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A REPORT TO
CALEDON DEVELOPMENT #2 LP

A SOIL INVESTIGATION FOR PROPOSED SUBDIVISION

NORTHWEST OF MCLAUGHLIN ROAD AND MAYFIELD ROAD

TOWN OF CALEDON

REFERENCE NO. 1604-S017

JULY 2016

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1.0 INTRODUCTION

In accordance with written authorization dated April 4, 2016 from Mr. Nick Cortellucci of Caledon Development #2 LP, a soil investigation was carried out at a parcel of land located in the northwest quadrant of McLaughlin Road and Mayfield 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 for the design and construction of a proposed subdivision.

The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

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

The subject site is located on the west side of McLaughlin Road, approximately 620 m north of Mayfield Road in the Town of Caledon. It is irregular in shape, encompassing an approximate area of 80 ha, and generally consists of farmland. The site gradient is undulated, and relatively higher at the mid-portion of the property.

It is understood that the subject site will be developed into a residential subdivision consisting of residential dwellings, a public elementary school, a community park, a commercial block, and a stormwater management pond (SWMP), with municipal services and roadways meeting urban standards.

3.0 FIELD WORK

The field work, consisting of twenty (20) boreholes to depths ranging from 6.3 to 10.4 m, was performed during the period from April 26 to 29, 2016. The borehole locations are shown on 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 granular 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.

The elevation at each of the borehole locations was surveyed using hand-held Global Navigation Satellite System surveying equipment (Trimble Geoexplorer 6000) with a maximum accuracy of 10± cm.

4.0 **SUBSURFACE CONDITIONS**

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 20 inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing Nos. 2 and 3. The engineering properties of the disclosed soils are discussed herein.

Beneath a veneer of topsoil, the site is generally underlain by strata of silt till, silt and silty sand till.

4.1 **Topsoil** (All Boreholes)

The thickness of the revealed topsoil ranges from 10 to 25 cm. Due to the past farming activities, the thickness of topsoil may vary randomly across the site, and thicker topsoil layer may be encountered.

The topsoil is dark brown in colour, showing it contains appreciable roots and humus. These materials are unstable and compressible under loads; therefore, the topsoil is considered to be void of engineering value but can be used for general landscaping purposes.

Due to the humus content, the topsoil will generate an offensive odour under anaerobic conditions and may produce volatile gases; therefore, it must not be buried within the building envelope, or deeper than 1.2 m below the finished grade, as it may have an adverse impact on the environmental well-being of the development. It should be noted that the topsoil varies randomly in thickness. This renders it difficult to estimate the quantity of topsoil to be stripped. In order to prevent overstripping, diligent control of the stripping operation will be required.

4.2 **Silt Till** (All Boreholes) and **Silty Sand Till** (Boreholes 12, 15 and 17)

The silt till was encountered below the topsoil veneer. The deposit consists of a random mixture of soils; the particle sizes range from clay to gravel, with silt being the predominant fraction. It is amorphous in structure, showing it is a glacial deposit.

The silty sand till is reddish-brown in color, and was generally found below the silt till and silt. Sample examination revealed that the silty sand till contains occasional rock fragments.

The natural water content of the samples was determined, and the results are plotted on the Borehole Logs; the values range from 2% to 29%, with a median of 13%, indicating that the tills are dry to wet, being generally moist.

The relative density of the tills, as inferred from the 'N' values of 3 to over 100 blows per 30 cm penetration, with a median of 26 blows, is very loose to very dense, being generally compact. The very loose to loose sandy silt till generally occurs in the upper 1.2 m of the stratigraphy where the soil is weathered or has been disturbed by the farming activities.

Grain size analyses were performed on four representative samples of the silt till and one representative sample of the silty sand till; the results are plotted on Figures 21 and 22, respectively.

Based on the field and laboratory findings, the deduced soil engineering properties pertaining to the project are listed below:

- High frost susceptibility and moderate water erodibility.
- Relatively pervious to low permeability depending on its clay content, with an estimated coefficient of permeability of 10^{-4} to 10^{-6} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.07 to 0.15
2% - 6%	0.12 to 0.20
6% +	0.18 to 0.28

- Frictional soils, their shear strength is primarily derived from internal friction, and is augmented by cementation. Therefore, their strength is density dependent.
- They will be stable in steep cuts; however, under prolonged exposure, localized sheet collapse will likely occur.
- Fair pavement-supportive materials, with an estimated California Bearing Ratio (CBR) value of 10%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5000 ohm·cm.

4.3 **Silt** (Boreholes 1, 2, 3, 4, 10 and 12)

The silt deposit was encountered below the silt till. Sample examination revealed that the silt contains traces to some sand and clay.

The natural water content of the silt was determined, and the results are plotted on the Borehole Logs; the values range from 12% to 26%, with a median of 17%, indicating that the silt is moist to wet, and is generally water bearing. The wet silt displayed appreciable dilatancy when shaken by hand.

The relative density of the deposit is loose to very dense, being generally compact, as inferred from the 'N' values which range from 6 to over 100 blows per 30 cm penetration, with a median of 24. The low value of 6 obtained at a depth of 10 m below grade in Borehole 2 likely resulted from disturbance and loosening of the deposit by hydrostatic pressure during sampling.

Grain size analyses were performed on two representative samples; the result are plotted on Figure 23.

Based on the field and laboratory findings, the deduced soil engineering properties pertaining to the project are listed below:

- High frost susceptibility with high soil-adfreezing potential.
- High water erodibility; susceptible to migration through small openings under seepage pressure.
- Relatively low permeability to relatively pervious with an estimated coefficient of permeability of 10^{-4} to 10^{-5} cm/sec, an estimated percolation rate of 40 to 60 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 soil has a high capillarity and water retention capacity.

- A frictional soil, its shear strength is density dependent. Due to its dilatancy, the strength of the wet silt is susceptible to impact disturbance, i.e., the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction in shear strength.
- In excavation, the wet silt will slough and run slowly with seepage bleeding from the cut face. It will boil with a piezometric head of 0.4 m.
- A poor pavement-supportive material, with an estimated CBR value of 3%.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.4 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 +**
Silt Till	2 to 29 (median 13)	11	7 to 16
Silty Sand Till		10	6 to 15
Silt	12 to 26 (median 17)	13	8 to 17

Based on the above findings, the silt till and the silty sand till are generally suitable for 95% or + Standard Proctor compaction. However, the silt is generally too wet or on the wet side of the optimum for 95% or + Standard Proctor compaction and it will need to be aerated by being spread thinly on the ground during dry, warm weather prior to compaction.

The tills should be compacted using a heavy weight, kneading-type roller. The silt can be compacted by a smooth drum roller, with or without vibration, depending on the water content of the soil being compacted. 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.

When compacting the very dense tills on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts of these soils must be limited to 20 cm or less (before compaction). It is difficult to monitor the lifts of backfill placed in deep trenches; therefore, it is preferable that the compaction of backfill at depths over 1.0 m below the road subgrade be carried out on the wet side of the optimum. This would allow a wider latitude of lift thickness.

One should be aware that with considerable effort, a 90%± Standard Proctor compaction of the wet silt is achievable. Further densification is prevented by the pore pressure induced by the compactive effort; however, large random voids will have been expelled, and with time, the pore pressure will dissipate and the percentage of compaction will increase. There are many cases on record where after a few months of rest, the density of the compacted mantle has increased to over 95% of its maximum Standard Proctor dry density.

If the compaction of the soils is carried out with the water content within the range for 95% Standard Proctor dry density but on the wet side of the optimum, the surface of the compacted soil mantle will roll under the dynamic compactive load. This is unsuitable for road construction since each component of the pavement structure is to be placed under dynamic conditions which will induce the rolling action of the subgrade surface and cause structural failure of the new pavement. The foundations or bedding of the sewer and slab-on-grade will be placed on a subgrade which will not be subjected to impact loads. Therefore, the structurally compacted soil mantle, with the water content on the wet side or dry side of the optimum, will provide an adequate subgrade for the construction.

5.0 GROUNDWATER CONDITIONS

The boreholes were checked for the presence of groundwater or the occurrence of cave-in upon completion of the field work. Groundwater levels were recorded in the borehole logs and summarized in Table 2.

Table 2 - Groundwater Levels

Borehole Info			**Soil Colour Changes from Brown to Grey (m)**	**Measured Groundwater Level On Completion**	
BH No.	**Depth (m)**	**Ground El. (m)**		**Depth (m)**	**El. (m)**
1	10.4	262	4.6	8.5	253.5
2	10.4	259.8	3.3	6.7	253.1
3	10.4	260.9	3.4	5.4	255.5
4	10.2	261.9	4.6	5.4	256.5
5	6.6	261.3	4.6	Dry	-
6	6.6	260.3	3.1	Dry	-
7	6.6	261.7	4.6	5.4	256.3
8	6.6	262.2	4.6	4.3	257.9
9	6.6	263	3.1	5.8	257.2
10	10.4	262.5	4.6	5.4	257.1
11	6.4	264.5	4.6	Dry	-
12	10.2	263.7	3.3	6.7	257
13	6.6	263.9	4.6	Dry	-
14	6.3	263.6	4.6	Dry	-
15	6.4	263.3	4.6	Dry	-
16	6.6	261.9	3.1	5.8	256.1
17	6.6	261.2	3.1	5.8	255.4
18	6.3	260.6	4.6	Dry	-
19	6.4	261.9	3.3	Dry	-
20	6.6	262.8	4.6	Dry	-

Groundwater was detected in 11 of the boreholes upon their completion at depths of 4.3 to 8.5 m (El. 253.1 to 257.9 m) while the remaining 9 boreholes were dry upon completion. The detected groundwater levels represent the groundwater regime at the time of the investigation. The groundwater level will fluctuate with seasons. The colour of the soil changes from brown to grey at depths of 3.1 to 4.6 m. The brown colour indicates that the soil in the upper zone has oxidized.

The groundwater yield from the tills will be small to some while the yield from the silt will be moderate to appreciable and likely persistent.

Where excavation is to be carried out in the water bearing stratum, dewatering may be required. The appropriate method of dewatering can be determined by test pits or test pumping at the time of or prior to construction.

6.0 SLOPE STABILITY ANALYSIS

Soil Engineers Ltd. reviewed the topographic survey prepared by Rady-Pentek & Edward Surveying Ltd. dated March 23, 2016.

The slope of concern is located along the north boundary of the site, and is associated with a tributary of Etobicoke Creek West Branch.

Visual inspection of the slope was conducted on May 3, 2016. The inspection revealed that much of the slope is well-covered with trees and vegetation, with occasional signs of surface sloughing, creeping, and gullies observed. No sign of toe erosion was observed along the creek bank. A flood plain was observed between the slope and the creek along the toe of slope. The distance between the creek and the physical toe of the slope is more than 15 m along the majority of the subject slope, with a small portion where the creek is within 5 m from the physical toe of the slope.

Analysis of four (4) cross sections (A-A, B-B, C-C and D-D) was carried out to determine the Stable Slope Gradient and the Long Term Stable Slope Line (LTSSL). The locations of the cross sections are illustrated on Drawing No. 4. Details of the slope profile are summarized in Table 3.

Table 3 - Slope Details

Cross-Section	Height (m)	Overall Gradient	Steepest Gradient
A-A	5.5	1V:3.37H	1V:2.40H
B-B	6.0	1V:3.46H	1V:1.79H
C-C	2.8	1V:3.94H	1V:3.94H
D-D	4.0	1V:2.25H	1V:1.20H

The surface profile of the cross-sections is interpreted from the topographic survey, and the subsurface profile of the sections is interpreted from Boreholes 1, 2 and 7.

The analysis was carried out using force-moment-equilibrium criteria with the soil strength parameters listed in Table 4. Where applicable, the groundwater levels measured in the boreholes were incorporated into the analysis as a phreatic surface.

Table 4 - Soil Parameters (Slope Stability Analysis)

Soil Type	**Bulk Unit Weight γ (kN/m3)**	**Cohesion c (kPa)**	**Effective Internal Friction Angle ϕ (°)**
Silt Till	22.0	2	31
Silt	21.0	0	31

The results of the slope stability analyses for the existing slope bank at cross-sections A-A, B-B, C-C and D-D are summarized in Table 5 and are presented on Drawing Nos. 5 to 9, inclusive.

Table 5 - Results of Slope Stability Analyses (Existing Slope)

Cross Section	**FOS**	**Toe Erosion Allowance**	**Remodeled Slope Gradient**	**Remodeled FOS**
A-A	2.01	0 m	N/A	N/A
B-B	1.82	5 m	1V:3H	2.10
C-C	3.14	0 m	N/A	N/A
D-D (Overall)	2.63	0 m	N/A	N/A
D-D (Local)	1.73	0 m	1V:2H	2.32

The results indicate that the Factor of Safety (FOS) for the existing slope bank at all cross sections meets the OMNR guideline requirements for ‘Active’ land use (FOS of 1.5).
With no evidence of toe erosion, and in accordance with OMNR requirement, a 5 m toe erosion allowance is required in areas where the toe of slope is within 15 m from the edge of the creek.

Cross Section B-B was re-analyzed incorporating the toe erosion allowance and a stable slope gradient of 1V:3H. The respective FOS for the remodelled slope is 2.10, meeting the OMNR requirements. The result for the remodelled cross section is presented on Drawing No. 10.

Cross Section D-D was re-analyzed to incorporate a gentler slope gradient of 1V:3H at the steepest slope gradient area as a safety precaution. The respective FOS for the remodelled slope is 2.32, meeting the OMNR requirements. The result for the remodelled cross section is presented on Drawing No. 11.

The LTSSL is determined by incorporating both the stability setback and, where applicable, the toe erosion allowance along the slope. The LTSSL is delineated on Drawing No. 4.

In order to prevent any disturbance of the existing slope condition and to enhance the stability of the bank for the proposed project, the following geotechnical constraints should be stipulated:

1. The prevailing vegetation cover must be maintained, since its extraction would deprive the bank of the rooting system that is reinforcement against soil

erosion by weathering. If for any reason the vegetation cover is stripped, it must be reinstated to its original, or better than its original, protective condition.

2. The topsoil cover on the bank face should not be disturbed, since this provides insulation and screen against frost wedging and rainwash erosion.
3. Grading of the land near the tops of banks must be such that concentrated runoff is not allowed to drain onto the bank face. Landscaping features which may cause runoff to pond at the top of the bank, as well as saturation of the crown of the bank, must not be permitted.
4. Construction near the top of the bank, stripping of topsoil or vegetation and dumping of any loose fill over the bank must be prohibited.

It should be noted that the above recommendations are subject to approval of the TRCA.

7.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a veneer of topsoil, the site is generally underlain by strata of very loose to very dense, generally compact silt till and silty sand till and loose to very dense, generally compact silt.

The groundwater generally lies within the silt deposit and the sand seams within the silt till between El. 253.1 m and El. 257.9 m. The groundwater level will fluctuate with seasons. The groundwater yield from the tills will be small to some while the yield from the silt will be moderate to appreciable and likely persistent.

It is understood that the subject site will be developed into a subdivision consisting of residential dwellings, a public elementary school, a community park, a commercial block, and a stormwater management pond (SWMP), with municipal services and roadways meeting urban standards.

The geotechnical findings which warrant special consideration are presented below:

1. The thickness of the revealed topsoil is approximately 10 to 25 cm. Due to the past farming activities, the thickness of topsoil may vary randomly across the site and thicker topsoil layer may be encountered.
2. The topsoil is void of engineering value and should be stripped and removed for the project construction. In order to prevent overstripping, diligent control of the stripping operation will be required. The topsoil must not be buried within the building envelope or deeper than 1.2 m below the exterior finished grade of the development. It should only be used for landscaping and landscape contouring purposes.
3. The ploughed soil and weathered soil are not suitable to support any structure

sensitive to movement. These soils must be subexcavated and sorted free of topsoil inclusions or deleterious materials before it is reused as structural backfill. If it is impractical to sort the topsoil and deleterious materials from the soils, then it must be wasted and disposed of off-site.

4. The sound natural soils below the weathered soil, topsoil and ploughed soil are suitable for normal spread and strip footing construction for the proposed buildings. The footings must be designed in accordance with the recommended bearing pressures in Section 6.1 and the footing subgrade must be inspected to ensure that its condition is compatible with the design of the foundations.
5. Where the site will be regraded with earth fill, it is more economical to place engineered fill for normal footing, sewer and pavement construction.
6. A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run Limestone, or equivalent, is recommended for the construction of the underground services. Where extensive dewatering is required, a Class 'A' bedding consisting of concrete will likely be required, and the pipe joints should be leak proof or wrapped with a waterproof membrane.
7. Some of the revealed soils are highly frost susceptible, with high soil-adfreezing potential. Where these soils are used to backfill against foundation walls, special measures must be incorporated into the building construction to prevent serious damage due to soil adfreezing.

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

7.1 Foundations

Based on the borehole findings, conventional footings should be placed onto the sound natural soils. The recommended soil bearing pressures for use in the design of normal strip and spread footings, founded onto the sound natural soils, together with the corresponding founding levels, are presented in Table 6.

Table 6 - Founding Levels

BH No.	Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Corresponding Founding Level			
	150 kPa (SLS) 250 kPa (ULS)		300 kPa (SLS) 500 kPa (ULS)	
	Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**
1	1.2 or +	260.8 or -	3.1 or +	258.9 or -
2	1.2 or +	258.6 or -	-	-
3	1.0 or +	259.9 or -	2.3 or +	258.6 or -
4	1.2 or +	260.7 or -	1.5 or +	260.4 or -
5	1.0 or +	260.3 or -	2.3 or +	259.0 or -
6	-	-	1.0 or +	259.3 or -
7	1.2 or +	260.5 or -	-	-
8	1.2 or +	261.0 or -	6.1 or +	256.1 or -
9	1.0 or +	262.0 or -	1.5 or +	261.5 or -
10	1.0 or +	261.5 or -	4.6 or +	257.9 or -
11	1.5 or +	263.5 or -	6.1 or +	258.4 or -
12	1.0 or +	262.7 or -	1.5 to 3.6 6.1 or +	262.2 to 259.1 256.6 or -

BH No.	Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Corresponding Founding Level			
	150 kPa (SLS) 250 kPa (ULS)		300 kPa (SLS) 500 kPa (ULS)	
	Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**
13	1.0 or +	262.9 or -	-	-
14	1.0 or +	262.6 or -	6.1 or +	257.5 or -
15	1.0 or +	262.3 or -	6.1 or +	257.2 or -
16	1.0 or +	260.9 or -	-	-
17	1.2 or +	260.0 or -	4.6 or +	256.6 or -
18	1.0 or +	259.6 or -	3.1 or +	257.5 or -
19	1.0 or +	260.9 or -	6.1 or +	255.8 or -
20	1.0 or +	261.8 or -	1.5 to 3.6	261.3 to 259.2

If extended footings and/or cut and fill is required for site grading, it is generally more economical to place engineered fill for normal footing, sewer and pavement construction. Recommended soil bearing pressures of 150 kPa (SLS) and 250 kPa (ULS) can be used for the design of the normal spread and strip foundations founded on engineered fill. The requirements for engineered fill construction are discussed in Section 6.2.

One must be aware the recommended Maximum Allowable Soil Pressures (SLS) and corresponding founding depths are given as a guide for foundation design and must be confirmed by subgrade inspection performed by a geotechnical engineer at the building locations.

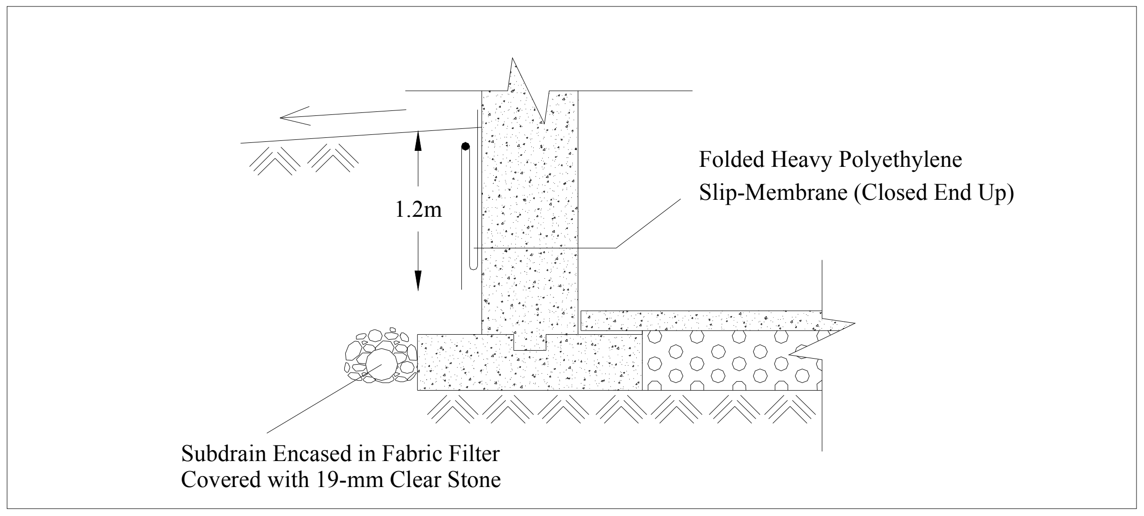
The recommended soil pressures (SLS) incorporate a safety factor of 3. The total and differential settlements of the footings are estimated to be 25 mm and 15 mm, respectively.

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

The building foundation must meet the requirements specified in the latest Ontario Building Code. As a guide, the structure should be designed to resist an earthquake force using Site Classification 'D' (stiff soil).

The in situ soils have moderately high to high soil-adfreezing potential. In order to alleviate the risk of frost damage, the foundation walls must be constructed of concrete and either the trench backfill must consist of non-frost-susceptible granular material, or the foundation walls must be shielded with a polyethylene slip-membrane. The recommended scheme is illustrated in Diagram 1.

Diagram 1 - Frost Protection Measures (Foundations)



Perimeter subdrains and dampproofing of the foundation walls will be required for the project construction. All subdrains must be encased in a fabric filter to protect against blockage by silting.

7.2 Engineered Fill

Where earth fill is required to raise the site, or where extended footings are necessary, it is generally more economical to place engineered fill for normal footing, sewer and road construction.

The engineering requirements for a certifiable fill for road construction, municipal services, and footings designed with a Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 250 kPa, are presented below:

1. All of the topsoil must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement. All of the ploughed soil and badly weathered soil must be subexcavated, inspected, aerated and properly compacted in layers.
2. The in situ organic-free soils can be used, and they must be uniformly compacted in lifts 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed lot grade and/or road subgrade. The soil moisture must be properly controlled on the wet side of the optimum.
3. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% of the maximum Standard Proctor compaction.
4. If imported fill is to be used, the hauler is responsible for its environmental

quality and must provide a document to certify that the material is free of hazardous contaminants.

5. 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.
6. The engineered fill must extend over the entire graded area; the engineered fill envelope and the finished elevations must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors. Foundations partially on engineered fill must be reinforced by two 15-mm or 20-mm steel reinforcing bars, depending on the thickness of the fill, 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 15± mm) between the natural soils and engineered fill.
7. The engineered fill must not be placed during the period from late November to early April, when freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
8. 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.
9. Where the fill is to be placed on a bank steeper than 1 vertical (V): 3 horizontal (H), the face of the bank must be flattened to 3+ so that it is suitable for safe operation of the compactor and the required compaction can be obtained.
10. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
11. The footings and underground services subgrade must be inspected by the

geotechnical consulting firm that inspected the engineered fill placement. This is to ensure that the foundations 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.

12. 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 excavation and/or to inspect 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.
13. Despite stringent control in the placement of engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the strip footings and the upper section of the foundation walls constructed on the engineered fill will require continuous reinforcement with steel bars, depending on the uniformity of the soils in the engineered fill and the thickness of the engineered fill underlying the foundations. Should the footings and/or walls require reinforcement, the required number and size of reinforcing bars must be assessed by considering the uniformity as well as the thickness of the engineered fill beneath the foundations. In sewer construction, the engineered fill is considered to have the same structural proficiency as a natural inorganic soil.

7.3 **Underground Services**

The subgrade for the underground services should consist of natural soils or engineered fill. In areas where the subgrade consists of ploughed soil and/or weathered soil, these soils should be subexcavated and replaced with properly compacted inorganic soil and/or bedding material compacted to at least 95% or + of their Standard Proctor compaction.

Where the sewers are to be constructed using the open-cut method, the construction must be carried out in accordance with Ontario Regulation 213/91. In areas where a vertical cut is necessary, the use of a trench box is considered to be appropriate. In the design of the trench box and/or shoring structure, the recommended lateral earth pressure coefficients presented in Table 9, Section 7.9, can be used.

A Class ‘B’ bedding is recommended for construction of the underground services. The bedding material should consist of compacted 20-mm Crusher-Run Limestone, or equivalent, as approved by a geotechnical engineer.

In water-bearing soils, where extensive dewatering is required, a Class ‘A’ bedding consisting of concrete will be required, and the pipe joints should be leak proof or wrapped with a waterproof membrane.

Where the sewer trench extends into the erodible silt stratum, anti-seepage collars must be provided in the pipe bedding in 50 m centres to prevent the flow of groundwater within the bedding.

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

Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

The subgrade of the underground services will generally consist of soils with an electrical resistivity ranging from 4500 to 5000 ohm·cm. These soils are considered corrosive to ductile iron pipes and metal fittings; therefore, the underground services should be protected against soil corrosion. For estimation of anode weight requirements, the estimated electrical resistivities of the disclosed soils can be used. This, however, should be confirmed by testing the soil along the water main alignment at the time of sewer construction.

7.4 Backfilling in Trenches and Excavated Areas

The backfill in service trenches should be compacted to at least 95% of its maximum Standard Proctor dry density. In the zone within 1.0 m below the road subgrade, the material should be compacted with the water content 2% to 3% drier than the optimum; and the compaction should be increased to 98% of the respective maximum Standard Proctor dry density to provide the required stiffness for pavement construction.

Some of the in situ inorganic soils are generally suitable for use as trench backfill; however, where the soil is too wet for a 95% or + Standard Proctor compaction, it can be aerated by spreading it thinly on the ground for drying prior to structural compaction or it can be mixed with drier soils. In cases where the material is too dry to compact, it may require the addition of water or mixing with a wet material.

In normal construction practice, the problem areas of settlement largely occur adjacent to foundation walls, columns, manholes, catch basins and services crossings. In areas which are inaccessible to a heavy compactor, sand backfill should be used. Unless compaction of the backfill is carefully performed, settlement will occur. Often, the interface of the native soils and sand backfill will have to be flooded for a period of several days.

Narrow trenches for services crossings should be cut at 1 V:2 H, so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches 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 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 soil have a water content on the dry side of the optimum, it would be impossible to wet the soil due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as 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 underground services construction is carried out during 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.

- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the side of the cut is flattened to at least 1 V:1.5+ H, 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 95% of the maximum Standard Proctor dry density, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, 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 sand fill mantle, seepage collars should be provided.

7.5 Garages, Driveways and Landscaping

Due to high frost susceptibility of the underlying soil, heaving of the pavement is expected to occur during the cold weather.

The driveways at the entrances to the garages must be backfilled with non-frost-susceptible granular material, with a frost taper at a slope of 1 V:1 H. The garage floor slab must be insulated with 50 mm Styrofoam, or equivalent.

The slab-on-grade in open areas should be designed to tolerate frost heave, and the grading around the slab-on-grade must be such that it directs runoff away from the surface.

Interlocking stone pavement and slab-on-grade to be constructed in areas susceptible to ground movement must be constructed on a free-draining granular base at least 1.0 m thick, with proper drainage, which will prevent water from ponding in the granular base.

7.6 Pavement Design

The recommended pavement design for the local and collector roads is presented in Table 7.

Table 7 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder Local Collector	 65 90	HL-8
Granular Base	150	Granular 'A'
Granular Sub-Base Local Collector	 300 450	Granular 'B'

In preparation of the subgrade, the topsoil, ploughed soil and weathered soil must be removed. Any new fill should consist of organic fill material, compacted to 95% or + of its maximum Standard Proctor dry density. In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted to at least 98% of its maximum Standard Proctor dry density, with the water content 2% to 3% drier than the optimum.

The final subgrade should be inspected and proof-rolled. Any soft spots should be subexcavated, and replaced by properly compacted inorganic earth fill.

All the granular bases should be compacted to their maximum Standard Proctor dry density.

The pavement subgrade will suffer a strength regression if water is allowed to infiltrate prior to paving. The following measures should therefore be incorporated into the construction and road design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Lot areas adjacent to the roads should be properly graded to prevent the ponding of large amounts of water during the interim construction period.
- If the roads are to be constructed during the wet seasons and extremely soft subgrade occurs, the granular sub-base may require thickening. This can be further assessed during construction.
- Fabric filter-encased curb subdrains are required to meet the town requirements.

7.7 Stormwater Management Pond

The proposed stormwater management pond (SWMP) will be constructed on top of the slope near the watercourse. The details of the pond, however, were not finalized at the time that this report was prepared.

Based on the borehole findings (Boreholes 2 and 3), the material at the sides and the bottom of the pond will consist of relatively pervious silt till or silt having relatively low permeability. An impervious clay liner or synthetic clay membrane will be required on the bottom and the sides of the pond. The thickness and details of the liner, however, will depend on the invert elevation of the pond, and this information will have to be further reviewed by our office before the design of the pond is finalized.

7.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 8.

Table 8 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Silt	21.0	11.0	1.20	1.00
Silt Till/Silty Sand Till	22.0	12.0	1.20	1.00
Lateral Earth Pressure Coefficients				
		Active	**At Rest**	**Passive**
		K_a	K_o	K_p
Silt/Silt Till/Silty Sand Till		0.32	0.48	3.12
Coefficients of Friction				
Between Concrete and Granular Base			0.5	
Between Concrete and Sound Natural Soils			0.4	

7.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified in Table 9.

Table 9 - Classification of Soils for Excavation

Material	Type
Sound Tills	2
Weathered soils and dewatered silt	3
Saturated soils	4

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

The groundwater yield from the tills will be small to some while the yield from the silt will be moderate to appreciable and likely persistent.

Where excavation is to be carried out in the water bearing stratum, dewatering may be required. This should be assessed by test pumping prior to the project construction when the intended bottom of excavation is determined.

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 sewer subgrade. 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

It should be noted that this report deals only with the geotechnical aspects of the proposed project.

This report was prepared by Soil Engineers Ltd. for the account of Caledon Development #2 LP, and for review by its designated consultants and government agencies. The material in it reflects the judgment of Kin Fung Li, B.Eng., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation. Any uses 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.

per

Kin Fung Li, B.Eng.

Bernard Lee, P.Eng.
KFL/BL:cy

July 8, 2016
10010456

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

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CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 1

FIGURE NO: 1

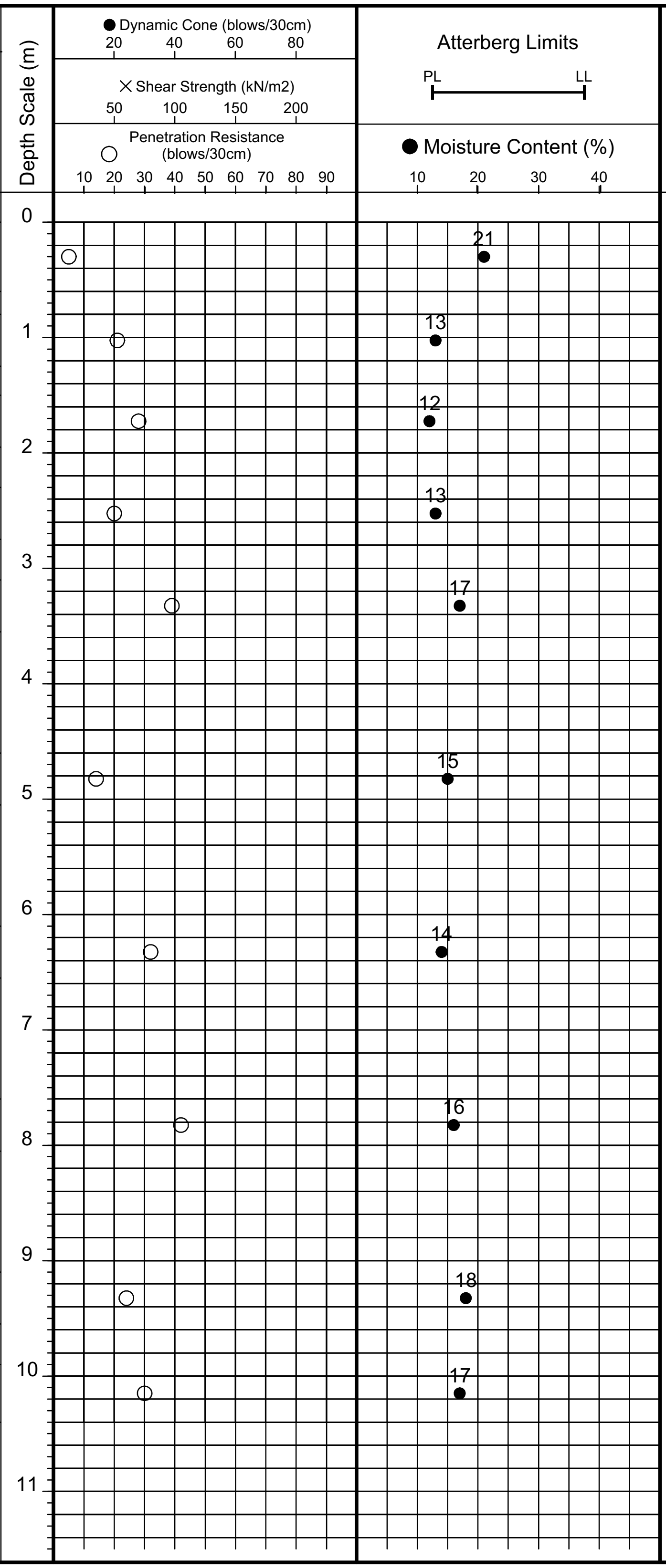
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 262.0	Ground Surface			
	15 cm TOPSOIL	1	DO	5
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed weathered	2	DO	21
		3	DO	28
		4	DO	20
		5	DO	39
	brown grey	6	DO	14
		7	DO	32
7.6 254.4	Grey, compact, wet **SILT** some sand a trace of clay	8	DO	42
		9	DO	24
		10	DO	30
10.4 251.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 253.5 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 2

FIGURE NO: 2

JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

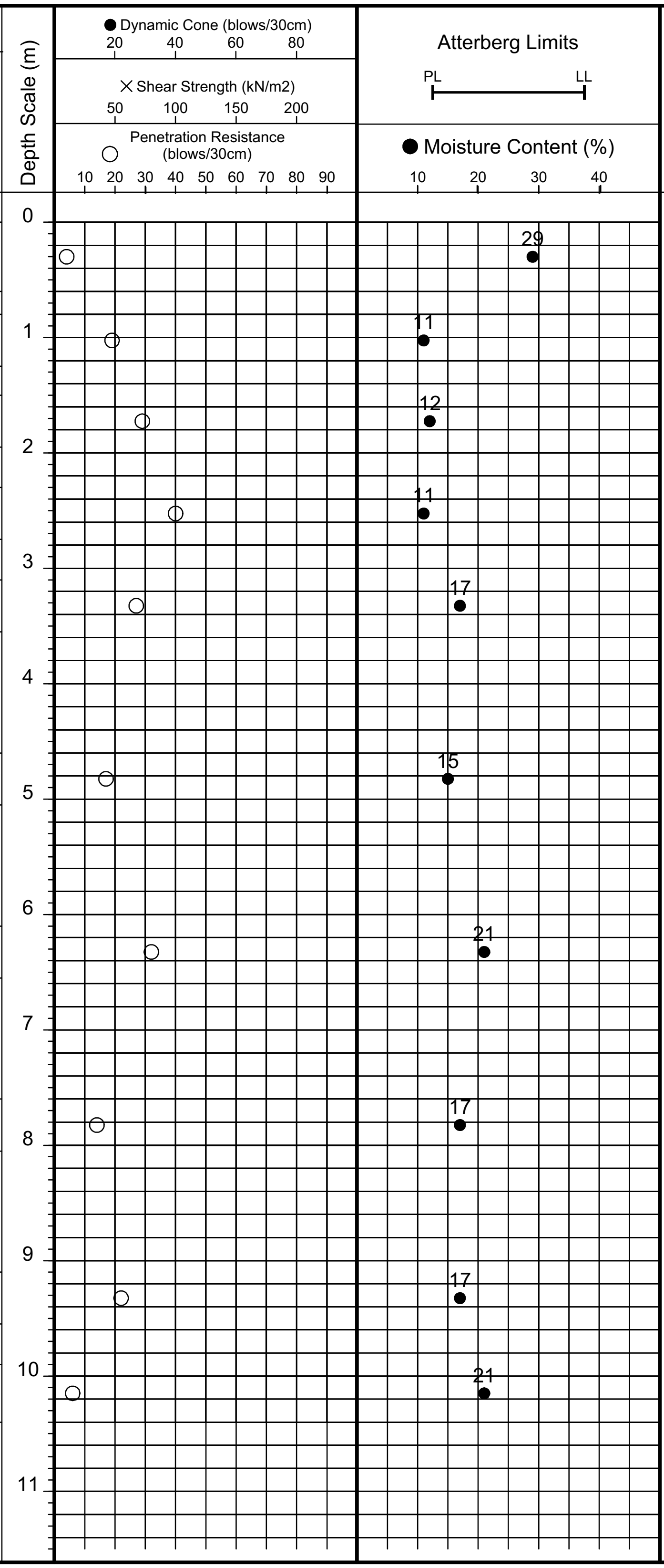
METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
259.8	**15 cm TOPSOIL**
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed weathered brown grey
6.1 253.7	Grey, compact, wet **SILT** some sand a trace of clay
10.4 249.4	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value
1	DO	4
2	DO	19
3	DO	29
4	DO	40
5	DO	27
6	DO	17
7	DO	32
8	DO	14
9	DO	22
10	DO	6



WATER LEVEL

W.L. @ El. 253.1 m upon completion

Soil Engineers Ltd.

TOWN OF CALEDON
PLANNING
RECEIVED

Dec 18, 2020

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 3

FIGURE NO: 3

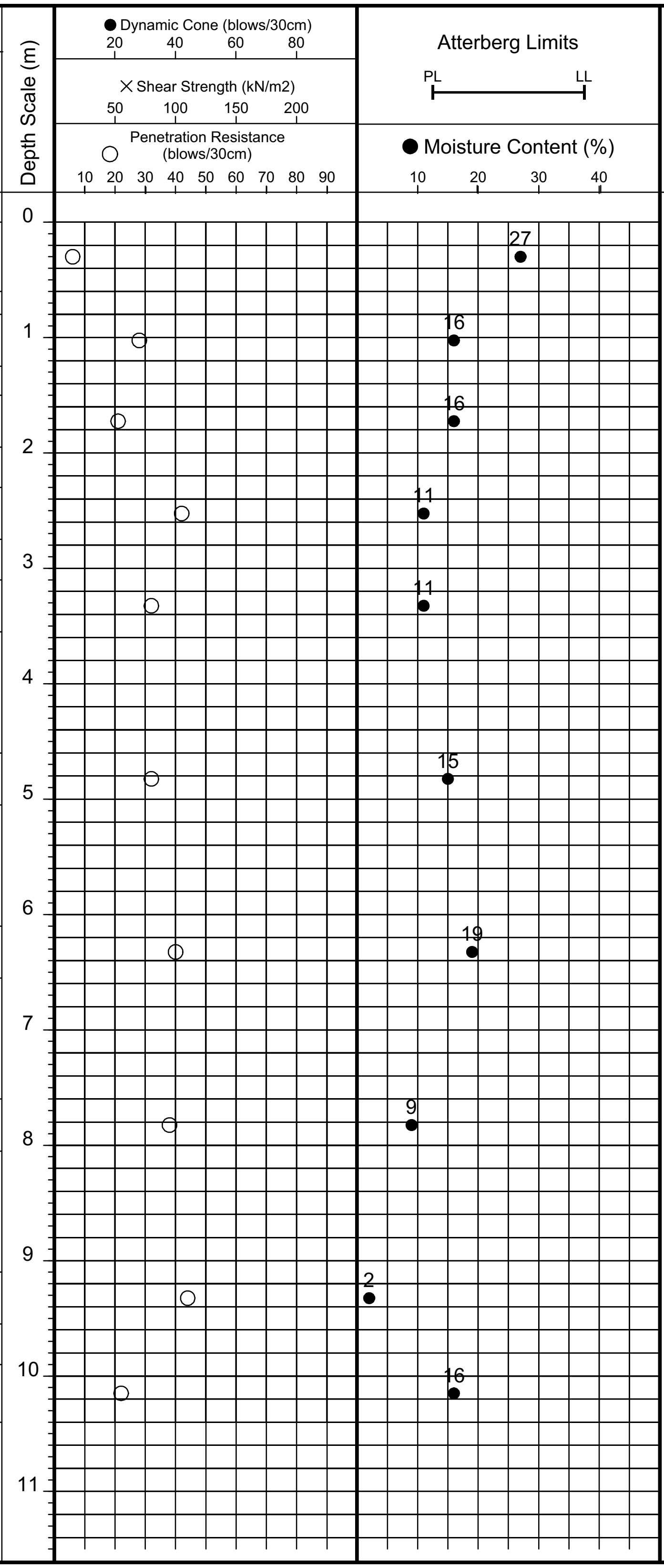
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 260.9	Ground Surface **15 cm TOPSOIL**			
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams	1	DO	6
	ploughed	2	DO	28
		3	DO	21
		4	DO	42
	brown grey	5	DO	32
		6	DO	32
	seepage	7	DO	40
		8	DO	38
		9	DO	44
9.5 251.4	Grey, compact, wet **SILT** some sand a trace of clay	10	DO	22
10.4 250.5	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 255.5 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 4

FIGURE NO: 4

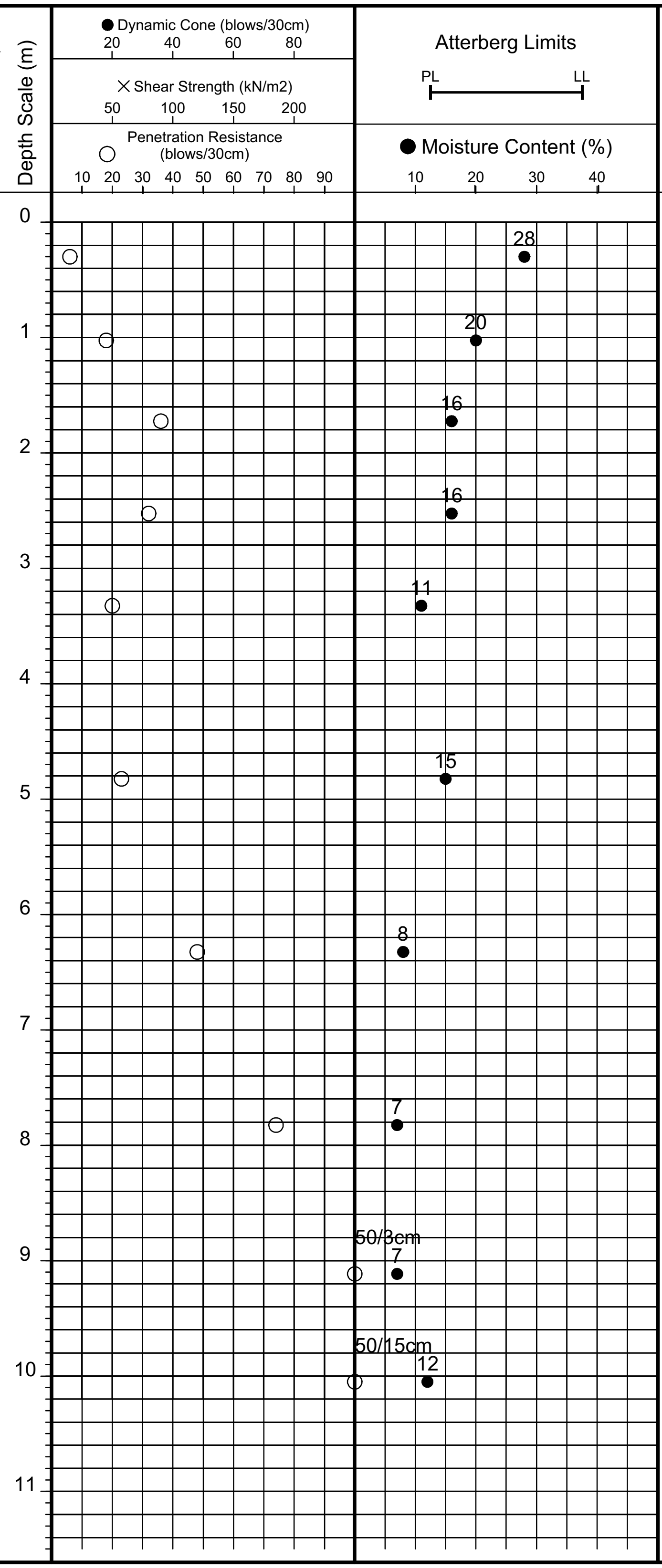
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION		SAMPLES Number	Type	N-Value
0.0 261.9	Ground Surface **10 cm TOPSOIL**				
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams		1	DO	6
		ploughed			
		weathered	2	DO	18
			3	DO	36
			4	DO	32
			5	DO	20
		brown grey	6	DO	23
		seepage			
			7	DO	48
			8	DO	74
			9	DO	50/3
9.9 252.0	Grey, very dense		10	DO	50/15
10.2 251.7	**SILT** some sand a trace of clay				
	END OF BOREHOLE				



WATER LEVEL

∇ W.L. @ El. 256.5 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 5

FIGURE NO: 5

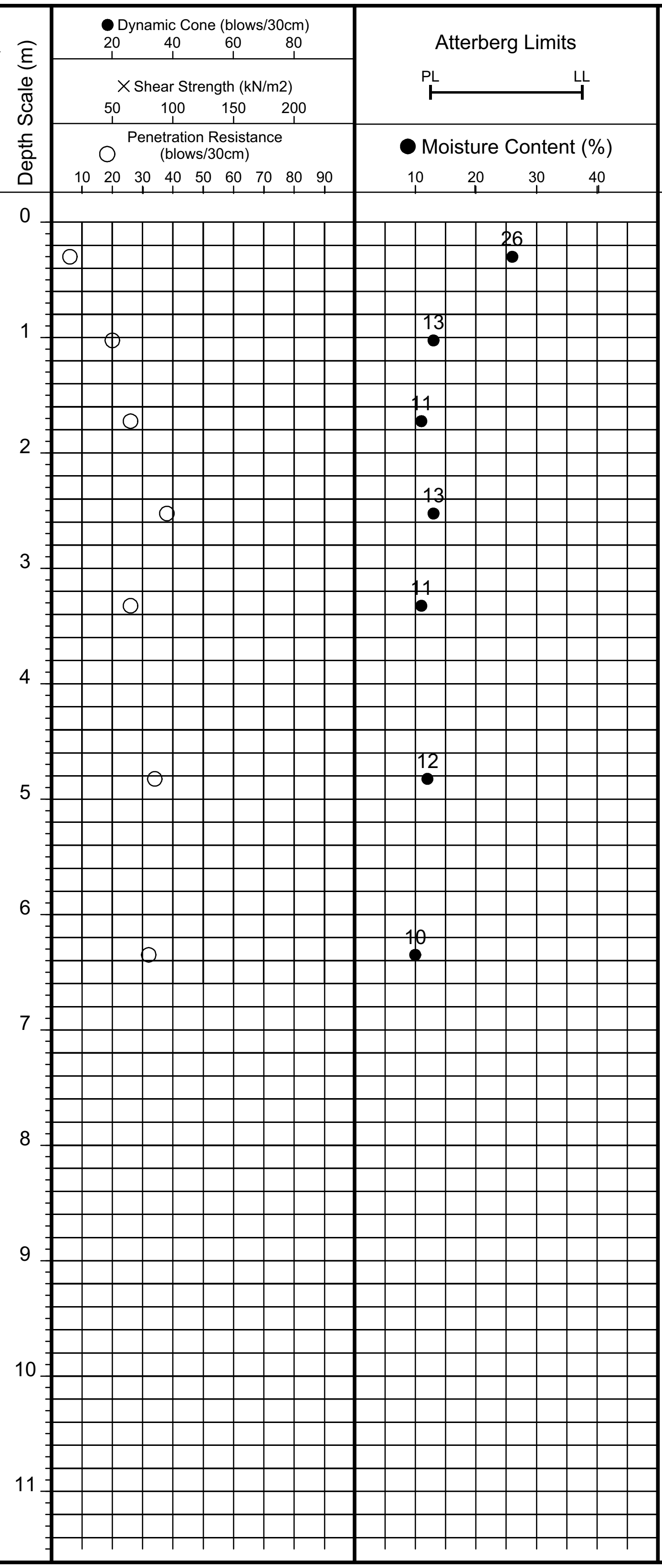
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 26, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES			WATER LEVEL
		Number	Type	N-Value	
0.0 261.3	Ground Surface **20 cm TOPSOIL**				
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams	1	DO	6	
	ploughed weathered	2	DO	20	
		3	DO	26	
		4	DO	38	
		5	DO	26	
	brown grey	6	DO	34	
		7	DO	32	
6.6 254.7	**END OF BOREHOLE**				Dry upon completion



LOG OF BOREHOLE NO: 6

JOB NO: 1604-S017

FIGURE NO: 6

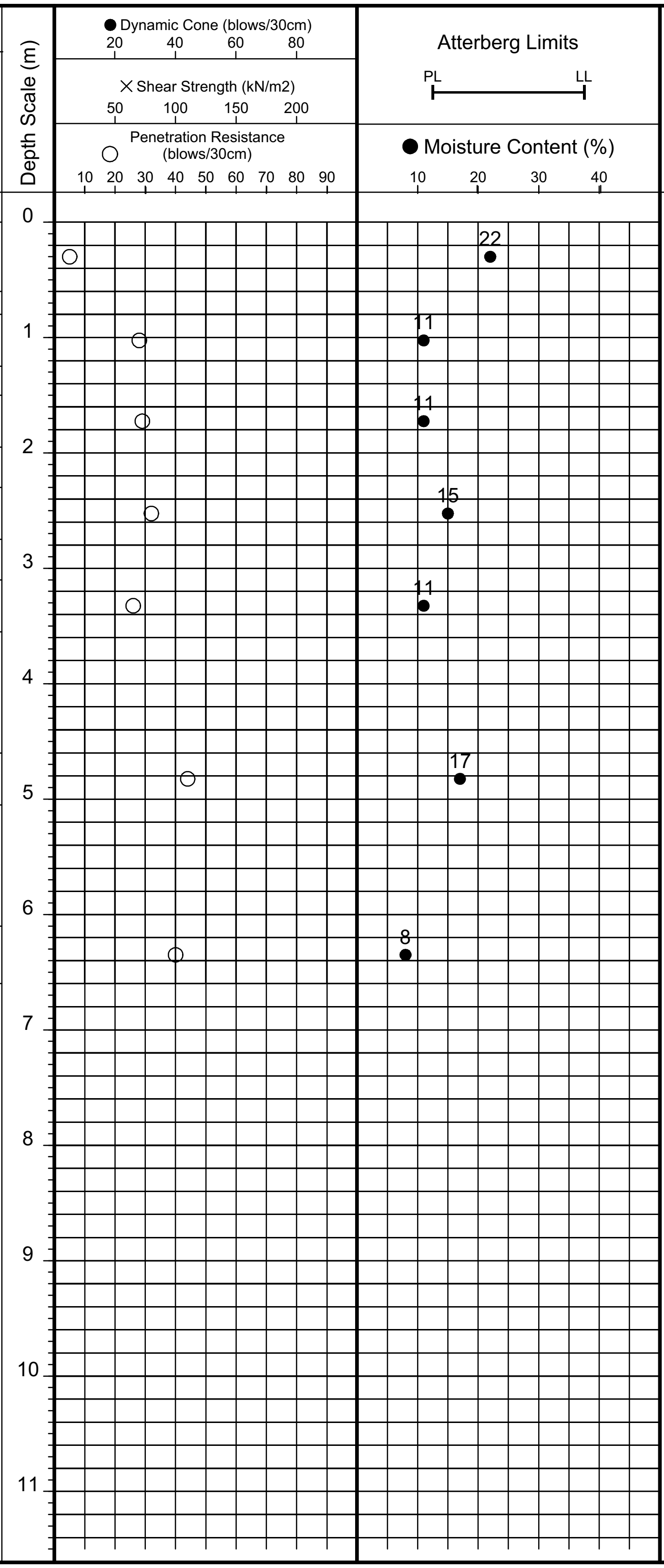
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 26, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0 260.3	Ground Surface **20 cm TOPSOIL** Compact to dense **SILT, Till** ploughed some sand a trace to some clay occ. sand seams brown grey	1	DO	5
		2	DO	28
		3	DO	29
		4	DO	32
		5	DO	26
		6	DO	44
		7	DO	40
6.6 253.7	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 7

FIGURE NO: 7

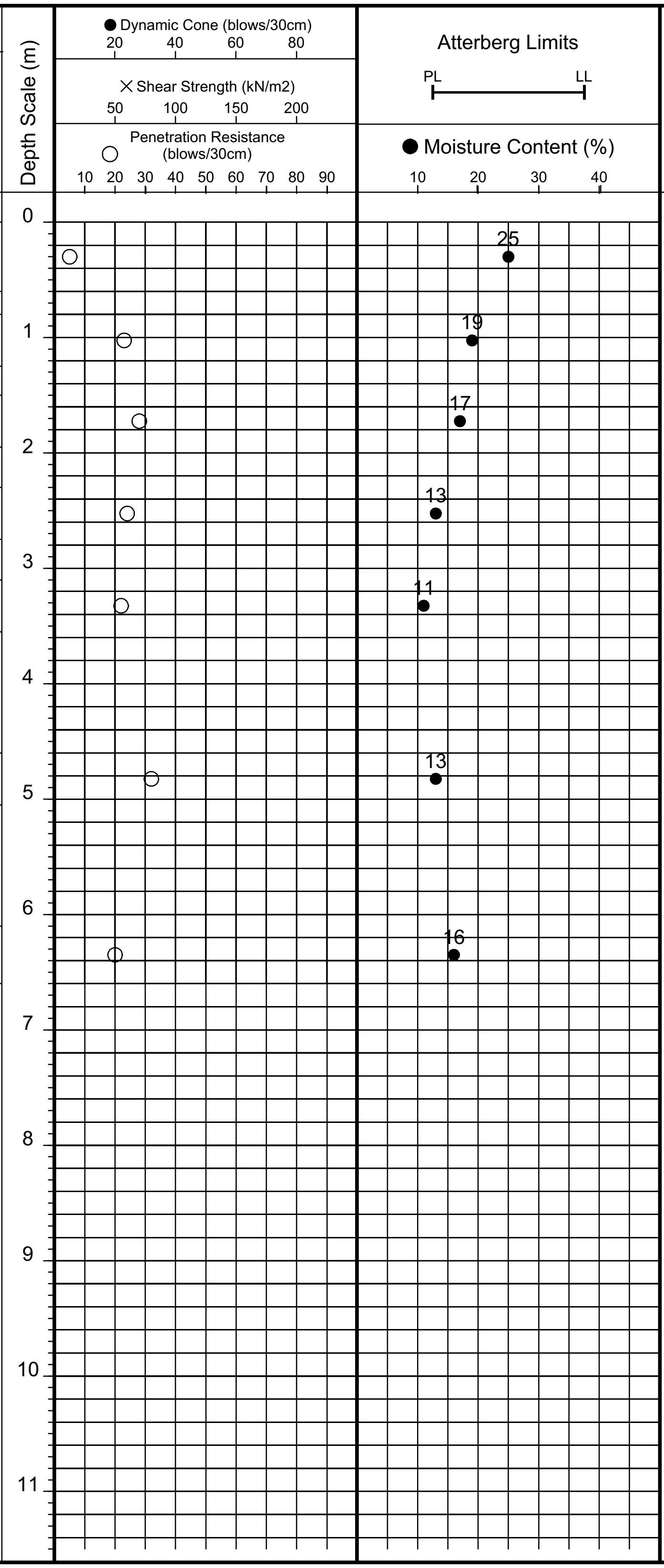
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 26, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 261.7	Ground Surface **20 cm TOPSOIL**			
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams	1	DO	5
	ploughed			
	weathered	2	DO	23
		3	DO	28
		4	DO	24
		5	DO	22
	brown grey	6	DO	32
	seepage			
		7	DO	20
6.6 255.1	**END OF BOREHOLE**			



WATER LEVEL

∇ W.L. @ El. 256.3 m upon completion

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JOB NO: 1604-S017

LOG OF BOREHOLE NO: 8

FIGURE NO: 8

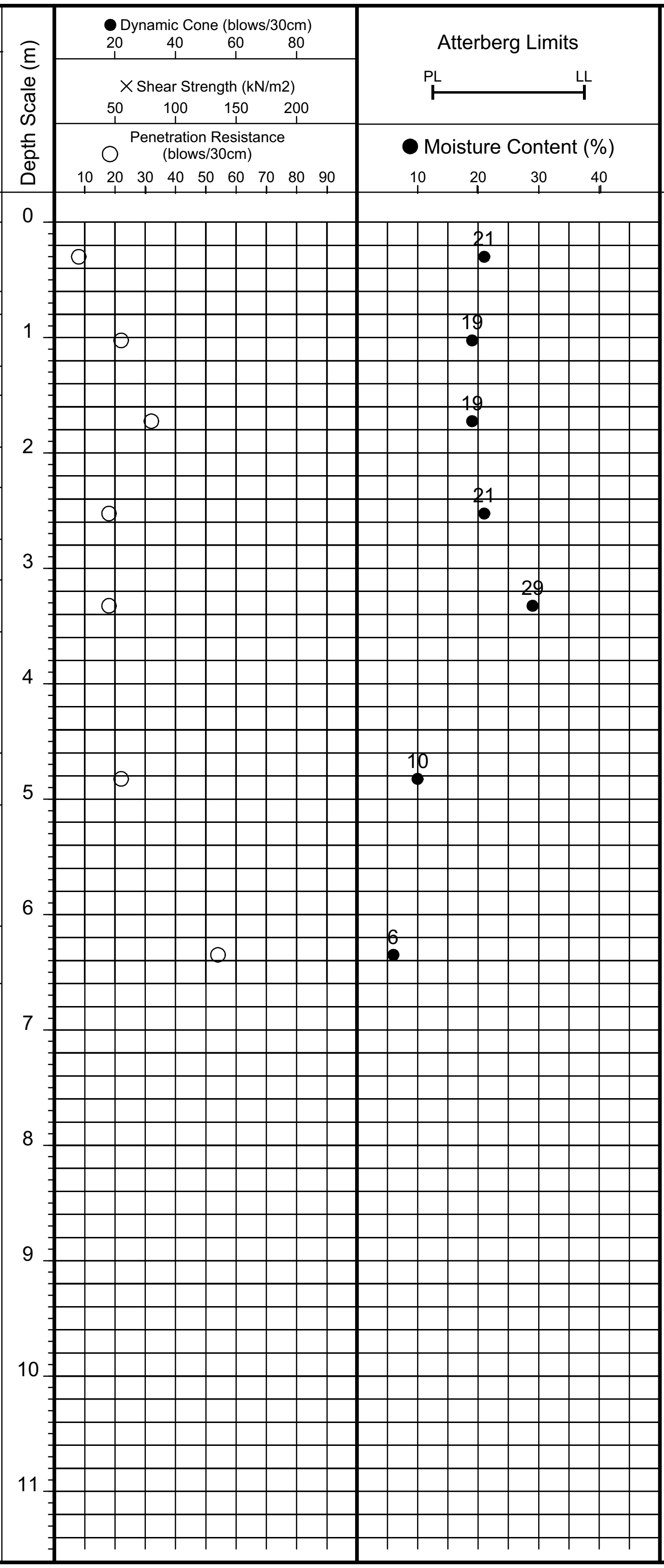
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 26, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 262.2	Ground Surface			
	20 cm TOPSOIL	1	DO	8
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed weathered	2	DO	22
		3	DO	32
		4	DO	18
	fine sand layer	5	DO	18
	brown grey	6	DO	22
6.6		7	DO	54
255.6	**END OF BOREHOLE**			



WATER LEVEL

∇

W.L. @ El. 257.9 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 9

FIGURE NO: 9

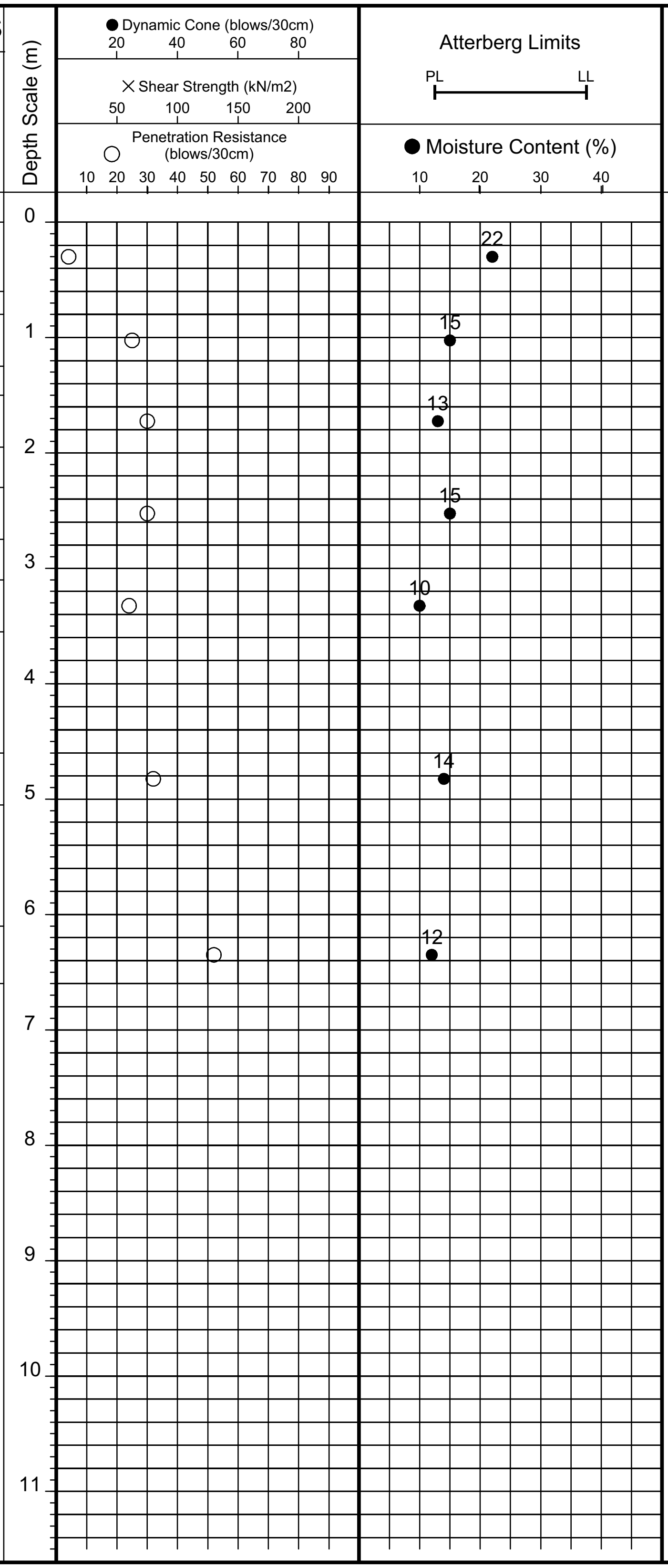
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 29, 2016

Depth Elev. (m)	SOIL DESCRIPTION	Number	Type	N-Value	Moisture Content (%)
0.0	Ground Surface				
263.0	**25 cm TOPSOIL**				
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed	1	DO	4	22
	weathered	2	DO	25	15
		3	DO	30	13
		4	DO	30	15
	brown grey	5	DO	24	10
		6	DO	32	14
		7	DO	52	12
6.6 256.4	**END OF BOREHOLE**				



WATER LEVEL

∇ W.L. @ El. 257.2 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 10

FIGURE NO: 10

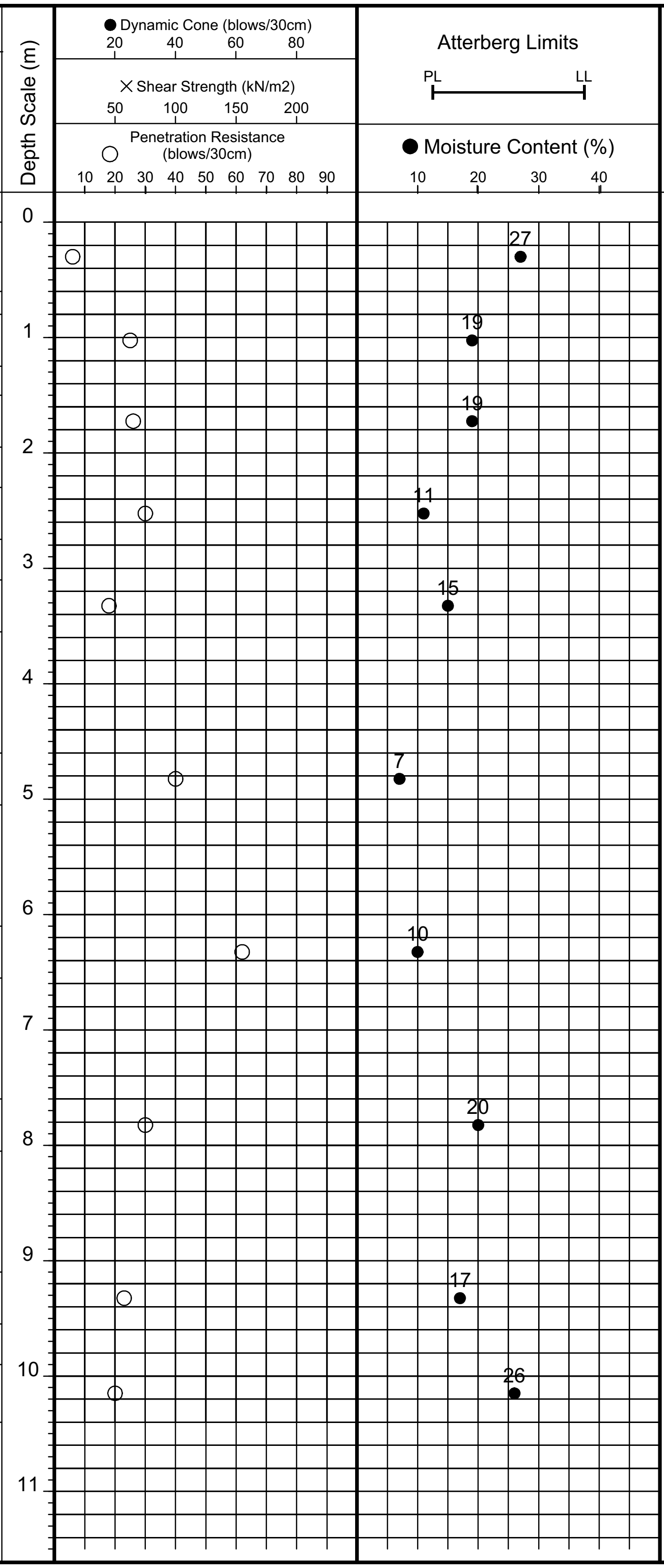
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION	Number	Type	N-Value	Moisture Content (%)
0.0 262.5	Ground Surface **20 cm TOPSOIL**				
	Compact to very dense **SILT, Till**, some sand, a trace to some clay, occ. sand seams ploughed	1	DO	6	27
	weathered	2	DO	25	19
		3	DO	26	19
		4	DO	30	11
		5	DO	18	15
	brown grey	6	DO	40	7
		7	DO	62	10
7.6 254.9	Grey, compact, wet **SILT**, some sand, a trace of clay	8	DO	30	20
		9	DO	23	17
		10	DO	20	26
10.4 252.1	**END OF BOREHOLE**				



WATER LEVEL

W.L. @ El. 257.1 m upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 11

FIGURE NO: 11

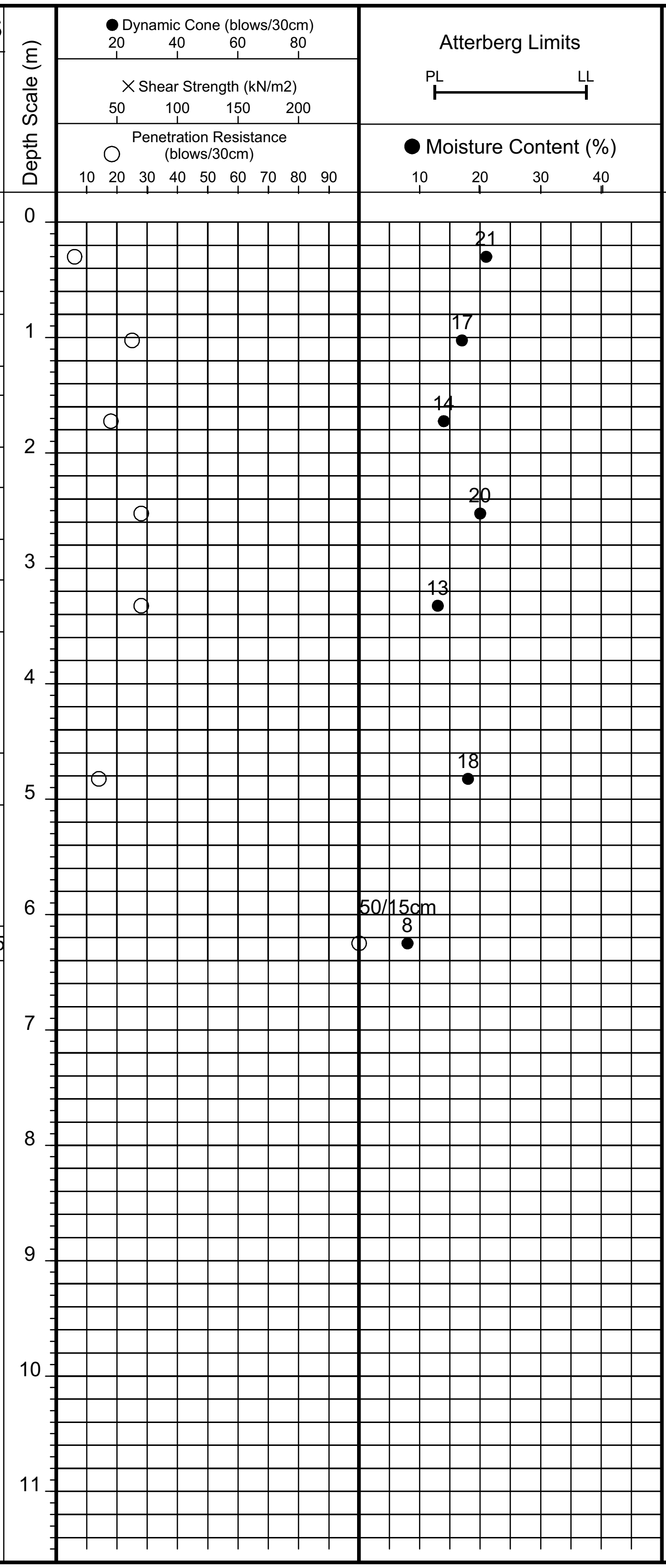
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 29, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0 264.5	Ground Surface **20 cm TOPSOIL**			
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed	1	DO	6
	weathered	2	DO	25
		3	DO	18
		4	DO	28
		5	DO	28
	brown grey	6	DO	14
		7	DO	50/15
6.4 258.1	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

TOWN OF CALEDON
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JOB NO: 1604-S017

LOG OF BOREHOLE NO: 12

FIGURE NO: 12

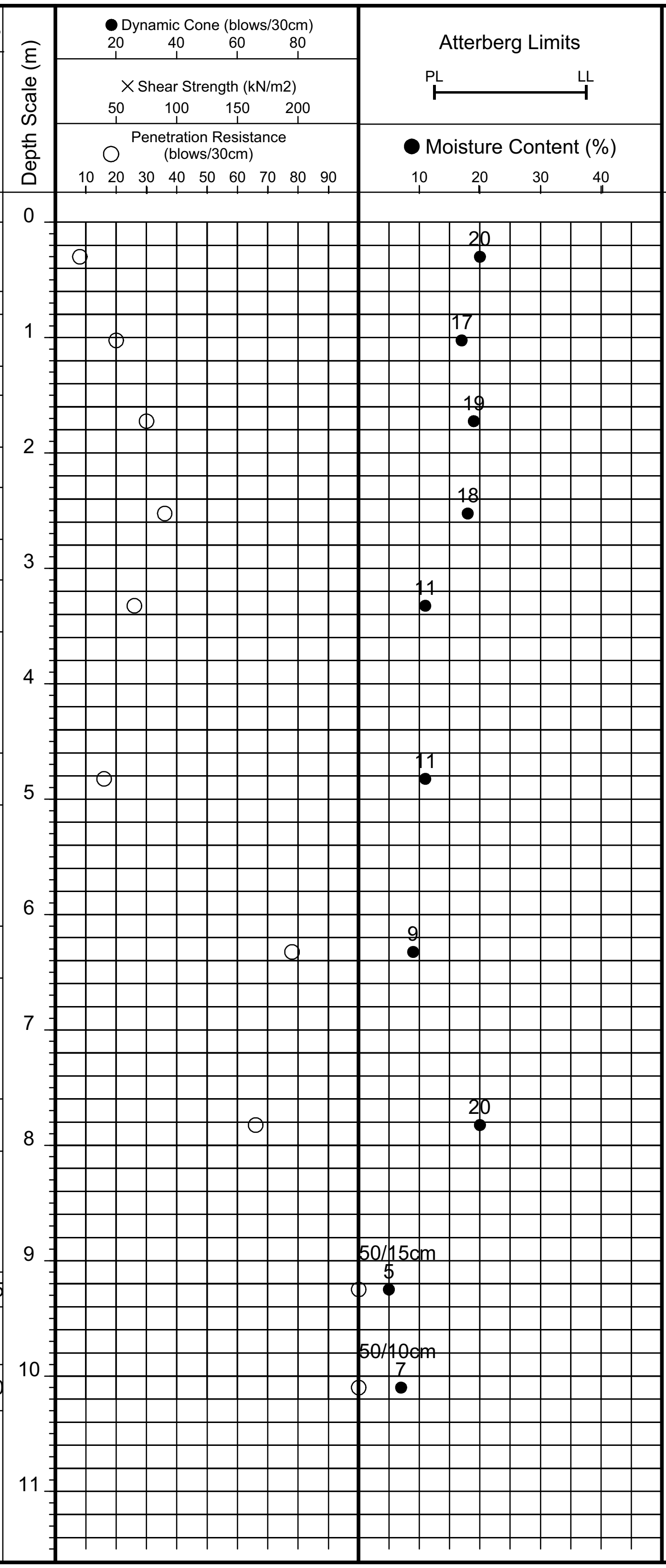
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
263.7	**15 cm TOPSOIL**			
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams; ploughed	1	DO	8
	weathered	2	DO	20
		3	DO	30
		4	DO	36
	brown grey	5	DO	26
		6	DO	16
		7	DO	78
7.6 256.1	Grey, very dense, wet **SILT** some sand occ. clay seams	8	DO	66
9.1 254.6	Reddish brown, very dense **SILTY SAND, Till** some gravel a trace to some clay occ. rock fragments	9	DO	50/15
10.2 253.5	**END OF BOREHOLE**	10	DO	50/10



WATER LEVEL

∇ W.L. @ El. 257.0 m upon completion

Soil Engineers Ltd.

LOG OF BOREHOLE NO: 13

JOB NO: 1604-S017

FIGURE NO: 13

JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

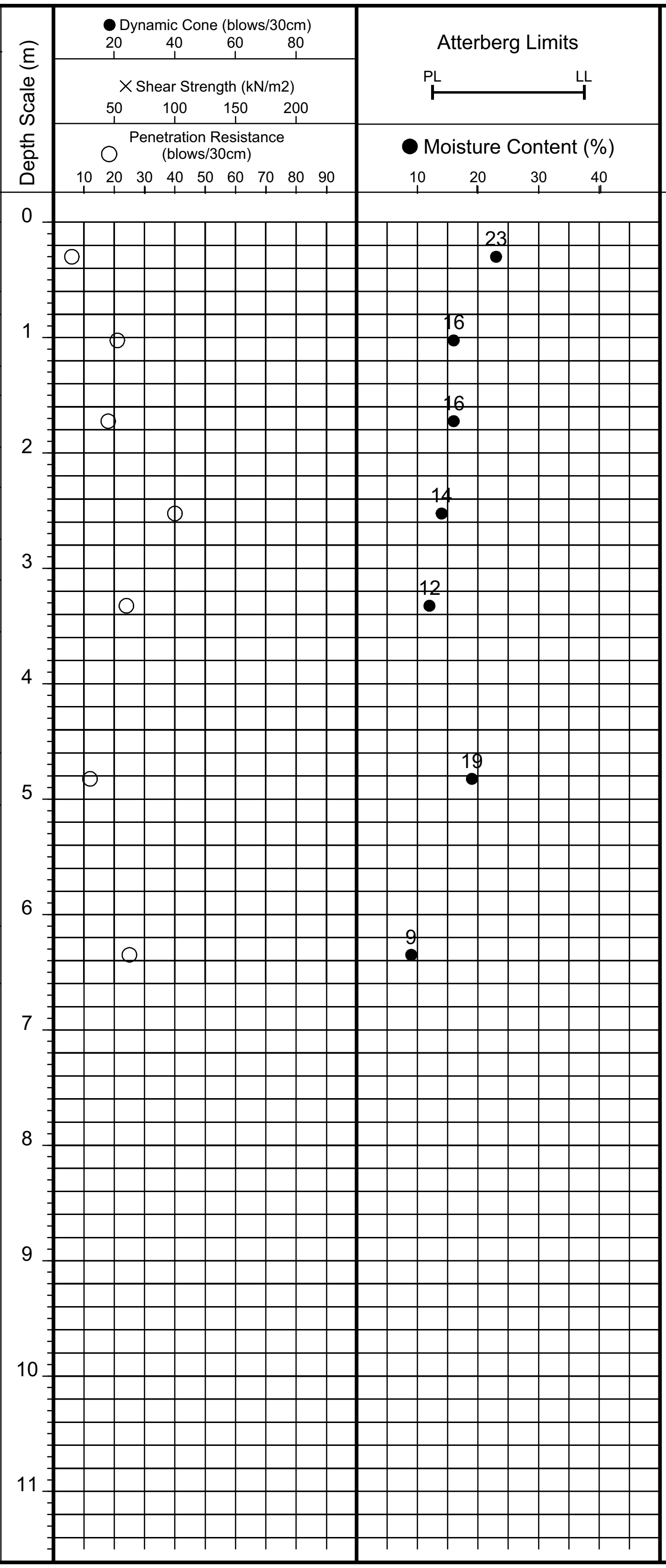
METHOD OF BORING: Flight Auger

DATE: April 27, 2016

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
263.9	**20 cm TOPSOIL**
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed brown grey
6.6 257.3	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value	Moisture Content (%)
1	DO	6	23
2	DO	21	16
3	DO	18	16
4	DO	40	14
5	DO	24	12
6	DO	12	19
7	DO	25	9



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 14

FIGURE NO: 14

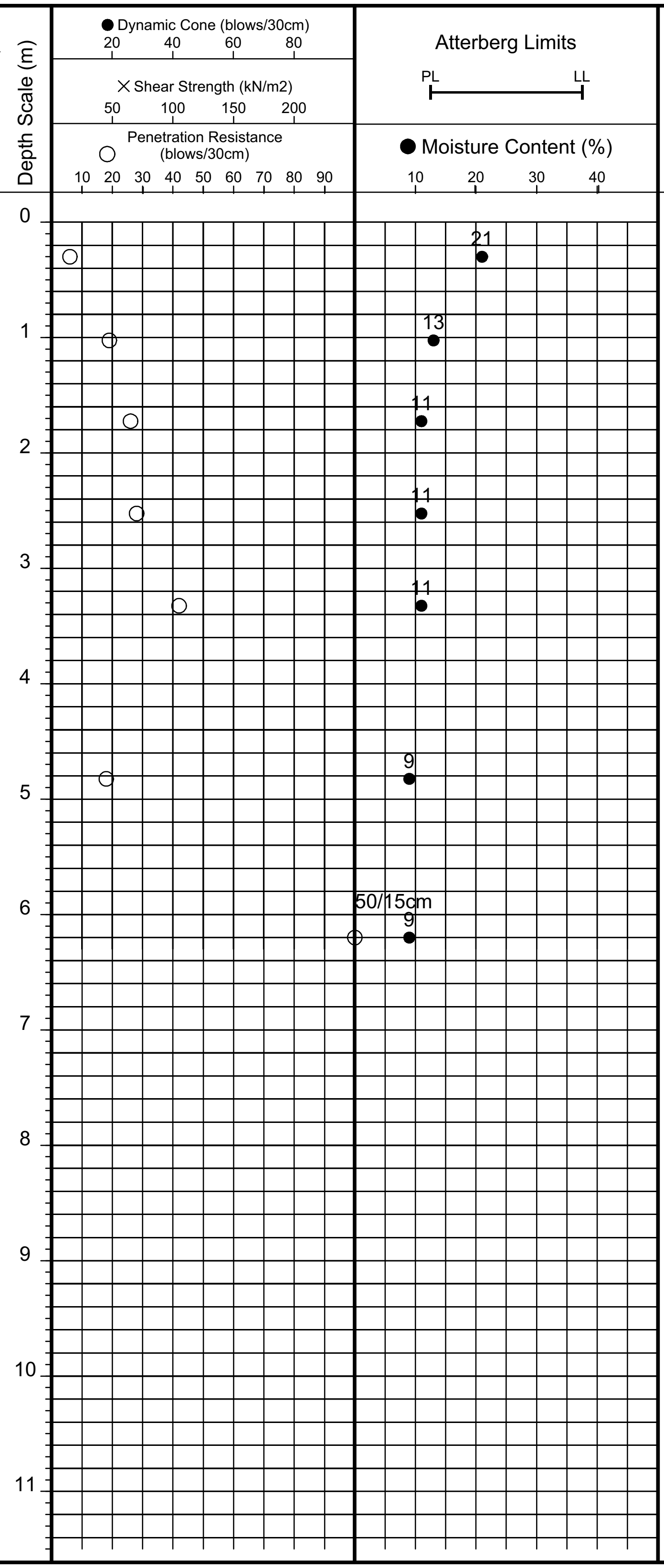
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 29, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
263.6	**20 cm TOPSOIL**			
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed	1	DO	6
	weathered	2	DO	19
		3	DO	26
		4	DO	28
		5	DO	42
	brown grey	6	DO	18
6.3		7	DO	50/15
257.3	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 15

FIGURE NO: 15

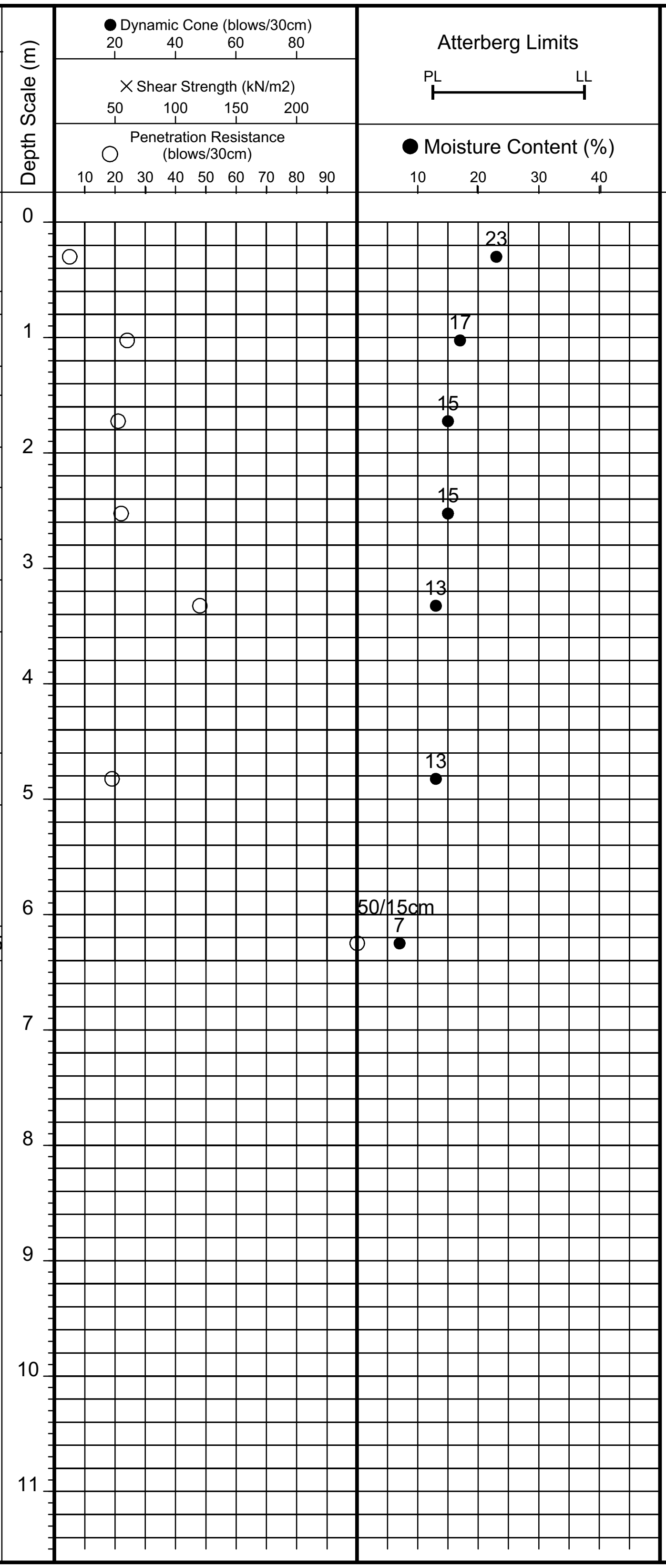
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
263.3	**20 cm TOPSOIL**			
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams	1	DO	5
	ploughed	2	DO	24
		3	DO	21
		4	DO	22
	occ. rock fragments	5	DO	48
	brown grey	6	DO	19
6.1 257.2	Reddish brown, very dense **SILTY SAND, Till** some gravel a trace of clay occ. rock fragments	7	DO	50/15
6.4 256.9	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 16

FIGURE NO: 16

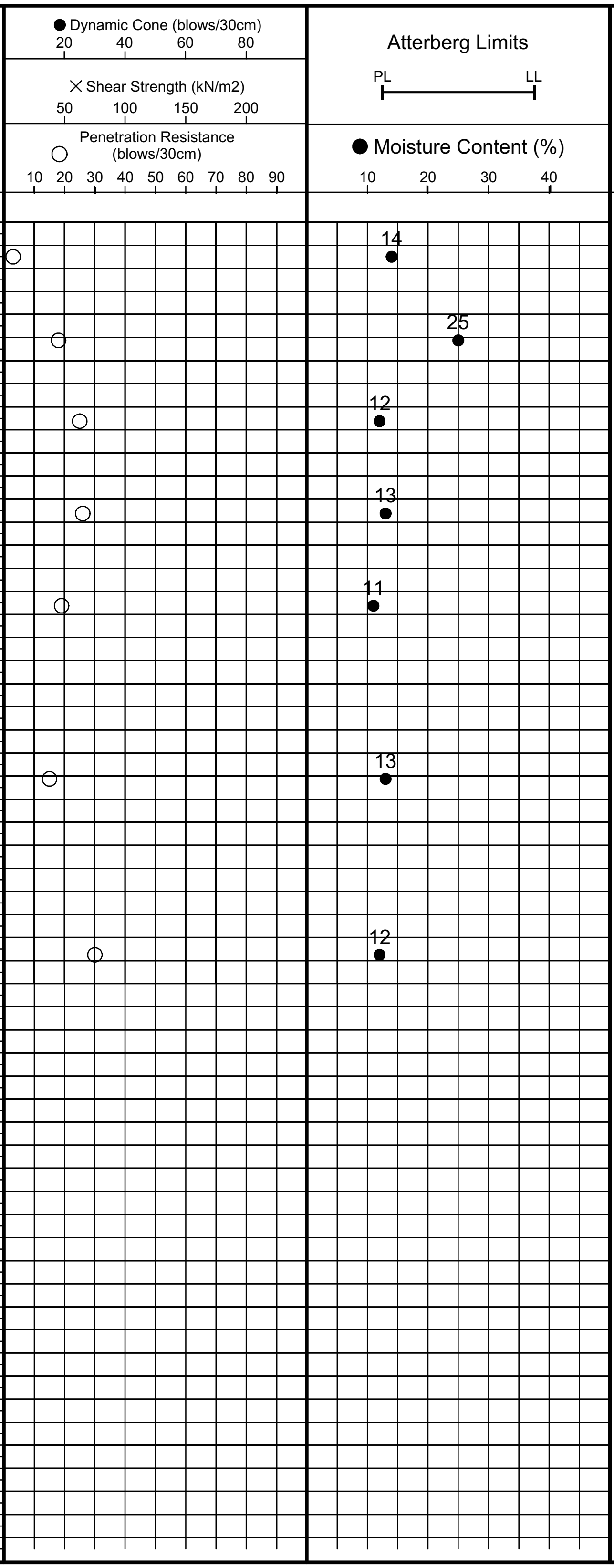
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Moisture Content (%)	WATER LEVEL
0.0	Ground Surface				0		
261.9	**25 cm TOPSOIL**						
	Compact ploughed	1	DO	3		14	
	SILT, Till weathered	2	DO	18	1	25	
	some sand a trace to some clay occ. sand seams	3	DO	25	2	12	
		4	DO	26		13	
	brown grey	5	DO	19	3	11	
					4		
		6	DO	15	5	13	
					6		∇
		7	DO	30		12	
6.6 255.3	**END OF BOREHOLE**				7		
					8		
					9		
					10		
					11		



W.L. @ El. 256.1 m upon completion

Soil Engineers Ltd.

LOG OF BOREHOLE NO: 17

JOB NO: 1604-S017

FIGURE NO: 17

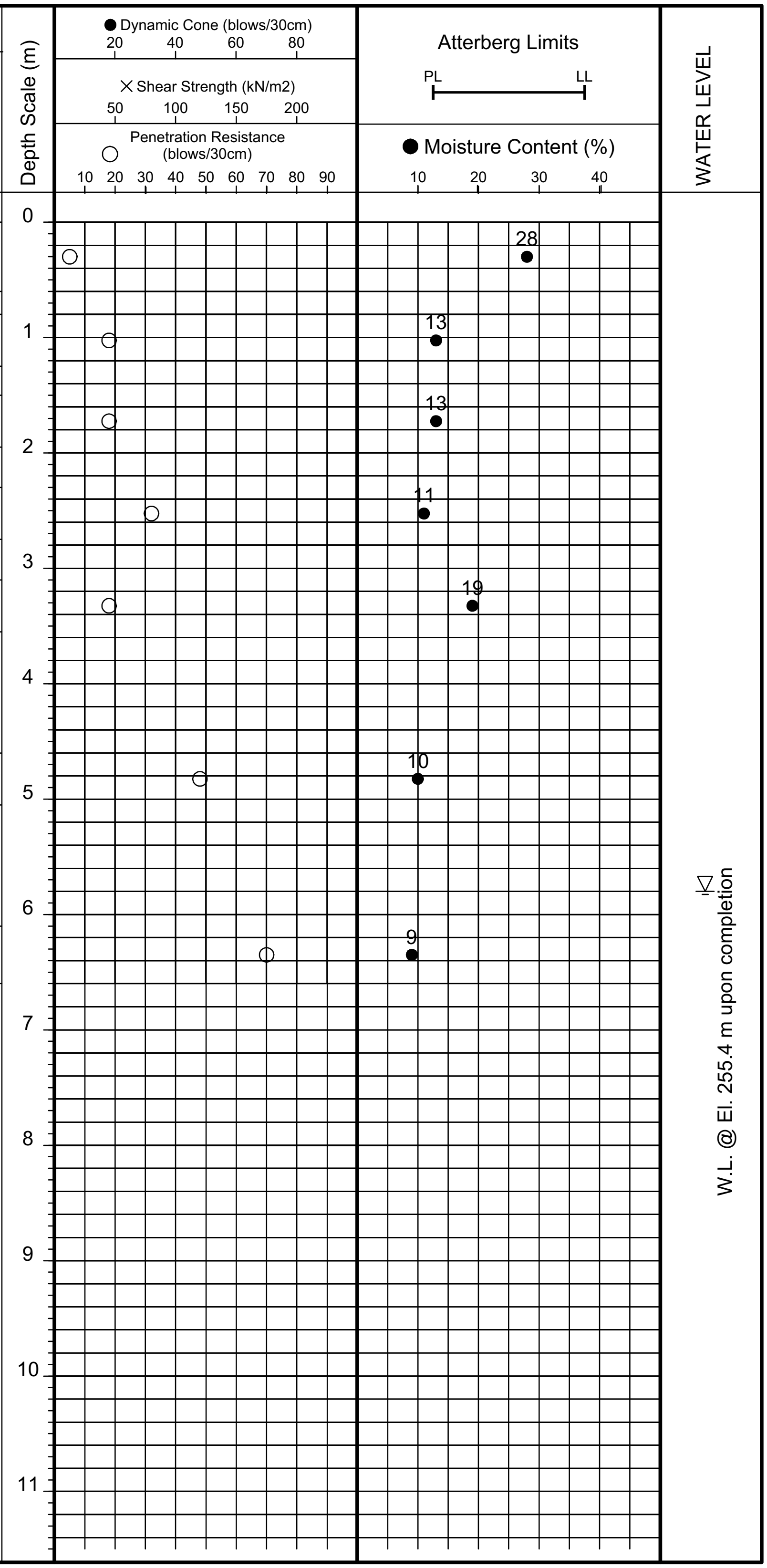
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0 261.2	Ground Surface **25 cm TOPSOIL**			
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams	1	DO	5
	ploughed			
	weathered	2	DO	18
		3	DO	18
		4	DO	32
	brown grey seepage	5	DO	18
		6	DO	48
6.1 255.1	Reddish brown, very dense **SILTY SAND, Till** some gravel a trace of clay	7	DO	70
6.6 254.6	**END OF BOREHOLE**			



JOB NO: 1604-S017

LOG OF BOREHOLE NO: 18

FIGURE NO: 18

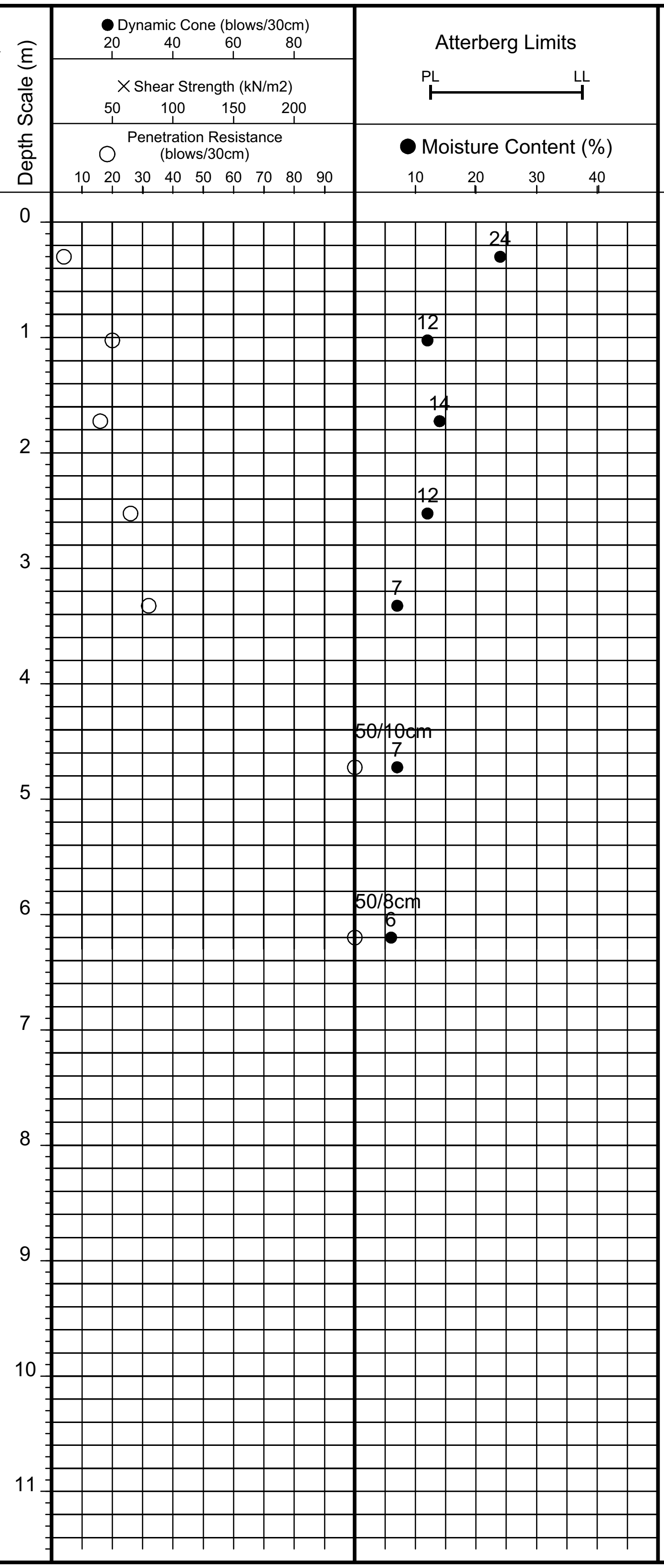
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
260.6	**20 cm TOPSOIL**	1	DO	4
	Compact to very dense			
	SILT, Till ploughed / weathered	2	DO	20
	some sand a trace to some clay occ. sand seams	3	DO	16
		4	DO	26
		5	DO	32
	brown / grey	6	DO	50/10
6.3		7	DO	50/8
254.3	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO: 1604-S017

LOG OF BOREHOLE NO: 19

FIGURE NO: 19

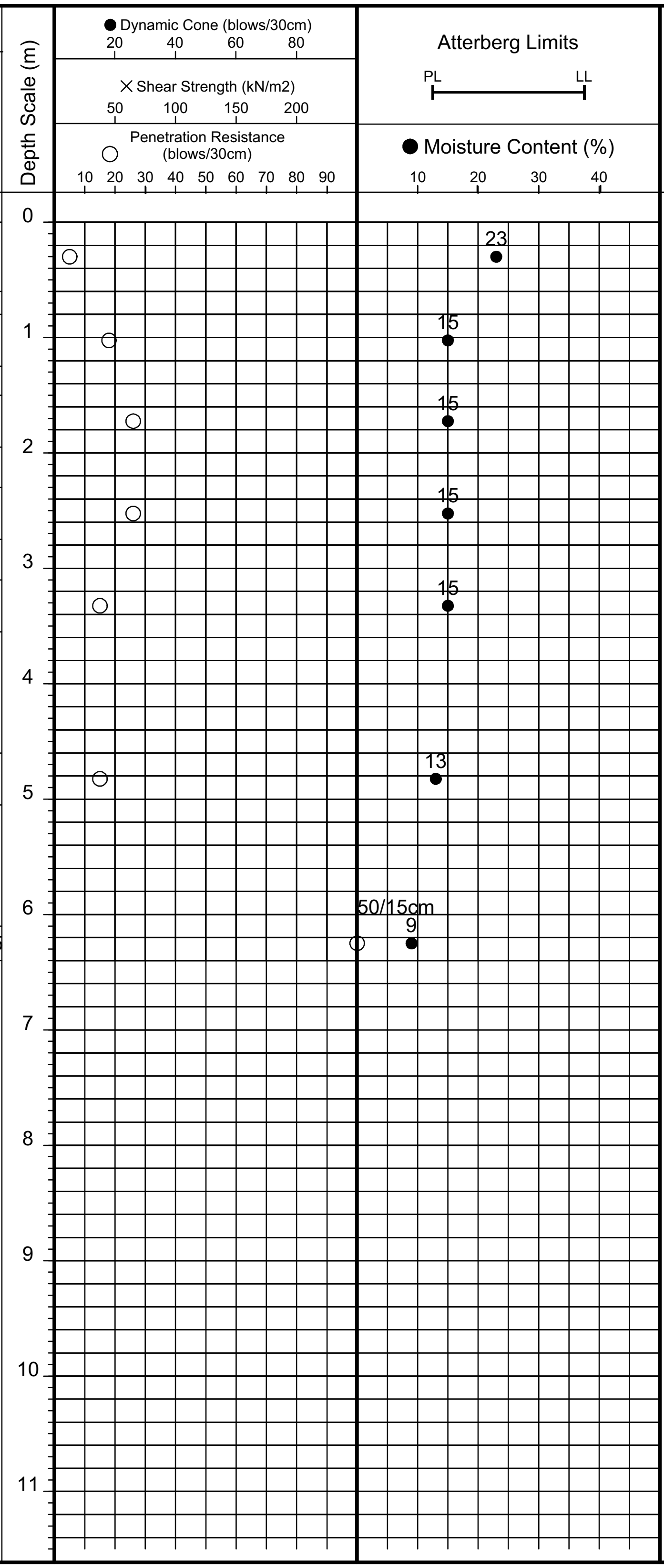
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES			WATER LEVEL
		Number	Type	N-Value	
0.0 261.9	Ground Surface **20 cm TOPSOIL**				
	Compact to very dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed	1	DO	5	
	weathered	2	DO	18	
		3	DO	26	
		4	DO	26	
	brown grey	5	DO	15	
		6	DO	15	
6.4		7	DO	50/15	
255.5	**END OF BOREHOLE**				Dry upon completion



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JOB NO: 1604-S017

LOG OF BOREHOLE NO: 20

FIGURE NO: 20

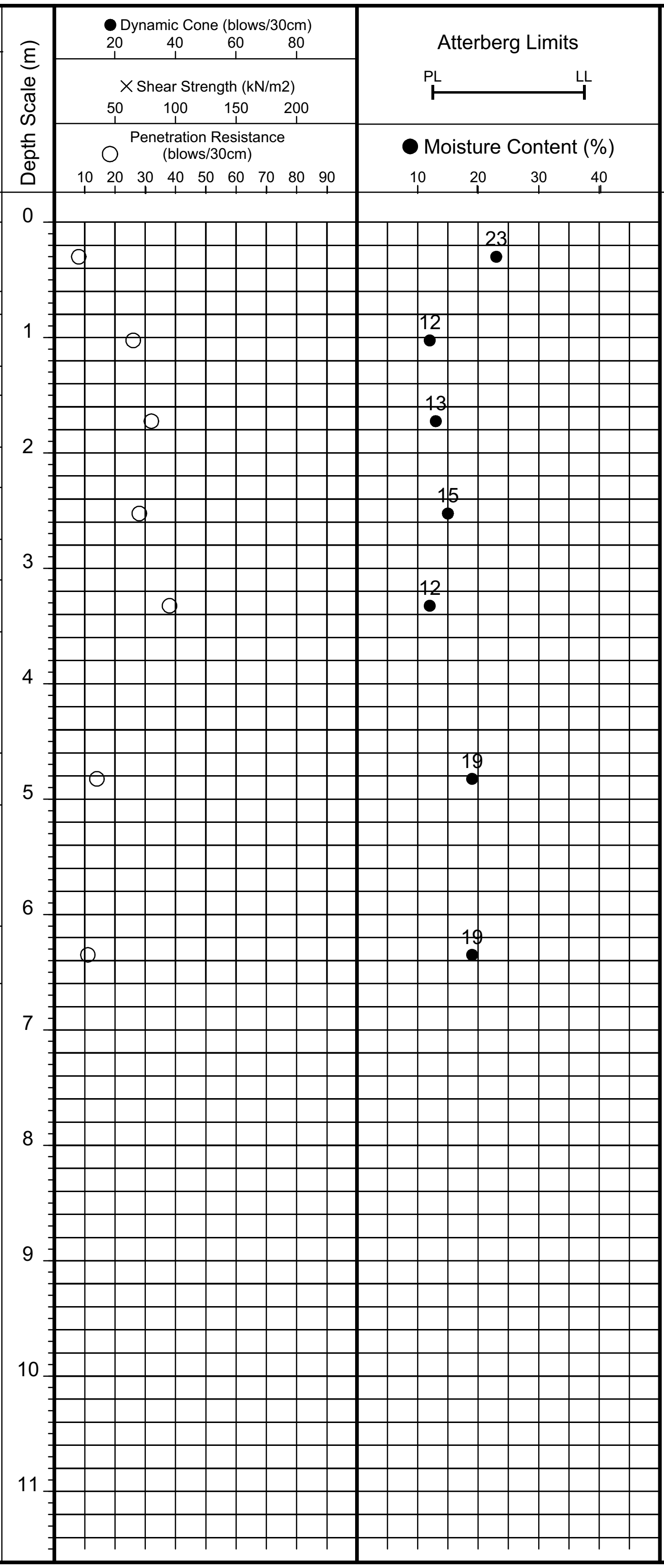
JOB DESCRIPTION: Proposed Subdivision

JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

METHOD OF BORING: Flight Auger

DATE: April 28, 2016

Depth Elev. (m)	SOIL DESCRIPTION	Number	Type	N-Value
0.0	Ground Surface			
262.8	**20 cm TOPSOIL**			
	Compact to dense **SILT, Till** some sand a trace to some clay occ. sand seams ploughed	1	DO	8
	weathered	2	DO	26
		3	DO	32
		4	DO	28
		5	DO	38
	brown grey	6	DO	14
		7	DO	11
6.6 256.2	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

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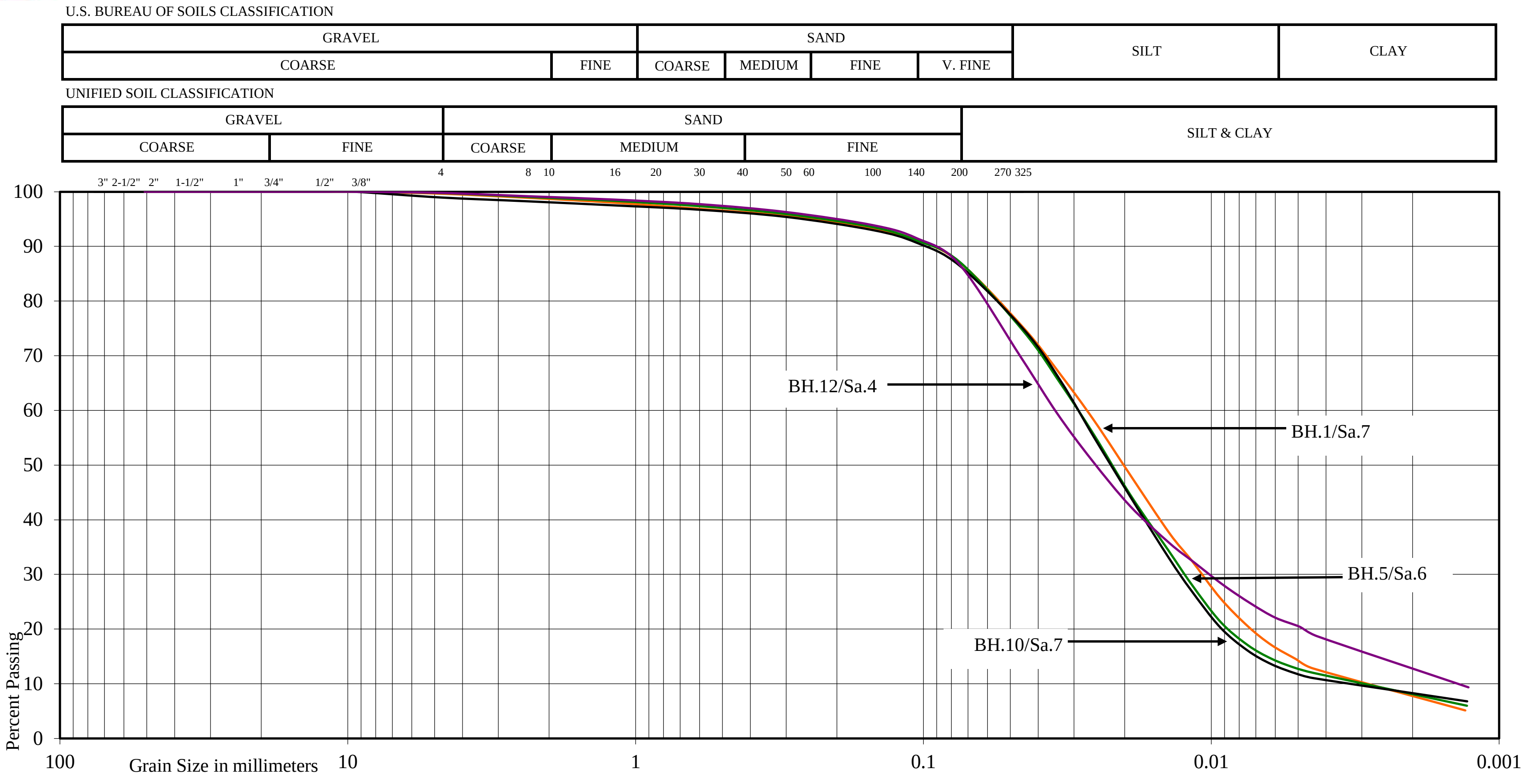
GRAIN SIZE DISTRIBUTION

Reference No: 1604-S017



Project: Proposed Subdivision

Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon

Borehole No:	1	5	10	12
Sample No:	7	6	7	4
Depth (m):	6.3	4.8	6.3	2.5
Elevation (m):	255.7	256.5	256.2	261.2

BH./Sa.	1/7	5/6	10/7	12/4
Liquid Limit (%) =	-	-	-	-
Plastic Limit (%) =	-	-	-	-
Plasticity Index (%) =	-	-	-	-
Moisture Content (%) =	14	12	10	18
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-5}	10^{-5}	10^{-6}

Classification of Sample [& Group Symbol]: SILT, Till
some sand, a trace to some clay

Figure: 21

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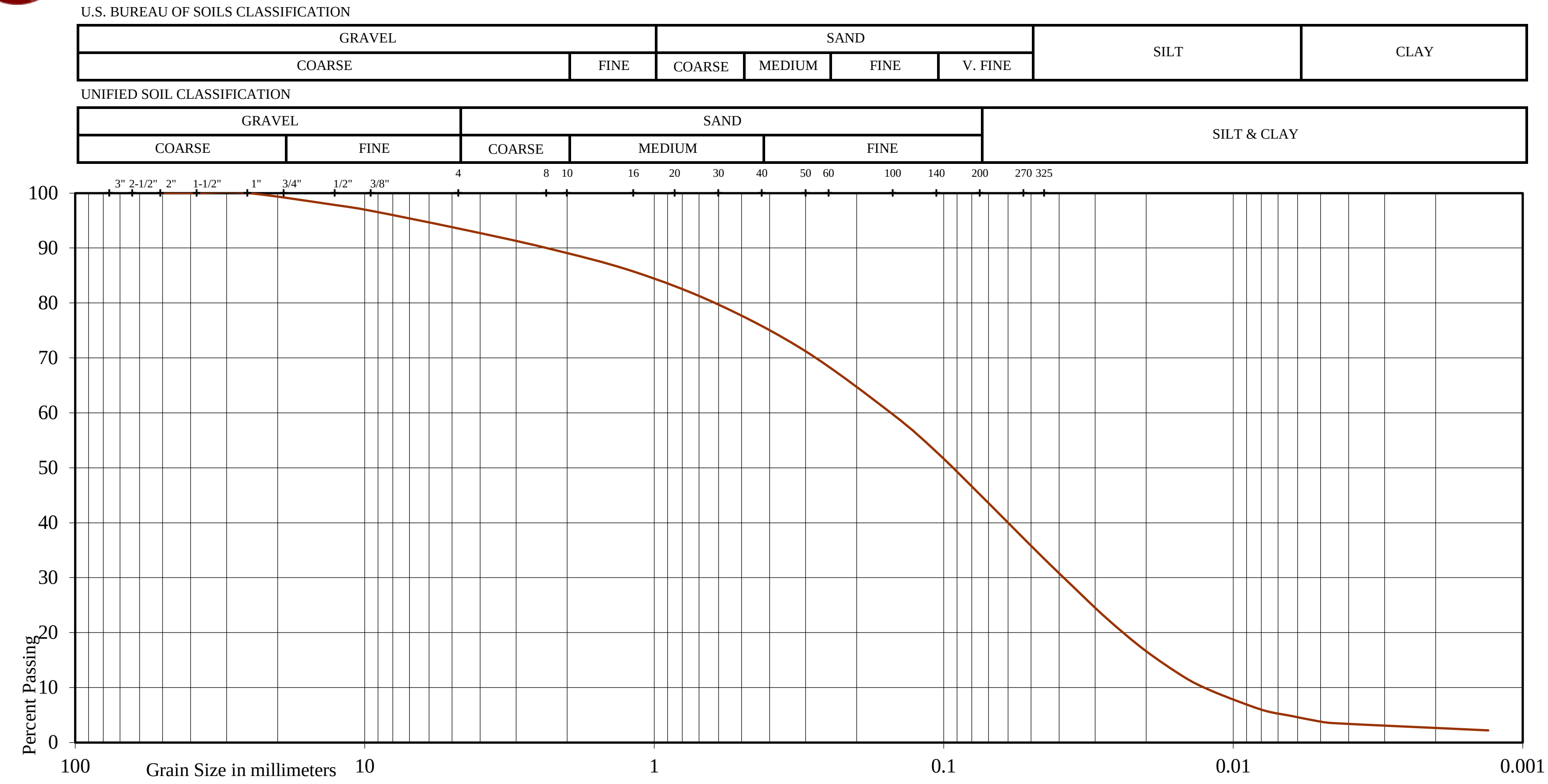
GRAIN SIZE DISTRIBUTION

Reference No: 1604-S017



Project: Proposed Subdivision

Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon

Borehole No: 17

Sample No: 7

Depth (m): 6.3

Elevation (m): 254.9

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 9

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

Classification of Sample [& Group Symbol]: SILTY SAND, Till
traces of clay and gravel

Figure: 22

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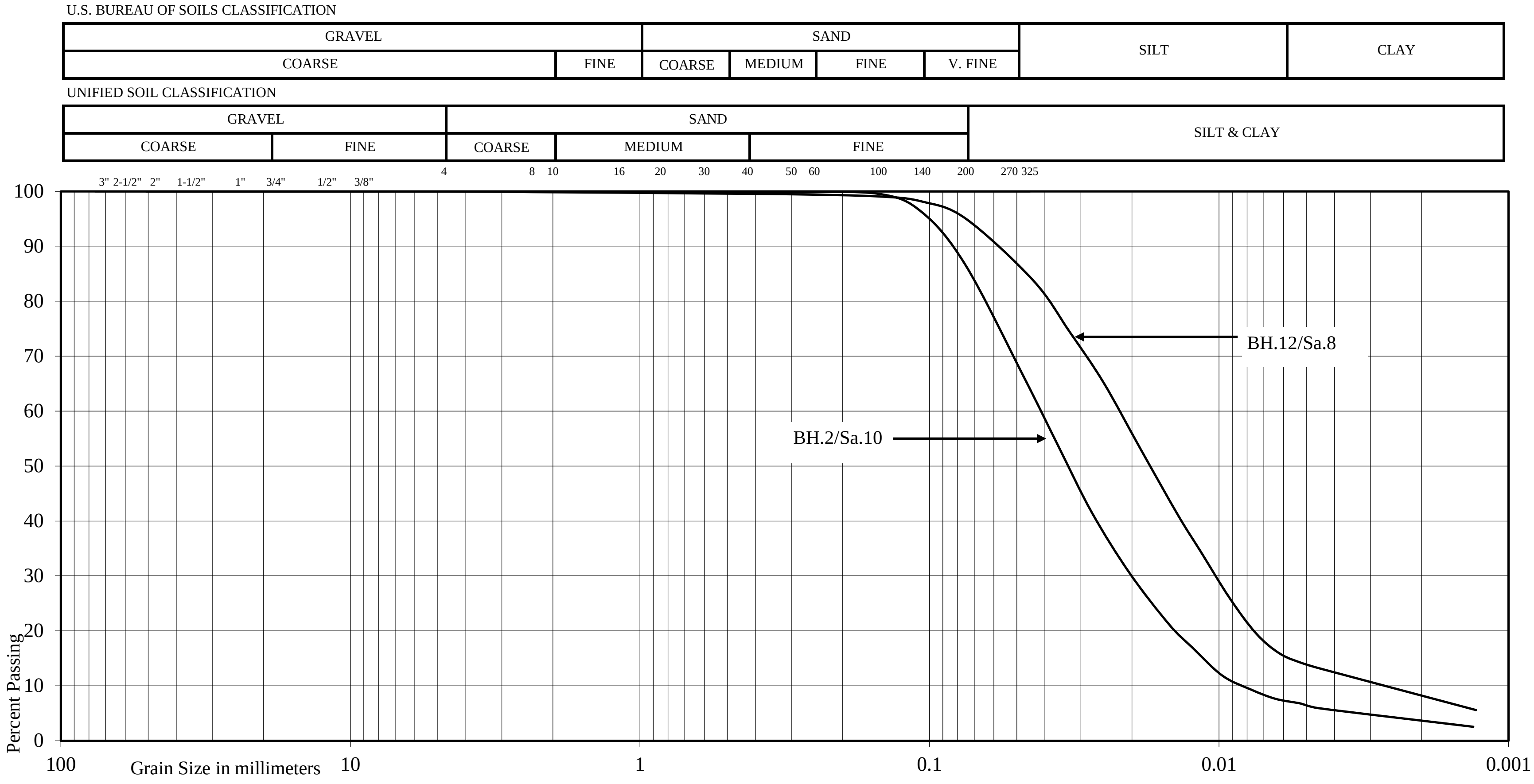
GRAIN SIZE DISTRIBUTION

Reference No: 1604-S017

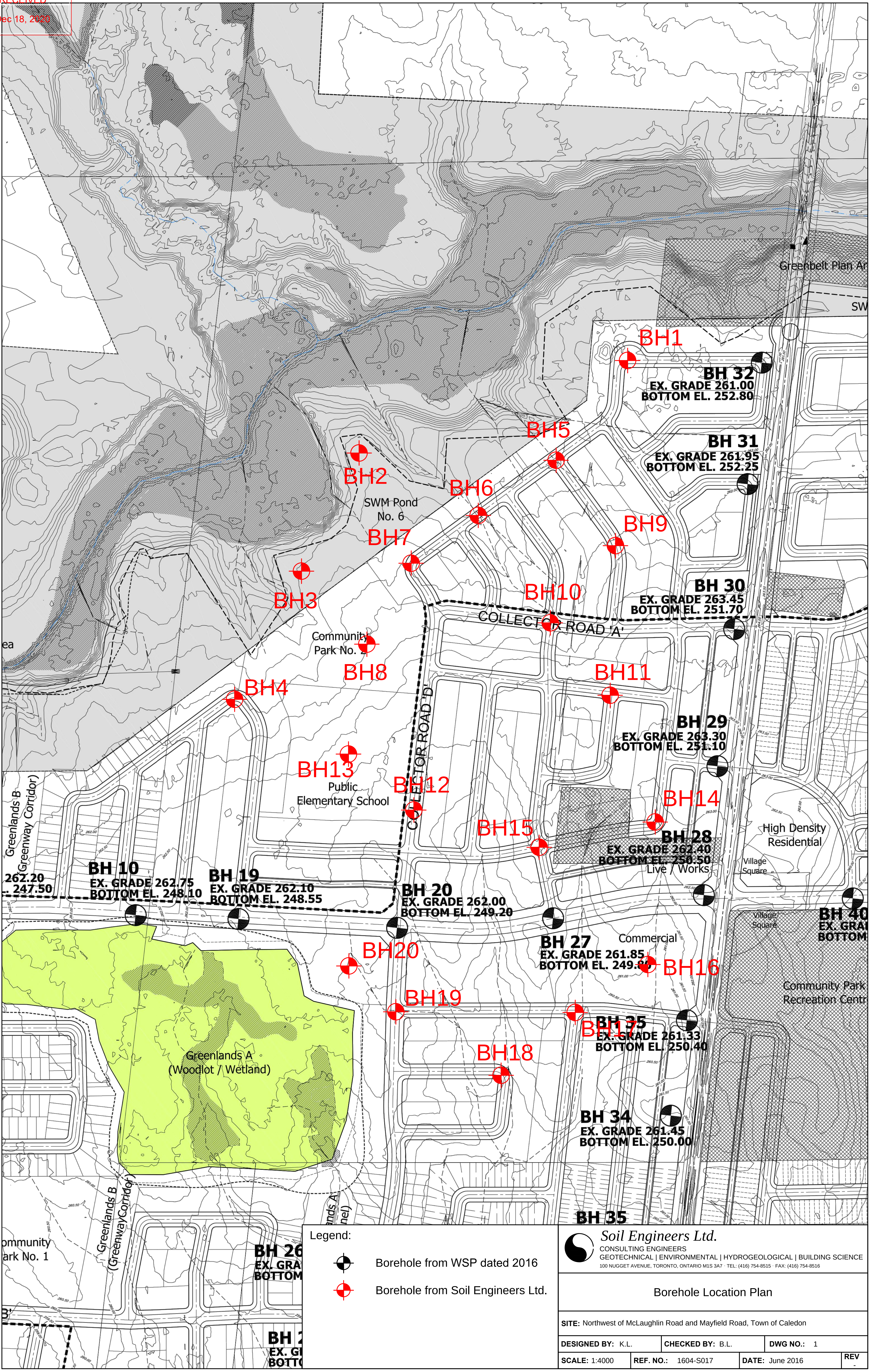


Project:	Proposed Subdivision	
Location:	Northwest of McLaughlin Road and Mayfield Road, Town of Caledon	
Borehole No:	2	12
Sample No:	10	8
Depth (m):	10.2	7.8
Elevation (m):	249.6	255.9

BH./Sa.	2/10	12/8
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	21	20
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-5}

Classification of Sample [& Group Symbol]: SILT
a trace of clay, a trace to some fine sand

Figure: 23



Legend:

⊕	Borehole from WSP dated 2016
⊕	Borehole from Soil Engineers Ltd.

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100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 · TEL: (416) 754-8515 · FAX: (416) 754-8516

Borehole Location Plan

SITE: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon

DESIGNED BY: K.L. **CHECKED BY:** B.L. **DWG NO.:** 1

SCALE: 1:4000 **REF. NO.:** 1604-S017 **DATE:** June 2016 **REV** -

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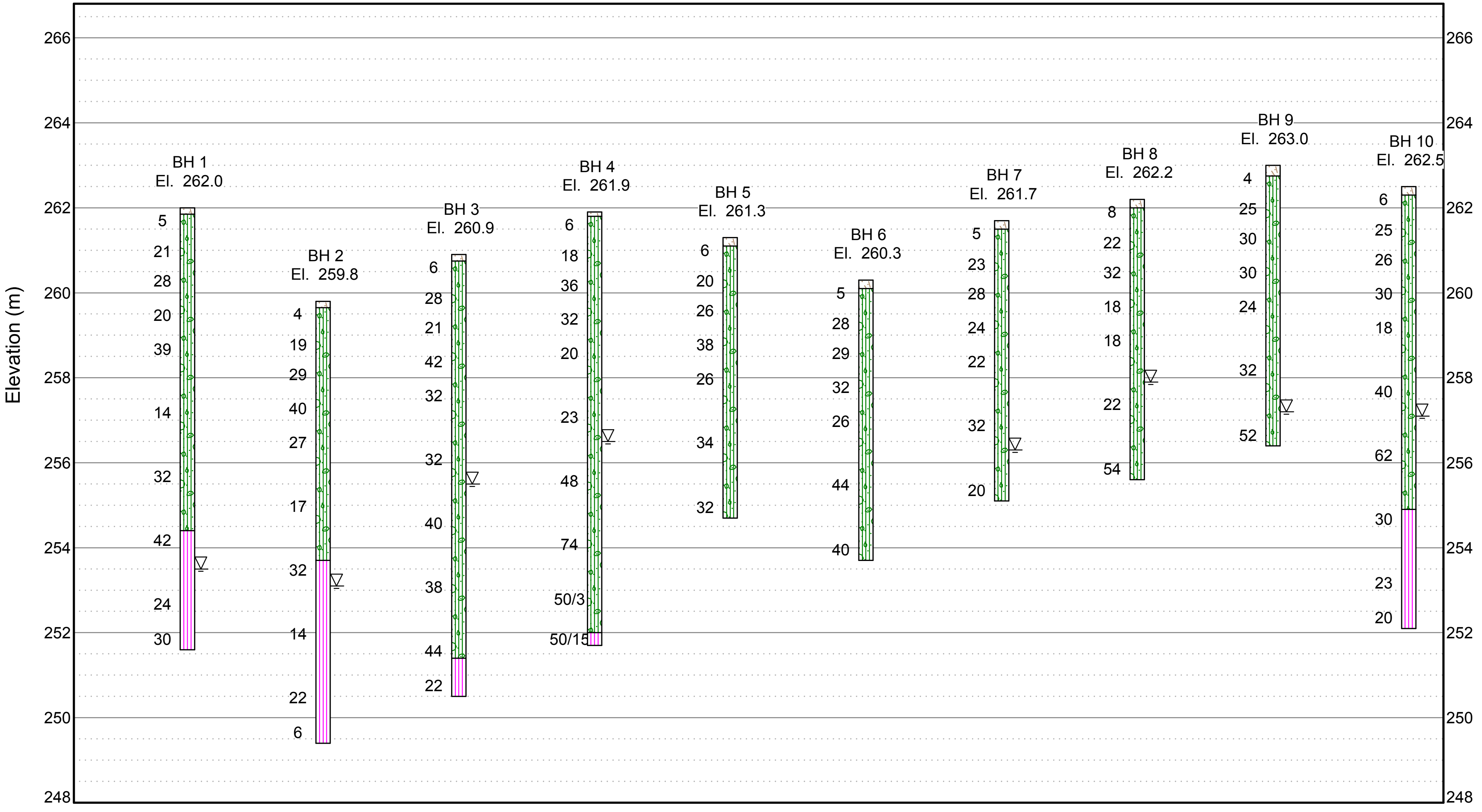
SUBSURFACE PROFILE
DRAWING NO.: 2
SCALE: AS SHOWN

JOB NUMBER: 1604-S017
REPORT DATE: June 2016
JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon
JOB DESCRIPTION: Proposed Subdivision

LEGEND

▽ Water Level (End of Drilling)	≡ Cave-In	▼ Water Level (Stabilized)
▨ Topsoil	🟩 Silt Till	▥ Silt



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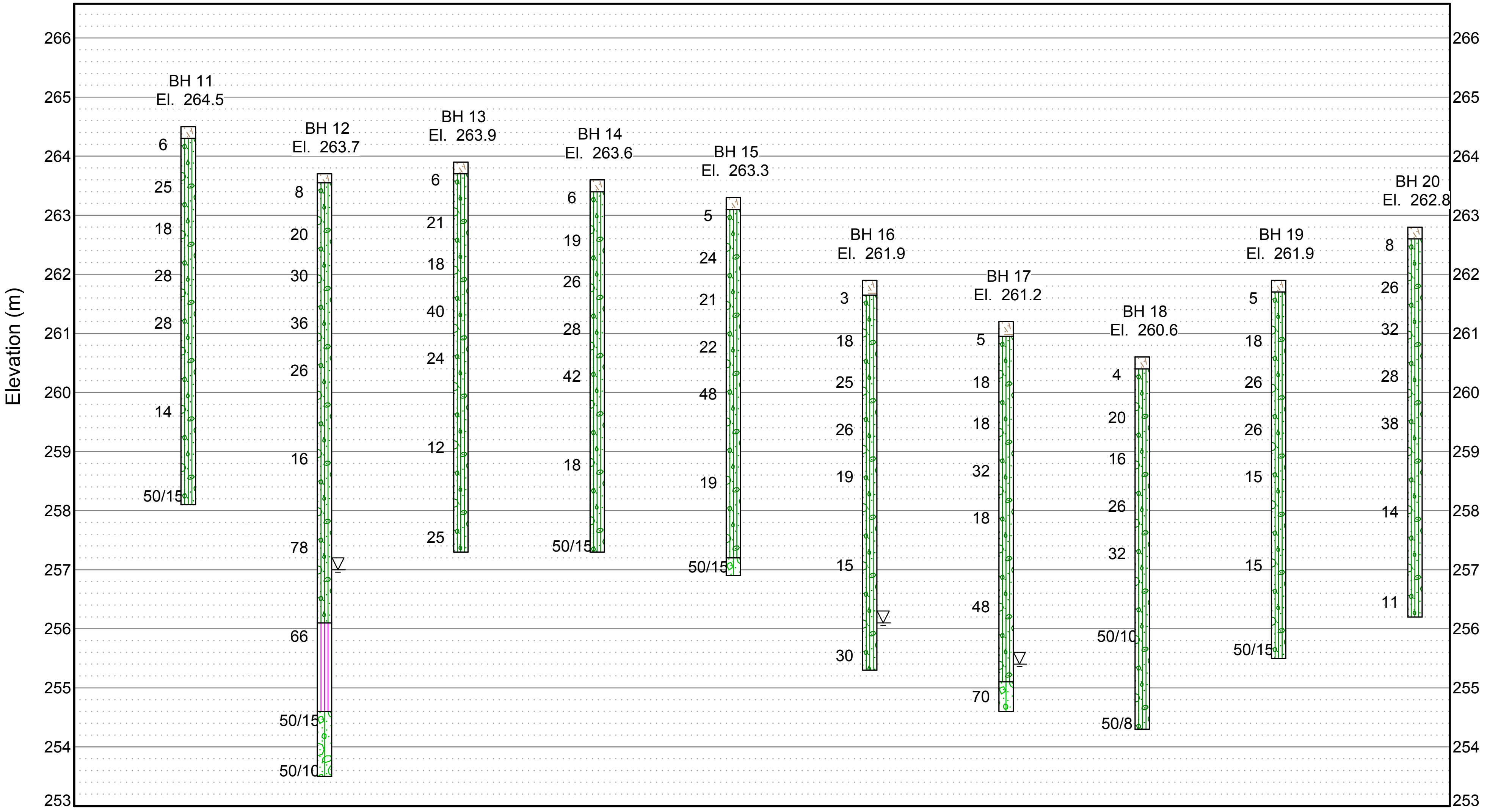
SUBSURFACE PROFILE
DRAWING NO.: 3
SCALE: AS SHOWN

LEGEND

▽ Water Level (End of Drilling)
≡ Cave-In
▼ Water Level (Stabilized)
▨ Topsoil
▨ Silt Till
▥ Silt
▨ Silty Sand Till

JOB NUMBER: 1604-S017
REPORT DATE: June 2016
JOB LOCATION: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon
JOB DESCRIPTION: Proposed Subdivision



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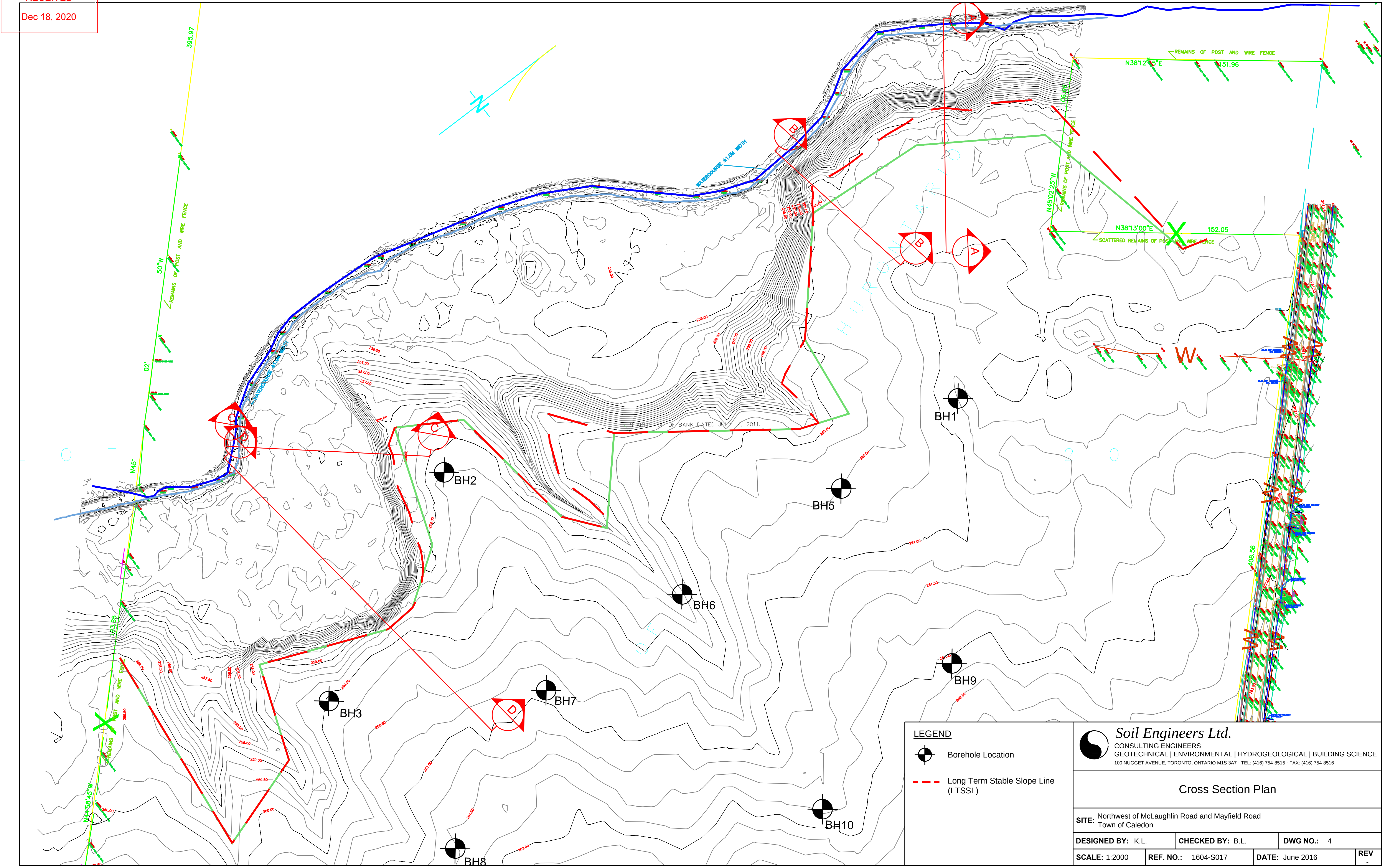
Dec 18, 2020



LEGEND

⌖	Borehole Location
🟥 🟥 🟥	Long Term Stable Slope Line (LTSSL)

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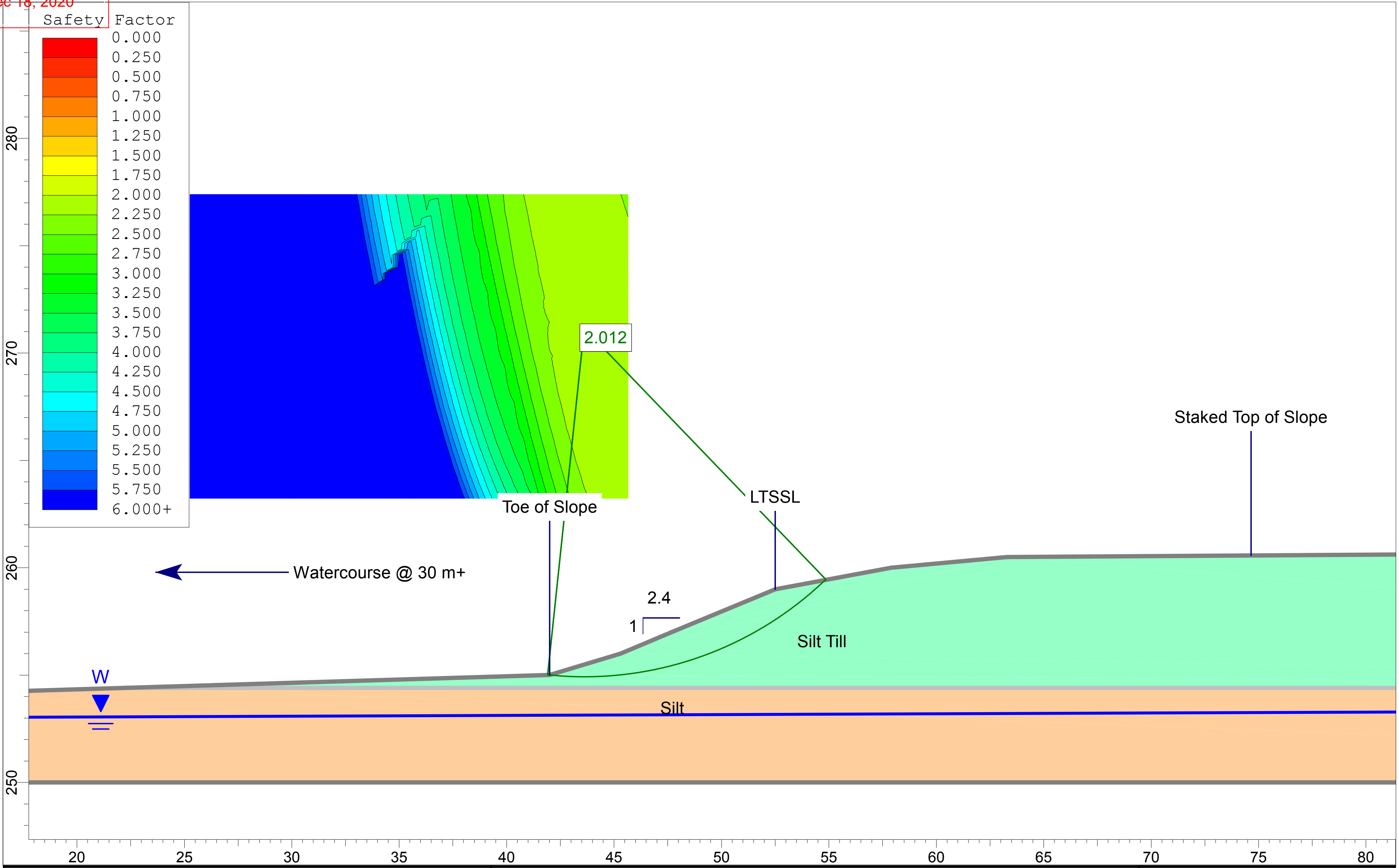
Cross Section Plan

SITE: Northwest of McLaughlin Road and Mayfield Road
Town of Caledon

DESIGNED BY: K.L.
CHECKED BY: B.L.
DWG NO.: 4
SCALE: 1:2000
REF. NO.: 1604-S017
DATE: June 2016
REV -



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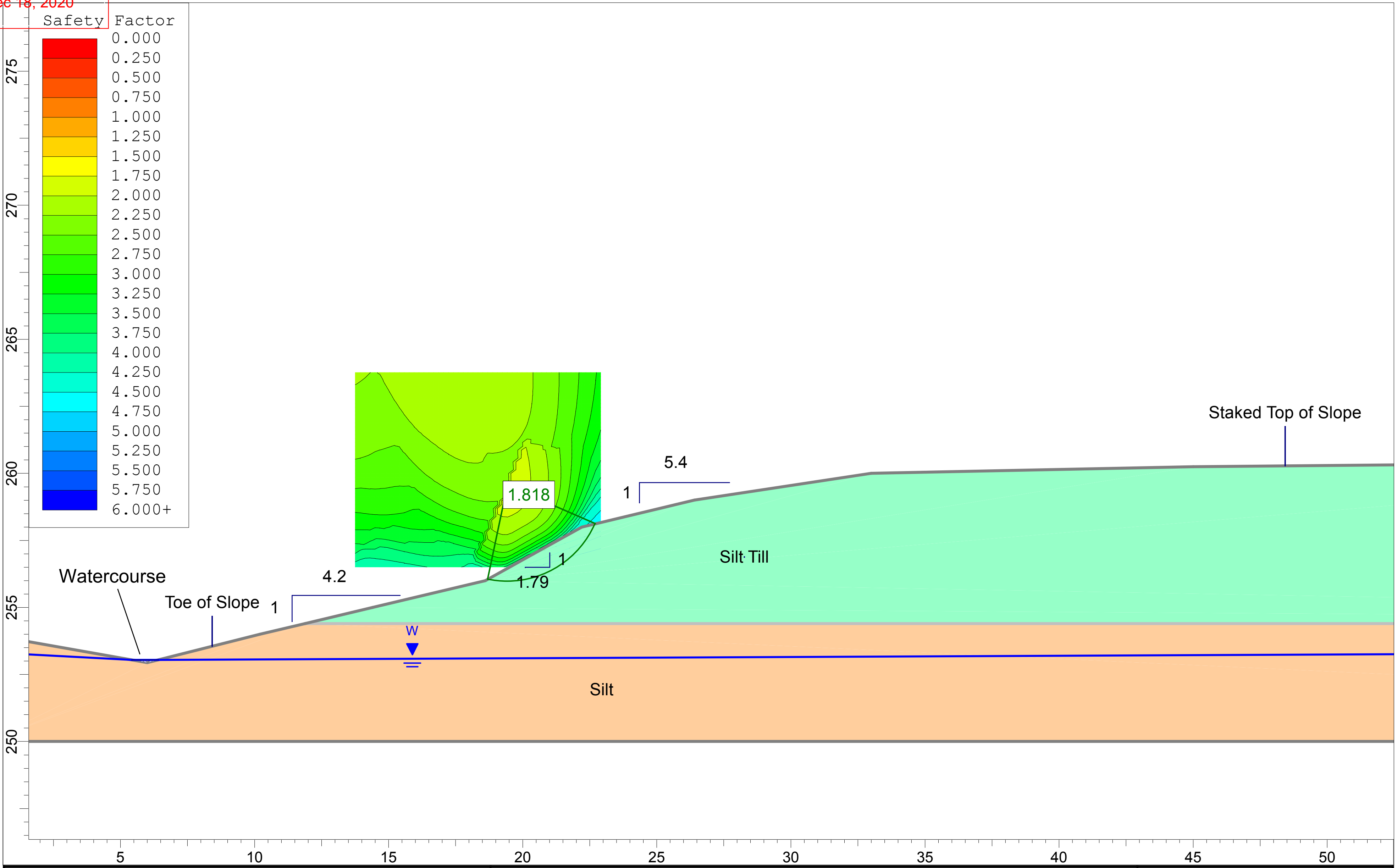
Project Title: Proposed Subdivision
Load Case: Cross Section A-A
Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon
Drawn By: K.L.
Checked By: B.L.
Scale: 1:250
Revision: -
Date: June 2016
Reference No.: 1604-S017
Drawing No.: 5



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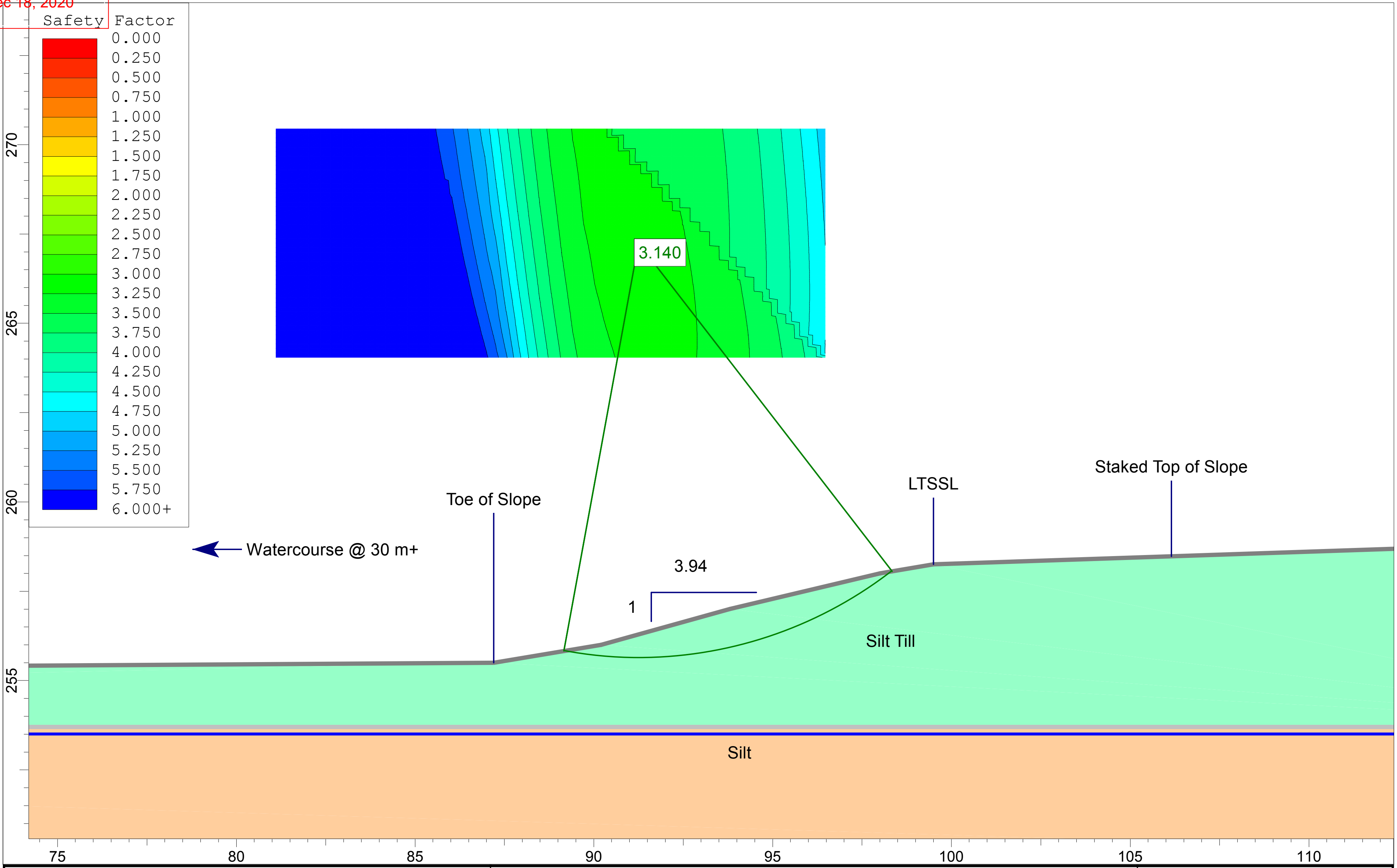
Project Title	Proposed Subdivision			Load Case	Cross Section B-B
Location	Northwest of McLaughlin Road and Mayfield Road, Town of Caledon				
Drawn By K.L.	Checked By B.L.	Scale	1:200	Revision	-
Date	June 2016	Reference No.	1604-S017	Drawing No.	6



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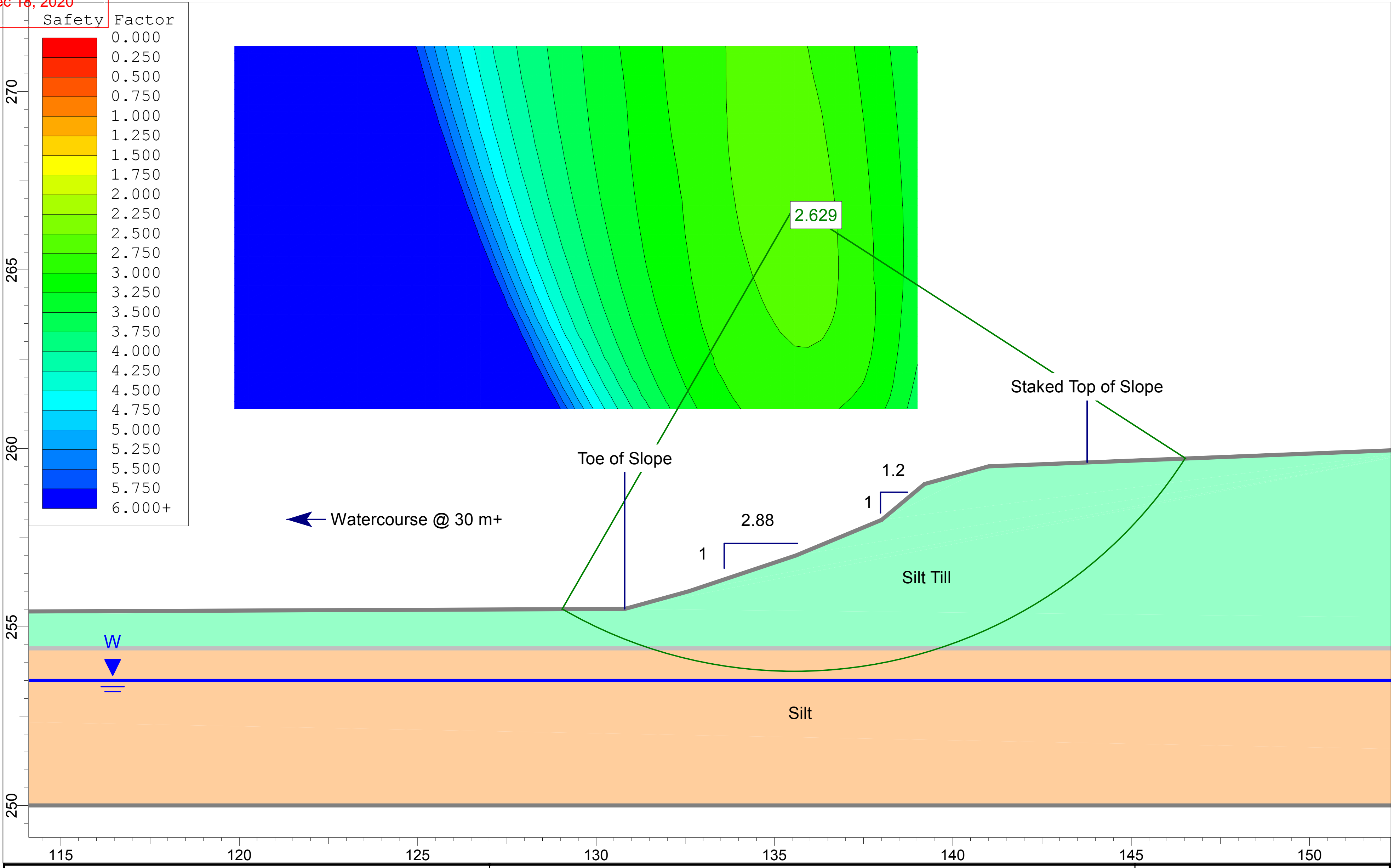
Project Title: Proposed Subdivision
Load Case: Cross Section C-C
Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon
Drawn By: K.L.
Checked By: B.L.
Scale: 1:150
Revision: -
Date: June 2016
Reference No.: 1604-S017
Drawing No.: 7



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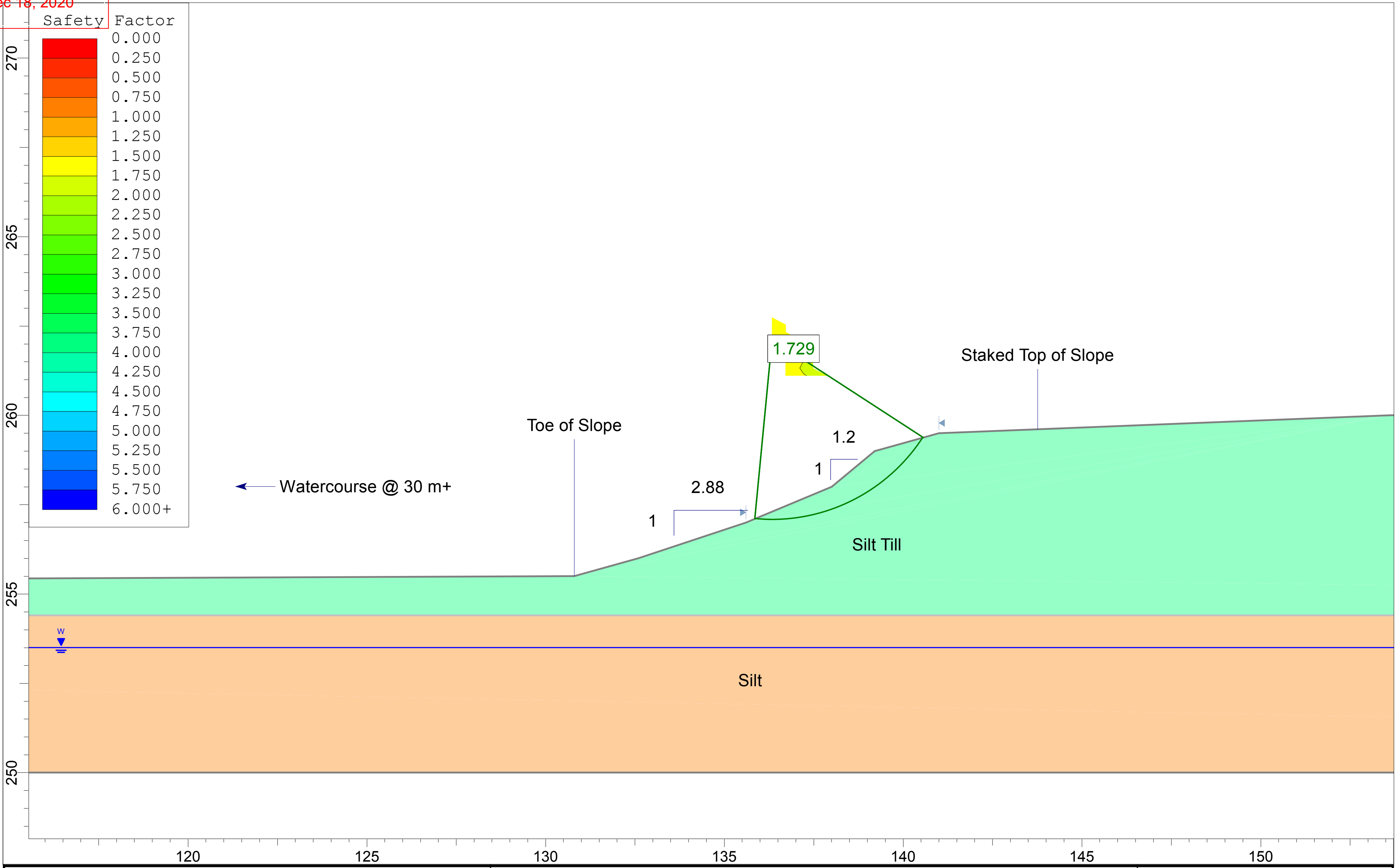
Project Title
Proposed Subdivision

Load Case
Cross Section D-D (Overall)

Location
Northwest of McLaughlin Road and Mayfield Road, Town of Caledon

Drawn By K.L.
Checked By B.L.
Scale 1:150
Revision -
Date June 2016
Reference No. 1604-S017
Drawing No. 8



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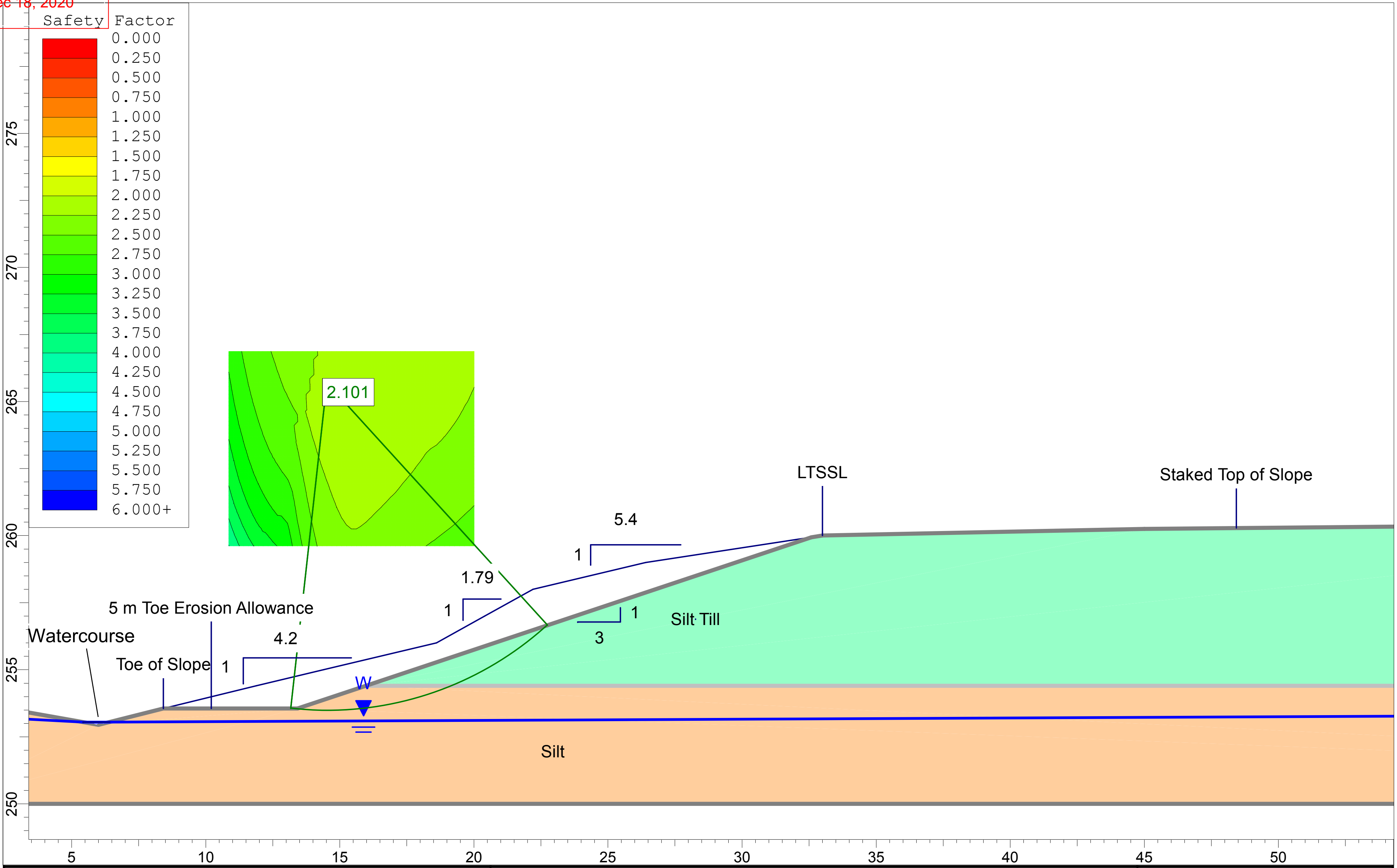
Project Title	Proposed Subdivision			Load Case	Cross Section D-D (Local)
Location	Northwest of McLaughlin Road and Mayfield Road, Town of Caledon				
Drawn By	K.L.	Checked By	B.L.	Scale	1:150
Revision	-				
Date	June 2016	Reference No.	1604-S017	Drawing No.	9



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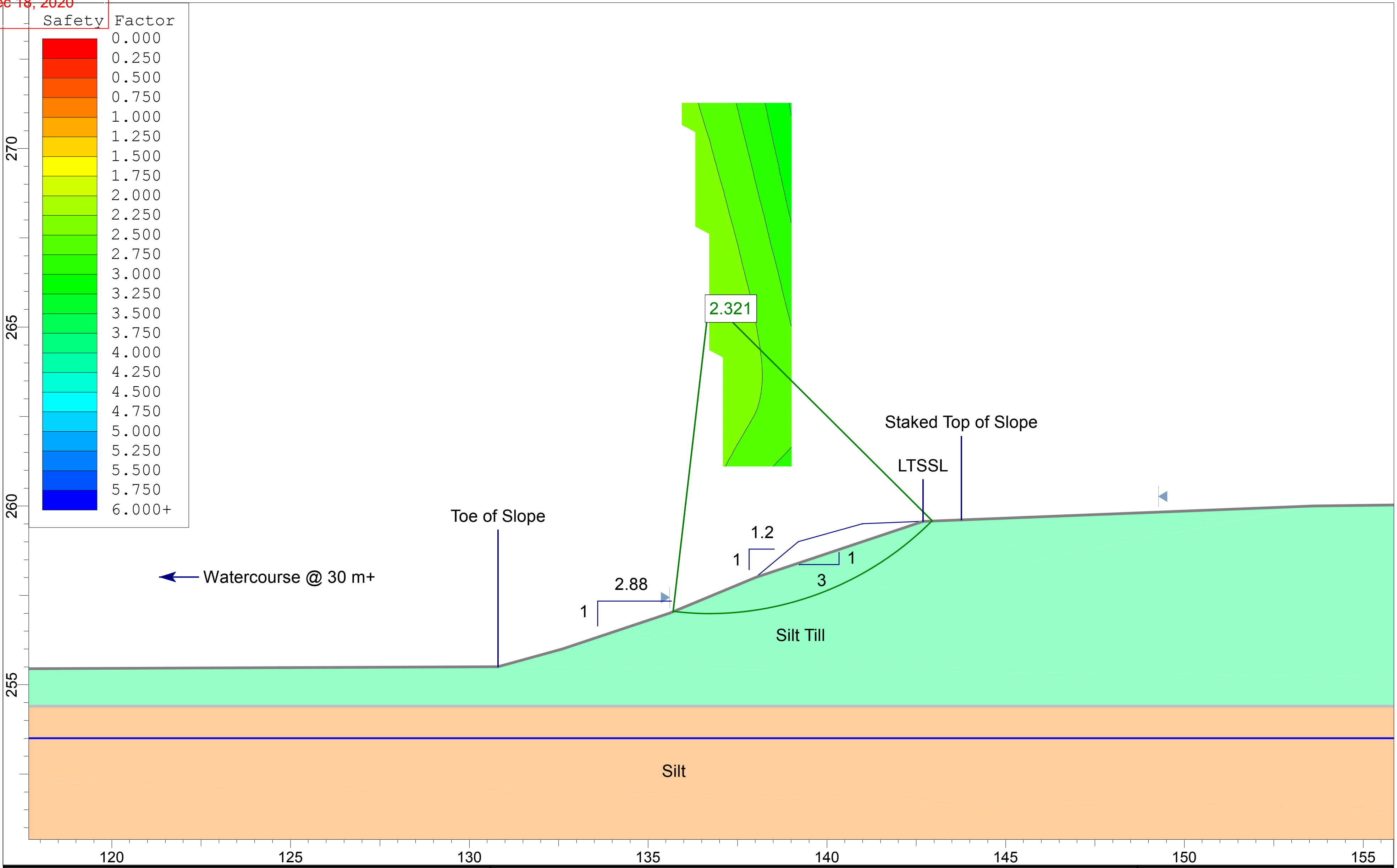
Project Title: Proposed Subdivision
Load Case: Cross Section B-B Geotechnically Stable Condition
Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon
Drawn By: K.L.
Checked By: B.L.
Scale: 1:200
Revision: -
Date: June 2016
Reference No.: 1604-S017
Drawing No.: 10



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Project Title: Proposed Subdivision

Load Case: Cross Section D-D (Local) Geotechnically Stable Condition

Location: Northwest of McLaughlin Road and Mayfield Road, Town of Caledon

Drawn By: K.L.
Checked By: B.L.
Scale: 1:150
Revision: -

Date: June 2016
Reference No.: 1604-S017
Drawing No.: 11