HYDROGEOLOGICAL INVESTIGATION REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
79 COLLIER STREET, BARRIE, ONTARIO

Prepared for:

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1.0. INTRODUCTION AND BACKGROUND

Sirati & Partners Consultants Ltd. (SIRATI) was retained by Vitmont Holdings (Barrie) Inc. c/o Marydel Homes ("the Client") to conduct a Hydrogeological Investigation at the property identified as 79 Collier Street, Barrie, Ontario (the Property or the Site). The location of the Property is shown in Figure 1-1.

We understand that prior to December 2019, the municipal address for the Site was 36 Mulcaster Street, Barrie, Ontario. According to a City of Barrie memo dated December 11, 2019, the municipal address 79 Collier Street was assigned to the Site.

We also understand that the Site is an L-shaped property with an approximate area of 1,600 m^2 (0.16 hectares) located at the southwest corner of the intersection of Mulcaster Street and Collier Street in Downtown Barrie. It is bounded by Collier Street to the north, by Mulcaster Street to the east, by a retaining wall and a laneway to the south, followed by multiple commercial buildings, and by commercial property to the west. To the southeast of the Site is an armory building currently in operation as the Grey & Simcoe Foresters Regimental Museum.

It is understood that the Client intends to develop the Property with a fifteen-storey apartment complex with added commercial spaces.

The hydrogeological study was undertaken to ascertain the soil and groundwater conditions of the Site, assess any impacts on the surrounding natural environment due to the proposed development and provide recommendations or mitigative measures.

2.0. SCOPE OF WORK

This hydrogeological investigation assessment was carried out with the following tasks:

- **Review of available background information**: a review of available geological and hydrogeological information for the site and surrounding areas and the investigation reports completed for the Site was conducted to provide background information to allow for characterization of the Site's soil and groundwater conditions.
- **Detailed site inspection**: an inspection of the Site was completed to review existing site conditions including identification of any hydrogeological features such as significant areas of potential groundwater recharge or areas of groundwater discharge.
- **Measurement of groundwater levels:** groundwater levels were measured in the existing monitoring wells to establish and/or confirm the general groundwater flow condition.

- **Water Balance (Preliminary):** a preliminary water balance study was completed for the proposed development using the Thornthwaite approach and the climatic data obtained from Environment Canada.
- **Dewatering Assessment:** an assessment of the short-term and long-term dewatering was conducted for the construction of the proposed residential building with one level of underground parking. The assessment also evaluated the need for Permit to Take Water (PTTW) or Environmental Activity and Sector Registry (EASR) registration.
- **Report Preparation:** a hydrogeological report was prepared presenting the results, findings, and recommendations of this investigation.

It should be noted that a Phase Two Environmental Site Assessment (ESA) was concurrently conducted by SIRATI at the Site. In addition, environmental site assessments and geotechnical investigations were completed previously at the Site by other consultants.

The data or information obtained in the current and former investigations has been incorporated into this hydrogeological investigation report.

3.0. PAST INVESTIGATIONS

1) V.A. Wood Associates Ltd. (V.A. Wood) completed a geotechnical assessment at the Site in 2016. A report entitled *"Geotechnical Investigation, Proposed Condominium, 36 Mulcaster Street, Barrie, Ontario,"* dated April 2016 was prepared for Edgecon Inc. by V.A. Wood. (Ref. No. 6862-16-02). The extracted data including borehole locations and borehole logs are presented in Appendix A1.

   During geotechnical investigation, a total of six (6) boreholes (with no monitoring well installation) were completed across the Site. The boreholes were advanced to the depths ranging from 3.5 m below ground surface (mbgs) to 15.7 mbgs. The boreholes encountered a pavement 300 mm to 400 mm thick, followed by 1 m to 3.7 m of loose to compact gravelly sand fill, then generally competent native deposits of sand, gravelly sand till. The groundwater table is considered to be at least 5.5 mbgs. Soil samples taken from fill materials were submitted for analysis of polyaromatic hydrocarbons (PAHs), petroleum hydrocarbons (PHCs), and metals. The analytical results were summarized in a letter report "*Ref. No. 6862-16-02, Soil Analytical Testing, 36 Mulcaster Street, Barrie, Ontario,*" dated April 8, 2016. The test results show that some of the samples have concentrations of PAHs, some metals, sodium adsorption ratio (SAR) and electrical conductivity (EC) exceeding the Ministry of Environment, Conservation and

Parks (MECP) Site Condition Standards (SCS).

2) PGL Environmental Consultants (PGL) conducted a Phase II ESA at the Site in 2019, which was based on the findings of a Phase I ESA completed in February 2015 by Spice Environmental Inc. (Spice). A report entitled *"Phase II Environmental Site Assessment, 36 Mulcaster Street, Barrie, Ontario,"* dated June 2019 was prepared for Grant Thornton Limited by PGL. The extracted data including the borehole locations and borehole logs are presented in Appendix A2.

   The Spice's Phase I ESA identified onsite risks of environmental contamination due to the importation of up to 2,500 m^3 fill of unknown quality and the remains of a drill shed which was destroyed by fire in 1885.

   The 2019 Phase II ESA findings are described below:

   - Six (6) boreholes (BH101 to BH104 and BH201 and BH202) were advanced at the Site, to the depths ranging from 6.1 mbgs to 13.7 mbgs. Five (5) boreholes were completed as monitoring wells (identified as BH101M, BH102M, BH103M, BH201M and BH201M). However, monitoring wells BH101M, BH102M, BH103M were found to be dry.
   - Fill material was present at depths ranging from 2 mbgs to 5mbgs in the boreholes across the Site. Staining and extraneous materials such as bricks, debris, and charcoal were observed in the fill.
   - Soil samples were collected and analyzed for petroleum hydrocarbons Fractions 1 to 4 (PHC F1-F4), benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and metals.
   - Groundwater was encountered at roughly 8.7 mbgs. Two (2) groundwater samples were collected and tested for PAHs and metals.
   - Soil and groundwater results were compared to Ontario Regulation 153/04 Table 2 Site Condition Standards (SCS) for industrial/commercial/community land use and a coarse-textured soil. They were also compared against the Table 2 residential/parkland/institutional SCS in the event the Site is redeveloped for residential purposes.
   - Impacts of PAHs and metals were identified in the fill material on the west side of the Site. The groundwater results met the applicable Table 2 SCS for both industrial/commercial/community and residential/parkland/ institutional land uses.
   - The 2019 Phase II ESA recommended that impacted fill be addressed through remediation and/or a Risk Assessment during redevelopment of the Site.

It should be noted that the previous Phase II ESA was carried out for due diligence purpose for prior to divestment of the Site. A Phase One ESA, followed by a Phase Two ESA was recently conducted by SIRATI in support of the proposed development. The preliminary results indicate that exceedances of the MECP Table 2 Standards were found in some soil and groundwater samples for one or more parameters including PAHs, metals, PHCs and VOCs.

4.0. LAND USE

The Site is located located at the southwest corner of the intersection of Mulcaster Street and Collier Street, in a built up mixed residential and commercial area, in Barrie.

The Site is relatively flat with a gentle slope from north to south. To the southeast corner of the Site is an existing heritage structure currently in operation as the Grey & Simcoe Foresters Regimental Museum.

5.0. SITE DEVELOPMENT PLAN

The Property covering an area of about 0.40 acres (0.16 ha) was proposed to be developed as a step-like structure consisting of a 15-storey bulging in the north, a 14-storey structure in the center and a 13-storey building in the south, with a total of 127 residential units and equal number of parking spaces. Parking is being provided at one level underground parking and three (3) levels of above ground parking. Commercial spaces are being provided in the eastern half of the Site.

The site development plan with the outlay of the building is shown in Figure 5-1.

Figure 5-2 shows the building sectional plan provided by the Client, which indicates the finished floor (FF) grade elevation at 234.38 m above mean sea level (mAMSL).

6.0. ENVIRONMENTAL FEATURES

To assess environmental features, the databases maintained by the Ministry of Natural Resources and Forestry (MNRF), the Ministry of Environment, Conservation and Parks (MECP), and the Lake Simcoe and the Region Conservation Authority (LSRCA) were reviewed.

Based on the data reviewed, the Site is situated within the Barrie Creeks subwatershed, as shown on Figure 6-1, under the jurisdiction of the Lake Simcoe and Couchiching Black Source Protection Area. No creeks or waterbodies are present at the Site.

As per MNRF Natural Heritage System database, the Site is not located in any significant natural areas or areas of natural and scientific interests (ANSIs) (Figure 6-2).

As shown on the MECP Sourcewater Protection Atlas map (Figure 6-3), the Site is located within a drinking water vulnerable area (wellhead protection area, WHPA-B, and Issue Contributing Area).

The Site is not located in any LSRCA regulation areas, as shown in Figure 6-4.

7.0. PHYSICAL SETTING

7.1 Topography and Drainage

The Site is located within the Barrie subwatershed of the Lake Simcoe watershed area. As shown in Figure 6-1, the Barrie subwatershed consists of Barrie Creeks, Lovers Creek and Hewitt's Creek. The Site falls within the Barrie Creeks subwatershed. Barrie Creeks subwatershed is roughly 37.5 km^2 in area and includes six (6) major creeks and all these creeks drain separately into Kempenfelt Bay of the Lake Simcoe.

Figure 7-1 presents the topography survey map prepared by C.A. MacDonald Surveying Inc., dated June 9, 2015. It indicates that the Site slopes generally to the south, with the elevations ranging from approximately 234.6 mAMSL in the north/northeast to about 230.4 mAMSL at the southwest corner. The nearest water body is Kempenfelt Bay of the Lake Simcoe, with the nearest point located about 160 m southeast of the Site.

7.2 Physiography

According to Chapman and Putnam (1984), three (3) physiographic regions are found within the subwatershed: the Simcoe Uplands, the Simcoe Lowlands, and the Peterborough Drumlin Field. As shown in Figure 7-2, the Site is located in the Sand Plain area in the Simcoe Lowlands physiographic region. The region is described as having lower elevations, with flat-floored valley features that generally correspond to current river systems (Sharpe *et al*., 1999). The lowlands were flooded by glacial Lake Algonquin, and as a result, are floored by sand, silt and clay (Chapman and Putnam, 1984).

7.3 Overburden Geology

The surficial geology at the Site, was described as foreshore-basinal deposits consisting mainly of sand and silt with varying amounts of gravel, with high infiltration rates (Figure 7-3). In general, the thickness ranges from approximately 83 m to 191 m.

The Paleozoic bedrock topography appears to strongly influence the overlying Quaternary sediment thickness and distribution. The thicker Quaternary sediments occur in bedrock topographical lows (i.e. within bedrock valleys), while the thinnest areas of Quaternary deposits occur along the shoreline of Kempenfelt Bay.

7.4 Bedrock Geology

The bedrock can be characterized as being from the Paleozoic Era, consisting primarily of limestone of the Middle Ordovician Simcoe Group (Figure 7-4). The Simcoe Group consists of four formations that dip gently towards the southwest: Gull River Formation, Bobcaygeon Formation, Verulam Formation and the Lindsay Formation from oldest to youngest. However, only the Verulam and Lindsay Formations are found within these subwatersheds.

Verulam Formation occurs along the shoreline of Kempenfelt Bay and expands west of the City of Barrie and ranges in thickness from 32 m to 65 m and consists of fossiliferous limestone with inter-beds of calcareous shale.

8.0. HYDROGEOLOGY

Water well records on file with the Ministry of the Environment, Conservation and Parks (MECP) serve as a database for this hydrogeological assessment. The well locations were provided from the MECP interactive water well record database. According to the well records, there appears to be 79 wells within a 500 m radius around the property. The locations of the recorded water wells are shown in Figure 8-1.

Five (5) water wells (#5700235 for municipal, #5700236 and #5700262 for industrial, #5718640 for cooling/AC and #5719264 for public) were found for water supply use, and the others were recorded as test holes, observation wells, abandoned wells or with no detailed information.

Based on the details in the well records, a thick layer of overburden materials seems to be present in the study area. Bedrock was not encountered at the maximum explored depth of about 98 mbgs in a test hole identified as #5700288. The groundwater levels recorded in water supply wells and deep test holes ranged from 3 m above ground surface (artesian flowing water) to about 8.4 mbgs.

9.0. BOREHOLE DRILLING AND MONITORING WELL INSTALLATION

Concurrently with the Phase Two ESA, a total of five (5) boreholes (BH1 to BH5) were advanced at the Site, of which two (2) monitoring wells identified as BH/MW2 and BH/MW3 were completed with installation of monitoring wells.

As mentioned earlier, five (5) monitoring wells were installed at the Site in the previous investigations. However, during the site visit, only two (2) monitoring wells (BH201M and BH202M) were found existing at the Site.

Figure 9-1 depicts the locations of boreholes and monitoring wells completed by SIRATI, along with the monitoring wells completed previously by other consultant. The observed soil stratigraphy and the details of monitoring well construction are presented in Borehole Logs included in Appendix A1, A2 and A3.

9.1 Soil Stratigraphy

The soil stratigraphy as revealed from the advanced boreholes by SIRATI, generally consisted of topsoil/asphalt overlying the fill materials, underlain by cohesionless soils, predominantly composed of sand. No bedrock was encountered at the maximum explored depth of 15.7 mbgs (by V.A.Wood).

Following is the generalized stratigraphy at the Site, as depicted in the boreholes.

Topsoil

A layer of topsoil with a maximum thickness of 0.15 m was found at the surface of borehole number 1.

Asphalt

A layer of asphalt was found at the surface of all the boreholes, except MW1, with a maximum thickness of about 0.1 m.

Fill

Fill material consisting of sand, some stone, trace silt, clay with pieces of brick was found to a maximum depth of 2.3 mbgs at BH2.

Sand

A layer of sand with trace gravel with some silt was encountered from about 2.3 mbgs to the explored depth of 13.7 mbgs. This layer was moist to wet, white to dark grey in color.

The cross-section profiles A-A' and B-B' as shown in Figures 9-2 and 9-3, respectively, present the general soil stratigraphy of the Site. As can be seen from the cross-section, a layer of sand deposits exists below the fill materials across the entire Site.

A representative soil sample taken from BH/MW2 was selected for grain size analysis. The result is provided in Appendix B, which indicated the tested soil as silty fine sand.

9.2 Groundwater Levels

Groundwater levels were measured on July 16, and July 27, 2020 in two (2) new monitoring wells (BH/MW2 and BH/MW3) installed by SIRATI and two (2) existing monitoring wells (BH201M and BH202M) previously installed by PGL. The recorded groundwater levels are presented in Table 9-1 below.

Table 9-1: Well Construction Details and Measured Groundwater Levels

Monitoring Well	Ground Elevation (mAMSL)	Well Depth (mbgs)	Screen Depth (mbgs)	Screened Soil Type	June 3, 2019		July 16, 2020		July 27, 2020	
					Depth to Ground water (mbgs)	Ground water Elevation (mAMSL)	Depth to Ground water (mbgs)	Ground water Elevation (mAMSL)	Depth to Ground water (mbgs)	Ground water Elevation (mAMSL)
BH/MW 2	231.75	10.70	7.7 ~10.7	Sand	-	-	9.48	222.27	9.51	222.24
BH/MW 3	232.10	12.20	9.2 ~ 12.2	Sand	-	-	9.88	222.22	9.82	222.28
BH201M	230.80	13.70	10.7 ~ 13.7	Sand	8.7	222.10	8.80	222.00	8.87	221.93
BH202M	231.05	13.70	10.7 ~ 13.7	Sand	8.7	222.35	8.81	222.24	8.89	222.16

Notes: mAMSL - metres above mean sea level; mbgs - metres below ground surface

As presented above, the latest measured groundwater levels ranged in depth from 8.87 mbgs to 9.82 mbgs, and the elevations ranged from 221.93 mAMSL to 222.28 mAMSL, with an average groundwater elevation of 222.15 mAMSL.

9.3 Groundwater Flow Direction and Hydraulic Gradients

Based on the groundwater elevation data obtained from the latest monitoring event, a site-specific groundwater elevation contour map was prepared to present the inferred the groundwater flow direction. As shown in Figure 9-4, the groundwater flow direction was inferred to be southwards, generally following the local surface drainage.

The hydraulic gradient is a gradient or slope between two or more hydraulic head measurements over the length of the flow path. The hydraulic gradients help determine the groundwater flux or discharge. Groundwater will flow down the hydraulic gradient. Based on the groundwater elevation data for the shallow monitoring wells, horizontal hydraulic gradient was calculated to be approximately 0.004 m/m (Table 9-2).

Table 9-2: Horizontal Hydraulic Gradients – 79 Collier Street, Barrie, Ontario

Monitoring Well	Groundwater Elevation (mAMSL)		Distance Between Monitors (m)	Gradient (m/m)
BH/MW2 to BH/MW3	222.24	222.28	27	0.001
BH/MW2 to BH202M	222.24	222.16	16	0.005
BH/MW3 to BH202M	222.28	222.16	20	0.006
			Average	**0.004**

9.4 Estimated Hydraulic Conductivity

The native soils present at the Site are predominantly sandy soils. Based on the result of grain size analysis of one representative soil sample, the hydraulic conductivity was estimated using empirical Hazen equation, and was estimated to be 4.3 x 10^{-6} m/s.

It should be noted that the theoretical hydraulic conductivity (K-value) of the sandy soils may range from 1.0 x 10^{-5} m/s to 1.0 x 10^{-6} m/s.

10.0. CONSTRUCTION DEWATERING REQUIREMENTS

Construction dewatering is intended to lower the groundwater levels in the excavation area in order to ensure a dry working condition.

The requirements for construction dewatering generally depend on the site's soil and groundwater conditions including soil type, soil permeability or hydraulic conductivity, local groundwater levels, and the design of the proposed development such as the foundation and/or basement elevation, as well as the size of proposed structure, etc.

10.1 Proposed Development and Anticipated Excavation

As mentioned earlier, the Property covering an area of about 1,660 m^2 (0.16 hectares) was proposed to be developed into a 15-storey residential apartment building with part of commercial use, accommodate 127 dwelling units. The proposed building will consist of one level underground parking and three (3) levels of above ground parking. Commercial spaces are being provided in the eastern half of the building.

Based building sectional plan (Figure 5-2) made available by the Client, the finished main floor elevation is at 234.38 mAMSL, the underground level elevation is at 231.38 mAMSL and the lower loading level elevation, which appears to be similar to footing elevation, is at 227.68 mAMSL,

For construction of the footing/foundation and loading level, the excavation may extend to the elevation of 227. 23 mAMSL (227.68 minus 0.45 m below the loading level or footing for the placement of granular materials and construction of concrete slab).

Based on the soil stratigraphy revealed at the Site, the excavation will cut through the fill material and into the sandy soil.

10.2 Dewatering Requirements

As discussed, the excavation may extend to the elevation of 227. 23 mAMSL. Based on the groundwater monitoring completed at the monitoring wells (MW2, MW3, BH201M and BH202M), the measured

groundwater elevations ranged from 221.93 mAMSL to 222.28 mAMSL, which are well below the final excavation elevation of 227.23 mAMSL for the footing as well as lower loading level. Therefore, groundwater control will not be required for the proposed development either for temporary construction dewatering or for long-term drainage discharge. Therefore, PTTW or EASR registration are not required.

11.0. ASSESSMENT OF POTENTIAL IMPACTS

As discussed, there is no construction dewatering, either short-term or long-term due to the prevailing deep-water table conditions. The potential impacts due to the Site development were assessed as follows.

11.1 Natural Features

As discussed, no natural features including a wetland, a pond or a creek are located on the Site. The nearest water body is located at about 160 m southeast of the Site and therefore, there should be no impact on the local natural features, due to the site development.

11.2 Water Supply Wells near the Site

Given that no dewatering will be required for completion of the proposed development, impacts on the local water wells (private or public) will not be anticipated to be associated with the dewatering activity, although the Site is located within the Barrie Water Supply Wells # 11, 12 and 14 combined wellhead protection area.

11.3 Considerations on Drinking Water Vulnerability

Based on the MECP Source Protection Information Atlas, the Site is located within the Lakes Simcoe and Couchiching/Blake River Source Protection Area (Figure 6-3), and vulnerable areas are identified to be associated with at the site development.

It is understood that the following South Georgian Bay Lake Simcoe Source Protection Plan policies apply to the proposed development: RLU-1, DNAPL-1, Salt (ICA)-2, LUP-2.

11.3.1 Well Head Protection Area

The proposed development lies within the 2- year Time of Travel (TOT) capture zone, i.e. Well Head Protection Area, WHPA-B (Figure 6-3), which is related to the Barrie Water Supply Wells #11, 12 and 14. Time of travel is important because it is an indication of how quickly a contaminant can move from a WHPA into a municipal well.

Use and/or storage of chemicals on Site may result in contamination in soil and/or groundwater due to inadvertent release on the Property, and potentially would result in contamination in the source of groundwater for the municipal wells.

Policies: RLU-1, DNAPL-1, and Salt(ICA)-2 should be considered to be applied during the design and construction of the proposed development, which restrict storage and handling of road salt, snow, fuels, dense nonaqueous phase liquid (DNAPL) and/or organic solvent on Site.

11.3.2 Issue Contributing Area – Chloride and Sodium

The Site is located in an issue contributing area for chloride and sodium, associated with water supply Well# 11, 12 and 14. As such, the Site is susceptible to contamination in soil and groundwater due to chloride and sodium. Therefore, storage and/or application of de-icing salt material would pose a potential impact at the Site, because chloride and sodium are typical components of de-icing salt.

Policies: RLU-1 and Salt (ICA)-2 should be considered to be applied during the design and construction of the proposed development.

11.3.3 Significant Groundwater Recharge Area

The Site is located in a Significant Groundwater Recharge Area with a vulnerable score of 6. Significant Groundwater Recharge Areas are areas on the landscape that are characterized by porous soils, such as sand or gravel, which allows water to seep easily into the ground and flow to an aquifer. A recharge area is considered significant when it helps maintain the water level in an aquifer that supplies a community or private residence with drinking water.

Given that the Site is located in an urbanized area, the Site and its neighbouring properties would be relying on the City's water supply. The proposed development may reduce the pervious area at the Site, which result in decreased infiltration into subsurface or decrease in groundwater recharge.

However, considering that the municipal water wells are usually constructed in deep aquifers and no dewatering is required, the impact on the groundwater recharge may not be considered.

11.3.4 Highly Vulnerable Aquifer

The Site is located in a Highly Vulnerable Aquifer area with a vulnerable score of 6. An aquifer is an area underground that is highly saturated with water – enough water that it can be withdrawn for human use. A Highly Vulnerable Aquifer is one that is particularly susceptible to contamination because of its location near the ground's surface or where the types of materials in the ground around it are highly permeable.

Based on the site condition, the shallow groundwater at the Site is susceptible to contamination. Considerations should be taken into as in Section 11.3.1 and 11.3.2.

11.3.5 Wellhead Protection Area – Q (Water Quantity)

The Site is identified to be an area of a Wellhead Protection Area – Q (Water Quantity), with low stress level. Any WHPA-Q areas where significant or moderate drinking water stress has been identified is an area where significant drinking water quantity threat activities can occur. Within these areas, future activities which take water without returning it to the same source or which reduce recharge to the aquifer are significant water quantity threats.

As discussed, no dewatering is required for the proposed development. Therefore, no concerns on Wellhead Protection Area – Q (Water Quantity) would be considered due to the proposed development.

12.0. WATER BALANCE

A preliminary water balance for the Site was calculated for both pre-development and post-development conditions in order to assess the change in overall rate of infiltration.

12.1 Site Condition

The Site is currently occupied by a parking lot, a landscaped area with trees and a private drive lane. There are no creeks, ponds or wetlands located on the Subject Property.

It is understood that a residential development has been proposed consisting of construction of a 15-storey residential building with one (1) level of underground level and 3-levels of above ground parking.

Based on the design information, the development area at the Site can be generally categorized into three (3) types as paved area, roof area, and landscape area as shown in Figures 12-1 and 12-2. A summary of the surface areas of the development is listed in Table 12-1.

Table 12-1: Pre-and Post-Development Site Conditions

Type of Land Coverage	Pre-Development Area (m^2)	Post- Development Area (m^2)
Paved Area	1260	558
Building Roof Area	0	1102
Landscape/Vegetated Area	400	0
Total (m^2)	**1660**	**1660**

12.2 Site Level Water Balance

Based on the Thornthwaite and Mather methodology (1957), the water balance is an accounting of water in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can run off towards lakes and streams (R), infiltrate to the groundwater table (I), or evaporate from ground or evapotranspiration by vegetation (ET). When long-term average values of P, R, I, and ET are used, there is minimal or no net change to groundwater storage (ΔS).

The annual water budget can be expressed as:

$$P = ET + R + I + \Delta S$$

Where:

P = Precipitation (mm/year)

ET = Evapotranspiration (mm/year)

R = Run-off (mm/year)

I = Infiltration (mm/year)

ΔS = Change in groundwater storage (taken as zero) (mm/year)

12.3 Climatic Data

The climatic data including monthly average temperature and precipitation were obtained from Environment Canada, for Shanty Bay weather station (Climate Identifier: 6117684) located at about 4 km distance from the Site.

The data were available between the years 1973 to 2006 i.e. 33 years. Temporal variations of mean annual temperature and precipitation are shown in Figures 12-3 and 12-4.

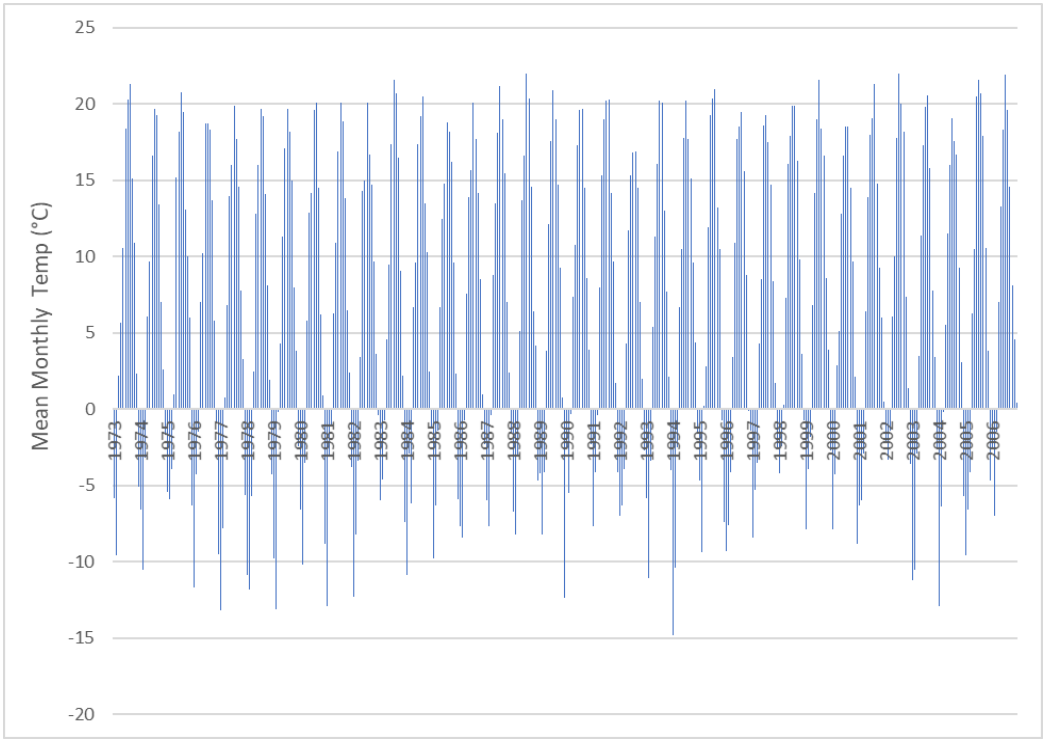

Figure 12-3: Mean Annual Temperature at the Site

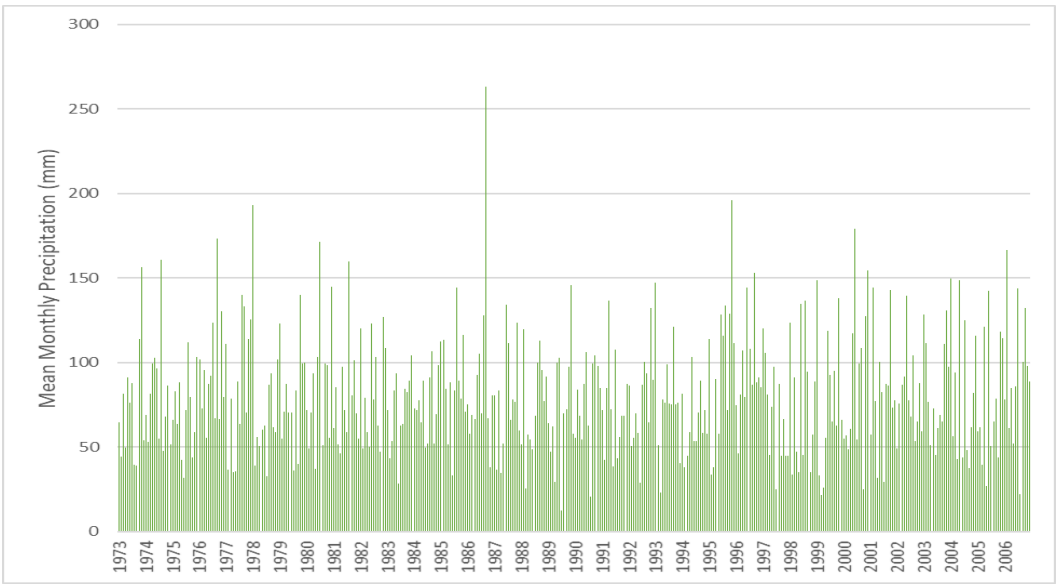

Figure 12-4: Mean Annual Precipitation at the Site

Average monthly variations of both temperature and precipitation were calculated for the period from 1973 to 2006 (33 years) and is presented below in Figure 12-5. The highest average temperature was recorded in the month of August, while the highest precipitation was in the month of November.

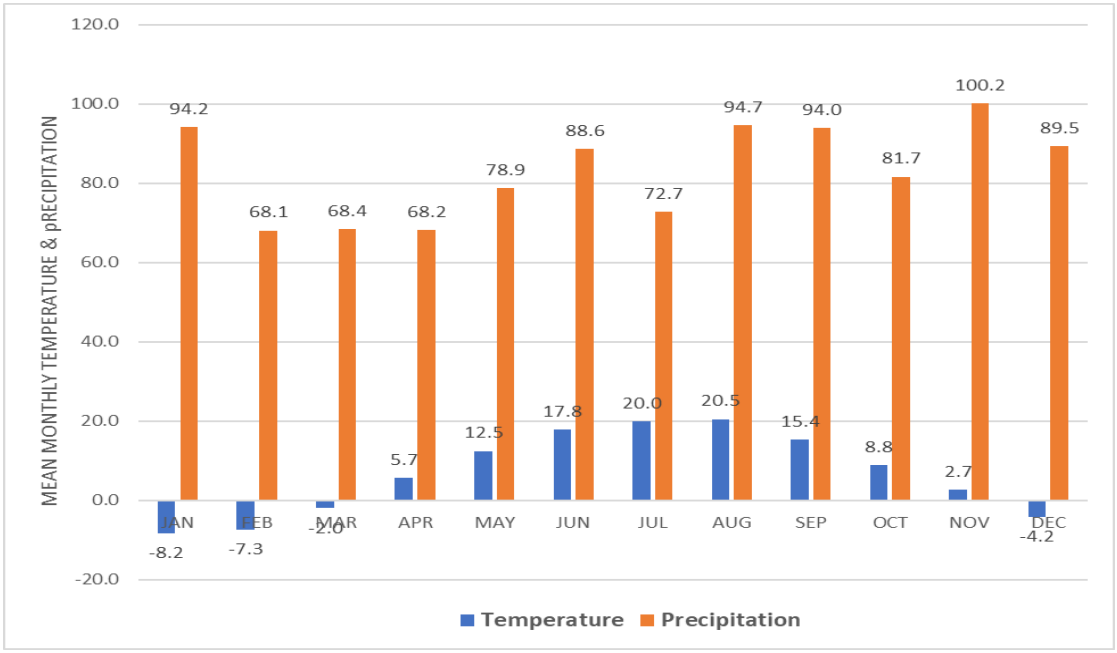

Figure 12-5: Mean Monthly Average Temperature and Precipitation at the Site

Based on the data for the precipitation and temperature, actual evapotranspiration was estimated to be about 531 mm/annum using the USGS Thornthwaite Monthly Water Balance software (Appendix E), and the average annual precipitation was recorded to be 999 mm/annum.

12.4 Infiltration and Runoff

As mentioned above, the actual evapotranspiration was estimated to be 531 mm/annum. Given the average annual precipitation of 999 mm/annum, there is a water surplus of 468 (=999-531) mm/annum occurring at the Site, which can either infiltrate into subsurface or go as run-off.

The rate of infiltration at a site is expected to vary, based on a number of factors to be considered in any infiltration model. To partition the available water surpluses into infiltration and surface run-off, the Ministry of Environment, Conservation and Parks (MECP) infiltration factor was used. The MECP Storm Water Management Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding run-off component was calculated for the soil moisture storage conditions.

The calculation of infiltration and runoff in the stages of pre-development and post-development is provided in Appendix D, and are presented in Tables 12-2 to 12-5, below.

Table 12-2: Annual Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1260	1259	126	0	1133
	Roof Area	0	0	0	0	0
Pervious Areas	Landscape Area	400	400	212	140	47
		1,660	**1,658**	**338**	**140**	**1,180**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

Table 12-3: Annual Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	558	557	56	0	502
	Roof Area	1102	1,101	110	0	991
Pervious Areas	Landscape Area	0	0	0	0	0
		1,660	**1,658**	**166**	**0**	**1,493**
Assuming no infiltration occurring in paved and roof areas, 10% of precipitation to be evaporated from paved and general roof areas.						

Table 12-4: Comparison of Pre- and Post Development Water Balance Components

	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	**1,658**	**338**	**140**	**1,180**
Post-Development	**1,658**	**166**	**0**	**1,493**
Change in Volume		**-172**	**-140**	**313**
Change in %			**-100**	**27**

Table 12-5: Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/annum)	**140**
Volume of Post-Development Infiltration (m^3/annum)	**0**
Deficit from Pre to Post Development Infiltration (m^3/annum)	**140**
Percentage of Roof Runoff required to match the pre-development infiltration (%)	**14**

12.5 Summary of Water Balance Calculation

Based on the above calculations, a summary of water balance could be provided as below:

1) There is a net increase in run-off at the Site of about 313 m^3/annum, from 1,180 m^3/annum to 1,493 m^3/annum. This increase is a result of the development of the Site with more impervious areas such as roof and paved areas, and reduction in pervious areas.
2) Without implementation of mitigation measures, there is a net deficit of about 140 m^3 /annum (or 100% decrease) in the post-development infiltration on a yearly basis.
3) There is a volume of 991 m^3/annum collected from the general roof area, which can be used for the enhanced infiltration for the purpose of implementing the Low Impact Development (LID) measures, if applicable. Based on the estimation, diversion of 14% of the general roof water for infiltration would maintain a balanced infiltration after the development.

12.6 Discussions on LID Measures

It is known that low impact development (LID) practices have received increasing attention as these strategies attempt to capture the runoff and mimic the natural hydrologic cycle.

The City of Barrie has introduced an Infiltration LID Screening Process to guide the selection and implementation of LID measures.

In general, there are two primary categories of LIDs. The first promotes the infiltration of stormwater close to the source. These infiltration type LIDs are preferred when hydrogeological and physical

conditions are optimal and allow for their emplacement. The second captures and slowly releases the water to the surface water system through the process of storage and filtration. Storage and filtration type LIDs are to be considered when conditions do not permit infiltration LIDs to be implemented. As it is discussed, the Site is located in an area categorized as WHPA-B and Issue Contributing Area – Chloride and Sodium. According to the LID Screening Process, water source from the paved area (driveway and/or walkway) is not permitted for use of infiltration, based LID practices. In other words, the LID measures such as permeable pavers or other open infiltration facility may not be allowed.

Given the proposed design, there is little or no space available for the implementation of LID measures. However, as SIRATI is not providing any design of LID facilities, it would be beneficial to consult with design engineers for the LID design recommendations.

13.0. CONCLUSIONS AND RECOMMENDATIONS

This report was prepared by SIRATI in support of a proposed mix-use residential/commercial development at the Site located at 79 Collier Street, Barrie, Ontario. Based on the hydrogeological investigation conducted on the Property, the following conclusions and recommendations are presented:

- The Site is located within the Barrie Creeks subwatershed of Simcoe Watershed within the Lakes Simcoe and Couchiching/Black River Source Protection Area. No creeks or waterbodies are present at the Site.
- Topographically, the Site slopes generally to the south, with the elevations ranging from approximately 234.6 mAMSL in the north/northeast to about 230.4 mAMSL at the southwest corner. The nearest water body is Kempenfelt Bay of Lake Simcoe, which is located about 160 m southeast of the Site.
- The Site is located in the Sand Plain area in the Simcoe Lowlands physiographic region, covered by foreshore-basinal deposits consisting mainly of sand and silt with varying amounts of gravel and underlain by the bedrock of the Middle Ordovician Simcoe Group consisting primarily of limestone.
- The soil stratigraphy revealed at the Site generally consisted of topsoil or asphalt pavement structure overlying the fill materials, underlain by cohesionless soils consisting predominantly of sand. No bedrock was encountered on the Site to the maximum explored depth of 15.7 mbgs.
- Groundwater levels measured recently in the monitoring wells ranged in depth from 8.87 mbgs to 9.82 mbgs, and the elevations ranged from 221.93 mAMSL to 222.28 mAMSL. The groundwater flow was inferred to be to the southwestwards.
- Based on the soil and groundwater conditions and the proposed development design, short-term construction dewatering and long-term sub-drain discharge are not expected at the Site. Therefore, PTTW or EASR registration are not required
- No significant impact due to the proposed development would be anticipated with regards to the natural environmental features or water wells near the development Site.
- However, the proposed development lies within the 2- year Time of Travel (TOT) capture zone (WHPA-B) of Barrie Water Supply Well #s 11, 12 and 14 with moderate intrinsic vulnerability score between 6 and 8, and hence, the Lake Simcoe Source Protection Plan policies are applicable to the Site.
- As per City of Barrie Risk Management Plan within the wellhead protection areas, the road salt application best management practices should be adhered to in order to reduce any impacts to the local groundwater supply.

- As the subject property is within the Wellhead Protection Area B, WHPA-Q1, and HVA area, it is recommended to conduct and submit a Source Water Impact Assessment and Mitigation Plan (SWIAMP).
- Water balance assessment indicated a net deficit of 140 m^3 /annum (or 100% decrease) in the post-development infiltration (changed from 140 m^3/annum to zero), due to the fact that landscape areas were not proposed in the post-development scenario. This The deficit of 140 m^3 / annum is considered insignificant.
- As per City of Barrie's LID guideline, infiltration based LID practices (such as permeable pavers) is not permitted. Given the proposed design, there is little or no space available for the implementation of LID measures.

14.0. SELECTED BIBLIOGRAPHY

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CITY OF BARRIE, Infiltration Low Impact Development Screening Process (undated)

15.0. LIMITATIONS AND USE OF THE REPORT

This report was produced for the sole use of Vitmont Holdings (Barrie) Inc. (the Client), for the property located at 79 Collier Street, in the City of Barrie, Ontario and may not be relied upon by any other person or entity without the written authorization of Sirati & Partners Consultants Ltd. (SIRATI).The conclusions presented in this report are professional opinions based on the historical and current records search, visual observations and limited information provided by persons knowledgeable about past and current activities on this site. As such, SIRATI cannot be held responsible for environmental conditions at the Property that was not apparent from the available information. No investigation method can completely eliminate the possibility of obtaining partially imprecise or incomplete information; it can only reduce the possibility to an acceptable level.

Professional judgement was exercised in gathering and analyzing data and formulation of recommendations using current industry guidelines and standards. Similar to all professional persons rendering advice, SIRATI cannot act as absolute insurer of the conclusion we have reached. No additional warranty or representation, expressed or implied, is included or intended in this report other than stated herein the report.

The assessment should not be considered a comprehensive audit that eliminates all risks of encountering environmental problems. The information presented herein this report is primarily based on information collected during the hydrogeological study based on the condition of the Property at the time of site inspection/drilling followed by a review of historical data, as appended to this report.

In assessing the environmental setting of the Property, SIRATI has solely relied upon information supplied by others in good faith and has therefore assumed that the information supplied is factual and accurate. We accept no responsibility for any inaccurate information, misrepresentation or for any deficiency of the information supplied by any third party.

The scope of services performed in the execution of this investigation may not be appropriate to satisfy third parties. SIRATI accepts no responsibility for damages if any, suffered by any third party as a result of decisions made or action taken based on this report. Any use, copying or distribution of the report in whole or in part is not permitted without the express written permission of SIRATI and use of findings, conclusions and recommendations represented in this report, is at the sole risk of third parties.

In the event that during future work new information regarding the environmental condition of the Property is encountered, or in the event that the outstanding responses from the regulatory agencies indicate outstanding issues on file with respect to the Property, SIRATI should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.

16.0. SIGNATURES

Should you have any questions regarding the information presented or limitation set in this report, please do not hesitate to contact our office.

Yours truly,

Sirati and Partners Consultants Ltd.

Sudhakar Kurli, M.Sc., P. Geo.
Hydrogeologist/Project Manager

Bujing Guan, M. A.Sc., P. Geo.
Senior Hydrogeologist/Environmental Specialist

FIGURES

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

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Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

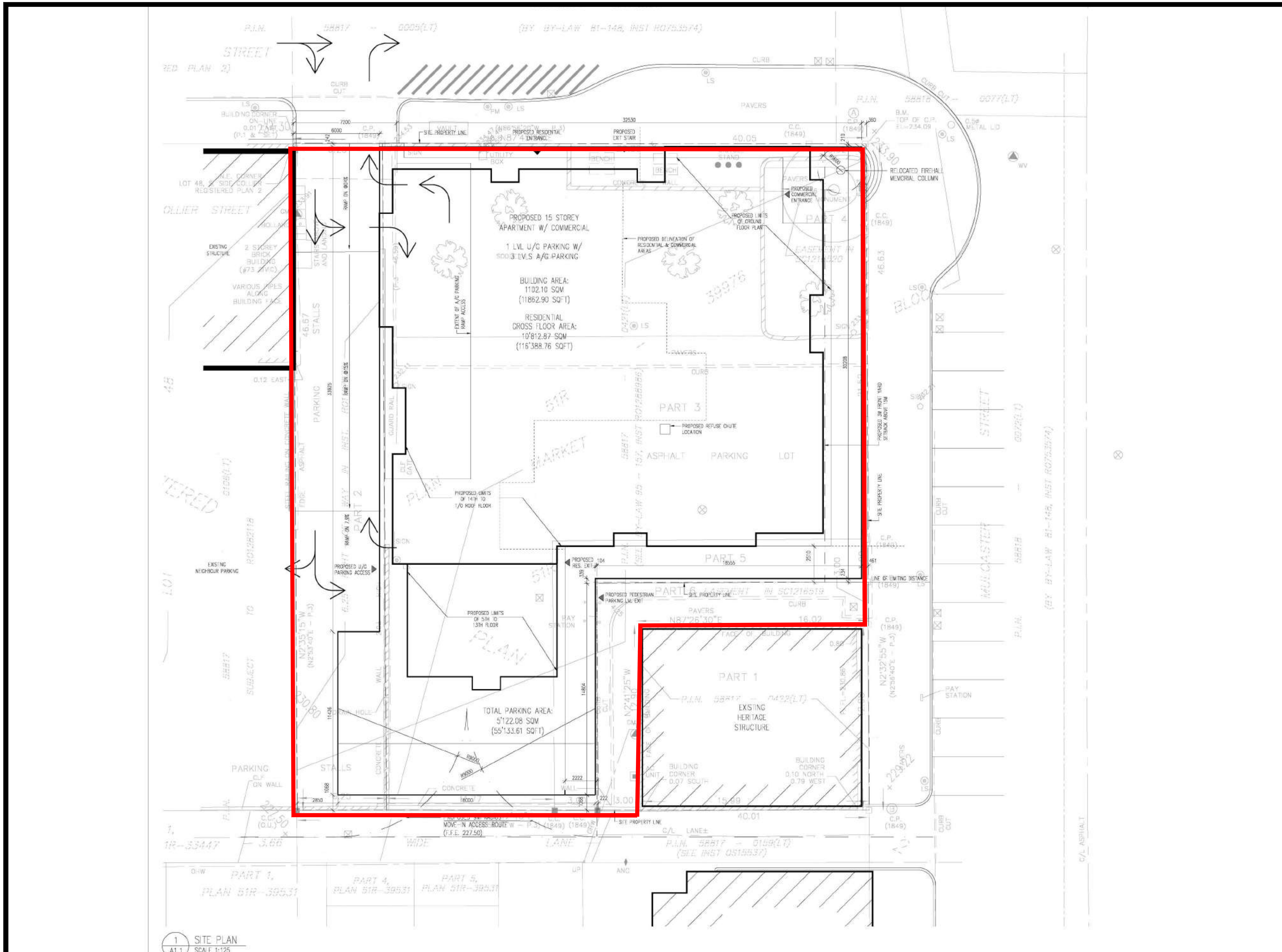
Property Boundary

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Site Location Plan

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	1-1



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North:

Legend:

Property Boundary

PROJECT NAME: BAYSIDE APARTMENTS
PROJECT ADDRESS: 79 COLLIER STREET, BARRIE, ONTARIO

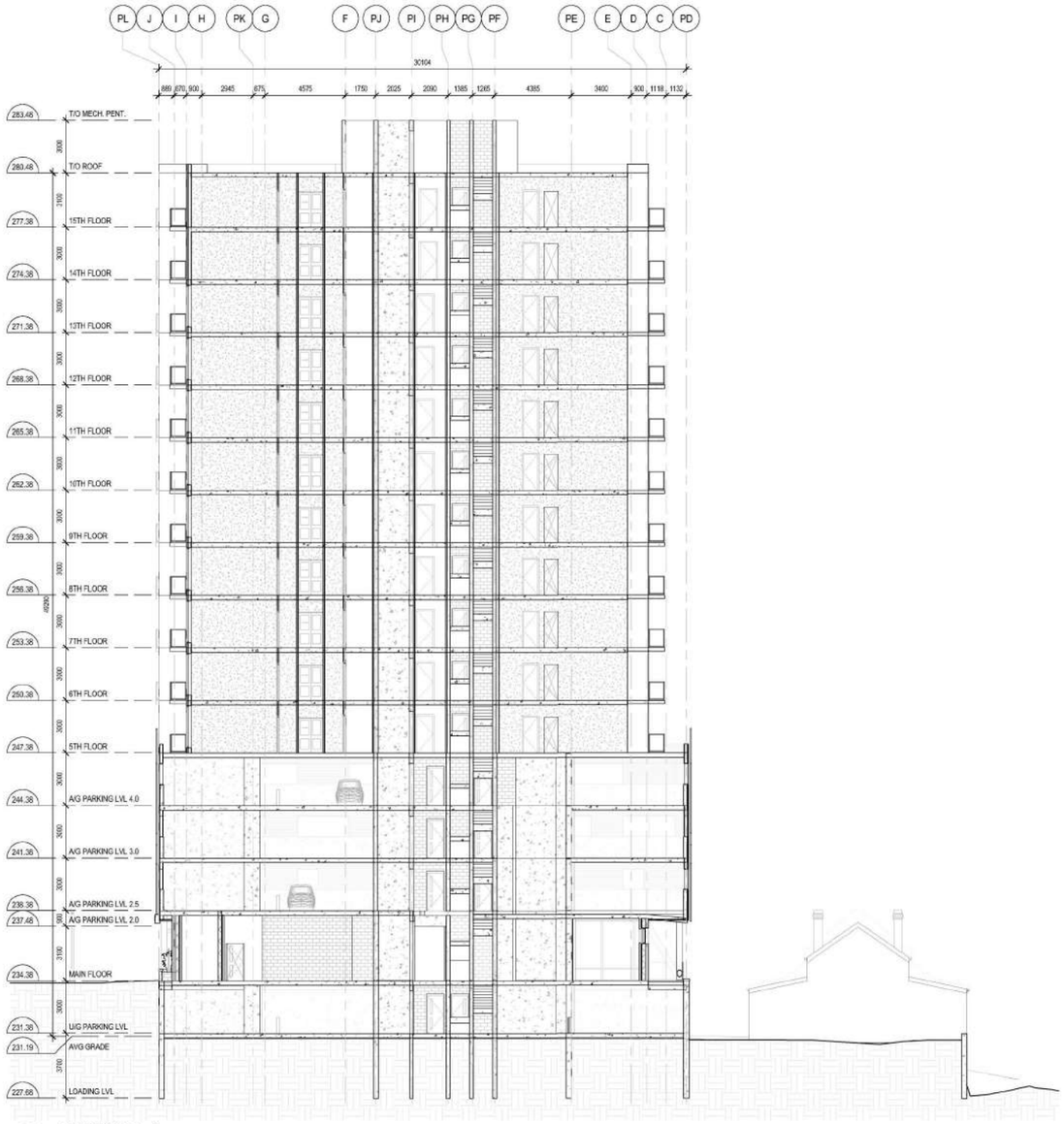
DATE: MAY 05, 2020	JOB NO.	SHEET NO.
DRAWN BY: NT	00-000	A1.1
SCALE: 1:125		

Project Title: Hydrogeological Investigation

Site Location: 79 Collier Street, Barrie, ON

Figure Title: Site Development Plan

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	5-1



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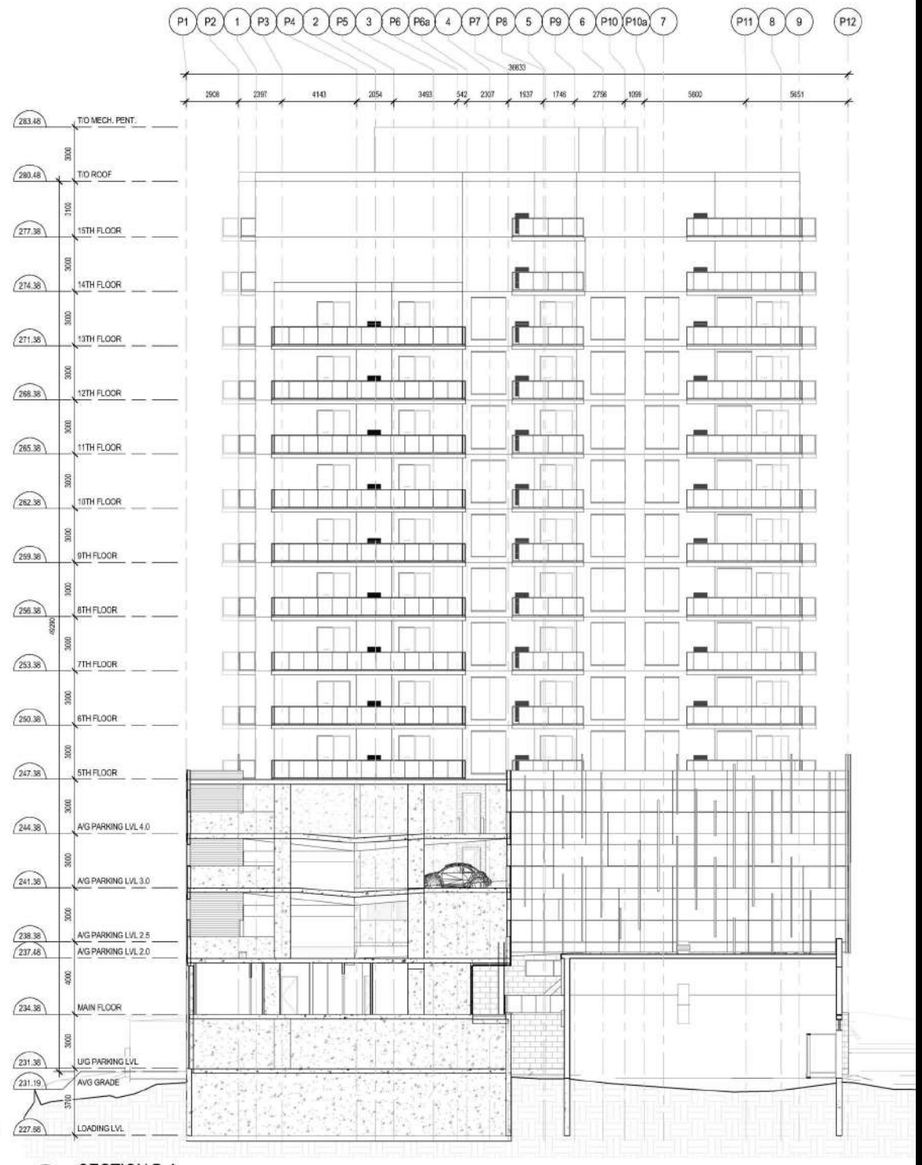

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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

DRAWING TITLE
BUILDING SECTION
PROJECT NAME
BAYSIDE APARTMENT
79 COLLIER ST. BARRIE, ON
MARYDEL

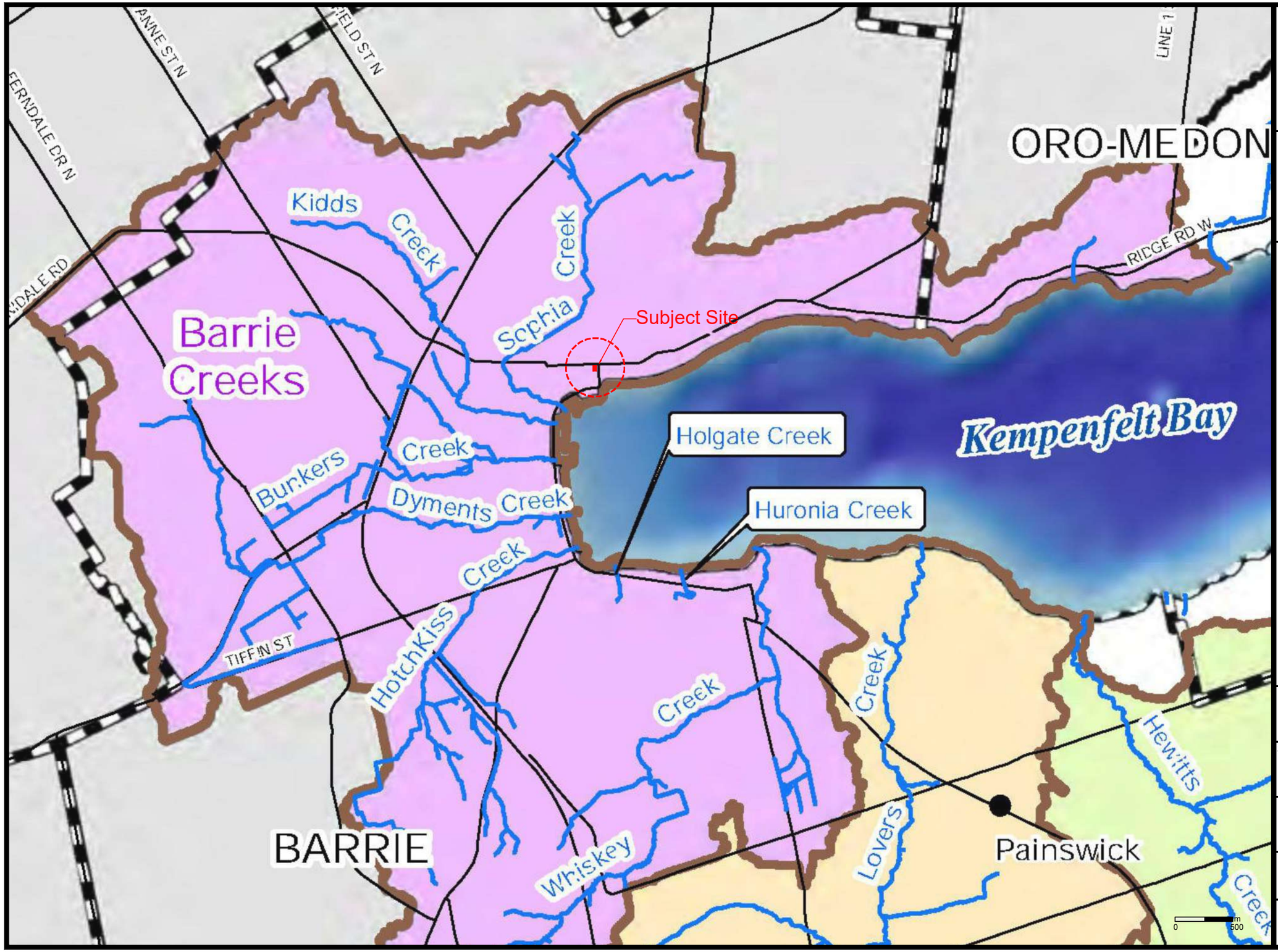
DATE	MAY 11, 2020	PROJECT #	SHEET #
DRAWN BY	Author	PROJECT #	A4.1
SCALE	1 : 150		

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Building Sectional Map

Scale:	Project Number:
As Shown	SP20-666-30
Date: September 2020	**Figure Number:** 5-2



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North:

Legend:

Subject Site

Approximately 500 m from the Site

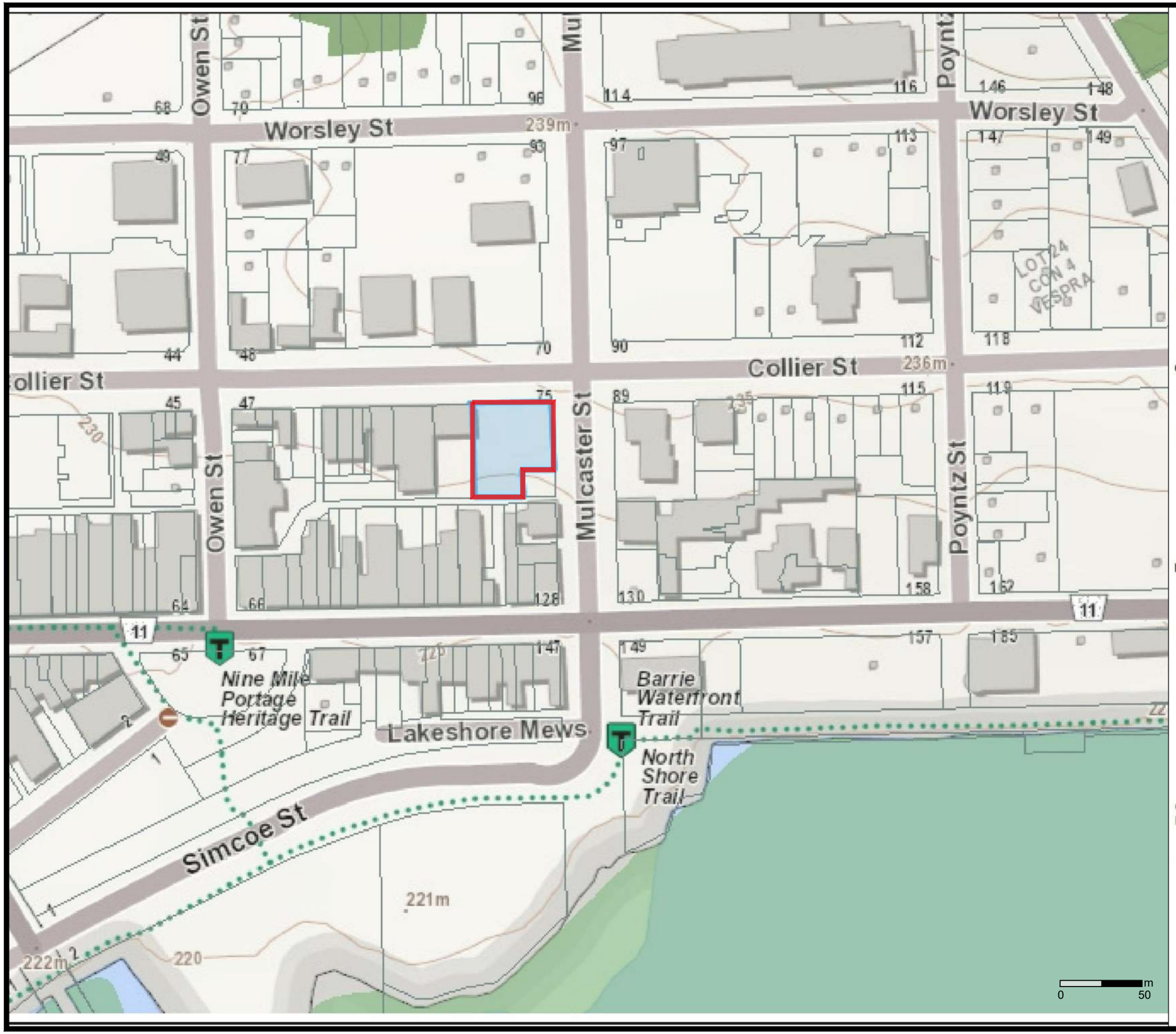
Legend
- Road
- Municipal Boundary
- Watercourse
- Barrie Creeks
- Hewitts Creeks
- Lovers Creeks

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Barries Creeks Watershed Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	6-1



Legend

- Assessment Parcel
- Woodland
- Conservation Reserve
- Provincial Park
- Natural Heritage System
- Ecoregion

Wetland

- Provincially Significant Wetland Evaluated
- Non - Provincially Significant Wetland Evaluated
- Unevaluated Wetland

Area of Natural Heritage & Scientific Interest (ANSI)

- Provincially Significant Life Science ANSI
- Provincially Significant Earth Science ANSI

Greenbelt Plan

- Boundary
- Greenbelt External Connections

Land Use Designations

- Protected Countryside
- Greenbelt Towns and Villages
- Greenbelt Hamlets
- Urban River Valley
- Greenbelt Specialty Crop Area

Niagara Escarpment Plan (NEP)

- Boundary
- Parks and Open Space System

Land Use Designations

- Escarpment Natural Area
- Escarpment Protection Area
- Escarpment Rural Area
- Mineral Resource Extraction Area
- Escarpment Recreation Area
- Urban Area
- Minor Urban Centre

Oak Ridges Moraine Conservation Plan (ORM)

- Boundary

Land Use Designations

- Natural Core Area
- Natural Linkage Area
- Countryside Area
- Rural Settlement
- Palgrave Estates Residential Community
- Settlement Area

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North:

Legend:

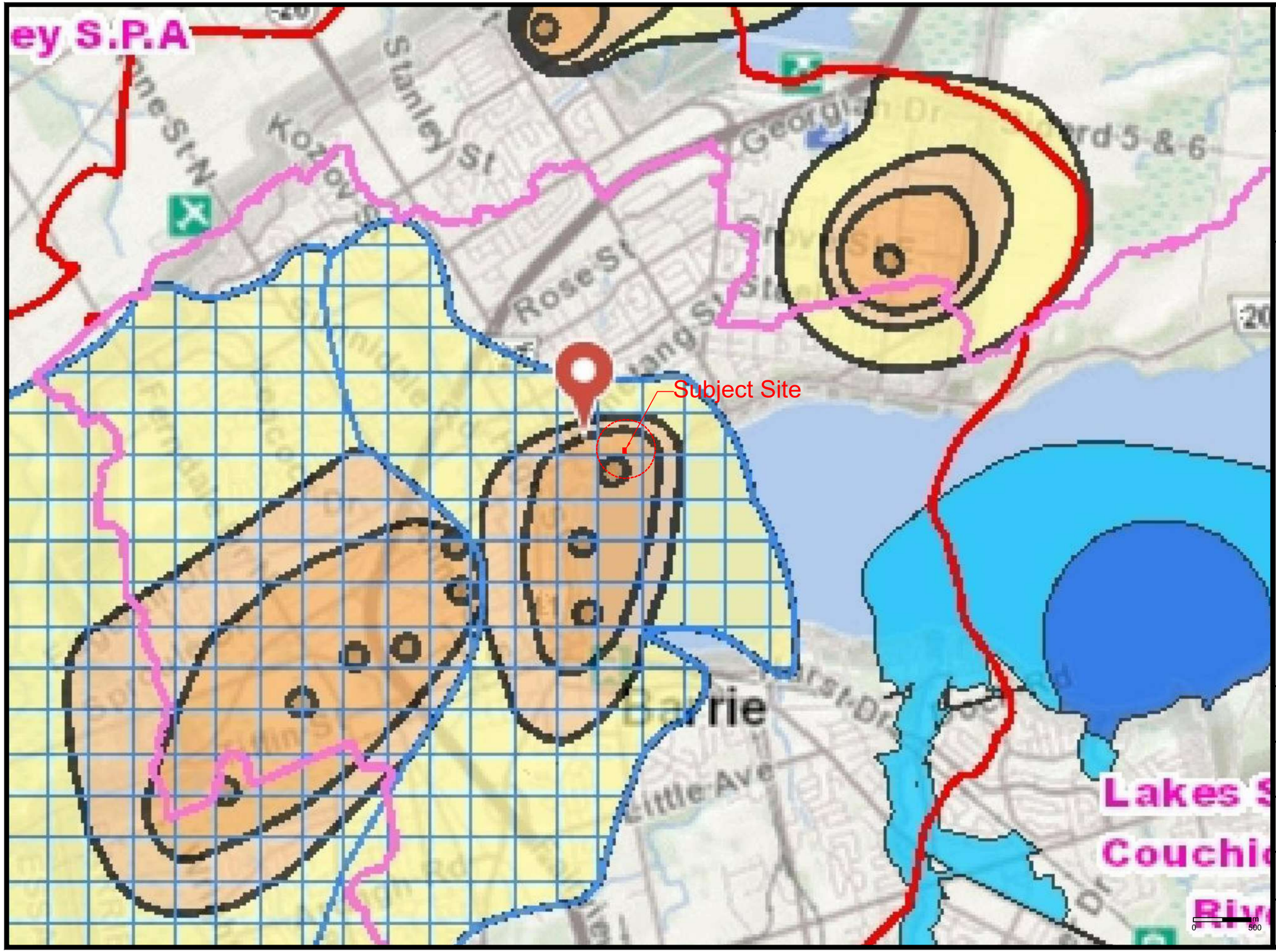
Property Boundary

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Key Hydrological and Natural Heritage Features Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	6-2



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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

Subject Site

Approximately 500 m from the Site

Legend

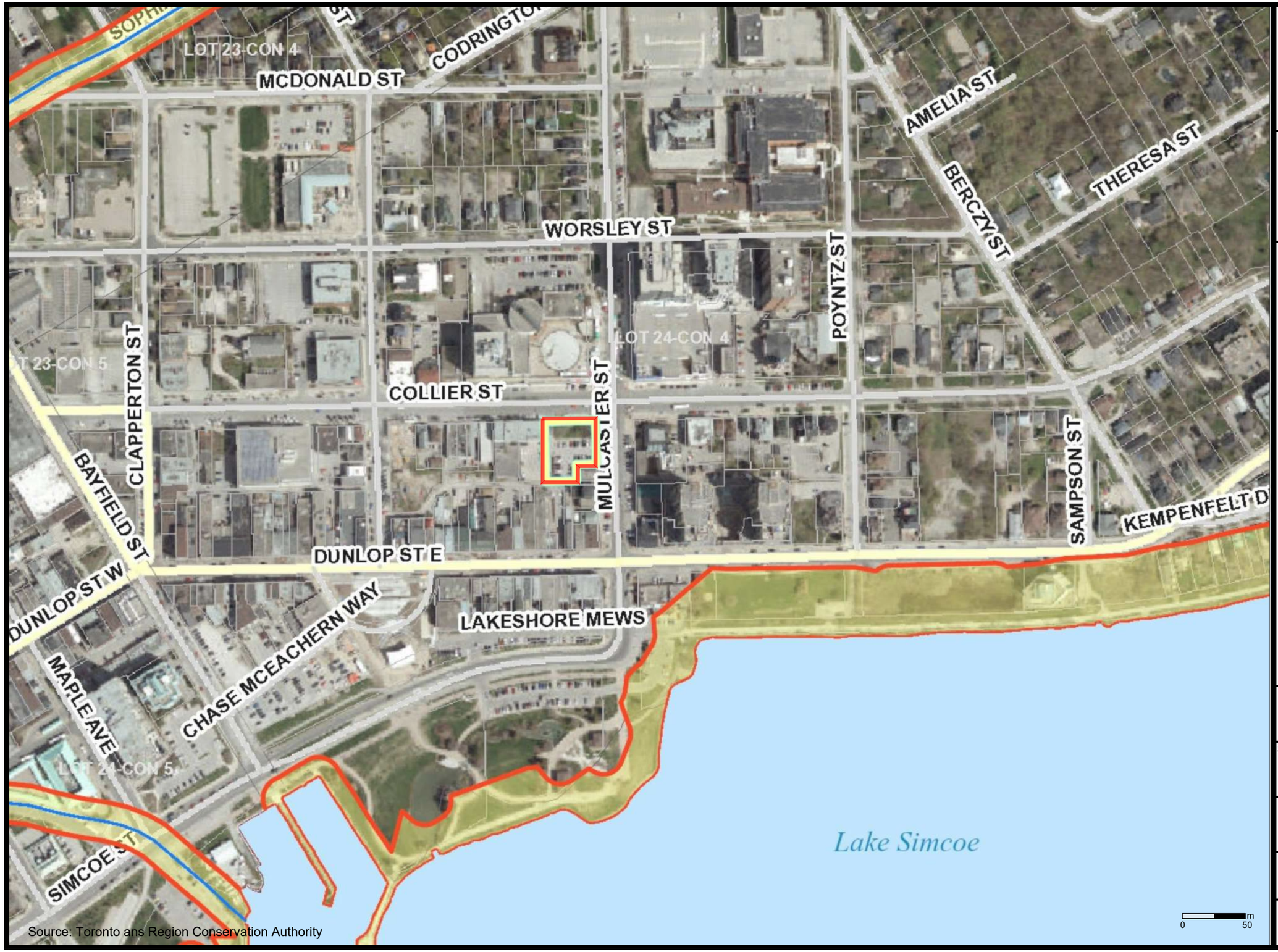
- Source Protection Areas
- Intake Protection Zone Q
- Wellhead Protection Area Q1
- Wellhead Protection Area Q2
- Issue Contributing Areas
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Source Protection Areas Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	6-3



Source: Toronto ans Region Conservation Authority

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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

Property Boundary

Features

- LSRCA Watershed Boundary
- Lake Simcoe
- Watercourse
- Regulated Area Boundary
- Regulated Area
- Road Labels
- Assessment Parcel
- Lot and Concession
- Roads
  - Hwy 400 Series
  - Highway, Arterials
  - Local Road
- Railway

Project Title:

Hydrogeological Investigation

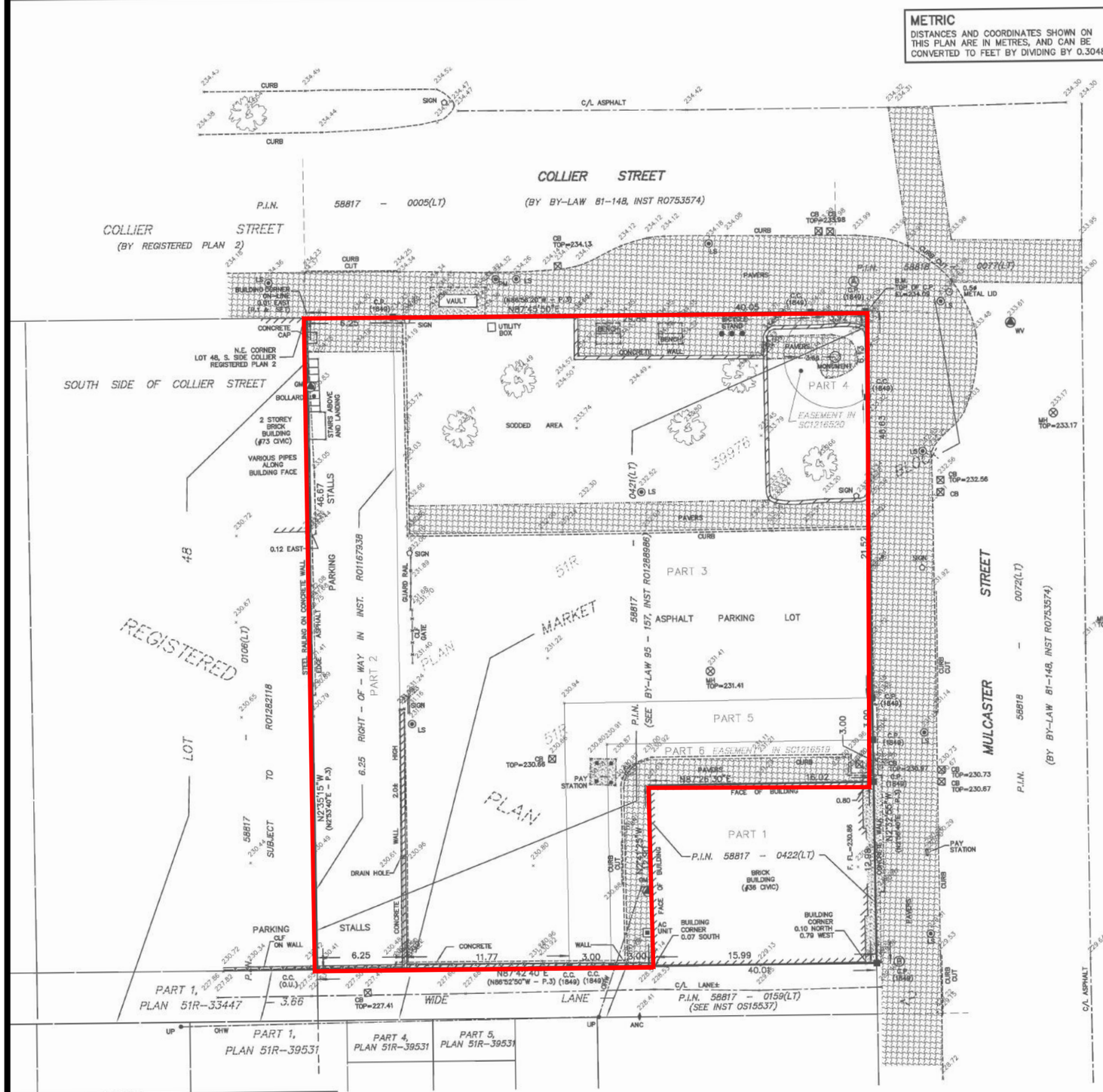
Site Location:

79 Collier Street, Barrie, ON

Figure Title:

LSRCA Regulated Area Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	6-4



C.A. MacDONALD SURVEYING Inc.

N

TOPOGRAPHIC SURVEY
OF PART OF
MARKET BLOCK
REGISTERED PLAN 2
CITY OF BARRIE
COUNTY OF SIMCOE

SCALE 1:200

4 2 0 4 8 12 16 20 METRES

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

(1) THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT AND THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.

(2) THE SURVEY WAS COMPLETED ON JUNE 4, 2015.

JUNE 9, 2015.
BARRIE, ONTARIO

C.A. MacDONALD
ONTARIO LAND SURVEYOR

LEGEND

■	DENOTES	SURVEY MONUMENT FOUND
□	"	SURVEY MONUMENT SET
S.I.B.	"	STANDARD IRON BAR
I.B.	"	IRON BAR
S.S.I.B.	"	SHORT STANDARD IRON BAR
C.P.	"	CONCRETE PIN
C.C.	"	CUT CROSS
P.I.N.	"	PROPERTY IDENTIFICATION NUMBER
(1849)	"	C.A. MACDONALD O.L.S.
O.U.	"	ORIGIN UNKNOWN
P.1	"	PLAN OF SURVEY BY J. DIAMOND O.L.S., DATED JULY 27, 1965.
P.2	"	PLAN OF SURVEY BY R. WELSMAN O.L.S., DATED FEBRUARY 12, 1965.
P.3	"	PLAN 51R–10642
P.4	"	PLAN 51R–39531
PM	"	PARKING METER
LS	"	LIGHT STANDARD
MH	"	MANHOLE
CB	"	CATCH BASIN
UP	"	UTILITY POLE
OHW	"	OVER HEAD WIRES
GM	"	GAS METER
ANC	"	ANCHOR
CLF	"	CHAIN LINK FENCE
WV	"	WATER VALVE
F.FL.	"	FINISHED FLOOR
	"	DECIDUOUS TREE

DISTANCE NOTE:
DISTANCES SHOWN ON THIS PLAN ARE GROUND DISTANCES AND CAN BE CONVERTED TO GRID DISTANCES BY MULTIPLYING BY A COMBINED SCALE FACTOR OF 0.999699.

BEARING NOTE:
BEARINGS ARE UTM GRID BEARINGS AND ARE REFERRED TO THE CENTRAL MERIDIAN ZONE 17 (NAD 83) (81°W) AND ARE DERIVED FROM OBSERVATIONS ON CITY OF BARRIE HORIZONTAL CONTROL MONUMENTS 03120040004 AND 00119673109.

OBSERVED REFERENCE POINTS:
UTM ZONE 17, NAD83 (ORIGINAL)
COORDINATES TO URBAN ACCURACY PER SEC.14(2) OF O.REG. 216/10

STATION	NORTHING	EASTING
ORP A	4916065.92	604682.25
ORP B	4916019.35	604684.33

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE–ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN.

ELEVATION NOTES:

ELEVATIONS ARE GEODETIC AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE RELATED TO MNR CONTROL MONUMENT 00119673109.
BRASS TABLET SET FLUSH WITH CONCRETE ON THE GOVERNMENT WHARF AT END OF BAYFIELD STREET, BARRIE. HAVING AN ELEVATION OF 220.21 (CGVD–1928–1978)

LOCAL BENCHMARK – TOP OF C.P. AT N.E. CORNER OF PART 4, PLAN 51R–39976
ELEVATION = 234.09

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
1939550

THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR.
In accordance with Regulation 1026, Section 29(3)

SIRATI & PARTNERS
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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

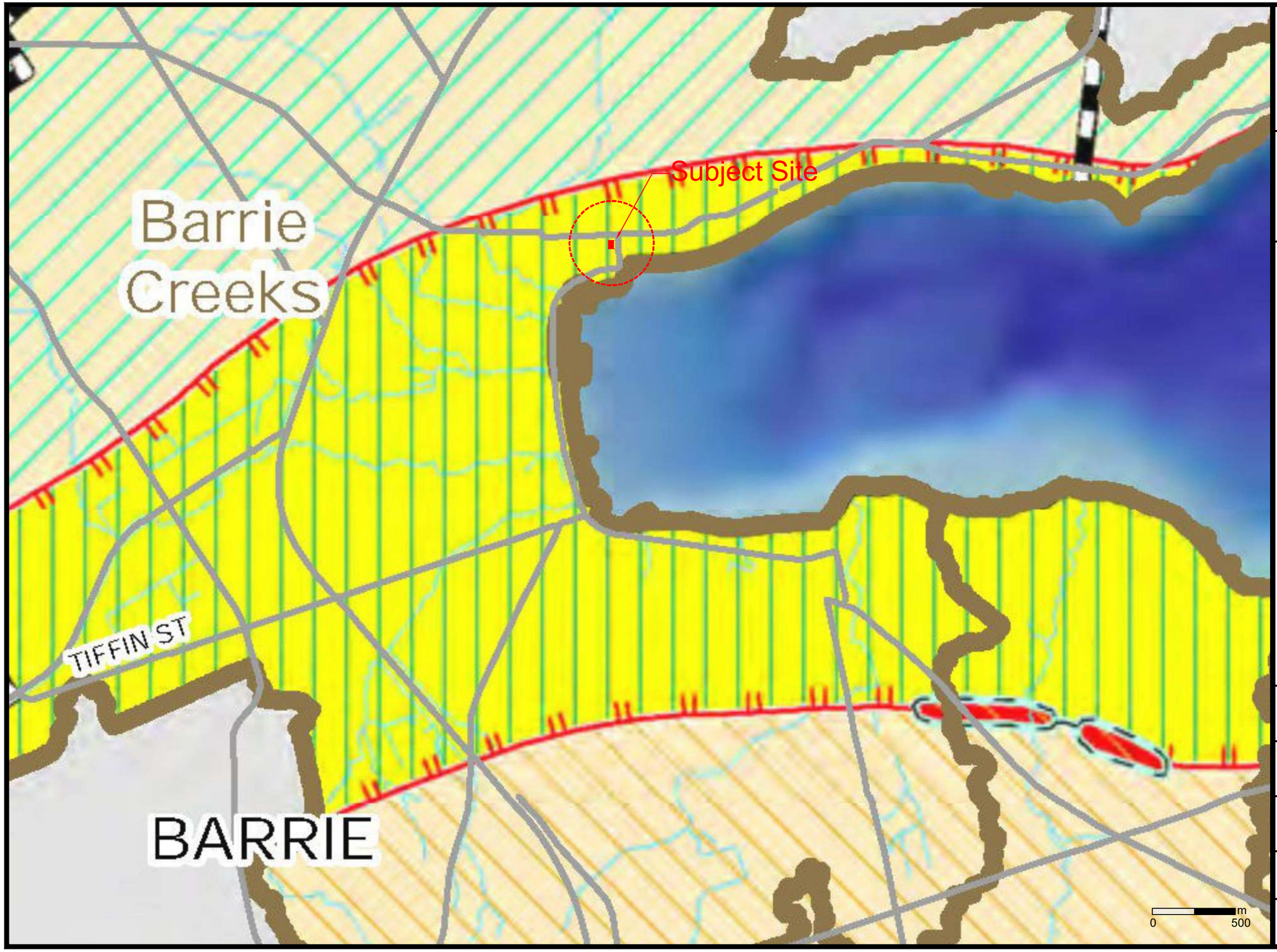
Property Boundary

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Site Survey Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	7-1



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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

N

Legend:

Subject Site

Approximately 500 m from the Site

Legend
- Road
- Municipal Boundary
- Watercourse

Physiography Features
- Dissected terrain
- Mud flow scars
- Contact
- Shorecliff
- Simcoe Uplands
- Simcoe Lowlands
- Peterborough Drumlin Field
- Beach
- Drumlin
- Sand Plain
- Till Plain (Drumlinized)

Project Title:

Hydrogeological Investigation

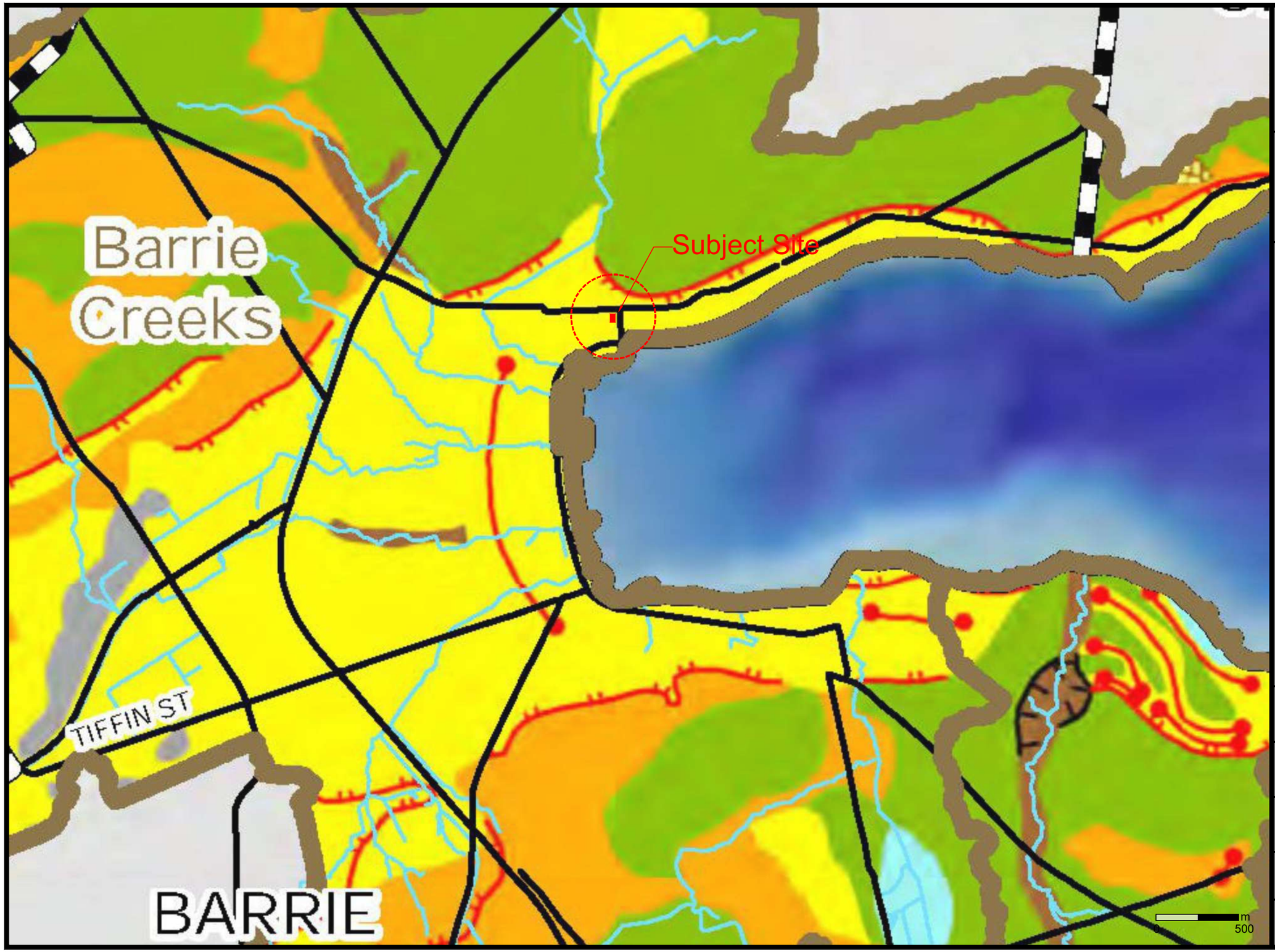
Site Location:

79 Collier Street, Barrie, ON

Figure Title:

Physiography Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	7-2



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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

Subject Site

Approximately 500 m from the Site

Legend
- Road
- Municipal Boundary
- Watercourse

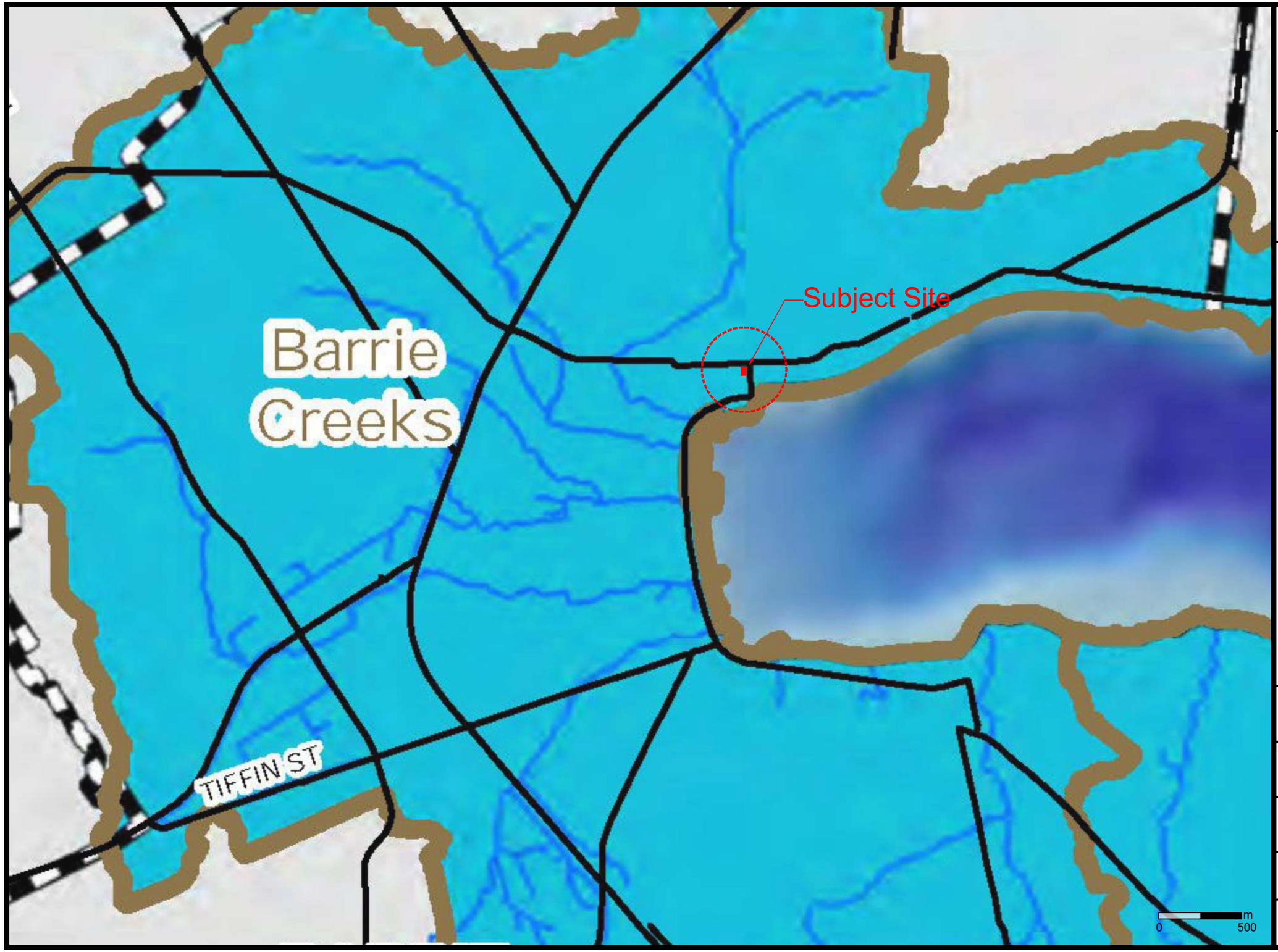
Surficial Geology Features
- drumlin
- beach
- bluff
- eskern
- icslope
- ribl
- terrace
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 8a: Massive-well laminated
- 9b: Littoral-foreshore deposits
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Surficial Geology Map

Scale:	Project Number:
As Shown	SP20-666-30
Date: Septemebr 2020	**Figure Number:** 7-3



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King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

N

Legend:

Subject Site

Approximately 500 m from the Site

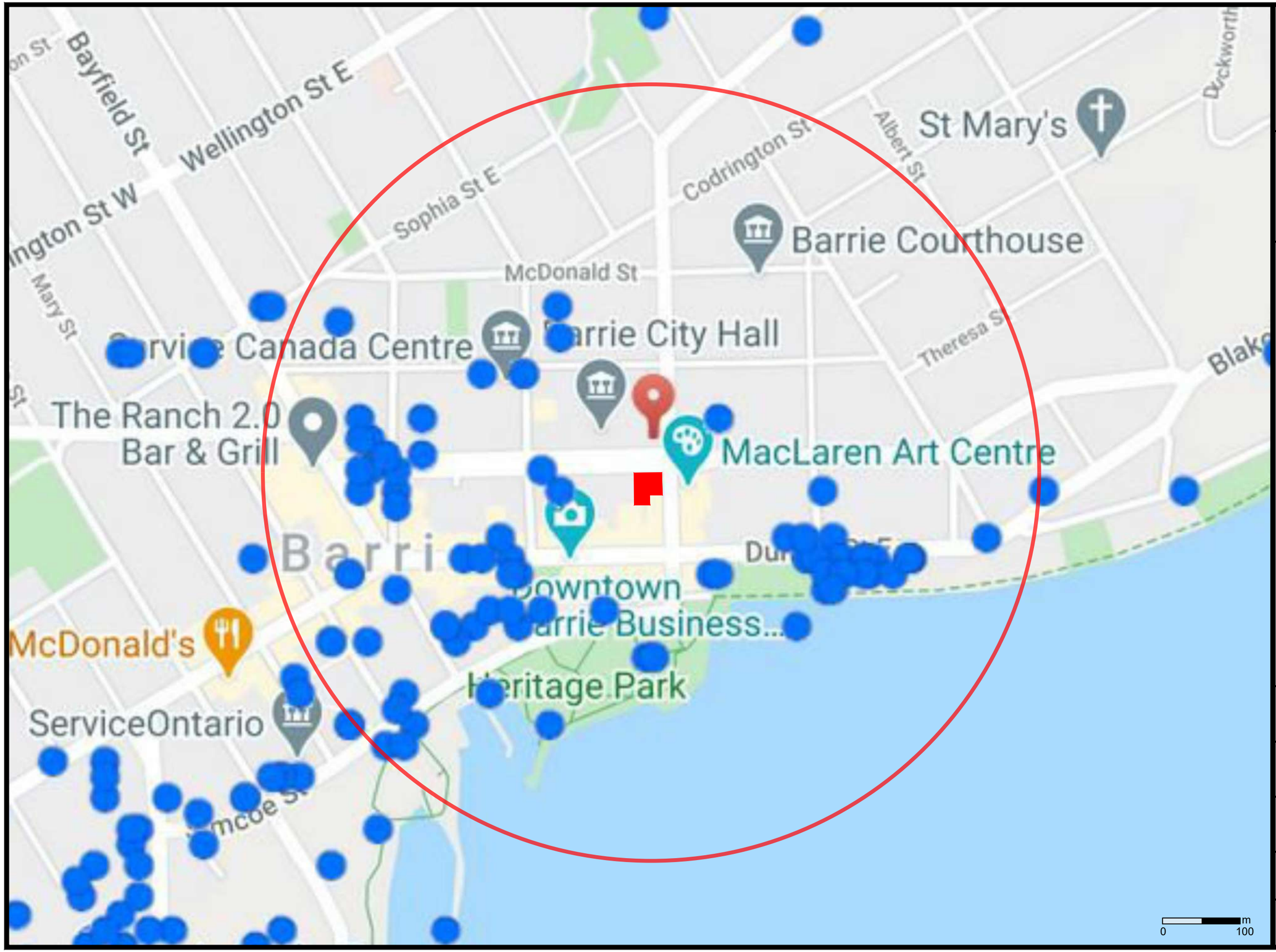
Legend
- Road
- Municipal Boundary
- Watercourse
- 51a Ottawa Group; Simcoe Group; Shadow Lake Fm.

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Bedrock Geology Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	7-4



SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

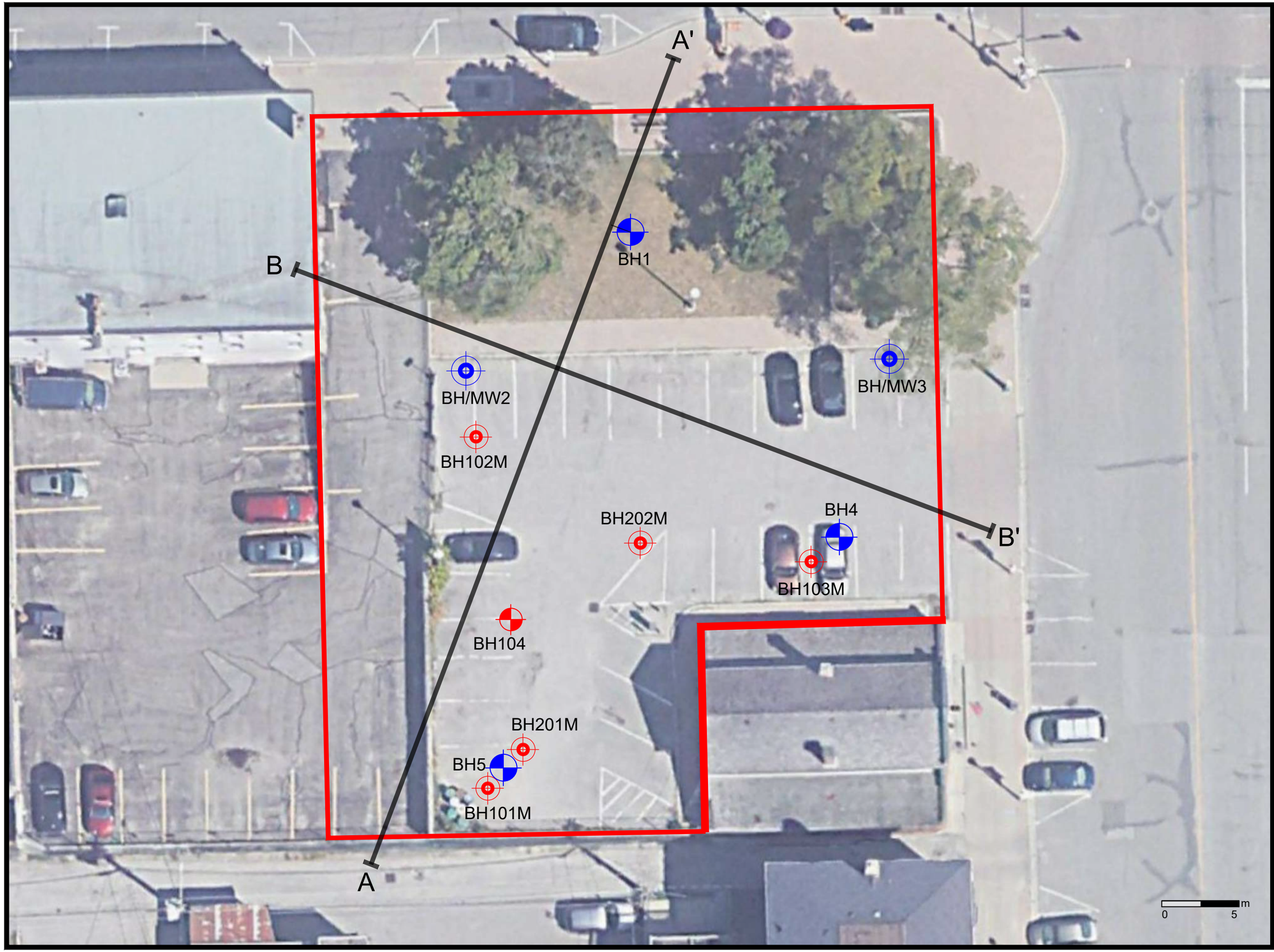
- Subject Site
- 500m Study Area
- MECP Well

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
MECP Water Well Records Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	8-1



SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

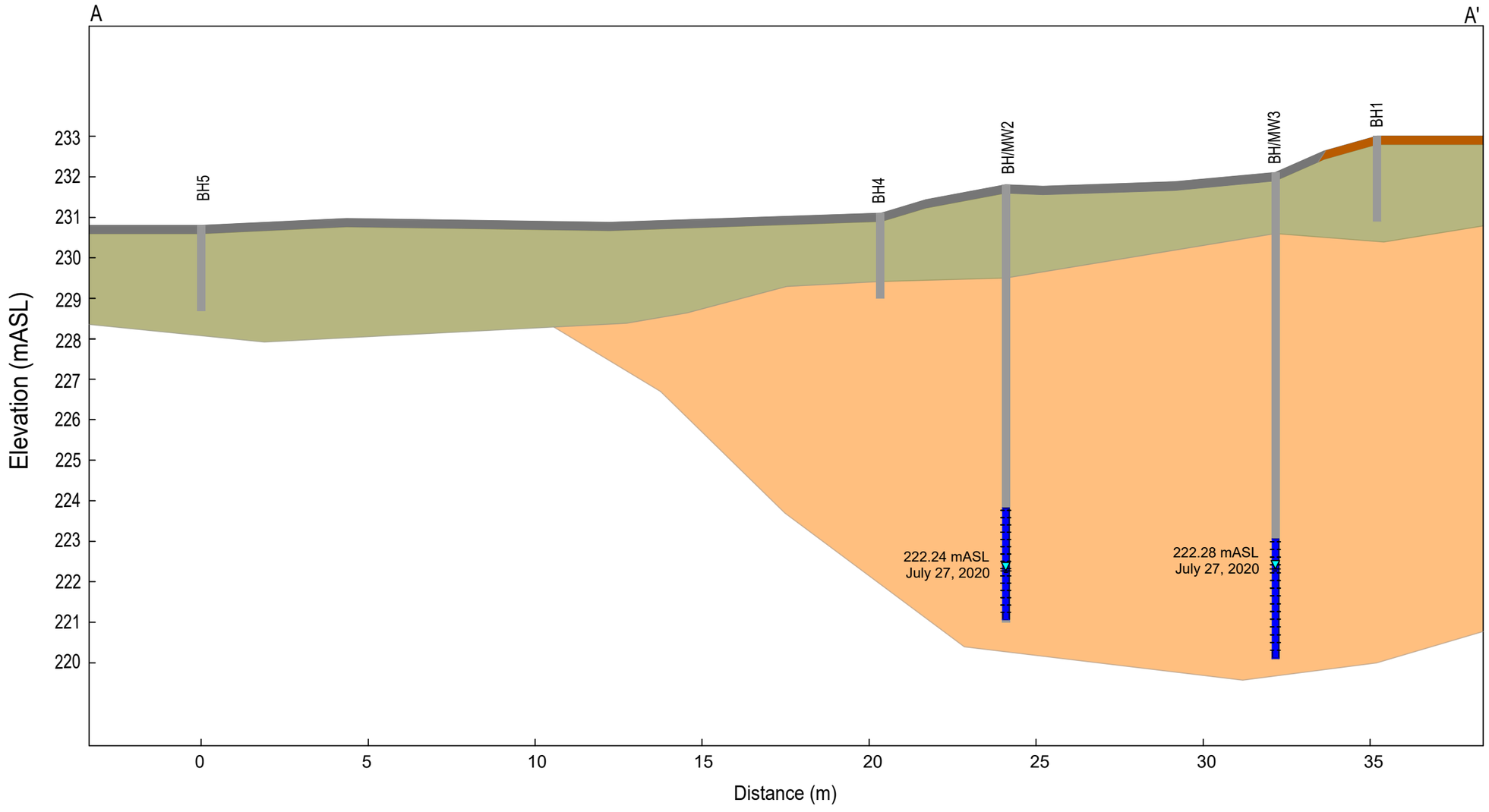
- Property Boundary
- Monitoring Wells (2020 by Sirati)
- Boreholes (2020 by Sirati)
- Boreholes (2019 by PGL)
- Monitoring Wells (2019 by PGL)

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Borehole Location plan

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	9-1



SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Asphalt
- Topsoil
- Fill
- Sand

MW1 — Borehole / Well ID

Water Level

Well Screen

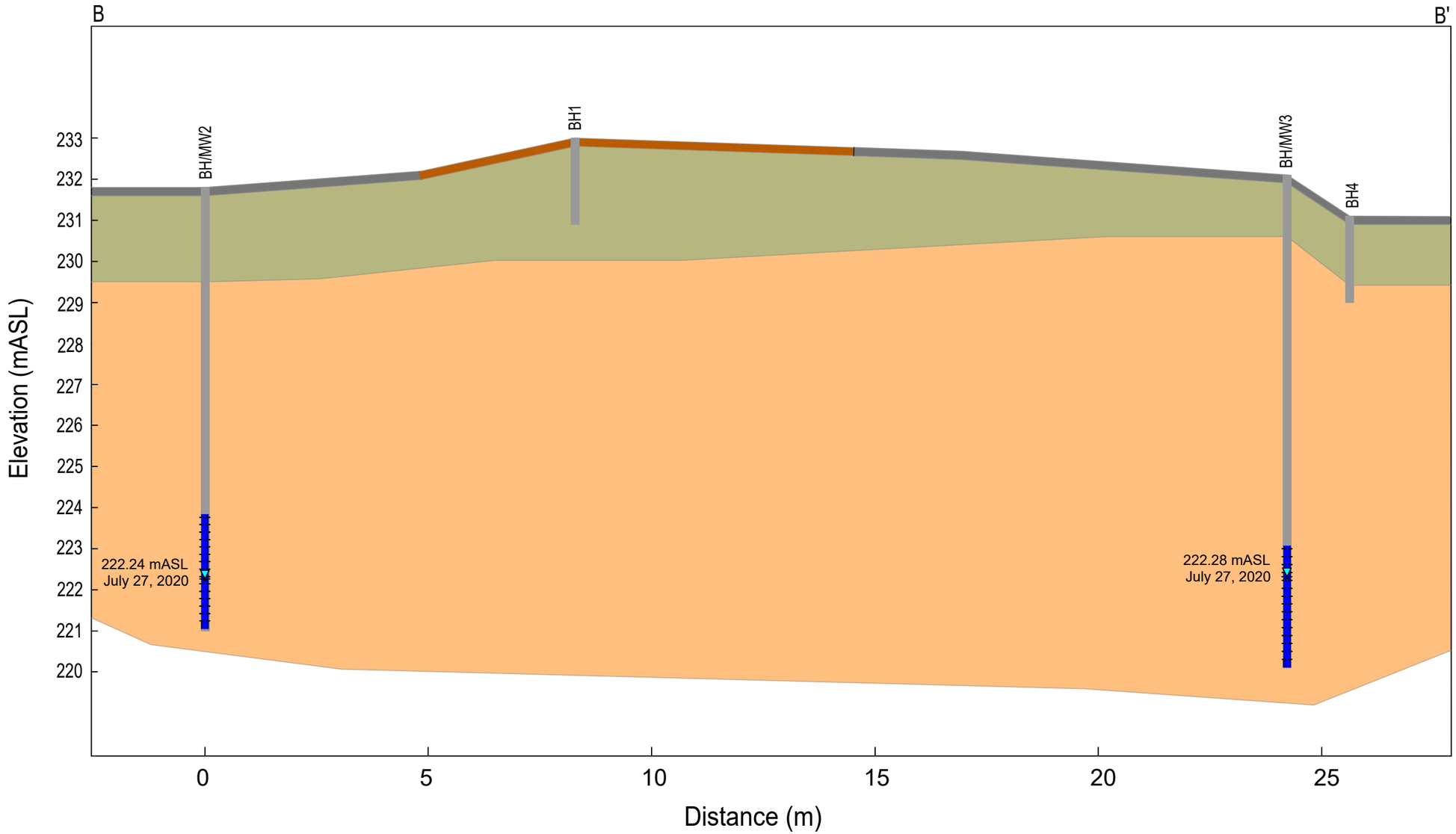
Note: Groundwater Elevation were obtained on July 27, 2020

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Cross Section Profile A-A'

Scale:	Project Number:
N.T.S	SP20-666-30
Date:	**Figure Number:**
September 2020	9-2



SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Asphalt
- Topsoil
- Fill
- Sand

MW1 — Borehole / Well ID

Water Level

Well Screen

Note: Groundwater Elevation were obtained on July 27, 2020

Project Title:
Hydrogeological Investigation

Site Location:
79 Collier Street, Barrie, ON

Figure Title:
Cross Section Profile B-B'

Scale:	Project Number:
N.T.S.	SP20-666-30
Date:	**Figure Number:**
September 2020	9-3

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Property Boundary
- Monitoring Wells (2020 by Sirati)
- Boreholes (2020 by Sirati)
- Boreholes (2019 by PGL)
- Monitoring Wells (2019 by PGL)
- Contour Line
- Inferred Shallow Groundwater Flow Direction

Note: Groundwater Elevation were obtained on July 27, 2020

Project Title:

Hydrogeological Investigation

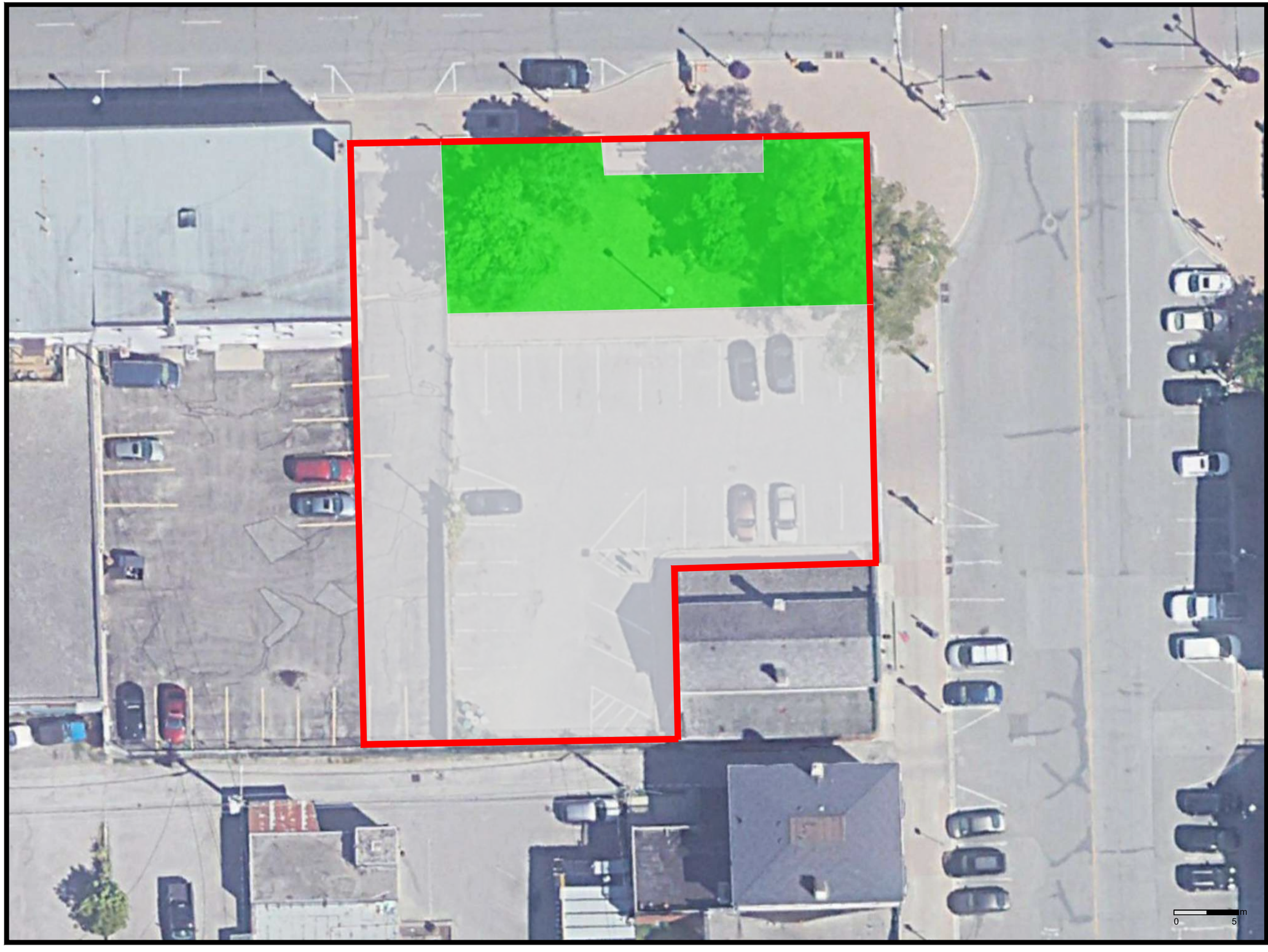
Site Location:

79 Collier Street, Barrie, ON

Figure Title:

Inferred Shallow Groundwater Flow Direction Map

Scale:	Project Number:
As Shown	SP20-666-30
Date:	**Figure Number:**
September 2020	9-4



SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions
12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Property Boundary
- Paved Area
- Roof
- Landscape

Site Statistics:

Paved Area:	1260 sq.m
Roof:	0 sq.m
Landscape:	400 sq.m
Total	1660 sq.m

Project Title:

Hydrogeological Investigation

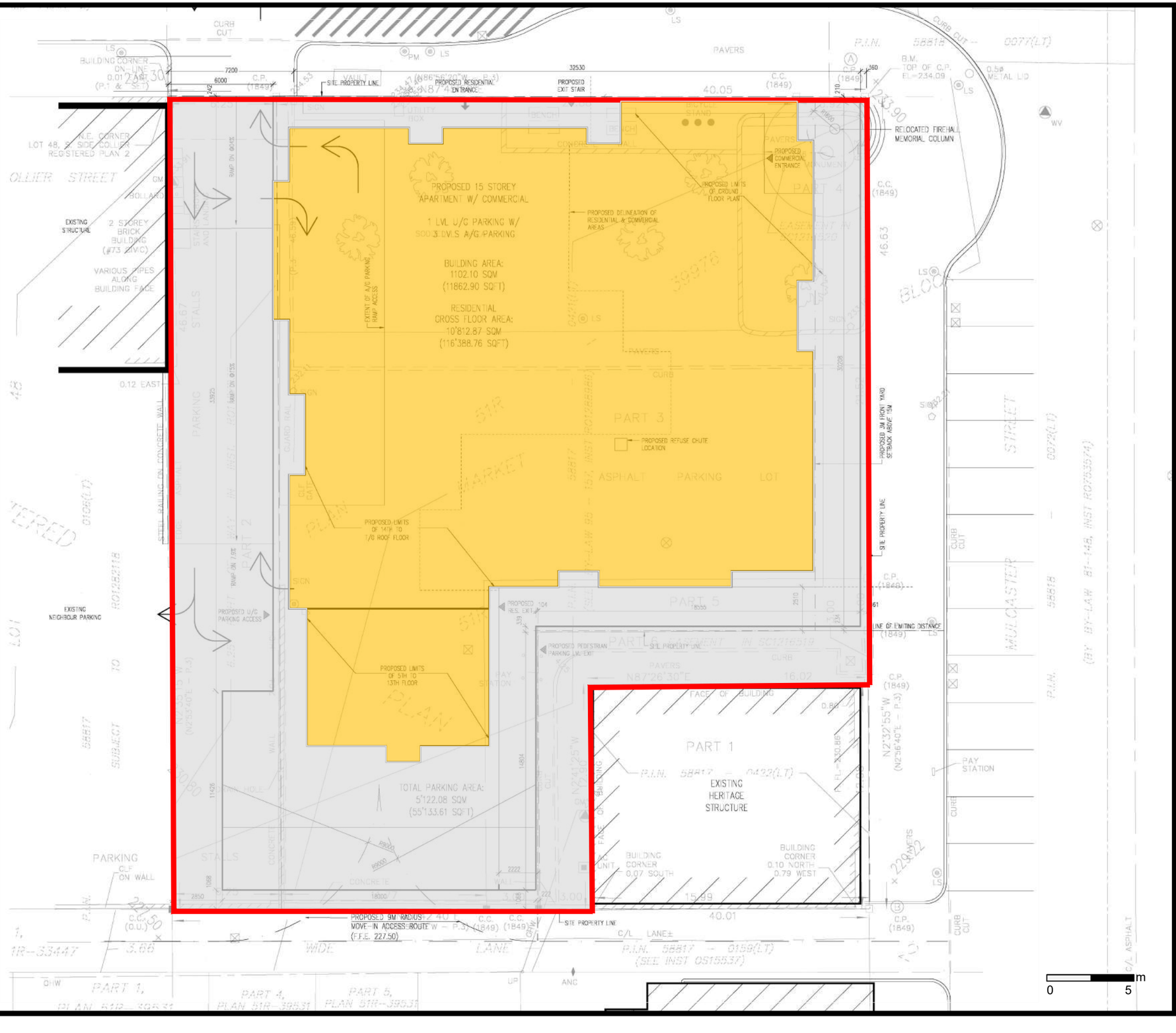
Site Location:

79 Collier Street, Barrie, ON

Figure Title:

Pre-Development Plan - Site Statistics

Scale: As Shown	**Project Number:** SP20-666-30
Date: September 2020	**Figure Number:** 12-1



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Property Boundary
- Paved Area
- Roof
- Landscape

Site Statistics:

Paved Area:	558 sq.m
Roof:	1102 sq.m
Landscape:	0 sq.m
Total	1660 sq.m

Project Title:

Hydrogeological Investigation

Site Location:

79 Collier Street, Barrie, ON

Figure Title:

Post-Development Plan - Site Statistics

Scale: As Shown	**Project Number:** SP20-666-30
Date: September 2020	**Figure Number:** 12-2

APPENDICES

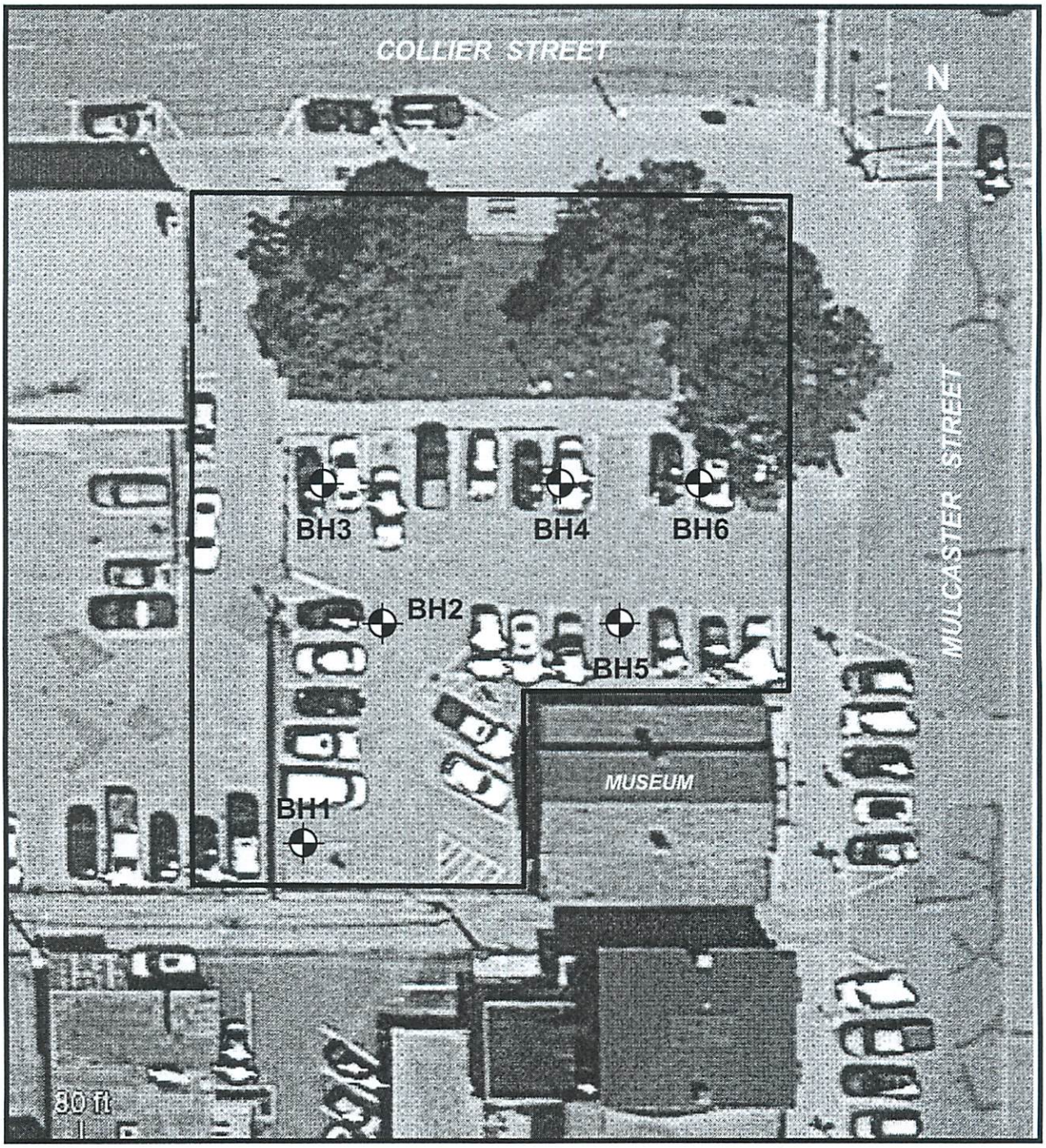
SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

APPENDIX A1

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions



BOREHOLE LOCATION PLAN

Reference No : 6862-16-02

Borehole No : 1

Enclosure No : 2

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 29, 2016

Elevation m	Depth m	Description	Symbol	Water	Number	Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
99.88	0	Ground Surface								
		Asphalt 75 mm Granular Base 250 mm FILL Gravelly well graded sand, cinders, brick fragments and organics in places, dark grey to dark brown, moist, very loose to compact			1	SS	17			
	1				2	SS	8			
	2				3	SS	3			
					4	AS	14			
	3				5	SS	8			
95.88	4	***FINE SAND*** Loose, fine sand, trace to some silt, brown, moist to wet moist / wet			6	SS	4			
	5									
	6				7	SS	4			
92.88	7	***GRAVELLY SAND*** Very dense, well graded sand with fine to medium gravel, brown, wet		dry to cave in level	8	SS	100+			
91.38	8									
	9	***SANDY SILT TILL*** Dense, trace fine gravel, some seams of fine sand, brownish grey, moist			9	SS	38			cave in at 9 m
89.88	10									
	11	***FINE SAND*** Very dense, fine sand, some silt, some gravel at the bottom, grey, wet			10	SS	96			
	12									
87.23					11	AS	100+			
	13	End of Borehole								

V.A. WOOD ASSOCIATES LIMITED

Disk :

Sheet : 1 of 1

Reference No : 6862-16-02

Borehole No : 2

Enclosure No : 3

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 28, 2016

Elevation m	Depth m	Description	Symbol	Water	Sample Number	Sample Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
99.96	0	Ground Surface								
		Asphalt 75 mm Granular Base 325 mm			1	SS	15	○		Borehole open and dry on completion
	1	FILL Gravelly sand, trace brick fragments, dark grey, moist, compact			2	SS	9	○	●	
98.56										
		FILL Fine to medium sand, trace topsoil, brown, moist, loose		DRY	3	SS	4	○		
97.86	2									
		SAND			4	SS	14	○	●	
	3	Compact, fine sand, trace silt, brown, damp to moist			5	SS	18	○		
96.46										
		End of Borehole								
	4									
	5									
	6									
	7									

V.A. WOOD ASSOCIATES LIMITED

Disk :

Sheet : 1 of 1

Reference No : 6862-16-02

Borehole No : 3

Enclosure No : 4

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 28, 2016

Elevation m	Depth m	Description	Symbol	Water	Number	Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
100.74	0	Ground Surface								
		Asphalt 75 mm Granular Base 275 mm FILL Gravelly well graded sand, trace brick fragments, dark grey, moist, compact then loose			1	SS	29	○	●	Borehole open and dry on completion
	1				2	SS	8	○		
99.34										
		SAND Compact to dense, fine to medium sand, trace silt and fine gravel, brown, damp to moist		DRY	3	SS	24	○	●	
	2				4	SS	44	○		
	3				5	SS	45	○	●	
96.74	4									
		FINE SAND Compact, trace silt, greyish brown, moist then wet moist wet			6	SS	30	○		
	5									
	6				7	SS	17	○	●	
94.19										
		End of Borehole								
	7									
	8									

V.A. WOOD ASSOCIATES LIMITED

Disk :

Sheet : 1 of 1

Reference No : 6862-16-02

Borehole No : 4

Enclosure No : 5

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 30, 2016

Elevation m	Depth m	Description	Symbol	Water	Number	Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
100.61	0	Ground Surface								
		Asphalt 75 mm Granular Base 225 mm FILL Fine sand, then gravelly sand, dark brown, moist, loose then compact			1	SS	8	○		Borehole open and dry on completion
	1				2	SS	15	○	●	
99.21										
		SAND Dense, fine to medium sand, trace fine gravel, brown, damp		DRY	3	SS	42	○		
98.51	2									
		SAND Compact to dense, fine sand, trace silt, brown, damp			4	SS	38	○	●	
	3				5	SS	25	○		
97.11										
		End of Borehole								
	4									
	5									
	6									
	7									

V.A. WOOD ASSOCIATES LIMITED

Disk :

Sheet : 1 of 1

Reference No : 6862-16-02

Borehole No : 5

Enclosure No : 6

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 30, 2016

Elevation m	Depth m	Description	Symbol	Water	Sample Number	Sample Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
100.29	0	Ground Surface								
		Asphalt 75 mm Granular Base 240 mm FILL Fine sand, then gravelly sand, trace brick fragments, greyish brown, moist, compact			1	SS	18	○	●	Borehole open and dry on completion
	1				2	SS	15	○		
98.89										
		SAND Loose, fine to medium sand, brown, damp			3	SS	7	○	●	
98.19	2			DRY						
					4	SS	30	○		
	3				5	SS	23	○	●	
		FINE SAND Compact, trace fine gravel at the top, very dense and with some silt at the bottom, brown and damp, then brownish grey and wet								
	4				6	SS	18	○		
	5	brown, damp brownish grey, wet								
	6				7	SS	73	○	●	
93.74										
		End of Borehole								
	7									
	8									

V.A. WOOD ASSOCIATES LIMITED

Disk :

Sheet : 1 of 1

Reference No : 6862-16-02

Borehole No : 6

Enclosure No : 7

Client : Edgecon Inc.

Project : Proposed Condominium

Method : Auger

Location : 36 Mulcaster Street, Barrie, ON

Diameter : 110 mm

Datum Elevation : Local

Date : March 30, 2016

Elevation m	Depth m	Description	Symbol	Water	Sample Number	Sample Type	N-value	Standard Penetration Test blows/300mm (20 40 60 80)	Moisture Content, % (5 15 25)	Remarks
100.94	0	Ground Surface								
		Asphalt 75 mm Granular Base 300 mm FILL			1	SS	12			
99.54	1	Gravelly well graded sand, brownish grey, moist, compact to dense			2	SS	43			
	2	***SAND***			3	SS	44			
98.04		Dense to very dense, fine to medium sand, some gravel, brown, damp			4	SS	60			
	3				5	SS	38			
	4	***FINE SAND***								
		Compact to dense, fine sand, trace silt, greyish brown, moist			6	SS	21			
95.44	5									
	6	***SILTY SAND TILL***			7	SS	56			
93.94		Very dense, trace fine gravel, some seams of sand, brown, moist to wet								
	7	***GRAVELLY SAND***			8	SS	95			
92.44	8	Very dense, well graded sand with fine to medium gravel, brown, moist								
	9			dry to cave in level	9	SS	84			
	10	***FINE SAND***								cave in at 10.4 m
	11	Very dense to dense, fine sand, trace to some silt, brown then grey, wet			10	SS	88			
	12				11	SS	44			
87.94	13									
	14	***SILT TILL***			12	SS	28			
		Compact, trace fine gravel, grey, moist								
	15									
85.24					13	SS	23			
	16	End of Borehole								

V.A. WOOD ASSOCIATES LIMITED

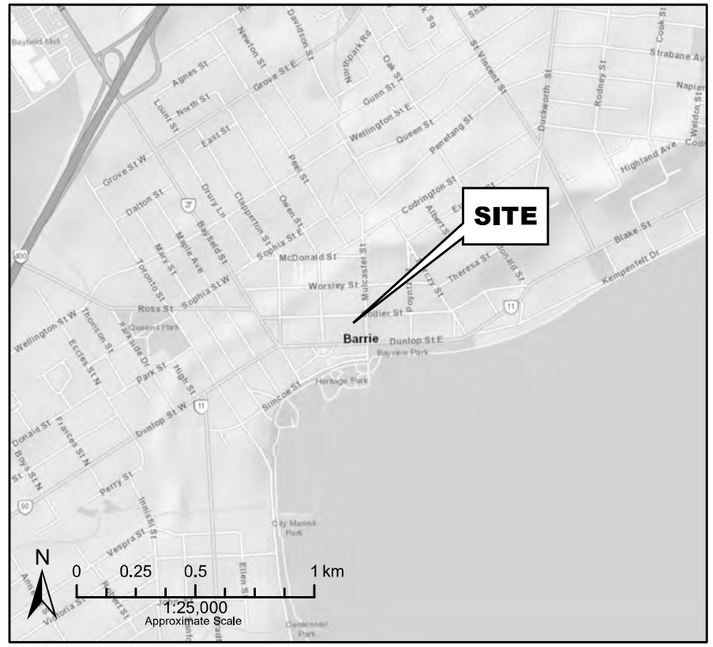
Disk :

Sheet : 1 of 1

APPENDIX A2

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions



Site Boundary (Approximate)

Borehole

Monitoring Well

N 0 5 10 20 m

1:500
Approximate Scale

Parcel: *Approximate* **Image:** *ESRI Base Imagery*

SITE LOCATION AND INVESTIGATION LOCATIONS

36 Mulcaster Street, Barrie, ON

GRANT THORNTON LTD.

PGL ENVIRONMENTAL CONSULTANTS	File No.:	Date:	Dwg No.:	Drawn by:	FIGURE
	5717-01.01	JUN 2019	57170101-11	DPL	1

Y:\5700-5799\5717 - Grant Thornton\01-01\Graphics\57170101-11.mxd

Original in colour

WELL RECORD

WELL NO: **BH101M**

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	PID READING (ppmv) / VAPOUR READING (ppmv)	WATER LEVEL	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2		**ASPHALT**						Flushmount	
0.4		**SAND (FILL)**		BH101M-01	<25			J Plug	
0.6		fine to medium grained, with gravel, trace ceramics,			2			Cement	
0.8		trace debris, dry to moist		BH101M-02	<25			Silica Sand	
1.0		increased silt content for 0.15m below 0.9m		BH101M-03	<25				
1.2		dry, white fine sand, some black staining for 0.3m		BH101M-04	<25				
1.4		below 1.1m		BH101M-09	<25				
1.6		black, charcoal for 0.15m below 1.8m		BH101M-05: Metals PAHs	<25				
1.8		black staining, hydrocarbon odour for 0.6m below 2.0m		BH101M-06	<25			Bentonite	
2.0		brick debris, trace asphalt for 0.9m below 2.7m		BH101M-07	<25				
2.2									
2.4		trace organics for 0.3m below 3.7m		BH101M-08	<25				
2.6		orange-brown, moist, fine sand for 1.2m below 3.7m							
2.8									
3.0				BH101M-10	<25				
3.2		black, charcoal for 0.1m below 4.9m		BH101M-11: Metals PAHs	<25				
3.4		**SAND**			<25			Silica Sand	
3.6		fine grained, trace clay, brown, moist		BH101M-12	<25				
3.8		grey to brown below 5.5m		BH101M-13					
4.0		wet below 6.1m		BH101M-14	<25				
4.2									
4.4				BH101M-15	<25			50mm 010	
4.6								Slot PVC	
4.8		increased clay content below 7.2m		BH101M-16	<25				
5.0		end of sampling at 7.6m; auger to depth.							
5.2									
5.4									
5.6									
5.8									
6.0									
6.2									
6.4									
6.6									
6.8									
7.0									
7.2									
7.4									
7.6									
7.8									
8.0									
8.2									
8.4									

End of borehole at 8.50 m

Screened interval from 5.5 m to 8.5 m below surface.
dry on 28 May, 2019

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 23, 2019

LOGGED BY: OWM HOLE DIAM (mm): 250

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

WELL RECORD

WELL NO: **BH102M**

PGL ENVIRONMENTAL CONSULTANTS

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	PID READING (ppmv) / VAPOUR READING (ppmv)	WATER LEVEL	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2		**ASPHALT**						Flushmount	
0.4		**SAND (FILL)**		BH102M-01	<25			J Plug	
0.6		fine to medium grained, with gravel, trace debris,						Cement	
0.8		trace bricks, brown, dry to moist						Silica Sand	
1.0				BH102M-02: Metals	<25				
1.2		black staining for 0.3m below 0.9m		PAHs	<25				
1.4									
1.6		rocks, asphalt pieces for 0.15m below 1.2m		BH102M-03	<25				
1.8		coarse-grained for 0.1m below 1.7m		BH102M-04	<25				
2.0		**SAND**		BH102M-05					
2.2									
2.4		fine grained, trace clay, grey and brown, moist						Bentonite	
2.6				BH102M-06	<25				
2.8									
3.0									
3.2				BH102M-07	<25				
3.4									
3.6		coarse-grained, trace gravel for 0.3m below 3.4m		BH102M-08	<25				
3.8									
4.0									
4.2				BH102M-09	<25				
4.4								Silica Sand	
4.6					1 125				
4.8				BH102M-10: BTEX					
5.0				PHC F1-F4	<25				
5.2		increased clay content for 0.15m below 5.2m							
5.4				BH102M-13	<25				
5.6		wet below 5.6m		BH102M-11					
5.8									
6.0				BH102M-12	<25			50mm 010	
6.2								Slot PVC	
6.4									
6.6				BH102M-14	80				
6.8		increased coarse sand content below 6.7m							
7.0									
7.2									
7.4				BH102M-15	<25				
7.6									

End of borehole at 7.60 m

Screened interval from 4.6 m to 7.6 m below surface.
dry on 28 May, 2019

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 23, 2019

LOGGED BY: OWM HOLE DIAM (mm): 150

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

PGL ENVIRONMENTAL CONSULTANTS

WELL RECORD

WELL NO: **BH103M**

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	PID READING (ppmv) / VAPOUR READING (ppmv)	WATER LEVEL	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2		**ASPHALT**						Flushmount	
0.4		**SAND (FILL)**						J Plug	
0.6		with gravel, trace brick debris, brown, dry to moist		**BH103M-01**: Metals <25	1			Cement	
0.8		some rocks for 0.15m below 0.9m						Silica Sand	
1.0									
1.2				**BH103M-02** <25					
1.4									
1.6				**BH103M-03**: PAHs <25					
1.8					1				
2.0									
2.2		some rocks for 0.15m below 2.1m							
2.4		no bricks, debris below 2.3m						Bentonite	
2.6		white and brown fine grained sand for 0.9m below 2.4m		**BH103M-04** <25					
2.8									
3.0									
3.2				**BH103M-05** <25					
3.4									
3.6		organics for 0.1m below 3.4m		**BH103M-06** <25					
3.8		**SAND**							
4.0		fine grained, trace clay, white and brown, moist							
4.2				**BH103M-07** <25					
4.4		coarse grained sand for 0.15m below 4.0m						Silica Sand	
4.6									
4.8				**BH103M-08** <25					
5.0									
5.2				**BH103M-09** <25					
5.4		wet below 5.3m							
5.6									
5.8				**BH103M-10** <25					
6.0								50mm 010	
6.2								Slot PVC	
6.4									
6.6		increased coarse sand for 0.3m below 6.4m		**BH103M-11** <25					
6.8		moist below 6.4m							
7.0									
7.2		increased gravel content for 0.3m below 6.7m							
7.4				**BH103M-12** <25					
7.6									

End of borehole at 7.60 m

Screened interval from 4.6 m to 7.6 m below surface.
dry on 28 May, 2019

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 23, 2019

LOGGED BY: OWM HOLE DIAM (mm): 150

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

PGL ENVIRONMENTAL CONSULTANTS

BOREHOLE RECORD

BOREHOLE NO: **BH104**

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	● PID READING (ppmv) ● ■ VAPOUR READING (ppmv) ■	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2		**ASPHALT**						
0.4		**SAND (FILL)**		**BH104-01**	<25			
0.6		with gravel, trace organics, trace debris, brown, moist						
0.8								
1.0								
1.2		no organics, reduced gravel below 1.1m		**BH104-02**: Metals	<25			
1.4								
1.6								
1.8								
2.0		moist to wet below 1.8m		**BH104-03**	<25			
2.2								
2.4								
2.6		trace black staining, some oxidation for 0.6m below 2.4m		**BH104-04**: BTEX PAHs PHCs	<25		Bentonite	
2.8								
3.0								
3.2								
3.4								
3.6		some black staining for 0.3m below 3.4m		**BH104-05**	<25			
3.8		some rocks for 0.1m below 3.7m						
4.0				**BH104-06**	<25			
4.2		**SAND**						
4.4		fine grained, brown, moist						
4.6								
4.8								
5.0		some organics for 0.3m below 4.9m		**BH104-07**	<25			
5.2								
5.4				**BH104-08**	<25			
5.6		wet below 5.5m						
5.8								
6.0				**BH104-09**	<25			

End of borehole at 6.10 m

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 23, 2019

LOGGED BY: OWM HOLE DIAM (mm): 50

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

WELL RECORD

WELL NO: **BH201M**

PGL ENVIRONMENTAL CONSULTANTS

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	PID READING (ppmv) / VAPOUR READING (ppmv)	WATER LEVEL	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2 – 7.6		Auger to 7.6m; samples below this depth only Stratigraphy per BH101M						Flushmount J Plug Cement Silica Sand Bentonite	
7.6 – 13.6		**SAND** fine grained, some gravel, trace clay, grey and brown, moist no gravel, reduced clay contents below 7.9m moist to wet below 8.8m some clay fragments below 9.1m		BH201M-01 <25 BH201M-02 <25 BH201M-03 <25 BH201M-04 <25 BH201M-05 <25					
9.4 – 9.8		**CLAY** some silt, trace fine sand, grey and brown, moist							
10.0 – 13.6		**SAND** fine grained, trace clay, grey and brown, moist to wet saturated below 10.7m grey below 11.9m		BH201M-06 <25 BH201M-07 BH201M-08 <25 BH201M-09 <25 BH201M-10 BH201M-11 <25	30 1 1 115			Silica Sand 50mm 010 Slot PVC	

End of borehole at 13.70 m

Screened interval from 10.7 m to 13.7 m below surface.
GW 8.70 mbgs
(6/3/2019)

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 28, 2019

LOGGED BY: OWM HOLE DIAM (mm): 250

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

PGL MULTI-TEST VAPOR LOG 2015 5717-01.GPJ PGL_DF_STD_2016.GDT 6/10/19

WELL RECORD

WELL NO: **BH202M**

PGL ENVIRONMENTAL CONSULTANTS

CLIENT: Grant Thornton Ltd.

PROJECT: 36 Mulcaster Street, Barrie, ON

PGL PROJECT NO: **5717-01.01**

SURFACE ELEVATION: **n/a**

DEPTH (m)	SOIL TYPE	SOIL DESCRIPTION	SAMPLE TYPE	LABORATORY ANALYSES	● PID READING (ppmv) ● ■ VAPOUR READING (ppmv) ■	WATER LEVEL	WELL COMPLETION	COMPLETION NOTES	ELEVATION (m)
0.2 – 10.6		Auger to 10.7m; samples below this depth only						Flushmount J Plug Cement Silica Sand Bentonite	
10.8 – 13.6		**SAND** fine grained, some clay, brown, saturated reduced clay content below 11.3m grey below 11.9m increased clay content below 12.2m		BH202M-01 BH202M-02 BH202M-03 BH202M-04 BH202M-05 BH202M-06	50 <25 <25 <25 <25 <25			Silica Sand 50mm 010 Slot PVC	

End of borehole at 13.70 m

Screened interval from 10.7 m to 13.7 m below surface.
GW 8.75 mbgs
(6/3/2019)

INVESTIG. METHOD: Geoprobe 7822 DT

INVESTIG. DATE: May 28, 2019

LOGGED BY: OWM HOLE DIAM (mm): 250

Sample Notes: Macro Core Sampler

THIS LOG IS FOR ENVIRONMENTAL PURPOSES ONLY.

APPENDIX A3

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

LOG OF BOREHOLE BH 1

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 2

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-16-2020

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity (REM) × FIELD VANE & Sensitivity (NAT) (20 40 60 80 100)	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)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"						
233.0											
232.8 0.0	**TOPSOIL:** 150 mm thick										
0.2	**FILL:** sandy silt, dark brown, brick debris, some stone		1	SS							
1	sand, brick debris		2	SS			232				
2 230.9	piece of gravel and some stones, white/grey		3	SS			231				SS2 - PHCs/VOCs
2.1	**END OF BOREHOLE:**										
	Note:										

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE MW 2

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 3

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-15-2020

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
231.8							
231.7 0.1	**ASPHALT:** 70 mm thick			AUGER			
	FILL: sand, some stone, trace silt, brown		1	SS			
	pieces of brick		2	SS			231
			3	SS			230
229.5 2.3	**SAND:** brown, moist		4	SS			
	coarse gravel, white/grey		5	SS			229
	brown, moist		6	SS			228
			7	SS			227
			8	SS			
	very moist, coarse sand		9	SS			226
	white/grey, dry		10	SS			225
	some gravel		11	SS			224
	brown, moist		12	SS			223
	End of spoon sampling		13	AUGER		W. L. 222.3 m Jul 27, 2020	222

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

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity (REM)
- × FIELD VANE & Sensitivity (NAT)

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)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

LOG OF BOREHOLE MW 2

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 3

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-15-2020

SOIL PROFILE			SAMPLES									
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity (REM) × FIELD VANE & Sensitivity (NAT) 20 40 60 80 100	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)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.1	**SAND:** brown, moist(Continued)											
10.7	**END OF BOREHOLE:**											

Note:
1. Monitoring well was installed upon completion of drilling.
2. Monitoring well was covered with flush mount well cover protection.
3. Groundwater level observation(s):

Date:	Depth (m):
July 16, 2020	9.48
July 27, 2020	9.51

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

LOG OF BOREHOLE MW 3

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 4

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-15-2020

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
232.1							
232.0 0.1	**ASPHALT:** 100 mm thick			AUGER			232
	FILL: sandy silt, some cobbles, trace stone, trace clay		1	SS			
1	more stones and cobbles		2	SS			231
230.6							
1.5	**SAND:** trace stone, white/brown, moist		3	SS			
2			4	SS			230
3			5	SS			229
4	fine sand, dark gery, very moist		6	SS			228
5			7	SS			227
6			8	SS			
			9	SS			226
7	trace gravel, moist		10	SS			225
8			11	SS			224
9			12	SS			
	End of spoon sampling		13	SS			223
10							

W. L. 222.3 m

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity (REM)
● QUICK TRIAXIAL × FIELD VANE & Sensitivity (NAT)
20 40 60 80 100

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)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

SS13 - PHC/VOC

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ε=3% Strain at Failure

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

LOG OF BOREHOLE MW 3

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 4

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-15-2020

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity (REM) × FIELD VANE & Sensitivity (NAT) (20 40 60 80 100)	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)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SAND: trace gravel, white/brown, moist(Continued)						Jul 27, 2020				
11				AUGER			221				
12 219.9							220				
12.2	**END OF BOREHOLE:**										

Note:
1. Monitoring well was installed upon completion of drilling.
2. Monitoring well was covered with flush mount well cover protection.
3. Groundwater level observation(s):

Date:	Depth (m):
July 16, 2020	9.88
July 27, 2020	9.82

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

LOG OF BOREHOLE BH 4

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 5

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-15-2020

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity (REM) × FIELD VANE & Sensitivity (NAT) (20 40 60 80 100)	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)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
231.1											
231.0	**ASPHALT:** 100 mm thick			AUGER			231				
0.1	**FILL:** sand, some stone, trace gravel, brown		1	SS							SS1 - M&I
1	piece of brick		2	SS			230				
229.4											
1.7	**SAND:**		3	SS							SS3 - PHC/VOC, PAH, PCB
2 229.0											
2.1	**END OF BOREHOLE:**						229				
	Note:										

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH 5

SIRATI & PARTNERS

REF. NO.: SP20-666-20

PROJECT: Hydrogeological and Environmental Investigation | Method: Hollow Stem Auger | ENCL NO.: 6

CLIENT: Vitmont Holdings (Barrie) Inc. | Diameter: 200 mm

PROJECT LOCATION: 79 Collier Street, ON | Date: Jul-16-2020

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity (REM) × FIELD VANE & Sensitivity (NAT) (20 40 60 80 100)	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)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"						GR SA SI CL
230.8											
230.7 0.1	**ASPHALT:** 80 mm thick			AUGER							
	FILL: sand, some stone, some asphalt, gravel, dark brown		1	SS							
1			2	SS			230				
	some organics, dark brown		3	SS			229				SS3 - M&I, PHC/VOC, PAH
2 228.7											
2.1	**END OF BOREHOLE:**										
	Note:										

SPCL SOIL LOG-DRAFT SP20-666-20.GPJ SPCL.GDT 20-9-1

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

APPENDIX B

SIRATI & PARTNERS

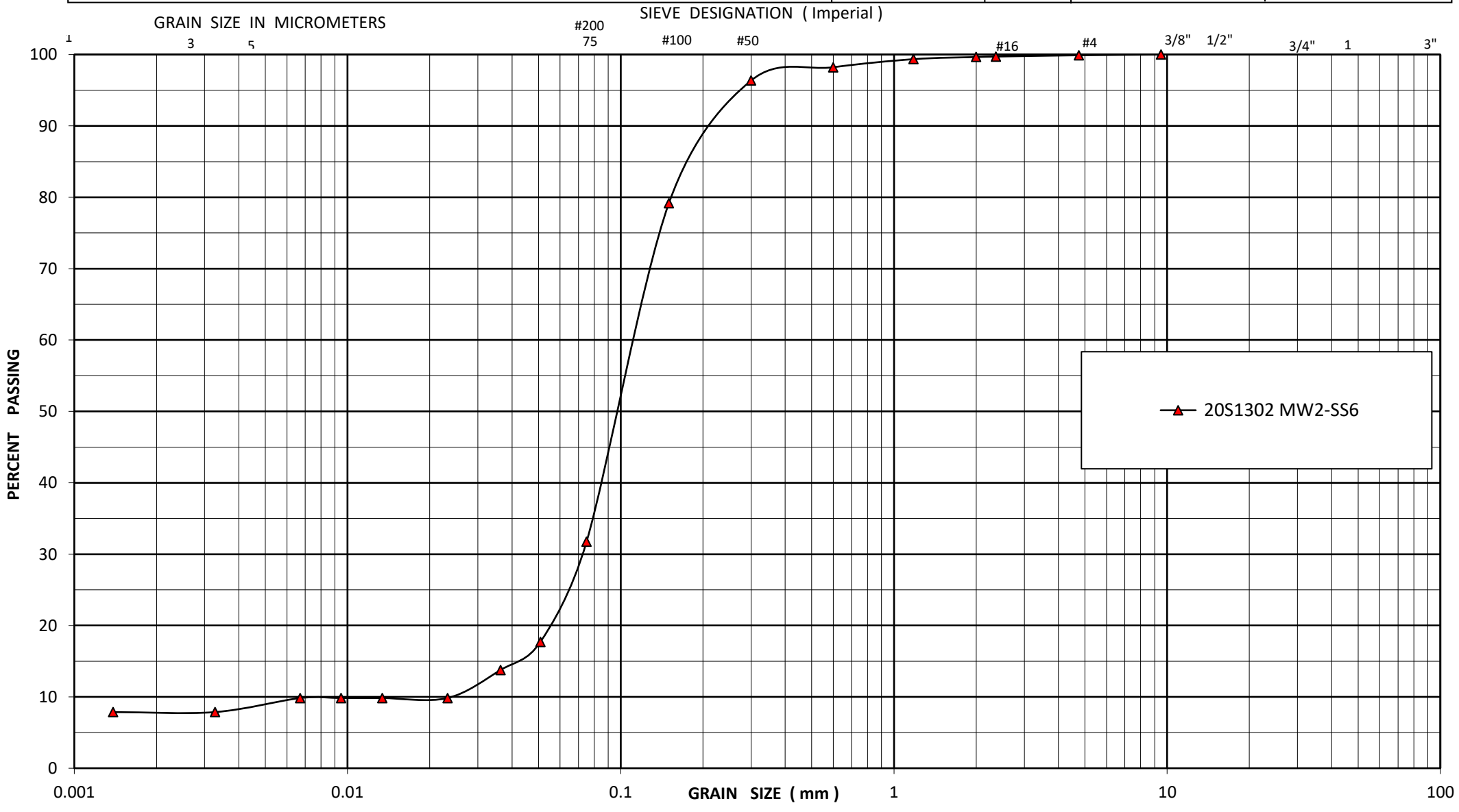
Geotechnical Hydrogeological & Environmental Solutions

SIRATI & PARTNERS

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

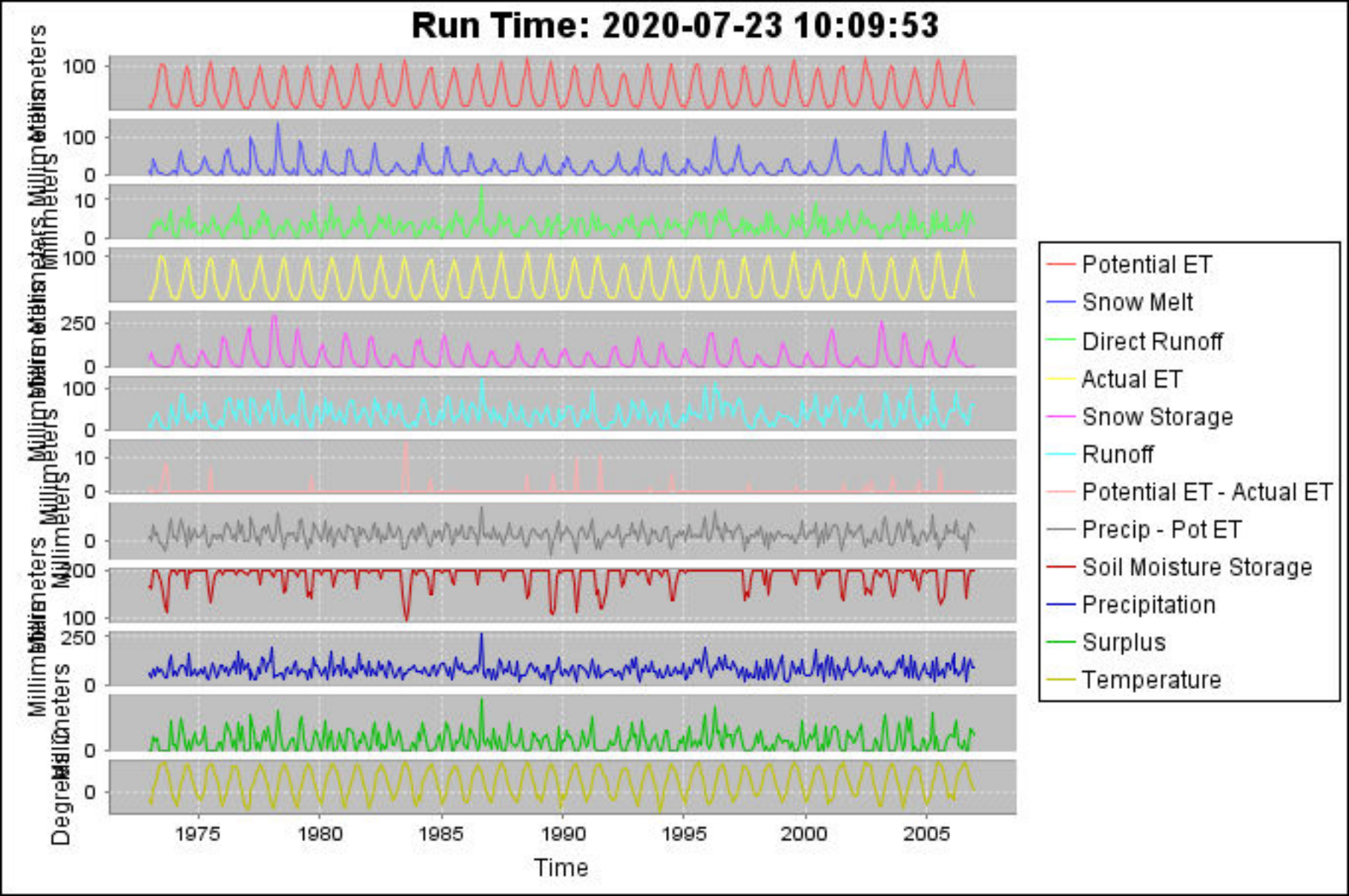
CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Project No.	:	SP20-666-00
Date	:	21 August 2020
Figure No.	:	

APPENDIX C

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions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Millimeters
Degrees Celsius
100
0
10
250
Time
1975
1980
1985
1990
1995
2000
2005
Potential ET
Snow Melt
Direct Runoff
Actual ET
Snow Storage
Runoff
Potential ET - Actual ET
Precip - Pot ET
Soil Moisture Storage
Precipitation
Surplus
Temperature

THORNTHWAITE DATA

				Soil			Snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
========	========	========	========	========	========	========	========	========	========
Jan-73	10.4	64.5	15.9	165.9	10.4	0	37.2	0	13.7
Feb-73	8.6	44.2	-6.2	160.8	7.6	1.1	78.8	0	6.4
Mar-73	23.7	81.5	86.6	200	23.7	0	46.3	47.4	30.6
Apr-73	34	49.8	36.4	200	34	0	23.2	36.4	34.1
May-73	54.5	91.4	43.9	200	54.5	0	11.6	43.9	42.3
Jun-73	91.3	76.2	-13.2	186.8	91.3	0	5.8	0	22.7
Jul-73	103	87.6	-14	173.8	102.1	0.9	0	0	13.8
Aug-73	97.5	39.4	-60.1	121.6	89.7	7.9	0	0	6.7
Sep-73	54.3	38.9	-17.4	111	47.5	6.8	0	0	4.3
Oct-73	36.1	113.8	72	183	36.1	0	0	0	6.9
Nov-73	17.2	156.5	125.7	200	17.2	0	6.3	108.7	62.2
Dec-73	10.3	54.1	16.1	200	10.3	0	33	16.1	36.5
Jan-74	9.9	69.1	17.7	200	9.9	0	73.7	17.7	27.5
Feb-74	8.2	52.8	-8.2	191.8	8.2	0	126.5	0	13.3
Mar-74	17	81.3	65	200	17	0	123.7	56.9	37.2
Apr-74	34.9	99.6	121.6	200	34.9	0	61.9	121.6	83.3
May-74	51.5	102.9	77.1	200	51.5	0	30.9	77.1	82.9
Jun-74	81.7	96.5	25.4	200	81.7	0	15.5	25.4	56.4
Jul-74	99.2	55.1	-39.1	160.9	99.2	0	7.7	0	28.5
Aug-74	86.2	161	74.5	200	86.2	0	0	35.4	38.6
Sep-74	48.9	47.8	-3.5	196.5	48.9	0	0	0	17.7
Oct-74	28.3	67.8	36.1	200	28.3	0	0	32.6	27.3
Nov-74	17.6	86.1	64.4	200	17.6	0	0	64.4	48.3
Dec-74	12.8	51.3	23.7	200	12.8	0	13.3	23.7	35.5
Jan-75	10.7	66	20.8	200	10.7	0	46.7	20.8	28.5
Feb-75	10.9	82.8	29.4	200	10.9	0	87.9	29.4	29.7
Mar-75	16.2	63.8	39.6	200	16.2	0	94.4	39.6	35.5
Apr-75	25.4	88.4	89.4	200	25.4	0	64.3	89.4	65.4
May-75	72.5	42.2	-0.2	199.8	72.5	0	32.2	0	33
Jun-75	90.2	31.5	-44.2	155.6	90.2	0.1	16.1	0	17
Jul-75	106.2	71.6	-30.2	132.1	99.5	6.7	8	0	11.3
Aug-75	87.2	112	27.2	159.3	87.2	0	0	0	9.5
Sep-75	48	79.8	27.8	187.1	48	0	0	0	5.9
Oct-75	34.1	43.9	7.6	194.7	34.1	0	0	0	3.2
Nov-75	21.7	58.7	34.1	200	21.7	0	0	28.8	17.8
Dec-75	9.6	103.1	28	200	9.6	0	64.1	28	22.9
Jan-76	7.2	101.6	-7.2	192.8	7.2	0	165.7	0	10.7
Feb-76	12	72.6	62	200	12	0	162.8	54.7	34.3
Mar-76	18.8	95.5	102.2	200	18.8	0	134.2	102.2	70.5
Apr-76	36.9	55.6	83	200	36.9	0	67.1	83	78
May-76	53.2	87.1	63.1	200	53.2	0	33.6	63.1	73.5
Jun-76	93.1	91.9	11	200	93.1	0	16.8	11	44.7
Jul-76	93.3	123.4	32.4	200	93.3	0	8.4	32.4	42.4
Aug-76	81	67.1	-8.8	191.2	81	0	0	0	21.5

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
Sep-76	49.8	173.2	114.7	200	49.8	0	0	105.9	70.7
Oct-76	26.3	66.5	36.9	200	26.3	0	0	36.9	52.8
Nov-76	14.1	130.3	84.6	200	14.1	0	27.1	84.6	71.5
Dec-76	7.9	79.5	-3.1	196.9	7.9	0	101.6	0	33.7
Jan-77	6.6	111.2	-6.6	190.4	6.5	0.1	212.8	0	16.8
Feb-77	9.7	36.6	16.2	200	9.7	0	223.3	6.7	12
Mar-77	21.7	78.4	135.4	200	21.7	0	141.4	135.4	76.7
Apr-77	36.4	34.9	67.4	200	36.4	0	70.7	67.4	72.2
May-77	67.3	35.4	1.7	200	67.3	0	35.3	1.7	37.8
Jun-77	78.7	88.9	23.4	200	78.7	0	17.7	23.4	34.2
Jul-77	100.5	63.5	-31.3	168.7	100.5	0	8.8	0	18
Aug-77	78	140.2	64	200	78	0	0	32.7	30.8
Sep-77	52.7	133	73.7	200	52.7	0	0	73.7	55.4
Oct-77	29.8	70.2	36.9	200	29.8	0	0	36.9	46.3
Nov-77	18.4	113.8	89.8	200	18.4	0	0	89.8	72
Dec-77	10	125.7	43.4	200	10	0	70.2	43.4	56.9
Jan-78	7.6	193	-7.6	192.4	7.6	0	263.2	0	27.4
Feb-78	7.5	38.8	-7.5	185.2	7.2	0.3	302	0	13.7
Mar-78	14.5	55.8	57.5	200	14.5	0	284.8	42.7	29.1
Apr-78	27.9	50.8	152.7	200	27.9	0	152.6	152.7	92.9
May-78	62.5	60	70.8	200	62.5	0	76.3	70.8	83.7
Jun-78	78.7	62.6	18.9	200	78.7	0	38.2	18.9	52.9
Jul-78	99.2	32.8	-49	151	99.2	0	19.1	0	26.5
Aug-78	85.6	87	6.6	157.6	85.6	0	9.5	0	16.8
Sep-78	51.1	93.4	47.2	200	51.1	0	0	4.8	13.3
Oct-78	30.3	61.8	28.4	200	30.3	0	0	28.4	21.6
Nov-78	16.8	59	39.5	200	16.8	0	0	39.5	31.7
Dec-78	10.9	101.6	42.9	200	10.9	0	45.6	42.9	38.2
Jan-79	8.1	123.3	-5.1	194.9	8.1	0	165.8	0	18.1
Feb-79	6.9	55	-6.9	188.1	6.8	0.2	220.8	0	9
Mar-79	20.4	71	117.5	200	20.4	0	151.3	105.6	59.9
Apr-79	31.2	87.2	127.3	200	31.2	0	75.6	127.3	96.6
May-79	56.9	70.4	47.8	200	56.9	0	37.8	47.8	73.6
Jun-79	84.3	70.3	1.4	200	84.3	0	18.9	1.4	39.2
Jul-79	99.2	36	-55.6	144.4	99.2	0	9.5	0	19.7
Aug-79	80.5	83.4	8.2	152.6	80.5	0	0	0	13.1
Sep-79	54	39.8	-16.2	140.3	50.2	3.8	0	0	6.5
Oct-79	30.1	140	102.9	200	30.1	0	0	43.1	30.8
Nov-79	18.9	99.2	75.3	200	18.9	0	0	75.3	54.5
Dec-79	12.2	99.8	54.2	200	12.2	0	30.6	54.2	54.7
Jan-80	9.9	71.8	18.3	200	9.9	0	73.3	18.3	36
Feb-80	8.3	49	-8.3	191.7	8.3	0	122.3	0	17.5
Mar-80	16.6	70.2	54.6	200	16.6	0	119.5	46.3	33.6
Apr-80	34.2	93.4	114.2	200	34.2	0	59.8	114.2	77.7

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
May-80	62.9	36.8	2	200	62.9	0	29.9	2	39.4
Jun-80	70.4	103.2	42.6	200	70.4	0	14.9	42.6	45.2
Jul-80	98.6	171.6	71.9	200	98.6	0	7.5	71.9	64.5
Aug-80	90.5	51.2	-34.4	165.6	90.5	0	0	0	30.5
Sep-80	52.4	99.2	41.9	200	52.4	0	0	7.5	22.7
Oct-80	26.9	98.6	66.7	200	26.9	0	0	66.7	47.1
Nov-80	15.8	55.6	31.6	200	15.8	0	5.9	31.6	39.2
Dec-80	8.2	144.8	10.4	200	8.2	0	131.4	10.4	24.3
Jan-81	6.7	61	-6.7	193.3	6.7	0	192.4	0	11.8
Feb-81	12.9	85.2	89.6	200	12.9	0	172.9	82.9	49.6
Mar-81	19.4	51.6	77.9	200	19.4	0	125.4	77.9	64.4
Apr-81	35.3	46.4	71.5	200	35.3	0	62.7	71.5	69.4
May-81	55.5	97.6	68.6	200	55.5	0	31.4	68.6	72.7
Jun-81	83.2	71.8	0.7	200	83.2	0	15.7	0.7	37.8
Jul-81	101.7	58.6	-38.2	161.8	101.7	0	7.8	0	20
Aug-81	84	159.8	75.6	200	84	0	0	37.4	35.2
Sep-81	50.1	80.4	26.2	200	50.1	0	0	26.2	30.8
Oct-81	27.5	101.4	68.9	200	27.5	0	0	68.9	52.9
Nov-81	17.4	70	49.4	200	17.4	0	0	49.4	51.9
Dec-81	11.2	55	20	200	11.2	0	22.5	20	35.6
Jan-82	7	120	-7	193	7	0	142.5	0	17.1
Feb-82	9.4	49	9.4	200	9.4	0	172.4	2.4	10.1
Mar-82	16.7	79	73.1	200	16.7	0	159.5	73.1	43.4
Apr-82	29.5	58.8	106.1	200	29.5	0	79.8	106.1	76.7
May-82	68.6	50.2	19	200	68.6	0	39.9	19	48.9
Jun-82	74	123.2	63	200	74	0	19.9	63	60.9
Jul-82	101.7	78	-17.6	182.4	101.7	0	10	0	31.2
Aug-82	73.3	103.4	34.9	200	73.3	0	0	17.2	27.5
Sep-82	53	62.8	6.7	200	53	0	0	6.7	17.6
Oct-82	33.5	47.2	11.4	200	33.5	0	0	11.4	15.3
Nov-82	18.7	126.8	101.8	200	18.7	0	0	101.8	63.7
Dec-82	13.8	108.4	71.4	200	13.8	0	19.3	71.4	68.3
Jan-83	10.3	72	20.8	200	10.3	0	59.1	20.8	43.6
Feb-83	11.8	43.2	22.1	200	11.8	0	67.6	22.1	33.2
Mar-83	19.8	53.4	44.9	200	19.8	0	54.4	44.9	40.5
Apr-83	31.8	83.6	74.8	200	31.8	0	27.2	74.8	60.9
May-83	50.9	93.8	51.8	200	50.9	0	13.6	51.8	59
Jun-83	85.9	28.2	-52.3	147.7	85.9	0	6.8	0	28.5
Jul-83	111.6	62.8	-45.2	114.4	99.8	11.8	0	0	16.7
Aug-83	94	63.6	-33.6	95.2	79.6	14.4	0	0	10
Sep-83	59.3	84.4	20.9	116.1	59.3	0	0	0	7.6
Oct-83	32.3	82.4	46	162.1	32.3	0	0	0	5.8
Nov-83	17.1	89	67.8	200	17.1	0	0	29.9	19.9
Dec-83	9	104.4	18.6	200	9	0	75.8	18.6	18.2

THORNTHWAITE DATA

				Soil			Snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
========	=========	=========	=========	=========	========	=========	=========	=========	========
Jan-84	7.6	72.6	-7.6	192.4	7.6	0	148.4	0	8.6
Feb-84	13.1	72	72	200	13.1	0	133.4	64.4	38.4
Mar-84	14.1	77.4	33.9	200	14.1	0	161.7	33.9	36.3
Apr-84	36.2	64.8	106.2	200	36.2	0	80.9	106.2	73.9
May-84	51.2	89.4	74.1	200	51.2	0	40.4	74.1	76.9
Jun-84	85.9	49.8	-18.3	181.7	85.9	0	20.2	0	38.7
Jul-84	96.2	52.2	-36.5	148.5	92.8	3.3	10.1	0	20.7
Aug-84	92.8	91	-1.3	147.5	92.5	0.3	5.1	0	13.6
Sep-84	49.2	106.8	57.3	200	49.2	0	0	4.8	12.3
Oct-84	34.7	51.8	14.5	200	34.7	0	0	14.5	13.3
Nov-84	17.5	69.2	48.5	200	17.5	0	0	48.5	32.8
Dec-84	13.2	98.6	59.8	200	13.2	0	22.3	59.8	48
Jan-85	8.1	112.6	-5.5	194.5	8.1	0	132.2	0	22.4
Feb-85	10.6	113.4	49.2	200	10.6	0	184.3	43.6	34.6
Mar-85	19	84.2	102	200	19	0	144.9	102	70.2
Apr-85	36.2	51.6	85.2	200	36.2	0	72.4	85.2	78.9
May-85	61.3	88.4	58.9	200	61.3	0	36.2	58.9	72
Jun-85	73.1	33.2	-23.4	176.6	73.1	0	18.1	0	35.5
Jul-85	93.8	83.4	-5.6	171.7	93.2	0.7	9.1	0	21.1
Aug-85	80.5	144.2	65.6	200	80.5	0	0	37.2	34.3
Sep-85	58.2	89.4	26.8	200	58.2	0	0	26.8	31.4
Oct-85	33.3	78.8	41.6	200	33.3	0	0	41.6	38.2
Nov-85	17.2	116.4	93.8	200	17.2	0	0	93.8	69.4
Dec-85	9.8	71	18.5	200	9.8	0	41.5	18.5	42.4
Jan-86	9.3	75	12	200	9.3	0	94.6	12	27.3
Feb-86	9.3	58	6.1	200	9.3	0	136.9	6.1	16.7
Mar-86	19.8	68.8	81	200	19.8	0	102.5	81	51.1
Apr-86	38.3	66.4	76	200	38.3	0	51.2	76	65.7
May-86	66.9	92.6	46.7	200	66.9	0	25.6	46.7	59.2
Jun-86	77.3	105	35.3	200	77.3	0	12.8	35.3	50.2
Jul-86	101.7	70	-28.8	171.2	101.7	0	6.4	0	26
Aug-86	78	128	50	200	78	0	0	21.2	28.2
Sep-86	51.4	263.2	198.6	200	51.4	0	0	198.6	123.4
Oct-86	31.1	66.8	32.4	200	31.1	0	0	32.4	74.6
Nov-86	15.9	38	20.5	200	15.9	0	0	20.5	47.5
Dec-86	12.3	80.6	41.8	200	12.3	0	24.1	41.8	46.2
Jan-87	10.3	80.4	24.8	200	10.3	0	68.3	24.8	35.5
Feb-87	9.7	36.4	4.8	200	9.7	0	89.9	4.8	19.9
Mar-87	20.2	83.6	78	200	20.2	0	72.3	78	51.8
Apr-87	41.3	34.4	27.6	200	41.3	0	36.1	27.6	39.9
May-87	65.2	52	2.2	200	65.2	0	18.1	2.2	22.8
Jun-87	89.7	134	46.7	200	89.7	0	9	46.7	40.1
Jul-87	108.9	111.6	6.2	200	108.9	0	0	6.2	25.4
Aug-87	84.6	66	-21.9	178.1	84.6	0	0	0	13.2

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
Sep-87	55.7	78.2	18.6	196.7	55.7	0	0	0	8.9
Oct-87	28.3	76.8	44.6	200	28.3	0	0	41.4	27
Nov-87	17.4	123.6	100.5	200	17.4	0	0	100.5	67.6
Dec-87	12.9	59.8	30	200	12.9	0	15.1	30	47.8
Jan-88	9.8	51.4	8.9	200	9.8	0	47.1	8.9	28.1
Feb-88	9.4	119.6	16.1	200	9.4	0	140.3	16.1	22.6
Mar-88	17.2	25.2	35.5	200	17.2	0	112.2	35.5	29.3
Apr-88	32.8	57.2	77.6	200	32.8	0	56.1	77.6	56
May-88	66.1	54.4	13.7	200	66.1	0	28	13.7	36.1
Jun-88	81.7	48.8	-21.3	178.7	81.7	0	14	0	19.1
Jul-88	114.4	68.6	-42.2	140.9	109.9	4.5	7	0	11.8
Aug-88	92.2	99.8	9.6	150.5	92.2	0	0	0	9.2
Sep-88	52.7	113	54.7	200	52.7	0	0	5.2	10.3
Oct-88	27.3	95.4	63.3	200	27.3	0	0	63.3	38.8
Nov-88	19.4	77	53.7	200	19.4	0	0	53.7	47.7
Dec-88	10.6	91.8	35.2	200	10.6	0	44.2	35.2	41.3
Jan-89	11.5	64	32.5	200	11.5	0	62.8	32.5	37.4
Feb-89	9.4	47.2	3.7	200	9.4	0	96.6	3.7	20.2
Mar-89	16	62	39.2	200	16	0	102	39.2	30.9
Apr-89	30.3	29.4	48.7	200	30.3	0	51	48.7	40.6
May-89	59.8	100	60.7	200	59.8	0	25.5	60.7	54.9
Jun-89	86.9	102.6	23.3	200	86.9	0	12.8	23.3	41.7
Jul-89	106.9	12.2	-88.9	111.1	106.9	0	6.4	0	18.9
Aug-89	84.6	69.9	-11.8	104.5	79.3	5.2	0	0	12.6
Sep-89	53	72.4	15.8	120.3	53	0	0	0	8.2
Oct-89	32.7	97.6	60.1	180.4	32.7	0	0	0	7.2
Nov-89	15.7	145.8	107.9	200	15.7	0	16.3	88.2	51.2
Dec-89	6.6	58	-6.6	193.4	6.6	0	74.3	0	22.6
Jan-90	12.8	55.4	44.7	200	12.8	0	70.7	38.1	31.9
Feb-90	11.1	84	37.2	200	11.1	0	104.9	37.2	35.2
Mar-90	20.3	68.4	72.1	200	20.3	0	78.4	72.1	55.4
Apr-90	37.8	54.4	53.1	200	37.8	0	39.2	53.1	55.7
May-90	55.2	87.2	47.3	200	55.2	0	19.6	47.3	54.5
Jun-90	85.3	106	25.2	200	85.3	0	9.8	25.2	43
Jul-90	98.6	62.8	-29.1	170.9	98.6	0	0	0	22
Aug-90	88.3	20.8	-68.6	112.3	78.3	10	0	0	10.5
Sep-90	52.4	99.2	41.9	154.2	52.4	0	0	0	9.7
Oct-90	31.3	104	67.5	200	31.3	0	0	21.7	18.4
Nov-90	19	97.8	73.9	200	19	0	0	73.9	48.4
Dec-90	12.3	85	44.8	200	12.3	0	25.4	44.8	46.6
Jan-91	9.3	71.6	9.8	200	9.3	0	77.3	9.8	27.6
Feb-91	12.1	42.2	28	200	12.1	0	78.4	28	28.4
Mar-91	20.2	85	75	200	20.2	0	65.2	75	54.3
Apr-91	39.3	136.6	123.1	200	39.3	0	32.6	123.1	94

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
May-91	72.9	72.4	12.1	200	72.9	0	16.3	12.1	53.3
Jun-91	94.8	38.6	-50	150	94.8	0	8.2	0	26.8
Jul-91	102.3	107.4	7.8	157.9	102.3	0	0	0	17.8
Aug-91	91.7	43.4	-50.4	118	81	10.6	0	0	8.4
Sep-91	51.4	56	1.8	119.9	51.4	0	0	0	5.9
Oct-91	33.5	68.6	31.7	151.5	33.5	0	0	0	5
Nov-91	16.6	68.4	48.8	200	16.6	0	0	0.3	3.9
Dec-91	11	87.2	36.5	200	11	0	37.8	36.5	20.7
Jan-92	9.7	86.2	20.6	200	9.7	0	92.7	20.6	20.6
Feb-92	10.6	50.6	20.8	200	10.6	0	111.3	20.8	20.9
Mar-92	16.2	55.6	40.4	200	16.2	0	109	40.4	31.6
Apr-92	31.2	69.8	89.6	200	31.2	0	54.5	89.6	63.4
May-92	58.4	58.2	24.2	200	58.4	0	27.2	24.2	45
Jun-92	75.4	28.8	-34.4	165.6	75.4	0	13.6	0	22.5
Jul-92	82.9	87	6.6	172.2	82.9	0	6.8	0	14.9
Aug-92	74.2	100.2	27.8	199.9	74.2	0	0	0	10.3
Sep-92	52.4	93.8	36.8	200	52.4	0	0	36.7	25.7
Oct-92	28.3	64.4	32.9	200	28.3	0	0	32.9	30.1
Nov-92	16.9	132.4	102.4	200	16.9	0	7.1	102.4	70.6
Dec-92	12	89.6	47.8	200	12	0	34.5	47.8	58.7
Jan-93	10.4	147.4	55.2	200	10.4	0	114	55.2	58
Feb-93	7.9	51	-7.9	192.1	7.9	0	165	0	27.8
Mar-93	16.7	23.2	38	200	16.7	0	132.8	30.2	29.6
Apr-93	33.4	78.2	107.3	200	33.4	0	66.4	107.3	72.1
May-93	56.9	76.4	48.9	200	56.9	0	33.2	48.9	62.3
Jun-93	79.2	99	31.4	200	79.2	0	16.6	31.4	49.9
Jul-93	102.3	75.8	-22	178	102.3	0	8.3	0	26.3
Aug-93	90.5	75.4	-10.6	168.5	89.4	1.2	0	0	15
Sep-93	47.7	121	67.2	200	47.7	0	0	35.8	29.6
Oct-93	29.6	75	41.7	200	29.6	0	0	41.7	36.3
Nov-93	17	76.4	55.9	200	17	0	0	55.9	47.7
Dec-93	11.1	40.4	11.2	200	11.1	0	17.2	11.2	28.7
Jan-94	6	81.3	-6	194	6	0	98.5	0	13.9
Feb-94	8.2	38.2	-8.2	186.1	8	0.2	136.7	0	6.9
Mar-94	17.7	44.6	50.2	200	17.7	0	112.1	36.3	22.9
Apr-94	36.2	58.8	75.7	200	36.2	0	56.1	75.7	51.6
May-94	54.2	103.2	71.9	200	54.2	0	28	71.9	65.4
Jun-94	88	53.6	-23.1	176.9	88	0	14	0	32.8
Jul-94	102.3	53.6	-44.4	137.6	97.2	5.1	7	0	17.7
Aug-94	78	70.2	-4.3	134.7	76.7	1.3	0	0	11
Sep-94	54.3	89.4	30.6	165.2	54.3	0	0	0	8.2
Oct-94	33.3	58.4	22.2	187.4	33.3	0	0	0	4.8
Nov-94	19.6	72	48.8	200	19.6	0	0	36.2	22.6
Dec-94	12.9	58	28.7	200	12.9	0	14.6	28.7	25.7

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
Jan-95	11.1	113.8	48.5	200	11.1	0	66.5	48.5	38.4
Feb-95	8.7	33.6	-5.1	194.9	8.7	0	96.4	0	18.2
Mar-95	20.9	38	47.1	200	20.9	0	64.9	42	31.5
Apr-95	28.4	90.2	86.9	200	28.4	0	35.4	86.9	62.8
May-95	59.1	58	13.7	200	59.1	0	17.7	13.7	39
Jun-95	96.6	128.6	34.4	200	96.6	0	8.9	34.4	41.7
Jul-95	103.6	115.8	15.2	200	103.6	0	0	15.2	31
Aug-95	95.7	133.8	31.4	200	95.7	0	0	31.4	35
Sep-95	48.3	71.6	19.7	200	48.3	0	0	19.7	27.6
Oct-95	35.2	129	87.4	200	35.2	0	0	87.4	62.1
Nov-95	14.3	196	136.5	200	14.3	0	38.3	136.5	102.9
Dec-95	9	111.6	24.3	200	9	0	115.6	24.3	61.3
Jan-96	8.4	74.6	0.3	200	8.4	0	181.4	0.3	30.4
Feb-96	9.8	46.2	17.9	200	9.8	0	199.5	17.9	24.5
Mar-96	16	81.2	72.4	200	16	0	190.4	72.4	50.1
Apr-96	29.5	107	167.3	200	29.5	0	95.2	167.3	113.1
May-96	55.5	79.8	67.9	200	55.5	0	47.6	67.9	91.8
Jun-96	87.5	144.4	73.5	200	87.5	0	23.8	73.5	87.9
Jul-96	92.1	108.2	22.6	200	92.1	0	11.9	22.6	57
Aug-96	87.2	86.8	1.2	200	87.2	0	5.9	1.2	30.7
Sep-96	56.1	152.8	95.1	200	56.1	0	0	95.1	68.4
Oct-96	31.7	88.2	52.1	200	31.7	0	0	52.1	60.8
Nov-96	14.9	91.2	58.3	200	14.9	0	14.6	58.3	60.8
Dec-96	13	85.2	53.8	200	13	0	30.3	53.8	58.3
Jan-97	8.9	120.4	13.1	200	8.9	0	128	13.1	35.1
Feb-97	11.3	105.6	58.9	200	11.3	0	161.6	58.9	48.5
Mar-97	16.6	81	70.6	200	16.6	0	153.4	70.6	60.6
Apr-97	31.2	45.4	88.6	200	31.2	0	76.7	88.6	75.9
May-97	47.9	74	60.8	200	47.9	0	38.4	60.8	70.9
Jun-97	92.5	97.4	19.2	200	92.5	0	19.2	19.2	48.1
Jul-97	96.8	25	-63.5	136.5	96.8	0	9.6	0	22.9
Aug-97	77.1	87.4	15.6	152.1	77.1	0	0	0	15.2
Sep-97	53	44.6	-10.6	144	50.5	2.5	0	0	7.6
Oct-97	30.9	66.6	32.4	176.4	30.9	0	0	0	6
Nov-97	16.6	44.6	26	200	16.6	0	0	2.4	4.5
Dec-97	12.2	45	17.5	200	12.2	0	14.1	17.5	11.3
Jan-98	11.5	123.4	57.9	200	11.5	0	65.4	57.9	36.6
Feb-98	13.5	33.6	27.6	200	13.5	0	57	27.6	31.7
Mar-98	21.1	91.2	76.1	200	21.1	0	47.5	76.1	56.9
Apr-98	37.6	47	30.8	200	37.6	0	23.8	30.8	44.5
May-98	76.7	35	-31.5	168.5	76.7	0	11.9	0	22.8
Jun-98	88.6	134.8	45.4	200	88.6	0	5.9	13.9	24.2
Jul-98	100.5	45.2	-51.6	148.4	100.5	0	0	0	11
Aug-98	89.4	136.6	40.3	188.8	89.4	0	0	0	11.2

THORNTHWAITE DATA

				Soil			Snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
========	=========	=========	=========	=========	========	=========	=========	=========	========
Sep-98	58.5	94.4	31.1	200	58.5	0	0	19.9	16.9
Oct-98	33.7	35.2	-0.2	199.8	33.7	0	0	0	7.8
Nov-98	18.7	57.2	35.6	200	18.7	0	0	35.4	23.6
Dec-98	13.6	88.8	54.7	200	13.6	0	17.4	54.7	40.8
Jan-99	9.1	148.8	24.4	200	9.1	0	131.4	24.4	32.3
Feb-99	12.3	33	36.3	200	12.3	0	115	36.3	34.5
Mar-99	18.5	21.4	32	200	18.5	0	85.3	32	33.5
Apr-99	36.4	26	30.9	200	36.4	0	42.6	30.9	33.2
May-99	68.1	55.4	5.8	200	68.1	0	21.3	5.8	21.6
Jun-99	94.8	118.8	28.7	200	94.8	0	10.7	28.7	29.7
Jul-99	111.6	92.4	-18.5	181.5	111.6	0	5.3	0	16.5
Aug-99	81.5	65.2	-14.2	168.6	80.2	1.3	0	0	9.2
Sep-99	59.6	94.8	30.4	199	59.6	0	0	0	7.7
Oct-99	31.3	62.8	28.4	200	31.3	0	0	27.4	18.3
Nov-99	19	138.2	112.2	200	19	0	0	112.2	70.6
Dec-99	12	66	30.6	200	12	0	21.6	30.6	49
Jan-00	9.1	55	4.5	200	9.1	0	62.6	4.5	26.2
Feb-00	12	56.8	31.5	200	12	0	74.7	31.5	29.9
Mar-00	24.7	48.8	57.1	200	24.7	0	39.2	57.1	45.3
Apr-00	32.8	60.8	44.6	200	32.8	0	19.6	44.6	46.8
May-00	62.5	117.4	58.9	200	62.5	0	9.8	58.9	57.2
Jun-00	81.7	179	98.2	200	81.7	0	0	98.2	83.7
Jul-00	92.1	54.4	-40.4	159.6	92.1	0	0	0	40.1
Aug-00	82	99.4	12.4	172	82	0	0	0	23.7
Sep-00	52.4	108.4	50.6	200	52.4	0	0	22.6	26.1
Oct-00	33.5	24.8	-9.9	190.1	33.5	0	0	0	11.6
Nov-00	17	127.6	98.5	200	17	0	6.3	88.6	55.3
Dec-00	8.2	154.6	11.7	200	8.2	0	140.3	11.7	31.2
Jan-01	10.1	57.4	30.4	200	10.1	0	156.5	30.4	31.3
Feb-01	10.8	144.4	69.2	200	10.8	0	218.7	69.2	52
Mar-01	17.3	77.2	89.9	200	17.3	0	186.7	89.9	71.9
Apr-01	35.5	31.6	87.8	200	35.5	0	93.4	87.8	80.4
May-01	66.9	100.4	75.2	200	66.9	0	46.7	75.2	82
Jun-01	89.1	82.4	12.5	200	89.1	0	23.3	12.5	48.9
Jul-01	95.6	29.2	-56.2	143.8	95.6	0	11.7	0	23.8
Aug-01	97.5	87.4	-8.7	137.6	95.1	2.4	5.8	0	15.6
Sep-01	53.3	86.2	34.4	172	53.3	0	0	0	9.9
Oct-01	32.7	142.8	103	200	32.7	0	0	75	47.4
Nov-01	21.7	73.2	47.8	200	21.7	0	0	47.8	47.7
Dec-01	14.6	77.6	50	200	14.6	0	9.9	50	50.1
Jan-02	13.1	49.2	23.5	200	13.1	0	21	23.5	36.7
Feb-02	12.8	75.6	38.2	200	12.8	0	43.8	38.2	38.6
Mar-02	19	86.8	58.4	200	19	0	50.4	58.4	50.4
Apr-02	34.9	91.8	77.5	200	34.9	0	25.2	77.5	67.1

THORNTHWAITE DATA

Date	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal
May-02	52.5	139.6	92.7	200	52.5	0	12.6	92.7	84.6
Jun-02	88	77.6	-8	192	88	0	6.3	0	42.7
Jul-02	114.4	68.2	-43.3	150.4	112.7	1.7	0	0	22.8
Aug-02	90	104.2	9	159.4	90	0	0	0	14.9
Sep-02	65.9	53.6	-14.9	147.5	62.8	3	0	0	7.5
Oct-02	29	65.2	32.9	180.4	29	0	0	0	5.7
Nov-02	16.3	88	60.7	200	16.3	0	7.2	41.1	25.6
Dec-02	11.4	59.2	24.8	200	11.4	0	28.8	24.8	24.7
Jan-03	7.4	128.2	-7.4	192.6	7.4	0	157	0	11.7
Feb-03	8.2	111.6	-8.2	184.7	7.9	0.3	268.6	0	5.8
Mar-03	17.3	76.6	102.8	200	17.3	0	223.1	87.5	48.7
Apr-03	29.7	51.2	130.5	200	29.7	0	111.5	130.5	91.1
May-03	57.3	73	67.8	200	57.3	0	55.8	67.8	81.9
Jun-03	85.3	45.4	-14.3	185.7	85.3	0	27.9	0	41.4
Jul-03	99.8	61	-27.9	159.7	97.8	2	13.9	0	22.6
Aug-03	93.4	68.8	-21.1	142.9	89.2	4.2	7	0	13.2
Sep-03	56.8	65.2	12.2	155.1	56.8	0	0	0	8.1
Oct-03	29.8	111	75.7	200	29.8	0	0	30.8	23.4
Nov-03	18.5	131	106	200	18.5	0	0	106	68.5
Dec-03	12.1	97.4	51.4	200	12.1	0	31.2	51.4	59.4
Jan-04	6.7	149.6	-6.7	193.3	6.7	0	180.8	0	28.3
Feb-04	10.5	56.6	34.1	200	10.5	0	192	27.4	28.6
Mar-04	20.4	94.2	125.4	200	20.4	0	136.9	125.4	80.1
Apr-04	33.6	43	75.7	200	33.6	0	68.5	75.7	78.3
May-04	57.6	148.6	117.8	200	57.6	0	34.2	117.8	104.4
Jun-04	78.7	44	-19.8	180.2	78.7	0	17.1	0	50.7
Jul-04	95.6	124.8	31.5	200	95.6	0	8.6	11.7	36.3
Aug-04	77.5	48	-23.4	176.6	77.5	0	0	0	17.5
Sep-04	60	37.4	-24.5	155	57.1	2.9	0	0	9.4
Oct-04	32.7	61.6	25.9	180.9	32.7	0	0	0	6.8
Nov-04	18.1	81.8	59.6	200	18.1	0	0	40.5	26.2
Dec-04	10	115.6	38.2	200	10	0	65.6	38.2	32
Jan-05	8.2	59.2	-4.7	195.3	8.2	0	121.2	0	15.2
Feb-05	10.4	61.8	26	200	10.4	0	145.8	21.3	19
Mar-05	16	39.4	37.8	200	16	0	130.5	37.8	28.9
Apr-05	35.3	121	144.9	200	35.3	0	65.3	144.9	92.5
May-05	54.2	26.8	3.9	200	54.2	0	32.6	3.9	46.5
Jun-05	104	142.4	47.5	200	104	0	16.3	47.5	53.5
Jul-05	111.6	50.4	-55.6	144.4	111.6	0	8.2	0	25.7
Aug-05	94	65.2	-23.9	127.2	87.3	6.6	0	0	14.8
Sep-05	64.6	78.6	10	137.2	64.6	0	0	0	9.7
Oct-05	35.4	44	6.4	143.6	35.4	0	0	0	5.1
Nov-05	18.9	118.2	93.4	200	18.9	0	0	37	25.8
Dec-05	10.6	114.6	46.5	200	10.6	0	55.2	46.5	35.5

THORNTHWAITE DATA

				Soil			Snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
========	=========	=========	=========	=========	========	=========	=========	=========	========
Jan-06	12.8	78.2	54.3	200	12.8	0	64.1	54.3	46
Feb-06	10.1	166.6	47.3	200	10.1	0	171.4	47.3	47.4
Mar-06	18.8	61	80	200	18.8	0	131.6	80	64.7
Apr-06	36.9	85	109.6	200	36.9	0	65.8	109.6	90.5
May-06	64.4	52.2	18	200	64.4	0	32.9	18	54.7
Jun-06	90.8	85.8	7.2	200	90.8	0	16.4	7.2	33.9
Jul-06	113.7	143.8	31.1	200	113.7	0	8.2	31.1	37.6
Aug-06	87.8	22.2	-58.5	141.5	87.8	0	0	0	16.3
Sep-06	52.7	100.2	42.5	184	52.7	0	0	0	12.6
Oct-06	30.3	132.4	95.5	200	30.3	0	0	79.5	50.2
Nov-06	19.9	97.8	73	200	19.9	0	0	73	63.2
Dec-06	14.5	88.8	59	200	14.5	0	11.8	59	62.1
	535	999	425	2346	531	4	551	427	465

DETAILED WATER BALANCE CALCULATIONS

79 Collier Street, City of Barrie

1 Climate Information

Precipitation	999	mm/a
Actual Evapotranspiration	531	mm/a
Water Surplus	468	mm/a

2 Infiltration Rates

Table 2 Approach - Infiltration factors

Topography: Flat to rolling Land	0.25	
Soil Type: predominantly open sandy loam	0.4	
Cover: Open Land	0.1	
Total	**0.75**	

Infiltration (0.75 x 468)	351	mm/a
Run-off (468-351)	117	mm/a

Table 3 Approach - Typical Recharge Rates

Coarse Sand and Gravel	>250	mm/a
Fine to medium sand	200-250	mm/a
Silty sand to sandy silt	150-200	mm/a
Silt	125-150	mm/a
Clayey Silt	100- 125	mm/a
Clay	<100	mm/a

Site development area is underlain predominantly by sandy soils

Based on the above, the recharge rate is typically 200-250 mm/a

3 Pre-Development Property Statistics	**ha**	**m2**
Paved Area	0.126	1260
Roof Area	0	0
Landscape Area	0.04	400
Total	**0.166**	**1660**

4 Post-Development Property Statistics	**ha**	**m2**
Paved Area	0.0558	558
Total Building Roof Area	0.1102	1102
Landscape Area	0	0
Total Land Area	**0.166**	**1660**

5. Annual Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1260	1259	126	0	1133
	Roof Area	0	0	0	0	0
Pervious Areas	Landscape Area	400	400	212	140	47
		1,660	**1,658**	**338**	**140**	**1,180**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

6. Annual Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	558	557	56	0	502
	Roof Area	1102	1,101	110	0	991
Pervious Areas	Landscape Area	0	0	0	0	0
		1,660	**1,658**	**166**	**0**	**1,493**
Assuming no infiltration occurring in paved and roof areas, 10% of precipitation to be evaporated from paved and general roof areas.						

7. Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	**1,658**	**338**	**140**	**1,180**
Post-Development	**1,658**	**166**	**0**	**1,493**
Change in Volume		**-172**	**-140**	**313**
Change in %			**-100**	**27**

8. Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/annum)	**140**
Volume of Post-Development Infiltration (m^3/annum)	**0**
Deficit from Pre to Post Development Infiltration (m^3/annum)	**140**
Percentage of Roof Runoff required to match the pre-development infiltration (%)	**14**