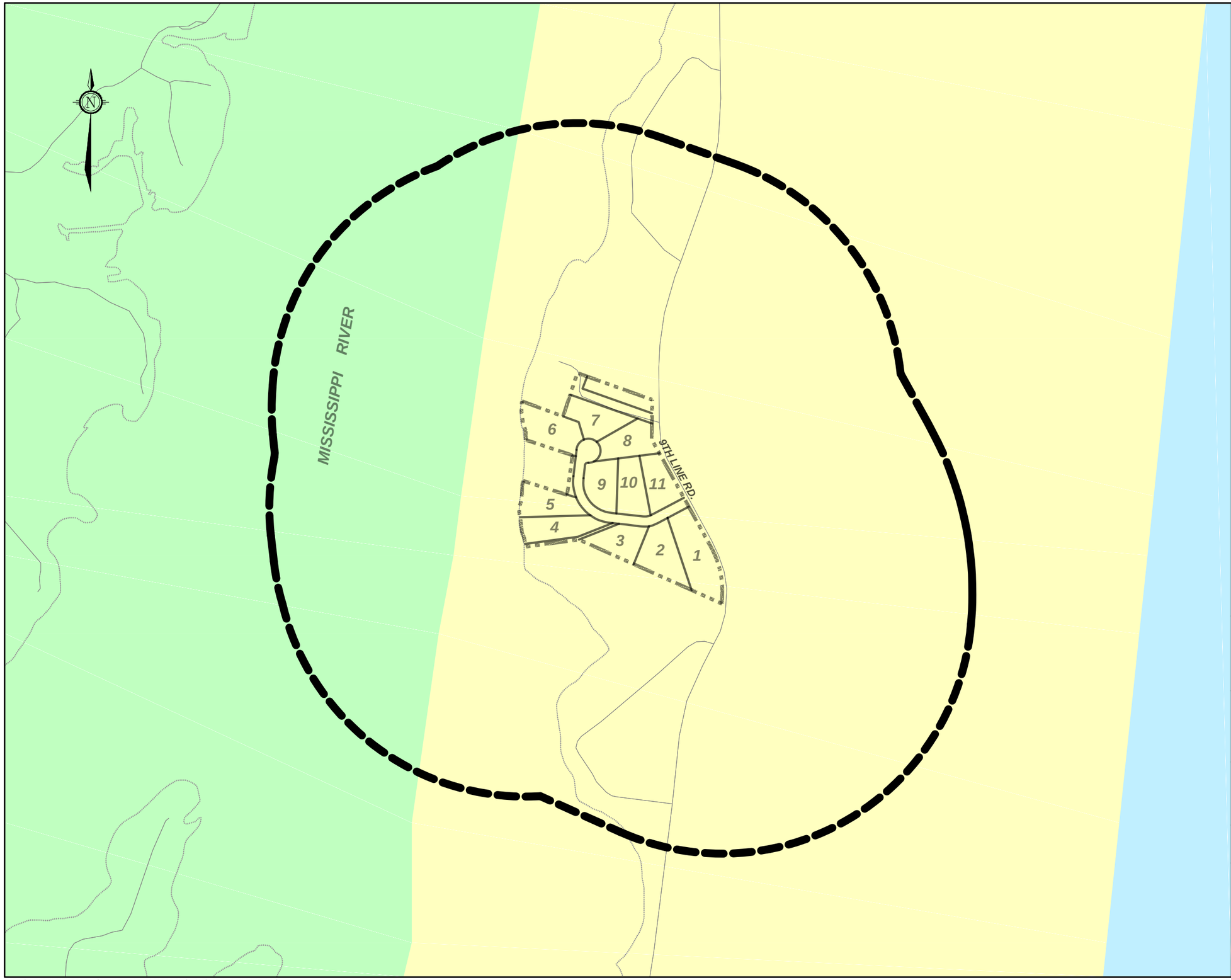
Drawing: OGS SURFICIAL GEOLOGY

Client: ZANDER PLAN INC.

Project		
60215.11		HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS LOT 3, CONCESSION 8 BECKWITH TOWNSHIP, ONTARIO
Drwn by: P.C.	Chkd by: A.P.	
Date: MARCH 2020	Rev.: 0	**FIGURE 3**

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg



LEGEND

- SUBJECT SITE
- STUDY AREA
  500m AROUND SUBJECT SITE
- 11 — LOT NUMBER
- WATER BODIES
- Dolostone, sandstone
  Beekmantown Group
- Conglomerate, sandstone, shale dolostone
  Potsdam Group; Nepean Formation;
  Covey Hill Formation
- Clastic metasedimentary rocks
  Conglomerate, wacke, quartz arenite, arkose, limestone, siltstone, chert, minor iron formation, minor metavolcanic rocks
  Grenville Supergroup and Flinton Group

Scale 1:7500

0 150 300 450m

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Drawing: OGS BEDROCK GEOLOGY

Client: ZANDER PLAN INC.

Project: 60215.11

HYDROGEOLOGICAL INVESTIGATION
& TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C.

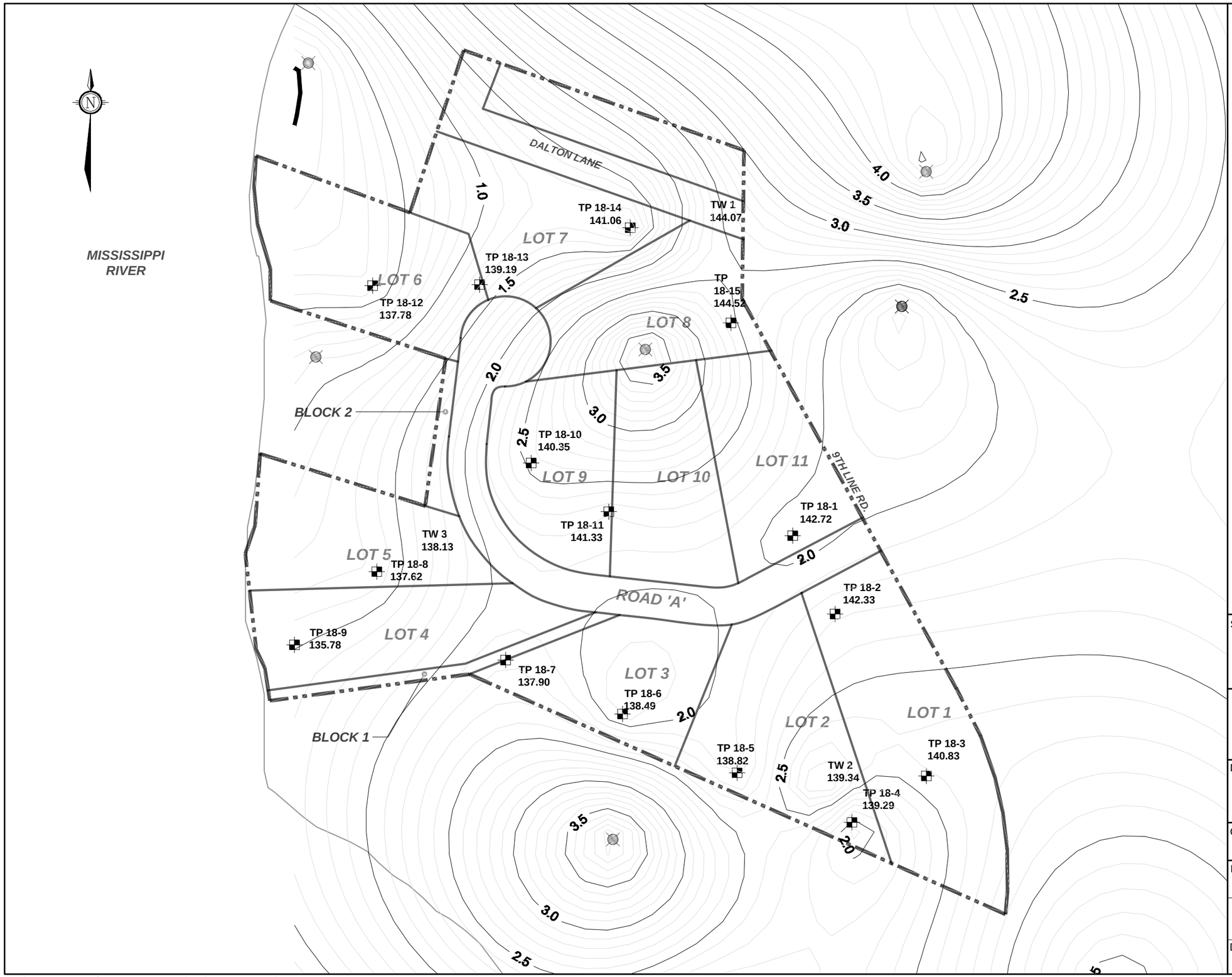
Chkd by: A.P.

Date: MARCH 2020

Rev.: 0

FIGURE 5

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg



LEGEND

- SUBJECT SITE
- STUDY AREA
  500m AROUND SUBJECT SITE
- 2.5 — OVERBURDEN THICKNESS CONTOURS IN METRES
- WATER BODIES
- MECP WELL LOCATION
- **TEST PIT LOCATION IN PLAN**
  (current investigation by GEMTEC)
- **TEST WELL LOCATION IN PLAN**
  (current investigation by GEMTEC)
- TP/TW # — TEST PIT/TEST WELL ID
- XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

Scale 1:2000

0 40 80 120m

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Drawing: OVERBURDEN THICKNESS MAP

Client: ZANDER PLAN INC.

Project: 60215.11

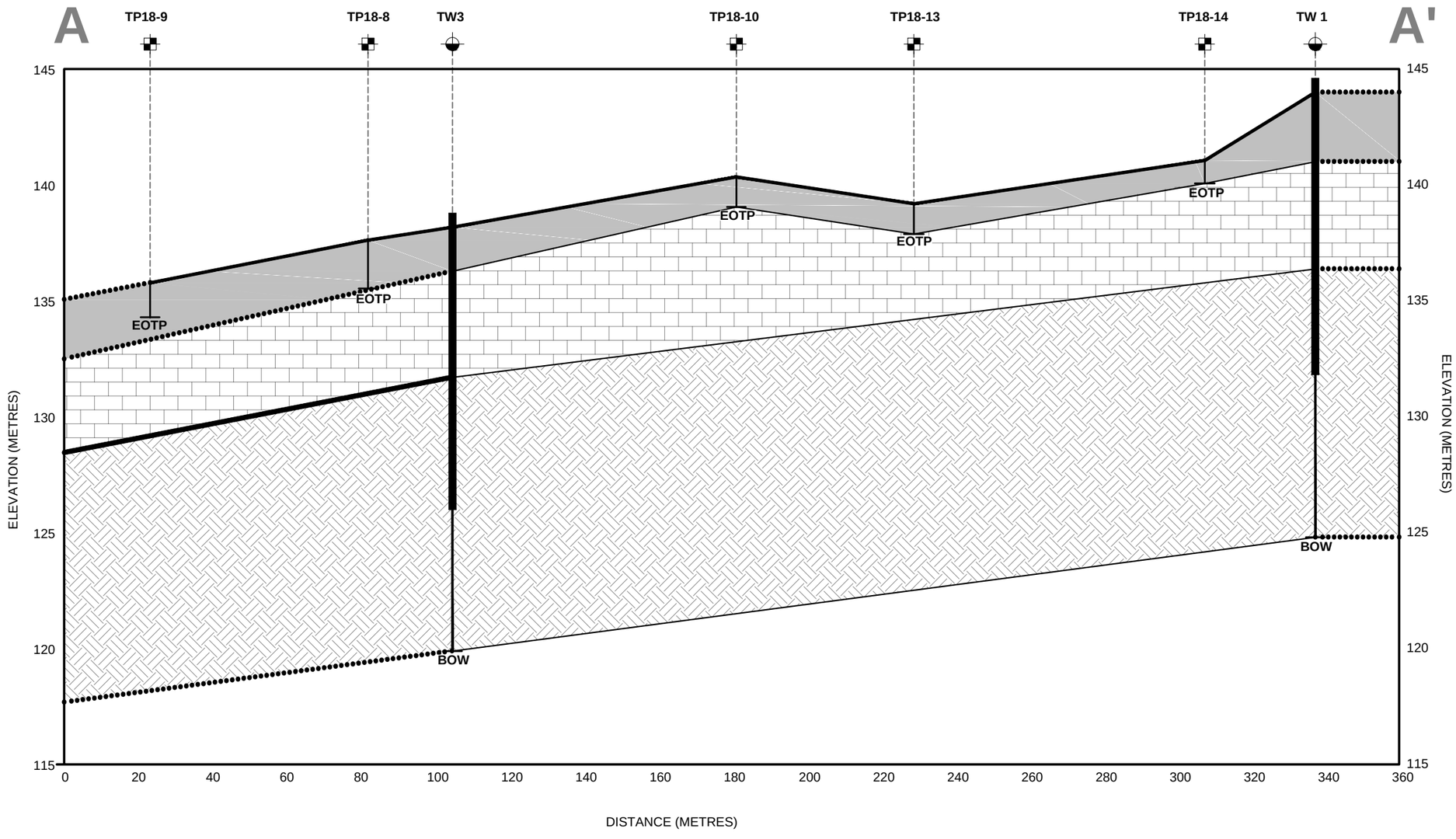
HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C. | Chkd by: A.P.

Date: MARCH 2020 | Rev.: 0

FIGURE 6

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg



LEGEND

- **TEST PIT LOCATION** (current investigation by GEMTEC)
- **TEST WELL LOCATION** (current investigation by GEMTEC)
- **OVERBURDEN**
- **LIMESTONE/SANDSTONE**
- **GRANITE**
- **INTERPRETED PROFILE**
- **WELL CASING**

ABBREVIATIONS

TP 18-1	TEST PIT ID
TW1	TEST WELL ID
EOTP	END OF TEST PIT
BOW	BOTTOM OF WELL

Vertical Scale

1:200

0 4 8 12m

Horizontal Scale

1:1250

0 25 50 75m

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Drawing

CROSS SECTION A-A'

Client

ZANDER PLAN INC.

Project 60215.11

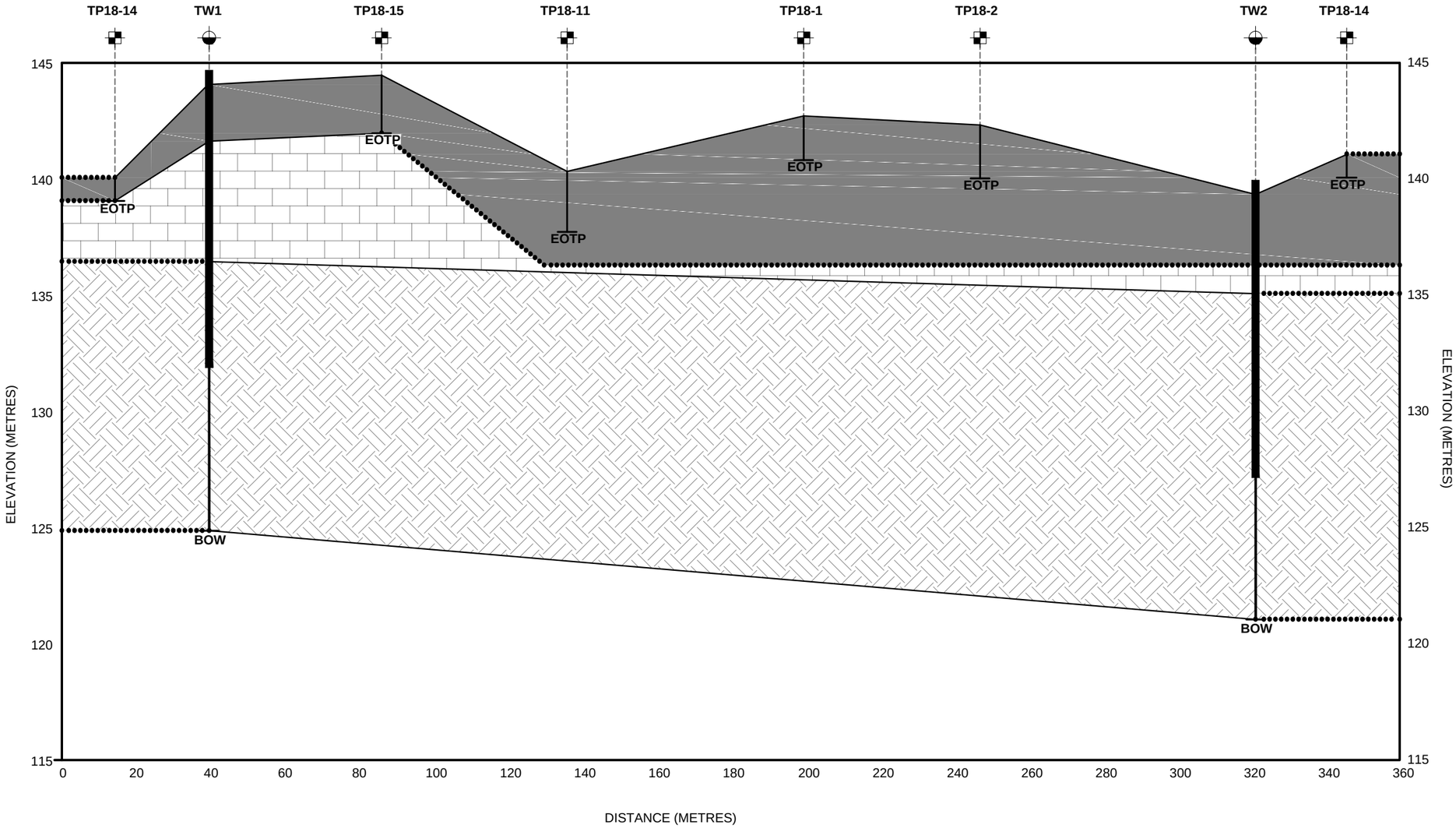
HYDROGEOLOGICAL INVESTIGATION
& TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by P.C. | Chkd by A.P.

Date MARCH 2020 | Rev. 0

FIGURE 7A

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg



LEGEND

- **TEST PIT LOCATION** (current investigation by GEMTEC)
- **TEST WELL LOCATION** (current investigation by GEMTEC)
- **OVERBURDEN**
- **LIMESTONE/SANDSTONE**
- **GRANITE**
- **INTERPRETED PROFILE**
- **WELL CASING**

ABBREVIATIONS

TP 18-1	TEST PIT ID
TW1	TEST WELL ID
EOTP	END OF TEST PIT
BOW	BOTTOM OF WELL

Vertical Scale

1:200

0 4 8 12m

Horizontal Scale

1:1250

0 25 50 75m

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Drawing

CROSS SECTION B-B'

Client

ZANDER PLAN INC.

Project 60215.11

HYDROGEOLOGICAL INVESTIGATION
& TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by P.C. | Chkd by A.P.

Date MARCH 2020 | Rev. 0

FIGURE 7B

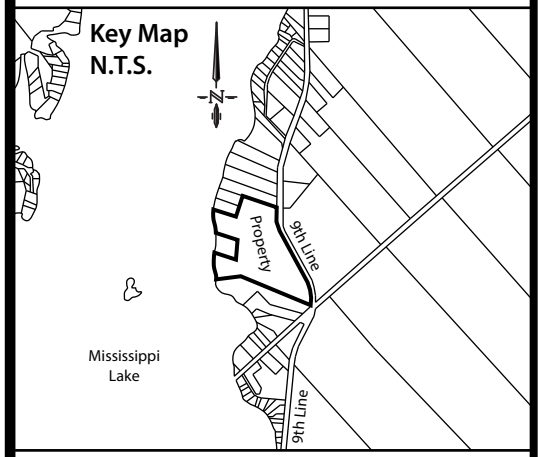
P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg

APPENDIX A

Lot Development Plans (ZanderPlan & GEMTEC)

Young Subdivision Concept

3160 Ninth Line Beckwith
Part Lot 3, Concession 8
Parts 1 - 3, 27R-2652, Parts 1 & 2,
27R-2874, Part 1, 27R-9676
Township of Beckwith
COUNTY OF LANARK



Legend

- Proposed Easement
- Subdivision Boundary
- Right-of-Way / Edge of Road
- Road Centreline
- Lot Lines
- Block Lines
- TW — Test Wells

Notes:

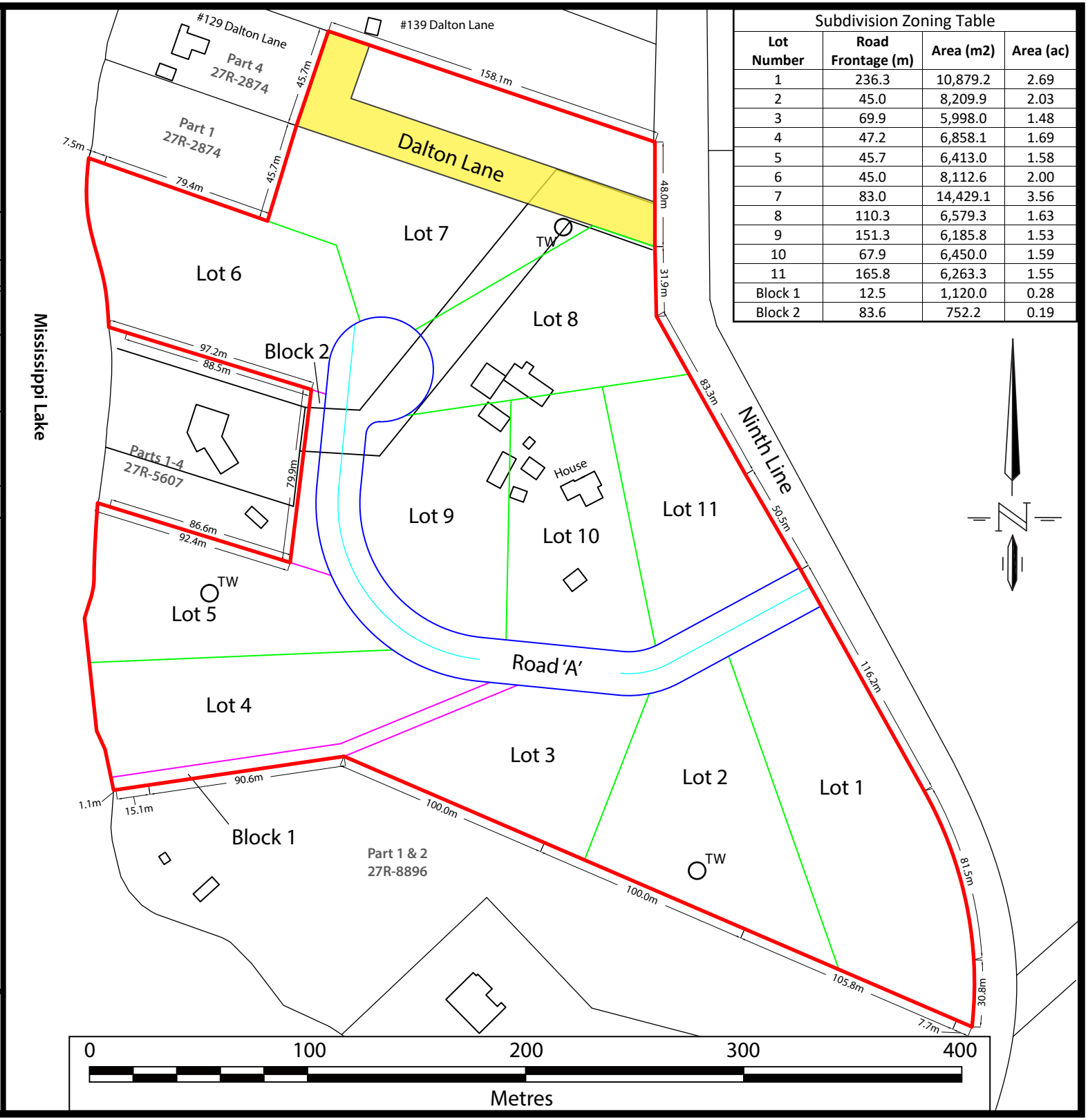
1. The proposed easement is to protect the access for those lots fronting on Mississippi Lake which currently use Dalton Lane for road access.
2. Block 2 will form an addition onto the proponents property, described as Parts 1 - 4 on 27R-5607.
3. Boundary and dimensions of the subject property derived in part from Plan 27R-2652, Plan 27R-2874, Plan 27R-4439, Plan 27R-5607 and Plan 27R-8896 with some dimensions approximated using aerial photography.

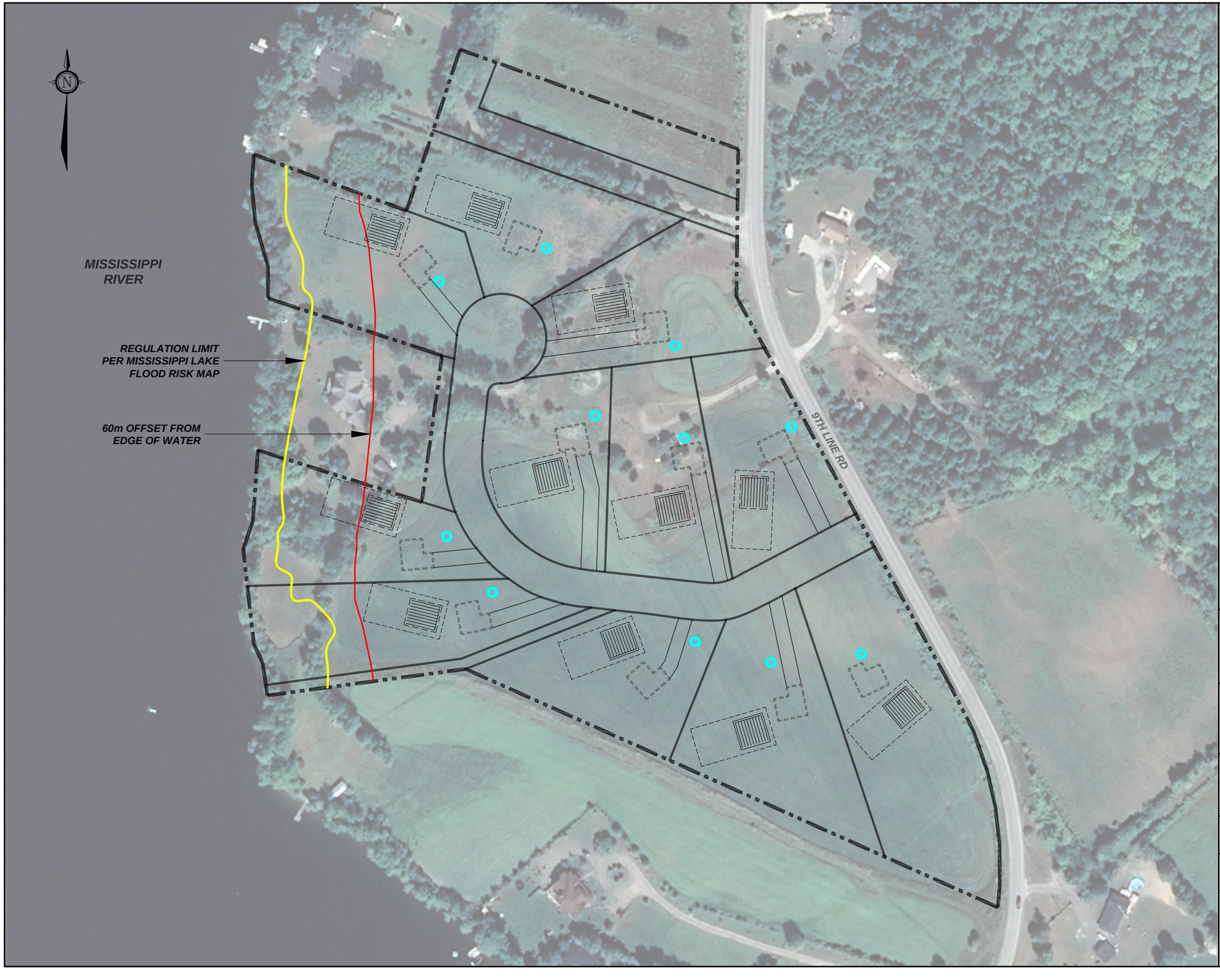
zanderPLAN
Your rural land planning experts

Version Date: February 18, 2020

Subdivision Zoning Table

Lot Number	Road Frontage (m)	Area (m2)	Area (ac)
1	236.3	10,879.2	2.69
2	45.0	8,209.9	2.03
3	69.9	5,998.0	1.48
4	47.2	6,858.1	1.69
5	45.7	6,413.0	1.58
6	45.0	8,112.6	2.00
7	83.0	14,429.1	3.56
8	110.3	6,579.3	1.63
9	151.3	6,185.8	1.53
10	67.9	6,450.0	1.59
11	165.8	6,263.3	1.55
Block 1	12.5	1,120.0	0.28
Block 2	83.6	752.2	0.19





LEGEND

- SUBJECT SITE
- REGULATION LIMIT PER MISSISSIPPI LAKE RISK MAP (REV. 4 - October 16, 2015)
- 60 METRE OFFSET FROM WATER'S EDGE
- POTENTIAL WELL LOCATION
- CONCEPTUAL DWELLING FOOTPRINT
- CONCEPTUAL SEPTIC SYSTEM

Septic System Assumptions:

Septic System Envelope = 42 x 21 metres

Class 4 - Fully Raised Fill Based Absorption Trench (Conventional) System on material with a loading rate = 4

Daily flow calculated assuming dwelling with 300m² area; 5 bedrooms, 4.5 bathrooms = 3,500 litres per day

Required Septic System Separation Distances per 2012 Ontario Building Code, Part 8.2.1.6.

1) Septic tank/tertiary unit to dwelling/structures = 1.5 m (min)
2) Septic tank/tertiary treatment unit to well = 18 m (min)
3) Septic tank/tertiary unit to property line = 6 m (min)
4) Distribution pipe to dwelling/structures = 8 m (min)
5) Distribution pipe to property line = 6 m (min)
6) Distribution pipe to drilled well = 18 m (min)
6a) Increased to 30m based on recommendation from Hydrogeological Investigation & Terrain Analysis report.
7) Septic tank/tertiary treatment unit/distribution pipe to river = 30 m (min)

Note:

This drawing is conceptual and is intended for illustration purposes only.

All structures shown on this plan have been drawn to scale and meet the minimum separation distances required per 2012 Ontario Building Code.

Scale 1:2000

0 40 80 120m

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Drawing: CONCEPTUAL LOT DEVELOPMENT PLAN

Client: ZANDER PLAN INC.

Project		HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS LOT 3, CONCESSION 8 BECKWITH TOWNSHIP, ONTARIO
60215.11		
Drwn by: P.C.	Chkd by: A.P.	
Date: MARCH 2020	Rev.: 0	**FIGURE A.1**

APPENDIX B

Background Documentation

Carleton Place

Greater Blacks Corners

Ottawa

ADDITION OF "SPECIAL SERVICE AREA" OVERLAY

Project 60215.11
Subject site is approximately 7.0 kilometres southwest and upgradient of the mapped contamination plume.

NOTE: EXCERPT FROM SCHEDULE "A" TO THE OFFICIAL PLAN

OVERLAY

SPECIAL SERVICE AREA

LEGEND:

Commercial
Industrial
Institutional
Residential

Special Policy Area 1
Special Policy Area 2
Special Policy Area 3
Agriculture
Mineral Aggregate Pit

Flood Plain
Wetlands
Rural Lands
Wrecking Yard
Airport

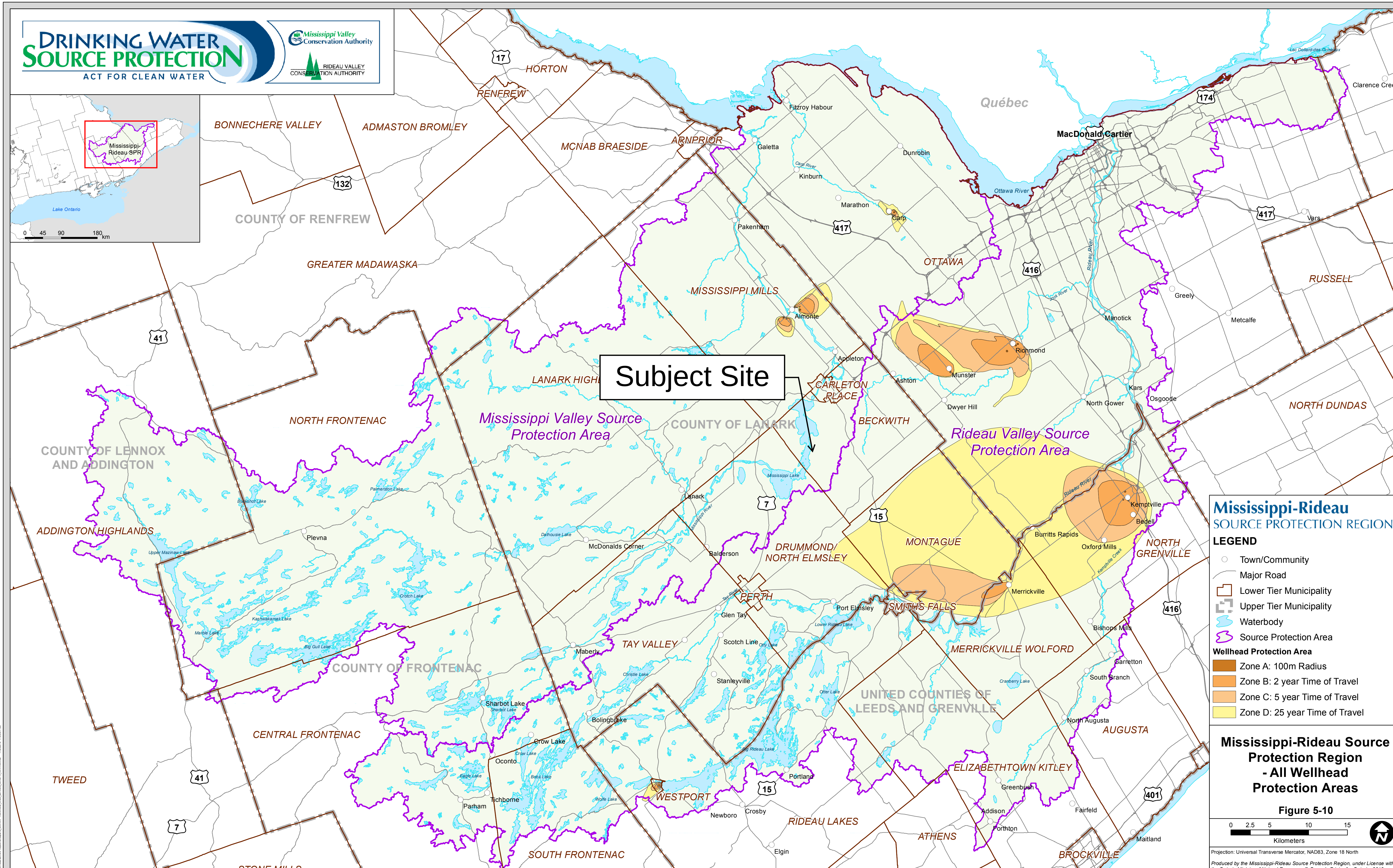
500 250 0 500 1000m

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

DRAWING:

Amendment No. 22 to the Official Plan for the Township of Beckwith

DESIGN: T.K.O'B.	DRAWN: T.K.O'B.	DRAWING No: Schedule "A"
DATE: 15/02/07		
SCALE: 1/25000		JOB No:


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
RIDEAU VALLEY CONSERVATION AUTHORITY
Mississippi-Rideau SPR
Lake Ontario
0 45 90 180 km
Subject Site
Mississippi Valley Source Protection Area
Rideau Valley Source Protection Area
Québec
COUNTY OF RENFREW
COUNTY OF LANARK
COUNTY OF LENNOX AND ADDINGTON
COUNTY OF FRONTENAC
UNITED COUNTIES OF LEEDS AND GRENVILLE
HORTON
RENFREW
BONNECHERE VALLEY
ADMASTON BROMLEY
MCNAB BRAESIDE
ARNPRIOR
GREATER MADAWASKA
MISSISSIPPI MILLS
OTTAWA
RUSSELL
NORTH FRONTENAC
LANARK HIGHLANDS
CARLETON PLACE
BECKWITH
NORTH DUNDAS
ADDINGTON HIGHLANDS
DRUMMOND/ NORTH ELMSLEY
MONTAGUE
NORTH GRENVILLE
PERTH
SMITHS FALLS
TAY VALLEY
MERRICKVILLE WOLFORD
AUGUSTA
CENTRAL FRONTENAC
ELIZABETHTOWN KITLEY
TWEED
WESTPORT
RIDEAU LAKES
ATHENS
BROCKVILLE
SOUTH FRONTENAC
STONE MILLS
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Town/Community
Major Road
Lower Tier Municipality
Upper Tier Municipality
Waterbody
Source Protection Area
Wellhead Protection Area
Zone A: 100m Radius
Zone B: 2 year Time of Travel
Zone C: 5 year Time of Travel
Zone D: 25 year Time of Travel
Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas
Figure 5-10
0 2.5 5 10 15
Kilometers
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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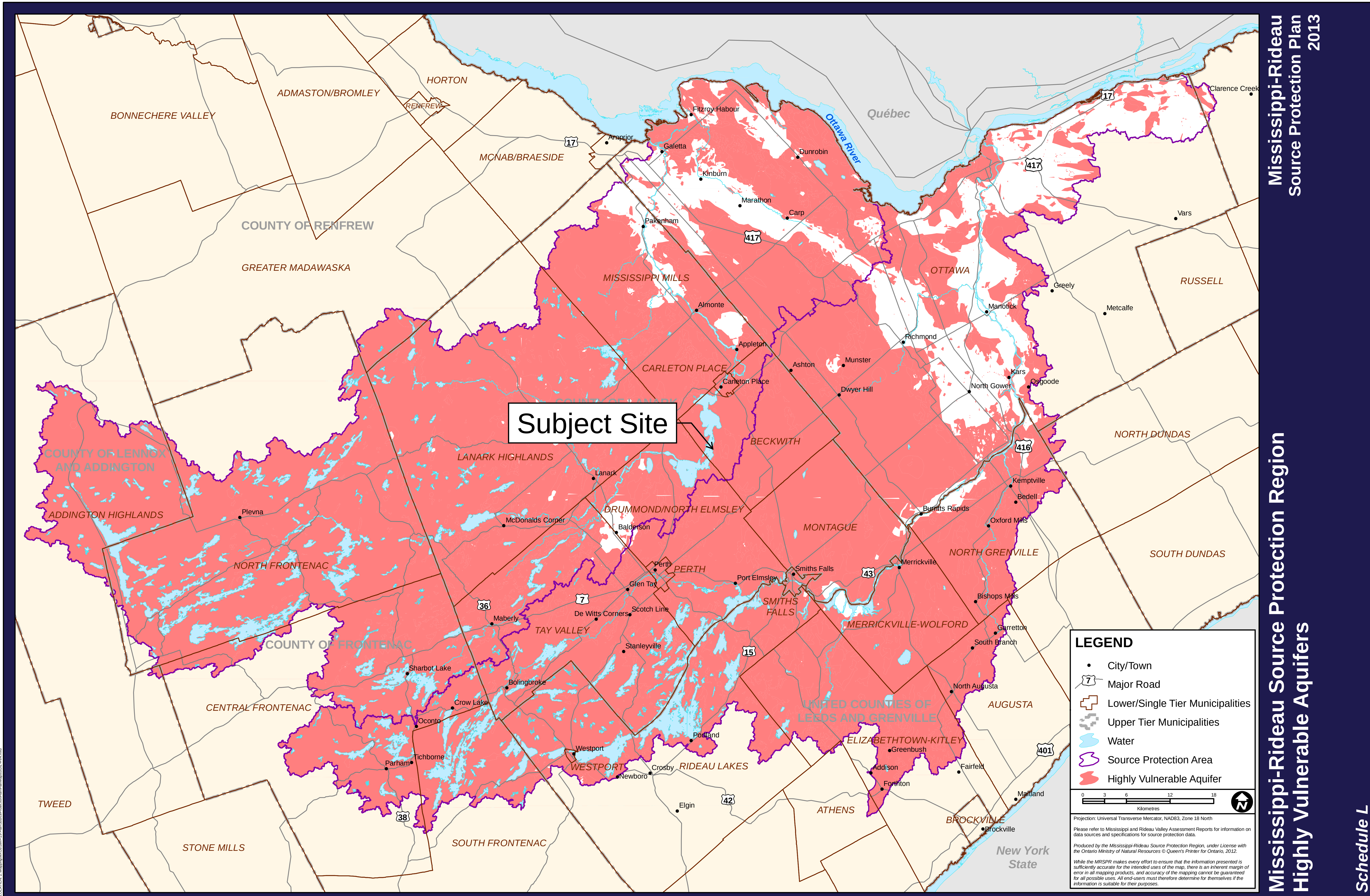
Notes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009.
Groundwater Vulnerability Study, Richmond Village Well System, Richmond Ontario, July 2018 Golder Associates Ltd.
Groundwater Vulnerability Study, Municipality of North Grenville and Village of Merrickville-Wolford Municipal Wells Golder Associates, May 2008. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009


Mississippi-Rideau
Source Protection Plan
2013
Mississippi-Rideau Source Protection Region
Highly Vulnerable Aquifers
Schedule L
Subject Site
Québec
Ottawa River
New York State
COUNTY OF RENFREW
COUNTY OF LENNOX AND ADDINGTON
COUNTY OF FRONTENAC
UNITED COUNTIES OF LEEDS AND GRENVILLE
BONNECHERE VALLEY
ADMASTON/BROMLEY
HORTON
RENFREW
MCNAB/BRAESIDE
GREATER MADAWASKA
MISSISSIPPI MILLS
CARLETON PLACE
OTTAWA
RUSSELL
BECKWITH
LANARK HIGHLANDS
ADDINGTON HIGHLANDS
NORTH FRONTENAC
DRUMMOND/NORTH ELMSLEY
MONTAGUE
NORTH GRENVILLE
NORTH DUNDAS
SOUTH DUNDAS
PERTH
SMITHS FALLS
TAY VALLEY
MERRICKVILLE-WOLFORD
CENTRAL FRONTENAC
AUGUSTA
ELIZABETHTOWN-KITLEY
WESTPORT
RIDEAU LAKES
ATHENS
BROCKVILLE
TWEED
STONE MILLS
SOUTH FRONTENAC
Arnprior
Fitzroy Habour
Galetta
Dunrobin
Kinburn
Marathon
Carp
Pakenham
Clarence Creek
Vars
Greely
Metcalfe
Manotick
Almonte
Appleton
Richmond
Munster
Ashton
Carleton Place
Dwyer Hill
Kars
North Gower
Osgoode
Lanark
Kemptville
Bedell
Burritts Rapids
Oxford Mills
Plevna
McDonalds Corner
Balderson
Perth
Glen Tay
Merrickville
Smiths Falls
Port Elmsley
Bishops Mills
De Witts Corners
Scotch Line
Maberly
Garretton
South Branch
Stanleyville
Sharbot Lake
Bolingbroke
North Augusta
Crow Lake
Oconto
Portland
Greenbush
Westport
Tichborne
Parham
Crosby
Newboro
Addison
Fairfield
Forthton
Maitland
Elgin
Brockville
17
417
416
7
36
43
15
401
42
38
LEGEND
City/Town
Major Road
Lower/Single Tier Municipalities
Upper Tier Municipalities
Water
Source Protection Area
Highly Vulnerable Aquifer
0
3
6
12
18
Kilometres
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
Please refer to Mississippi and Rideau Valley Assessment Reports for information on data sources and specifications for source protection data.
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APPENDIX C

MECP Water Well Records

Project: 60215.11
Cameron and June Young
Lot 3, Concession 8
1000 metre radius MECP Water Well Records

WELL_ID	COMPLETED	Well Depth (m BGS)	Depth To Bedrock (m)	Static Water Level (m)	Water found (metres BGS)	Water Detail	Well Use
3500353	October 23, 1958	19.5	2.7	1.2	19.5	FR	PS
3500373	April 17, 1959	12.2	0.6	1.5	12.2	FR	MN
3500367	May 3, 1968	21.9	0.6	4.3	21.9	FR	DO
7109867	July 28, 2008	36.6	-	-	26.8, 34.7	FR	DO
3515348	May 19, 2006	13.1	-	-	-	-	-
3515410	July 27, 2006	22.6	0.9	13.4	7.9, 14.6, 20.7	FR	DO
7137634	December 8, 2009	70.1	-	1.7	31.4, 54.9, 6.7	FR	DO
3513789	July 8, 2002	30.5	0	5.8	17.1, 23.8, 27.4	UK	DO
7115351	October 15, 2008	24.4	-	5.2	-	UT	DO
3512096	July 10, 1997	61	3	3.7	58.8	UK	DO
3500379	August 18, 1964	11.3	8.2	1.5	11.3	FR	DO
3504343	April 15, 1976	50.3	1.8	7.6	48.8	FR	DO
3515382	July 18, 2006	21	7	3.7	7, 12.5, 17.7	FR	DO
3504956	June 7, 1977	24.4	3.7	4.3	9.1, 21.6	FR	DO
3509438	May 7, 1990	38.1	1.5	4.6	36.6	FR	DO
3500372	March 27, 1959	7.9	1.8	0.6	7.9	FR	DO
7046713	June 4, 2007	18.3	-	-	-	-	DO
3500357	March 21, 1962	13.4	3	1.8	13.4	FR	DO
3503854	September 28, 1974	62.2	4.3	6.1	27.4, 60.4	FR	DO
7131835	September 16, 2009	70.1	-	-	-	-	-
3500352	August 1, 1958	21.6	10.4	5.5	21.3	FR	DO
3500358	June 24, 1963	16.5	10.1	3.7	15.8	FR	DO
3503812	August 8, 1974	13.4	0.6	4.6	10.4	FR	DO
3514755	November 22, 2004	54.9	2.1	1.8	-	-	DO
3500368	October 11, 1967	67.4	2.7	3	18, 45.7, 66.4	FR	DO
3506157	October 13, 1981	35.4	6.7	0	15.2, 33.8	FR	DO
3506666	May 23, 1983	50.3	0	3.4	48.8	FR	DO
3503381	June 14, 1973	19.5	0.6	3	18.3	FR	DO
3500365	June 21, 1960	6.1	1.5	3.7	6.1	FR	PS
3505241	October 31, 1978	13.4	4	4.6	-	-	DO
3513594	November 17, 2001	24.1	6.1	6.1	22.3	FR	DO
3500366	April 10, 1968	17.4	9.8	4.3	17.4	FR	DO
3500374	October 13, 1959	9.4	1.5	3.7	9.4	FR	DO
3500375	May 17, 1960	10.1	4.6	0	10.1	FR	DO
3504688	June 26, 1977	16.8	0.9	2.1	14.9	FR	DO
3506951	July 18, 1984	31.7	18.3	5.5	29.9	FR	DO
3508144	September 22, 1987	42.7	0	2.4	7.3, 35.1, 41.1	FR	DO
3506418	February 18, 1983	48.2	0.6	5.2	47.2	FR	DO
3505426	May 9, 1979	25.6	0	5.8	24.4	FR	DO
3512664	June 30, 1999	13.7	4.3	2.4	6.4, 11	FR	DO
3506366	May 5, 1982	13.4	0	3.7	11.6	FR	DO
3509593	September 26, 1990	43.3	0.3	1.8	41.1	FR	DO
3506563	September 6, 1983	32	0.9	-	15.2	UK	DO
3500359	March 13, 1961	18.6	4.6	6.7	18.3	FR	DO
3508914	July 7, 1989	106.7	1.5	7.6	88.4	FR	DO
3506543	July 28, 1983	15.5	3.7	0.6	7.9	FR	DO
7145657	March 4, 2010	11.6	-	0.7	19.8, 36	UT	DO
3510020	August 30, 1991	33.5	0	6.4	29.9	UK	DO
3500371	March 19, 1958	9.8	0.6	2.4	9.8	FR	IN
3512508	October 5, 1998	83.2	1.8	6.4	78.6	UK	ST
3504821	November 18, 1977	22.6	0	1.5	15.8, 21.9	FR	DO
7109890	July 28, 2008	-	-	-	-	-	-
3500376	June 11, 1960	6.7	1.8	1.2	6.7	FR	DO
7131530	September 15, 2009	54.9	-	5.3	23.8, 33.8, 52.7	UT	DO
3505073	May 25, 1978	9.8	5.8	0.6	8.2	FR	DO
3503813	August 7, 1974	31.7	0.9	4.6	30.2	FR	DO
3503814	August 7, 1974	13.4	0	4.6	10.4, 11.9	FR	DO
3514044	March 1, 2003	61	4.9	4.6	48.2	UK	DO
3502793	June 23, 1971	22.9	9.1	4.3	18.3	FR	DO
3502582	May 4, 1970	16.8	0	0.6	16.8	FR	DO
3500355	November 4, 1959	19.8	3.7	2.4	18.3	FR	DO
7145658	March 4, 2010	17.6	-	1.3	56.4	UT	DO
3503332	May 2, 1973	66.1	0	6.1	65.8	FR	DO
3508755	January 26, 1989	25.9	0.6	5.2	25	FR	DO
3515280	February 6, 2006	26.5	6.4	1.2	11.3, 18.6, 24.1	FR	DO
3500354	June 3, 1959	18.3	6.4	1.8	16.5	FR	DO
3505242	October 31, 1978	13.4	0	6.7	11.9	FR	DO
7170948	September 7, 2011	52.7	-	2.8	51.2	UT	DO
3512481	August 7, 1998	18.9	0.6	3.7	15.5, 17.1	FR	DO
3506665	November 2, 1983	18.3	0	6.4	16.8	FR	DO
3500377	July 2, 1960	15.8	9.4	3.7	15.8	FR	DO
3510966	November 30, 1993	23.2	3.7	2.4	22.6	FR	DO
3500370	January 26, 1958	18.3	0.6	1.8	18	FR	MN
	Average	**29.3**	**3.1**	**3.7**	**26.0**		
	Geomean	**23.7**	**0.4**	**2.6**	**20.6**		
	10th Percentile	**11.3**	**0.0**	**1.0**	**9.2**		
	90th Percentile	**61.0**	**8.1**	**6.4**	**52.2**		

Code	Description for "Well Use"
DO	Domestic
ST	Livestock
IR	Irrigation
IN	Industrial
CO	Commercial
MN	Municipal
PS	Public
AC	Cooling and A/C
NU	Not Used
OT	Other
TH	Test Hole
DE	Dewatering
MO	Monitoring
MT	Monitoring Testhole
AB	Abondoned

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

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Ministry of Environment and Energy
Ontario

PW3

The Ontario Water Resources Act
WATER WELL RECORD

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

11 — 3512664

Municipality 35002 — Con. CON 08

County or District: LANARK / MISSISSIPPI MILLS
Township/Borough/City/Town/Village: BECKWITH
Con block tract survey, etc.: 8
Lot: 3
Address: 3004 MOONLIGHT BAY RD. CARLETON PLACE
Date completed: 30 day 6 month 99 year

21 — T M — Northing — RC — Elevation — RC — Basin Code: ii iii iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
BROWN	CLAY			0	6
BROWN	SAND	GRAVEL & STONES		6	13½
BROWN	SANDSTONE			13½	21
GREY	LIMESTONE	LAYERS OF GREY	SANDSTONE	21	45

31
32

41 WATER RECORD

Water found at – feet	Kind of water
21	1 ☒ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
30	1 ☒ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6¼	1 ☒ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	0+1/2	18½
6	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☒ Open hole 5 ☐ Plastic		18½	45
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			

SCREEN

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

61 PLUGGING & SEALING RECORD

☒ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
0	18½	cement grout

71 PUMPING TEST

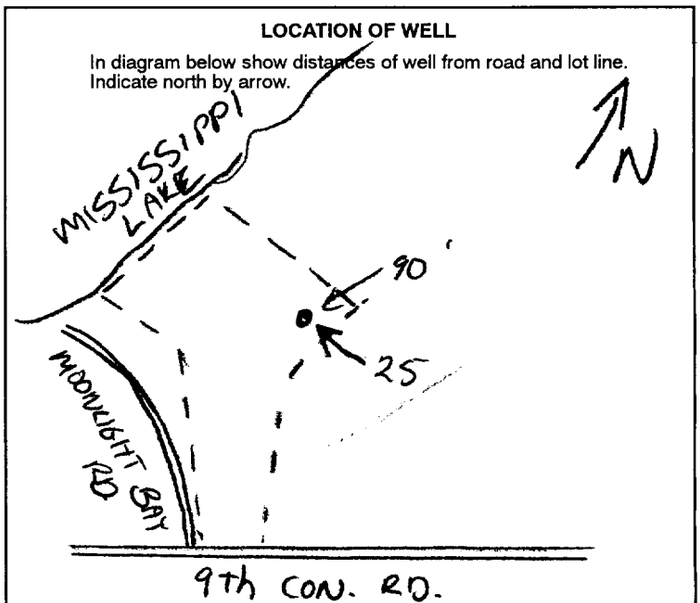
Pumping test method: 1 ☐ Pump 2 ☐ Bailer 3 ☒ AIR LIFT
Pumping rate: 40 GPM
Duration of pumping: 1 Hours 0 Mins

Static level	Water level end of pumping	Water levels during: 1 ☐ Pumping 2 ☒ Recovery			
8 feet	44 feet	15 minutes: 8 feet	30 minutes: 8 feet	45 minutes: 8 feet	60 minutes: 8 feet

If flowing give rate: GPM
Pump intake set at: 44 feet
Water at end of test: ☒ Clear ☐ Cloudy
Recommended pump type: ☐ Shallow ☒ Deep
Recommended pump setting: 25 feet
Recommended pump rate: 15 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line.
Indicate north by arrow.



198681

FINAL STATUS OF WELL

1 ☒ Water supply
2 ☐ Observation well
3 ☐ Test hole
4 ☐ Recharge well
5 ☐ Abandoned, insufficient supply
6 ☐ Abandoned, poor quality
7 ☐ Abandoned (Other)
8 ☐ Dewatering
9 ☐ Unfinished
10 ☐ Replacement well

WATER USE

1 ☒ Domestic
2 ☐ Stock
3 ☐ Irrigation
4 ☐ Industrial
5 ☐ Commercial
6 ☐ Municipal
7 ☐ Public supply
8 ☐ Cooling & air conditioning
9 ☐ Not used
10 ☐ Other

METHOD OF CONSTRUCTION

1 ☐ Cable tool
2 ☐ Rotary (conventional)
3 ☐ Rotary (reverse)
4 ☐ Rotary (air)
5 ☒ Air percussion
6 ☐ Boring
7 ☐ Diamond
8 ☐ Jetting
9 ☐ Driving
10 ☐ Digging
11 ☐ Other

Name of Well Contractor	Well Contractor's Licence No.
T. SAUNDERS DRILLING LTD	4879
Address: RR#1 BRAESIDE ONT K0A 1G0	
Name of Well Technician: TROY SAUNDERS	Well Technician's Licence No.: T-0517
Signature of Technician/Contractor: Troy Saunders	Submission date: 29 day 7 mo 99 yr

MINISTRY USE ONLY

Data source	Contracctor	Date received
	4879	AUG 13 1999
Date of inspection	Inspector	
Remarks: CSS.ES0		

0506 (07/94) Front Form 9

2 - MINISTER OF ENVIRONMENT & ENERGY COPY

APPENDIX D

Record of Test Pit Sheet & Grain Size Analyses

RECORD OF TEST PIT 18-1

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		142.72			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		142.47					
	Brown SILTY SAND, trace gravel with organic material		0.25	SA1	G.S.			
1			141.42					
	Grey brown SANDY SILT, trace clay		1.30	SA2	G.S.			
			140.82					
2	End of Test Pit		1.90					No groundwater observed upon completion of excavation
3								

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Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-2

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		142.33			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		142.03					
	Brown SAND, trace silt and gravel		0.30	SA1	G.S.		M	
1				SA2	G.S.			
	Grey brown silty sand, some clay, trace gravel (GLACIAL TILL)		140.93 1.40	SA3	G.S.			
2			140.03					
	End of Test Pit		2.30					No groundwater observed upon completion of excavation
3								

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CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-3

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		140.83			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		140.48 / 0.35					
1	Grey brown silty sand, some clay, trace gravel (GLACIAL TILL)			SA1	G.S.		MH	
2			138.23 / 2.60					
	End of Test Pit							
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.40 ▽	139.43

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Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-4

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		139.29			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		138.94 / 0.35					
1	Grey brown silty sand, some clay, trace gravel (GLACIAL TILL)			SA1	G.S.			▽
			137.49 / 1.80					
2	End of Test Pit Test Pit Caving @ 0.90 metres							
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.10 ▽	138.19

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-5

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		138.83			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		138.53 / 0.30					
1	Grey brown silty sand, some clay, trace gravel (GLACIAL TILL)			SA1	G.S.			
2			136.83 / 2.00					
	End of Test Pit Test Pit Caving @ 0.80 metres							
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.20 ▽	137.63

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-6

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		138.49			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		138.19 / 0.30					
1	Grey brown SILTY CLAY, some sand			SA1	G.S.			
			136.69 / 1.80					
2	End of Test Pit Test Pit Caving @ 1.10 metres							
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.50 ▽	136.99

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Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-7

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		137.90			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		137.70 / 0.20					
	Brown silty clayey sand, trace gravel (GLACIAL TILL)			SA1	G.S.			
1								
			136.40 / 1.50					
	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)			SA2	G.S.			
2								
			135.70 / 2.20					
	End of Test Pit Test Pit Caving @ 1.20 metres							
3								

Groundwater inflow at 1.5 metres below surface grade.

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.50 ▽	136.40

GEMTEC
Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-8

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

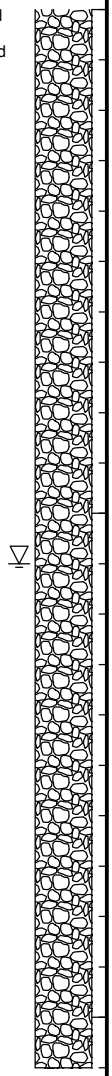
SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING
0	Ground Surface		137.62			
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		137.37 / 0.25			
	Brown silty clayey sand, trace gravel (GLACIAL TILL)			SA1	G.S.	MH
1			136.02 / 1.60			
	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)			SA2	G.S.	M
2			135.52 / 2.10			
	End of Test Pit Test Pit Caving @ 0.60 metres					
3						

SHEAR STRENGTH (Cu), kPA
+ NATURAL ⊕ REMOULDED
10 20 30 40 50 60 70 80 90

WATER CONTENT, %
W_P — W — W_L

WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.10 ▽	136.52

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-9

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

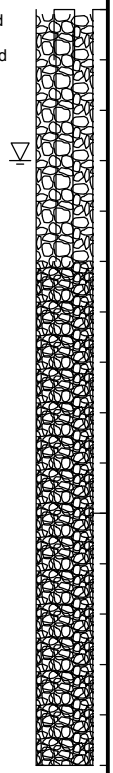
DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE
0	Ground Surface		135.78		
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		135.58 / 0.20		
	Brown silty clayey sand, trace gravel (GLACIAL TILL)			SA1	G.S.
			134.98 / 0.80		
1	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)			SA2	G.S.
			134.28 / 1.50		
	End of Test Pit Test Pit Caving @ 0.70 metres				
2					
3					

SHEAR STRENGTH (Cu), kPA
+ NATURAL ⊕ REMOULDED
10 20 30 40 50 60 70 80 90

WATER CONTENT, %
W_P — W — W_L

ADDITIONAL LAB. TESTING

WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION



Groundwater level observed at about 0.3 metres below surface grade on March 2, 2018.

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	0.30 ▽	135.48

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-10

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		140.35			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		140.05 / 0.30					
	Brown silty clayey sand, trace gravel (GLACIAL TILL)			SA1	G.S.			
			139.55 / 0.80					
1	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)			SA2	G.S.			
			139.05 / 1.30					
	End of Test Pit Excavator refusal on inferred bedrock							No groundwater observed upon completion of excavation
2								
3								

GEMTEC
Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-11

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		141.33			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		141.03					
	Red brown SAND, some gravel, trace silt		0.30	SA1	G.S.			
1								
2								
	End of Test Pit		138.73 2.60					No groundwater observed upon completion of excavation
3								

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Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-12

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		137.78			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		137.48 / 0.30					
	End of Test Pit Excavator Refusal on Inferred Bedrock							No groundwater observed upon completion of excavation
1								
2								
3								

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Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-13

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		139.19			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		138.89 / 0.30					
	Brown sandy clayey silt, trace gravel (GLACIAL TILL)			SA1	G.S.		MH	
			138.29 / 0.90					
1	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)			SA2	G.S.			
			137.89 / 1.30					
	End of Test Pit Excavator Refusal on Inferred Bedrock Test Pit Caving @ 0.50 metres							Groundwater level observed at about 0.2 metres below surface grade on Mrach 2, 2018.
2								
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	0.20 ▽	138.99

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-14

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		141.06			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		140.76 / 0.30					
	Brown SAND and gravel, trace silt			SA1	G.S.		M	
1			140.06 / 1.00					Groundwater seepage at 0.95 metres below surface grade.
	End of Test Pit Excavator Refusal on Inferred Bedrock							
2								
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.00 ▽	140.06

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LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

RECORD OF TEST PIT 18-15

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED / WATER CONTENT, % W_P W W_L (10 20 30 40 50 60 70 80 90)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		144.52					Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		144.27					
	Red brown SAND, some gravel, trace silt		0.25	SA1	G.S.			
	Brown SAND and gravel, trace silt with cobbles		143.72 0.80	SA2	G.S.			
1								
2								
	End of Test Pit Excavator Refusal on Inferred Bedrock		142.02 2.50					No groundwater observed upon completion of excavation
3								

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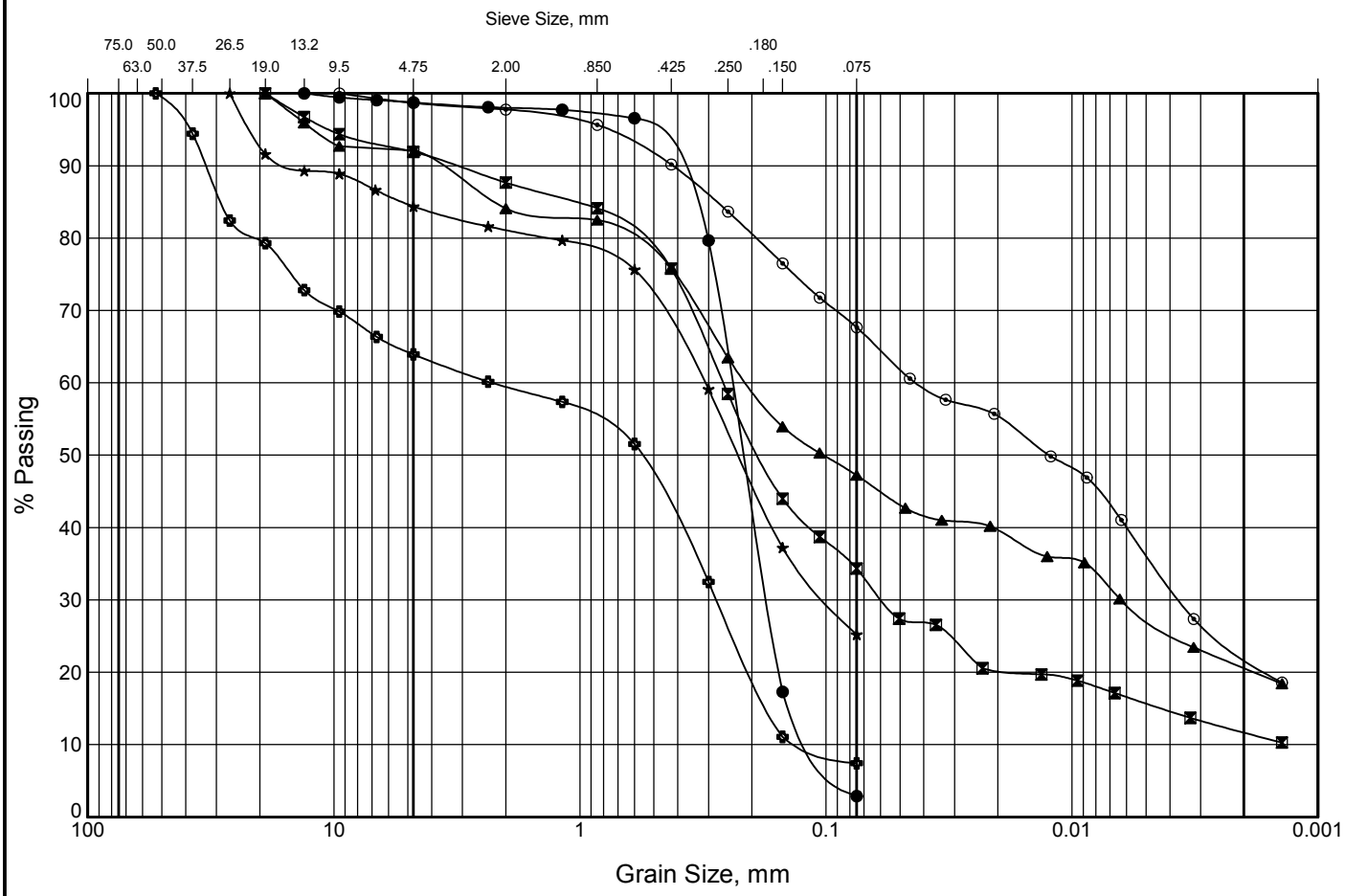
LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

Legend	Test pit	Sample	Depth (m)	% Gravel	% Sand	% Silt & Clay	
●	18-2	1	0.3 - 0.9	1	96	3	
⊠	18-3	1	0.4 - 2.6	8	58	23	12
▲	18-8	1	0.3 - 1.6	8	45	27	21
★	18-8	2	1.6 - 2.1	16	59	25	
⊙	18-13	1	0.3 - 0.9	1	31	45	22
✿	18-14	1	0.3 - 0.9	36	57	7	

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Consulting Engineers and Scientists

Date: March 2018

Project: 60215.11

SOILS GRAIN SIZE GRAPH UNIFIED % (HYDRO) 60215.11_GINT_TESTPITS_2018-03-05.GPJ HOULE CHEVRIER FEB 9 2011.GDT 10/5/18

APPENDIX E

Nitrate Dilution Calculations

Nitrate Dilution Calculation Worksheet

Nitrate Loading

Residential Septic Systems (assumes 1,000 L/day/lot)

Number of lots with untreated septic systems =	11	lots
Nitrate loading from untreated septic system =	40	grams/lot/day
Total annual nitrate loading from untreated systems =	160600	grams/year
Total Annual Nitrate Loading from all Systems =	**160600**	**grams/year**

Dilution Volumes

Infiltration Factors

Topography factor =	0.1	
Soil factor =	0.4	
Cover factor =	0.1	
Combined infiltration factor =	0.6	

Precipitation Infiltration

Annual water surplus =	0.381	metres/year
Annual infiltration (Water Surplus x Infiltration Factor) =	0.2286	metres/year

Infiltration Area and Infiltration Volumes

Total Lot Area	88250.5	total
Area available for infiltration (Lot Area - Hard Surface Area) = *(assumes 10% HS in residential for roofs, driveways)*	79425.45	square metres (- hard surface)
Total Annual Volume of Infiltration (Infiltration x Area) =	18157	cubic metres/year
Annual Flow from Residential Lots (assuming 1000 L/day/lot) =	4015	cubic metres/year
Total Annual Volume Available for Dilution =	**22172**	**cubic metres/year**

Dilution Calculation

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

$$\mathbf{C_{Nitrate} = \frac{160600\ grams/year}{22172\ cubic\ metres/year} = 7.24\ mg/L}$$

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APPENDIX F

Test Well Water Well Records

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*: A229129

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
	Cameron & June Young		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
3144 9th Line	Carleton Place	ON	K7C 3P2	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 9th Line (TEST WELL #1)	Beckwith	P/L 3	8

County/District/Municipality	City/Town/Village	Province	Postal Code
Lanark	Carleton Place	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	408608	4990237		

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
	Clay	& Boulders		0	8
Brown	Limestone			8	25
Black	Granite			25	52
Black	Granite			52	56
Black	Granite			56	63
	* Testwell #1 of 3				

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/cm)
40	30	Neat cement	12.5
30	0	Bentonite slurry	4.2

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ 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)	Well Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4"	Steel	188"	+2'	40'
6"	Open Hole		40'	63'

Construction Record - Screen

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

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 ____

Water Details

Water found at Depth (m/ft)	Kind of Water	Hole Diameter Depth From (m/ft)	Depth To (m/ft)	Diameter (cm/in)
52 ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify ____	0'	40'	9 3/4"
56 ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify ____	40'	63'	6"
____ ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify ____			

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify Not tested

If pumping discontinued, give reason: Y

Pump intake set at (m/ft): 50

Pumping rate (l/min / GPM): 10

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 46.3'

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

Recommended pump depth (m/ft): 50'

Recommended pump rate (l/min / GPM): 10

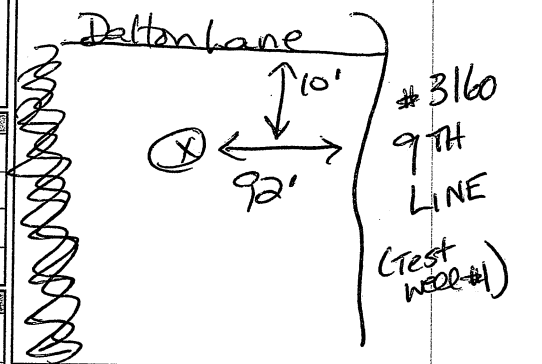
Well production (l/min / GPM): 10

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	25.8"		46.3"
1	33.3	1	35.2
2	35.7	2	33.9
3	37.3	3	31.4
4	38.4	4	30.6
5	39.1	5	30
10	41.4	10	29
15	42.5	15	28
20	43.2	20	27.2
25	43.8	25	26
30	49.3	30	25.8
40	45.1	40	25.8
50	45.7	50	25.8
60	46.3"	60	25.8"

Map of Well Location

Please provide a map below following instructions on the back.



Comments:
1/2 HP 10 GPM SET AT 50 FEET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
6659 Franktown Road, RR#1	Richmond	ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
[redacted] T4033		2018 07 31 (Y Y Y Y M M D D)

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2018 07 10	2018 07 10

Ministry Use Only
Audit No. Z276977
Received

0506E (2014/11)

Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE
(REQUIRED FOR OCCUPANCY INSPECTION ONLY)

I, Kenny Desaulniers Air Rock DRILLING Co LT
Name of Well Driller/Company

Do hereby certify that I am licensed to drill wells in the Province of Ontario AND THAT I have supervised the drilling of a well on the property of Cameron & June Young
Name of Landowner

Located in # 3160 9TH LINE ROAD, Carleton Place in the
Legal Description (Lot, Concession, Plan No., Part or Sub-lot)

Township of Beckwith.

Part Lot 3 Con 8 Plan# X S/L# X

AND FURTHER THAT I am aware of the well drilling requirements of the Township of Beckwith and the guidelines, recommendations and regulations of the Ministry of the Environment as they govern well installation in the Province of Ontario,

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased and cement grouted to the standards required.

Signed this 10TH day of JULY 2018.

LICENSED PROFESSIONAL ENGINEER
Aug. 23/18
A. C. HOULE
A.C. Houle
PROVINCE OF ONTARIO

A.C. Houle, P. Eng.
Hydrologist
Gemtec

Well Driller/Company Kenny Desaulniers

Witness Debbie Davis

Landowner

2018384
TAG A229129
TW# 1 of 3

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Tag#: A229130 (see Below)

A229130

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
	Cameron & June Young		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3144 9th Line	Carleton Place	ON	K7C 3P2	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 9th Line (TEST WELL #2)	Beckwith	P L 3	8

County/District/Municipality	City/Town/Village	Province	Postal Code
Lanark	Carleton Place	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	408674	4989932		

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
	Clay	& Gravel		0'	10'
Brown	Sandstone	[redacted]		10'	24'
Red & Black	Granite			24'	53'
Red & Black	Granite			53'	55'
Red & Black	Granite			55'	60'

* Test Well #2 of 3

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
40'	30'	Neat cement	9.36
30'	0'	Bentonite slurry	18.8

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ 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	To
6 1/4"	Steel	.188"	+2'	40'
6 1/8"	Open Hole		40'	60'

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	To

Water Details

Water found at Depth (m/ft)	Kind of Water	Other, specify
53 ☐ Gas	☐ Fresh ☒ Untested	
55 ☐ Gas	☐ Fresh ☒ Untested	
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	40'	9 3/4"
40'	60'	6 1/8"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify Not tested

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 50

Pumping rate (l/min / GPM): 20

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 34.1'

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

Recommended pump depth (m/ft): 50'

Recommended pump rate (l/min / GPM): 20

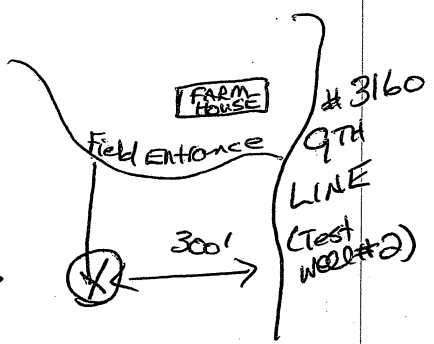
Well production (l/min / GPM): 20

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	13'1"		34'1"
1	20.4	1	22.5
2	23.6	2	19.2
3	25.7	3	18
4	27.2	4	17
5	28.2	5	16
10	30.9	10	13.1
15	32.1	15	13.1
20	32.8	20	13.1
25	33.3	25	13.1
30	33.5	30	13.1
40	33.8	40	13.1
50	34	50	13.1
60	34'1"	60	13'1"

Map of Well Location

Please provide a map below following instructions on the back.



Comments:
1/2 HP 10 GPM SET AT 50 FEET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.: [redacted] T4033

Signature of Technician and/or Contractor

Date Submitted: 2018 07 31 (Y Y Y Y M M D D)

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2018 07 14	2018 07 11

Ministry Use Only

Audit No. Z276978

Received

0506E (2014/11)

Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE
(REQUIRED FOR OCCUPANCY INSPECTION ONLY)

I, Kenny Desaulniers Air Rock DRILLING Co Ltd
Name of Well Driller/Company

Do hereby certify that I am licensed to drill wells in the Province of Ontario AND THAT I have supervised the drilling of a well on the property of Cameron & June Young
Name of Landowner

Located in # 3160 9TH LINE Rd. D, Carleton Place in the
Legal Description (Lot, Concession, Plan No., Part or Sub-lot)

Township of Beckwith.

Part Lot 3 Con 8 Plan# X S/L# X

AND FURTHER THAT I am aware of the well drilling requirements of the Township of Beckwith and the guidelines, recommendations and regulations of the Ministry of the Environment as they govern well installation in the Province of Ontario,

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased and cement grouted to the standards required.

Signed this 11TH day of JULY 2018.

LICENSED PROFESSIONAL ENGINEER
Aug. 23/18
A. C. HOULE
A.C. Houle
PROVINCE OF ONTARIO

Well Driller/Company Kenny Desaulniers

Witness Debbie Davis

A. C. Houle, P. Eng.
Hydrologist Gemtec

Landowner

2018381
TAG A229130
TW# 2 of 3

Ontario — Ministry of the Environment and Climate Change

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☒ Imperial

Tag#: A229131 (…t Below)

A229131

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Cameron & June Young		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3144 9th Line	Carleton Place	ON	K7C 3P2	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 9th Line (TEST WELL #1)	Beckwith	P/L3	8

County/District/Municipality	City/Town/Village	Province	Postal Code
Lanark	Carleton Place	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	408445	4990060		

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	To
	Clay			0'	5'
Brown	Sandstone			5'	20'
Black	Granite			20'	51'
Black	Granite			51'	53'
Black	Granite			53'	60'

* Test Well # 3 of 3

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
40'	30'	Neat cement	9.36
30'	0'	Bentonite slurry	8.4

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/4"	Steel	.188"	+2'	40'
6 1/8"	Open Hole		40'	60'

Construction Record - Screen

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

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

Water Details

Water found at Depth	Kind of Water
51 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify
53 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	40'	9 3/4"
40'	60'	6 1/8"

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify Not tested

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 50

Pumping rate (l/min / GPM): 10

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 49'2"

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

Recommended pump depth (m/ft): 50'

Recommended pump rate (l/min / GPM): 10

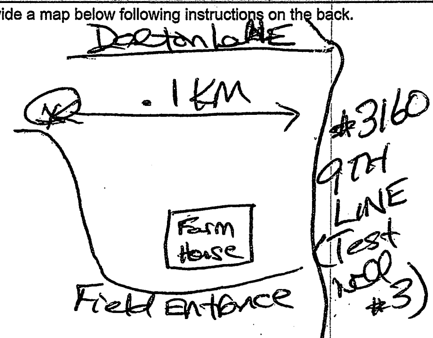
Well production (l/min / GPM): 10

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	10'3"		49'2"
1	19.3	1	38
2	23.4	2	31.9
3	26.7	3	28.7
4	27.5	4	26.1
5	31.8	5	24
10	39.2	10	17.9
15	43.1	15	15.4
20	45.5	20	13.2
25	47.2	25	11.3
30	47.9	30	10.3
40	48.8	40	10.3
50	49.2	50	10.3
60	49'2"	60	10'3"

Map of Well Location

Please provide a map below following instructions on the back.



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Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
[redacted] T4033	[signature]	2018 07 31

Comments: 1/2 HP 10 GPM SET AT 50 FEET

Well owner's information package delivered ☒ Yes ☐ No

Date Package Delivered: 2018 07 14

Date Work Completed: 2018 07 11

Ministry Use Only — Audit No. Z276979 — Received

0506E (2014/11) Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE
(REQUIRED FOR OCCUPANCY INSPECTION ONLY)

I, Kenny Desaulniers Air Rock DRILLING Co LTD
Name of Well Driller/Company

Do hereby certify that I am licensed to drill wells in the Province of Ontario AND THAT I have supervised the drilling of a well on the property of Cameron & June Young
Name of Landowner

Located in # 3160 9TH LINE Road D, Carleton Place in the
Legal Description (Lot, Concession, Plan No., Part or Sub-lot)

Township of Beckwith.

Lot Part 3 Con 8 Plan# X S/L# X

AND FURTHER THAT I am aware of the well drilling requirements of the Township of Beckwith and the guidelines, recommendations and regulations of the Ministry of the Environment as they govern well installation in the Province of Ontario,

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased and cement grouted to the standards required.

Signed this 11TH day of JULY 2018.

LICENSED PROFESSIONAL ENGINEER
Aug. 23/18
A. C. HOULE
PROVINCE OF ONTARIO

A.C. Houle, P.Eng.
Hydrologist
Gemtec

Well Driller/Company Kenny Desaulniers

Witness Debbie Davis

Landowner

2018385
TAG A229131
TW# 383

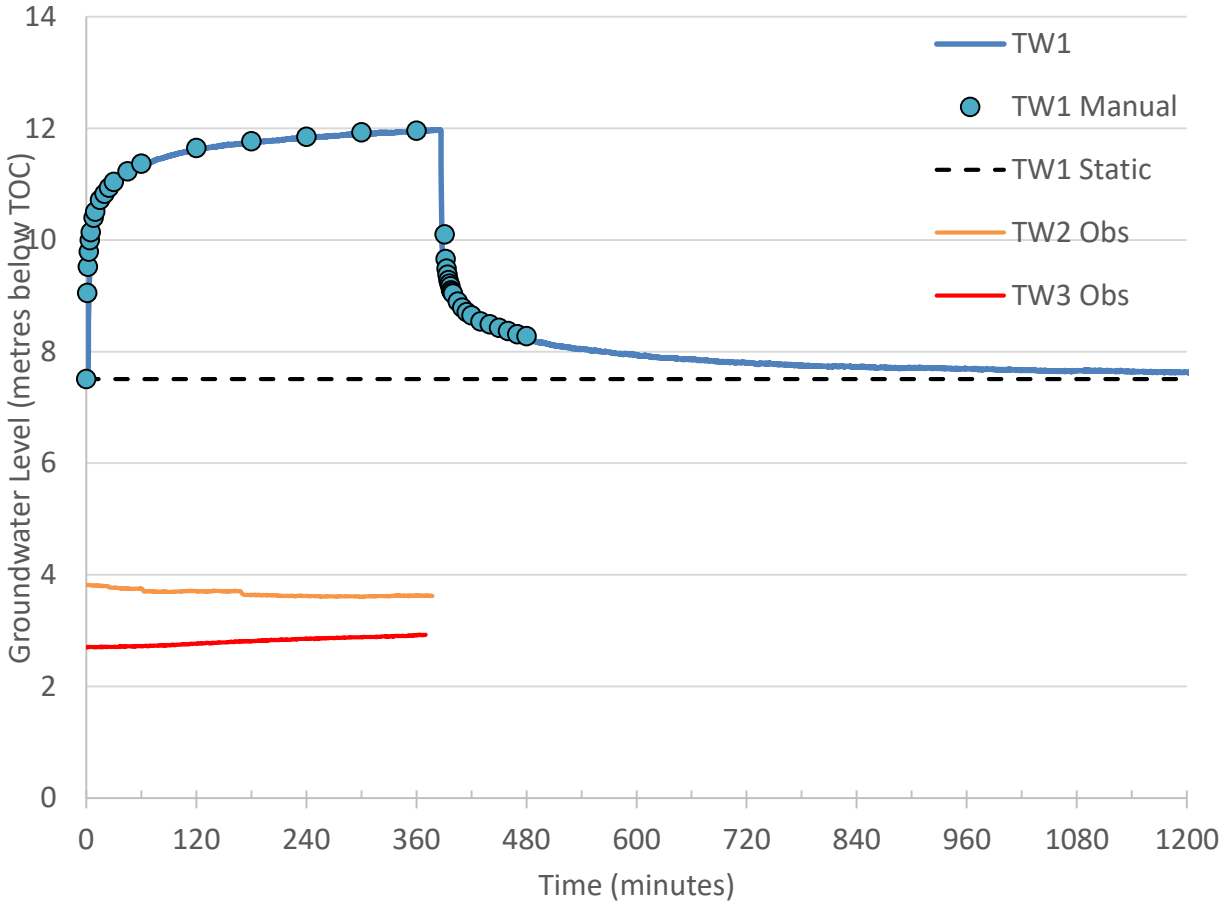
APPENDIX G

Pumping Test Drawdown and Recovery

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report
	Project: Hydrogeological Investigation
	Project Number: 60215.11
	Client: Cameron and June Young

Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW1	P-Test Date: August 9, 2018
Analysis Performed by: AP	Method: -	Analysis Date: September, 2018
Aquifer Thickness: 6.0 m	Discharge: 30.3 L/min	Duration: 385 minutes

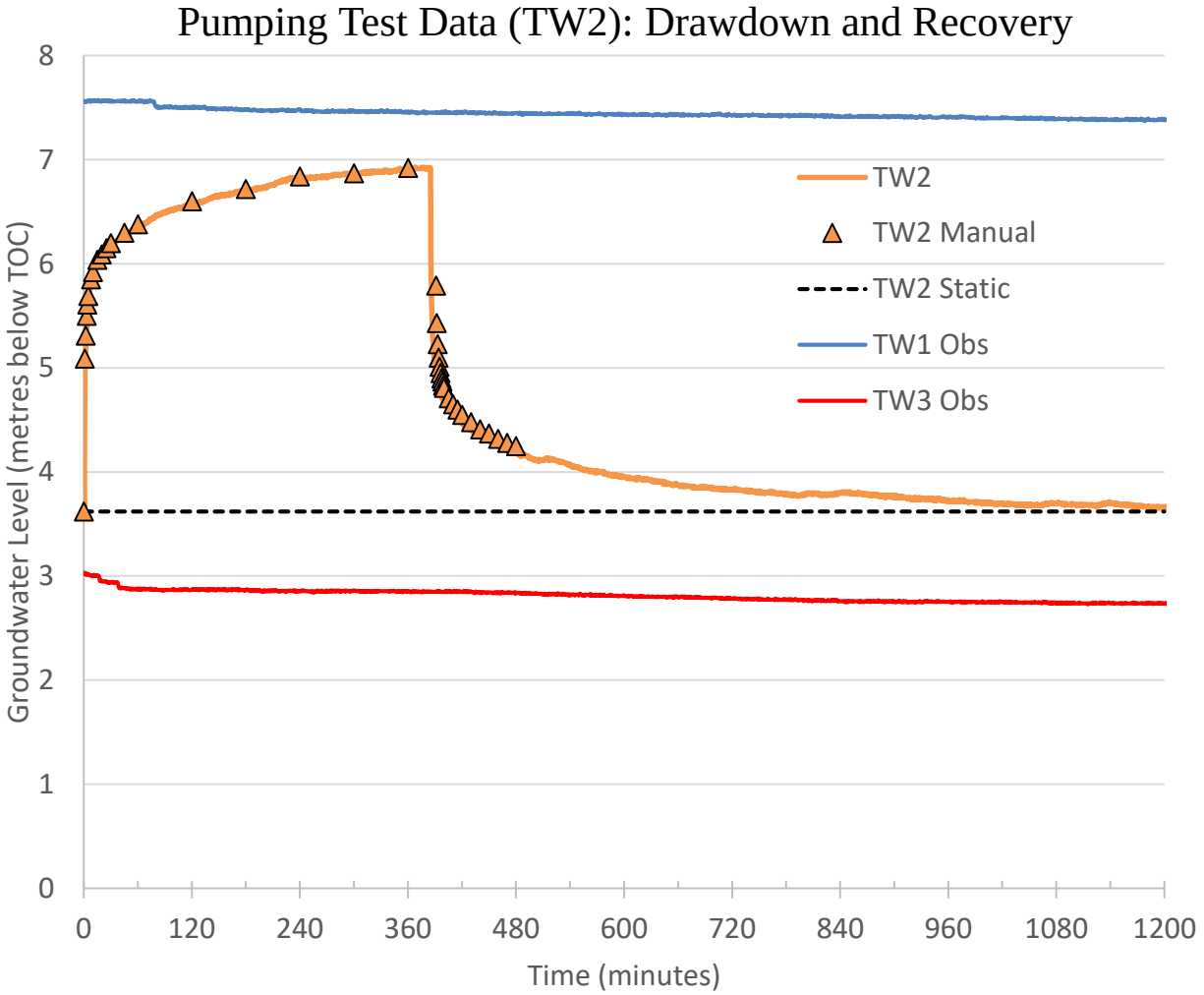
Pumping Test Data (TW1): Drawdown and Recovery



Water Levels (metres below top of casing)
Casing height above ground surface: 0.60
Static : 7.51 m
End of pump test (385 minutes): 11.96 m
Final water level following recovery (20-hours): 7.62 m

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report
	Project: Hydrogeological Investigation
	Project Number: 60215.11
	Client: Cameron and June Young

Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW2	P-Test Date: August 8, 2018
Analysis Performed by: AP	Method: -	Analysis Date: September, 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 385 minutes



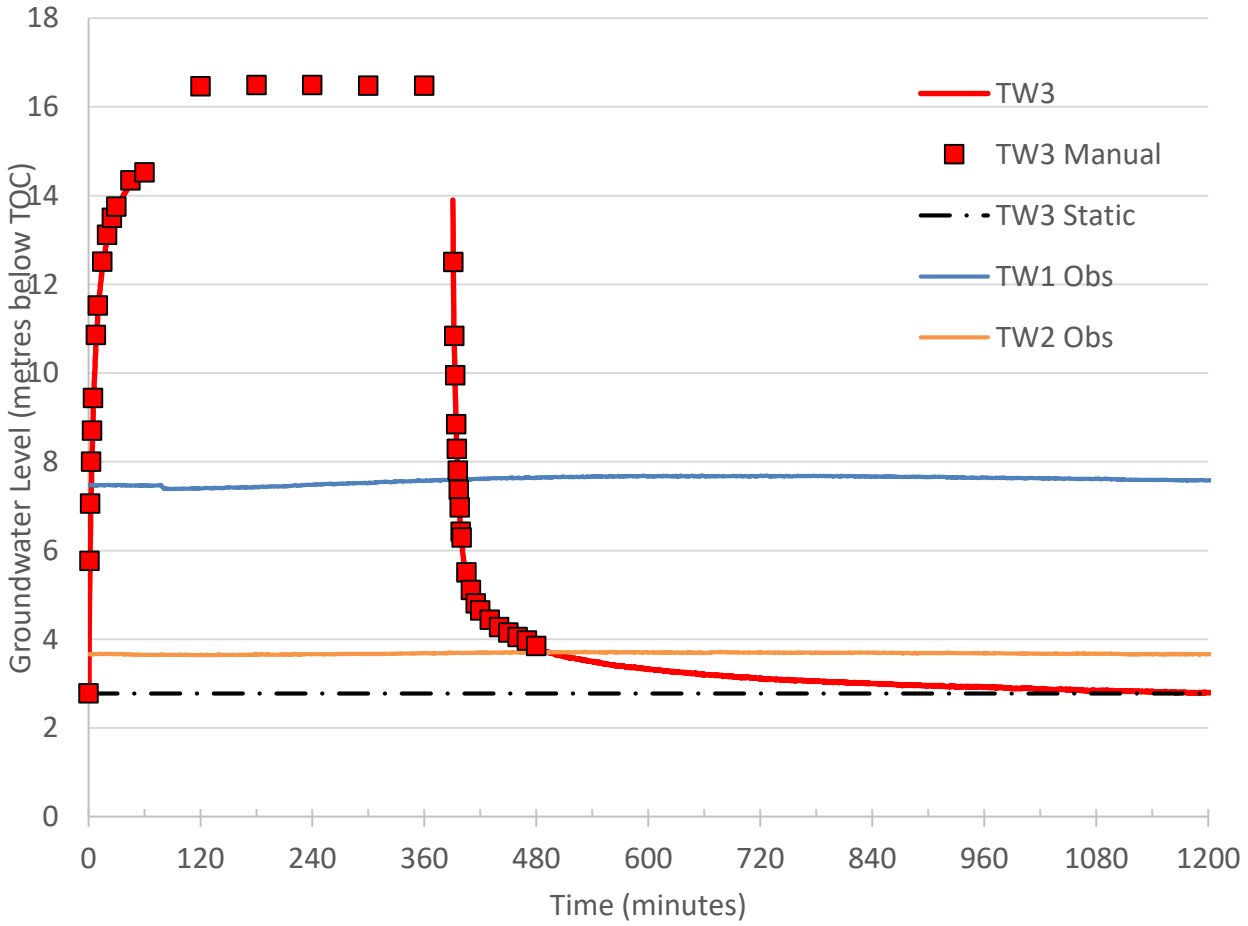
Note: Diver Datalogger recording at 15-second intervals; compensated with on-site barometer.

Water Levels (metres below top of casing)
Casing height above ground surface: 0.60 m
Static : 3.62 m
End of pump test (385 minutes): 6.92 m
Final water level following recovery (20 hours): 6.92 m

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report
	Project: Hydrogeological Investigation
	Project Number: 60215.11
	Client: Cameron and June Young

Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW3	P-Test Date: August 7, 2018
Analysis Performed by: AP	Method: -	Analysis Date: September, 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 390 minutes

Pumping Test Data (TW3): Drawdown and Recovery



Note: Diver Datalogger recording at 15-second intervals; compensated with on-site barometer.

Water Levels (metres below top of casing)
Casing height above ground surface: 0.60 m
Static : 2.72 m
End of pump test (390 minutes): 16.48 m
Final water level following recovery (20 hours): 2.72 m

APPENDIX H

Water Quality Field and Lab Data Summary

Report to: Cameron and June Young
Project: 60215.11 (March 11, 2020)

Summary of Measured Field Parameters

Test Well	Time Since Initiation of Pumping (Hours)	Date	Temp[1] (°C)	pH	Electrical Conductivity (µS/cm)	Total Dissolved Solids (ppm)	Colour (ACU[2])	Colour (TCU[1,3])	Turbidity (NTU)	Total Chlorine (mg/L)
TW19-1	1	August 9, 2018	8.9	7.32	-	-	-	-	2.73	-
	2	-	8.9	7.83	-	-	-	-	1.59	-
	3	-	8.9	7.78	-	-	-	-	1.62	0
	4	-	8.9	7.31	636	314	-	-	1.20	-
	5	-	8.9	7.51	610	301	-	-	1.52	-
	6		8.9	7.34	658	327	-	-	1.14	0
TW19-2	1	August 8, 2018	9.3	7.31	542	274	-	-	2.44	-
	2	-	8.9	6.89	564	282	-	-	3.05	-
	3	-	9.0	7.53	516	263	-	-	2.73	0
	4	-	9.0	7.51	544	270	-	-	4.71	-
	5	-	9.0	7.65	532	268	-	-	2.16	-
	6	-	9.0	7.74	525	261	-	-	1.50	0
TW19-2 R1		September 6, 2018	10.9	8.24	593	297	31	0	0.87	0
TW19-3	1	August 7, 2018	9.5	7.15	760	375	-	-	2.13	-
	2	-	9.5	7.42	745	396	-	-	2.22	-
	3	-	9.2	7.45	761	378	-	-	0.67	0
	4	-	9.4	7.45	770	382	-	-	0.83	-
	5	-	9.4	7.47	751	375	-	-	0.84	-
	6	-	9.4	4.65	748	372	-	-	0.66	0
PW1		December 27, 2017	-	-	-	-	-	-	4.60	0
PW2		December 27, 2017	-	-	-	-	-	-	0.34	0
PW3		February 19, 2018	9.9	7.06	705	352	-	-	2.05	0

1. Temperature for pumping tests measured utilizing downhole datalogger.
2. Field filtered using 0.45 micron filter
2. ACU = Actual Colour Units
3. TCU = True Colour Units

Summary of Laboratory Parameters Analyzed (1/4)

	Parameter	Units	PW1 Dec 27, 2017	PW2 Dec 27, 2017	PW3 Feb 19, 2018	TW1 Aug 9, 2018 3-hr	TW1 Aug 9, 2018 6-hr	TW2 Aug 8, 2018 3-hr	TW2 Aug 8, 2018 6-hr[8]	TW3 Aug 7, 2018 3-hr	TW3 Aug 7, 2018 6-hr	ODWS[1]	Standard
Microbiological Parameters	Escherichia coli	CFU/100mL	ND[5]	ND	ND	ND[7]	ND[7]	ND[7]	ND[7] / ND[7]	ND	ND	0	MAC[2]
	Fecal Coliform	CFU/100mL	ND	ND	ND	ND	ND	**59**	ND[7] / ND	ND	ND	-	-
	Total coliforms	CFU/100mL	ND	ND	ND	ND[7]	ND[7]	**Confluent**	ND[7] / **3**[7]	ND	ND	0	MAC
	Heterotrophic Plate Count	CFU/1mL	<10	<10	50	-	-	-	-	80	90	-	-
General Inorganics	Alkalinity (as $CaCO_3$)	mg/L	322	283	270	269	267	240	244	340	342	30-500	OG[3]
	Ammonia as N (NH_3)	mg/L	0.11	0.03	0.04	0.11	0.17	0.13	0.15	0.07	0.07	-	-
	Dissolved Organic Carbon (DOC)	mg/L	3.1	3.4	0.9	4.1	4.1	ND (0.5)	ND (0.5)	1.6	1.7	5	AO[4]
	Colour	ACU	-	-	-	-	-	-	- / 13	-	-	-	-
	Colour	TCU	<2	<2	<2	**24**	**50**	**22**	**24 / 10**	**21**	**19**	5	AO
	Electrical Conductivity	uS/cm	701	1030	726	718	716	596	595	832	832	-	-
	Total Hardness (as $CaCO_3$)	mg/L	**349**	**268**	**244**	**357**	**344**	**290**	**284**	**401**	**327**	80-100	OG
	pH	pH units	7.5	7.4	7.6	8.0	8.0	8.0	8.0	8.0	7.9	6.5-8.5	OG
	Phenols	mg/L	<0.001	<0.001	<0.001	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	-	-
	Total Dissolved Solids (TDS)	mg/L	404	**562**	**836**	452	448	328	310	472	462	500	AO
	Sulphide (S_2)	mg/L	<0.02	<0.02	<0.02	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	0.05	AO
	Tannin & Lignin	mg/L	ND (0.1)	ND (0.1)	ND (0.1)	0.2	0.2	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	-	-
	Total Kjeldahl Nitrogen (TKN)	mg/L	0.3	0.2	0.2	0.5	0.2	0.2	0.2	0.4	0.3	-	-
	Organic Nitrogen (TKN - NH_3)	mg/L	**0.2**	**0.2**	**0.2**	**0.4**	0	0.1	0.1	**0.3**	**0.2**	0.15	OG
	Turbidity	NTU	3.2	0.5	0.2	5.0	4.9	3.0	2.4	1.6	1.5	5	AO

1. ODWS = Ontario Drinking Water Standards
2. MAC = Maximum Acceptable Concentration
3. OG = Operational Guideline
4. AO = Aesthetic Objective
5. ND = Not Detectable
6. WL = Warning Level
7. Background counts greater than 200 (refer to laboratory certificate of analysis)
8. Additional water samples collected September 6, 2018 following well chlorination and about six (6) hours of pumping at approx. 10 GPM (US)

Summary of Laboratory Parameters Analyzed (2/4)

	Parameter	Units	PW1 Dec 27, 2017	PW2 Dec 27, 2017	PW3 Oct 26, 2017	TW1 Aug 9, 2018 3-hr	TW1 Aug 9, 2018 6-hr	TW2 Aug 8, 2018 3-hr	TW2 Aug 8, 2018 6-hr	TW3 Aug 7, 2018 3-hr	TW3 Aug 7, 2018 6-hr	ODWS[1]	Standard
Anions	Chloride (Cl)	mg/L	31	164	73	68	66	43	42	66	66	250	AO[4]
	Fluoride (F)	mg/L	0.7	<0.1	0.2	0.5	0.5	0.9	1.0	0.7	0.7	1.5	MAC[2]
	Nitrate as N (NO_3)	mg/L	<0.1	1.0	0.2	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.2	10	MAC
	Nitrite as N (NO_2)	mg/L	<0.05	<0.05	<0.05	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.1	MAC
	Sulphate (SO_4)	mg/L	48	44	28	33	32	25	25	39	38	500	AO
Metals	Calcium (Ca)	mg/L	100	81.8	71.4	110	106	78.0	77.3	105	76.0	-	-
	Iron (Fe)	mg/L	**0.424**	<0.1	<0.1	**1**	**1**	**0.6**	**0.5 / 0.4[8]**	0.3	0.3	0.3	AO
	Magnesium (Mg)	mg/L	23.9	15.5	16.0	20.0	19.4	23.2	22.2	33.4	33.4	-	-
	Manganese (Mn)	mg/L	0.035	<0.005	<0.005	0.046	0.046	0.017	0.015 / 0.013[8]	0.036	0.035	0.05	AO
	Potassium (K)	mg/L	5.47	1.45	1.0	4.0	3.9	5.2	4.8	9.8	9.7	-	-
	Sodium (Na)	mg/L	11.8	**123**	**63.5**	14.0	13.8	14.9	14.5	**32.8**	**32.4**	(20) 200	(WL[6]) AO

NOTES:
1. ODWS = Ontario Drinking Water Standards
2. MAC = Maximum Acceptable Concentration
3. OG = Operational Guideline
4. AO = Aesthetic Objective
5. ND = Not Detectable
6. WL = Warning Level
7. Background counts greater than 200 (refer to laboratory certificate of analysis)
8. Additional water samples collected September 6, 2018 following well chlorination and about six (6) hours of pumping at approx. 10 GPM (US)

Summary of Laboratory Parameters Analyzed (3/4)

	Parameter	Units	PW1 Dec 27, 2017 6-hr	PW2 Dec 27, 2017 6-hr	PW3 Oct 26, 2017 6-hr	TW1 Aug 9, 2018 6-hr	TW2 Aug 8, 2018 6-hr	TW3 Aug 7, 2018 6-hr	ODWS[1]	Standard
Heavy Metals	Mercury	mg/L	-	-	-	ND (0.0001)	ND (0.0001)	ND (0.0001)	0.001	MAC
	Aluminum	mg/L	-	-	-	ND (0.001)	0.001	0.002	0.1	OG
	Antimony	mg/L	-	-	-	ND (0.0005)	ND (0.0005)	ND (0.0005)	0.006	MAC
	Arsenic	mg/L	-	-	-	0.002	ND (0.001)	ND (0.001)	0.025	IMAC
	Barium	mg/L	-	-	-	0.465	0.140	0.159	1.0	MAC
	Beryllium	mg/L	-	-	-	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-
	Boron	mg/L	-	-	-	0.05	0.15	0.11	5.0	MAC
	Cadmium	mg/L	-	-	-	ND (0.0001)	ND (0.0001)	ND (0.0001)	0.005	MAC
	Chromium	mg/L	-	-	-	0.002	0.003	ND (0.001)	0.05	MAC
	Chromium (VI)	mg/L	-	-	-	ND (0.010)	-	-	-	-
	Cobalt	mg/L	-	-	-	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-
	Copper	mg/L	-	-	-	ND (0.0005)	ND (0.0005)	0.0005	1	AO
	Lead	mg/L	-	-	-	0.0001	ND (0.0001)	ND (0.0001)	0.01	MAC
	Molybdenum	mg/L	-	-	-	0.0016	0.0009	ND (0.0005)	-	-
	Nickel	mg/L	-	-	-	0.002	0.001	0.002	-	-
	Potassium	mg/L	-	-	-	3.9	4.8	9.7	-	-

NOTES:
1. ODWS = Ontario Drinking Water Standards
2. MAC = Maximum Acceptable Concentration
3. IMAC = Interim Maximum Acceptable Concentration
4. OG = Operational Guideline
5. AO = Aesthetic Objective
6. ND = Not Detectable

Summary of Laboratory Parameters Analyzed (4/4)

	Parameter	Units	PW1 Dec 27, 2017 6-hr	PW2 Dec 27, 2017 6-hr	PW3 Oct 26, 2017 6-hr	TW1 Aug 9, 2017 6-hr	TW2 Aug 8, 2018 6-hr	TW3 Aug 7, 2018 6-hr	ODWS[1]	Standard
Heavy Metals	Silicon	mg/L	-	-	-	6.47	5.11	3.22	-	-
	Selenium	mg/L	-	-	-	ND (0.001)	ND (0.001)	ND (0.001)	0.01	MAC
	Silver	mg/L	-	-	-	ND (0.0001)	ND (0.0001)	ND (0.0001)	-	-
	Strontium	mg/L	-	-	-	1.09	2.55	3.95	-	-
	Thallium	mg/L	-	-	-	ND (0.001)	ND (0.001)	ND (0.001)	-	-
	Tin	mg/L	-	-	-	ND (0.01)	ND (0.01)	ND (0.01)	-	-
	Titanium	mg/L	-	-	-	ND (0.005)	ND (0.005)	ND (0.005)	-	-
	Tungsten	mg/L	-	-	-	ND (0.01)	ND (0.01)	ND (0.01)	-	-
	Uranium	mg/L	-	-	-	0.0005	0.0008	0.0012	0.02	MAC
	Vanadium	mg/L	-	-	-	0.0060	0.0065	0.0010	-	-
	Zinc	mg/L	-	-	-	0.007	ND (0.005)	0.007	5	AO

NOTES:
1. ODWS = Ontario Drinking Water Standards
2. MAC = Maximum Acceptable Concentration
3. IMAC = Interim Maximum Acceptable Concentration
4. OG = Operational Guideline
5. AO = Aesthetic Objective
6. ND = Not Detectable

APPENDIX I

Laboratory Certificates of Analysis

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

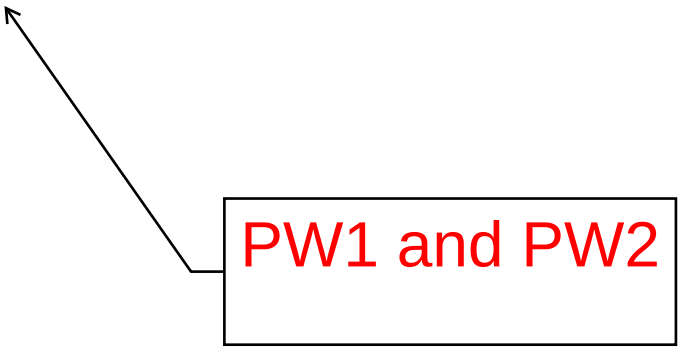
Client PO:
Project: 60211.11
Custody: 39710

Report Date: 3-Jan-2018
Order Date: 27-Dec-2017

Order #: 1752025

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1752025-01	TW1
1752025-02	TW2



Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 03-Jan-2018
Order Date: 27-Dec-2017
Project Description: 60211.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	28-Dec-17	28-Dec-17
Ammonia, as N	EPA 351.2 - Auto Colour	28-Dec-17	28-Dec-17
Anions	EPA 300.1 - IC	29-Dec-17	29-Dec-17
Colour	SM2120 - Spectrophotometric	28-Dec-17	28-Dec-17
Conductivity	EPA 9050A- probe @25 °C	28-Dec-17	28-Dec-17
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	3-Jan-18	3-Jan-18
E. coli	MOE E3407	27-Dec-17	27-Dec-17
Fecal Coliform	SM 9222D	27-Dec-17	27-Dec-17
Heterotrophic Plate Count	SM 9215C	27-Dec-17	27-Dec-17
Metals, ICP-MS	EPA 200.8 - ICP-MS	3-Jan-18	3-Jan-18
pH	EPA 150.1 - pH probe @25 °C	28-Dec-17	28-Dec-17
Phenolics	EPA 420.2 - Auto Colour, 4AAP	27-Dec-17	28-Dec-17
Subdivision Package	Hardness as CaCO3	3-Jan-18	3-Jan-18
Sulphide	SM 4500SE - Colourimetric	29-Dec-17	29-Dec-17
Tannin/Lignin	SM 5550B - Colourimetric	2-Jan-18	2-Jan-18
Total Coliform	MOE E3407	27-Dec-17	27-Dec-17
Total Dissolved Solids	SM 2540C - gravimetric, filtration	2-Jan-18	3-Jan-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	28-Dec-17	28-Dec-17
Turbidity	SM 2130B - Turbidity meter	28-Dec-17	28-Dec-17

Certificate of Analysis

Report Date: 03-Jan-2018

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 27-Dec-2017

Client PO:

Project Description: 60211.11

	Client ID:	TW1	TW2	-	-
	Sample Date:	27-Dec-17	27-Dec-17	-	-
	Sample ID:	1752025-01	1752025-02	-	-
	MDL/Units	Water	Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND	ND	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND	ND	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	<10	-	-
General Inorganics					
Alkalinity, total	5 mg/L	322	283	-	-
Ammonia as N	0.01 mg/L	0.11	0.03	-	-
Dissolved Organic Carbon	0.5 mg/L	3.1	3.4	-	-
Colour	2 TCU	<2	<2	-	-
Conductivity	5 uS/cm	701	1030	-	-
Hardness	mg/L	349	268	-	-
pH	0.1 pH Units	7.5	7.4	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	404	562	-	-
Sulphide	0.02 mg/L	<0.02	<0.02	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.3	0.2	-	-
Turbidity	0.1 NTU	3.2	0.5	-	-
Anions					
Chloride	1 mg/L	31	164	-	-
Fluoride	0.1 mg/L	0.7	<0.1	-	-
Nitrate as N	0.1 mg/L	<0.1	1.0	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	48	44	-	-
Metals					
Calcium	100 ug/L	100000	81800	-	-
Iron	100 ug/L	424	<100	-	-
Magnesium	200 ug/L	23900	15500	-	-
Manganese	5 ug/L	36	<5	-	-
Potassium	100 ug/L	5470	1450	-	-
Sodium	200 ug/L	11800	123000	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Calcium	ND	100	ug/L						
Iron	ND	100	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Potassium	ND	100	ug/L						
Sodium	ND	200	ug/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	31.5	1	mg/L	31.3			0.6	10	
Fluoride	0.72	0.1	mg/L	0.71			0.5	10	
Nitrate as N	ND	0.1	mg/L	ND			0.0	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	48.7	1	mg/L	48.4			0.7	10	
General Inorganics									
Alkalinity, total	321	5	mg/L	322			0.3	14	
Ammonia as N	ND	0.01	mg/L	ND				17.7	
Dissolved Organic Carbon	3.3	0.5	mg/L	3.1			6.3	37	
Colour	ND	2	TCU	ND				12	
Conductivity	692	5	uS/cm	701			1.3	11	
pH	7.6	0.1	pH Units	7.5			1.5	10	
Phenolics	0.004	0.001	mg/L	0.004			9.6	10	
Total Dissolved Solids	420	10	mg/L	404			3.9	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	5.50	0.4	mg/L	5.60			1.9	10	
Turbidity	3.3	0.1	NTU	3.2			0.9	10	
Metals									
Calcium	ND	100	ug/L	ND			0.0	20	
Iron	ND	100	ug/L	ND			0.0	20	
Magnesium	ND	200	ug/L	ND			0.0	20	
Manganese	ND	5	ug/L	ND			0.0	20	
Potassium	ND	100	ug/L	ND			0.0	20	
Sodium	ND	200	ug/L	ND			0.0	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	41.3	1	mg/L	31.3	101	78-112			
Fluoride	1.68	0.1	mg/L	0.71	96.9	73-113			
Nitrate as N	1.04	0.1	mg/L	ND	104	81-112			
Nitrite as N	0.897	0.05	mg/L	ND	89.7	76-117			
Sulphate	57.8	1	mg/L	48.4	94.1	75-111			
General Inorganics									
Ammonia as N	0.247	0.01	mg/L		98.7	81-124			
Dissolved Organic Carbon	14.4	0.5	mg/L	3.1	113	60-133			
Phenolics	0.024	0.001	mg/L	0.004	80.5	69-132			
Total Dissolved Solids	102	10	mg/L		102	75-125			
Sulphide	0.51	0.02	mg/L	ND	101	79-115			
Tannin & Lignin	0.9	0.1	mg/L	ND	91.5	71-113			
Total Kjeldahl Nitrogen	1.79	0.1	mg/L		89.6	81-126			
Metals									
Calcium	1010		ug/L	ND	101	80-120			
Iron	1010		ug/L	ND	101	80-120			
Magnesium	1060		ug/L	ND	105	80-120			
Manganese	58.5		ug/L	ND	117	80-120			
Potassium	1020		ug/L	ND	101	80-120			
Sodium	1030		ug/L	ND	100	80-120			

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers :

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 4839

Report Date: 26-Feb-2018
Order Date: 20-Feb-2018

Order #: 1808039

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1808039-01	PW3

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 26-Feb-2018
Order Date: 20-Feb-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	20-Feb-18	20-Feb-18
Ammonia, as N	EPA 351.2 - Auto Colour	23-Feb-18	23-Feb-18
Anions	EPA 300.1 - IC	20-Feb-18	20-Feb-18
Colour	SM2120 - Spectrophotometric	21-Feb-18	21-Feb-18
Conductivity	EPA 9050A- probe @25 °C	20-Feb-18	20-Feb-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	20-Feb-18	21-Feb-18
E. coli	MOE E3407	20-Feb-18	20-Feb-18
Fecal Coliform	SM 9222D	20-Feb-18	20-Feb-18
Heterotrophic Plate Count	SM 9215C	20-Feb-18	20-Feb-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	21-Feb-18	21-Feb-18
pH	EPA 150.1 - pH probe @25 °C	20-Feb-18	20-Feb-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	21-Feb-18	23-Feb-18
Subdivision Package	Hardness as CaCO3	21-Feb-18	21-Feb-18
Sulphide	SM 4500SE - Colourimetric	21-Feb-18	21-Feb-18
Tannin/Lignin	SM 5550B - Colourimetric	20-Feb-18	20-Feb-18
Total Coliform	MOE E3407	20-Feb-18	20-Feb-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	21-Feb-18	22-Feb-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	22-Feb-18	23-Feb-18
Turbidity	SM 2130B - Turbidity meter	21-Feb-18	21-Feb-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 26-Feb-2018

Order Date: 20-Feb-2018

Project Description: 60215.11

	Client ID:	PW3	-	-	-
	Sample Date:	19-Feb-18	-	-	-
	Sample ID:	1808039-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND	-	-	-
Fecal Coliforms	1 CFU/100 mL	ND	-	-	-
Total Coliforms	1 CFU/100 mL	ND	-	-	-
Heterotrophic Plate Count	10 CFU/mL	50	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	270	-	-	-
Ammonia as N	0.01 mg/L	0.04	-	-	-
Dissolved Organic Carbon	0.5 mg/L	0.9	-	-	-
Colour	2 TCU	<2	-	-	-
Conductivity	5 uS/cm	726	-	-	-
Hardness	mg/L	244	-	-	-
pH	0.1 pH Units	7.6	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	836	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	-	-	-
Turbidity	0.1 NTU	0.2	-	-	-
Anions					
Chloride	1 mg/L	73	-	-	-
Fluoride	0.1 mg/L	0.2	-	-	-
Nitrate as N	0.1 mg/L	0.2	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	28	-	-	-
Metals					
Calcium	0.1 mg/L	71.4	-	-	-
Iron	0.1 mg/L	<0.1	-	-	-
Magnesium	0.2 mg/L	16.0	-	-	-
Manganese	0.005 mg/L	<0.005	-	-	-
Potassium	0.1 mg/L	1.0	-	-	-
Sodium	0.2 mg/L	63.5	-	-	-

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 26-Feb-2018
Order Date: 20-Feb-2018
Project Description: 60215.11

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Calcium	ND	0.1	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 26-Feb-2018
Order Date: 20-Feb-2018
Project Description: 60215.11

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	10.2	1	mg/L	10.2			0.1	10	
Fluoride	0.28	0.1	mg/L	0.29			0.9	10	
Nitrate as N	ND	0.1	mg/L	ND				20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	127	1	mg/L	124			2.5	10	
General Inorganics									
Alkalinity, total	301	5	mg/L	305			1.3	14	
Ammonia as N	0.494	0.01	mg/L	0.494			0.1	17.7	
Dissolved Organic Carbon	8.2	0.5	mg/L	7.7			6.6	37	
Colour	ND	2	TCU	ND				12	
Conductivity	819	5	uS/cm	817			0.2	11	
pH	7.9	0.1	pH Units	7.8			1.3	10	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	850	10	mg/L	854			0.5	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.16	0.1	mg/L	0.17			11.0	10	QR-01
Turbidity	0.2	0.1	NTU	0.2			0.0	10	
Metals									
Calcium	9.0	0.1	mg/L	9.5			5.8	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	2.2	0.2	mg/L	2.3			0.4	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Potassium	0.7	0.1	mg/L	0.7			1.5	20	
Sodium	17.7	0.2	mg/L	17.8			0.5	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	
Heterotrophic Plate Count	40	10	CFU/mL	50			22.0	30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	19.7	1	mg/L	10.2	95.4	78-112			
Fluoride	1.27	0.1	mg/L	0.29	98.0	73-113			
Nitrate as N	0.99	0.1	mg/L	ND	99.3	81-112			
Nitrite as N	0.944	0.05	mg/L	ND	94.4	76-107			
Sulphate	134	1	mg/L	124	97.5	75-111			
General Inorganics									
Ammonia as N	0.778	0.01	mg/L	0.494	114	81-124			
Dissolved Organic Carbon	19.1	0.5	mg/L	7.7	114	60-133			
Phenolics	0.027	0.001	mg/L	ND	109	69-132			
Total Dissolved Solids	104	10	mg/L		104	75-125			
Sulphide	0.50	0.02	mg/L	ND	100	79-115			
Tannin & Lignin	0.9	0.1	mg/L	ND	94.7	71-113			
Total Kjeldahl Nitrogen	2.01	0.1	mg/L	0.17	91.9	81-126			
Metals									
Calcium	1000		ug/L		100	80-120			
Iron	950		ug/L	57	89.3	80-120			
Magnesium	3050		ug/L	2250	79.5	80-120			QM-07
Manganese	45.7		ug/L	4.42	82.5	80-120			
Potassium	1580		ug/L	671	90.9	80-120			
Sodium	993		ug/L		99.3	80-120			

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 37656

Report Date: 7-Mar-2018
Order Date: 2-Mar-2018

Order #: 1809497

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1809497-01	TP18-3
1809497-02	TP18-9
1809497-03	TP18-13

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 07-Mar-2018
Order Date: 2-Mar-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Ammonia, as N	EPA 351.2 - Auto Colour	2-Mar-18	5-Mar-18
Anions	EPA 300.1 - IC	6-Mar-18	7-Mar-18
Phosphorus, total, water	EPA 365.4 - Auto Colour, digestion	5-Mar-18	6-Mar-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	5-Mar-18	6-Mar-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 07-Mar-2018

Order Date: 2-Mar-2018

Project Description: 60215.11

	Client ID:	TP18-3	TP18-9	TP18-13	-
	Sample Date:	02-Mar-18	02-Mar-18	02-Mar-18	-
	Sample ID:	1809497-01	1809497-02	1809497-03	-
	MDL/Units	Water	Water	Water	-
General Inorganics					
Ammonia as N	0.01 mg/L	0.07	0.11	0.11	-
Phosphorus, total	0.01 mg/L	0.10	1.18	0.71	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.4	1.1	0.9	-
Anions					
Nitrate as N	0.1 mg/L	<0.1	<0.1	0.1	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	<0.05	-

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 07-Mar-2018
Order Date: 2-Mar-2018
Project Description: 60215.11

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
General Inorganics									
Ammonia as N	ND	0.01	mg/L						
Phosphorus, total	ND	0.01	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 07-Mar-2018
Order Date: 2-Mar-2018
Project Description: 60215.11

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	0.47	0.1	mg/L	0.46			1.3	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
General Inorganics									
Ammonia as N	0.575	0.02	mg/L	0.578			0.4	17.7	
Phosphorus, total	0.102	0.01	mg/L	0.103			1.0	10	
Total Kjeldahl Nitrogen	0.43	0.1	mg/L	0.39			10.0	10	QR-01

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 07-Mar-2018
Order Date: 2-Mar-2018
Project Description: 60215.11

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	1.48	0.1	mg/L	0.46	102	81-112			
Nitrite as N	1.00	0.05	mg/L	ND	100	76-117			
General Inorganics									
Ammonia as N	0.252	0.01	mg/L		101	81-124			
Phosphorus, total	0.532	0.01	mg/L	0.103	85.9	80-120			
Total Kjeldahl Nitrogen	2.35	0.1	mg/L	0.39	98.1	81-126			

Qualifier Notes:

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 8553

Report Date: 14-Aug-2018
Order Date: 8-Aug-2018

Order #: 1832213

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1832213-01	TW18-3 3hr
1832213-02	TW18-3 6hr

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 14-Aug-2018
Order Date: 8-Aug-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	10-Aug-18	10-Aug-18
Ammonia, as N	EPA 351.2 - Auto Colour	14-Aug-18	14-Aug-18
Anions	EPA 300.1 - IC	9-Aug-18	10-Aug-18
Colour	SM2120 - Spectrophotometric	9-Aug-18	9-Aug-18
Conductivity	EPA 9050A- probe @25 °C	10-Aug-18	10-Aug-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	9-Aug-18	9-Aug-18
E. coli	MOE E3407	8-Aug-18	8-Aug-18
Fecal Coliform	SM 9222D	8-Aug-18	8-Aug-18
Heterotrophic Plate Count	SM 9215C	8-Aug-18	8-Aug-18
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	9-Aug-18	9-Aug-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	9-Aug-18	9-Aug-18
pH	EPA 150.1 - pH probe @25 °C	10-Aug-18	10-Aug-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	13-Aug-18	13-Aug-18
Subdivision Package	Hardness as CaCO3	9-Aug-18	9-Aug-18
Sulphide	SM 4500SE - Colourimetric	10-Aug-18	10-Aug-18
Tannin/Lignin	SM 5550B - Colourimetric	14-Aug-18	14-Aug-18
Total Coliform	MOE E3407	8-Aug-18	8-Aug-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	9-Aug-18	10-Aug-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	9-Aug-18	9-Aug-18
Turbidity	SM 2130B - Turbidity meter	9-Aug-18	9-Aug-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Aug-2018

Order Date: 8-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-3 3hr	TW18-3 6hr	-	-
	Sample Date:	08/07/2018 12:30	08/07/2018 15:30	-	-
	Sample ID:	1832213-01	1832213-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND	ND	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND	ND	-	-
Heterotrophic Plate Count	10 CFU/mL	80	90	-	-
General Inorganics					
Alkalinity, total	5 mg/L	340	342	-	-
Ammonia as N	0.01 mg/L	0.07	0.07	-	-
Dissolved Organic Carbon	0.5 mg/L	1.6	1.7	-	-
Colour	2 TCU	21	19	-	-
Conductivity	5 uS/cm	832	832	-	-
Hardness	mg/L	401	327	-	-
pH	0.1 pH Units	8.0	7.9	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	472	462	-	-
Sulphide	0.02 mg/L	<0.02	<0.02	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.4	0.3	-	-
Turbidity	0.1 NTU	1.6	1.5	-	-
Anions					
Chloride	1 mg/L	66	66	-	-
Fluoride	0.1 mg/L	0.7	0.7	-	-
Nitrate as N	0.1 mg/L	<0.1	0.2	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	39	38	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Aluminum	0.001 mg/L	-	0.002	-	-
Antimony	0.0005 mg/L	-	<0.0005	-	-
Arsenic	0.001 mg/L	-	<0.001	-	-
Barium	0.001 mg/L	-	0.159	-	-
Beryllium	0.0005 mg/L	-	<0.0005	-	-
Boron	0.01 mg/L	-	0.11	-	-
Cadmium	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	105	76.0	-	-
Chromium	0.001 mg/L	-	<0.001	-	-

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Aug-2018

Order Date: 8-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-3 3hr	TW18-3 6hr	-	-
	Sample Date:	08/07/2018 12:30	08/07/2018 15:30	-	-
	Sample ID:	1832213-01	1832213-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Cobalt	0.0005 mg/L	-	<0.0005	-	-
Copper	0.0005 mg/L	-	0.0005	-	-
Iron	0.1 mg/L	0.3	0.3	-	-
Lead	0.0001 mg/L	-	<0.0001	-	-
Magnesium	0.2 mg/L	33.4	33.4	-	-
Manganese	0.005 mg/L	0.036	0.035	-	-
Molybdenum	0.0005 mg/L	-	<0.0005	-	-
Nickel	0.001 mg/L	-	0.002	-	-
Potassium	0.1 mg/L	9.8	9.7	-	-
Selenium	0.001 mg/L	-	<0.001	-	-
Silicon	0.01 mg/L	-	3.22	-	-
Silver	0.0001 mg/L	-	<0.0001	-	-
Sodium	0.2 mg/L	32.8	32.4	-	-
Strontium	0.01 mg/L	-	3.95	-	-
Thallium	0.001 mg/L	-	<0.001	-	-
Tin	0.01 mg/L	-	<0.01	-	-
Titanium	0.005 mg/L	-	<0.005	-	-
Tungsten	0.01 mg/L	-	<0.01	-	-
Uranium	0.0001 mg/L	-	0.0012	-	-
Vanadium	0.0005 mg/L	-	0.0010	-	-
Zinc	0.005 mg/L	-	0.007	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Beryllium	ND	0.0005	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium	ND	0.001	mg/L						
Cobalt	ND	0.0005	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Molybdenum	ND	0.0005	mg/L						
Nickel	ND	0.001	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Silicon	ND	0.01	mg/L						
Silver	ND	0.0001	mg/L						
Sodium	ND	0.2	mg/L						
Strontium	ND	0.01	mg/L						
Thallium	ND	0.001	mg/L						
Tin	ND	0.01	mg/L						
Titanium	ND	0.005	mg/L						
Tungsten	ND	0.01	mg/L						
Uranium	ND	0.0001	mg/L						
Vanadium	ND	0.0005	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	27.7	1	mg/L	27.4			1.2	10	
Fluoride	0.77	0.1	mg/L	0.84			8.9	10	
Nitrate as N	0.37	0.1	mg/L	0.37			0.6	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	26.3	1	mg/L	26.2			0.4	10	
General Inorganics									
Alkalinity, total	33.3	5	mg/L	33.0			0.9	14	
Ammonia as N	0.070	0.01	mg/L	0.072			2.4	17.7	
Dissolved Organic Carbon	ND	0.5	mg/L	ND				37	
Colour	21	2	TCU	21			0.0	12	
Conductivity	168	5	uS/cm	154			8.8	11	
pH	8.6	0.1	pH Units	8.8			1.8	10	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	462	10	mg/L	472			2.1	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.52	0.1	mg/L	0.45			14.5	10	QR-01
Turbidity	1.6	0.1	NTU	1.6			1.3	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Aluminum	0.019	0.001	mg/L	0.017			7.6	20	
Antimony	ND	0.0005	mg/L	ND			0.0	20	
Arsenic	ND	0.001	mg/L	ND			0.0	20	
Barium	0.032	0.001	mg/L	0.031			5.4	20	
Beryllium	ND	0.0005	mg/L	ND			0.0	20	
Boron	ND	0.01	mg/L	ND			0.0	20	
Cadmium	ND	0.0001	mg/L	ND			0.0	20	
Calcium	41.3	1.0	mg/L	40.8			1.4	20	
Chromium	0.002	0.001	mg/L	0.001			12.7	20	
Cobalt	ND	0.0005	mg/L	ND			0.0	20	
Copper	0.0670	0.0005	mg/L	0.0650			3.1	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Lead	0.0016	0.0001	mg/L	0.0015			3.8	20	
Magnesium	12.3	0.2	mg/L	11.7			5.4	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Molybdenum	0.0005	0.0005	mg/L	0.0006			5.7	20	
Nickel	0.002	0.001	mg/L	0.002			8.7	20	
Potassium	0.6	0.1	mg/L	0.6			6.0	20	
Selenium	ND	0.001	mg/L	ND			0.0	20	
Silicon	3.74	0.01	mg/L	3.47			7.5	20	
Silver	ND	0.0001	mg/L	ND			0.0	20	
Sodium	3.7	0.2	mg/L	3.6			3.2	20	
Thallium	ND	0.001	mg/L	ND			0.0	20	
Tin	ND	0.01	mg/L	ND			0.0	20	
Titanium	ND	0.005	mg/L	ND			0.0	50	
Tungsten	ND	0.01	mg/L	ND			0.0	20	
Uranium	0.0002	0.0001	mg/L	0.0002			0.3	20	
Vanadium	0.0045	0.0005	mg/L	0.0040			10.6	20	
Zinc	0.015	0.005	mg/L	0.011			30.3	20	QR-01
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	
Heterotrophic Plate Count	80	10	CFU/mL	80			0.0	30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	37.5	1	mg/L	27.4	101	78-112			
Fluoride	1.83	0.1	mg/L	0.84	98.9	73-113			
Nitrate as N	1.44	0.1	mg/L	0.37	107	81-112			
Nitrite as N	0.804	0.05	mg/L	ND	80.4	76-107			
Sulphate	36.0	1	mg/L	26.2	98.1	75-111			
General Inorganics									
Ammonia as N	0.358	0.01	mg/L	0.072	115	81-124			
Dissolved Organic Carbon	10.4	0.5	mg/L	ND	104	60-133			
Phenolics	0.025	0.001	mg/L	ND	99.0	69-132			
Total Dissolved Solids	96.0	10	mg/L		96.0	75-125			
Sulphide	0.50	0.02	mg/L	ND	100	79-115			
Tannin & Lignin	0.8	0.1	mg/L	ND	82.0	71-113			
Total Kjeldahl Nitrogen	2.53	0.1	mg/L	0.45	104	81-126			
Metals									
Mercury	0.0027	0.0001	mg/L	ND	88.8	70-130			
Aluminum	60.9		ug/L	17.5	86.8	80-120			
Antimony	43.3		ug/L	ND	86.6	80-120			
Arsenic	51.0		ug/L	0.185	102	80-120			
Barium	74.2		ug/L	30.7	86.9	80-120			
Beryllium	45.7		ug/L	0.0373	91.3	80-120			
Boron	48.2		ug/L	6.03	84.3	80-120			
Cadmium	44.0		ug/L	ND	88.0	80-120			
Calcium	1240		ug/L	242	99.4	80-120			
Chromium	59.7		ug/L	1.47	116	80-120			
Cobalt	43.4		ug/L	0.0438	86.7	80-120			
Copper	106		ug/L	65.0	82.9	80-120			
Iron	1010		ug/L	45	96.5	80-120			
Lead	45.2		ug/L	1.51	87.4	80-120			
Magnesium	928		ug/L	8.8	91.9	80-120			
Manganese	48.4		ug/L	4.58	87.7	80-120			
Molybdenum	43.8		ug/L	0.560	86.6	80-120			
Nickel	45.5		ug/L	1.92	87.1	80-120			
Potassium	1360		ug/L	554	80.4	80-120			
Selenium	53.0		ug/L	0.644	105	80-120			
Silicon	3510		ug/L	3470	86.6	80-120			
Silver	43.4		ug/L	0.0152	86.7	80-120			
Sodium	4640		ug/L	3570	106	80-120			
Thallium	43.7		ug/L	0.011	87.4	80-120			
Tin	43.6		ug/L	0.16	86.8	80-120			
Titanium	27.7		ug/L		111	70-130			
Tungsten	44.6		ug/L	0.26	88.7	80-120			
Uranium	46.1		ug/L	0.229	91.7	80-120			
Vanadium	48.4		ug/L	4.04	88.7	80-120			
Zinc	58.0		ug/L	11.3	93.5	80-120			

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

Alkali/Alkaline Earth Metals analyzed by ICP-OES for high concentration samples.

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 9900

Report Date: 16-Aug-2018
Order Date: 10-Aug-2018

Order #: 1832379

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1832379-01	TW18-1 3hr
1832379-02	TW18-1 6hr

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 16-Aug-2018
Order Date: 10-Aug-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	14-Aug-18	14-Aug-18
Ammonia, as N	EPA 351.2 - Auto Colour	14-Aug-18	14-Aug-18
Anions	EPA 300.1 - IC	10-Aug-18	10-Aug-18
Chromium, hexavalent - water	MOE E3056 - colourimetric	14-Aug-18	14-Aug-18
Colour	SM2120 - Spectrophotometric	10-Aug-18	10-Aug-18
Conductivity	EPA 9050A- probe @25 °C	14-Aug-18	14-Aug-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	13-Aug-18	14-Aug-18
E. coli	MOE E3407	10-Aug-18	11-Aug-18
Fecal Coliform	SM 9222D	10-Aug-18	11-Aug-18
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	14-Aug-18	14-Aug-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	16-Aug-18	16-Aug-18
pH	EPA 150.1 - pH probe @25 °C	14-Aug-18	14-Aug-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	13-Aug-18	13-Aug-18
Subdivision Package	Hardness as CaCO3	16-Aug-18	16-Aug-18
Sulphide	SM 4500SE - Colourimetric	16-Aug-18	16-Aug-18
Tannin/Lignin	SM 5550B - Colourimetric	14-Aug-18	14-Aug-18
Total Coliform	MOE E3407	10-Aug-18	11-Aug-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	15-Aug-18	16-Aug-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	14-Aug-18	15-Aug-18
Turbidity	SM 2130B - Turbidity meter	10-Aug-18	10-Aug-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 16-Aug-2018

Order Date: 10-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-1 3hr	TW18-1 6hr	-	-
	Sample Date:	08/09/2018 11:30	08/09/2018 14:30	-	-
	Sample ID:	1832379-01	1832379-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND [1]	ND [1]	-	-
General Inorganics					
Alkalinity, total	5 mg/L	269	267	-	-
Ammonia as N	0.01 mg/L	0.11	0.17	-	-
Dissolved Organic Carbon	0.5 mg/L	4.1	4.1	-	-
Colour	2 TCU	24	50	-	-
Conductivity	5 uS/cm	718	716	-	-
Hardness	mg/L	357	344	-	-
pH	0.1 pH Units	8.0	8.0	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	452	448	-	-
Sulphide	0.02 mg/L	<0.02	<0.02	-	-
Tannin & Lignin	0.1 mg/L	0.2	0.2	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.5	0.2	-	-
Turbidity	0.1 NTU	5.0	4.9	-	-
Anions					
Chloride	1 mg/L	68	66	-	-
Fluoride	0.1 mg/L	0.5	0.5	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	33	32	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Aluminum	0.001 mg/L	-	<0.001	-	-
Antimony	0.0005 mg/L	-	<0.0005	-	-
Arsenic	0.001 mg/L	-	0.002	-	-
Barium	0.001 mg/L	-	0.465	-	-
Beryllium	0.0005 mg/L	-	<0.0005	-	-
Boron	0.01 mg/L	-	0.05	-	-
Cadmium	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	110	106	-	-
Chromium	0.001 mg/L	-	0.002	-	-
Chromium (VI)	0.010 mg/L	-	<0.010	-	-

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 16-Aug-2018

Order Date: 10-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-1 3hr	TW18-1 6hr	-	-
	Sample Date:	08/09/2018 11:30	08/09/2018 14:30	-	-
	Sample ID:	1832379-01	1832379-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Cobalt	0.0005 mg/L	-	<0.0005	-	-
Copper	0.0005 mg/L	-	<0.0005	-	-
Iron	0.1 mg/L	1	1	-	-
Lead	0.0001 mg/L	-	0.0001	-	-
Magnesium	0.2 mg/L	20.0	19.4	-	-
Manganese	0.005 mg/L	0.046	0.046	-	-
Molybdenum	0.0005 mg/L	-	0.0016	-	-
Nickel	0.001 mg/L	-	0.002	-	-
Potassium	0.1 mg/L	4.0	3.9	-	-
Selenium	0.001 mg/L	-	<0.001	-	-
Silicon	0.01 mg/L	-	6.47	-	-
Silver	0.0001 mg/L	-	<0.0001	-	-
Sodium	0.2 mg/L	14.0	13.8	-	-
Strontium	0.01 mg/L	-	1.09	-	-
Thallium	0.001 mg/L	-	<0.001	-	-
Tin	0.01 mg/L	-	<0.01	-	-
Titanium	0.005 mg/L	-	<0.005	-	-
Tungsten	0.01 mg/L	-	<0.01	-	-
Uranium	0.0001 mg/L	-	0.0005	-	-
Vanadium	0.0005 mg/L	-	0.0060	-	-
Zinc	0.005 mg/L	-	0.007	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Beryllium	ND	0.0005	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Chromium	ND	0.001	mg/L						
Cobalt	ND	0.0005	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Molybdenum	ND	0.0005	mg/L						
Nickel	ND	0.001	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Silicon	ND	0.01	mg/L						
Silver	ND	0.0001	mg/L						
Sodium	ND	0.2	mg/L						
Strontium	ND	0.01	mg/L						
Thallium	ND	0.001	mg/L						
Tin	ND	0.01	mg/L						
Titanium	ND	0.005	mg/L						
Tungsten	ND	0.01	mg/L						
Uranium	ND	0.0001	mg/L						
Vanadium	ND	0.0005	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	14.9	1	mg/L	14.8			0.6	10	
Fluoride	ND	0.1	mg/L	ND			0.0	10	
Nitrate as N	ND	0.1	mg/L	ND			0.0	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	26.6	1	mg/L	26.3			1.3	10	
General Inorganics									
Alkalinity, total	266	5	mg/L	269			1.4	14	
Ammonia as N	0.070	0.01	mg/L	0.072			2.4	17.7	
Dissolved Organic Carbon	3.7	0.5	mg/L	3.5			4.5	37	
Colour	24	2	TCU	24			0.0	12	
Conductivity	712	5	uS/cm	718			0.8	11	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	456	10	mg/L	452			0.9	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.55	0.1	mg/L	0.54			1.4	10	
Turbidity	5.0	0.1	NTU	5.0			0.4	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Aluminum	ND	0.001	mg/L	0.002			0.0	20	
Antimony	0.0008	0.0005	mg/L	0.0009			18.5	20	
Arsenic	0.002	0.001	mg/L	0.002			4.0	20	
Barium	0.580	0.001	mg/L	0.588			1.3	20	
Beryllium	ND	0.0005	mg/L	ND			0.0	20	
Boron	0.04	0.01	mg/L	0.05			6.1	20	
Cadmium	ND	0.0001	mg/L	ND			0.0	20	
Calcium	196	0.1	mg/L	110			56.2	20	
Chromium (VI)	ND	0.010	mg/L	ND				20	
Chromium	0.006	0.001	mg/L	0.006			3.7	20	
Cobalt	ND	0.0005	mg/L	ND			0.0	20	
Copper	ND	0.0005	mg/L	ND			0.0	20	
Iron	1	0.1	mg/L	1			0.3	20	
Lead	0.0001	0.0001	mg/L	0.0001			4.9	20	
Magnesium	19.6	0.2	mg/L	20.0			1.7	20	
Manganese	0.046	0.005	mg/L	0.046			1.0	20	
Molybdenum	0.0016	0.0005	mg/L	0.0017			6.1	20	
Nickel	0.003	0.001	mg/L	0.003			1.3	20	
Potassium	4.1	0.1	mg/L	4.0			3.8	20	
Selenium	ND	0.001	mg/L	ND			0.0	20	
Silicon	13.3	0.01	mg/L	13.4			1.1	20	
Silver	ND	0.0001	mg/L	0.0002			0.0	20	
Sodium	13.5	0.2	mg/L	14.0			4.0	20	
Thallium	ND	0.001	mg/L	ND			0.0	20	
Tin	ND	0.01	mg/L	ND			0.0	20	
Titanium	ND	0.005	mg/L	ND			0.0	50	
Tungsten	ND	0.01	mg/L	ND			0.0	20	
Uranium	0.0006	0.0001	mg/L	0.0006			3.6	20	
Vanadium	0.0017	0.0005	mg/L	0.0017			5.5	20	
Zinc	ND	0.005	mg/L	ND			0.0	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	25.4	1	mg/L	14.8	105	78-112			
Fluoride	1.08	0.1	mg/L	ND	108	73-113			
Nitrate as N	1.10	0.1	mg/L	ND	110	81-112			
Nitrite as N	1.02	0.05	mg/L	ND	102	76-107			
Sulphate	36.4	1	mg/L	26.3	101	75-111			
General Inorganics									
Ammonia as N	0.358	0.01	mg/L	0.072	115	81-124			
Dissolved Organic Carbon	11.5	0.5	mg/L	ND	115	60-133			
Phenolics	0.025	0.001	mg/L	ND	99.0	69-132			
Total Dissolved Solids	100	10	mg/L		100	75-125			
Sulphide	0.49	0.02	mg/L	ND	98.0	79-115			
Tannin & Lignin	0.8	0.1	mg/L	ND	82.0	71-113			
Total Kjeldahl Nitrogen	2.29	0.1	mg/L	0.54	87.2	81-126			
Metals									
Mercury	0.0029	0.0001	mg/L	ND	95.6	70-130			
Aluminum	56.5		ug/L	1.87	109	80-120			
Antimony	58.7		ug/L	0.935	116	80-120			
Arsenic	65.0		ug/L	1.51	127	80-120			
Barium	52.1		ug/L		104	80-120			
Beryllium	61.0		ug/L	0.0345	122	80-120			QM-07
Boron	99.1		ug/L	47.0	104	80-120			
Cadmium	57.5		ug/L	0.0057	115	80-120			
Calcium	190000		ug/L	110000	8050	80-120			
Chromium (VI)	0.181	0.010	mg/L	ND	90.5	70-130			
Chromium	61.8		ug/L	5.84	112	80-120			
Cobalt	54.3		ug/L	0.432	108	80-120			
Copper	54.4		ug/L	0.277	108	80-120			
Iron	2260		ug/L	1290	96.8	80-120			
Lead	59.9		ug/L	0.129	120	80-120			
Magnesium	1040		ug/L		104	80-120			
Manganese	99.0		ug/L	46.5	105	80-120			
Molybdenum	59.8		ug/L	1.66	116	80-120			
Nickel	56.0		ug/L	2.56	107	80-120			
Potassium	4960		ug/L	3950	101	80-120			
Selenium	62.6		ug/L	0.142	125	80-120			QM-07
Silicon	64.0		ug/L		128	80-120			
Silver	67.6		ug/L	0.161	135	80-120			QM-07
Sodium	14600		ug/L	14000	60.7	80-120			QM-07
Thallium	59.3		ug/L	0.033	118	80-120			
Tin	60.5		ug/L	0.31	120	80-120			QM-07
Titanium	54.4		ug/L		109	70-130			
Tungsten	56.5		ug/L		113	80-120			
Uranium	62.0		ug/L	0.572	123	80-120			QM-07
Vanadium	58.6		ug/L	1.65	114	80-120			
Zinc	59.4		ug/L	2.78	113	80-120			

Qualifier Notes:

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

Alkali/Alkaline Earth Metals analyzed by ICP-OES for high concentration samples.

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 7090

Report Date: 16-Aug-2018
Order Date: 10-Aug-2018

Order #: 1832380

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1832380-01	TW18-2 3 hr
1832380-02	TW18-2 6 hr

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 16-Aug-2018
Order Date: 10-Aug-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	14-Aug-18	14-Aug-18
Ammonia, as N	EPA 351.2 - Auto Colour	14-Aug-18	14-Aug-18
Anions	EPA 300.1 - IC	10-Aug-18	10-Aug-18
Colour	SM2120 - Spectrophotometric	10-Aug-18	10-Aug-18
Conductivity	EPA 9050A- probe @25 °C	14-Aug-18	14-Aug-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	13-Aug-18	14-Aug-18
E. coli	MOE E3407	10-Aug-18	11-Aug-18
Fecal Coliform	SM 9222D	10-Aug-18	11-Aug-18
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	14-Aug-18	14-Aug-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	16-Aug-18	16-Aug-18
pH	EPA 150.1 - pH probe @25 °C	14-Aug-18	14-Aug-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	13-Aug-18	13-Aug-18
Subdivision Package	Hardness as CaCO3	16-Aug-18	16-Aug-18
Sulphide	SM 4500SE - Colourimetric	16-Aug-18	16-Aug-18
Tannin/Lignin	SM 5550B - Colourimetric	14-Aug-18	14-Aug-18
Total Coliform	MOE E3407	10-Aug-18	11-Aug-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	15-Aug-18	16-Aug-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	14-Aug-18	15-Aug-18
Turbidity	SM 2130B - Turbidity meter	10-Aug-18	10-Aug-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 16-Aug-2018

Order Date: 10-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-2 3 hr	TW18-2 6 hr	-	-
	Sample Date:	08/08/2018 11:30	08/08/2018 14:30	-	-
	Sample ID:	1832380-01	1832380-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [2]	ND [2]	-	-
Fecal Coliforms	1 CFU/100 mL	59	ND	-	-
Total Coliforms	1 CFU/100 mL	Confluent [1] [2]	ND [2]	-	-
General Inorganics					
Alkalinity, total	5 mg/L	240	244	-	-
Ammonia as N	0.01 mg/L	0.13	0.15	-	-
Dissolved Organic Carbon	0.5 mg/L	<0.5	<0.5	-	-
Colour	2 TCU	22	24	-	-
Conductivity	5 uS/cm	596	595	-	-
Hardness	mg/L	290	284	-	-
pH	0.1 pH Units	8.0	8.0	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	328	310	-	-
Sulphide	0.02 mg/L	<0.02	<0.02	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	0.2	-	-
Turbidity	0.1 NTU	3.0	2.4	-	-
Anions					
Chloride	1 mg/L	43	42	-	-
Fluoride	0.1 mg/L	0.9	1.0	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	25	25	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Aluminum	0.001 mg/L	-	0.001	-	-
Antimony	0.0005 mg/L	-	<0.0005	-	-
Arsenic	0.001 mg/L	-	<0.001	-	-
Barium	0.001 mg/L	-	0.140	-	-
Beryllium	0.0005 mg/L	-	<0.0005	-	-
Boron	0.01 mg/L	-	0.15	-	-
Cadmium	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	78.0	77.3	-	-
Chromium	0.001 mg/L	-	0.003	-	-
Cobalt	0.0005 mg/L	-	<0.0005	-	-

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 16-Aug-2018

Order Date: 10-Aug-2018

Project Description: 60215.11

	Client ID:	TW18-2 3 hr	TW18-2 6 hr	-	-
	Sample Date:	08/08/2018 11:30	08/08/2018 14:30	-	-
	Sample ID:	1832380-01	1832380-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Copper	0.0005 mg/L	-	<0.0005	-	-
Iron	0.1 mg/L	0.6	0.5	-	-
Lead	0.0001 mg/L	-	<0.0001	-	-
Magnesium	0.2 mg/L	23.2	22.2	-	-
Manganese	0.005 mg/L	0.017	0.015	-	-
Molybdenum	0.0005 mg/L	-	0.0009	-	-
Nickel	0.001 mg/L	-	0.001	-	-
Potassium	0.1 mg/L	5.2	4.8	-	-
Selenium	0.001 mg/L	-	<0.001	-	-
Silicon	0.01 mg/L	-	5.11	-	-
Silver	0.0001 mg/L	-	<0.0001	-	-
Sodium	0.2 mg/L	14.9	14.5	-	-
Strontium	0.01 mg/L	-	2.55	-	-
Thallium	0.001 mg/L	-	<0.001	-	-
Tin	0.01 mg/L	-	<0.01	-	-
Titanium	0.005 mg/L	-	<0.005	-	-
Tungsten	0.01 mg/L	-	<0.01	-	-
Uranium	0.0001 mg/L	-	0.0008	-	-
Vanadium	0.0005 mg/L	-	0.0065	-	-
Zinc	0.005 mg/L	-	<0.005	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Beryllium	ND	0.0005	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium	ND	0.001	mg/L						
Cobalt	ND	0.0005	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Molybdenum	ND	0.0005	mg/L						
Nickel	ND	0.001	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Silicon	ND	0.01	mg/L						
Silver	ND	0.0001	mg/L						
Sodium	ND	0.2	mg/L						
Strontium	ND	0.01	mg/L						
Thallium	ND	0.001	mg/L						
Tin	ND	0.01	mg/L						
Titanium	ND	0.005	mg/L						
Tungsten	ND	0.01	mg/L						
Uranium	ND	0.0001	mg/L						
Vanadium	ND	0.0005	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	14.9	1	mg/L	14.8			0.6	10	
Fluoride	ND	0.1	mg/L	ND			0.0	10	
Nitrate as N	ND	0.1	mg/L	ND			0.0	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	26.6	1	mg/L	26.3			1.3	10	
General Inorganics									
Alkalinity, total	266	5	mg/L	269			1.4	14	
Ammonia as N	0.070	0.01	mg/L	0.072			2.4	17.7	
Dissolved Organic Carbon	3.7	0.5	mg/L	3.5			4.5	37	
Colour	24	2	TCU	24			0.0	12	
Conductivity	712	5	uS/cm	718			0.8	11	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	456	10	mg/L	452			0.9	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.55	0.1	mg/L	0.54			1.4	10	
Turbidity	5.0	0.1	NTU	5.0			0.4	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Aluminum	ND	0.001	mg/L	0.002			0.0	20	
Antimony	0.0008	0.0005	mg/L	0.0009			18.5	20	
Arsenic	0.002	0.001	mg/L	0.002			4.0	20	
Barium	0.580	0.001	mg/L	0.588			1.3	20	
Beryllium	ND	0.0005	mg/L	ND			0.0	20	
Boron	0.04	0.01	mg/L	0.05			6.1	20	
Cadmium	ND	0.0001	mg/L	ND			0.0	20	
Calcium	196	0.1	mg/L	110			56.2	20	
Chromium	0.006	0.001	mg/L	0.006			3.7	20	
Cobalt	ND	0.0005	mg/L	ND			0.0	20	
Copper	ND	0.0005	mg/L	ND			0.0	20	
Iron	1	0.1	mg/L	1			0.3	20	
Lead	0.0001	0.0001	mg/L	0.0001			4.9	20	
Magnesium	19.6	0.2	mg/L	20.0			1.7	20	
Manganese	0.046	0.005	mg/L	0.046			1.0	20	
Molybdenum	0.0016	0.0005	mg/L	0.0017			6.1	20	
Nickel	0.003	0.001	mg/L	0.003			1.3	20	
Potassium	4.1	0.1	mg/L	4.0			3.8	20	
Selenium	ND	0.001	mg/L	ND			0.0	20	
Silicon	13.3	0.01	mg/L	13.4			1.1	20	
Silver	ND	0.0001	mg/L	0.0002			0.0	20	
Sodium	13.5	0.2	mg/L	14.0			4.0	20	
Thallium	ND	0.001	mg/L	ND			0.0	20	
Tin	ND	0.01	mg/L	ND			0.0	20	
Titanium	ND	0.005	mg/L	ND			0.0	50	
Tungsten	ND	0.01	mg/L	ND			0.0	20	
Uranium	0.0006	0.0001	mg/L	0.0006			3.6	20	
Vanadium	0.0017	0.0005	mg/L	0.0017			5.5	20	
Zinc	ND	0.005	mg/L	ND			0.0	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	25.4	1	mg/L	14.8	105	78-112			
Fluoride	1.08	0.1	mg/L	ND	108	73-113			
Nitrate as N	1.10	0.1	mg/L	ND	110	81-112			
Nitrite as N	1.02	0.05	mg/L	ND	102	76-107			
Sulphate	36.4	1	mg/L	26.3	101	75-111			
General Inorganics									
Ammonia as N	0.358	0.01	mg/L	0.072	115	81-124			
Dissolved Organic Carbon	11.5	0.5	mg/L	ND	115	60-133			
Phenolics	0.025	0.001	mg/L	ND	99.0	69-132			
Total Dissolved Solids	100	10	mg/L		100	75-125			
Sulphide	0.49	0.02	mg/L	ND	98.0	79-115			
Tannin & Lignin	0.8	0.1	mg/L	ND	82.0	71-113			
Total Kjeldahl Nitrogen	2.29	0.1	mg/L	0.54	87.2	81-126			
Metals									
Mercury	0.0029	0.0001	mg/L	ND	95.6	70-130			
Aluminum	56.5		ug/L	1.87	109	80-120			
Antimony	58.7		ug/L	0.935	116	80-120			
Arsenic	65.0		ug/L	1.51	127	80-120			
Barium	52.1		ug/L		104	80-120			
Beryllium	61.0		ug/L	0.0345	122	80-120			QM-07
Boron	99.1		ug/L	47.0	104	80-120			
Cadmium	57.5		ug/L	0.0057	115	80-120			
Calcium	190000		ug/L	110000	8050	80-120			
Chromium	61.8		ug/L	5.84	112	80-120			
Cobalt	54.3		ug/L	0.432	108	80-120			
Copper	54.4		ug/L	0.277	108	80-120			
Iron	2260		ug/L	1290	96.8	80-120			
Lead	59.9		ug/L	0.129	120	80-120			
Magnesium	1040		ug/L		104	80-120			
Manganese	99.0		ug/L	46.5	105	80-120			
Molybdenum	59.8		ug/L	1.66	116	80-120			
Nickel	56.0		ug/L	2.56	107	80-120			
Potassium	4960		ug/L	3950	101	80-120			
Selenium	62.6		ug/L	0.142	125	80-120			QM-07
Silicon	64.0		ug/L		128	80-120			
Silver	67.6		ug/L	0.161	135	80-120			QM-07
Sodium	14600		ug/L	14000	60.7	80-120			QM-07
Thallium	59.3		ug/L	0.033	118	80-120			
Tin	60.5		ug/L	0.31	120	80-120			QM-07
Titanium	54.4		ug/L		109	70-130			
Tungsten	56.5		ug/L		113	80-120			
Uranium	62.0		ug/L	0.572	123	80-120			QM-07
Vanadium	58.6		ug/L	1.65	114	80-120			
Zinc	59.4		ug/L	2.78	113	80-120			

Qualifier Notes:

Sample Qualifiers :

1 : Confluent - continuous bacterial growth on the identification media in which bacterial colonies are not discrete and individual colonies cannot be counted.

2 : A2C - Background counts greater than 200

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

Alkali/Alkaline Earth Metals analyzed by ICP-OES for high concentration samples.

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 60215.11
Custody: 9001

Report Date: 12-Sep-2018
Order Date: 7-Sep-2018

Order #: 1836381

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1836381-01	TW18-2 R1

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 12-Sep-2018
Order Date: 7-Sep-2018
Project Description: 60215.11

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Colour	SM2120 - Spectrophotometric	7-Sep-18	7-Sep-18
Colour, apparent	SM2120 - Spectrophotometric	7-Sep-18	7-Sep-18
E. coli	MOE E3407	7-Sep-18	7-Sep-18
Fecal Coliform	SM 9222D	7-Sep-18	7-Sep-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	11-Sep-18	12-Sep-18
Total Coliform	MOE E3407	7-Sep-18	7-Sep-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 12-Sep-2018

Order Date: 7-Sep-2018

Project Description: 60215.11

	Client ID:	TW18-2 R1	-	-	-
	Sample Date:	09/06/2018 16:00	-	-	-
	Sample ID:	1836381-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	-	-	-
Fecal Coliforms	1 CFU/100 mL	ND	-	-	-
Total Coliforms	1 CFU/100 mL	3 [1]	-	-	-
General Inorganics					
Colour	2 TCU	10	-	-	-
Colour, apparent	2 ACU	13	-	-	-
Metals					
Iron	0.1 mg/L	0.4	-	-	-
Manganese	0.005 mg/L	0.013	-	-	-

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 12-Sep-2018
Order Date: 7-Sep-2018
Project Description: 60215.11

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Colour	ND	2	TCU						
Colour, apparent	ND	2	ACU						
Metals									
Iron	ND	0.1	mg/L						
Manganese	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 12-Sep-2018
Order Date: 7-Sep-2018
Project Description: 60215.11

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Colour	ND	2	TCU	ND			0.0	12	
Colour, apparent	13	2	ACU	13			0.0	12	
Metals									
Iron	ND	0.1	mg/L	ND			0.0	20	
Manganese	0.014	0.005	mg/L	0.014			2.5	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 12-Sep-2018
Order Date: 7-Sep-2018
Project Description: 60215.11

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Metals									
Iron	965		ug/L	ND	96.5	80-120			
Manganese	58.3		ug/L	14.0	88.6	80-120			

Qualifier Notes:

Login Qualifiers :

Samples received submerged in water, possibly melted ice. This condition can compromise sample integrity.
Applies to samples: TW18-2 R1

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

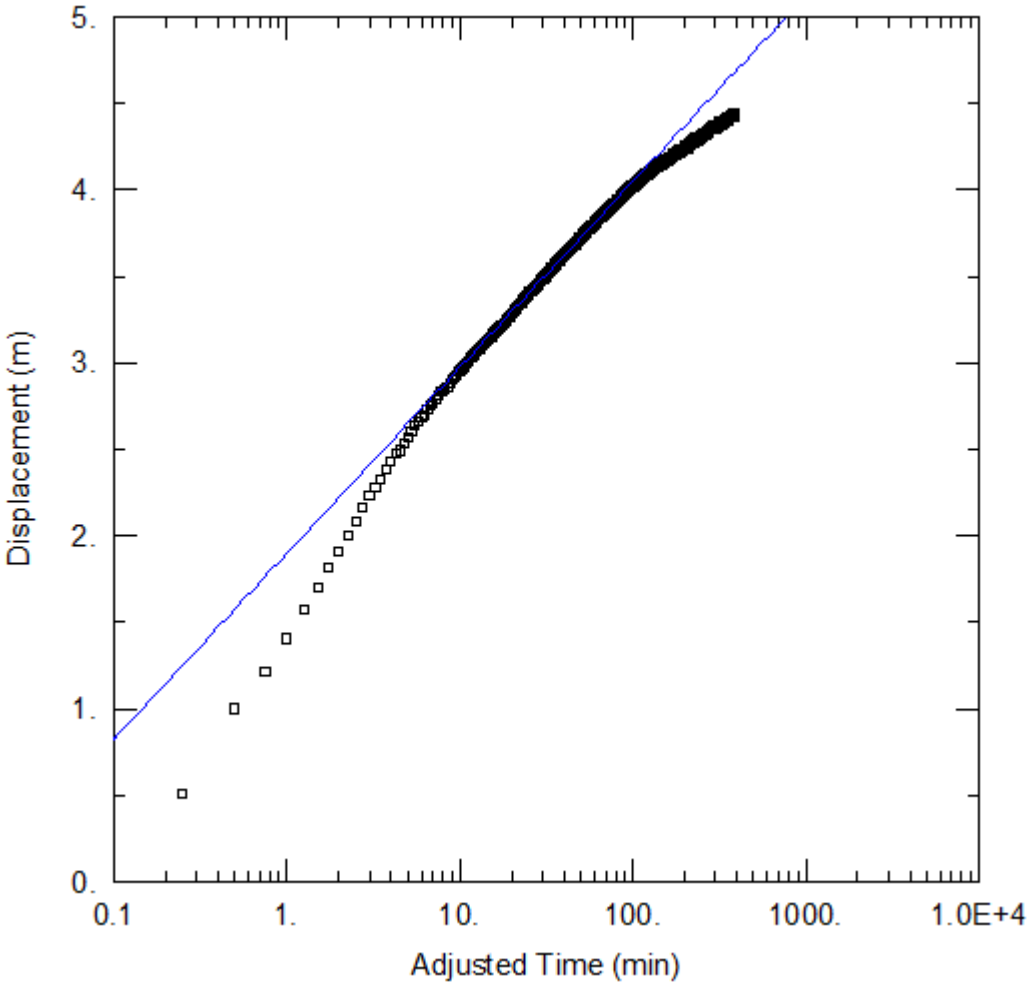
APPENDIX J

Aqtesolv Transmissivity Analyses

GEMTEC
Consulting Engineers and Scientists

Pumping Test Analysis Report		
Project: Hydrogeological Investigation		
Project Number: 60215.11		
Client: Cameron and June Young		
Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW1	P-Test Date: August 9, 2018
Analysis Performed by: AP	Method: Cooper Jacob Analysis	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 30.3 L/min	Duration: 385 minutes

Pumping Test Analysis – Cooper-Jacob (TW1)

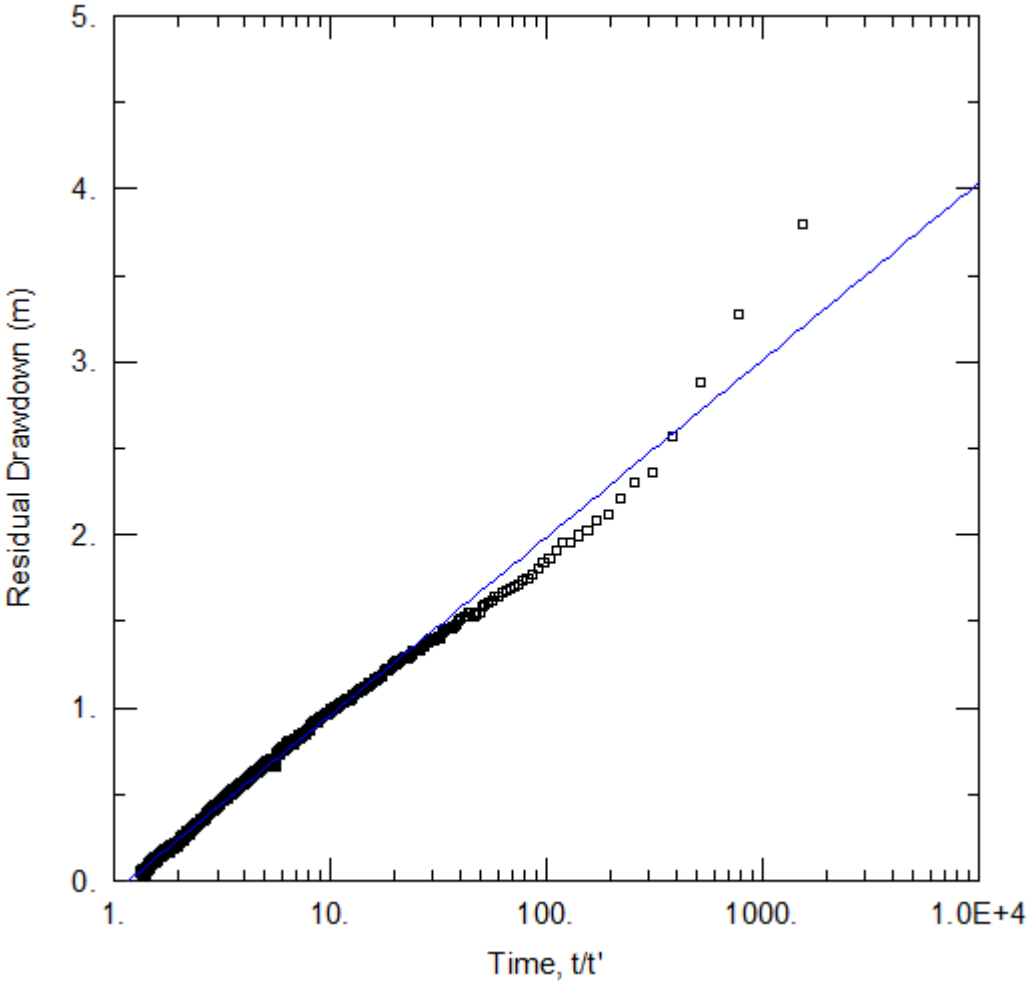


Aquifer Model: Confined
Estimated Transmissivity: 7.4 m^2/day
Estimated Storativity: 0.03
Kz/Kr: 1

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report
	Project: Hydrogeological Investigation
	Project Number: 60215.11
	Client: Cameron and June Young

Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW1	P-Test Date: August 9, 2018
Analysis Performed by: AP	Method: Theis Recovery	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 30.3 L/min	Duration: 385 minutes

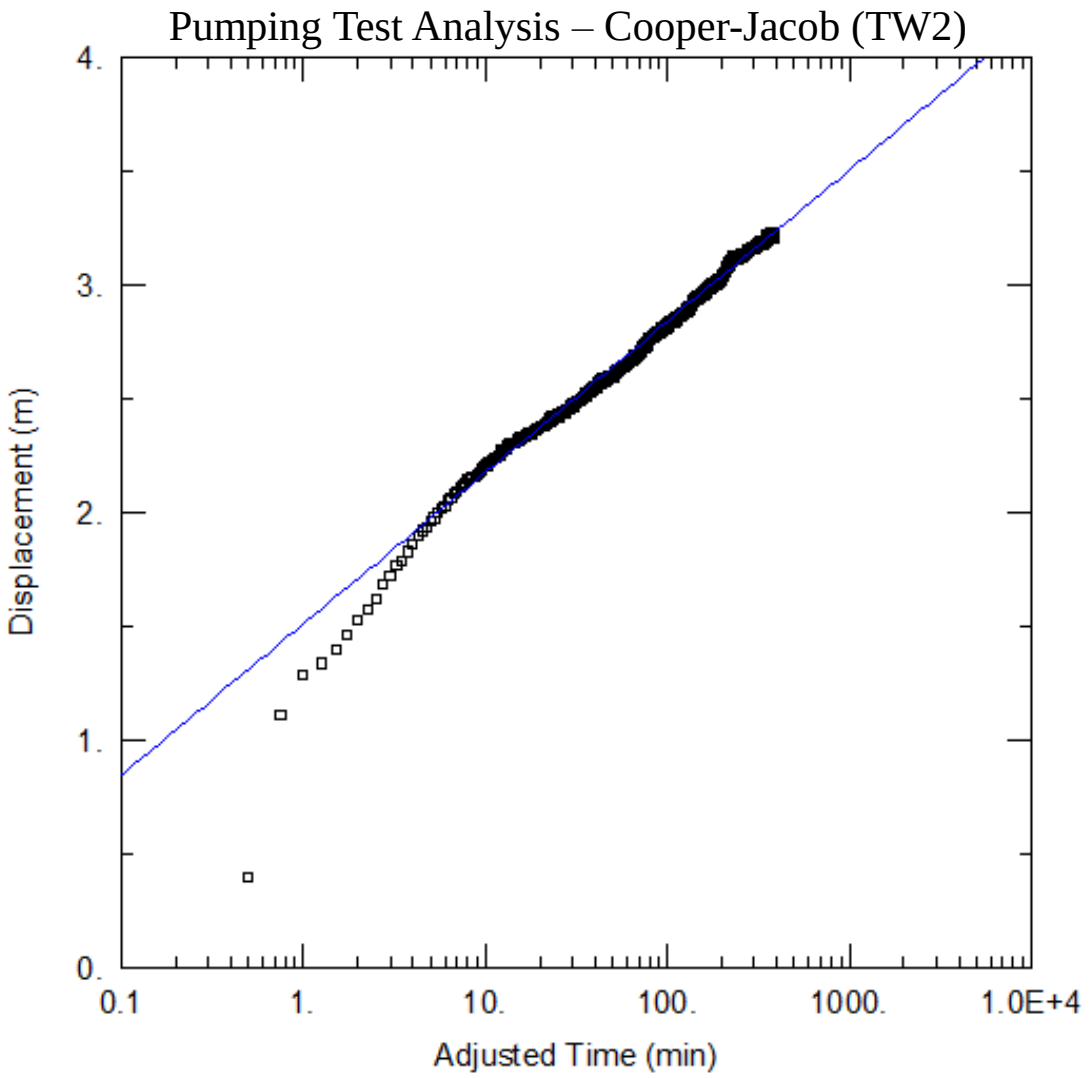
Pumping Test Analysis – Theis Recovery (TW1)



Aquifer Model: Confined
Estimated Transmissivity: 7.8 m^2/day
Estimated S/S': 1.2

GEMTEC
Consulting Engineers and Scientists

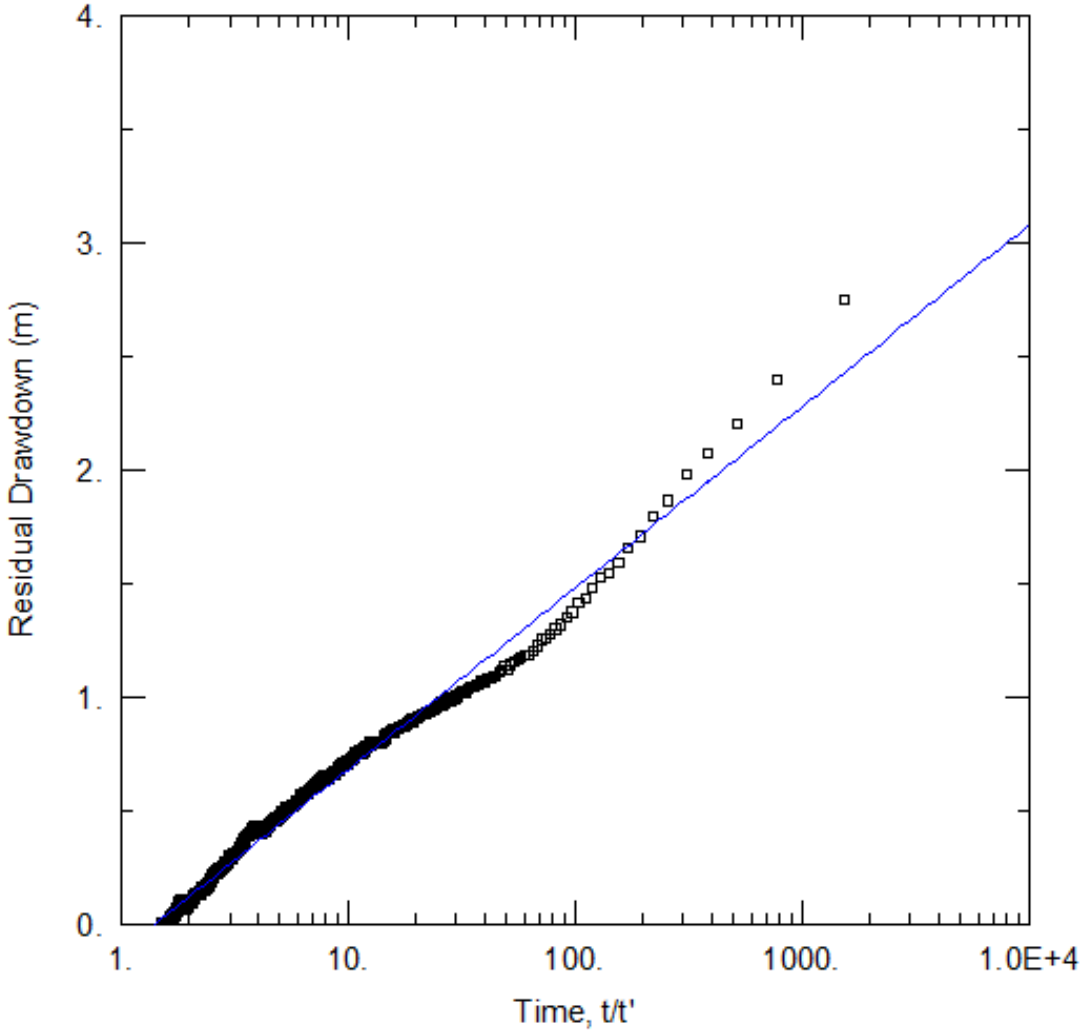
Pumping Test Analysis Report		
Project: Hydrogeological Investigation		
Project Number: 60215.11		
Client: Cameron and June Young		
Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW2	P-Test Date: August 8, 2018
Analysis Performed by: AP	Method: Cooper Jacob Analysis	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 385 minutes



Aquifer Model: Confined
Estimated Transmissivity: 15 m^2/day
Estimated Storativity: 0.02
Kz/Kr: 1

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report	
	Project: Hydrogeological Investigation	
	Project Number: 60215.11	
	Client: Cameron and June Young	
Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW2	P-Test Date: August 8, 2018
Analysis Performed by: AP	Method: Theis Recovery	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 385 minutes

Pumping Test Analysis – Theis Recovery (TW2)

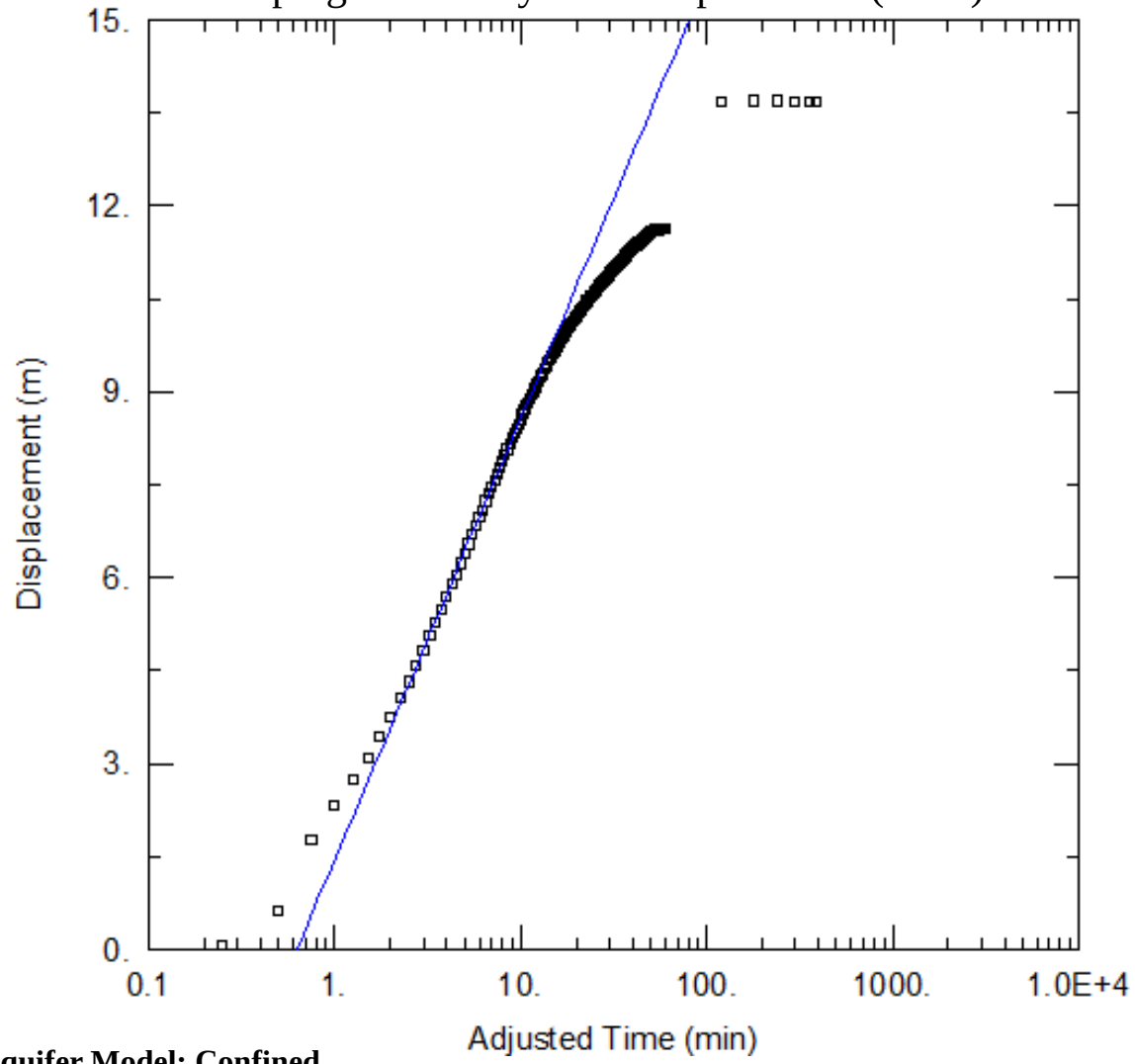


Aquifer Model: Confined
Estimated Transmissivity: 12 m^2/day
Estimated S/S': 1.4

GEMTEC Consulting Engineers and Scientists	Pumping Test Analysis Report
	Project: Hydrogeological Investigation
	Project Number: 60215.11
	Client: Cameron and June Young

Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW3	P-Test Date: August 7, 2018
Analysis Performed by: AP	Method: Cooper Jacob Analysis	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 390 minutes

Pumping Test Analysis – Cooper-Jacob (TW3)



Aquifer Model: Confined
Estimated Transmissivity: 1.4 m^2/day
Estimated Storativity: 0.2
Kz/Kr: 1

GEMTEC
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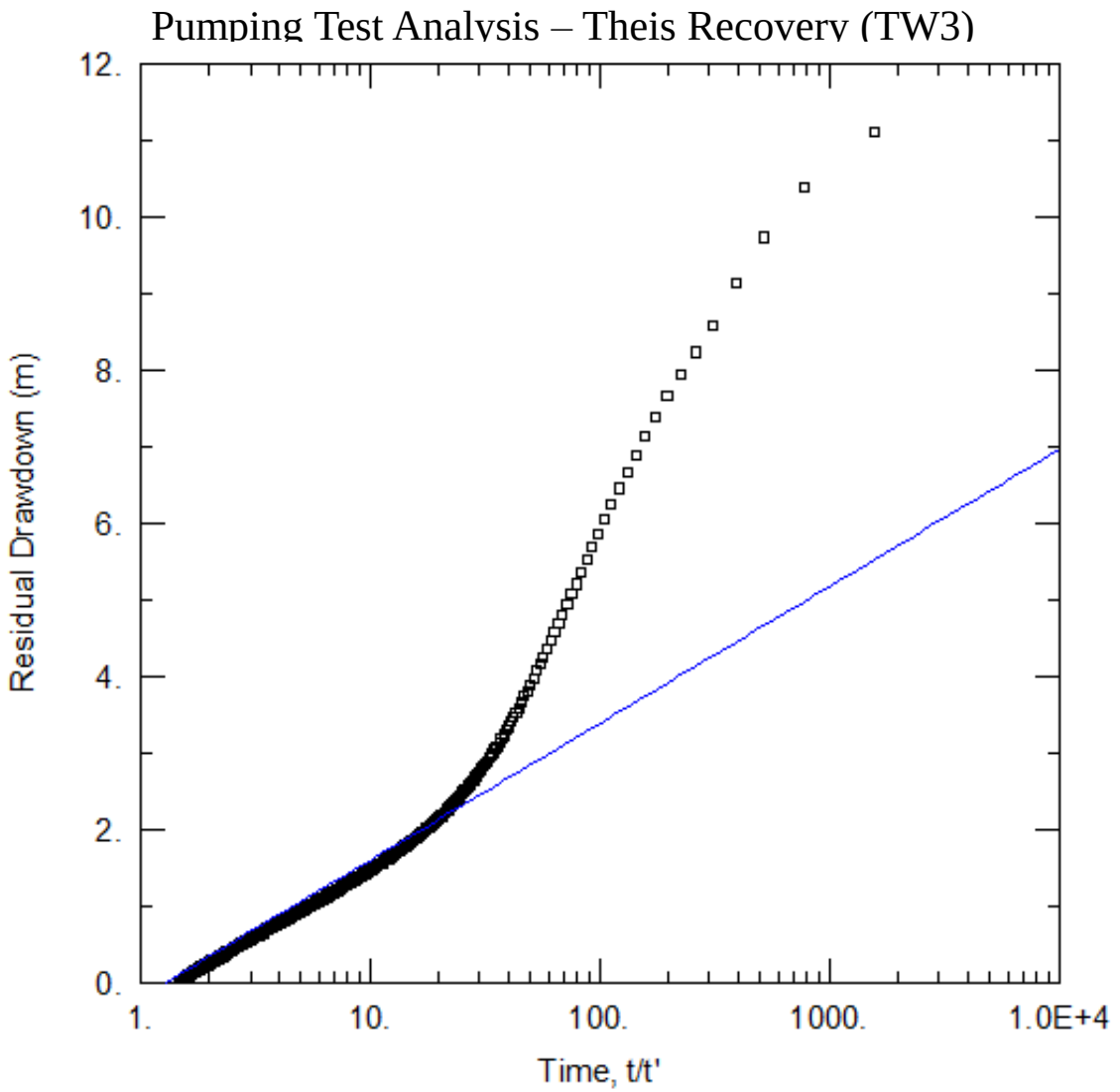
Pumping Test Analysis Report		
Project: Hydrogeological Investigation		
Project Number: 60215.11		
Client: Cameron and June Young		
Location: Lot 3, Concession 8, Beckwith		
Test Conducted by: LM	Pumping Well: TW3	P-Test Date: August 7, 2018
Analysis Performed by: AP	Method: Theis Recovery	Analysis Date: September 2018
Aquifer Thickness: 6.0 m	Discharge: 37.8 L/min	Duration: 390 minutes

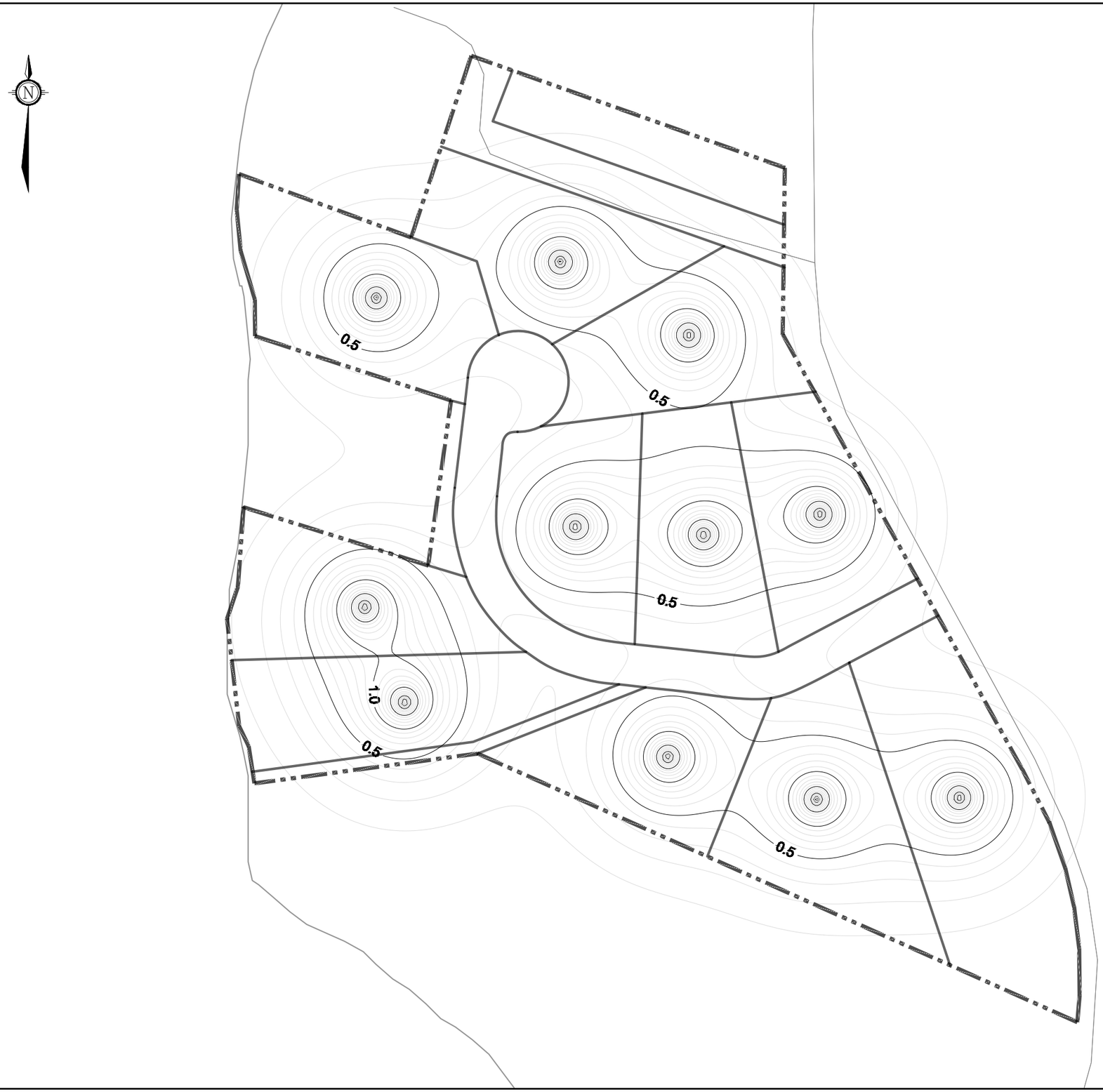


Aquifer Model: Confined
Estimated Transmissivity: 5.8 m^2/day
Estimated S/S': 1.3

APPENDIX K

Aqtesolv Well Interference Analysis

Report to: Cameron and June Young
Project: 60215.11 (March 11, 2020)



LEGEND

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A.P.

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