Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

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March 17, 2023

Reference No. 2201-W054

Bolton Summit Developments Inc.
6198 Tremaine Court
Mississauga, Ontario
L5V 1B5

TOWN OF CALEDON
PLANNING
RECEIVED

Mar 23, 2023

Attention: Mr. Sam Morra

Re: Hydrogeological Assessment Report
Proposed Residential Development
13290 Nunnville Road,
Town of Caledon (Bolton)

Dear Sir:

Soil Engineers Ltd. (SEL) was retained to provide a hydrogeological study to assess any construction dewatering, and long-term foundation drainage needs, that may be required in support of a proposed development for a property, located at 13290 Nunnville Road, in the Town of Caledon (Bolton). The findings of this report have been update based on review of the updated development plans and from the results of the follow-up groundwater level monitoring carried out in the spring of 2022.

It is proposed to construct a residential building development, consisting of 3 blocks of townhouse units, for a total of fifteen (15) units. It is anticipated that each unit will be completed with a basement foundation structure. The development will be provided with above ground parking facilities driveways and roads to access the developed site, along with full municipal services including lake based municipal water and municipal storm and sanitary sewers.

Background

The proposed development, at the location shown on the Site Location Plan, Drawing No. 1, is situated, approximately 145 m south of the intersection of Old King Road, and Nunnville Road, in the Town of Caledon (Bolton). The subject site is currently occupied by a 2-storey residential building with an associated shed and gazebo, where the surrounding area comprises existing single detached dwellings and wooded areas. The subject site lies within the Physiographic Region of Southern Ontario known as the South Slope which is located on the drumlinized till plain shallow surficial physiographic feature. The South Slope rises 90 to 150 m in elevation to the line of contact with the Oak Ridges Moraine, at elevations ranging from 240 to 300 masl. It exhibits an average width of 9.6 to 11.3 km; extending from the Niagara Escarpment, in the west to the Trent River, in the east. It covers an area of approximately 2,400 km^2. The south slope is smoothed, faintly drumlinized, and scarred at intervals by valleys and tributaries of the Rouge, Don, and Humber River systems (Chapman and Putnam, 1984).

Review of the surface soil, geological map of Ontario shows that the subject site is located on the Halton Till Unit, consisting, predominantly of silt to silty clay matrix, being high in matrix calcium carbonate content, considered as being clast-poor. Drawing No. 2, as reproduced from Ontario Geological Survey mapping, illustrates the Quaternary surface soil geology for the subject site, and surrounding areas.

The underlying bedrock is comprised mainly of shale, limestone, dolostone and siltstone of the Georgian Bay formation which were deposited during the Upper Ordovician Epoch (Bedrock Geology of Ontario, 1993). The approximate elevation for the top of the bedrock beneath the site is about 145 masl which is about 100 m below existing grade.

Topographic Setting

A review of the topographic map for the subject site, and surrounding area indicates that there is a decline in elevation relief from south to the northeast. Based on the ground surface elevations, measured at the boreholes and monitoring well locations, and from review of the existing topographic map, the total elevation relief across the subject site is about 10.0 m. Drawing No. 3 shows the mapped topographical contours for the subject site and for the surrounding area. The subject site exhibits a decline in elevation relief towards the north where a steep ravine demarks the northern, north eastern and north western limits of the site.

Watershed Setting

The subject site is located in the Humber River Watershed and the Main Humber sub-watershed. The Humber River watershed occupies an area of approximately 911 square kilometers, making it the largest watershed in the Greater Toronto Area. The headwaters of the Humber River begin within the Oak Ridges Moraine and on the Niagara Escarpment. The river flows through many municipalities, including, but not limited to; the Town of Caledon, The City of Vaughan, and the City of Toronto. It consists of five principal tributaries which are known as the Main Humber, West Humber, East Humber, Lower Humber, and Black Creek.

The Humber River Watershed is bounded to the west by the Mimico Creek Watershed and by the Etobicoke Creek Watershed, to the east by the Don River Watershed, and by the Rouge River Watershed, and to the south by the Waterfront Watershed. Drawing No. 4 shows the location of the subject site within the Humber River Watershed.

Local Surface Water and Natural Features

The Humber River is located, about 210 m north of the subject site, where it flows in a northwest to southeast direction. Cold Creek, a tributary of the Humber River is located, about 450 m northeast of the site where it flows in a northwest to southeast direction. Wooded areas occupy portions of the subject site, and its adjacent areas. These wooded areas are associated with both the Humber River and its associated tributaries. Wetlands which have not been classified under the Ontario Wetland Evaluation System (OWES), are also located, about 390 m to the east, and also 480 m southeast of the subject site. Ponded water bodies are also located within these non-evaluated wetland areas. The locations of the subject site and the noted natural features are shown on Drawing No. 5.

Borehole Advancement and Monitoring Well Installation

Borehole drilling and monitoring well installation were conducted on March 3, 4, 8 and 9, 2022. The program consisted of the drilling of four (4) boreholes (BH) and the installation of four (4) monitoring wells (MW); with one (1) monitoring well installed within each of the four (4) drilled boreholes. The drilling and monitoring well construction were completed by a licensed water well contractor, under the full-time supervision of a hydrogeological technician from SEL, who also logged the subsoil strata, encountered during borehole advancement and collected representative soil samples for textural classification. The boreholes were drilled using continuous-flight power-augers. The locations of the boreholes/monitoring wells are shown on Drawing No. 6. Detailed descriptions of the encountered subsurface soil and groundwater conditions are presented on the enclosed draft borehole and monitoring well logs, Figures 1 to 4, inclusive.

The monitoring wells were constructed, using 50 mm diameter PVC riser pipes and screens, which were installed in the boreholes in accordance with Ontario Regulation (O. Reg.) 903. All monitoring wells were provided with a monument-type, steel protective casings at the ground surface. The details for the monitoring well construction and disclosed subsoil conditions are provided on the enclosed Borehole Logs (Figures 1 to 4, inclusive).

The UTM coordinates and ground surface elevations at the borehole/monitoring well locations, together with the monitoring well construction details, are summarized on Table 1.

Table 1 - Monitoring Well Installation Details

Well ID	Installation Date	UTM Coordinates		Ground El. (masl)	Borehole Depth (mbgs)	Well Screen Interval (mbgs)	Casing Dia. (mm)
		East (m)	North (m)				
BH/MW 1	March 3, 2022	602852.06	4859703.15	244.83	6.60	3.1-6.1	50
BH/MW 2	March 3, 2022	602845.40	4859725.32	244.40	6.60	3.1-6.1	50
BH/MW 3	March 4, 8 and 9, 2022	602814.09	4859715.24	244.75	27.7	3.1-6.1	50
BH/MW 4	March 3, 2022	602829.59	4859671.93	247.00	6.60	3.1-6.1	50

Notes: mbgs -- metres below ground surface masl -- metres above sea level

Subsurface Conditions

The investigation has revealed that beneath a pavement structure, consisting of topsoil and earth fill, native subsoils are comprised of silty clay till, silt, and silty clay, extending to the maximum investigated depth of 27.7 m. The estimated permeability for the silt unit, encountered at BH 3, at a depth of 18.5 mbgs is about 10^{-6} m/sec., and the estimated permeability for the silty clay and silty clay till, encountered at the BHs 2 and 4 locations, at depths of 4.8 mbgs and 3.3 mbgs respectively, is 10^{-9} m/sec. Grain size analyses were performed on three (3) subsoil samples, and the soil gradation curves are plotted on Figure No's. 5 and 6. Drawing 8-1 provides the key plan for the delineated cross sections across the site in both northeast to southwest and southeast to northwest transects with the interpreted cross section shown on Drawing 8-2.

MECP Water Well Records Review

SEL reviewed the MECP Water Well Records (WWRs) for registered monitoring wells on the subject site, and within 500 m of the site boundaries (study area). The records indicate that thirty-nine (39) wells are located within the 500 m study area relative to the subject site. A summary of the Ontario WWRs reviewed for this study is provided in Appendix ‘A’ with the locations of the well records shown on Drawing No. 7.

A review of the final status of the well records within the study area reveals that twenty six (26) are registered as water supply wells, two (2) are identified as unfinished wells, two (2) are test hole wells three (3) are observation wells, 3 (three) are abandoned-supply wells, two (2) are abandoned other wells, and one (1) well record has no information associated with it .

A review of the first status of the monitoring wells shows that twenty (26) are domestic wells, five (5) are registered as unused wells, four (4) are monitoring wells, and 4 four records have no other information associated with them.

Groundwater Monitoring

The groundwater levels within in the monitoring wells were measured, manually on March 17, 2022, on April 26, 2022 and again on May 17, 2022 record the fluctuation of the shallow groundwater table beneath the site. The recorded groundwater levels and corresponding elevations are summarized in Table 2.

Table 2 - Water Level Measurements

Well ID		March 17, 2022	April 26, 2022	May 19, 2022
BH/MW 1	mbgs	2.34	2.98	2.53
	masl	242.49	241.85	242.30
BH/MW 2	mbgs	>6.1	5.06	5.07
	masl	<238.30	239.34	239.33
BH/MW 3	mbgs	5.27	4.07	4.26
	masl	239.48	240.68	240.49
BH/MW 4	mbgs	3.46	0.95	1.1
	masl	243.54	246.05	245.90

Notes: mbgs -- metres below ground surface masl -- metres above sea level
</> -- well is recorded as being dry

As shown above, the groundwater levels within the BH/MWs were manually measured on March 17, 2022, where the groundwater level elevations range from between 246.05 masl to below 238.30 masl (i.e. at the depths of 0.5 to >6.1 mbgl). The shallow groundwater flow pattern suggests that it flows away from a localized higher groundwater table area, located, approximately beneath the southern portions of the site, where it flows, mainly in a northerly direction mimicking the local topography for the area. The interpreted shallow groundwater flow pattern for the subject site is illustrated on Drawing No.'s 9 and 9-1.

Single Well Response Test Analysis

BH/MWs, underwent development in preparation for the single well response testing (SWRT) to estimate the hydraulic conductivity (K) for the subsoil strata at the depths of the monitoring well screens. Well development involved the purging and removal of several casing volumes of groundwater from each of the monitoring wells to remove remnants of clay, silt, sand, and other debris introduced into the monitoring wells during construction, and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata at the monitoring well screen depths. The K estimates, derived from the SWRT's provide an indication of the yield capacity for the shallow groundwater-bearing subsoil strata at the well screen depths, and can be used to estimate the flow of groundwater through the water-bearing sub-soil formation.

The SWRT involves the placement of a slug of known volume into the monitoring well, below the groundwater table, to displace the groundwater level upward. The rate at which the groundwater level recovers to static conditions (falling head) is tracked using a data logger/pressure transducer, and/or manually, using a water level tape.

The rates at which the groundwater table recovers to static conditions are used to estimate the K value for the groundwater-bearing sub-soil strata formation at the monitoring well screen depths.

BH/MW's 1, 3 and 4 underwent single well response tests (SWRT) on April 26, 2022, to estimate the hydraulic conductivity (K) for the saturated shallow aquifer sub-soils at the depths of the monitoring well screens. The results for the SWRT analyses are presented in Appendix 'B', with a summary of the findings, provided in Table 3.

Table 3 Summary of SWRT Results

Well ID	Ground El. (msl)	Monitoring Well Depth (mbgs)	Borehole Depth (mbgs)	Well Screen Interval (mbgs)	Screened Subsoil Strata	Hydraulic Conductivity (K) (m/sec)
BH/MW 1	244.83	6.1	6.60	3.1-6.1	Silty Clay over Silty Clay Till	4.3×10^{-8}
BH/MW 3	244.75	6.1	27.7	3.1-6.1	Silty Clay Till	1.1×10^{-7}
BH/MW 4	247.0	6.1	6.60	3.1-6.1	Silty Clay over Silty Clay Till	3.6×10^{-8}

Notes: mbgs -- metres below ground surface masl -- metres above sea level

As shown in Table 3 the K estimates for the sub-soils units beneath the site range from between 3.6×10^{-8} to 1.1×10^{-7} m/sec. The results of the SWRTs provide an indication of the yield capacity for the groundwater-bearing subsoil strata at the depths of the monitoring well screens.

The above results suggests that the K estimates for the groundwater-bearing subsoil units at the depths of the monitoring well screens are within the low range, with corresponding low anticipated groundwater seepage rates being anticipated into open excavations, below the groundwater table.

Assessment of Hydraulic Conductivity Based on the Hazen Equation

The Hazen Equation method was also adopted to estimate the hydraulic conductivity (K) for different subsoil layers which may contain groundwater during the seasonal (spring) high groundwater table period, or if encountered within the deeper excavations. These layers are primarily above the monitoring well screen depths.

The Hazen Equation method relies on the interrelationship between hydraulic conductivity (K) and effective particle grain size (mm), d_{10}, for the soil media. This empirical relation predicts a power-law relation with K, as follows:

$$K = Ad_{10}^2$$

where;

d_{10}: Value of the soil grain size gradation curve in mm, as determined by sieve analysis, whereby 10% by weight of the soil particles are finer and 90% by weight of the soil particles are coarser.

A: Coefficient; it is equal to 1 when K in cm/sec and d_{10} is in mm

The Hazen Equation estimation method provides an indication of the yield capacity for the groundwater-bearing sub-soil strata at the depths where the soil samples that underwent grain size analyses were collected. The calculated results indicate that the K estimate for the silt, having traces of clay and sand, retrieved from a depth of 18.5 mbgs at BH 3 is 6.40×10^{-7} m/sec. The results for the Hazen grainsize method, determined K estimates are provided in Table 3 below. The K estimates determined from the Hazen Method suggests low hydraulic conductivity (K) estimates for the groundwater bearing sub-soil layers beneath the subject site.

Table 4 - Summary of Hazen Equation Estimated K Results

Well ID	Sample Depth (mbgs)	Sample El. (masl)	Description of Soil Strata	D_{10} (mm)	Hydraulic Conductivity (K) (m/sec)
BH 3	18.5	226.3	Silt, traces of Clay and Sand	0.008	6.40×10^{-7}

Notes: mbgs -- metres below ground surface masl -- metres above sea level

Dewatering Flow Estimation

The proposed site plans, prepared by VA3 Design Project No 222008, Drawings 1, dated March 2023 indicates that it is planned to construct three (3) townhouse blocks, having a total of fifteen (15) residential units. It is anticipated that each unit will be completed with a basement structure. with an underground foundation depth of about 3.0 m which was generally considered for the dewatering needs assessment for the development.

Townhouse Block Units 3 Units (Units 13, 14, 15) Within the South-Eastern Portion of the site, at a Grade Elevation of approximately 244.83 masl:

For the proposed townhouse buildings, having 3 units, the finished floor plans elevations range from 248.50 to 248.80 masl where the underside of footing elevations were provided that range from 245.53 to 245.60 masl for the proposed basement foundation footings which are about 2.97 to 3.2 m below the finished floor elevations, To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 244.53 masl, which is about 1 m below the lowest proposed excavation depth.

Comparison of the proposed foundation structure depth with the measured groundwater levels, indicates that the measured shallow groundwater level elevation of 242.49 masl, as recorded at the BH/MW 1 location is about 3.04 m below the lowest proposed excavation depth elevation for the townhouse foundations. As such no temporary limited groundwater control is required for earthworks and construction and not long-term foundation is anticipated for the completed town-housing basement foundations.

Townhouse Block with Units 1-6 Within the North East Section of the Site, at a Grade Elevation of approximately 245 masl:

For the proposed town-housing block with Units 1 to 6, the finished floor grading plan elevations for the six units ranges from 245.85 to 247.48 masl, where the undersides of footings range from 242.88 to 244.60 masl which are being proposed townhouse building basement structures. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 241.88 masl, which is about 1 m below the lowest proposed excavation depth. Comparison of the lowest proposed foundation structure depth with the measured groundwater levels indicates that the highest shallow groundwater level elevation of 240.68 masl as recorded at the BH/MW 3 location is about 2.20 m below the lowest proposed excavation depth for construction, and, as such, it is not anticipated that temporary groundwater control is required for earthworks and construction with no anticipated long term foundation drainage needs for the complete town housing basement structures.

Townhouse Block with 4 Units No.'s 7-12, within the Western Central area of the stie at Grade Elevation of approximately 248.0 masl:

For the proposed Townhouse block with 4 Units No.'s 7-12, an estimated finished floor grading plan elevations range from 248 to 249.50 masl, with the underside of footing elevations, ranging from 244.80 to 246.30 masl for the proposed basement foundation footings. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 243.80 masl, which is about 1 m below the lowest proposed excavation depth.

Comparison of the proposed townhouse foundation structure depth with the measured, groundwater levels, indicates that the shallow groundwater level elevation of 246.05 masl, as recorded at the BH/MW 4 location is about 1.55 m above the lowest proposed excavation depth elevation. By having the anticipated groundwater table lowered by an additional one (1) meter. As such temporary limited groundwater control is required for earthworks and construction.

The site plans, prepared by VA3 Design Project No 222008, Drawings 1, dated March 2023, were reviewed for the dewatering needs assessment.

Based on the considered dimensions for housing basement structures of approximately 13.5 by 9 m for the average town-housing block within the western section of the site with an estimated perimeter of about 45 m. Using the highest hydraulic conductivity of 1.1 x 10^{-7} m/second and the anticipated drawdown of 2.3 m for the water table to facilitate dry stable subsoil conditions, the temporary dewatering flows to facilitate construction for the town-housing blocks within the western section of the site could reach a daily rate of 3,387.0 L/day by applying a safety factor of three the daily flow rate could reach a maximum of 10,161.1 L / day. The zone of influence associated with temporary groundwater control could reach a distance of up to 9 m away from the excavation footprints around the town-housing blocks with the western area of the site.

In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), where the dewatering flow rate is lower than 50,000 L/day, there is no need to register for a proposed groundwater-taking approval for construction, by means of the filing an Environmental Activity and Sector Registry (EASR), or through a Permit-To-Take water (PTTW) application with the MECP. Since the estimated maximum dewatering flow rate is lower than 50,000 L/day where it could reach a maximum daily rate of 6,494.9 L/day, the registering or applying for an EASR, or a PTTW with the MECP as approvals to facilitate any proposed temporary groundwater-taking for construction is not anticipated. There may be a need to remove temporary runoff accumulation within construction excavations, and/or servicing trenches follow high rainfall events. It is anticipated that any management for the removal of any accumulated runoff within excavations can be accomplished without the need for an EASR.

Given the low subsoil permeability, the shallow water table is like perched within the silty clay till subsoils with minimal to negligible groundwater seepage anticipated to the completed town-housing foundations structures which can likely managed with a simple footing weeper tile drain around the perimeter of the foundation. Seepage may occasional be picked up by the weeper drain during high rainfall events or within the spring thaw the weepers can be drained to a sump within the basement if needed.

Underground Services Installation

The development and servicing plans provided by VA3 Design Project No 222008, Drawings 1, dated March 2023 did not show the invert depths and profiles for the proposed underground services beneath the site. To maintain a conservative dewatering needs assessment a depth of 5 m below grade was considered for the installation of underground services beneath the site with the lowest invert depth being proposed at an elevation of below an average surface grade of 248 masl to a considered invert depth elevation of 243 masl. By using the highest groundwater depth elevation of 246.05 masl, the groundwater table is about 3.05 m above the lowest considered underground services installation depth. By considering a 25 m length open servicing trench excavation and the highest hydraulic conductivity estimate of 1.01 x10^{-7} m/sec, and by lowering the groundwater table to a depth elevation of about 242.0 the assessed temporary dewatering flow rates could reach a daily rate 1, 675 L/day by considering a 3x safety factor the temporary dewatering flow rate could reach a maximum 5,025.1 L/day. The assesses zone of influence could extend to a distance of 4 m away from the dowering alignment being considered for the installation of underground services.

Groundwater Control Methodology

Low to moderate groundwater seepage rates which may be encountered within open excavations below the groundwater table can likely be controlled by occasional pumping from sumps. Well points can be employed to lower water table if wet subsoil is unstable and seepage cannot be controlled via sump pumping. The final designs for the dewatering system will be the responsibility of the construction contractors.

Mitigation of Potential Impacts Associated with Dewatering

The maximum conceptual zone of influence for any dewatering well or dewatering array used during services installation is approximately 4 m away from the conceptual dewatering wells or array around the servicing trenches. There are no natural features, such as; watercourses, bodies of water, wetlands or any groundwater receptors, including water supply wells on site, or within anticipated zones of influence for any temporary construction dewatering.

Groundwater Function for the Subject Site

The zone of influence for any temporary construction dewatering array or wells could reach a maximum of 4.0 m away from the conceptual dewatering wells/array considered for installation of the underground services. No private wells, bodies of water, watercourses, wetlands or any natural features are present within the conceptual zone of influence for any temporary construction dewatering array being considered for construction. In addition, the subject site is underlain by lower permeable subsoil, resulting in limited estimated zones of influence for temporary construction dewatering, resulting in minimal to negligible anticipated impacts to any nearby features from any temporary dewatering for construction. As such no long-term impacts to groundwater function of the subject site are anticipated.

Ground Settlement

Potential ground settlement to existing structures associated with temporary construction dewatering should be assessed by a geotechnical engineer prior to earthworks and construction.

Conclusions

1. The measured groundwater level elevations ranged from between March 17 and May 19, 2022, where the groundwater level elevations ranged from between 246.05 masl to below 238.30 masl (i.e. at the depths of 0.5 to >6.1 mbgl. The interpreted shallow groundwater flow pattern suggests that it flows away from a localized higher groundwater table area, located, approximately beneath the southern portions of the site, and flows, mainly in a northerly direction mimicking the local topography for the area.
2. The Hazen Equation, calculated hydraulic conductivity (K) estimates indicates that for the silt sub-soil units, is 6.40 x 10^{-7} m/sec. The K estimates determined from the Hazen method suggests low hydraulic conductivities (K) for the groundwater bearing subsoil layers beneath the subject site.
3. The results for the SWRT completed at 3 of the monitoring wells indicates that the hydraulic conductivity for the silty clay till and silty clay at the depths of the monitoring well screens is low in the range of 3.6 x 10^{-8} to 1.1 x10^{-7} m/sec which is in the low range with low anticipated seepage rates below the groundwater table.
4. Based on the anticipated low hydraulic conductivity estimates for the silty clay till, silty clay and silt sub-soils, and the measured groundwater elevations, recorded to date, temporary limited groundwater control will be required for earthworks and construction for portions of the site with expected temporary dewatering flow rates ranging from a low of 3,387.0 L/day up to 10,161.1 L/day after applying a 3x safety factor. For installation of underground services, the temporary flows could range from ,1675 up to 5,025 L/day. The assessed zones of influence for temporary groundwater control could reach a distance of about 2.2 m away from the town-housing blocks and up to 4 m away from the underground services trench excavations. The are no groundwater receptors within the maximum 4 m zone of influence for town-housing construction within the western section of the site. Based on the assessment the temporary dewatering flows are all below the 50,000 L/day threshold limit for requiring an approval from the MECP for a temporary groundwater control program for construction.
5. The basement structures for the proposed town-housing blocks within the south east and north east portions of the site are above the water table where no construction dewatering for groundwater control or long-term foundation drainage is anticipated. However, given the low permeability for the subsoils at the founding depths, minimal long-term foundation seepage needs can be anticipated for the completed basements after construction within the western portion of the site.
6. The timing of construction and earthworks should be considered for summer and fall when the seasonal groundwater table is lower to minimize any construction dewatering needs requirements for the proposed development.
7. It is recommended that shallow groundwater be sampled for analysis to determine disposal discharge options for any dewatering effluent generated during construction.

Yours very truly,
SOIL ENGINEERS LTD.

PROFESSIONAL GEOSCIENTIST
GAVIN R. O'BRIEN
PRACTISING MEMBER
1267
March 22, 2023
ONTARIO

Gavin O'Brien, M.Sc., P.Geo.
GO

ENCLOSURES

Draft Borehole/Monitoring Well Logs	Figures 1 to 4
Grain Size Distribution Graphs	Figures 5 to 6
Site Location Plan	Drawing No. 1
Surface Geology Map	Drawing No. 2
Topography Map	Drawign No. 3
Watershed and Subwatershed Map	Drawing No. 4
Area of Natural Features and Protection Area Plan	Drawing No. 5
Borehole and Monitoring Well Location Plan	Drawing No. 6
MECP Water Well Loctions Plan	Drawing No. 7
Cross Section Key Plan	Drawing No'8-1
Geological Cross Sections (A-A' and B-B)	Drawing No'8-2
Shallow Groundwater Flow Pattern Plan	Drawing No. 9
Shallow Groundwater Flow Pattern Plan	Drawing No. 9-1

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test
☐	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

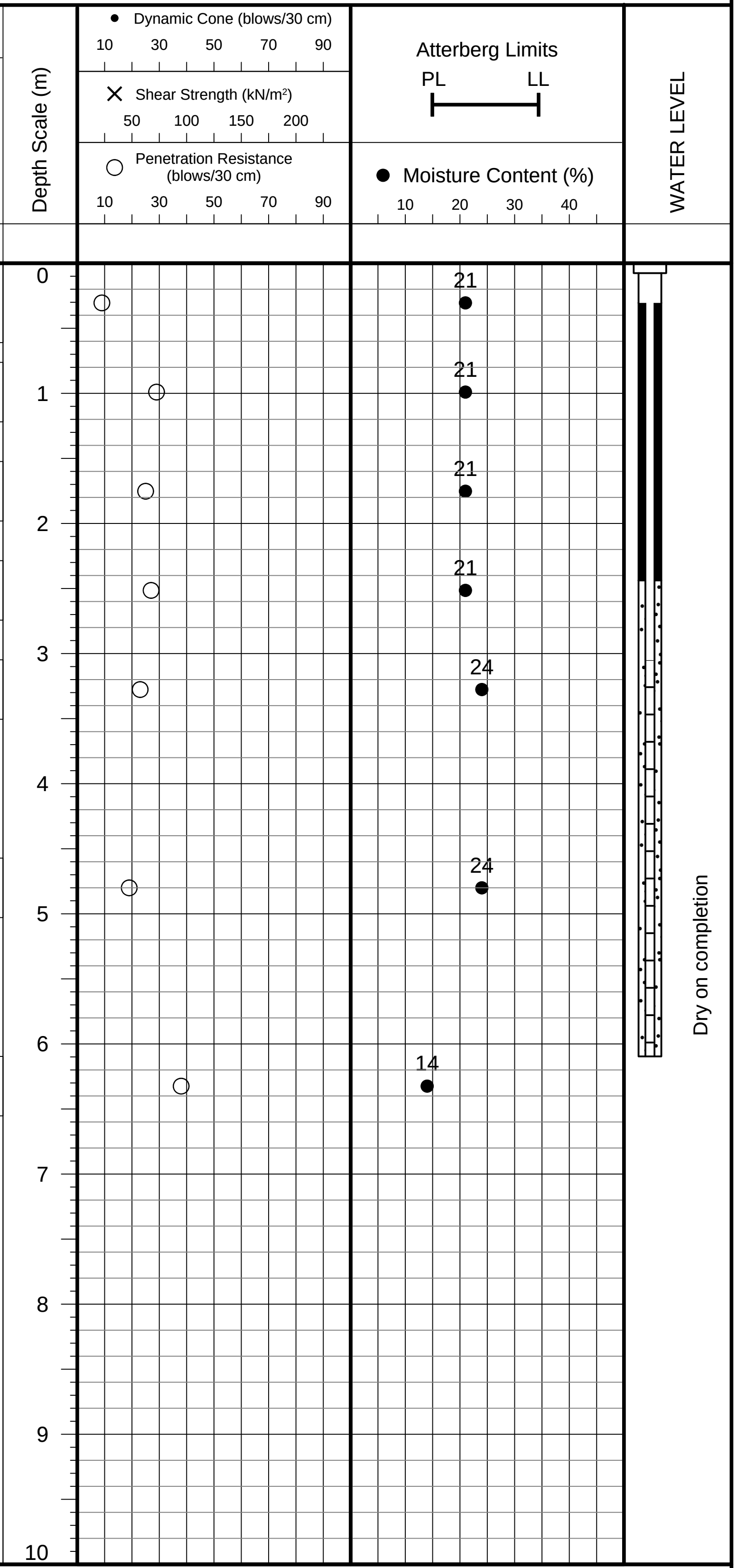
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 3, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)
244.8	Ground Surface				
0.0	**10 cm TOPSOIL** Brown, weathered **SILTY CLAY TILL** traces of sand and gravel occ. sand seams and layers, cobbles and boulders	1	DO	9	21
244.0 0.8	Brown, very stiff **SILTY CLAY** a trace of sand occ. gravel	2	DO	29	21
		3	DO	25	21
		4	DO	27	21
		5	DO	23	24
240.2 4.6	Very stiff to hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders brown grey	6	DO	19	24
		7	DO	38	14
238.2 6.6	**END OF BOREHOLE**				

Installed 50 mm Ø PVC monitoring well to 6.1 m (3.0 m screen)
Sand backfill from 2.4 m to 6.1 m
Bentonite holeplug from 0.3 m to 2.4 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

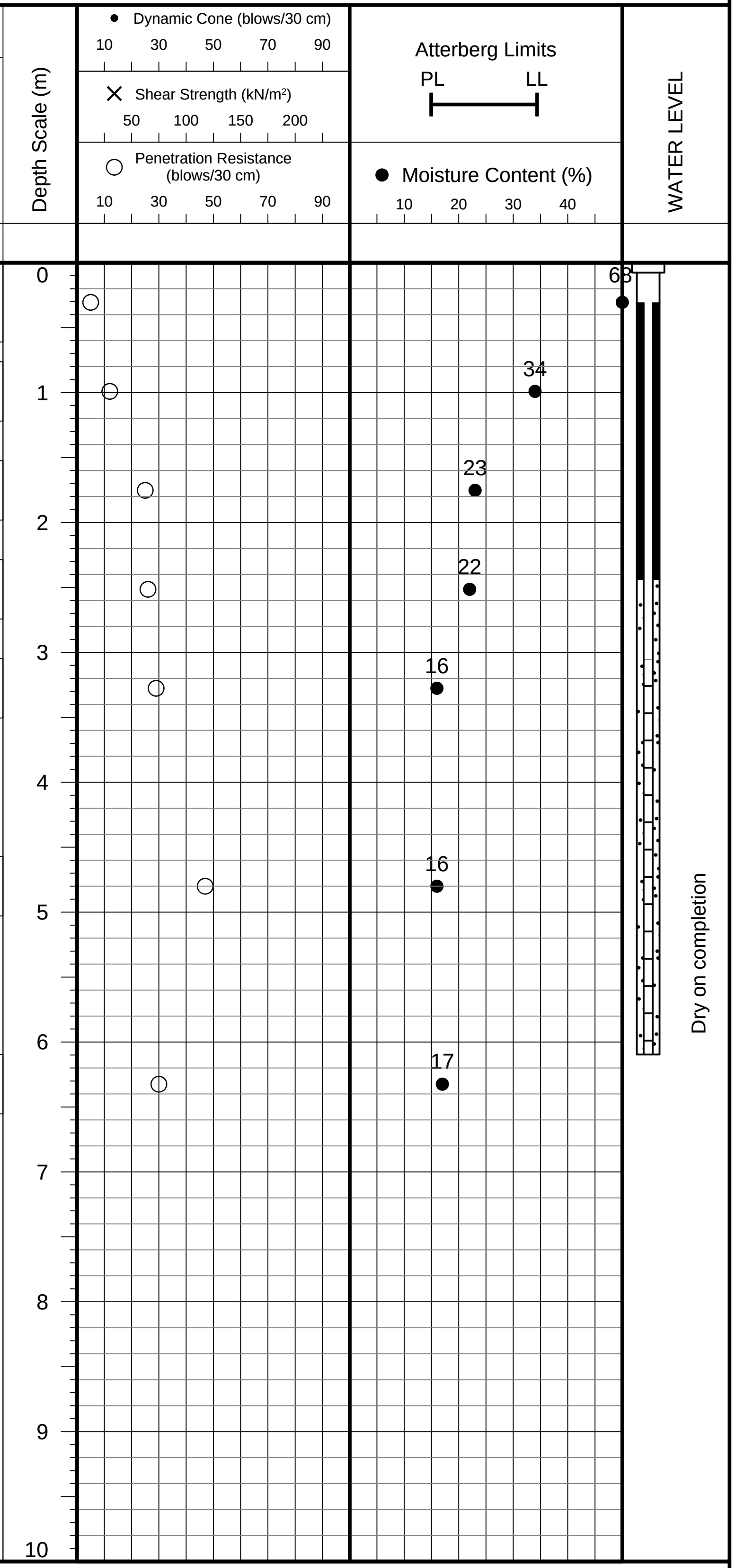
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 3, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
244.4	Ground Surface			
0.0	**10 cm TOPSOIL** Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel with organic inclusions	1	DO	5
243.6 0.8	Brown, stiff to hard weathered **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	2	AS	12
		3	DO	25
		4	DO	26
		5	DO	29
		6	DO	47
		7	DO	30
237.8 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 6.1 m (3.0 m screen)
Sand backfill from 2.4 m to 6.1 m
Bentonite holeplug from 0.3 m to 2.4 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

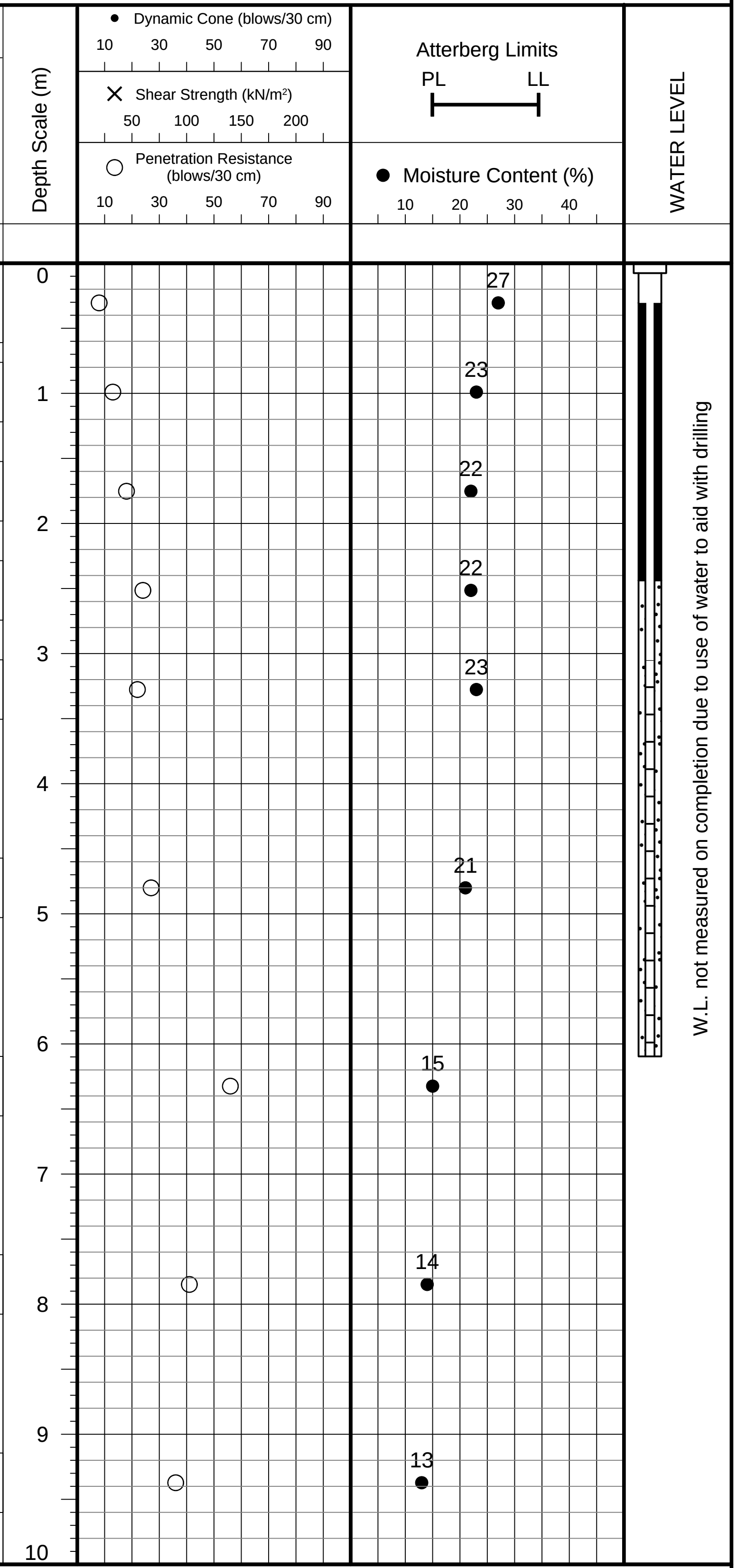
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers and Tricone

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 4, 8 and 9, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
244.8	Ground Surface			
0.0	**8 cm TOPSOIL** Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel	1	DO	8
243.9 0.9	Brown, firm to very stiff **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	13
		3	DO	18
		4	DO	24
241.8 3.0	Brown, very stiff **SILTY CLAY** a trace of sand	5	DO	22
240.2 4.6	Very stiff to hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	6	DO	27
		7	DO	56
	brown grey	8	DO	41
		9	DO	36
234.8	*(Continued on next page)*			



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

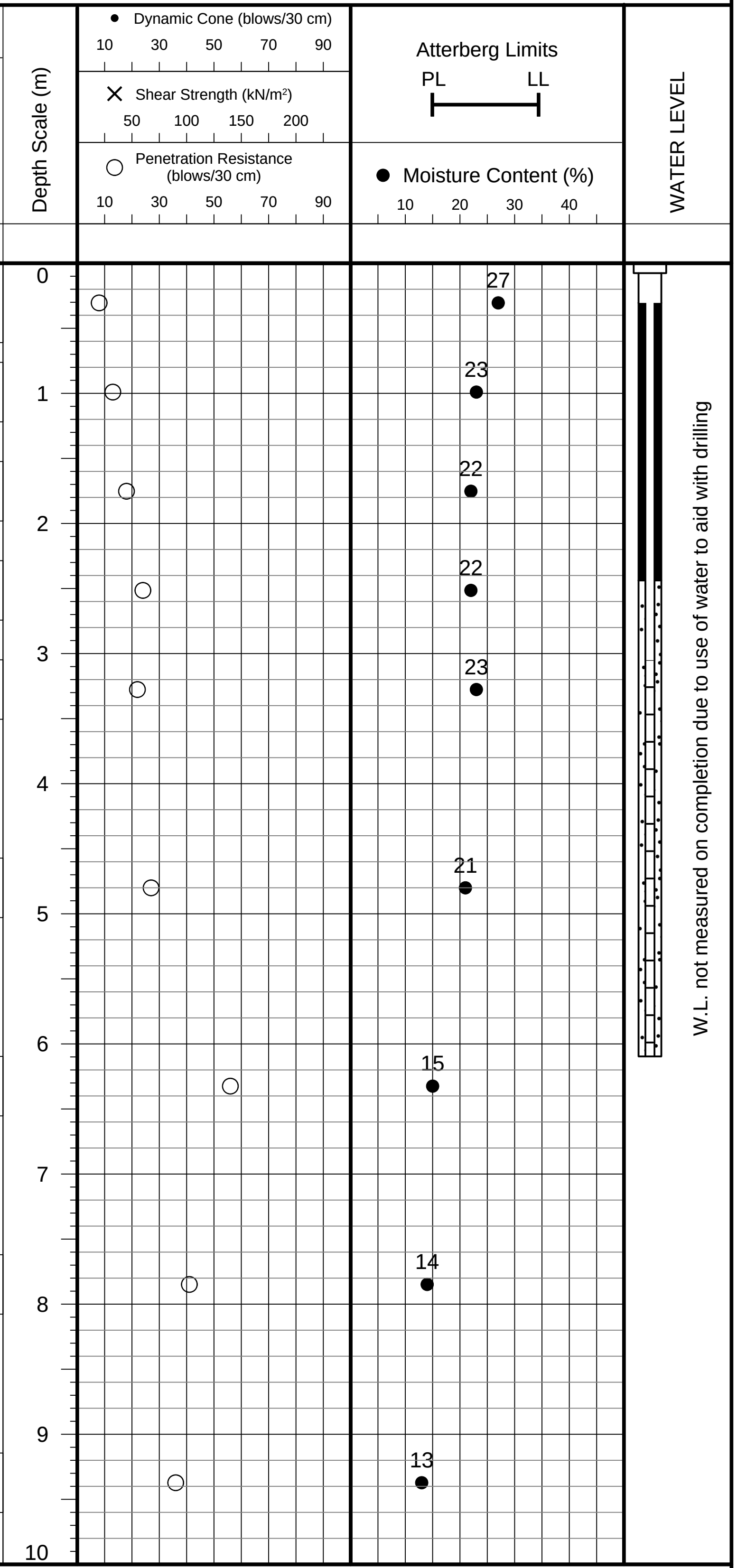
METHOD OF BORING: Hollow Stem Augers and Tricone

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 4, 8 and 9, 2022

El. (m) Depth (m)	SOIL DESCRIPTION
244.8	Ground Surface
0.0	**8 cm TOPSOIL** Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel
243.9 0.9	Brown, firm to very stiff **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders
241.8 3.0	Brown, very stiff **SILTY CLAY** a trace of sand
240.2 4.6	Very stiff to hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders — — brown / grey
234.8	*(Continued on next page)*

SAMPLES		
Number	Type	N-Value
1	DO	8
2	DO	13
3	DO	18
4	DO	24
5	DO	22
6	DO	27
7	DO	56
8	DO	41
9	DO	36



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

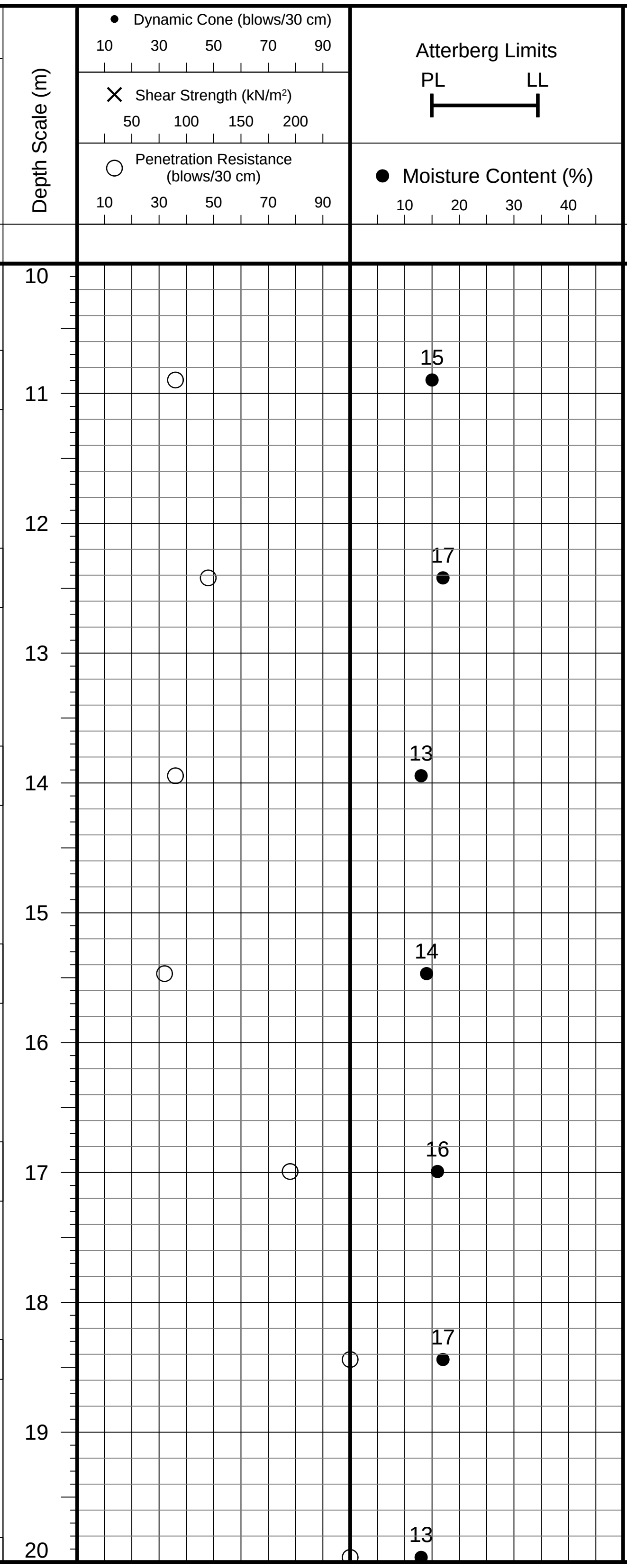
METHOD OF BORING: Hollow Stem Augers and Tricone

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 4, 8 and 9, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
10.0	*(Continued)* Very stiff to hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	10	DO	36
	— — grey/brown	11	DO	48
	— — brown/grey	12	DO	36
		13	DO	32
228.0 16.8	Very dense **SILT** traces of clay and sand — — grey/brown	14	DO	78
		15	DO	50/15
225.0 224.8	Grey, hard **SILTY CLAY TILL** — sand layers	16	DO	50/15

WATER LEVEL



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

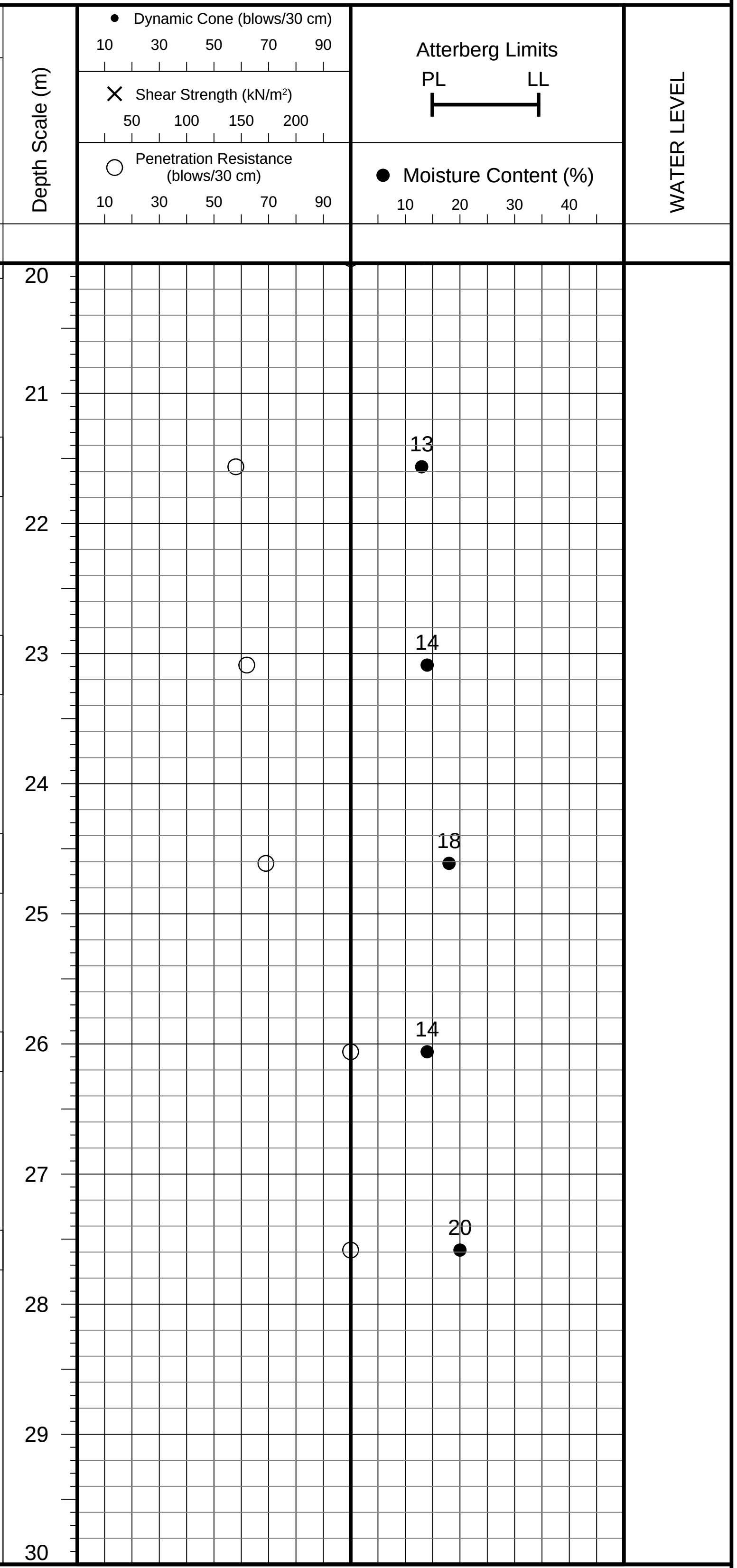
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers and Tricone

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 4, 8 and 9, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
20.0	*(Continued)* Grey, hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	17	DO	58
	sand layers	18	DO	62
220.4 24.4	Grey, very dense **SANDY SILT** a trace of clay	19	DO	69
218.7 26.1	Grey, hard **SILTY CLAY TILL** some sand, a trace of gravel occ. sand seams and layers, cobbles and boulders	20	DO	50/15
		21	DO	50/15
217.1 27.7	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (3.0 m screen) Sand backfill from 2.4 m to 6.1 m Bentonite holeplug from 0.3 m to 2.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2201-W054

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

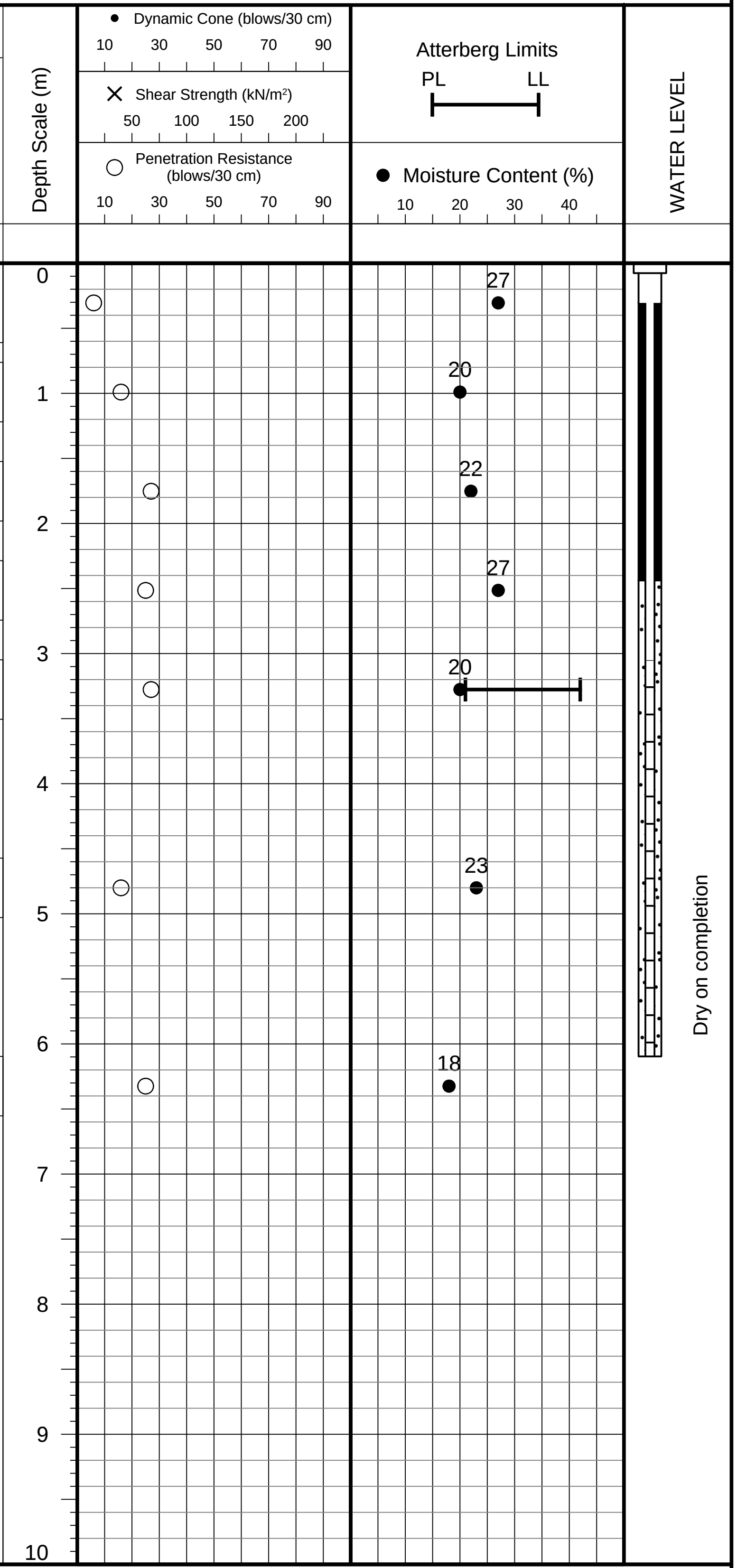
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 13290 Nunnville Road
Town of Caledon (Bolton)

DRILLING DATE: March 3, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
247.0	Ground Surface			
0.0	**15 cm TOPSOIL** Brown, firm to very stiff **SILTY CLAY TILL** weathered a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	1	DO	6
		2	DO	16
		3	DO	27
244.7 2.3	Stiff to very stiff **SILTY CLAY** a trace of sand brown grey	4	DO	25
		5	DO	27
		6	DO	16
240.9 6.1	Grey, very stiff **SILTY CLAY TILL** traces of sand and gravel occ. sand seams and layers, cobbles and boulders	7	DO	25
240.4 6.6	**END OF BOREHOLE**			

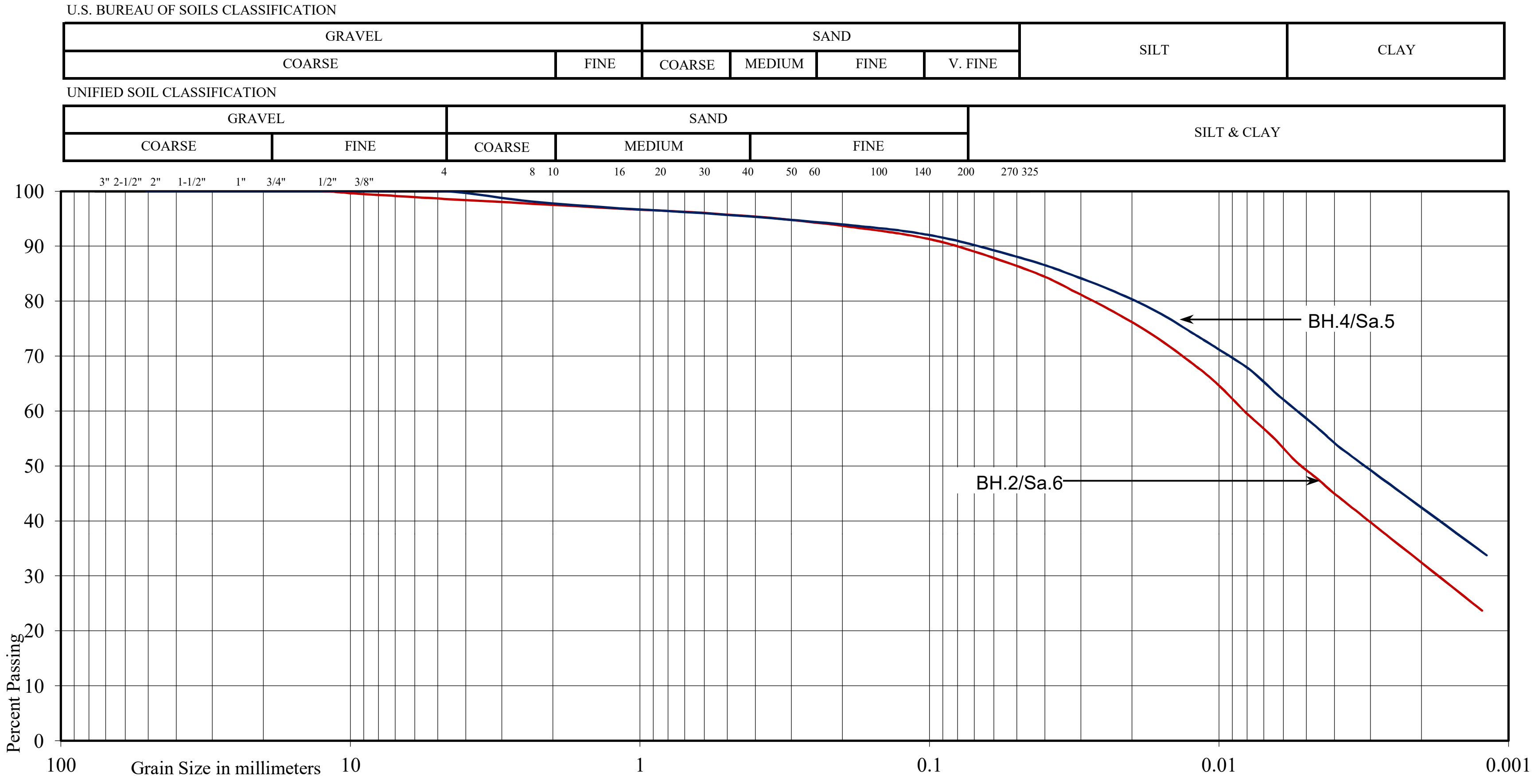
Installed 50 mm Ø PVC monitoring well to 6.1 m (3.0 m screen)
Sand backfill from 2.4 m to 6.1 m
Bentonite holeplug from 0.3 m to 2.4 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2201-W054



Project: Proposed Residential Development

Location: 13290 Nunnville Road, Town of Caledon (Bolton)

Borehole No:	2	4
Sample No:	6	5
Depth (m):	4.8	3.3
Elevation (m):	239.6	243.7

BH./Sa.	2/6	4/5
Liquid Limit (%) =	-	42
Plastic Limit (%) =	-	21
Plasticity Index (%) =	-	21
Moisture Content (%) =	16	20
Estimated Permeability (m./sec.) =	10^{-9}	10^{-9}

Classification of Sample [& Group Symbol]:

BH.2/Sa.6 - SILTY CLAY TILL, traces of sand and gravel

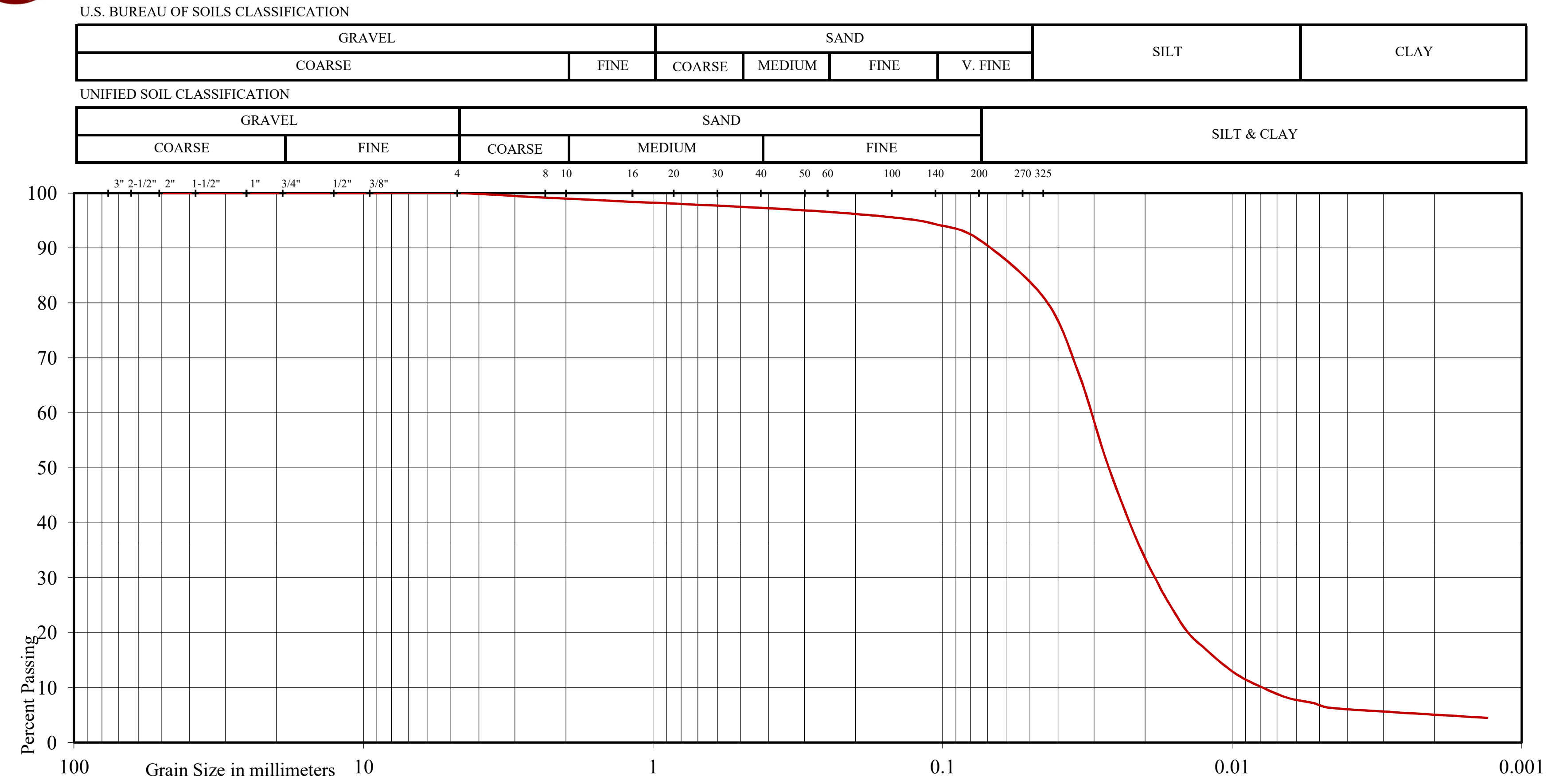
BH.4/Sa.5 - SILTY CLAY, a trace of sand

Figure: 5

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2201-W054



Project: Proposed Residential Development

Location: 13290 Nunnville Road, Town of Caledon (Bolton)

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 3

Plasticity Index (%) = -

Sample No: 15

Moisture Content (%) = 17

Depth (m): 18.5

Estimated Permeability

Elevation (m): 226.3

(m./sec.) = 10^{-6}

Classification of Sample [& Group Symbol]: SILT

traces of clay and sand

Figure: 6

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

Legend

🟥 Approximate Boundary of Subject Site

— Road

Soil Engineers Ltd.

Title: Site Location Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

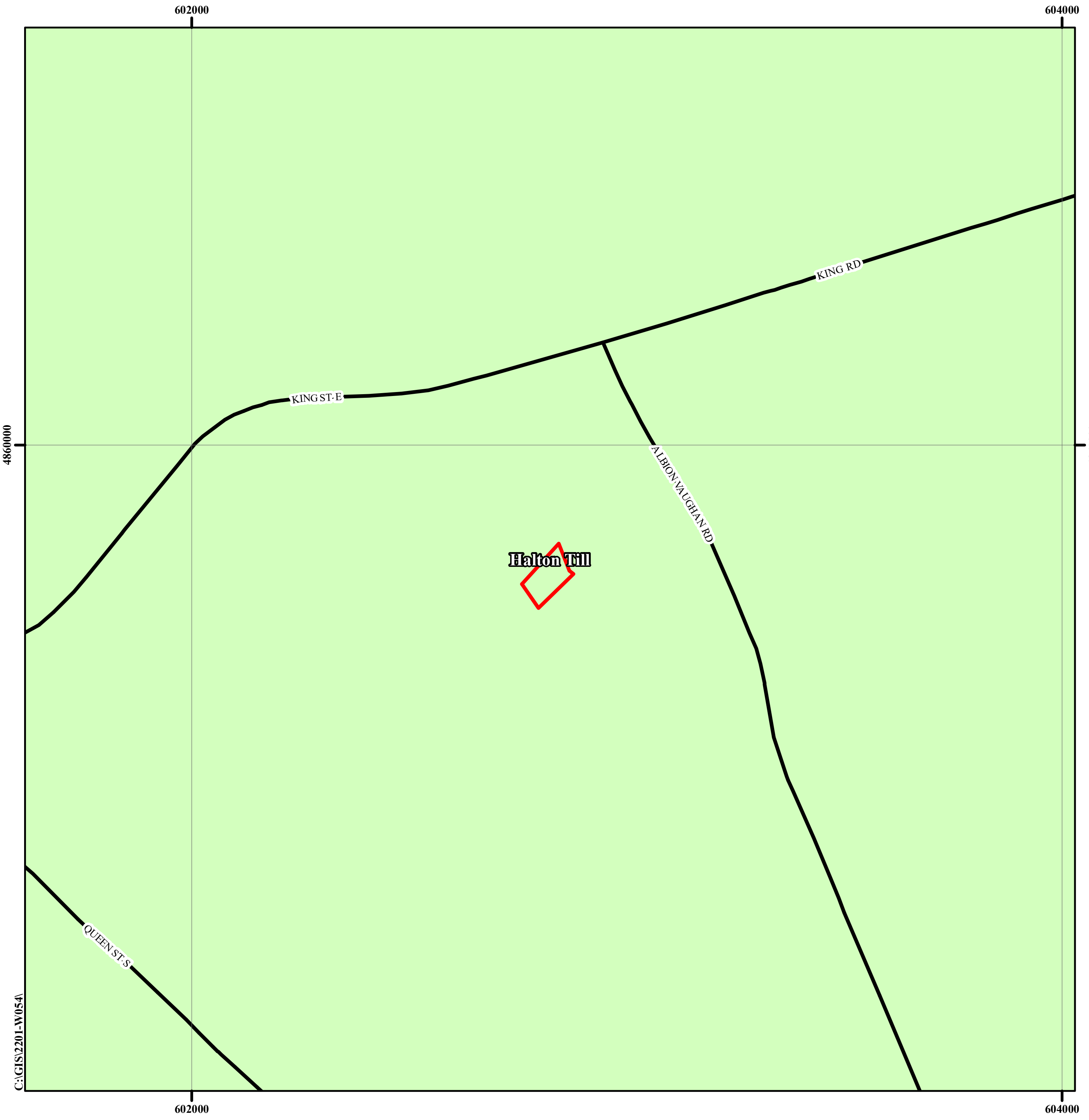
Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 1

Source: Ontario Ministry of Natural Resources and Forestry



N

Legend

🟩 Halton Till
Material: predominantly silt to
silty clay matrix, high in matrix
carbonate content and clast poor

═ Expressway/Freeway

━ Major Road

Soil Engineers Ltd.

Title: Quarternary and Surface
Geology Map

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

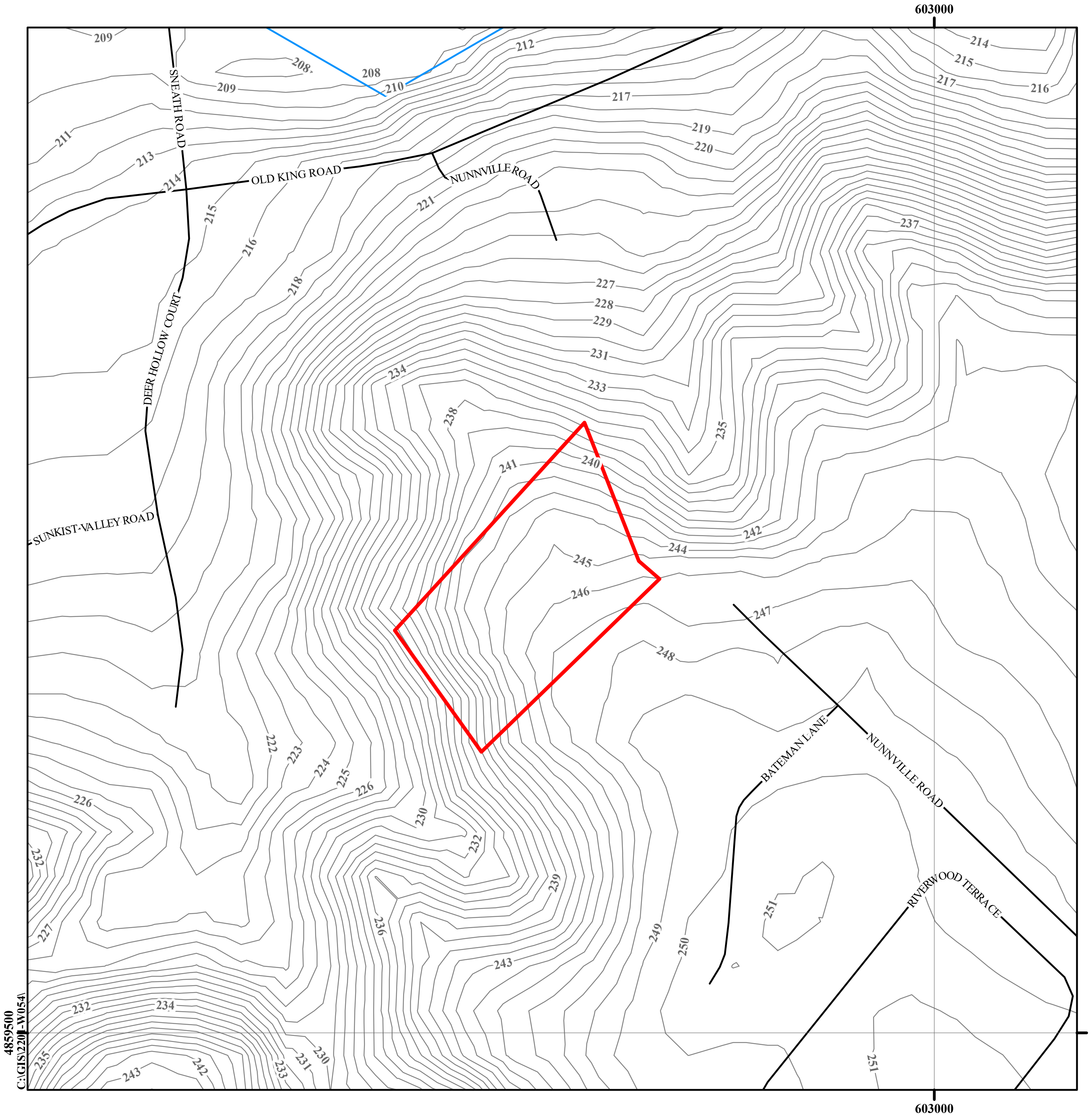
Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 80 160 240 320 400
Metres

Drawing No. 2

Source: Ontario Geological Survey, 1997, Miscellaneous Release---Data 0014



N

Legend

🟥 Approximate Boundary of Subject Site

Roads

Watercourse

—100— Topographic Contour (masl)

Soil Engineers Ltd.

Title: Topographic Map

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

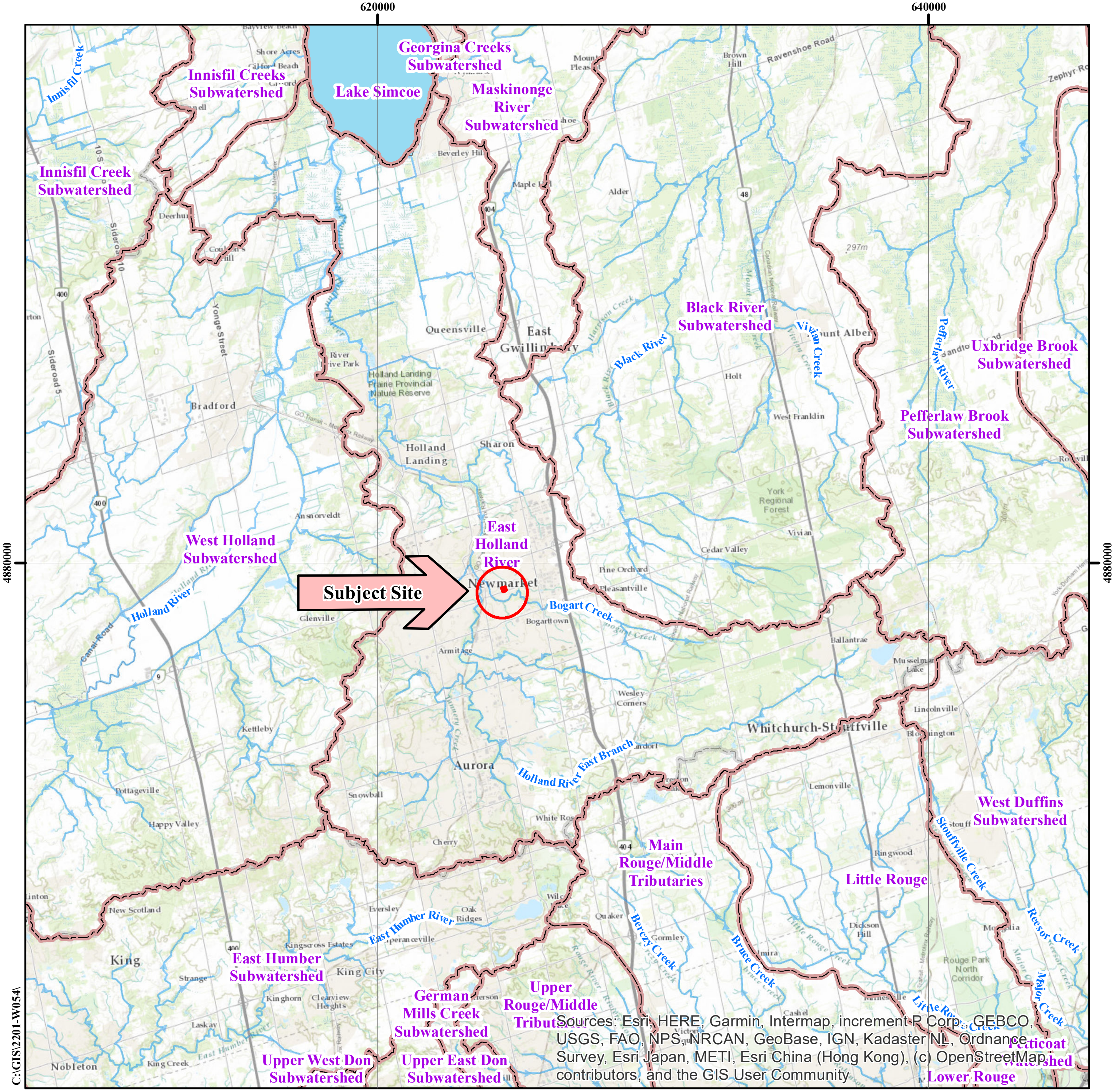
Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 12.5 25 50 75 100 125
Metres

Drawing No. 3

Source: Ontario Ministry of Natural Resources and Forestry

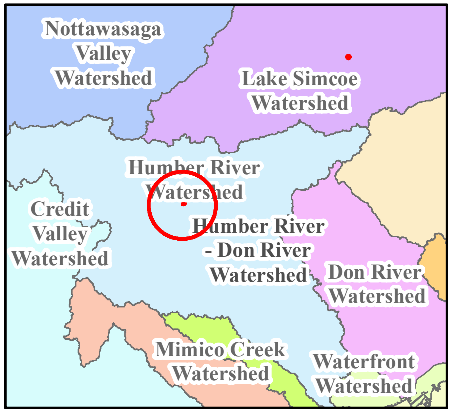


C:\GIS\2201-W054\

This mapping was produced by SEL and should be used for information purposes only.
Data sources used in its production are of varying quality and accuracy and all boundaries should be considered approximate.

N

Watershed:



Legend

🟥	Approximate Boundary of the Subject Site
▭	Watershed Boundaries
🟦	Waterbody
—	Watercourse
—	Expressway/Major Road

Soil Engineers Ltd.

Title: Watershed and Subwatershed Map

Project:

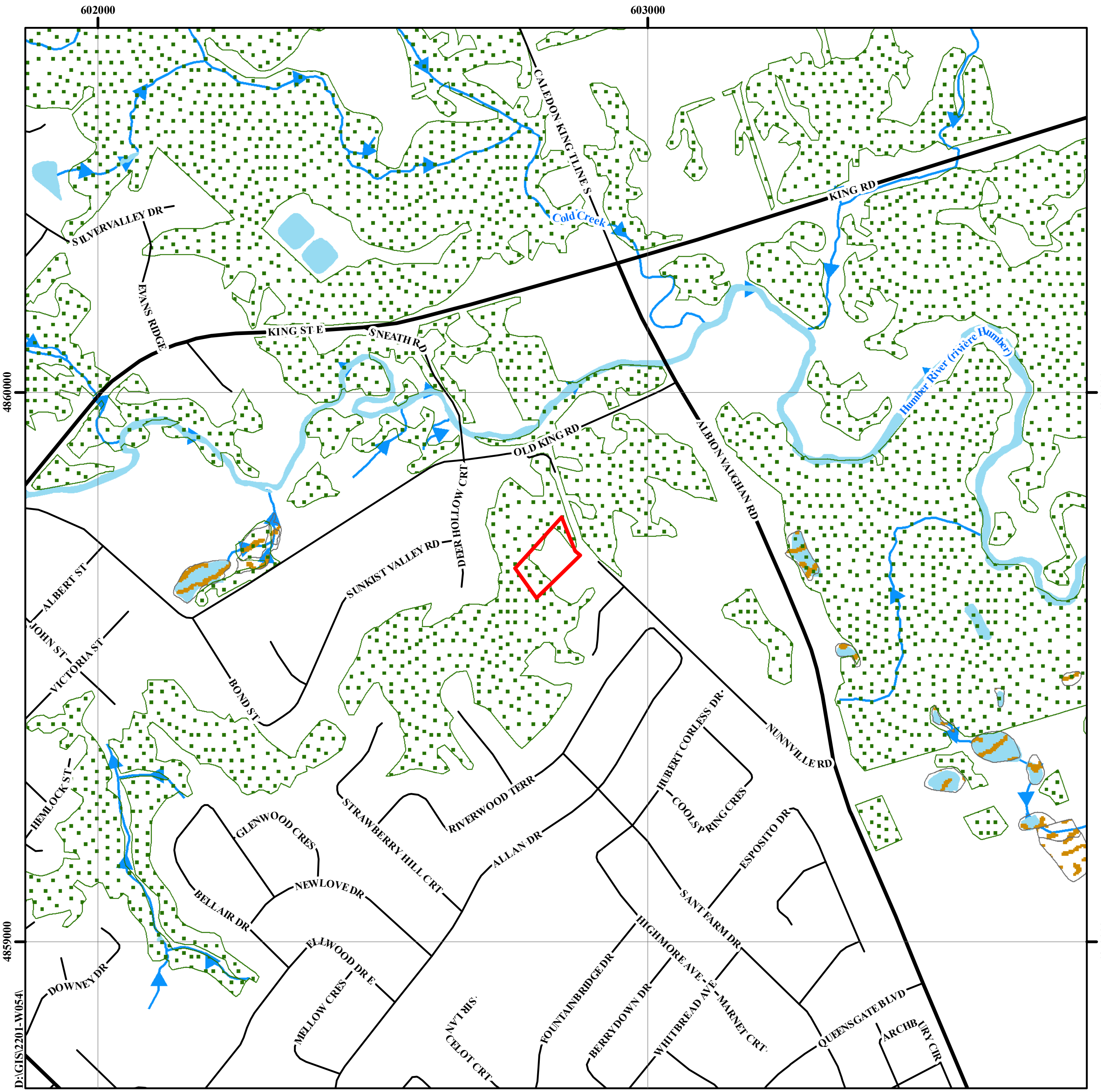
Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 2,200 4,400 6,600 8,800 11,000
Metres

Drawing No. 4



N

Legend

▨ Wetland (Not evaluated per OWES)

🟩 Wooded Area

🟦 Waterbody

→ Watercourse

━ Major Road

— Local Road

Soil Engineers Ltd.

Title: Natural Features and
Protection Area Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 60 120 180 240 300
Metres

Drawing No. 5

Includes information: Provincial Park, Conservation Reserve, Area of Natural and Scientific Interest, Wetland, Niagara Escarpment Protection Area, Oak Ridges Moraine Conservation and Wilderness Areas

Source: Ontario Ministry of Natural Resources and Forestry

OWES: Ontario Wetland Evaluation System

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

Legend

🟥	Approximate Boundary of Subject Site
⊕	Borehole with Monitoring Well
—	Road

Soil Engineers Ltd.

Title: Borehole and Monitoring
Well Location Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 4 8 16 24 32 40
Metres

Drawing No. 6

Source: Ontario Ministry of Natural Resources and Forestry

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

Legend

🟥	Approximate Boundary of Subject Site
▭	500 metres from Subject Site Boundary
● 1	Well Location from MECP Well Records (see Appendix 'A')
▨	Waterbody
→	Watercourse
━	Major Road
—	Local Road

Soil Engineers Ltd.

Title: MECP Well Location Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 7

Source: Ontario Ministry of Natural Resources and Forestry
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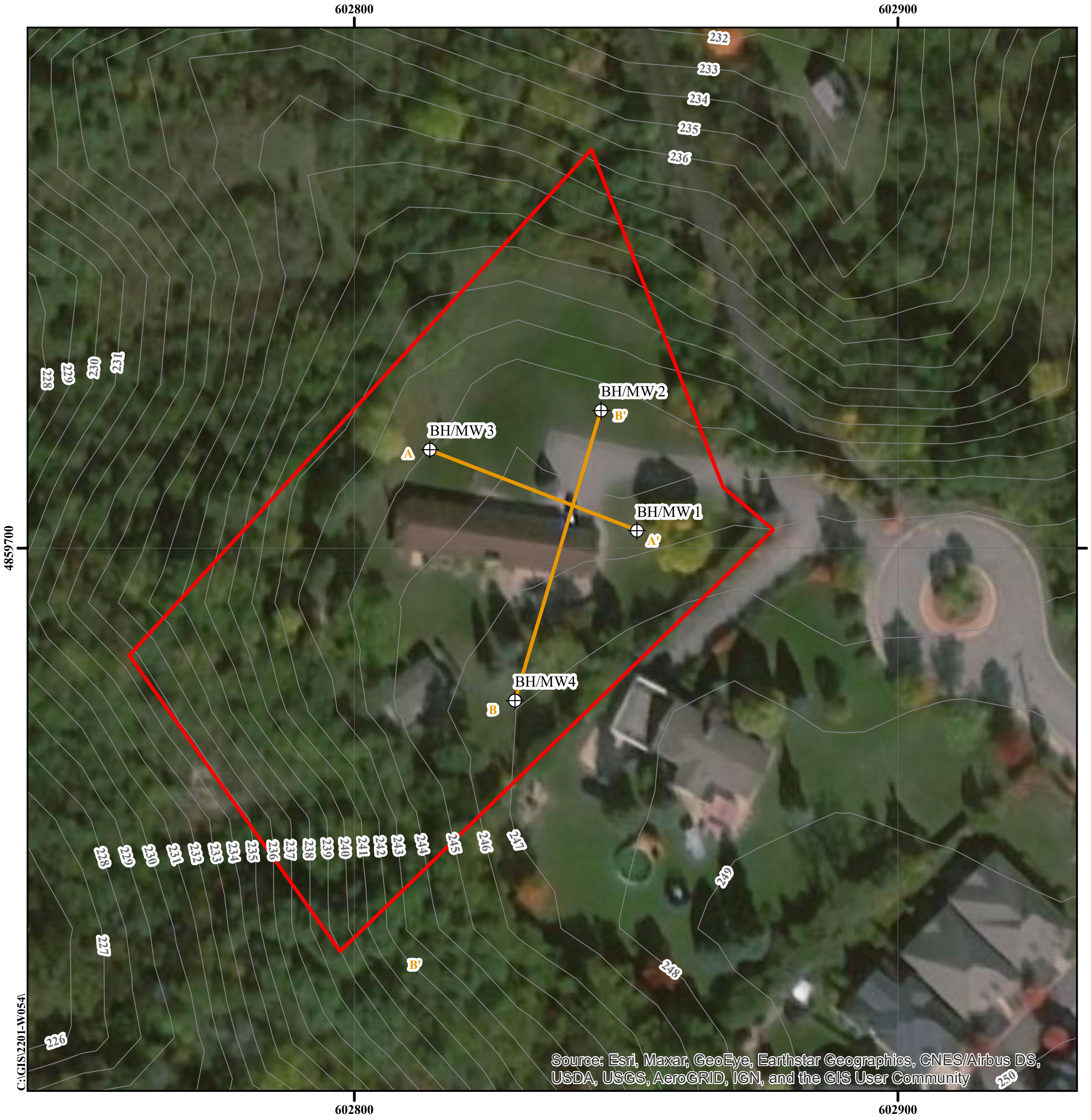


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

Legend

🟥 Approximate Boundary of Subject Site

⊕ Borehole with Monitoring Well

A — A' Cross-Section Direction

—100— Topographic Contour (masl)

Soil Engineers Ltd.

Title: Cross-Section Key Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

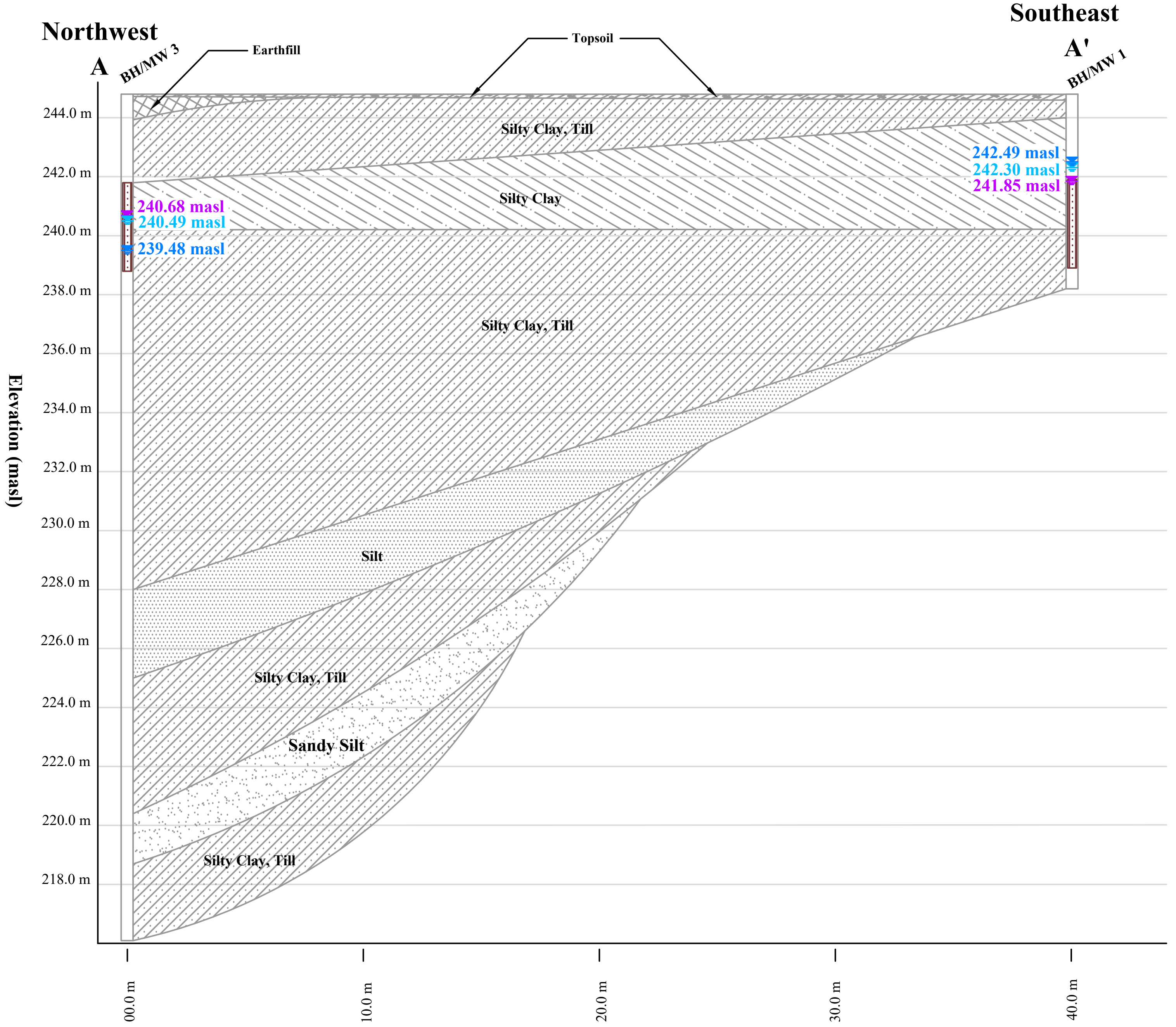
Reference No. 2201-W054

Date: April 7, 2022

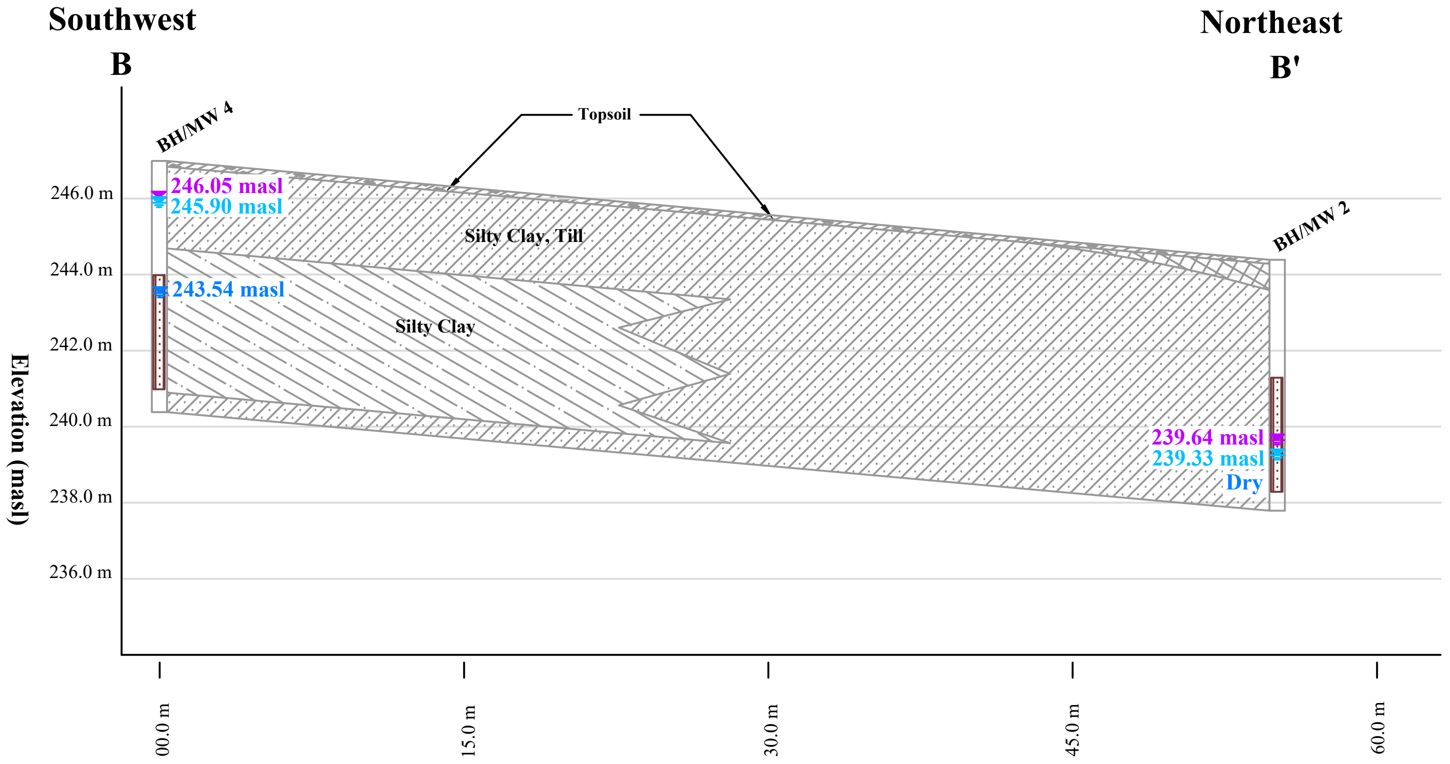
Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 8-1

Source: Ontario Ministry of Natural Resources and Forestry



Section A-A'



Section B-B'

▨	Topsoil	░	Silt
▩	Earth, Fill	▧	Silty Clay
		▨	Silty Clay, Till

▯ 3.0 m Screen

▼ Water Table on March 17, 2022

▼ Water Table on April 26, 2022

▼ Water Table on May 19, 2022

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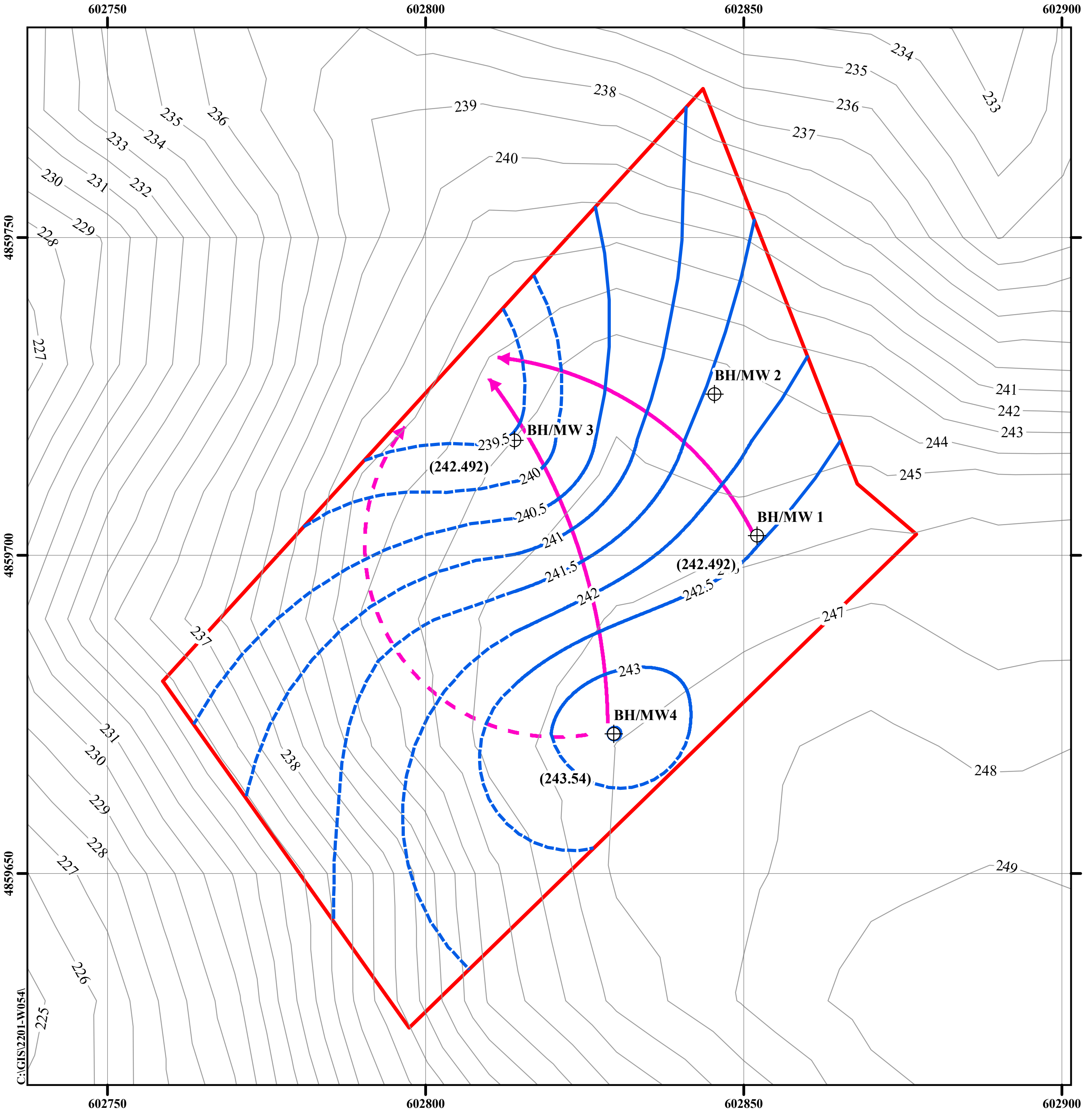
CONSULTING SOIL, FOUNDATION & ENVIRONMENTAL ENGINEERS

Title: Geological Cross-Section (A-A' and B-B')

Project: Hydrogeological Assessment
Proposed Residential Development
13290 Nunnville Road, Town of Caledon (Bolton), Ontario

Reference No:	Date:	Scale: V	Scale: H	Drawing No.
2201-W054	March, 2023	1:100	1:2500	8-2



N

Legend

🟥	Approximate Boundary of Subject Site
⌖	Borehole with Monitoring Well
→	Interpreted Shallow Groundwater Flow Direction
- - →	Inferred Shallow Groundwater Flow Direction
—	Interpreted Shallow Groundwater Level Elevation (masl)
- - -	Inferred Shallow Groundwater Level Elevation (masl)
—	Road
(232.04)	Average Shallow Groundwater Level Elevation (masl)

Soil Engineers Ltd.

Title: Shallow Groundwater
Flow Pattern Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

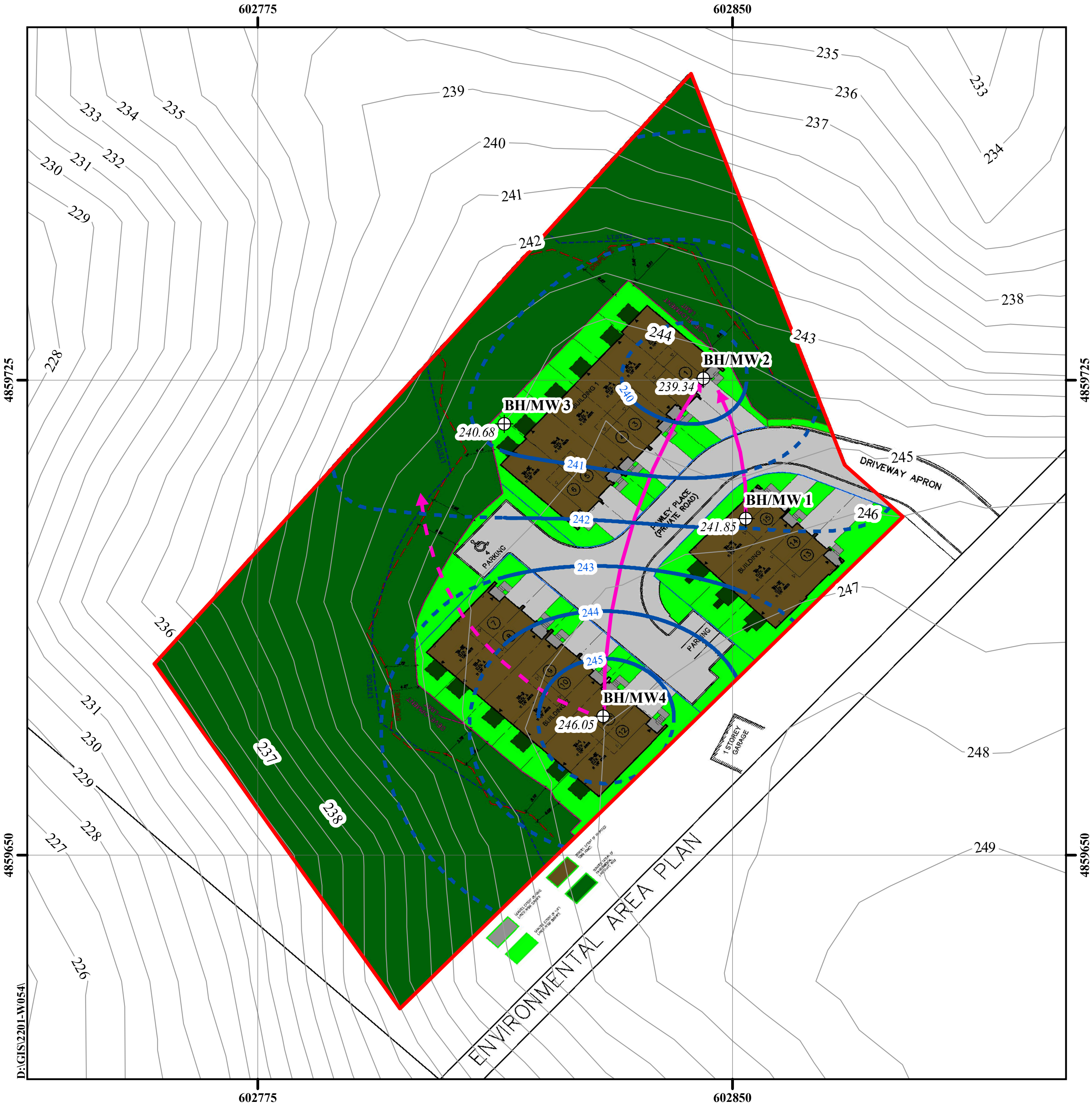
Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 4.25 8.5 17 25.5 34 42.5
Metres

Drawing No. 9

Source: Ontario Ministry of Natural Resources and Forestry



N

Legend

- □ Approximate Boundary of Subject Site
- ⊕ Borehole with Monitoring Well
- → Interpreted Shallow Groundwater Flow Direction
- ⇢ Inferred Shallow Groundwater Flow Direction
- ― Interpreted Shallow Groundwater Level Elevation (masl)
- - - Inferred Shallow Groundwater Level Elevation (masl)
- (246.05) Highest Shallow Groundwater Level Elevation (masl)

Soil Engineers Ltd.

Title: Shallow Groundwater Flow Pattern Plan

Project:

Hydrogeological Assessment
Proposed Development
Address: 13290 Nunnville Road,
Town of Caledon (Bolton)

Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 4.25 8.5 17 25.5 34 42.5
Metres

Drawing No. 9-1

Source: Ontario Ministry of Natural Resources and Forestry
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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

APPENDIX ‘A’

MECP WATER WELL RECORDS SUMMARY

REFERENCE NO. 2201-W054

Ontario Water Well Records

WELL ID	MECP WWR ID	Construction Method	Well Depth (m)	Well Usage		Water Found (m)	Static Water Level (m)	Top of Screen Depth (m)	Bottom of Screen Depth (m)
				Final Status	First Use				
1	4900374	Cable Tool	87.80	Water Supply	Domestic	85.04	38.40	86.56	87.78
2	4900375	Boring	8.50	Test Hole	Not Used	7.32	5.80	-	-
3	4900376	Boring	7.90	Test Hole	Not Used	7.01	5.50	-	-
4	4900378	Cable Tool	41.50	Unfinished	Not Used	40.84	18.30	39.62	40.84
5	4900381	Boring	13.40	Water Supply	Domestic	13.41	9.10	-	-
6	4900441	Cable Tool	99.10	Water Supply	Domestic	70.71	21.90	97.84	99.06
7	4900443	Cable Tool	48.80	Abandoned-Supply	-	-	-	-	-
8	4900444	Cable Tool	79.20	Water Supply	Domestic	76.81	36.60	78.03	79.25
9	4900445	Cable Tool	56.40	Water Supply	Domestic	53.95	41.10	55.17	56.39
10	4903559	Cable Tool	86.30	Water Supply	Domestic	84.74	36.60	84.74	85.95
11	4902957	Boring	16.80	Water Supply	Domestic	12.80	4.30	-	-
12	4903180	Boring	9.10	Water Supply	Domestic	7.92	3.70	-	-
13	4903447	Boring	4.00	Water Supply	Domestic	3.96	2.40	-	-
14	4903461	Boring	22.90	Water Supply	Domestic	16.76	12.20	-	-
15	4903547	Boring	15.20	Abandoned-Supply	-	-	-	-	-
16	4903685	Cable Tool	91.40	Water Supply	Domestic	89.92	41.10	90.22	91.44
17	4903814	Cable Tool	99.70	Water Supply	Domestic	98.76	38.70	98.45	99.67
18	4903898	Boring	6.70	Water Supply	Domestic	6.71	3.00	-	-
19	4904206	Boring	8.50	Water Supply	Domestic	8.53	3.00	-	-
20	4904237	Cable Tool	102.40	Water Supply	Domestic	94.79	40.50	94.79	95.71
21	4904422	Cable Tool	73.80	Unfinished	Domestic	60.66	-	-	-
22	4904452	Rotary (Convent.)	33.50	Water Supply	Domestic	13.72	5.50	32.61	33.53
23	4904675	Cable Tool	96.00	Water Supply	Domestic	74.68	39.00	91.14	92.05
24	4905208	Rotary (Convent.)	101.80	Water Supply	Domestic	61.57	41.10	100.59	101.80
25	4905242	Boring	5.50	Water Supply	Domestic	1.52	1.50	-	-
26	4905773	Rotary (Convent.)	93.60	Water Supply	Domestic	91.44	39.00	90.53	91.44
27	4907985	Cable Tool	64.00	Water Supply	Domestic	62.18	31.10	62.48	64.01

Ontario Water Well Records

WELL ID	MECP WWR ID	Construction Method	Well Depth (m)	Well Usage		Water Found (m)	Static Water Level (m)	Top of Screen Depth (m)	Bottom of Screen Depth (m)
				Final Status	First Use				
28	4907987	Cable Tool	49.40	Water Supply	Domestic	46.33	8.20	47.24	49.07
29	4908077	Rotary (Convent.)	41.50	Water Supply	Domestic	41.45	7.00	39.62	41.45
30	4908651	Cable Tool	41.50	Water Supply	Domestic	38.71	14.90	39.32	40.84
31	4909057	Cable Tool	42.40	Water Supply	Domestic	38.71	-0.30	40.54	42.06
32	6927633	Other Method	-	Abandoned-Supply	Not Used	-	-	-	-
33	7140937	-	-	Abandoned-Other	Not Used	-	-	-	-
34	7223334	Boring	-	Water Supply	-	-	20.70	-	-
35	7336660	Rotary (Convent.)	6.10	Observation Wells	Monitoring	-	-	3.05	6.10
36	7336661	Rotary (Convent.)	6.10	Observation Wells	Monitoring	-	-	3.05	6.10
37	7336662	-	6.10	-	Monitoring	-	-	3.05	6.10
38	7336663	Rotary (Convent.)	27.40	Observation Wells	Monitoring	-	-	24.38	27.43
39	7339282	-	-	Abandoned-Other	-	3.10	-	-	-

*MECP WWID: Ministry of the Environment, Conservation and Parks Water Well Records Identification

**metres below ground surface

Final Status	
-	1
Abandoned-Other	2
Abandoned-Supply	3
Observation Wells	3
Test Hole	2
Unfinished	2
Water Supply	26
Total	39

First Use	
-	4
Domestic	26
Monitoring	4
Not Used	5
Total	39

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APPENDIX ‘B’

SINGLE WELL RESPONSE TEST RESULTS

REFERENCE NO. 2101-W054

Falling Head Test (Slug Test)

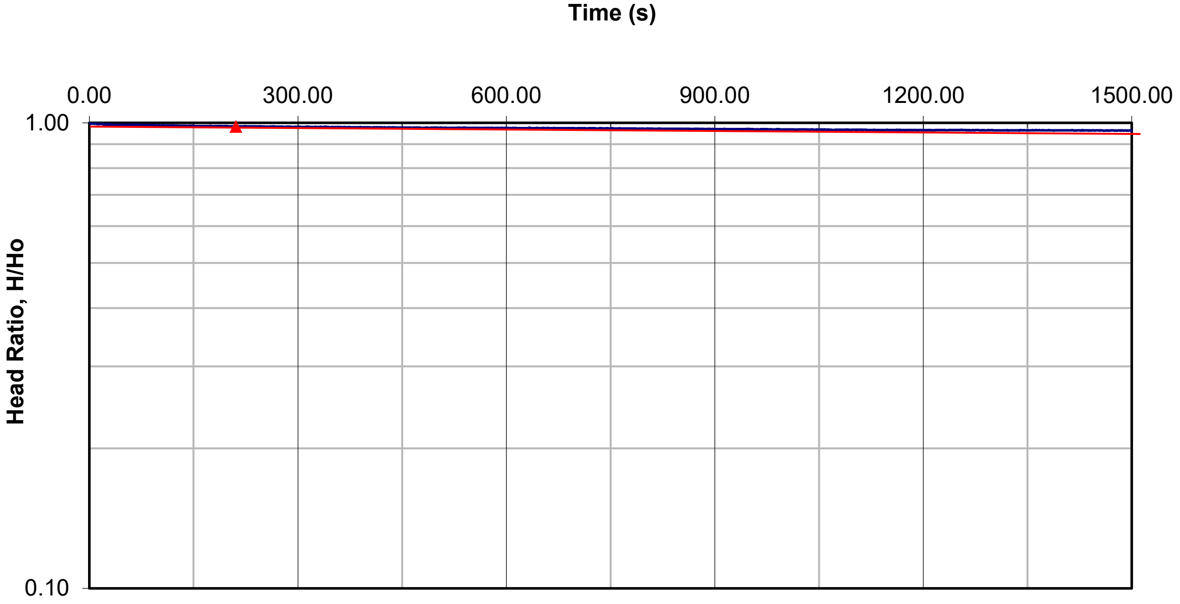
Test Date:		26-Apr-22	
Piezometer/Well No.:		BH/MW 1	
Ground level:		244.83	m
Screen top level:		241.93	m
Screen bottom level:		238.93	m
Test El. (at midpoint of screen):		240.43	m
Test depth (at midpoint of screen):		4.4	m
Screen length	L=	3.0	m
Diameter of undisturbed portion c	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.3449	m
Initial water depth		2.98	m
Aquifer material:		**Silty Clay and Silty Clay Till**	

Shape factor F=
$$\frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815 \text{ m}$$

Permeability K=
$$\frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$$
(Bouwer and Rice Method)

$$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.0001259$$

K= **4.3E-06** cm/s
4.3E-08 m/s



Falling Head Test (Slug Test)

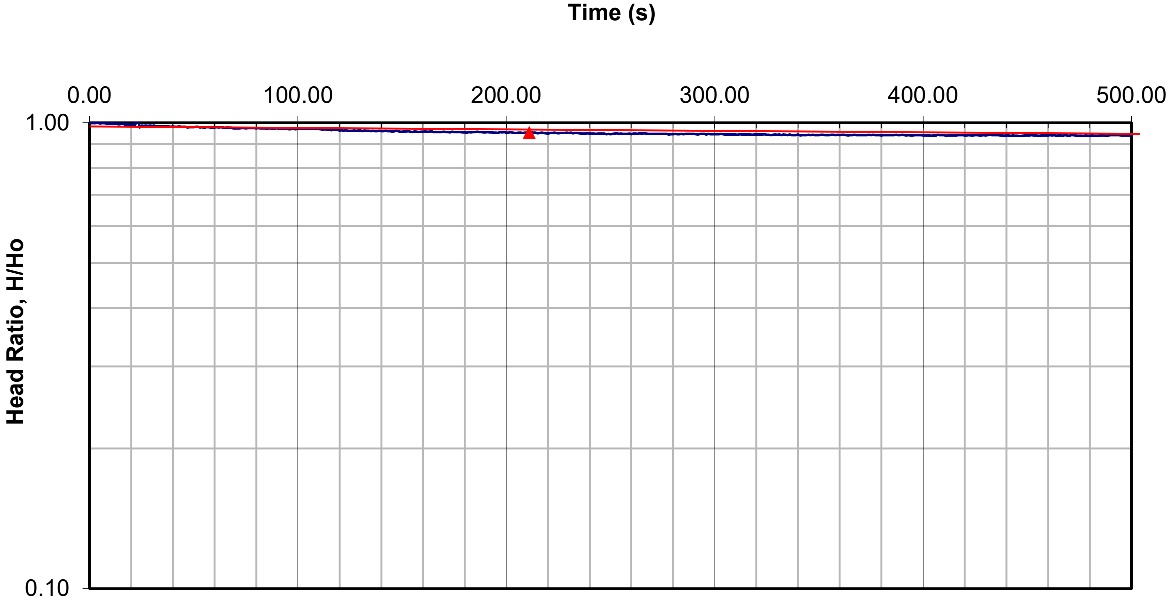
Test Date:		26-Apr-22	
Piezometer/Well No.:		BH/MW 3	
Ground level:		244.75	m
Screen top level:		241.75	m
Screen bottom level:		238.75	m
Test El. (at midpoint of screen):		240.25	m
Test depth (at midpoint of screen):		4.5	m
Screen length	L=	3.0	m
Diameter of undisturbed portion c	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.1766	m
Initial water depth		4.07	m
Aquifer material:		**Silty Clay and Silty Clay Till**	

Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 5.701815 m

Permeability K= $\frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000333$$

K= **1.1E-05** cm/s
1.1E-07 m/s



Falling Head Test (Slug Test)

Test Date:		26-Apr-22	
Piezometer/Well No.:		BH/MW 4	
Ground level:		247.00	m
Screen top level:		244.00	m
Screen bottom level:		241.00	m
Test El. (at midpoint of screen):		242.50	m
Test depth (at midpoint of screen):		4.5	m
Screen length	L=	3.0	m
Diameter of undisturbed portion c	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.5453	m
Initial water depth		0.95	m
Aquifer material:		**Silty Clay and Silty Clay Till**	

Shape factor F=
$$\frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815 \text{ m}$$

Permeability K=
$$\frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$$ (Bouwer and Rice Method)

$$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00010468$$

K= **3.6E-06** cm/s
3.6E-08 m/s