HYDROGEOLOGICAL INVESTIGATION REPORT
28-60 Bronte Street North, Milton
ONTARIO

Prepared for:

2183271 Ontario Inc.
c/o Korsiak Urban Planning
206-277 Lakeshore Road east
Oakville ON L6J 1H9

Prepared By:

SIRATI & PARTNERS (SIRATI)

Geotechnical Hydrogeological & Environmental Solutions

Project: SP18-317-30
November 8, 2018 (Revised)

12700- Keele Street, King City
Ontario L7B 1H5
Tel: (905) 833-1582
Fax: (905) 833-5360

Table of Contents

FIGURES

APPENDICES

1. INTRODUCTION AND BACKGROUND

Sirati & Partners (SIRATI) was retained by Korsiak Urban Planning (Korsiak) on behalf of Durante Group of Companies (2183271 Ontario Inc) to conduct a Hydrogeological Assessment at the property (the "Property" or "Site") located at 28-60 Bronte Street North, Milton, Regional Municipality of Halton, Ontario. The Site location map is presented in Figure 1-1.

The entire Property is an approximately 1.34 hectares (3.3 acres) of regularly shaped parcel of land with a frontage of about 200 metres (m) north-south along Bronte Street North and approximately 70 m east-west along Main Street West. The Property is currently developed with a large building with several interconnected sections and additions. Four concrete silos and a grain dryer which are no longer in use are located at the northernmost part of the building. The Canadian National Railway (CNR) rail line borders the western edge of the Site. The study was conducted to identify potential impact to the groundwater flow, local streams or significant natural features, if any in close proximity to the Property. The hydrogeological study was conducted to assess the subsurface conditions, soil stratigraphy, groundwater table and flow direction in accordance with 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. This is to provide background information to allow for characterization of regional hydrogeological conditions.
- **Detailed site inspection**: an inspection of the Property was conducted to review existing site conditions including identification of any hydrogeological features such as significant areas of potential groundwater recharge or areas of groundwater discharge.
- **Measurement of groundwater levels:** confirm the groundwater level using existing monitoring wells installed during the geotechnical and environmental investigation program.
- **In-situ hydraulic conductivity tests:** conduct in-situ hydraulic conductivity tests (rising head tests) in all monitoring wells. In-situ hydraulic conductivity of the underlying soils to be assessed in order to determine potential dewatering requirements.
- **Private well survey:** a well survey was conducted for properties within approximately 500 m radius of the Site boundary and well information was obtained from the properties owners where possible, and if permission granted.
- **Water Balance (Preliminary):** a preliminary water balance to be estimated for the proposed development in comparison to pre-development conditions. The water balance is to be calculated based on available climatic information, the site development plans along with long-term dewatering estimates.

Structure of the Report:

This report provides the following information:

- Description of the work program and factual information gathered during the study including the results of site inspection and water level measurements. The results of the subsurface investigations including borehole logs and grain size analysis were reviewed and summarized.
- Identification of significant hydrogeological features and functions in the study area. This report identifies the local groundwater functions, particularly with respect to the natural environment.
- The potential impact of the development on local water wells was identified and appropriate mitigating measures were provided in form of general recommendations. Detailed and site-specific mitigation measures are beyond the scope of this report.
- During this hydrogeological assessment, SPCL has drilled and installed three (3) monitoring wells to describe the lithological details and to be partly employed to conduct hydraulic conductivity tests.
- Preliminary estimate of dewatering requirements, based on water level monitoring and the development plans at the Site.
- Water balance for the existing pre-development and proposed post-development conditions was estimated using the Thornthwaite method. The water balance calculations were completed using both manual and Low Impact Development LIDTTT tools utilizing climate information obtained from the nearest Environment Canada weather station.
- Prior to this hydrogeological assessment, several environmental investigations during the period from 1993 to 1997 were conducted by XCG Environmental Services Inc. and a Phase 2 Environmental Soil and Groundwater Investigation was conducted at 28 Bronte Street North, by Shaheen & Peaker Limited in September 2007.
- Data synthesis and preparation of a report with conclusions and recommendations of the local hydrogeological conditions, briefly address possible dewatering and infiltration concerns, and establishment of the shallow water table and/or piezometric surface.

This report presents the results of the hydrogeological assessment for the proposed development along with supporting materials.

2. LAND USE

The Property, with an existing building at the western part of the Site is located at the northwest corner of Bronte Street North and Main Street West, Milton and is bounded by Main Street to the south, Bronte Street North to the east and CNR rail line to the west and a vegetated grassed area to the north (Figure 1-1). The Subject Site falls within the Sixteen Mile Creek watershed.

The Site is located in an area of mixed commercial and residential development. Adjacent properties include a Petro-Canada gasoline station to the east and a rail embankment to the western property boundary of the Subject Property.

The majority of the north and western portion of the Subject Property is vegetated with grasses, weeds and trees. The eastern part of the Site which provides to access to the Site is either asphalt or gravel covered.

3. DEVELOPMENT PLAN

The land covering the Property is to be developed into one (1) 19-storey residential building and one (1) 21 storey residential building on two separate 6-storey podiums with commercial uses and amenity space at grade as depicted in Figure 3-1. The development plan includes a total of 435 residential units, covering an area of about 3,307 m^2 . The development does include a two-level (P1&P2) underground parking in the residential condominiums. Landscaped areas, driveways and walkways along with on-grade parking for visitors are included in the development. The overall area of the development is about 1.34 ha with about 0.40 ha to be covered by the buildings, about 0.33 ha landscaped green open space and an area of 0.61 ha for paved parking area.

No grading plan was provided by the client at the time of writing this report. Based on the cursory information provided by the client (Figure 3-1) and on the geodetic survey conducted at the Site, a preliminary approximation on the parking levels and existing ground elevations, was assumed as below:

- Average Ground Elevation: 202.27 metres Above Sea Level (mASL)
- Average Level 2 U/G Parking Elevation: 195.77 mASL

4. ENVIRONMENTAL FEATURES

The Subject Property falls within the Sixteen Mile Creek subwatershed, which is an Environmentally Sensitive Area (ESA) and is an incised valley cut into both the Queenston Formation and Georgian Bay Formation shales. It has an average gradient of about 6.1 m/km with a shale-walled gorge characterizing its central and lower reaches (Karrow 1987a). The area is one of the top botanical sites in Halton Region (Varga and Allen 1990) with almost 400 species of vascular plants recorded. This ESA includes a rich selection of habitats associated with the floodplain, valley walls and associated tablelands. The southern section of this ESA is threatened by adjacent urban development and there is potential impact from water run-off and siltation. Most of the ESA is privately owned, although the Halton Region Conservation Authority and the Management Board Secretariat own portions.

Middle Sixteen Mile Creek Valley, the incised valley has been rated as a provincially significant earth science Area of Natural and Scientific Interest (ANSI).

Other designations include Regionally Significant Life Science ANSI and Locally Significant Wetland Complex.

The Subject Property is not known to having any ANSIs and no known wetlands are situated within the Site.

5. PHYSICAL SETTING

5.1. TOPOGRAPHY AND DRAINAGE

In general, the ground surface at the Property is relatively flat with general slope towards east and southeast.

Using the interactive topographic map generator (http://www.gisapplication.lrc.gov.on.ca) the Property slopes towards east from an elevation of about 205 mASL in the west to about 200 mASL in the east as shown in Figure 5-1. Based on the survey map provided by the client, the highest average elevation at the northern part of the Property is about 203.45 mASL and the lowest average elevation occurs in the southern part of the Site at about 201.10 mASL, with an average elevation of about 202.27 mASL, for the entire Site. No surface drainage was observed on the Site or in close proximity to the Site.

Figure 5-1a is the Conservation Halton regulated area map for the Subject Property. The regulated area represents the greatest physical extent of the combined hazards, plus a prescribed allowance as set out in the Conservation Authorities Act to protect and safeguard watershed health in terms of environmental areas such as wetlands, shorelines and watercourses.

The Subject Property does not fall in any of sensitive environmental areas, although Halton Region regulated area map shows an ephemeral creek flowing through the Site as depicted in Figure 5-1a. During the Site visit no creeks, either perennial or ephemeral were noticed to exist on the Site.

5.2. PHYSIOGRAPHY

The Subject Property is located within the Region of Halton and its physiographic features are characterized by the Peel Plain physiographic region (Figure 5-2). This plain is the former lake bottom of the glacial Lake Peel, which formed between the ice front and the Niagara Escarpment. The Peel Plain gradually slopes down toward Lake Ontario, following the topography of the underlying Halton Till. A calm lake environment resulted in the deposition of silts and clays, particularly in the depressions in the till. These sediments were quite thin, suggesting the Lake Peel had a brief existence.

The Property is situated within the Middle Sixteen Mile Creek Watershed which is located within the Peel Plain physiographic region (Figure 5-2). No creeks or surficial flows were found on the Subject Property.

5.3. OVERBURDEN

According to the geological map entitled "Quaternary Geology of Ontario-Southern Sheet" Map 2556, published by the Ministry of Northern Development and Mines (MNDM), dated 1991, the overburden in the region of the Property consists of till deposits. This material is generally characterized as a silt and clay deposits.

The surficial geology of the area is mostly represented by glacier and glacial lake sediments overlying the Upper Ordovician Age, Queenston Formation shale, consisting primarily of thick silty to sandy clay till referred to as the Halton Till. This till is reddish in color as it is composed primarily of glacially reworked Queenston shales. Soils, which form on the Halton Till, are heavier clay loams. The overburden consisting of silt, sand, clay and clayey silt extends to maximum depth ranging from 13.0 to 17.0 m below the existing grade, corresponding to elevations of 178.5 to 180.5 mASL.

5.4. BEDROCK GEOLOGY

According to the bedrock geology map entitled "Bedrock Geology of Ontario-Southern Sheet" published by the MNDM, dated 1991, the bedrock of the area belongs to the Upper Ordovician, Queenston Formation which consists of shale, dolostone, limestone and siltstone. The Queenston Formation, which underlies the Subject Property, is characterized by easily weathered red shales and silt stones (Figure 5-3). Ice movement and water flow have eroded the shale over hundreds of thousands of years. This erosion has left an irregular bedrock surface and an unpredictable thickness of overlying soils. According to geological information, the bedrock seems to be situated within about 13.0 and 17.0 m below ground surface (mbgs) in the study area. In general, a relatively thick clay to silty clay layer seem to be present above the shale layer near the bedrock.

6. HYDROGEOLOGY

Water well records on file with the Ministry of the Environment and Climate Change (MOECC) were used as a database for this hydrogeological assessment. Well locations were obtained from the MOECC interactive water well record database. A plot of the local water well records is presented in Figure 6-1. According to the well records, there appears to be 21 wells within a 500 m radius around the Property, out of which only 9 wells have lithological details. Only two wells were drilled for factory or industrial purposes and the rest of wells are used for observation/dewatering purposes. All these wells were completed between 1957 and 2012 with water levels observed at depths from 3.0 to 7.0 mbgs. Depths of the wells range between 4.5 to 23 mbgs. Based on the information extracted from well records where available, the majority of upper layers contains clay and silt with some sand, stones and gravel. Wells have encountered Queenston Shale at a depth ranging from 13.0 to 15.0 mbgs. A cross-section depicting the local geologic profile based on the information acquired from well records is shown in Figure 6-2.

Fresh groundwater was encountered in most of the wells. The regional groundwater flow is towards south and southeast. The Site-specific groundwater flow was described in the Section 9, below.

7. DOOR TO DOOR WELL SURVEY

A door to door well survey was conducted on June 19, 2018 to verify any property that utilizes a private well for domestic purposes, aimed at the assessment of any potential future impacts due to the Site development. Accordingly, the properties within 500 m radius of the Site were investigated. All the properties are currently under piped municipal services and no domestic use wells were identified.

8. BOREHOLE INSTALLATION PROGRAM

The borehole drilling program consisted of drilling three (3) boreholes (denoted BH/MW1, BH/MW2 and BH/MW3) and installation of monitoring wells in all three of the boreholes on June 01, 2018, for the long-term (stabilized) groundwater level monitoring. The borehole location plan showing the SPCL drilled boreholes and the existing monitoring wells installed by XCG and S&P are provided in Figure 8-1.

The boreholes were drilled to depths ranging from 4.9 to 9.4 mbgs. Boreholes were drilled with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SPCL personnel. Samples were retrieved at regular intervals with a 50 millimeters (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 SPCL laboratory for detailed examination by the project engineer and for laboratory testing.

Along with the visual examination in the laboratory, all the soil samples were tested for moisture content.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations.

The elevations at the borehole locations were surveyed by the SPCL personnel using a geodetic differential GPS system on June 19, 2018. Borehole logs are presented in Appendix A.

8.1. BOREHOLE LITHOLOGY

Following is the inferred lithology at the Site based on the borehole logs prepared and interpreted by SPCL field staff.

The generalized lithology at the Site consists of:

- Fill materials from grade to 1.5 mbgs
- Clayey Silt Till from 1.5 to 4.6 mbgs
- Sandy Silt Till from 4.6 to 7.6 m mbgs
- Silt to Sandy Silt Till with limestone fragments from 7.6 to 9.1 mbgs
- Weathered shale fragments from 9.1 mbgs to the drilled depth of 9.4 mbgs

Auger refusal was noted at 5.1 mbgs at borehole BH3 as shale bedrock was encountered at that depth.

Typical cross sections and soil profile based on the boreholes drilled during the hydrogeological investigation are presented in Figures 8-2 to 8-4, to depict the on-site lithological variations.

8.2. PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Phase I and II Environmental Site Investigations and Remediation studies were conducted by XCG during, 1993, 1996 and 1997, respectively. During the site investigations a total of twenty (20) boreholes, including three (3) monitoring wells were completed. These investigations mainly focused on determining the environmental quality of both soil and groundwater identified as an underground storage tank area and a former bulk fuel facility. Presently, there is only one monitoring well identified on-site, named as XCG16.

In 2007, Shaheen & Peaker Limited (S&P) was retained by Durante Group of Companies to conduct a Phase 2 Environmental and Groundwater Investigation to obtain soil and groundwater samples for chemical analysis to better understand the environmental quality of soil and groundwater. As part of this investigation, twelve (12) boreholes, including three (3) groundwater monitoring wells, were completed. The three monitoring wells were identified as BH101, BH102 and BH103.

As part of this hydrogeological investigation, the existing wells were also monitored for groundwater levels, as described in Section 9.

9. GROUNDWATER LEVEL MONITORING

The stabilized groundwater levels observed in the SPCL monitoring wells on June 5, 2018 during well development were at depths ranging from 1.55 to 2.63 mbgs, corresponding to elevations ranging from 200.05 to 198.78 mASL, as listed on Table 9-1.

Table 9-1: Groundwater Levels Observed in SPCL Monitoring Wells, June 5, 2018

BH	Easting	Northing	Existing Grade Elevation (mASL)	Well Depth (mbTOC)	s/u (m)	Depth to Groundwater (mbTOC)	Depth to Groundwater (mbgs)	Elevation of Groundwater (mASL)
BH/MW1	589804.80	4817865.40	201.60	7.08	GL	1.55	1.55	200.05
BH/MW2	589780.31	4817963.96	201.41	6.73	GL	2.63	2.63	198.78
BH/MW3	589735.34	4817973.38	201.41	5.56	0.8	3.26	2.46	198.95

Notes: mASL - metres above sea level; mbTOC - metres below top of casing; s/u - stick up; mbmp - metres below measuring point; GL - ground level

Another round of water level monitoring was completed on June 19, 2018, during the hydraulic conductivity testing and the results are summarized below in Table 9.2.

Table 9.2: Groundwater Levels Observed in SPCL Monitoring Wells, June 19, 2018

BH	Easting	Northing	Existing Grade Elevation (mASL)	Well Depth (mbTOC)	s/u (m)	Depth to Groundwater (mbTOC)	Depth to Groundwater (mbgs)	Elevation of Groundwater (mASL)
BH/MW1	589804.80	4817865.40	201.60	7.08	GL	1.67	1.67	199.93
BH/MW2	589780.31	4817963.96	201.41	6.73	GL	1.54	1.54	199.87
BH/MW3	589735.34	4817973.38	201.41	5.56	0.8	1.84	1.04	200.37

Water level monitoring was also completed on the existing monitoring wells installed by XCG (1997) and Shaheen & Peaker (2007) and the details are as shown in the Table 9.3 below.

Table 9.3: Groundwater Levels Observed in XCG and S&P Monitoring Wells, June 19, 2018

BH	Easting	Northing	Existing	Well	s/u	Depth to	Depth to	Elevation of

			Grade Elevation (mASL)	Depth (mbTOC)	(m)	Groundwater (mbmp)	Groundwater (mbgs)	Groundwater (mASL)
BH 101	589837.63	4817903.31	200.697	12.51	GL	1.23	1.23	199.47
XCG 16	589827.78	4817925.05	200.855	9.07	GL	2.25	2.25	198.61
BH 102	589808.13	4817917.63	201.367	Could not open the cap as it got stuck, high traffic area				
BH 103	589717.25	4817972.27	201.926	Could not cut the lock in spite of best efforts				

Notes: mASL - metres above sea level; mbTOC - metres below top of casing; s/u - stick up; mbmp - metres below measuring point; GL-ground level

Water level monitoring completed across the Site in all existing and newly drilled boreholes, has indicated an average groundwater elevation of approximately 199.65 mASL, with average depth to water table at 1.55 mbgs.

Hydraulic gradients estimated between the monitoring wells BH/MW1, BH/MW2 and BH/MW3, ranged between 0.001 to 0.006 m/m with average gradient of 0.0035 m/m for the entire Site.

Based on the groundwater elevations measured at all the monitoring wells at the Subject Property, the water table contour map was constructed and as depicted in the Figure 9-1, the inferred groundwater flow is towards east and southeast.

It is to be noted that groundwater flow and levels may change with changing weather patterns and seasons.

The present water levels and elevations represent the summer seasonal variations, however, for the fall, winter and spring seasonal variations, a long-term monitoring program should be initiated to fully understand the seasonal variation of the water table elevations and their impact on the ecosystem.

10. IN-SITU HYDRAULIC CONDUCTIVITY TEST

Rising head hydraulic conductivity tests (slug tests) were conducted on three monitoring wells on June 19, 2018. The hydraulic conductivity was analyzed utilizing Aqtesolv pumping test software using the Hvorslev method for rising head tests conducted on BH/MW1, BH/MW2, and BH/MW3. The results are summarized in Table 10.1 and are compared to typical ranges of hydraulic conductivities of soil types similar to those found at the Site.

Table 10.1. Results of Slug Tests conducted in the SPCL monitoring wells, June 19,2018.

Borehole	**Hydraulic Conductivity (m/s)**	**Soil Type**	**Range of Hydraulic Conductivity (m/s)**[*]
BH/MW 1	$3.45 * 10^{-7}$	Clayey Silt Till (Halton Till)	$10^{-9} – 10^{-7}$
BH/MW 2	$2.91 * 10^{-6}$	Sandy Silt Till (Halton Till)	$10^{-9} – 10^{-6}$
BH/MW3	$1.62 * 10^{-6}$	Clayey Silt Till (Halton Till)	$10^{-9} – 10^{-7}$
Average	**$1.63 * 10^{-6}$**		

[*] Domenico, P.A. and F.W. Schwartz, 1990. *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

The average hydraulic conductivity at the Site was estimated to be about 1.63 x 10^{-6} m/sec. Hydraulic conductivity at BH/MW3 resembles more of a sandy silt till rather than a clayey silt till, as logged in the borehole log, likely due to the sand content. Plots of the rising head tests along with calculations of the hydraulic conductivity based on the Hvorslev method are presented in Appendix B.

11. CONSTRUCTION DEWATERING – SHORT TERM

As per the information from the client, the proposed development consists of a nineteen (19) and twenty-one (21) storey residential condominium building with commercial and amenity uses at grade with two (2) levels (P1 and P2) of underground parking covering the entire development (Figure 11-1).

The lowest level in the proposed development is the P2-level basement in the condominium buildings A and B and as depicted in Figure 3-1, the footing elevations of parking level 1 and 2 are in the order of 198.00 mASL and 194.40 mASL, respectively. Since, the general slope and the layout of the land does not vary significantly across the proposed buildings footprint area, it would be technically feasible to consider the whole area as one construction block in estimating the associated dewatering volumes (Figure 11-2).

The shape and dimensions of the excavation at the Site was conservatively estimated (175 m x 75 m) and included a safety factor of 1.2 (i.e. 20% larger length and width compared to the actual extent of the excavation). Based on the average ground elevation and groundwater table elevations at the Site and considering the depth of the excavation to the parking Level P2, as 7.2 mbgs, the maximum depth of excavation (in terms of geodetic elevation) was estimated. The dewatering depth was assumed to be about 1.0 m below the P2 parking level depth of excavation to provide for a safe and dry working conditions. The overall average depth of dewatering was estimated based on the water table elevations. The cross-section of the depths and elevations of the proposed grade elevation (201.60 mASL), groundwater (199.65 mASL) and assumed lowered groundwater level (192.95 mASL) along with the finished slab floor elevation of the P2 parking level (194.40 mASL) are shown in Figure 11-3.

Based on the available geological information from databases and literature, and the information extracted from the on-site boreholes advanced by SPCL and XCG, the thickness of the aquifer was estimated. It appears from the borehole logs that the weathered shale bedrock with limestone fragments was encountered at shallower depths of about 5 mbgs on the northern part and at a maximum depth of 9.5 mbgs in the southern part of the Site. Hence, based on the depth to the level P2 underground parking, the average depth to competent bedrock was conservatively estimated to be at 10 mbgs and the corresponding geodetic elevation of the Queenston Shale was estimated at 192.27 mASL. The depth to the base of the aquifer was very conservatively estimated to be 10 m and the aquifer thickness approximately 7.38 m (i.e. parameter H), as indicated in the borehole logs BH/MW1 (SPCL) and XCG16 (XCG) which have encountered the shale bedrock at a depth of approximately 10 mbgs.

The average hydraulic conductivity of $1.63 * 10^{-6}$ m/s was assumed to be uniform at the Site and a safety factor of 1.5 was applied to the final calculated dewatering rate. The average water table elevation, due to the variation of groundwater levels at the Site, was assumed to be 199.65 mASL and the final geodetic elevation of the construction excavation was 192.95 mASL (Figure 11-3).

The resulting short-term construction dewatering rates during excavation and construction of the parking levels (i.e. the lowest elevation to be excavated) at the Site was in the order of 117,000 L/day which is lower than the 400,000 L/day limit required by the new regulation (ONTARIO REGULATION 63/16, REGISTRATIONS UNDER PART II.2 OF THE ACT - WATER TAKING). Results of the construction dewatering rate are presented in Appendix C.

12. LONG TERM GROUNDWATER DEWATERING

Different types of foundation design would require different rates of dewatering or lowering of static groundwater level. The final design of foundation was not available at the time of preparing this report.

The groundwater flux from the entire area covering the buildings A and B and other structures on-Site, was calculated using the equation:

$Q = k\ i\ A$ where,

Q is the volume of water (m^3/sec)

K is hydraulic conductivity (m/sec)

i is hydraulic gradient (m/m), and

A is the total area of foundation drainage system (m^2)

Based on the average groundwater table elevation (199.65 mASL) and the bottom of the P2 parking level basement (194.40 mASL) where the foundation drainage system is likely to be situated, the long-term dewatering rates were estimated (Figure 11-3). Assuming an average horizontal hydraulic conductivity of about $1.63 * 10^{-6}$ m/s for the soils around the drainage system, the flow rate going through the portion of drainage system exposed to the groundwater table is estimated in about 1,077 L/day or about 393 m^3/annum (Appendix C). These values should be re-evaluated upon completion of final design of the foundation and its drainage system.

13. ASSESSMENT OF POTENTIAL DEWATERING IMPACTS

An assessment was made on the impacts of groundwater level lowering due to the dewatering on the natural features present at the Site. It is to be noted that there were no surficial water bodies like creeks, streams, wetlands or any other natural features located on the Subject Property and hence the effects on the natural ecosystem such as potential depletion in stream flow or reduction in flow to wetlands are not expected.

The radius of influence due to the short-term dewatering is expected to extend to a maximum distance of about 128 m (Appendix C) from the center of the proposed construction excavation. Since, there are no water well users within 500 m radius from the Subject Property, no water well interference effects are expected to occur at the Site and its near-by areas.

The following Sections deal with general recommendations for handling the short- and long-term dewatering operations at the Subject Property.

Short Term Discharge of Pumped Groundwater (Construction Phase)

The short-term groundwater control system may consist of a series of well points installed at the perimeter of the proposed excavation to perform the dewatering operations. The resulting flow from the groundwater control system will be directed towards the local sewer, if available and if it meets the applicable sewer use By-Laws.

- The well points must be appropriately screened and filtered in order to prevent the pumping of fines.
- Impacts from the short-term pumping on the local private wells (i.e. existing groundwater users), if any, are not expected, as the residences around the Subject Property are connected to the municipal water main service.
- The impacts to the local natural environment due to the groundwater dewatering are expected to be low as the radius of influence due to dewatering is expected to be 120 m and there are no water courses or wetlands within 250 m from the Site.
- Due to the absence of surface water features within the zone of influence, groundwater and surface water interactions are not anticipated during the construction phase.

Long Term Discharge of Pumped Groundwater (Post-Construction)

Reuse of the long-term extracted groundwater on the Property through landscape irrigation should be considered in addition to discharge of the flow into storm/sanitary sewer systems in order to lower the associated eventual impacts. Along with compliance with the Halton Region Sanitary and Combined Sewer Use By-Laws, some general requirements on dewatering systems need to be taken into consideration as follows:

- Water can only be discharged into the sewer line if it meets all the applicable water quality criteria.
- If some contamination is present a filtration system should be installed on Site before the extracted groundwater being discharged into the sewer system.
- The dewatering system has to be isolated from the other plumbing systems within the building

Source Water Protection and Wellhead Protection Areas (WHPA).

The Subject Property (28-60 Bronte Street North) lies outside the Wellhead Protection Areas (WHPA) of any municipal drinking water wells within the Halton Region and also falls outside the intrinsic groundwater susceptibility zones, as depicted on Figure 13.1. Hence, the construction dewatering is expected to cause nil or negligible environmental impacts on the WHPAs.

14. WATER BALANCE

A preliminary water balance for the Site was calculated for both pre-development (Figure 14-1) and post-development (Figure 14-2) conditions in order to assess the change in overall rate of infiltration. Impermeable and permeable surfaces in pre-development and post-development plans were identified and their surface areas (as measured and cross-checked using the drawings/information provided by the client) were used to calculate the amount of run-off and infiltration. The post-development plan consists of different types of surfaces as listed in Table 14-1 along with pre-development conditions.

Table 14.1. Pre-and Post-Development Plan for the Property as per the Updates Provided by the Client

Type of Land Coverage	Pre-Development Area(ha)	Post- Development Area (ha)
Concrete/Roadway/ Paved Area	0.36	0.61
Roof.	0.17	0.40
Landscape/Vegetated Area	0.81	0.33
Total	**1.34**	**1.34**

Monthly average temperature and precipitation data were obtained from Environment Canada, for Georgetown weather station (Climate Identifier: 6152695) located at about 9 km distance from the Property. Data was available between the years 1979 to 2006 i.e. 28 years. Temporal variations of temperature and rainfall are shown in Figures 14-1 and 14-2. Long-term average annual rainfall at the Property is 864 mm.

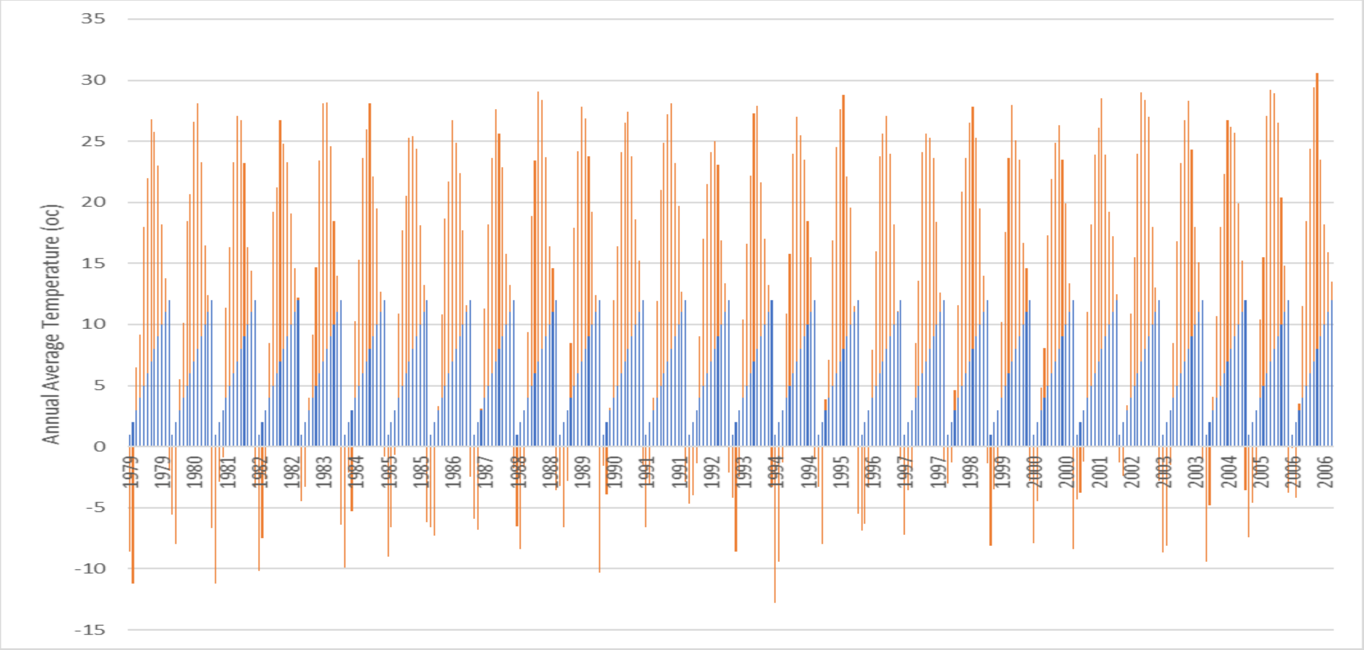


Figure 14-3 Annual Temperature at the Site

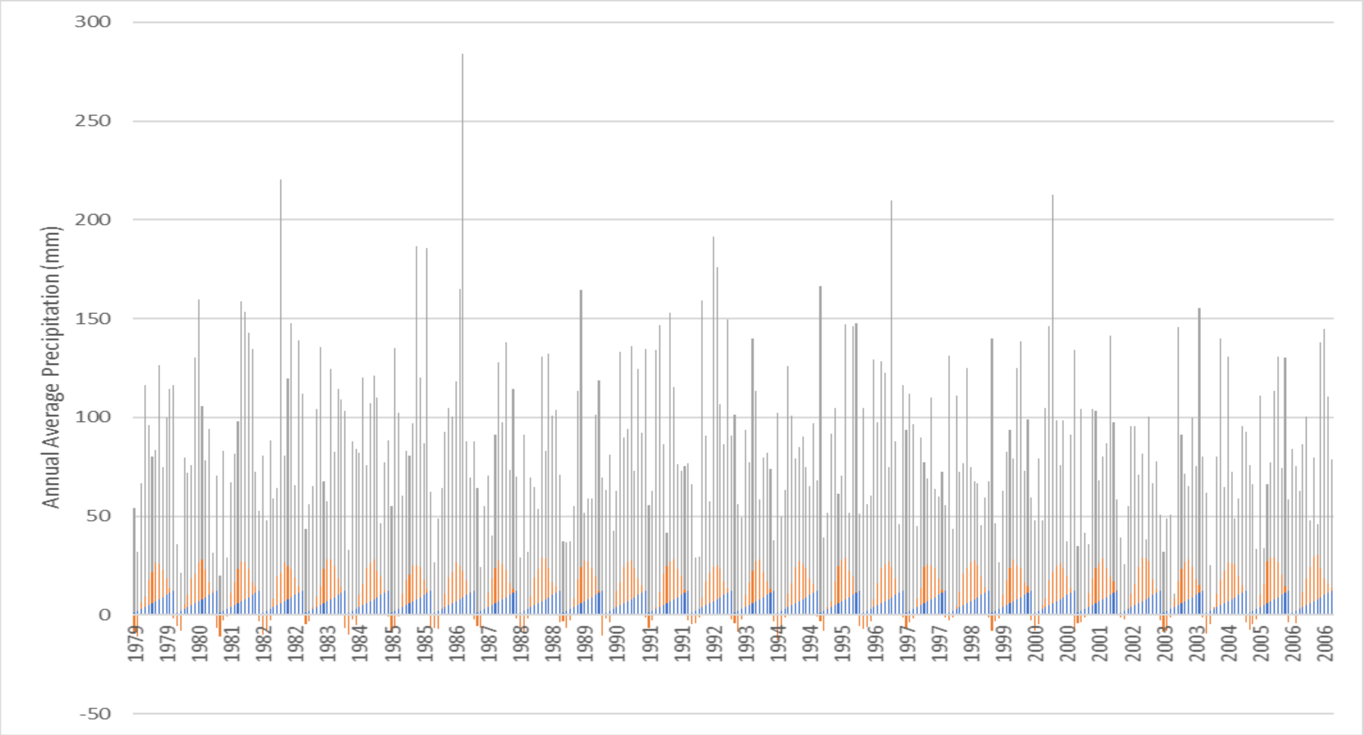


Figure 14-4 Annual Precipitation at the Site

Average monthly variations of both temperature and precipitation were calculated for the period from 1979 to 2006 (28 years) and is presented below in Figures 14-5. As noted in the Figure 14-5, the highest average temperature is noted in the month of July and highest average precipitation in the month of November.

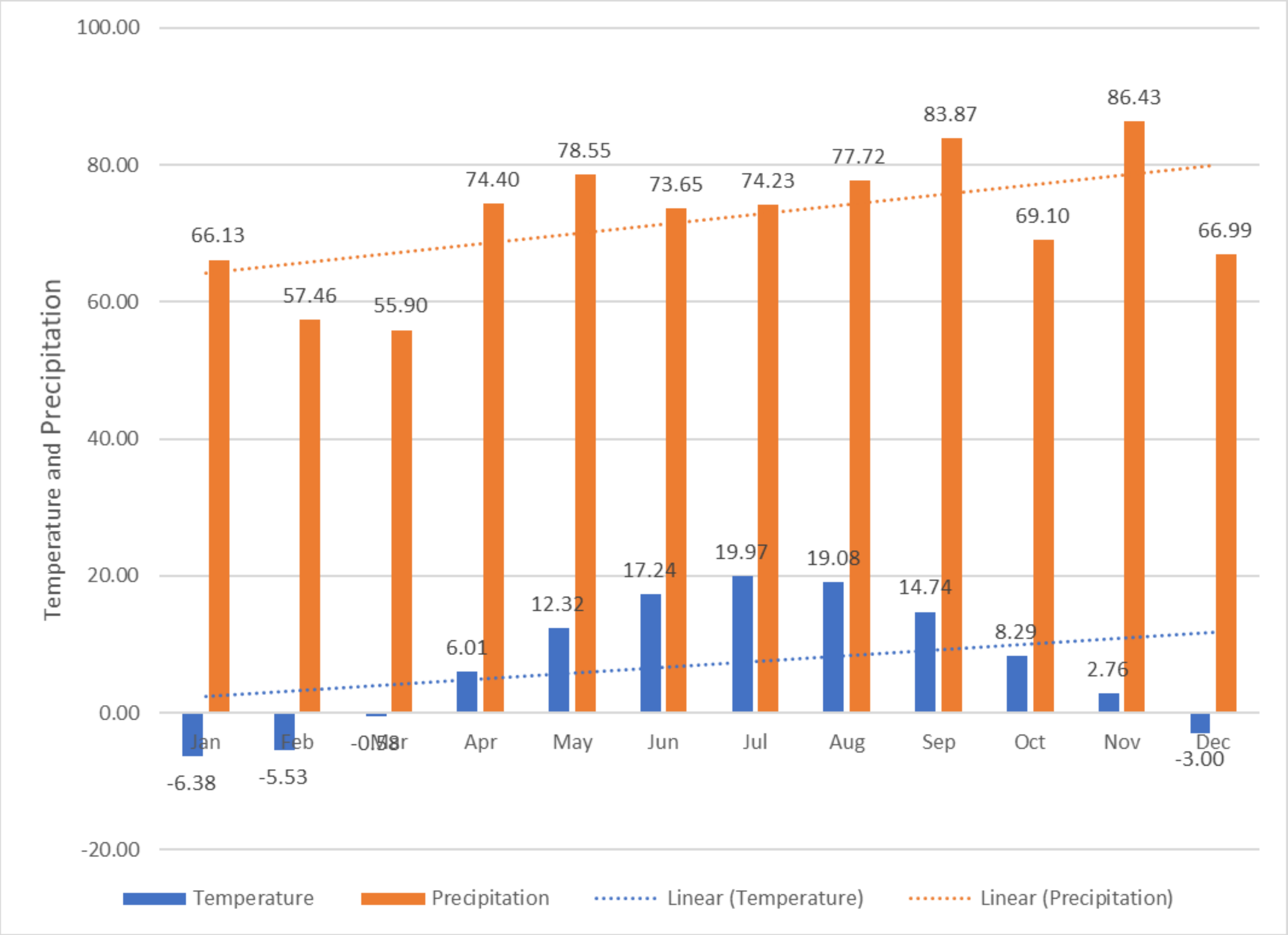


Figure 14-5. Monthly Average Temperature and Precipitation at the Site

Potential evapotranspiration was estimated to be about 523 mm/annum using the USGS Thornthwaite Monthly Water Balance software (Appendix D). The use of the average monthly temperature and precipitation results of the preliminary water balance presented in Table 14.2 indicates about 1,969 m^3/annum deficit in infiltration and an increase of about 3,491 m^3/annum in run-off.

Table 14-2: Pre- and Post-Development Water Balance Calculation

Pre-Development	**Area**	**Precipitation**	**Evapotranspiration**	**Precipitation**	**Evapotranspiration**	**Runoff**	**Infiltration**
	(m^2)	**(mm)**	**(mm)**	**m^3**	**m^3**	**m^3**	**m^3**
Landscape/Vegetated Area	8124	864	523	7019	2974	404	3640
Paved/Parking/Concrete	3607	864	523	3116	189	2635	293
Roof	1664	864	523	1438	87	1351	0
Total	**13395**				**3250**	**4390**	**3933**
Post-Development	**(m^2)**	**(mm)**	**(mm)**	**m^3**	**m^3**	**m^3**	**m^3**
Landscape/Vegetated Area	3272	864	523	2827	1198	163	1466
Paved/Parking/Concrete	6141	864	523	5306	321	4486	498
Roof	3982	864	523	3440	208	3232	0
Total	**13395**				**1727**	**7881**	**1965**
Difference (-:deficit, + increase) in m3/year					**-1523**	**3491**	**-1969**
Note: The Precipitation and Evapotranspiration values were obtained from the Thornthwaite program run.							

The water balance (pre-and post-development) is summarized below:

1. There is a net increase in run-off at the site from 4,390 m^3 to 7,881 m^3. This increase is a result of the development of the Site with hard surfaced or impermeable parking areas.
2. There is a net decrease in the evapotranspiration rate from 3,250 m^3 to 1,727 m^3.
3. Without implementation of mitigation measures there is a net decrease in the infiltration from 3,933 m^3 to 1,965 m^3 on a yearly basis.
4. Percentage of roof run-off required to match pre-development infiltration is about 56%

The Low Impact Development Treatment Train Tool (LID TTT) has been developed by Lake Simcoe Region Conservation Authority (LSRCA), Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA) (http://www.lsrca.on.ca/Pages/LIDTTTool.aspx) as a tool to help developers, consultants, municipalities and landowners understand and implement more sustainable stormwater management planning and design practices in their watersheds.

Accordingly, the water balance was also calculated alternatively using the new Version 1.2.1 of the LID TTT and the results of both manual and LIDTTT water balance calculations are shown in Figure 14-6 for comparison purposes. A report generated by LIDTT Tool is presented in Appendix E.

The lower infiltration deficit and lower run-off rates predicted by the LIDTT tool were probably due to the fact that the default average annual precipitation value for Milton location was 800 mm, whereas it was actually calculated to be 864 mm (Table 14-2).

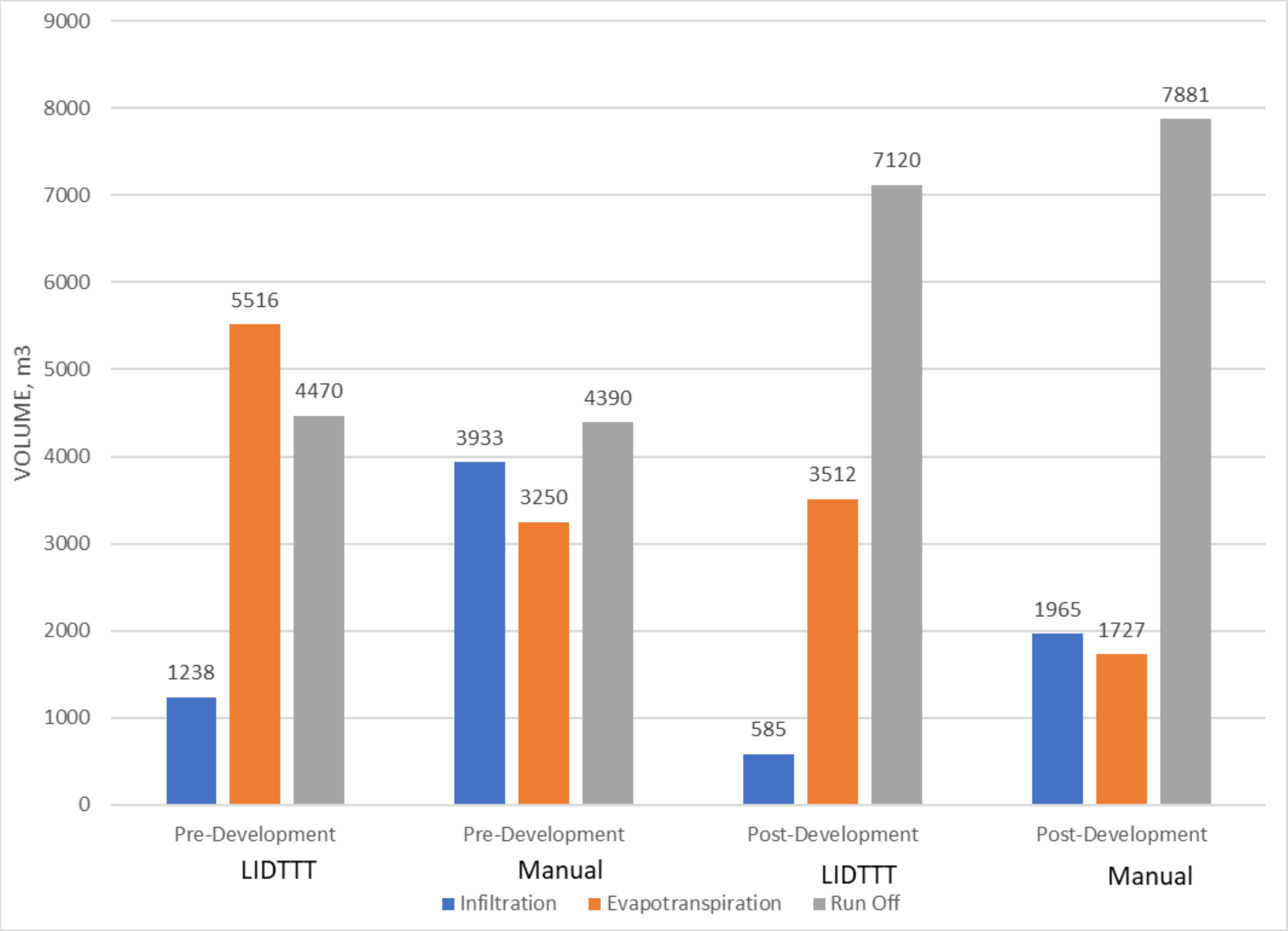


Figure 14-6. Water Balance Calculation Results of Both Manual and LIDTTT Methods

The Property mainly includes sandy silt to clayey silt till (Halton Till). Appropriate low-impact development techniques can be applied to maintain the overall groundwater recharge across the Site area. The net increase in run-off provides an opportunity for maintenance of groundwater recharge through a variety of infiltration techniques. The amount of deficit in infiltration upon development of the Site does seem to be moderate being about 1,969 m^3/annum or about 5.4 m^3 /day.

The permanent (long-term) dewatering volume of water from the basement drainage system was calculated to be on a high side at about 1,077 L/day (Section 12). Since, the permanent dewatering is a permanent loss to the groundwater recharge, this dewatering volume should be part of the infiltration loss to the groundwater. Hence, the total infiltration loss including the permanent dewatering rate would be about 2,362 m^3 /annum (1,969 m^3 plus 393 m^3).

Low Impact Development (LID) techniques are, however, recommended to be considered as part of the storm water management concept for the Site, in order to reduce the infiltration deficit. The below listed measures could potentially be incorporated in the development, including:

- Collection of clean run-off from the building rooftops and redirection to grassed areas and overland flow.
- Use of infiltration trenches or perforated pipes at selected areas.
- Installation of bio-swales at appropriate locations can effectively increase the 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 backyards in order to allow time for roof run-off to infiltrate into the topsoil.

14.1. LID TECHNIQUE DESIGN

It should be noted that the LID techniques implementation dealt with in this report is to be considered only as a recommendation. SPCL is not providing any design of LID techniques since these will be designed and provided by the project engineer under separate cover to provide appropriate site-specific LID design to reduce the above-mentioned infiltration deficit.

15. CONCLUSIONS AND RECOMMENDATIONS

This report was prepared by SPCL in support of the proposed residential development at the Site located at 28-60 Bronte Street North, Milton, Regional Municipality of Halton, Ontario. Based on the hydrogeological investigation conducted on the Subject Property the following conclusions are presented:

- Topographically the Site is generally flat with gentle slope towards east and southeast with an average ground elevation of 202.27 mASL with a maximum elevation of 203.45 mASL at the northern part of the Property.
- The average elevation of the groundwater table was observed at 199.65 mASL (corresponding to average depth to water level of 1.55 mbgs) based on June 2018 monitoring event, representing the dry season water level.
- The generalized lithology at the Site consists of:
  - Fill materials from grade to 1.5 mbgs
  - Clayey Silt Till from 1.5 to 4.6 mbgs
  - Sandy Silt Till from 4.6 to 7.6 m mbgs
  - Silt to Sandy Silt Till with limestone fragments from 7.6 to 9.1 mbgs
  - Weathered shale fragments from 9.1 m to drilled depth of 9.4 mbgs
- In-situ soil permeability tests resulted in hydraulic conductivity values between 1.62 * 10^{-6} m/s and 3.45 * 10^{-7} m/s with an average hydraulic conductivity of about 1.63 * 10^{-6} m/s which is in the typical range of hydraulic conductivity for sandy silt till present at the Property as observed in the boreholes.
- Based on the excavation requirements, the lowest groundwater dewatering level was estimated to be 192.55 mASL and the average water table elevation of 199.65 mASL.
- It is estimated that a maximum of 6.70 m drop in groundwater level is needed for the construction excavation of the foundation, considering the elevation of the underground parking levels at the condominium buildings. This resulted in the estimation of groundwater dewatering in the range of about 117,700 L/d for the entire area for the short-term (less than 6 months). The estimated dewatering rate is less than the 400,000 L/d limit set by the new regulation (ONTARIO REGULATION 63/16, REGISTRATIONS UNDER PART II.2 OF THE ACT - WATER TAKING) to apply for Permit to Take Water application.
- The long-term dewatering (foundation drainage) rate was estimated at about 1,077 L/day for the entire underground parking area.
- A preliminary water balance was conducted for the Site to compare the pre-and post-development infiltration rates, resulting in approximately 1,970 m^3/annum deficit in infiltration.
- Since, the permanent (long-term) dewatering is a permanent loss to the groundwater recharge, this dewatering volume should be part of the infiltration loss to the groundwater. Hence, the total infiltration loss including the permanent long-term dewatering rate would be 2,363 m^3 /annum (1,970 m^3 plus 393 m^3)

- The infiltration deficit can be compensated through the application of appropriate LID plans using the run-off generated at the Site.
- Hydrogeological impacts resulting from the proposed development are considered to be low.

SELECTED BIBLIOGRAPHY

Bedrock Geology; Ontario Ministry of Northern Development, Mines and Forestry; http://www.mndmf.gov.on.ca/mines/ogs_earth_e.asp; 2010

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

Ecological and Environmental Advisory Committee. 1978. Environmentally Sensitive Area Study. Regional Municipality of Halton, Planning Department. [ESA 1-38; flora; fauna; earth science; hydrology; hydrogeology; vegetation] *

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

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

Halton-Hamilton Source Protection Committee: Assessment Report for the Halton Region Source Protection Area, Version 2.1, January 2012

Halton Region and North - South Environmental Inc. 2005. Halton Region Environmentally Sensitive Areas Consolidation Report. Unpublished report prepared by Halton Region Planning and Public Works Department in conjunction with North - South Environmental Inc. 222 pp. + app

Karrow, P.F. 1987a. Quaternary geology of the Hamilton-Cambridge Area; Southern Ontario. Mines and Minerals Division, Ontario Geological Survey, Ministry of Northern Development and Mines, Report 255 and Maps 2508 and 2509: scale 1:50 000

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 Natural Resources. 1983b. A Summary Report of Earth Science Areas of Natural and Scientific Interest in the Cambridge District. Central Region, Parks and Recreation Section. [ESAs 10, 18, 19; earth science]

Ontario Ministry of Natural Resources. 1991a. Registry of Provincially Significant ANSIs. Cambridge District. Open electronic file of Mr. D. Kirk. Cambridge District.

Surficial Geology of Southern Ontario; Ontario Ministry of Northern Development, Mines and Forestry; http://www.mndmf.gov.on.ca/mines/ogs_earth_e.asp; 2010

Varga, S., and G.M. Allen. 1990. County/Regional Municipality vascular plant floras for the Carolinian Zone of Canada. pp. 129-153 in: G.M. Allen, P.F.J. Eagles and S.D. Price (eds.). Conserving Carolinian Canada. University of Waterloo Press. Waterloo, Ontario.

LIMITATIONS AND USE OF THE REPORT

This report was produced for the sole use of 2183271 Ontario Inc c/o Korsiak Urban Planning (the Client) for the property located at 28-60 Bronte Street North, Milton, Regional Municipality of Halton, Ontario and may not be relied upon by any other person or entity without the written authorization of Sirati & Partners Consultants Limited (SPCL).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, SPCL 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, SPCL 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, SPCL 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. SPCL 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 SPCL 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, SPCL 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

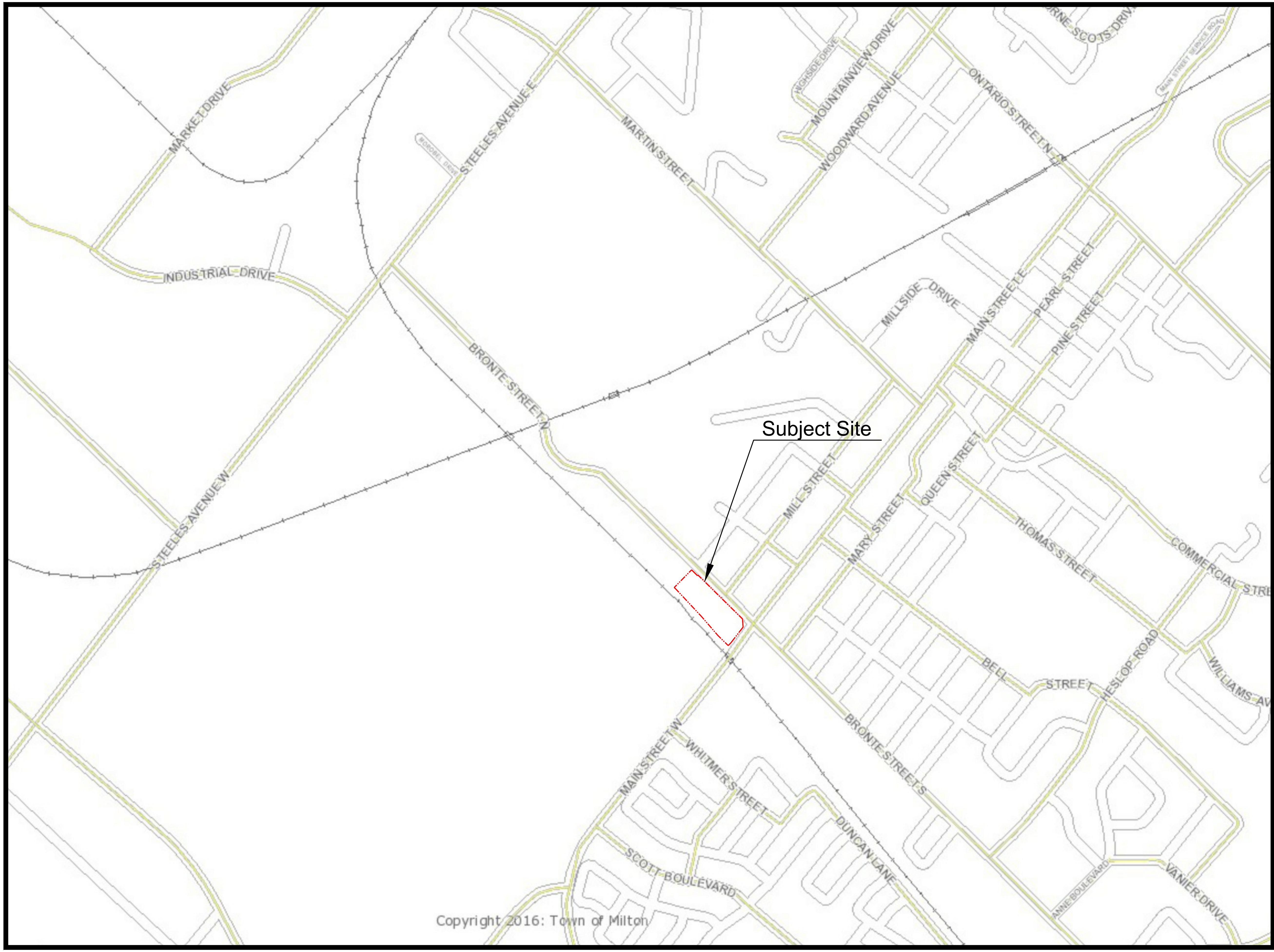
Sudhakar Kurli, P.Geo.
Hydrogeologist/Project Manager

Dr. Giorgio Garofalo, P. Geo., QP
Manager – Environmental Division

FIGURES

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

North:

N

Legend:

— - - — - - Property Boundary

Project Title:

Hydrogeological Investigation

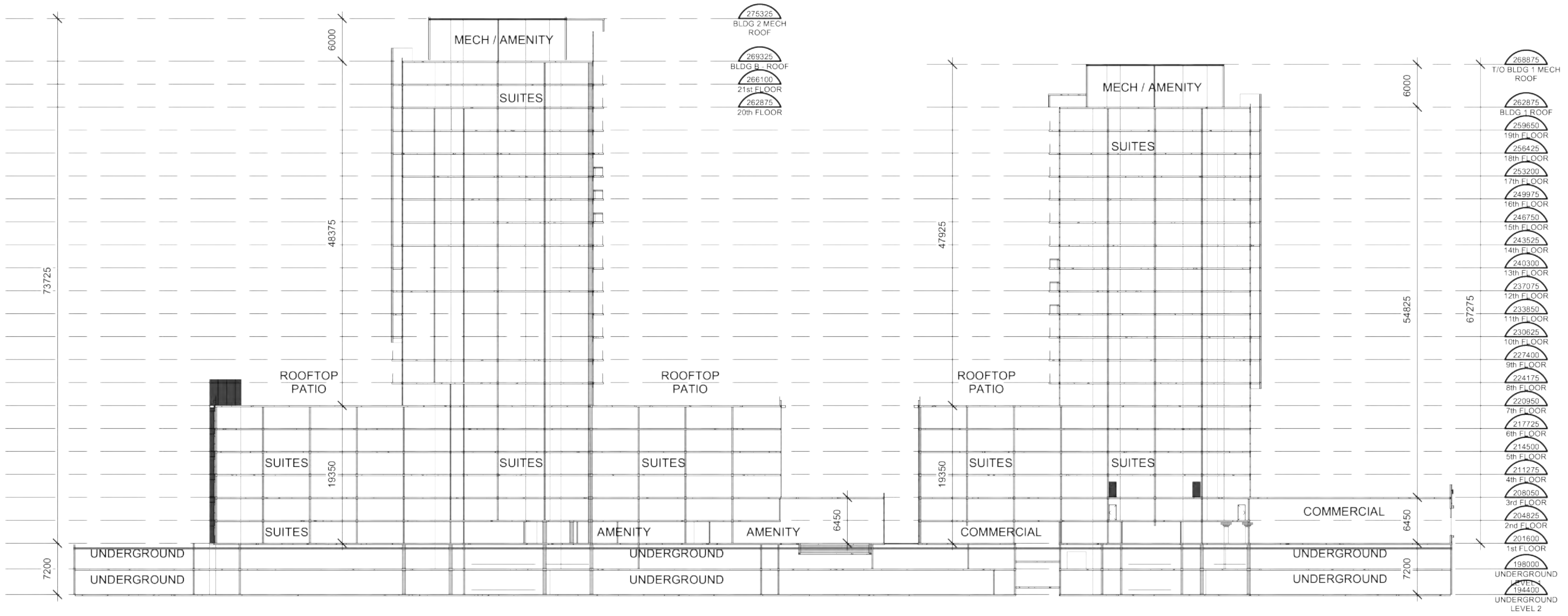
Site Location:

28-60 Bronte Street North, Milton, ON

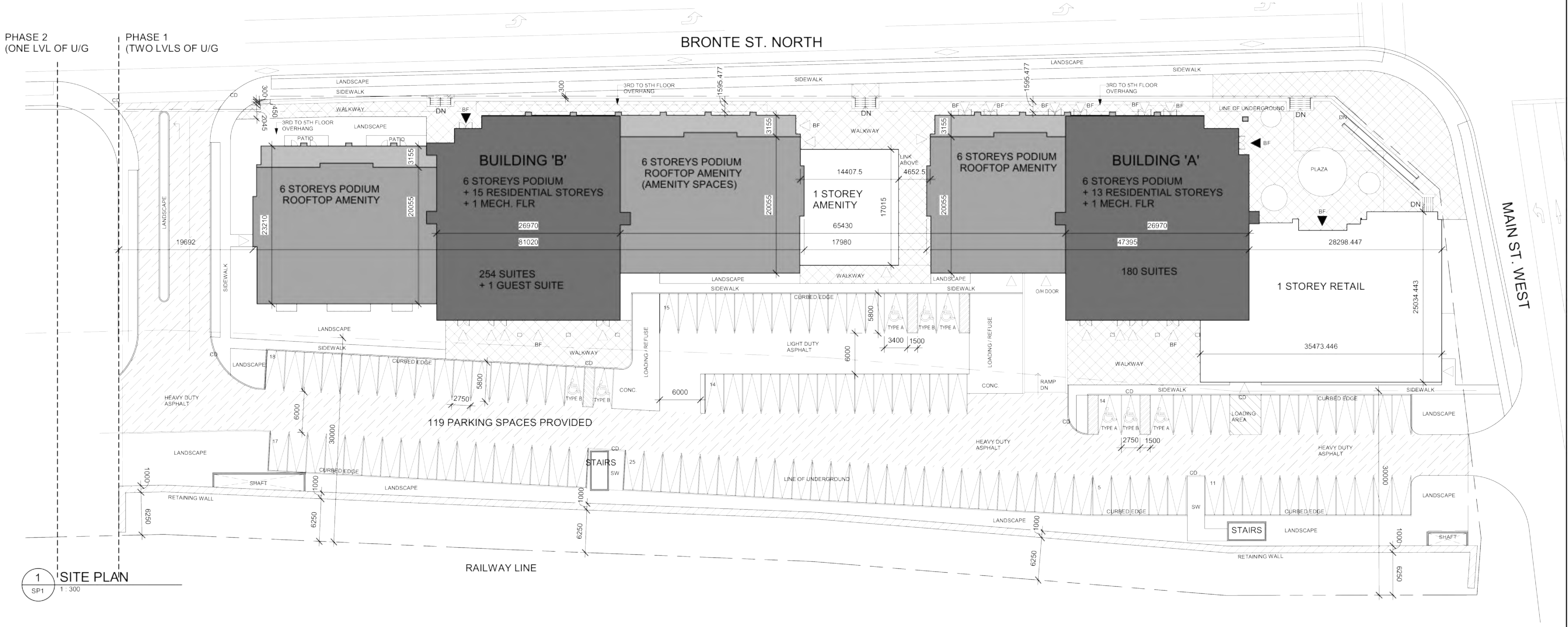
Figure Title:

Site Location Plan

Scale: 0m 100 m 200 m	**Project Number:** SP18-317-30
Date: July 2018	**Figure Number:** 1-1



2 BUILDING 'A' & 'B' CROSS SECTION
SP1 1 : 400



1 SITE PLAN
SP1 1 : 300

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

North:

Legend:

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

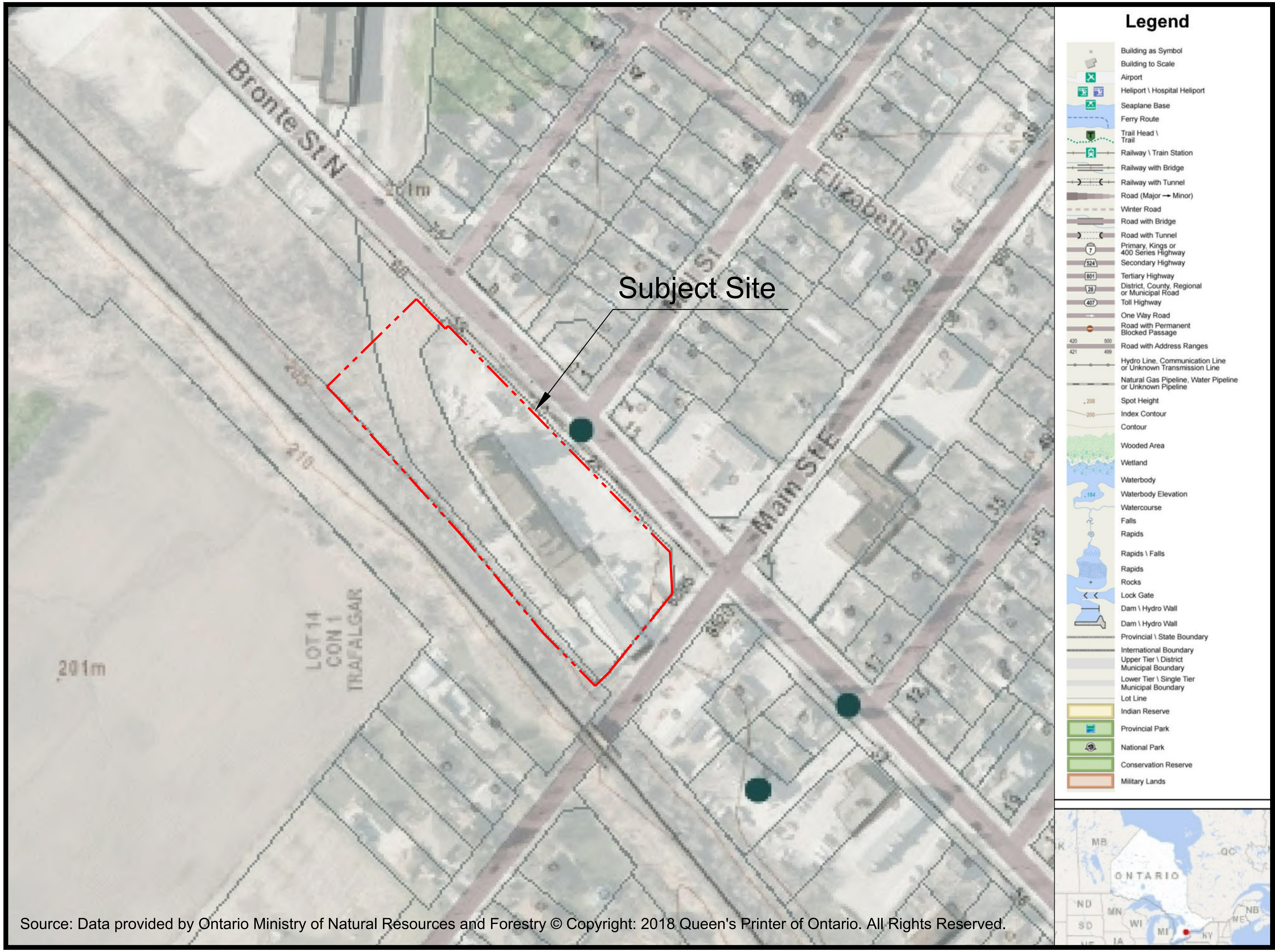
Figure Title:
Site Development Plan

Scale: 0m 10m

Project Number: SP18-317-30

Date: October 2018

Figure Number: 3-1



Source: Data provided by Ontario Ministry of Natural Resources and Forestry © Copyright: 2018 Queen's Printer of Ontario. All Rights Reserved.

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

North:

N

Legend:

-·-·—·-·- Property Boundary

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Topographic Map

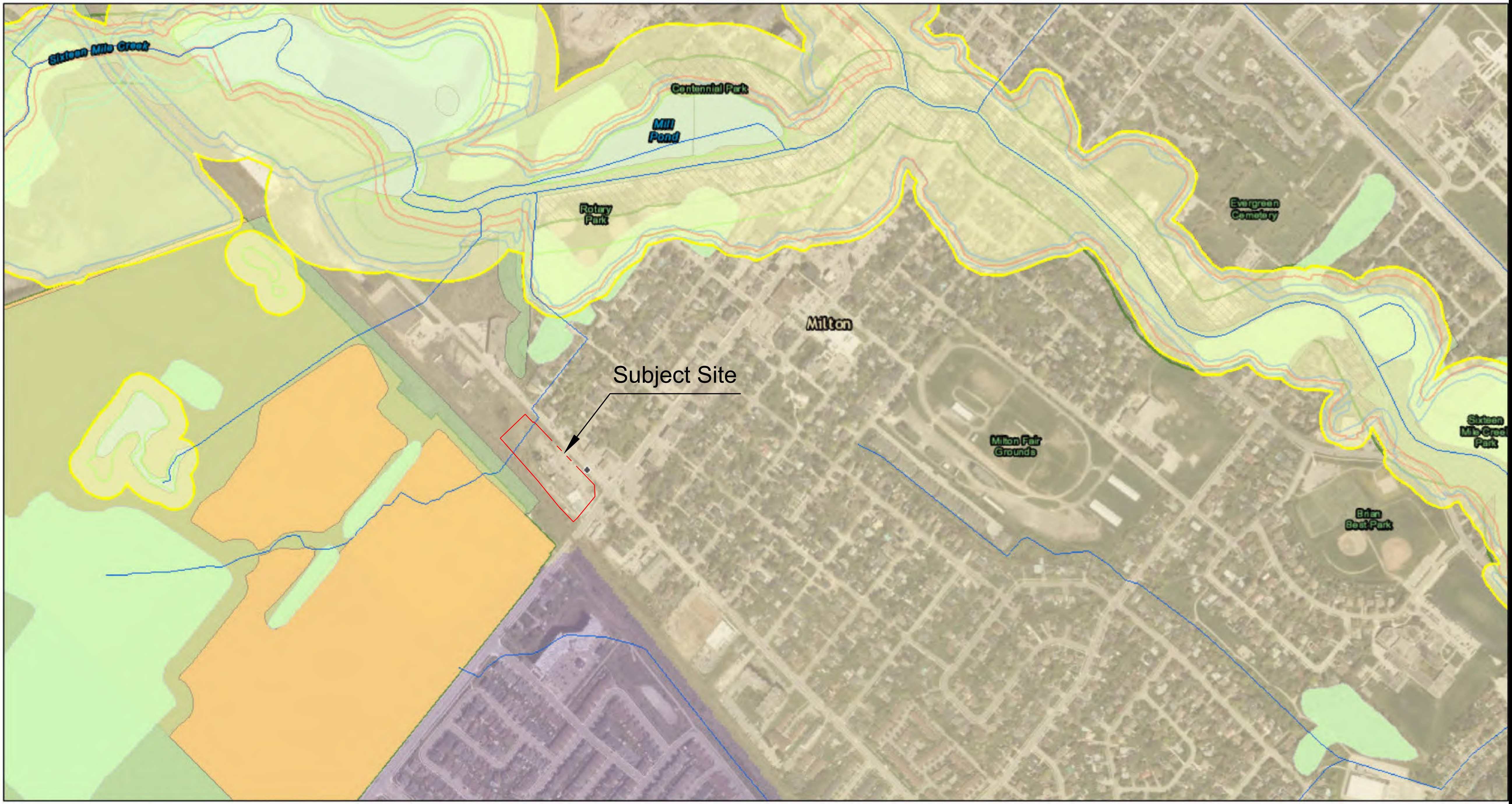
Scale: 0m 25m

Project Number: SP18-317-30

Date: July 2018

Figure Number: 5-1

Conservation Halton



6/26/2018, 1:59:33 PM

1:9,028

- Waterflow
- ARL_20120513_BendS10m_NC_CH
- ARL
- Stable Top of Bank Hazard
- Meander Belt Hazard
- Floodplain Hazard
- Headwater Floodplains
- Wetlands Hazard
- Shoreline Hazard
- Dynamic Beach Hazard
- 100 year Flood Hazard
- Stable Top of Bank Allowance
- Meander Belt Allowance
- Floodplains Allowance
- Headwater Floodplains Allowance
- Wetlands Allowance
- Shoreline Allowance
- Dynamic Beach Allowance
- 100 year Flood Allowance
- ANSI (MNR)
- ESAs (Hamilton, Halton)
- Wetlands (MNR)
- Significant Woodlands (Halton & Hamilton)
- Natural Heritage System (Halton)A
- Natural Heritage System (Halton)B

NEC Planning Areas

- Escarpment Natural Area
- Escarpment Protection Area
- Escarpment Rural Area
- Mineral Resource Extraction Area
- Urban Area
- Greenbelt

Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Conservation Halton
Conservation Halton, 2018

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

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

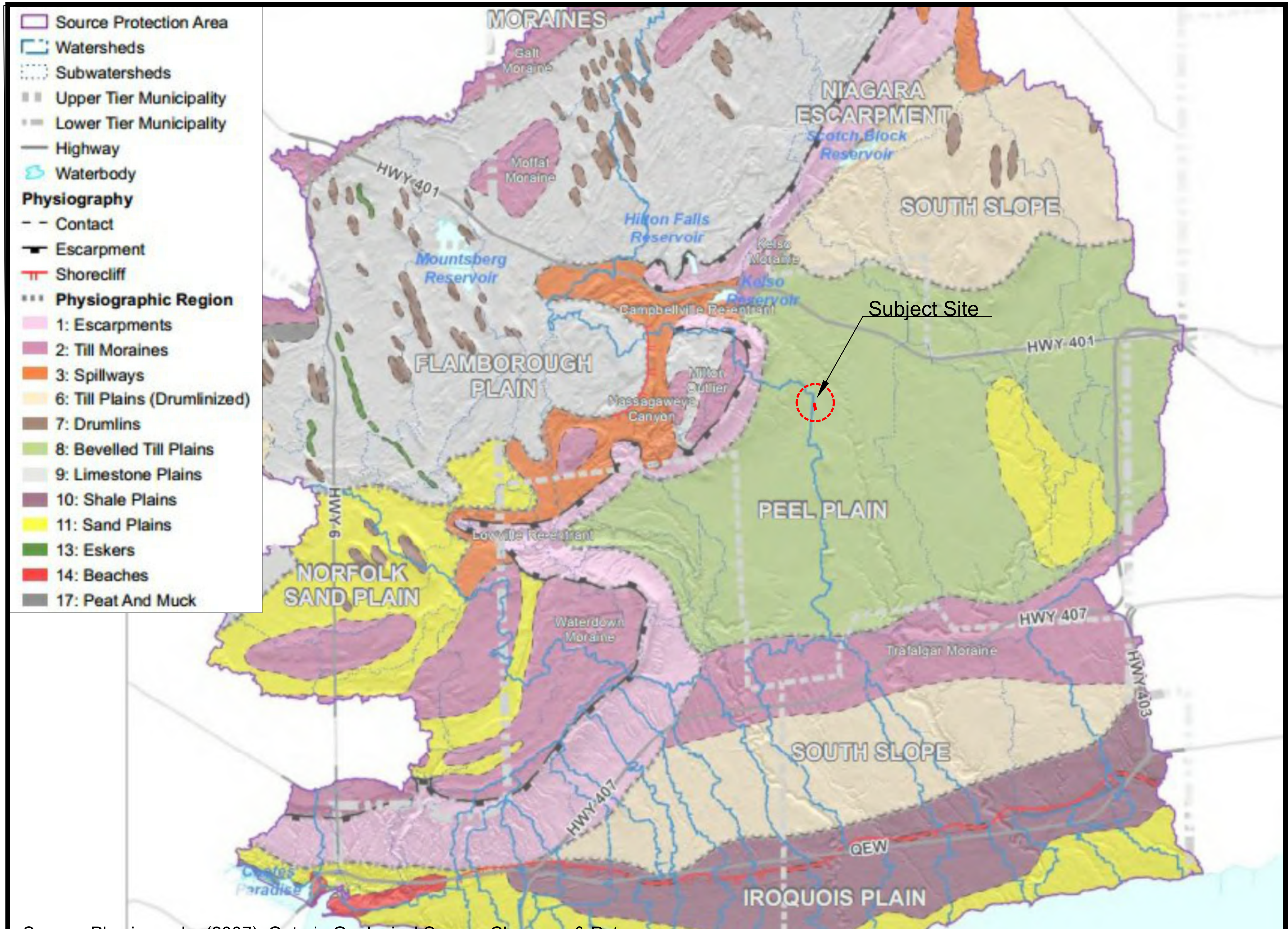
Figure Title:
Regulated Area Map

Scale: As Shown

Project Number: SP18-317-30

Date: July 2018

Figure Number: 5-1a



Source: Physiography (2007), Ontario Geological Survey, Chapman & Putnam

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

North:

Legend:

🟥	Subject Site
◌	Approximate Site Location

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

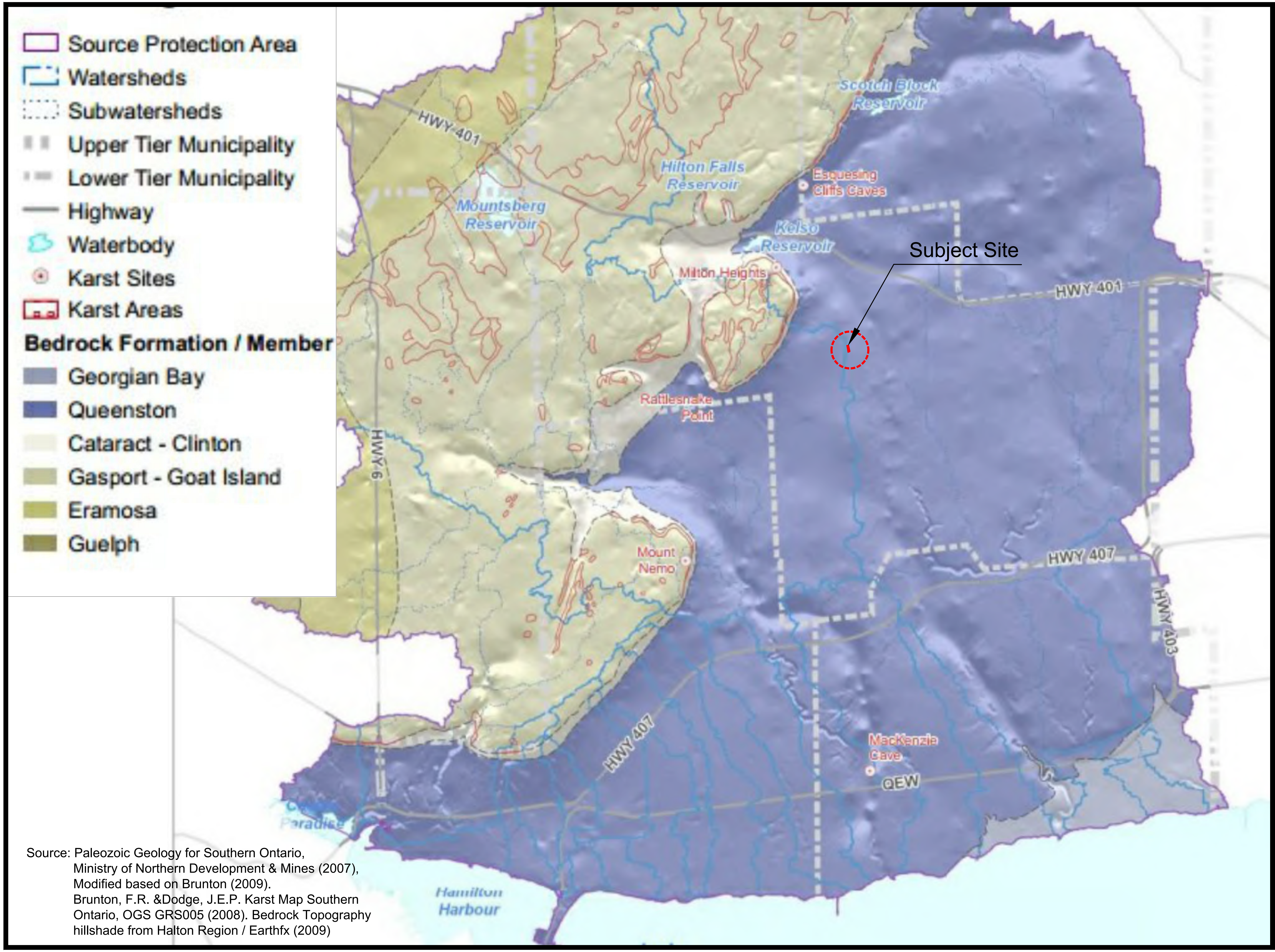
Physiography Map

Scale: 0m 2km

Project Number: SP18-317-30

Date: July 2018

Figure Number: 5-2



Source: Paleozoic Geology for Southern Ontario, Ministry of Northern Development & Mines (2007), Modified based on Brunton (2009). Brunton, F.R. &Dodge, J.E.P. Karst Map Southern Ontario, OGS GRS005 (2008). Bedrock Topography hillshade from Halton Region / Earthfx (2009)

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

North:

Legend:

🟥 Subject Site

◯ Approximate Site Location

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

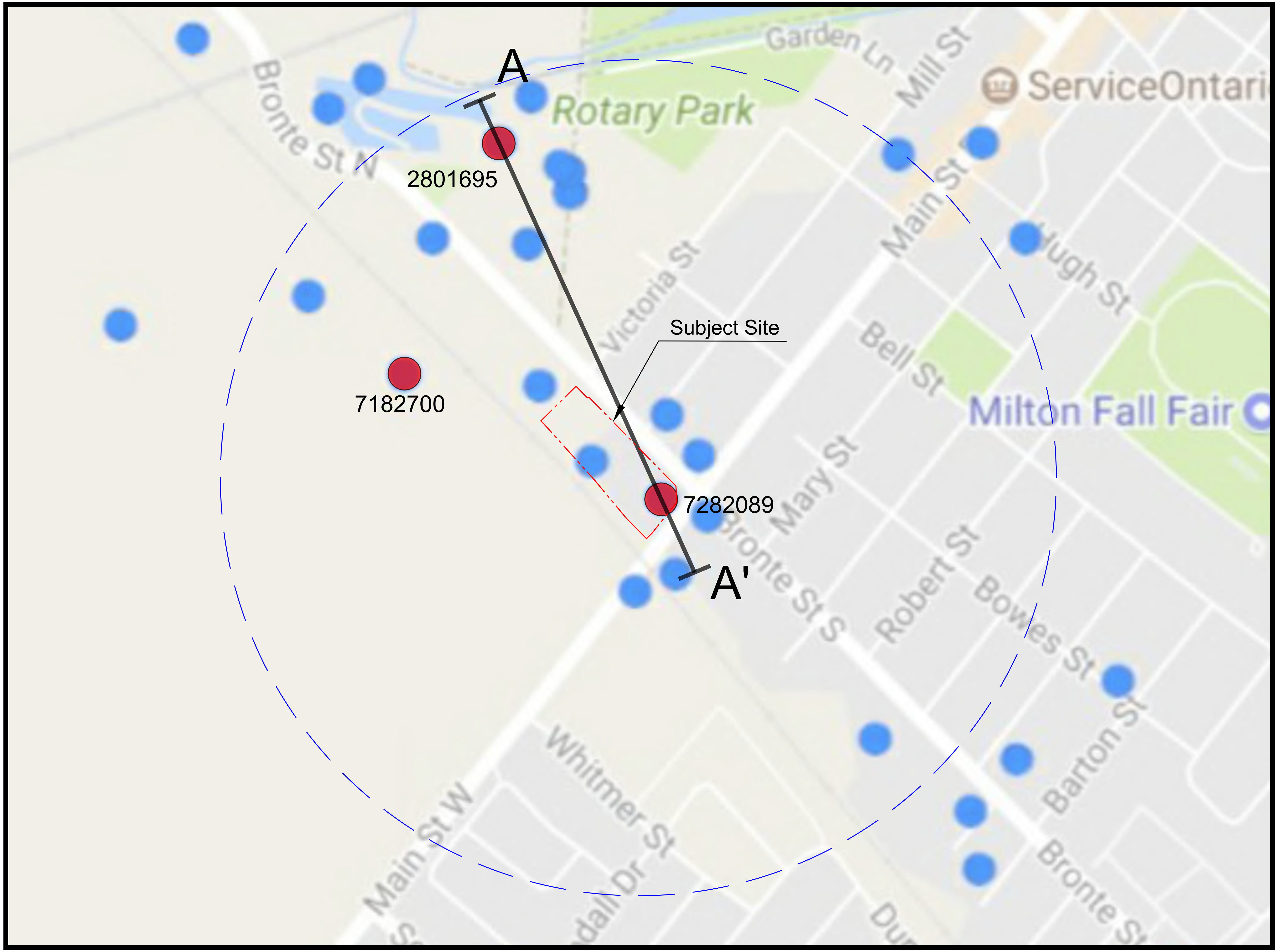
Bedrock Geology

Scale: 0m 2km

Project Number: SP18-317-30

Date: July 2018

Figure Number: 5-3



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

North:

Legend:

-·-·-	Property Boundary
- - - -	500m Study Area
●	MOECC Well
●	MOECC Well Used in Cross Section

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

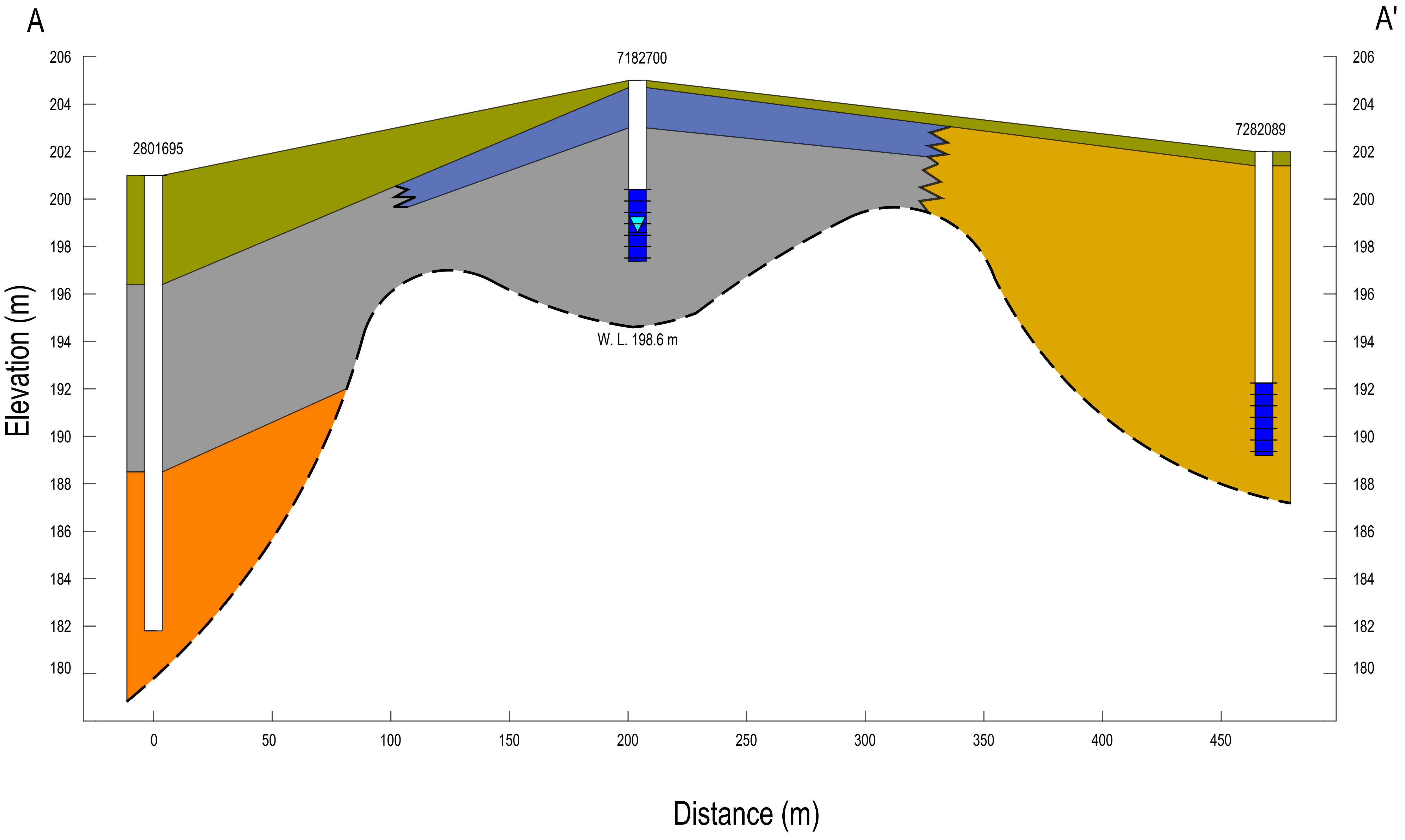
Figure Title:
MOECC Water Well Records Map

Scale:
0m 100m

Project Number:
SP18-317-30

Date:
July 2018

Figure Number:
6-1



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

Legend:

🟩 Fill

⬜ Clay

🟨 Sandy Silt Till / Silty Sand Till

🟧 Shale

🟦 Silt

MW1 ← Borehole / Well ID

▽ ← Water Level

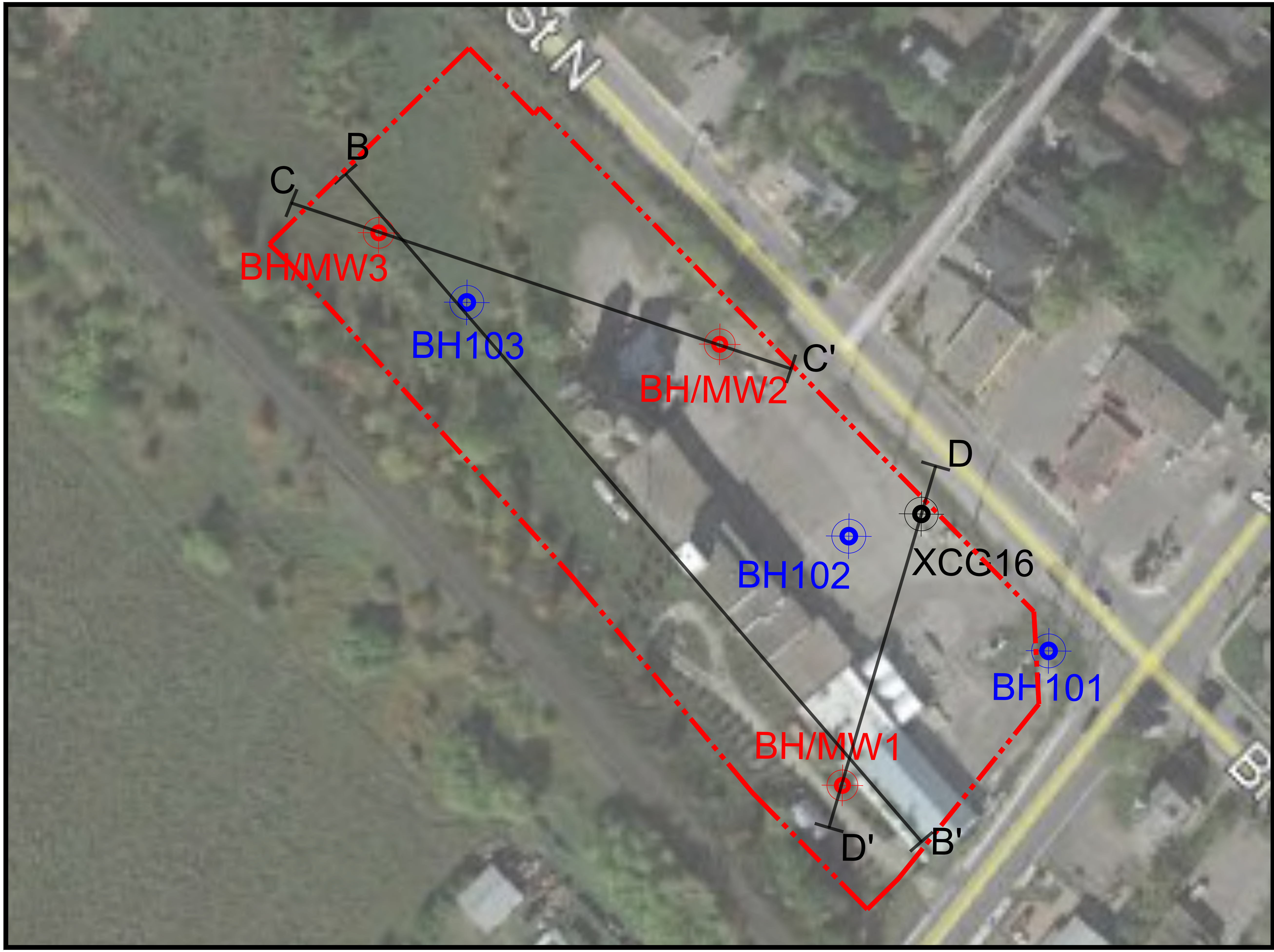
▤ ← Well Screen

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

Figure Title:
MOECC Well Record Profile-Section A-A'

Scale: As Shown	**Project Number:** SP18-317-30
Date: July 2018	**Figure Number:** 6-2



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
- ⊕ Monitoring Well Completed by XCG (May 1997)
- ⊕ Monitoring Well Completed by S&P (August 2007)
- ⊕ Monitoring Well SPCL

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

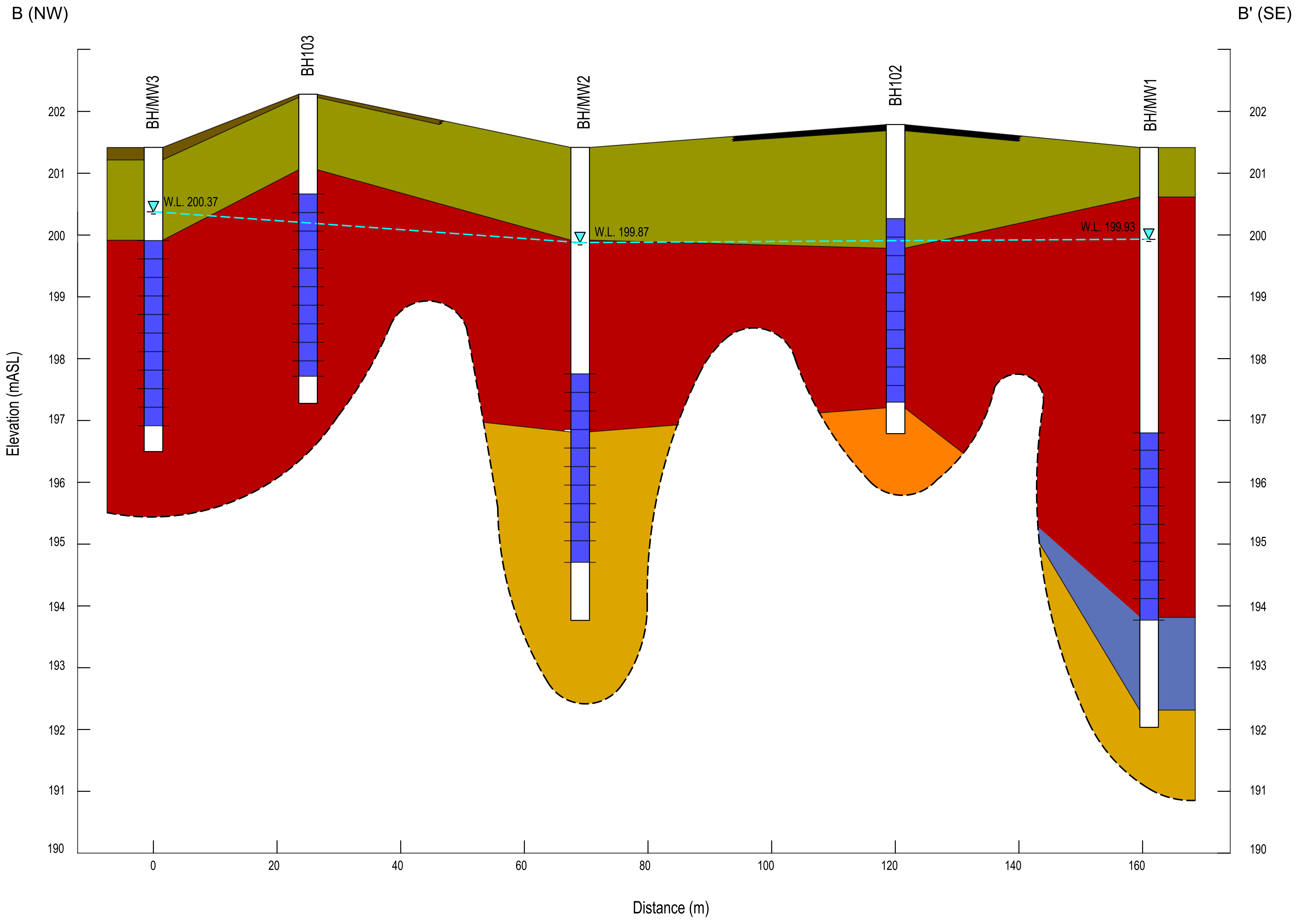
SPCL Borehole Location Map

Scale: 0m 20m

Project Number: SP18-317-30

Date: July 2018

Figure Number: 8-1



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

Legend:

- - - -	Water Level
■	Asphalt
■	Top Soil
■	Fill
■	Clayey Silt Till / Silty Clay Till
■	Sandy Silt Till / Silty Sand Till
■	Shale
■	Silt

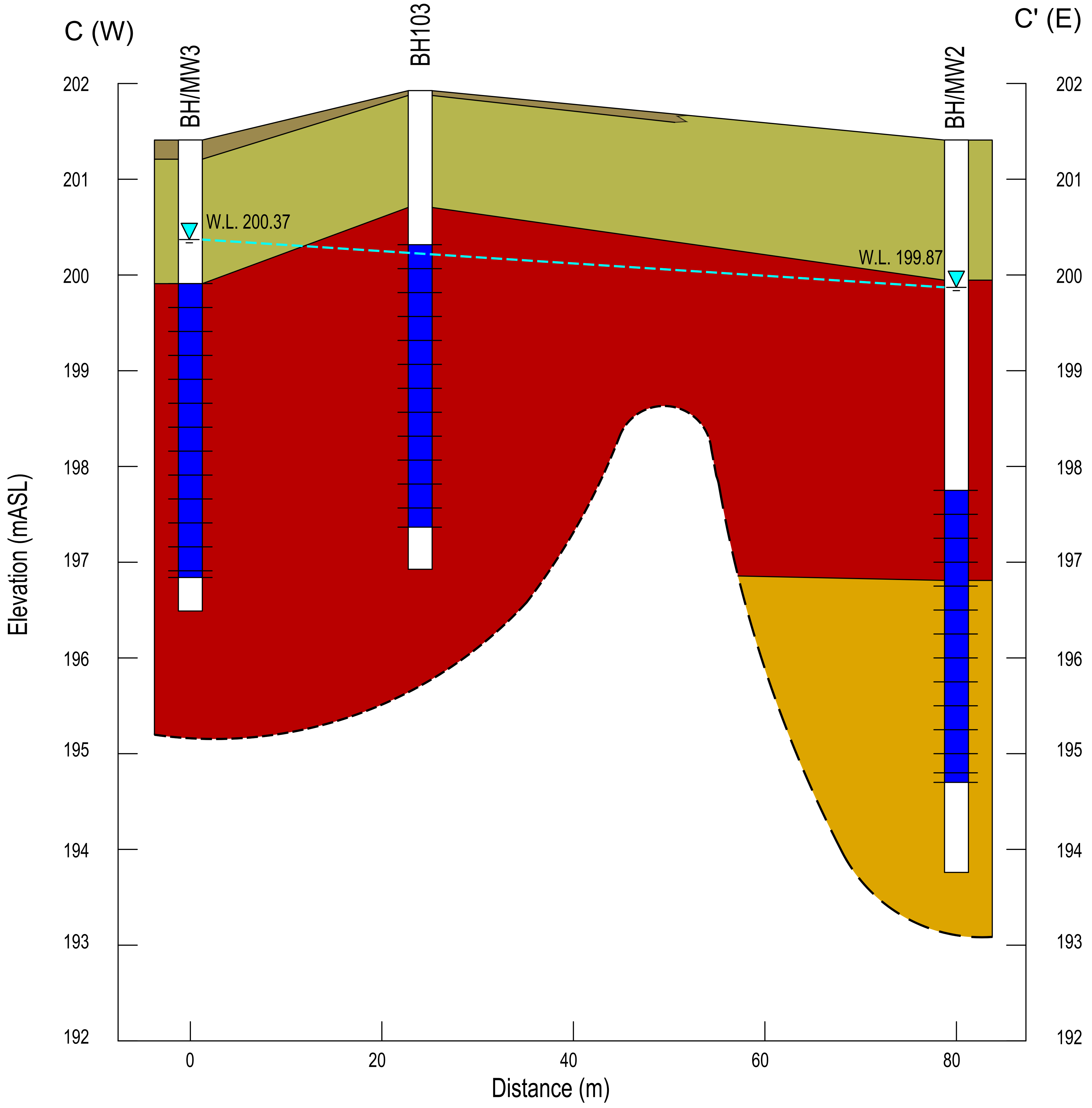
MW1 ← Borehole / Well ID
← Water Level
← Well Screen

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

Figure Title:
Borehole Cross Section B-B'

Scale: As Shown	**Project Number:** SP18-317-30
Date: July 2018	**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

Legend:

- - - - - Water Level

🟫 Top Soil

🟩 Fill

🟥 Clayey Silt Till / Silty Clay Till

🟧 Sandy Silt Till / Silty Sand Till

MW1 ← Borehole / Well ID

← Water Level

← Well Screen

Project Title:

Hydrogeological Investigation

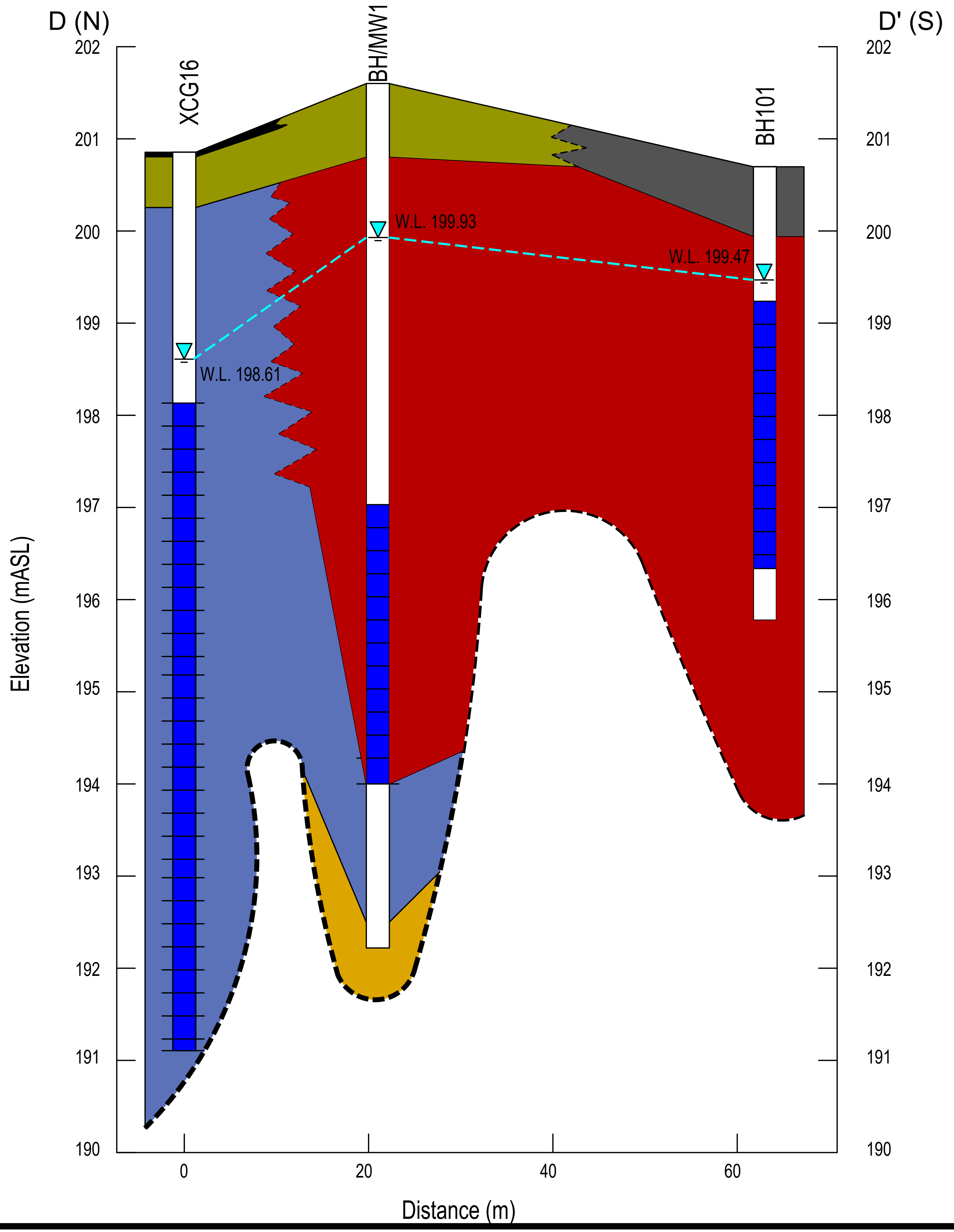
Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Borehole Cross Section C-C'

Scale: As Shown	**Project Number:** SP18-317-30
Date: July 2018	**Figure Number:** 8-3



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

Legend:

- - - - Water Level

■ Asphalt

🟨 Fill

■ Clayey Silt / Silty Clay

🟥 Clayey Silt Till / Silty Clay Till

🟦 Silt

🟧 Sandy Silt Till / Silty Sand Till

MW1 ← Borehole / Well ID

← Water Level

← Well Screen

Project Title:

Hydrogeological Investigation

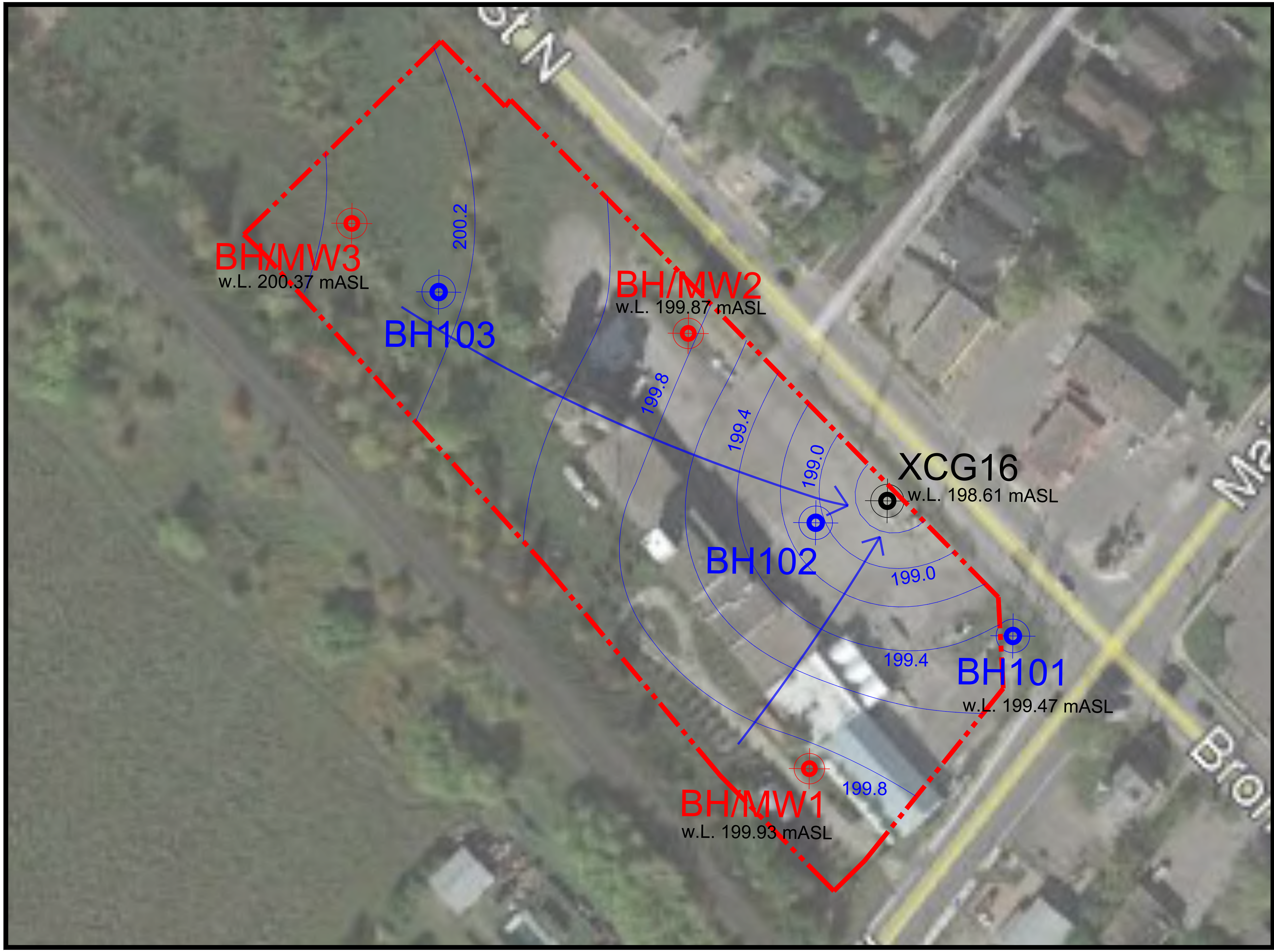
Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Borehole Cross Section D-D'

Scale: As Shown	**Project Number:** SP18-317-30
Date: July 2018	**Figure Number:** 8-4



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

North:

Legend:

- Property Boundary
- Contour Line
- Inferred Shallow Groundwater Flow Direction
- 188.0 mASL Monitoring Well & Groundwater Elevation
- Monitoring Well Completed by XCG
- Monitoring Well Completed by S&P
- Proposed Monitoring Well SPCL

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street Norht, Milton, ON

Figure Title:

Inferred Shallow Groundwater Flow Direction

Scale:

0m 10m 20m

Project Number:

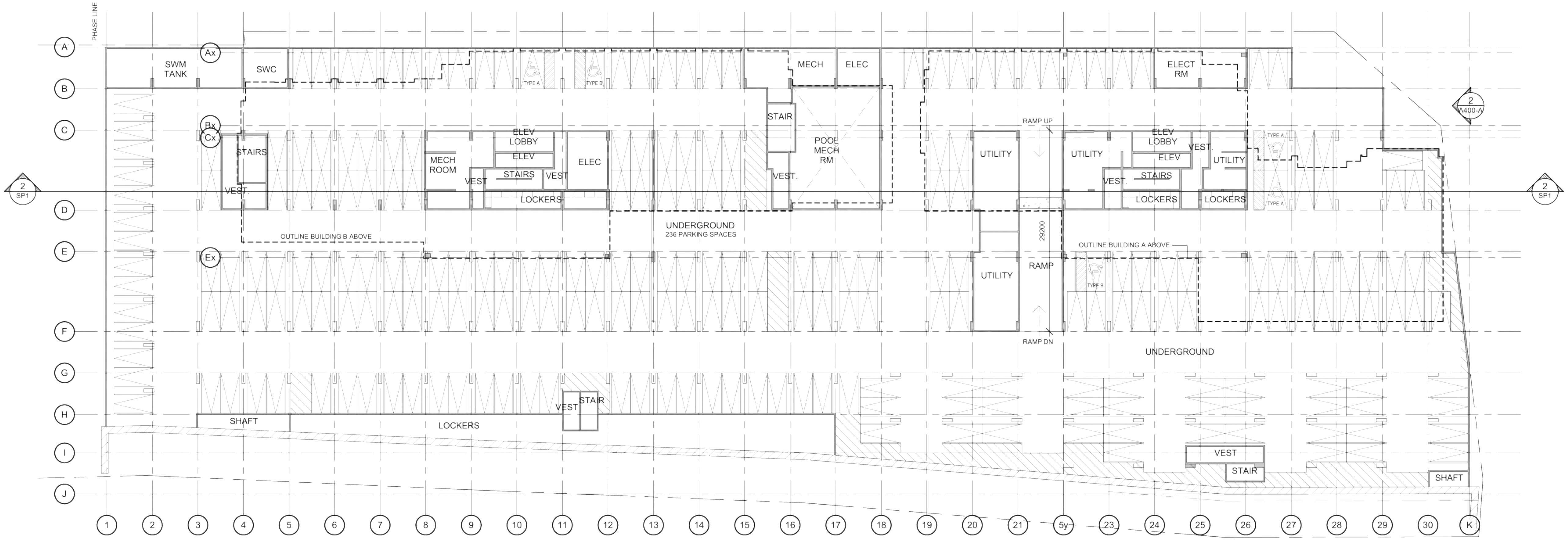
SP18-317-30

Date:

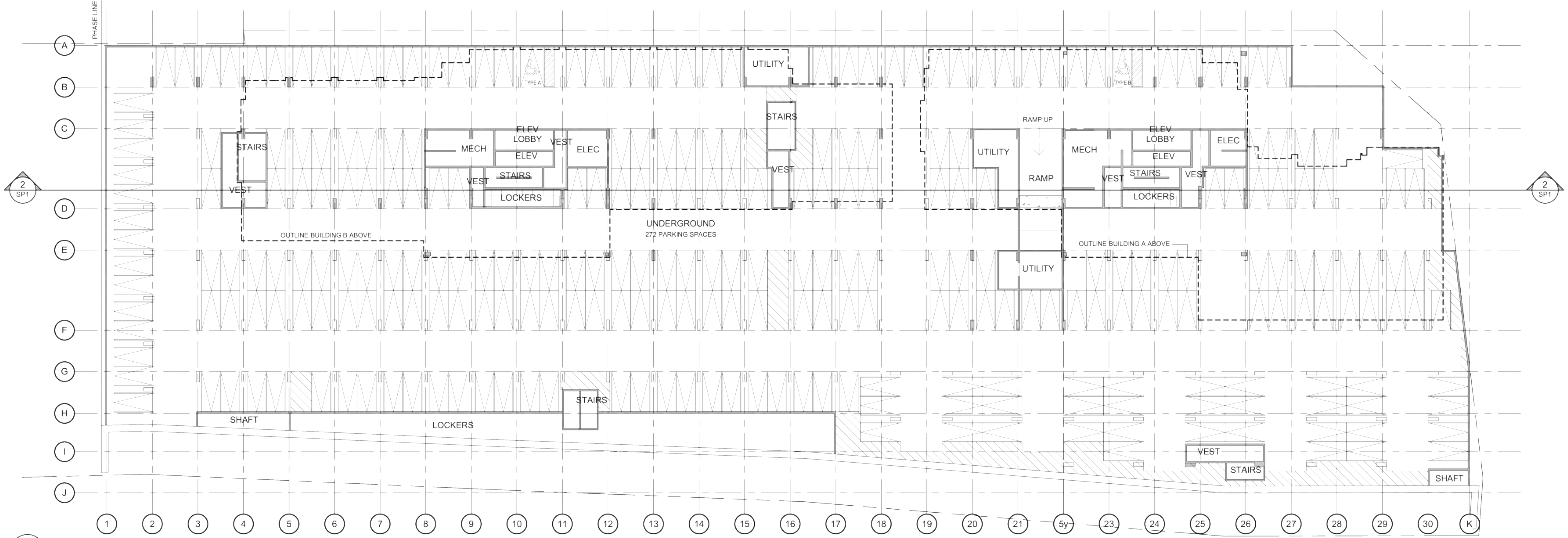
July 2018

Figure Number:

9-1



1
A200
UNDERGROUND LEVEL 1
1 : 300



2
A200
UNDERGROUND LEVEL 2
1 : 300

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

North:

Legend:

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Underground Parking Level 1 and 2

Scale:

0m 10m

Project Number:

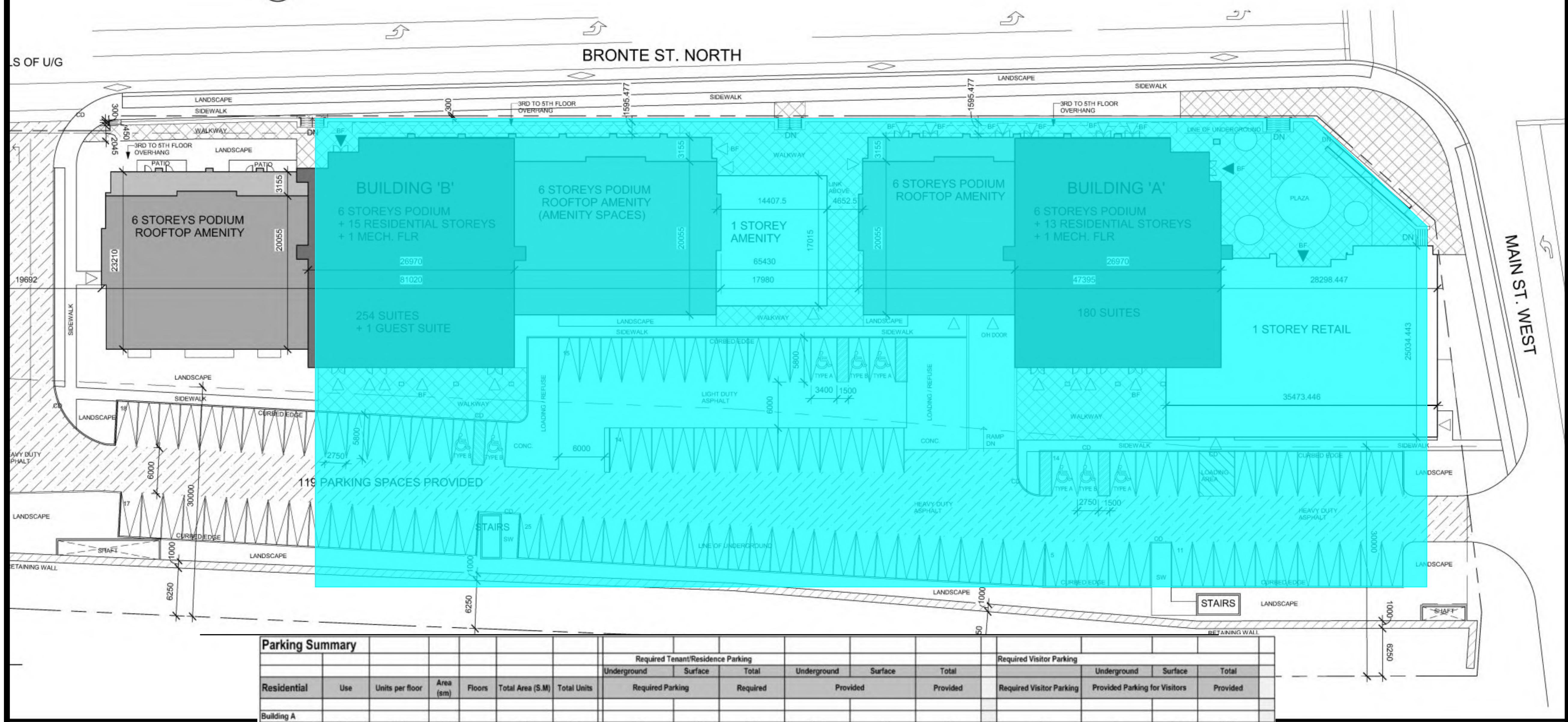
SP18-317-30

Date:

October 2018

Figure Number:

11-1



Parking Summary																
							Required Tenant/Residence Parking						Required Visitor Parking			
							Underground	Surface	Total	Underground	Surface	Total		Underground	Surface	Total
Residential	Use	Units per floor	Area (sm)	Floors	Total Area (S.M)	Total Units	Required Parking		Required	Provided		Provided	Required Visitor Parking	Provided Parking for Visitors		Provided
Building A																
Floor 1	Retail	TBD	1195	1	1195	TBD	0.0	0.00	0.0	0.0	0.0	0.0	59.8	0	60.0	60.0
	Residential	0				0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Floor 2	Residential	6		1		6	6.00	0.00	6.00	6.00	0.00	6.0	1.5	0.0	1.0	1.0
Floor 3	Residential	15		1		15	15.00	0.00	15.00	15.00	0.00	15.0	3.8	0.0	4.0	4.0
Floor 4	Residential	14		1		14	14.00	0.00	14.00	14.00	0.00	14.0	3.5	0.0	4.0	4.0
Floor 5	Residential	15		1		15	15.00	0.00	15.00	15.00	0.00	15.0	3.8	0.0	4.0	4.0
Floor 6	Residential	13		1		13	13.00	0.00	13.00	13.00	0.00	13.0	3.3	0.0	3.0	3.0
Floor 7	Residential	9		1		9	9.00	0.00	9.00	9.00	0.00	9.0	2.3	0.0	2.0	2.0
Floor 8-17	Residential	10		10		100	100.00	0.00	100.00	100.00	0.00	100.0	25.0	20.0	5.0	25.0
Floor 18-19	Residential	4		2		8	8.00	0.00	8.00	8.00	0.00	8.0	2.0	0.0	2.0	2.0
Floor 20	Mechanical															
Total				19		180	180.00	0.00	180.00	180.00	0.00	180.0	104.8	20.0	85.0	105.0
Building B																
Floor 1	Amenity	TBD	2112	1	2112	TBD										
	Residential	9				9	9.00	0.00	9.00	9.00	0.00	9.0	2.3	0.0	2.0	2.0
Floor 2	Residential	19		1		19	19.00	0.00	19.00	19.00	0.00	19.0	4.8	0.0	5.0	5.0
Floor 3	Residential	24		1		24	24.00	0.00	24.00	24.00	0.00	24.0	6.0	0.0	6.0	6.0
Floor 4	Residential	23		1		23	23.00	0.00	23.00	23.00	0.00	23.0	5.8	0.0	6.0	6.0
Floor 5	Residential	24		1		24	24.00	0.00	24.00	24.00	0.00	24.0	6.0	0.0	6.0	6.0
Floor 6	Residential	20		1		20	20.00	0.00	20.00	20.00	0.00	20.0	5.0	0.0	5.0	5.0
Floor 7	Residential	8		1		8	8.00	0.00	8.00	8.00	0.00	8.0	2.0	0.0	2.0	2.0
Floor 8-19	Residential	10		12		120	120.00	0.00	120.00	120.00	0.00	120.0	30.0	30.0	0.0	30.0
Floor 20-21	Residential	4		2		8	8.00	0.00	8.00	8.00	0.00	8.0	2	0.0	2.0	2.0
Floor 22	Mechanical															
Total				21		255	255.00	0.00	255.00	255.00	0.00	255.00	64	30.0	34.0	64.0
Grand Total						435	435	0	435	435	0	435	169	50	119	169

Total Underground Parking Provided	508
Total Surface Parking Provided	119
Total Parking	627

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

North:

Legend:

▭ Dewatering Area

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

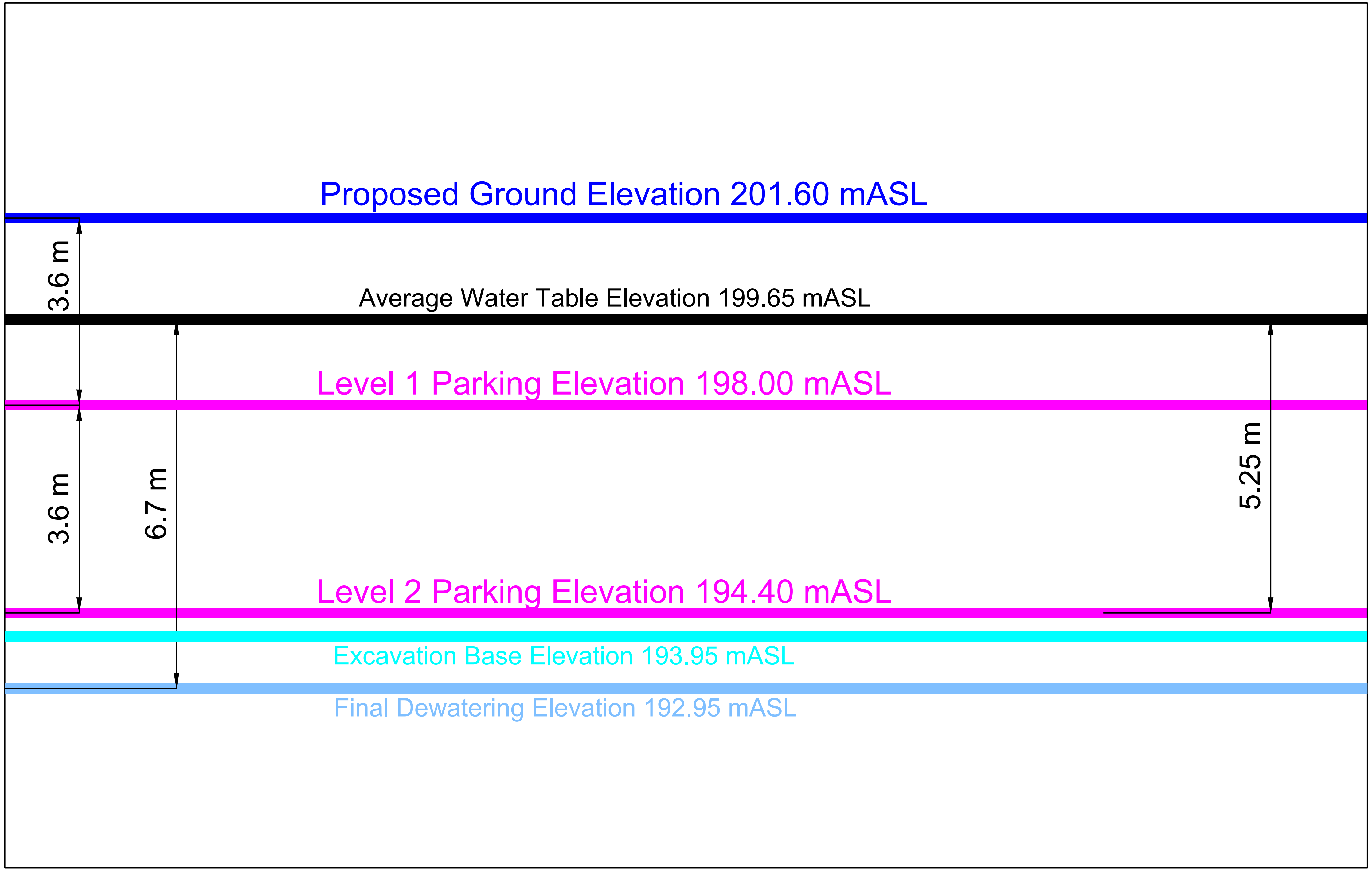
Dewatering Area Map

Scale: 0m 10m

Project Number: SP18-317-30

Date: October 2018

Figure Number: 11-2



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

North:

Legend: As Shown

Project Title:
Hydrogeological Investigation

Site Location:
28-60 Bronte Street North, Milton, ON

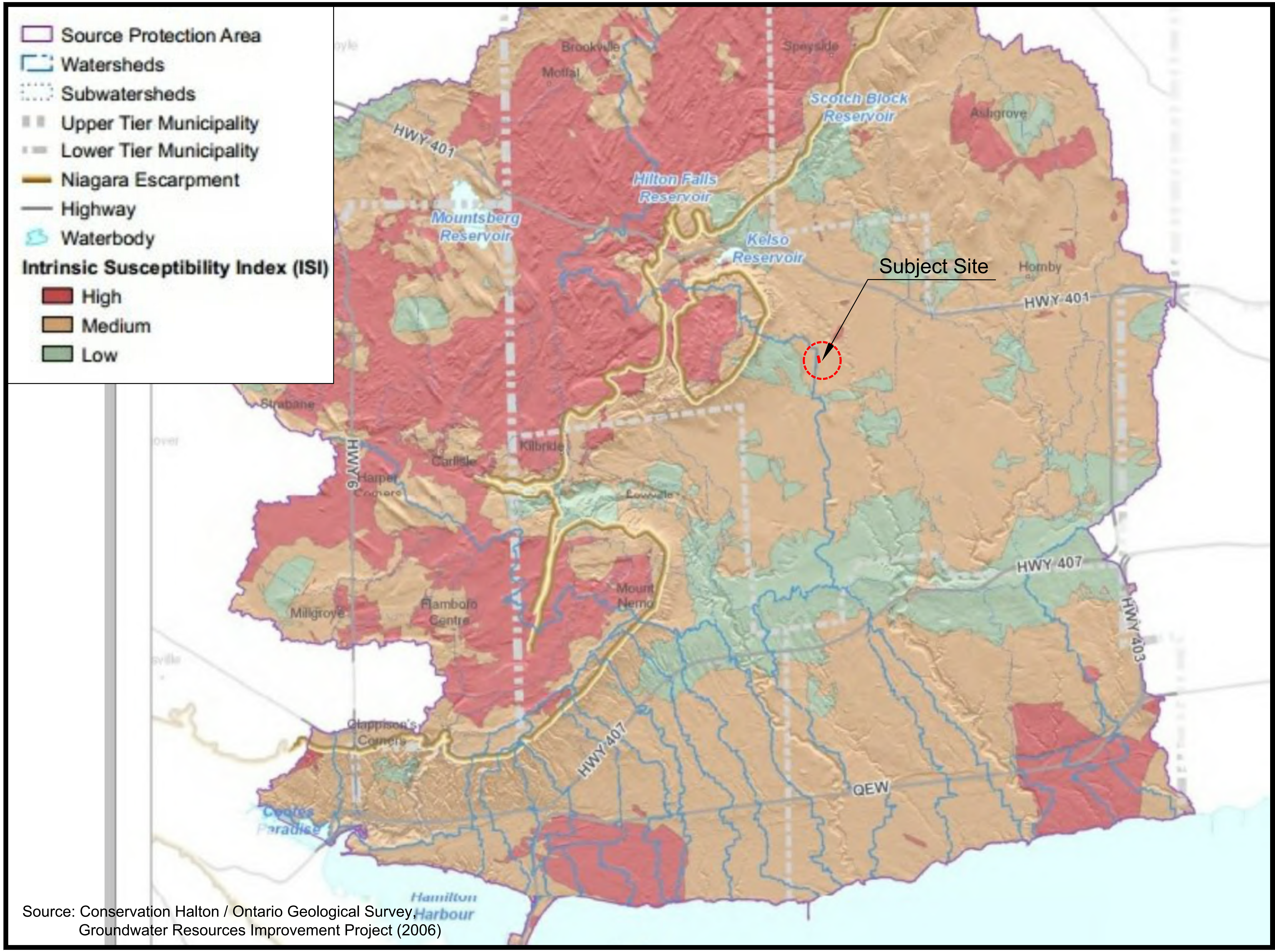
Figure Title:
Site Dewatering Cross Section Elevation Map

Scale: 0m 3m

Project Number: SP18-317-30

Date: October 2018

Figure Number: 11-3



Source: Conservation Halton / Ontario Geological Survey, Groundwater Resources Improvement Project (2006)

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

North:

Legend:

🟥 Subject Site

○ Approximate Site Location

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Intrinsic Groundwater Susceptibility Map

Scale:

0m 2km

Project Number:

SP18-317-30

Date:

July 2018

Figure Number:

13-1

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

North:

Legend:

-·-·-	Phase ONE Property Boundary
▨	Phase TWO Property Boundary
⬜	Paving
🟦	Roof
🟩	Landscape

Site Statistics:

Paving:	3607 sq.m
Roof:	1664 sq.m
Landscape:	8124 sq.m
Total	13395 sq.m

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Pre-Development Site Statistics

Scale:

0m 50m

Project Number:

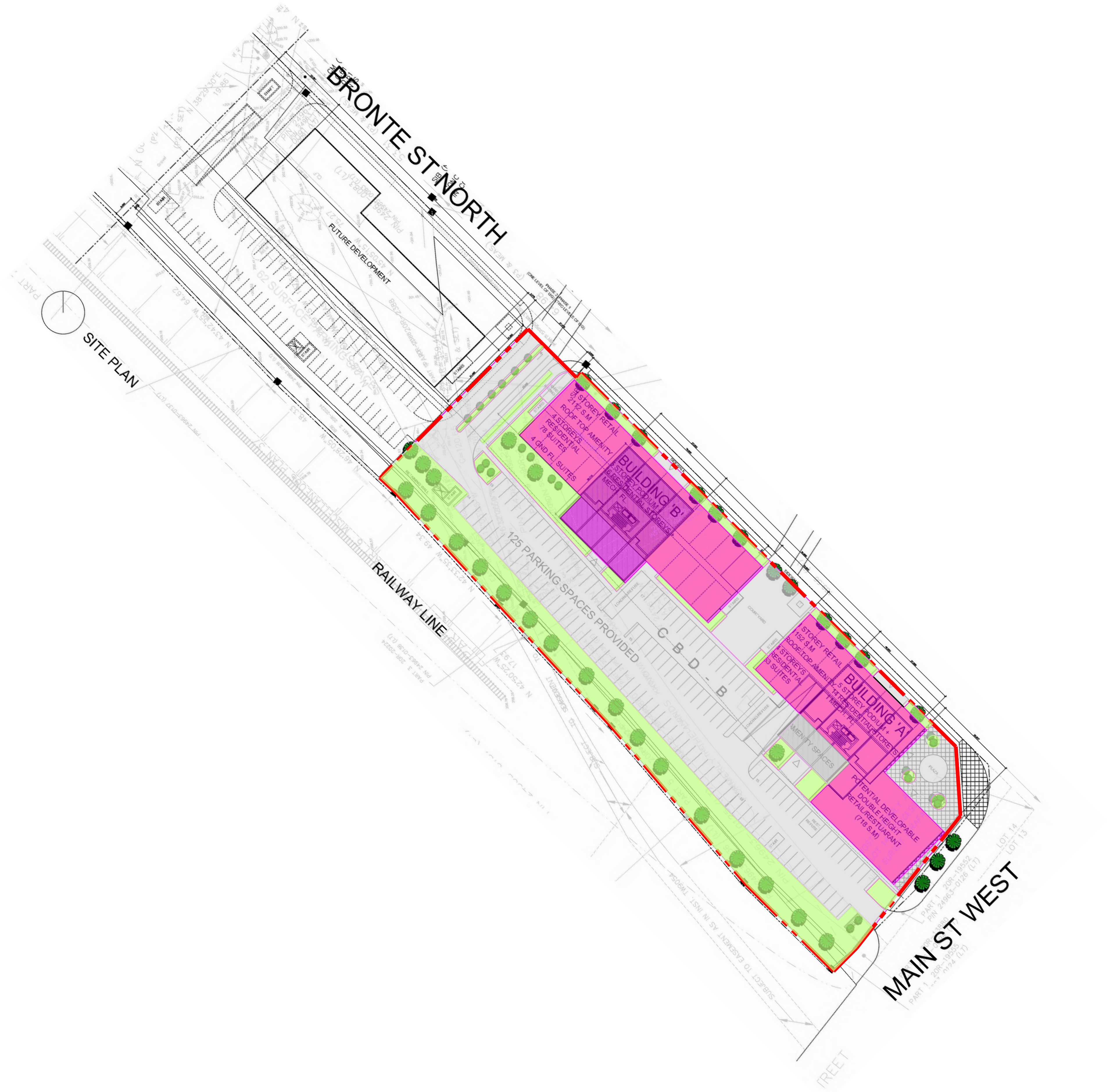
SP18-317-30

Date:

July 2018

Figure Number:

14-1



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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

North:

Legend:

-·-·—·-·-	Phase ONE Property Boundary
⬜	Paving
🟪	Roof
🟩	Landscape

Site Statistics:

Paving:	6141 sq.m
Roof:	3982 sq.m
Landscape:	3272 sq.m
Total	13395 sq.m

Project Title:

Hydrogeological Investigation

Site Location:

28-60 Bronte Street North, Milton, ON

Figure Title:

Post-Development Site Statistics

Scale:

0m 10m 20m

Project Number:

SP18-317-30

Date:

July 2018

Figure Number:

14-2

APPENDICES

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

APPENDIX A

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

SIRATI & PARTNERS

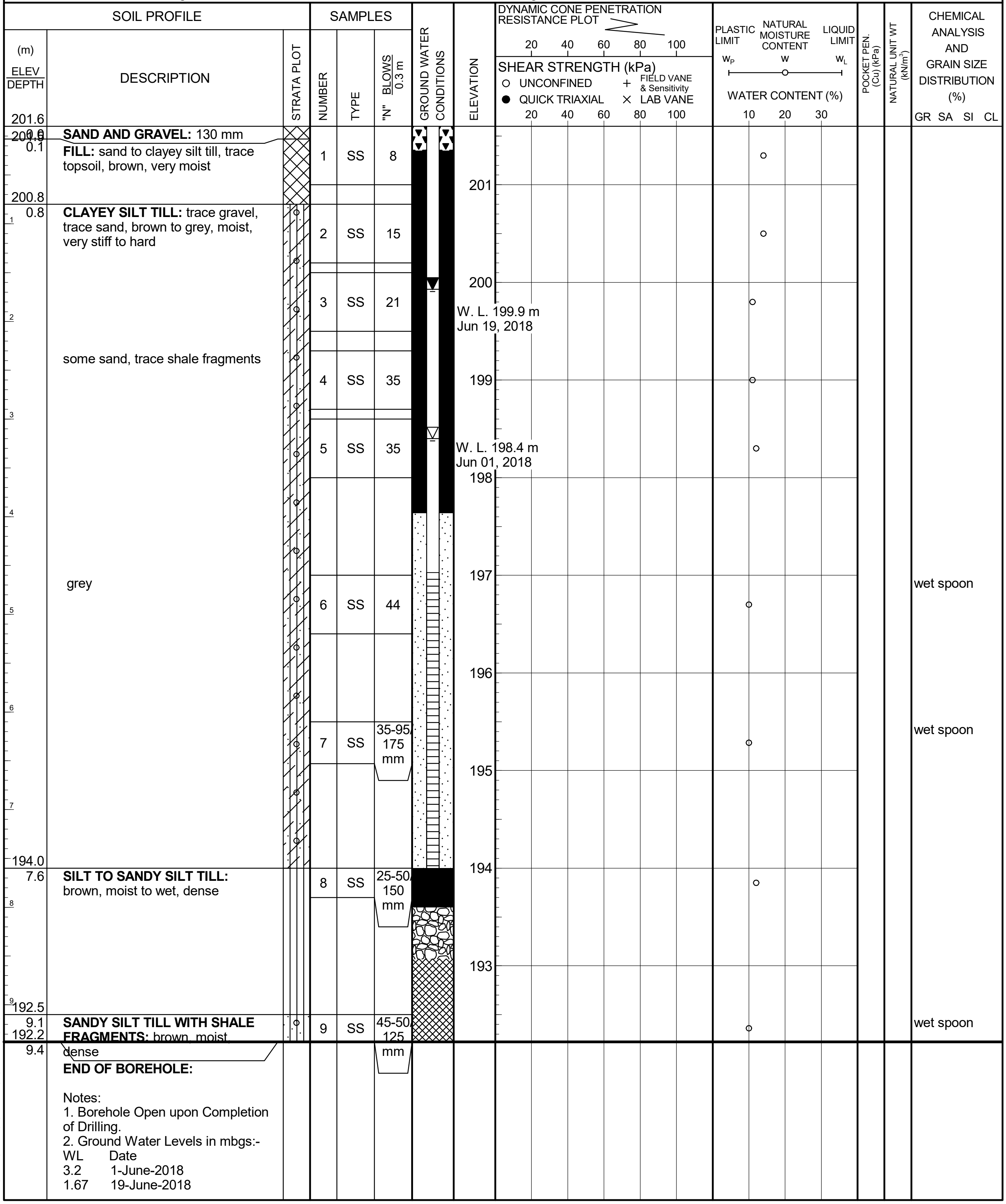
LOG OF BOREHOLE BH1

1 OF 1

PROJECT: Proposed Hydrogeological Investigation
CLIENT: 2183271 Ontario Inc.
PROJECT LOCATION: 28 - 60 Bronte St. North, Milton, Ontario
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Jun/01/2018
Drilling Contractor:

REF. NO.: SP18-317-30
ENCL NO.: 2



(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%)
201.6					
201.5 0.0	**SAND AND GRAVEL:** 130 mm				
0.1	**FILL:** sand to clayey silt till, trace topsoil, brown, very moist	1	SS	8	
200.8 0.8	**CLAYEY SILT TILL:** trace gravel, trace sand, brown to grey, moist, very stiff to hard	2	SS	15	
		3	SS	21	
	some sand, trace shale fragments	4	SS	35	
		5	SS	35	
	grey				wet spoon
		6	SS	44	
		7	SS	35-95/ 175 mm	wet spoon
194.0 7.6	**SILT TO SANDY SILT TILL:** brown, moist to wet, dense	8	SS	25-50/ 150 mm	
192.5 9.1	**SANDY SILT TILL WITH SHALE FRAGMENTS:** brown, moist dense	9	SS	45-50/ 125 mm	wet spoon
192.2 9.4	**END OF BOREHOLE:**				

Notes:
1. Borehole Open upon Completion of Drilling.
2. Ground Water Levels in mbgs:-

WL	Date
3.2	1-June-2018
1.67	19-June-2018

SPCL SOIL LOG SP18-317-10.GPJ SPCL.GDT 6/27/18

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

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

LOG OF BOREHOLE BH2

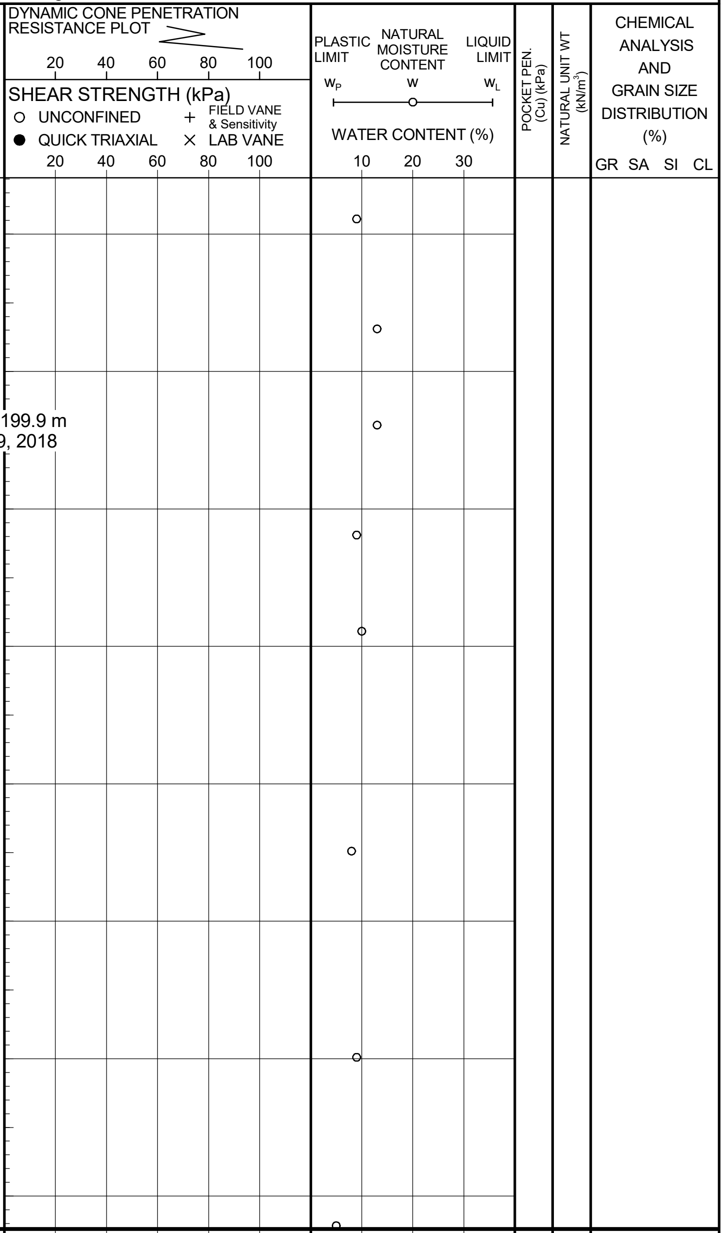
PROJECT: Proposed Hydrogeological Investigation
CLIENT: 2183271 Ontario Inc.
PROJECT LOCATION: 28 - 60 Bronte St. North, Milton, Ontario
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Jun/01/2018
Drilling Contractor:

REF. NO.: SP18-317-30
ENCL NO.: 3

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m		
201.4						
201.2 0.0	**SAND AND GRAVEL:** 180 mm					
0.2	**FILL:** clayey silt mixed with topsoil, trace gravel, brown, moist	1	SS	15		201
		2	SS	10		200
199.9 1.5	**CLAYEY SILT TILL:** some sand, trace gravel, brown to dark brown, moist, very stiff to hard	3	SS	24	W. L. 199.9 m Jun 19, 2018	
	becoming dense	4	SS	31		199
		5	SS	50		198
						197
196.8 4.6	**SANDY SILT TILL WITH SEAMS OF LIMESTONE:** trace clay, trace gravel, grey, moist, dense	6	SS	40		196
		7	SS	62		195
193.8 7.7		8	SS	50/ 50 mm		194
7.7	**END OF BOREHOLE:**					

Notes:
1. Borehole Open and Dry Upon Completion of Drilling.
2. round Water Levels in mbgs:-
WL Date
1.67 19-June-2018



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

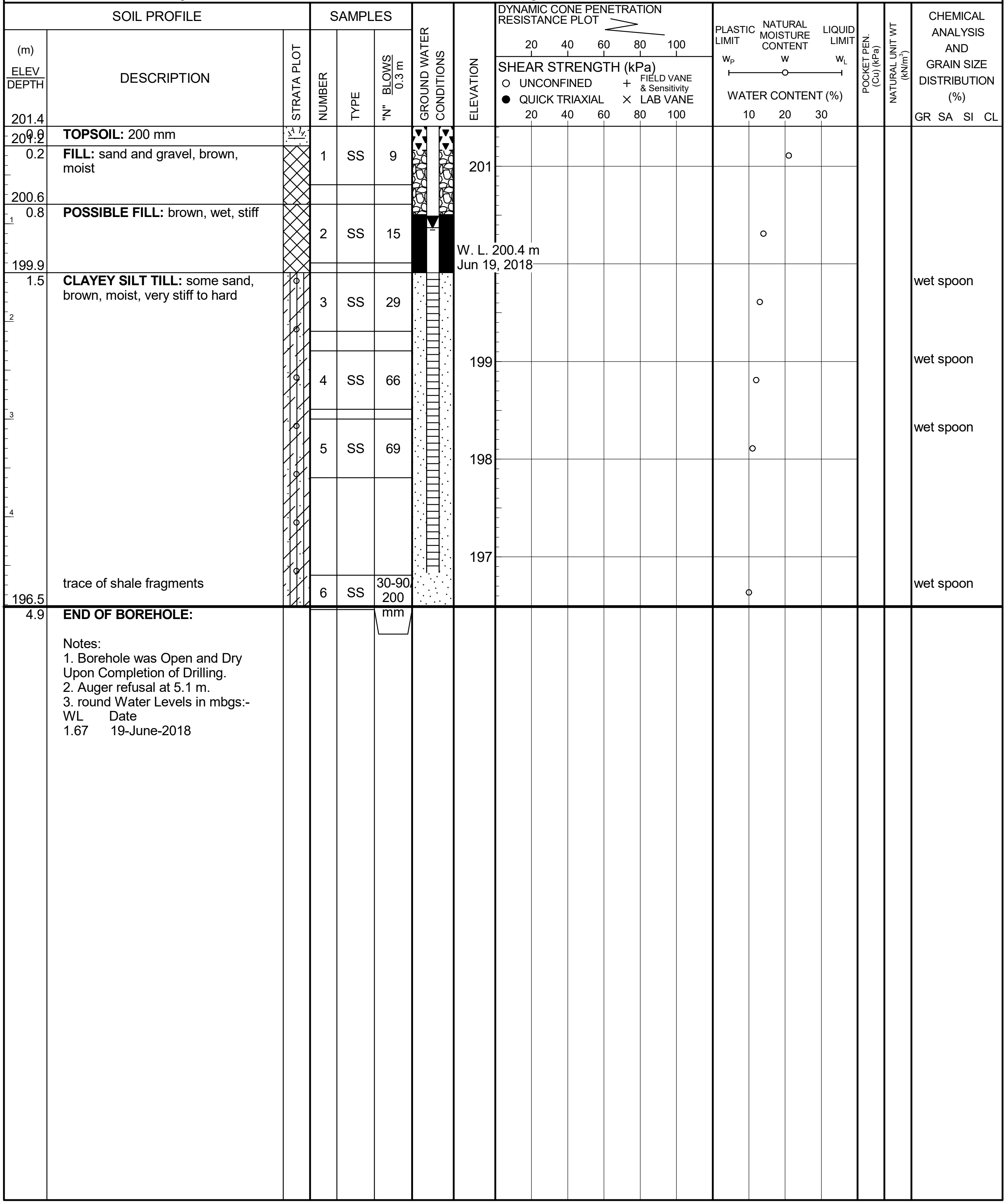
GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH3

PROJECT: Proposed Hydrogeological Investigation
CLIENT: 2183271 Ontario Inc.
PROJECT LOCATION: 28 - 60 Bronte St. North, Milton, Ontario
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Jun/01/2018
Drilling Contractor:

REF. NO.: SP18-317-30
ENCL NO.: 4



SOIL PROFILE		SAMPLES			CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	GR SA SI CL
201.4					
0.0	**TOPSOIL:** 200 mm				
201.2 0.2	**FILL:** sand and gravel, brown, moist	1	SS	9	
200.6 0.8	**POSSIBLE FILL:** brown, wet, stiff	2	SS	15	
199.9 1.5	**CLAYEY SILT TILL:** some sand, brown, moist, very stiff to hard	3	SS	29	wet spoon
		4	SS	66	wet spoon
		5	SS	69	wet spoon
	trace of shale fragments	6	SS	30-90/200 mm	wet spoon
196.5 4.9	**END OF BOREHOLE:**				

Notes:
1. Borehole was Open and Dry Upon Completion of Drilling.
2. Auger refusal at 5.1 m.
3. round Water Levels in mbgs:-

WL	Date
1.67	19-June-2018

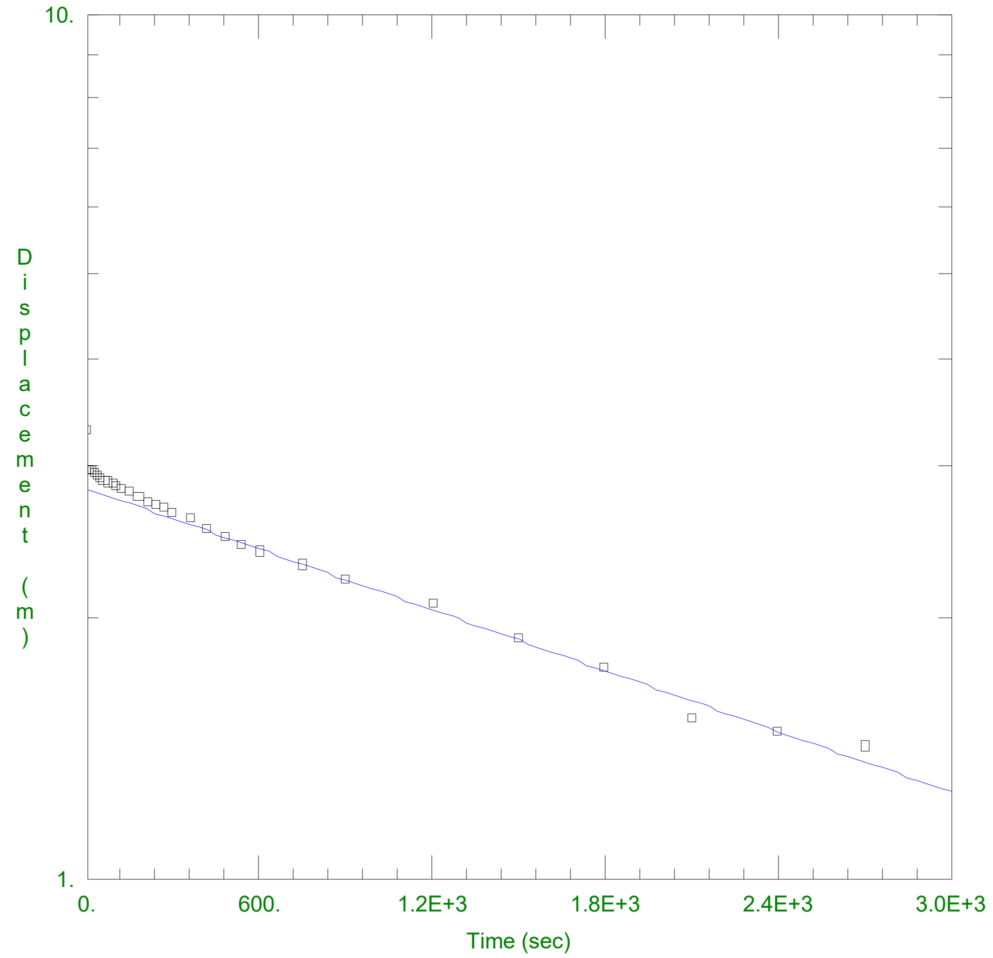
GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

APPENDIX B

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions



RISING HEAD TEST RESULTS

Data Set: Z:\...\BH101.aqt
Date: 06/20/18 Time: 12:15:36

PROJECT INFORMATION

Company: Sirati and Partners
Client: Korsiak Urban Planning
Project: SP18-317-30
Location: 28-60 Bronte St.N, Milton
Test Well: BH101
Test Date: June 20,2018

AQUIFER DATA

Saturated Thickness: 5.93 m
Anisotropy Ratio (Kz/Kr): 1.

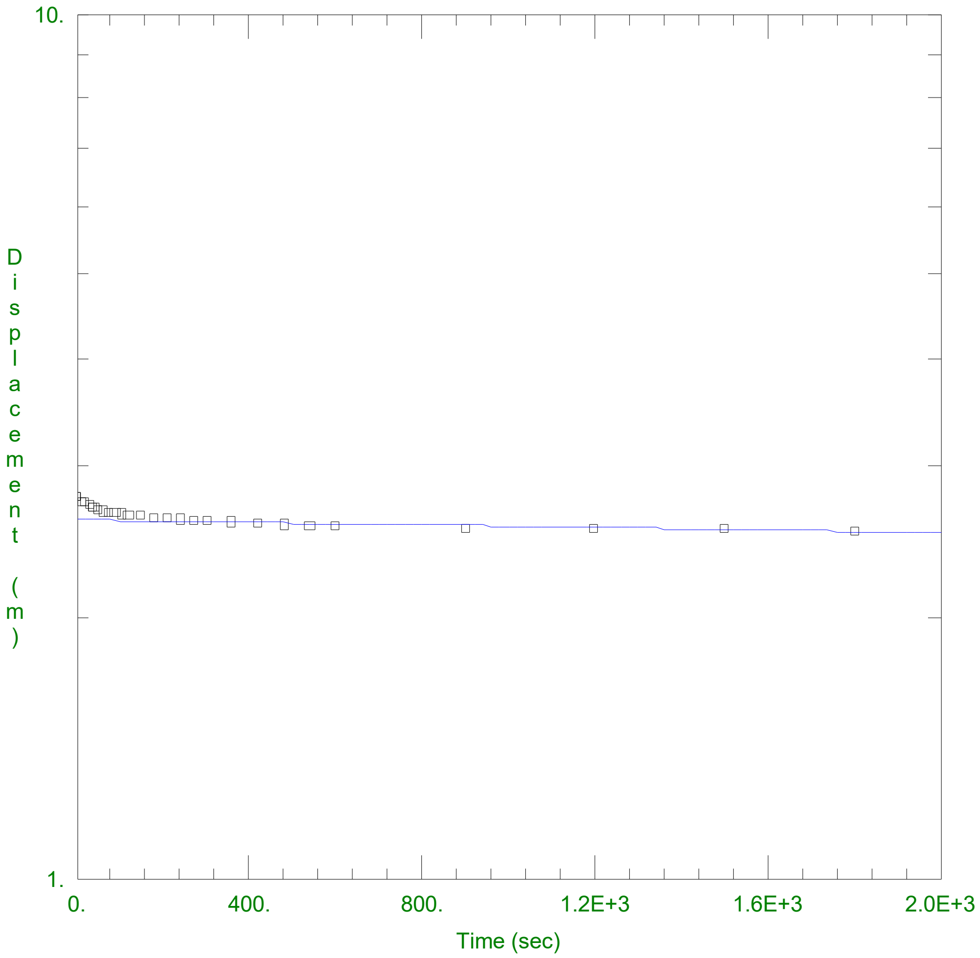
WELL DATA (BH101)

Initial Displacement: 3.31 m
Static Water Column Height: 5.93 m
Total Well Penetration Depth: 7.6 m
Screen Length: 3. m
Casing Radius: 0.05 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 3.45E-7 m/sec
y0 = 2.83 m



WELL TEST ANALYSIS

Data Set:
Date: 06/20/18

Time: 13:17:31

PROJECT INFORMATION

Company: Sirati and Partners
Client: Korsiak Urban Planning
Project: SP18-317-30
Location: 28-60 Bronte St.N, Milton
Test Well: BH102
Test Date: June 20,2018

AQUIFER DATA

Saturated Thickness: 6.06 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH102)

Initial Displacement: 2.779 m
Total Well Penetration Depth: 6.7 m
Casing Radius: 0.5 m

Static Water Column Height: 6.06 m
Screen Length: 3. m
Well Radius: 0.1 m

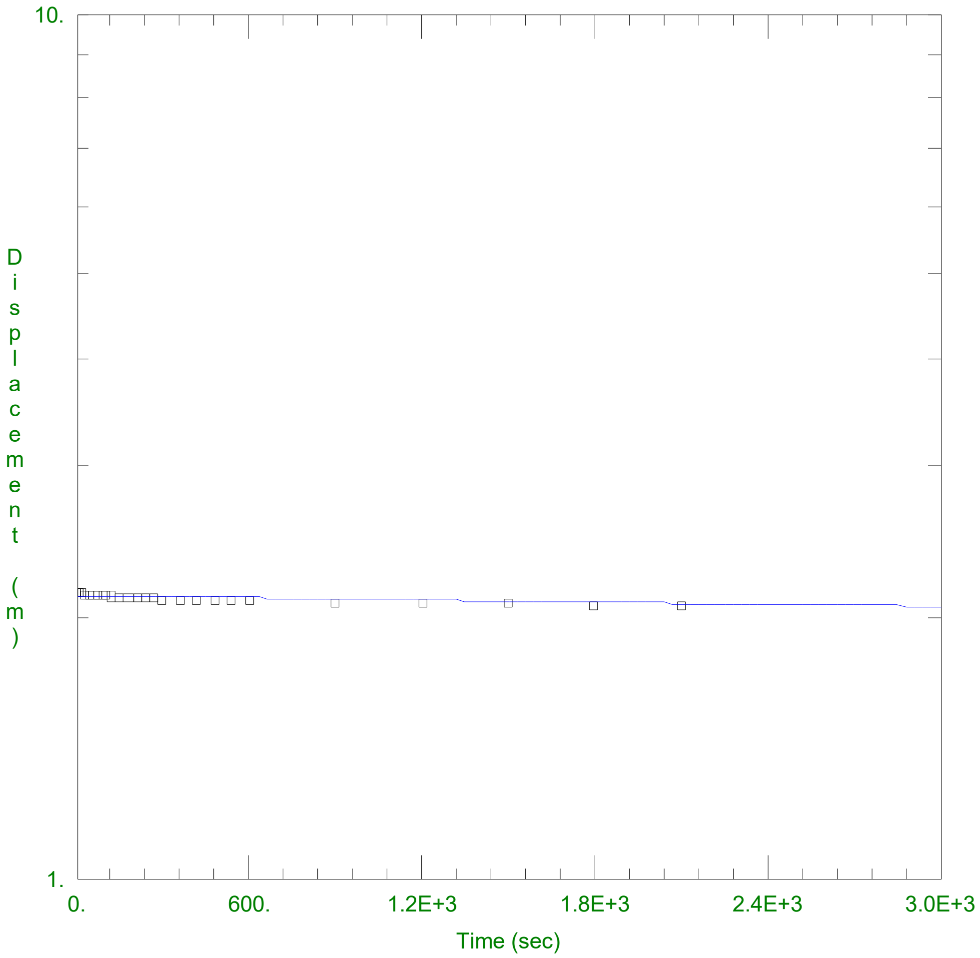
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 2.91E-6 m/sec

y0 = 2.603 m



RISING HEAD DATA ANALYSIS

Data Set:
Date: 06/20/18 Time: 13:29:34

PROJECT INFORMATION

Company: Sirati and Partners
Client: Korsiak Urban Planning
Project: SP18-317-30
Location: 28-60 Bronte St.N, Milton
Test Well: BH103
Test Date: June 20,2018

AQUIFER DATA

Saturated Thickness: 3.06 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH103)

Initial Displacement: 2.15 m
Total Well Penetration Depth: 4.6 m
Casing Radius: 0.5 m
Static Water Column Height: 3.06 m
Screen Length: 3. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.618E-6 m/sec
y0 = 2.127 m

APPENDIX C

SIRATI & PARTNERS

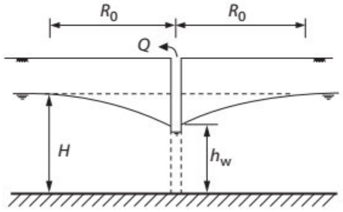
Geotechnical Hydrogeological & Environmental Solutions

Dewatering Calculations for 28-60 Bronte Street North, Milton, ON

Eq. Eq. **SHORT TERM (6 MONTHS)**

						7.1	7.2	Average		**FPW**
	H	**h_w**	**k**	**a**	**b**	r_e	r_e	r_e	R_0	**Q**
	m	m	m/sec	m	m	m	m	m	m	**L/day**
Base of Excavation	7.38	0.28	1.63E-06	175	75	64.65	79.62	72.14	99	**117,694**

Fully penetrating well, unconfined aquifer, circular source at distance R_0 (Dupuit–Forcheimer equation)



$$Q = \frac{\pi k\left(H^2 - h_w^2\right)}{\ln\left[R_0/r_e\right]} \qquad (7.5)$$

k = soil permeability;
H = initial water table level in aquifer;
h_w = lowered water level in equivalent well;
r_e = equivalent radius of well;
R_0 = radius of influence.

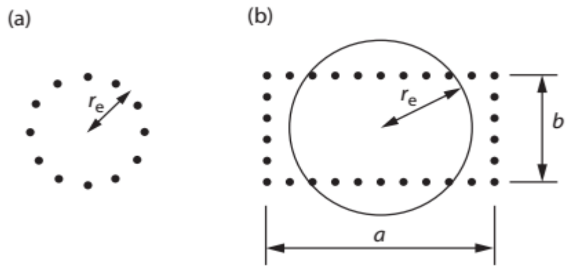


Figure 7.5 Equivalent radius of arrays of wells. (a) Circular system of radius r_e. (b) Rectangular system.

plan dimensions *a* by *b*, the equivalent radius can be estimated by assuming a well of equal perimeter

$$r_e = \frac{(a+b)}{\pi} \qquad (7.1)$$

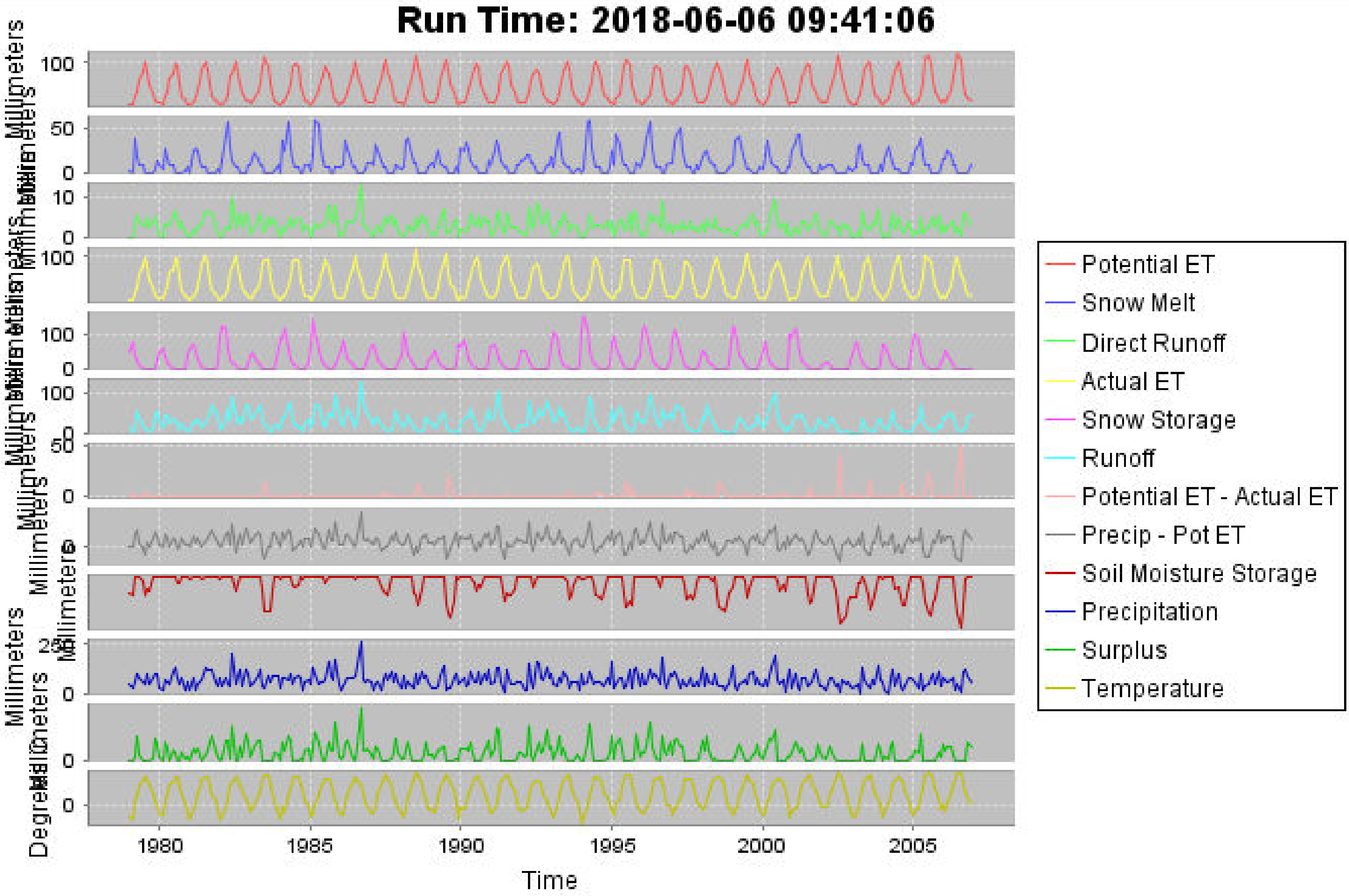
or equal area

$$r_e = \sqrt{\frac{ab}{\pi}} \qquad (7.2)$$

28-60 Bronte Street North, Milton, ON

Long Term Dewatering	Gradient	MW1-MW2	0.001	
		MW2-MW3	0.006	
	Q = K i A		0.0000134	m^3/sec
			1077	L/day
	K		1.63E-06	m/sec
	i		0.0035	
height of wet wall drain	h		5.25	m
length of wall drain	L		416	m

APPENDIX D


Run Time: 2018-06-06 09:41:06
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Millimeters
Degrees
100
50
0
10
0
100
100
0
100
0
50
0
0
25
0
0
0
1980
1985
1990
1995
2000
2005
Time
Potential ET
Snow Melt
Direct Runoff
Actual ET
Snow Storage
Runoff
Potential ET - Actual ET
Precip - Pot ET
Soil Moisture Storage
Precipitation
Surplus
Temperature

Date	PET	P	P-PET	Soil Moisture	AET	PET-AE T	Snow Storage	Surplus	ROtotal
========	=========	=========	=========	=========	========	=========	=========	==========	========
Jan-79	8.8	53.3	-0.9	149.3	8.5	0.2	45.2	0	13
Feb-79	7.8	29.9	-7.8	143.5	5.8	2	75.1	0	6.3
Mar-79	25.7	60	68.9	200	25.7	0	37.5	12.3	12.3
Apr-79	33	106.9	87.3	200	33	0	18.8	87.3	53.7
May-79	63.2	78	20.2	200	63.2	0	9.4	20.2	38.2
Jun-79	78.7	58.2	-14	186	78.7	0	0	0	20.1
Jul-79	99.8	56.8	-45.9	143.3	96.6	3.2	0	0	11.4
Aug-79	78.5	100.4	16.9	160.2	78.5	0	0	0	9.3
Sep-79	50.8	51.6	-1.7	158.8	50.4	0.3	0	0	4.7
Oct-79	30.5	81.9	47.3	200	30.5	0	0	6.1	8.2
Nov-79	17.8	100.8	78.2	200	17.8	0	0	78.2	46
Dec-79	12.5	104.1	59.4	200	12.5	0	29	59.4	53.4
Jan-80	10.5	34.9	9.1	200	10.5	0	43.7	9.1	30.3
Feb-80	9.5	19.2	-2.3	197.7	9.5	0	55.5	0	15
Mar-80	24.1	74.1	70.2	200	24.1	0	31.8	67.9	44.9
Apr-80	34.9	62	39.9	200	34.9	0	15.9	39.9	43.7
May-80	65.2	57.4	-2.8	197.2	65.2	0	7.9	0	23.2
Jun-80	72.6	109.8	39.6	200	72.6	0	0	36.9	34.1
Jul-80	98.6	133.3	28	200	98.6	0	0	28	35
Aug-80	90.5	77.7	-16.7	183.3	90.5	0	0	0	18
Sep-80	51.7	54.8	0.3	183.6	51.7	0	0	0	9.8
Oct-80	27.5	77.7	46.4	200	27.5	0	0	30	22.4
Nov-80	16.3	19	1.9	200	16.3	0	0	1.9	11
Dec-80	9.4	58.5	9.9	200	9.4	0	38.5	9.9	10.8
Jan-81	7.4	19	-7.4	192.6	7.4	0	57.5	0	5
Feb-81	13.1	81.2	53.6	200	13.1	0	69.9	46.1	27.7
Mar-81	19.6	26.2	24.2	200	19.6	0	51.4	24.2	25.8
Apr-81	37.8	55.8	40.9	200	37.8	0	25.7	40.9	35.7
May-81	56.9	65.3	18	200	56.9	0	12.9	18	28.7
Jun-81	85.3	74.8	-7.8	192.2	85.3	0	6.4	0	16.5
Jul-81	101.7	131.6	29.7	200	101.7	0	0	21.9	23.9
Aug-81	83	126.8	37.4	200	83	0	0	37.4	33.7
Sep-81	51.4	119.8	62.4	200	51.4	0	0	62.4	50.9
Oct-81	27.1	118.1	85.1	200	27.1	0	0	85.1	70.9
Nov-81	18.5	58.2	36.8	200	18.5	0	0	36.8	53.8
Dec-81	11.6	40.6	12.9	200	11.6	0	15.1	12.9	32.9
Jan-82	7.9	79.4	-7.9	192.1	7.9	0	94.5	0	16
Feb-82	9.8	45.6	10.7	200	9.8	0	119.1	2.7	9.8
Mar-82	17.5	85.3	70.2	200	17.5	0	114.4	70.2	42.1
Apr-82	31.6	50.3	73.4	200	31.6	0	57.2	73.4	59.1
May-82	68.1	44.8	3	200	68.1	0	28.6	3	32
Jun-82	74.9	199.4	128.8	200	74.9	0	14.3	128.8	89.3
Jul-82	99.2	53.8	-41	159	99.2	0	7.1	0	42.3
Aug-82	73.8	94.9	23.5	182.6	73.8	0	0	0	24.6
Sep-82	51.7	124.3	66.4	200	51.7	0	0	48.9	40.6
Oct-82	32.3	46.6	12	200	32.3	0	0	12	25.5
Nov-82	18.7	124.4	99.5	200	18.7	0	0	99.5	67.6

Dec-82	14.4	99.8	67.3	200	14.4	0	14.3	67.3	68.1
Jan-83	11.3	42.5	13.5	200	11.3	0	31.1	13.5	39.8
Feb-83	12.8	54	27.7	200	12.8	0	43.3	27.7	34.7
Mar-83	22	61	48.2	200	22	0	31.6	48.2	43.3
Apr-83	33	95.2	73.2	200	33	0	15.8	73.2	61.8
May-83	51.5	120.8	71.1	200	51.5	0	7.9	71.1	70.1
Jun-83	85.9	44.2	-36	164	85.9	0	0	0	34.2
Jul-83	108.2	29.4	-80.3	98.2	93.8	14.4	0	0	17.5
Aug-83	91.1	96.5	0.6	98.8	91.1	0	0	0	12.8
Sep-83	56.1	58.1	-0.9	98.3	55.6	0.4	0	0	6.9
Oct-83	31.1	95.9	60	158.4	31.1	0	0	0	6.8
Nov-83	18	95.1	72.4	200	18	0	0	30.8	21
Dec-83	9.5	91.4	23	200	9.5	0	57.6	23	20.9
Jan-84	8.1	31.8	-7.5	192.5	8.1	0	88.9	0	9.9
Feb-84	13.7	85.8	71.4	200	13.7	0	87	63.9	39.4
Mar-84	14.9	81.1	37	200	14.9	0	114.8	37	38.4
Apr-84	35.3	71.6	90.1	200	35.3	0	57.4	90.1	67.1
May-84	53.5	104.8	74.8	200	53.5	0	28.7	74.8	74.4
Jun-84	86.9	52	-23.2	176.8	86.9	0	14.3	0	37.2
Jul-84	95	81.1	-10.8	167.3	93.8	1.3	7.2	0	21.3
Aug-84	90.5	93.2	5.2	172.5	90.5	0	0	0	13.3
Sep-84	48	87.7	35.3	200	48	0	0	7.8	12.6
Oct-84	33.1	26.8	-7.6	192.4	33.1	0	0	0	5.4
Nov-84	16.6	64.6	45.1	200	16.6	0	0	37.5	23.7
Dec-84	13.5	76.4	44.8	200	13.5	0	15.4	44.8	35.5
Jan-85	8.5	53.9	-2.2	197.8	8.5	0	62.8	0	16.6
Feb-85	10.4	133.3	42.7	200	10.4	0	141.3	40.5	30.1
Mar-85	19.8	99.4	106.1	200	19.8	0	111.4	106.1	70.7
Apr-85	36.7	49.4	65.9	200	36.7	0	55.7	65.9	69.1
May-85	62.1	65.2	27.7	200	62.1	0	27.8	27.7	50.4
Jun-85	71.7	59.9	-0.9	199.1	71.7	0	13.9	0	26.6
Jul-85	91	71.8	-15.8	183.4	90.9	0.1	7	0	15.4
Aug-85	76.6	161.3	83.6	200	76.6	0	0	67	47.4
Sep-85	55.4	95.8	35.6	200	55.4	0	0	35.6	42.3
Oct-85	30.3	68.8	35	200	30.3	0	0	35	39.7
Nov-85	17.1	172.5	139.7	200	17.1	0	7.7	139.7	95.9
Dec-85	9.7	50.1	10.2	200	9.7	0	37.3	10.2	49.8
Jan-86	9.9	25.8	3.6	200	9.9	0	49.3	3.6	26.7
Feb-86	10	46.9	7.9	200	10	0	77.9	7.9	17.6
Mar-86	21.1	60.8	59.1	200	21.1	0	56.1	59.1	40.5
Apr-86	36.4	82	69.5	200	36.4	0	28.1	69.5	57.9
May-86	66.1	86	29.7	200	66.1	0	14	29.7	46
Jun-86	77.3	78.9	4.7	200	77.3	0	7	4.7	27.2
Jul-86	99.2	91.3	-5.5	194.5	99.2	0	0	0	16.2
Aug-86	74.2	140.2	58.9	200	74.2	0	0	53.5	39.6
Sep-86	48.9	261.8	199.8	200	48.9	0	0	199.8	129.3
Oct-86	29.6	70.2	37.1	200	29.6	0	0	37.1	80.2
Nov-86	15.5	58.1	33.2	200	15.5	0	7.1	33.2	57.2
Dec-86	12.2	75.8	39.8	200	12.2	0	28.8	39.8	49.5
Jan-87	10.3	63.2	19.3	200	10.3	0	61.4	19.3	34.3

Feb-87	10.3	22	4.2	200	10.3	0	68.7	4.2	19
Mar-87	20.8	52	47.5	200	20.8	0	50.4	47.5	35.1
Apr-87	37.6	59.2	43.8	200	37.6	0	25.2	43.8	41.4
May-87	64	21.9	-30.6	169.4	64	0	12.6	0	20.3
Jun-87	86.9	67.6	-16.4	155.5	84.4	2.5	6.3	0	13
Jul-87	104.9	100.4	-3.2	152.9	104.2	0.7	0	0	9.8
Aug-87	77.5	72	-9.1	146	75.4	2.2	0	0	6
Sep-87	50.4	115.2	59	200	50.4	0	0	4.9	9.4
Oct-87	26.3	57.6	28.4	200	26.3	0	0	28.4	18.9
Nov-87	17.1	101.4	79.6	200	17.1	0	0	79.6	52.5
Dec-87	12.7	57.9	28.1	200	12.7	0	15.4	28.1	39.7
Jan-88	10	28.2	1.8	200	10	0	31.4	1.8	20.3
Feb-88	9.3	89.2	7.5	200	9.3	0	103.2	7.5	14.2
Mar-88	18.6	29	34.2	200	18.6	0	78.5	34.2	24.9
Apr-88	33.4	60	62.9	200	33.4	0	39.3	62.9	46.4
May-88	66.9	45.8	-3.7	196.3	66.9	0	19.6	0	24
Jun-88	85.9	30.2	-47.3	149.8	85	0.9	9.8	0	12.4
Jul-88	115.1	101.7	-8.7	143.3	113	2.2	0	0	10.5
Aug-88	92.2	54.5	-40.5	114.3	80.8	11.5	0	0	5.4
Sep-88	53	108.6	50.2	164.4	53	0	0	0	6.8
Oct-88	27.3	84.6	53.1	200	27.3	0	0	17.5	13.7
Nov-88	18.7	89	65.9	200	18.7	0	0	65.9	42.1
Dec-88	11.4	59	23	200	11.4	0	23.2	23	31.7
Jan-89	12.2	36.2	15.8	200	12.2	0	30.5	15.8	24
Feb-89	10.4	34.8	5.3	200	10.4	0	49.2	5.3	14.6
Mar-89	17.4	34.3	17.8	200	17.4	0	47.3	17.8	16.9
Apr-89	31.6	46.8	36.5	200	31.6	0	23.7	36.5	28.6
May-89	62.9	95.7	39.9	200	62.9	0	11.8	39.9	37.9
Jun-89	90.2	140.2	48.9	200	90.2	0	5.9	48.9	48
Jul-89	106.2	23.8	-77.7	122.3	106.2	0	0	0	21.7
Aug-89	84	32	-53.6	89.5	63.2	20.8	0	0	11.8
Sep-89	53.3	35.2	-19.9	80.6	42.3	11	0	0	6.9
Oct-89	32.5	82	45.4	126	32.5	0	0	0	6.7
Nov-89	16.3	106.2	76.7	200	16.3	0	8.7	2.7	7.2
Dec-89	7.5	57.4	-7.5	192.5	7.5	0	66.1	0	1.3
Jan-90	13.5	62.5	52.1	200	13.5	0	61	44.6	24.9
Feb-90	12.3	79.1	46	200	12.3	0	80	46	36.3
Mar-90	20.9	39.2	41.8	200	20.9	0	54.9	41.8	39.6
Apr-90	39.3	50.9	36.6	200	39.3	0	27.5	36.6	39.9
May-90	57.3	116.6	67.2	200	57.3	0	13.7	67.2	58.1
Jun-90	89.7	65.6	-20.5	179.5	89.7	0	6.9	0	29.4
Jul-90	98	67.4	-27.1	155.2	95.2	2.8	0	0	16.4
Aug-90	86.7	108.8	16.7	171.9	86.7	0	0	0	12
Sep-90	53.3	49.2	-6.6	166.2	52.4	0.9	0	0	5.7
Oct-90	31.3	105.8	69.2	200	31.3	0	0	35.4	24.6
Nov-90	19.4	77.2	53.9	200	19.4	0	0	53.9	40.5
Dec-90	12.9	122.4	75.5	200	12.9	0	30.1	75.5	60
Jan-91	9.9	54.7	12.4	200	9.9	0	61.7	12.4	34.9
Feb-91	13	60.9	41.3	200	13	0	66.7	41.3	39.4
Mar-91	22	130.2	117.2	200	22	0	52.3	117.2	82.9

Apr-91	39	134.8	115.2	200	39	0	26.2	115.2	103.1
May-91	76.2	65.4	-1	199	76.2	0	13.1	0	51.4
Jun-91	94.2	16.5	-72	127.4	93.9	0.3	6.5	0	24.9
Jul-91	102.3	125.7	23.6	151	102.3	0	0	0	18.3
Aug-91	90.5	87.2	-7.7	145.2	88.7	1.9	0	0	10.4
Sep-91	51.4	53.1	-0.9	144.5	51.1	0.3	0	0	5.7
Oct-91	33.5	53.3	17.2	161.6	33.5	0	0	0	4.2
Nov-91	16.6	62.4	43	200	16.6	0	0	4.7	5.8
Dec-91	11.9	64.9	29.1	200	11.9	0	22.2	29.1	17.8
Jan-92	11.1	65.3	25.8	200	11.1	0	49.2	25.8	22.3
Feb-92	12.2	27	13.8	200	12.2	0	49.6	13.8	18
Mar-92	19	26.4	16.3	200	19	0	39.9	16.3	17.7
Apr-92	32.6	150.4	130.2	200	32.6	0	19.9	130.2	81.1
May-92	59.4	73.9	20.7	200	59.4	0	10	20.7	50.8
Jun-92	76.3	36.2	-32	168	76.3	0	0	0	25.4
Jul-92	84.4	167.4	74.6	200	84.4	0	0	42.6	41.5
Aug-92	74.7	151.1	68.8	200	74.7	0	0	68.8	58.5
Sep-92	51.1	83.4	28.2	200	51.1	0	0	28.2	43.7
Oct-92	28.1	69.5	37.9	200	28.1	0	0	37.9	42.2
Nov-92	17.4	136.1	112.4	200	17.4	0	0	112.4	81.9
Dec-92	12.5	78.8	41.5	200	12.5	0	22.5	41.5	60.9
Jan-93	11.5	100.4	47.3	200	11.5	0	61.9	47.3	55.1
Feb-93	9.2	54	2	200	9.2	0	104.4	2	27.8
Mar-93	17.7	46.5	42.4	200	17.7	0	89.5	42.4	36.2
Apr-93	35.5	83.4	88.4	200	35.5	0	44.8	88.4	65.8
May-93	58	60.6	22	200	58	0	22.4	22	44.8
Jun-93	79.7	117.6	43.2	200	79.7	0	11.2	43.2	48.4
Jul-93	103	86.2	-15.5	184.5	103	0	5.6	0	25.6
Aug-93	89.4	30.5	-54.9	133.9	85.2	4.3	0	0	12.2
Sep-93	46.5	57.9	8.5	142.4	46.5	0	0	0	8.2
Oct-93	28.3	65.2	33.6	176	28.3	0	0	0	5.9
Nov-93	17.1	60.6	40.7	200	17.1	0	0	16.7	12.4
Dec-93	11.6	25.6	3.9	200	11.6	0	9.5	3.9	7.4
Jan-94	6.7	101.3	-6.7	193.3	6.7	0	110.8	0	3.4
Feb-94	8.7	47.9	-3.2	190.2	8.6	0.1	153	0	1.8
Mar-94	19.1	60.4	75.3	200	19.1	0	117	65.5	35.6
Apr-94	36.7	115	131.1	200	36.7	0	58.5	131.1	88.1
May-94	55.2	84.9	54.7	200	55.2	0	29.3	54.7	72.8
Jun-94	89.1	55.2	-22	178	89.1	0	14.6	0	37
Jul-94	101.1	57.8	-38.9	143.4	96.8	4.3	7.3	0	20
Aug-94	77.1	64.8	-8.2	137.5	74.7	2.3	0	0	11.8
Sep-94	52.4	51.2	-3.7	135	51.2	1.2	0	0	6.8
Oct-94	31.1	46.7	13.3	148.2	31.1	0	0	0	4.5
Nov-94	19.8	81.5	57.7	200	19.8	0	0	5.9	8.1
Dec-94	13.3	55.9	28.7	200	13.3	0	12	28.7	18.3
Jan-95	12.2	165.5	90.7	200	12.2	0	70.4	90.7	57.7
Feb-95	9.5	37.2	3.4	200	9.5	0	94.3	3.4	28.8
Mar-95	21.9	48	57.7	200	21.9	0	60.8	57.7	45.1
Apr-95	29	84.7	80.8	200	29	0	31.5	80.8	66.1
May-95	59.1	87.7	40	200	59.1	0	15.7	40	55.4

Jun-95	91.9	37	-48.9	151.1	91.9	0	7.9	0	27.3
Jul-95	104.9	42.8	-56.4	108.5	91.1	13.8	0	0	14.9
Aug-95	94.6	118.2	17.7	126.2	94.6	0	0	0	12.3
Sep-95	48	29.6	-19.9	113.7	40.7	7.3	0	0	4.7
Oct-95	33.3	126.6	87	200	33.3	0	0	0.7	8.3
Nov-95	15.4	136	97.9	200	15.4	0	17.3	97.9	55.3
Dec-95	10.1	39.4	9.9	200	10.1	0	36.1	9.9	30.6
Jan-96	9.7	103.6	26.7	200	9.7	0	102	26.7	29.5
Feb-96	10.6	53.9	23.3	200	10.6	0	121.3	23.3	26.5
Mar-96	16.8	57.4	48.4	200	16.8	0	112.1	48.4	38.5
Apr-96	30.4	121.3	140.8	200	30.4	0	56	140.8	95
May-96	55.9	81.5	49.6	200	55.9	0	28	49.6	73.3
Jun-96	88	104.4	25.2	200	88	0	14	25.2	52.4
Jul-96	92.7	96.8	6.3	200	92.7	0	7	6.3	31.6
Aug-96	85.1	47.8	-32.7	167.3	85.1	0	0	0	15.8
Sep-96	54	185.7	122.4	200	54	0	0	89.7	60.8
Oct-96	30.5	69.5	35.5	200	30.5	0	0	35.5	47
Nov-96	15	34.8	18.4	200	15	0	0	18.4	32.3
Dec-96	13.3	104.1	64.4	200	13.3	0	22.9	64.4	51.2
Jan-97	9.5	92.6	19.1	200	9.5	0	85.9	19.1	34.4
Feb-97	12.5	109.9	72.1	200	12.5	0	108.5	72.1	55.4
Mar-97	18.4	93.7	80	200	18.4	0	101	80	69.3
Apr-97	31.6	36.6	53.7	200	31.6	0	50.5	53.7	61.9
May-97	48.1	76.4	49.7	200	48.1	0	25.2	49.7	58.7
Jun-97	89.7	53.3	-26.4	173.6	89.7	0	12.6	0	30.1
Jul-97	92.7	43.5	-45	134.5	86.7	5.9	6.3	0	15.9
Aug-97	76.1	84.7	10.7	145.2	76.1	0	0	0	11.1
Sep-97	52.7	40.1	-14.6	134.6	48.7	4	0	0	5.4
Oct-97	30.9	41.4	8.4	143	30.9	0	0	0	3.8
Nov-97	16.5	59.6	40.5	183.5	16.5	0	0	0	3.5
Dec-97	13.2	43.7	19.2	200	13.2	0	9.9	2.7	3.2
Jan-98	12.4	130	71.4	200	12.4	0	52.7	71.4	40
Feb-98	14.4	41.7	33.4	200	14.4	0	45.1	33.4	36.4
Mar-98	22.8	106.3	90.9	200	22.8	0	33.1	90.9	67.6
Apr-98	38.3	60.8	36	200	38.3	0	16.6	36	52.5
May-98	75.7	56	-14.2	185.8	75.7	0	8.3	0	27.5
Jun-98	86.9	101.5	17.8	200	86.9	0	0	3.6	19.2
Jul-98	98	48.5	-51.9	148.1	98	0	0	0	9.5
Aug-98	88.9	40	-50.9	110.4	75.7	13.2	0	0	5.5
Sep-98	58.5	41.3	-19.3	99.8	49.9	8.6	0	0	3.8
Oct-98	33.1	25.8	-8.6	95.5	28.8	4.3	0	0	2.2
Nov-98	18	45.2	25	120.5	18	0	0	0	2.7
Dec-98	13	55.5	27.4	147.9	13	0	13.3	0	2
Jan-99	9	138.7	19.2	167.1	9	0	122.7	0	1.1
Feb-99	12.6	44.4	43.5	200	12.6	0	109.9	10.7	6.5
Mar-99	18.7	23.5	32.8	200	18.7	0	81.1	32.8	19.8
Apr-99	35.1	52.5	55.3	200	35.1	0	40.6	55.3	39.8
May-99	61.7	64.9	20.2	200	61.7	0	20.3	20.2	32
Jun-99	86.9	70.2	-10.1	189.9	86.9	0	10.1	0	17.9
Jul-99	107.6	51.2	-53.8	138.8	104.8	2.7	5.1	0	9.7

Aug-99	75.2	99.9	24.8	163.6	75.2	0	0	0	8.6
Sep-99	52.4	115.2	57.1	200	52.4	0	0	20.7	17.9
Oct-99	27.8	56.4	25.8	200	27.8	0	0	25.8	21.8
Nov-99	18.7	84.1	61.2	200	18.7	0	0	61.2	44.3
Dec-99	11.9	47.5	18.4	200	11.9	0	15.9	18.4	30.5
Jan-00	9.1	46.7	2.2	200	9.1	0	50.9	2.2	16.1
Feb-00	11.8	77.4	38.5	200	11.8	0	76.3	38.5	28.7
Mar-00	23.1	42.8	49	200	23.1	0	45.2	49	39.9
Apr-00	30.8	96.4	83.3	200	30.8	0	22.6	83.3	65.5
May-00	60.6	128.8	73.1	200	60.6	0	11.3	73.1	73.3
Jun-00	78.2	190.6	108.5	200	78.2	0	5.6	108.5	97.2
Jul-00	88.7	73.5	-13.3	186.7	88.7	0	0	0	47.5
Aug-00	81	49.6	-33.9	155.1	78.7	2.2	0	0	24.4
Sep-00	52.4	74.9	18.8	173.9	52.4	0	0	0	14.7
Oct-00	33.9	17.2	-17.6	158.6	31.6	2.3	0	0	6.3
Nov-00	17.4	77.6	56.6	200	17.4	0	0	15.3	14
Dec-00	8.4	121.9	12	200	8.4	0	100.8	12	11.9
Jan-01	11.4	33.8	28.1	200	11.4	0	94.4	28.1	20.3
Feb-01	12.4	102.2	67.6	200	12.4	0	114.2	67.6	46
Mar-01	19.2	38.5	47.1	200	19.2	0	85.1	47.1	46.6
Apr-01	36.9	24.9	29.3	200	36.9	0	42.6	29.3	38.6
May-01	64	86	38.9	200	64	0	21.3	38.9	42.4
Jun-01	88.6	79.5	-2.4	197.6	88.6	0	10.6	0	23
Jul-01	95.6	42.2	-50.2	148	95	0.6	5.3	0	11.6
Aug-01	92.8	51.4	-38.7	119.4	82.8	10	0	0	7.3
Sep-01	53.7	63.1	6.3	125.7	53.7	0	0	0	5.5
Oct-01	32.5	122	83.4	200	32.5	0	0	9.1	11.9
Nov-01	22	80.1	54.1	200	22	0	0	54.1	33.9
Dec-01	14.6	45.9	29.5	200	14.6	0	0	29.5	31.5
Jan-02	13.8	38.4	14.4	200	13.8	0	8.9	14.4	23.3
Feb-02	13.5	23.9	5	200	13.5	0	13.7	5	14.2
Mar-02	21.2	51.5	26.8	200	21.2	0	15.2	26.8	22.2
Apr-02	36.7	84.6	51.3	200	36.7	0	7.6	51.3	40
May-02	54.2	79.9	29.3	200	54.2	0	0	29.3	36.5
Jun-02	89.1	46.9	-44.6	155.4	89.1	0	0	0	18.6
Jul-02	114.4	52.8	-64.3	105.5	100.1	14.3	0	0	10.8
Aug-02	92.2	9.7	-83	61.7	53	39.2	0	0	4.6
Sep-02	65	73.2	4.5	66.2	65	0	0	0	5.7
Oct-02	30.1	48.4	15.9	82	30.1	0	0	0	3.4
Nov-02	16.9	64.9	45	127.1	16.9	0	0	0	3.4
Dec-02	11.9	38.8	12.8	139.9	11.9	0	13	0	1.3
Jan-03	8.7	31.1	-3.8	137.3	7.6	1.1	39	0	0.3
Feb-03	9.5	47	2.6	139.8	9.5	0	73.7	0	0.4
Mar-03	18.8	47.9	39.3	179.1	18.8	0	61.9	0	1.6
Apr-03	31.6	2.4	1.6	180.8	31.6	0	30.9	0	0.1
May-03	58.7	128.8	79.1	200	58.7	0	15.5	59.9	36.4
Jun-03	84.8	68	-12.5	187.5	84.8	0	7.7	0	18.4
Jul-03	99.2	45	-48.7	141.8	96.2	3	0	0	9.7
Aug-03	91.7	36.8	-56.7	101.6	75.2	16.5	0	0	5.6
Sep-03	55	75.4	16.6	118.2	55	0	0	0	5.6

Oct-03	30.1	57.2	24.2	142.4	30.1	0	0	0	3.8
Nov-03	19.3	140.3	114	200	19.3	0	0	56.4	35.7
Dec-03	13.3	68	37.5	200	13.3	0	15	37.5	35.4
Jan-04	8.3	60.8	-4.1	195.9	8.3	0	71.4	0	16.7
Feb-04	11.6	23	13.6	200	11.6	0	68.7	9.5	13.5
Mar-04	22.1	0	6.5	200	22.1	0	40	6.5	9.8
Apr-04	36.2	69.6	49.9	200	36.2	0	20	49.9	33.3
May-04	63.2	121.8	62.5	200	63.2	0	10	62.5	52.3
Jun-04	80.2	42.2	-35.1	164.9	80.2	0	5	0	25.2
Jul-04	99.2	104.1	4.7	169.6	99.2	0	0	0	16.7
Aug-04	80.5	46.1	-36.7	138.5	74.9	5.6	0	0	8.1
Sep-04	60	23.2	-38	112.2	48.3	11.7	0	0	4
Oct-04	33.9	39.1	3.2	115.4	33.9	0	0	0	3.4
Nov-04	19.4	80.2	56.8	172.2	19.4	0	0	0	4.7
Dec-04	11.4	80.9	35.7	200	11.4	0	31.9	7.9	6.3
Jan-05	9.4	75	13.5	200	9.4	0	83.2	13.5	9.7
Feb-05	11.8	64.1	37.6	200	11.8	0	96.7	37.6	24.5
Mar-05	17.9	30.6	30.6	200	17.9	0	77.8	30.6	27.8
Apr-05	35.5	100.8	99.1	200	35.5	0	38.9	99.1	68.1
May-05	54.2	18.3	-17.3	182.7	54.2	0	19.5	0	32.4
Jun-05	108	39	-61.2	126.8	102.7	5.3	9.7	0	17.7
Jul-05	115.9	48.1	-60.4	88.5	93.7	22.1	0	0	10.3
Aug-05	95.1	84.7	-14.7	82	87	8.2	0	0	8.2
Sep-05	63.1	104.4	36.1	118.1	63.1	0	0	0	7.2
Oct-05	35	54.1	16.4	134.5	35	0	0	0	3.7
Nov-05	18.9	115.4	90.7	200	18.9	0	0	25.2	18.9
Dec-05	11.2	46.4	15.1	200	11.2	0	19	15.1	15.2
Jan-06	14.8	83.1	58.9	200	14.8	0	25.3	58.9	39.6
Feb-06	12.1	73.5	32.9	200	12.1	0	52.2	32.9	36.3
Mar-06	21.3	59.1	48.5	200	21.3	0	39.1	48.5	43.9
Apr-06	38.1	75	52.7	200	38.1	0	19.6	52.7	50.9
May-06	65.2	82.1	22.5	200	65.2	0	9.8	22.5	39
Jun-06	91.3	23.3	-59.4	140.6	91.3	0	0	0	18.6
Jul-06	117.3	50.4	-69.4	91.8	96.7	20.6	0	0	11.2
Aug-06	105.7	15.4	-91.1	50	56.4	49.3	0	0	5.1
Sep-06	52.4	114.5	56.4	106.4	52.4	0	0	0	7.9
Oct-06	30.5	126.4	89.6	196	30.5	0	0	0	7.4
Nov-06	20.3	94.7	69.7	200	20.3	0	0	65.7	38.1
Dec-06	15.6	65	46.6	200	15.6	0	0	46.6	42.8

APPENDIX E

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

Summary

Site	Project Name	Project Title	Storm Type
Pre-Development	SP18-317-30	28-60 Brnte St. N, Milton	avg-annual
Post-Development	SP18-317-30	28-60 Bronte St.N, Milton	avg-annual

Water Balance Comparison

Site	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
Pre-Development Total	1.33 ha	847.60 mm 11,264.60 m^3	93.15 mm 1,237.96 m^3	415.01 mm 5,515.48 m^3	336.34 mm 4,470.00 m^3	511.26 mm 60.32 %
Post-Development Total	1.33 ha	847.60 mm 11,264.60 m^3	44.01 mm 584.89 m^3	264.24 mm 3,511.75 m^3	535.74 mm 7,120.00 m^3	311.86 mm 36.79 %
Difference	**0.00 ha**	**0.00 mm** **0.00 m^3**	**-49.14 mm** **-653.07 m^3**	**-150.77 mm** **-2,003.73 m^3**	**199.40 mm** **2,650.00 m^3**	**-199.40 mm** **-23.53 %**
Difference	**0.00 %**	**0.00 %**	**-52.75 %**	**-36.33 %**	**59.28 %**	**-39.00 %**

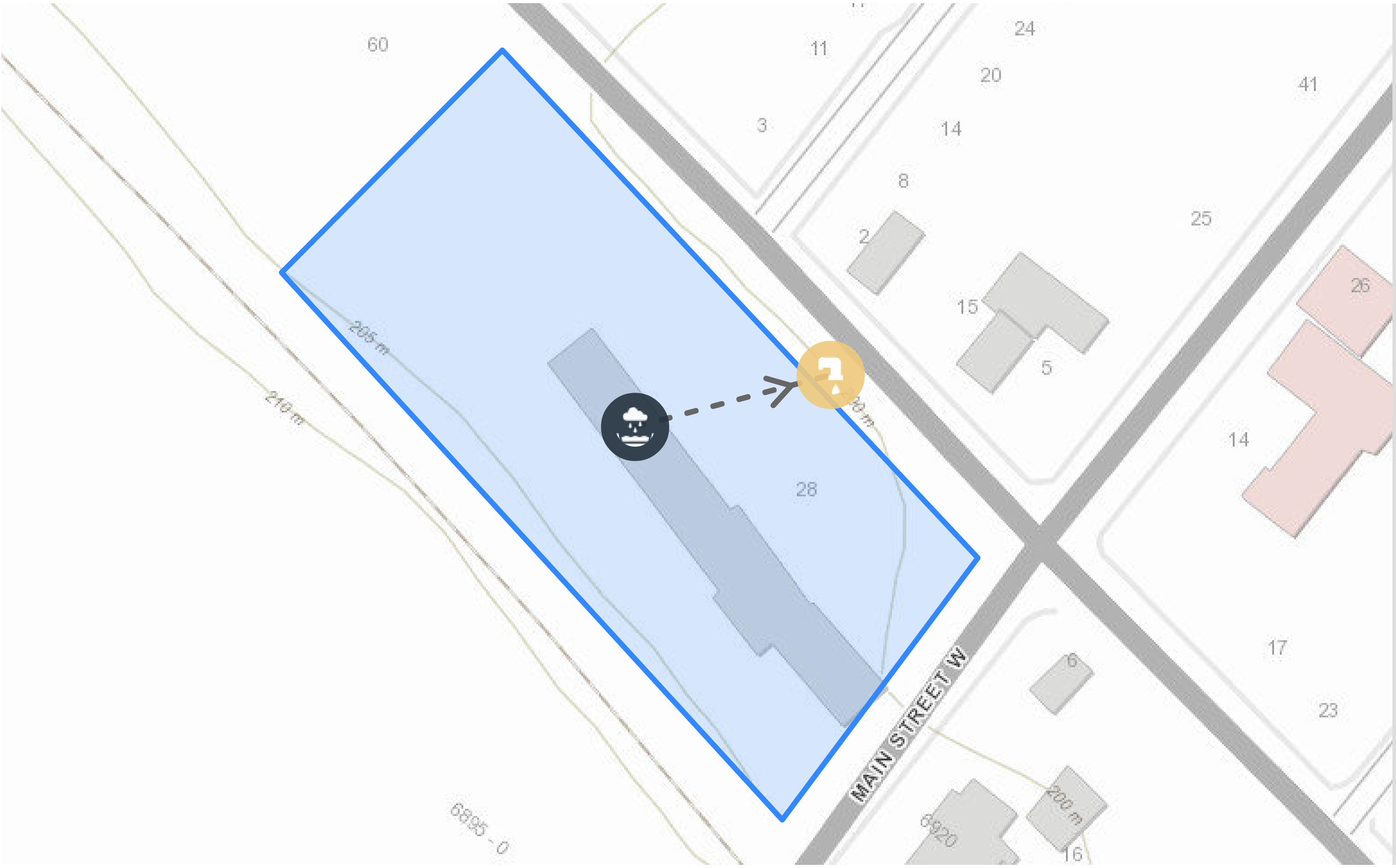
Water Balance | Pre-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	1.33 ha	847.60 mm 11,264.60 m^3	93.15 mm 1,237.96 m^3	415.01 mm 5,515.48 m^3	336.34 mm 4,470.00 m^3	511.26 mm 60.32 %
TOTAL	**1.33 ha**	**847.60 mm** **11,264.60 m^3**	**93.15 mm** **1,237.96 m^3**	**415.01 mm** **5,515.48 m^3**	**336.34 mm** **4,470.00 m^3**	**511.26 mm** **60.32 %**

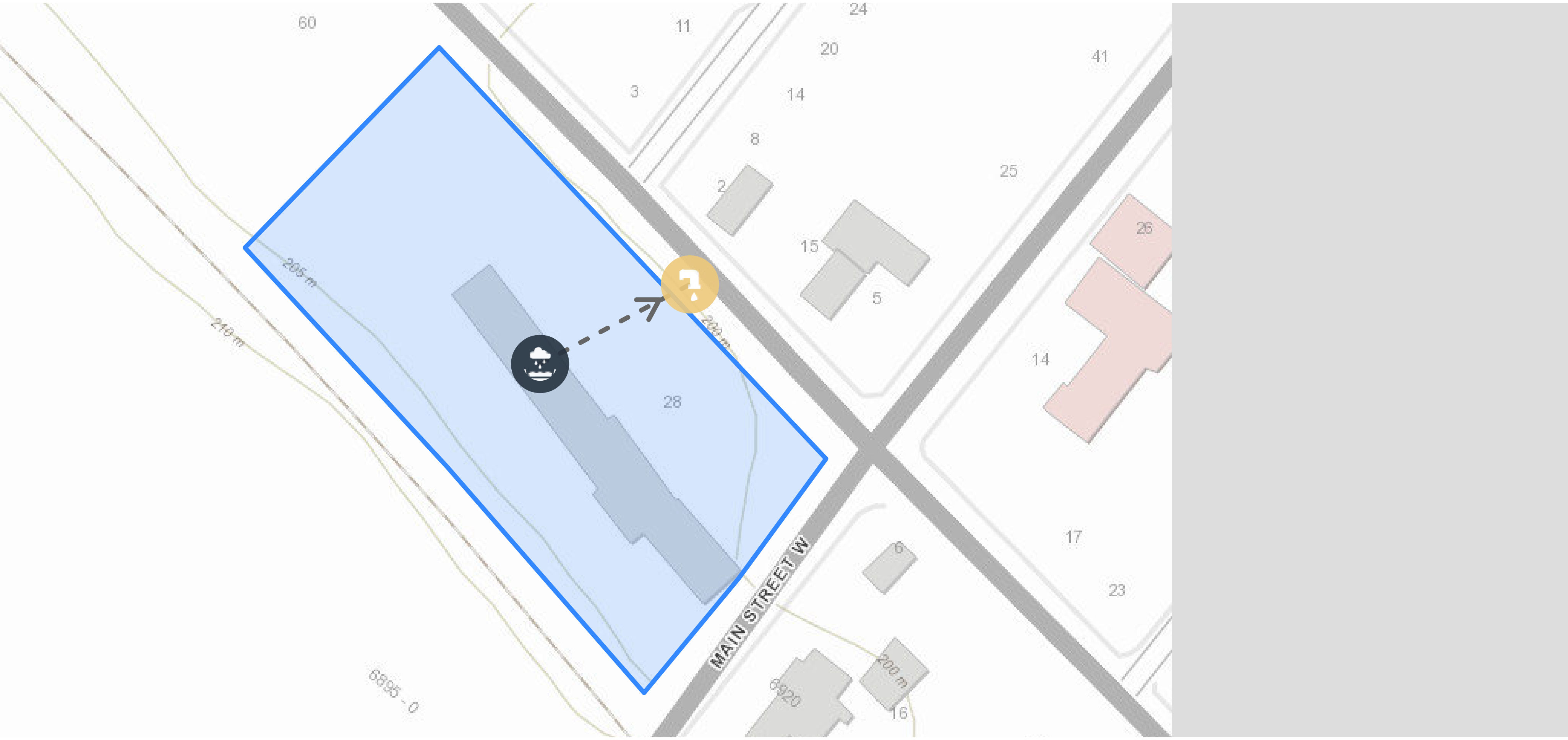
Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	1.33 ha	847.60 mm 11,264.60 m^3	44.01 mm 584.89 m^3	264.24 mm 3,511.75 m^3	535.74 mm 7,120.00 m^3	311.86 mm 36.79 %
TOTAL	**1.33 ha**	**847.60 mm** **11,264.60 m^3**	**44.01 mm** **584.89 m^3**	**264.24 mm** **3,511.75 m^3**	**535.74 mm** **7,120.00 m^3**	**311.86 mm** **36.79 %**

Map | Pre-Development



Map | Post-Development



LID Summary | Post-Development

Element	Type	LID Area	Drawdown Time	Effective Impervious to Pervious Ratio	FLOW	TSS	TP
					Flow In (m^3)	Load In (kg)	Load In (kg)
					Flow Out (m^3)	Load Out (kg)	Load Out (kg)
					Actual Reduction (%)	Actual Reduction (%)	Actual Reduction (%)

Loading Summary TSS | Pre Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.042 m^3/s	4,470.000 m^3 66.340 mg/l 296.540 kg	4,470.000 m^3 66.340 mg/l 296.540 kg
Total	**0.000 %**	**0.042 m^3/s**	**4,470.000 m^3** **66.340 mg/l** **296.540 kg**	**4,470.000 m^3** **66.340 mg/l** **296.540 kg**

Loading Summary TSS | Post Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.071 m^3/s	7,120.000 m^3 58.364 mg/l 415.552 kg	7,121.000 m^3 58.356 mg/l 415.552 kg
Total	**0.000 %**	**0.071 m^3/s**	**7,120.000 m^3** **58.364 mg/l** **415.552 kg**	**7,121.000 m^3** **58.356 mg/l** **415.552 kg**

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.042 m^3/s	4,470.000 m^3 0.171 mg/l 0.765 kg	4,470.000 m^3 0.171 mg/l 0.765 kg
Total	**0.000 %**	**0.042 m^3/s**	**4,470.000 m^3** **0.171 mg/l** **0.765 kg**	**4,470.000 m^3** **0.171 mg/l** **0.765 kg**

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.071 m^3/s	7,120.000 m^3 0.138 mg/l 0.981 kg	7,121.000 m^3 0.138 mg/l 0.981 kg
Total	**0.000 %**	**0.071 m^3/s**	**7,120.000 m^3** **0.138 mg/l** **0.981 kg**	**7,121.000 m^3** **0.138 mg/l** **0.981 kg**

Peak Flow | Pre-Development

Catchment	Element	Description	Peak outflow
1	Pre_Dev	PEAK RUNOFF FLOW from	0.04 m^3/s
	Outfall 1	MAXIMUM FLOW at	0.042 m^3/s

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	Post_Dev	PEAK RUNOFF FLOW from	0.07 m^3/s
	Outfall2	MAXIMUM FLOW at	0.071 m^3/s

Loading TSS | Pre Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Pre_Dev	0 %	0.04 m^3/s	11,264.604 m^3 66.340 mg/l 747.294 kg	4,470.000 m^3 66.340 mg/l 296.540 kg
Outfall 1	0 %	0.042 m^3/s	4,470.000 m^3 66.340 mg/l 296.540 kg	4,470.000 m^3 66.340 mg/l 296.540 kg

Loading TSS | Post Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Post_Dev	0 %	0.07 m^3/s	11,264.604 m^3 58.364 mg/l 657.447 kg	7,120.000 m^3 58.364 mg/l 415.552 kg
Outfall2	0 %	0.071 m^3/s	7,121.000 m^3 58.356 mg/l 415.552 kg	7,121.000 m^3 58.356 mg/l 415.552 kg

Loading TP | Pre Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Pre_Dev	0 %	0.04 m^3/s	11,264.604 m^3 0.171 mg/l 1.929 kg	4,470.000 m^3 0.171 mg/l 0.765 kg
Outfall 1	0 %	0.042 m^3/s	4,470.000 m^3 0.171 mg/l 0.765 kg	4,470.000 m^3 0.171 mg/l 0.765 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Post_Dev	0 %	0.07 m^3/s	11,264.604 m^3 0.138 mg/l 1.551 kg	7,120.000 m^3 0.138 mg/l 0.981 kg
Outfall2	0 %	0.071 m^3/s	7,121.000 m^3 0.138 mg/l 0.981 kg	7,121.000 m^3 0.138 mg/l 0.981 kg

Detailed Report Parameters | Pre Development

Pre_Dev

Field	Value
Subcatchment name	Pre_Dev
Catchment	1
Total AREA (HA)	1.329
Impervious area (HA)	0.35883000000000004
Roof area (HA)	0.15947999999999998
Landscaped area (HA)	0.8106899999999999
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	82

Outfall 1

Field	Value
Name	Outfall 1
Catchment	1
Outfall Elevation (m)	0

Post_Dev

Field	Value
Subcatchment name	Post_Dev
Catchment	1
Total AREA (HA)	1.329
Impervious area (HA)	0.613998
Roof area (HA)	0.38806799999999997
Landscaped area (HA)	0.326934
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	82

Outfall2

Field	Value
Name	Outfall2
Catchment	1
Outfall Elevation (m)	0