



Hydrogeological Assessment Update

211 Dock Road

Barrie, Ontario

Prepared for:
1000067364 Ontario Inc.

Prepared by:
Azimuth Environmental
Consulting, Inc.

Revised May 2024

AEC 16-202



Environmental Assessments & Approvals

May 21st, 2024

AEC 16-202

1000067364 Ontario Inc
P.O. Box 310
Aurora, ON
L4G 3H4

Attention: Mike Cross

Re: **Hydrogeological Assessment Update**
211 Dock Road, City of Barrie, Ontario

Dear Mr. Cross:

Azimuth Environmental Consulting, Inc. (Azimuth) is pleased to provide our Hydrogeological Assessment Update for the property located at 211 Dock Road within the City of Barrie (the "Site"). This evaluation focused on the existing soil and ground water regime underlying the Site and the potential for the proposed development to impact the existing conditions. The report has been updated to reflect a revised Site Plan and the inclusion of additional ground water data.

Should you have any questions or wish to discuss the report in greater detail, please do not hesitate to contact the undersigned.

Yours truly,
AZIMUTH ENVIRONMENTAL CONSULTING, INC.



Jenn Millington, M.A.Sc., P.Geo.
Senior Hydrogeologist



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1.0 INTRODUCTION

Azimuth Environmental Consulting, Inc. (“Azimuth”) has been retained by 1000067364 Ontario Inc. to conduct a Hydrogeological Assessment Update for the proposed residential development located at 211 Dock Road within the City of Barrie, Ontario (the “Site”)(Figure 1). The previous report titled Hydrogeological Evaluation, 211 Dock Road, Barrie, Ontario was issued in November of 2018.

The Site is approximately 1.25 hectares (ha) in size and is located on the north side of Dock Road, west of Tynhead Road, approximately 190 m east of Tyndale Road (Figure 2). The Site is currently composed of undeveloped forest, with one residential home currently under construction. There is a wetland feature located in the south east portion of the Site.

The proposed development of the Site includes five single lot residential homes off of Dock Road. The north portion of the Site will be dedicated to the City of Barrie. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

2.0 ENVIRONMENTAL SETTING

2.1 Soil

The soil map of Simcoe County (Soil Survey Report No. 29, Scale 1:63,360) shows the uppermost soil to be composed of a combination of Bondhead sandy loam – stony phase, and Sargent gravelly sandy loam. Bondhead sandy loam is classified within hydrologic soil group “AB” while Sargent gravelly sandy loam is classified within hydrologic soil group “A”. Group A soils represent material which have low runoff potential and high infiltration rates even when thoroughly wet. They consist of deep, well to excessively drained sand or gravel and have a high rate of water transmission. Group B soils represent material which has a moderate infiltration rate when thoroughly wet and consists of moderately deep to deep, fine to coarse textured soil.

2.2 Physiography

The Ontario Geologic Survey (Chapman and Putnam, 1984) describes the area as being located within the Simcoe Lowlands Physiographic region. The Simcoe Lowlands represent areas that were flooded by Lake Algonquin and are bordered by shore cliffs, beaches, and boulder terraces. The Barrie area represents a flat floored valley connecting the Nottawasaga basin and the Lake Simcoe basin.



2.3 Topography and Drainage

According to local topographic mapping, the Site is found at an elevation between 224 – 228 meters above sea level (masl). The Site displays a gradual slope to the north east toward Lake Simcoe, which is located approximately 115 m from the Site boundary. There is a wetland feature in the south east portion of the Site. There is a seasonal drainage feature which overlaps the northern tip of the Site in a west to east direction, discharging into a road side ditch along the western side of Tynhead Road. This ditch flows into a culvert crossing beneath Tynhead Road that flows through the Tynhead development and outlets directly into Lake Simcoe. Based on local topographic mapping, the Site is considered to be located within one catchment and all runoff is expected to flow north east toward the seasonal drainage feature or road side ditch along Tynhead Road.

2.4 Bedrock Geology

The Ontario Geologic Survey Earth Database shows that the uppermost bedrock unit at the subject property consists of limestone and shale of the Simcoe Group of the Verulam Formation (OGS, 2017). The Verulam Formation is Middle Ordovician in age. Bedrock is sufficiently deep (100m+) and does not influence the water balance assessment.

2.5 Quaternary Geology

The surficial material for the Site is variable, and is composed of three different materials (OGS, 2017). The south west corner of the Site is composed of sandy silt to silty sand textured till, and the eastern Site boundary is composed of fine-textured silt and clay with minor sand and gravel. There is a narrow strip of coarse textured glaciolacustrine deposits aligned north west to south east containing sand and gravel with minor silt and clay associated with a former beach ridge and near shore deposit.

2.6 Hydrogeology

The Ontario Ministry of the Environment, Conservation, and Parks (MECP) Water Well Records (Appendix B) were referenced for any recorded well information within the vicinity (~ 300 m) of the Site (GIN, 2018, Table 1). The development will be serviced with municipal water and sewer utilities; however, many of the existing homes surrounding the development utilize private well and septic systems. Well records can be used to gain subsurface information which can provide insight into the geological formations within the area.

The well records included within Table 1 were advanced primarily for domestic use, with three wells listed for test hole purposes, one well used for observation, one well was abandoned, and one well listed as not used. Well depths ranged between 7.3 – 103.3



mbgs, with corresponding water levels ranging between 0.0 – 7.3 mbgs. The overburden materials listed in the well records included in Table 1 vary significantly, and are composed of both sand and clay deposits. This is consistent with the information reviewed above, which indicates a highly variable Quaternary geology along the Lake Simcoe shoreline. None of the well records encountered bedrock, indicating it is found at a depth greater than 100 mbgs in the vicinity of the Site.

Table 1: MECP Water Well Database Summary

Well No.	Distance from the Site (m)	Direction from the Site	Elevation (m)	Date Drilled	Well Type	Well Depth (m)	Water Level (m)	Primary Use
5705815	20	W	224	1968-07-16	Overburden	7.3	3.7	Domestic
5718499	25	E	221	1982-09-21	Overburden	18.9	1.8	Domestic
5717012	45	E	221	1980-07-25	Overburden	79.6	3.1	Observation
7104787	45	SE	-	2008-03-11	Overburden	25.3	1.1	Test Hole
5727029	55	NW	-	1990-06-14	Overburden	27.4	1.2	Domestic
5721022	55	NW	-	1986-08-07	Overburden	35.1	-	Domestic
5725739	55	NW	-	1989-09-22	Overburden	10.4	0.6	Domestic
5734432	55	NW	-	1999-07-26	Overburden	11.6	7.3	Domestic
5730409	55	NW	-	1993-11-22	Overburden	31.1	1.8	Domestic
5701773	65	E	220	1966-09-01	Overburden	9.8	0.0	Domestic
5701770	65	E	221	1956-10-16	Overburden	44.5	-	Domestic
5701769	70	E	221	1956-07-13	Overburden	43.3	-	Domestic
7104786	70	SE	-	2008-03-11	Overburden	22.6	-	Not Used
7120047	70	SE	-	2008-12-01	Overburden	7.6	5.0	Test Hole
5718492	90	W	221	1982-09-16	Overburden	26.2	6.1	Domestic
5720118	150	SW	229	1985-07-29	Overburden	12.8	4.3	Domestic
5720227	150	SW	229	1985-09-30	Overburden	25.6	6.7	Domestic
5701771	155	SW	230	1963-07-12	Overburden	63.4	0.6	Domestic
5708974	200	W	229	1972-06-12	Overburden	21.0	4.6	Domestic
5720403	220	W	229	1985-12-11	Overburden	22.6	6.1	Domestic
5708973	230	NW	229	1972-06-10	Overburden	21.0	4.6	Domestic
5708971	235	NW	227	1972-06-15	Overburden	21.0	3.6	Domestic
5707696	265	W	232	1970-08-06	Overburden	19.8	0.9	Domestic
5710324	265	W	232	1973-07-14	Overburden	35.7	4.6	Domestic
5715730	270	NW	221	1978-10-79	Overburden	103.3	-	Test Hole
5716048	280	NW	222	1978-09-04	Overburden	34.1	1.2	Domestic
5709546	280	NW	227	1972-08-20	Overburden	15.9	0.6	Domestic
5737317	295	NW	226	2002-08-08	-	-	-	Abandoned

The Oak Ridges Moraine Groundwater Program (ORMGP, 2018) includes a water table layer which was created by contouring the static water levels from all wells where the well screen is less than 20 m deep. This layer is meant to represent an average water table since the values used in its creation were collected from all seasons over time. ORMGP (2018) suggests that the actual water table at any given time of the year may be up to 2-3m lower or higher than the values indicated on the water table layer. According to ORMGP (2018) the water table at the Site is found between 221 - 224 masl, which



represents 1 - 3 mbgs. Ground water flow is from south west to north east toward the Lake Simcoe shoreline. Maps from the ORMGP (2018) are included in Appendix C.

The Site is not considered a Significant Ground Water Recharge Area (SGRA) or a Highly Vulnerable Aquifer (HVA), and it is not located within a Wellhead Protection Area (WHPA) A, B, C, D, Q1, or Q2. A small portion of the eastern property boundary overlaps with the Intake Protection Zone 2 (IPZ-2) associated with the City of Barrie Water Treatment Plant (WTP) intake. The raw water intake is located approximately 10km south west of the mouth of Kempenfelt Bay, approximately 400 m from the south shore, in approximately 27 m of water. The IPZ-2 is delineated based on linear distance and travel time to the intake point.

3.0 MONITORING

3.1 Geotechnical Program

Peto MacCallum Ltd (PML) completed a geotechnical evaluation at the Site in September of 2017 which included advancing three (3) boreholes to depths of 5.0 to 6.4 mbgs. Each borehole was completed with a monitoring well (BH-1, BH-2, & BH-3). The geology of the site is given below (PML, 2017):

Topsoil: A 350 to 400 mm thick layer of topsoil was found at the surface of all boreholes

Sandy Silt: A 300 mm thick sandy silt layer was encountered and penetrated in Borehole 2 between 0.4 m and 0.7 m depth (223.2 – 222.9 masl). The unit was loose and was moist with moisture content of 8%.

Sand: A 2.2 and 0.4 m thick layer of sand was encountered in Boreholes 2 and 3 below the topsoil or sandy silt, extending to 2.9 m / 220.7 masl and 0.8 m / 224.3 masl respectively. The sand had variable silt and gravel content. Cobbles and boulders were noted in Borehole 3. The unit was dense to very dense in Borehole 2 and loose in Borehole 3. The sand was moist in Borehole 3 (moisture content of 4%) and wet in Borehole 2 (moisture content 8 to 17%).

Sand and Gravel: A sand and gravel deposit was encountered in Boreholes 1 and 2 below the topsoil and upper soil units extending to the depth of each borehole. The unit contained trace to some silt, and cobbles and boulders were noted. Borehole 1 met auger refusal at 5.0 mbgs and this is believed to be due to boulders. The material was dense to very dense, locally compact near the surface of Borehole 1. The deposit was moist to wet with depth and a moisture content between 2 to 15%.



Layered Clayey Silt/Silty Clay: A layered clayey silt/silty clay unit was encountered in Borehole 3, occurring from 0.8 m / 224.3 masl to 5.2 m / 218.9 masl. The unit was typically very stiff to hard with wet layers noted at depth.

Sandy Silt Till: A sandy silt till deposit was encountered in Borehole 3 below the clayey silt/silty clay unit at 5.2 m depth extending to the 6.4 m depth of the borehole. Cobbles and boulders were noted. The material was very dense and moist with a moisture content of 10%. The deposit also has wet sand layers.

The results of the geotechnical program (PML, 2017) are consistent with the surficial geology described in Section 2.5. The two boreholes located in the north east portion of the Site (BH-1 and BH-2) contain sand and gravel typical of a near shore environment (*i.e.*, Lake Simcoe to the north east). The borehole located in the south west of the Site (BH-3) contained a thin sand unit with trace gravel overlying clayey silt/silty clay overlying sandy silt till.

3.2 Azimuth (2018) Field Program

Azimuth conducted a scoped field program in July of 2018 to investigate the surficial soil conditions in the south east portion of the Site in the vicinity of the proposed residential homes. This program included using a hand auger to advance three holes (BH-4, BH-5, & BH-6) to depths between 1.0 and 2.8 mbgs. A standpipe was installed within each hole to enable ground water measurements.

The material encountered at BH-4 was composed of 0.35m of topsoil overlying brown clayey silt to 2.8mbgs. The material encountered at BH-5 and BH-6 was composed of 0.30 – 0.35m of topsoil overlying brown medium to fine grained sand. The test pit logs are included in Appendix D.

A cross-section is provided on Figure 3 which shows the subsurface material encountered at BH-1, BH-2, and BH-3. The south portion of the Site in the vicinity of BH-3 contained a thin sand layer overlying more fine-grained clayey silt/silty clay/sandy silt till. The overlying sand layer appears to become increasingly thin as you move north east toward Lake Simcoe. The material encountered within BH-4, BH-5, and BH-6 was variable, and did not show the same trend of increasing sand thickness from west to east toward lake. Excavation in the vicinity of Dock Road will therefore likely encounter surficial sand overlying clayey silt/silty clay however the thickness of the overlying sand unit will be variable.



3.3 Ground Water Elevations

Ground water measurements were collected within BH-1 – BH-3 in November of 2017 and April, May, and June of 2018, within BH-1 – BH-6 in July and August of 2018, and within BH-1, BH-2, & BH-4 – BH-6 in March and April of 2024. The complete database of manual measurements is included in Appendix E.

It is noted that ground water table will fluctuate seasonally, with the highest values typically recorded within the Spring (March to June). The reading taken on April 19th 2024, and corresponding water elevations, should be used for the Site's high ground water levels and used for reference in Site design. This ground water level data is provided on Figure 4.

The water level measured on April 19th 2024 ranged between 0.25 mbgs and -0.07 mbgs which represents 223.5 masl to 224.6 masl. The ground water flow direction was noted to be north east, toward the Lake Simcoe shoreline. Surface water ponding was noted at BH-2, BH-4, and BH-6.

3.4 Hydraulic Conductivity Testing

In order to understand the hydraulic characteristics of the underlying overburden, a transient slug test can be performed within monitoring wells to determine the average hydraulic conductivity of the screened interval. A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by adding or displacing a known volume to/from a well and measuring water level response time to return to equilibrium.

Hydraulic conductivity testing was completed at the Site by Azimuth staff within the on-Site monitoring wells in November of 2017. Water level measurements were recorded both manually and with automatic dataloggers, which were programmed to record the pressure of water above the data logger every second. Data was analyzed using the Hvorslev Method (1951), which assumes a homogeneous, isotropic medium in which soil and water are incompressible. Hydraulic testing results are summarized in Table 2, and within Appendix F.

Table 2: Hydraulic Testing Results

Monitoring Well	Hydraulic Conductivity (m/s)	Soil Description
BH-1	4.1×10^{-6}	Sand & Gravel
BH-2	9.1×10^{-4}	Sand & Gravel
BH-3	1.1×10^{-5}	Clayey Silt/Silty Clay/Sandy Silt Till



The results indicate that the hydraulic conductivity of the deposits range between 9.1×10^{-4} to 4.1×10^{-6} m/s. The sand and gravel within the screened interval of BH-1 and BH-2 display hydraulic conductivities that are consistent with published values. The measured hydraulic conductivity for BH-3 is slightly higher than typical published values for sandy silt till. This discrepancy may be due to the presence of trace gravel, trace cobbles, trace boulders, and wet sand layers in the till producing an increase in water movement. The borehole log for BH-3 also noted wet layers within the bottom of the clayey silt/silty clay, which is included within the screened interval.

3.5 Water Quality Sample

A water quality sample was collected from BH-2 on April 19th 2024 to determine the onsite ground water quality in preparation for dewatering activities. The results are included in Appendix G and have been compared to both the City of Barrie Appendix B Parameter List (“Appendix B List”) and the Provincial Water Quality Objectives (PWQO).

The sample was analyzed for both filtered and unfiltered TSS and metals, as per the requirements of the City of Barrie. However the standard operating procedure is to filter metal parameters in the field. The following exceedances were noted:

PWQO Exceedances: total phosphorus, copper (unfiltered), iron (unfiltered), tungsten (unfiltered), zirconium (unfiltered), arsenic (unfiltered), lead (unfiltered), nickel (unfiltered), thallium (unfiltered), cadmium (unfiltered), cobalt (unfiltered), vanadium (unfiltered), and zinc (unfiltered)

Appendix B List Exceedances: oil & grease – animal/vegetable, total kjeldahl nitrogen (TKN), total phosphorus, aluminum (unfiltered), chromium (unfiltered), copper (unfiltered), iron (unfiltered), lead (unfiltered), nickel (unfiltered), zinc (unfiltered), and TSS

The sample contained an oil & grease (animal & vegetable) concentration of 1.8 mg/L which is above the Appendix B threshold of 0. The Site contains a mature forest and wetland with organic material at surface. This detection is therefore considered a natural occurrence due to the accumulation and decomposition of plant material.

It should be noted that the sample had an unfiltered TSS concentration of 34,900 NTU, which is considered very high. The majority of the elevated parameters noted above are therefore the result of excess metals or nutrients that are attached to the sediment grains in suspension. This is evident when comparing the filtered and unfiltered results for the noted metal exceedances above. The filtered results of aluminum, chromium, copper,



iron, lead, tungsten, zirconium, arsenic, thallium, cadmium, cobalt, vanadium, nickel, and zinc all met their respective PWQO and Appendix B limits. As per standard operation procedures, the phosphorus and TKN analyses were completed only on water that was unfiltered, and therefore contained high concentration of sediment particles. The increased phosphorus and TKN are therefore likely attributed to the excess sediment.

On-site filtration or settling of dewatering effluent prior to any discharge is therefore recommended as part of any dewatering program. It is recommended that the discharge water be tested using a portable turbidimeter at the onset of dewatering to confirm adequate sediment filtration.

4.0 WELL SURVEY

The Site is located within a residential area of the City of Barrie, Ontario. Although the Site will be serviced with water and sewer utilities, there are some adjacent parcels which still obtain potable water from private wells and utilize private septic systems.

A Baseline Residential Water Well Survey was completed by Azimuth in November of 2017. This survey included all parcels within 300 m of the Site boundary and included homes along Dock Road, Tynhead Road, Tyndale Road, Jean Street, Tollendale Mill Road, Plunkett Court, and Gray Lane. The survey included a review of available Ontario Ministry of the Environment, Conservation, and Parks (MECP) well records (Section 2.6), a door-to-door survey requesting home owner participation, and a home owner questionnaire if response was received.

Based on an interpretation of aerial imagery, there are approximately 60 parcels that may contain private wells within 300 m of the Site boundary. The area has historically been privately serviced, but municipal services (water and septic) have recently become available for existing homes. Most of these wells were decommissioned after municipal services were provided to the area.

A letter inviting residents to participate in the water well survey program was hand delivered to these surrounding residences on November 10th 2016. Parcels that were undeveloped (no permanent structure) were not targeted during the door-to-door survey.

Seven residences responded to the residential well survey. One resident indicated they had connected to municipal water and their well had been decommissioned. Four residents contacted Azimuth to follow up regarding the letter notifications however did not wish to provide well details or participate in the survey. One of the respondents that did not provide details did indicate they had a good functioning well and septic system.



The remaining two responding residents indicated that they had drilled wells, estimated to be 100 ft and 160 ft deep. The owner of the 160 ft drilled well indicated that the well head was not accessible for a water level or additional monitoring. The owner of the 100 ft drilled well indicated that he tests it regularly with the Simcoe County Health Unit and he has not had any issues with bacteria.

A road side survey was completed by Azimuth staff in October of 2018. All parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.

5.0 WATER BALANCE

In order to determine the potential changes to the natural ground water recharge conditions, a pre- and post-development water balance assessment has been completed using the Thornthwaite and Mather method (1957). This method evaluates evapotranspiration based on precipitation and temperature. Residual soil saturation is a function of topography and soil type. Monthly data are tabulated from daily average temperature and precipitation, and the water budget is a continuous calculation over the period of record.

Values were determined on a monthly basis, compiled from daily Environment Canada meteorological data station located in Barrie, Ontario between 1970 and 2021 (Station ID 6110557). The calculations are based on the average conditions during this period; the average precipitation was 907 mm, rainfall was 654 mm, evapotranspiration was 479 mm and the surplus was 428 mm.

5.1 Land Use

5.1.1 Pre-Development

The pre-development Site area was classified according to land use/vegetation type. Land within the pre-development area is provided in Table 3.



Table 3: Pre Development Area Classification

Land Use	Land Area (m ²)
Forest	8,839
Wetland	3,727
TOTAL	12,566

Land within the pre-development scenario is considered 30% impervious. It should be noted that the limits of the existing wetland are subject to change depending on the upcoming in-season delineation with the City of Barrie and LSRCA.

5.1.2 Post-Development

The land classification in the post-development scenario was classified based on the Site Plan (Appendix H). Land within the post-development area is provided in Table 4.

Table 4: Post Development Area Classification

Land Use	Land Area (m ²)
Forest	4,174
Wetland	2,865
Landscaped	3,268
Driveway	749
Structures	1,510
TOTAL	12,566

Land within the post-development scenario is considered 41% impervious.

5.2 Infiltration

Infiltration is generated one of two ways: (1) directly from rainfall impact on pervious surfaces; and (2) indirectly when runoff from impervious surfaces is diverted into adjacent naturalized areas.

Infiltration factors for the Site were estimated based on the underlying soil, local topography, and ground cover as per Table 2 of the Ministry of Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (1995).

The soil variable factor was determined by taking into account information obtained from the regional geologic mapping and the geotechnical program completed for the Site. This information confirms that the surficial material is variable, however is composed primarily of sand and gravel to depth in the north and south east portion of the Site, and is composed of about 1.2 m of sand with trace silt overlying clayey silt in the south east



portion of the Site. Since the surficial material is primarily composed of sandy deposit, a sandy loam classification was used in the water balance assessment.

The infiltration factors utilized in the water balance assessment are summarized in Table 5 below.

Table 5: Summary of Pervious Land Infiltration Factor

Scenario	Land Use	Infiltration Factor	Assumption
Pre-Development	Forest	0.90	Flat land (0.3), sandy loam soil (0.4), woodland (0.2)
	Wetland	0.00	Saturated conditions do not enable infiltration
Post-Development	Forest	0.90	Flat land (0.3), sandy loam soil (0.4), woodland (0.2)
	Wetland	0.00	Saturated conditions do not enable infiltration
	Landscaped	0.80	Flat land (0.3), sandy loam soil (0.4), grass (0.1)

5.2.1 Pre-Development Infiltration

Pre-development direct infiltration was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The pre-development annual infiltration is therefore 3,405 m³/year (Appendix I).

5.2.2 Post-Development

Post-development infiltration (without mitigation) was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The post-development annual direct infiltration is therefore 2,727 m³/year. There is therefore a decrease in infiltration of 678 m³/year from pre- to post-development without mitigation measures employed.

The surplus infiltration from the rooftop downspouts is determined by multiplying the annual precipitation (904 mm), by 50% as per the CVC LID Manual for HSG A & B soils, and by 90% to account for a 10% evapotranspiration factor. It is then assumed that only 75% of the rooftop downspouts will be directed to pervious grass. This contributes an additional 462 m³/year.



5.3 Water Balance Summary

Using the climate model data and calculations mentioned above, the water balance was completed for pre-development, post-development, and post-development with mitigation (Appendix I).

The pre-development infiltration volume is 3,405 m³/year. This assumes the Site is composed of primarily agricultural land with a wetland. The post-development without mitigation infiltration volume is 2,727 m³/year, which is a deficit of 678 m³/year. This assumes the Site contains five single lot residential homes and associated driveways. An additional 462 m³ of infiltration can be obtained by discharging downspouts to pervious surfaces. The post-development with mitigation volume is therefore 3,189 m³/year, which represents a 6% decrease from the pre-development volume. This change in pre- to post-development infiltration is not anticipated to significantly impact the Site.

6.0 DEWATERING ASSESSMENT

The proposed development will include the construction of 5 single detached homes. Each home will be individually serviced with water and sanitary services. The service connections will be off of Dock Road to the south. Due to the high ground water table at the Site and proximity to Lake Simcoe, dewatering may be required to maintain dry conditions during construction.

6.1 Drawdown Conditions

The City of Barrie's Lot Grading and Drainage Infrastructure Design Standard (2023) stipulates that the underside of the floor slab should be set 0.5m higher than the seasonal high ground water level. Temporary dewatering would therefore not be anticipated during construction of the detached home foundation. The basement floor slab elevation for the homes will be determined during detailed design. Although the seasonally high ground water is noted to be within 0.5m of the ground surface across the Site, the minimum separation will be created through the importation of fill across the development area and the use of a raised bungalow design.

Each of the homes will require connection to water and sanitary services, which will overlap with the underlying ground water table. Information obtained from the Water and Sanitary Servicing Plan (Appendix H) indicates that a 74.6 m sanitary line will be installed along Dock Road. This line will connect to the existing municipal sanitary network at the corner of Plunkett Court and Dock Road. Potable water will be obtained from an existing watermain along Dock Road. Each home will then have individual water and sanitary connections off of Dock Road.



The minimum depth of servicing will be 221.63 masl, which represents the north connection of the existing sanitary manhole SAH09132 at the corner of Dock Road and Plunkett Court (Appendix H).

The high ground water level in the vicinity of Dock Road is 224.75 masl (Figure 4). Construction dewatering will target 0.5m below the trench base to maintain dry working conditions. The maximum ground water lowering will therefore be 3.6 m for the current dewatering assessment.

Given the required drawdown is greater than 1.5 m, the use of shallow well points or eductor systems will likely be required. The exact dewatering methodology will depend on site-specific conditions and construction methods such that it will be determined by the dewatering contractor. Water generated from construction dewatering could be discharged into the road side ditch along the north side of Dock Road. This water would flow east, ultimately discharging into Lake Simcoe.

The following assumptions have been made with respect to variables and approach for the dewatering calculations:

- Each townhouse unit is designed so that the underside of the basement slab is at least 0.5m above the ground water table. Based on this information, dewatering for structure construction is not anticipated;
- Trench dewatering will likely be required to enable construction of the sanitary line along Dock Road, and the individual water and sanitary connection for each home;
- Construction ground water lowering will target a depth of 0.5 m below the base of the servicing trench;
- The high ground water level used for the Dock Road sanitary line is 224.75 masl. The high ground water level used for each of the individual sanitary and water lines range between 224.0 masl and 224.75 masl (Figure 4);
- Each of the individual water and sanitary lines are assumed to be up to 20m long. Each trench is assumed to be 3m wide;
- The required drawdown for each 20 m segment of individual sanitary/water line ranges between 1.6m - 2.9m;
- Two dewatering assessments were completed: one using the worst-case hydraulic conductivity for the sand and gravel unit measured within BH-2 (9.1×10^{-4} m/s) and one for the clayey silt/silty clay unit measured within BH-1 (4.0×10^{-6} m/s);

The actual drawdown will depend on construction timing and the seasonal water table elevation.



6.2 Approximate Dewatering Volumes

For trench dewatering, calculations for the dewatering rate / volume were completed using the steady state method from Powers, *et al.* (2007) for estimating radial flow to an excavation in an unconfined aquifer.

The following equation was used:

$$Q = \{[(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)] + 2 * [a * K * (H^2 - h^2) / 2R_o]\}$$

(Ref: Powers *et al.* (2007))

The full dewatering assessment can be found in Appendix J, while the details are also summarized in Table 6 below.

Based on the information provided in Appendix J, when using the hydraulic conductivity measured within the sand and gravel at BH-2 the anticipated total dewatering for the Dock Road sanitary line and five 20m individual connections is 4,797,100 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 7,195,800 L/day to account for any onsite variability.

Based on the information provided in Appendix J, when using the hydraulic conductivity measured within the clayey silt/silty clay/sandy silt till at BH-3 the anticipated total dewatering for the Dock Road sanitary line and five 20m individual connections is 49,800 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 74,700 L/day to account for any onsite variability.

Two estimates have been provided to cover the range of conditions that may be encountered during the specified construction. Based on the subsurface field programs completed, excavations in the vicinity of Dock Road will likely encounter surficial sand overlying clayey silt/silty clay. However, the thickness of the overlying sand unit will be variable. The actual dewatering rate will therefore likely fall somewhere in between the two estimates provided in Table 6. Additional work such as a test pit program could be completed after vegetation removal once the depth of infrastructure is confirmed. This program would add additional clarity to the understanding of the subsurface conditions and refine the expected dewatering estimate.

Any construction dewatering between 50,000 L/day and 400,000 L/day can be completed after registration under the Environmental Activity and Sector Registry (EASR). Any



active construction dewatering above 400,000 L/day requires a Permit To Take Water (PTTW).

Based on the current understanding of the Site and calculated values, without additional subsurface details, a PTTW should be obtained to ensure construction water can be properly managed under the full range of potential conditions. The magnitude of dewatering required will vary on the timing of construction as less dewatering would be needed in the summer drought conditions when the water table is highly variable. Peak ground water elevation typically occurs between mid April and the end of May. The daily dewatering rate may be reduced by limiting the length of excavation open at one time, however this may not be feasible for the proposed development.

Table 6: Summary of Dewatering Conditions

Variable	75m Dock Road Sanitary		Five 20m Service Connections	
	Low K	High K	Low K	High K
Effective Radius [r_e] (m)	25	25	7	7
Hydraulic Conductivity [K] (m/s)	4.0×10^{-6}	9.1×10^{-4}	4.0×10^{-6}	9.1×10^{-4}
Required Drawdown [$H-h$] (m)	3.6	3.6	1.6 – 2.9	1.6 – 2.9
Saturated Thickness Before Pumping [H] (m)	4.1	4.1	2.1 – 3.4	2.1 – 3.4
Depth of Water During Pumping [h] (m)	0.5	0.5	0.5	0.5
Length of excavation [a] (m)	75	75	20	20
Width of excavation [b] (m)	3	3	3	3
Radius of Influence [R] (m) ¹	47	352	17 - 25	151 - 267
Total Discharge [Q] (L/day)	37,600	1,809,000	49,800	2,988,100
Total Discharge [Q] (L/day) 1.5 X Safety Factor Applied	<u>56,400</u>	<u>2,713,500</u>	<u>74,700</u>	<u>4,482,300</u>

6.3 Well Impact Assessment

Based on the information provided in Table 6, the predicted zone of influence for the Dock Road sanitary line may range between 47m and 352m while the predicted zone of influence for the individual service connections range between 17m and 267m.

The zone of influence describes the distance between the point of greatest drawdown (dewatering trench) and the point where there is no drawdown. The drawdown within the outer reaches of the zone of influence is therefore much smaller than the maximum drawdown.

As noted in Section 4.0, a well survey and road side survey was completed by Azimuth. As part of the road side survey, all parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most



homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible in 2018. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.

Additional private supply wells are located within the maximum zone of influence noted in Table 6. The potential for impact will depend on the subsurface conditions encountered during construction, the depth of the individual wells, and the depth of available water within the water column. Any well impact that does occur would be temporary in nature during the construction phase of development. To reduce the potential for impact, construction should be completed in stages and during dry summer months when the water level is not at its highest to reduce the required drawdown.

7.0 SUMMARY AND CONCLUSIONS

Azimuth Environmental Consulting, Inc. has been retained by 1000067364 Ontario Inc. to conduct a Hydrogeological Assessment Update for the proposed residential development located at 211 Dock Road within the City of Barrie, Ontario. The Site is approximately 1.25 ha in size and is located on the north side of Dock Road, west of Tynhead Road, south east of Tyndale Park. The Site is currently composed of undeveloped forest, with one residential home currently under construction. There is a wetland feature located in the south east portion of the Site.

The proposed development of the Site includes five single lot residential homes off of Dock Road. The north portion of the Site will be dedicated to the City of Barrie. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

The Site is found at an elevation between 224 – 228 masl and slopes to the north east toward Lake Simcoe. There is a wetland in the south east portion of the Site. There is a seasonal drainage feature which overlaps the northern tip of the Site in a west to east direction, discharging into a road side ditch along the western side of Tynhead Road. This ditch flows into a culvert crossing beneath Tynhead Road that flows through the Tynhead development and outlets directly into Lake Simcoe.

A cross-section is provided on Figure 3 which shows the subsurface material encountered at BH-1, BH-2, and BH-3. The south portion of the Site in the vicinity of BH-3 contained a thin sand layer overlying more fine-grained clayey silt/silty clay/sandy silt



till. The overlying sand layer appears to become increasingly thin as you move north east toward Lake Simcoe. The material encountered within BH-4, BH-5, and BH-6 was variable, and did not show the same trend of increasing sand thickness from west to east toward lake. Excavation in the vicinity of Dock Road will therefore likely encounter surficial sand overlying clayey silt/silty clay however the thickness of the overlying sand unit will be variable.

The reading taken on April 19th 2024, and corresponding water elevations, should be used for the Site's high ground water levels and used for reference in Site design. The water level measured on April 19th 2024 ranged between 0.25 mbgs and -0.07 mbgs which represents 223.5 masl to 224.6 masl. The ground water flow direction was noted to be north east, toward the Lake Simcoe shoreline.

A water quality sample was collected from BH-2 on April 19th 2024. The results indicate minor exceedances of both the PWQO and City of Barrie Appendix B parameter list. However, the use of on-site filtration or settling of dewatering effluent prior to discharge is recommended and would likely reduce many of the identified parameters. The detection of oil & grease (animal & vegetable) is considered a natural occurrence due to the accumulation and decomposition of plant material within the mature forest and wetland conditions.

A well survey was conducted for all parcels within 300 m of the Site boundary in November 2017 and included homes along Dock Road, Tynhead Road, Tyndale Road, Jean Street, Tollendale Mill Road, Plunkett Court, and Gray Lane. Seven residences responded to the residential well survey. One resident indicated they had connected to municipal water and their well had been decommissioned. Four residences contacted Azimuth to follow up regarding the letter notifications however did not wish to provide well details or participate in the survey. One of the respondents that did not provide details did indicate they had a good functioning well and septic system. The remaining two responding residents indicated that they had drilled wells, estimated to be 100 ft and 160 ft deep. A road side survey was completed by Azimuth staff in October of 2018. All parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.



A pre- and post-development water balance assessment was completed to assess any impacts to the infiltration rate at the Site. The pre-development infiltration volume is 3,405 m³/year. This assumes the Site is composed of primarily agricultural land with a wetland. The post-development without mitigation infiltration volume is 2,727 m³/year, which is a deficit of 678 m³/year. This assumes the Site contains five single lot residential homes and associated driveways. An additional 462 m³ of infiltration can be obtained by discharging downspouts to pervious surfaces. The post-development with mitigation volume is therefore 3,189 m³/year, which represents a 6% decrease from the pre-development volume. This change in pre- to post-development infiltration is not anticipated to significantly impact the Site.

The proposed development will include the construction of 5 single detached homes. Each home will be individually serviced with municipal water and sanitary services. The service connections will be off of Dock Road to the south. Due to the high ground water table at the Site and proximity to Lake Simcoe, dewatering may be required to maintain dry conditions during construction.

Two dewatering assessments were completed: one using the worst-case hydraulic conductivity for the sand and gravel unit measured within BH-2 (9.1×10^{-4} m/s) and one for the clayey silt/silty clay unit measured within BH-1 (4.0×10^{-6} m/s). When using the high hydraulic conductivity value, the total dewatering is calculated at 4,797,100 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 7,195,800 L/day to account for any onsite variability. When using the low hydraulic conductivity value, the total dewatering is calculated at 49,800 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 74,700 L/day to account for any onsite variability.

Based on the subsurface field programs completed, excavations in the vicinity of Dock Road will likely encounter surficial sand overlying clayey silt/silty clay. However, the thickness of the overlying sand unit will be variable. The actual dewatering rate will therefore likely fall somewhere in between the two estimates provided in Table 6.

Based on the current understanding of the Site and calculated values, without additional subsurface details, a PTTW should be obtained to ensure construction water can be properly managed under the full range of potential conditions. The magnitude of dewatering required will vary on the timing of construction as less dewatering would be needed in the summer drought conditions when the water table is highly variable. The daily dewatering rate may be reduced by limiting the length of excavation open at one time, however this may not be feasible for the proposed development.



Private supply wells are located within the maximum zone of influence noted in Table 6. The potential for impact will depend on the subsurface conditions encountered during construction, the depth of the individual wells, and the depth of available water within the water column. Any well impact that does occur would be temporary in nature during the construction phase of development. To reduce the potential for impact, construction should be completed in stages and during dry summer months when the water level is not at its highest to reduce the drawdown required.

8.0 REFERENCES

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<https://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth>
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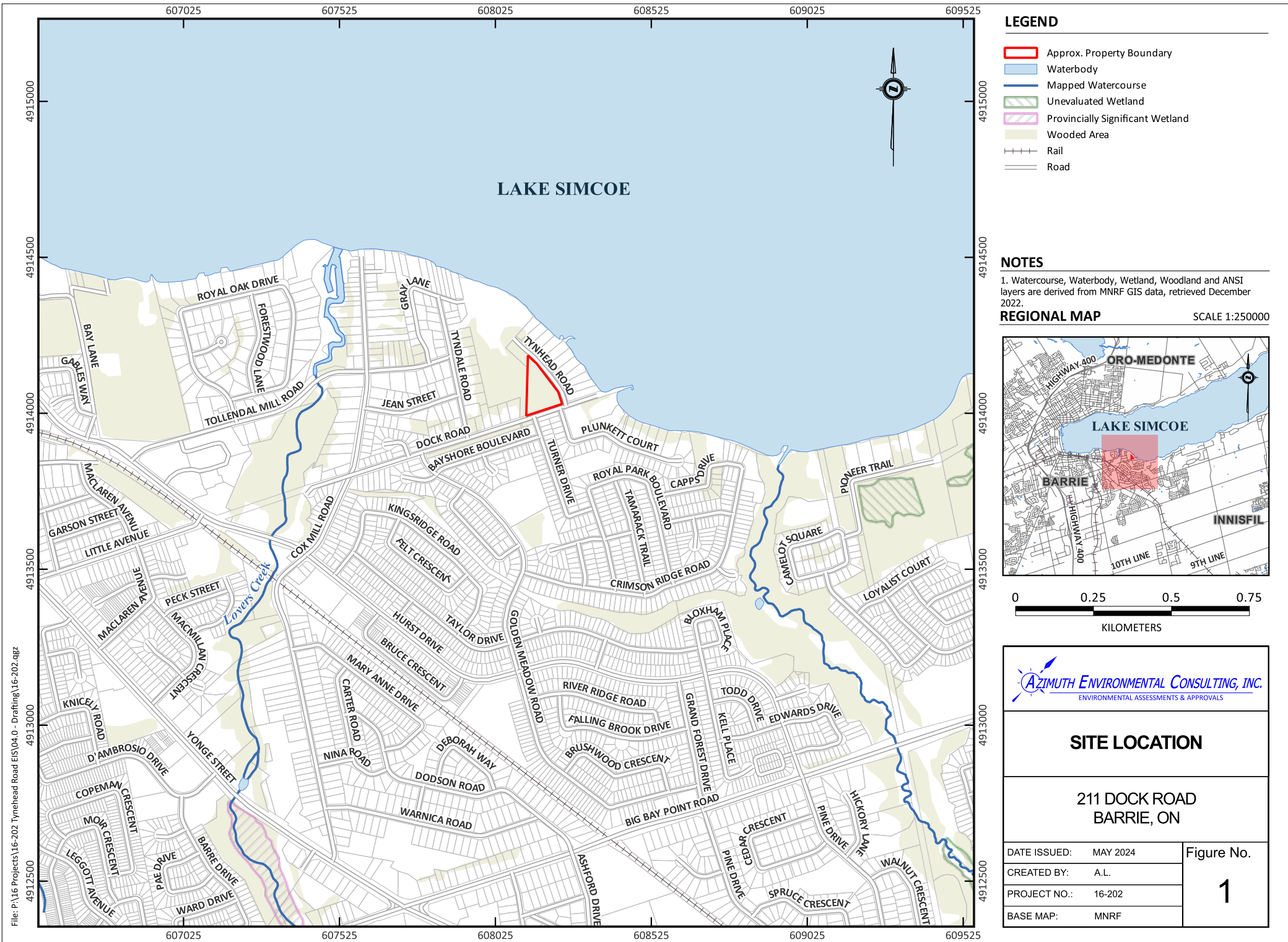
APPENDICES

- Appendix A: Figures**
 - Appendix B: MECP Well Records**
 - Appendix C: ORMGP Mapping**
 - Appendix D: Azimuth (2018) Field Program**
 - Appendix E: Ground Water Data**
 - Appendix F: Hydraulic Conductivity Results**
 - Appendix G: Water Quality Results**
 - Appendix H: Development Drawings**
 - Appendix I: Water Balance**
 - Appendix J: Dewatering Assessment**
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APPENDIX A

Figures



Plotted by: ALU on May 10, 2024 at 3:52pm
File: \\azimuth\shared\Projects\16-202 Simcoe\16-202 Site Layout 2.dwg Layout: SITE LAYOUT PlotScale: 1



LEGEND:

- APPROX. PROPERTY BOUNDARY
- 0.5m CONTOURS (OMAFRA LAKE SIMCOE DTM, 2022)
- WETLAND
- MONITORING WELL

LOCATION PLAN

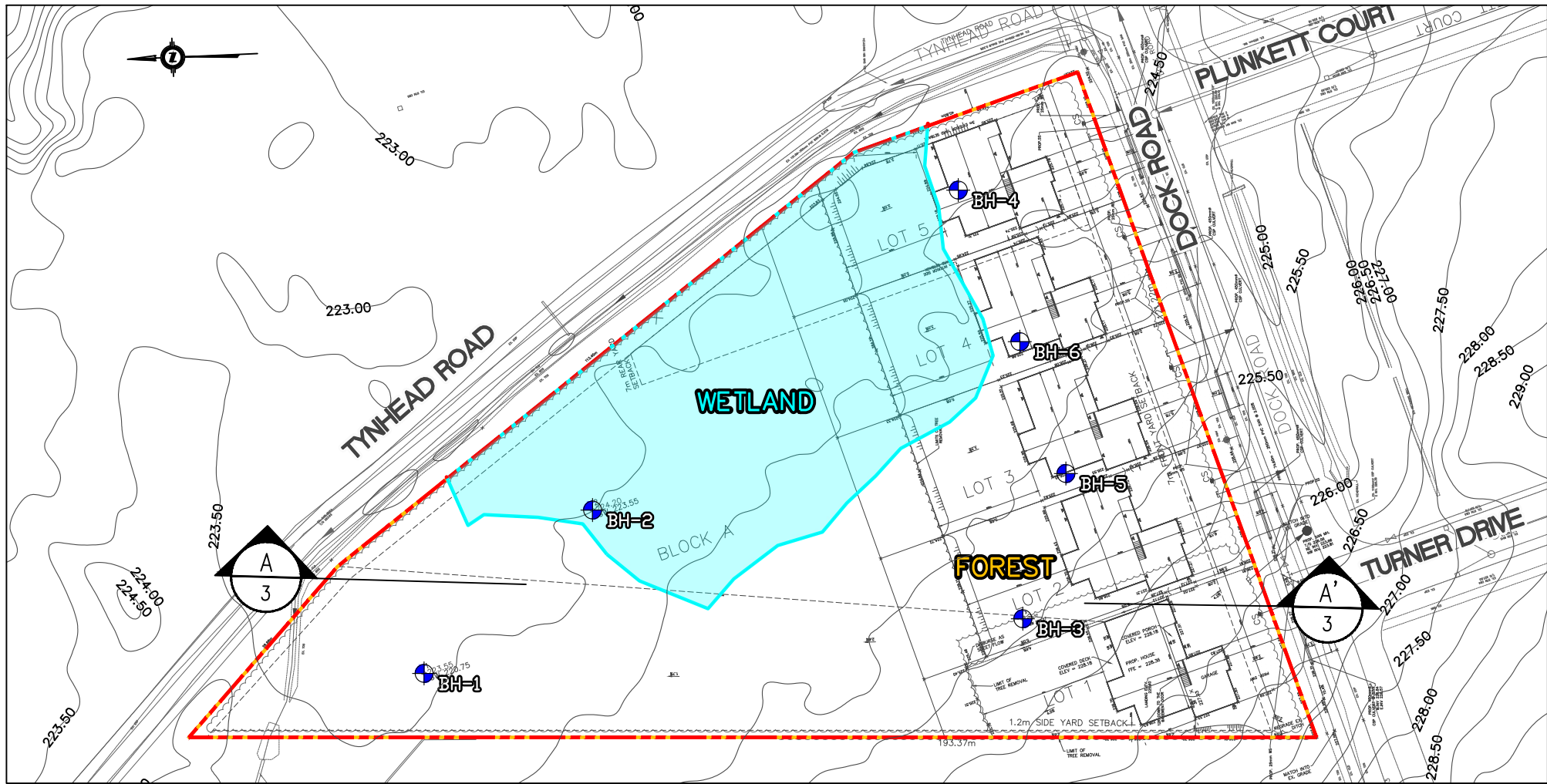
The location plan shows a map of Lake Simcoe with a red triangle indicating the site's location. Surrounding roads are labeled: GRAY LANE, TYNDAL ROAD, TYNHEAD ROAD, DOCK ROAD, TURNER DRIVE, and PLUNKETT COURT. A north arrow is in the top right corner. Below the map is a scale bar with markings for 0, 25.00, and 50.0, and the text 'HORIZONTAL SCALE 1:1000'.

 **AZIMUTH ENVIRONMENTAL CONSULTING, INC.**
ENVIRONMENTAL ASSESSMENTS & APPROVALS

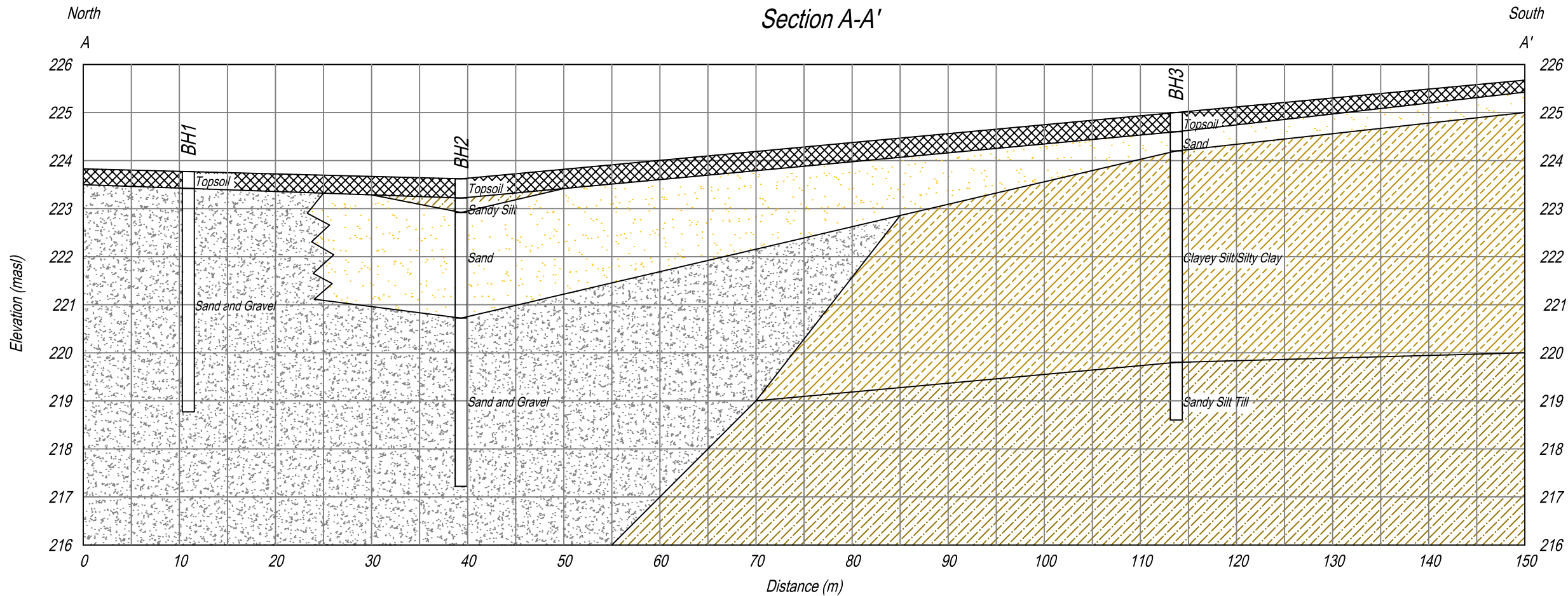
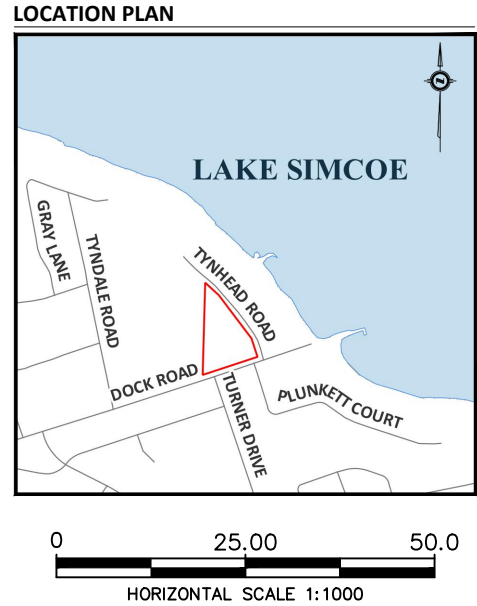
SITE LAYOUT

211 DOCK ROAD
BARRIE, ON

DATE ISSUED:	MAY 2024	Figure No. 2
CREATED BY:	A.L.	
PROJECT NO.:	16-202	
REFERENCE:	SIMCOE COUNTY	



- LEGEND:**
- APPROX. PROPERTY BOUNDARY
 - 0.5m CONTOURS (OMAFRA LAKE SIMCOE DTM, 2022)
 - WETLAND
 - MONITORING WELL



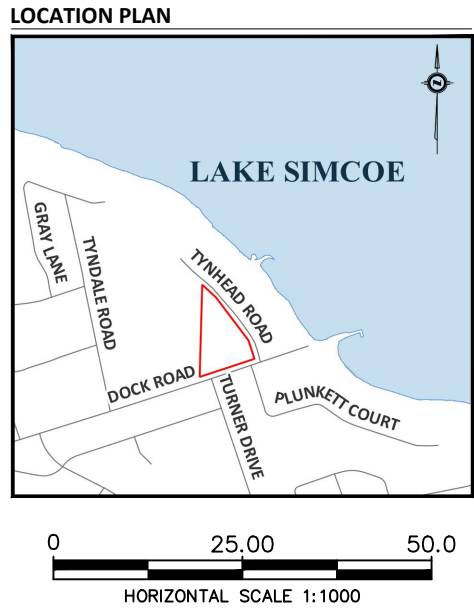
CROSS SECTION A-A'

211 DOCK ROAD
BARRIE, ON

DATE ISSUED:	MAY 2024	Figure No. 3
CREATED BY:	A.L.	
PROJECT NO.:	16-202	
REFERENCE:	SIMCOE COUNTY	

LAKE
SIMCOE

- LEGEND:
- APPROX. PROPERTY BOUNDARY
 - 100.00 0.25m GROUND WATER CONTOURS
 - INFERRED DIRECTION OF GROUND WATER FLOW
 - MONITORING WELL AND GROUND WATER LEVEL



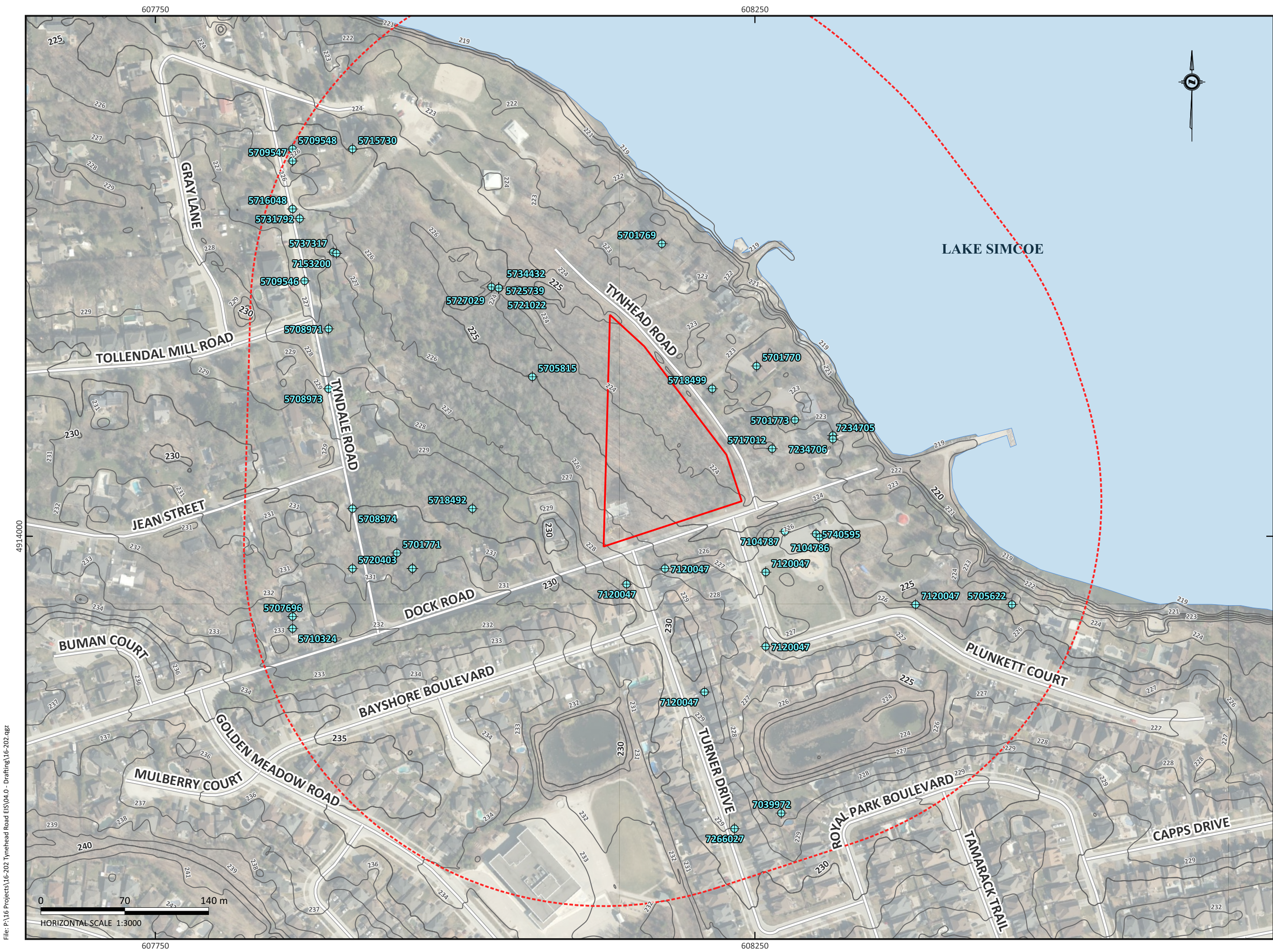
AZIMUTH ENVIRONMENTAL CONSULTING, INC.
ENVIRONMENTAL ASSESSMENTS & APPROVALS

GROUND WATER FLOW

211 DOCK ROAD
BARRIE, ON

DATE ISSUED:	MAY 2024	Figure No.
CREATED BY:	A.L.	4
PROJECT NO.:	16-202	
REFERENCE:	SIMCOE COUNTY	

Printed by: ALU on May 3, 2024 at 3:43pm
File: E:\16-202-202-Tynhead Road\16-202-Tynhead Road.dwg - dwt:16-202-Tynhead Road.dwg - dwt:16-202-Tynhead Road.dwg - dwt:16-202-Tynhead Road.dwg



LEGEND

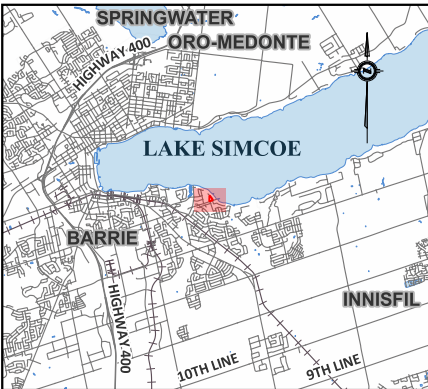
- Approx. Property Boundary
- 300m Buffer
- Waterbody
- Road

1m Contours (OMAFRA Lake Simcoe DTM 2022)

- Major Contour - 5m Intervals
- Minor Contour - 1m Intervals
- MECP Water Well Location

LOCATION MAP

SCALE 1:250000



PRIVATE WELL USERS

211 DOCK ROAD
BARRIE, ON

DATE ISSUED: MAY 2024
CREATED BY: A.L.
PROJECT NO.: 16-202
BASE MAP: SIMCOE COUNTY

Figure No.

5



APPENDIX B

MECP Well Records



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5705815

External identity : ca.on.waterWell.5705815

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 7.32m

Elevation : 224.03m

Water level : 3.66m

Water yield : 9.09lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
4.57	7.32	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5718499

External identity : ca.on.waterWell.5718499

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 18.90m

Elevation : 220.98m

Water level : 1.83m

Water yield : 36.37lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 17.0688 to 19.20m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	3.35	Clay	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
3.35	14.02	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
14.02	15.85	Clay	CLAY SAND SILTY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
15.85	18.90	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5717012

External identity : ca.on.waterWell.5717012

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 79.55m

Elevation : 220.98m

Water level : 3.05m

Water use : Not Used

Well status : Observation Wells

Well type : Unknown

Screen components : From 60.96 to 62.79m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.96	Gravel Sand Gravel	GRAVEL SAND BOULDERS	[24,44]% [26,53]% [24,44]%	[3E-4,3E-2]m.s-1 [2E-7,6E-3]m.s-1 [3E-4,3E-2]m.s-1
3.96	15.85	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
15.85	17.68	Clay Unknown material	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
17.68	18.90	Clay Sand Unknown material	CLAY SANDY LAYERED	[34,57]%, [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
18.90	20.42	Clay Unknown material	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
20.42	38.71	Clay Unknown material	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
38.71	51.82	Clay Unknown material	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
51.82	64.62	Sand Clay Unknown material	FINE SAND CLAY LAYERED	[26,53]%, [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1
64.62	69.19	Clay Unknown material	CLAY HARD PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7104787

External identity : ca.on.waterWell.7104787

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 19.51m

Elevation : NaNm

Water level : 1.14m

Water use : Test Hole

Well status : Test Hole

Well type : Unknown

Well casings : From 0.00 to 19.51m.

Sealing components : From 0.00 to 18.29m.

Screen components : From 19.5072 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	0.91	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
0.91	2.44	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.44	9.75	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
9.75	10.06	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1
10.06	23.77	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
23.77	25.30	Silt	SILT CLAY	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5727029

External identity : ca.on.waterWell.5727029

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 27.43m

Elevation : NaNm

Water level : 1.22m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 4.57 to 6.10m.

Screen components : From 26.2128 to 27.43m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	12.19	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
12.19	18.29	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
18.29	25.30	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
25.30	27.43	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5721022

External identity : ca.on.waterWell.5721022

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 35.05m

Elevation : NaNm

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 34.1376 to 35.05m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Gravel Sand Unconsolidated material	GRAVEL SAND MUCK	[24,44]% [26,53]%	[3E-4,3E-2]m.s-1 [2E-7,6E-3]m.s-1
1.52	27.43	Silt Clay Sand	SILT CLAY SAND	[34,61]% [34,57]% [26,53]%	[1E-9,2E-5]m.s-1 [1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
27.43	33.53	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1
33.53	35.05	Sand Silt	SAND SILT	[26,53]% [34,61]%	[2E-7,6E-3]m.s-1 [1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5725739

External identity : ca.on.waterWell.5725739

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 10.36m

Elevation : NaNm

Water level : 0.61m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 8.5344 to 10.36m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	8.53	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
8.53	10.36	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5734432

External identity : ca.on.waterWell.5734432

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 11.58m

Elevation : NaNm

Water level : 7.32m

Water yield : 150.02lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 2.44m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	6.10	Clay	CLAY SANDY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
6.10	7.01	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
7.01	11.58	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5730409

External identity : ca.on.waterWell.5730409

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 31.09m

Elevation : NaNm

Water level : 1.83m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 1.83m; From 1.83 to 3.05m.

Screen components : From 30.1752 to 31.09m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
1.83	29.57	Silt	SILT CLAY SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
29.57	31.09	Sand	COARSE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701773

External identity : ca.on.waterWell.5701773

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 9.75m

Elevation : 220.07m

Water level : 0.00m

Water yield : 9.09lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.05	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.05	6.71	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
6.71	9.75	Sand	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701770

External identity : ca.on.waterWell.5701770

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 44.50m

Elevation : 220.68m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.49	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
5.49	8.23	Limestone	LIMESTONE	[7,56]%	[1E-9,6E-6]m.s-1
8.23	19.81	Clay	CLAY QUICKSAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
19.81	25.91	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
25.91	30.78	Unconsolidated material	MUCK CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Clay			
30.78	44.50	Sand	QUICKSAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701769

External identity : ca.on.waterWell.5701769

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 43.28m

Elevation : 220.98m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	Soil	TOPSOIL		
1.22	10.97	Anthropogenic material	FILL		
10.97	14.02	Unconsolidated material Gravel	MUCK GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
14.02	23.47	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
23.47	26.21	Diamicton	HARDPAN		
26.21	28.65	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
28.65	32.92	Unconsolidated material Clay	MUCK CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
32.92	34.75	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
34.75	39.01	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
39.01	43.28	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7104786

External identity : ca.on.waterWell.7104786

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 22.56m

Elevation : NaNm

Water use : Not Used

Well type : Unknown

Well casings : From 0.00 to 19.51m.

Sealing components : From 19.51 to 22.56m; From 0.00 to 19.51m.

Screen components : From 19.5072 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Soil	TOPSOIL		
0.61	1.52	Clay	CLAY SILTY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
1.52	2.44	Sand	SAND SILTY	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
2.44	3.96	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.96	10.67	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
10.67	11.58	Sand	FINE SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
11.58	22.56	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7120047

External identity : ca.on.waterWell.7120047

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 7.60m

Elevation : NaNm

Water level : 5.00m

Water use : Test Hole

Well status : Test Hole

Well type : Unknown

Well casings : From 0.00 to 4.60m.

Sealing components : From 0.00 to 0.00m.

Screen components : From 4.6 to 7.60m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.50	Silt	SILT CLAY SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
1.50	7.60	Silt	SILT CLAY SILT	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5718492

External identity : ca.on.waterWell.5718492

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 26.21m

Elevation : 220.98m

Water level : 6.10m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 24.384 to 26.21m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material	FILL		
0.61	4.27	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.27	23.16	Clay	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
23.16	23.77	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
23.77	26.21	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720118

External identity : ca.on.waterWell.5720118

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 12.80m

Elevation : 228.60m

Water level : 4.27m

Water yield : 18.18lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.35	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.35	10.36	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
10.36	12.80	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720227

External identity : ca.on.waterWell.5720227

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 25.60m

Elevation : 228.60m

Water level : 6.71m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 24.6888 to 25.60m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Clay	CLAY BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	SAND	[24,44]%	[3E-4,3E-2]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
1.52	24.69	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
24.69	25.60	Sand	SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701771

External identity : ca.on.waterWell.5701771

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 63.40m

Elevation : 230.12m

Water level : 0.61m

Water yield : 31.82lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 62.1792 to 63.09m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Anthropogenic material	FILL		
0.30	10.67	Sand	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	GRAVEL CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
10.67	56.69	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
56.69	61.57	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
61.57	62.18	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
62.18	63.40	Sand	COARSE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708974

External identity : ca.on.waterWell.5708974

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 228.60m

Water level : 4.57m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
0.30	0.61	Soil	TOPSOIL		
0.61	2.44	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.44	14.94	Sand	SAND BOULDERS	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
14.94	17.68	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
17.68	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720403

External identity : ca.on.waterWell.5720403

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 22.56m

Elevation : 228.60m

Water level : 6.10m

Water yield : 36.37lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 21.6408 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.01	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	WOOD	[24,44]%	[3E-4,3E-2]m.s-1
		Organic material	FRAGMENTS		
7.01	20.73	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
20.73	22.56	Sand	SAND CLEAN	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708973

External identity : ca.on.waterWell.5708973

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 228.60m

Water level : 4.57m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material	FILL		
0.61	0.91	Soil	TOPSOIL		
0.91	9.14	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	BOULDERS	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
9.14	14.33	Gravel	GRAVEL CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
14.33	14.94	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
14.94	17.98	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
17.98	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708971

External identity : ca.on.waterWell.5708971

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 227.08m

Water level : 3.66m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
0.30	0.61	Soil	TOPSOIL		
0.61	2.44	Sand	SAND BOULDERS	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
2.44	4.88	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
4.88	18.29	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
18.29	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5707696

External identity : ca.on.waterWell.5707696

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 19.81m

Elevation : 231.65m

Water level : 0.91m

Water yield : 4.55lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material Gravel	FILL GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
0.61	15.24	Clay Gravel Gravel	CLAY GRAVEL BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1
15.24	19.81	Sand Gravel	MEDIUM SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5710324

External identity : ca.on.waterWell.5710324

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 35.66m

Elevation : 231.65m

Water level : 4.57m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 35.052 to 35.97m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
1.52	1.83	Unconsolidated material	MUCK		
1.83	4.88	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.88	35.05	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
35.05	35.66	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5715730

External identity : ca.on.waterWell.5715730

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 103.33m

Elevation : 220.98m

Water use : Not Used

Well status : Test Hole

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.13	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	BOULDERS	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
2.13	17.68	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	HARD	[24,44]%	[3E-4,3E-2]m.s-1
		Unknown material			
17.68	24.38	Clay	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
24.38	28.35	Silt	SILT CLAY PACKED	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
28.35	38.71	Clay	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
38.71	47.55	Silt	SILT SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Sand	PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
47.55	51.82	Clay	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
51.82	63.09	Sand	SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt	GRAVEL	[34,61]%	[1E-9,2E-5]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
63.09	99.97	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5716048

External identity : ca.on.waterWell.5716048

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 34.14m

Elevation : 222.50m

Water level : 1.22m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	Clay Sand	CLAY SAND	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
1.22	17.07	Clay Unknown material	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
17.07	30.18	Clay Gravel Unknown material	CLAY GRAVEL LAYERED	[34,57]% [24,44]%	[1E-11,4.7E-9]m.s-1 [3E-4,3E-2]m.s-1
30.18	32.92	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
32.92	34.14	Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5709546

External identity : ca.on.waterWell.5709546

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 15.85m

Elevation : 227.08m

Water level : 0.61m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Sand Anthropogenic material	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
0.61	1.22	Soil	TOPSOIL		
1.22	3.35	Sand Clay	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
				[34,57]%	[1E-11,4.7E-9]m.s-1
3.35	6.40	Clay Sand	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
				[26,53]%	[2E-7,6E-3]m.s-1
6.40	15.85	Sand Clay	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
				[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5731792

External identity : ca.on.waterWell.5731792

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 42.67m

Elevation : NaNm

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 41.76m.

Screen components : From 41.7576 to 42.67m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	31.39	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	STONES	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
31.39	32.61	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		
32.61	39.62	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
39.62	42.67	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



APPENDIX C

ORMGP Mapping

Depth To Water Table (mbgs) - 211 Dock Road



Legend

-  CAMC Boundary
 Oak Ridges Moraine Boundary
 Well
 VFlow YC Area - 100m - Strahler
 Depth to Water Table (m)
 High : 512.956
 Low : 1.1e-005

114.7	0	57.33	114.7	Metres
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1: 2,257



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Map Compiled by the Conservation Authorities Moraine Coalition
101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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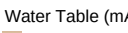
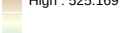
SOURCE: CAMC, 2018; MNR, 2018;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary Sphere

DATE PRINTED: February 7, 2018

Water Table Elevation (masl) - 211 Dock Road

Legend

-  CAMC Boundary
-  Oak Ridges Moraine Boundary
-  Well
-  VFlow YC Area - 100m - Strahler (
-  Water Table (mASL)
High : 525.169
-  Low : 3.71631



114.7 0 57.33 114.7 Metres

1: 2,257



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**AZIMUTH ENVIRONMENTAL
CONSULTING, INC.**
Environmental Assessments & Approvals

SOURCE: CAMC, 2018; MNR, 2018;
PROJECTION: WGS_1984_Web_Mercator_Au
xiliav Sphere
DATE PRINTED: February 7, 2018



APPENDIX D

Azimuth (2018) Field Program



TEST PIT / BOREHOLE LOGS

TEST PIT LOGS

Date: July 9, 2018

Weather: Sunny, 28°C.

Location: 211 Dock Road, City of Barrie

Attendance: Colin Ross - Azimuth Environmental Consulting, Inc.

Method of Examination: Hand augured test holes examining soil brought up at each location.

LEGEND:

SOIL TEXTURE

Boulders		>200 mm
Cobbles		60 – 200 mm
Gravel	Coarse	20 – 60 mm
	Medium	6 – 20 mm
	Fine	2 – 6 mm
Sand	Coarse	0.6 – 2 mm
	Medium	0.2 – 0.6 mm
	Fine	0.06 – 0.02 mm
Silt		0.02 – 0.006 mm
Clay		<0.002 mm

Fine sand: smallest particle visible to the naked eye
Silt: particles not visible to the eye / slightly plastic
Clay sticks to skin / plastic

SOIL COMPOSITION

“trace”	<10%
“some”	10 – 20%
adjective (e.g. sandy)	20 – 35%
“and”	35 – 50%
noun (e.g. sand)	>50%



MOISTURE CONDITION – COHESIONLESS SOILS

“dry”	absence of moisture, dusty
“moist”	damp but no visible water
“wet”	damp and contains noticeable water
“saturated”	soil is completely wetted to excess and may be dripping

COMPACTNESS CONDITION – COARSE SOILS

	‘N’ Value	
“very loose”	<4	can be excavated by hand
“loose”	4 - 10	can be excavated with a spade
“compact”	10 - 30	requires a sharp spade
“dense”	30 - 50	requires a pick for excavation
“very dense”	>50	difficult to excavate with pick

CONSISTANCY CONDITION – COHESIVE SOILS

	‘N’ value	
“very soft”	< 2	Exudes between fingers when squeezed
“soft”	2-4	Moulded by light finger pressure
“firm”	4-8	Moulded by strong finger pressure
“stiff”	8-15	Can be indented by thumb
“hard”	>30	



Test Hole #4 (BH-4)

Easting: 608227 m (NAD 83 Zone 17)

Northing: 4914038 m

Test Hole Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.35 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.35 – 2.8 m Clayey Silt

Brown clayey silt, dry, stiff, becoming hard with depth, poorly sorted.

Becomes gray at ~1.0 m and increasingly hard with depth.

Excavation halted at 2.8 m due to depth limits of hand auger.

Monitoring Well Details

2 inch diameter PVC well construction with 1.5 m screen

Total Depth: 2.8 mbgs

Stickup: 0.84 m

Water Level: 0.79 mbgs

Test Hole #5 (BH-5)

Easting: 608182 m (NAD 83 Zone 17)

Northing: 4914019 m

Test Pit Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.35 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.35 – 1.20 m Sand

Brown, medium to fine grained sand, trace silt, some stones at depth, loose, poorly sorted.

Excavation halted at 1.2 m due to borehole cave, could not extend any deeper.



Monitoring Well Details

2 inch diameter PVC well construction with 0.65 m screen

Total Depth: 1.2 mbgs

Stickup: 0.96 m

Water Level: 0.88 mbgs

Test Hole #6 (BH-6)

Easting: 608206 m (NAD 83 Zone 17)

Northing: 4914030 m

Test Pit Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.30 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.30 – 1.00 m Sand

Brown, medium to fine grained sand, trace silt, some stones at depth, loose, poorly sorted.

Excavation halted at 1.0 m due to borehole cave, could not extend any deeper.

Monitoring Well Details

2 inch diameter PVC well construction with 0.8 m screen

Total Depth: 1.0 mbgs

Stickup: 0.84 m

Water Level: 0.42 mbgs



APPENDIX E

Ground Water Data

16-202 211 Dock Road Water Level Database

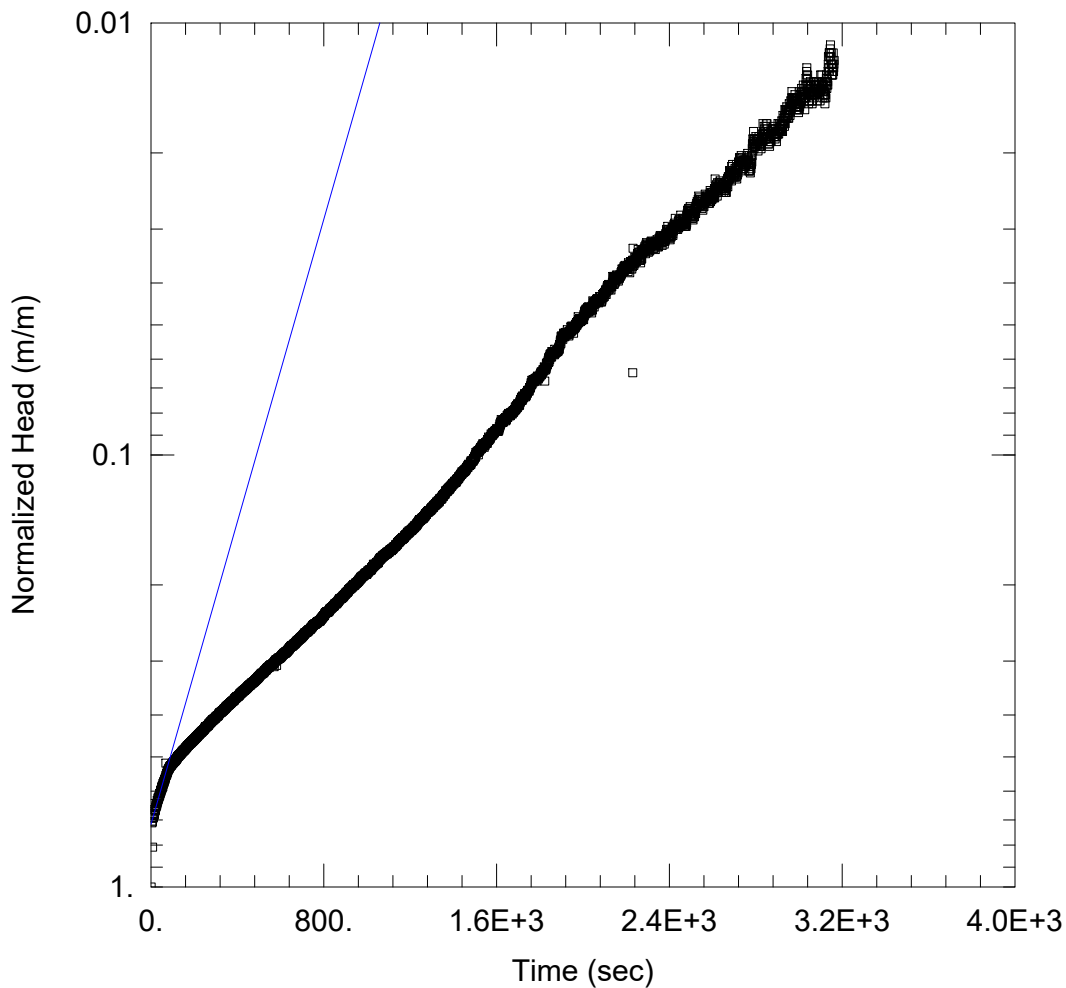
Well ID	Depth (mbgs)	Stick Up (m)	Ground Elevation ¹	Ground Water Level																			
				2017-10-11		2017-11-28		2018-04-23		2018-05-16		2018-06-12		2018-07-03		2018-07-10		2018-08-20		2024-03-08		2024-04-19	
				mbgs	masl	mbgs	masl	mbgs	mbgs	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH 1	5.0	0.77	223.77	2.80	221.00	2.40	221.40	0.28	223.50	1.23	222.54	1.56	222.20	2.15	221.62	2.17	221.6	2.62	221.15	1.43	222.34	0.25	223.5
BH 2	5.9	0.85	223.62	0.70	222.90	0.11	223.50	-0.09	223.70	0.05	223.60	0.11	223.50	0.31	223.31	0.35	223.27	0.08	223.54	-0.02	223.64	-0.07	223.7
BH 3	6.0		225.07	0.10	225.00	0.72	224.40	0.46	224.60	0.65	224.40	0.77	224.30	0.89	224.18	0.90	224.17	1.51	223.56	NA	NA	NA	NA
BH 4	2.8	1.02	224													0.79	223.21	0.45	223.55	0.46	223.54	-0.01	224.0
BH 5	1.2	1.08	224.75													0.88	223.87	0.31	224.44	0.31	224.44	0.16	224.6
BH 6	1.0	0.97	224.5													0.42	224.08	0.10	224.40	0.09	224.41	0.11	224.4

from grading plan



APPENDIX F

Hydraulic Conductivity Results



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH1.aqt
 Date: 09/25/18 Time: 11:56:14

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH1
 Test Date: November 27 2017

AQUIFER DATA

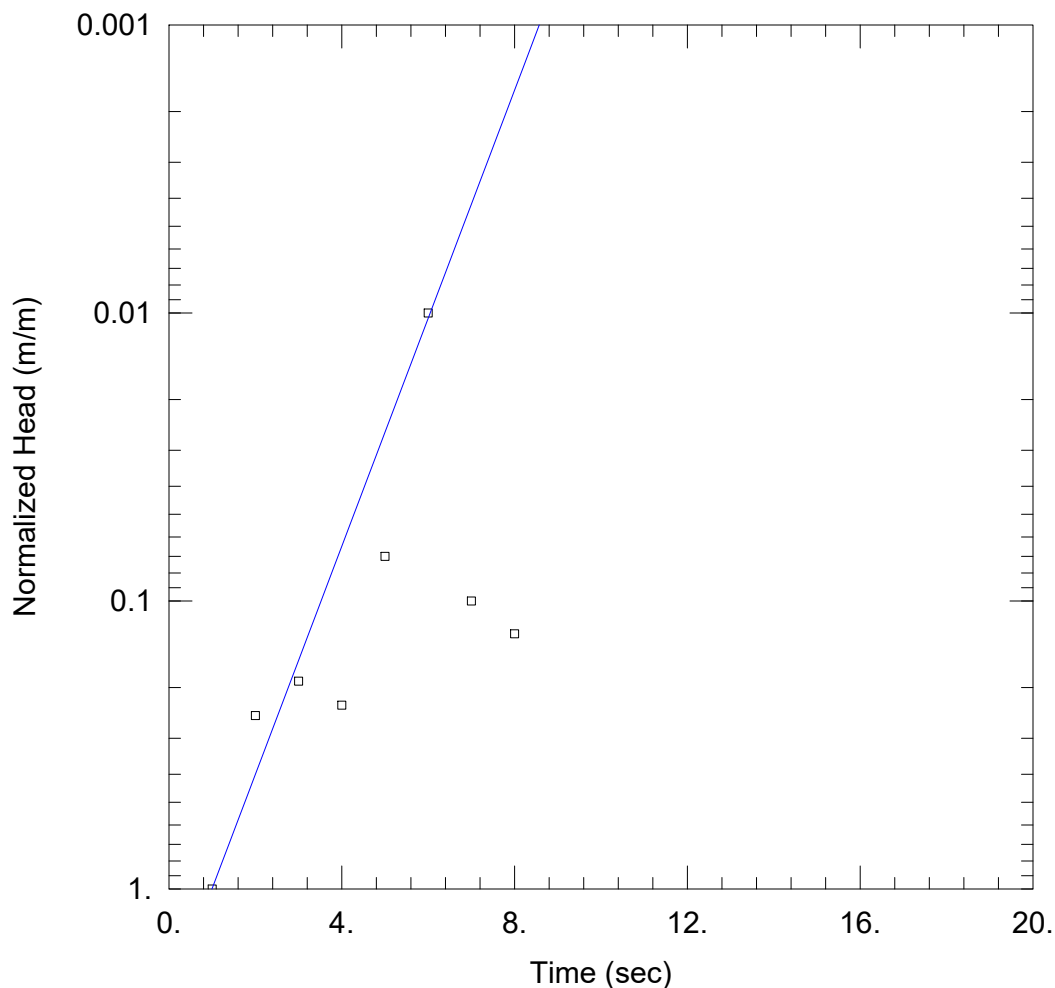
Saturated Thickness: 2.6 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH1)

Initial Displacement: -0.4092 m Static Water Column Height: 2.6 m
 Total Well Penetration Depth: 5. m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 4.02E-6$ m/sec $y_0 = -0.293$ m



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH2.aqt
 Date: 09/25/18 Time: 11:56:57

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH2
 Test Date: November 27 2017

AQUIFER DATA

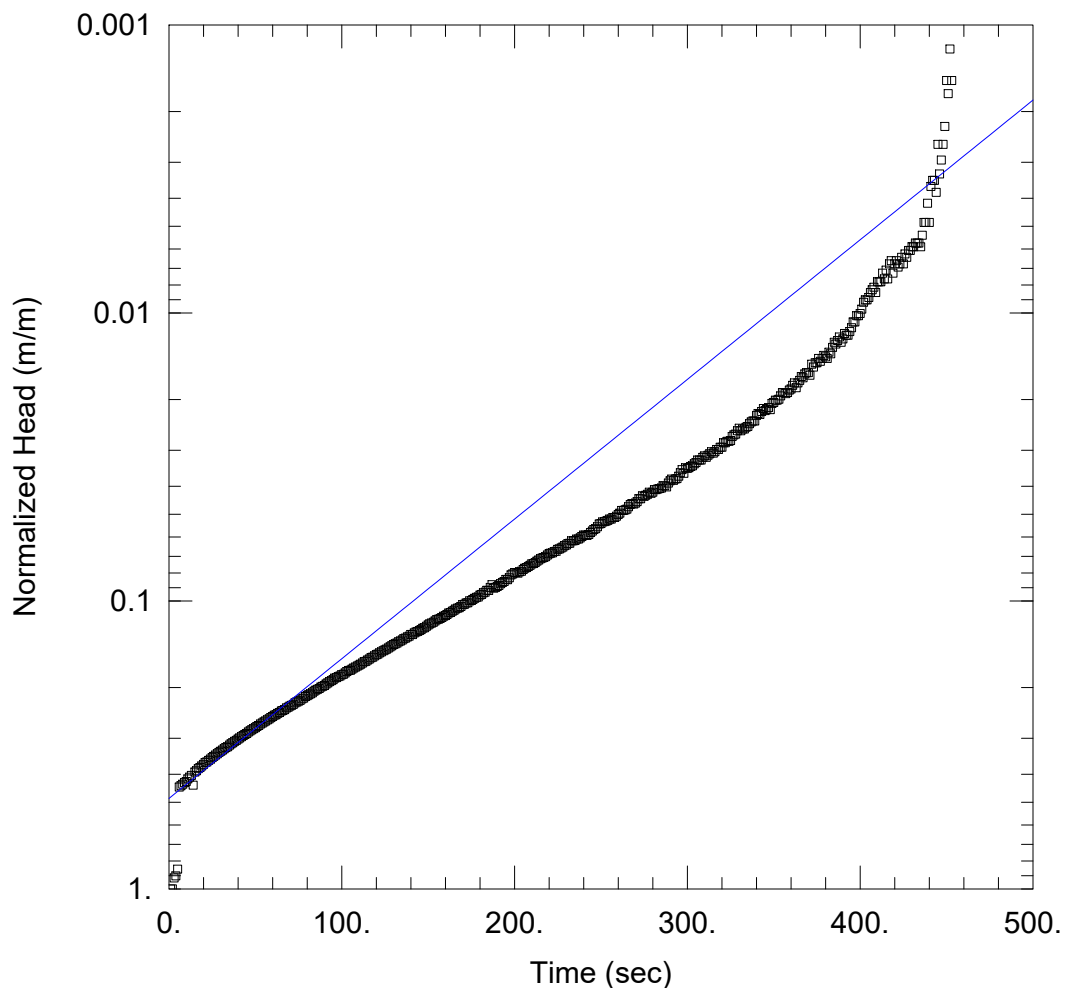
Saturated Thickness: 5.18 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH2)

Initial Displacement: -1. m Static Water Column Height: 5.18 m
 Total Well Penetration Depth: 5.18 m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.0009093$ m/sec $y_0 = -2.477$ m



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH3.aqt
 Date: 09/25/18 Time: 11:57:33

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH3
 Test Date: November 27 2017

AQUIFER DATA

Saturated Thickness: 5.8 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH3)

Initial Displacement: -0.5771 m Static Water Column Height: 5.8 m
 Total Well Penetration Depth: 5.9 m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
 $K = 1.114E-5$ m/sec $y_0 = -0.2798$ m



APPENDIX G

Water Quality Results

C.O.C.: G114928

REPORT No: 24-010875 - Rev. 1

Report To:

Azimuth Environmental
642 Welham Rd
Barrie, ON L4N9A1

CADUCEON Environmental Laboratories

112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Jenn Millington

DATE RECEIVED: 2024-Apr-19
DATE REPORTED: 2024-May-03
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 16-202
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	PCURIEL	2024-Apr-24	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	BOD-001	SM 5210B
COD (Liquid)	1	KINGSTON	EHINCH	2024-Apr-24	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2024-Apr-24	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
Cyanide Total (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-23	CN-001	SM 4500-CN-E
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-25	D-ICPMS-01	EPA 6020
ICP/MS (Liquid)	1	OTTAWA	TPRICE	2024-Apr-25	D-ICPMS-01	EPA 200.8
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-25	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-24	D-ICP-01	SM 3120B
Mercury (Liquid)	2	OTTAWA	TBENNETT	2024-Apr-24	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	1	OTTAWA	TPRICE	2024-Apr-30	D-ICPMS-01	EPA 6020
ICPMS Precious Metals (Liquid)	1	OTTAWA	TPRICE	2024-Apr-30	D-ICPMS-01	EPA 200.8
Ammonia (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-23	NH3-001	SM 4500NH3
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2024-Apr-23	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	1	KINGSTON	MLANE	2024-Apr-23	O&G-001	SM 5520
PHC F1 (Liquid)	1	RICHMOND_HILL	JEVANS	2024-Apr-24	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	1	KINGSTON	STHOMPSON	2024-Apr-25	PHC-W-001	MECP E3421
Phenols (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-25	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	EHINCH	2024-Apr-23	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	EASIEDU	2024-Apr-25	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	1	KINGSTON	KDIBBITS	2024-Apr-25	TPTKN-001	MECP E3516.2
TSS (Liquid)	2	KINGSTON	DCASSIDY	2024-Apr-23	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-24	C-VOC-02	EPA 8260


Christine Burke

Laboratory Manager

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µg/g = micrograms per gram (parts per million) and is equal to mg/Kg

F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)

F2 C10-C16 hydrocarbons in µg/g, (F2-naph if requested)

F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)

F4 C34-C50 hydrocarbons in µg/g

This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.

Any deviations from the method are noted and reported for any particular sample.

nC6 and nC10 response factor is within 30% of response factor for toluene:

nC10, nC16 and nC34 response factors within 10% of each other:

C50 response factors within 70% of nC10+nC16+nC34 average:

Linearity is within 15%:

All results expressed on a dry weight basis.

Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

R.L. = Reporting Limit

NC = Not Calculated

Test methods may be modified from specified reference method unless indicated by an *

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.

If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in

application to the CWS PHC

QC will be made available upon request.



Christine Burke
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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.	
					MW-102	MW-102F
					Sample I.D.	24-010875-1
					Date Collected	2024-Apr-19
Parameter	Units	R.L.	Limits		-	-
pH @25°C	pH units	-	8.5	PWQO	8.19	
Fluoride	mg/L	0.1			<0.1	
Chloride	mg/L	0.5			12.1	
Sulphate	mg/L	1			11	
BOD5	mg/L	3			5	
Total Suspended Solids	mg/L	3			34900	3
Phosphorus (Total)	µg/L	10	10	INTERIM	388000	
Total Kjeldahl Nitrogen	mg/L	0.1			180	
Ammonia (N)-Total (NH3+NH4)	mg/L	0.05			0.23	
Sulphide	mg/L	0.01			<8.00	
Cyanide (Total)	mg/L	0.005			<0.005	
Phenolics	µg/L	1	1	PWQO	<1	
COD	mg/L	5			100	
Aluminum	µg/L	10	75	INTERIM		20
Barium	µg/L	1				63
Bismuth	µg/L	20				<20
Boron	µg/L	5	200	INTERIM		34
Iron	µg/L	5	300	PWQO		137
Manganese	µg/L	1				16
Tin	µg/L	50				<50
Tungsten	µg/L	10				<10


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Final Report
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					Client I.D.	
					MW-102	MW-102F
					Sample I.D.	24-010875-1
					Date Collected	2024-Apr-19
Parameter	Units	R.L.	Limits		-	-
Zinc	µg/L	5	30	PWQO		<5
Zirconium	µg/L	3				<3
Hardness (as CaCO3)	mg/L as CaCO3	-			4000	
Aluminum (Total)	µg/L	10			57100	
Barium (Total)	µg/L	1			1220	
Bismuth (Total)	µg/L	20			<20	
Boron (Total)	µg/L	5	200	INTERIM	102	
Calcium (Total)	µg/L	20			1520000	
Iron (Total)	µg/L	5	300	PWQO	101000	
Magnesium (Total)	µg/L	20			116000	
Manganese (Total)	µg/L	1			3710	
Tin (Total)	µg/L	50			<50	
Tungsten (Total)	µg/L	10	30	INTERIM	50	
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO	282	
Zirconium (Total)	µg/L	3	4	INTERIM	27	
Antimony	µg/L	0.1	20, 5	INTERIM, PWQO		<0.1
Arsenic	µg/L	0.1	5, 0.0	INTERIM, PWQO		0.8
Beryllium	µg/L	0.1	0.0, 11	INTERIM, PWQO		<0.1
Cadmium	µg/L	0.015	0.1, 0.2	INTERIM, PWQO		<0.030
Chromium	µg/L	1.0				<1.0
Cobalt	µg/L	0.1				0.1


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Laboratory Manager

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Parameter	Units	R.L.	Limits	Client I.D.	MW-102	MW-102F
				Sample I.D.	24-010875-1	24-010875-2
				Date Collected	2024-Apr-19	2024-Apr-19
					-	-
Copper	µg/L	0.1	5	INTERIM		0.6
Lead	µg/L	0.02	1, 5	INTERIM, PWQO		<0.09
Molybdenum	µg/L	0.1	40	INTERIM		0.6
Nickel	µg/L	0.2	25	PWQO		0.4
Selenium	µg/L	1.00	100	PWQO		<1.00
Silver	µg/L	0.1	0.1	PWQO		<0.1
Thallium	µg/L	0.05	0.3, 0.3	INTERIM, PWQO		<0.05
Uranium	µg/L	0.05	5	INTERIM		0.10
Vanadium	µg/L	0.1	6	INTERIM		<0.4
Gold	mg/L	0.0007				<0.0007
Platinum	mg/L	0.00004				<0.00004
Rhodium	mg/L	0.00002				<0.00002
Antimony (Total)	µg/L	0.5	20	INTERIM	<0.5	
Arsenic (Total)	µg/L	0.5	5, 5	INTERIM, PWQO	9.6	
Beryllium (Total)	µg/L	0.5	11	PWQO	2.2	
Cadmium (Total)	µg/L	0.080	0.1, 0.2	INTERIM, PWQO	0.560	
Chromium (Total)	µg/L	5			86	
Cobalt (Total)	µg/L	0.5	0.9	INTERIM	46.8	
Copper (Total)	µg/L	0.5	5	INTERIM	218	
Lead (Total)	µg/L	0.10	1, 5	INTERIM, PWQO	61.6	
Molybdenum (Total)	µg/L	0.5	40	INTERIM	0.8	


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					Client I.D.	
					MW-102	MW-102F
					Sample I.D.	
					24-010875-1	24-010875-2
					Date Collected	
					2024-Apr-19	2024-Apr-19
Parameter	Units	R.L.	Limits		-	-
Nickel (Total)	µg/L	1.0	25	PWQO	89.0	
Selenium (Total)	µg/L	5	100	PWQO	<5	
Silver (Total)	µg/L	0.5	0.1	PWQO	<0.5	
Thallium (Total)	µg/L	0.30	0.3, 0.3	INTERIM, PWQO	1.00	
Uranium (Total)	µg/L	0.30	5	INTERIM	3.90	
Vanadium (Total)	µg/L	0.5	6	INTERIM	118	
Gold (Total)	mg/L	0.0007			<0.0007	
Platinum (Total)	mg/L	0.00004			<0.00004	
Rhodium (Total)	mg/L	0.00002			<0.00002	
Mercury	µg/L	0.02	0.2	PWQO	<0.02	<0.02


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Final Report
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					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		-
Benzene	µg/L	0.5	100	INTERIM	<0.5
Bromodichloromethane	µg/L	2	200	INTERIM	<2
Bromoform	µg/L	5	60	INTERIM	<5
Bromomethane	µg/L	0.5	0.9	INTERIM	<0.5
Chlorobenzene	µg/L	0.5	15	PWQO	<0.5
Chloromethane (Methyl Chloride)	µg/L	2	700	INTERIM	<2
Dichlorobenzene,1,2-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	4	PWQO	<0.5
Dichloroethane,1,1-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethane,1,2-	µg/L	0.5	100	INTERIM	<0.5
Dichloroethylene,1,1-	µg/L	0.5	40	INTERIM	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethylene,1,2-cis+trans-	µg/L	0.7			<0.7
Dichloroethylene,1,2-trans-	µg/L	0.5	200	INTERIM	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.7	INTERIM	<0.5
Ethylbenzene	µg/L	0.5	8	INTERIM	<0.5
Dichloromethane (Methylene Chloride)	µg/L	5	100	INTERIM	<5
Methyl tert-Butyl Ether (MTBE)	µg/L	2	200	INTERIM	<2
Styrene	µg/L	0.5	4	INTERIM	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	20	INTERIM	<0.5


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REPORT No: 24-010875 - Rev. 1

					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		
Tetrachloroethane,1,1,2,2-	µg/L	0.5	70	INTERIM	<0.5
Tetrachloroethylene	µg/L	0.5	50	INTERIM	<0.5
Toluene	µg/L	0.5	0.8, 0.8	INTERIM, PWQO	<0.5
Trichlorobenzene,1,2,4-	µg/L	0.5	0.5	PWQO	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	10	INTERIM	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	800	INTERIM	<0.5
Trichloroethylene	µg/L	0.5	20	INTERIM	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5			<5
Trimethylbenzene,1,3,5-	µg/L	0.1	3	INTERIM	<0.1
Vinyl Chloride	µg/L	0.2	600	INTERIM	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1			<1.1
Xylene, o-	µg/L	0.5	40	INTERIM	<0.5
PHC F1 (C6-C10)	µg/L	25			<25
PHC F2 (>C10-C16)	µg/L	50			<50
PHC F3 (>C16-C34)	µg/L	400			<400
PHC F4 (>C34-C50)	µg/L	400			<400
Oil and Grease (Mineral)	mg/L	1.0			<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0			1.8


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					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05	0.0008	PWQO	<0.05
Benzo[a]anthracene	µg/L	0.05	0.0004	INTERIM	<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05	0.00002	INTERIM	<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Chrysene	µg/L	0.05	0.0001	INTERIM	<0.05
Dibenzo(a,h)anthracene	µg/L	0.05	0.002	INTERIM	<0.05
Fluoranthene	µg/L	0.05	0.0008	INTERIM	<0.05
Fluorene	µg/L	0.05	0.2	INTERIM	<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05
Methylnaphthalene,1-	µg/L	0.05	2	INTERIM	<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	µg/L	0.05	2	INTERIM	<0.05
Naphthalene	µg/L	0.05	7	INTERIM	<0.05
Phenanthrene	µg/L	0.05	0.03	INTERIM	<0.05
Pyrene	µg/L	0.05			<0.05
Total PAH	µg/L	0.1			<0.1


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Laboratory Manager

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REPORT No: 24-010875 - Rev. 1

					Client I.D.	MW-102
					Sample I.D.	24-010875-1
					Date Collected	2024-Apr-19
Parameter	Units	R.L.	Limits			-
Hexachlorobenzene	µg/L	0.01				<0.01

Revised report to include dissolved metals to match the total list

: PWQO Limits
 INTERIM: Interim PWQO
 PWQO: PWQO



Christine Burke
 Laboratory Manager

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Summary of Exceedances		
Interim PWQO		
MW-102	Found Value	Limit
Phosphorus (Total)	388000	10
Tungsten (Total)	50	30
Zinc (Total)	282	20
Zirconium (Total)	27	4
Arsenic (Total)	9.6	5
Cadmium (Total)	0.560	0.1
Cobalt (Total)	46.8	0.9
Copper (Total)	218	5
Lead (Total)	61.6	1
Thallium (Total)	1.00	0.3
Vanadium (Total)	118	6
Benzo[a]anthracene	<0.05	0.0004
Benzo(g,h,i)perylene	<0.05	0.00002
Chrysene	<0.05	0.0001
Dibenzo(a,h)anthracene	<0.05	0.002
Fluoranthene	<0.05	0.0008
Phenanthrene	<0.05	0.03
PWQO		
MW-102	Found Value	Limit
Iron (Total)	101000	300
Zinc (Total)	282	30
Arsenic (Total)	9.6	5
Cadmium (Total)	0.560	0.2
Lead (Total)	61.6	5
Nickel (Total)	89.0	25
Silver (Total)	<0.5	0.1
Thallium (Total)	1.00	0.3
Anthracene	<0.05	0.0008

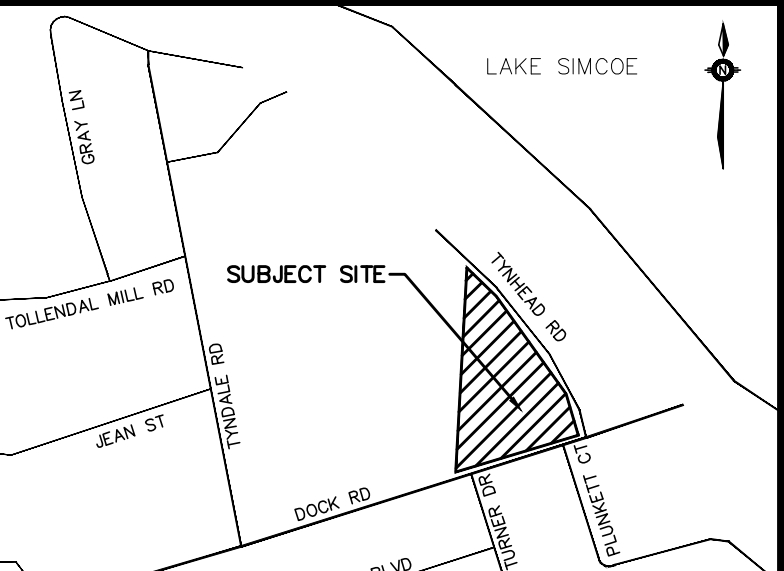
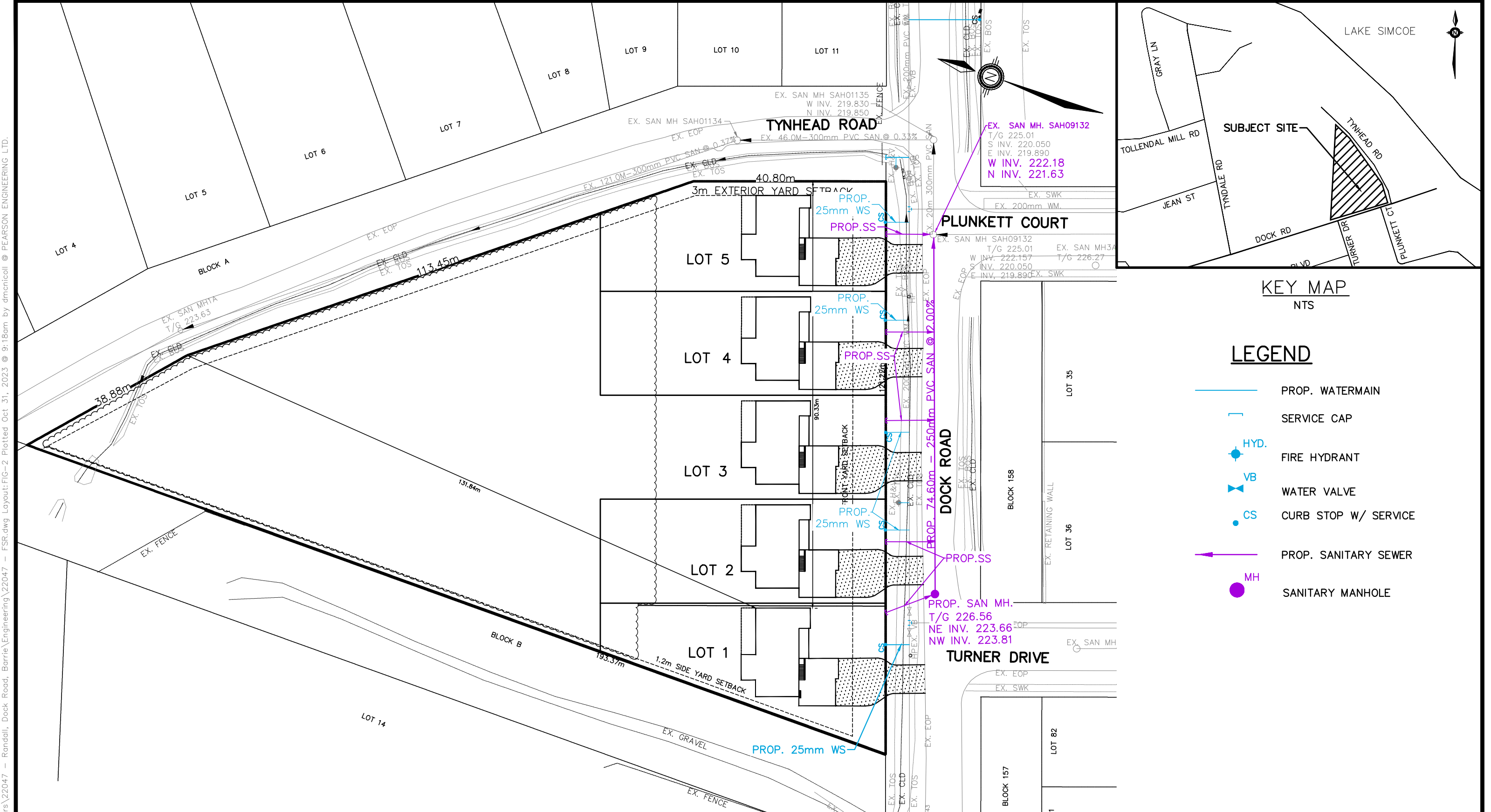

 Christine Burke
 Laboratory Manager



APPENDIX H

Drawings

P:\Autodesk Vault\Working Folders\22047 - Randall, Dock Road, Barrie\Engineering\22047 - FSR.dwg Layout: FIG-2 Plotted Oct 31, 2023 @ 9:18am by dmonicoli @ PEARSON ENGINEERING LTD.



KEY MAP
NTS

LEGEND

- PROP. WATERMAIN
- SERVICE CAP
- HYD. FIRE HYDRANT
- VB WATER VALVE
- CS CURB STOP W/ SERVICE
- PROP. SANITARY SEWER
- MH SANITARY MANHOLE

NO.	REVISION NOTE	DATE	BY

1000067324 ONTARIO INC.
211 DOCK ROAD
CITY OF BARRIE

WATER AND SANITARY
SERVICING PLAN



PEARSON
ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC	HORIZ SCALE	1: 750	PROJECT #	22047
DRAWN BY	WT	VERT SCALE	N/A	DRAWING #	FIG-2
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	0



APPENDIX I

Water Balance

Table A: Pre-Development

Catchment Designation	Forest	Wetland	Total
Area (m ²)	8,839	3,727	12,566
Pervious Area (m ²)	8,839	0	8,839
Impervious Area (m ²)	0	3,727	3,727
Infiltration Factors			
Topography Infiltration Factor	0.3	0	
Soil Infiltration Factor	0.4	0	
Land Cover Infiltration Factor	0.2	0	
Infiltration Factor	0.9	0	
Run-Off Coefficient	0.1	1	
Run-Off From Impervious Surfaces	0.8	0.8	
Inputs (Per Unit Area)			
Precipitation (mm/yr)	907	907	907
Rainfall (mm/yr)	654	654	654
Run-On (mm/yr)	0	0	0
Other Inputs (mm/yr)	0	0	0
Total Inputs (mm/yr)	907	907	907
Outputs (Per Unit Area)			
Precipitation Surplus (mm/yr)	428	726	516
Net Surplus (mm/yr)	428	726	516
Evapotranspiration (mm/yr)	479	181	391
Infiltration (mm/yr)	385	0	271
Surplus Infiltration (mm/yr)	0	0	0
Total Infiltration (mm/yr)	385	0	271
Run-Off Pervious Areas (mm/yr)	43	0	30
Run-Off Impervious Areas (mm/yr)	0	726	215
Total Run-Off (mm/yr)	43	726	245
Total Outputs (mm/yr)	907	907	907
Difference (Inputs - Outputs)	0	0	0
Inputs (Volumes)			
Precipitation (m ³ /yr)	8,017	3,380	11,397
Run-On (m ³ /yr)	0	0	0
Other Inputs (m ³ /yr)	0	0	0
Total Inputs (m³/yr)	8,017	3,380	11,397
Outputs (Volumes)			
Precipitation Surplus (m ³ /yr)	3,783	2,704	6,487
Net Surplus (m ³ /yr)	3,783	2,704	6,487
Evapotranspiration (m ³ /yr)	4,234	676	4,910
Infiltration (m ³ /yr)	3,405	0	3,405
Surplus Infiltration (m ³ /yr)	0	0	0
Total Infiltration (m³/yr)	3,405	0	3,405
Run-Off Pervious Areas (m ³ /yr)	378	0	378
Run-Off Impervious Areas (m ³ /yr)	0	2,704	2,704
Total Run-Off (m ³ /yr)	378	2,704	3,082
Total Outputs (m³/yr)	8,017	3,380	11,397
Difference (Inputs - Outputs)	0	0	0

Table B: Post-Development (no mit)

Catchment Designation	Forest	Landscaped Grass	Driveway	Wetland	Structure	Total
Area (m ²)	4,174	3,268	749	2,865	1,510	12,566
Pervious Area (m ²)	4,174	3,268	0	0	0	7,442
Impervious Area (m ²)	0	0	749	2,865	1,510	5,124
Infiltration Factors						
Topography Infiltration Factor	0.3	0.3	0	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	0	
Infiltration Factor	0.9	0.8	0	0	0	
Run-Off Coefficient	0.1	0.2	1	1	1	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	
Inputs (Per Unit Area)						
Precipitation (mm/yr)	907	907	907	907	907	907
Rainfall (mm/yr)	654	654	654	654	654	654
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	907	907	907	907	907	907
Outputs (Per Unit Area)						
Precipitation Surplus (mm/yr)	428	428	726	726	726	549
Net Surplus (mm/yr)	428	428	726	726	726	549
Evapotranspiration (mm/yr)	479	479	181	181	181	358
Infiltration (mm/yr)	385	342	0	0	0	217
Surplus Infiltration (mm/yr)	0	0	0	0	0	0
Total Infiltration (mm/yr)	385	342	0	0	0	217
Run-Off Pervious Areas (mm/yr)	43	86	0	0	0	36
Run-Off Impervious Areas (mm/yr)	0	0	726	726	726	296
Total Run-Off (mm/yr)	43	86	726	726	726	332
Total Outputs (mm/yr)	907	907	907	907	907	907
Difference (Inputs - Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitation (m ³ /yr)	3,786	2,964	679	2,598	1,370	11,397
Run-On (m ³ /yr)	0	0	0	0	0	0
Other Inputs (m ³ /yr)	0	0	0	0	0	0
Total Inputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Outputs (Volumes)						
Precipitation Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Net Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Evapotranspiration (m ³ /yr)	1,999	1,565	136	520	274	4,494
Infiltration (m ³ /yr)	1,608	1,119	0	0	0	2,727
Surplus Infiltration (m ³ /yr)	0	0	0	0	0	0
Total Infiltration (m³/yr)	1,608	1,119	0	0	0	2,727
Run-Off Pervious Areas (m ³ /yr)	179	280	0	0	0	458
Run-Off Impervious Areas (m ³ /yr)	0	0	543	2,079	1,096	3,718
Total Run-Off (m ³ /yr)	179	280	543	2,079	1,096	4,176
Total Outputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Difference (Inputs - Outputs)	0	0	0	0	0	0

Table C: Post-Development (with mitigation)

Catchment Designation	Forest	Landscaped Grass	Driveway	Wetland	Structure	Total
Area (m ²)	4,174	3,268	749	2,865	1,510	12,566
Pervious Area (m ²)	4,174	3,268	0	0	0	7,442
Impervious Area (m ²)	0	0	749	2,865	1,510	5,124
Infiltration Factors						
Topography Infiltration Factor	0.3	0.3	0	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	0	
Infiltration Factor	0.9	0.8	0	0	0	
Run-Off Coefficient	0.1	0.2	1	1	1	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	
Inputs (Per Unit Area)						
Precipitation (mm/yr)	907	907	907	907	907	907
Rainfall (mm/yr)	654	654	654	654	654	654
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	907	907	907	907	907	907
Outputs (Per Unit Area)						
Precipitation Surplus (mm/yr)	428	428	726	726	726	549
Net Surplus (mm/yr)	428	428	726	726	726	549
Evapotranspiration (mm/yr)	479	479	181	181	181	358
Infiltration (mm/yr)	385	342	0	0	0	217
Surplus Infiltration (mm/yr)	0	0	0	0	306	37
Total Infiltration (mm/yr)	385	342	0	0	306	254
Run-Off Pervious Areas (mm/yr)	43	86	0	0	0	36
Run-Off Impervious Areas (mm/yr)	0	0	726	726	419	259
Total Run-Off (mm/yr)	43	86	726	726	419	296
Total Outputs (mm/yr)	907	907	907	907	907	907
Difference (Inputs - Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitation (m ³ /yr)	3,786	2,964	679	2,598	1,370	11,397
Run-On (m ³ /yr)	0	0	0	0	0	0
Other Inputs (m ³ /yr)	0	0	0	0	0	0
Total Inputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Outputs (Volumes)						
Precipitation Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Net Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Evapotranspiration (m ³ /yr)	1,999	1,565	136	520	274	4,494
Infiltration (m ³ /yr)	1,608	1,119	0	0	0	2,727
Surplus Infiltration (m ³ /yr)	0	0	0	0	462	462
Total Infiltration (m³/yr)	1,608	1,119	0	0	462	3,189
Run-Off Pervious Areas (m ³ /yr)	179	280	0	0	0	458
Run-Off Impervious Areas (m ³ /yr)	0	0	543	2,079	633	3,256
Total Run-Off (m ³ /yr)	179	280	543	2,079	633	3,714
Total Outputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Difference (Inputs - Outputs)	0	0	0	0	0	0

Table D: Water Balance Summary Table

Parameter	Site						
	Pre-Development	Post-Development	Change (Pre to Post)		Post-Development with Mitigation	Change (Pre to Post with Mitigation)	
Inputs (Volume)							
Precipitation (m³/yr)	11,397	11,397	0	0%	11,397	0	0%
Run-On (m³/yr)	0	0	0	NA	0	0	NA
Other Inputs (m³/yr)	0	0	0	NA	0	0	NA
Total Inputs (m³/yr)	11,397	11,397	0	0%	11,397	0	0%
Outputs (Volume)							
Precipitation Surplus (m³/yr)	6,487	6,903	416	6%	6,903	416	6%
Net Surplus (m³/yr)	6,487	6,903	416	6%	6,903	416	6%
Evapotranspiration (m³/yr)	4,910	4,494	-416	-8%	4,494	-416	-8%
Infiltration (m³/yr)	3,405	2,727	-678	-20%	2,727	-678	-20%
Rooftop Infiltration (m³/yr)	0	0	0	NA	462	462	NA
Total Infiltration (m³/yr)	3,405	2,727	-678	-20%	3,189	-216	-6%
Run-Off Pervious Areas (m³/yr)	378	458	80	21%	458	80	21%
Run-Off Impervious Areas (m³/yr)	2,704	3,718	1,014	37%	3,256	552	20%
Total Run-Off (m³/yr)	3,082	4,176	1,094	35%	3,714	632	20%
Total Outputs (m³/yr)	11,397	11,397	0	0%	11,397	0	0%



APPENDIX J

Dewatering Assessment

16-202 Dock Road - Low K Scenario

Type	ID	Length (m)	Width (m)	Effectivve Radius ¹ (m)	Hydraulic Conductivity (m/s)	Hydraulic Conductivity (m/day)	Initial Depth of Water (static head) prior to dewatering (m)	H ²	Depth of Water in the well while pumping (m)	h ²	H-h (m)	H ² -h ²	Radius of Influence ² (m)	Discharge Into Ends ³ (m ³ /day)	Plane Discharge ⁴ (m ³ /day)	Total Discharge (m ³ /day)	Total Discharge (L/day)	Total Discharge x 1.5 Safety Factor (L/day)
		a	b	re	k	k	H		h				Ro	Q	Q	Q	Q	Q
Dock Road Sanitary	NA	75	3	25	4.00E-06	3.46E-01	4.12	17	0.5	0.5	3.62	16	47	28	9.2	37.6	37,600	56,400
Lot 1	NA	20	3	7	4.00E-06	3.46E-01	2.09	4	0.5	0.5	1.59	4	17	5	1.6	6.6	6,600	9,900
Lot 2	NA	20	3	7	4.00E-06	3.46E-01	2.39	6	0.5	0.5	1.89	5	19	6	1.9	8.0	8,000	12,000
Lot 3	NA	20	3	7	4.00E-06	3.46E-01	2.91	8	0.5	0.5	2.41	8	22	8	2.5	10.4	10,400	15,600
Lot 4	NA	20	3	7	4.00E-06	3.46E-01	3.21	10	0.5	0.5	2.71	10	24	9	2.9	12.0	12,000	18,000
Lot 5	NA	20	3	7	4.00E-06	3.46E-01	3.37	11	0.5	0.5	2.87	11	25	10	3.1	12.8	12,800	19,200
Total Dewatering																	87,400	131,100

Notes

¹ $r_e = (a+b) / \pi$ - assuming $a/b > 1.5$, or $r_e = \sqrt{ab} / \pi$ (Powers et. al., 2007)

² $R_o = r_e + 3000 * (H-h) * \sqrt{k}$ - Sichardt's Formula, (Cashman and Preene, 2001)

³ $Q = [(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)]$ (Powers et al., 2007)

⁴ $Q = 2 * [\pi * K * (H^2 - h^2)] / (2R_o)$ (Powers et al., 2007)

* H & h are relative to base of active ground water levels

16-202 Dock Road - High K Scenario

Type	ID	Length (m)	Width (m)	Effectivve Radius ¹ (m)	Hydraulic Conductivity (m/s)	Hydraulic Conductivity (m/day)	Initial Depth of Water (static head) prior to dewatering (m)	H ²	Depth of Water in the well while pumping (m)	h ²	H-h (m)	H ² -h ²	Radius of Influence ² (m)	Discharge Into Ends ³ (m ³ /day)	Plane Discharge ⁴ (m ³ /day)	Total Discharge (m ³ /day)	Total Discharge (L/day)	Total Discharge x 1.5 Safety Factor (L/day)
		a	b	re	k	k	H		h				Ro	Q	Q	Q	Q	Q
Dock Road Sanitary	NA	75	3	25	9.10E-04	7.86E+01	4.12	17	0.5	0.5	3.62	16	352	1533	275.6	1809.0	1,809,000	2,713,500
Lot 1	NA	20	3	7	9.10E-04	7.86E+01	2.09	4	0.5	0.5	1.59	4	151	315	40.2	355.7	355,700	533,600
Lot 2	NA	20	3	7	9.10E-04	7.86E+01	2.39	6	0.5	0.5	1.89	5	178	403	46.0	449.3	449,300	674,000
Lot 3	NA	20	3	7	9.10E-04	7.86E+01	2.91	8	0.5	0.5	2.41	8	225	572	55.5	628.0	628,000	942,000
Lot 4	NA	20	3	7	9.10E-04	7.86E+01	3.21	10	0.5	0.5	2.71	10	253	685	61.1	745.8	745,800	1,118,700
Lot 5	NA	20	3	7	9.10E-04	7.86E+01	3.37	11	0.5	0.5	2.87	11	267	745	63.9	809.3	809,300	1,214,000
Total Dewatering																	4,797,100	7,195,800

Notes

¹ $r_e = (a+b) / \pi$ - assuming $a/b > 1.5$, or $r_e = \sqrt{ab} / \pi$ (Powers et. al., 2007)

² $R_o = r_e + 3000 * (H-h) * \sqrt{k}$ - Sichardts Formula, (Cashman and Preene, 2001)

³ $Q = [(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)]$ (Powers et al., 2007)

⁴ $Q = 2 * [\pi * K * (H^2 - h^2) / (2R_o)]$ (Powers et al., 2007)

* H & h are relative to base of active ground water levels