Hydrogeological Investigation

41-43 Essa Road and 259 Innisfil Street
Barrie, Ontario
L4N 3K4

Prepared For:

Tonlu Holdings Ltd.

Project No: 21-113-100
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September 13, 2021

Tonlu Holdings Ltd.
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Attention: Mr. Richard Faccio

RE: Hydrogeological Investigation
41-43 Essa Road and 259 Innisfil Street, Barrie, Ontario

DS Consultants Limited (DS) was retained by Tonlu Holdings Limited to complete a hydrogeological investigation in support of the proposed residential-commercial development located at 41-43 Essa Road and 259 Innisfil Street, Barrie, Ontario (site). The investigation was completed to provide an overview of the existing geological and hydrogeological conditions at the Site and to provide an assessment of the hydrogeological constraints to development including an estimation of construction dewatering requirements and potential impacts to local groundwater resources. Based on the results of our investigation, the following summary of conclusions and recommendations are presented:

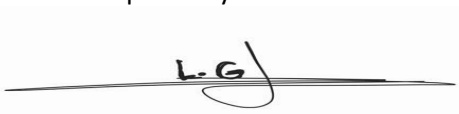
1. A review of the water well records indicated that there are one hundred fourteen (114) registered water wells within 500 m. Of the one hundred fourteen records, fourteen (14) are records of well abandonments/dewatering wells, one (1) is listed as public supply well and five (5) as a municipal observation well, five (5) are listed as domestic supply wells, sixty-nine (69) as test holes/observation wells and twenty (20) that did not specify. The depths of the water supply wells range from 4.0 to 108.8 mbgs.
2. Surficial geology mapping made available by the Ontario Geological Survey (2010) indicates that the Site is covered by a coarse-textured glaciolacustrine deposit including sand, gravel, minor silt and clay littoral deposits. Locally, the glaciolacustrine deposit forms a thin veneer overlying the regionally extensive Glacial till. The glaciolacustrine deposits are generally discontinuous, deposited in valley systems and low-lying areas.
3. Groundwater levels were measured on August 24th, 2021. The water levels ranged from 2.57 – 3.57 mbgs, corresponding to elevations ranging from 224.38 - 226.03 masl. Based on measured water levels, the localized groundwater flow in the vicinity of the Site is interpreted to be in a north-easterly direction.
4. Single Well Response Tests (SWRTs) to assess in-situ hydraulic conductivity (K) were completed by DS on August 24, 2021, at three (3) monitoring wells. The test method is a bail test, which is a rapid removal of a volume of water using a bailer. The ensuring rising recovery to static level is observed over time. K values were calculated using the Bouwer and Rice method. The K values ranged from 7.34 x 10-6 m/sec in the fine silty sand unit to as high as 1.05 x 10-6 m/sec in the clay silt unit with a geometric mean of 2.04x 10-5 m/sec

5. A pre-development and post-development water balance was completed to understand existing hydrologic conditions. Based on results, the proposed development will produce a reduction in annual AET (72 m^3/yr), a slight increase in annual ET (344 m^3/yr), a reduction in annual infiltration (201 m^3/yr) and an increase in annual runoff (473 m^3/yr). The effects are mainly the result of reduced infiltration following a slight increase in impervious area replacing pervious areas of the site.
6. To address the small loss of infiltration pre to post-development (201 m^3/yr), Low Impact Development (LID) measures which promote onsite infiltration can be incorporated into development plan. The permeability and storage of proposed pervious areas could be enhanced to provide more topsoil thickness. Additional LIDs suitable for the site includes the collection, storage and infiltration of runoff from the roof area via buried infiltration facilities or infiltration of runoff from other impervious surfaces following pre-treatment.
7. Based on conceptual plans, it is understood that the proposed development will not include underground parking or a basement. The design grades are not known at this stage however, based on well data, the building foundation requiring excavation will be founded above the seasonally high water table. Dewatering is not anticipated with exception to the potential need to remove storm water. Based on the anticipated size of the excavation, a large storm event (40mm) could result in approximately 240 m^3 which could be pumped out of the excavation in a single day. The dewatering would require registration on the Environmental Activity Sector Registration (EASR) as required by the Ministry of the Environment, Conservation and Parks (MECP) for takings between 50,000 L/day and 400,000 L/ day.
8. In conformance with Regulation 903 of the Ontario Water Resources Act, the decommissioning of any dewatering system and monitoring wells should be carried out by a licensed contractor under the supervision of a licensed water well technician.

Should you have any questions regarding these findings, please contact the undersigned.

DS Consultants Ltd

Prepared By:



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1. INTRODUCTION

DS Consultants Limited (DS) was retained by Tonlu Holdings Limited to complete a hydrogeological investigation in support of the proposed residential-commercial development located at 41-43 Essa Road and 259 Innisfil Street, Barrie, Ontario (site). The site is bounded by Essa Road to the east, Innisfil Street to the west, commercial and residential properties to the north and residential properties to the south. The site consists of one one- storey commercial building in Essa Road and one one-storey commercial building in Innisfil Street. The paved surfaces are partially granular and partially asphalt pavement. The total site area is about 1.8 ha in size. It is treed along the east, west, and south boundaries. The proposed development will consist of four towers varying from 25 to 37 storey structures.

The investigation was completed to characterize groundwater conditions and understand potential constraints to development.

1.1 Purpose

The purpose of this investigation is to document existing hydrogeological conditions of the site, identify potential impacts to local groundwater conditions from the proposed development, and recommend mitigation measures to reduce or eliminate the impacts of development on local water resources, groundwater users, and the natural environment.

1.2 Scope of Work

The scope of work for this investigation included:

(i) Background information review of relevant information to assess local conditions, available through past geotechnical, geological, and environmental studies along with the Ministry of the Environment and Climate Change Water Well Record database for the area

(ii) Monitoring of nine (9) wells which are designated as BH101, BH102, BH201, BH205 and BH308 in Essa Road property and MW102, MW108, MW202 and MW203 in Innisfil Street property.

(iii) Single well response tests to assess the hydraulic conductivity were performed on monitoring wells BH102 and BH201 in Essa Road property and MW108 in Innisfil Street property.

(iv) Complete a Thornthwaite site water balance assessment; and

(v) Data analyses and preparation of a hydrogeological report.

2. PHYSICAL SETTING

2.1 Regional Physiography and Drainage

The Site is situated within the Simcoe Lowlands Physiographic Region of Southern Ontario (Chapman and Putnam, 1984). The Simcoe Lowlands are generally characterized as flat-lying contiguous valleys, consisting

of sandy glacial till interpreted as the Newmarket Till. The site lies within a Sand Plain Physiographic Landform. Relief across the Site is low ranging from an elevation of about 230 masl on the south boundary sloping east toward lake Simcoe to an elevation of approximately 229 masl, in a distance of around 100m. The site drains toward Lake Simcoe. The site lies within the regulatory limits of the Lake Simcoe Region Conservation Authority (LSRCA) and is located within the Barrie Creeks Sub Watershed.

2.2 Geology

A Phase II ESA evaluation was completed in 2012 for 259 Innisfil Street (G2S, 2012). Eight (8) boreholes were completed to depth between 1.2m to 6.1m below grade surface. Five of the boreholes were completed as groundwater monitoring wells. A description of the soil stratigraphy encountered on the Site, in order of depth, are Asphalt to depth of 4cm, Fill (Silty Sand) to an approximately depth of 1.7m, Native material (Silty Sand) was encountered beneath the fill.

In March 2018, G2S completed a Phase II ESA report in 41-43 Essa Road (G2S, 2018). Twelve (12) boreholes were completed to depth between 3.5m to 10.6m below grade surface. Eleven (11) groundwater monitors were installed. A description of the soil stratigraphy encountered on the Site, in order of depth, are Concrete/Topsoil/Asphalt to depth of between 5cm to 10cm, Fill (Sand and Gravel) to an approximately depth of 0.3m to 0.9m, Native material (Silty Sand/ Clayey Silt) was encountered beneath the fill to the depth of 6.0m to 10.6m below grade surface.

In October 2018, five (5) boreholes were advanced at 41-43 Essa Road, with four (4) of which were completed as groundwater monitoring wells by Azimuth Environmental (Azimuth) for the purpose of completing a Phase II ESA (Azimuth, 2018). In May/June 2019, Azimuth returned to the site to complete a subsurface delineation investigation by advancing twenty-five (25) boreholes, of which twenty-four (24) were completed as ground water monitoring wells. The results of the drilling program showed that the stratigraphic profile at the Property remained consistent across the drilling locations. Overburden was observed throughout each of the boreholes advanced and across the entire Property. Coarse grained sand and gravel was observed overtop medium/ fine grained sands with trace silts.

As part of the geotechnical investigation completed concurrently, one (1) borehole (BH21-4) was completed by DS on June 14th, 2021 at 41-43 Essa Road. The depth of the borehole was 25m below the existing ground surface (mbgs). Geotechnical boreholes BH21-1 through BH21-3 are to be drilled for 259 Innisfil Street at a later date. Subsurface conditions are summarized as follows:

Granular Fill: Granular fill, consisting of sand and gravel, with approximate thickness of 600 mm, was present at the surface of the borehole. The fill was brown in color and contained some organics.

Silty Sand/Sand/Silt to Sandy Silt: Brown to grey deposit consisting of silty sand to sand and sandy silt to silt extended below the granular fill material to the maximum explored depth of the borehole, to a depth of 25 m. This deposit contained trace of clay and gravel.

Grain size analyses of six (6) soil samples from the sandy and silty materials (BH21-4/SS5, SS8, SS9, SS12, SS16 and SS18) were conducted, with the following fractions:

Clay: Up to 7%
Silt: 7 to 73%
Sand: 20 to 93%
Gravel: up to 4%

Surficial geology mapping made available by the Ontario Geological Survey (2010) indicates that the site is covered by a coarse-textured glaciolacustrine deposit including sand, gravel, minor silt and clay littoral deposits. Locally, the glaciolacustrine deposit forms a thin veneer overlying the regionally extensive Glacial till. The glaciolacustrine deposits are generally discontinuous, deposited in valley systems and low-lying areas. An illustration of surficial geology for the site and surrounding area is provided in **Figure 2.**

Bedrock mapping suggests that the site is underlain by the bedrock of the Middle Ordovician sedimentary period. The bedrock surface surrounding the Site is generally flat, consisting of grey shale over Limestone each belonging to the Simcoe Group Formation. Based on local MECP water well records within 500m of the Site, bedrock was encountered at a test wells WWR ID 5709345 completed about 450m east of the site in 1972. The bedrock was found at a depth of 86.6m and was reported as limestone bedrock. Based on bedrock mapping for the area (OGS), overburden thickness ranges from approximately 85 - 115 metres.

2.3 Hydrogeology

The following sections provide an overview of the general hydrogeological characteristics of the study area. The hydrogeological conditions were evaluated using the data collected from the MECP water well records, on-site monitoring wells installed as part of this investigation, and other reports for the area.

2.3.1 Regional Hydrostratigraphy

Hydrostratigraphy of the Barrie Creeks subwatershed is largely the result of deposition and erosion events occurring during glacial and post-glacial periods. Initiatives to characterize the hydrostratigraphy of Barrie has been completed as part of the Tier 3 Water Budget and Risk Assessment. A stratigraphic model of quaternary sediments was completed by AquaResource et al. (2011). The conceptual model builds upon previous studies and includes four (4) regional aquifers defined throughout the City of Barrie. The aquifers are named A1 through A4, from top to bottom. The aquifers are separated by confining layers ranging from clay and silt to silty sand and sandy silt with varying thickness. A description of the aquifers is provided below.

- The A1 aquifer is located mainly in upland areas (not regionally extensive). The aquifer is described as being composed of fine to medium grained sand with occasional occurrences of gravel.

- The A2 aquifer is generally found within the elevation range of approximately 175 to 230 masl (LSRCA, 2012). The aquifer is generally described as ranging in thickness from approximately 10 to 30 m and is regionally extensive. The aquifer mainly consists of sand however is noted for its

complexity in the central core of Barrie, where stratigraphy is inter-layered with sand and silt/clay deposits. The aquifer is interpreted to extend under Kempenfelt Bay with potential connections to the deeper channelized aquifers in this area which were formed as in-filled former river channels.

- The A3 and A4 aquifers are connected within the Barrie area and are commonly referred to as the lower aquifer. This is the primary supply source for the City of Barrie's drinking water. A discussion of municipal groundwater supply wells is provided in Section 2.3.2 of this report. The A3 and A4 aquifer is generally found at an elevation ranging from 150 to 195 masl, and 115 to 160 masl, respectively (LSRCA, 2012). The A3/A4 aquifer is generally composed of coarse grained sand and gravel.

2.3.2 Groundwater Resources and Supply

As part of the hydrogeological study, DS completed a search of the Ministry of Environment, Climate and Parks (MECP) Water Well Record (WWR) and Permit to Take Water (PTTW) database. A summary of the search is presented in **Appendix D** and **Figure 1** shows the location of all MECP-registered water well and PTTW records within a 500-meter radius of the site.

A review of the water well records indicated that there are one hundred fourteen (114) registered water wells within 500 m. Of the one hundred fourteen records, fourteen (14) are records of well abandonments/dewatering wells, one (1) is listed as public supply well and five (5) as a municipal observation well, five (5) are listed as domestic supply wells, sixty-nine (69) as test holes/observation wells and twenty (20) that did not specify. The depths of the water supply wells range from 4.0 to 108.8 mbgs.

Records for the five (5) domestic water wells (MECP WWR # 5701723, 5709345, 5700243, 5700261 and 5700270) indicate that the wells were drilled in 1953, 1972, 1958, 1962 and 1963, respectively. It is interpreted that the supply wells were completed in underlying Silty Sand/Sand to Sandy Silt. The well records show fine to coarse sand deposits with intermittent (stratified) silt and clay deposits. The area is currently serviced by a municipal water supply and these wells have likely since been decommissioned or are no longer in use.

The city of Barrie began supplying water from surface water sources in 2011, however only for the south end of the city. The north end does still use ground water sources. The Site is located along the boundary of the groundwater and surface water sourced groundwater distribution systems. The public supply well found within 500m (MECP WWR # 5701725) was completed in August 1957 however is not currently in use. The closest municipal wells currently in use includes Production Well W12 (WWR #5720696) located about 350m northeast in Centennial Park adjacent Kempenfelt Bay, and Production Well W5 (WWR #5700253) which is located approximately 1km northwest on John St.

Based on a review of the water well record for Production Well W12, the well is screened at a depth of about 66 to 90 mbgs corresponding to an approximate elevation of about 144 to 156 masl. The log

provided in the record does not indicate stratigraphy encountered below 58 mbgs and so a description of screened overburden is not available however it is expected that there is a continuation of sand and gravel as last logged. The sand and gravel is confined by a clay unit extending from about 45 to 48 mbgs (~ 174 to 177 masl). The bottom of the confining layer is interpreted to be the top of the A3 aquifer as described in Section 2.3.1. The site is noted as being within the Well Head Protection Area (WHPA) "C" for W12. This area represents a 5-year time of travel for the W12 catchment area.

Based on a review of the water well record for Production Well W5, the well is screened at a depth of about 94 to 107 mbgs corresponding to an approximate elevation of about 126 to 139 masl. The well was completed in a gravel and sand deposit which is confined by a clay unit extending from about 42 to 50 mbgs (~ 191 to 183 masl). The bottom of the confining layer is interpreted to be the top of the A3 aquifer as described in Section 2.3.1.

2.3.3 Groundwater Conditions

Groundwater conditions at the Site were assessed using nine monitoring wells (BH101, BH102, BH201, BH205, BH308, MW102, MW108, MW202 and MW203) installed in the upper groundwater zone at depths between 4.5 and 10.5m below ground surface. The monitoring wells are screened in sandy silt, and sand for boreholes BH101, BH102, BH205, BH308, MW102, MW108, MW202 and MW203 and clayey silt for BH201. The most recent groundwater level monitoring was conducted on August 24th, 2021, at all available monitoring wells. The location of the monitoring wells is presented in **Figure 3**. A summary of the measured groundwater level elevations is provided in **Table 1** below.

Table 1: Groundwater Levels in Monitoring Wells

Monitoring Well	Ground Elevation (masl)	Well Depth (mbgs)	Screened Interval (mbgs)	Ground Water Elevation (masl)	Ground Water Elevation (masl)	Ground Water Elevation (masl)	Ground Water Elevation (masl)
				May 2012	Winter 2018 and 2019	June 05, 2020	August 24, 2021
BH101	227.7	5.4	2.4-5.4	-	224.8	225.1	224.77
BH102	226.9	4.3	2.8-5.8	-	224.2	224.3	224.07
BH201	226.9	9.8	6.8-10.5	-	224.7	224.7	224.38
BH205	227.4	5.5	2.6-5.6	-	224.7	224.8	224.65
BH308	227.1	4.6	1.5-4.6	-	224.0	224.2	224.13
MW102	228.9	6.1	3-4.5	225.3	-	-	225.61
MW202	228.2	-	-	-	-	-	225.25
MW203	228.5	-	-	-	-	-	225.60
MW108	229.6	5.6	3-6	225.8	-	-	226.03

Notes: Water levels measured are representative of stabilized conditions.

Groundwater levels were measured on August 24th. The water levels ranged from 2.57 – 3.57 mbgs, corresponding to elevations ranging from 224.38 - 226.03 masl. Based on measured water levels, the

localized groundwater flow in the vicinity of the Site is interpreted to be in a north-easterly direction. A groundwater flow direction map is provided in **Figure 4**.

2.3.4 Hydraulic Conductivity

Single Well Response Tests (SWRTs) to assess in-situ hydraulic conductivity (K) were completed by DS on August 24, 2021, at three (3) monitoring wells. The test method is a bail test, which is a rapid removal of a volume of water using a bailer. The ensuring rising recovery to static level is observed over time. K values were calculated using the Bouwer and Rice method. The K values ranged from 7.34×10^{-6} m/sec in the fine silty sand unit to as high as 1.05×10^{-6} m/sec in the clay silt unit with a geometric mean of 2.04×10^{-5} m/sec. **Table 2** presents a summary of the Hydraulic Conductivity (K) results for the testing. Individual reports are provided in **Appendix B.**

Table 2: Summary of Hydraulic Conductivity Results

Monitoring Well	Depth (mbgs)	Sample Screened Interval (masl)	Screen Formation	In-situ Hydraulic Conductivity (K) (m/sec)	Geomean Hydraulic Conductivity * (m/sec)
BH102	4.34	224.1-221.1	Sandy Silt	1.10×10^{-6}	2.04×10^{-7}
BH201	9.81	220.1-216.4	Clayey Silt	1.05×10^{-6}	
MW108	5.64	226.6-223.6	Sandy Silt	7.34×10^{-8}	

2.3.5 Water Quality

On May 7, 2012, G2S attended the site located at 259 Innisfil Street to collect groundwater samples for chemical analysis of various parameters. The monitoring wells were sampled using dedicated bailers and samples transported to AGAT Laboratories Inc. Based on the results, groundwater in the area tested meets the MOE Table 2 SCS for industrial/ commercial property use and coarse-grained soil.

G2S collected groundwater samples throughout February and March 2018, and Azimuth Environmental Consultant collected groundwater samples throughout the October 2018, the May/June and November 2019 from existing wells which located on 41-43 Essa Road. The monitoring wells were sampled using low-flow sampling by removing a minimum of three casing volumes and until field parameter measurements had stabilized. The groundwater samples were submitted under a chain of custody for chemical analysis of various parameters to ALS Laboratory and AGAT respectively. Based upon the analytical findings of the groundwater evaluation, the site was determined to have not met the MECP table 2 SCS for Residential/ Parkland/Institutional Property Use for coarse textured soils for at least one or more parameters. Environmental work at site is ongoing.

If temporary lowering of the water table is required for construction of foundations or installation of services, and the intent be to discharge to city infrastructure, the quality of groundwater in the vicinity of the water taking should be sampled and sent to a certified lab for comparison against the Barrie sewer use By-law.

3. SITE WATER BALANCE

To understand and compare existing hydrologic conditions, a Thornthwaite site water balance was completed. The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are monthly temperature, Site latitude, precipitation, and stormwater run-on. Outputs include monthly potential and actual evapotranspiration, evaporation, water surplus, total infiltration, and total runoff. For ease of calculation, a spreadsheet model was used for the computation.

When precipitation (P) occurs, it can either runoff (R) through the surface water system, infiltrate (I) to the water table, or evaporate/evapotranspiration (ET) from the earth's surface and vegetation. The sum of R and I is termed as the water surplus (S). When long-term averages of P, R, I and ET are used, there is no net change in groundwater storage (ST). Annually, however, there is a potential for small changes in ST. The annual water budget can be stated as **P = ET + R + I + ST** and the components are discussed below.

Precipitation (P)

Based on the 30-year average for the Shanty Bay Climate Station in Ontario, the average precipitation for the area is about 968 mm/year for the period between 1981 and 2010. Also, the average monthly temperature from this station has been used. The monthly distribution of precipitation is presented in **Table D-1, Appendix D.**

Storage (St)

Groundwater storage (ST) of native soils for the existing Site was estimated using values of Water Holding Capacity (mm) of respective land use and soil types identified in Table 3.1 of the Storm Water Management (SWM) Planning & Design Manual (MOE, March 2003). The land uses and soil types chosen to represent existing conditions at the Site include urban lawn and treed areas with a fine sand soil, as well as impervious areas consisting of buildings, paved areas and gravel lots (assumed impervious). Water holding capacities for the pervious areas were selected to be 50 mm (lawn) and 250 mm (treed areas) and applied to March for monthly calculations. Using the procedures outlined in the SWM Planning & Design Manual for the above land use and soil type, the annual change in storage is zero (0).

Evapotranspiration (Et)

Monthly Potential Evapotranspiration (PET) is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation-covered area that never lacks water (Thornthwaite,1948; Mather, 1978). In the Thornthwaite water balance model, PET is calculated using the Hamon equation (Hamon, 1061);

PET Hamon = 13.97 * d * D2 * Wt

Where:
d = the number of days in the month
D = the mean monthly hours of daylight in units of 12 hours

Wt = a saturated water vapour density term = 4.95 * e0.627/100
T = the monthly mean temperature in degrees Celsius

The calculated Actual Evapotranspiration (AET) is based on PET and changes in ST (Δ ST). Where there is not enough P to satisfy PET, a reduction in ST occurs. As a result, volumes of AET are less than PET. Also, it is assumed that evaporation will occur and will amount to approximately 15% of the total precipitation for an impervious cover.

Precipitation Surplus (S)

Precipitation surplus is calculated as P–ET. For pervious areas, ET is considered AET and for impervious areas, ET is evaporation.

Infiltration (I) and Runoff (R)

For pervious areas, precipitation surplus has two components in the Thornthwaite model: a runoff component (overland flow that occurs when soil moisture capacity is exceeded) and an infiltration component. The accumulation of infiltration factors for topography, soil types and cover as prescribed in Table 3.1 of the SWM Planning & Design Manual give infiltration factors for existing conditions on the Site as shown below in **Table 4**. The runoff component calculated in the pre-development model is the remaining volume of precipitation surplus following AET, ET, and infiltration.

Table 4- Existing Conditions – Infiltration Factor

Land uses / soil types	Topography	Soil	Cover	Total infiltration factor
Urban Lawn /Fine Sand	0.30	0.20	0.10	0.60
Treed /Fine Sand	0.2	0.20	0.20	0.60

3.1 Pre-development Water Balance

The subject Site has a total area of 17,896 m^2 with existing buildings and asphalt/gravel parking/storage areas consisting of about 15,134 m^2. Pervious areas of the site consist of a treed areas (1,944 m^2) and a lawn areas (818 m^2). For the purpose of this assessment, the gravel area is assumed to be relatively impermeable as a result of compaction. **Figure 5** shows the pre-development conceptual model considered for establishing current hydrologic conditions. To predict outputs of the pre-development water balance, various inputs were entered into the Thornthwaite model including monthly precipitation and temperature, site latitude, water holding capacity values for native soils and factors of infiltration. Various inputs and outputs of the model are summarised below. The detailed calculations are presented in **Table D-1, D-2 Appendix** D.

The average precipitation for the area is about 968 mm/yr. For the pervious area, the calculated PET is 574 mm/year or about 59% of the total precipitation. The monthly distribution of ST for landscaped area (urban lawns) with sandy soils produced a unit area annual AET of 506 mm/yr. For the treed areas AET is 554 mm/yr. Given existing conditions, the pre-development site water balance includes 2,197 m^3/yr evaporation, 1,491 m^3/year of evapotranspiration, a total of 672 m^3/year infiltration and 12,963 m^3/year runoff.

3.2 Post-development Water Balance

The proposed development has the same total area of 17,896 m^2. The proposed building has an area of 12,074 m^2. Additional impervious areas include the paved drive and hardscaped surfaces (3,555 m^2). The pervious area of the proposed development includes 2,267 m^2 of lawn and pervious landscaping. **Figure 6** shows the pre-development conceptual model considered for establishing proposed hydrologic conditions. To predict outputs of the post-development water balance, various inputs were entered into the Thornthwaite model including monthly precipitation and temperature, site latitude, water holding capacity values for native soils and factors of infiltration. Various inputs and outputs of the model are summarised below. The detailed calculations are presented in **Table D-1, D-3 Appendix D**.

PRECIPITATION (P)

Precipitation remains the same (ie. The 30-year climate normals (1981-2010) for the Shanty Bay Climate Station).

STORAGE (ST)

Groundwater storage (ST) of native soils for the post-development site changes to reflect the increased landscaped areas. These areas are given a soil moisture holding capacity of 50 mm for sandy soils. Similar to the pre-development conditions, using the procedures outlined in the SWM Planning & Design Manual for each land use, the annual change in storage is 0. The monthly distribution of ST for each of the land use/soil types is presented in Table D-3 Appendix D.

EVAPORATION / EVAPOTRANSPIRATION (ET)

In the post construction scenario, changes in land use do not result in a significant change in pervious/impervious areas. This is due to the site currently being primarily impervious to begin with. Considering a total annual precipitation of 968 mm, evaporation is estimated at 145 mm. As a result, a total annual volume of evaporation is estimated at 2,269 m^3/yr. The detailed calculations for evaporation are included in Table D-3 Appendix D.

For post-development pervious areas, monthly PET is estimated using the same inputs and calculations described in the pre-development model respective of land use and soil moisture holding capacity. In the post-development scenario, annual AET is 506 m^3/yr . The monthly distribution of Post-development AET and detailed calculations are presented in Table D-3, Appendix D.

PRECIPITATION SURPLUS (S)

For post-development pervious surfaces at the site, precipitation surplus is calculated as P –AET which includes about 462 mm/yr. For Impervious surfaces at the site, surplus is P-ET where ET is estimated at 15% of P. The resulting precipitation surplus is about 823 mm/yr. The more detailed calculations are included in Table D-3, Appendix D.

INFILTRATION (I)

The same accumulation of infiltration factors for topography, soil types and cover as prescribed in Table 3.1 of the SWM Planning & Design Manual were used give infiltration factors for post-development conditions.

A 10% decrease in the infiltration factor was applied to account for soil compaction activities which may occur during construction practices. It is expected that fill materials brought in to reclaim the areas of these structures will be of a similar quality or better with regards to permeability.

Considering the infiltration factors used, the total volume of Infiltration (I) estimated for post-development conditions is about 471 m^3/yr. The more detailed calculations are presented in Table D-3, Appendix D.

RUNOFF (R)

The runoff component calculated in the post-development model is a combination of the remaining volume of precipitation surplus for both pervious and impervious areas. The total volume of runoff (R) estimated for post-development conditions is 13,436 m^3/yr. The more detailed calculations are presented in Table D-3, Appendix D.

3.3 POST-DEVELOPMENT WATER BALANCE (WITH MITIGATION)

Based on results of the pre-development and post-development water balance completed, the proposed development will produce a reduction in annual AET (72 m^3/yr), a slight increase in annual ET (344 m^3/yr), a reduction in annual infiltration (201 m^3/yr) and an increase in annual runoff (473 m^3/yr), as shown in Table D-4, Appendix D. The effects are mainly the result of a slight increase in impervious area.

Based on the results of the pre and post-development site water balance, the hydrology of the site pre to post development is relatively unchanged. The small infiltration deficit of 201 m^3/yr could be mitigated with enhanced topsoil to improve soil moisture storage and permeability. For additional benefits, the permeability of the native soils and groundwater conditions are favorable for infiltration facilities. Buried facilities should maintain 1m between the seasonally high water table and the bottom of the facility to ensure an effective design. In-situ testing in the area of any proposed infiltration facility is recommended.

4. CONSTRUCTION DEWATERING

4.1 Estimation of Flow Rates- Proposed Building and Site Servicing

Building concept plans were provided for review however detailed designs were not available at the time of writing the report. It is understood that the proposed development will not include underground parking or a basement. The design grades are not known at this stage. Based on well data, most of the building foundation requiring excavation will be founded above the groundwater elevation during high water table. Dewatering will not be required during the construction of the proposed building unless it is

to remove stormwater from precipitation events.

4.2 Total Estimation of Flow Rate (Short-Term/ Temporary Discharge)

Temporary dewatering to remove groundwater seepage for an unsealed excavation is not anticipated to be a requirement considering excavation work is not expected to intersect the water table. To estimate dewatering to remove storm water from the excavation, a rainfall of 40mm is considered for the approximated 12,074 m^2 excavation. The resulting volume of water would be 482,960 m^3 which could be pumped out of the excavation in a single day without going over the 400 m^3/day bottom limit requiring a PTTW.

4.3 Permanent Drainage (Long-term Discharge)

The proposed construction of the building is expected to remain above the water table at the site and as such, permanent dewatering is not anticipated.

4.4 Environmental Activity and Sector Registry (EASR) /Permit to Take Water (PTTW) Application

An Environmental Activity Sector Registration (EASR) is required to be submitted to the Ministry of the Environment, Conservation and Parks (MECP) if the taking of groundwater and stormwater for a temporary construction project is between 50,000 L/day and 400,000 L/ day. The EASR application is an online registry and should be submitted to the MECP before any construction dewatering. A PTTW is required to be submitted to the MECP if the taking of groundwater and stormwater for a temporary construction project is more than 400,000 L/ day.

Since the temporary dewatering rate could be greater than 50,000 L/day with a large precipitation event, an EASR is required from the MECP for short-term dewatering, however a PTTW is not.

5. POTENTIAL IMPACTS

The following are the predicted potential impacts as a result of the proposed development and associated construction dewatering:

5.1 Local Groundwater Use

Based on the MECP WWRs, there are no wells expected in the predicted radius of Influence (40m). Water supply wells are noted to be installed at deeper depths within lower aquifers. Since the proposed construction is anticipated to be above the water table, there will be no short-term or long-term predicted impacts on private and public water wells occurring from dewatering.

No adverse impact on any source water is anticipated since the proposed construction will not have permanent under-slab drainage and short-term construction dewatering is expected to remove stormwater only.

5.2 Point of Discharge and Groundwater Quality

Since the proposed construction is anticipated to be above the water table, there will be no short-term or long-term dewatering to control groundwater. Any discharged water from the excavation would be from stormwater events during construction. The water could be high in suspended solids as a result of encountering loose soils from the excavation. As a result any pumped water should first be treated with a settling tank and possibly a filtration system to remove solids prior to discharge. Should dewatering be required in this regard, testing of the water against the Barrie Sewer use By law should be completed to confirm acceptable quality.

5.3 Groundwater Recharge

Potential impacts to aquifer recharge are anticipated since there is not a reduction in pervious area where infiltration can occur. A small infiltration deficit of 201m^3/yr was estimated as a result of decreased infiltration from compaction activities over the pervious area. Decreasing the effects of soil compaction can be achieved by increasing topsoil depth over the pervious areas. Other Low Impact Development (LID) measures to improve infiltration are not considered necessary unless to provide a post-development phosphorus load reduction.

6.4 Well Decommissioning

Following the completion of construction activities, all dewatering wells, well points, eductors and monitoring wells installed at various stages of this project must be decommissioned. The installation and eventual decommissioning of the wells and the dewatering system must be carried out by a licenced water well contractor in accordance with Regulation 903 of the Ontario Water Resources Act.

6. LIMITATIONS

This report was prepared for the sole use of the addressee to provide an assessment of the hydrogeological conditions on the property. The information presented in this report is based on information collected during the completion of the hydrogeological investigation. DS Consultants Ltd. was required to use and rely upon various information sources produced by other parties. The information provides in this report reflects DS's judgment in light of the information available at the time of report preparation. This report may not be relied upon by any other person or entity without the written authorization of DS Consultants Ltd. The scope of services performed in the execution of this investigation may not be appropriate to satisfy the needs of other users, and any use or reuse of these documents or findings, conclusions, and recommendations represented herein, is at the sole risk of said users. The conclusions drawn from the Hydrogeological report were based on information at selected observation and sampling locations. Different conditions between and beyond these locations may become apparent during future investigations or on-site work, which could not be detected or anticipated at the time of this investigation. DS Consultants Ltd. cannot be held responsible for hydrogeological conditions at the Site that was not apparent from the available information.

Should you have any questions regarding these findings, please do not hesitate to contact the undersigned.

DS CONSULTANTS LTD

Prepared By:

Lili Ghasemi, M.Sc. GIT.,
Project Manager

Reviewed By:

Senior Hydrogeologist

7. REFERENCES

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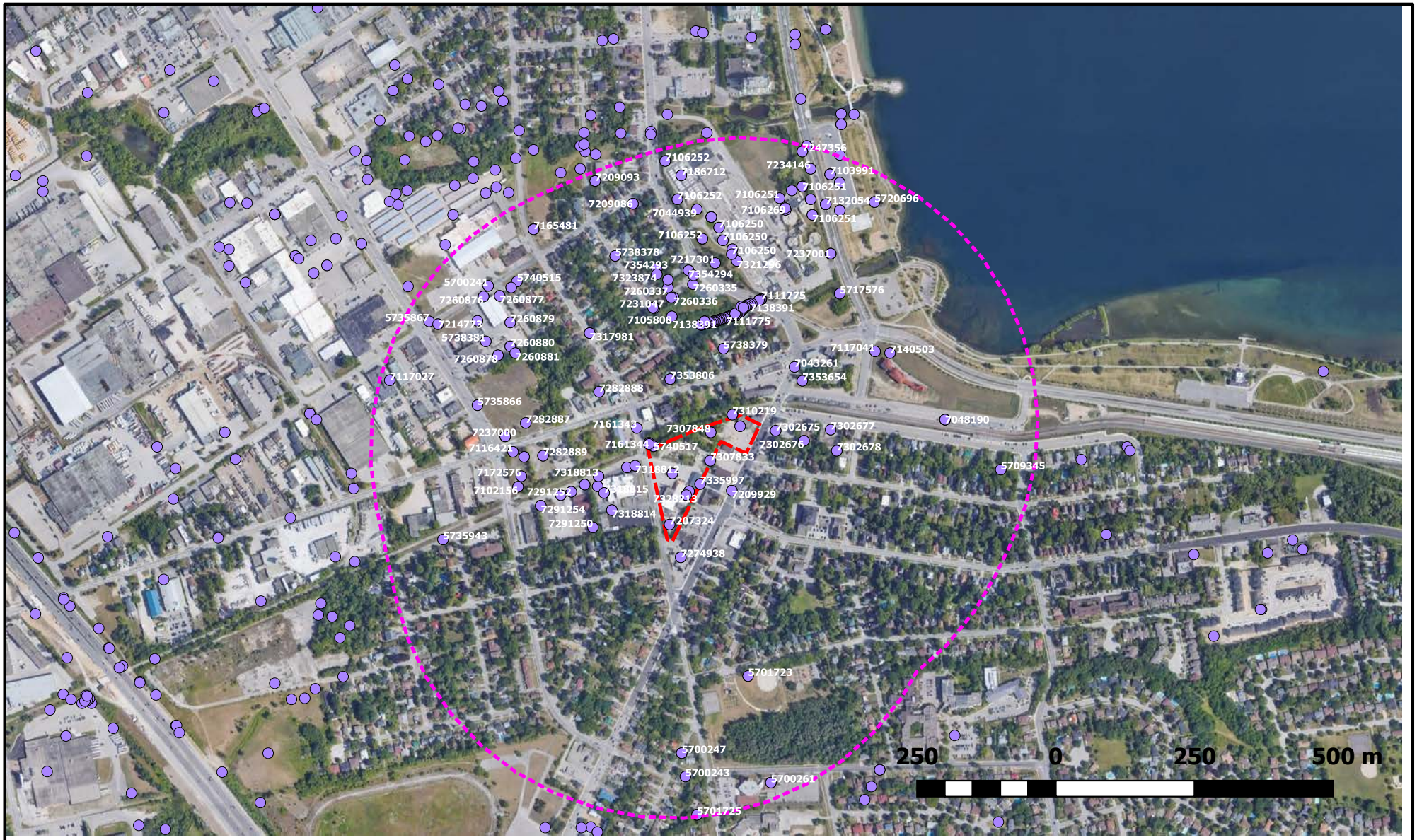
Drawings



Legend

- Aproximate Site Boundary
- 500m Site Buffer
- MOECC Water Well Record Locations

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www.dsconsultants.ca

Project: HYDROGEOLOGICAL INVESTIGATION - 41-43 ESSA RD. & 259 INNISFIL ST.

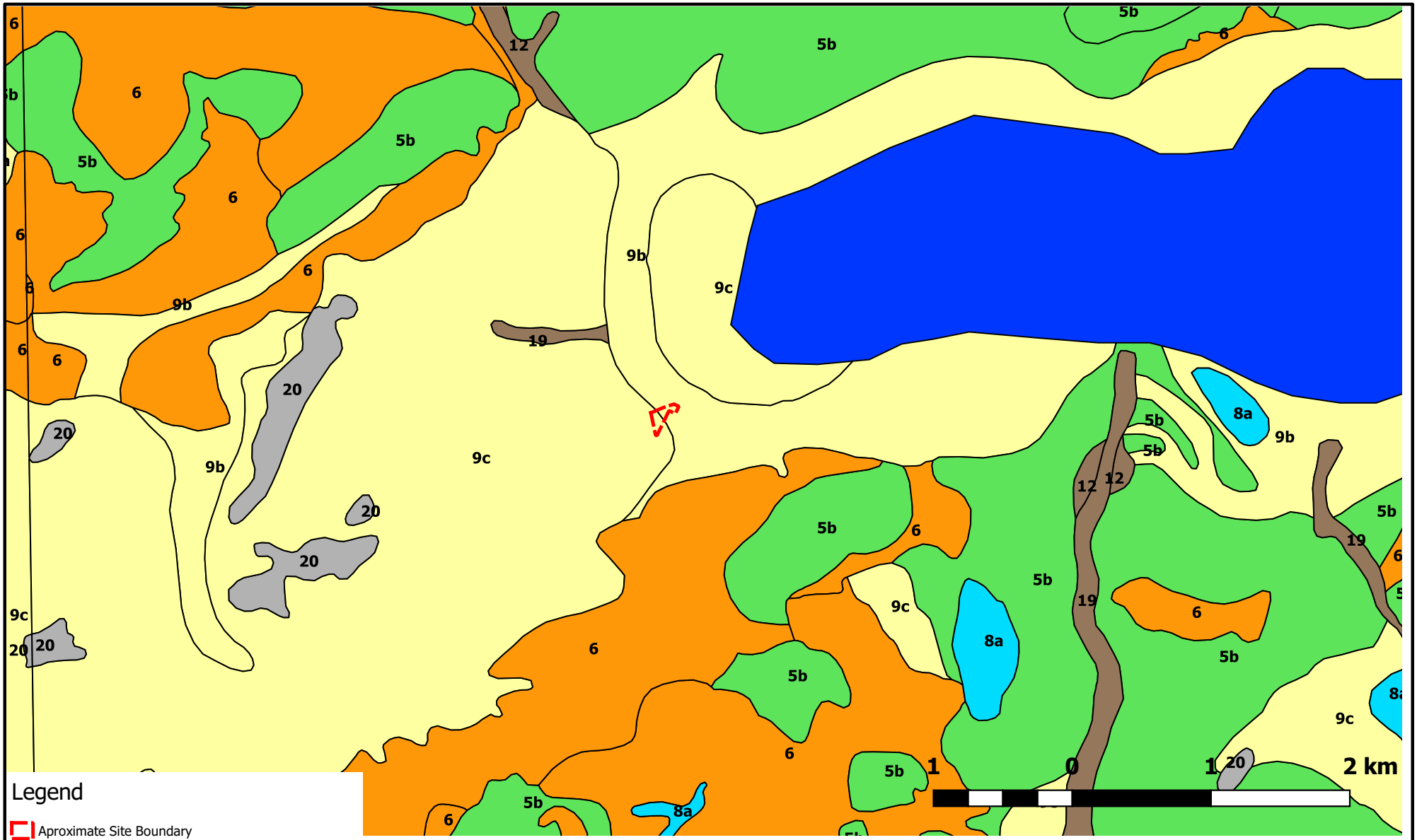
Title: **MOECC WATER WELL RECORD LOCATION MAP**

N

Client: Tonlu Holdings Limited

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	L.G	AUGUST 2021
Rev: 0	Scale: As Shown	Project No.: 21-113-100	Figure No.: 1

Image/Map Source: *Google Satellite Image*



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Project: HYDROGEOLOGICAL INVESTIGATION - 41-43 ESSA RD. & 259 INNISFIL ST.

Title: **SURFICIAL GEOLOGY MAP**

Client: Tonlu Holdings Limited

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	L.G	AUGUST 2021
Rev: 0	Scale: As Shown	Project No.: 21-113-100	Figure No.: 2

Image/Map Source: *Google Satellite Image*

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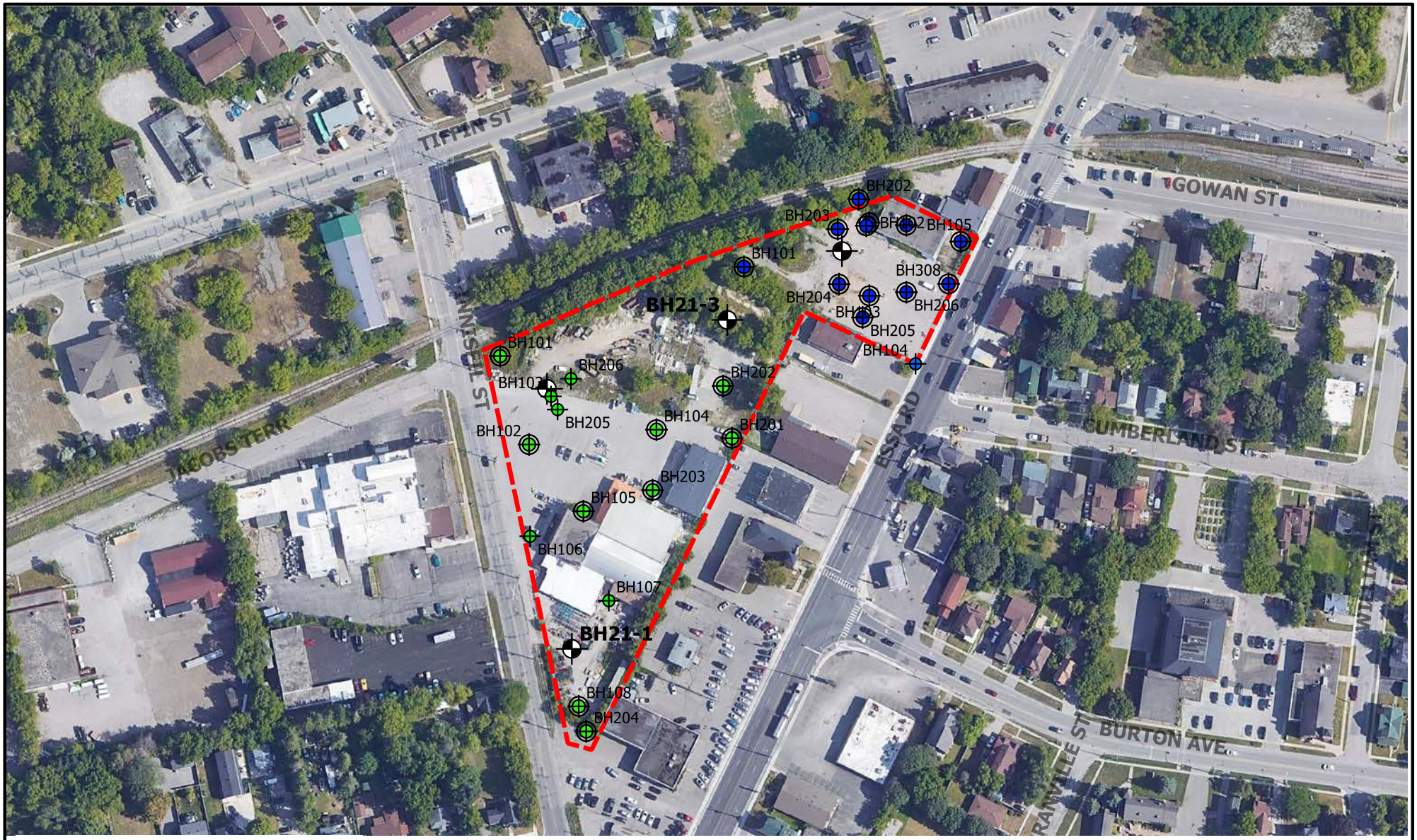

Legend

- Aproximate Site Boundary
- BH Location (259 Innisfil Street)
- BH/MW Location (259 Innisfil Street)
- BH Location (41-43 Essa Road)
- BH/MW Location (41-43 Essa Road)
- Borehole Location (DS 2021)

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Project: Hydrogeological Investigation
41-43 Essa Road and 259 Inisfil Street, Barrie, Ontario

Title: **Borehole and MonitoringWell Location Map**

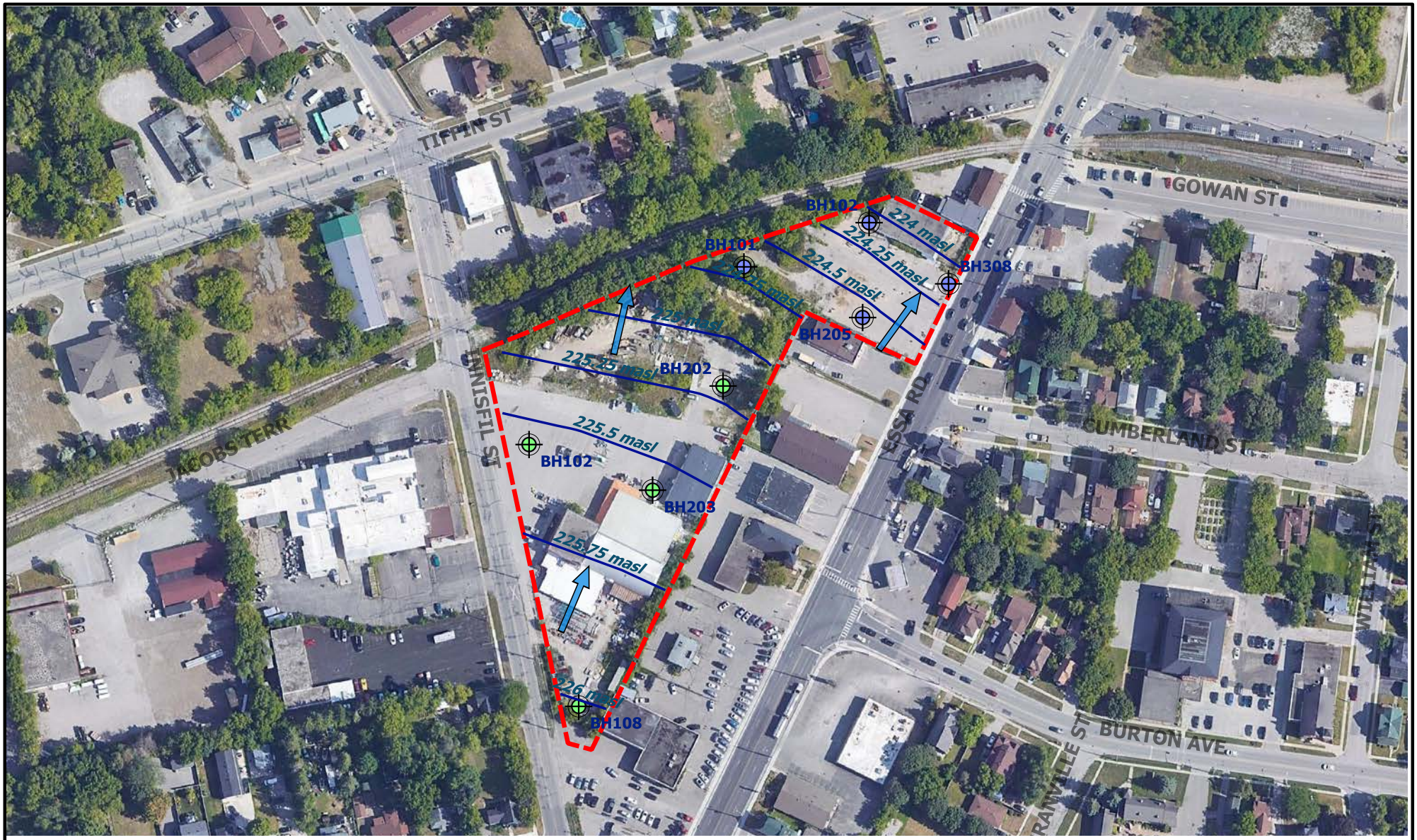
N

Client: Tonlu Holdings Ltd.

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	L.M	S.W	September 2021
Rev: 0	Scale: As Shown	Project No.: 21-113-100	Figure No.: 3

Image/Map Source: *Google Satellite Image*

C:\Projects\Essa Rd\GW Flow.qgs



Legend

- Aproximate Site Boundary
- Monitoring Wells (41-43 Essa Road)
- Monitoring Wells (259 Innisfil Street)
- Groundwater Contours (0.25m)
- Groundwater Flow Direction

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Project: Hydrogeological Investigation
41-43 Essa Road and 259 Inisfil Street, Barrie, Ontario

Title: **Groundwater Flow Direction Map**

N

Client: Tonlu Holdings Ltd.

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	L.M	S.W	September 2021
Rev: 0	Scale: As Shown	Project No.: 21-113-100	Figure No.: 4

Image/Map Source: *Google Satellite Image*

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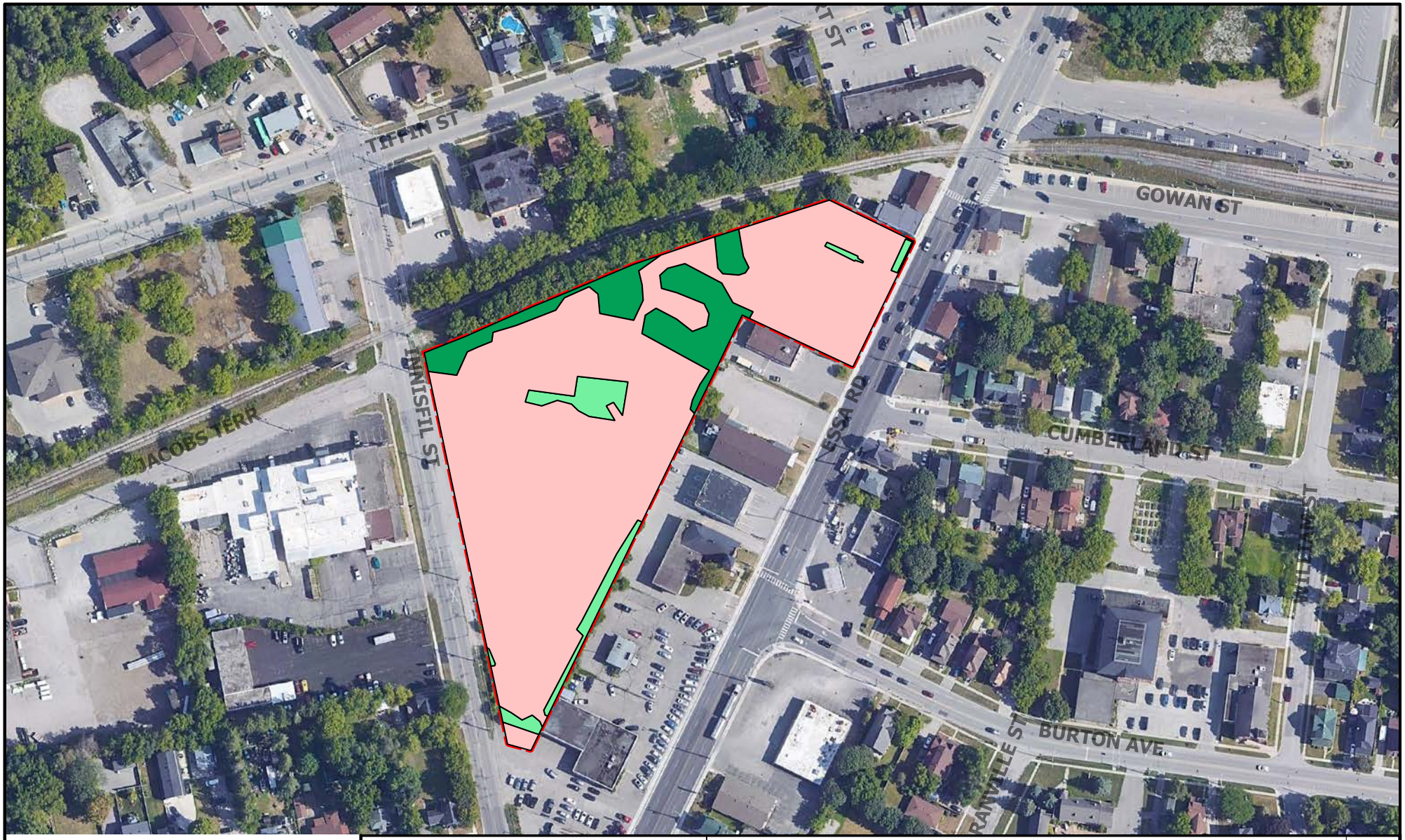

Legend

- Aproximate Site Boundary
- Impervious Area (roof / Paved)
- Forest
- Landscaped (lawn)

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Project: Hydrogeological Investigation
259 Innisfil St. and 41-43 Essa Rd. Barrie, Ontario

Title: **Pre-Development Conceptual Site Model**

N

Client: Tonlu Holdings Ltd.

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	L.M	S.W	September 2021
Rev: 0	Scale: As Shown	Project No.: 21-018-100	Figure No.: 5

Image/Map Source: *Google Satellite Image*

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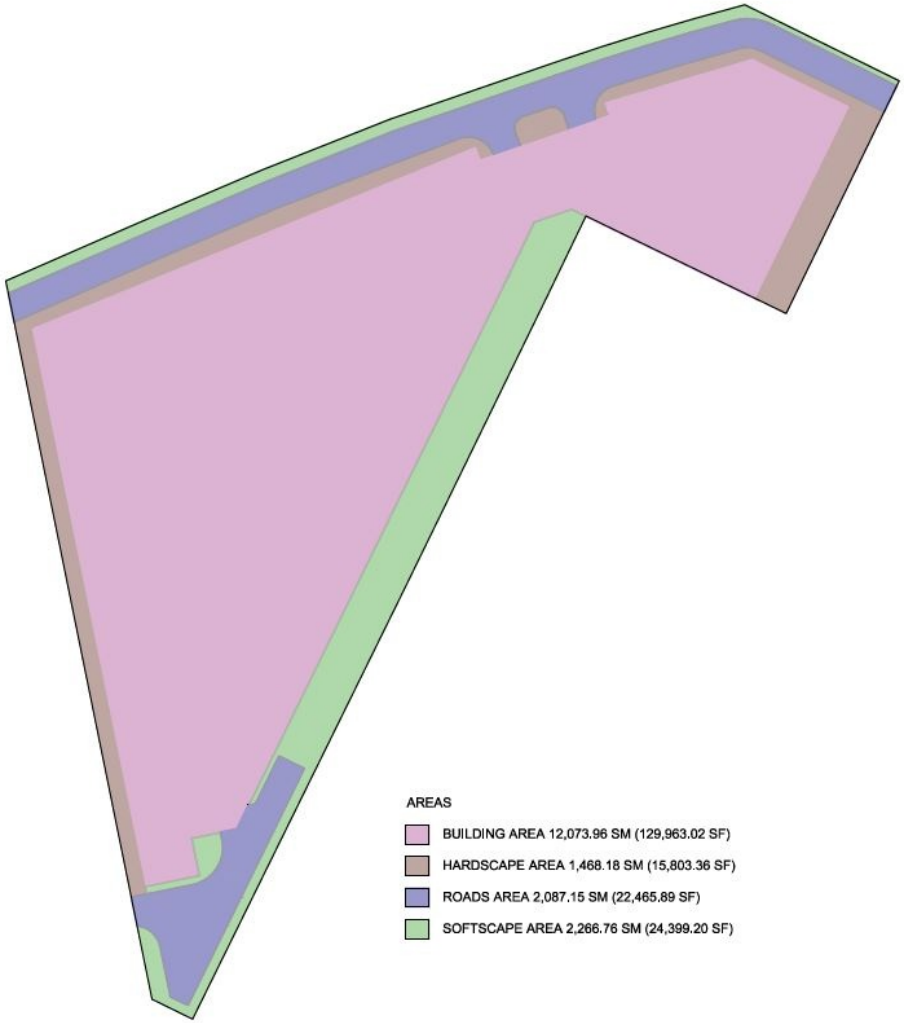

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Project: Hydrogeological Investigation
41-43 Essa Road and 259 Inisfil Street, Barrie, Ontario

Title: **Post-Development Conceptual Site Model**

N

Client: Tonlu Holdings Ltd.

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	L.M	S.W	September 2021
Rev: 0	Scale: As Shown	Project No.: 21-113-100	Figure No.: **6**

Image/Map Source: *Google Satellite Image*

Appendix A

LOG OF TEST PIT BH21-4

PROJECT: Geotech and hydrogeo - Proposed Residential Development

CLIENT: Tonlu Holdings Limited

PROJECT LOCATION: 41-43 Essa Rd. and 259 Innisfil St., Barrie, ON

DATUM: Geodetic

BH LOCATION: See Drawing 1 N 4914178.332 E 604213.78

DRILLING DATA

Method: Hollow Stem Auger/ Mud Rotary

Diameter: 200mm

Date: Jun/14/2021

REF. NO.: 21-113-100

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
227.0								
0.0 / 226.4	**GRANULAR FILL:** sand some gravel, some organics, brown, moist, loose		1	SS	7			HEX:15, IBL:0
0.6	**SAND:** trace silt, yellowish brown, moist, loose to compact		2	SS	14		226	HEX:15, IBL:0
			3	SS	7			HEX:10, IBL:0
			4	SS	19			HEX:10, IBL:0
	grey below 3m		5	SS	24		224	0 93 7 0 HEX:10, IBL:0 wet spoon
			6	SS	16		Bentonite	HEX:5, IBL:0
220.1			7	SS	23			HEX:20, IBL:0
6.9	**SANDY SILT:** trace clay, grey, wet, compact		8	SS	11		220	0 31 64 5 HEX:0, IBL:0
217.9			9	SS	40		218	0 20 73 7 HEX:0, IBL:0
9.1	**SILT:** some sand, trace clay, grey, wet, stiff							
216.0			10	SS	22		216	HEX:0, IBL:0
11.0	**SAND:** grey, wet, compact		11	SS	24			HEX:20, IBL:0
213.3							214	
13.7	**SANDY SILT:** trace gravel, trace clay, grey, wet, compact to dense		12	SS	18			4 35 53 7 HEX:5, IBL:0
			13	SS	35		212	HEX:0, IBL:1
			14	SS	61		210 Grout	HEX:0, IBL:0
	some clay below 18.3m		15	SS	62			HEX:0, IBL:0
207.2							208	
19.8	**SILT AND SAND:** trace clay, grey, wet, compact (disturbed due to groundwater)		16	SS	11			0 45 50 5 HEX:0, IBL:0
205.4			17	SS	70		206	HEX:0, IBL:0
21.6	**SAND:** some silt, grey, wet, very dense							
204.1								
22.9	**SANDY SILT:** grey, wet, very dense		18	SS	>100		204	0 34 66 0 HEX:0, IBL:0
202.0			19	SS	>100			HEX:0, IBL:0
25.0	**END OF BOREHOLE:** Notes: 1)water at 3mbgs during drilling 2)BH backfilled with grout to 10m							

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WELL NUMBER BH/MW101

CLIENT Barrie Drive-A-Car (1979) Ltd. **PROJECT NAME** Phase Two ESA

PROJECT NUMBER G2S18006B **PROJECT LOCATION** 41 & 43 Essa Road, Barrie, Ontario

DATE STARTED 2/8/18 **COMPLETED** 2/8/18 **GROUND ELEVATION** 100.76 m **HOLE SIZE** 15 cm

DRILLING CONTRACTOR Profile Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Hollow Stem Augers/Split Spoon Samplers **AT TIME OF DRILLING** ---

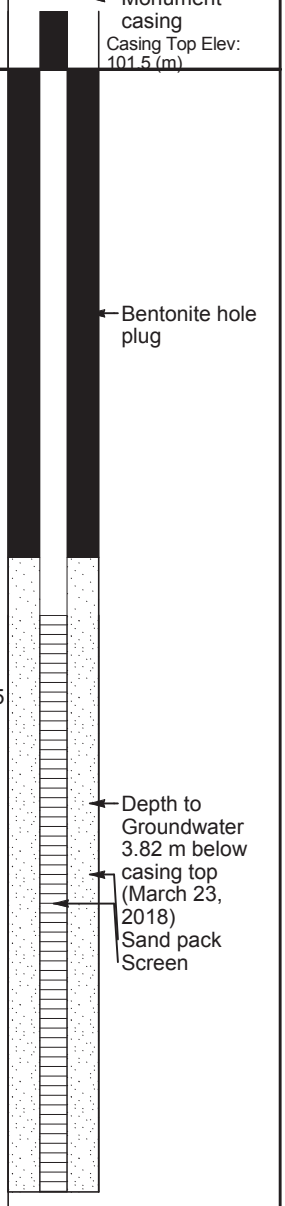
LOGGED BY DH **CHECKED BY** JS **AT END OF DRILLING** ---

NOTES Vapour Measurements in ppm **AFTER DRILLING** 3.08 m / Elev 97.68 m

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
				0.10 Approximately 10 cm of concrete 100.66	
	SS1	90-18-10-10/0.05		FILL - Sand, some silt, trace gravel, black, dry to moist, compact	GSTH = 0 PID = 0
				0.60 100.16	
				SILTY SAND - Brown, moist, fine, loose	
1	SS2	3-3-3-4 (6)			GSTH = 0 PID = 0
	SS3	3-4-5-6 (9)			GSTH = 5 PID = 0
2					
	SS4	2-3-4-7 (7)			GSTH = 5 PID = 0
3					
	SS5	5-8-12-15 (20)			GSTH = 15 PID = 0
4				Grey and saturated at 4.5 m bgs	
	SS6	0-6-10-13 (16)			GSTH = 0 PID = 0
5					
6					
	SS7	0-4-9-12 (13)			GSTH = 0 PID = 0
				End of sampling at 6.6 m bgs	
				6.60 94.16	

Bottom of hole at 6.60 m.

WELL DIAGRAM



WELL NUMBER BH/MW102

CLIENT Barrie Drive-A-Car (1979) Ltd. **PROJECT NAME** Phase Two ESA

PROJECT NUMBER G2S18006B **PROJECT LOCATION** 41 & 43 Essa Road, Barrie, Ontario

DATE STARTED 2/8/18 **COMPLETED** 2/8/18 **GROUND ELEVATION** 99.91 m **HOLE SIZE** 15 cm

DRILLING CONTRACTOR Profile Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Hollow Stem Augers/Split Spoon Samplers **AT TIME OF DRILLING** ---

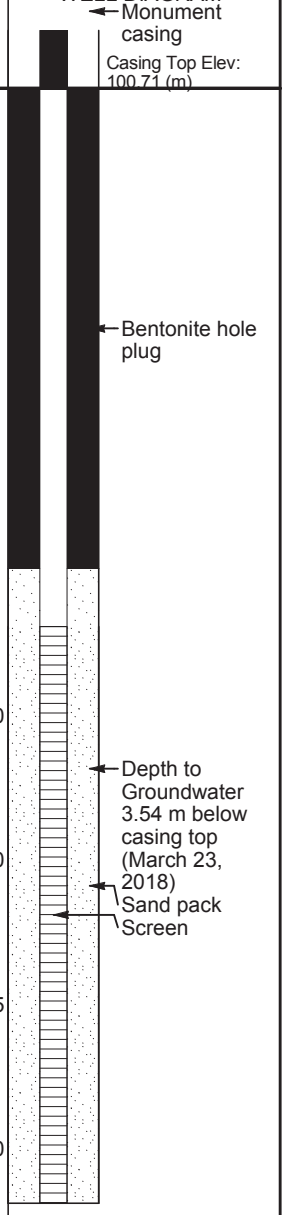
LOGGED BY DH **CHECKED BY** JS **AT END OF DRILLING** ---

NOTES Vapour Measurements in ppm **AFTER DRILLING** 2.74 m / Elev 97.17 m

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
					0.05 / 99.86 Approximately 5 cm of topsoil	
	SS1	10-4-4-7/0.10	MC = 15%		FILL - Sand and gravel, some silt, trace rocks, dry to moist, black/brown, hard, compact	GSTH = 0 PID = 0
					0.60 / 99.31 SILTY SAND - Brown, fine, moist to wet, compact, layering	
1	SS2	1-2-5-5 (7)	MC = 21%			GSTH = 0 PID = 0
	SS3	2-1-2-4 (3)	MC = 19%			GSTH = 0 PID = 0
2					Petroleum odour from 1.5 m bgs to bottom of hole	
	SS4	3-7-9-13 (16)	MC = 16%			GSTH = 310 PID = 268
3						
	SS5	4-6-8-11 (14)	MC = 19%		Greyish brown and saturated at 3.0 m bgs	GSTH = 60 PID = 104
4	SS6	0-2-5-7 (7)	MC = 24%			GSTH = 90 PID = 88
	SS7	0-0-2-5 (2)	MC = 23%			GSTH = 15 PID = 8
5						
	SS8	2-1-2-4 (3)	MC = 25%			GSTH = 20 PID = 14
6						
	SS9	0-3-7-11 (10)	MC = 20%			GSTH = 300 PID = 90
					6.60 / 93.31 End of sampling at 6.6 m bgs	

Bottom of hole at 6.60 m.

WELL DIAGRAM



WELL NUMBER BH/MW201

CLIENT Barrie Drive-A-Car (1979) Ltd. **PROJECT NAME** Phase Two ESA

PROJECT NUMBER G2S18006B **PROJECT LOCATION** 41 & 43 Essa Road, Barrie, Ontario

DATE STARTED 3/19/18 **COMPLETED** 3/19/18 **GROUND ELEVATION** 99.87 m **HOLE SIZE** 15 cm

DRILLING CONTRACTOR Profile Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Direct Push/Hollow Stem Augers **AT TIME OF DRILLING** ---

LOGGED BY DH **CHECKED BY** JS **AT END OF DRILLING** ---

NOTES Vapour Measurements in ppm **AFTER DRILLING** 2.28 m / Elev 97.59 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA	WELL DIAGRAM
			0.05 Approximately 5 cm of asphalt 99.82		Monument Casing Top Elev: 100.69 (m)
			FILL - Sand and gravel, some rocks, hard, compact, black/brown		
			0.60 99.27		
			SILTY SAND - Brown, fine, wet, compact		
2					
			Greyish brown and saturated at 3.0 m bgs		Depth to Groundwater 3.08 m below casing top (March 23, 2018)
4					Bentonite hole plug
6	SS1		Sample refusal at 6.9 m bgs	GSTH = 0 PID = 1	
			6.90 92.97		
			CLAYEY SILT - Auger cuttings observed to be grey clayey silt from 7.5 m bgs to bottom of hole		
8	AU				Sand pack Screen
10			10.50 89.37		

Bottom of hole at 10.60 m.

GENERAL BH / TP / WELL ESSA BH LOGS.GPJ GINT STD CANADA LAB.GDT 4/2/18

WELL NUMBER BH/MW205

CLIENT Barrie Drive-A-Car (1979) Ltd.
PROJECT NAME Phase Two ESA
PROJECT NUMBER G2S18006B
PROJECT LOCATION 41 & 43 Essa Road, Barrie, Ontario
DATE STARTED 3/20/18 **COMPLETED** 3/20/18
GROUND ELEVATION 100.4 m **HOLE SIZE** 15 cm
DRILLING CONTRACTOR Profile Drilling
GROUND WATER LEVELS:
DRILLING METHOD Direct Push/Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY DH **CHECKED BY** JS
AT END OF DRILLING ---
NOTES Vapour Measurements in ppm
AFTER DRILLING 2.83 m / Elev 97.57 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA	WELL DIAGRAM
			0.10 Approximately 10 cm of asphalt 100.30		Casing Top Elev: 100.4 (m)
			FILL - Sand and gravel, dry to moist, compact, some silt, brown		Flush mount casing
			0.60 99.80		
	SS1		SILTY SAND - Brown, fine, moist, compact	GSTH = 0 PID = 0	
1					
	SS2			GSTH = 0 PID = 0	Bentonite hole plug
2			Greyish brown and saturated at 2.4 m bgs		
	SS3			GSTH = 0 PID = 1	Depth to Groundwater 2.83 m bgs (March 23, 2018)
3					
	SS4			GSTH = 0 PID = 0	Sand pack
4					Screen
	SS5			GSTH = 0 PID = 0	
5					
	SS6			GSTH = 0 PID = 0	
			End of sampling at 6.0 m bgs		
6			6.00 94.40		

Bottom of hole at 6.00 m.

AZIMUTH ENVIRONMENTAL CONSULTING, INC.
Environmental Assessments & A

Project: 41 & 43 Essa Rd	**Project Number:** 18-175	**Client:** Barrie Drive-A-Car (1979) Ltd.	**Borehole ID:** BH308/ MW308
Project Location: 41 & 43 Essa Road, Barrie, ON		**Drilling Contractor:** Orbit Garant	**Drilling Method:** Hollow Stems with Split Spoons
Logged By: I. Acheson	**Date:** 24-Oct-2018	**Flushmount (mbgs):** 0.11	**Well Depth (mbgs):** 4.5
UTM: (NAD 83, Zone 17T)	**Ground Elevation (masl):**	**Water Level (mbgs):** 3.23	**Well Diameter (mm)** 50.8
Easting: 604240	**Well Screen Type:**	**Riser Pipe Type:**	**Well Screen Length (m):**
Northing: 4914197	10-Slot PVC, schedule 40	Schedule 40 PVC	3.0

Depth Below Ground Surface (mbgs)	Sample Type	Sample Number	Headspace (ppm)	Lithology	Monitoring Well Construction	Lithology Description
	SS	1	0			Asphalt at surface (0.1 m thick)
						Sand & Gravel, compact, dry, brown (0.0 - 0.2 m)
	SS	2	10			Medium/ Fine Sand with trace Silt, compact, dry, dark brown transitioning to brown (0.2 - 1.0 m)
2	SS	3	5			
						Medium/ Fine Sand with trace Silt, compact, dry, dark brown transitioning to brown (1.0 - 1.7 m)
	SS	4	0			
	SS	5	0			Silty Medium/ Fine Sand, compact, moist, brown (1.7 - 2.5 m)
						Silty Medium/ Fine Sand, compact, wet, brown (2.5 - 3.7 m)
4						
6						
8						
10						
12						

Soil Group Name: grain size,color, density/consistency, moisture, stratification, other descriptors

Rock Description: modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.

Ground Water Level Upon Well Completion (mbgs)

Seal (grout / hole plug) **Silica Sand Pack** **Well Screen**

BOREHOLE NUMBER BH102

Environmental Consulting Inc.

CLIENT Bryan Moffatt
PROJECT NAME Phase II ESA
PROJECT NUMBER G2S12275B
PROJECT LOCATION 259 Innisfil Street, Barrie, Ontario
DATE STARTED 01/05/12 **COMPLETED** 01/05/12
GROUND ELEVATION 100.33 m **HOLE SIZE** 15cm
DRILLING CONTRACTOR Profile Drilling
GROUND WATER LEVELS:
DRILLING METHOD Direct Push
AT TIME OF DRILLING ---
LOGGED BY PH **CHECKED BY** SC
AT END OF DRILLING ---
NOTES Vapour Measurements in ppm (Gastech)
AFTER DRILLING 3.68 m / Elev 96.65 m

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 100.22 (m)
	SS1		GSTH = 0		0.10 Asphalt 100.23 FILL - Brown, sand some gravel, some silt, dry to moist	Flush mount casing
1	SS2		GSTH = 0			
	SS3		GSTH = 0			Bentonite hole plug
2	SS4		GSTH = 0			
	SS5		GSTH = 0			
3	SS6		GSTH = 0			
	SS7		GSTH = 10			Depth to Groundwater 3.68 m bgs (07/05/12)
4	SS8		GSTH = 0		4.50 95.83 SILTY SAND - brown, dry to wet	Sand pack
5	SS9		GSTH = 0			
	SS10		GSTH = 0		6.10 94.23	
6					Bottom of hole at 6.10 m.	
7						
8						

ENVIRONMENTAL BH G2S12275B 259 INNISFIL STREET.GPJ GINT STD CANADA.GDT 25/05/12

BOREHOLE NUMBER BH108

Environmental Consulting Inc.

CLIENT Bryan Moffatt
PROJECT NAME Phase II ESA
PROJECT NUMBER G2S12275B
PROJECT LOCATION 259 Innisfil Street, Barrie, Ontario
DATE STARTED 01/05/12 **COMPLETED** 01/05/12
GROUND ELEVATION 101.04 m **HOLE SIZE** 15cm
DRILLING CONTRACTOR Profile Drilling
GROUND WATER LEVELS:
DRILLING METHOD Direct Push
AT TIME OF DRILLING ---
LOGGED BY PH **CHECKED BY** GB
AT END OF DRILLING ---
NOTES Vapour Measurements in ppm (Gastech)
AFTER DRILLING 3.23 m / Elev 97.81 m

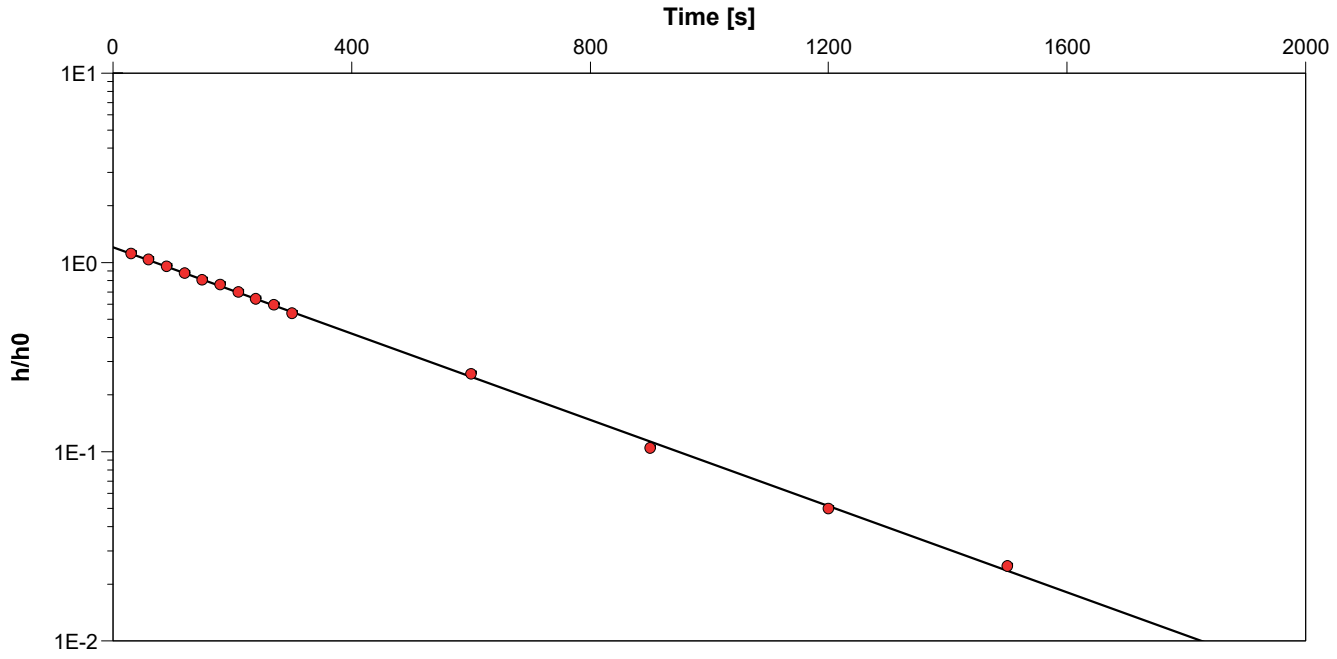
DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 100.92 (m)
	SS1		GSTH = 0		FILL - Brown, limestone screenings overlying silty sand with organics, dry	Flush mount casing
					0.40 / 100.64	
1	SS2		GSTH = 0		SILTY SAND - brown, dry to wet	
	SS3		GSTH = 0			Bentonite hole plug
2	SS4		GSTH = 0			
	SS5		GSTH = 0			
3	SS6		GSTH = 0			
4	SS7		GSTH = 0			Depth to Groundwater 3.94 m bgs (07/05/12)
	SS8		GSTH = 0			Sand pack
5						
6					6.10 / 94.94	
					Bottom of hole at 6.10 m.	
7						
8						

ENVIRONMENTAL BH G2S12275B 259 INNISFIL STREET.GPJ GINT STD CANADA.GDT 25/05/12

Appendix B

	Slug Test Analysis Report
	Project: 41 & 43 Essa Rd and 259 Innisfil St
	Number: 21-113-100
	Client: Tonlu Holdings

Location: 41-43 Essa Rd & 259 Innisfil St	Slug Test: BH201	Test Well: BH201
Test Conducted by: LG		Test Date: 8/24/2021
Analysis Performed by: LG	Bouwer & Rice	Analysis Date: 8/27/2021
Aquifer Thickness: 10.60 m		

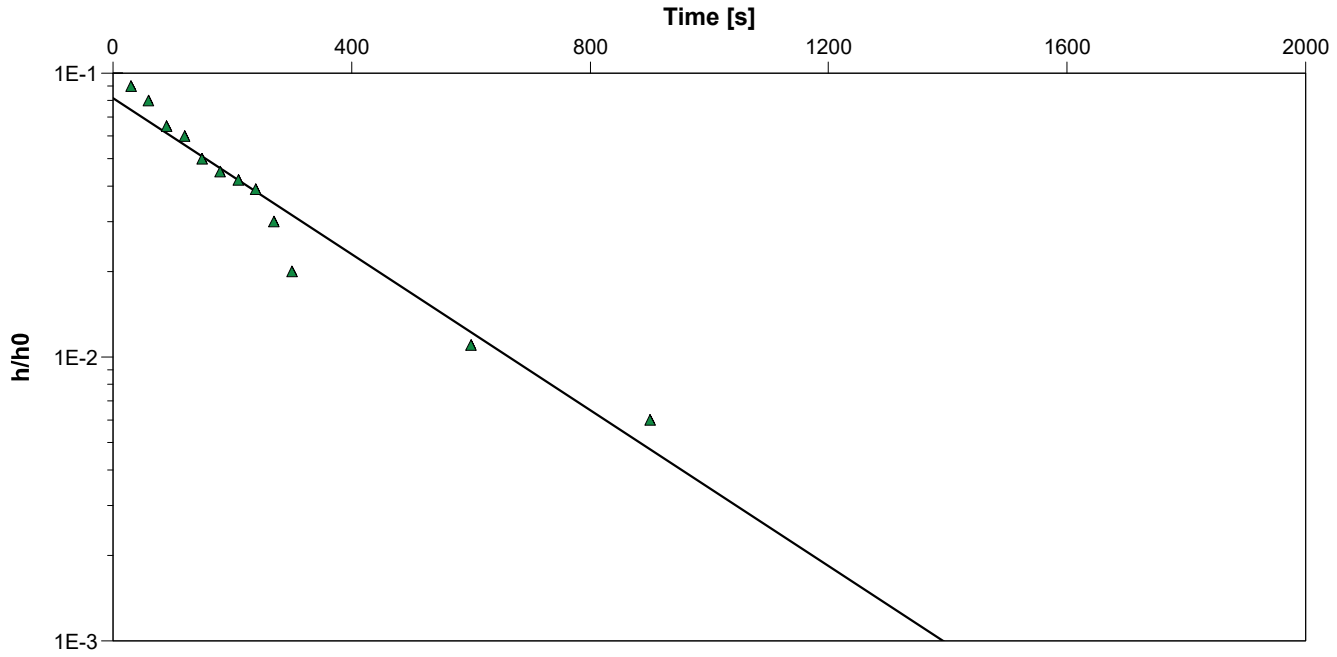


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH201	1.05×10^{-6}	

	Slug Test Analysis Report
	Project: 41 & 43 Essa Rd and 259 Innisfil St
	Number: 21-113-100
	Client: Tonlu Holdings

Location: 41-43 Essa Rd & 259 Innisfil St	Slug Test: BH102	Test Well: BH102
Test Conducted by: LG		Test Date: 8/24/2021
Analysis Performed by: LG	Bouwer & Rice	Analysis Date: 8/27/2021
Aquifer Thickness: 10.60 m		

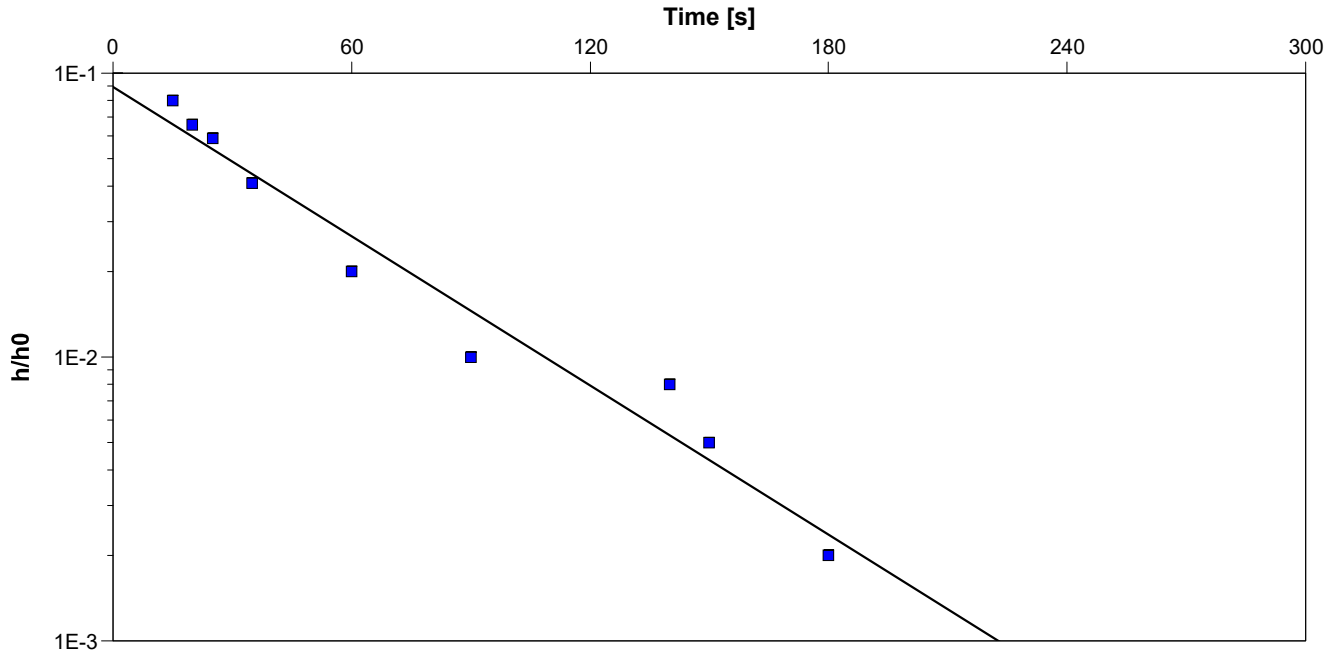


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH102	1.10×10^{-6}	

	Slug Test Analysis Report
	Project: 41 & 43 Essa Rd and 259 Innisfil St
	Number: 21-113-100
	Client: Tonlu Holdings

Location: 41-43 Essa Rd & 259 Innisfil St	Slug Test: MW108	Test Well: MW108
Test Conducted by: LG		Test Date: 8/24/2021
Analysis Performed by: LG	Bouwer & Rice	Analysis Date: 8/27/2021
Aquifer Thickness: 10.60 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW108	7.34×10^{-6}	

Appendix C

Table: MECP Water Wells Records (500 m Radius)

MOECC WWR	Easting	Northing	Depth		Thickness		Stratigraphy				Water Found		Static Level		Water Kind	Date Completed	Status	Water Use
ID	UTM N17	UTM N17	(ft)	(m)	(ft)	(m)	Color	Primary	Secondary	Tertiary	(ft)	(m)	(ft)	(m)				
7352638	604235	4914184	-	-	-	-	-	-	-	-	-	-	-	-	-	26/Oct/18	-	-
7310219	604221	4914205	-	-	-	-	-	-	-	-	-	-	-	-	-	20/Mar/18	-	-
7307848	604182	4914173	-	-	-	-	-	-	-	-	-	-	-	-	-	9/Feb/18	-	-
7307833	604181	494122	-	-	-	-	-	-	-	-	-	-	-	-	-	8/Feb/18	-	-
7335997	604163	4914080	-	-	-	-	-	-	-	-	-	-	-	-	-	2/Apr/19	-	-
7161345	604031	4914110	1.6	0.5	1.6	0.5	Brown	Sand	Gravel	-	-	-	-	-	-	24/Mar/11	Test Hole	Monitoring
			22	6.7	20.4	6.2	Brown	Sand	Silt	-								
5700247	604130	4913595	13	4.0	13	4.0	-	Sand	Silt	-	-	-	-	-	-	15/May/59	Test Hole	-
			18	5.5	5	1.5	-	Gravel	-	-								
			218	66.4	200	61.0	-	Clay	Gravel	Boulder								
			278	84.7	60	18.3	-	Clay	Sand	Gravel								
			307	93.6	29	8.8	-	Clay	Gravel									
			324	98.8	17	5.2	-	Boulder	-	-								
5740515	603833	4914445	1	0.3	1	0.3	-	Topsoil	-	-	-	-	25.6	7.8	-	1/Dec/05	Observ.	Municipal
			38	11.6	37	11.3	Brown	Sand	-	-								
			69	21.0	31	9.4	Grey	Clay	-	-								
			96	29.3	27	8.2	Brown	Sand	-	-								
			121	36.9	25	7.6	Grey	Clay	-	-								
			149	45.4	28	8.5	Brown	Sand	-	-								
			154	46.9	5	1.5	Grey	Clay	Silt	-								
			164	50.0	10	3.0	Brown	Sand	-	-								
			237	72.2	73	22.3	Brown	Sand	Clay	-								
7106251	604347	4914616	20	6.1	20	6.1	Brown	Fill	-	-	13.1	4.0	-	-	-	29/Feb/08	Dewatering	Dewatering
			30	9.1	10	3.0	Brown	Sand	Silt	-								
5740516	604071	4914154	31	9.4	31	9.4	Brown	Sand	-	-	23.6	7.2	-	-	-	3/Dec/05	Observ.	Municipal
			39	11.9	8	2.4	Brown	Sand	Clay	-								
			102	31.1	63	19.2	Brown	Sand	Gravel	-								
			111	33.8	9	2.7	Grey	Clay	-	-								
			163	49.7	52	15.8	Brown	Sand	-	-								
			216	65.8	53	16.2	Brown	Sand	Gravel	-								
5740517	604079	4914148	31	9.4	31	9.4	Brown	Sand	-	-	-	-	-	-	-	1/Dec/05	Observ.	Municipal
			39	11.9	8	2.4	Brown	Sand	Clay	-								
			102	31.1	63	19.2	Brown	Sand	Gravel	-								
			111	33.8	9	2.7	Grey	Clay	-	-								
			163	49.7	52	15.8	Brown	Sand	-	-								
			271	82.6	108	32.9	Brown	Sand	Gravel	-								
7138391	604241	4914398	4.9	1.5	4.9	1.5	Brown	Fill	-	-	-	-	-	-	-	6/Sep/08	Abandoned	Dewatering
			13.8	4.2	8.9	2.7	Brown	Sand	-	-								
			29.9	9.1	16.1	4.9	Brown	Sand	-	-								
7231045	604080	4914398	20	6.1	20	6.1	Brown	Sand	-	-	-	-	-	-	-	30/Sep/14	Observ.	Monitoring
7335980	604143	4914067	-	-	-	-	-	-	-	-	-	-	-	-	-	2/Apr/19	-	-
7231046	604080	4914397	28	8.5	28	8.5	Brown	Sand	Silt	-	-	-	-	-	-	30/Sep/14	Observ.	Monitoring
7231047	604078	4914398	40	12.2	40	12.2	Brown	Sand	Silt	-	-	-	-	-	-	30/Sep/14	Observ.	Monitoring
			45	13.7	5	1.5	Grey	Silt	Clay	-								
			73	22.3	28	8.5	Grey	Sand	Silt	-								
			75	22.9	2	0.6	Grey	Silt	Clay	-								
7106250	604220	4914494	10	3.0	10	3.0	Brown	Fill	-	-	-	-	-	-	-	7/Mar/08	Dewatering	Dewatering
			26.9	8.2	16.9	5.2	Brown	Sand	Silt	-								
			27.2	8.3	0.3	0.1	Grey	Clay	Silt	-								

5720696	604477	4914588	7	2.1	7	2.1	-	Fill	-	-	51.8	170	-	-	-	25/Feb/86	Water supply	Municipal
			25	7.6	18	5.5	-	Sand	Boulder	-								
			29	8.8	4	1.2	-	Clay	Silt	-								
			75	22.9	46	14.0	Grey	Clay	-	-								
			96	29.3	21	6.4	Grey	Clay	-	-								
			113	34.4	17	5.2	Grey	Clay	-	-								
			116	35.4	3	0.9	-	Fsnd	-	-								
			136	41.5	20	6.1	Grey	Fsnd	Clay	-								
			148	45.1	12	3.7	Grey	Sand	Clay	-								
			158	48.2	10	3.0	Grey	Clay	Gravel	-								
			170	51.8	12	3.7	-	Gravel	Boulder	-								
			192	58.5	22	6.7	-	Gravel	Sand	-								
7106252	604167	4914522	13	4.0	13	4.0	Brown	Fill	-	-	12.1	3.7	-	-	-	7/Mar/08	Observ.	Monitoring
			29.5	9.0	16.5	5.0	Brown	Sand	Silt	-								
			36.1	11.0	6.6	2.0	Grey	Clay	Silt	-								
7354293	604085	4914468	12	3.7	12	3.7	Brown	Sand	-	-	-	-	-	-	-	3/Feb/20	Test Hole	Test Hole
			24	7.3	12	3.7	Brown	Sand	-	-								
			35	10.7	11	3.4	Brown	Sand	Silt	-								
7354294	604142	4914465	9	2.7	9	2.7	Brown	Sand	-	-	-	-	-	-	-	30/Jan/20	Test Hole	Test Hole
			24	7.3	15	4.6	Brown	Sand	-	-								
			30	9.1	6	1.8	Brown	Sand	Silt	-								
			35	10.7	5	1.5	Grey	Silt	-	-								
7105808	604112	4914382	25	7.6	25	7.6	Brown	Peat	-	-	-	-	-	-	-	22/Apr/08	Observ.	Monitoring
7234146	604362	4914648	-	-	-	-	-	-	-	-	-	-	-	-	-	11/Sep/14	-	-
7106269	604317	4914574	-	-	-	-	-	-	-	-	-	-	-	-	-	11/Jun/08	Abandoned	-
7247356	604347	4914679	-	-	-	-	-	-	-	-	-	-	-	-	-	29/Jun/15	-	-
7223750	603846	4914129	-	-	-	-	-	-	-	-	-	-	-	-	-	16/Jun/14	-	-
5701723	604249	4913734	28	8.5	28	8.5	-	Prdg	-	-	22	72	-	-	Fresh	9/Dec/53	Water supply	Domestic
			72	21.9	44.0	13.4	-	Clay	Msnd	-								
			78	23.8	6.0	1.8	-	Fsnd	-	-								
			82	25.0	4.0	1.2	-	Csnd	-	-								
5701725	604157	4913484	1	0.3	1	0.3	-	Loam	-	-	52	15.85	-	-	Fresh	3/Aug/57	Water supply	Public
			4	1.2	3.0	0.9	-	Msnd	-	-								
			52	15.8	48.0	14.6	-	Msnd	Clay	-								
			63	19.2	11.0	3.4	-	Msnd	-	-								
7291250	603970	4914002	2	0.6	2	0.6	Brown	Fill	-	Dnse	-	-	-	-	-	9/Jun/17	Test Hole	Test Hole
			20	6.1	18.0	5.5	Brown	Sand	Silt	Loos								
			25	7.6	5.0	1.5	Grey	Silt	Sand	Soft								
7291251	603955	4914079	9	2.7	9	2.7	Brown	Sand	-	-	-	-	-	-	-	14/Jun/17	Test Hole	Test Hole
			25	7.6	16.0	4.9	Brown	Sand	Wbrg	-								
7291252	603931	4914066	2	0.6	2	0.6	Brown	Fill	-	Dnse	-	-	-	-	-	9/Jun/17	Test Hole	Test Hole
			20	6.1	18.0	5.5	Brown	Sand	Silt	Loos								
			24.5	7.5	4.5	1.4	Brown	Silt	Sand	Soft								
7291253	603912	4914060	2	0.6	2	0.6	Brown	Fill	-	Dnse	-	-	-	-	-	9/Jun/17	Test Hole	Test Hole
			18	5.5	16.0	4.9	Brown	Sand	Silt	Loos								
			23	7.0	5.0	1.5	Grey	Silt	Sand	Soft								
7291254	603876	4914041	20	6.1	20	6.1	Brown	Sand	Silt	Loos	-	-	-	-	-	9/Jun/17	Test Hole	Test Hole
			23.5	7.2	3.5	1.1	Grey	Silt	Sand	Soft								
7260876	603773	4914418	-	-	-	-	-	-	-	-	10	3.048	-	-	-	8/Jul/15	Test Hole	Test Hole
5709345	604704	4914106	1	0.3	1	0.3	Black	Muck	-	-	206	62.789	-	-	Fresh	21/Nov/72	Test Hole	Domestic
			4	1.2	3	0.9	Brown	Sand	Gravel	-								
			9	2.7	5	1.5	Brown	Sand	-	-								
			27	8.2	18	5.5	Brown	Sand	Gravel	Clay								
			53	16.2	26	7.9	Grey	Clay	Stns	-								
			67	20.4	14	4.3	-	Gravel	Sand	-								
			81	24.7	14	4.3	Grey	Clay	Gravel	-								
			83	25.3	2	0.6	-	Sand	Gravel	Boulder								
			150	45.7	67	20.4	Grey	Clay	-	-								
			176	53.6	26	7.9	Grey	Fsnd	Sand	-								
			178	54.3	2	0.6	Grey	Sand	Gravel	-								
			208	63.4	30	9.1	Grey	Fsnd	Gravel	-								
			213	64.9	5	1.5	Grey	Clay	Sand	Gravel								
			230	70.1	17	5.2	Grey	Gravel	Sand	-								
			243	74.1	13	4.0	Grey	Clay	-	-								
			244	74.4	1	0.3	Grey	Clay	Gravel	-								
			254	77.4	10	3.0	Grey	Clay	-	-								
			273	83.2	19	5.8	-	Gravel	Sand	Clay								
			284	86.6	11	3.4	Grey	Clay	Sand	Gravel								
			286	87.2	2	0.6	Brown	Lmsn	-	-								

7260877	603802	4914419	-	-	-	-	-	-	-	-	10	3.0	-	-	-	8/Jul/15	Test Hole	Test Hole
7260878	603799	4914312	-	-	-	-	-	-	-	-	10	3.0	-	-	-	7/Jul/15	Test Hole	Test Hole
7260335	604150	4914440	20	6.1	20	6.1	Brown	Sand	Silt	-	-	-	-	-	-	23/Feb/16	Test Hole	Test Hole
7260879	603821	4914371	-	-	-	-	-	-	-	-	10	3.0	-	-	-	7/Jul/15	Test Hole	Test Hole
7260880	603821	4914328	-	-	-	-	-	-	-	-	10	3.0	-	-	-	7/Jul/15	Test Hole	Test Hole
7353654	604347	4914266	-	-	-	-	-	-	-	-	-	-	-	-	-	8/Jan/20	-	-
5722890	603822	4914434	24	7.3	24	7.3	Brown	Fsnd	-	-	90	27.432	-	-	Fresh	20/Apr/87	Observ.	Not Used
			47	14.3	23	7.0	Grey	Clay	Fsnd	Sndy								
			62	18.9	15	4.6	Grey	Clay	Stky	Soft								
			90	27.4	28	8.5	-	Clay	Silt	Stky								
			108	32.9	18	5.5	-	Fsnd	Fgvl	Clay								
			123	37.5	15	4.6	Grey	Clay	Sand	-								
			134	40.8	11	3.4	-	Clay	Fsnd	Sndy								
			142	43.3	8	2.4	-	Fsnd	Fgvl	-								
			157	47.9	15	4.6	-	Clay	Sndy	Fsnd								
			193	58.8	36	11.0	Grey	Clay	Sand	Sndy								
			217	66.1	24	7.3	-	Fsnd	Silt	Slty								
			237	72.2	20	6.1	-	Fsnd	Fgvl	Sndy								
			242	73.8	5	1.5	-	Gravel	Clay	Cmtd								
			267	81.4	25	7.6	-	Gravel	Fcrd	-								
			308	93.9	41	12.5	-	Boulder	Gravel	Sand								
			329	100.3	21	6.4	-	Gravel	Fsnd	Cmtd								
			357	108.8	28	8.5	-	Gravel	Sand	Hard								
7140503	604505	4914316	3.3	1.0	3.3	1.0	Black	Sand	Gravel	Dry	-	-	-	-	-	5/Jan/09	Observ.	Monitoring
			9.8	3.0	6.5	2.0	Brown	Sand	-	Dry								
			16.4	5.0	6.6	2.0	Brown	Sand	-	Wbrg								
7111775	604241	4914398	5	1.5	5.0	1.5	Brown	Fill	-	-	6.6	2.0	-	-	-	8/Sep/08	Dewatering	Dewatering
			13.8	4.2	8.8	2.7	Brown	Sand	Wbrg	-								
			30	9.1	16.2	4.9	Brown	Sand	-	Dnse								
5717576	604414	4914423	1	0.3	1	0.3	-	Fill	-	-	-	-	-	-	-	19/May/81	Test Hole	-
			21	6.4	20	6.1	Grey	Clay	Sand	Lyrd								
			41	12.5	20	6.1	Grey	Clay	Sand	Silt								
			52	15.8	11	3.4	Grey	Clay	Fsnd	-								
			54	16.5	2	0.6	-	Wdfr	-	-								
			60	18.3	6	1.8	Grey	Clay	Lyrd	Slty								
			65	19.8	5	1.5	Grey	Clay	Sndy	Soft								
			68	20.7	3	0.9	-	Fgvl	-	-								
			71	21.6	3	0.9	-	Gravel	Sand	Boulder								
			84	25.6	13	4.0	-	Clay	Sand	Hard								
			93	28.3	9	2.7	Grey	Clay	Csnd	Silt								
			96	29.3	3	0.9	Grey	Clay	Slty	-								
			108	32.9	12	3.7	Grey	Clay	Sndy	Lyrd								
			126	38.4	18	5.5	-	Clay	Slty	soft								
			138	42.1	12	3.7	Grey	Clay	Silt	-								
			147	44.8	9	2.7	-	Silt	Fsnd	Clay								
			194	59.1	47	14.3	Grey	Clay	Slty	-								
			230	70.1	36	11.0	Grey	Clay	Sndy	-								
			245	74.7	15	4.6	-	Clay	Fgvl	Marl								
			250	76.2	5	1.5	-	Clay	Gravel	Cmtd								
			255	77.7	5	1.5	Grey	Clay	-	-								
			261	79.6	6	1.8	-	Clay	Gravel	Marl								
			269	82.0	39	11.9	-	Clay	Sndy	-								
			289	88.1	20	6.1	-	Clay	Gravel	Marl								
7047930	604604	4914196	11.5	3.5	11.5	3.5	Brown	Loam	Loam	Fill	6.6	2.0	-	-	-	8/Sep/08	Dewatering	Not Used
			23	7.0	11.5	3.5	Grey	Sand	Wbrg	Slty								
7122332	604389	4914584	13	4.0	13.0	4.0	Brown	Fill	-	-	10	3	-	-	-	4/Apr/09	Dewatering	Dewatering
			23	7.0	10.0	3.0	Black	Peat	-	Dense								
			37.7	11.5	14.7	4.5	Brown	Sand	Silt	-								
7302675	604299	4914176	2	0.6	2.0	0.6	Grey	Fill	Gravel	-	8.5	2.6	-	-	-	30/Nov/17	Observ.	Monitoring
			15	4.6	13.0	4.0	Brown	Sand	-	-								
7302676	604250	4914158	2	0.6	2.0	0.6	Grey	Fill	Gravel	-	8	2.4	-	-	-	30/Nov/17	Observ.	Monitoring
			15	4.6	13.0	4.0	Brown	Sand	Dense	-								
7302677	604398	4914178	2	0.6	2.0	0.6	Grey	Fill	Gravel	-	8	2.4	-	-	-	30/Nov/17	Observ.	Monitoring
			15	4.6	13.0	4.0	Brown	Sand	Dense	-								
7302678	604409	4914140	12	3.7	12.0	3.7	Grey	Fill	Gravel	-	8.5	2.6	-	-	-	30/Nov/17	Observ.	Monitoring
			15	4.6	3.0	0.9	Brown	Sand	Dense	-								

7321296	604229	4914482	5	1.5	5	1.5	Brown	Sand	Clay	Silt	5.2	1.6	-	-	-	-	Observ.	-
			21	6.4	16	4.9	Brown	Sand	Gravel	Soft								
			27	8.2	6	1.8	Grey	Clay	Silt	Clay								
			55	16.8	28	8.5	Brown	Sand	Silt	Gravel								
			65	19.8	10	3.0	Brown	Gravel	Sndy	Silt								
7280991	604042	4914585	-	-	-	-	-	-	-	-	11.5	3.5	-	-	-	6/Jul/16	Abandoned	-
7048190	604604	4914196	11.5	3.5	11.5	3.5	Brown	Loam	Fill	Slty	-	-	-	-	-	3/Aug/07	Abandoned	-
			23	7.0	11.5	3.5	Grey	Sand	Slty	Wbrg								
5735943	603700	4913980	14	4.3	14.0	4.3	Brown	Fsnd	-	-	-	-	-	-	-	26/Jul/00	Observ.	Not Used
			18	5.5	4.0	1.2	Brown	Fsnd	Msnd	-								
			24	7.3	6.0	1.8	Brown	Fsnd	Slty	-								
			36	11.0	12.0	3.7	Brown	Fsnd	-	-								
			42	12.8	6.0	1.8	Brown	Fsnd	Slty	-								
			69	21.0	27.0	8.2	Brown	Fsnd	-	-								
			70	21.3	1.0	0.3	Grey	Fsnd	Silt	-								
5700241	603781	4914437	6	1.8	6.0	1.8	-	Loam	-	-	-	-	-	-	-	12/Aug/55	Test Hole	-
			42	12.8	36.0	11.0	-	Fsnd	-	-								
			91	27.7	49.0	14.9	-	Fsnd	Silt	-								
			104	31.7	13.0	4.0	-	Fsnd	Clay	-								
			170	51.8	66.0	20.1	-	Clay	Msnd	-								
			192	58.5	22.0	6.7	-	Fsnd	-	-								
			205	62.5	13.0	4.0	-	Clay	Msnd	-								
			215	65.5	10.0	3.0	-	Msnd	Silt	-								
			224	68.3	9.0	2.7	-	Fsnd	-	-								
5700243	604136	4913553	14	4.3	14.0	4.3	-	Msnd	-	-	57	17.4	-	-	Fresh	4/Aug/58	Water supply	Domestic
			43	13.1	29.0	8.8	-	Clay	Msnd	-								
			57	17.4	14.0	4.3	-	Fsnd	-	-								
7317981	603964	4914352	7	2.1	7.0	2.1	-	Fill	-	-	20	6.1	-	-	-	8/Aug/18	Observ.	Monitoring
			45	13.7	38.0	11.6	Brown	Sand	-	-								
7209093	603974	4914626	5	1.5	5.0	1.5	Brown	Sand	Silt	Loos	-	-	-	-	-	26/Jul/13	Observ.	Monitoring
			13	4.0	8.0	2.4	Brown	Sand	Silt	Wbrg								
7117041	604478	4914319	1.3	0.4	1.3	0.4	Brown	Fill	Sand	Gravel	-	-	-	-	-	15/Aug/08	Test Hole	Monitoring
			22.6	6.9	21.3	6.5	Brown	Sand	Silt	Loos								
7044938	604316	4914577	1	0.3	1	0.3	Black	Loam	-	-	-	-	-	-	Fresh	17/Mar/07	Observ.	Municipal
			23	7.0	22	6.7	Grey	Clay	Sand	Soft								
			48	14.6	25	7.6	Grey	Clay	Silt	Soft								
			55	16.8	7	2.1	Brown	Sand	Silt	-								
7044939	604157	4914575	1	0.3	1	0.3	Black	Loam	-	-	20	6.1	-	-	Fresh	20/Mar/07	Observ.	Municipal
			25	7.6	24	7.3	Brown	Sand	Silt	-								
5738378	604010	4914491	5	1.5	5.0	1.5	-	Fill	-	-	4	1.2	-	-	Fresh	23/Sep/03	Observ.	Not Used
			10	3.0	5.0	1.5	Brown	Sand	-	-								
			13	4.0	3.0	0.9	Grey	Silt	Sndy	-								
			14	4.3	1.0	0.3	Grey	Sand	-	-								
			15	4.6	1.0	0.3	Grey	Silt	Clyy	-								
5738379	604205	4914324	1	0.3	1.0	0.3	-	Fill	-	-	5	1.5	-	-	Fresh	22/Sep/03	Observ.	Not Used
			7	2.1	6.0	1.8	Brown	Silt	Sndy	-								
			12	3.7	5.0	1.5	Grey	Silt	-	-								
			16	4.9	4.0	1.2	Grey	Silt	Sndy	-								
5717394	604414	4914223	16	4.9	16.0	4.9	-	Fill		-	60	18.3	-	-	-	17/Mar/81	Observ.	Not Used
			60	18.3	44.0	13.4	Grey	Sand	Clay	Soft								
			100	30.5	40.0	12.2	Grey	Clay	Gravl	Slty								
			110	33.5	10.0	3.0	Grey	Sand	Gravl	Boulder								
			138	42.1	28.0	8.5	Grey	Fsnd	Loos	-								
			162	49.4	24.0	7.3	Grey	Gravl	Clay	Lyrd								
			209	63.7	47.0	14.3	Grey	Gravl	Boulder	Sand								
			296	90.2	87.0	26.5	Grey	Gravl	Sand	Loos								
			306	93.3	10.0	3.0	Grey	Msnd	Loos	-								
7214773	603691	4914368	25	7.6	25.0	7.6	Brown	Sand	-	-	-	-	-	-	-	13/Dec/12	Observ.	Monitoring
7282889	603880	4914131	8	2.4	8.0	2.4	Brown	Sand	Grvl	-	-	-	-	-	-	5/Feb/17	Test Hole	Monitoring
			17	5.2	9.0	2.7	Brown	Sand	Cgrd	Wbrg								
7282888	603981	4914246	10	3.0	10.0	3.0	Brown	Sand	Grvl	-	-	-	-	-	-	5/Feb/17	Test Hole	Monitoring
			18	5.5	8.0	2.4	Brown	Sand										
7282887	603849	4914190	15	4.6	15.0	4.6	Brown	Sand	Grvl	-	-	-	-	-	-	5/Feb/17	Test Hole	Monitoring
			21	6.4	6.0	1.8	Brown	Sand										
7274938	604128	4913948	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7260881	603830	4914316	-	-	-	-	-	-	-	-	10	3.0	-	-	-	7/Jul/17	Test Hole	Test Hole
7132054	604389	4914584	-	-	-	-	-	-	-	-	10	3.0	-	-	Fresh	5/Oct/09	Abandoned	-
7353806	604109	4914269	-	-	-	-	-	-	-	-	8	2.4	-	-	Untested	16/Aug/19	Observ.	Monitoring
7328212	604113	4914099	-	-	-	-	-	-	-	-	-	-	-	-	-	16/Jan/19	-	-
7328213	604113	4914099	-	-	-	-	-	-	-	-	-	-	-	-	-	16/Jan/19	-	-

7260337	604105	4914434	20	6.1	20.0	6.1	Brown	Sand	Silt	Soft			-	-	-	23/Feb/16	Test Hole	Monitoring
7260336	604115	4914416	20	6.1	20.0	6.1	Brown	Sand	Silt	Soft			-	-	-	23/Feb/16	Test Hole	Monitoring
7260724	603762	4914374	-	-	-	-	-	-	-	-	10	3.0	-	-	-	7/Jul/15	Test Hole	Test Hole
7187612	617745	4921942	-	-	-	-	-	-	-	-	-	-	-	-	-	17/Jul/12	Abandoned	Not Used
7237000	603812	4914166	35	10.7	35.0	10.7	Brown	Sand	Silt	Loos	-	-	-	-	-	4/Sep/14	Observ.	Monitoring
			45	13.7	10.0	3.0	Grey	Silt	Clay	Loos								
			56	17.1	11.0	3.4	Grey	Sand	Silt	Loos								
7237001	604398	4914495	10	3.0	10.0	3.0	Black	Loam	Sand	Wbrg	-	-	-	-	-	9/Sep/14	Observ.	Monitoring
			19	5.8	9.0	2.7	Brown	Sand	Silt	Loos								
			25	7.6	6.0	1.8	Grey	Silt	Sand	Loos								
7237002	604398	4914495	10	3.0	10.0	3.0	Black	Loam	Wbrg	loos	-	-	-	-	-	8/Sep/14	Observ.	Monitoring
			19	5.8	9.0	2.7	Brown	Sand	Silt	Loos								
			27	8.2	8.0	2.4	Grey	Silt	Sand	Loos								
			34	10.4	7.0	2.1	Grey	Sand	Silt	Loos								
			45	13.7	11.0	3.4	Grey	Sand	Silt	Loos								
7236999	603812	4914166	28	8.5	28.0	8.5	Brown	Sand	Silt	Loos	-	-	-	-	-	5/Sep/14	Observ.	Monitoring
7103990	604397	4914638	-	-	-	-	-	-	-	-	-	-	-	-	-	8/Feb/08	-	-
7103991	604397	4914638	-	-	-	-	-	-	-	-	-	-	-	-	-	8/Feb/08	-	-
7217301	604190	4914478	-	-	-	-	-	-	-	-	-	-	-	-	-	19/Jul/13	-	-
7207324	604108	4914007	-	-	-	-	-	-	-	-	-	-	-	-	-	1/May/12	-	-
7209086	604042	4914585	13.5	4.1	13.5	4.1	Brown	Sand	Silt	Loos	-	-	-	-	-	26/Jul/13	Observ.	Monitoring
7172576	603841	4914094	14	4.3	14.0	4.3	Brown	Sand	Silt	Soft	-	-	-	-	-	17/Dec/15	Observ.	Monitoring
			22	6.7	8.0	2.4	Brown	Sand	Dnse	Wbrg								
7165481	603863	4914539	10	3.0	10.0	3.0	Brown	Sand		Dry	-	-	-	-	-	24/Nov/10	Obersv.	Monitoring
			45	13.7	35.0	10.7	Grey	Sand		Wbrg								
			47.5	14.5	2.5	0.8	Grey			Silt								
7165482	603863	4914539	10	3.0	10.0	3.0	Brown	-	-	-	-	-	-	-	-	24/Nov/10	Obersv.	-
			30	9.1	20.0	6.1	Grey	Sand	-	-								
7102156	603835	4914075	19.7	6.0	19.7	6.0	Brown	Sand	-	-	-	-	-	-	-	6/Feb/08	Obersv.	Not Used
			25	7.6	5.3	1.6	Grey	Sand	-	-								
5700261	604290	4913542	33	10.1	33.0	10.1	-	Prdg	-	-	57	17	-	-	Fresh	11/Jul/62	Water supply	Domestic
			65	19.8	32.0	9.8	Yellow	Fsnd	-	-								
7318812	604046	4914113	1	0.3	1.0	0.3	-	-	-	-	13	4	-	-	-	1/Aug/18	Obersv.	Monitoring
			4	1.2	3.0	0.9	Brown	Gravel	-	-								
			20	6.1	16.0	4.9	Brown	Silt	Sand	-								
7318813	603980	4914094	1	0.3	1.0	0.3	-	-	-	-	11	3	-	-	-	1/Aug/18	Obersv.	Monitoring
			4	1.2	3.0	0.9	Brown	-	-	-								
			20	6.1	16.0	4.9	Brown	Slty	-	-								
7318814	604004	4914033	1	0.3	1.0	0.3	-	-	-	-	11	3	-	-	-	1/Aug/18	Obersv.	Monitoring
			4	1.2	3.0	0.9	Brown	Gravel	-	-								
			20	6.1	16.0	4.9	Brown	Sand	Slty	-								
7318815	603990	4914064	1	0.3	1.0	0.3	-	-	-	-	14	4	-	-	Untested	1/Aug/18	Obersv.	Monitoring
			4	1.2	3.0	0.9	Brown	Gravel	-	-								
			20	6.1	16.0	4.9	Brown	Silt	Sand	-								
7323874	604085	4914458	4	1.2	4.0	1.2	Brown	Sand	-	Loos	-	-	-	-	-	23/Aug/18	-	Monitoring
			20	6.1	16.0	4.9	Brown	Sand	-	Wbrg								
7323875	604111	4914416	2	0.6	2.0	0.6	Brown	Sand	-	Loos	-	-	-	-	-	23/Aug/18	-	-
			20	6.1	18.0	5.5	Brown	Sand	-	Wbrg								
7323876	604105	4914448	5	1.5	5.0	1.5	Brown	Sand	-	Loos	-	-	-	-	-	23/Aug/18	-	Monitoring
			20	6.1	15.0	4.6	Brown	Sand	-	Wbrg								
7323877	604151	4914456	5	1.5	5.0	1.5	Brown	Sand	-	Loos	-	-	-	-	-	23/Aug/18	-	-
			20	6.1	15.0	4.6	Brown	Sand	-	Wbrg								
7161343	604049	4914181	0.5	0.2	0.5	0.2	Brown	Sand	Grvl	Loos	-	-	-	-	-	24/Mar/11	Test Hole	Monitoring
			20	6.1	19.5	5.9	Brown	Sand	Silt	Loos								
7161344	604071	4914152	0.5	0.2	0.5	0.2	Black	-	-	-	-	-	-	-	-	24/Mar/11	Test Hole	Monitoring
			1	0.3	0.5	0.2	Brown	Sand	Gravel	-								
			22	6.7	21.0	6.4	Brown	Sand	Silt	-								
7117039	604237	4914400	-	-	-	-	-	-	-	-			-	-	-	18/Sep/08	Abandoned	Dewatering
7117027	603604	4914267	10	3.0	10.0	3.0	Brown	Sand	Dry	Loos	-	-	-	-	-	17/Sep/08	Obersv.	-
			18	5.5	8.0	2.4	Brown	Sand	Wbrg	Loos								
7116421	603826	4914138	18	5.5	18.0	5.5	Brown	Sand			-	-	-	-	-	6/Oct/08	Obersv.	Monitoring
			24.93	7.6	6.9	2.1	Grey	Sand										
7106252	604167	4914522	13.12	4.0	13.1	4.0	Brown	Fill	-		-	-	12.13	3.70	-	7/Mar/08	Obersv.	Monitoring
			29.52	9.0	16.4	5.0	Brown	Sand										
			36.08	11.0	6.6	2.0	Grey	Clay	Till									
7106250	604183	4914561	9.84	3.0	9.8	3.0	Brown	Fill	-		8.20	2.50	8.20	2.50	-	6/Mar/08	Dewatering	Dewatering
			26.9	8.2	17.1	5.2	Brown	Sand	Silt									
			27.231	8.3	0.3	0.1	Grey	Clay	Till	Silty								
7209929	604220	4914068	-	-	-	-	-	-	-	-	-	-	-	-	-	13/Mar/13	-	-
7043261	604333	4914291	1.96	0.6	2.0	0.6	Brown	Sand	Gravel	Fill	-	-	-	-	-	13/Feb/07	Abandoned	-
			10.17	3.1	8.2	2.5	Brown	Sand	Sand									
			14	4.3	3.8	1.2	Brown	Sand	Sand									

5738381	603777	4914337	2	0.6	2	0.6	Brown	Sand	-	-	3	0.9144	-	-	Fresh	4/Oct/03	Observ.	not used
			9	2.7	7	2.1	Grey	Sand	Silty	-								
			11	3.4	2	0.6	Grey	Clay	Silty	-								
			12	3.7	1	0.3	Grey	Silt	Sandy	-								
			20	6.1	8	2.4	Grey	Sand	-	-								
5735866	603762	4914222	8	2.4	8	2.4	-	Fill	-	-	-	-	13	3.9624	-	20/Jan/01	Observ.	Not Used
			10	3.0	2.0	0.6	-	Peat	-	-								
			20	6.1	10.0	3.0	Brown	FSND	-	-								
			22	6.7	2.0	0.6	Grey	FSND	-	-								
			27	8.2	5.0	1.5	-	Silt	Sandy	-								
			59	18.0	32.0	9.8	Grey	FSND	-	-								
			62	18.9	3.0	0.9	Grey	Clay	Silty	-								
5735867	603675	4914373	5	1.5	5	1.5	-	Sand	Gravel	Clay	-	-	-	-	-	2/Jan/01	Observ.	Not Used
			8	2.4	3	0.9	Black	Peat	-	-								
			10	3.0	2.0	0.6	Grey	Fsnd	-	-								
			14	4.3	4.0	1.2	Grey	Fsnd	-	-								
			23	7.0	9.0	2.7	Brown	Fsnd	-	-								
			26	7.9	3.0	0.9	Grey	Fsnd	Slty	Clay								
			40	12.2	14.0	4.3	Grey	Silt	Fsnd	-								
			42	12.8	2.0	0.6	Grey	Fsnd	Silt	-								
			62	18.9	20.0	6.1	Grey	Fsnd	-	-								
5700270	603978	4914076	1	0.3	1	0.3	-	Fill	-	-	272	82.9	11	3.4	Fresh	23/Nov/63	Water supply	Domestic
			60	18.3	59	18.0	-	MSND	-	-								
			70	21.3	10	3.0	Blue	Clay	-	-								
			160	48.8	90	27.4	-	FSND	-	-								
			265	80.8	105	32.0	-	CSND	Gravel	Silt								
			290	88.4	25	7.6	-	FSND	Gravel	-								

Appendix D

TABLE D-1

CLIMATE NORMALS 1981-2010 (SHANTY BAY CLIMATE STATION)

41-43 Essa Road and 259 Inisfil Street, Barrie, ON.

	Thornthwaite (1948)					
Month	Mean Temperature (°C)	Heat Index	Unadjusted Potential Evapotranspiration (mm)	Daylight Correction Value	Adjusted Potential Evapotranspiration (mm)	Total Precipitation (mm)
January	-7.7	0.0	0.0	0.77	0.0	88.8
February	-6.5	0.0	0.0	0.87	0.0	69.8
March	-1.9	0.0	0.0	0.99	0.0	63.8
April	5.7	1.2	26.4	1.12	29.5	65.0
May	12.1	3.8	58.5	1.23	71.9	79.9
June	17.4	6.6	86.0	1.29	110.5	88.6
July	20.1	8.2	100.2	1.26	126.1	73.2
August	19.2	7.7	95.4	1.16	111.2	86.2
September	15.2	5.4	74.5	1.04	77.7	92.2
October	8.7	2.3	41.3	0.92	37.9	78.2
November	2.6	0.4	11.5	0.81	9.2	98.0
December	-3.6	0.0	0.0	0.75	0.0	84.3
TOTALS		**35.6**	**493.7**		**574.0**	**968.0**

Notes: Daylight Correction values obtained from Instruction and Tables For Computing Potential Evapotranspiration and The Water Balance (Thornthwaite & Mather, 1957)

TABLE D-2
PRE-DEVELOPMENT SITE WATER BALANCE
41-43 Essa Road and 259 Inisfil Street, Barrie, ON.

Hydrologic Components			Month												Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.00	29.48	71.89	110.55	126.10	111.17	77.71	37.88	9.25	0.00	0.00	0.00	**574.04**
P - Total Precipitation (mm)			63.80	65.00	79.90	88.60	73.20	86.20	92.20	78.20	98.00	84.30	88.80	69.80	**968.00**
P-PET (mm)			63.80	35.52	8.01	-21.95	-52.90	-24.97	14.49	40.32	88.75	84.30	88.80	69.80	**393.96**
Soil Moisture Deficit (mm)			0.00	0.00	0.00	-21.95	-74.85	-99.82	-85.33	-45.02	0.00	0.00	0.00	0.00	-
Total Site	Pervious Area (Urban Lawns +)	Soil Moisture Storage (mm)	50.00	50.00	50.00	28.05	0.00	0.00	14.49	50.00	50.00	50.00	50.00	50.00	-
		Actual Evapotranspiration (mm)	0.00	29.48	71.89	105.73	88.04	86.20	77.71	37.88	9.25	0.00	0.00	0.00	**506.19**
		P-AET (mm)	63.80	35.52	8.01	-17.13	-14.84	0.00	14.49	40.32	88.75	84.30	88.80	69.80	-
		Actual Soil Moisture Deficit (mm)	0.00	0.00	0.00	-17.13	-31.97	-31.97	-17.48	0.00	0.00	0.00	0.00	0.00	-
		Change in Soil Moisture Deficit (mm)	0.00	0.00	0.00	17.13	14.84	0.00	-14.49	-17.48	0.00	0.00	0.00	0.00	-
		Precipitation Surplus (mm)	63.80	35.52	8.01	0.00	0.00	0.00	0.00	22.83	88.75	84.30	88.80	69.80	**461.81**
		MOECC Infiltration Factor	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
		Run-Off Coefficient	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
		Infiltration (mm)	31.90	17.76	4.00	0.00	0.00	0.00	0.00	11.42	44.38	42.15	44.40	34.90	**230.90**
		Run-Off (mm)	31.90	17.76	4.00	0.00	0.00	0.00	0.00	11.42	44.38	42.15	44.40	34.90	**230.90**
		Catchment Area (m^2) = 818	**Monthly Volumes (Pervious Area)**												
	Total AET (m^3)		0.00	24.11	58.80	86.48	72.01	70.51	63.56	30.99	7.57	0.00	0.00	0.00	**414.03**
	Total Evaporation (m^3)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Total Infiltration (m^3)		26.09	14.53	3.27	0.00	0.00	0.00	0.00	9.34	36.30	34.48	36.32	28.55	**188.86**
	Total Run-Off (m^3)		26.09	14.53	3.27	0.00	0.00	0.00	0.00	9.34	36.30	34.48	36.32	28.55	**188.86**
	Pervious Area (Treed)	Soil Moisture Storage (mm)	250.00	250.00	250.00	228.05	175.15	150.18	164.67	100.00	145.02	145.02	145.02	145.02	-
		Actual Evapotranspiration (mm)	0.00	29.48	71.89	109.58	115.86	102.45	77.71	37.88	9.25	0.00	0.00	0.00	**554.11**
		P-AET (mm)	63.80	35.52	8.01	-20.98	-42.66	-16.25	14.49	40.32	88.75	84.30	88.80	69.80	-
		Actual Soil Moisture Deficit (mm)	0.00	0.00	0.00	-20.98	-63.65	-79.89	-65.41	-25.09	0.00	0.00	0.00	0.00	-
		Change in Soil Moisture Deficit (mm)	0.00	0.00	0.00	20.98	42.66	16.25	-14.49	-40.32	-25.09	0.00	0.00	0.00	-
		Precipitation Surplus (mm)	63.80	35.52	8.01	0.00	0.00	0.00	0.00	0.00	63.66	84.30	88.80	69.80	**413.89**
		MOECC Infiltration Factor	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	-
		Run-Off Coefficient	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	-
		Infiltration (mm)	38.28	21.31	4.80	0.00	0.00	0.00	0.00	0.00	38.20	50.58	53.28	41.88	**248.33**
		Run-Off (mm)	25.52	14.21	3.20	0.00	0.00	0.00	0.00	0.00	25.46	33.72	35.52	27.92	**165.55**
		Catchment Area (m^2) = 1944	**Monthly Volumes (Pervious Area)**												
	Total AET (m^3)		0.00	57.31	139.76	213.03	225.23	199.16	151.07	73.65	17.98	0.00	0.00	0.00	**1077.19**
	Total Evaporation (m^3)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Total Infiltration (m^3)		74.42	41.43	9.34	0.00	0.00	0.00	0.00	0.00	74.25	98.33	103.58	81.41	**482.75**
	Total Run-Off (m^3)		49.61	27.62	6.23	0.00	0.00	0.00	0.00	0.00	49.50	65.55	69.05	54.28	**321.84**
	Impervious Area (Roof and Paved)	Catchment Area (m^2) = 15134	**Monthly Volumes (Impervious Area)**												
		Evaporation from Imperv. (m^3), 15% of P.	144.83	147.56	181.38	201.13	166.17	195.68	209.30	177.52	222.47	191.37	201.58	158.45	**2197.44**
		Run-Off from Imperv. (m^3), P - ET	820.71	836.15	1027.82	1139.73	941.63	1108.86	1186.04	1005.95	1260.65	1084.42	1142.30	897.89	**12452.14**
	Total Monthly Volumes (No Mitigation)														
	Total ET (m^3)		**144.83**	**147.56**	**181.38**	**201.13**	**166.17**	**195.68**	**209.30**	**177.52**	**222.47**	**191.37**	**201.58**	**158.45**	2197.44
	Total AET (m^3)		**0.00**	**81.42**	**198.57**	**299.51**	**297.25**	**269.66**	**214.64**	**104.63**	**25.55**	**0.00**	**0.00**	**0.00**	1491.22
	Total Infiltration (m^3)		**100.51**	**55.96**	**12.61**	**0.00**	**0.00**	**0.00**	**0.00**	**9.34**	**110.55**	**132.80**	**139.89**	**109.96**	**671.62**
	Total Runoff (m^3)		**896.41**	**878.29**	**1037.32**	**1139.73**	**941.63**	**1108.86**	**1186.04**	**1015.28**	**1346.45**	**1184.44**	**1247.67**	**980.71**	12962.84

NOTES:
1) PET and P Taken from Table 1
2) Soil Moisture Deficit (mm) is a function of P-Pet, once there is a shortage of P to satisfy PET
3) Water Holding Capacity (mm) of soils types taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003) and applied to March
4) Actual Evapotranspiration (AET) is a function of Adjusted Potential Evapotranspiration (PET) and change in Groundwater Storage (Δ ST) for a given soil type

TABLE D-3
POST-DEVELOPMENT SITE WATER BALANCE
41-43 Essa Road and 259 Inisfil Street, Barrie, ON.

Hydrologic Components			Month											Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.00	29.48	71.89	110.55	126.10	111.17	77.71	37.88	9.25	0.00	0.00	0.00	**574.04**
P - Total Precipitation (mm)			63.80	65.00	79.90	88.60	73.20	86.20	92.20	78.20	98.00	84.30	88.80	69.80	**968.00**
P-PET (mm)			63.80	35.52	8.01	-21.95	-52.90	-24.97	14.49	40.32	88.75	84.30	88.80	69.80	**393.96**
Soil Moisture Deficit (mm)			0.00	0.00	0.00	-21.95	-74.85	-99.82	-85.33	-45.02	0.00	0.00	0.00	0.00	-
Total Site	Pervious Area (Urban Lawns +)	Soil Moisture Storage (mm)	50.00	50.00	50.00	28.05	0.00	0.00	14.49	50.00	50.00	50.00	50.00	50.00	-
		Actual Evapotranspiration (mm)	0.00	29.48	71.89	105.73	88.04	86.20	77.71	37.88	9.25	0.00	0.00	0.00	**506.19**
		P-AET (mm)	63.80	35.52	8.01	-17.13	-14.84	0.00	14.49	40.32	88.75	84.30	88.80	69.80	-
		Actual Soil Moisture Deficit (mm)	0.00	0.00	0.00	-17.13	-31.97	-31.97	-17.48	0.00	0.00	0.00	0.00	0.00	-
		Change in Soil Moisture Deficit (mm)	0.00	0.00	0.00	17.13	14.84	0.00	-14.49	-17.48	0.00	0.00	0.00	0.00	-
		Precipitation Surplus (mm)	63.80	35.52	8.01	0.00	0.00	0.00	0.00	22.83	88.75	84.30	88.80	69.80	**461.81**
		MOECC Infiltration Factor	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	-
		Run-Off Coefficient	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	-
		Infiltration (mm)	28.71	15.98	3.60	0.00	0.00	0.00	0.00	10.27	39.94	37.94	39.96	31.41	**207.81**
		Run-Off (mm)	35.09	19.54	4.40	0.00	0.00	0.00	0.00	12.56	48.81	46.37	48.84	38.39	**253.99**
		Catchment Area (m^2) = 2267	**Monthly Volumes (Pervious Area)**												
	Total AET (m^3)		0.00	66.83	162.97	239.67	199.57	195.39	176.16	85.88	20.97	0.00	0.00	0.00	**1147.42**
	Total Evaporation (m^3)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Total Infiltration (m^3)		65.08	36.23	8.17	0.00	0.00	0.00	0.00	23.29	90.53	85.99	90.58	71.20	**471.06**
	Total Run-Off (m^3)		79.54	44.28	9.98	0.00	0.00	0.00	0.00	28.46	110.65	105.10	110.71	87.02	**575.74**
	Impervious Area (Roof)	Catchment Area (m^2) = 12074	**Monthly Volumes (Impervious Area)**												
		Evaporation from Imperv. (m^3), 15% of P.	115.55	117.72	144.71	160.46	132.57	156.12	166.98	141.63	177.49	152.68	160.83	126.41	**1753.14**
		Run-Off from Imperv. (m^3), P - ET	654.77	667.09	820.00	909.29	751.24	884.66	946.24	802.56	1005.76	865.16	911.34	716.35	**9934.45**
	Impervious Area (Paved)	Catchment Area (m^2) = 3555	**Monthly Volumes (Impervious Area)**												
		Evaporation from Imperv. (m^3), 15% of P.	34.02	34.66	42.61	47.25	39.04	45.97	49.17	41.70	52.26	44.96	47.36	37.22	**516.23**
		Run-Off from Imperv. (m^3), P - ET	192.81	196.43	241.46	267.75	221.21	260.50	278.63	236.32	296.16	254.76	268.36	210.94	**2925.33**
	Total Monthly Volumes (No Mitigation)														
	Total ET (m^3)		**149.57**	**152.39**	**187.32**	**207.71**	**171.61**	**202.09**	**216.15**	**183.33**	**229.75**	**197.63**	**208.18**	**163.64**	**2269.37**
	Total AET (m^3)		**0.00**	**66.83**	**162.97**	**239.67**	**199.57**	**195.39**	**176.16**	**85.88**	**20.97**	**0.00**	**0.00**	**0.00**	**1147.42**
	Total Infiltration (m^3)		**65.08**	**36.23**	**8.17**	**0.00**	**0.00**	**0.00**	**0.00**	**23.29**	**90.53**	**85.99**	**90.58**	**71.20**	**471.06**
	Total Runoff (m^3)		**927.12**	**907.80**	**1071.44**	**1177.04**	**972.45**	**1145.16**	**1224.87**	**1067.34**	**1412.57**	**1225.02**	**1290.41**	**1014.31**	**13435.52**

NOTES:
1) PET and P Taken from Table 1
2) Soil Moisture Deficit (mm) is a function of P-Pet, once there is a shortage of P to satisfy PET
3) Water Holding Capacity (mm) of soils types taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003) and applied to March
4) Actual Evapotranspiration (AET) is a function of Adjusted Potential Evapotranspiration (PET) and change in Groundwater Storage (Δ ST) for a given soil type

TABLE D-4
WATER BUDGET SUMMARY
41-43 Essa Road and 259 Inisfil Street, Barrie, ON.

Total Site	Month												Total
	March	April	May	June	July	August	September	October	November	December	January	February	
Pre-Development													
Total ET (m^3)	145	148	181	201	166	196	209	178	222	191	202	158	**2197**
Total AET (m^3)	0	81	199	300	297	270	215	105	26	0	0	0	**1491**
Total Infiltration (m^3)	101	56	13	0	0	0	0	9	111	133	140	110	**672**
Total Runoff (m^3)	896	878	1037	1140	942	1109	1186	1015	1346	1184	1248	981	**12963**
Post-Development without Mitigation													
Total ET (m^3)	150	152	187	208	172	202	216	183	230	198	208	164	**2269**
Total AET (m^3)	0	67	163	240	200	195	176	86	21	0	0	0	**1147**
Total Infiltration (m^3)	65	36	8	0	0	0	0	23	91	86	91	71	**471**
Total Runoff (m^3)	927	908	1071	1177	972	1145	1225	1067	1413	1225	1290	1014	**13436**
Post-Development Deficit (-ve value implies a net gain)													
Total ET (m^3)	-5	-5	-6	-7	-5	-6	-7	-6	-7	-6	-7	-5	**-72**
Total AET (m^3)	0	15	36	60	98	74	38	19	5	0	0	0	**344**
Total Infiltration (m^3)	35	20	4	0	0	0	0	-14	20	47	49	39	**201**
Total Runoff (m^3)	-31	-30	-34	-37	-31	-36	-39	-52	-66	-41	-43	-34	**-473**