TOWN OF CALEDON
PLANNING
RECEIVED
Jan. 27/2021

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	PETERBOROUGH	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 440-2040	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

A REPORT TO
12148 ALBION VAUGHAN INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

12148 ALBION-VAUGHAN ROAD

TOWN OF CALEDON

REFERENCE NO. 1609-S145

JANUARY 2017

DISTRIBUTION

3 Copies - 12148 Albion Vaughan Inc.
1 Copy - Soil Engineers Ltd. (Mississauga)
1 Copy - Soil Engineers Ltd. (Toronto)

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE AND PROJECT DESCRIPTION 2

3.0 FIELD WORK 3

4.0 SUBSURFACE CONDITIONS 4

- 4.1 Topsoil 4
- 4.2 Earth Fill 5
- 4.3 Silty Clay/Silty Clay Till 6
- 4.4 Sandy Silt 8
- 4.5 Silty Sand 9
- 4.6 Compaction Characteristics of the Revealed Soils 10

5.0 GROUNDWATER CONDITIONS 13

6.0 DISCUSSION AND RECOMMENDATIONS 14

- 6.1 Foundations 16
- 6.2 Engineered Fill 19
- 6.3 Underground Services 22
- 6.4 Backfilling in Trenches and Excavated Areas 23
- 6.5 Garages, Driveways, Interlocking Stone Pavement and Landscaping 25
- 6.6 Pavement Design 26
- 6.7 Soil Parameters 29
- 6.8 Excavation 29

7.0 LIMITATIONS OF REPORT 31

TABLES

Table 1 - Estimated Water Content for Compaction 11
Table 2 - Founding Levels 16
Table 3 - Pavement Design 27
Table 4 - Soil Parameters 29
Table 5 - Classification of Soils for Excavation 30

DIAGRAMS

Diagram 1 - Frost Protection Measures (Foundations) 19
Diagram 2 - Frost Protection Measures (Garage) 26

ENCLOSURES

Borehole Logs .... Figures 1 to 10
Grain Size Distribution Graphs .... Figures 11 to 13
Borehole Location Plan .... Drawing No. 1
Subsurface Profile .... Drawing No. 2

1.0 INTRODUCTION

In accordance with written authorization dated September 27, 2016, from Mr. Mike Liburdi of 12148 Albion Vaughan Inc., a geotechnical investigation was carried out at 12148 Albion-Vaughan Road, in the Town of Caledon, for a Proposed Residential Development.

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for the design and construction of the proposed project.

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 till, which has been reworked by the water action of Peel Ponding (glacial lake), have modified the drift stratigraphy.

The subject site is located 370 m north of Mayfield Road between Regional Road 50 and Albion-Vaughan Road in the south sector of the Town of Caledon. At the time of investigation, the site was covered with grass, having a minor ditch/creek cutting the northwest corner of the site. At the centre portion of the site, there are three structures in place, including a single storey dwelling with an attached garage, a barn and a mobile home. There are access driveways and parking areas generally covered with gravel in front of the buildings.

It is understood that a residential development is planned for this site. The new development will be provided with municipal services and paved access roadways meeting urban standards.

3.0 FIELD WORK

The field work, consisting of 10 boreholes to depths ranging from 5.0 to 8.1 m, was performed on October 11 and 12, 2016, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The holes 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 determined using GPS (Trimble 6000 GeoXH), which has an 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 10, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, on Drawing No. 2, and the engineering properties of the disclosed soils are discussed herein.

The investigation has revealed that beneath a veneer of topsoil or topsoil fill, and in places a layer of earth fill, the site is underlain by strata of silty clay till and silty clay being laminated with sand and silt deposits. In places, the soil is weathered up to 1.8 m below the prevailing ground surface.

4.1 **Topsoil** (All Boreholes, except Borehole 2)

The revealed thickness of topsoil ranges from 3 to 30 cm. A buried layer of topsoil, approximately 20 cm thick, was contacted below the earth fill at Borehole 3. In addition, a stockpile of topsoil was also present at the southeast portion of the property.

The topsoil is dark brown in colour, indicating appreciable amounts of roots and humus. These materials are unstable and compressible under loads; therefore, the topsoil is considered to be void of engineering value. Due to the humus content, the topsoil will generate an offensive odour and may produce volatile gases under anaerobic conditions. Therefore, the topsoil must not be buried deeper than 1.2 m below the external finished grade or within the house envelopes. This is to avoid an adverse impact on the environmental well-being of the proposed project.

Since the topsoil is considered void of engineering value, it can only be used for general landscaping and landscape contouring purposes. A fertility analysis should be carried out to determine the suitability of the topsoil and/or topsoil fill for use as a general planting material.

As shown by the borehole findings, the topsoil varies in thickness randomly and thicker topsoil than that revealed by the boreholes may occur in places. 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 **Earth Fill** (Boreholes 1 to 6, inclusive)

The earth fill extends to depths ranging from 0.6 to 1.1 m. It is amorphous and consists of silty clay or sandy silt, with occasional topsoil inclusions.

The natural water content values range from 7% to 22%, with a median of 11%, indicating that the earth fill is in a damp to very moist condition.

The obtained ‘N’ values range from 4 to 32 blows per 30 cm of penetration, indicating that the fill was non-uniform in consistency or relative density.

In Borehole 3, a layer of topsoil was detected beneath the earth fill at a depth of 0.8 m; this indicates that the original topsoil was not completely removed at the time of filling or site grading in the past, implying lack of quality control in the filling process. In using the fill for structural backfill, in the proposed development, the existing earth fill must be subexcavated, inspected, sorted free of concentrated topsoil inclusions and deleterious materials, if any, and properly recompacted in thin layers.

The fill is amorphous in structure; it will ravel and is susceptible to collapse in steep cuts. Otherwise, where it is free of deleterious materials, its engineering properties are generally similar to those of the silty clay or sandy silt, which are described in the following sections.

One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by laboratory testing and/or test pits.

4.3 **Silty Clay/Silty Clay Till** (All Boreholes)

The silty clay till, with layers of silty clay, is the predominant stratum in the soil stratigraphy, extending to the maximum investigated depth of boreholes. The surficial stratum is found to be weathered to depths of 1.0 to 2.0 m from the prevailing ground surface.

The till is heterogeneous and amorphous in structure, and, in places, is platy. This indicates the till is a glacial deposit which, in places, has been reworked by the past glaciation.

The consistency of the clay and clay till was found to be firm to hard, being generally very stiff. This is confirmed by the ‘N’ values, which varied from 4 to 58 blows per 30 cm, with a median of 32 blows per 30 cm of penetration. The marginally firm clay and clay till occurred in Boreholes 3 and 10 within the weathered zone immediately underlying the topsoil or earth fill.

The Atterberg Limits of 1 clay sample and 2 clay till samples and the moisture content of all the samples were determined in the laboratory. The results are plotted on the Borehole Logs and summarized below:

	Clay	Clay Till
Liquid Limit	37%	37% and 38%
Plastic Limit	17%	19% and 20%
Natural Water Content	13% to 22% (median 18%)	9% to 21% (median 14%)

The above results show that the clay and clay till are cohesive materials, with low to medium plasticity. The natural water content lies below or slightly above the plastic limits, confirming the consistency of the clay and till as determined by the 'N' values.

Grain size analyses were performed on 1 clay sample and 2 clay till samples; the results are plotted on Figures 11 and 12.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and soil-adfreezing potential.
- Low potential of erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec and runoff coefficients of:

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

- Cohesive-frictional soils, the shear strength is derived from consistency and augmented by the internal friction of silt and sand. The shear strength is moisture dependent.

- It will generally be stable in a relatively steep cut; however, prolonged exposure will allow the silt or sand seams to become saturated, which may lead to localized sloughing.
- A poor pavement-supportive material, with an estimated CBR value of 3%.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 2500 to 3000 ohm·cm.

4.4 **Sandy Silt** (Boreholes 7 and 9)

The sandy silt layer was contacted underlying the topsoil veneer and extending to depths of 0.9 m and 1.2 m below the prevailing ground surface. The surficial deposit contains occasional rootlets and is generally weathered.

The obtained ‘N’ values are 2, 7 and 30 blows per 30 cm of penetration, indicating that the relative density of the sandy silt is very loose to compact. The very loose or loose deposit occurred in the weathered zone of the sandy silt.

The natural water content values were determined at 5% and 10%, indicating a damp to moist condition. The results are plotted on the Borehole Logs.

A grain size analysis was performed on 1 representative sample; the result is plotted on Figure 13.

Based on the above findings, the deduced engineering properties relating to the project are given below:

- High frost susceptibility and soil-adfreezing potential.
- High water erodibility; it is susceptible to migration through small openings under seepage pressure.

- Semi-permeable, with an estimated coefficient of permeability of 10^{-4} cm/sec, an average percolation rate of 15 min/cm or 40 mm/hour, and runoff coefficients of:

Slope	
0% - 2%	0.07
2% - 6%	0.12
6% +	0.18

- A frictional soil, its shear strength is primarily derived from internal friction; therefore, its strength is density dependent. Due to its dilatancy, the shear 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 of shear strength.
- In excavation, the silt will slough and run with water seepage. 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.

4.5 **Silty Sand** (Borehole 8)

The silty sand layer underlies the topsoil veneer and extends to a depth of 1.4 m below the prevailing ground surface. It is fine grained and contains seams of sandy silt.

The obtained ‘N’ values are 2 and 18 blows per 30 cm of penetration, indicating that the relative density of the sand is very loose to compact.

The natural water content values were determined at 13% and 15%, indicating that the sand is in a moist condition.

The deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and soil-adfreezing potential.
- High water erodibility.
- Relatively pervious, with an estimated coefficient of permeability of 10^{-3} cm/sec, an average percolation rate of 10 min/cm or 60 mm/hour, and runoff coefficients of:

Slope	
0% - 2%	0.04 to 0.07
2% - 6%	0.09 to 0.12
6% + 0.	0.13 to 0.18

- A frictional soil, its shear strength is primarily derived from internal friction; therefore, its strength is density dependent. Due to its dilatancy, the shear strength of the wet sand 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 of shear strength.
- In excavation, the sand will slough and run with water seepage.
- A poor pavement-supportive material, with an estimated CBR value of 5%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 6000 ohm·cm.

4.6 <u>Compaction Characteristics of the Revealed Soils</u>

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 +**
Existing Earth Fill/Clay/Clay Till	7 to 22	17 to 19	12 to 22
Sandy Silt/Silty Sand	5 and 15	12	8 to 15

The above values show that the on-site material is suitable for 95% or + Standard Proctor compaction; however, any dry material will require wetting for dust control and proper compaction, particularly in areas where compaction is best performed on the wet side of the optimum.

The silty clay and silty clay till should be compacted using a heavy-weight, kneading-type roller. The sand and silt can be compacted by a smooth roller with or without vibration, depending on the water content of the soils 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 clay and clay till 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 this soil 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 wider latitude of lift thickness.

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 pavement 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 for buildings and utilities 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.

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

5.0 GROUNDWATER CONDITIONS

No groundwater or cave-in was detected in the boreholes during the investigation. All boreholes remained dry and open upon completion of the field work. The soil colour changed from brown to grey at depths ranging from 3.1 to 4.2 m. The brown colour indicates that the soils have oxidized.

In excavations, infiltrated precipitation will often become trapped water in the fissures of the weathered soil or in the sand and silt deposits, rendering perched groundwater at shallow depths. The yield will be limited and can be controlled by conventional pumping from sumps.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a veneer of topsoil, and in places an earth fill, the site is underlain by a stratum of firm to hard, generally very stiff silty clay and silty clay till being laminated with very loose to compact sand and silt deposits. The soil is weathered up to 1.8 m below the prevailing ground surface.

No groundwater or cave-in was detected in the boreholes during the investigation. All boreholes remained dry and open upon completion of the field work. Any groundwater yield in excavation will be limited, and can be controlled by conventional pumping from sumps.

The geotechnical findings which warrant special consideration are presented below:

1. The revealed topsoil varies randomly in thickness. Thicker topsoil than found in the boreholes may occur at the site.
2. The topsoil is void of engineering value and unsuitable for engineering applications. Due to the humus content, the topsoil will generate an offensive odour and may produce volatile gases under unaerobic conditions. For the environmental as well as the geotechnical well-being of the future development, the topsoil should not be buried deeper than 1.2 m below the external grade or within the house envelopes.
3. The earth fill was non-uniform in consistency or relative density and contained occasional topsoil inclusions. It is unsuitable for supporting structures sensitive to movement. In using the fill for structural backfill, or in pavement and slab construction, it should be subexcavated, inspected, sorted free of serious topsoil inclusions, proof-rolled and properly recompacted.

4. The on site native soils are weathered to depths of 1.0 to 1.8 m. For structural use, the weathered soils should be subexcavated, aerated, sorted free of topsoil inclusions and recompacted.
5. The sound natural soil below the topsoil, earth fill and/or weathered soil is suitable for normal spread and strip footing construction.
6. Due to the presence of topsoil, earth fill and weathered soils, the footing subgrade must be inspected by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, or by a building inspector who has geotechnical experience, to ensure that its condition is compatible with the design of the foundation.
7. Where extended footings are required and/or where cut and fill is necessary for site grading, substantial savings can be realized by placing the fill in an engineered manner suitable for foundation, underground services and road construction. This must, however, be properly planned and implemented during the site grading stage.
8. Perimeter subdrains and dampproofing of the house foundation walls will be required. The subdrains should be shielded by a fabric filter to prevent blockage by silting, and they must be connected to a positive outlet.
9. Curb subdrains will be required for road construction.
10. A Class ‘B’ bedding, consisting of compacted 20-mm Crusher-Run Limestone, is recommended for the construction of the underground services.
11. Excavation should be carried out in accordance with Ontario Regulation 213/91.
12. The till contains occasional cobbles and boulders. Excavation into the till containing boulders will require extra effort and the use of a heavy-duty backhoe. Boulders over 15 cm in size must not be used for structural backfill and/or construction of engineered fill.

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.

6.1 Foundations

The conventional spread and strip footings for house construction must be placed below the topsoil, earth fill and weathered soils onto the sound, natural soil. As a general guide, the recommended soil pressures for use in the design of the footings, together with the corresponding suitable founding levels, are presented in Table 2.

Table 2 - Founding Levels

BH No.	Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Suitable Founding Level			
	200 kPa (SLS) 320 kPa (ULS)		250 kPa (SLS) 400 kPa (ULS)	
	Depth (m)	El. (m)	Depth (m)	El. (m)
1	-	-	1.1 or +	229.0 or -
2	1.5 or +	228.7 or -	-	-
3	-	-	2.2 or +	228.0 or -
4	-	-	1.2 or +	229.5 or -
5	1.8 or +	229.1 or -	-	-
6	-	-	1.9 or +	228.9 or -

Table 2 - Founding Levels (cont'd)

BH No.	**Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Suitable Founding Level**			
	200 kPa (SLS) 320 kPa (ULS)		**250 kPa (SLS) 400 kPa (ULS)**	
	Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**
7	-	-	0.9 or +	229.8 or -
8	1.0 or +	229.7 or -	-	-
9	1.0 or +	229.6 or -	2.4 or +	228.2 or -
10	-	-	1.0 or +	229.2 or -

Where earth fill is required to raise the site or extended footings are required, or where cut and fill may be required for lot grading, it is generally more practical and economical to place engineered fill suitable for a Maximum Allowable Soil Pressure (SLS) of 150 kPa for normal footing construction. The requirements and procedures for engineered fill construction are discussed in Section 6.2.

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

The foundations exposed to weathering, or in unheated areas, should have at least 1.2 m of earth cover for protection against frost action, or must be properly insulated.

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

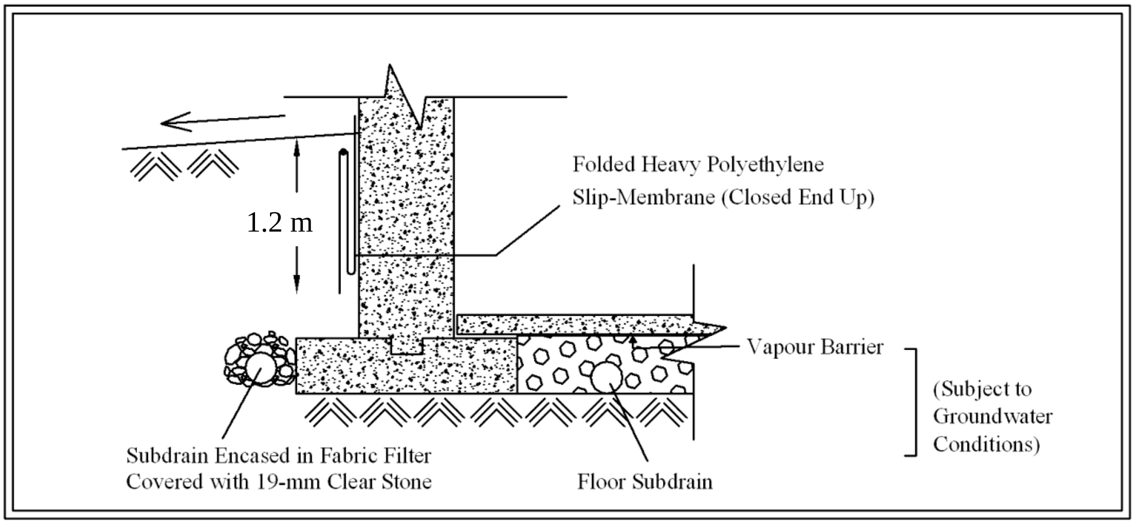
Due to the presence of earth fill and weathered soils, the footing subgrade must be inspected by either a geotechnical engineer, or by a geotechnical technician under the supervision of a geotechnical engineer, or a building inspector who has geotechnical experience, to assess its suitability for bearing the designed foundations.

Perimeter subdrains and dampproofing of the house foundation walls will be required in order to provide a dry basement. All the subdrains should be encased in a fabric-filter to protect them against blockage by silting.

The entrances to garages should be backfilled with non-frost-susceptible granular material, such as Granular 'B'.

The on-site material has high frost susceptibility and soil-adfreezing potential. If it is to be used for the foundation backfill, the exterior foundation walls must be constructed with concrete and should be shielded by a polyethylene slip-membrane for protection against soil adfreezing. The recommended measures are schematically illustrated in Diagram 1.

Diagram 1 - Frost Protection Measures (Foundations)



The membrane will allow vertical movement of the heaving soil (due to frost) without imposing structural distress on the foundations. The external grading should be such that runoff is directed away from the foundation.

The above recommendations should be further assessed and/or confirmed during construction.

6.2 Engineered Fill

In areas where earth fill is required to raise the site or cut and fill works, it is generally more economical to place engineered fill for normal footing, underground services and pavement construction. The engineering requirements for a certifiable fill for pavement construction, municipal services, slab-on-grade, 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 and earth fill must be removed and the subgrade must be inspected and proof-rolled prior to any fill placement. The highly weathered

soils must be subexcavated and the subgrade must be inspected and proof-rolled prior to any fill placement.

2. Inorganic soils must be used, and they must be uniformly compacted in lifts of 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed finished grade and/or slab-on-grade subgrade. The soil moisture must be properly controlled on the wet side of the optimum.
3. 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.
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% of the maximum Standard Proctor compaction.
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 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 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 or snow.
8. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement.

9. Where the fill is to be placed on sloping ground steeper than 1 vertical: 3 horizontal, the face of the sloping ground 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 footing 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 supervised 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.
13. Despite stringent control in the placement of the 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 may 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.

6.3 **Underground Services**

The subgrade for the underground services should consist of sound natural soil or properly compacted, organic-free earth fill. Where badly weathered or loose soils are encountered, they should be subexcavated and replaced with bedding material compacted to at least 95% or + of its Standard Proctor compaction.

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

In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover at least equal in thickness 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.

Sewer excavation must be sloped at 1 vertical:1 or + horizontal for stability. Alternatively, a trench box can also be used for the construction of the sewer.

Since the silty clay and silty clay till have moderately high corrosivity to buried metal, the water main should be protected against corrosion. In determining the mode of protection, an electrical resistivity of 2500 to 3500 ohm·cm can be used. This, however, should be confirmed by testing the soil along the water main alignment at the time of sewer construction.

6.4 Backfilling in Trenches and Excavated Areas

The on-site inorganic soil is generally suitable for trench backfill. However, most of the clay till will require wetting prior to the backfilling.

The backfill in the trenches should be compacted to at least 95% of its maximum Standard Proctor dry density and increased to 98% or + below the floor slab. In the zone within 1.0 m below the road subgrade, the materials should be compacted with the water content 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% of the respective maximum Standard Proctor dry density. This is to provide the required stiffness for pavement construction. In the lower zone, the compaction should be carried out on the wet side of the optimum; this allows wider latitude of lift thickness. Backfill below any slab-on-grade which is sensitive to settlement must be compacted to at least 98% of its maximum Standard Proctor dry density. Wetting of the dry soils will be necessary to achieve this requirement.

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

The narrow trenches for services crossings should be cut at 1 vertical:
2 or + horizontal 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 flooding 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 underground services 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.
- 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 vertical: 1.5+ horizontal, 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

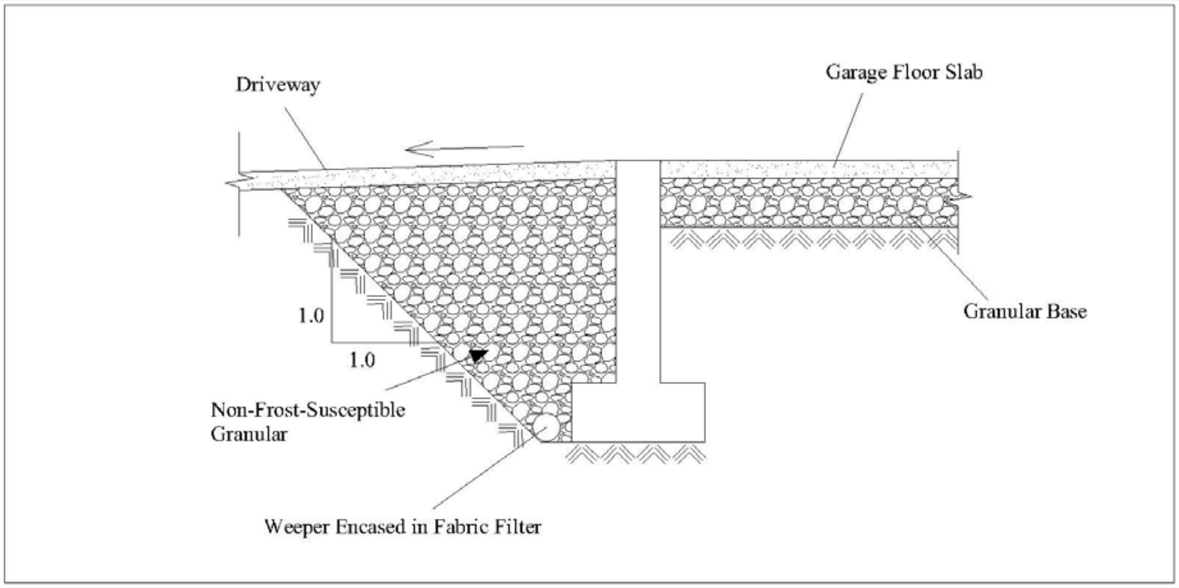
box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the 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, anti-seepage collars should be provided.

6.5 **Garages, Driveways, Interlocking Stone Pavement and Landscaping**

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

The driveways at the entrances to the garages can be backfilled with non-frost-susceptible granular material, with a frost taper at a slope of 1 vertical:1 horizontal. The recommended scheme is illustrated in Diagram 2.

Diagram 2 - Frost Protection Measures (Garage)



Interlocking stone pavement, slab-on-grade and landscaping structures in areas which are sensitive to frost-induced ground movement, such as in front of building entrances, must be constructed on a free-draining, non-frost-susceptible granular material such as Granular 'B'. This material must extend to at least 0.3 to 1.2 m below the slab or pavement surface, depending on the degree of tolerance of ground movement, and be provided with positive drainage, such as weeper subdrains connected to manholes or catch basins. Alternatively, the landscaping structures, slab-on-grade and interlocking stone pavement should be properly insulated with 50-mm Styrofoam, or equivalent.

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

6.6 **Pavement Design**

The access roads will be serving the local residents. Knowing that the predominant subsoil found at the site consists of silt and clay, which are a poor pavement-supportive materials, the recommended pavement design for the proposed roads is presented in Table 3.

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder	65	HL-8
Granular Base	150	Granular ‘A’ or equivalent
Granular Sub-base	350	50-mm Crusher-Run Limestone or equivalent

In preparation of the subgrade, the topsoil must be removed, and the subgrade surface must be proof-rolled. Any soft subgrade, organics, deleterious materials and foreign matter should be subexcavated and replaced by properly compacted, organic-free material. All the granular bases should be compacted to their 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. In the lower zone, a 95% or + Standard Proctor compaction is considered adequate.

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

- Areas adjacent to the pavement should be properly graded to prevent ponding of large amounts of water during the interim construction period.
- Curb subdrains will be required. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting.
- If the pavement 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.

In the paved areas, catch basins should be provided; they should drain into the storm sewer or a suitable outlet. The trenches for the connections to the catch basins should be backfilled with free-draining granular material such as Granular ‘B’, and filter-sleeved weeper stubs should be installed at the manholes and catch basins into the granular backfill. This will allow water in the trenches to drain into the storm sewers.

The subdrains should be installed to a depth of at least 1.0 m below the pavement and backfilled with free-draining granular material. The location and spacing of the subdrains can best be determined at the time of the subgrade preparation.

6.7 Soil Parameters

The recommended soil parameters for the project design are given in Table 4.

Table 4 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Topsoil	18.0	-	1.30	0.95
Earth Fill/Silty Clay	21.0	11.5	1.25	1.00
Silty Clay Till	22.0	12.5	1.33	1.03
Sandy Silt/Silty Sand	20.5	10.5	1.20	1.00

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Compacted Earth Fill and Silty Clay	0.40	0.56	2.50
Silty Clay Till	0.35	0.50	3.00
Sandy Silt/Silty Sand	0.32	0.48	3.10

6.8 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. Any excavations deeper than 1.2 m should be sloped.

For excavation purposes, the types of soils are classified in Table 5.

Table 5 - Classification of Soils for Excavation

Material	Type
Sound Till and Clay	2
Earth Fill, Sand or Silt	3
Saturated Soils	4

In excavations, precipitation will often become water trapped in the fissures of the weathered soil or in the sand and silt deposits, rendering perched groundwater at shallow depths. The yield will be limited and can be controlled by conventional pumping from sumps.

Prospective contractors must assess the in situ subsurface conditions prior to excavation 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.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of 12148 Albion Vaughan Inc., and for review by its designated agents, financial institutions, and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement. The material in the report reflects the judgment of Ahmad Hassan, B.Eng., and Bennett Sun, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, and/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.

Ahmad Hassan, B.Eng.

Bennett Sun, P.Eng.
AH/BS:dd

LICENSED PROFESSIONAL ENGINEER
CHUN C. B. SUN
Jan 26, 2017
PROVINCE OF ONTARIO

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

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

SAMPLE TYPES

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

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

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

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

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

Plotted as '○'

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

SOIL DESCRIPTION

Cohesionless Soils:

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

Cohesive Soils:

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

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

□ Compression test in laboratory

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

METRIC CONVERSION FACTORS

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

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

LOG OF BOREHOLE NO.: 1

Figure No.: 1

Job Number: 1609-S145

Project Description: Proposed Residential Development

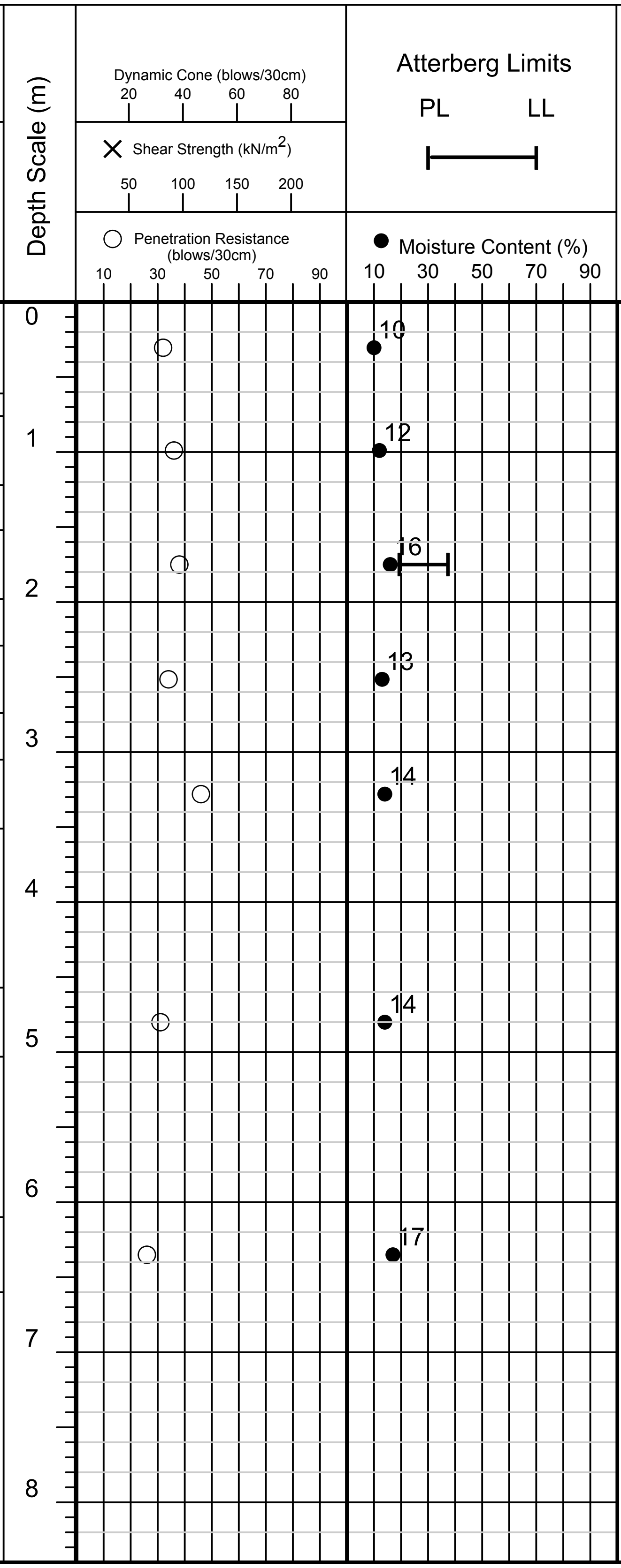
Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 12, 2016

Elevation (m)	SOIL DESCRIPTION
230.1	Ground Surface
0.1	8 cm **TOPSOIL**
229.5 0.6	**EARTH FILL** brown silty clay occ. topsoil inclusions
	Very stiff to hard weathered **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders brown grey
224.6 5.5	Grey, very stiff **SILTY CLAY**
223.5 6.6	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	32
2	DO	36
3	DO	38
4	DO	34
5	DO	46
6	DO	31
7	DO	26



Water Level: Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 10

Figure No.: 10

Job Number: 1609-S145

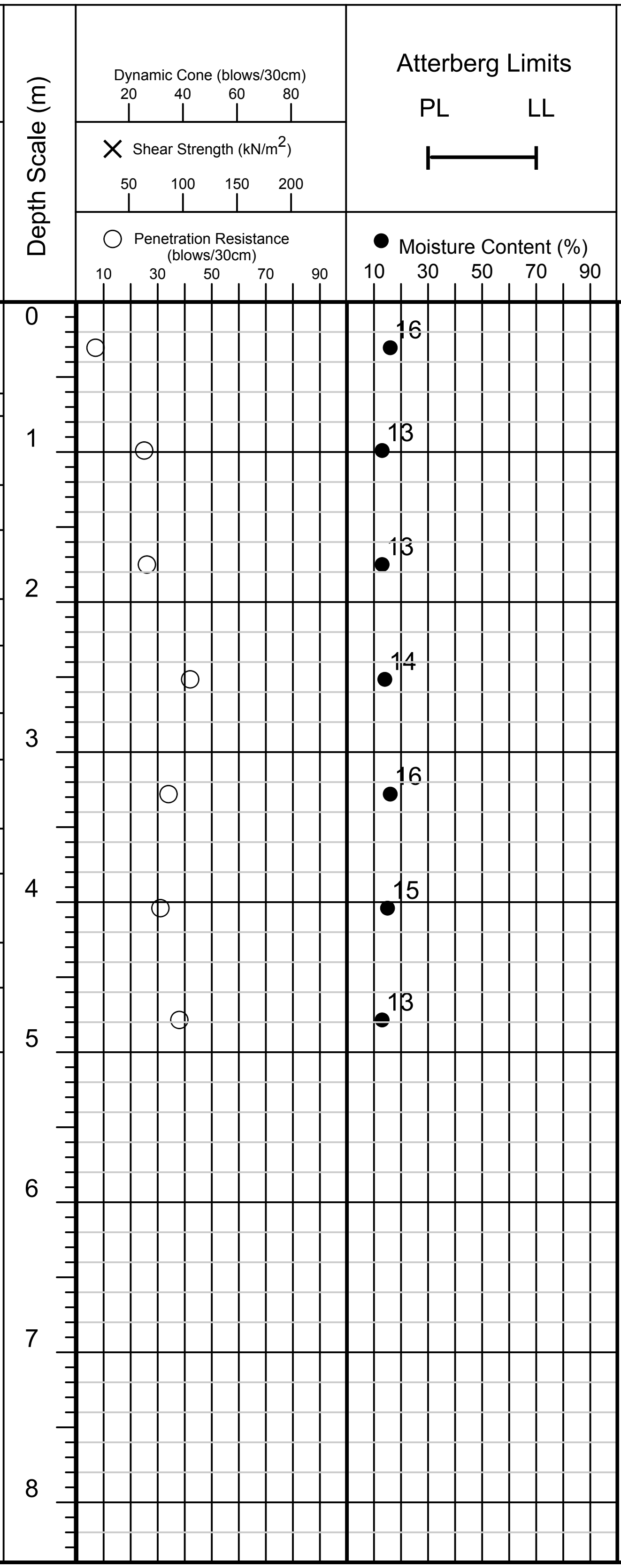
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 12, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
230.2	Ground Surface			
	30 cm TOPSOIL			
0.3	Firm to hard	1	DO	7
	SILTY CLAY TILL			
	weathered	2	DO	25
	a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	26
		4	DO	42
		5	DO	34
	brown grey	6	DO	31
		7	DO	38
225.2 5.0	**END OF BOREHOLE**			



Water Level: Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 2

Figure No.: 2

Job Number: 1609-S145

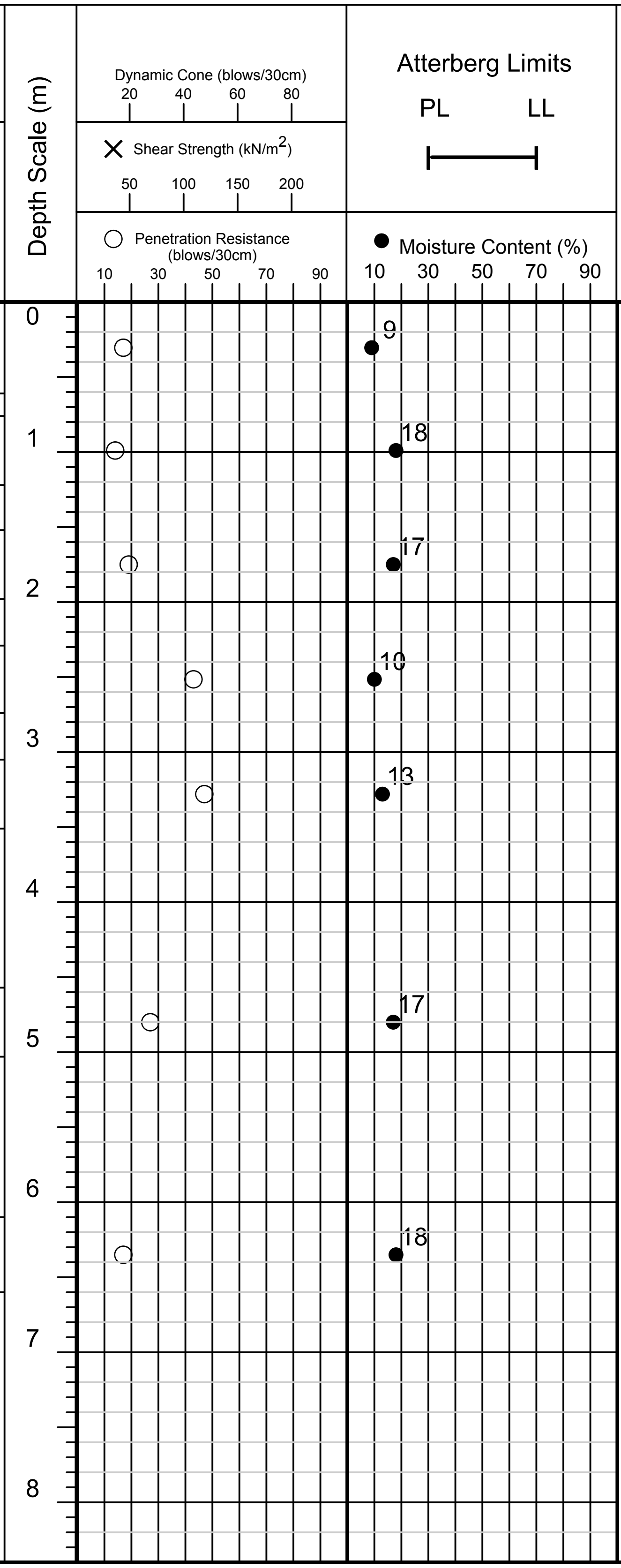
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 12, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
230.2	Ground Surface			
	EARTH FILL brown silty clay occ. topsoil inclusions	1	DO	17
0.6	Brown, stiff, weathered **SILTY CLAY**	2	DO	14
228.7 1.5	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	19
		4	DO	43
		5	DO	47
	brown grey			
		6	DO	27
		7	DO	17
223.6 6.6	**END OF BOREHOLE**			



Water Level: Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 3

Job Number: 1609-S145

Figure No.: 3

Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

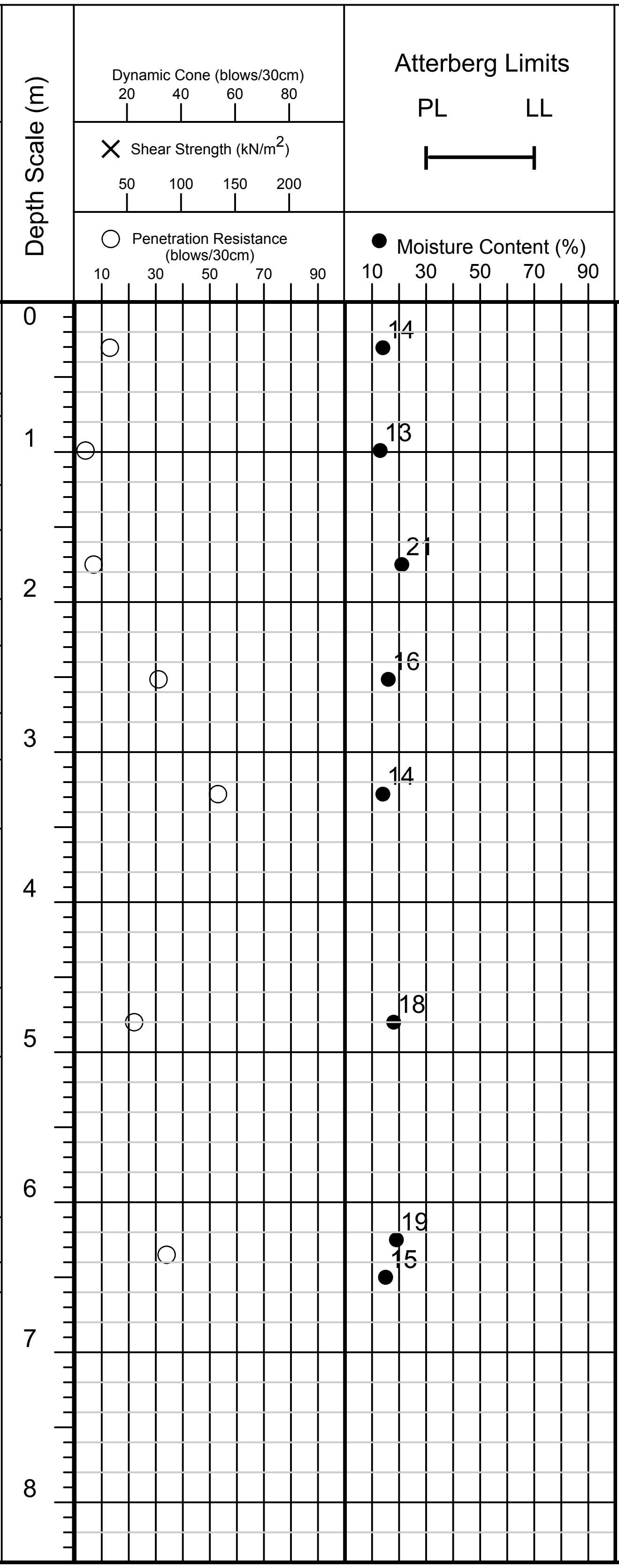
Method of Boring: Flight-Auger

Drilling Date: October 11, 2016

Elevation (m)	SOIL DESCRIPTION
230.2	Ground Surface
0.1	5 cm **TOPSOIL**
	EARTH FILL brown silty clay occ. topsoil inclusions
0.8	**TOPSOIL**
229.2 1.0	Brown, firm, weathered **SILTY CLAY**
228.2 2.0	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders brown grey
223.6 6.6	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value
1	DO	13
2	DO	4
3	DO	7
4	DO	31
5	DO	53
6	DO	22
7A 7B	DO	34



Water Level

Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 4

Figure No.: 4

Job Number: 1609-S145

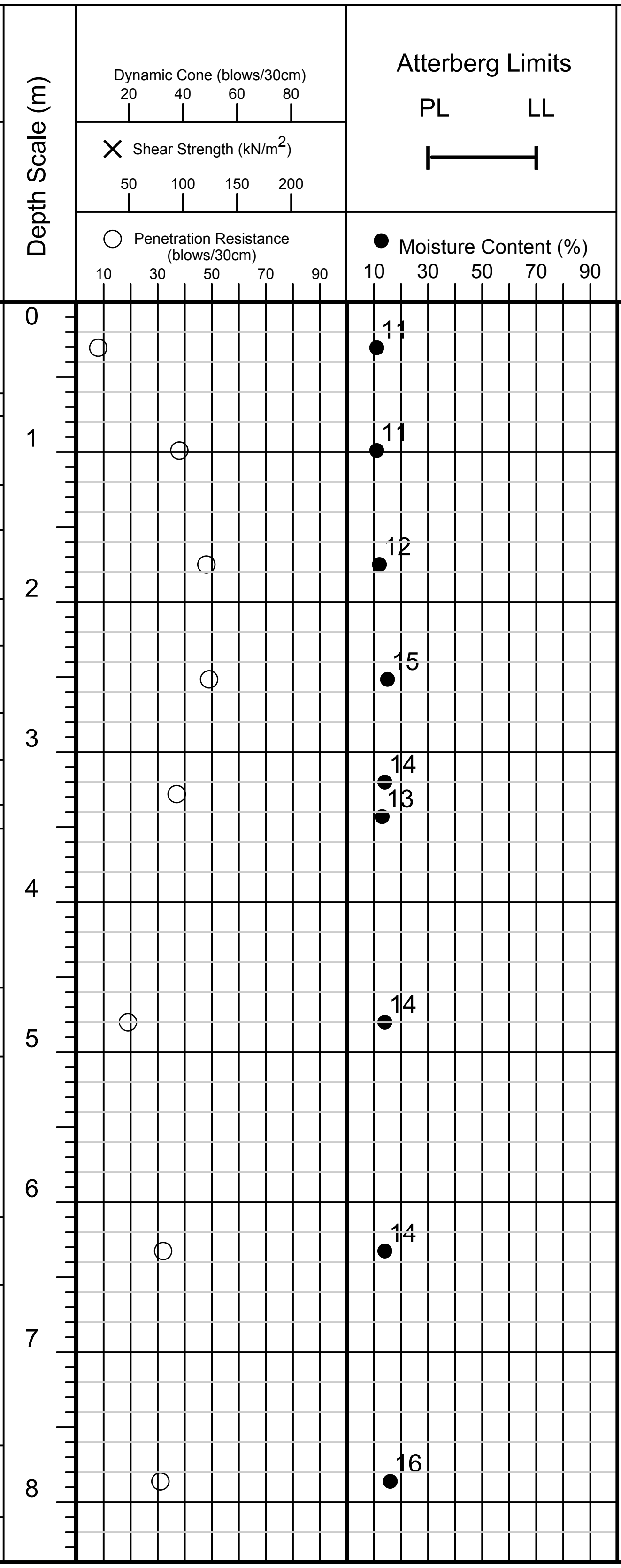
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 11, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
230.7	Ground Surface			
0.1	5 cm **TOPSOIL**			
	EARTH FILL brown sandy silt, some clay occ. topsoil inclusions	1	DO	8
229.8 0.9	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	2	DO	38
		3	DO	48
		4	DO	49
	brown	5A	DO	37
	grey	5B		
		6	DO	19
		7	DO	32
		8	DO	31
222.6 8.1	**END OF BOREHOLE**			



Water Level

Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 5

Figure No.: 5

Job Number: 1609-S145

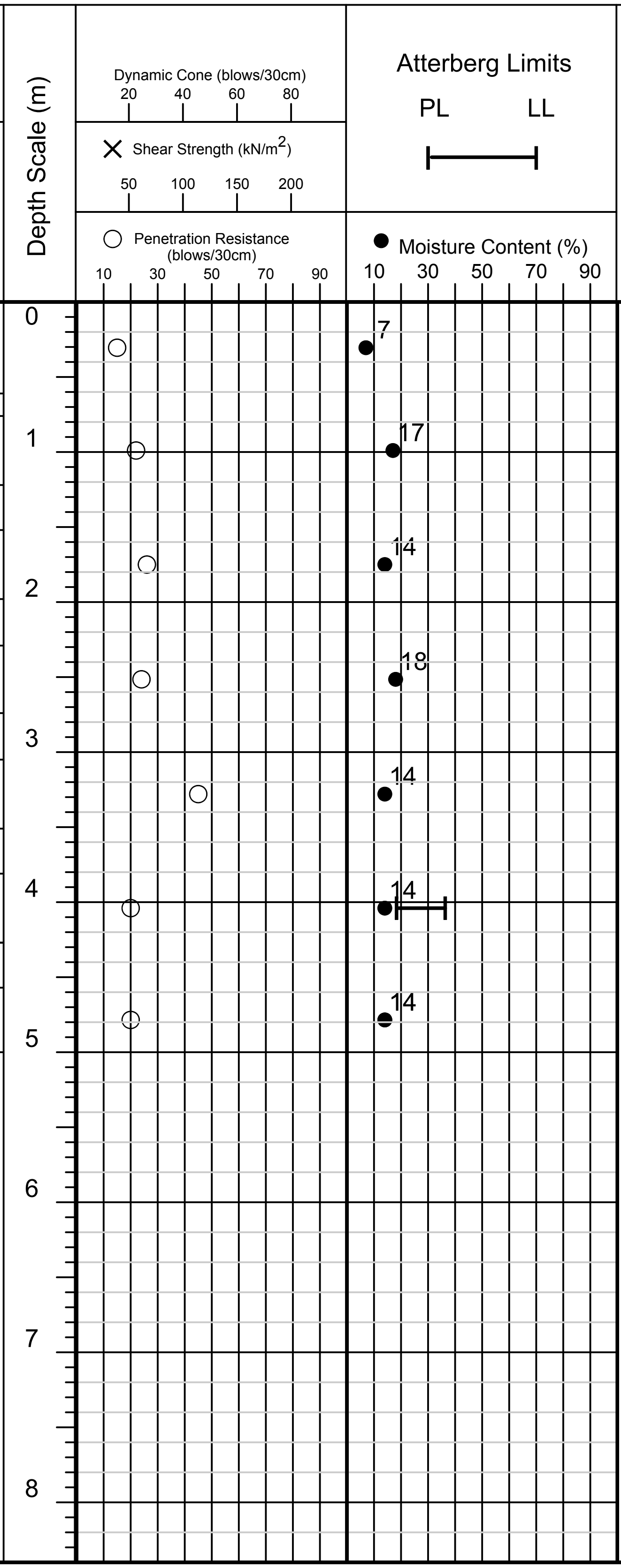
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 11, 2016

Elevation (m)	SOIL DESCRIPTION	Number	Type	N-Value
230.9	Ground Surface			
0.1	10 cm **TOPSOIL**			
	EARTH FILL brown silty clay occ. topsoil inclusions	1	DO	15
230.2 0.7	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	2	DO	22
	weathered	3	DO	26
		4	DO	24
		5	DO	45
	brown grey	6	DO	20
		7	DO	20
225.9 5.0	**END OF BOREHOLE**			



Water Level: Dry on completion

LOG OF BOREHOLE NO.: 6

Figure No.: 6

Job Number: 1609-S145

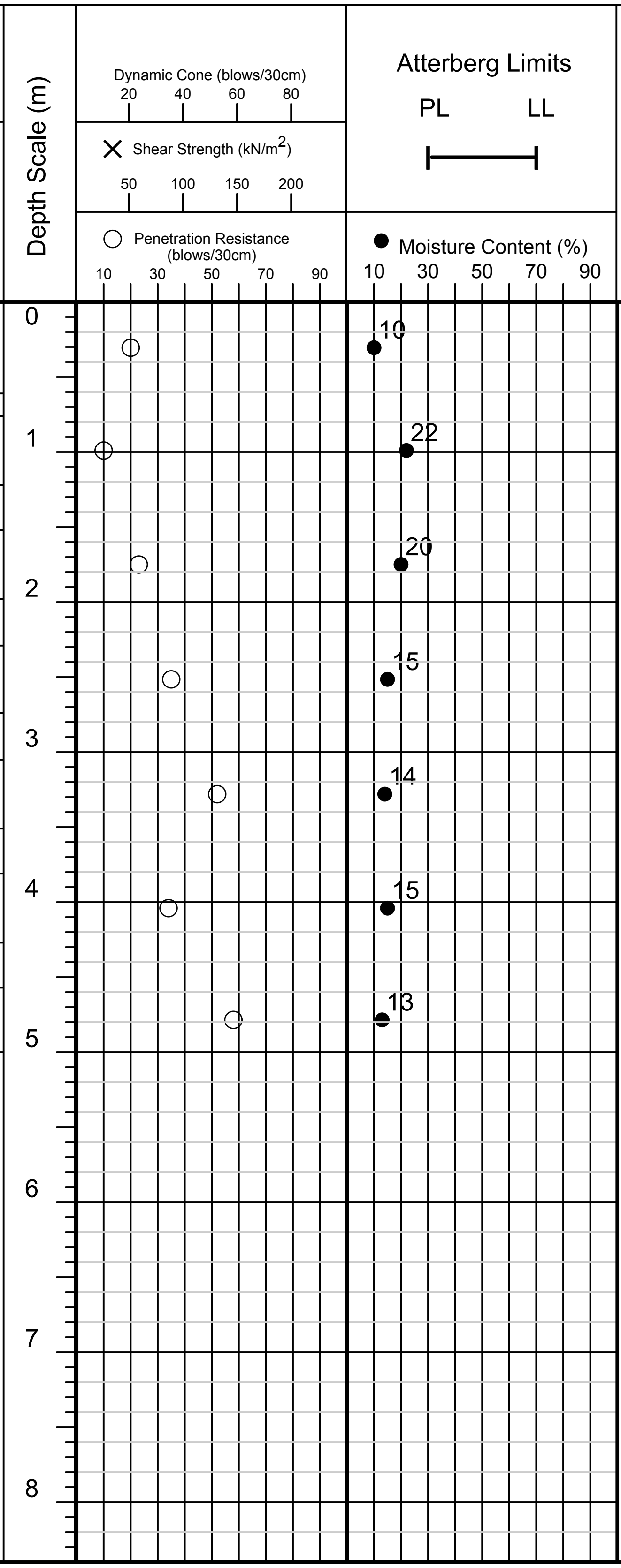
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 11, 2016

Elevation (m)	SOIL DESCRIPTION	Number	Type	N-Value	Water Level
230.8	Ground Surface				
0.1	13 cm **TOPSOIL**				
	EARTH FILL brown silty clay occ. topsoil inclusions	1	DO	20	
		2	DO	10	
229.7 1.1	Brown, stiff to very stiff **SILTY CLAY** weathered	3	DO	23	
228.7 2.1	Brown, hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	35	Dry on completion
		5	DO	52	
		6	DO	34	
		7	DO	58	
225.8 5.0	**END OF BOREHOLE**				



SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 7

Figure No.: 7

Job Number: 1609-S145

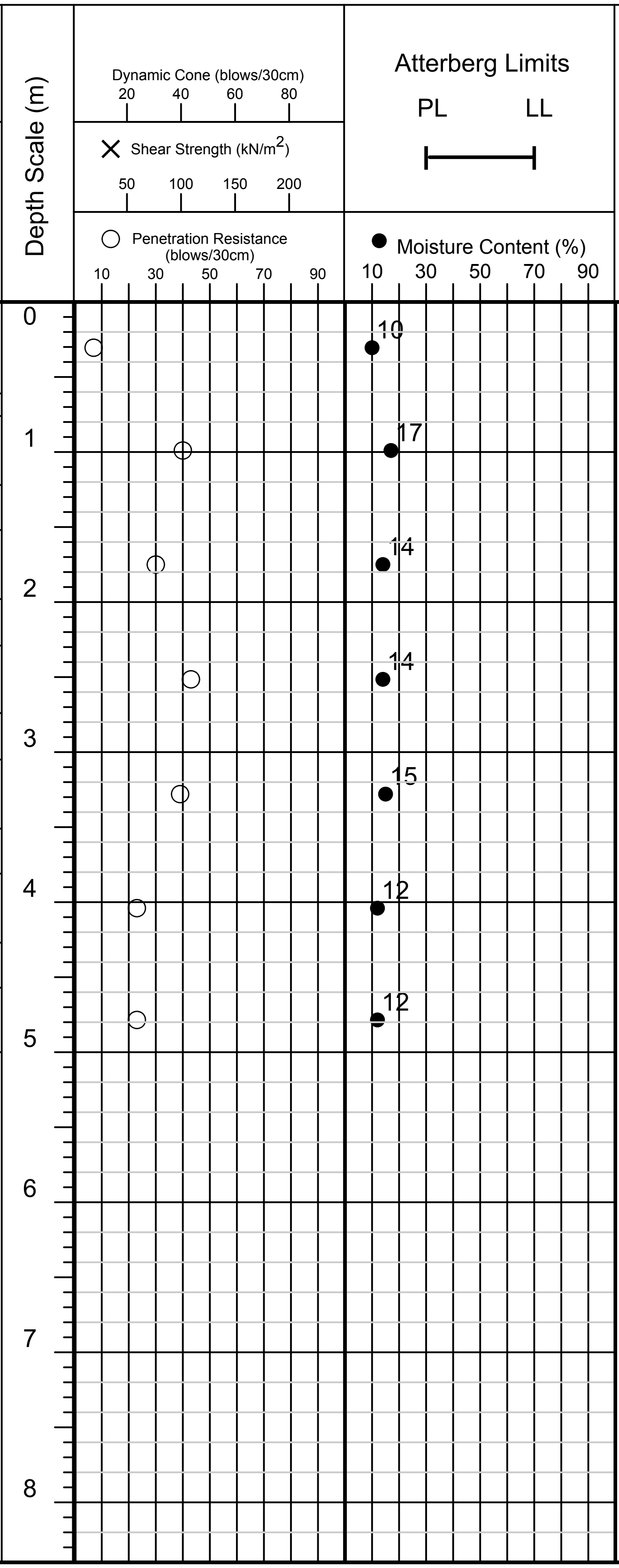
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 11, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Water Level
230.7	Ground Surface				
0.0	**3 cm TOPSOIL** Brown, loose, weathered **SANDY SILT** occ. root inclusions	1	DO	7	Dry on completion
229.8 0.9	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	2	DO	40	
		3	DO	30	
		4	DO	43	
		5	DO	39	
	brown grey	6	DO	23	
		7	DO	23	
225.7 5.0	**END OF BOREHOLE**				



SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 8

Figure No.: 8

Job Number: 1609-S145

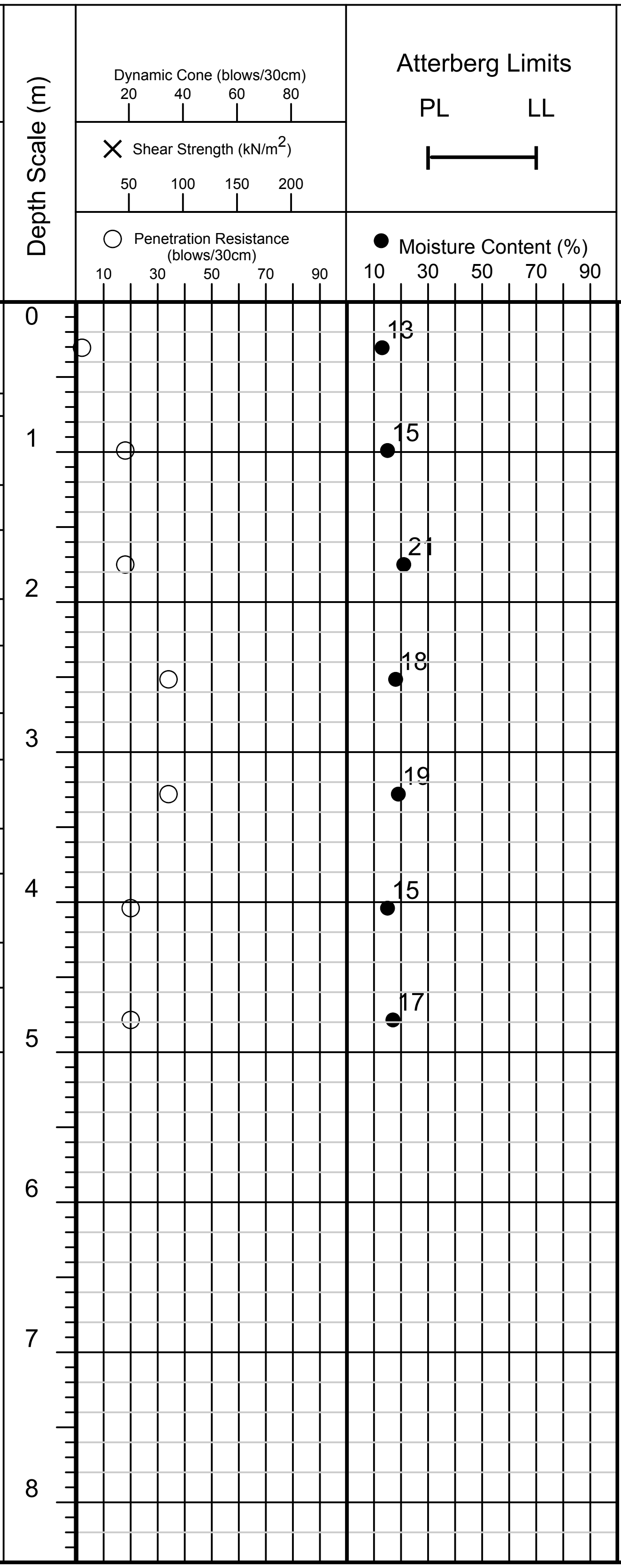
Project Description: Proposed Residential Development

Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 12, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
230.7	Ground Surface			
	25 cm TOPSOIL			
0.3	Brown, very loose to compact **SILTY SAND** fine grained	1	DO	2
		2	DO	18
229.3 1.4	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	18
		4	DO	34
		5	DO	34
	brown grey	6	DO	20
		7	DO	20
225.7 5.0	**END OF BOREHOLE**			



Water Level

Dry on completion

SOIL ENGINEERS LTD.

LOG OF BOREHOLE NO.: 9

Figure No.: 9

Job Number: 1609-S145

Project Description: Proposed Residential Development

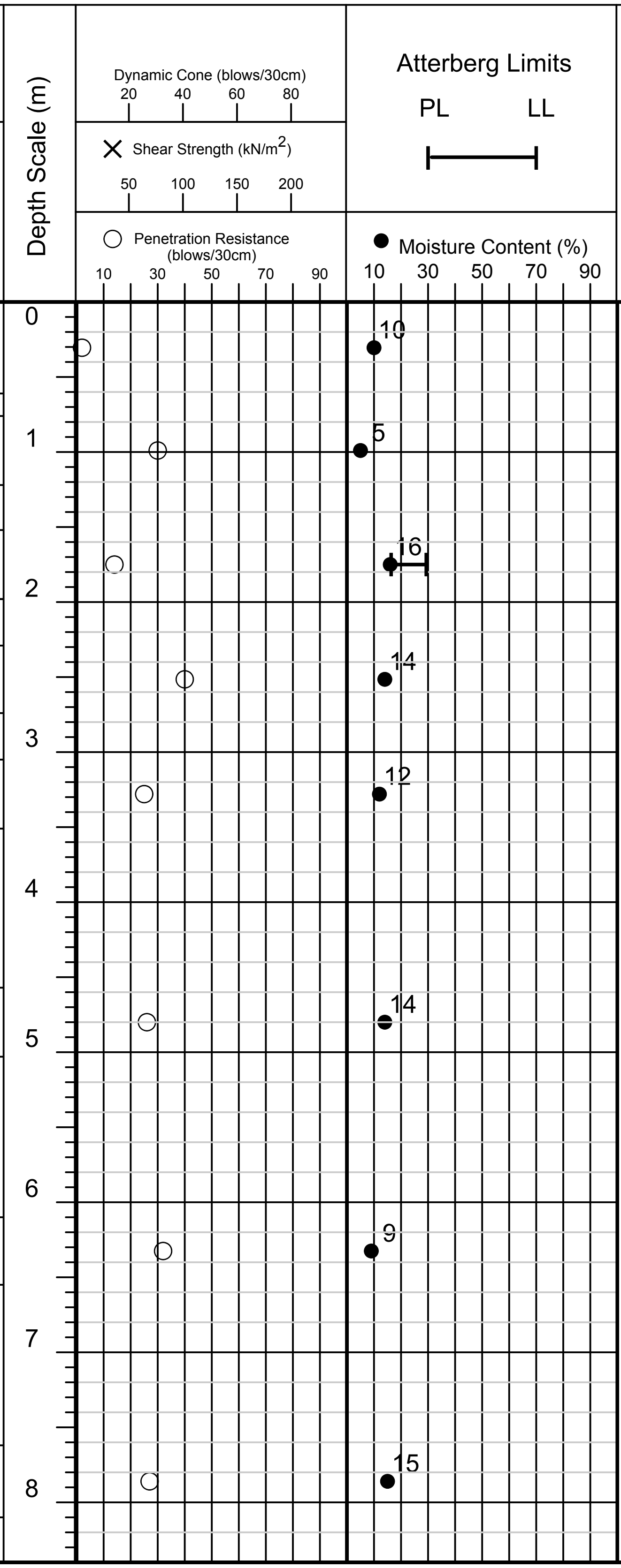
Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Method of Boring: Flight-Auger

Drilling Date: October 12, 2016

Elevation (m)	SOIL DESCRIPTION
230.6	Ground Surface
	25 cm TOPSOIL
0.3	Brown, very loose to compact **SANDY SILT** occ. root inclusions weathered
229.4 1.2	Brown, stiff **SILTY CLAY**
228.8 1.8	Very stiff to hard **SILTY CLAY TILL** a trace of gravel occ. sand and silt seams and layers, cobbles and boulders brown grey
222.5 8.1	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	2
2	DO	30
3	DO	14
4	DO	40
5	DO	25
6	DO	26
7	DO	32
8	DO	27



Water Level

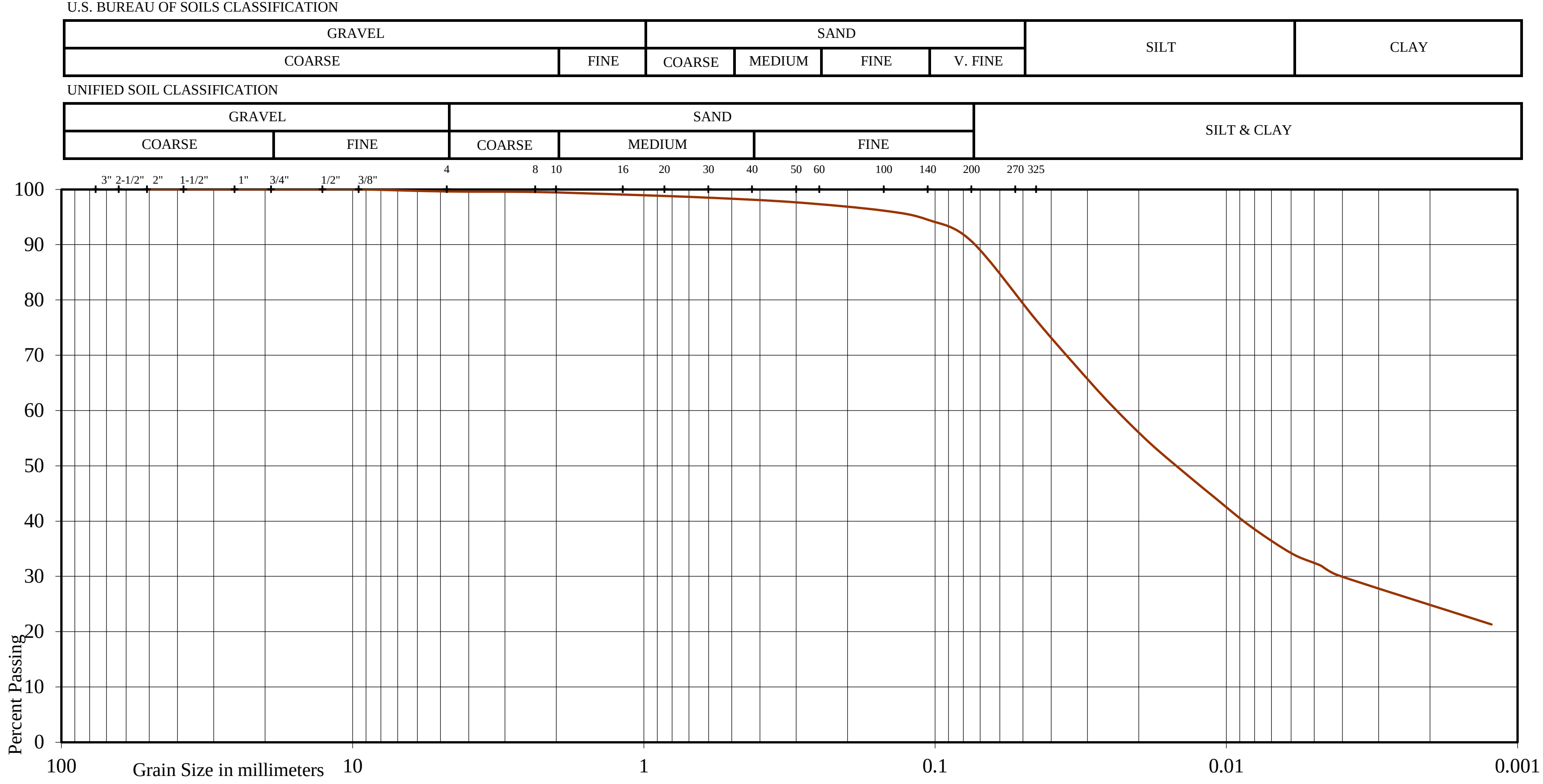
Dry on completion

SOIL ENGINEERS LTD.

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1609-S145



Project: Proposed Residential Development

Location: 12148 Albion-Vaughan Road, Town of Caledon

Borehole No: 9

Sample No: 3

Depth (m): 1.6

Elevation (m): 229.0

Liquid Limit (%) = 30

Plastic Limit (%) = 17

Plasticity Index (%) = 13

Moisture Content (%) = 16

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

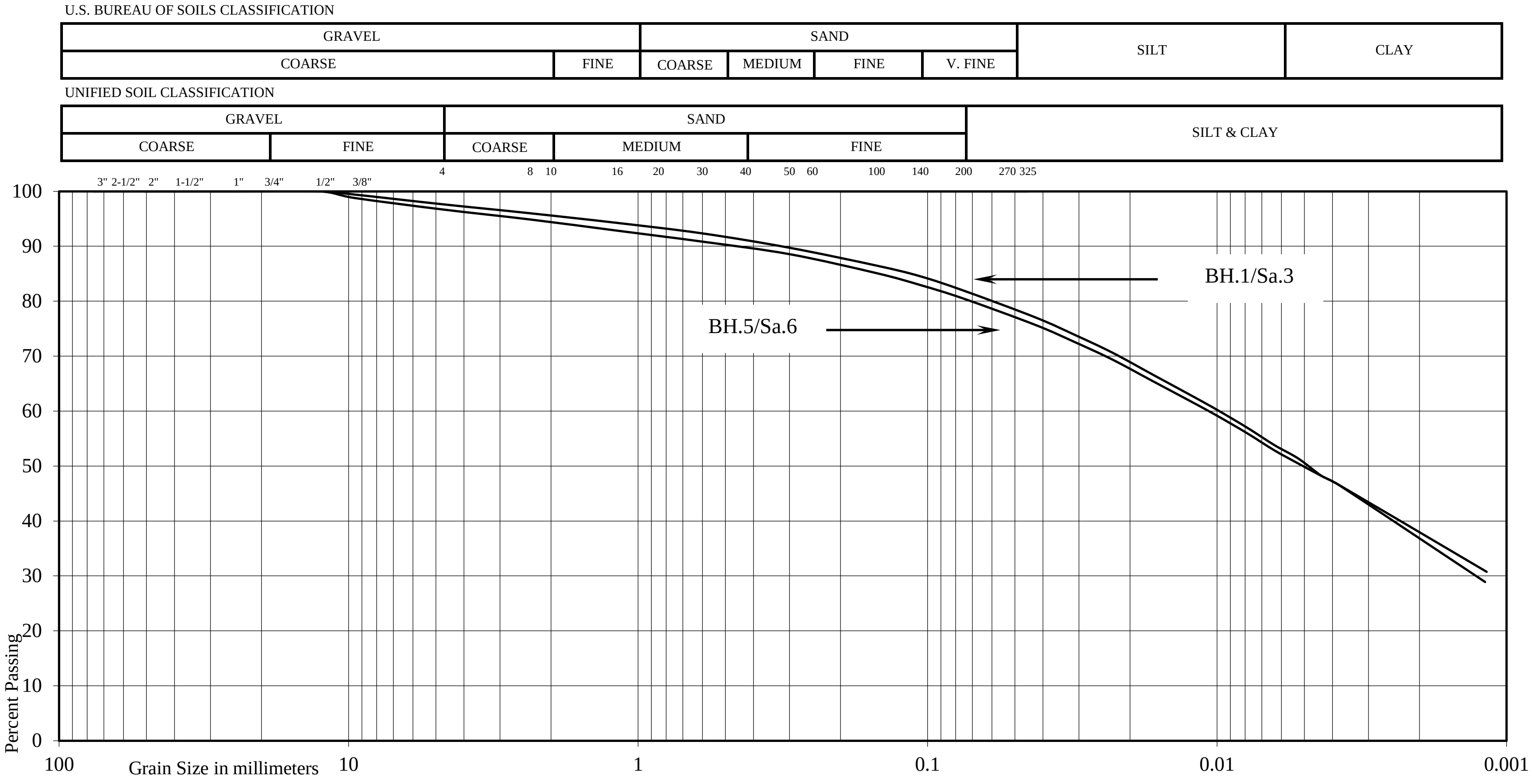
Classification of Sample [& Group Symbol]: SILTY CLAY
a tr. of sand

Figure: 11

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1609-S145



Project: Proposed Residential Development

Location: 12148 Albion-Vaughan Road, Town of Caledon

Borehole No:	1	5
Sample No:	3	6
Depth (m):	1.7	3.9
Elevation (m):	228.4	227.0

BH./Sa.	1/3	5/6
Liquid Limit (%) =	38	37
Plastic Limit (%) =	20	19
Plasticity Index (%) =	18	18
Moisture Content (%) =	16	14
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

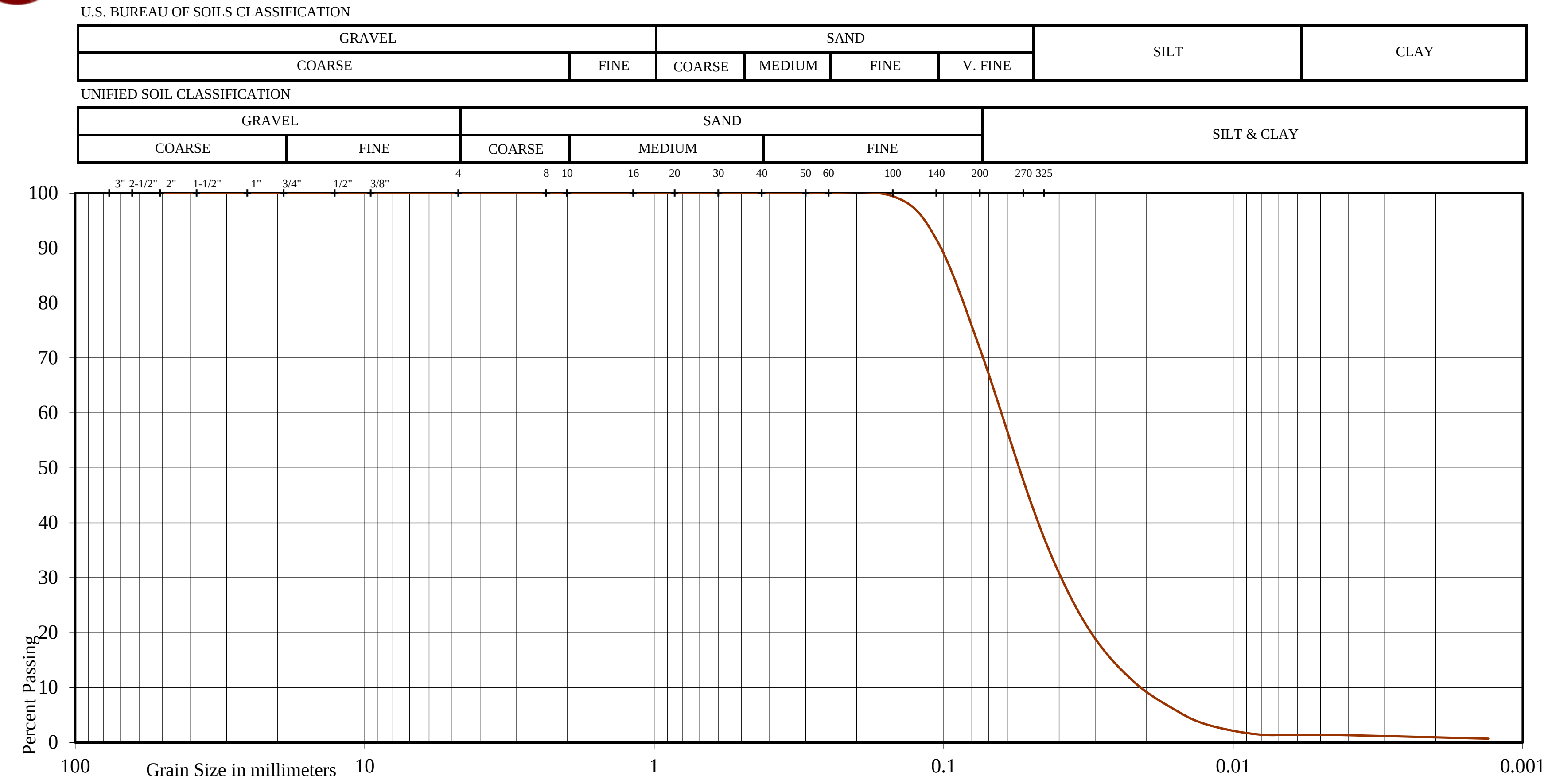
Classification of Sample [& Group Symbol]: SILTY CLAY, Till
some sand, a tr. of gravel

Figure: 12

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1609-S145



Project: Proposed Residential Development

Location: 12148 Albion-Vaughan Road, Town of Caledon

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 9

Plasticity Index (%) = -

Sample No: 2

Moisture Content (%) = 5

Depth (m): 0.8

Estimated Permeability

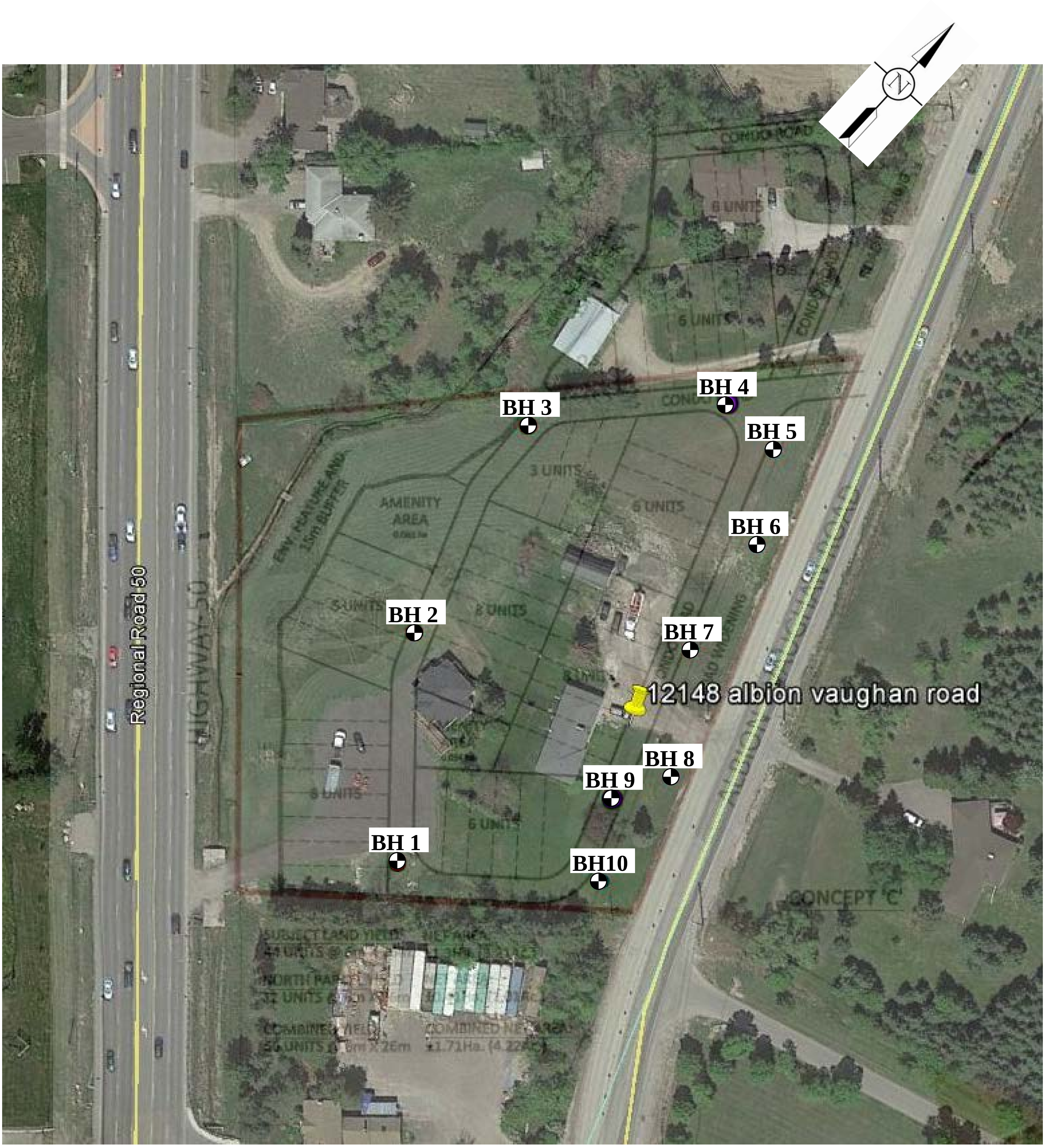
Elevation (m): 229.8

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

Classification of Sample [& Group Symbol]: SANDY SILT

a tr. of clay

Figure: 13



Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
100 NUGGET AVENUE. TORONTO. ONTARIO M1S 3A7 · TEL: (416) 754-8515 · FAX: (416) 754-8516

BOREHOLE LOCATION PLAN

DESIGNED	CHECKED	DWG NO. 1	REV

SCALE 1:1000	REF. NO. 1609-S145	DATE January 2017

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

Subsurface Profile
Drawing No. 2
Scale: As Shown

Job Number: 1609-S145
Report Date: January 2017
Job Location: 12148 Albion-Vaughan Road
Town of Caledon

Project Description: Proposed Residential Development

Legend

═ CAVE IN	▽ WL (END OF DRILLING)	▼ WL (STABILIZED)

TOPSOIL	FILL	SANDY SILT	SILTY CLAY TILL
CONCRETE	SAND	SANDY SILT TILL	SHALE
PAVEMENT	SILTY SAND	SILT	PEAT
GRANULAR	SILTY SAND TILL	SILTY CLAY	ALLUVIUM