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A REPORT TO
BOLTON SUMMIT DEVELOPMENTS INC.

A GEOTECHNICAL INVESTIGATION AND SLOPE STABILITY ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT

13290 NUNNVILLE ROAD
TOWN OF CALEDON (BOLTON)

REFERENCE NO. 2201-S054

APRIL 2022
(REVISION OF REPORT DATED MARCH 2022)

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1.0 INTRODUCTION

In accordance with written authorization dated January 18, 2022 from Mr. Sam Morra of Bolton Summit Developments Inc., a geotechnical investigation was carried out at 13290 Nunnville Road, in the Town of Caledon.

The purpose of the investigation was to reveal the subsurface conditions and determine the engineering properties of the disclosed soils to facilitate a slope stability assessment at the site, and for the design and construction of a proposed residential development. The geotechnical findings and resulting slope stability assessment and recommendations are presented in this report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Caledon is situated on Peel-Halton till plain where the drift dominates the soil stratigraphy. In places, lacustrine sand, silt, clay and drift, which has been reworked by the water action of Peel Ponding (glacial lake), have modified the drift stratigraphy.

The subject property is irrectangular in shape, and is located at the north end of Nunnville Road, in the community of Bolton within the Town of Caledon. At the time of investigation, the site consisted of a 1-storey brick bungalow with a shed and gazebo within the rear yard, and an associated asphalt-paved driveway that is partially shared beyond the property boundary with the property to the south. The remainder of the site is grass-covered. The tableland at the site, for the most part, is relatively flat, with a 2 to 3 m raise in grade towards the south boundary.

The north, east and west portions of the site descend towards Old King Road to the north, a walkway leading to Old King Road to the east and the neighbouring subdivision to the west, at an average gradient ranging from 2.9 to 6.8+ horizontal (H):1 vertical (V). The slope is approximately 22 to 24 m high, and is densely treed and weed-covered. Neighbouring properties are located at the bottom of slope, where the ground generally flattens out.

The existing house and other structures at the site will be demolished for development. The project, consisting of 15 townhouse units, will be provided with an access roadway and municipal services meeting urban standards.

3.0 FIELD WORK

The field work, consisting of 4 boreholes to depths of 6.6 m and 27.7 m, was performed between March 3 and 9, 2022, at the locations shown on the Borehole Location Plan, Drawing No. 1

The boreholes were advanced at intervals to the sampling depths by a track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms”, were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The relative density of the non-cohesive strata and the consistency of the cohesive strata are inferred from the ‘N’ values. Split-spoon samples were recovered for soil classification and laboratory testing. The field work was supervised and the findings were recorded by a Geotechnical Technician.

Upon completion of borehole drilling and sampling, monitoring wells were installed at the borehole locations to facilitate a hydrogeological assessment, presented under separate cover.

The ground elevation at each borehole location was obtained using a handheld Global Navigation Satellite System (Trimble Geoexplorer 6000 series).

4.0 SUBSURFACE CONDITIONS

The investigation has disclosed that beneath a veneer of topsoil, and a layer of earth fill in places, the site is underlain by a stratum of silty clay till, with deposits of silty clay at various locations and depths. Layers of silt and sandy silt were encountered within the lower zone of the deep borehole (Borehole 3).

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 4, inclusive; the revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2.

4.1 **Topsoil** (All Boreholes)

The revealed topsoil layer is approximately 8 to 15 cm thick at the boreholes. The topsoil is dark brown in colour, indicating appreciable amounts of roots and humus which are compressible under loads; it should be removed for site development. In order to prevent overstripping, diligent control of the stripping operation will be required.

The topsoil will generate an offensive odour and may produce volatile gases under anaerobic conditions. It can be reused for general landscaping purposes, but it must not be buried below any structures or deeper than 1.2 m below the exterior finished grade so it will not have an adverse impact on the environmental well-being of the developed area.

4.2 **Earth Fill** (Boreholes 2 and 3)

The earth fill at Boreholes 2 and 3 extend from below the topsoil layer to a depth of less than 1.0 m below the prevailing ground surface. The earth fill consists of silty clay with traces of sand and gravel, and organic inclusions.

The obtained 'N' values are 5 and 8 blows per 30 cm of penetration, indicating the fill was loosely placed.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the values are 27% and 68%, indicating that the earth fill is in a wet condition and contains organics.

Due to the unknown history of the earth fill and the presence of organics, the fill is unsuitable to support any structures in its current condition. In using the fill for structural backfill, or in pavement or slab-on-grade construction, it must be subexcavated, inspected, sorted free of any organics or other deleterious materials, aerated and properly compacted in thin lifts. If it is impractical to sort the deleterious materials from the fill, the fill must be properly disposed of off-site and replaced with properly compacted inorganic earth fill.

One must be aware that the samples retrieved from boreholes may not be truly representative of the geotechnical quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by test pits.

4.3 **Silty Clay Till** (All Boreholes) and **Silty Clay** (Boreholes 1, 3 and 4)

The silty clay till was encountered beneath the topsoil layer and/or earth fill at all boreholes; it extends to the maximum investigated depth of all the boreholes. The till consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its properties. The till is embedded with sand seams and layers, cobbles and boulders. In addition, silty clay layers were encountered interstratified with the till at Boreholes 1, 3 and 4 at shallow to moderate depths; it contains a trace of sand. Grain size analyses were performed on 1 representative sample each of the silty clay till and silty clay; the results are plotted on Figure 5.

The obtained 'N' values range from 6 to over 100, with a median of 27 blows per 30 cm of penetration, indicating that the consistency of the till and clay is firm to hard, being generally very stiff. The firm till is restricted to the sample directly beneath the surficial topsoil layer or fill; these soils have also been affected by the weathering process, of which the weathered soils are generally encountered within the top 0.8± to 1.0± m beneath the prevailing ground surface.

The Atterberg Limits of 1 representative sample of the silty clay and the water content of all the till and clay samples was determined. The results are plotted on the Borehole Logs and summarized below:

	Silty Clay Till	**Silty Clay**
Liquid Limit	-	42%
Plastic Limit	-	21%
Natural Water Content	13% to 34% (median 17%)	20% to 27% (median 23%)

The above results show that the silty clay has medium plasticity, and sample examinations show that the till has low plasticity. The natural water content of the samples generally lies close to the plastic limit, confirming the generally very stiff consistency as disclosed by the 'N' values. The high moisture content above 30% in the samples was encountered in the weathered till.

The engineering properties of the silty clay till and silty clay are given below:

- High frost susceptibility, and low water erodibility.
- The silty clay till has low soil-adfreezing potential, while the silty clay has high soil-adfreezing potential.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, an estimated percolation time of more than 80 min/cm, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- Their shear strength is derived from consistency and augmented by internal friction of the silt. The strength is moisture dependent and, to a lesser degree, dependent on the soil density.
- The soils will generally be stable in a relatively steep cut. However, prolonged exposure will allow infiltrating precipitation to saturate the weathered zone and the sand and silt seams and layers, leading to localized sloughing.

- Very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 2500 to 3500 ohm·cm.

4.4 Silt and Sandy Silt (Borehole 3)

The silts were contacted within the lower zone of the revealed stratigraphy at Borehole 3, embedded in the silty clay till. The deposits are very fine grained with a trace of clay. A grain size analysis was performed on 1 representative silt sample; the result is plotted on Figure 6.

The obtained 'N' values are 69, 78 and more than 100 blows per 30 cm of penetration, indicating the relative density of the silts is very dense.

The natural water content values were determined and the results are plotted on the Borehole Log; the values are 16%, 17% and 18%, indicating very moist to wet conditions. The silts are water bearing and displayed dilatancy when shaken by hand.

The engineering properties of the silts are given below:

- High frost susceptibility and high soil-adfreezing potential.
- High water erodibility; they are susceptible to migration through small openings under seepage pressure.
- Relatively pervious to relatively low permeability, with an estimated coefficient of permeability of 10^{-4} to 10^{-5} cm/sec, an estimated percolation time of 30 to 50 min/cm, and runoff coefficients of:

Slope	
0% - 2%	0.07 to 0.11
2% - 6%	0.12 to 0.16
6% +	0.18 to 0.23

- The shear strength is density dependent. Due to their dilatancy, the strength of the wet silt is susceptible to impact disturbance.

4.5 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	**Determined Natural Water Content (%)**	**Water Content (%) for Standard Proctor Compaction**	
		100% (optimum)	**Range for 95% or +**
Earth Fill	27 and 68	15	11 to 20
Silty Clay Till	13 to 34 (median 17)	15 to 17	11 to 22
Silty Clay	20 to 27 (median 23)	17 to 19	13 to 24
Silt/Sandy Silt	16, 17 and 18	12 to 13	8 to 17

The above values show that the in situ soils are generally suitable for a 95% or + Standard Proctor compaction. However, the earth fill and sandy silt, and portions of the till and silty clay, are too wet and will require aeration or mixing with drier soils prior to structural compaction. Aeration can be achieved by spreading the wet soil thinly on the ground in the dry and warm weather. In addition, the weathered soils may contain organic inclusions, and should be, along with the earth fill, sorted free of organic inclusions and any deleterious material prior to structural compaction.

The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

The presence of boulders in the till will prevent transmission of the compaction energy into the underlying material to be compacted. If an appreciable amount of boulders over 15 cm in size is mixed with the material, it must be sorted and must not be used for structural backfill and/or construction of engineered fill.

5.0 GROUNDWATER CONDITION

The boreholes were checked for the presence of groundwater and cave-in upon the completion of drilling. At Boreholes 1, 2 and 4, no groundwater was encountered and the boreholes remained dry and open upon their completion. At Borehole 3, no groundwater was recorded in the open borehole due to the use of water to aid with the drilling operation.

Upon completion of borehole drilling and sampling, groundwater monitoring wells were installed at all 4 borehole locations to facilitate a hydrogeological assessment, of which the assessment will be provided under a separate cover. The groundwater level readings to-date are summarized in Table 2.

Table 2 - Groundwater Levels in Monitoring Wells

Borehole No.	Ground Elevation (m)	Well Depth (m)	Measured Groundwater Level in Wells On March 17, 2022	
			Depth (m)	El. (m)
1	244.832	6.1	2.34	242.492
2	244.401	6.1	Dry	-
3	244.752	6.1	5.27	239.482
4	247.0	6.1	3.46	243.54

As shown above, groundwater was recorded in the monitoring wells at depths of 2.34 to 5.27 m below existing grade, or between El. 239.482 m and El. 243.54 m, in 3 of the wells, while the well at Borehole 2 remained dry. Further discussion on the groundwater conditions at the site should be confirmed through the hydrogeological assessment; the groundwater is subject to seasonal fluctuation.

In excavation, groundwater yield from the till and clay is expected to be slow in rate and limited in quantity, due to their low permeability. The yield, if encountered, from any silt deposit may be moderate to appreciable.

6.0 SLOPE STABILITY ASSESSMENT

A slope stability assessment was carried out to determine the stability of the existing slope, and to establish the Long-Term Stable Top of Slope (LTSTOS) for the proposed development. Visual inspection of the slope, carried out on March 17, 2022, revealed that the ground surface is densely treed and weed-covered with a thin leaf cover. In places, loose branches were observed to have been dumped at the top of slope.

The existing slope has an overall height of approximately 22 to 24 m, with an average slope gradient ranging from 2.9 to 6.8+H:1V, and local gradients ranging from 2.2 to 11.5H:1V.

Six (6) cross-sections, Cross-Sections A-A to F-F, inclusive, were selected as representative profile of the slope; the location of these cross-sections is shown on the Cross-Section and LTSTOS Location Plan, Drawing No. 3. The slope profiles at the cross-sections were interpreted from the provided topographic survey plan, prepared by R-PE Surveying Ltd. In addition, where the topographic information ends near the bottom of slope, flood plain mapping obtained from First Base Solutions Inc. was overlaid onto the survey to determine the existing grading near the bottom of slope. The subsurface profile at each cross-section was interpreted from the Borehole Logs. In addition, the groundwater measured in the installed wells has been incorporated into the analysis, and modelled as a phreatic surface at all cross-sections; it is assumed to taper to below the bottom of slope.

The slope stability at the cross-sections were analysed using the force-moment-equilibrium criteria of the Bishop Method with the soil strength parameters shown in Table 3.

Table 3 - Soil Strength Parameters

Soil Type	Unit Weight γ (kN/m^3)	Cohesion c (kPa)	Internal Friction Angle ϕ
Earth Fill	20.5	0	26°
Silty Clay Till	22.0	5	30°
Silty Clay	20.5	5	26°
Silt	21.0	0	30°
Sandy Silt	20.5	0	31°

The results of the analysis are presented on Drawing Nos. 4 to 9, inclusive, and the resulting minimum Factors of Safety (FOS) are summarized in Table 4.

Table 4 - Minimum Factors of Safety (FOS)

Cross-Section	FOS	Drawing No.
A-A (Existing Condition)	1.559	4
B-B (Existing Condition)	1.562	5
C-C (Existing Condition)	1.564	6
D-D (Existing Condition)	2.062	7
E-E (Existing Condition)	2.217	8
F-F (Existing Condition)	2.386	9

The results of the analyses at Cross-Sections A-A to F-F, inclusive, show that the minimum FOS is calculated to be between 1.559 and 2.386, which meets the Ontario Ministry of Natural Resources (MNR) guideline requirements for active land use (minimum FOS of

1.5); therefore, the slope is considered to be geotechnically stable, and the physical top of slope can be considered the stable top of slope.

Considering that the Humber River is more than 50 m away from the bottom of slope, and is located north of Old King Road, a toe erosion allowance is not required for this study.

The LTSTOS based on the slope stability analysis has been established on Drawing No. 3, and shows that the LTSTOS lies at the physical top of slope. Furthermore, a development setback for man-made and environmental degradation will be required from the LTSTOS. A typical 6 m development setback, in accordance with MNR guidelines, has been suggested for this development; however, this is subject to the requirements of the Toronto and Region Conservation Authority (TRCA).

In order to prevent disturbance of the existing slope, the following geotechnical constraints should be stipulated:

1. The prevailing vegetative cover on the slope must be maintained as its rooting system acts as reinforcement against soil erosion by weathering. If, for any reason, the vegetative cover is stripped, it must be reinstated to its original, or better than its original, protective condition. Restoration with selected native plantings including deep rooting systems must be carried out after development to ensure bank stability.
2. Any leafy topsoil cover on the slope face should not be disturbed, since this provides an insulation and screen against frost wedging and rainwash erosion, or the bare slope surface must be adequately sodded.
3. Grading of the land adjacent to the slope must be such that concentrated runoff is not allowed to drain onto the slope face. Landscaping features which may cause runoff to pond at the top of the slope, such as infiltration trenches, as well as saturating the crown of the bank, must not be permitted.
4. Where development is carried out adjacent to the slope, there are other factors to be considered related to possible human environmental abuse. These include soil saturation from frequent watering to maintain landscaping features, stripping of topsoil or vegetation, dumping of loose fill, and material storage close to the top of slope; none of these should be permitted.

The above recommendations are subject to the approval and requirements of the TRCA.

7.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a veneer of topsoil, and a layer of earth fill in places, the site is underlain by a stratum of silty clay till, with deposits of silty clay at various locations and depths; the clay and till are firm to hard in consistency, being generally very stiff. Layers of very dense silt and sandy silt were encountered within the lower zone of the deep borehole (Borehole 3). The till within the top 0.8± to 1.0± m from the existing grade has been weathered.

Groundwater was recorded at depths ranging from 2.34 to 5.27 m (or between El. 239.482 m and El. 243.54 m) on March 17, 2022 in wells installed at Boreholes 1, 3 and 4, while the well at Borehole 2 remained dry; the water levels will be confirmed through the hydrogeological study. The groundwater is expected to fluctuate with the seasons.

The site development will consist of 15 townhouse units, with an access roadway and municipal services meeting urban standards. The geotechnical findings which warrant special consideration are presented below:

1. Topsoil must be removed from the area of construction. It can be re-used for landscaping in designated areas only.
2. After demolition of the existing house and other on-site structures, the debris must be removed off-site. The cavities can be backfilled with engineered fill for project construction.
3. The existing earth fill must be removed or further assessed of its suitability as structural backfill, or for pavement or slab-on-grade construction.
4. The site can be re-graded with engineered fill for development. The weathered soils must be sub-excavated, sorted free of topsoil and organics for reuse.
5. If the site will be regraded with cut and fill, it will generally be more economical to place engineered fill for conventional footing, sewer and road construction.
6. The sound native soils are suitable for house construction on conventional footings. The footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that its condition is compatible with the design of the foundation.
7. A Class ‘B’ bedding, consisting of compacted 19-mm Crusher-Run Limestone, is recommended for the construction of underground services.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes.

Should subsurface variances become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

7.1 Site Preparation

The site can be re-graded with engineered fill for development. Prior to site grading, the topsoil must be removed and the existing buildings demolished. The building debris must be removed off-site. The cavities can be backfilled with selected earth fill and compacted to the engineered fill specifications.

The engineering requirements for a certifiable fill for pavement construction, municipal services and house foundation supports are presented below:

1. The topsoil must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement.
2. The existing earth fill and weathered soil must be subexcavated, sorted free of topsoil inclusions and other deleterious materials, if any, aerated and properly compacted.
3. Inorganic soils must be used for the engineered fill, and they must be uniformly compacted in lifts 20 cm thick to 98% or + of the maximum Standard Proctor Dry Density (SPDD) up to the proposed finished grade. The soil moisture must be properly controlled near the optimum.
4. If the house foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% SPDD.
5. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
6. If imported fill is to be used, it should be inorganic soils, free of any deleterious material with environmental issue (contamination). Any potential imported earth fill from off-site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
7. The engineered fill must not be placed during the period where freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
8. If the engineered fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.

9. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement, particularly if it is to be carried out on sloping ground.
10. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
11. The engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors.
12. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that supervised the engineered fill placement. This is to ensure that the foundations and service pipes are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by the footing excavation.
13. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who inspected the fill placement in order to document the locations of the excavation and/or to supervise reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.
14. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Foundations on engineered fill must be properly reinforced with two 15-mm steel reinforcing bars in the footings and upper section of the foundation walls, or be designed by a structural engineer to properly distribute the stress induced by the abrupt differential settlement (estimated to be 20± mm).

7.2 Foundation

For house construction, it is recommended that on conventional footings be placed below the existing earth fill and weathered soil onto the sound natural soils below a depth of 1.0 m from the existing ground surface, or onto engineered fill. The recommended bearing pressures for the design of conventional spread and strip footings on undisturbed native soil or on engineered fill are provided below:

- Maximum Soil Bearing Pressure at Serviceability Limit State (SLS) = 150 kPa
- Factored Ultimate Bearing Pressure at Ultimate Limit State (ULS) = 250 kPa

The total and differential settlements of footings designed for the recommended bearing pressures at SLS are estimated to be 25 mm and 20 mm, respectively.

During construction, the bearing subsoil must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the revealed conditions are compatible with the foundation design requirements.

Footings exposed to weathering, or in unheated areas, should have at least 1.2 m of earth cover for protection against frost action.

In case groundwater seepage is encountered or the subsoil is wet, the footings must be poured immediately after subgrade inspection or the subgrade should be protected by a concrete mud-slab immediately after exposure. This will prevent construction disturbance and costly rectification of the bearing subsoil.

The house foundations should meet the requirements specified in the latest Ontario Building Code. The structure should be designed to resist an earthquake force using Site Classification 'D' (stiff soil).

7.3 Basement and Slab-On-Grade Construction

Where a basement is proposed, perimeter subdrains and damp-proofing of the foundation walls will be required, as shown on Drawing No. 10. The subdrains should be encased in a fabric filter to protect them against blockage by silting.

The basement walls should be designed to sustain a lateral earth pressure calculated using the soil parameters given in Table 6 in this report. Any applicable surcharge loads beside the basement must also be included in the design of underground structure.

The subgrade for the slab-on-grade or basement slab must consist of sound natural soils or properly compacted inorganic fill. Any earth fill and weathered soil should be subexcavated, sorted free of any deleterious material, aerated and uniformly compacted to at least 98% SPDD. In addition, any new fill should consist of organic-free soil, compacted uniformly to at least 98% SPDD. The final subgrade must be inspected and assessed by proof-rolling prior to placement of granular bedding.

The basement floor slab or slab on grade should be constructed on a granular bedding, at least 15 cm in thickness, consisting of 19-mm Crusher-Run Limestone, or equivalent, compacted to 100% SPDD.

The exterior grading around the buildings must be such that it directs runoff away from the structures.

7.4 Underground Services

The subgrade for underground services should consist of sound natural soils or properly compacted engineered fill. Where earth fill or badly weathered soil is encountered, it should be subexcavated and replaced with properly compacted inorganic soil and/or bedding material, compacted to at least 98% SPDD.

A Class 'B' bedding, consisting of compacted 19-mm Crusher-Run Limestone, or equivalent, is recommended for the underground services construction.

The pipe joints into manholes and catchbasins should be leak-proof, or the joints should be wrapped with a waterproof membrane, to prevent subgrade upfiltration through the joints. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover of at least two times the diameter of the pipe should be in place at all times after completion of the pipe installation.

The subgrade of underground services may have moderately high corrosivity to metal pipes and fittings; therefore, the underground services should be protected against soil corrosion. For estimation for the anode weight requirements, the estimated electrical resistivity given for the disclosed soil can be used. The proposed anode weight must meet the minimum requirements as specified by the Town of Caledon and Peel Region Standard.

7.5 Backfilling in Trenches and Excavated Areas

The on site inorganic soils are generally suitable for use as trench backfill. The backfill soils should be sorted free of any topsoil inclusions and other deleterious material prior to the backfilling.

The backfill in service trenches and excavated areas should be compacted to at least 95% SPDD and increased to 98% SPDD below the floor slab and concrete sidewalk. In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted with the water content at 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% SPDD. This is to provide the required stiffness for pavement construction.

In normal construction practice, the problem areas of settlement largely occur adjacent to manholes, catch basins, services crossings, foundation walls and columns; it is recommended that a granular backfill should be used for compaction in confined spaces with a smaller vibratory compactor.

Narrow trenches for services crossings should be cut at 2H:1V, or flatter, so that the backfill can be effectively compacted. Otherwise, soil arching will prevent the achievement of proper compaction. The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips.

One must be aware of the possible consequences during trench backfilling and exercise caution as described below:

- When construction is carried out in freezing winter weather, allowance should be made for these following conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in-situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent wetting of the backfill when it is required, such as in a narrow vertical trench section, or when the trench box is removed. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.
- In areas where the construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to final surfacing of the new pavement and the slab-on-grade construction.
- In deep trench backfill, one must be aware that future settlement may occur, unless the side of the cut is flattened to at least 2H:1V, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 98% SPDD, with the moisture content controlled near the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is stabilized by a trench box. These sectors must be backfilled with sand or non shrinkable fill, and the compaction must be carried out diligently prior to the placement of the backfill above this sector; i.e., in the upper sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section.

- In areas where groundwater movement is expected in the trench backfill, anti-seepage collars (OPSS 802.095) should be provided.

7.6 Garages, Driveways, Sidewalks and Landscaping

Due to the high frost susceptibility of the underlying soil, movement of the pavement structure and sidewalk can be expected during the cold seasons.

The driveway leading to the garage should be backfilled with non-frost susceptible granular material with a frost taper at a slope of 1H:1V or gentler. The subgrade of the garage floor and the interior garage foundation walls should be insulated with 50-mm Styrofoam, or its thermal equivalent.

In areas where ground movement cannot be tolerated, the subgrade should consist of free-draining, non-frost-susceptible granular material such as Granular 'B'. The material must extend to a depth of 0.3 to 1.2 m, depending on the degree of tolerance for movement, and be provided with positive drainage, such as weeper subdrains connected to manholes or catch basins to minimize the movement by preventing the accumulation of water in the granular base.

7.7 Pavement Design

The recommended pavement design for the access road is presented in Table 5.

Table 5 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder	65	HL8
Granular Base	150	OPSS Granular 'A' or equivalent
Granular Sub-base	300	OPSS Granular 'B' or equivalent

In preparation of the subgrade, the subgrade surface must be proof-rolled. The existing earth fill and weathered/soft subgrade must be subexcavated, sorted free of any deleterious materials, aerated and properly compacted; otherwise, where it cannot be sorted, it must be replaced with properly compact inorganic soil. New fill used to raise the grade for pavement construction should consist of uniformly compacted inorganic soil. In the zone within 1.0 m below the pavement subgrade, the fill should be compacted to at least 98% SPDD, with the water content 2% to 3% drier than the optimum. In the lower zone, a 95% or + SPDD is considered adequate. All the granular bases should be compacted to 100% SPDD.

The road subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated into the construction procedures and pavement design:

- Areas adjacent to the road should be properly graded to prevent ponding of large amounts of water.
- Curb subdrains will be required. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting.
- The subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- If the road is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

7.8 **Stormwater Infiltration Potential**

Based on the borehole findings, the site is primarily underlain by a stratum of silty clay till with silty clay. The estimated permeability of the till and silty clay is 10^{-7} cm/sec, with an estimated percolation time of more than 80 min/cm. In general, infiltration of the rainwater is not practical where the subsoil consists of impervious clay till or clay. Any percolated water in the ground tends to move horizontally, being intercepted by subdrains, swales or ditches, which will eventually be drained into the storm sewer.

Due to the low permeability of the encountered soils, the potential for infiltration practice is low for this site.

The estimated percolation time is based on gradation analysis and is provided as a guideline only.

Infiltration galleries, if any, must not be located at or near the top of slope to prevent impacting the stability of the slope.

7.9 **Soil Parameters**

The recommended soil parameters for the project design are given in Table 6.

Table 6 - Soil Parameters

Unit Weight and Bulk Factor	**Bulk Unit Weight (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Earth Fill	20.5	10.5	1.25	0.98
Silty Clay Till	22.0	12.5	1.33	1.03
Silty Clay	20.5	11.5	1.30	1.00
Silt	21.0	10.5	1.20	1.00
Sandy Silt	20.5	10.8	1.20	0.98
Lateral Earth Pressure Coefficients		**Active K_a**	**At Rest K_0**	**Passive K_p**
Earth Fill and Silty Clay		0.40	0.55	2.50
Silty Clay Till and Silts		0.33	0.48	3.00
Coefficients of Friction				
Between Concrete and Granular Base			0.60	
Between Concrete and Sound Natural Soils			0.40	
Maximum Soil Pressure (SLS) for Thrust Block Design				
Engineered Fill and Sound Natural Soil			50 kPa	

7.10 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 7.

Table 7 - Classification of Soils for Excavation

Material	**Type**
Sound Silty Clay Till and Silty Clay	2
Earth Fill, weathered Soil and dewatered Silts	3
Saturated Soil	4

Excavation into the till containing boulders may require extra effort and the use of a heavy-duty excavator. Boulders larger than 15 cm in size are not suitable for structural backfill and/or construction of engineered fill.

In excavation, groundwater yield is expected to be slow in rate and limited in quantity due to the low permeability of the underlying soil, and can generally be removed by conventional pumping from sumps where necessary; however, this should be confirmed through the results of the hydrogeological assessment. Where silts are encountered, the groundwater yield may be moderate to appreciable.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the intended bottom of excavation. These test pits should be allowed to remain open for a period of at least 4 hours to assess the trenching conditions.

8.0 LIMITATIONS OF REPORT

This report was prepared for the accounts of Bolton Summit Developments Inc. and for review by the designated consultants and government agencies. The material in the report reflects the judgement of Mumta Mistry, B.A.Sc., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation.

Use of the report is subject to the conditions and limitations of the contractual agreement. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL ENGINEERS LTD.

LICENSED PROFESSIONAL ENGINEER
Apr 8, 202
B. P. Y. LEE
100104568
PROVINCE OF ONTARIO

per

Mumta Mistry, B.A.Sc.
MM/BL:dd

Bernard Lee, P.Eng.

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-S054

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

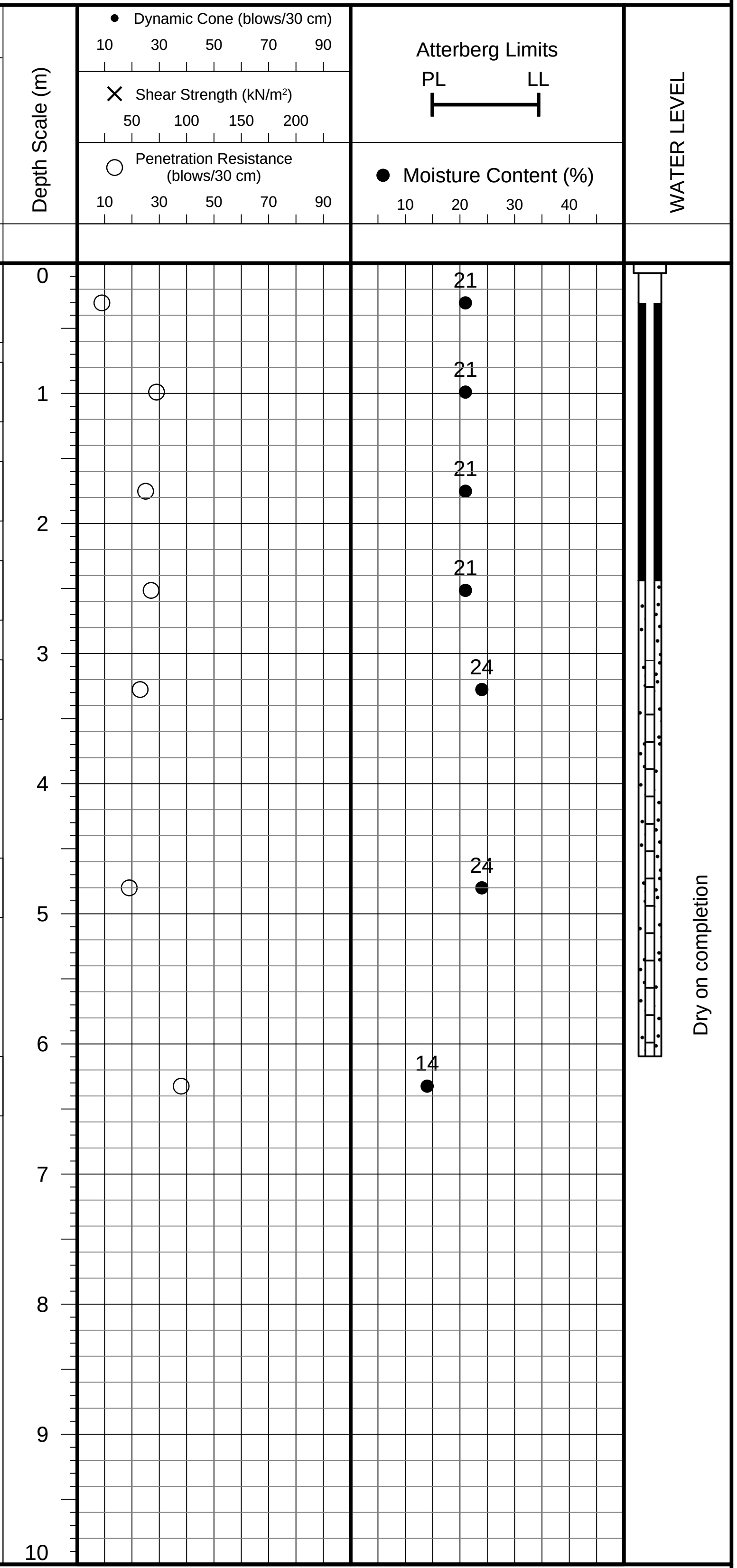
PROJECT DESCRIPTION: Proposed Residential Development

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
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
244.0 0.8	Brown, very stiff **SILTY CLAY** a trace of sand occ. gravel	2	DO	29
		3	DO	25
		4	DO	27
		5	DO	23
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
	brown grey	7	DO	38
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-S054

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

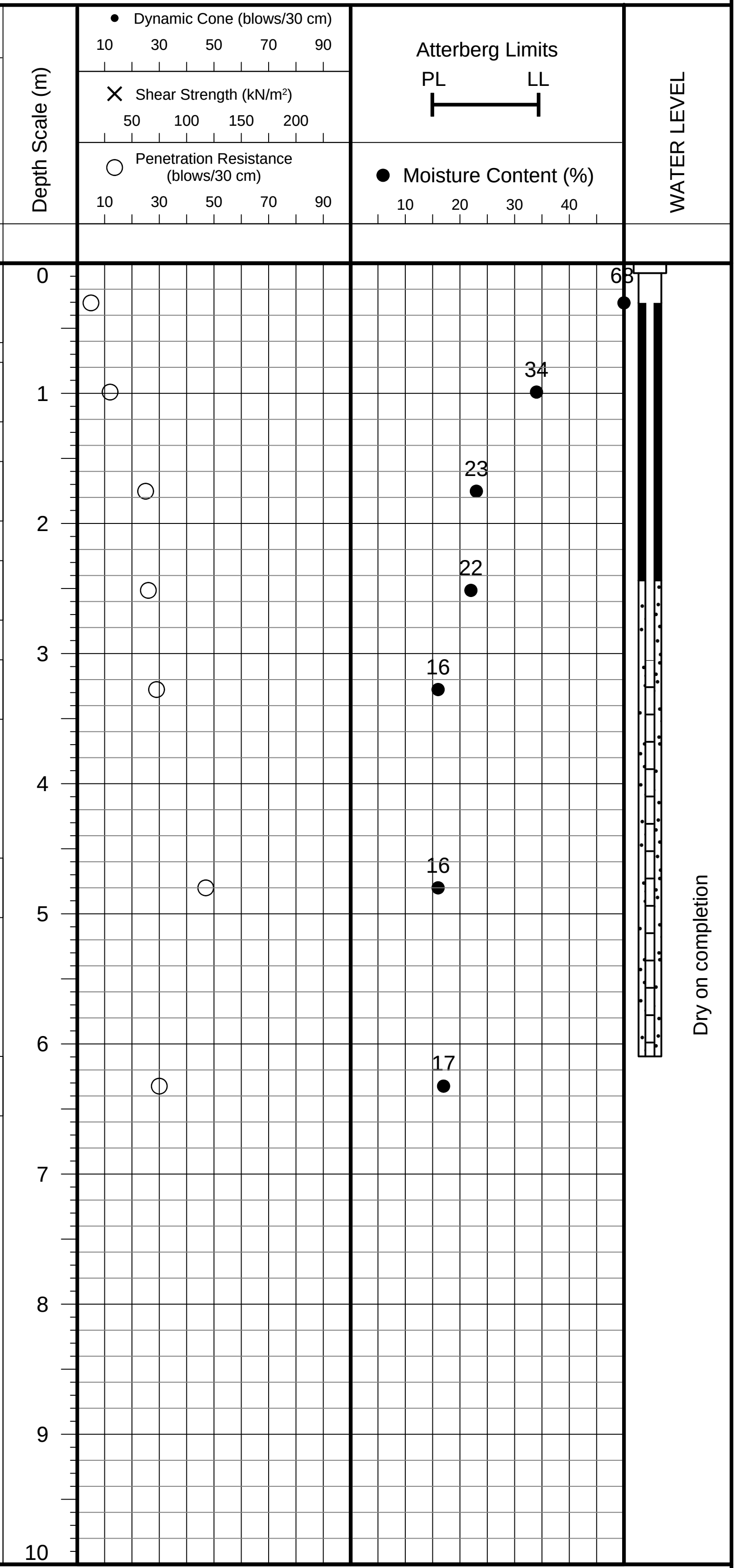
METHOD OF BORING: Solid Stem Augers

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

DRILLING DATE: March 3, 2022

El. (m) Depth (m)	SOIL DESCRIPTION
244.4	Ground Surface
0.0	**10 cm TOPSOIL**
	Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel with organic inclusions
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
237.8 6.6	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	5
2	AS	12
3	DO	25
4	DO	26
5	DO	29
6	DO	47
7	DO	30



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-S054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

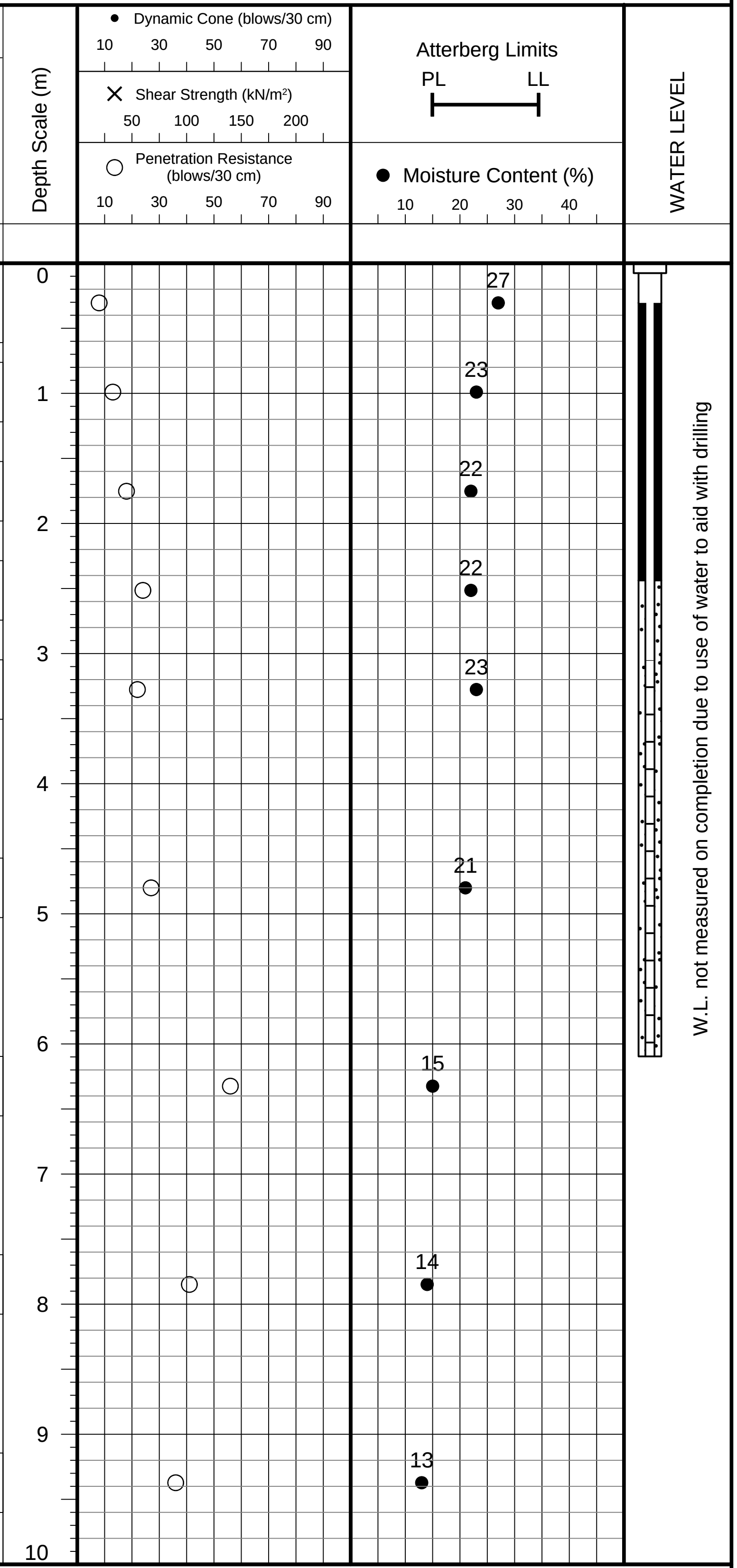
PROJECT DESCRIPTION: Proposed Residential Development

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
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-S054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

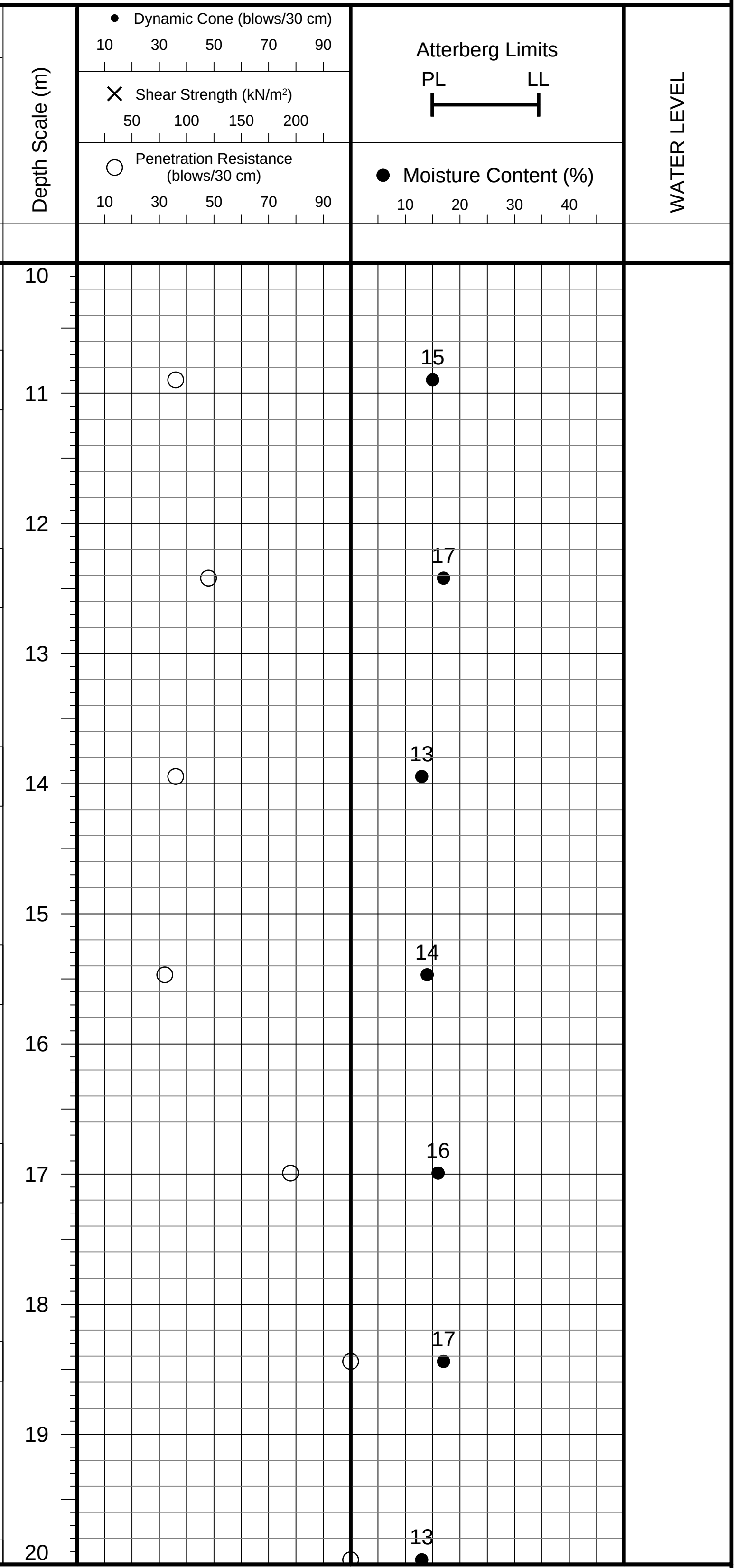
PROJECT DESCRIPTION: Proposed Residential Development

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



JOB NO.: 2201-S054

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

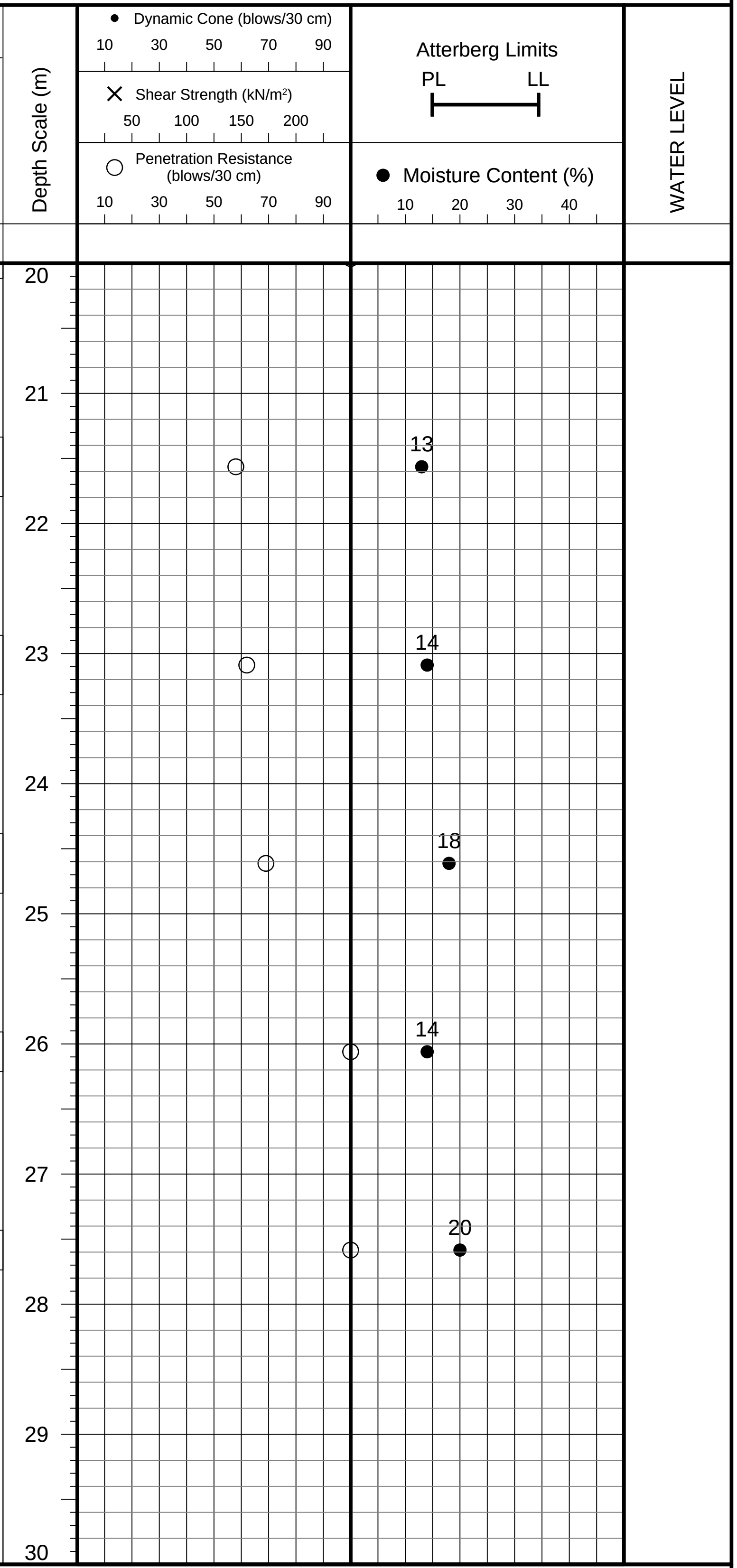
PROJECT DESCRIPTION: Proposed Residential Development

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
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			



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JOB NO.: 2201-S054

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

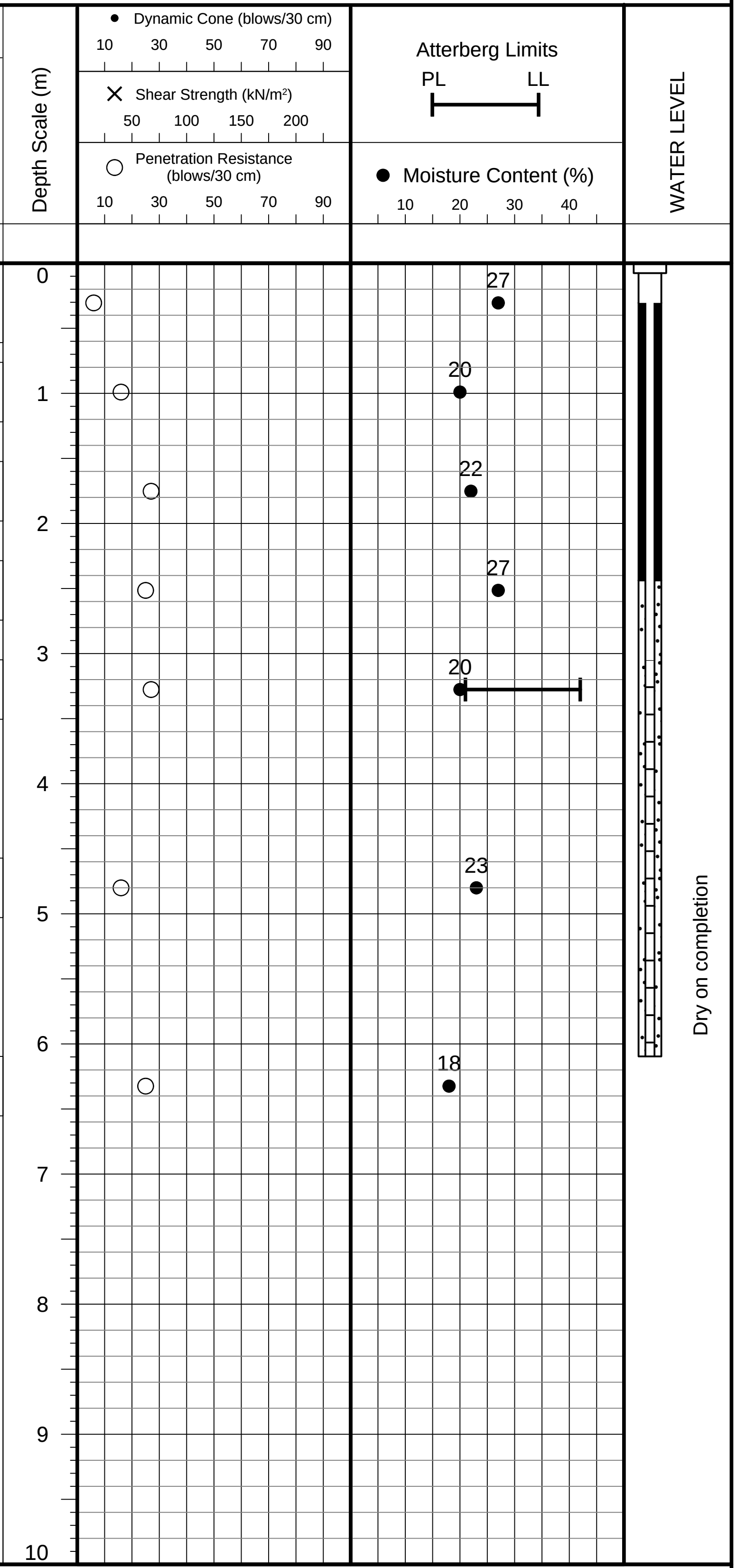
METHOD OF BORING: Solid Stem Augers

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

DRILLING DATE: March 3, 2022

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



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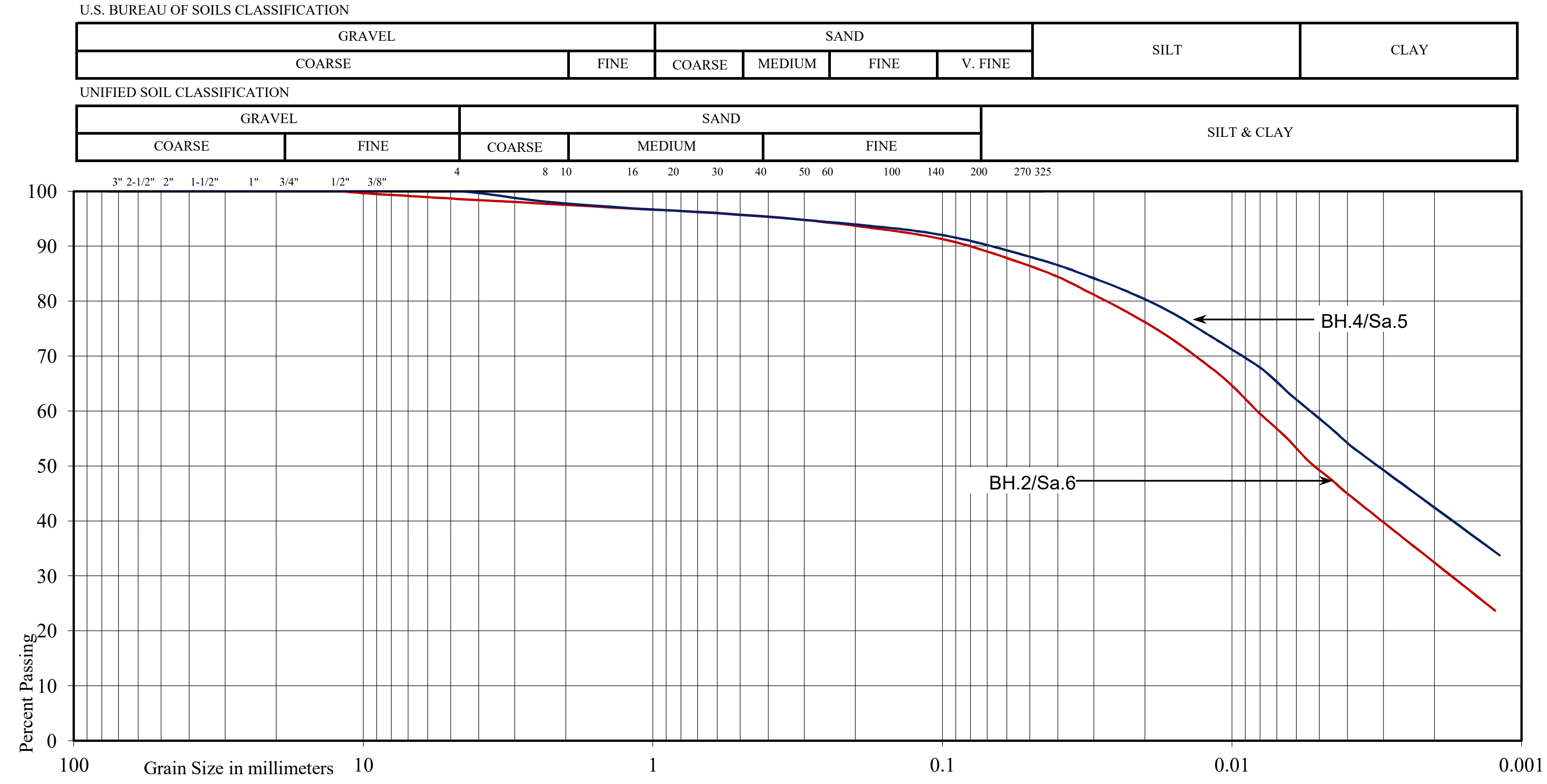
GRAIN SIZE DISTRIBUTION

Reference No: 2201-S054



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 (cm./sec.) =	10^{-7}	10^{-7}

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

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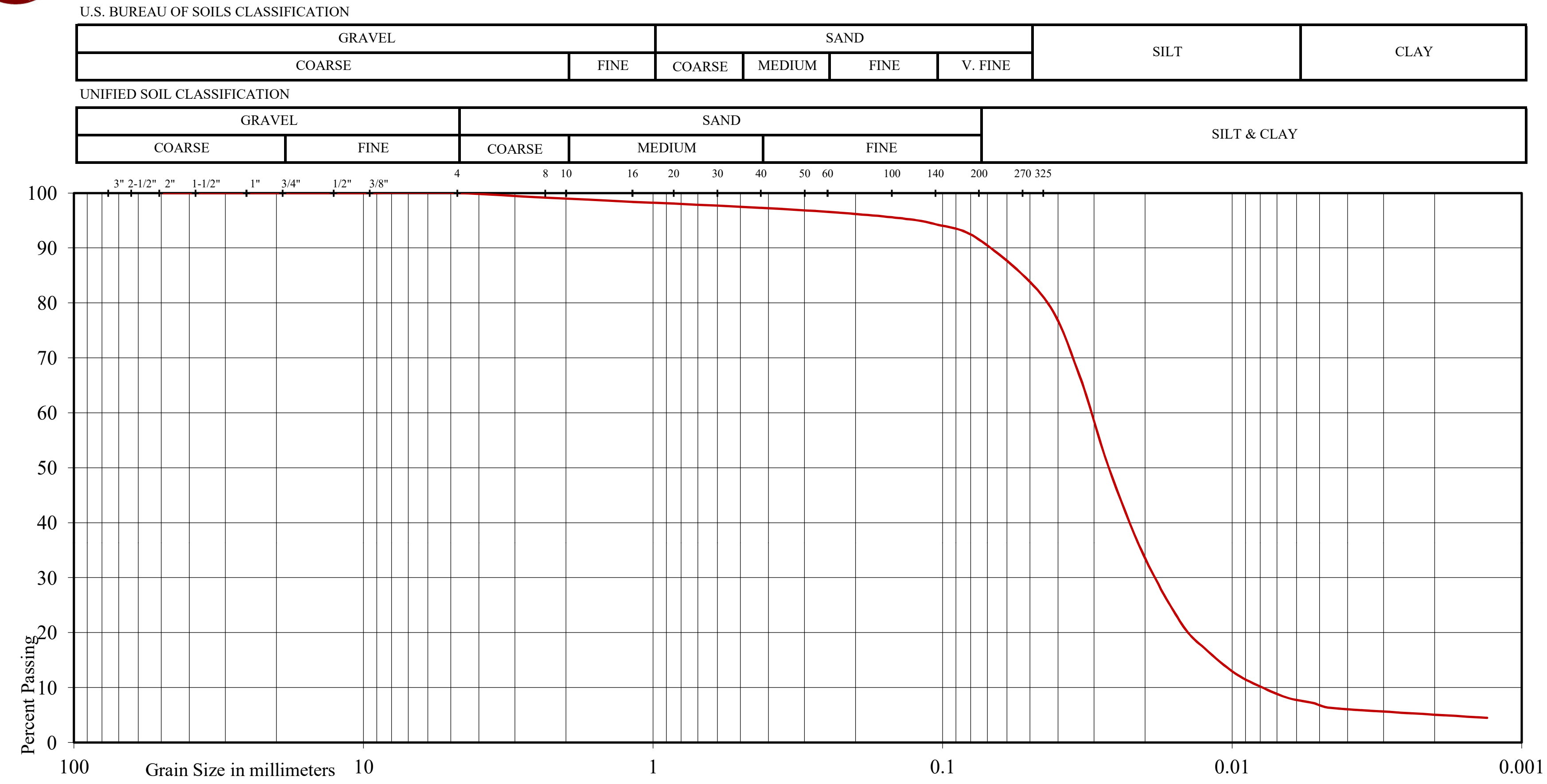
GRAIN SIZE DISTRIBUTION

Reference No: 2201-S054



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 (cm./sec.) = 10^{-4}

Classification of Sample [& Group Symbol]: SILT
traces of clay and sand

Figure: 6

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90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BOREHOLE LOCATION PLAN

SITE: 13290 NUNNVILLE ROAD, TOWN OF CALEDON (BOLTON)

DESIGNED BY:

CHECKED BY:

DWG NO.: 1

SCALE: 1:750

REF. NO.: 2201-S054

DATE: APRIL 2022

REV A

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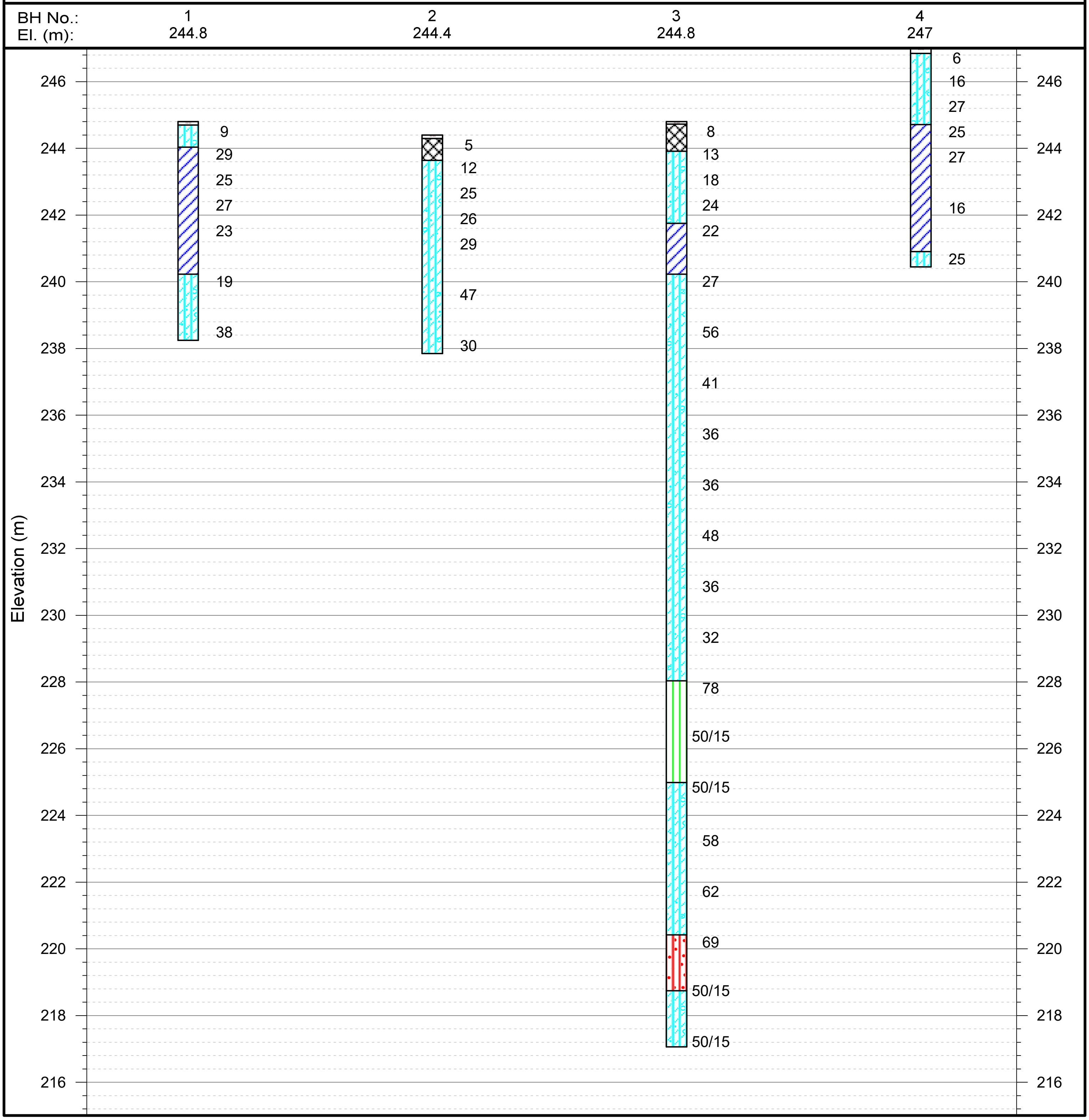
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.:	2201-S054
REPORT DATE:	March 2022
PROJECT DESCRIPTION:	Proposed Residential Development
PROJECT LOCATION:	13290 Nunnville Road Town of Caledon (Bolton)

LEGEND

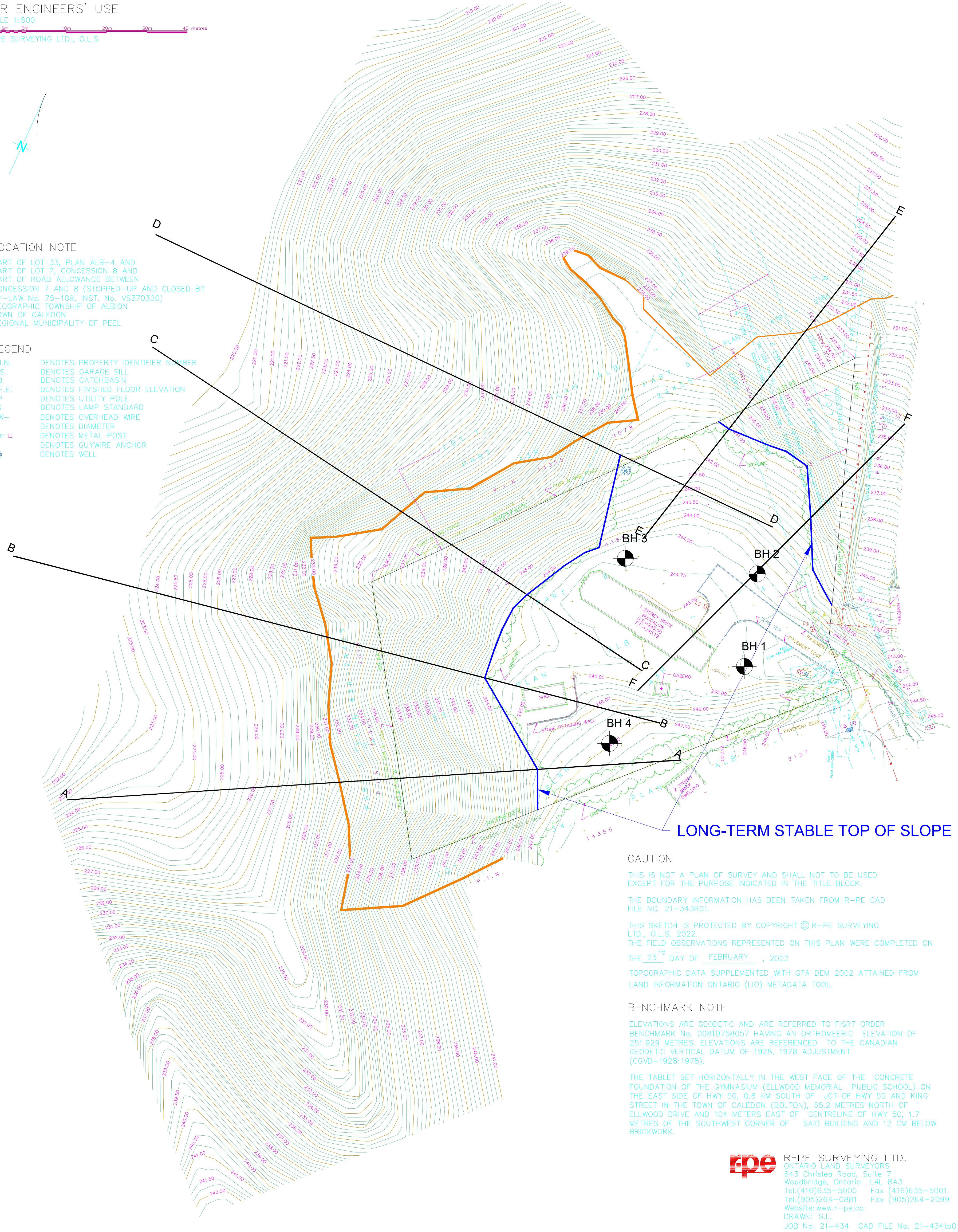
▨	TOPSOIL	▨	SANDY SILT	▨	SILTY CLAY
▨	FILL	▨	SILT	▨	SILTY CLAY TILL



SKETCH SHOWING ELEVATIONS FOR ENGINEERS' USE

SCALE 1: 500

R–PE SURVEYING LTD., O.L.S.



LOCATION NOTE

PART OF LOT 33, PLAN ALB–4 AND
PART OF LOT 7, CONCESSION 8 AND
PART OF ROAD ALLOWANCE BETWEEN
CONCESSION 7 AND 8 (STOPPED–UP AND CLOSED BY
BY–LAW No. 75–109, INST. No. VS370320)
GEOGRAPHIC TOWNSHIP OF ALBION
TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL

LEGEND

P.I.N.	DENOTES PROPERTY IDENTIFIER NUMBER
G.S.	DENOTES GARAGE SILL
CB	DENOTES CATCHBASIN
F.F.E.	DENOTES FINISHED FLOOR ELEVATION
UP	DENOTES UTILITY POLE
LS	DENOTES LAMP STANDARD
–W–	DENOTES OVERHEAD WIRE
ø	DENOTES DIAMETER
POST ☐	DENOTES METAL POST
✓	DENOTES GUYWIRE ANCHOR
Ⓦ	DENOTES WELL

CAUTION

THIS IS NOT A PLAN OF SURVEY AND SHALL NOT TO BE USED EXCEPT FOR THE PURPOSE INDICATED IN THE TITLE BLOCK.

THE BOUNDARY INFORMATION HAS BEEN TAKEN FROM R–PE CAD FILE NO. 21–343R01.

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THE FIELD OBSERVATIONS REPRESENTED ON THIS PLAN WERE COMPLETED ON THE 23rd DAY OF FEBRUARY , 2022

TOPOGRAPHIC DATA SUPPLEMENTED WITH GTA DEM 2002 ATTAINED FROM LAND INFORMATION ONTARIO (LIO) METADATA TOOL.

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO FISRT ORDER BENCHMARK No. 00819758057 HAVING AN ORTHOMEERIC ELEVATION OF 251.929 METRES. ELEVATIONS ARE REFERENCED TO THE CANADIAN GEODETIC VERTICAL DATUM OF 1928, 1978 ADJUSTMENT (CGVD–1928:1978).

THE TABLET SET HORIZONTALLY IN THE WEST FACE OF THE CONCRETE FOUNDATION OF THE GYMNASIUM (ELLWOOD MEMORIAL PUBLIC SCHOOL) ON THE EAST SIDE OF HWY 50, 0.8 KM SOUTH OF JCT OF HWY 50 AND KING STREET IN THE TOWN OF CALEDON (BOLTON), 55.2 METRES NORTH OF ELLWOOD DRIVE AND 104 METERS EAST OF CENTRELINE OF HWY 50, 1.7 METRES OF THE SOUTHWEST CORNER OF SAID BUILDING AND 12 CM BELOW BRICKWORK.

R–PE SURVEYING LTD.
ONTARIO LAND SURVEYORS
643 Chrislea Road, Suite 7
Woodbridge, Ontario L4L 8A3
Tel.(416)635–5000 Fax (416)635–5001
Tel.(905)264–0881 Fax (905)264–2099
Website: www.r–pe.ca
DRAWN: S.L.
JOB No. 21–434 CAD FILE No. 21–434tp01

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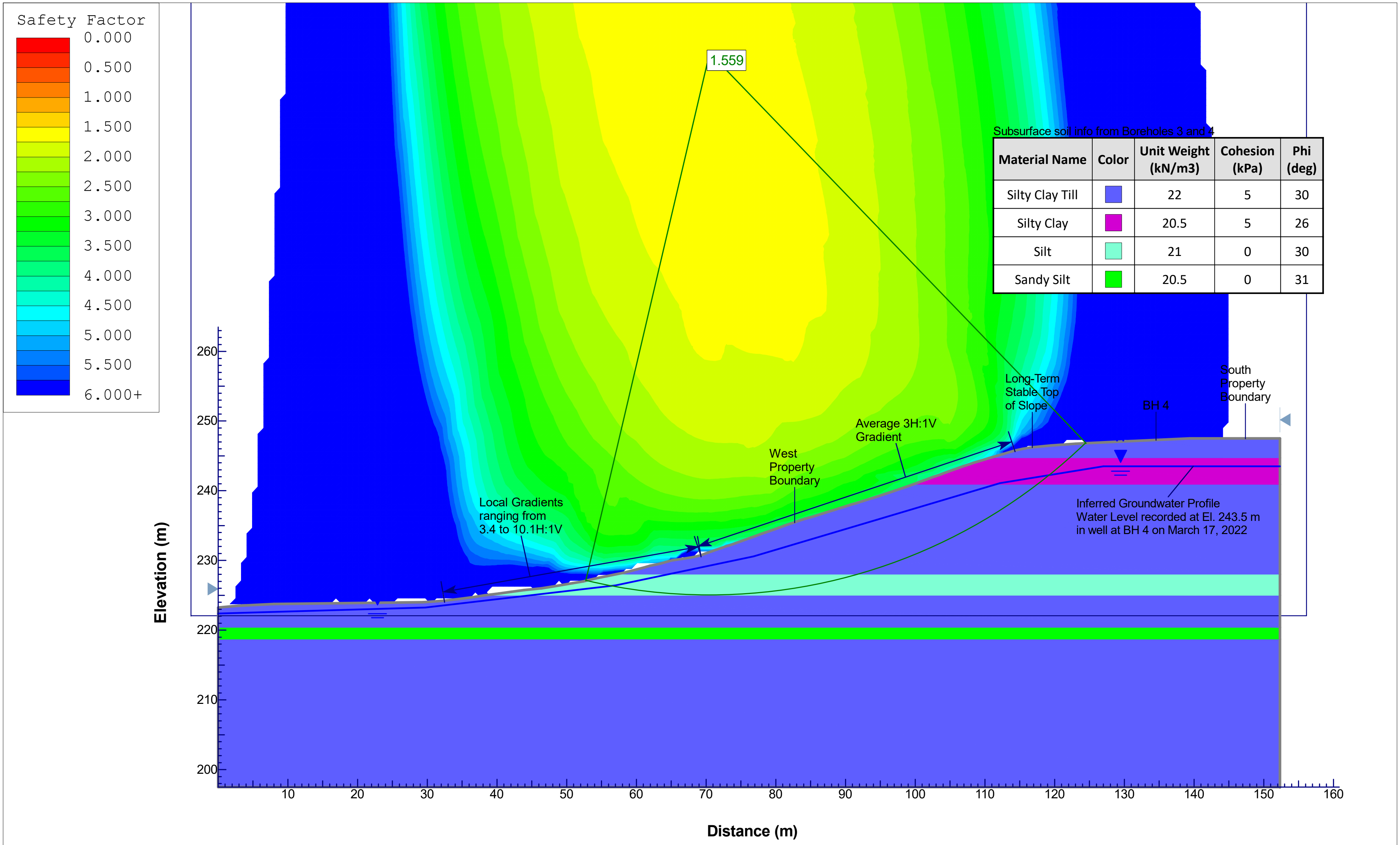
CROSS-SECTION AND LTSTOS LOCATION PLAN

SITE: 13290 NUNNVILLE ROAD, TOWN OF CALEDON (BOLTON)

DESIGNED BY:
CHECKED BY:
DWG NO.: 3
SCALE: 1:1000
REF. NO.: 2201-S054
DATE: MARCH 2022
REV -



Subsurface soil info from Boreholes 3 and 4

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Silty Clay Till	🟦	22	5	30
Silty Clay	🟪	20.5	5	26
Silt	▨	21	0	30
Sandy Silt	🟩	20.5	0	31

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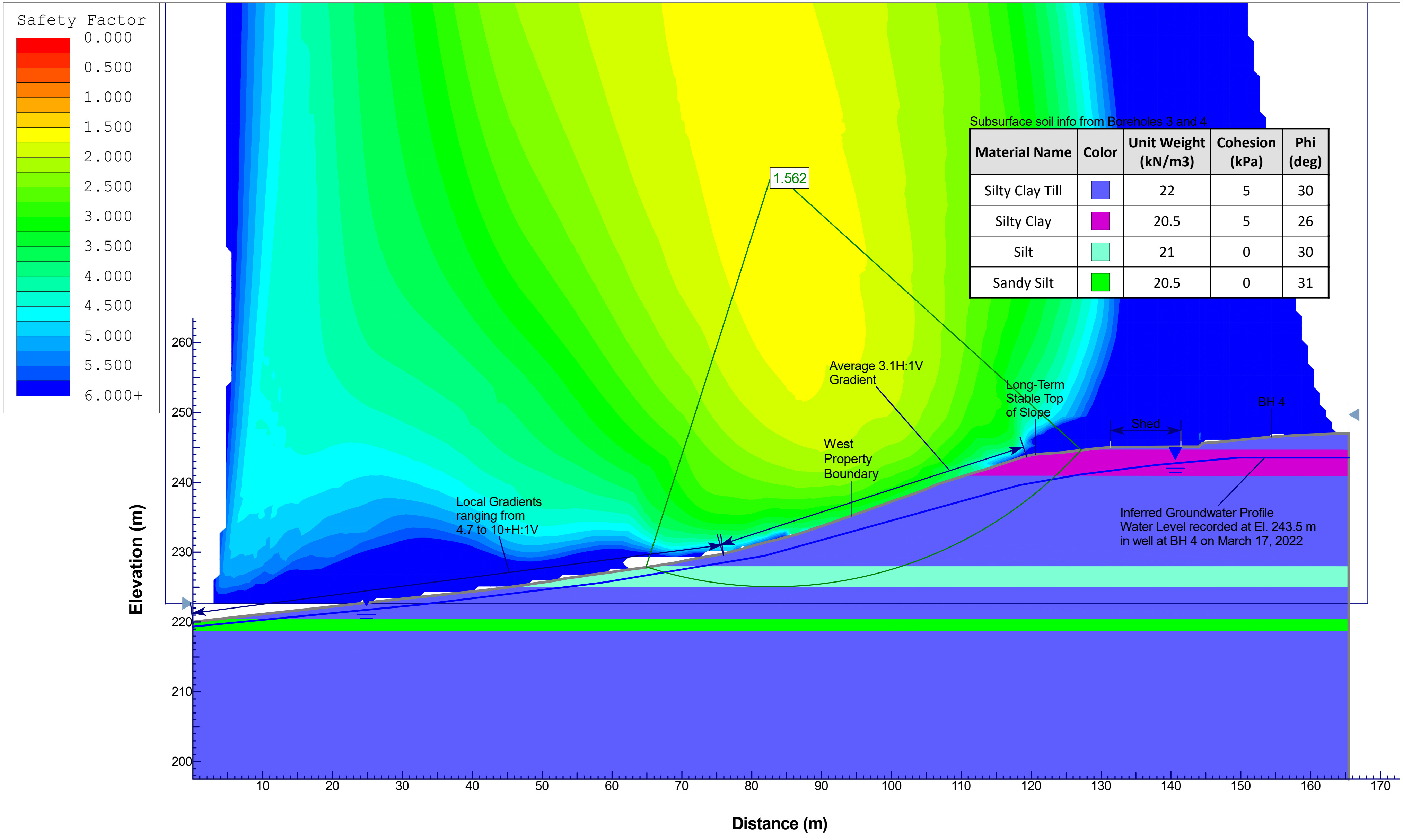
Project Title	Slope Stability Assessment for Proposed Residential Development	Load Case	Cross-Section A-A (Existing Condition)
Location	13290 Nunnville Road, Town of Caledon (Bolton)		
Drawn By	MM	Checked By	BL
Scale	1:750	Revision	
Date	March 2022	Reference No.	2201-S054
Drawing No.	4		



Subsurface soil info from Boreholes 3 and 4

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Silty Clay Till	🟦	22	5	30
Silty Clay	🟪	20.5	5	26
Silt	▢	21	0	30
Sandy Silt	🟩	20.5	0	31

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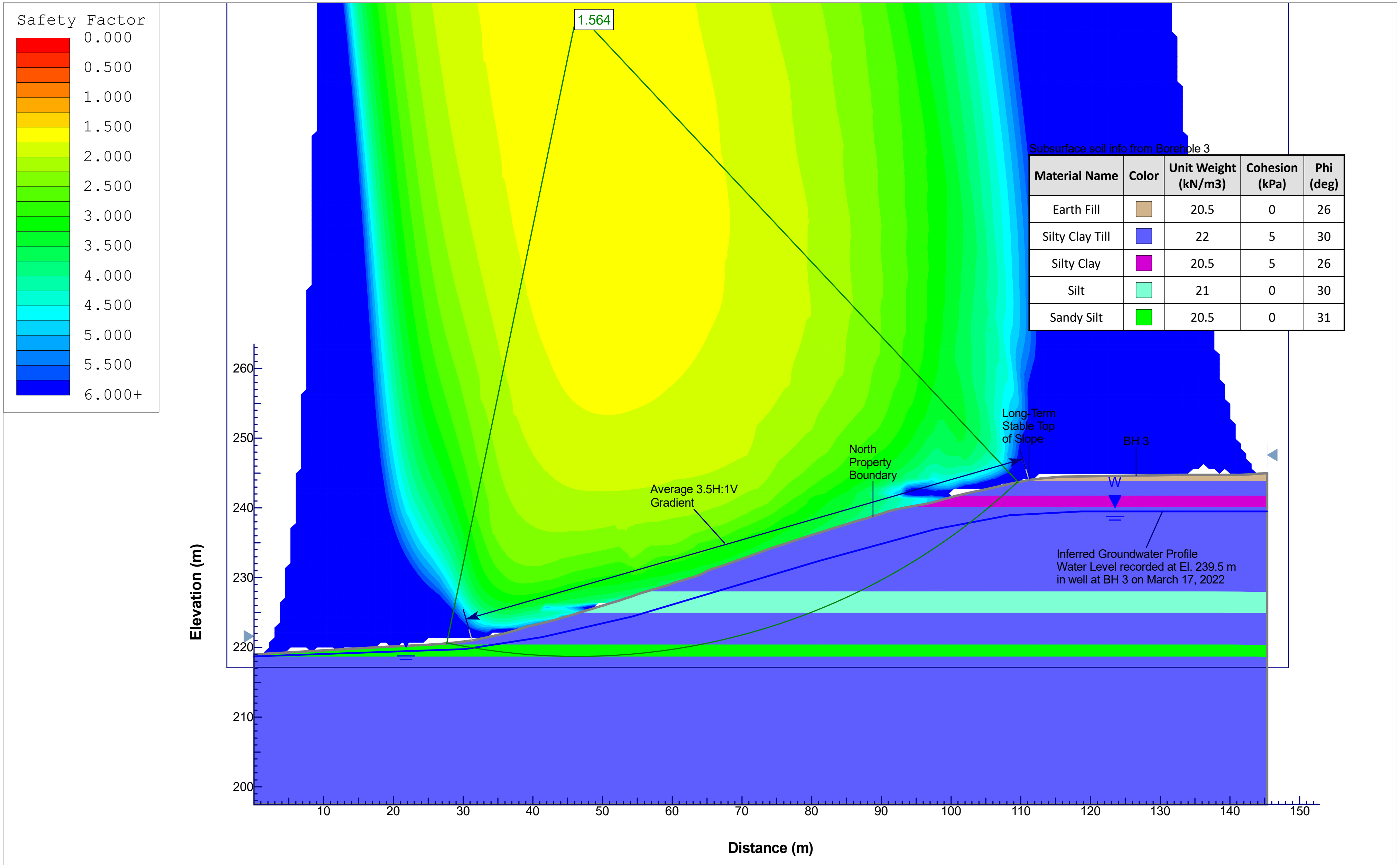
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

Project Title Slope Stability Assessment for Proposed Residential Development		Load Case Cross-Section B-B (Existing Condition)	
Location 13290 Nunnville Road, Town of Caledon (Bolton)			
Drawn By MM	Checked By BL	Scale 1:750	Revision
Date March 2022		Reference No. 2201-S054	Drawing No. 5



Subsurface soil info from Borehole 3

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill	🟫	20.5	0	26
Silty Clay Till	🟦	22	5	30
Silty Clay	🟪	20.5	5	26
Silt	🟦	21	0	30
Sandy Silt	🟩	20.5	0	31

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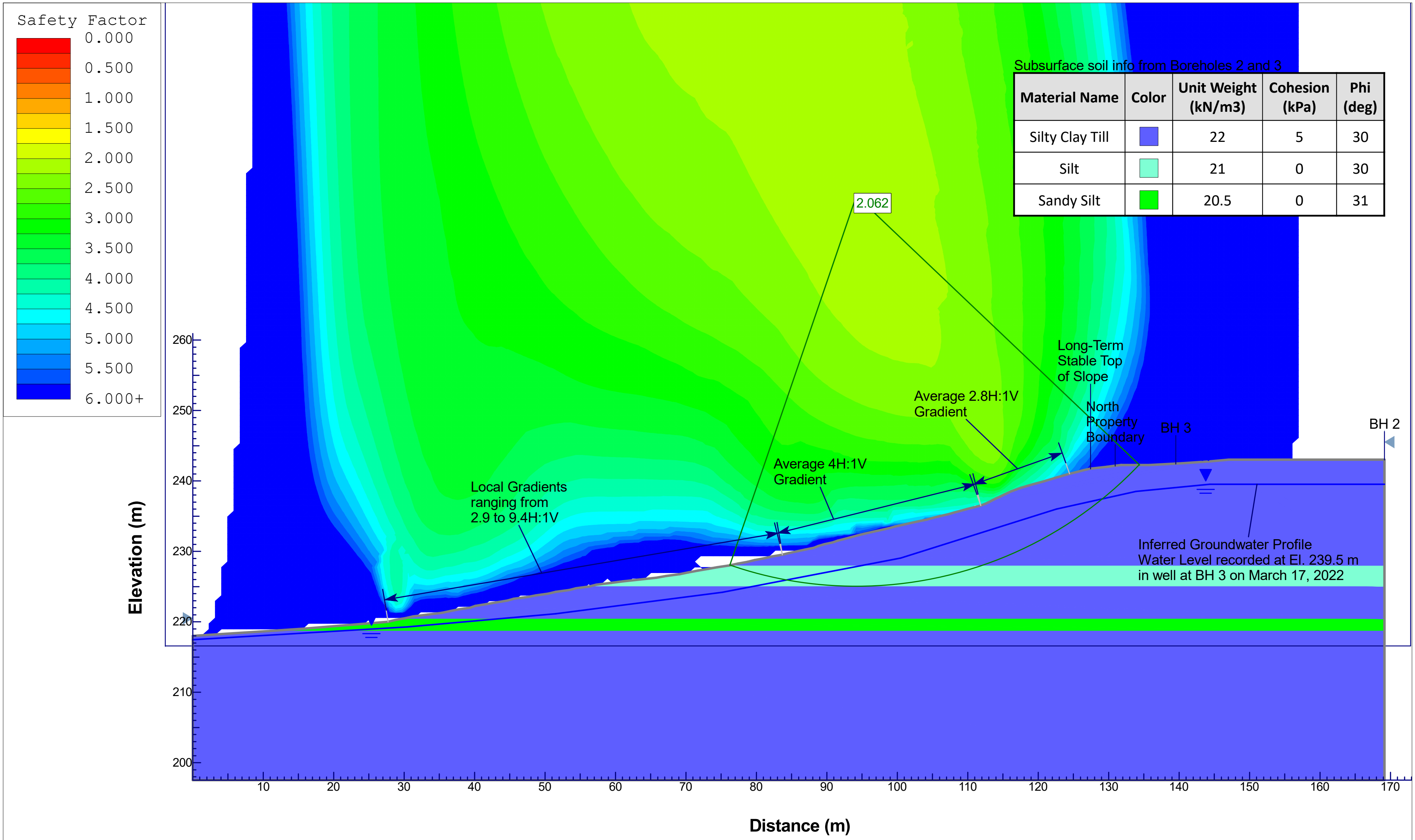
Project Title: Slope Stability Assessment for Proposed Residential Development

Load Case: Cross-Section C-C
(Existing Condition)

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

Drawn By: MM
Checked By: BL
Scale: 1:750
Revision:

Date: March 2022
Reference No.: 2201-S054
Drawing No.: 6



Subsurface soil info from Boreholes 2 and 3

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Silty Clay Till	🟪	22	5	30
Silt	🟦	21	0	30
Sandy Silt	🟩	20.5	0	31

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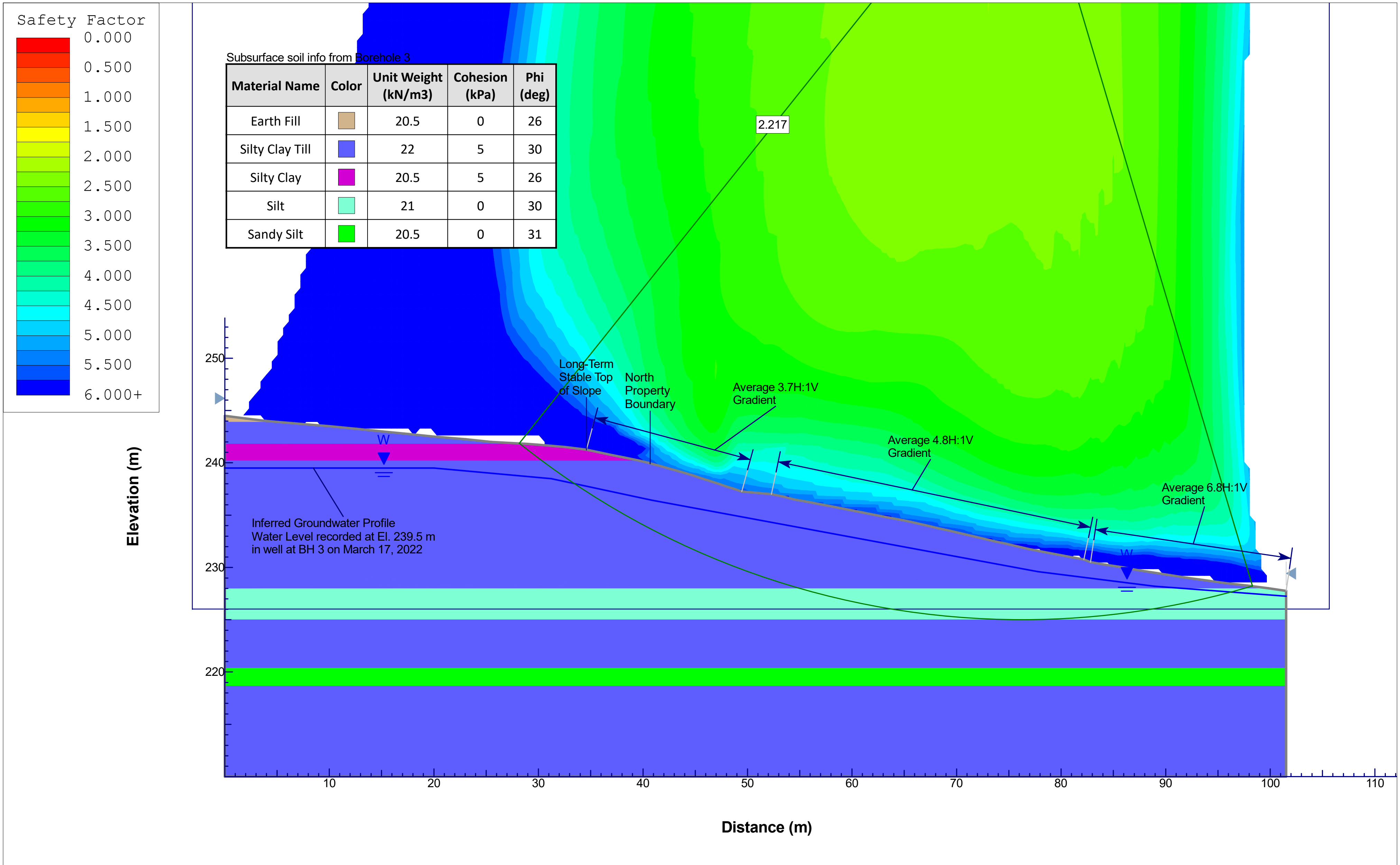
Project Title: Slope Stability Assessment for Proposed Residential Development

Load Case: Cross-Section D-D
(Existing Condition)

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

Drawn By: MM
Checked By: BL
Scale: 1:750
Revision:

Date: March 2022
Reference No.: 2201-S054
Drawing No.: 7



Subsurface soil info from Borehole 3

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill	🟫	20.5	0	26
Silty Clay Till	🟦	22	5	30
Silty Clay	🟪	20.5	5	26
Silt	🟩	21	0	30
Sandy Silt	🟩	20.5	0	31

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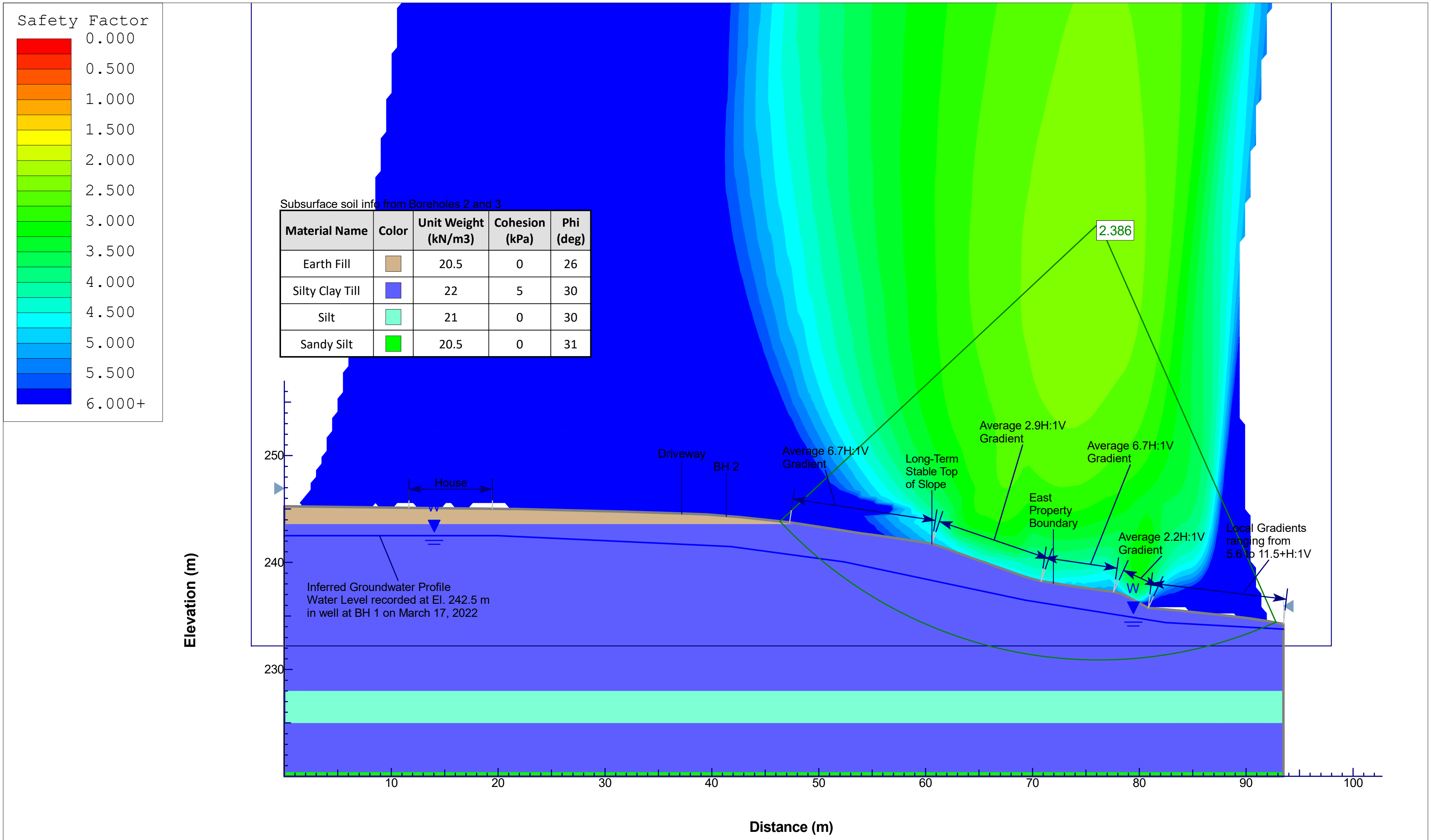
Project Title: Slope Stability Assessment for Proposed Residential Development

Load Case: Cross-Section E-E
(Existing Condition)

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

Drawn By: MM
Checked By: BL
Scale: 1:500
Revision:

Date: March 2022
Reference No.: 2201-S054
Drawing No.: 8



Subsurface soil info from Boreholes 2 and 3

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill	🟫	20.5	0	26
Silty Clay Till	🟦	22	5	30
Silt	🟦	21	0	30
Sandy Silt	🟩	20.5	0	31

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Project Title: Slope Stability Assessment for Proposed Residential Development

Load Case: Cross-Section F-F
(Existing Condition)

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

Drawn By: MM

Checked By: BL

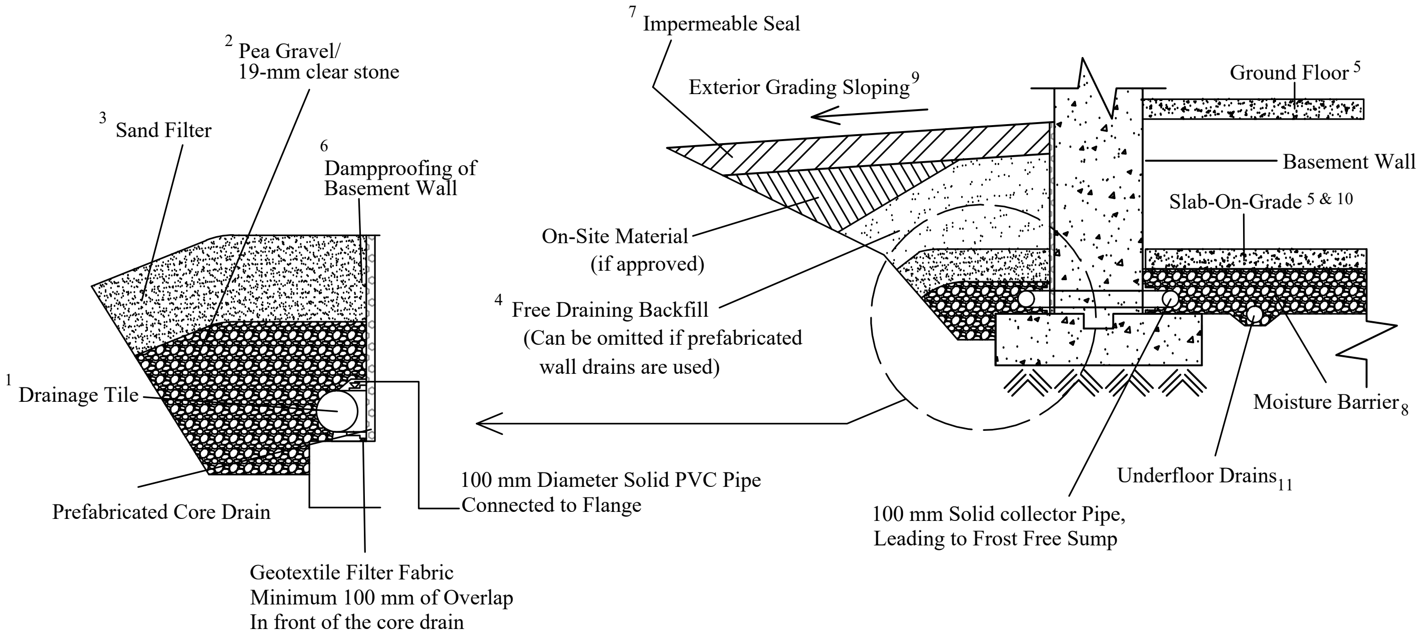
Scale: 1:500

Revision:

Date: March 2022

Reference No.: 2201-S054

Drawing No.: 9



NOTES:

1. **Drainage tile**: consists of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be at minimum of 150 mm (6") below underside of basement floor slab.

2. **Pea gravel**: at 150 mm (6") on the top and sides of drain. If drain is not placed on concrete footing, provide 100 mm (4") of pea gravel below drain. The pea gravel may be replaced by 19-mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270R or equivalent.

3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300 mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.

4. **Free-draining backfill**: OPSS Granular 'B' or equivalent, compacted to 95% to 98% (maximum) Standard Proctor dry density. Do not compact closer than 1.8 m (6') from wall with heavy equipment. This may be replaced by on-site material if prefabricated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.

5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adquate bracing.

6. **Dampproofing** of the basement wall is required before backfilling

7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free-draining sand, the seal may be omitted.

8. **Moisture barrier**: 19-mm clear stone or compacted OPSS Granular 'A', or equivalent. The thickness of this layer should be 150 mm (6") minimum.

9. **Exterior Grade**: slope away from basement wall on all the sides of the building.

10. **Slab-On-Grade** should not be structurally connected to walls or foundations.

11. **Underfloor drains**[*] should be placed in parallel rows at 6 to 8 m (20'-25') centre, on 100 mm (4") of pea gravel with 150 mm (6") of pea gravel on top and sides. The invert should be at least 300 mm (12") below the underside of the floor slab. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

[*] Underfloor drains can be deleted where not required.

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PERMANENT PERIMETER DRAINAGE SYSTEM

SITE: 13290 NUNNVILLE ROAD, TOWN OF CALEDON (BOLTON)

DESIGNED BY: K.L.
CHECKED BY: B.S.
DWG NO.: 10
SCALE: N.T.S.
REF. NO.: 2201-S054
DATE: MARCH 2022
REV -