Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
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April 25, 2022 Reference No. 2201-W054

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

Attention: Mr. Sam Morra

Re: Preliminary Hydrogeological Assessment
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 are preliminary, as groundwater monitoring for the assessment is ongoing. A revised finalized hydrogeological report will be provided when monitoring and field work are completed.

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 and a driveway to access the developed site, along with full municipal services meeting current urban standards.

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 1-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.

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. 3 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. 4.

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 9.0 m. Drawing No. 5 shows the mapped topographical contours for the subject site and for the surrounding area.

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 are provided on the enclosed draft 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 subsoil comprised of silty clay till, silt, and silty clay extends 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 Nos. 5 and 6.

Groundwater Monitoring

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

Table 2 - Water Level Measurements

Well ID		March 17, 2022
BH/MW 1	mbgs	2.34
	masl	242.49
BH/MW 2	mbgs	>6.1
	masl	<238.30
BH/MW 3	mbgs	5.27
	masl	239.48
BH/MW 4	mbgs	3.46
	masl	243.54

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 ranged from between 243.54 masl to below 238.30 masl (i.e., at the depths of 2.34 to >6.1 mbgl). The preliminary 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. The interpreted shallow groundwater flow pattern for the subject site is illustrated on Drawing No. 7.

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 3 - 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 development plans, prepared by WSP, dated April 12, 2022, 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 mbgs which was considered for the dewatering needs assessment for the development.

Townhouse Block with 6 Units Nos.1-6, at a Grade Elevation of approximately 244.58 masl:

For the proposed town-housing block with 6 Units Nos. 1 -6, the grading plan elevation was estimated at 244.58 masl, with an assumed excavation depth of up to 3.0 m for the proposed basement foundation footings. An estimated depth elevation for excavation for the construction of the building was considered at 241.58 masl. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 240.58 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 239.48 masl as recorded at the BH/MW 3 location is about 2.10 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.

Townhouse Block with 6 Units, Nos. 7-12, at a Grade Elevation of approximately 247.0 masl:

For the proposed Townhouse block with 6 Units Nos. 7-12, an estimated grading plan elevation of 247.0 masl was considered, with an assumed excavation depth of 3.0 m for the proposed basement foundation footings. The estimated depth elevation for the excavation for the construction of the townhouse building was estimated at 244.0 masl. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 243.0 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 shallow groundwater level elevation of 243.54 masl, as recorded at the BH/MW 4 location is about 0.46 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.

Townhouse Block with 3 Units, Nos. 13-15, at a Grade Elevation of approximately 244.83 masl:

For the proposed Townhouse block with 3 Units, Nos. 13-15, an estimated grading plan elevation of 244.830 masl was considered, with an assumed excavation depth of 3.0 m for the proposed basement foundation footings. The estimated depth elevation for the excavation for the construction of the building and basement structure was estimated at 241.83 masl. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 240.83 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 0.66 m above the lowest proposed excavation depth elevation. As such temporary limited groundwater control is required for earthworks and construction.

Conclusions

1. The preliminary, measured groundwater level elevations ranged from between 261.32 masl and 263.71 masl (i.e., 0.96 to 3.83 mbgl). The preliminary shallow groundwater flow patterns suggests that it flows away from a localized higher

groundwater table area, located, approximately beneath the southern portion of the site, where it flows mainly in a northerly direction.

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. 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.
4. The basement structures for the proposed residential buildings, with the exception of those constructed within the northern portion of the site, are anticipated to be below the shallow groundwater elevations, where it is anticipated that permanent limited foundation drainage will be required after construction for the majority of the proposed town-house basement structures. 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.
5. 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.
6. Groundwater monitoring at the subject site is ongoing. The report will be updated to reflect additional groundwater level measurement at the site, along with an updated discussion for the dewatering needs assessment.

Yours very truly,
SOIL ENGINEERS LTD.

Angella Graham, M.Sc.

GR O'Brien

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

PROFESSIONAL GEOSCIENTIST
GAVIN R. O'BRIEN
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1267
ONTARIO
April 25, 2022

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
Watershed and Subwatershed Map	Drawing No. 3
Area of Natural Features and Protection Area Plan	Drawing No. 4
Topographic Map	Drawing No. 5
Borehole and Monitoring Well Location Plan	Drawing No. 6
Shallow Groundwater Flow Pattern Plan	Drawing No. 7

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

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
244.8	Ground Surface							
0.0	**10 cm TOPSOIL**				0			
	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	1		21	
		3	DO	25			21	
		4	DO	27	2		21	
		5	DO	23	3		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	6	DO	19	4		24	
	brown / grey	7	DO	38	5		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				6			Dry on completion
					7			
					8			
					9			
					10			

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
244.4	Ground Surface							
0.0	**10 cm TOPSOIL**				0			
	Brown **EARTH FILL (Silty Clay)** traces of sand and gravel with organic inclusions	1	DO	5			68	
243.6 / 0.8	Brown, stiff to hard — weathered	2	AS	12	1		34	
	SILTY CLAY TILL a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	3	DO	25	2		23	
		4	DO	26			22	
		5	DO	29	3		16	
		6	DO	47	4		16	
		7	DO	30	5		17	
237.8 / 6.6	**END OF BOREHOLE**				6			
	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				7			Dry on completion
					8			
					9			
					10			

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
244.8	Ground Surface							
0.0	Brown **8 cm TOPSOIL**	1	DO	8	0		27	
243.9	**EARTH FILL (Silty Clay)** traces of sand and gravel							
0.9	Brown, firm to very stiff	2	DO	13	1		23	
	SILTY CLAY TILL							
	a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	3	DO	18	2		22	
		4	DO	24			22	
241.8					3			
3.0	Brown, very stiff	5	DO	22			23	
	SILTY CLAY a trace of sand				4			
240.2								
4.6	Very stiff to hard	6	DO	27	5		21	
	SILTY CLAY TILL a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	7	DO	56	6		15	
	brown / grey	8	DO	41	7		14	
		9	DO	36	8		13	
234.8	*(Continued on next page)*				9			
					10			

W.L. not measured on completion due to use of water to aid with drilling

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
244.8	Ground Surface							
0.0	Brown **8 cm TOPSOIL**	1	DO	8	0		27	
243.9	**EARTH FILL (Silty Clay)** traces of sand and gravel							
0.9	Brown, firm to very stiff	2	DO	13	1		23	
	SILTY CLAY TILL							
	a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	3	DO	18	2		22	
		4	DO	24			22	
241.8					3			
3.0	Brown, very stiff	5	DO	22			23	
	SILTY CLAY a trace of sand				4			
240.2								
4.6	Very stiff to hard	6	DO	27	5		21	
	SILTY CLAY TILL a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	7	DO	56	6		15	
	brown / grey	8	DO	41	7		14	
		9	DO	36	8		13	
234.8	*(Continued on next page)*				9			
					10			

W.L. not measured on completion due to use of water to aid with drilling

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
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	10 11		15	
	— — grey brown	11	DO	48	12		17	
	— — brown grey	12	DO	36	13 14		13	
		13	DO	32	15		14	
228.0 16.8	Very dense — — grey brown **SILT** traces of clay and sand	14	DO	78	16 17		16	
		15	DO	50/15	18		17	
225.0 224.8	Grey, hard **SILTY CLAY TILL** sand layers	16	DO	50/15	19 20		13	

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
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	20 21 22		13	
	sand layers	18	DO	62	23 24		14	
220.4 24.4	Grey, very dense **SANDY SILT** a trace of clay	19	DO	69	25		18	
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	26 27		14	
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	21	DO	50/15	28 29 30		20	

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	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
247.0	Ground Surface							
0.0	**15 cm TOPSOIL**				0			
	Brown, firm to very stiff	1	DO	6			27	
	SILTY CLAY TILL							
	weathered							
	a trace to some sand a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	16	1		20	
		3	DO	27	2		22	
244.7								
2.3	Stiff to very stiff	4	DO	25			27	
	SILTY CLAY							
	a trace of sand	5	DO	27	3		20	
	brown / grey	6	DO	16	4 5		23	
240.9					6			
6.1	Grey, very stiff	7	DO	25			18	
	SILTY CLAY TILL							
240.4	traces of sand and gravel occ. sand seams and layers, cobbles and boulders				7			
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				8 9 10			Dry on completion

Soil Engineers Ltd.

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GRAIN SIZE DISTRIBUTION

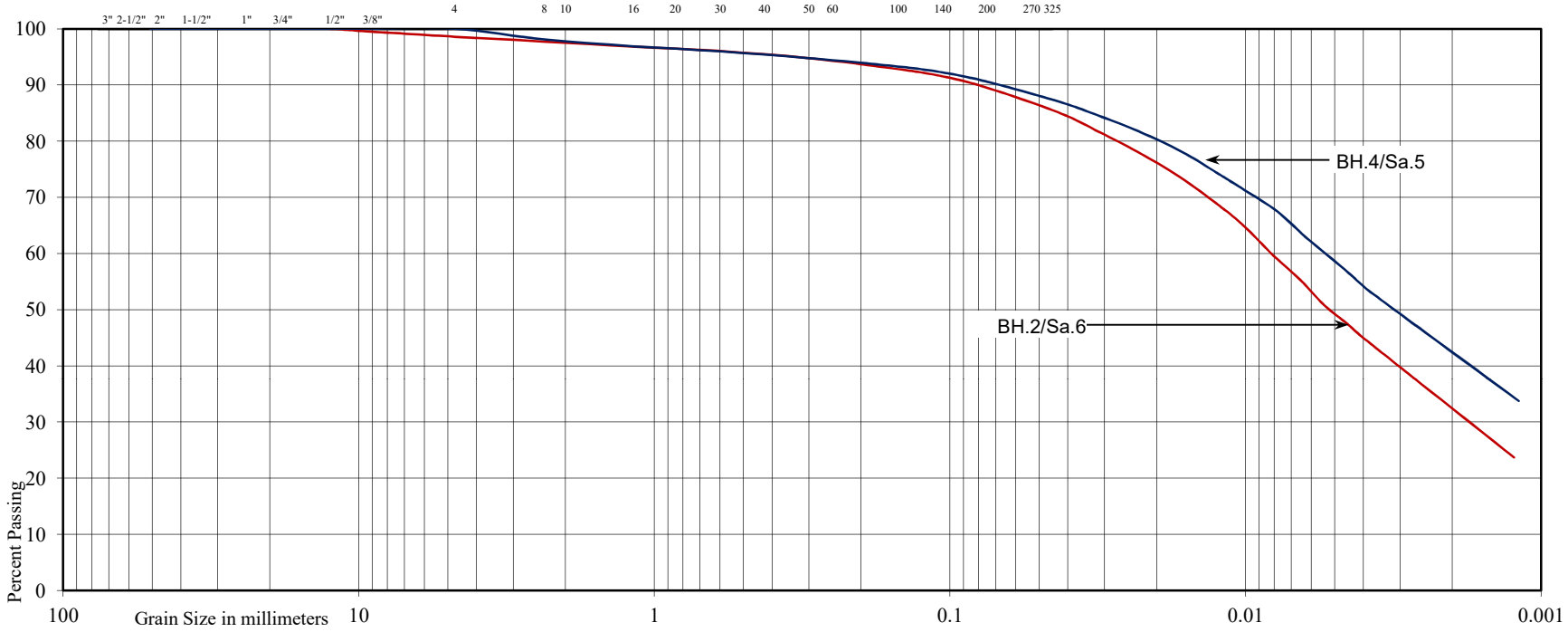
Reference No: 2201-W054

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL			SAND				SILT	CLAY
COARSE		FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



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

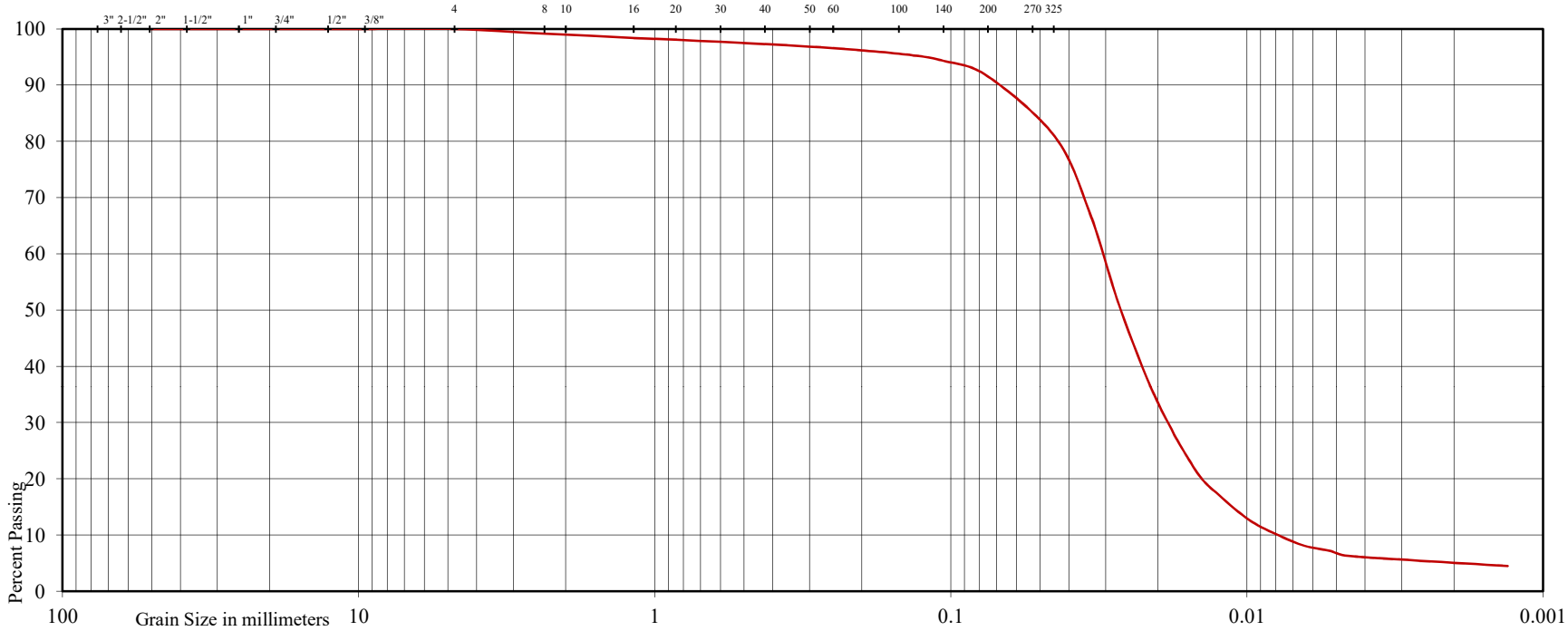
Reference No: 2201-W054

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Residential Development

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

Borehole No: 3

Sample No: 15

Depth (m): 18.5

Elevation (m): 226.3

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

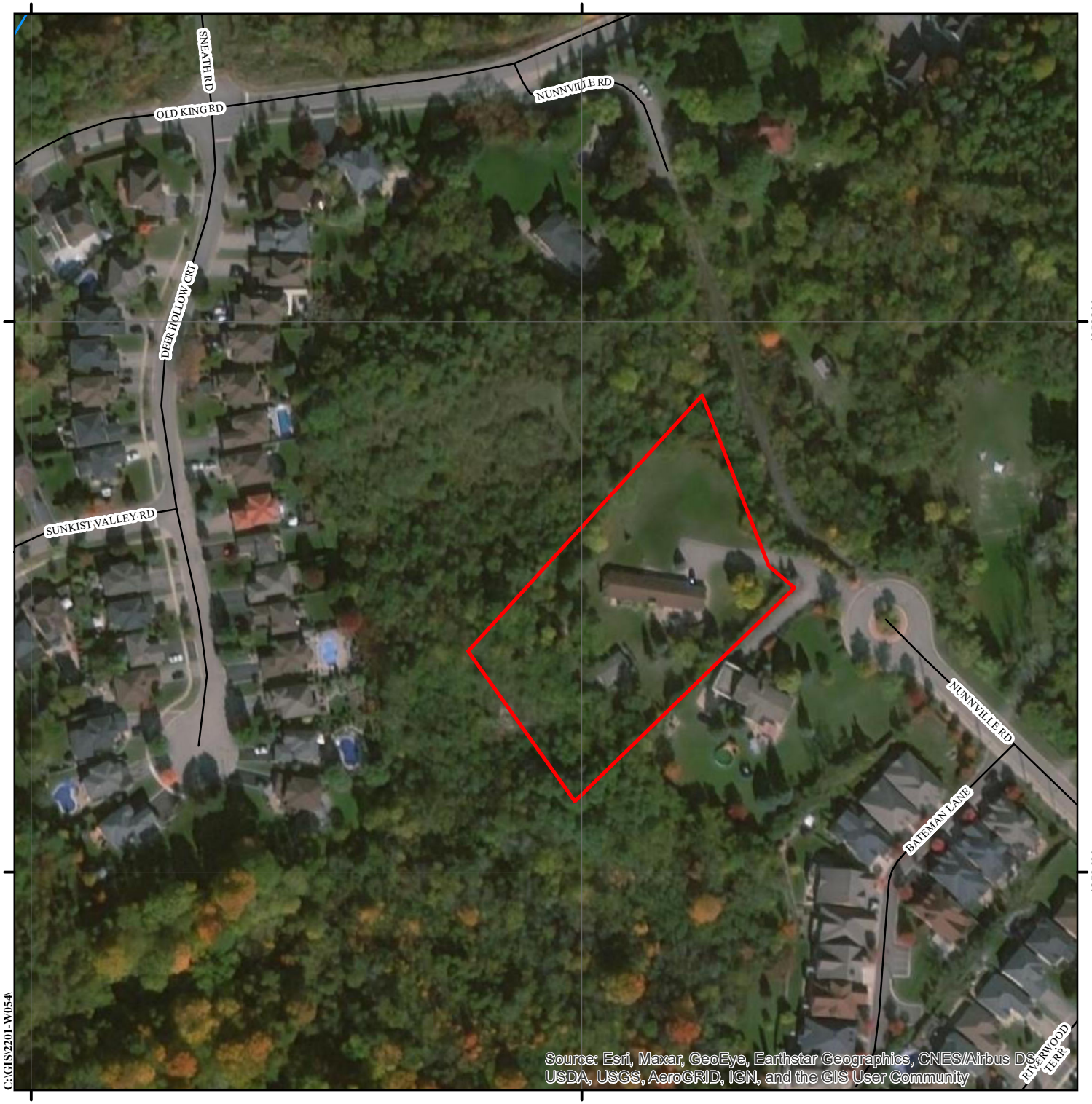
Moisture Content (%) = 17

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

Classification of Sample [& Group Symbol]: SILT

traces of clay and sand

Figure: 9



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

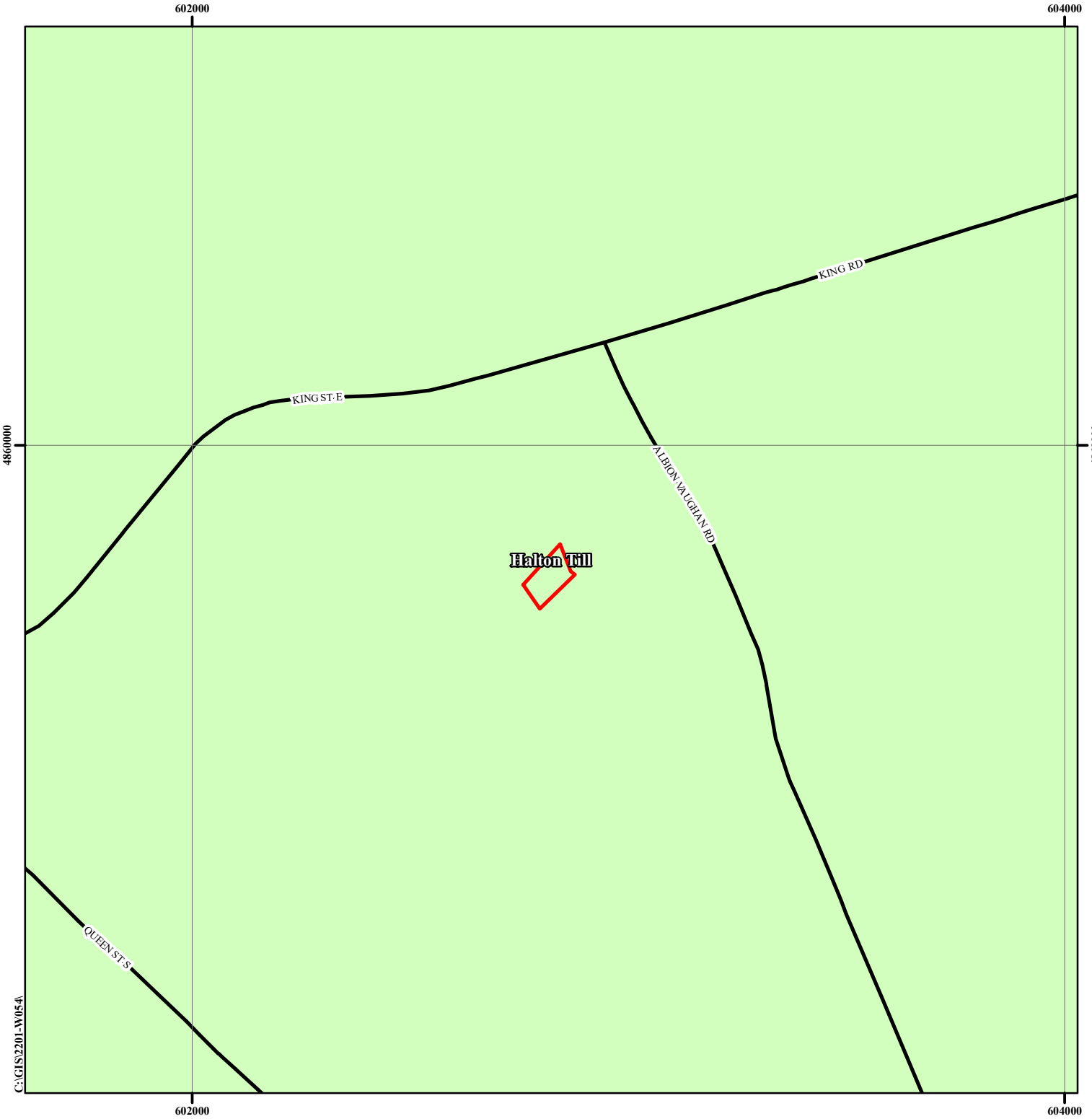
Date: April 7, 2022

Scale:

0 5 10 20 30 40 50

Metres

Drawing No. 1



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)

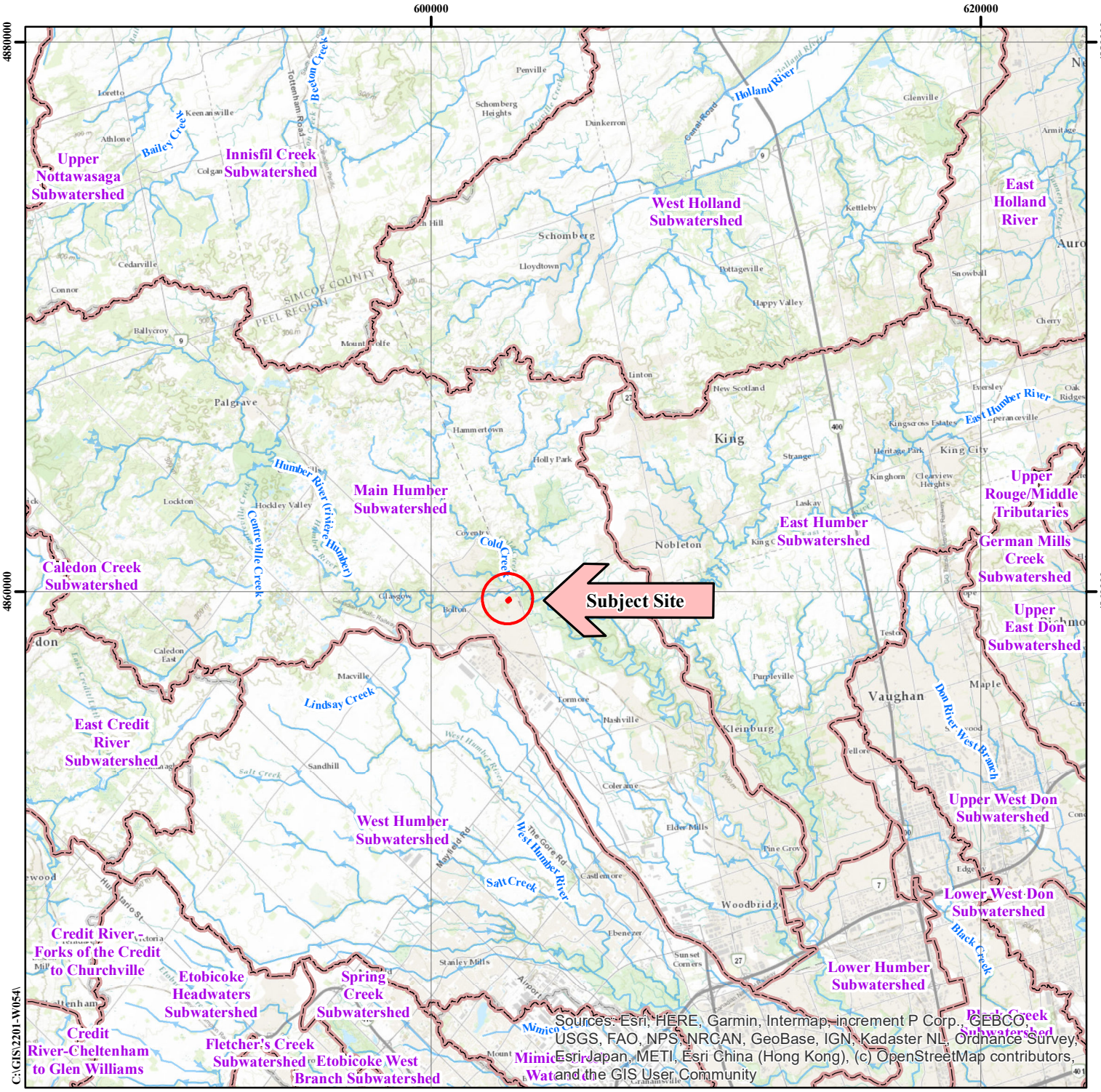
Reference No. 2201-W054

Date: April 7, 2022

Scale:
0 80 160 240 320 400
Metres

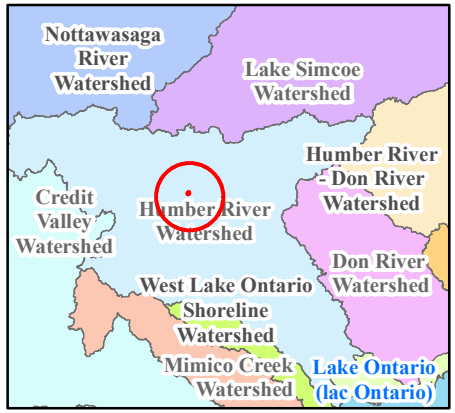
Drawing No. 2

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



N

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:

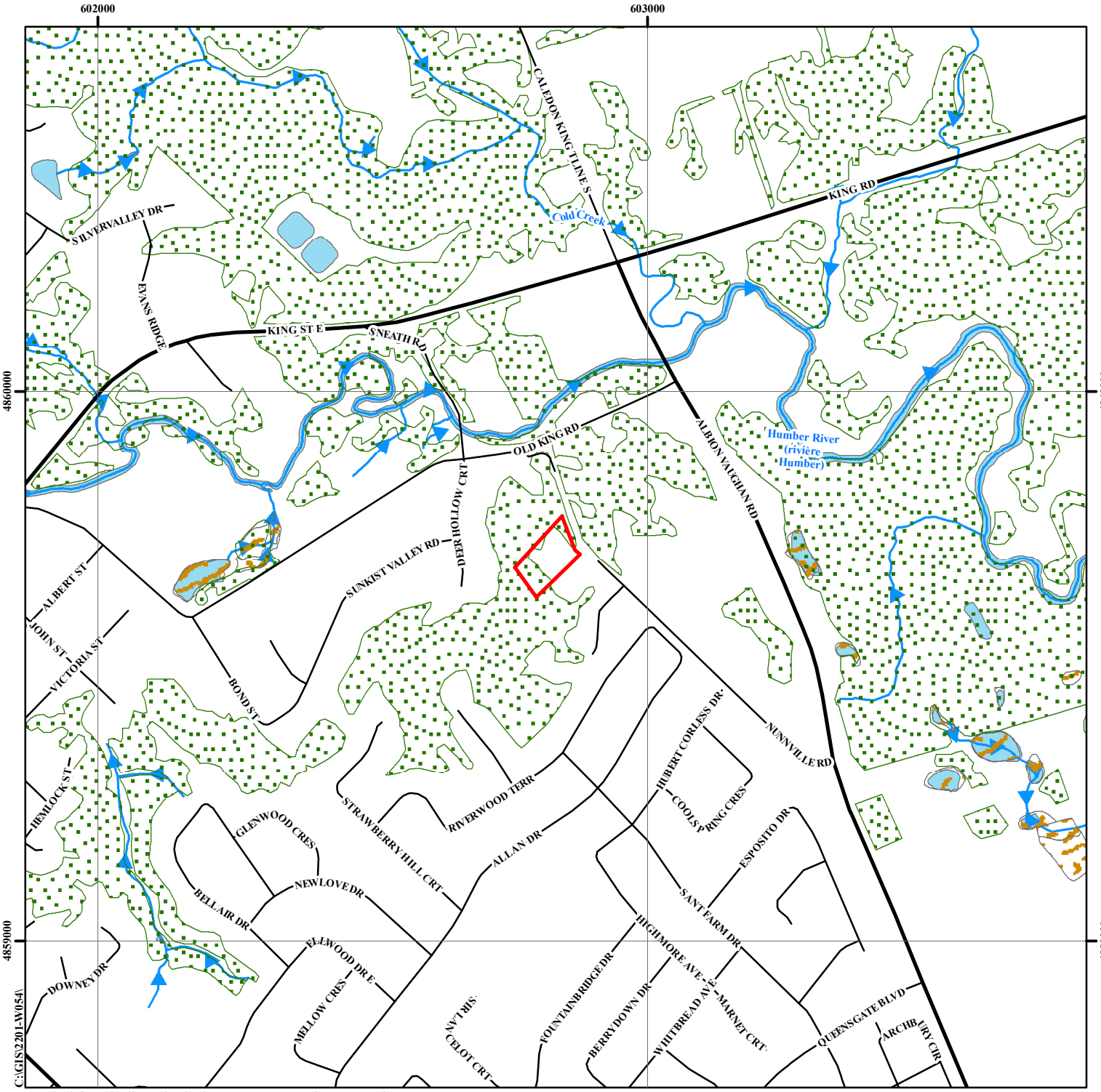
0 2,200 4,400 6,600 8,800 11,000

Metres

Drawing No. 3

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

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:

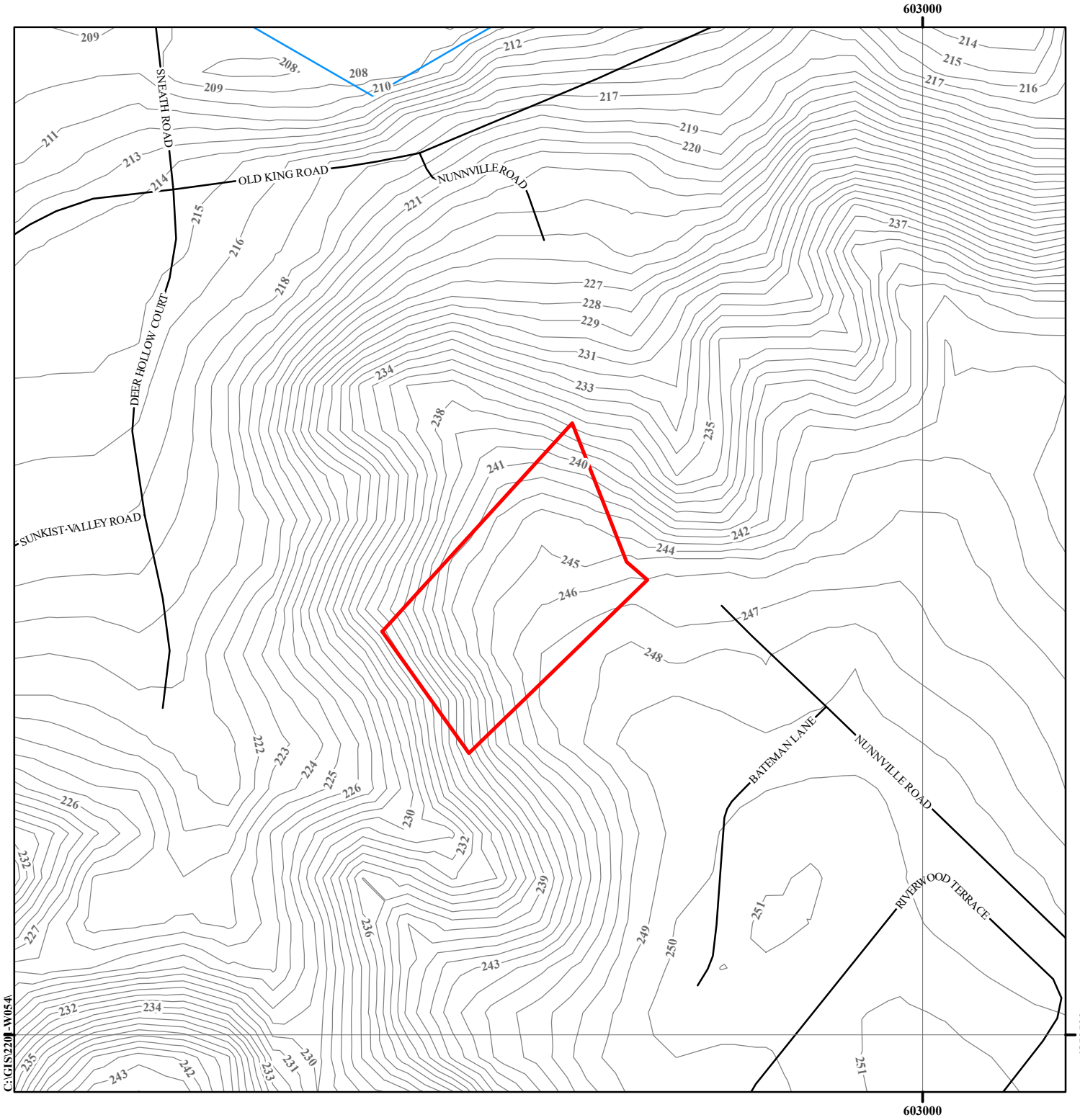
0 60 120 180 240 300

Metres

Draw ing No.4

Source: Ontario Ministry of Natural Resources and Forestry

OWES: Ontario Wetland Evaluation System



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. 5

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)

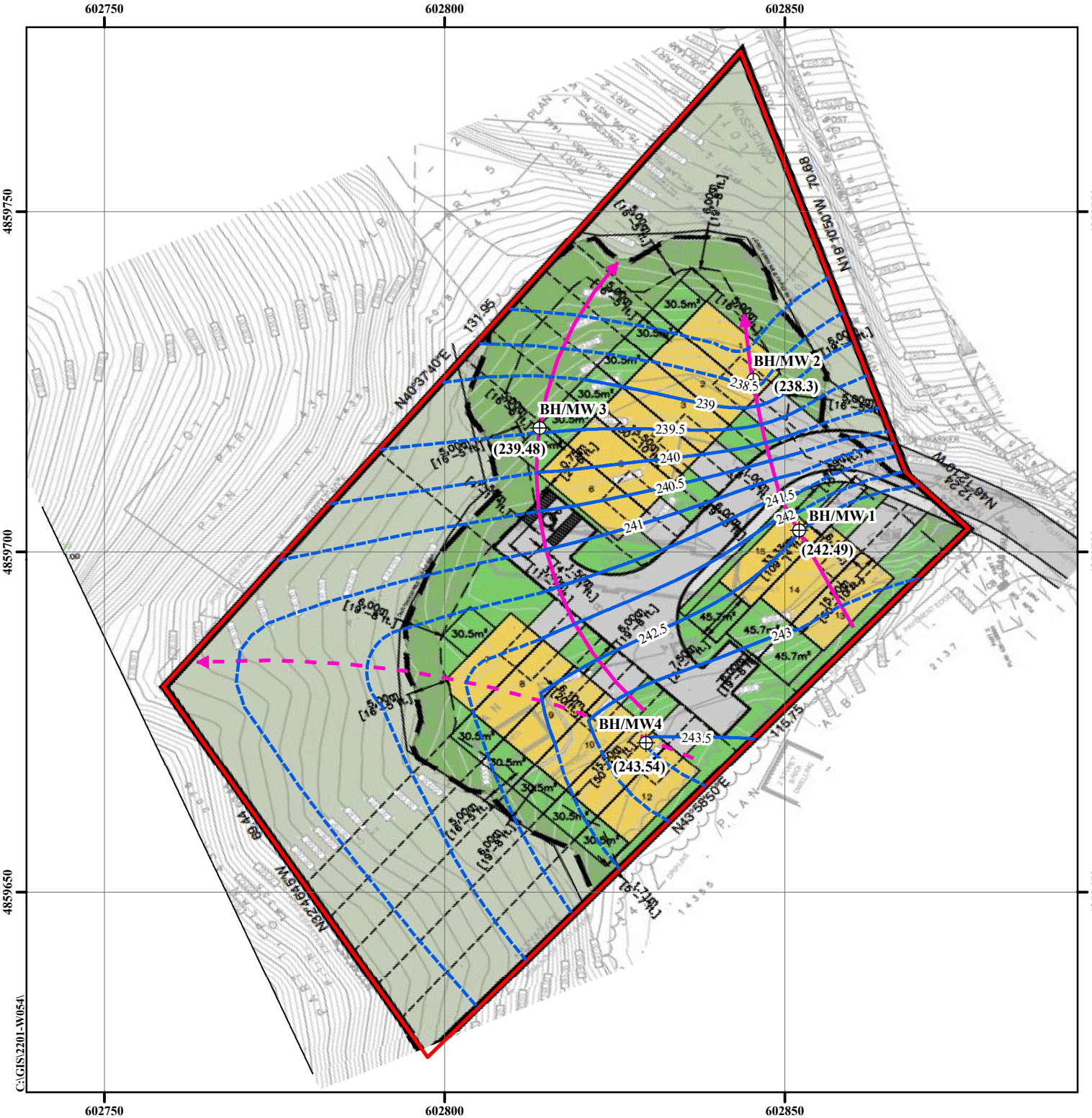
Reference No. 2201-W054

Date: April 7, 2022

Scale:

0 4 8 16 24 32 40
Metres

Drawing No. 6



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)
- (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 8 16 24 32 40
Metres

Drawing No. 7