

**TOWN OF CALEDON  
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**July 29, 2020**

**REPORT ON  
HYDROGEOLOGICAL INVESTIGATION**

**Proposed Sub-Division Development**

**17791 Mount Hope Road**

**Part of Lot 28, Concession 8**

**Town of Caledon, Region of Peel**

**Ontario**

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## 1.0 INTRODUCTION AND BACKGROUND

Sirati & Partners (SIRATI) was retained by Palgrave Development Inc. (the Client) to conduct a Hydrogeological Investigation of a property located at 17791 Mount Hope Road, described as Part of Lot 28, Concession 8, in the Town of Caledon, Ontario (the Site). The approximate site location is presented in Figure 1-1.

The Site is located on the northeast side of Mount Hope Road, in the Town of Caledon and consists of a parcel of land with an area of approximately 41 hectares (102 acres). The Site is currently a cultivated land with no structures developed on the property. It is understood that a residential subdivision development consisting of twenty-nine (29) single homes has been proposed to be built on part of the property with a total development area of about 29.8 hectares. A recent site development grading plan dated October 2019 provided by the Client is presented in Appendix A.

The purposes of the investigation were to characterize the soil and groundwater conditions at the Site, assess the pre- and post-construction water balances, identify the potential impacts of land development on local groundwater and surface water resources and/or natural environments, and provide mitigative options, when required.

## 2.0 SCOPE OF WORK

This hydrogeological investigation was carried out consisting of the following scope of work:

- **Review of available background information:** a review of available geological and hydrogeological information for the Site and surrounding areas was conducted to understand the regional geological and hydrogeological settings.
- **Review of available investigation reports:** a review of available subsurface investigation reports completed for the Site to understand the soil and groundwater conditions of the Site.
- **Site inspection:** an inspection of the Site to review existing site conditions including identification of any hydrogeological features such as significant areas of potential groundwater recharge or areas of groundwater discharge.
- **Completion of Boreholes/Monitoring Wells:** boreholes and monitoring wells were completed at the Site to obtain the information of soil and groundwater at the Site.

- **Groundwater monitoring:** Groundwater levels were measured in the monitoring wells installed at the Site to obtain the groundwater level conditions in the site area for interpretation of groundwater flow directions.
- **In-situ hydraulic conductivity tests:** In-situ hydraulic conductivity tests (or single well response tests) in the selected existing monitoring wells to estimate the hydraulic conductivity of the underlying soils.
- **Water balance (Preliminary):** a water balance assessment was completed using the Thornthwaite water balance method for the proposed development as part of the hydrogeological study. The water balance study was based on available climatic information associated with pre-development and proposed post-development conditions at the subject lands.
- **Data process and report preparation:** the data obtained from this hydrogeological investigation was reviewed and processed, and a report was prepared summarizing the results and findings of the investigation.

It should be noted that this hydrogeological investigation was carried out concurrently with a geotechnical investigation conducted by SIRATI, which consisted of advancing ten (10) boreholes and installation of five (5) monitoring wells at the Site. The results of geotechnical investigation were summarized in a separate report. However, the data obtained was utilized in this hydrogeological report. In addition, the monitoring wells were used for groundwater monitoring in this hydrogeological investigation.

### 3.0 LAND USE

The Site is geographically located in Nottawasaga Valley Watershed under the jurisdiction of Nottawasaga Valley Conservation Authority (NVCA). Figure 3-1 presents the approximate location of the Site.

The Site consists of an undeveloped parcel of land and is bounded by Mount Hope Road further with residential houses to the southwest, by a vegetated wood lot and a residential property to the northwest, and by woodlots further with residential houses to the southeast and northeast.

The Site is located in Town of Caledon, within the Municipal Region of Peel or Peel Region. Based on Town of Caledon Official Plan, the Site is located in a zoning area identified as rural area on Oak Ridges Moraine (A2-ORM). As shown in Figure 3-2, the Site is located, in an area designated as Palgrave Estate Residential Community land use area within Oak Ridges Moraine Conservation Plan area (a component of Countryside Area), where residential development is permitted.

## 4.0 ENVIRONMENTAL FEATURES

To assess the natural environmental features, the databases maintained by the Ministry of Natural Resources and Forestry (MNR), the Ministry of Environment, Conservation and Parks (MECP), Nottawasaga Valley Conservation Authority (NVCA) and Toronto and Region Conservation Authority (TRCA) were reviewed. As shown on Figure 4-1, no wetland, provincial parks, reserve area or area of natural heritage and scientific interest (ANSI) was found on or near the Property. However, the following features have been identified.

- 1) The Property is located in Oak Ridges Moraines (ORM) area. The ORM is an irregularly shaped geologic feature, formed from glacial sand and gravel deposition and is classified as Significant Recharge Area due to the presence of coarse-grained sand and gravel deposits with layers of silty clay to clayey silt till, protecting the water supply aquifers. The Site, however, as shown in Figure 3-2, is located in Palgrave Estate Residential Community land use area, where residential development is permitted.
- 2) The majority of the Site is located in Nottawasaga Valley Watershed, in Innisfil Creek subwatershed. A very small portion near the southwest property boundary is located in Humber River Watershed under the jurisdiction of Toronto and Region Conservation Authority (TRCA). As shown on Figure 4-1, unnamed creeks or tributaries are located crossing the middle of the property. As a result, part of the Site is located in NVCA regulated areas, which is shown on Figure 4-2.
- 3) As shown on Figure 4-3, the Site is located in an area identified as Significant Groundwater Recharge Areas (SGRAs). SGRAs are geographic areas within which it is desirable to regulate or monitor drinking water threats that may affect the recharge to an aquifer. SGRAs are the areas where the recharge is 15% greater than the average recharge across the study area.
- 4) As shown on Figure 4-4, the whole property of the Site is located in the wellhead protection area (WHPA) -D, (25 year time of travel) and part of the property is located in WHPA-C (5 year time of travel) for the Palgrave municipal system, with a vulnerability score of 2~6 out of 10. A wellhead protection area is the area around the wellhead where land use activities have the potential to affect the quality of water that flows into the well.
- 5) A small portion of the Property (shown on Figure 4-3) along east side of Mount Hope Road is located in an area identified as a highly vulnerable aquifer (HVA). HVA is one that is particularly

susceptible to contamination because of either its location near the ground's surface or because of the type of materials found in the ground around it.

## **5.0 PHYSICAL SETTING**

### **5.1 Topography and Drainage**

As shown in Figure 5-1, the topography of the Site ranges in elevation generally between 290 mASL and 310 mASL, mostly around 300 mASL in the southwest of the Property. An unnamed creek crossing from the northwest to the southeast divides the property in two (2) parts.

The Site is almost entirely located within the Nottawasaga Valley Watershed which has nine (9) subwatersheds. The Innisfil Creek subwatershed is one of the nine (9) subwatersheds, and consists of four main creek systems, namely Innisfil Creek, Bailey Creek, Beeton Creek and Penville Creek that drain the southeast portion of the Nottawasaga River watershed. The Subject Property falls within the Beeton Creek system.

Beeton Creek arises on the Oak Ridges Moraine south of Tottenham. Flowing north, the creek enters a reservoir at the Tottenham Conservation Area and then continues downstream. An east branch, originating east of Tottenham, flows westward through agricultural lands and enters Beeton Creek north of Tottenham. Beeton Creek continues to flow northward through an agricultural landscape, skirting the west side of Beeton before joining Bailey Creek and then entering Innisfil Creek.

As shown in Figures 3-1 and 5-1, the unnamed tributary flows southeasterly and joins into a main tributary of Beeton Creek, which flows northwards and joins into Innisfil Creek.

### **5.2 Physiography**

The Nottawasaga Valley Watershed is located within five (5) main regional-scale physiographic regions as defined by Chapman and Putnam (1984). These regions include the Horseshoe Moraines, Oak Ridges Moraine, Peterborough Drumlin Field, Schomberg Clay Plains and Simcoe Lowlands (Figure 5-2).

The Subject Property lies within the physiographic region termed as Oak Ridges Moraine. The Oak Ridges Moraine is comprised of rolling sandy hills, hummocky topography and closed depressions that form the source of the headwaters to major stream that drain off the moraine. The moraine within the subwatershed consists primarily of surficial sand and gravel deposits.



### **5.3 Overburden**

As shown in Figure 5-3, the Subject Property is located in an area covered with ice-contact stratified deposits, which generally consist of gravel and sand deposits, with minor till, and also contain esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits.

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 and beneath the ORM). The overburden thickness within the Oak Ridges Moraine (ORM) ranges from approximately 56 m to 240 m.

### **5.4 Bedrock**

The bedrock consists of shale, interbedded dolomitic siltstone, and minor limestone, which were deposited in shallow seas about 450 million years ago. These beds, named the Georgian Bay Formation are approximately 250 m thick and dip to the southeast at about 5 m/km. Following long periods of additional sedimentation and erosion, the ancient Laurentian River and its tributaries cut several deep, poorly-defined bedrock valleys trending northwest-southeast across the area. As depicted in Figure 5-4, the study area is underlain by the Georgian Bay Formation, which has an important influence on drift thickness and groundwater distribution in the study area.

## **6.0 HYDROGEOLOGY**

The regional hydrogeological conditions were assessed using the data obtained from the MECP water well database including domestic water wells and municipal water wells.

### **6.1 Private Water Wells**

As shown in Figure 6-1, a total of thirty (30) water wells have been found within a 500 m radius around the property. One (1) record for an abandoned well is found on Site.

Based on the well records, bedrock was encountered at three (3) wells (#4906507, #4906507 and #4906507) at the depth of 74.1 ~ 74.4 mbgs, indicating presence of thick overburden sediment at and/or near the Site. In addition, layers of sand and/gravel were recorded, where the well screens were installed. The recorded water levels ranged from approximately 14 mbgs to 26 mbgs. Therefore, several aquifers may be present in the overburden deposits.

## **6.2 Palgrave Municipal Water Supply Wells**

The Palgrave community is being serviced by Palgrave municipal supply wells #2, #3 and #4. The Subject Property is situated within a wellhead protection zone, which is associated with the municipal supply well Palgrave Well#3.

Palgrave Well#3 is located about 220 m southeast of the Site, on the northeast side of Mount Hope Road, in Caledon, Ontario. Geologically, Palgrave Well#3 is located near the edge of a local bedrock valley and is overlain by about 80 m thick overburden of Oak Ridges Moraine Aquifer Complex (ORMAC) stratified sediments. This sequence consists (from surface downward) of about four metres of sand and gravel, about 35 m of silt and clay with minor sand, about 25 m of gravelly sand and silty sand, a silt and clay unit about five metres thick, and finally, about 10 m of gravelly sand where the well is screened (Earthfx, May 2007).

Based on MECP water well record, Palgrave Well#3 was found to have a well ID of #4906859, and was drilled to the depth of approximately 82.3 mbgs into (sandy) clay, and screened between 71.3 mbgs and 80.5 mbgs in (gravelly) sand. The static water level was recorded to be 15.1 mbgs.

Based on the above findings, it can be inferred that layers of a significant thickness of unconsolidated overburden is present in the site area, and multiple sandy or gravelly soils can serve as the aquifer for water supply. However, it is more common that the deeper aquifer is selected for the water supply aquifer, probably because of having a thicker and better protection from the potential contamination.

## **7.0 FIELD WORK METHODOLOGY**

### **7.1 Borehole Drilling and Monitoring Well Installation**

As part of geotechnical investigation, a total of ten (10) boreholes (BH1 to BH10) were drilled on October 18 and 19, 2018, to depths ranging from 9.2 mbgs to 9.7 mbgs. Five (5) monitoring wells identified as BH/MW1, MW/BH3, MW/BH6, MW/BH9 & MW/BH10B) were installed at five (5) locations for subsequent groundwater monitoring and testing.

Boreholes were drilled with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SIRATI personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SIRATI laboratory for detailed examination by the project engineer and for laboratory testing.

Due to the completed dry wells, three (3) additional monitoring wells (BH/MW19-1 to BH/MW19-3) were installed on August 23, 2019 to depths ranging from 9.1 mbgs to 18.3 mbgs. Again, two (2) monitoring wells BH/MW19-1 and BH/MW19-3 were found dry. Therefore, two additional monitoring wells (BH/MW19-1A and BH/MW19-3A) were completed at these two (2) locations, during October 10 and 11, 2019.

The elevations at the borehole locations were surveyed by the SIRATI personnel using a differential GPS system. The approximate borehole/monitoring well locations are shown on Figure 7-1. The borehole logs are provided in Appendix B.

The construction details for the monitoring wells are presented in Table 7-1 below.

**Table 7-1: Well Construction Details**

<b>Monitoring Well</b>	<b>Borehole Depth (mbgs)</b>	<b>Screen Depth (mbgs)</b>	<b>Screened Soil Type</b>
BH/MW1	9.2	4.0 ~ 7.2	Sand; Gravelly Sand
BH/MW3	9.3	3 ~ 6.0	Sand
BH/MW6	9.7	3 ~ 6.0	Sand
BH/MW9	9.7	4.6 ~ 7.6	Gravelly Sand
BH/MW10B	9.7	3 ~ 6.0	Sand
BH/MW19-1	18.3	10.7 ~ 13.7	Sand; Sand and Gravel
BH/MW19-1A	16.8	13.8 ~ 16.8	Sand
BH/MW19-2	9.1	6.1 ~ 9.1	Sand
BH/MW19-3	14	11 ~ 14	Sand
BH/MW19-3A	16.8	13.4 ~ 16.5	Likely Sand

## 7.2 Groundwater Monitoring and Elevation Survey

After the well installation, groundwater levels were measured in the existing and new monitoring wells. In addition, the location and elevation survey were conducted using a GPS unit on the monitoring wells installed at the Site.

## 7.3 Hydraulic Conductivity Test (Single Well Response Test/Slug Test)

In-situ hydraulic conductivity tests, also called as single well response test or slug test, were conducted on October 8 and 21, 2019 in three (3) monitoring wells (BH/MW19-1A, BH/MW19-2 and BH/MW19-3A). Prior to the test, initial water levels were measured. Then, a datalogger was placed in each of the test wells to record the initial water pressure. To start the test, a certain amount of water was pumped out from a test well using a Waterra pump (Waterra tubing with a foot valve) for a rising head test or introduced into the test well for a falling head test, and the recovery of the water level was recorded by the datalogger. The recorded data was then used for estimating the hydraulic conductivity of the screened soil.

## 8.0 SUMMARIZED SITE CONDITIONS

### 8.1 Soil Stratigraphy

The soil stratigraphy of the Site as revealed in the boreholes generally consisted of topsoil and fill materials, underlain by native soils predominantly comprised of cohesionless soils, locally with cohesive soils. No bedrock was encountered at the maximum explored depth of 18.3 mbgs. A summary of the encountered soils is made as follows.

**Topsoil:** A 300 mm to 450 mm thick surficial layer of topsoil was found at all borehole locations except BH4, BH19-1/1A, BH19-2 and BH19-3/3A. The thickness of the topsoil in each borehole is shown in the respective borehole logs. It should be noted that the thickness of the topsoil observed at the borehole locations may not be representative for the entire site and should not be relied on to calculate the amount of topsoil that need to be stripped from the Site.

**Fill Material/Possible Fill:** Below the topsoil, where present, a zone of earth fill/disturbed native material was encountered in all boreholes. The fill layer was found extending to depths varying between 0.2 m (BH19-1/1A) and 3 m (BH6) below the existing ground surface. The fill material mainly consisted of silty sand, sandy silt and sand, with trace to some topsoil inclusion at some borehole locations. The composition of the weathered/disturbed sand was generally similar to that of the underlying undisturbed native soils.

**Cohesionless Layers:** Cohesionless layers of silt, sandy silt, silty sand, sand, gravelly sand, and sand and gravel were encountered in all borehole locations. The native cohesionless layers were encountered at different depths ranging from 0.2 m to 3.0 m below the existing ground surface and extended to the termination depth at all borehole locations.

**Cohesive Layer:** A thin cohesive layer of clayey silt was observed locally in BH5, extending from 1.5 m to 2.3 m depth.

Grain size analysis and Atterberg limits tests of a representative sample from this stratum (B5/SS3) was conducted and the results are presented in Figures 12 and 14, with the following fractions:

Clay: 27%  
Silt: 54%  
Sand: 17%  
Gravel: 2%

The details of the soil stratigraphy are presented in Borehole Logs in Appendix B. In addition, one (1) cross section (as shown on Figure 8-1) was constructed to illustrate the horizontal and vertical extents of the soil and groundwater conditions.

## **8.2 Groundwater Conditions**

Groundwater conditions were observed during the borehole drilling. Wet soils were observed at BH7, BH19-1, BH19-1A and BH19-2 at the depths from 3 mbgs to 15.3 mbgs.

### **8.2.1 Groundwater Levels and Elevations**

Groundwater monitoring was conducted in the monitoring wells installed at the Site on November 1 and 27, 2018, April 10, 2019, August 30, 2019, September 5, October 8, October 18, and October 21, 2019. Dry wells were noted during the groundwater monitoring in all the monitoring events at BH/MW1, BH/MW3, BH/MW10B. The groundwater levels measured in October 2019 are presented in Table 8-1 below.

**Table 8-1: Historical Recorded/Measured Groundwater Levels**

Monitoring Well	Ground Elevation (mASL)	Screen Depth (mbgs)	Depth to Ground water (mbgs)	Ground water Elevation (mASL)	Depth to Ground water (mbgs)	Ground water Elevation (mASL)	Depth to Ground water (mbgs)	Ground water Elevation (mASL)
			October 8, 2017		October 18, 2019		October 21, 2019	
BH/MW1	298.92	4.0 ~ 7.2	dry	dry	dry	dry	dry	dry
BH/MW3	297.75	3 ~ 6.0	dry	dry	dry	dry	dry	dry
BH/MW6	299.93	3 ~ 6.0	dry	dry	dry	dry	dry	dry
BH/MW9	298.19	4.6 ~ 7.6	dry	dry	dry	dry	dry	dry
BH/MW10B	295.67	3 ~ 6.0	dry	dry	dry	dry	dry	dry
BH/MW19-1	299.05	10.7 ~ 13.7	12.98	286.07	-	-	-	-
BH/MW19-1A	299.05	13.8 ~ 16.8	-	-	14.84	284.21	14.85	284.20
BH/MW19-2	298.17	6.1 ~ 9.1	6.33	291.84	6.53	291.64	6.52	291.65
BH/MW19-3	298.24	11 ~ 14	Dry	dry	-	-	-	-
BH/MW19-3A	298.24	13.4 ~ 16.5	-	-	14.45	283.79	14.44	283.80

As presented above, the measured groundwater levels ranged from 6.33 mbgs at BH/MW19-2 to 14.85 mbgs at BH/MW19-1A, and elevations ranged from 283.79 mASL at BH/MW19-3A to 291.65 mASL at BH/MW19-3A.

### 8.2.2 Groundwater Flow Direction and Hydraulic Gradients

Based on the groundwater elevation data obtained on October 21, 2019, a site-specific groundwater elevation contour map was prepared to present the inferred the groundwater flow direction. As shown in Figure 8-2, the groundwater flow direction was inferred to be generally northerly.

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. The horizontal hydraulic gradients across the development area were calculated to assess the general slope of the groundwater flow path. Accordingly, the average gradient across the Site was calculated at 0.012 m/m.

**Table 8-2: Horizontal Hydraulic Gradients – 17791 Mt. Hope Road, Caledon, Ontario**

Monitoring Well	Groundwater Elevation (mASL)		Distance Between Monitors (m)	Gradient (m/m)
BH19-1A to BH19-2	284.20	291.65	343	0.021
BH19-2 to BH19-3A	291.65	283.80	505	0.015
BH19-1A to BH19-3A	284.20	283.80	477	0.001
<b>AVERAGE</b>				<b>0.012</b>

### 8.3 Estimated Hydraulic Conductivity

The hydraulic conductivity (K-value) of the soils was estimated based on the results obtained from the single well response tests (slug tests).

The data was processed utilizing Aqtesolv pumping test software with the Hvorslev method. Records of the slug tests and the data processing are provided in Appendix C. The results of the estimated hydraulic conductivity are summarized in Table 8-3.

**Table 8-3: Results of Estimated Hydraulic Conductivity as per Slug Tests**

Borehole/Monitoring Well	Hydraulic Conductivity (m/s)	Screened Soil Type
BH19-1A	$3.83 \times 10^{-5}$	Sand, some silt, trace clay
BH19-2	$3.29 \times 10^{-7}$	Sand, some clay
BH19-3A	$1.23 \times 10^{-4}$	Sand
<b>Average</b>	<b><math>1.15 \times 10^{-5}</math></b>	

As presented above, the estimated hydraulic conductivity ranged from  $3.29 \times 10^{-7}$  m/s to  $1.23 \times 10^{-4}$  m/s, with a geometric average value of  $1.15 \times 10^{-5}$  m/s.

## 9.0 CONSTRUCTION DEWATERING REQUIREMENTS

Dewatering during the construction is intended to lower the groundwater levels in the excavation area in order to ensure a dry working condition. If groundwater levels are shallow, groundwater control such as using weeping tiles and foundation drainage system will also be considered to avoid hydrostatic pressure of shallow groundwater on the footing walls as well as to achieve a dry condition for the underground levels.

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.

Based on the latest grading plan in Appendix A, the lowest point of the finished road way is 296.7 mASL. Assuming that the finished ground floor elevation of the buildings will match the roadway elevation and the proposed residential houses will have one-level basement about 3 m below the ground floor, the lowest elevation of the basement will be at 293.7 mASL.

According to the groundwater monitoring, the measured groundwater elevations ranged from 283.79 mASL to 291.65 mASL, which is below the basement level. Therefore, there will be no requirements for construction dewatering either temporary dewatering or long-term drainage/dewatering.

## **10.0 ASSESSMENT OF IMPACTS DUE TO SITE DEVELOPMENT**

### **10.1 Private and Public Water Wells**

As discussed, no dewatering will be required during and after the construction. Therefore, there will be no impact on water wells located near the Site, since the existing water wells were screened or constructed much below the excavation level of the proposed development.

### **10.2 Ephemeral Creek or Open Water Body**

Based on review of the data and observation, no open water body was found to be present on the Property. The water course noted in the central portion of the Site was found to be ephemeral without a well-defined water channel or water flow.

Based on the site development grading plan, a setback from the existing channel has been proposed and the existing grading will remain undisturbed or any grading disturbance will be limited to proposed road areas and around the proposed housed. Therefore, the impact, if any, on the ephemeral creek will be very minor.

### **10.3 Well Head Protection Area (WHPA)**

As no dewatering will be anticipated, there should be no quantitative impact on the use of the municipal well – Palgrave Well#3.



However, it is known that the Site lies within the Palgrave municipal supply well No. 3 wellhead protection area (WHPA). As shown on Figures 4-4, most part of the Site is located within the WHPA-D (5 to 25-year time of travel zone), an area with a vulnerability score of 2 to 4 (low to medium score), while some part lies within WHPA-C (2 to 5-year time of travel zone), with a vulnerability score of 4 to 6. WHPA-C is DNPL/ Contaminant Protection Zone.

From the qualitative aspect, if the best construction and management practices are to be implemented, there would be no contamination during and after the development on the Property, and therefore, the impacts will be considered to be minimal to minor.

#### **10.4 Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer (HVA)**

Based on the NVCA database, the Property is located within a Significant Groundwater Recharge Area (SGRA), and part of Property is situated within the area with Highly Vulnerable Aquifer (Figure 4-3).

It is anticipated that the excavation for construction of the basement will extend to the depth about three (3) metres below the ground surface, which is very shallow as compared to the phreatic water table elevation and depth of the potential local aquifers.

However, the development may increase the impervious surface, which will result in the decrease in the filtration or the recharge of the groundwater. In addition, application of de-icing salt on the roadways in winter seasons for traffic safety purpose or other activities which involve potential contaminants may be an environmental concern related to the quality of recharge water.

### **11.0 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.

#### **11.1 Site Condition**

The Site is currently undeveloped with no structures or paved areas. It is understood that the Site has a total area of approximately 41 hectares.

Based on the design information, the site development area can be generally categorized into two (2) major types as Impervious Area (including roof and paved area) and Pervious Area (landscape and/or vegetated area). The details of the areas are shown on Figures 11-1 and 11-2, and summarized in Table 11-1.

**Table 11-1 Pre-and Post-development Site Statistics**

Type of Land Coverage		Pre-Development Area (m <sup>2</sup> )	Post- Development Area (m <sup>2</sup> )
Impervious Area	Roofs	-	5000
	Roadway/Paving/Parking	-	15000
Pervious Area	Landscape/Vegetated Area	410,000	390000
	<b>Total</b>	<b>410,000</b>	<b>410,000</b>

## 11.2 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 ( $\Delta S$ ).

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)

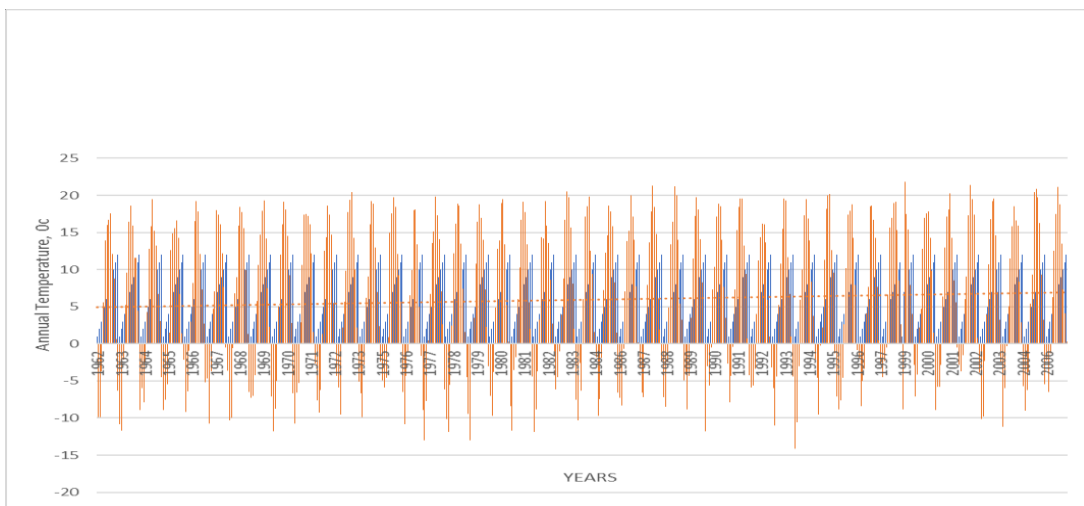
I = Infiltration (mm/year)

$\Delta S$  = Change in groundwater storage (taken as zero) (mm/year)

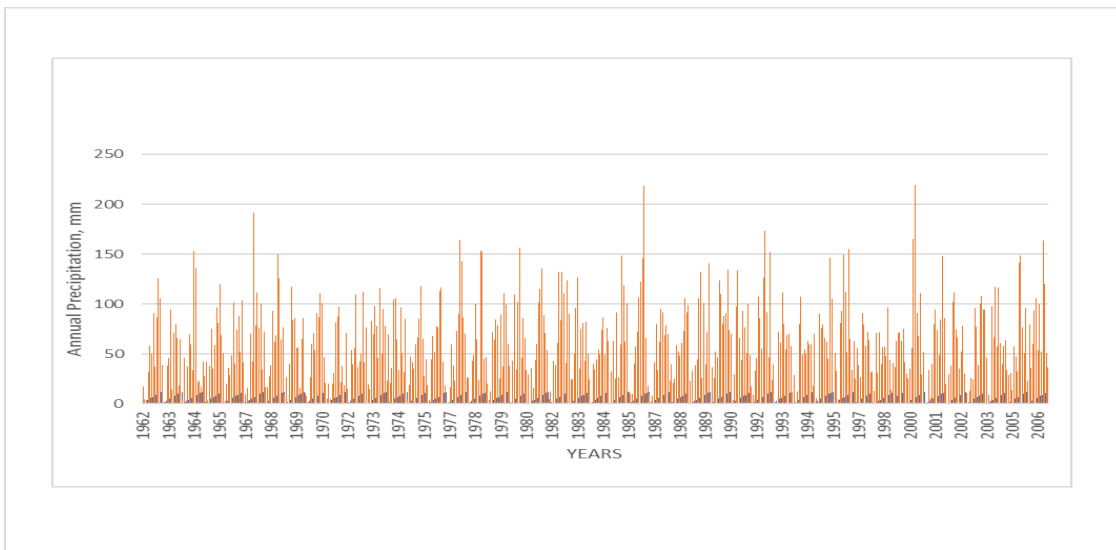
### 11.3 Climatic Data

The climatic data including monthly average temperature and precipitation were obtained from Environment Canada, for Orangeville WPCP station (climate identifier: 6155790) as the nearest station located at about 8 km distance from the Site.

The data was available for the years from 1962 to 2006. Temporal variations of annual temperature and precipitation are shown in Figures 11-3 and 11-4.

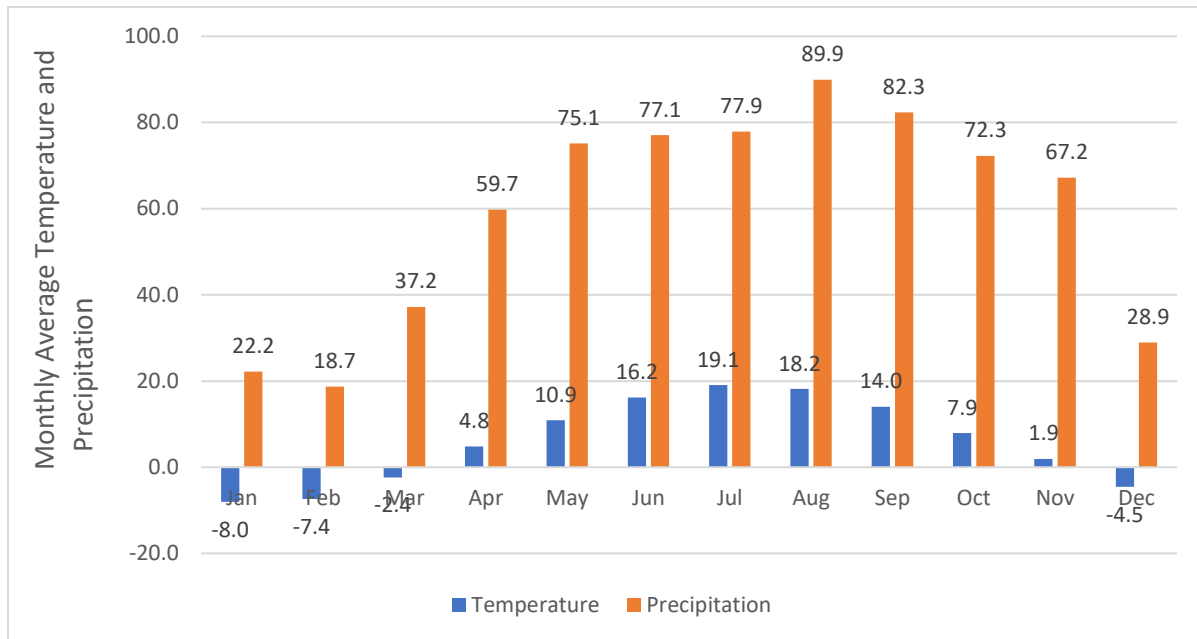


**Figure 11-3 Mean Annual Temperature at the Site**



**Figure 11-4 Mean Annual Precipitation at the Site**

Average monthly variations of both temperature and precipitation were calculated for the period from 1962 to 2006 and is presented below in Figure 11-5. The highest temperature was recorded in the month of July, while the highest rainfall was in the month of August.



**Figure 11-5 Average Monthly Temperature at the Site**

Based on the data for the precipitation and temperature, actual evapotranspiration was estimated to be about 482 mm/annum using the USGS Thornthwaite Monthly Water Balance software (Appendix D), and the average annual precipitation was recorded to be 901 mm/annum.

#### 11.4 Infiltration and Runoff

As mentioned above, the actual evapotranspiration was estimated to be 482 mm/annum. Given the average annual precipitation of 901 mm/annum, there is a water surplus of 419 (=901-482) 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 few 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 11-2 to 11-5, below.

**Table 11-2: Annual Pre-Development Water Balance**

Land Use		Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-off (m <sup>3</sup> )
Impervious	Paved Area	0	0	0	0	0
	Roof Area	0	0	0	0	0
Pervious	Landscape Area	410000	369410	197620	103074	68716
<b>Total</b>		<b>410000</b>	<b>369410</b>	<b>197620</b>	<b>103074</b>	<b>68716</b>
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

**Table 11-3: Annual Post-Development Water Balance**

Land Use		Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-off (m <sup>3</sup> )
Impervious	Paved Area	15000	13515	1352	0	12164
	Roof Area	5000	4505	451	0	4055
Pervious	Landscape Area	390000	351390	187980	98046	65364
<b>Total</b>		<b>410000</b>	<b>369410</b>	<b>189782</b>	<b>98046</b>	<b>81582</b>
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

**Table 11-4: Comparison of Pre- and Post Development Water Balance Components.**

	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-off (m <sup>3</sup> )
Pre-Development	<b>369410</b>	<b>197620</b>	<b>103074</b>	<b>68716</b>
Post-Development	<b>369410</b>	<b>189782</b>	<b>98046</b>	<b>81582</b>
Change in Volume			<b>5028</b>	<b>12866</b>
Change in Percentage (%)			<b>-5</b>	<b>19</b>

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

Volume of Pre-Development Infiltration (m <sup>3</sup> )	<b>103074</b>
Volume of Post-Development Infiltration (m <sup>3</sup> )	<b>98046</b>
Deficit from Pre to Post Development Infiltration (m <sup>3</sup> )	<b>5028</b>
Percentage of Roof Runoff required to match the pre-development infiltration (%)	<b>124</b>

## 11.5 Summary of Water Balance Calculation

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

- 1) Without implementation of mitigation measures, there is a net increase in run-off at the Site of about 12,866 m<sup>3</sup>/annum (or 19% increase), from 68,716 m<sup>3</sup>/annum to 81,582 m<sup>3</sup>/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 5,028 m<sup>3</sup> /annum (or 5 % decrease) in the post-development infiltration from 103,074 m<sup>3</sup> to 98,046 m<sup>3</sup> on a yearly basis.
- 3) There is a volume of 4,055 m<sup>3</sup>/annum collected from the roof area, which can be used for the enhanced infiltration for the purpose of implementing the Low Impact Development (LID) measures. However, it is not enough to compensate for the deficit in infiltration.

## 12.0 CONCLUSIONS AND RECOMMENDATIONS

This report was prepared by SIRATI in support of a proposed residential development at the Site located at 17791 Mount Hope Road, Town of Caledon, Ontario. Based on the hydrogeological investigation conducted on the Site, the following conclusions are presented:

- The Site geographically falls within the Innisfil Creek subwatershed under the jurisdiction of Nottawasaga Valley Conservation Authority (NVCA).
- As per the Oak Ridges Moraine Conservation Plan, 2017, the Subject Property falls within the Palgrave Estate Residential Community (a component of Countryside Area) land use designation area.
- The Site lies within the physiographic region termed as Oak Ridges Moraine, and is located in an area characterized by coarse-grained ice-contact glaciolacustrine sediments consisting of sand, gravelly sand and gravel.

- The Site is located within the Palgrave municipal supply well No. 3 wellhead protection area, within a Significant Groundwater Recharge Area (SGRA) and partly in a Highly Vulnerable Aquifer (HVA) area.
- The soil stratigraphy of the Site as revealed in the boreholes generally consisted of topsoil and fill materials, underlain by native soils predominantly comprised of cohesionless soils, locally with cohesive soils. No bedrock was encountered at the maximum explored depth of 18.3 mbgs.
- The groundwater levels measured in the monitoring wells at the Site ranged from 6.33 mbgs to 14.85 mbgs and elevations ranged from 283.79 mASL to 291.65 mASL. The groundwater flow was inferred to be generally in a northerly direction.
- The hydraulic conductivity estimated for the screened soils ranged from  $1.23 \times 10^{-4}$  m/s to  $3.28 \times 10^{-7}$  m/s, with a geometric average value of  $1.15 \times 10^{-5}$  m/s, which is in the typical range of hydraulic conductivity for sand and gravelly sand, as observed in the boreholes.
- Given the relatively deep groundwater levels found at the Site, construction dewatering (short-term or long-term) will not be required for the proposed development.
- A preliminary water balance assessment indicated that an infiltration deficit of approximately 5,028 m<sup>3</sup>/annum (about 13 m<sup>3</sup> /day) will occur due to the proposed development.

Based on the findings of this hydrogeological investigation, the following measures would be considered and recommended to protect and preserve the SGRAs and HVAs,

- Incompatible land uses such as storage of chemicals and/or liquids should be avoided and directed away from the SGRAs.
- Since the proposed development is a major development (> 500 m<sup>2</sup>) within the SGRAs, an Infiltration Management Plan that demonstrates pre-development recharge rates will be maintained, may be a requirement.
- Low-impact development (LID) measures would be designed and implemented to maintain or improve the post-development infiltration and/or groundwater recharge conditions. The measures may include, but are not limited to the following:
  - Use of infiltration trenches or bio-swales at selected areas to maximize the infiltration.
  - Provision of pervious road or parking areas to enhance infiltration.

- Provision of an extra thickness of topsoil at the Site (approximately 0.3 m) on open areas to promote water storage in surficial soil and infiltration.
- Provision of gradual slopes to open areas and back-yards in order to allow extra time for surficial run-off to infiltrate into the topsoil.
- It would be necessary to promote awareness of the importance of SGRAs and HVAs by means of sign boards explaining the linkage between surface activities and their impact on groundwater quality and quantity.
- A salt management plan may be considered to be developed and implemented.
- As the Subject Lands fall within the areas of high aquifer vulnerability, the following uses are prohibited with respect to land in Areas of High Aquifer Vulnerability.
  - Generation and storage of hazardous waste or liquid industrial waste;
  - Waste disposal sites and facilities, organic soil conditioning sites, and snow storage and disposal facilities;
  - Underground and above-ground storage tanks that are not equipped with an approved secondary containment device; and,
  - Storage of a contaminant listed in Schedule 3 (Severely Toxic Contaminants) to Regulation 347 of the Revised Regulations of Ontario, 1990.



### **13.0 SELECTED BIBLIOGRAPHY**

Construction Dewatering and Groundwater Control: New Methods and Applications, Third Edition. J. P. Powers, A. B. Corwin, Paul C. Schmall and W. E. Kaeck Copy Right © 2007 John Wiley & Sons, Inc. ISBN: 978-0-471-47943-7

Freeze, R. A. and Cherry, J. A., 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey

Groundwater Lowering In Construction: A Practical Guide To Dewatering. 2<sup>nd</sup> Edition. Boca Raton: CRC Press, 2013. Print.

Ministry of Natural Resources, Ontario Geologic Survey, 1984, The Physiography of Southern Ontario, Third Edition, L. J. Chapman and D. F. Putnam

Ontario Geological Survey, Industrial Minerals Report 38, by D.F. Hewitt, S.E. Yundt, 1971

Ontario Geologic Survey, Preliminary Map P 2204, Quaternary Geology of Toronto and Surrounding Area, Sharp D.R., 1980.

Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997, SG-6 Percolation Time and Soil Descriptions, Toronto, Ontario.

Sirati & Partners Consultants Ltd., Report on Preliminary Geotechnical Investigation, Proposed Residential Subdivision, Mount Hope Road, Caledon, Ontario, December 06, 2018 (SP18-334-10).

## 14.0 LIMITATIONS AND USE OF THE REPORT

This report was produced for the sole use of Palgrave Development Inc. c/o Mr. Joe Triumbari (the Client) for the property located at 17791 Mount Hope Road, Town of Caledon, Ontario and may not be relied upon by any other person or entity without the written authorization of Sirati & Partners Consultants Limited (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.

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 Limited**

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

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

# FIGURES



Source: Google Earth Map

# 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:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Site Location Plan

Scale:

As Shown

Project Number:

SP18-334-00

Date:

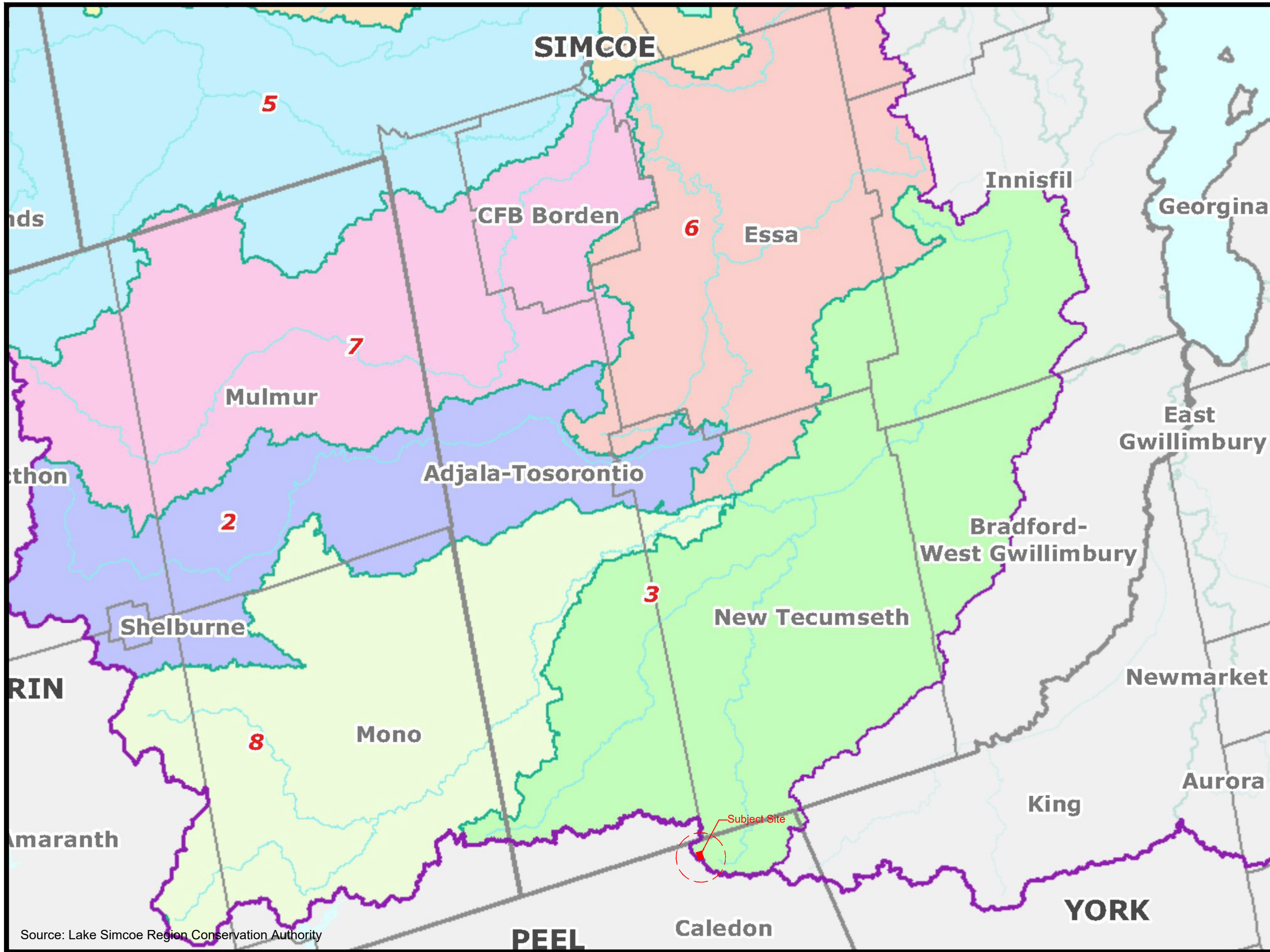
November 2019

Figure Number:

1-1



Palgrave Park



Source: Lake Simcoe Region Conservation Authority

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

North:



Legend:



Subject Site



Approximate Site Location

- 1, Blue Mountains W.
- 2, Boyne R.
- 3, Innisfil Cr.
- 4, Lower Nottawasaga R.
- 5, Mad R.
- 6, Middle Nottawasaga R.
- 7, Pine R.
- 8, Upper Nottawasaga R.
- 9, Willow Cr.
- SWP Watershed Region
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tiers Municipality
- Subwatershed Boundary
- Water Body
- Main Water Courses

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Innisfil Subwatershed Location Map

Scale:

N.T.S.

Project Number:

SP18-334-00

Date:

November 2019

Figure Number:

3-1



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North:



### Legend:

■ Subject Site

Legend	
	Oak Ridges Moraine Conservation Plan Area <small>• Boundary of Oak Ridges Moraine Conservation Plan Area            Ontario Regulation 140/02            • Boundary of Oak Ridges Moraine Area            Ontario Regulation D1.02</small>
	Natural Core Area
	Natural Linkage Area
	Countryside Area
	Rural Settlement <small>(a component of Countryside Area)</small>
	Palgrave Estates Residential Community <small>(a component of Countryside Area)</small>
	Settlement Area
	Upper and Single-Tier Municipal Boundaries
	Lower-Tier Municipal Boundaries
	Road or Highway
	First Nations
	Niagara Escarpment Plan Boundary

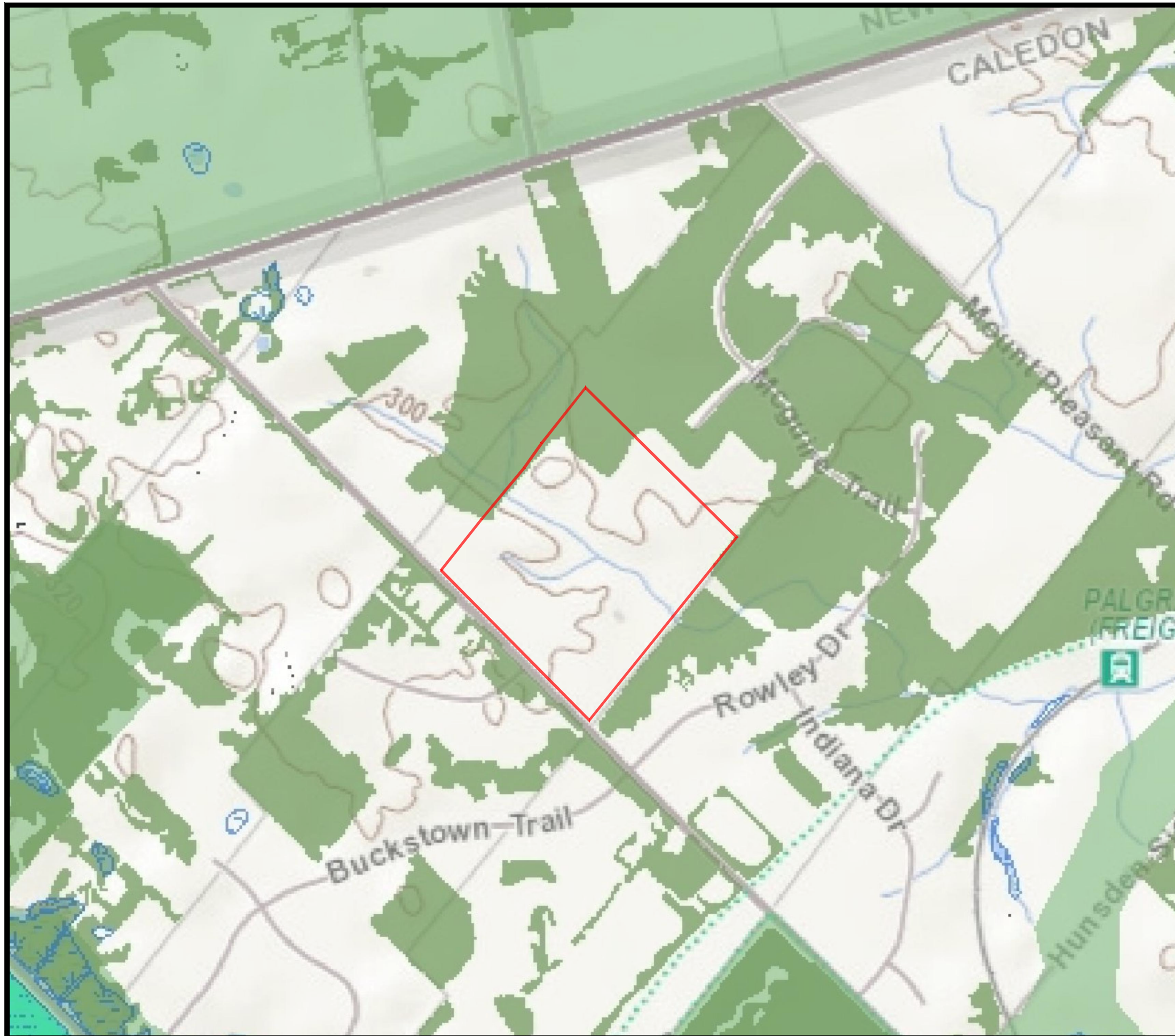
**Project Title:**  
 Hydrogeological Investigation

**Site Location:**  
 17791 Mount Hope Road, Caledon, ON

**Figure Title:**  
 Land Use Designation Map  
 Oak Ridges Moraine Conservation Plan

<b>Scale:</b> As Shown	<b>Project Number:</b> SP18-334-00
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<b>Date:</b> November 2019	<b>Figure Number:</b> 3-2
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### 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
- River Valley Connections

#### Land Use Designations

- Protected Countryside
- Towns and Villages
- Hamlets
- Urban River Valley
- 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:**

- Subject Site

**Project Title:**  
Hydrogeological Investigation

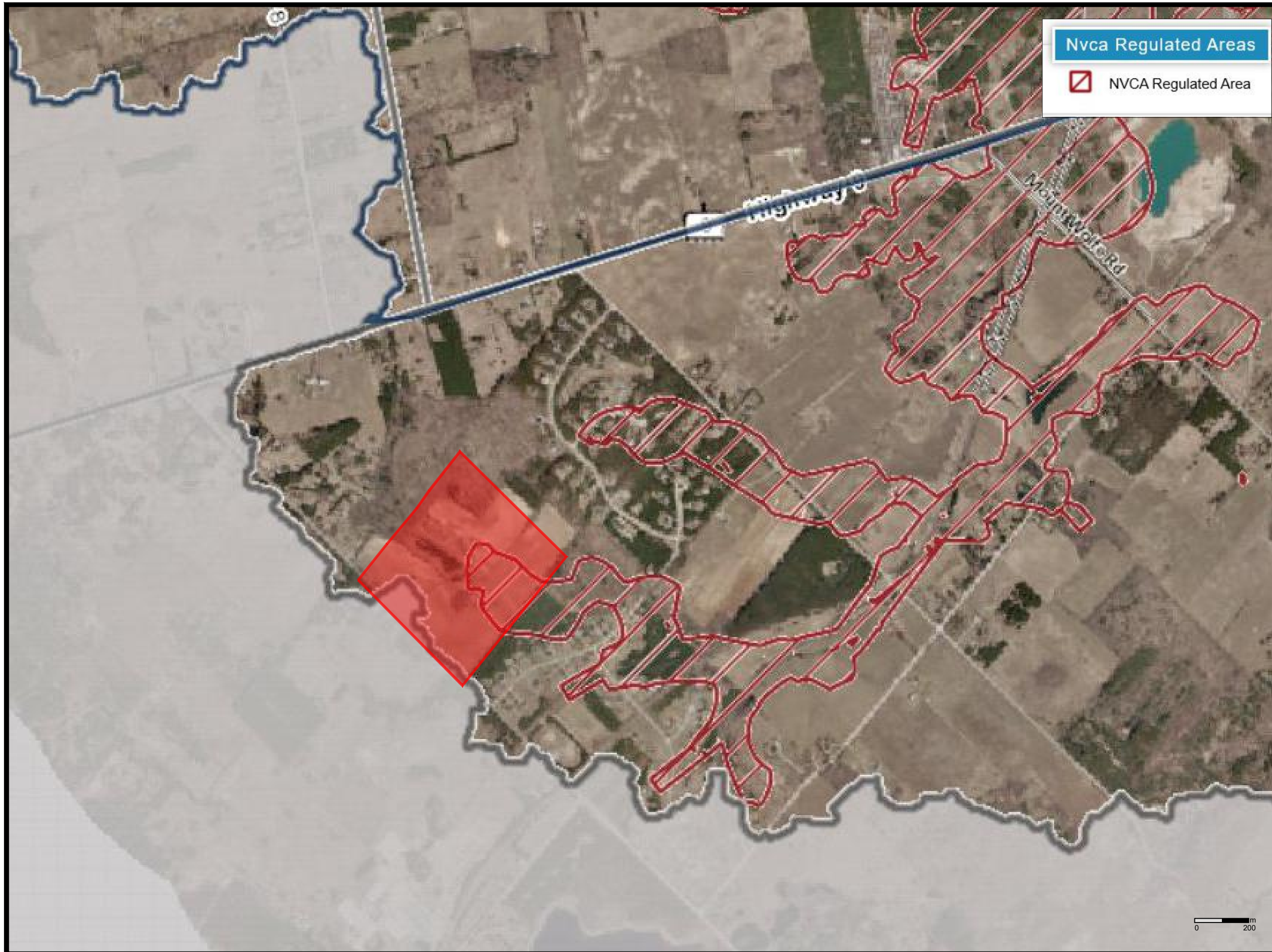
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17791 Mount Hope Road, Caledon, ON

**Figure Title:**  
Natural Features Area Map

**Scale:** As Shown  
**Project Number:** SP18-334-00

**Date:** November 2019  
**Figure Number:** 4-1






**Nvca Regulated Areas**

 NVCA Regulated Area

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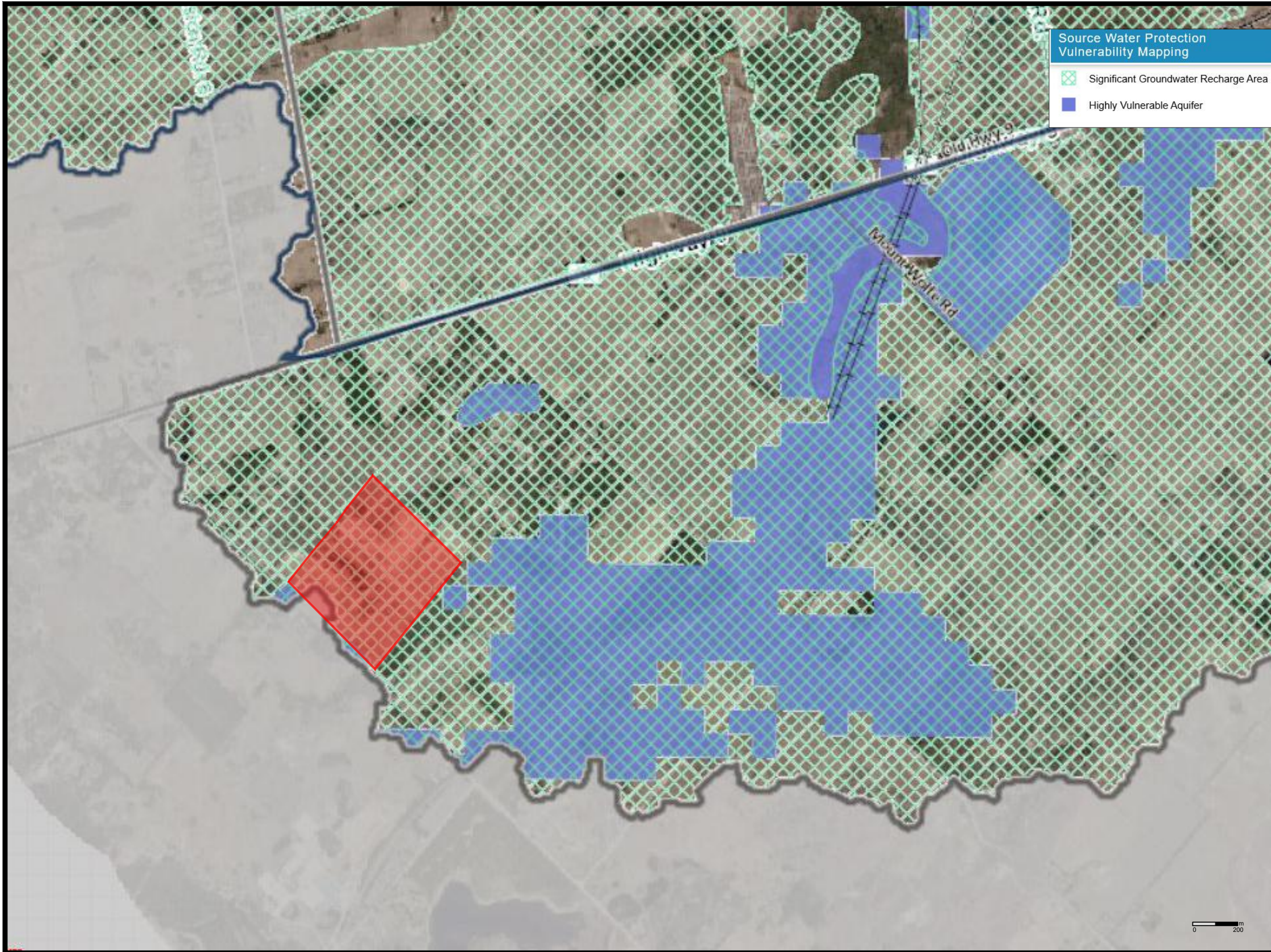
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Hydrogeological Investigation

**Site Location:**  
17791 Mount Hope Road, Caledon, ON



**Figure Title:**  
NVCA Regulated Areas Map

<b>Scale:</b> As Shown	<b>Project Number:</b> SP18-334-00
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<b>Date:</b> November 2019	<b>Figure Number:</b> 4-2
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**Source Water Protection  
Vulnerability Mapping**

-  Significant Groundwater Recharge Area
-  Highly Vulnerable Aquifer

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**Legend:**

-  Subject Site

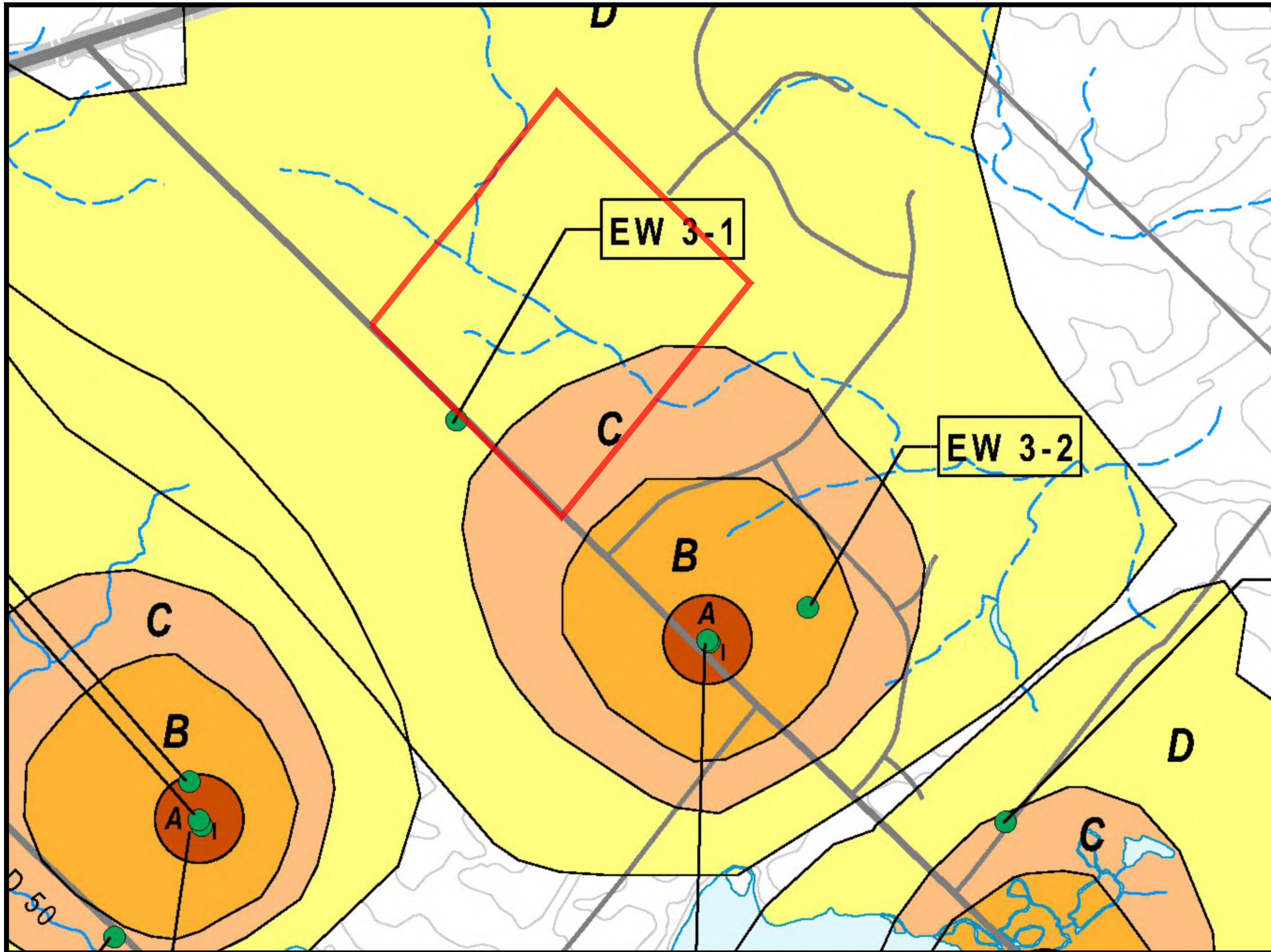
**Project Title:**  
Hydrogeological Investigation

**Site Location:**  
17791 Mount Hope Road, Caledon, ON

**Figure Title:**  
SGRA and HVA Areas Map

<b>Scale:</b> As Shown	<b>Project Number:</b> SP18-334-00
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<b>Date:</b> November 2019	<b>Figure Number:</b> 4-3
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North:



Legend:

Subject Site

Legend

- Well Type - 1 (Municipal Supply)
- Monitoring Well

Well Head Protection Area Zone

- WHPA-A: 100m Buffer Zone (Pathogen Security/Prohibition Zone)
- WHPA-B: Pathogen Management Zone (0 to 2 Year Time of Travel)
- WHPA-C: DNAPL/Contaminant Protection Zone (2 to 5 Year Time of Travel)
- WHPA-D: Secondary Protection Zone (5 to 25 Year Time of Travel)

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Well Head Protection Area (Palgrave Well#3) Map

Scale:

N.T.S.

Project Number:

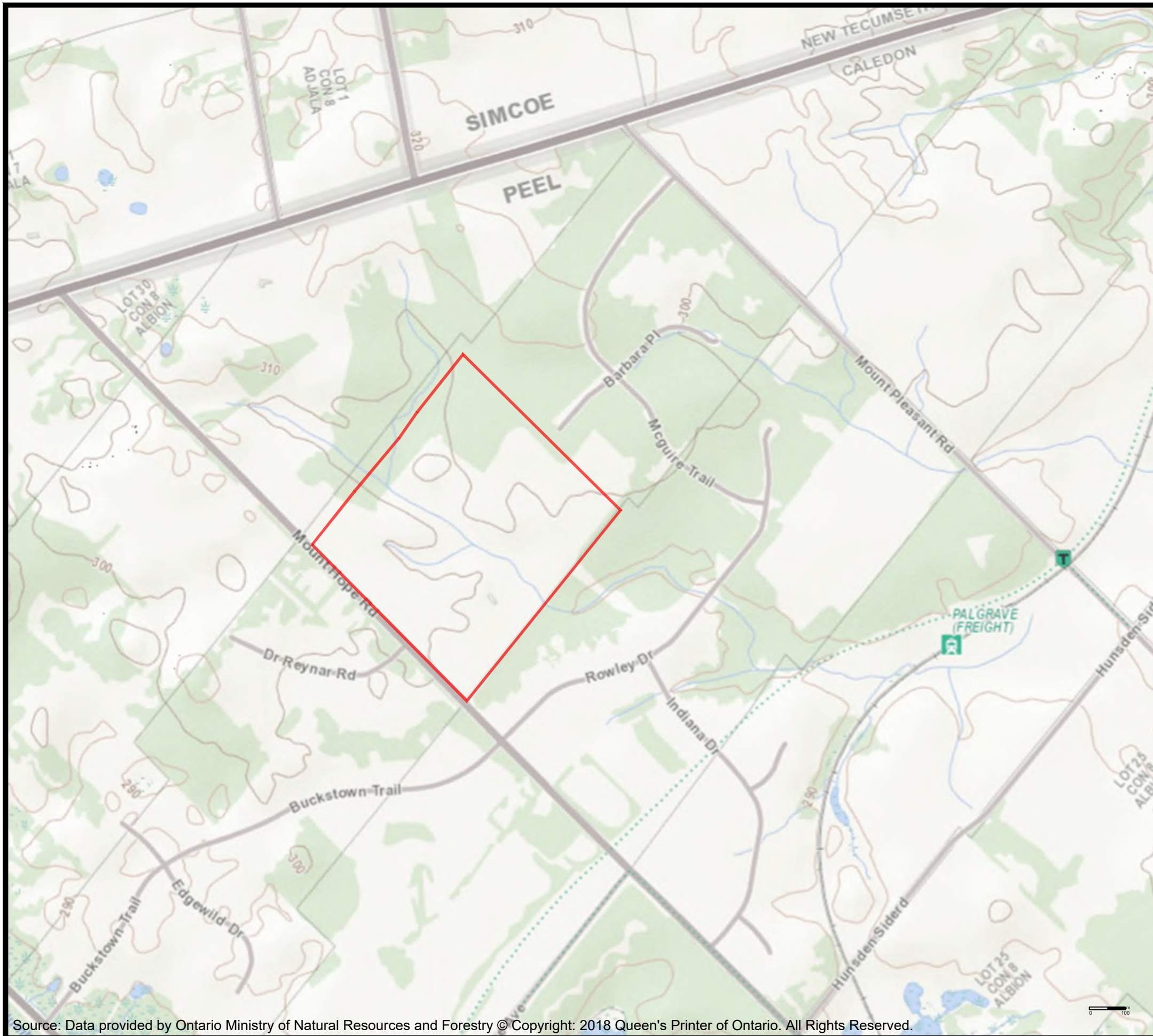
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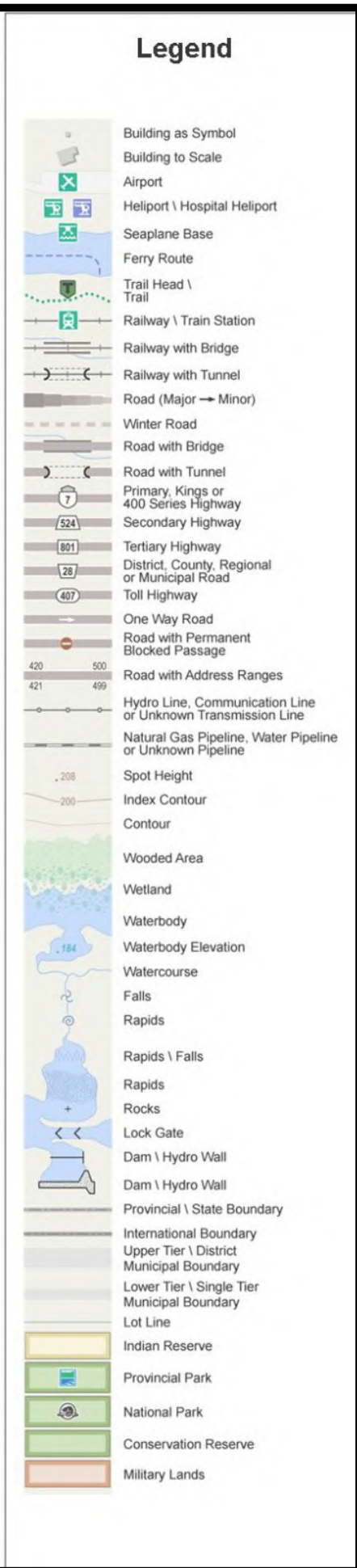
November 2019

Figure Number:

4-4



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**North:**

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**Legend:**

- Property Boundary

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**Project Title:**

Hydrogeological Investigation

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**Site Location:**

17791 Mount Hope Road, Caledon, ON

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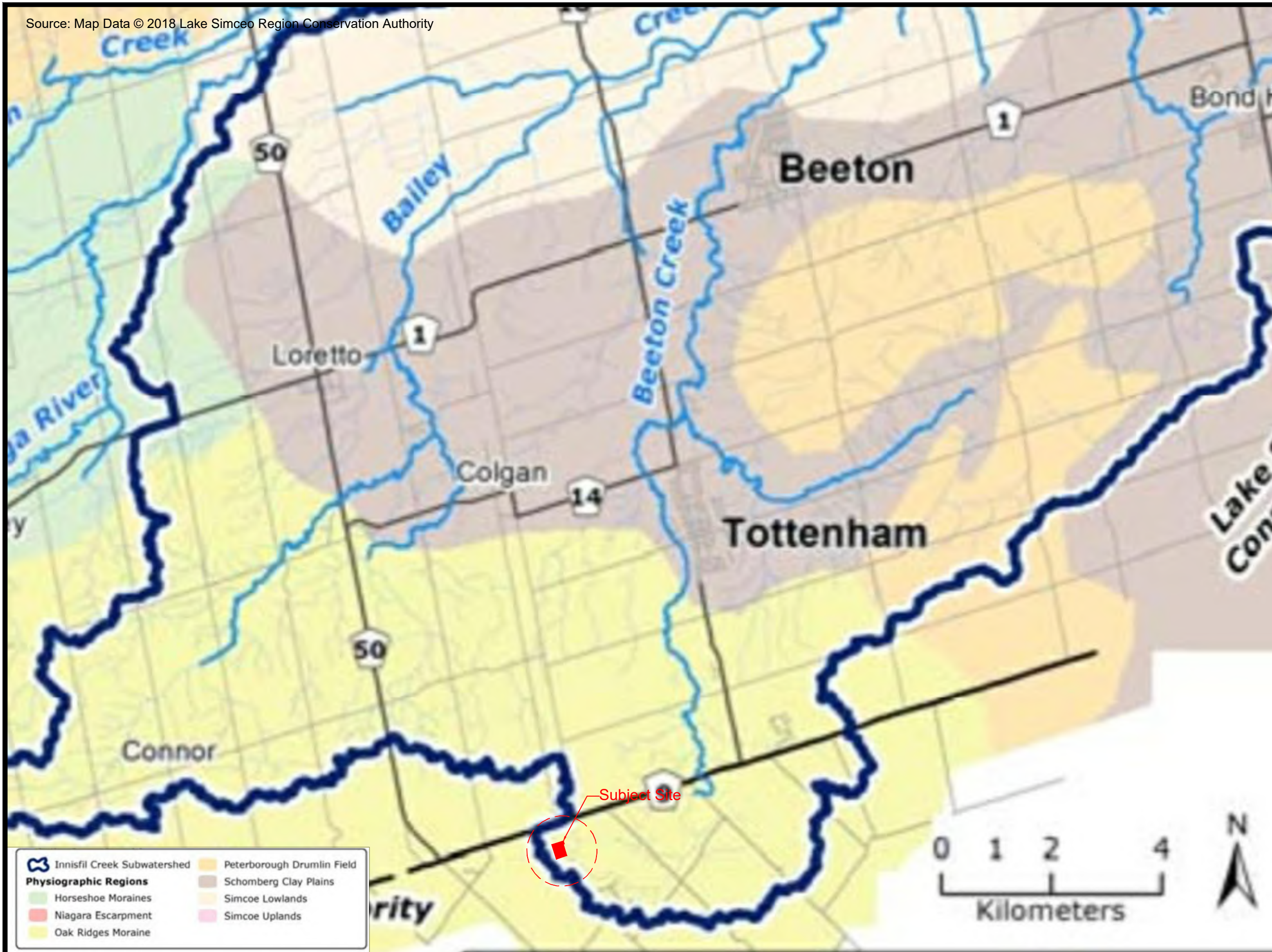
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Topographic Map

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<b>Scale:</b>	<b>Project Number:</b>
As Shown	SP18-334-00
<b>Date:</b>	<b>Figure Number:</b>
November 2019	5-1

Source: Map Data © 2018 Lake Simcoe Region Conservation Authority



Innisfil Creek Subwatershed	Peterborough Drumlin Field
<b>Physiographic Regions</b>	Schomberg Clay Plains
Horseshoe Moraines	Simcoe Lowlands
Niagara Escarpment	Simcoe Uplands
Oak Ridges Moraine	

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North:

**Legend:**

- Subject Site
- Approximate Site Location

**Project Title:**  
 Hydrogeological Investigation

**Site Location:**  
 17791 Mount Hope Road, Caledon, ON

**Figure Title:**  
 Physiography Map

<b>Scale:</b> As Shown	<b>Project Number:</b> SP18-334-00
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<b>Date:</b> November 2019	<b>Figure Number:</b> 5-2
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North:



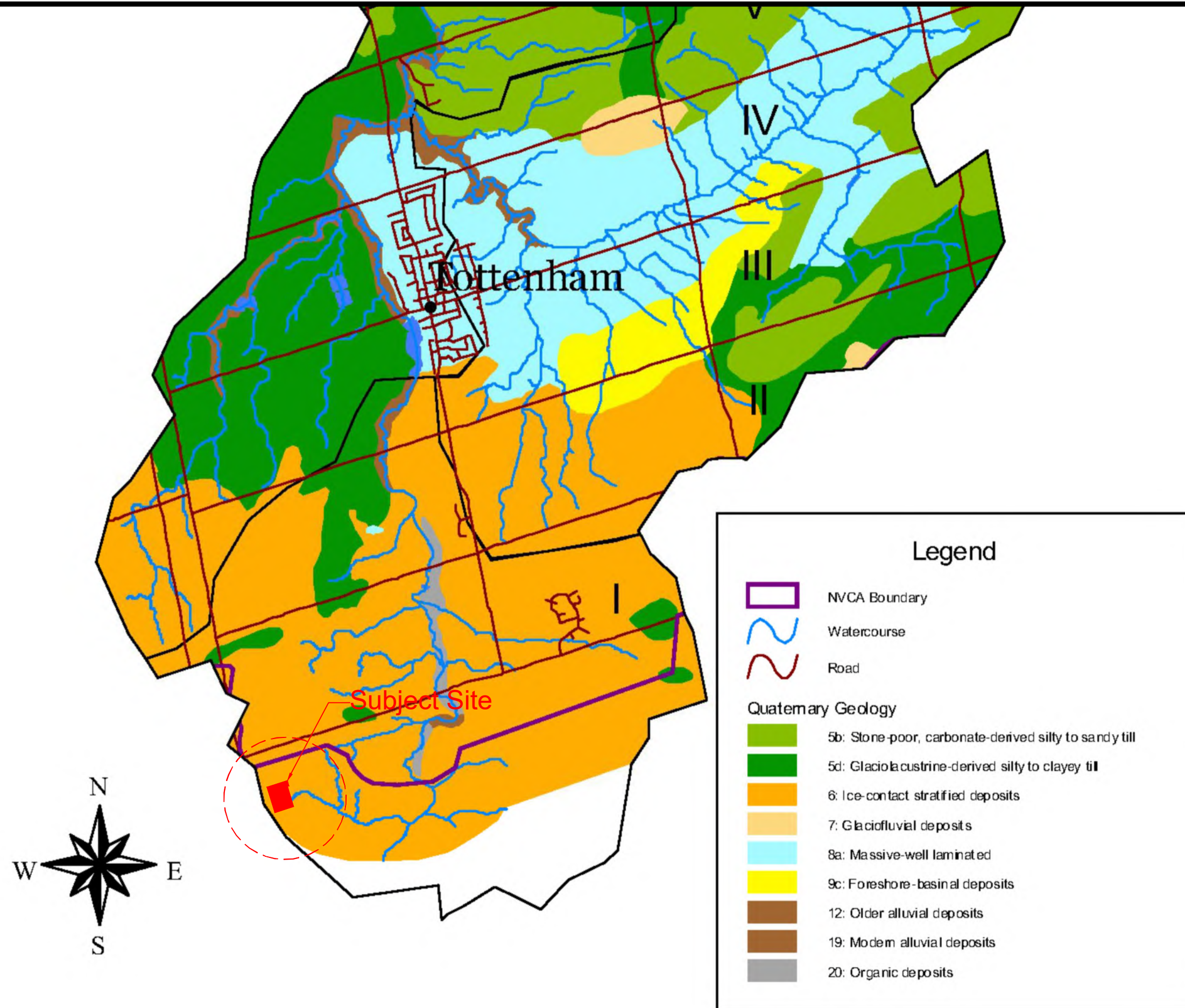
Legend:



Subject Site



Approximate Site Location



**Legend**



NVCA Boundary



Watercourse



Road

**Quaternary Geology**



5b: Stone-poor, carbonate-derived silty to sandy till



5d: Glaciolacustrine-derived silty to clayey till



6: Ice-contact stratified deposits



7: Glaciofluvial deposits



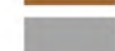
8a: Massive-well laminated



9c: Foreshore-basinal deposits



12: Older alluvial deposits



19: Modern alluvial deposits



20: Organic deposits

**Project Title:**

Hydrogeological Investigation

**Site Location:**

17791 Mount Hope Road, Caledon, ON

**Figure Title:**

Surficial Geology Map

**Scale:**

N.T.S.

**Project Number:**

SP18-334-00

**Date:**

November 2019

**Figure Number:**

5-3

North:



Legend:



Subject Site



Approximate Site Location

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Bedrock Geology Map

Scale:

N.T.S.

Project Number:

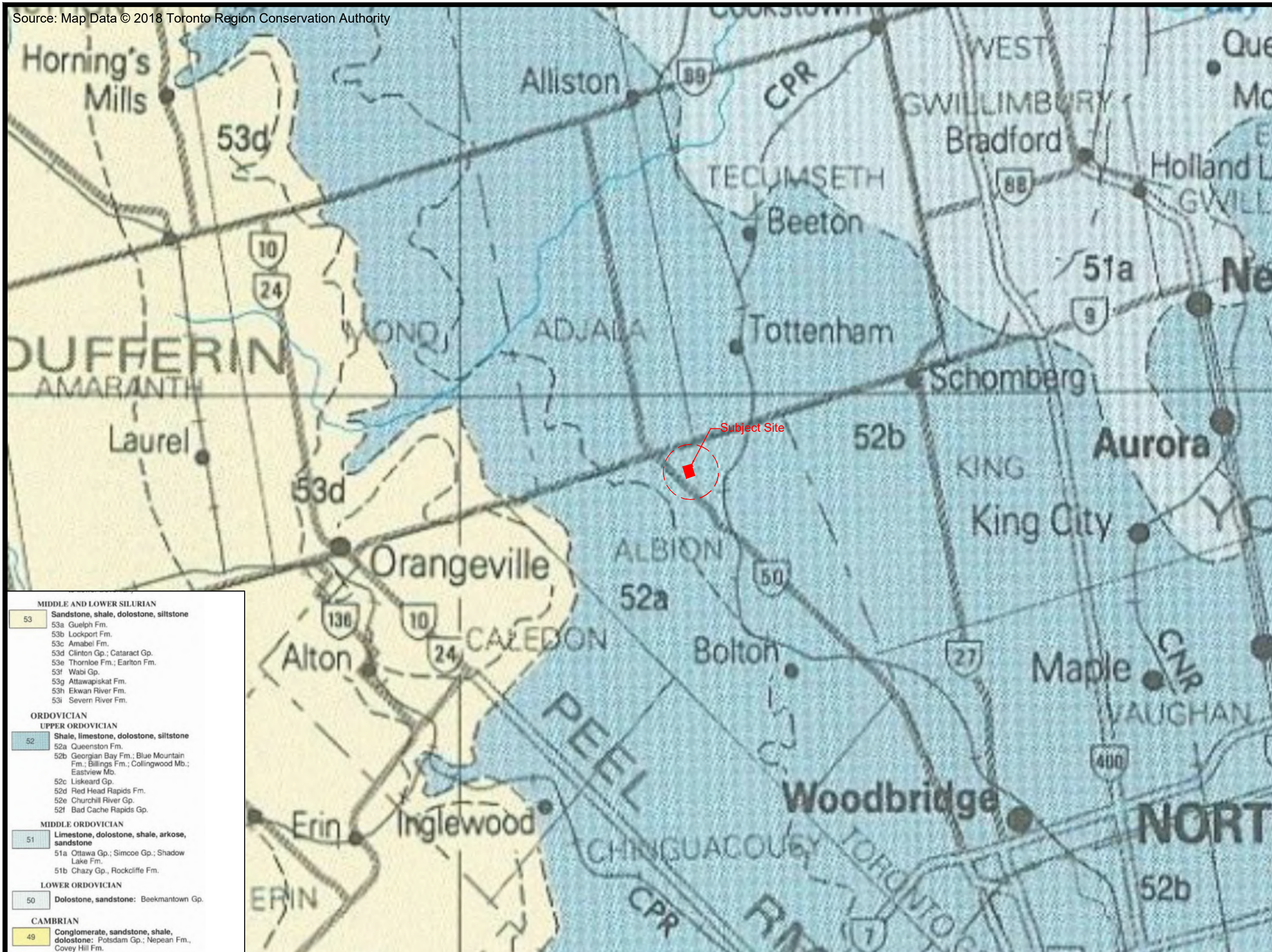
SP18-334-00

Date:

November 2019

Figure Number:

5-4






<b>MIDDLE AND LOWER SILURIAN</b>	
53	Sandstone, shale, dolostone, siltstone
53a	Guelph Fm.
53b	Lockport Fm.
53c	Amabel Fm.
53d	Clinton Gp.; Cataract Gp.
53e	Thornloe Fm.; Earleton Fm.
53f	Wabi Gp.
53g	Attawapiskat Fm.
53h	Ekwan River Fm.
53i	Severn River Fm.
<b>ORDOVICIAN</b>	
<b>UPPER ORDOVICIAN</b>	
52	Shale, limestone, dolostone, siltstone
52a	Queenston Fm.
52b	Georgian Bay Fm.; Blue Mountain Fm.; Billings Fm.; Collingwood Mb.; Eastview Mb.
52c	Liskeard Gp.
52d	Red Head Rapids Fm.
52e	Churchill River Gp.
52f	Bad Cache Rapids Gp.
<b>MIDDLE ORDOVICIAN</b>	
51	Limestone, dolostone, shale, arkose, sandstone
51a	Ottawa Gp.; Simcoe Gp.; Shadow Lake Fm.
51b	Chazy Gp., Rockcliffe Fm.
<b>LOWER ORDOVICIAN</b>	
50	Dolostone, sandstone: Beekmantown Gp.
<b>CAMBRIAN</b>	
49	Conglomerate, sandstone, shale, dolostone: Potsdam Gp.; Nepean Fm., Covey Hill Fm.

North:



Legend:

-  Subject Site
-  500m Study Area
-  MECP Well

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

MECP Water Well Location Map

Scale:

As Shown

Project Number:

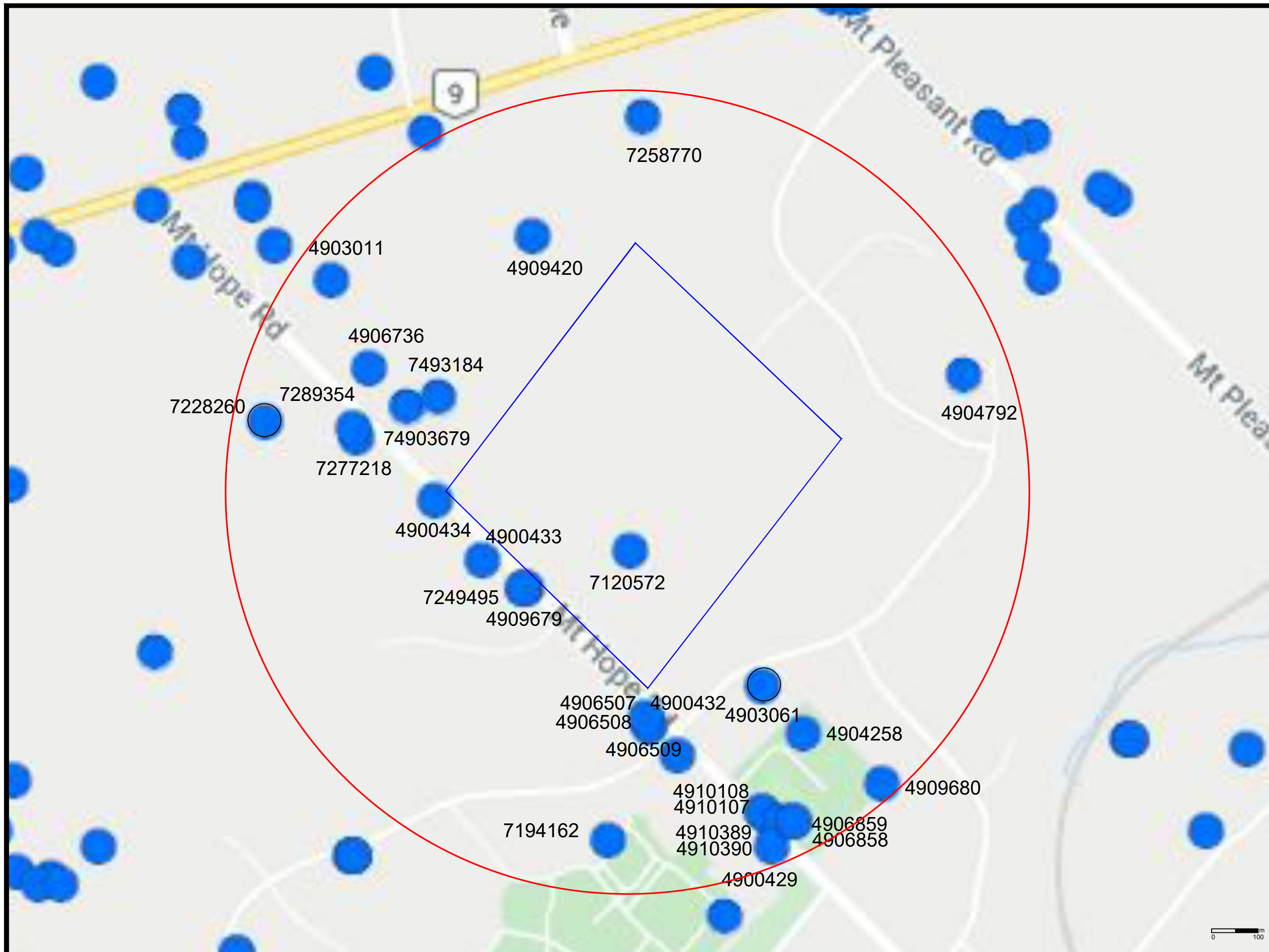
SP18-334-00

Date:

November 2019

Figure Number:

6-1






North:



Legend:

 Property Boundary

 Monitoring Wells

 Boreholes

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Borehole/Monitoring Well Location Plan

Scale:

As Shown

Project Number:

SP18-334-00

Date:

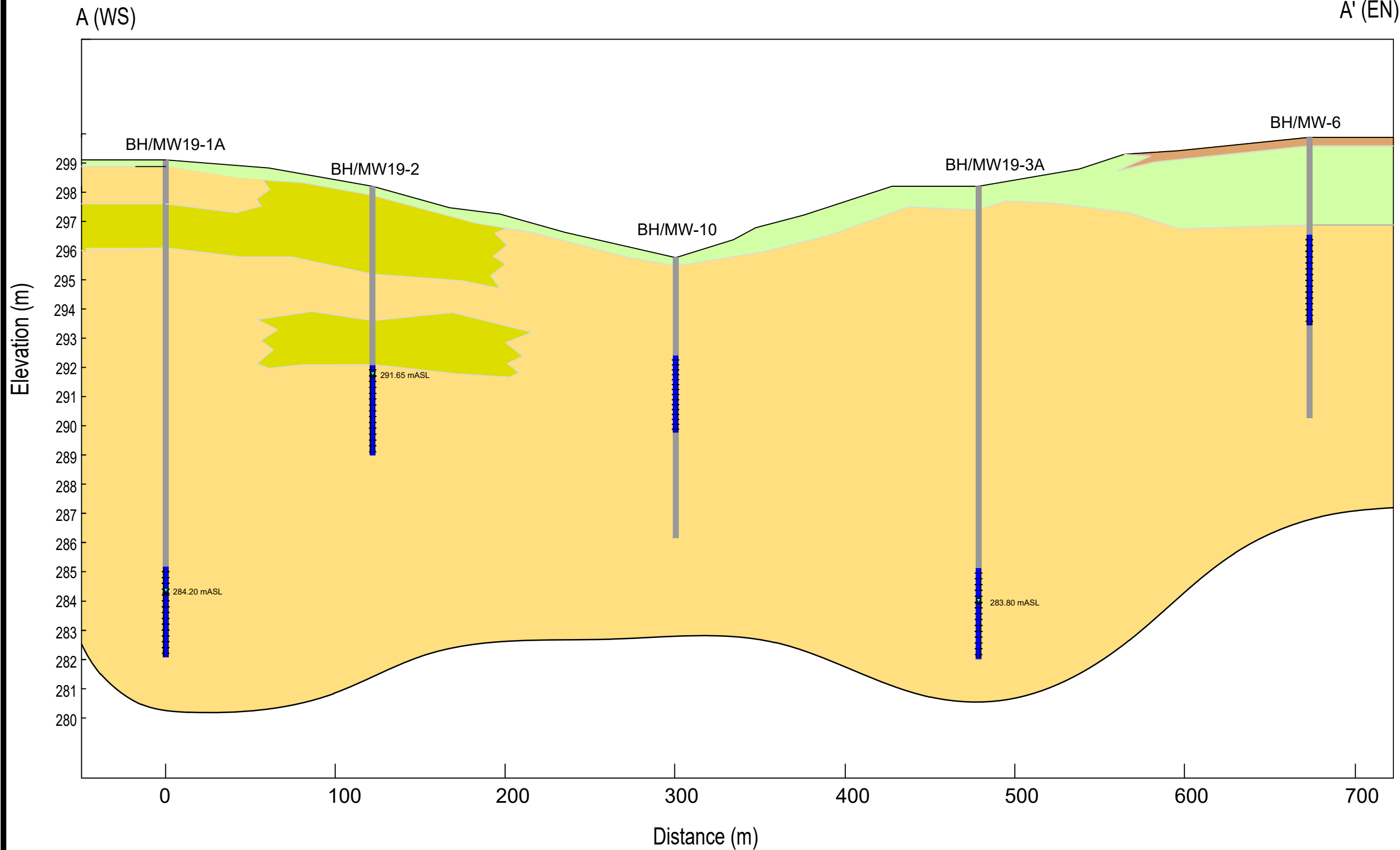
November 2019

Figure Number:

7-1



**North:**



**Project Title:**  
Hydrogeological Investigation

**Site Location:**  
17791 Mount Hope Road, Caledon, ON

**Figure Title:**  
Cross Section Profile A-A'





<b>Scale:</b> N.T.S	<b>Project Number:</b> SP18-334-00
------------------------	---------------------------------------

<b>Date:</b> November 2019	<b>Figure Number:</b> 8-2
-------------------------------	------------------------------

North:



Legend:

-  Property Boundary
-  Monitoring Well & Groundwater Elevation
-  Contour Line
-  Inferred Shallow Groundwater Flow Direction

Note:  
 Groundwater Elevation were obtained on October 21, 2019

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Groundwater Elevations and Inferred Groundwater Flow Direction

Scale:

As Shown

Project Number:

SP18-334-00

Date:

November 2019

Figure Number:

8-2





# SIRATI & PARTNERS

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

North:



### Legend:

- Property Boundary
- Pave Area
- Roof
- Landscape

### Site Statistics:

Landscape:	41 ha
Total	41 ha

### Project Title:

Hydrogeological Investigation

### Site Location:

17791 Mount Hope Road, Caledon, ON

### Figure Title:

Pre-Development Plan - Site Statistics

Scale:

As Shown

Project Number:

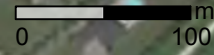
SP18-334-00

Date:

November 2019

Figure Number:

11-1



North:



Legend:

- - - - - Property Boundary
- Pavement Area
- Roof
- Landscape

Site Statistics:

Pave Area:	1.5 ha
Roof:	0.5 ha
Landscape:	39 ha
<b>Total</b>	<b>41 ha</b>

Project Title:

Hydrogeological Investigation

Site Location:

17791 Mount Hope Road, Caledon, ON

Figure Title:

Post-Development Plan - Site Statistics

Scale:

As Shown

Project Number:

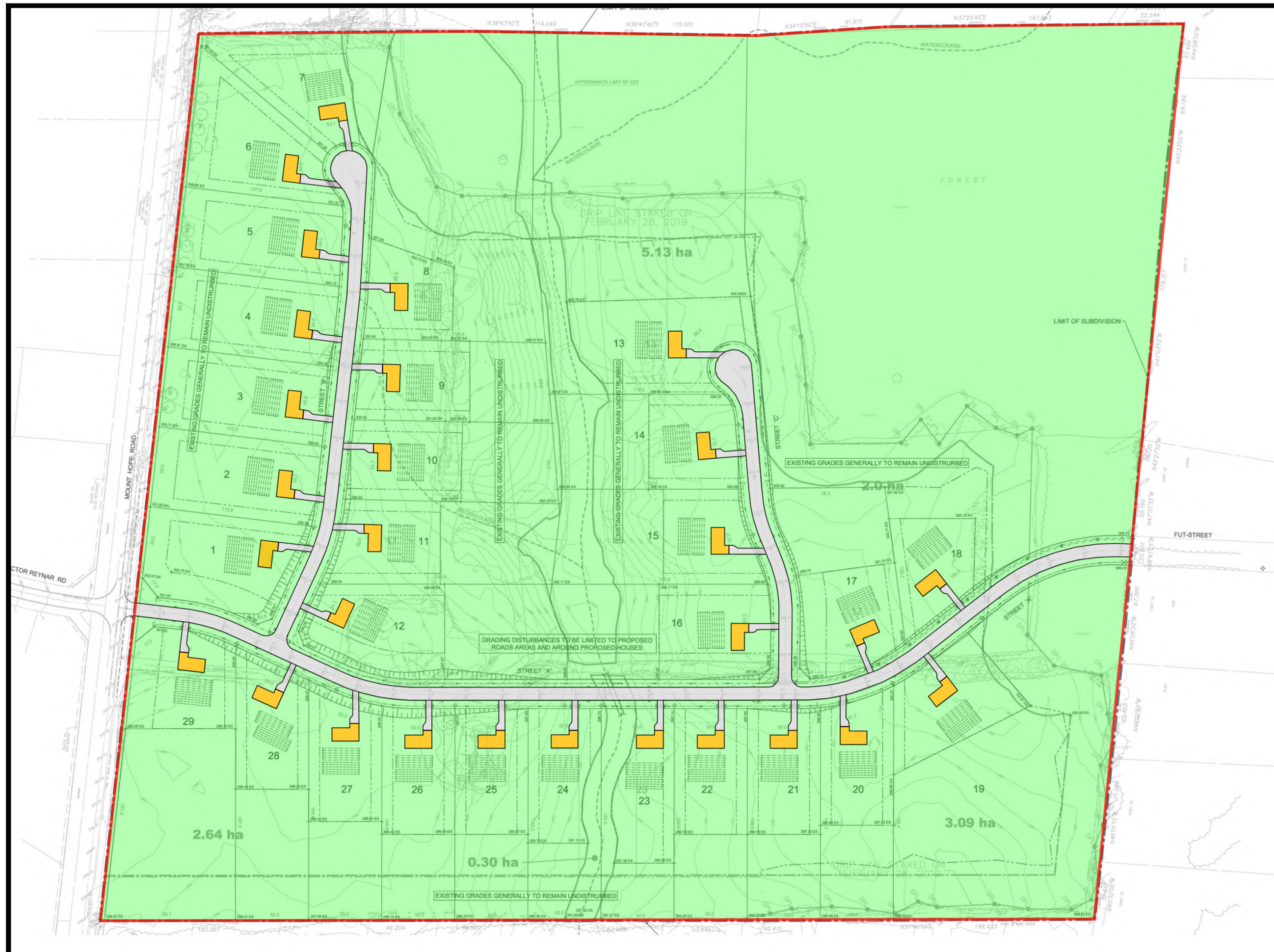
SP18-334-00

Date:

November 2019

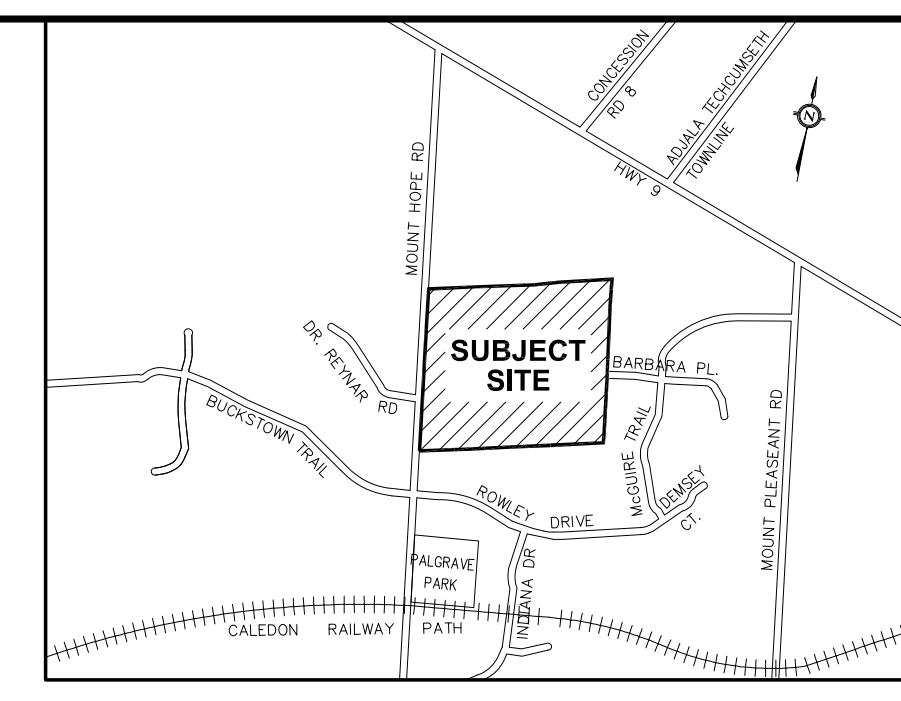
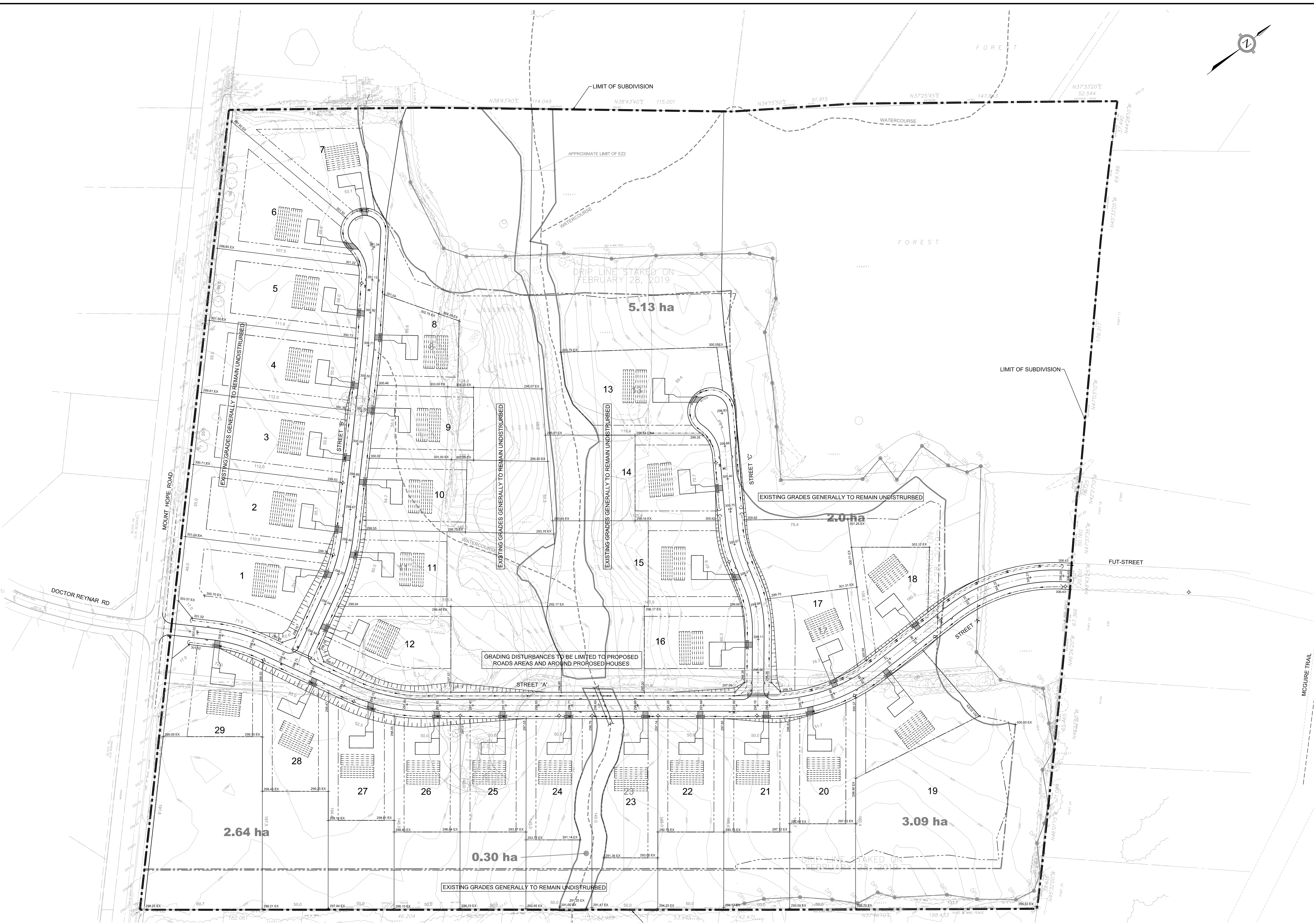
Figure Number:

11-2



# APPENDICES

# APPENDIX A



- LEGEND :**
- PROPOSED DRIVEWAY WITH CULVERT
  - PROPOSED CULVERT
  - HYDRANT
  - PROPOSED WATER SERV. CONNECTION
  - PROPOSED UTILITY BOX
  - PROPOSED LIGHT POLE
  - PROPOSED VALVE & BOX
  - LIMIT OF DEVELOPMENT
  - STRUCTURE ENVELOP LINE
  - WATERCOURSE
  - EXISTING TREES
  - EDGE OF VEGETATION
  - SEPTIC TANK SYSTEM (TYP)
  - PROPOSED HOUSE (TYP)
  - EXISTING ELEVATION
  - PROPOSED ELEVATION

REVISIONS				
No.	BY	DATE	REVISION	CONS. TOWN CHECKED APPROV.
1				

APPROVED FOR CONSTRUCTION  
 THIS APPROVAL CONSTITUTES A GENERAL REVIEW AND DOES NOT CERTIFY DIMENSIONAL ACCURACY.  
 THIS APPROVAL IS SUBJECT TO THE FURTHER CERTIFICATION OF THE "AS CONSTRUCTED" WORKS BY A REGISTERED PROFESSIONAL ENGINEER OF THE PROVINCE OF ONTARIO.

DATE: \_\_\_\_\_ APPROVED BY: **H. MONTÉZ, P. ENG.**  
 Town Engineer

**ELEVATION NOTES**  
 ELEVATION SHOWN HEREON ARE GEODETIC AND DERIVED FROM THE TOWN OF CALEDON BENCHMARKS.

**LOCAL BENCHMARK**  
 NO. 00819755065 ELEVATION = 277.870 METRES AND NO. 00819775416 ELEVATION = 318.849 METRES

DESIGNED BY: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_



**PALGRAVE ESTATES SUBDIVISION**

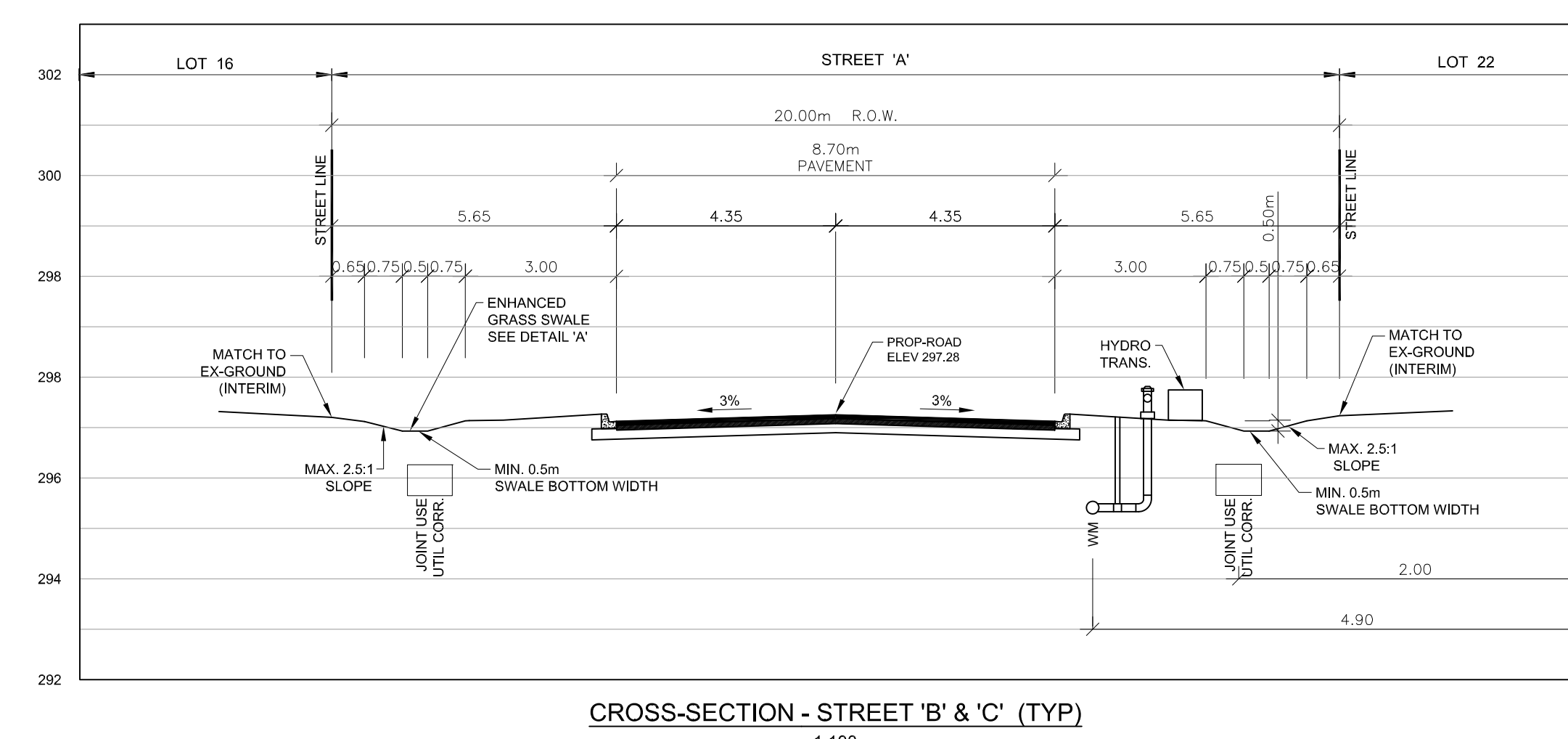
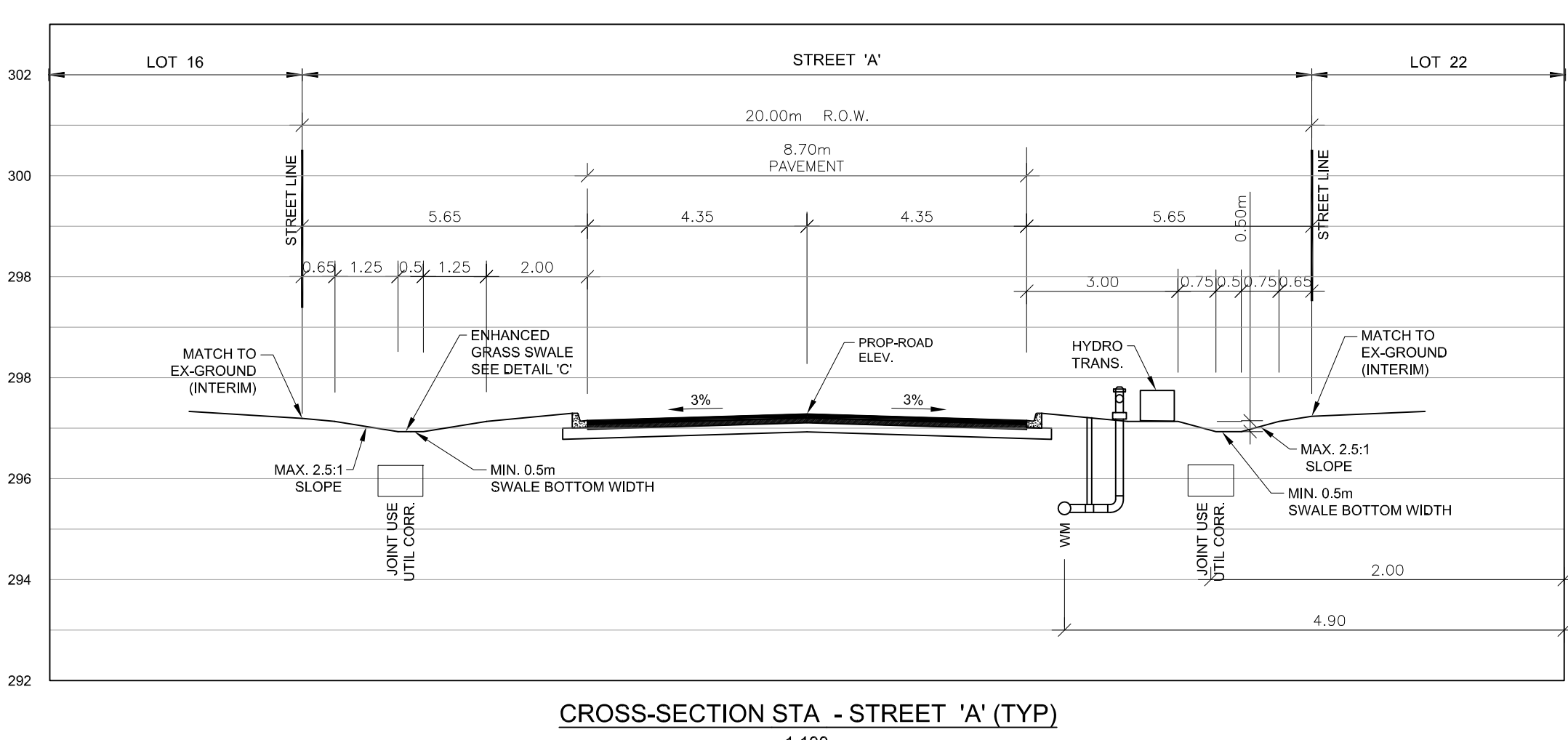
CONSULTANT: **MASONGSONG ASSOCIATES**  
 788 HEDBERG ROAD  
 SUITE 207  
 GERRARDTOWN, ONTARIO  
 L7R 4A4  
 (905) 881-1111

**Region of Peel**  
 Working for you

**TOWN OF CALEDON**

**GRADING PLAN**

SCALE: 1:1000	PROJECT No. <b>18-951</b>
DESIGNED BY: M.H.	DRAWN BY: MAEL CAD
CHECKED BY: A.J.	DATE: OCTOBER 2019
	PLAN No. <b>GR1</b>





# APPENDIX B

# LOG OF BOREHOLE BH 1

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/19/2018 Drilling Contractor:
	REF. NO.: SP18-334-10 ENCL NO.: 2

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)					
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE										"N" BLOWS 0.3 m	2	4	6	8
298.9	<b>TOPSOIL:</b> 350 mm																	
0.0 298.6	<b>SAND (REWORKED):</b> trace gravel, brown, moist, loose		1	SS	5													
0.4	possibly reworked, becoming light brown		2	SS	5													
1																		
297.4	<b>SAND:</b> light brown, moist, compact		3	SS	7													
1.5																		
2	trace gravel		4	SS	11													
3	becoming brown		5	SS	15													
4																		
5	some gravel		6	SS	23													
6																		
292.8	<b>GRAVELLY SAND:</b> trace cobbles, brown, moist, compact		7	SS	19													
6.1																		
7																		
291.3	<b>SILT:</b> greyish brown, trace gravel, very moist to wet, very dense		8	SS	74													
7.6																		
289.7	<b>END OF BOREHOLE:</b>		9	SS	50/ 75 mm													
9.2	Notes: 1. Borehole was open and dry upon completion of drilling. 2. Monitoring well was installed in the borehole upon completion of drilling. 3. Monitoring well was dry on November 1, 2018 and November 28, 2018.																	

SPCL SOIL LOG (W) VOC 0-12, PPM-2016 SP18-334-10.GPJ SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement  1st  2nd  3rd  4th

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ● = 3% Strain at Failure

# LOG OF BOREHOLE BH 2

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/19/2018 Drilling Contractor:
REF. NO.: SP18-334-10	ENCL NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m									
299.1														
0.0 298.8	<b>TOPSOIL:</b> 300 mm		1	SS	4		299							IBL in ppm
0.3	<b>FILL:</b> topsoil mixed with silty sand to sand, brown, moist													
	<b>SAND (REWORKED):</b> trace silt, light brown, moist		2	SS	4		298							
			3	SS	8		297							
296.8														
2.3	<b>SAND:</b> light brown, moist, compact to dense		4	SS	15		296							
			5	SS	21		295							
	some gravel, trace cobbles, becoming brown		6	SS	21		294							7 85 3 5
	trace gravel		7	SS	25		293							
	trace cobbles		8	SS	21		291							
	some gravel		9	SS	31		290							
289.4	<b>END OF BOREHOLE:</b>													
9.7	Notes: 1. Borehole was open and dry upon completion of drilling.													

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement:

**GRAPH NOTES**  
 + 3, x 3: Numbers refer to Sensitivity      ○ ● = 3% Strain at Failure

# LOG OF BOREHOLE BH 3

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/18/2018 Drilling Contractor:
REF. NO.: SP18-334-10	ENCL NO.: 4

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE									
297.8 0.0	<b>TOPSOIL:</b> 450 mm		1	SS	5								IBL in ppm
297.3 0.5	<b>FILL:</b> silty sand, trace gravel, dark brown, very moist to moist becoming sandy silt, trace clay, brown, moist		2	SS	6								
296.3 1.5	<b>SANDY SILT TO SILTY SAND:</b> trace clay, brown, moist, loose to compact		3	SS	7								
			4	SS	18								1 61 30 8
294.8 3.0	<b>SAND:</b> trace gravel, trace silt, light brown, very moist, compact to very dense		5	SS	16								
	trace to some gravel, trace cobbles		6	SS	29								
			7	SS	40								
			8	SS	31								
288.5 9.3	<b>END OF BOREHOLE:</b>  Notes: 1. Borehole was open and dry upon completion of drilling. 2. Monitoring well was installed in the borehole upon completion of drilling. 3. Monitoring well was dry on November 1, 2018 and November 28, 2018.		9	SS	50/ 75 mm								

SPCL SOIL LOG (W) VOC 0-12, PPM-2016 SP18-334-10.GPJ SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement: 1st, 2nd, 3rd, 4th

**GRAPH NOTES**  
 + 3, × 3: Numbers refer to Sensitivity      ○ ● = 3% Strain at Failure

# LOG OF BOREHOLE BH 4

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/18/2018 Drilling Contractor:
	REF. NO.: SP18-334-10 ENCL NO.: 5

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE									
298.5													GR SA SI CL
0.0	<b>FILL:</b> sandy silt, trace gravel, trace topsoil, brown, moist		1	SS	7	298	4		10				IBL in ppm
1	<b>POSSIBLE FILL:</b> silty sand, trace cobbles, trace gravel, brown		2	SS	32								
297.0													
1.5	<b>SAND:</b> light brown, moist, compact to dense		3	SS	27	297							
2													
3	trace gravel		4	SS	32	296							
4													
5			5	SS	17	295							
6													
7	some gravel		6	SS	12	294							
8													
9			7	SS	31	292							
10													
11			8	SS	40	291							
12													
13	trace gravel		9	SS	26	289							
288.8													
9.7	<b>END OF BOREHOLE:</b>  Notes: 1. Borehole was open and dry upon completion of drilling.												

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement  1st  2nd  3rd  4th

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ● = 3% Strain at Failure

# LOG OF BOREHOLE BH 5

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/18/2018 Drilling Contractor:
	REF. NO.: SP18-334-10 ENCL NO.: 6

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE									
294.1													GR SA SI CL
0.0 293.8	<b>TOPSOIL:</b> 300 mm	[Symbol]	1	SS	5	294							
0.3	<b>FILL:</b> silty sand, yellowish brown, moist	[Symbol]											
1	sandy silt, trace clay, light brown, very moist to wet	[Symbol]	2	SS	5	293							
292.6													
1.5	<b>CLAYEY SILT</b> some sand, trace cobbles, trace gravel, light brown, very moist, firm	[Symbol]	3	SS	7	292							2 17 54 27
291.8													
2.3	<b>SAND:</b> light brown, moist, compact	[Symbol]	4	SS	13	291							
3													
5			5	SS	11	291							
4													
6													
5	trace gravel		6	SS	16	289							
6													
7			7	SS	28	288							
286.5													
7.6	<b>SANDY SILT:</b> brown, moist, dense	[Symbol]	8	SS	32	286							1 28 65 6
285.0													
9.1	<b>SILT:</b> trace sand, brown, very moist, very dense	[Symbol]	9	SS	52	285							1 10 80 9
284.4													
9.7	<b>END OF BOREHOLE:</b>												
	Notes: 1. Borehole was dry and open upon completion of drilling.												

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement: 1st, 2nd, 3rd, 4th

**GRAPH NOTES** +3, x3: Numbers refer to Sensitivity      ○ = 3% Strain at Failure

# LOG OF BOREHOLE BH 6

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/18/2018 Drilling Contractor:
	REF. NO.: SP18-334-10 ENCL NO.: 7

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m			W <sub>p</sub>	w			
299.9														
0.0 299.6	<b>TOPSOIL:</b> 300 mm	[Pattern]	1	SS	5									IBL in ppm
0.3	<b>SAND (REWORKED):</b> trace gravel, trace silt, dark brown, moist becoming brown	[Pattern]	2	SS	2									
1														
2	becoming light brown		3	SS	0									
297.6														
2.3	<b>FILL:</b> silty sand, light brown, moist	[Pattern]	4	SS	2									
296.9														
3.0	<b>SAND:</b> some silt, light brown, moist, compact to very dense	[Pattern]	5	SS	11									
4														
5			6	SS	19									
6														
7			7	SS	36									
8			8	SS	59									
9	becoming greyish brown, very moist		9	SS	52									
290.2														
9.7	<b>END OF BOREHOLE:</b>													
	Notes: 1. Borehole was dry and open upon completion of drilling. 2. Monitoring well was installed in the borehole upon completion of drilling. 3. Borehole was dry on November 1, 2018 and November 27, 2018.													

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement    1st    2nd    3rd    4th

**GRAPH NOTES**    + 3, × 3: Numbers refer to Sensitivity    ○ ● = 3% Strain at Failure

# LOG OF BOREHOLE BH 7

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/19/2018 Drilling Contractor:
REF. NO.: SP18-334-10	ENCL NO.: 8

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m									
298.9	<b>TOPSOIL:</b> 300 mm													
0.0 298.6	<b>SAND (REWORKED):</b> trace silt, brown, moist, loose		1	SS	5									
0.3 298.1	<b>SAND:</b> trace silt, light brown, moist		2	SS	11									
1.0 297.1	some silt, wet		3	SS	16									
2.0 296.1			4	SS	24									
3.0 295.1			5	SS	32									
4.0 294.1			6	SS	30									
4.6 293.3	<b>SANDY SILT:</b> brown, wet, compact		7	SS	18									
5.0 292.3			8	SS	23									
6.0 291.3			9	SS	60									
7.6 289.3	<b>SAND:</b> brown, wet to moist, compact													
8.0 289.8	<b>GRAVELLY SAND:</b> brown, moist, very dense													
9.1 289.2	<b>END OF BOREHOLE:</b>													
9.7	Notes: 1. Borehole was dry and open upon completion of drilling.													

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18



# LOG OF BOREHOLE BH 8

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/18/2018 Drilling Contractor:
REF. NO.: SP18-334-10	ENCL NO.: 9

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m									
302.8	0.0	<b>TOPSOIL:</b> 450 mm												GR SA SI CL
302.3	0.5	<b>FILL:</b> silty sand, trace topsoil, dark brown, moist	1	SS	6									
302.0	1.0		2	SS	2									
301.5	1.5		3	SS	2									
300.5	2.3	<b>SAND:</b> trace cobbles, trace gravel, light brown, moist, compact	4	SS	16									
299.8	3.0		5	SS	14									
298.2	4.6	<b>SAND:</b> light brown, moist, compact to dense	6	SS	12									
297.5	5.3		7	SS	9									
296.8	6.0		8	SS	42									
296.1	6.7		9	SS	31									
293.1	9.7	<b>END OF BOREHOLE:</b>												
		Notes: 1. Borehole was dry and open upon completion of drilling.												

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement: 1st, 2nd, 3rd, 4th

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

# LOG OF BOREHOLE BH 9

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/19/2018 Drilling Contractor:
REF. NO.: SP18-334-10	ENCL NO.: 10

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)						
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE										"N" BLOWS 0.3 m	2	4	6	8	10
298.2																			
0.0 297.9	<b>TOPSOIL:</b> 300 mm	[Cross-hatch pattern]	1	SS	6	298													
0.3	<b>FILL:</b> sandy silt to silty sand, trace topsoil, dark brown, wet	[Cross-hatch pattern]																	
1			2	SS	3	297													
2			3	SS	4	296													
295.9																			
2.3	<b>SAND:</b> light brown, moist, compact	[Dotted pattern]	4	SS	15	295													
3			5	SS	29	294													
4																			
293.6																			
4.6	<b>GRAVELLY SAND:</b> trace cobbles, light brown, moist, dense	[Dotted pattern with circles]	6	SS	35	293													
5																			
6																			
7			7	SS	25	292													
290.6																			
7.6	<b>SAND:</b> trace silt, light brown, moist, dense	[Dotted pattern]	8	SS	41	291													
8																			
9	trace gravel	[Dotted pattern with larger circles]	9	SS	43	290													
288.5																			
9.7	<b>END OF BOREHOLE:</b>																		
	Notes: 1. Borehole was dry and open upon completion of drilling. 2. Monitoring well was installed in the borehole upon completion of drilling. 3. Monitoring well was dry on November 1, 2018, and November 27, 2018.																		

SPCL SOIL LOG (W) VOC 0-12, PPM-2016, SP18-334-10, GPJ, SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement: 1st, 2nd, 3rd, 4th

**GRAPH NOTES** +3, x3: Numbers refer to Sensitivity      ○ ●=3% Strain at Failure

# LOG OF BOREHOLE BH 10B

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION: See Drawing 1	<b>DRILLING DATA</b> Method: Solid Stem Augers Diameter: 150 mm Date: Oct/19/2018 Drilling Contractor:
	REF. NO.: SP18-334-10 ENCL NO.: 11

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	2	4	W <sub>p</sub>	W				W <sub>L</sub>	GR	SA
295.7																	
0.0 295.4	<b>TOPSOIL: 300 MM</b>	[Pattern]	1	SS	6				○								
0.3	<b>FILL:</b> topsoil mixed with silty sand, reddish brown, very moist, loose	[Pattern]															
1	<b>SAND (REWORKED):</b> brown, very moist, very loose	[Pattern]	2	SS	0				○								
2		[Pattern]	3	SS	0				○								
293.4		[Pattern]															
2.3	<b>SAND:</b> brown, moist to very moist, very loose to very dense	[Pattern]	4	SS	4				○								
3	trace cobbles	[Pattern]															
4		[Pattern]															
5	trace gravel	[Pattern]	5	SS	5				○								
6		[Pattern]															
7		[Pattern]	6	SS	9				○								
8		[Pattern]															
9	some gravel, trace clay, light brown	[Pattern]	7	SS	18				○								
8		[Pattern]	8	SS	50/ 125 mm				○					3	88	2	7
9	some silt (pockets)	[Pattern]	9	SS	38				○								
286.0		[Pattern]															
9.7	<b>END OF BOREHOLE:</b>																
	Notes: 1. Borehole was dry and open upon completion of drilling. 2. Monitoring well was installed in the borehole upon completion of drilling. 3. Borehole was dry on November 1, 2018 and November 27, 2018.																

SPCL SOIL LOG (W) VOC 0-12, PPM-2016 SP18-334-10.GPJ SPCL\_GDT\_12/5/18

**GROUNDWATER ELEVATIONS**  
 Measurement    1st    2nd    3rd    4th

**GRAPH NOTES**    + 3, × 3: Numbers refer to Sensitivity    ○ ●=3% Strain at Failure

LOG OF BOREHOLE BH 19-1

PROJECT: Proposed Residential Development  
 CLIENT: Palgrave Estate  
 PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario  
 DATUM: Geodetic  
 BH LOCATION:

**DRILLING DATA**  
 Method: Soild Stem Auger  
 Diameter: 150 mm  
 Date: Aug/23/2019  
 REF. NO.: SP19-334-00  
 ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
299.1															
299.0	<b>FILL:</b> silty sand, trace rootlets, brown, moist <b>SAND:</b> brown, moist, loose		1	SS	7										
0.2															
	oxidated		2	SS	5										
1															
297.6	<b>SILTY SAND:</b> brown, oxidated, moist, compact		3	SS	10										
1.5															
296.8	<b>SANDY SILT:</b> trace clay, brown, very moist, compact		4	SS	12										
2.3															
296.1	<b>SAND:</b> brown, moist, compact		5	SS	27										
3.0															
4															
	becoming grey and very moist		6	SS	26										
5															
6															
	becoming very dense		7	SS	63										
7															
8															
9															
290.0	<b>SAND AND GRAVEL:</b> trace cobbles, brown, moist, very dense		9	SS	98										
9.1															
10															

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

Continued Next Page

GROUNDWATER ELEVATIONS  
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, x3: Numbers refer to Sensitivity ○ s=3% Strain at Failure

LOG OF BOREHOLE BH 19-1

PROJECT: Proposed Residential Development  
 CLIENT: Palgrave Estate  
 PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario  
 DATUM: Geodetic  
 BH LOCATION:

**DRILLING DATA**  
 Method: Soild Stem Auger  
 Diameter: 150 mm  
 Date: Aug/23/2019  
 REF. NO.: SP19-334-00  
 ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	20 40 60 80 100						
288.4	<b>SAND AND GRAVEL:</b> trace cobbles, brown, moist, very dense(Continued)						289								
10.7	<b>SAND:</b> trace gravel, some cobbles, brown, very moist, very dense		10	SS	50/100 mm		288								
286.9	<b>SAND AND GRAVEL:</b> some cobbles, brown, very moist, dense		11	SS	49		287								
12.2							286.9								
15.2	<b>SAND:</b> grey, wet, dense		12	SS	36		285								
15.7	End of SPT sampling Augered from 15.66 m to 18.3 m below ground surface						284								
18.3	<b>END OF BOREHOLE:</b>  Note: 1. Borehole caved at 11.58 mbgs. 2. Water was encountered at 15.2 mbgs upon completion of drilling. 3. Monitoring well was installed upon completion of drilling. 4. Groundwater level was observed at 12.96 mbgs on August 30, 2019. 5. Groundwater level was observed at 13 mbgs on September 5, 2019.						283								
							282								
							281								
							280.8								

W. L. 286.1 m  
Oct 08, 2019

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

Continued Next Page

**GROUNDWATER ELEVATIONS**

Measurement

**GRAPH NOTES**

+ 3 , × 3 : Numbers refer to Sensitivity  
 ○ ● =3% Strain at Failure

LOG OF BOREHOLE BH 19-1

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Soild Stem Auger Diameter: 150 mm Date: Aug/23/2019 REF. NO.: SP19-334-00 ENCL NO.: 2
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)											WATER CONTENT (%)
	6. Groundwater level was observed at 12.98 mbgs on October 8, 2019.																	

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** +<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ ●=3% Strain at Failure

# LOG OF BOREHOLE BH 19-1A

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Hollow Stem Auger Diameter: 200 mm Date: Oct/10/2019 REF. NO.: SP19-334-00 ENCL NO.: 3
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)					
299.1		X											
299.0	FILL: silty sand, trace rootlets, brown, moist SAND: brown, moist, loose  oxidated	X											
297.6	SILTY SAND: brown, oxidated, moist, compact	X											
296.8	SANDY SILT: trace clay, brown, very moist, compact	X											
296.1	SAND: brown, moist, compact  becoming grey and very moist  becoming very dense  trace gravel, moist, very dense	X		AUGER									
			9	AS									
			10	SS	105								

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

# LOG OF BOREHOLE BH 19-1A

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Hollow Stem Auger Diameter: 200 mm Date: Oct/10/2019 REF. NO.: SP19-334-00 ENCL NO.: 3
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)	
289	<b>SAND:</b> brown, moist, compact(Continued)	[Dotted Pattern]																
11 288	trace cobbles, trace gravel, trace silt, light brown	[Dotted Pattern]	11	SS	64													
12 287		[Dotted Pattern]																
13 286		[Dotted Pattern]																
14 285	some gravel, trace silt	[Dotted Pattern]	13	SS	50													
15 284.2	some silt, trace clay, wet	[Dotted Pattern]																
16 283		[Dotted Pattern]																
282.3		[Dotted Pattern]																

16.8	<b>END OF BOREHOLE:</b>  Note:  1. Monitoring well was installed upon completion of drilling. 2. Groundwater level was observed at 14.84 mbgs on October 18, 2019. 3. Groundwater level was observed at 14.85 mbgs on October 21, 2019.	
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W. L. 284.2 m  
Oct 21, 2019

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

GROUNDWATER ELEVATIONS      GRAPH NOTES      + 3, × 3: Numbers refer to Sensitivity      ○ ●=3% Strain at Failure  
 Measurement      1st      2nd      3rd      4th



LOG OF BOREHOLE BH 19-2

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Solid Stem Auger Diameter: 150 mm Date: Aug/23/2019 REF. NO.: SP19-334-00 ENCL NO.: 4
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)	
298.2																		
0.0	<b>FILL:</b> sand, some cobbles, some gravel, brown to grey, moist	X																
297.9			1	SS	5													
0.3	<b>SILTY SAND:</b> brown, moist, loose	/	4	SS	21													
1			2	SS	5													
	trace cobbles, dark brown, very loose																	
2			3	SS	4													
295.9																		
2.3	<b>SANDY SILT:</b> trace clay, brown, very moist, compact	-																
295.2																		
3.0	<b>SAND:</b> brown, moist, compact	.	5	SS	25													
4																		
293.6																		
4.6	<b>SILTY SAND:</b> brown, very moist, very dense	/	6	SS	64													
5																		
292.1																		
6.1	<b>SAND:</b> some clay, brown, very moist, dense	.	7	SS	42													
6																		
7																		
8	brown to grey, wet, compact		8	SS	27													
289.1																		
9.1	<b>END OF BOREHOLE:</b>																	
	Note: 1. Borehole caved at 7 mbgs. 2. Water was encountered at 6.7 mbgs upon completion of drilling.																	

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

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GROUNDWATER ELEVATIONS  
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, x3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

LOG OF BOREHOLE BH 19-2

PROJECT: Proposed Residential Development	DRILLING DATA
CLIENT: Palgrave Estate	Method: Soild Stern Auger
PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario	Diameter: 150 mm
DATUM: Geodetic	Date: Aug/23/2019
BH LOCATION:	REF. NO.: SP19-334-00
	ENCL NO.: 4

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)											WATER CONTENT (%)
	3. Monitoring well was installed upon completion of drilling. 4. Groundwater level was observed at 5.8 mbgs on August 30, 2019. 5. Groundwater level was observed at 6.09 mbgs on September 5, 2019. 6. Monitoring well was observed to be dry on October 8, 2019. 7. Groundwater level was observed at 6.53 mbgs on October 18, 2019. 8. Groundwater level was observed at 6.52 mbgs on October 21, 2019.																	

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

GROUNDWATER ELEVATIONS  
 Measurement

GRAPH NOTES +<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ ●=3% Strain at Failure

# LOG OF BOREHOLE BH 19-3

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Soild Stem Auger Diameter: 150 mm Date: Aug/23/2019 REF. NO.: SP19-334-00 ENCL NO.: 5
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SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)									
298.2	<b>POSSIBLE FILL:</b> sand, brown, moist		1	SS	12											GR SA SI CL IBL in ppm	
297.4			2	SS	4												
0.8	<b>SAND:</b> brown, moist, very loose  trace cobbles, loose     becoming grey, very moist and very dense    becoming dense		3	SS	5												
			4	SS	5												
			5	SS	4												
			6	SS	53												
			7	SS	41												
			8	SS	36												

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

LOG OF BOREHOLE BH 19-3

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Soild Stem Auger Diameter: 150 mm Date: Aug/23/2019 REF. NO.: SP19-334-00 ENCL NO.: 5
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)		
11  12  13  14.0	SAND: brown, moist, very loose(Continued)	[Soil Profile Pattern]				288    287   286   285													
			9	AS															
14.0	<b>END OF BOREHOLE:</b>  Note:  1. Borehole caved at 7 mbgs. 2. Water was encountered at 12.2 mbgs upon completion of drilling. 3. Monitoring well was installed upon completion of drilling. 4. Monitoring well was observed to be dry on September 5, 2019. 4. Monitoring well observed to be dry on August 30, 2019. 5. Monitoring well observed to be dry on September 5, 2019. 6. Monitoring well observed to be dry on October 8, 2019.																		

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

GROUNDWATER ELEVATIONS      GRAPH NOTES      + 3, × 3: Numbers refer to Sensitivity      ○ ●=3% Strain at Failure  
 Measurement      1st      2nd      3rd      4th

LOG OF BOREHOLE BH 19-3A

PROJECT: Proposed Residential Development	<b>DRILLING DATA</b>
CLIENT: Palgrave Estate	Method: Hollow Stem Auger
PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario	Diameter: 200 mm
DATUM: Geodetic	Date: Oct/11/2019
BH LOCATION:	REF. NO.: SP19-334-00
	ENCL NO.: 6

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)						
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m										20	40	60	80	100	20
298.2																				
0.0	POSSIBLE FILL: sand, brown, moist						298													
297.4																				
0.8	SAND: brown, moist, very loose						297													
	trace cobbles, loose						296													
							295													
							294													
	becoming grey, very moist and very dense						293													
							292													
	becoming dense						291													
							290													
							289													

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

# LOG OF BOREHOLE BH 19-3A

PROJECT: Proposed Residential Development CLIENT: Palgrave Estate PROJECT LOCATION: Mount Hope Rd., Caledon, Ontario DATUM: Geodetic BH LOCATION:	<b>DRILLING DATA</b> Method: Hollow Stem Auger Diameter: 200 mm Date: Oct/11/2019 REF. NO.: SP19-334-00 ENCL NO.: 6
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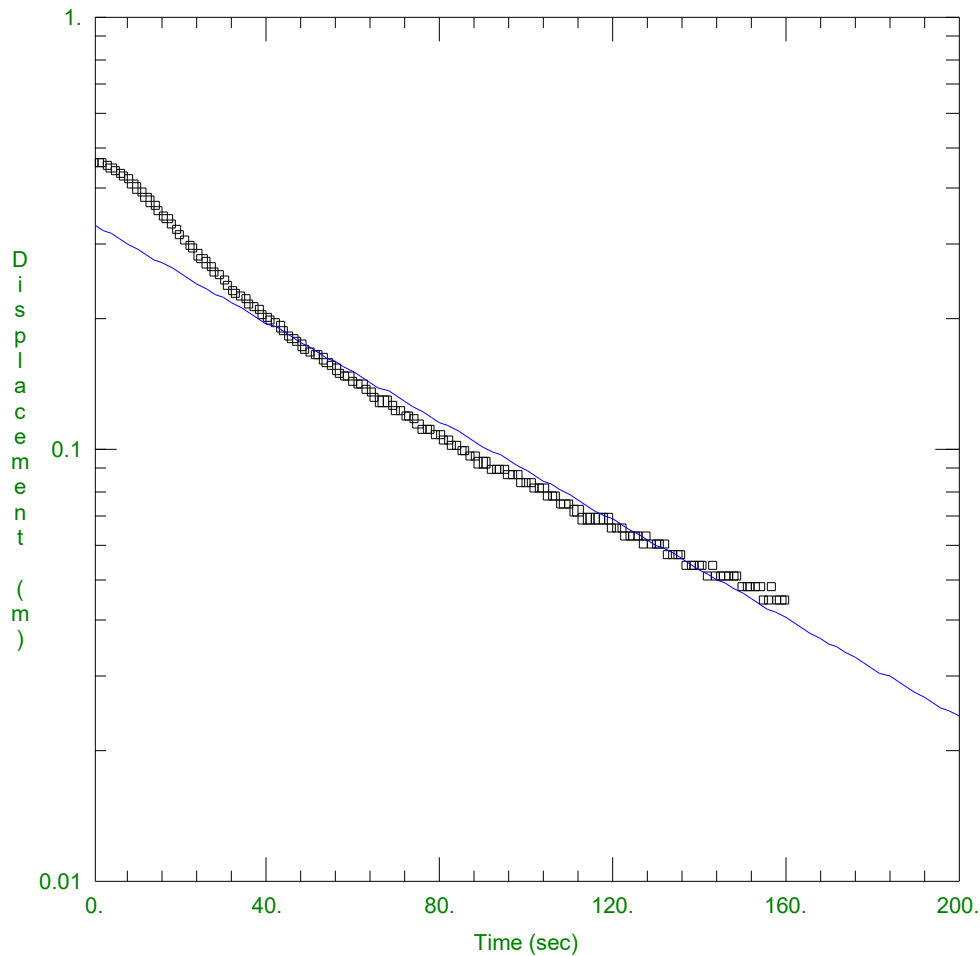
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)		
288.5	10.7	11	8	DO		288													
287.5	11.3	12				287													
287.0	Augered to 16.8 mbgs																		
286.5		13				286													
286.0		14				285													
285.5		15				284													
285.0		16				283													
284.5		17				282													
284.0		18				281.4													
283.5	<b>END OF BOREHOLE:</b>  Note: 1. Borehole caved at 16.8 mbgs. 2. Monitoring well was installed upon completion of drilling. 3. Groundwater level was observed at 14.45 mbgs on October 18, 2019. 4. Groundwater level was observed at 14.44 mbgs on October 21, 2019.																		

SPCL SOIL LOG SP18-334-10 - 2019.GPJ SPCL.GDT 10/22/19

**GROUNDWATER ELEVATIONS**  
 Measurement:

**GRAPH NOTES**    + 3, × 3: Numbers refer to Sensitivity    ○ ●=3% Strain at Failure

# APPENDIX C



### FALLING HEAD TEST RESULTS

Data Set:

Date: 10/22/19

Time: 14:30:28

### PROJECT INFORMATION

Company: Sirati and Partners

Client: JOE TRIUMBARI

Project: SP18-334-30

Location: 17791 MT HOPE ROAD, CALEDON

Test Well: BH19-1A

Test Date: October 21, 2109

### AQUIFER DATA

Saturated Thickness: 1.7 m

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (BH19-1A)

Initial Displacement: 0.459 m

Static Water Column Height: 1.7 m

Total Well Penetration Depth: 16.8 m

Screen Length: 3. m

Casing Radius: 0.05 m

Well Radius: 0.05 m

### SOLUTION

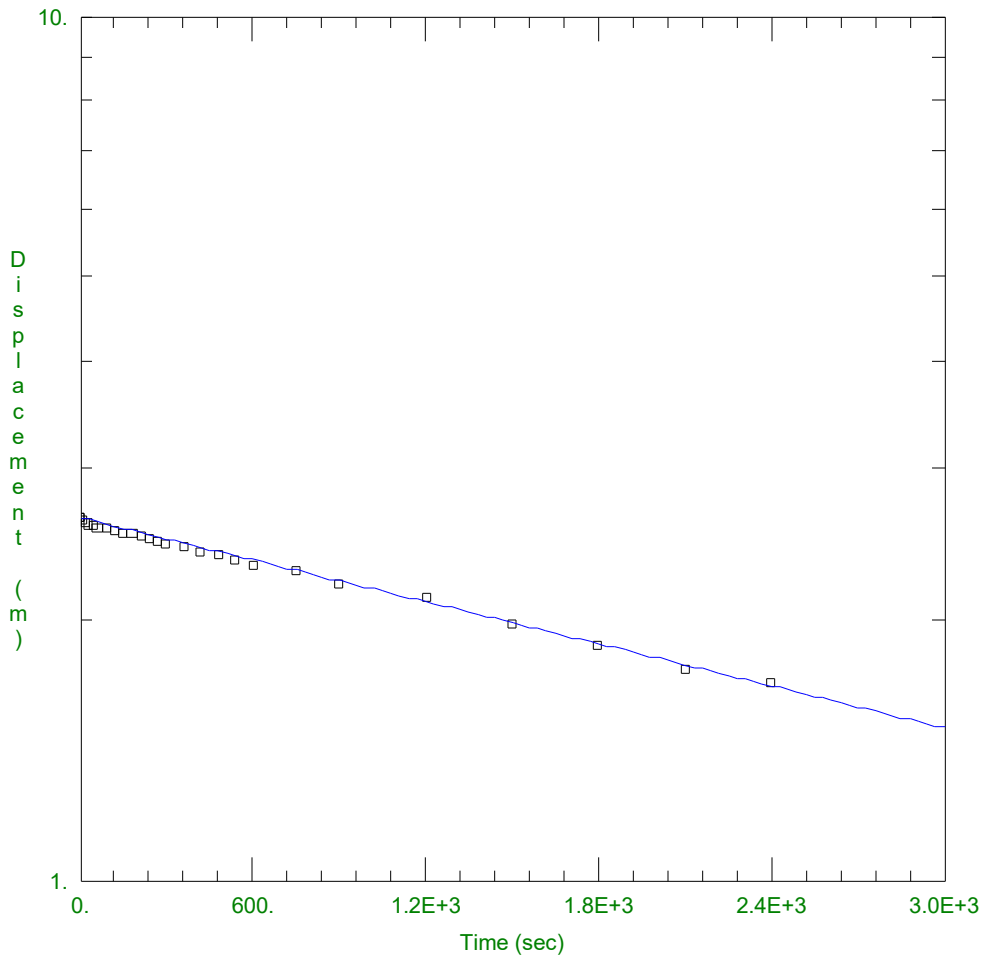
Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 3.833E-5 m/sec

y0 = 0.3313 m





### RISING HEAD TEST RESULTS

Data Set:

Date: 10/22/19

Time: 14:54:43

### PROJECT INFORMATION

Company: Sirati and Partners

Client: JOE TRIUMBARI

Project: SP18-334-30

Location: 17791 MT HOPE ROAD, CALEDON

Test Well: BH19-2

Test Date: October 8, 2109

### AQUIFER DATA

Saturated Thickness: 2.82 m

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (BH19-2)

Initial Displacement: 2.63 m

Static Water Column Height: 2.82 m

Total Well Penetration Depth: 9.1 m

Screen Length: 3. m

Casing Radius: 0.05 m

Well Radius: 0.05 m

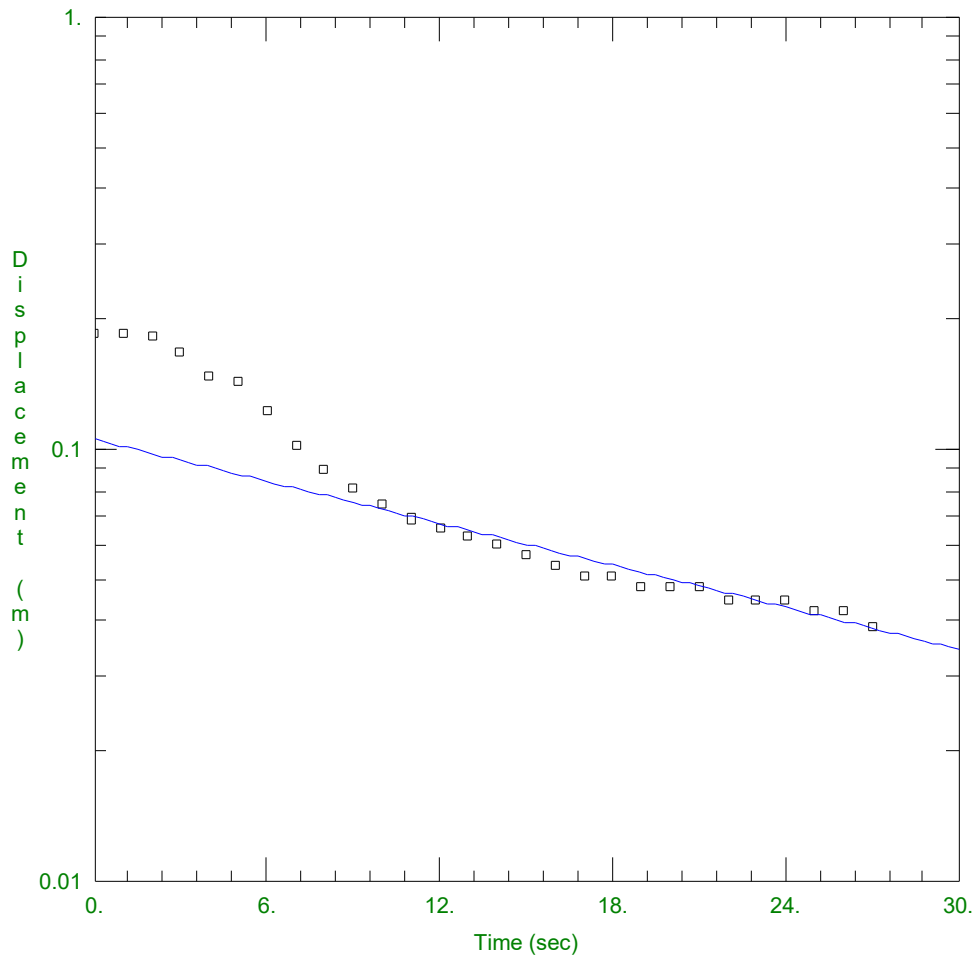
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 3.285E-7 m/sec

y0 = 2.633 m



### FALLING HEAD TEST RESULTS

Data Set: S:\...\BH19-3A.aqt

Date: 11/19/19

Time: 09:06:04

### PROJECT INFORMATION

Company: Sirati and Partners

Client: JOE TRIUMBARI

Project: SP18-334-30

Location: 17791 MT HOPE ROAD, CALEDON

Test Well: BH19-3A

Test Date: October 21, 2109

### AQUIFER DATA

Saturated Thickness: 1.51 m

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (BH19-3A)

Initial Displacement: 0.186 m

Static Water Column Height: 1.51 m

Total Well Penetration Depth: 16.5 m

Screen Length: 3. m

Casing Radius: 0.05 m

Well Radius: 0.05 m

### SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 0.0001226 m/sec

y0 = 0.1053 m

# APPENDIX C

Date	Soil					Snow			
	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jan-62	8.1	48	-7.6	144.3	6.2	1.9	47.5	0	12.7
Feb-62	8.5	72.1	-7.5	138.9	6.4	2.1	118.6	0	6.4
Mar-62	16.4	12.2	18.7	157.6	16.4	0	95.4	0	3.5
Apr-62	33.8	42.2	54	200	33.8	0	47.7	11.5	9.5
May-62	66.9	58.4	12.4	200	66.9	0	23.8	12.4	12.8
Jun-62	78.7	50	-19.3	180.7	78.7	0	11.9	0	7.5
Jul-62	82.4	90.9	9.9	190.6	82.4	0	6	0	7
Aug-62	77.5	37.3	-36.1	156.2	75.8	1.7	0	0	3.1
Sep-62	45.1	86.4	37	193.2	45.1	0	0	0	4.9
Oct-62	31.7	134.4	96	200	31.7	0	0	89.2	51.6
Nov-62	15.5	113.5	79.6	200	15.5	0	13.9	79.6	66.8
Dec-62	9.6	71.1	18.3	200	9.6	0	56.1	18.3	41.2
Jan-63	7.6	25.7	-7.6	192.4	7.6	0	81.8	0	20.1
Feb-63	7.6	15	-7.6	185.1	7.3	0.3	96.8	0	10.1
Mar-63	18.2	57.2	49.8	200	18.2	0	84.4	34.9	24.2
Apr-63	33	59.4	65.6	200	33	0	42.2	65.6	47
May-63	51.2	95	60.1	200	51.2	0	21.1	60.1	56.8
Jun-63	80.7	14.5	-56.4	143.6	80.7	0	10.5	0	26.8
Jul-63	92.7	70.9	-20.1	129.2	87	5.7	5.3	0	16.6
Aug-63	69.8	80	11.5	140.7	69.8	0	0	0	10.5
Sep-63	43.7	65.8	18.8	159.5	43.7	0	0	0	6.5
Oct-63	37.7	18.3	-20.3	143.3	33.6	4.1	0	0	2.5
Nov-63	19.8	71.1	47.8	191.1	19.8	0	0	0	4.4
Dec-63	8.2	58.9	-1.3	189.8	8.1	0.1	51.8	0	0.7
Jan-64	10.3	72.6	25.9	200	10.3	0	87.1	15.7	9.2
Feb-64	9.6	31.8	4.2	200	9.6	0	104.9	4.2	6.4
Mar-64	17.6	73.4	59.4	200	17.6	0	99.2	59.4	34.8
Apr-64	31.2	71.9	86.7	200	31.2	0	49.6	86.7	63.3
May-64	62.5	59.7	19.1	200	62.5	0	24.8	19.1	42.4
Jun-64	77.7	33.8	-33.2	166.8	77.7	0	12.4	0	21.4
Jul-64	98	152.7	53.3	200	98	0	6.2	20	27.5
Aug-64	66.8	136.1	68.7	200	66.8	0	0	68.7	51.1
Sep-64	48.3	21.6	-27.8	172.2	48.3	0	0	0	23.2
Oct-64	27.8	36.3	6.7	178.9	27.8	0	0	0	12.9
Nov-64	18.1	32.3	12.6	191.5	18.1	0	0	0	7.1
Dec-64	10.7	65.3	22.8	200	10.7	0	30.4	14.3	11.3
Jan-65	8.6	88.9	3	200	8.6	0	107.3	3	6.8
Feb-65	9.8	96.5	24.8	200	9.8	0	168.2	24.8	16.6
Mar-65	14.8	50	36.4	200	14.8	0	166.2	36.4	26.9
Apr-65	26.2	48	87.8	200	26.2	0	98	87.8	59
May-65	61.7	75.2	58.7	200	61.7	0	49	58.7	61.6
Jun-65	73.5	35.3	-15.5	184.5	73.5	0	24.5	0	30.7
Jul-65	77	58.7	-8.9	176.3	76.3	0.7	12.3	0	17.4
Aug-65	72.9	96.5	24.9	200	72.9	0	6.1	1.2	12.7

Sep-65	51.7	80.8	31.2	200	51.7	0	0	31.2	23.5
Oct-65	27.8	121.2	87.3	200	27.8	0	0	87.3	59.5
Nov-65	16.3	93.5	65.5	200	16.3	0	7.6	65.5	63.5
Dec-65	12.5	74.2	40.6	200	12.5	0	26.5	40.6	52.3
Jan-66	8.4	67.6	-1.9	198.1	8.4	0	87.4	0	25.2
Feb-66	10.5	37.1	14.5	200	10.5	0	98.9	12.6	19.3
Mar-66	19.6	60.2	59.9	200	19.6	0	77.6	59.9	41.4
Apr-66	28.8	48	54.2	200	28.8	0	40.2	54.2	49.2
May-66	47	69.1	38.8	200	47	0	20.1	38.8	46.3
Jun-66	81.2	101.3	25.1	200	81.2	0	10.1	25.1	39
Jul-66	96.2	40.4	-52.8	147.2	96.2	0	5	0	19
Aug-66	78.5	74.7	-2.5	145.4	77.8	0.7	0	0	12.2
Sep-66	45.1	87.9	38.4	183.8	45.1	0	0	0	8.6
Oct-66	28.8	52.3	20.8	200	28.8	0	0	4.6	7
Nov-66	17.7	112.5	89.4	200	17.7	0	0	89.4	52.3
Dec-66	10.3	72.1	22.8	200	10.3	0	37.8	22.8	36.1
Jan-67	11.1	66.3	29.4	200	11.1	0	62.2	29.4	33.5
Feb-67	8.1	46.7	-8.1	191.9	8.1	0	108.9	0	16.1
Mar-67	16.4	22.1	22	200	16.4	0	92	14	15.5
Apr-67	32	74.9	85.1	200	32	0	46	85.1	53.8
May-67	43.9	45.2	22.1	200	43.9	0	23	22.1	38.3
Jun-67	89.1	191.8	104.6	200	89.1	0	11.5	104.6	79.9
Jul-67	86	78.7	-5.5	194.5	86	0	5.7	0	39.1
Aug-67	70.7	111.8	41.3	200	70.7	0	0	35.8	41.1
Sep-67	45.4	75.9	26.7	200	45.4	0	0	26.7	34.9
Oct-67	29.6	99.8	65.2	200	29.6	0	0	65.2	53.2
Nov-67	14.5	66.8	37.6	200	14.5	0	12.3	37.6	45.3
Dec-67	11.4	88.1	42.9	200	11.4	0	44	42.9	45
Jan-68	7.9	65.5	-7.9	192.1	7.9	0	109.5	0	21.4
Feb-68	8.4	29.7	-8.4	184	8.1	0.3	139.2	0	10.7
Mar-68	19.9	55.4	72.2	200	19.9	0	100.5	56.3	35.4
Apr-68	36.4	40.4	52.2	200	36.4	0	50.3	52.2	44.9
May-68	49.4	92.7	63.8	200	49.4	0	25.1	63.8	58
Jun-68	78.2	62	-6.8	193.2	78.2	0	12.6	0	29.8
Jul-68	91.5	68.6	-20.1	173.8	90.9	0.7	6.3	0	16.8
Aug-68	78	150.4	71.1	200	78	0	0	45	36.7
Sep-68	56.1	125.5	63.2	200	56.1	0	0	63.2	52.4
Oct-68	33.9	67.3	30	200	33.9	0	0	30	41.5
Nov-68	16.2	107.7	77.6	200	16.2	0	9.3	77.6	62.4
Dec-68	9.5	73.7	17.3	200	9.5	0	55.2	17.3	38.6
Jan-69	9.5	63.5	13.5	200	9.5	0	95.1	13.5	26.2
Feb-69	10.1	39.4	12.5	200	10.1	0	111.5	12.5	19.4
Mar-69	15.9	56.1	38.5	200	15.9	0	111.9	38.5	30
Apr-69	34.2	117.3	133.1	200	34.2	0	55.9	133.1	86.8
May-69	54.5	84.1	53.4	200	54.5	0	28	53.4	71.4
Jun-69	72.6	85.6	22.7	200	72.6	0	14	22.7	49.2
Jul-69	88.7	56.1	-28.5	171.5	88.7	0	7	0	25.3

Aug-69	86.2	56.4	-25.6	149.6	82.5	3.6	0	0	14
Sep-69	51.4	15.7	-36.5	122.3	42.2	9.2	0	0	6.4
Oct-69	29.2	82	48.7	171	29.2	0	0	0	6.9
Nov-69	17.2	102.6	80.6	200	17.2	0	0	51.6	32
Dec-69	9.1	52.3	6.2	200	9.1	0	36.4	6.2	17.3
Jan-70	7.2	45.2	-7.2	192.8	7.2	0	81.6	0	8.3
Feb-70	9.1	23.1	-2	190.9	9.1	0.1	97.5	0	4.3
Mar-70	15.2	48.8	26.3	200	15.2	0	103.9	17.2	11.6
Apr-70	32.8	72.6	88.1	200	32.8	0	51.9	88.1	53
May-70	59.4	70.9	33.9	200	59.4	0	26	33.9	45.2
Jun-70	79.2	53.6	-15.3	184.7	79.2	0	13	0	23.5
Jul-70	95.6	90.7	-2.9	182	95.4	0.2	6.5	0	14.9
Aug-70	80	86.4	8.6	190.6	80	0	0	0	9.5
Sep-70	52.4	110.7	52.8	200	52.4	0	0	43.4	29.8
Oct-70	32.5	101.1	63.6	200	32.5	0	0	63.6	49
Nov-70	17.8	57.2	36.7	200	17.8	0	0	36.7	43.1
Dec-70	9.4	80.3	17.1	200	9.4	0	52.9	17.1	29.7
Jan-71	7.7	44.2	-7.7	192.3	7.7	0	97.1	0	14.3
Feb-71	10.4	67.3	24.8	200	10.4	0	128.4	17.1	16.6
Mar-71	14.9	36.8	24.4	200	14.9	0	125.3	24.4	20.7
Apr-71	28.6	25.9	56.4	200	28.6	0	64.9	56.4	39.5
May-71	54.5	31	7.4	200	54.5	0	32.5	7.4	24.4
Jun-71	85.9	81.5	7.8	200	85.9	0	16.2	7.8	19.4
Jul-71	86.6	87.1	4.3	200	86.6	0	8.1	4.3	14.2
Aug-71	75.6	97.5	25.1	200	75.6	0	0	25.1	22.3
Sep-71	57.8	21.8	-37.1	162.9	57.8	0	0	0	9.8
Oct-71	39.1	37.8	-3.2	160.3	38.5	0.6	0	0	6.3
Nov-71	16.5	45	26.5	186.8	16.5	0	0	0	4.1
Dec-71	12	106.4	56.6	200	12	0	34.8	43.5	25.7
Jan-72	9.3	56.4	7.7	200	9.3	0	73.7	7.7	15.8
Feb-72	8.8	56.1	-2.7	197.3	8.8	0	123.5	0	7.8
Mar-72	14.1	87.6	36.3	200	14.1	0	159.5	33.6	21.9
Apr-72	25.9	59.9	94	200	25.9	0	96.9	94	59.9
May-72	61.3	56.1	40.4	200	61.3	0	48.5	40.4	51.7
Jun-72	71.3	109.5	57	200	71.3	0	24.2	57	58.4
Jul-72	92.7	36.8	-45.6	154.4	92.7	0	12.1	0	28.3
Aug-72	76.6	42.7	-30	131.3	69.8	6.8	6.1	0	15.4
Sep-72	53	50.5	1	132.3	53	0	0	0	9.1
Oct-72	25.8	116.3	84.7	200	25.8	0	0	17	17.6
Nov-72	14.9	62.2	35	200	14.9	0	10	35	25.7
Dec-72	10.9	124.2	57	200	10.9	0	63.6	57	42.9
Jan-73	10.3	44.2	17.1	200	10.3	0	79.7	17.1	29.4
Feb-73	8.7	42.9	-4.9	195.1	8.7	0	118.7	0	14.4
Mar-73	23.7	98	119.9	200	23.7	0	68.6	115	69.1
Apr-73	34	76.7	73.1	200	34	0	34.3	73.1	72.7
May-73	51.9	98	58.4	200	51.9	0	17.2	58.4	68.5
Jun-73	87.5	78	-4.8	195.2	87.5	0	8.6	0	35.7

Jul-73	97.4	46	-45.1	151.2	96.3	1.1	0	0	18.2
Aug-73	92.2	115.8	17.8	168.9	92.2	0	0	0	13.7
Sep-73	51.7	50	-4.2	165.4	51.1	0.7	0	0	6.5
Oct-73	34.1	95.3	56.4	200	34.1	0	0	21.8	17.7
Nov-73	17.1	89.2	68	200	17.1	0	0	68	44.5
Dec-73	10.3	75.7	25	200	10.3	0	39	25	34.1
Jan-74	9.8	102.1	28.6	200	9.8	0	101.4	28.6	31.9
Feb-74	8.5	69.6	-7.3	192.7	8.5	0	169.8	0	15.3
Mar-74	17.4	60.5	67.2	200	17.4	0	144.1	59.9	39.2
Apr-74	35.1	104.1	135.8	200	35.1	0	72.1	135.8	91.9
May-74	49.7	106.2	87.3	200	49.7	0	36	87.3	92.3
Jun-74	79.2	64.8	0.4	200	79.2	0	18	0.4	46.9
Jul-74	96.2	33.5	-55.4	144.6	96.2	0	9	0	23.5
Aug-74	84	96.5	16.6	161.3	84	0	0	0	15.7
Sep-74	47.7	51.1	0.8	162.1	47.7	0	0	0	8
Oct-74	28.3	36.6	6.5	168.6	28.3	0	0	0	4.6
Nov-74	17.4	100.1	78.1	200	17.4	0	0	46.6	29.4
Dec-74	12.2	41.7	15.5	200	12.2	0	12.8	15.5	21.3
Jan-75	11	52.6	16.8	200	11	0	36.5	16.8	19.5
Feb-75	10.9	90.7	31	200	10.9	0	84	31	26.1
Mar-75	15.5	66.3	35.1	200	15.5	0	98.3	35.1	31.2
Apr-75	25.3	57.9	64.4	200	25.3	0	64.2	64.4	49.5
May-75	71.6	59.4	16.9	200	71.6	0	32.1	16.9	35
Jun-75	86.9	66.5	-7.7	192.3	86.9	0	16	0	19.3
Jul-75	99.2	85.1	-10.4	182.3	98.8	0.4	8	0	12.3
Aug-75	81.5	117.9	38.5	200	81.5	0	0	20.9	20.3
Sep-75	45.1	65	16.6	200	45.1	0	0	16.6	18.8
Oct-75	32.5	28.4	-5.5	194.5	32.5	0	0	0	9.2
Nov-75	21.3	52.6	28.7	200	21.3	0	0	23.2	18.1
Dec-75	9.5	83.3	19.4	200	9.5	0	53.3	19.4	18.5
Jan-76	7.6	88.4	-7.6	192.4	7.6	0	141.7	0	8.7
Feb-76	12	91.2	66.7	200	12	0	152.3	59	35.8
Mar-76	19.3	106.4	111.1	200	19.3	0	124.8	111.1	76
Apr-76	35.8	72.6	95.6	200	35.8	0	62.4	95.6	87.7
May-76	52.2	85.3	60	200	52.2	0	31.2	60	76.3
Jun-76	89.1	76.5	-0.8	199.2	89.1	0	15.6	0	39.8
Jul-76	89.9	112.8	25.1	200	89.9	0	7.8	24.3	35.8
Aug-76	85.1	110.5	27.7	200	85.1	0	0	27.7	34.4
Sep-76	48.9	116.8	62.1	200	48.9	0	0	62.1	51.3
Oct-76	25	74.4	45.7	200	25	0	0	45.7	49.3
Nov-76	13.5	35.8	12.1	200	13.5	0	9	12.1	30
Dec-76	8.2	41.7	-2.9	197.1	8.2	0	45.3	0	14.6
Jan-77	6.7	72.7	-6.7	190.5	6.6	0.1	118	0	7.2
Feb-77	9.7	33.3	8.3	198.8	9.7	0	133	0	3.9
Mar-77	21.3	85.2	102.1	200	21.3	0	91.3	101	55.7
Apr-77	36.2	40.7	48.1	200	36.2	0	45.7	48.1	52.2
May-77	65.6	23.7	-20.3	179.7	65.6	0	22.8	0	26.3

Jun-77	74.4	73	6.3	186	74.4	0	11.4	0	16.2
Jul-77	99.8	90.3	-8.3	178.3	99.3	0.6	5.7	0	10.8
Aug-77	76.1	164	85.4	200	76.1	0	0	63.7	43.2
Sep-77	51.1	142.9	84.7	200	51.1	0	0	84.7	67
Oct-77	28.5	86.8	54	200	28.5	0	0	54	61.2
Nov-77	17.6	85.9	64.3	200	17.6	0	0	64.3	64.6
Dec-77	9.7	114.6	34.1	200	9.7	0	69.1	34.1	49
Jan-78	8	82.5	-8	192	8	0	151.6	0	23.7
Feb-78	7.5	17.2	-7.5	184.8	7.2	0.3	168.8	0	11.8
Mar-78	14.7	50	35.5	200	14.7	0	167.7	20.4	16.9
Apr-78	27.9	61.6	107.7	200	27.9	0	90.9	107.7	64.8
May-78	60.2	100.2	80.4	200	60.2	0	45.4	80.4	76.2
Jun-78	79.7	64.8	4.6	200	79.7	0	22.7	4.6	41.1
Jul-78	94.4	23.8	-60.5	139.5	94.4	0	11.4	0	20.1
Aug-78	82.5	153.8	69.3	200	82.5	0	5.7	8.8	21.6
Sep-78	49.2	152.2	101.1	200	49.2	0	0	101.1	65.1
Oct-78	29	45.2	13.9	200	29	0	0	13.9	38
Nov-78	16.5	63.1	43.8	200	16.5	0	0	43.8	42.5
Dec-78	10.7	72.8	26.7	200	10.7	0	33.9	26.7	34.7
Jan-79	8.3	67.2	-3.2	196.8	8.3	0	95.8	0	16.8
Feb-79	7	29.2	-7	189.9	6.9	0.1	125	0	8.3
Mar-79	20.5	83.4	92.9	200	20.5	0	91.9	82.8	48.6
Apr-79	29.7	114.2	124.7	200	29.7	0	45.9	124.7	90.8
May-79	55.2	87.4	50.8	200	55.2	0	23	50.8	72.3
Jun-79	80.7	78.4	5.3	200	80.7	0	11.5	5.3	40.5
Jul-79	93.8	25	-64.3	135.7	93.8	0	5.7	0	19.6
Aug-79	74.7	89.2	15.8	151.4	74.7	0	0	0	13.6
Sep-79	50.8	37.4	-15.2	139.9	47.1	3.7	0	0	6.4
Oct-79	28.8	112.2	77.7	200	28.8	0	0	17.6	16.7
Nov-79	17.2	110.4	88	200	17.2	0	0	88	54.7
Dec-79	11.8	91.2	45.2	200	11.8	0	31.8	45.2	49.8
Jan-80	9.7	47.4	8.2	200	9.7	0	60.8	8.2	28.3
Feb-80	8.6	19.3	-7.3	192.7	8.6	0	78.8	0	13.9
Mar-80	16.3	64	38.3	200	16.3	0	86.6	31.1	24
Apr-80	32.4	111.7	117	200	32.4	0	43.3	117	75.3
May-80	62.5	34.2	-8.3	191.7	62.5	0	21.7	0	36.6
Jun-80	69.1	102	38.6	200	69.1	0	10.8	30.3	37.7
Jul-80	95	156.2	58.8	200	95	0	5.4	58.8	53.5
Aug-80	87.2	46	-38.1	161.9	87.2	0	0	0	25.1
Sep-80	48.9	86	32.8	194.7	48.9	0	0	0	15.7
Oct-80	25.3	66	37.4	200	25.3	0	0	32	25
Nov-80	15.2	50.8	26.6	200	15.2	0	7	26.6	26.1
Dec-80	8.4	59.4	1.9	200	8.4	0	55.7	1.9	13.4
Jan-81	7.2	13	-7.2	192.8	7.2	0	68.7	0	6.5
Feb-81	12.6	53.7	35.8	200	12.6	0	72.7	28.6	18.9
Mar-81	18.5	31.2	25.9	200	18.5	0	58.5	25.9	22.7
Apr-81	34.7	43.6	36	200	34.7	0	29.3	36	31



May-81	53.5	60	18.1	200	53.5	0	14.6	18.1	26.5
Jun-81	82.2	101.8	21.8	200	82.2	0	7.3	21.8	27.8
Jul-81	95.6	115.4	21.3	200	95.6	0	0	21.3	27.8
Aug-81	78	136	51.2	200	78	0	0	51.2	43.4
Sep-81	48.9	88.8	35.5	200	48.9	0	0	35.5	40.5
Oct-81	26	91.6	61.1	200	26	0	0	61.1	53.1
Nov-81	16.9	61.8	42.1	200	16.9	0	0	42.1	48.1
Dec-81	10.8	44.6	12.5	200	10.8	0	20.4	12.5	29.8
Jan-82	7.1	63.2	-7.1	192.9	7.1	0	83.6	0	14.4
Feb-82	9.1	21	-2.6	190.3	9	0.1	98.1	0	7.3
Mar-82	16.4	70.2	47.1	200	16.4	0	103	37.5	24
Apr-82	29.2	56	75	200	29.2	0	52.1	75	51.4
May-82	69	60.6	14.6	200	69	0	26.1	14.6	34.7
Jun-82	70.4	132.6	68.6	200	70.4	0	13	68.6	56.8
Jul-82	96.2	83.8	-10.1	189.9	96.2	0	6.5	0	29.3
Aug-82	69.8	132.6	62.7	200	69.8	0	0	52.6	45.5
Sep-82	49.5	110.8	55.7	200	49.5	0	0	55.7	52.8
Oct-82	31.3	41.2	7.9	200	31.3	0	0	7.9	29.6
Nov-82	17.7	134.4	110.3	200	17.7	0	0	110.3	75.4
Dec-82	13.3	102.2	63.5	200	13.3	0	21.9	63.5	69.7
Jan-83	10.2	37.6	7.4	200	10.2	0	41.3	7.4	37.4
Feb-83	11.8	32.2	13.3	200	11.8	0	47.8	13.3	25.7
Mar-83	19.4	66	46.4	200	19.4	0	45.7	46.4	37.9
Apr-83	30.4	96.2	83.8	200	30.4	0	22.9	83.8	64.6
May-83	48.7	126.4	82.8	200	48.7	0	11.4	82.8	77.6
Jun-83	82.2	35	-43.2	156.8	82.2	0	5.7	0	37.4
Jul-83	104.3	75.4	-26.9	135.7	98.4	5.8	0	0	21.6
Aug-83	88.3	81.2	-11.2	128.1	84.7	3.6	0	0	13
Sep-83	56.4	43.4	-15.2	118.4	50.9	5.5	0	0	6.6
Oct-83	30.3	82	47.6	165.9	30.3	0	0	0	6.3
Nov-83	16.9	77	56.6	200	16.9	0	0	22.5	15.9
Dec-83	8.9	96.1	15.6	200	8.9	0	70.7	15.6	14.9
Jan-84	7.9	41.5	-7.9	192.1	7.9	0	112.2	0	7
Feb-84	13.3	74	66.1	200	13.3	0	104.7	58.3	34.7
Mar-84	14	75.8	28.2	200	14	0	137.2	28.2	31.5
Apr-84	34.7	50.2	81.6	200	34.7	0	68.6	81.6	58.5
May-84	55.2	82.2	57.2	200	55.2	0	34.3	57.2	60.7
Jun-84	84.3	54.6	-15.2	184.8	84.3	0	17.2	0	31
Jul-84	92.1	49.4	-36.6	150.9	89.3	2.8	8.6	0	16.6
Aug-84	88.9	73.8	-10.2	143.3	86.4	2.5	0	0	10.8
Sep-84	46.3	86.7	36.1	179.4	46.3	0	0	0	7.9
Oct-84	32.9	49.6	14.3	193.6	32.9	0	0	0	4.2
Nov-84	16.5	78.4	52.8	200	16.5	0	5.7	46.4	27.5
Dec-84	12.7	97.7	57.8	200	12.7	0	29.8	57.8	44
Jan-85	8.2	63.3	-5.8	194.2	8.2	0	90.7	0	20.6
Feb-85	9.9	108.9	27.8	200	9.9	0	160.8	22	22.3
Mar-85	18.4	95.7	97.4	200	18.4	0	137.9	97.4	62.2

Apr-85	37.4	43.3	72.7	200	37.4	0	68.9	72.7	68.2	
May-85	60.6	91.6	60.9	200	60.6	0	34.5	60.9	68.1	
Jun-85	72.2	26.6	-29.7	170.3	72.2	0	17.2	0	33.1	
Jul-85	92.7	59.6	-27.4	147	88.6	4.1	8.6	0	18.8	
Aug-85	78.5	148.7	71.4	200	78.5	0	0	18.3	24.5	
Sep-85	56.8	118.9	56.2	200	56.8	0	0	56.2	42.6	
Oct-85	30.7	62.4	28.6	200	30.7	0	0	28.6	35.7	
Nov-85	16.4	114.6	84.4	200	16.4	0	8.8	84.4	63.5	
Dec-85	9.4	58.8	11.6	200	9.4	0	45.9	11.6	35.8	
Jan-86	9.5	30.8	3.6	200	9.5	0	63.3	3.6	19.6	
Feb-86	9.4	64.3	6.1	200	9.4	0	111.7	6.1	13.1	
Mar-86	19.8	59.3	64.9	200	19.8	0	84.3	64.9	40.9	
Apr-86	37.1	63.1	64.9	200	37.1	0	42.1	64.9	55	
May-86	66.5	72.1	23.1	200	66.5	0	21.1	23.1	41.1	
Jun-86	74.9	106.9	37.2	200	74.9	0	10.5	37.2	42.7	
Jul-86	101.1	122	20.1	200.0	1	1.1	0	5.3	20.1	34.8
Aug-86	75.2	145.6	68.4	200	75.2	0	0	68.4	55.8	
Sep-86	50.8	218.9	157.2	200	50.8	0	0	157.2	113.8	
Oct-86	29.8	64.4	31.4	200	29.8	0	0	31.4	70.4	
Nov-86	15.1	33.4	17	200	15.1	0	0	17	43.3	
Dec-86	11.6	53.8	21.2	200	11.6	0	19.6	21.2	33	
Jan-87	9.9	70.4	16.4	200	9.9	0	62.8	16.4	24.9	
Feb-87	10	20	2.3	200	10	0	70.3	2.3	13.3	
Mar-87	20.5	68.7	60.7	200	20.5	0	55.2	60.7	39.5	
Apr-87	39	85	69.3	200	39	0	27.6	69.3	57.4	
May-87	66.1	33.6	-20.3	179.7	66.1	0	13.8	0	28.2	
Jun-87	88	62	-22.2	159.7	85.8	2.3	6.9	0	16.4	
Jul-87	109.6	95.1	-12.3	149.9	1	7.1	2.5	0	0	11.4
Aug-87	81.5	91.6	5.5	155.4	81.5	0	0	0	0	7.9
Sep-87	53.3	68.5	11.7	167.1	53.3	0	0	0	0	5.1
Oct-87	26.6	79.5	48.9	200	26.6	0	0	16	12.8	
Nov-87	16.8	93.2	72.2	200	16.8	0	0	72.2	44.7	
Dec-87	12.2	44.9	17.6	200	12.2	0	13.7	17.6	30.4	
Jan-88	9.5	52.8	6.8	200	9.5	0	49.6	6.8	18.5	
Feb-88	9.2	91.4	7.9	200	9.2	0	123.3	7.9	13.5	
Mar-88	17.7	32.2	38.3	200	17.7	0	98.6	38.3	26.5	
Apr-88	32.4	58.9	72.9	200	32.4	0	49.3	72.9	52.2	
May-88	64.8	52.4	9.6	200	64.8	0	24.7	9.6	32	
Jun-88	80.7	48.2	-22.6	177.4	80.7	0	12.3	0	17.1	
Jul-88	108.9	61.2	-44.6	137.9	1	3.9	5	6.2	0	10.4
Aug-88	90	73	-14.5	127.9	85.5	4.5	0	0	0	7.3
Sep-88	50.8	106.1	50	177.9	50.8	0	0	0	0	7.1
Oct-88	25.6	93.5	63.2	200	25.6	0	0	41.1	26.2	
Nov-88	18.2	101.9	78.6	200	18.2	0	0	78.6	55.1	
Dec-88	10.5	37	7.4	200	10.5	0	18.4	7.4	29.4	
Jan-89	11.6	49	19.2	200	11.6	0	35.6	19.2	25.1	
Feb-89	9.1	39.6	-2.4	197.6	9.1	0	68.4	0	12.2	

Mar-89	15.8	58	29.5	200	15.8	0	79.8	27.1	20.8
Apr-89	29.7	47.5	55.3	200	29.7	0	39.9	55.3	39.8
May-89	57.6	106.2	63.2	200	57.6	0	19.9	63.2	55.6
Jun-89	84.8	132	50.6	200	84.8	0	10	50.6	57
Jul-89	99.2	26.2	-64.4	135.6	99.2	0	0	0	26.5
Aug-89	80	100.6	15.6	151.2	80	0	0	0	17.6
Sep-89	51.1	39.7	-13.4	141.1	47.8	3.3	0	0	8.3
Oct-89	30.7	75.2	40.7	181.9	30.7	0	0	0	6.9
Nov-89	15	154.6	110.6	200	15	0	23.1	92.5	53.7
Dec-89	6.8	41	-6.8	193.2	6.8	0	64.1	0	23.9
Jan-90	12.4	60.2	42.1	200	12.4	0	68.2	35.3	31.2
Feb-90	11.1	60.2	25.8	200	11.1	0	90.6	25.8	28.7
Mar-90	20	64.4	62.6	200	20	0	70	62.6	47.4
Apr-90	37.6	49.6	44.6	200	37.6	0	35	44.6	47.3
May-90	53.8	124	81.5	200	53.8	0	17.5	81.5	69.4
Jun-90	84.3	109.8	28.8	200	84.3	0	8.8	28.8	51.5
Jul-90	94.4	80.4	-9.3	190.7	94.4	0	0	0	27
Aug-90	82	88.1	1.7	192.4	82	0	0	0	15.9
Sep-90	50.8	90.9	35.6	200	50.8	0	0	28	24.3
Oct-90	29.6	134.4	98.1	200	29.6	0	0	98.1	65.7
Nov-90	18.6	83.1	60.4	200	18.6	0	0	60.4	63.8
Dec-90	12	98	51.2	200	12	0	32.1	51.2	58.1
Jan-91	9.1	48	3.8	200	9.1	0	66.8	3.8	30
Feb-91	12	63.3	35.8	200	12	0	80.9	35.8	34.1
Mar-91	20.2	106.1	92.4	200	20.2	0	70.6	92.4	66.4
Apr-91	37.6	133.6	124.6	200	37.6	0	35.3	124.6	100.3
May-91	72.9	65.6	7	200	72.9	0	17.6	7	53.6
Jun-91	91.3	44.1	-40.6	159.4	91.3	0	8.8	0	27.4
Jul-91	98.6	93	-1.4	158.2	98.3	0.3	0	0	17.2
Aug-91	87.8	76.6	-15	146.3	84.6	3.1	0	0	10.1
Sep-91	48.3	51.1	0.2	146.6	48.3	0	0	0	5.7
Oct-91	32.9	100.2	62.3	200	32.9	0	0	8.9	11
Nov-91	15.6	59.6	34.6	200	15.6	0	7	34.6	22.7
Dec-91	10.9	64	25	200	10.9	0	33.7	25	24
Jan-92	10.3	42.5	11.8	200	10.3	0	53.3	11.8	17.9
Feb-92	11.1	46.2	17.4	200	11.1	0	70.3	17.4	18.1
Mar-92	16.7	52.6	32.1	200	16.7	0	72.8	32.1	26
Apr-92	30.6	107.2	107.6	200	30.6	0	36.4	107.6	71.5
May-92	56.6	85.6	42.9	200	56.6	0	18.2	42.9	58.8
Jun-92	71.3	55.4	-9.6	190.4	71.3	0	9.1	0	30
Jul-92	79.9	126.6	49.5	200	79.9	0	0	39.9	39.9
Aug-92	70.7	173.8	94.5	200	70.7	0	0	94.5	72.7
Sep-92	49.8	91.4	37	200	49.8	0	0	37	55.1
Oct-92	26.5	48.6	19.7	200	26.5	0	0	19.7	37.5
Nov-92	15.9	167.2	127.4	200	15.9	0	17	127.4	88.2
Dec-92	11.6	70.6	35.8	200	11.6	0	38.3	35.8	60.3
Jan-93	10.3	85.9	29.1	200	10.3	0	83.6	29.1	45.1

Feb-93	7.9	34	-7.9	192.1	7.9	0	117.6	0	21.9
Mar-93	15.7	33.2	26.3	200	15.7	0	108	18.4	20.9
Apr-93	33	75.6	92.8	200	33	0	54	92.8	60.3
May-93	55.2	61.6	30.3	200	55.2	0	27	30.3	46.5
Jun-93	76.3	111.4	43	200	76.3	0	13.5	43	48.8
Jul-93	98.6	80.4	-15.5	184.5	98.6	0	6.7	0	25.6
Aug-93	86.2	54.4	-27.7	158.9	84	2.1	0	0	13.5
Sep-93	44	68.8	21.3	180.3	44	0	0	0	8.8
Oct-93	27.8	72.3	40.9	200	27.8	0	0	21.2	16.9
Nov-93	15.9	63.4	38.4	200	15.9	0	6.4	38.4	28.5
Dec-93	10.8	20	1	200	10.8	0	14.2	1	13.8
Jan-94	6.2	69	-6.2	193.8	6.2	0	83.2	0	6.7
Feb-94	8.1	18	-8.1	185.9	7.9	0.3	101.2	0	3.4
Mar-94	17.2	35.4	31.6	200	17.2	0	86.9	17.5	11.4
Apr-94	34.5	87.4	92	200	34.5	0	43.5	92	55.6
May-94	52.5	107.6	71.4	200	52.5	0	21.7	71.4	66.7
Jun-94	85.3	49.4	-27.5	172.5	85.3	0	10.9	0	33.1
Jul-94	98	54.7	-40.6	137.5	92.4	5.6	5.4	0	18.1
Aug-94	74.2	50	-21.3	122.8	67.6	6.7	0	0	10.2
Sep-94	50.4	63	9.4	132.2	50.4	0	0	0	7
Oct-94	30.9	59.5	25.6	157.9	30.9	0	0	0	4.9
Nov-94	18.9	71	48.5	200	18.9	0	0	6.4	7.7
Dec-94	12.5	38.4	13.8	200	12.5	0	11	13.8	10.1
Jan-95	11.2	116.9	50.2	200	11.2	0	64.1	50.2	32
Feb-95	8.7	24.2	-6.2	193.8	8.7	0	85.7	0	14.8
Mar-95	20.4	3.4	13.9	200	20.4	0	54.7	7.7	11.4
Apr-95	27.4	93.2	82.4	200	27.4	0	33.8	82.4	51.1
May-95	56.9	76.2	32.4	200	56.9	0	16.9	32.4	43.4
Jun-95	90.2	79.8	-6	194	90.2	0	8.4	0	23.8
Jul-95	101.1	65.9	-30	164.9	1	0.2	0.9	0	13.2
Aug-95	91.1	62.2	-32	138.5	85.5	5.6	0	0	8.1
Sep-95	46.5	45.4	-3.4	136.1	45.5	1	0	0	4.7
Oct-95	33.3	146.3	105.7	200	33.3	0	0	41.9	29.5
Nov-95	13.8	142.2	90.7	200	13.8	0	33.1	90.7	61.1
Dec-95	9.1	34	4.4	200	9.1	0	53.2	4.4	30.8
Jan-96	8.6	66.8	2.2	200	8.6	0	108.8	2.2	16.6
Feb-96	9.8	43.8	10.8	200	9.8	0	131.6	10.8	13.9
Mar-96	15.5	62.8	43	200	15.5	0	134.7	43	29.5
Apr-96	28.1	97.8	126.2	200	28.1	0	73.6	126.2	81.8
May-96	53.2	93	72	200	53.2	0	36.8	72	79.2
Jun-96	85.9	149.2	74.3	200	85.9	0	18.4	74.3	81.9
Jul-96	88.7	112.4	27.2	200	88.7	0	9.2	27.2	56.5
Aug-96	83.5	52	-24.9	175.1	83.5	0	0	0	28
Sep-96	51.7	155.1	95.6	200	51.7	0	0	70.7	55.8
Oct-96	29.9	65.2	32	200	29.9	0	0	32	43.3
Nov-96	14.2	40.6	16.8	200	14.2	0	8.2	16.8	29.8
Dec-96	12.5	107.7	64.4	200	12.5	0	35.7	64.4	49.6

Jan-97	8.9	87.5	7.9	200	8.9	0	105.9	7.9	27.7
Feb-97	11.5	77.6	45.2	200	11.5	0	125.3	45.2	37.7
Mar-97	16.7	84	64.5	200	16.7	0	126.1	64.5	52.4
Apr-97	30.8	29.6	60.3	200	30.8	0	63	60.3	56.8
May-97	45.5	90.8	72.2	200	45.5	0	31.5	72.2	68.3
Jun-97	91.9	79.7	-0.4	199.6	91.9	0	15.8	0	35.9
Jul-97	92.7	58.3	-29.4	170.2	92.6	0.1	7.9	0	18.9
Aug-97	73.3	72.5	3.4	173.6	73.3	0	0	0	11.6
Sep-97	51.7	63.7	8.8	182.4	51.7	0	0	0	7.2
Oct-97	29.6	50.6	18.5	200	29.6	0	0	0.9	5
Nov-97	15.4	70.6	43.4	200	15.4	0	9	43.4	25.7
Dec-97	11.9	30.6	10	200	11.9	0	16.8	10	17.3
Jan-98	11.3	129.2	58.6	200	11.3	0	73.4	58.6	40.2
Feb-98	13.6	40.8	35.1	200	13.6	0	64.4	35.1	37.5
Mar-98	20	117.8	94.9	200	20	0	63	94.9	69.8
Apr-98	36	39.2	32.8	200	36	0	31.5	32.8	51.1
May-98	74.8	56.7	-5.2	194.8	74.8	0	15.8	0	27.4
Jun-98	83.8	57	-21.7	173.7	83.2	0.6	7.9	0	15.1
Jul-98	95	47.8	-41.7	137.5	89.5	5.5	0	0	8.5
Aug-98	85.1	96.4	6.5	143.9	85.1	0	0	0	7.9
Sep-98	55	44	-13.2	134.4	51.3	3.7	0	0	3.7
Oct-98	31.1	13.6	-18.2	122.2	25.1	6	0	0	1.4
Nov-98	17.6	45.2	25.5	147.7	17.6	0	0	0	2.5
Dec-98	12.3	51	22	169.7	12.3	0	15.3	0	1.7
Jan-99	8.6	125.5	8	177.6	8.6	0	123.6	0	0.7
Feb-99	13.4	40.6	48.2	200	13.4	0	101.5	25.8	14.1
Mar-99	19.2	15.5	25.9	200	19.2	0	71.4	25.9	19.9
Apr-99	33.2	48.2	48.3	200	33.2	0	35.7	48.3	36.3
May-99	73.9	85	24.7	200	73.9	0	17.9	24.7	33.5
Jun-99	89.1	68.7	-14.9	185.1	89.1	0	8.9	0	18.1
Jul-99	113	63.4	-43.9	144.5	1	9.7	3.3	0	10.5
Aug-99	77.1	70.7	-9.9	137.3	74.3	2.7	0	0	7.2
Sep-99	55.4	71.6	12.7	150	55.4	0	0	0	5.4
Oct-99	29.9	64.1	31	181	29.9	0	0	0	4.1
Nov-99	19.2	102.4	78.1	200	19.2	0	0	59.1	35.1
Dec-99	11.9	55	23.2	200	11.9	0	18.4	23.2	28.1
Jan-00	9.6	46.1	5.9	200	9.6	0	48.5	5.9	16.7
Feb-00	12.1	55.7	29	200	12.1	0	61.9	29	23.8
Mar-00	23.7	40.6	41.6	200	23.7	0	35.3	41.6	34
Apr-00	32	67	49.3	200	32	0	17.7	49.3	44.1
May-00	62.5	164.9	103	200	62.5	0	8.8	103	80.1
Jun-00	83.8	219	133.1	200	83.8	0	0	133.1	113.4
Jul-00	87.1	91.2	-0.5	199.5	87.1	0	0	0	55.8
Aug-00	78.5	68.4	-13.5	186	78.5	0	0	0	29
Sep-00	51.7	110.6	53.4	200	51.7	0	0	39.4	38
Oct-00	33.7	29.6	-5.6	194.4	33.7	0	0	0	17.7
Nov-00	16.4	65.4	46.2	200	16.4	0	0	40.6	31.3

Dec-00	8.2	74.7	0.5	200	8.2	0	65.7	0.5	14.8
Jan-01	10.4	11.5	4.7	200	10.4	0	61.9	4.7	9.7
Feb-01	10.9	70.5	27.6	200	10.9	0	92.8	27.6	19.7
Mar-01	17.4	30.5	27.2	200	17.4	0	77.9	27.2	23.7
Apr-01	35.5	41	42.3	200	35.5	0	38.9	42.3	34.7
May-01	63.2	79.2	31.5	200	63.2	0	19.5	31.5	36
Jun-01	84.3	94.4	15.1	200	84.3	0	9.7	15.1	28.3
Jul-01	89.9	73.6	-10.2	189.8	89.9	0	0	0	15.5
Aug-01	91.7	48.6	-45.5	146.6	89.4	2.3	0	0	8.3
Sep-01	51.7	84.4	28.5	175.1	51.7	0	0	0	7.2
Oct-01	31.1	150.3	111.7	200	31.1	0	0	86.8	52.4
Nov-01	21.2	85.6	60.2	200	21.2	0	0	60.2	56.8
Dec-01	13.8	37	15.1	200	13.8	0	6.8	15.1	35.1
Jan-02	12.5	31.5	9.4	200	12.5	0	15.5	9.4	22.5
Feb-02	12.4	45.8	17.5	200	12.4	0	30.2	17.5	20.7
Mar-02	18.8	54.1	29.9	200	18.8	0	33.8	29.9	26.5
Apr-02	34.7	112.5	89.1	200	34.7	0	16.9	89.1	62.6
May-02	49.7	111.4	64.6	200	49.7	0	8.5	64.6	66.4
Jun-02	85.3	74.8	-5.8	194.2	85.3	0	0	0	34.1
Jul-02	110.3	66.6	-47	148.6	8.9	1.4	0	0	18.5
Aug-02	87.2	35	-54	108.5	73.4	13.9	0	0	9.3
Sep-02	62.7	52.5	-12.8	101.5	56.8	5.9	0	0	6.4
Oct-02	27.8	78	46.3	147.8	27.8	0	0	0	5.8
Nov-02	15.7	56	31.8	179.6	15.7	0	6.3	0	3.2
Dec-02	11.1	33.5	9	188.6	11.1	0	18.8	0	1.2
Jan-03	8	29	-8	181.1	7.5	0.5	47.8	0	0.2
Feb-03	8.5	50.5	-7.1	174.7	7.9	0.7	96.8	0	0.2
Mar-03	17.9	38.6	36	200	17.9	0	80.3	10.7	6.5
Apr-03	30.4	33.6	41.6	200	30.4	0	40.2	41.6	25.2
May-03	54.8	95.6	56.1	200	54.8	0	20.1	56.1	44.6
Jun-03	82.7	77.3	0.8	200	82.7	0	10	0.8	24.1
Jul-03	96.2	38.8	-54.3	145.7	96.2	0	5	0	12.1
Aug-03	87.8	99.9	12.1	157.8	87.8	0	0	0	10.1
Sep-03	52.7	107.8	49.7	200	52.7	0	0	7.6	11.7
Oct-03	28.3	95.6	62.5	200	28.3	0	0	62.5	39.2
Nov-03	18.2	116.4	92.4	200	18.2	0	0	92.4	69.2
Dec-03	12.2	80.6	40.9	200	12.2	0	25.2	40.9	54.4
Jan-04	7.4	72.7	-7.4	192.6	7.4	0	97.9	0	26.1
Feb-04	10.8	20	11.8	200	10.8	0	95.1	4.3	15.5
Mar-04	20.3	110	101.5	200	20.3	0	79.3	101.5	62.3
Apr-04	32.8	71.8	75.1	200	32.8	0	39.7	75.1	70.3
May-04	57.6	117	73.4	200	57.6	0	19.8	73.4	75.9
Jun-04	77.7	57.5	-13.2	186.8	77.7	0	9.9	0	37.9
Jul-04	92.1	116.7	28.7	200	92.1	0	0	15.5	31.1
Aug-04	72.9	60.8	-15.1	184.9	72.9	0	0	0	15.7
Sep-04	57.1	39.7	-19.4	167	55.6	1.5	0	0	8.3
Oct-04	30.9	58.4	24.6	191.6	30.9	0	0	0	6.1

Nov-04	17.9	73.9	52.4	200	17.9	0	0	44	27.1	
Dec-04	10	103.7	33.2	200	10	0	58.8	33.2	30.1	
Jan-05	8.5	64	0.5	200	8.5	0	113.6	0.5	14.7	
Feb-05	10.7	78.5	34.9	200	10.7	0	145.4	34.9	25.8	
Mar-05	16.3	56.5	49.6	200	16.3	0	134.7	49.6	38.5	
Apr-05	33.4	97.1	126.2	200	33.4	0	67.3	126.2	86.5	
May-05	50.3	47.2	28.2	200	50.3	0	33.7	28.2	57.3	
Jun-05	103.4	32.3	-55.9	144.1	1	3.4	0	16.8	0	29.1
Jul-05	106.9	141.7	36.1	180.3	1	6.9	0	8.4	0	20.8
Aug-05	88.3	148.3	61	200	88.3	0	0	41.2	34.9	
Sep-05	58.5	76.6	14.2	200	58.5	0	0	14.2	24.7	
Oct-05	32.7	51	15.8	200	32.7	0	0	15.8	20.9	
Nov-05	18.2	122.9	98.6	200	18.2	0	0	98.6	64.5	
Dec-05	10.2	97.3	32.8	200	10.2	0	52.6	32.8	47.3	
Jan-06	13	109.9	77	200	13	0	69.3	77	64.5	
Feb-06	10.5	141	47.6	200	10.5	0	150.4	47.6	56.3	
Mar-06	19.1	62.9	76.3	200	19.1	0	115.9	76.3	67.4	
Apr-06	35.3	95.1	113	200	35.3	0	57.9	113	93.9	
May-06	61.3	106.1	68.4	200	61.3	0	29	68.4	84.1	
Jun-06	86.4	53.9	-20.7	179.3	86.4	0	14.5	0	42.1	
Jul-06	108.2	100.4	-5.6	174.3	1	7.6	0.6	7.2	0	24.7
Aug-06	83.5	52.6	-26.3	151.3	80.1	3.4	0	0	12.5	
Sep-06	49.2	163.3	105.9	200	49.2	0	0	57.3	41.7	
Oct-06	28.8	122.2	87.2	200	28.8	0	0	87.2	66.5	
Nov-06	19.3	50.8	29	200	19.3	0	0	29	47.2	
Dec-06	14.5	59.6	34.6	200	14.5	0	8.2	34.6	42	
	506	901	358	2295	482	4	425	361	395	

TABLE 1 : DETAILED WATER BALANCE CALCULATIONS- MT. HOPE ROAD, TOWN OF CALEDON

**1 Climate Information**

Precipitation	901 mm/a
Evapotranspiration (Actual)	482 mm/a
Water Surplus	419 mm/a

**2 Infiltration Rates**

**Table 2 Approach - Infiltration factors**

Topography: Hilly Land	0.1
Soil: medium combinations of clay and loam to Open sand loam	0.3
Cover: Cultivated lands	0.1
Total	0.6
Infiltration (0.6 x 419)	251.4 mm/a
Run-off (419-251)	168 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 by sand and gravel with silty soils		
Based on the above, the recharge rate is typically	200-250	mm/a
Run-off		mm/a

**3 Pre-Development Property Statistics**

	ha	m2
Paved Area	0	0
Roof Area	0	0
Landscape Area	41	410000
<b>Total</b>	<b>41</b>	<b>410000</b>

**4 Post-Development Property Statistics**

	ha	m2
Paved Area	1.5	15000
Roof Area	0.5	5000
Landscape Area	39	390000
<b>Total</b>	<b>41</b>	<b>410000</b>



### 5.0 Annual Pre-Development Water Balance

Land Use	Area (m2)	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Paved Area	0	0	0	0	0
Roof Area	0	0	0	0	0
Landscape Area	410000	369410	197620	103074	68716
	<b>410000</b>	<b>369410</b>	<b>197620</b>	<b>103074</b>	<b>68716</b>

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 (m2)	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Paved Area	15000	13515	1352	0	12164
Roof Area	5000	4505	451	0	4055
Landscape Area	390000	351390	187980	98046	65364
	<b>410000</b>	<b>369410</b>	<b>189782</b>	<b>98046</b>	<b>81582</b>

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

### 7. Comparison of Pre- and Post -Development

	Precipitation (m3)	Evapotraspiration (m3)	Infiltration (m3)	Run-off (m3)
Pre-Development	369410	197620	103074	68716
Post-Development	369410	189782	98046	81582
% Change			-5	19

### 8. Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration	103074
Volume of Post-Development Infiltration	98046
Deficit from Pre to Post Development Infiltration	5028
Percentage of Roof Runoff required to match the pre-development infiltration	124