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A REPORT TO
DIBLASIO HOMES

A SOIL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

DIBLASIO ESTATE
6620 ROTHSCHILD TRAIL

CITY OF MISSISSAUGA

Reference No. 1406-S151

AUGUST 2014

DISTRIBUTION

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1.0 INTRODUCTION

In accordance with written authorization dated June 23, 2014, by Mr. Alvaro DiBlasio of DiBlasio Homes, a soil investigation was carried out at 6620 Rothschild Trail, City of Mississauga, for a proposed Residential Development.

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 the proposed project.

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

2.0 SITE AND PROJECT DESCRIPTION

The City of Mississauga is situated on Halton-Peel till plain where drift beds onto a shale bedrock at shallow to moderate depths. In places, the drift has been partly eroded by Peel Ponding (glacial lake) and filled with lacustrine sand, silt, clay and reworked tills.

The subject property is located at the end of Rothschild Trail, near Fletchers Creek, in the City of Mississauga. It is irregular in shape and has an area of approximately 9,200 sq. m. The property is currently occupied by a residential house.

It is understood that the subject property will be developed for residential use with an infiltration basin to the southwest of the site. Details of the development including the proposed grade, number of basements, number of storeys, etc., were not provided at the time that this report was prepared.

3.0 FIELD WORK

The field work, consisting of 7 boreholes to depths ranging from 4.7 to 5.3 m, was performed on July 25, 2014, at the locations shown on the Borehole Location Plan and Subsurface Profile, 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 provided by the client.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 7, inclusive. The revealed stratigraphy is plotted on the subsurface profile on Drawing No. 1, and the engineering properties of the disclosed soils are discussed herein.

Beneath a veneer of topsoil fill in some locations, overlying a layer of earth fill, the site is generally underlain by a stratum of silty sand till; strata and lenses of silty clay till, sand and gravel, and silt were found on and/or below the silty sand till at various depths and locations. Shale bedrock was found in Boreholes 4 and 5 at a depth of 4.6± m from the prevailing ground surface. Refusal to augering occurred at depths ranging from 4.9 to 5.3± m at Boreholes 1, 2 and 3, which indicates that boulders and/or bedrock occurred at these depths.

4.1 Topsoil Fill (Boreholes 2 to 6, inclusive)

The existing ground surface was covered with a grass lawn and a minor topsoil fill layer. The revealed topsoil thickness varies between 2.5 cm and 7.5 cm.

The topsoil fill is dark brown and permeated with roots. This infers that it contains appreciable amounts of roots and humus. These materials are unstable and compressible under loads; therefore, the topsoil fill is considered to be void of engineering value but can be used for general landscaping purposes.

A fertility analysis should be carried out to assess the suitability of the topsoil fill for use as a planting soil or sodding medium.

Due to its humus content, the topsoil fill 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.

4.2 **Earth Fill** (All Boreholes)

A layer of earth fill was encountered in all borehole locations; in Boreholes 2 to 6, inclusive, the fill lies beneath the topsoil till. It extended to depths ranging from 0.2± to 2.4± m from the prevailing ground surface.

In Boreholes 1, 2 and 7, the fill consisted of sand and gravel with traces to some concrete or brick fragments. Traces of rootlets were also observed in the fill. In Boreholes 3, 4, 5, 6 and 7, the fill consisted of sandy silt with some clay and traces of gravel and rootlets.

The obtained 'N' values range from 6 to 27, with a median of 10 blows per 30 cm of penetration, showing the fill is loose to compact, generally being compact.

The natural water content of the samples ranges from 5% to 20%, with a median of 12%, showing the fill is in a moist to wet, generally very moist condition.

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 Sand Till** (All Boreholes)

The silty sand till was encountered below the earth fill in all boreholes, except Borehole 7, where it was found below a silt deposit. It consists of a random mixture of soil particle sizes ranging from clay to gravel, with the sand being the predominant fraction. The material is heterogeneous, showing that it is a glacial till. It extends to depths ranging from 3.4 to 4.6 m from prevailing ground surface. In places, the upper 0.5± m of the till has been weathered.

A tactile examination of the soil samples showed that the till contains occasional seams of fine sand. It is slightly cemented and varies in cohesiveness from appreciable to slight, revealing that the till contains traces to some clay and gravel.

Hard resistance was encountered during augering showing that the till is permeated with occasional cobbles and boulders.

The relative density of the till, as inferred from the ‘N’ values ranging from 8 to 90, with a median of 28, is loose to very dense, being generally compact. The loose to marginally compact till occurred in the weathered zone of the till stratum.

The natural water content of the samples ranges from 8% to 22%, with a median of 14%, showing that the till is generally in a moist to saturated, generally very moist condition.

Grain size analyses were performed on 2 representative samples; the gradations are plotted on Figure 8.

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

- High frost susceptibility and medium to low water erodibility.
- Moderate permeability, with an estimated coefficient of permeability of 10^{-4} to 10^{-5} cm/sec, 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

- A frictional soil, its shear strength is primarily derived from internal friction and is augmented by cementation. Therefore, its strength is primarily soil density dependent.
- The till will slough slowly if submerged in an unconfined state or from an open-face cut under seepage conditions, particularly in the zone where the saturated sand layers are prevalent. The sides will be stable with a relatively steep slope when excavated in a moist condition.
- A poor flexible pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 7%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5000 ohm·cm.

4.4 **Silt** (Boreholes 6 and 7)

A silt deposit was encountered beneath the silty sand till in Borehole 6 and extended to the maximum investigated depth of 5.0 m from grade; it was encountered below the earth fill in Borehole 7 and extended to 2.7 m below grade. The upper layer of the silt in Borehole 7 has been weathered.

The relative density of the silt, as inferred from the ‘N’ values of 3, 22 and 52, is very loose to very dense. The low ‘N’ value was due to weathering.

The natural water content values of the samples are 22%, 28% and 32%, showing that the silt is in a wet and water-bearing condition. The wet samples displayed appreciate dilatancy where shaken by hand.

A grain size analysis was performed on a representative sample of the silt. The result is plotted on Figure 9.

Accordingly, the engineering properties are listed below:

- Highly frost susceptible, with high soil-adfreezing potential.
- Highly water erodible; it is susceptible to migration through small openings under seepage pressure.
- Moderate permeability, with an estimated coefficient of permeability of 10^{-5} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.11
2% - 6%	0.16
6% +	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.
- It will be subject to sliding in steep cuts. When excavated, the silt will run with seepage and the bottom will boil under a piezometric head of 0.3 m.
- A poor pavement-supportive material, with an estimated CBR value of 5%.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.5 **Sand and Gravel** (Borehole 7)

A sand and gravel layer was encountered below the silty sand till deposit, which extended to the maximum investigation depth of 4.7 m below grade.

Sample examinations showed that the sand is non-cohesive and generally in a wet condition. The latter is confirmed by the determined water content of the sample, which was found to be 8%, indicating that it is water bearing.

The obtained 'N' value is 50 blows per 15 cm, indicating that the relative density of the sand is very dense.

Accordingly, the engineering properties are listed below:

- Low frost susceptibility and low soil-adfreezing potential.
- Pervious, with an estimated coefficient of permeability of 10^{-2} to 10^{-3} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.04
2% - 6%	0.09
6% +	0.13

- The soil has a high capillarity and water retention capacity.
- A frictional soil, its shear strength is dependent on its internal friction angle and soil density.
- In steep cuts, the sand will be stable in a damp to moist condition, but will slough if it is in a wet condition, run with seepage and boil with a piezometric head of about 0.4 m.
- A fair pavement-supportive material, with an estimated CBR value of 20%.

- Low corrosivity to buried metal, with an estimated electrical resistivity of 6500 ohm·cm.

4.6 **Silty Clay Till** (Boreholes 1 to 3, inclusive)

The silty clay till was encountered below the silty sand till at a depth of 4.6 m from grade. It is reddish-brown in colour and contains clay with low plasticity, seams of fine sand and a trace of gravel. Pieces of shale were also observed near the termination depths of the boreholes which ranged between 4.9 m and 5.3 m, where auger and sample refusal was encountered.

The till appears to be a shale-clay reversion.

The obtained 'N' values are all over 50 blows per 15 cm, indicating that the consistency of the clay till is hard.

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

Liquid Limit	20%
Plastic Limit	14%
Natural Water Content	6% and 11%

The above results show that the till is a cohesive material with low plasticity. The natural water content lies below its plastic limit, confirming the consistency of the till determined by the 'N' values.

A grain size analysis was performed on 1 representative sample of the silty clay till. The result is plotted on Figure 10.

Based on the above findings, the following engineering properties are deduced:

- High frost susceptibility and low soil-adfreezing potential.
- Low water erodibility.
- The clay is virtually impervious. The estimated coefficient of permeability is 10^{-7} cm/sec, with runoff coefficients of:

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

- A cohesive-frictional soil, its shear strength is derived from consistency and augmented by the internal friction of the silt. Its shear strength is moisture dependent.
- In excavations, the till will be stable in a relatively steep cut for a short duration; however, as water seepage saturates the sand or silt layers, the sides will slough and sheet collapse may occur without warning.
- A very poor material to support flexible pavement, with an estimated CBR value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3500 ohm·cm.

4.7 **Shale** (Boreholes 4 and 5)

A layer of shale was encountered beneath the silty sand till at Boreholes 4 and 5 at 4.6 m below grade and extended to the auger and sample refusal depth of 4.7 m below grade.

In Boreholes 1, 2 and 3, refusal to augering occurred at depths ranging from 4.9± to 5.3± m from the prevailing ground surface. This refusal indicates that boulders and/or shale bedrock occurred at these depths; however, this can be verified by test pits prior to or during the project construction.

Shale is a laminated, sedimentary, moderately soft rock composed predominantly of clay material. The bedrock at this site is reddish-brown to grey in colour, showing it is a Dundas and/or Queenston Formation which consists of about 20% hard, limy and sandy layers.

The upper layers of the shale are often fissured as a result of the weathering process and/or overstressing by glaciation. The weathered condition often extends to about 2.0 or + m below the surface of the bedrock. Infiltrated precipitation and groundwater from the overburden soils will often permeate the fissures in the rock and, in places, will be under subterranean artesian pressure. However, because the shale is a clay rock, it is considered to be a material of low permeability and a poor aquifer, and the groundwater yield from the rock will be limited.

The shale is susceptible to disintegration and swelling upon exposure to air and water, with subsequent reversion to a clay soil, but the laminated limy and sandy layers would remain as rock slabs.

The weathered rock can be excavated with considerable effort by a heavy-duty backhoe equipped with a rock-ripper; however, excavation will become progressively more difficult with depth into the sound shale. Efficient removal of the sound shale may require the aid of blasting or pneumatic hammering.

When excavating the sound shale, slight lateral displacement of the excavation walls is often experienced. This is due to the release of residual stress stored in the bedrock mantle and the swelling characteristic of the rock.

The excavated spoil will contain a large amount of hard limy and sandy rock slabs, rendering it virtually impossible to obtain uniform compaction. Therefore, unless the spoil is sorted, it is considered unsuitable for engineering applications.

4.8 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 +
Sandy Silt Fill	5 to 20	10	5 to 13
Silty Sand Till	8 to 22	10	5 to 13
Silt	22, 28 and 32	10	5 to 13
Sand and Gravel	8	8	5 to 12
Silty Clay Till	6 and 11	14	10 to 19

Based on the above findings, the majority of the in situ soils are generally not suitable for a 95% or + Standard Proctor compaction. Some of the sandy silt fill, silty sand till and silt are excessively wet and will require prior aeration. This should be carried out during the dry, warm weather by spreading them thinly on the ground. The silty clay till is generally too dry and will require the constant addition of water for structural construction.

The tills should be compacted using a heavy-weight, kneading-type roller while 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, clay till and cemented sandy silt till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soils 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.

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.

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 soil mantle has increased to over 95% of its maximum Standard Proctor dry density.

The presence of boulders in the tills 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 is 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

The boreholes were checked for the presence of groundwater or the occurrence of cave-in upon their completion of the field work. The data are plotted on the Borehole Logs and listed in Table 2.

Table 2 - Groundwater Levels

		Soil Colour Changes Brown to Grey	Seepage Encountered During Augering		Measured Groundwater on Completion	
BH No.	**Borehole Depth (m)**	**Depth (m)**	**Depth (m)**	**Amount**	**Depth (m)**	**El. (m)**
1	5.3	5.3+	-	-	Dry	-
2	4.9	4.9+	-	-	Dry	-
3	5.0	5.0+	-	-	Dry	-
4	4.7	0.8	-	-	Dry	-
5	4.7	4.6	-	-	Dry	-
6	5.0	4.6	4.5	Small	Dry	-
7	4.7	4.7+	1.5	Small	4.6	174.1

Groundwater was not observed upon completion in the majority of the boreholes. Signs of wetness were observed within the silt in Boreholes 6 and 7 at depths of 4.5 m and 1.5 m below grade, respectively. Groundwater was detected in Borehole 7 at depth of 4.6± m in the sand and gravel layer.

The native soil colour changes from brown to grey in Boreholes 4, 5 and 6 at depths ranging from 0.8± to 4.6± m from the prevailing ground surface. The brown colour indicates that the soils have oxidized. The groundwater will fluctuate with the seasons.

The groundwater yield from the silt and sand and gravel deposits and embedded sand and silt layers may be appreciable; however, it is expected to be spent with time if allowed to drain continuously.

The yield of groundwater from the shale bedrock, if encountered, may be appreciable initially, but will drain readily upon release through excavation.

The groundwater yield in the tills will be slow in rate and limited in quantity.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation disclosed that beneath a veneer of topsoil fill in some locations, overlying a layer of earth fill, the site is generally underlain by strata of loose to very dense, generally compact silty sand till, very loose to very dense, generally compact silt, very dense sand and gravel, and hard silty clay till overlying shale bedrock. The upper portion of the silt and silty sand till, in places, has been weathered.

Groundwater was encountered within the depth of investigation only in Borehole 7 in the sand and gravel deposit. Perched water derived from infiltrated precipitation may occur at shallower depths in the wet seasons.

The groundwater yield from the tills, due to their low permeability, will be slow and limited in quantity. The silt, and sand and gravel deposits, are often water bearing, and the yield from these deposits and from the bedrock, if encountered, may be appreciable initially and is expected to decrease or become spent with time if allowed to drain continuously.

As noted previously, details regarding the proposed residential development were not provided prior to the completion of the report; hence, all recommendations are made based on the existing conditions of the site, and deeper boreholes may be required when the draft plan of the development has been finalized.

The geotechnical findings which warrant special consideration are presented below:

1. The thickness of the revealed topsoil fill ranged from 2.5 to 7.5 cm. However, topsoil fill thicker than that disclosed by the boreholes may occur in the low-lying depressions or highly vegetated areas.

2. The topsoil fill should be stripped and removed for the project construction. The topsoil fill contains an appreciable amount of humus and will generate volatile gases under anaerobic conditions; therefore, it should not be buried within the building envelope or deeper than 1.2 m below the exterior finished grade of the development.
3. The fill is not suitable to support any structural loads. The earth fill must be subexcavated and sorted free of topsoil inclusions or deleterious materials to be reused as structural backfill and/or for construction of engineered fill on site. If it is impractical to sort the topsoil and deleterious materials from the fill, then it must be wasted and disposed of from the site.
4. The sound natural soils below the earth fill and weathered soils are suitable for normal spread and strip footing construction.
5. Where extended footings are required, or where earth fill is to be placed to raise the site, it is generally more economical to place engineered fill for normal footing, sewer and road construction.
6. A Class ‘B bedding, consisting of compacted 20-mm Crusher-Run Limestone, is recommended for the construction of the underground services.
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.
8. Perimeter subdrains and dampproofing of the foundation walls will be required for the building with a basement. The subdrains should be shielded by a fabric filter to prevent blockage by silt.
9. As noted, the tills contain shale debris and are likely to contain boulders. Extra effort and a properly equipped backhoe will be required for excavation. Boulders larger than 15 cm in size are not suitable for structural backfill and/or in the construction of engineered fill.

10. Water-bearing silt and sand and gravel were found in the area delineated by Boreholes 6 and 7; these deposits will run and boil when excavated and must be stabilized by vigorous pumping from closely spaced-well or, if necessary, by a well-point dewatering system prior to construction of the under services and/or foundations.
11. Services constructed in the thick water-bearing sand and silt deposits should consist of pipes with leak-proof joints or the joints should be wrapped with a waterproof membrane.
12. The shale bedrock occurs in places, and its excavation will be costly. Substantial savings can be realized by proper manipulation of the site grading which will minimize rock excavation.
13. Sewer construction may require rock excavation in places; in general, it can be carried out by a backhoe equipped with a rock-ripper, but where deep trenches are required, the use of a pneumatic hammer may be required to break up the sound rock mass prior to excavation.
14. Curb subdrains will be required by the City for road construction.

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**

Based on the borehole findings, the footings should be placed below the topsoil fill, earth fill and weathered soils onto the sound natural soils. As a general guide, the recommended soil 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 3.

Table 3 - Founding Levels

Borehole No.	**Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Corresponding Founding Level**	
	200 kPa (SLS) 320 kPa (ULS)	
	Depth (m)	**El. (m)**
1	1.2 or +	183.6 or -
2	1.2 or +	182.8 or -
3	1.2 or +	182.8 or -
4	2.7 or +	179.0 or -
5	1.2 or +	181.1 or -
6	1.2 or +	180.2 or -
7	2.5 or +	176.2 or -

Where earth fill is required to raise the site or where extended footings are required, it is generally more practical and economical to place engineered fill suitable for a Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 250 kPa for normal footing construction, depending on location. 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.

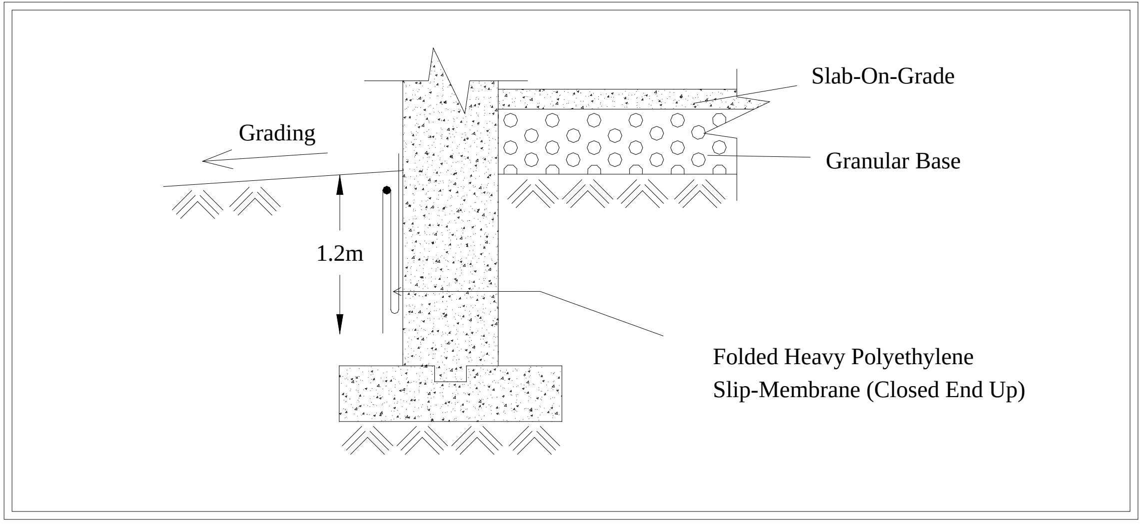
Footings exposed to weathering, and in unheated areas, should have at least 1.2 m of earth cover for protection against frost action.

Due to the presence of topsoil fill, earth fill and weathered soils, all of the footing subgrade should be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, or a building inspector who has geotechnical background, to ensure that the revealed conditions are compatible with the foundation design requirements.

The footings 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 will need to consist of non-frost-susceptible granular, or it should be shielded with a polyethylene slip-membrane between the concrete wall and the backfill. The recommended scheme is illustrated in Diagram 1.

Diagram 1 - Frost Protection Measures (Foundations)



6.2 **Engineered Fill**

Where earth fill is required to raise the site, or in areas where extended foundations will be required for house and services construction, it is generally economical to place engineered fill for normal footing, sewer and/or road construction

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

1. All of the topsoil fill must be removed. The earth fill and weathered soils must be subexcavated, sorted free of topsoil inclusions and deleterious material, aerated and properly compacted to at least 98% of its maximum Standard Proctor dry density. The subgrade surface 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 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed finished lot grade and/or road subgrade. The soil moisture must be properly controlled on the wet side of the optimum. If the building 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.
3. If imported fill is to be used, the hauler is responsible for its environmental quality and must provide a document to certify that it is free of hazardous contaminants.
4. 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.
5. The engineered fill must extend over the entire graded area; the engineered fill envelope and finished elevations must be clearly and accurately defined in the

field, and they must be precisely documented by qualified surveyors. 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.

6. 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.
7. 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.
8. 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.
9. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
10. 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 integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by the excavation.
11. Any excavation carried out in the certified engineered fill must be reported to the geotechnical consultant who inspected the fill placement in order to document the locations of the excavation and/or to 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.

12. 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 **Garages, Driveways and Landscaping**

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

The driveways at the entrances to the garages should be backfilled with non-frost-susceptible granular material, with a frost taper at a slope of 1 vertical:1 horizontal. 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 1.2 m thick, with proper drainage, which will prevent water from ponding in the granular base.

6.4 **Underground Services**

The subgrade for the underground services should consist of properly compacted inorganic earth fill or sound natural soils. A Class ‘B’ bedding is recommended for the design of the underground services construction. The bedding material should consist of compacted 20-mm Crusher-Run Limestone, or equivalent. Lean concrete and thickening of the Crusher-Run Limestone bedding may be used for subgrade stabilization. In areas where extensive dewatering is required, a Class ‘A’ concrete bedding may be necessary.

Where water-bearing sand and silt occur, the sewer joints should be leak-proof or wrapped with a waterproof membrane to prevent subgrade migration through leakage at faulty pipe joints. The necessity for implementing these measures can best be determined during sewer construction.

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 by a fabric filter to prevent blockage by silting.

6.5 **Trench Backfilling**

The backfill in the trenches should be compacted to at least 95% of its maximum Standard Proctor dry density and increased to 98% below the floor slab. 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; within 0.6 m from the subgrade, the compaction should be increased to 98% of the respective maximum Standard Proctor dry density to provide the required stiffness for pavement construction.

The in situ inorganic soils are suitable for use as trench fill; however, the water content of some of the occurring soils, as determined, is generally too wet for a 95% or + Standard Proctor compaction. The soils can be aerated by proper stockpiling prior to structural compaction. Furthermore, some of the silty clay till is too dry and may require the constant addition of water prior to backfilling.

In normal construction practice, the problem areas of road 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.

The narrow trenches for services crossings should be cut at 1 vertical:2 horizontal so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches will prevent the achievement of proper compaction. In this case, imported sand fill which can be appropriately compacted by using a smaller vibratory compactor must be used. The areas at the interface of the native soil and the sand backfill should preferably be flooded for at least 1 day.

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 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 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 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, seepage collars should be provided.

6.6 Pavement Design

Permeable pavement will be used for the local road. Based on the borehole findings, the recommended pavement design is given in Table 4.

Table 4 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Pavers		Unit Pavers conforming to ASTM-C936
Pedestrian and Driveway	60	
Vehicular Light Duty and Heavy Duty	80	
Bedding Sand	30	Clean Sand conforming to ASTM-C33
Granular Base		OPSS Granular ‘A’ or equivalent
Pedestrian and Driveway	150	
Vehicular Light Duty and Heavy Duty	200	
Granular Sub-base		50-mm Crusher-Run Limestone or equivalent
Pedestrian and Driveway	150	
Vehicular - Light Duty	250	
Vehicular - Heavy Duty	350	

The granular base and sub-base should be compacted to 100% of the maximum Standard Proctor dry density.

In order to provide a stable subgrade for pavement construction, it is imperative that the subgrade within the 1.0 m zone below the underside of the granular base be compacted to at least 98% of its maximum Standard Proctor dry density with the moisture content 2% to 3% drier than the optimum. This is to provide adequate stability for the pavement construction.

The following measures should be incorporated in the construction procedures and road design:

- If the parking lot 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 roads should be properly graded to prevent ponding of large amounts of water. Otherwise, the water will seep into the subgrade mantle and induce a regression of the subgrade strength with costly consequences for the pavement construction.
- Prior to placement of the granular bases, the subgrade should be proof-rolled and any soft spots should be rectified.
- If the pavement is to be constructed during wet seasons, thickening of the granular sub-base may be required. The requirement for this can be determined at the time of the pavement construction.
- Fabric filter-encased curb subdrains will be required. They should be installed in wet areas at depths below the underside of the granular sub-base.

6.7 **Infiltration Basin**

An infiltration basin is a type of stormwater management facility constructed within highly permeable soils that provides temporary storage of stormwater runoff.

The proposed infiltration basin is located to the southwest of the subdivision, with an area of 708 m^2. The surface runoff is likely collected from the roof of the buildings, and the surrounding landscape and pavement area, and drains into the infiltration basin.

Based on the findings in Borehole 7, located at the proposed infiltration basin, it consisted of sandy silt fill, silt and silty sand till material to 4.6 m below grade with a layer of sand and gravel to the termination depth of 4.7 m below grade.

The sandy silt fill, silt and silty sand till generally have a moderate permeability while the sand and gravel have a high permeability. The recommended percolation time (‘T’) for the design of the infiltration basin is T = 45 min/cm for silt and silty sand till and 25 min/cm for the sandy silt fill.

The interior slope gradient of the proposed infiltration basin should be maintained to a minimum of 1 vertical:3 horizontal. Sediment and erosion control measure must be implemented during construction.

6.8 **Soil Corrosivity**

The subgrade of the water main and the backfill material will consist generally of sandy silt or silty sand till material. The silt has moderate corrosivity to ductile iron pipes and metal fittings; therefore, cathodic protection will be required. The precise size of the anodes can be calculated at the time of the sewer construction when the soils at the water main level are exposed and sufficient samples can be taken to analyze their corrosivity potential. To estimate the anode weight requirements, the electrical resistivity which has been determined for each of the disclosed soils can be used.

6.9 **Soil Parameters**

The recommended soil parameters for the project design are given in Table 5.

Table 5 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**	**Estimated Bulk Factor**	
	Bulk	**Loose**	**Compacted**
Earth Fill	20.0	1.20	1.00
Silt, Sand and Gravel	21.0	1.20	1.00
Silty Sand Till	22.5	1.33	1.03
Silty Clay Till	20.0	1.33	1.03
Lateral Earth Pressure Coefficients			
	Active K_a	**At Rest K_o**	**Passive K_p**
Earth Fill, Silt, Silty Sand Till, and Sand and Gravel	0.34	0.45	3.00
Silty Clay Till	0.40	0.55	2.50
Coefficients of Friction			
Between Concrete and Granular Base		0.50	
Between Concrete and Sound Natural Soils		0.40	

6.10 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified in Table 6.

Table 6 - Classification of Soils for Excavation

Material	Type
Sound Shale Bedrock	1
Silty Sand Till, weathered Shale Bedrock, Silty Clay Till	2
Earth Fill, dewatered Silt and Sand and Gravel	3
Water-bearing Silt, Sand and Gravel	4

In the tills which generally contain sand and silt deposits, the sides of excavations above groundwater may suffer localized sloughing or side collapse. Therefore, the sides must be sloped at 1 vertical:1 horizontal or + for stability.

At depths below the groundwater level, seepage in the till mantles during excavation is expected to be slow; in the shale, it may be slow to appreciable and can be controlled by pumping from sump wells.

Excavation into the hard or dense tills containing boulders or the weathered shale will require extra effort and the use of a heavy-duty backhoe equipped with a rock-ripper. If blasting of the bedrock is considered to expedite excavation, an expert should be consulted to determine the precautionary measures which should be taken to guard against damage to existing buildings and buried structures from the blasting shock waves.

Where the excavations are to be carried out in the water-bearing sand and gravel and silt, the possibility of flowing sides and bottom boiling dictates that the ground be predrained, either by pumping from closely spaced-wells or, if necessary, by the use of a well-point dewatering system. In order to provide a stable subgrade for services or foundation construction, the groundwater should be depressed to at least 0.5 m below the subgrade. Alternatively, the sides of the excavation can be sheeted. The sheeting should be driven into the underlying soils with low permeability to seal off the water infiltration.

As previously discussed, the groundwater yield from the sand and gravel and silt deposits is likely to be appreciable; however, this should be confirmed by test pumping at the time of construction.

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.

7.0 LIMITATIONS OF REPORT

It should be noted that no chemical tests have been carried out to determine whether environmental contaminants are present in the soils. Therefore, this report deals only with the geotechnical aspects of the proposed project.

This report was prepared by Soil Engineers Ltd. for the account of DiBlasio Homes, and for review by their designated consultants and government agencies. The material in it reflects the judgement of Kin Fung Li, B.Eng., and Daniel Man, 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, 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.

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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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GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 1

FIGURE NO: 1

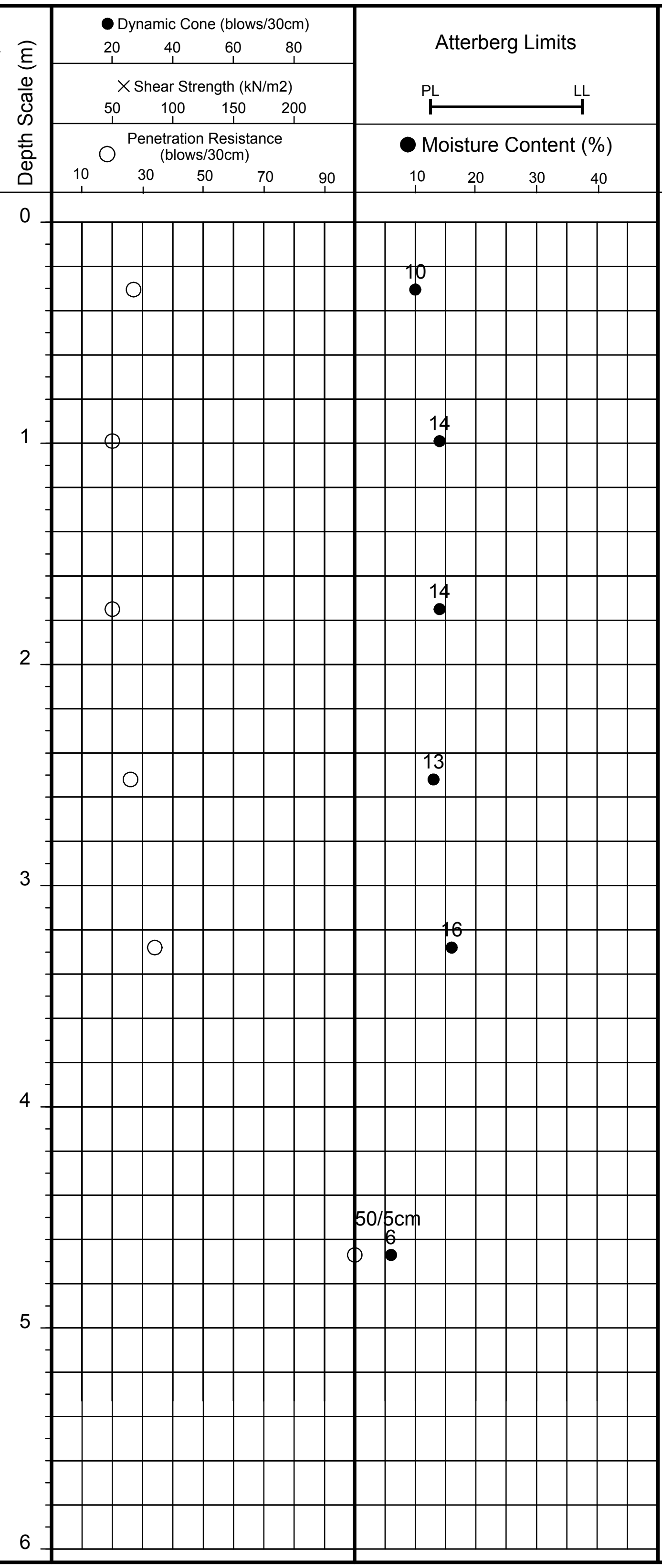
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0	Ground Surface			
184.8	Brown, compact **SAND AND GRAVEL, Fill** trace of concrete fragments a layer of sandy silt at 0.45 m moist	1	DO	27
0.8 184.0	Brown, compact to dense **SILTY SAND, Till** seams of fine sand some gravel and clay moist	2	DO	20
		3	DO	20
		4	DO	26
		5	DO	34
4.6 180.2	Reddish brown, hard **SILTY CLAY, Till** seams of fine sand trace of gravel pieces of shale fragments moist	6	DO	50/5
5.3 179.5	**REFUSAL TO AUGERING** **END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 2

FIGURE NO: 2

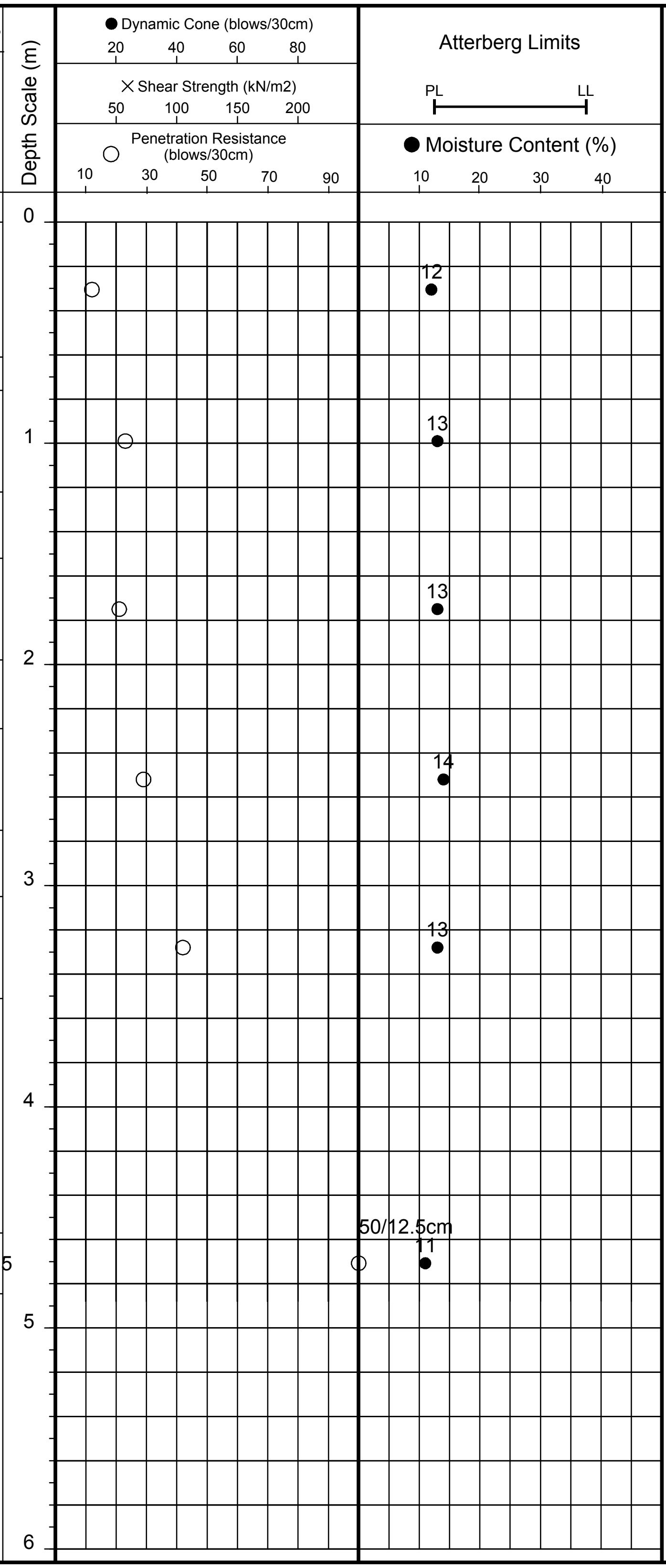
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
0.0	Ground Surface				
184.0 0.2	**TOPSOIL**				
183.8	Brown, compact **SAND AND GRAVEL, Fill** trace of concrete fragments trace of rootlets moist	1	DO	12	
	Brown, compact to dense **SILTY SAND, Till** seams of fine sand some gravel and clay moist	2	DO	23	
		3	DO	21	
		4	DO	29	
		5	DO	42	Dry on completion
4.6 179.4	Reddish brown, hard **SILTY CLAY, Till** seams of fine sand trace of gravel pieces of shale fragments moist	6	DO	50/12.5	
4.9 179.1	**REFUSAL TO AUGERING** **END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 3

FIGURE NO: 3

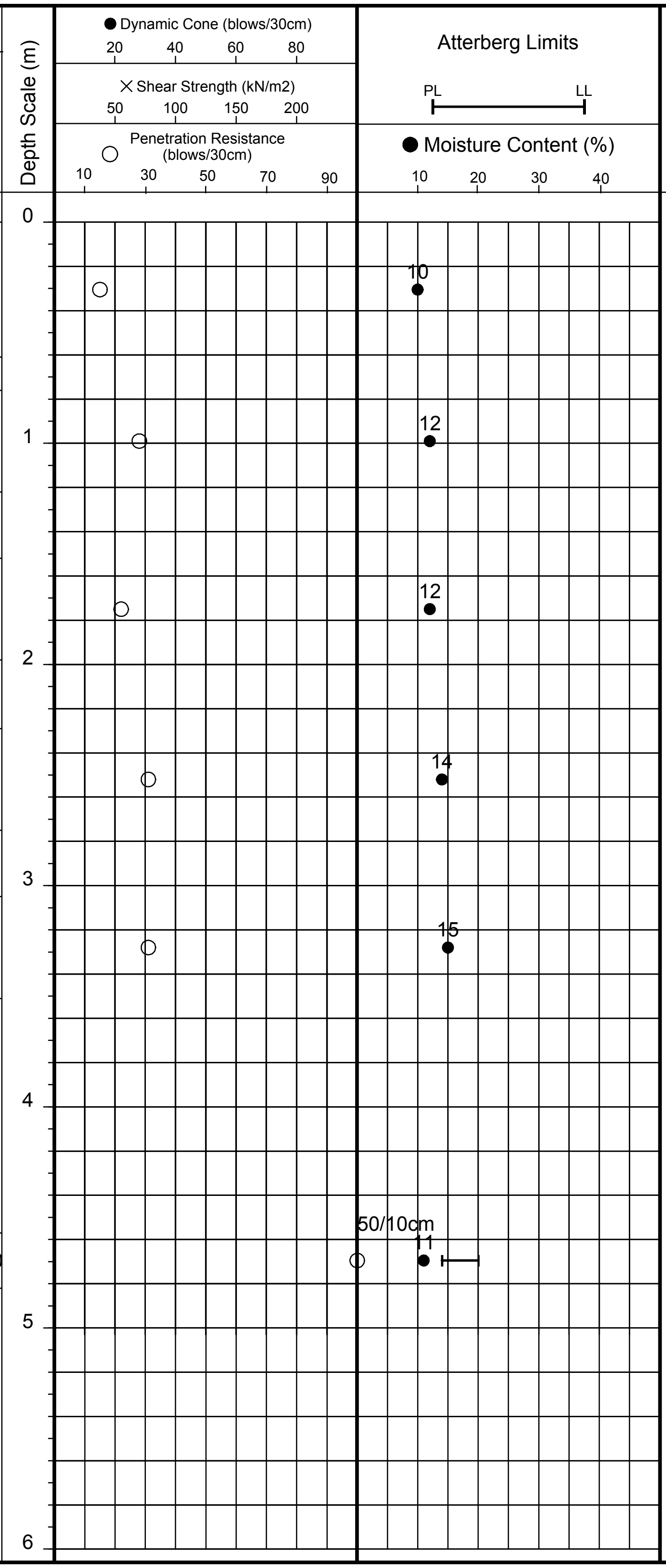
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
184.0	**TOPSOIL**			
	Brown, compact **SANDY SILT, Fill** some clay and gravel trace of rootlets moist	1	DO	15
0.8 183.2	Brown, compact to dense **SILTY SAND, Till** seams of fine sand some gravel and clay moist	2	DO	28
		3	DO	22
		4	DO	31
		5	DO	31
4.6 179.4	Reddish brown, hard **SILTY CLAY, Till** seams of fine sand trace of gravel pieces of shale fragments moist	6	DO	50/10
5.0 179.0	**REFUSAL TO AUGERING** **END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 4

FIGURE NO: 4

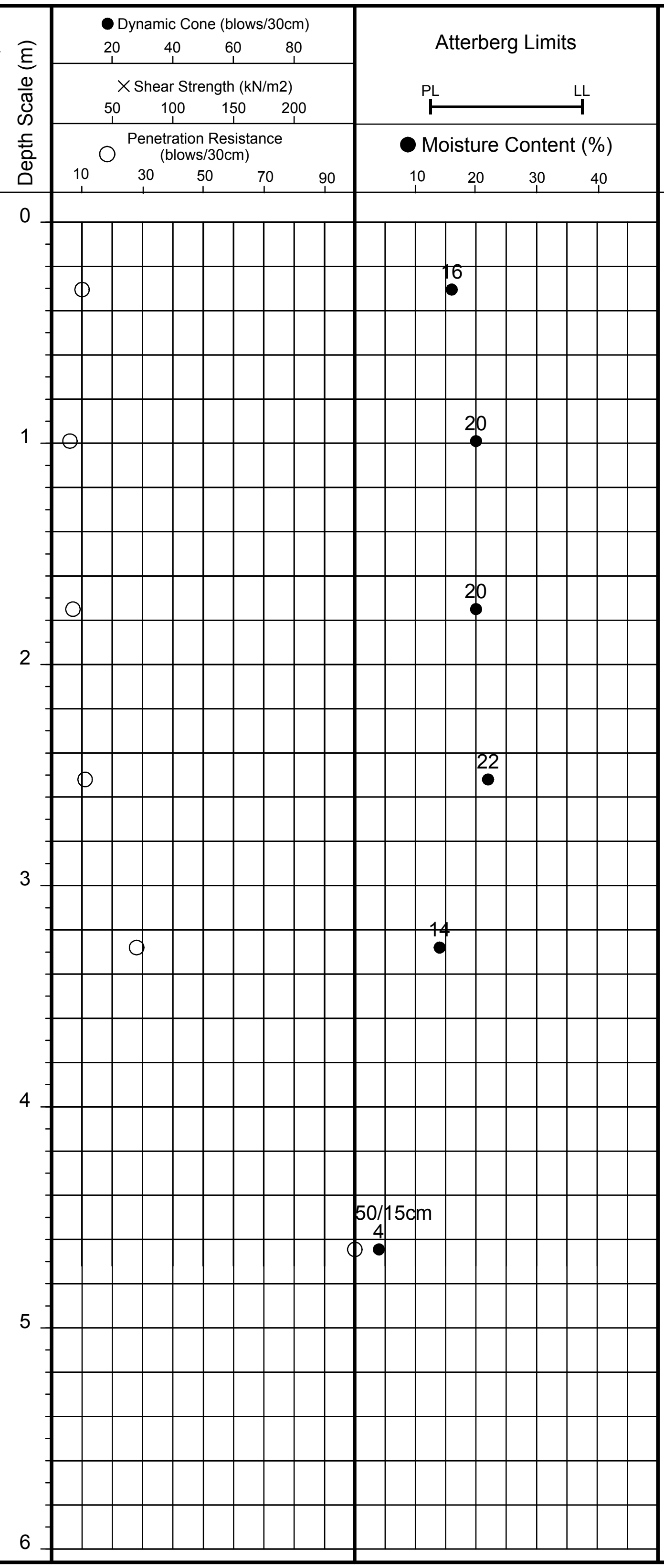
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
181.7	**TOPSOIL**			
	Loose to compact **SANDY SILT, Fill** some clay trace of rootlets and topsoil trace of gravel moist brown grey	1	DO	10
		2	DO	6
		3	DO	7
2.4 179.4	Reddish brown, compact **SILTY SAND, Till** layer of silty fine sand at 3.5 m some gravel and clay moist	4	DO	11
		5	DO	28
4.6 177.2	Reddish brown, hard **SILTY CLAY, Till** seams of fine sand trace of gravel pieces of shale fragments moist	6	DO	50/15
4.7 177.0				
	END OF BOREHOLE			



WATER LEVEL

Dry on completion

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 5

FIGURE NO: 5

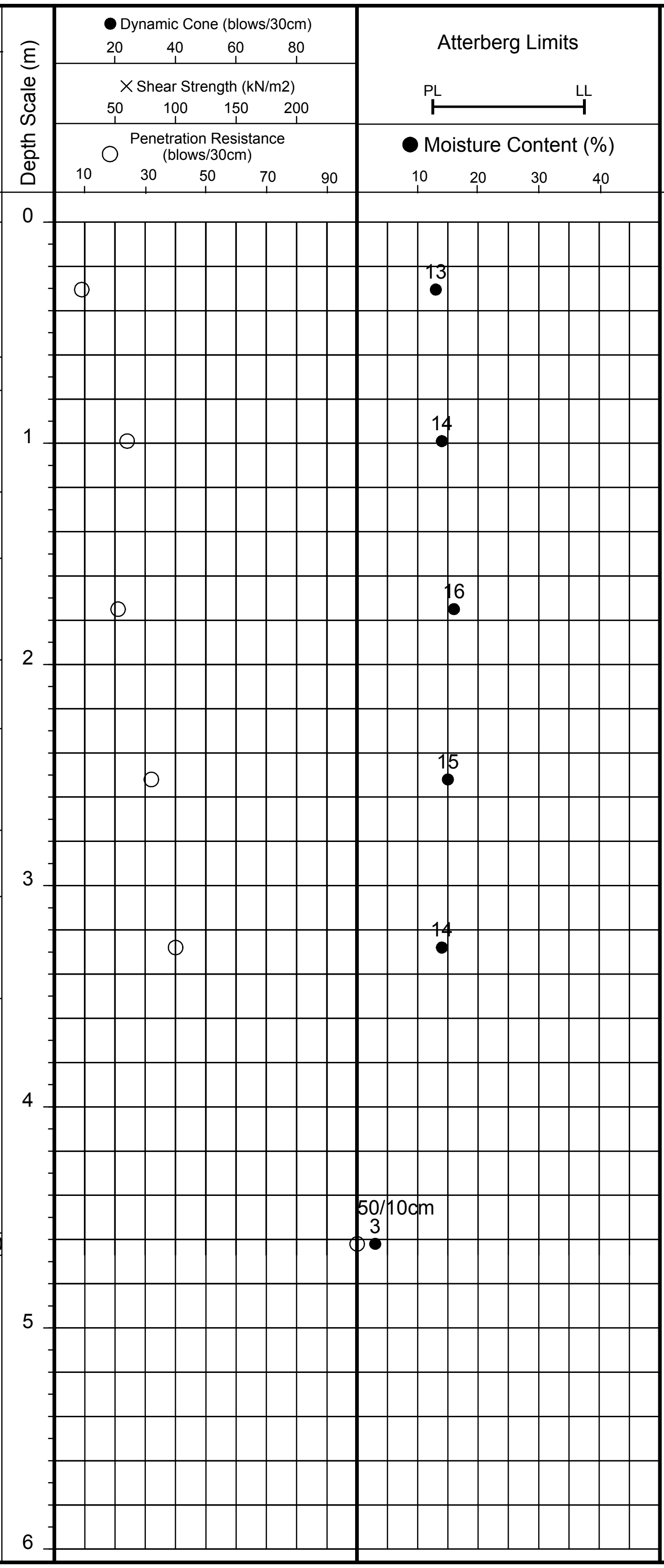
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
0.0 182.3	Ground Surface **TOPSOIL** Brown, loose **SANDY SILT, Fill** a layer of sand and gravel at 0.05 m some gravel trace of rootlets moist	1	DO	9	
0.8 181.6	Brown, compact to dense **SILTY SAND, Till** seams of fine sand some gravel and clay moist	2	DO	24	
		3	DO	21	
		4	DO	32	
		5	DO	40	Dry on completion
4.6 177.8	Grey, hard **SHALE** seams of fine sand moist	6	DO	50/10	
4.7 177.6	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 6

FIGURE NO: 6

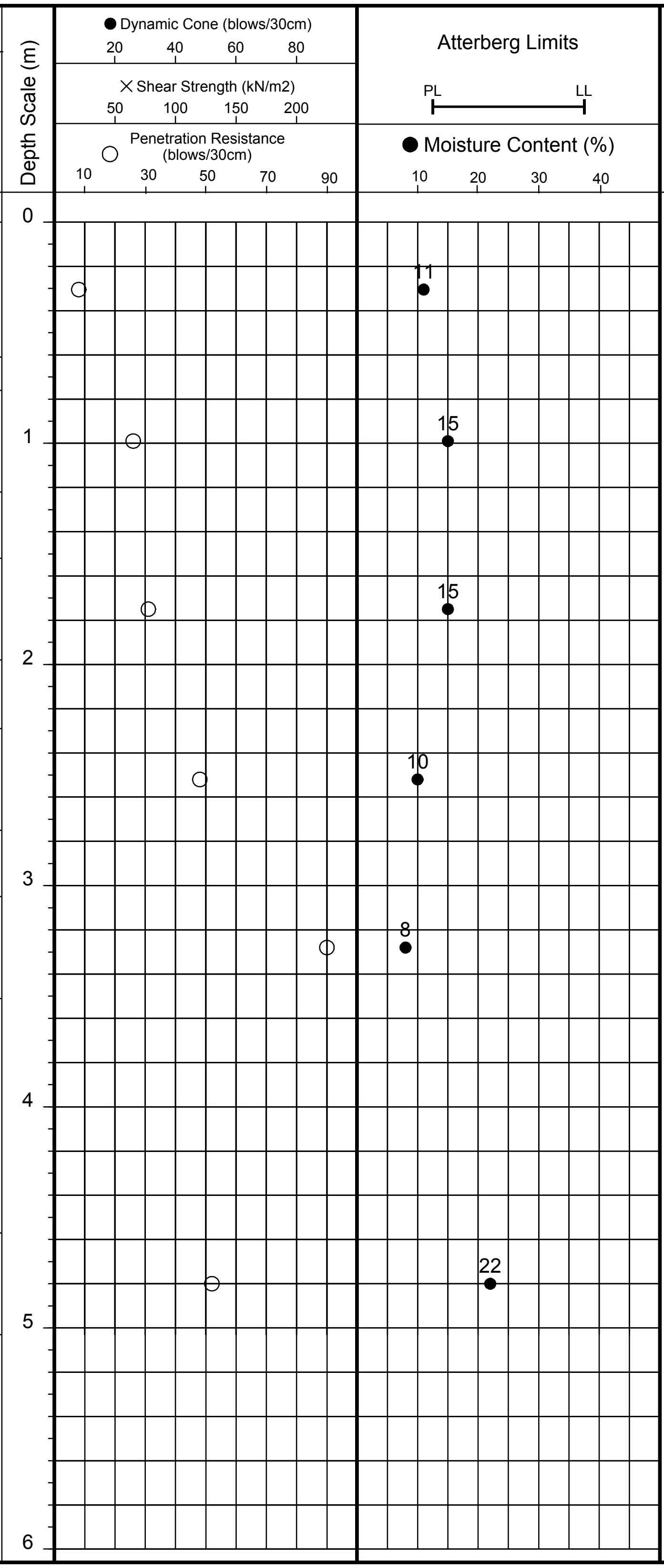
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
181.4	**TOPSOIL** Brown, loose			
0.3 181.2	**SANDY SILT, Fill** trace of rootlets and gravel moist	1	DO	8
	Brown, compact to very dense **SILTY SAND, Till** seams of fine sand some gravel and clay moist	2	DO	26
		3	DO	31
		4	DO	48
		5	DO	90
3.4 178.1	Hard **SILT** moist wet below 4.5 m			
	brown grey	6	DO	52
5.0 176.4	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1406-S151

LOG OF BOREHOLE NO: 7

FIGURE NO: 7

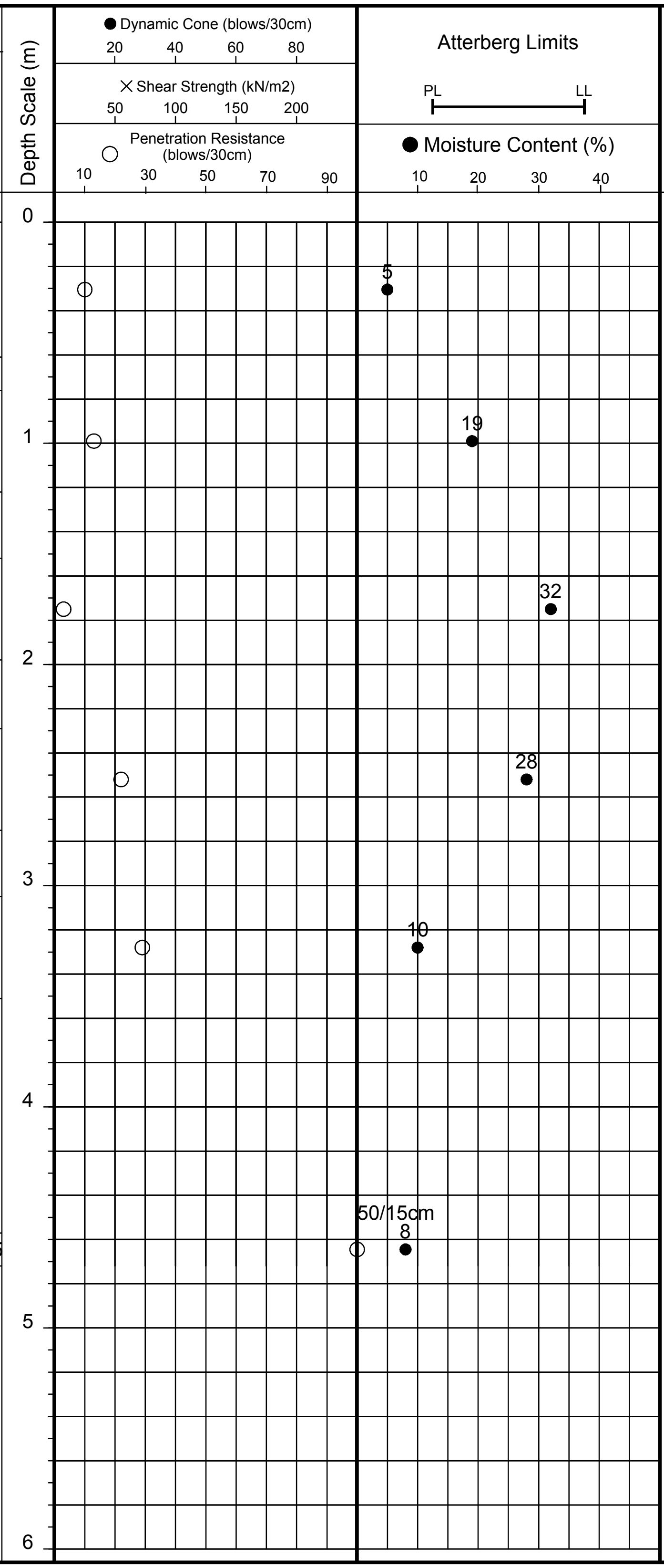
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 6620 Rothschild Trail, Mississauga, Ontario

METHOD OF BORING: Flight-Auger

DATE: July 25, 2014

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 178.7	Ground Surface Brown, compact **SAND AND GRAVEL, Fill**			
0.3 178.4	some concrete and brick fragments moist	1	DO	10
	Brown, compact **SANDY SILT, FIll** some clay trace of brick fragments moist	2	DO	13
1.5 177.2	Brown, loose to compact **SILT** wet	3	DO	3
		4	DO	22
2.7 176.0	Brown, compact **SILTY SAND, Till** seams of fine sand some clay and gravel moist to wet	5	DO	29
4.6 174.1	Brown, very dense	6	DO	50/15
4.7 174.0	**SAND AND GRAVEL** moist to wet **END OF BOREHOLE**			



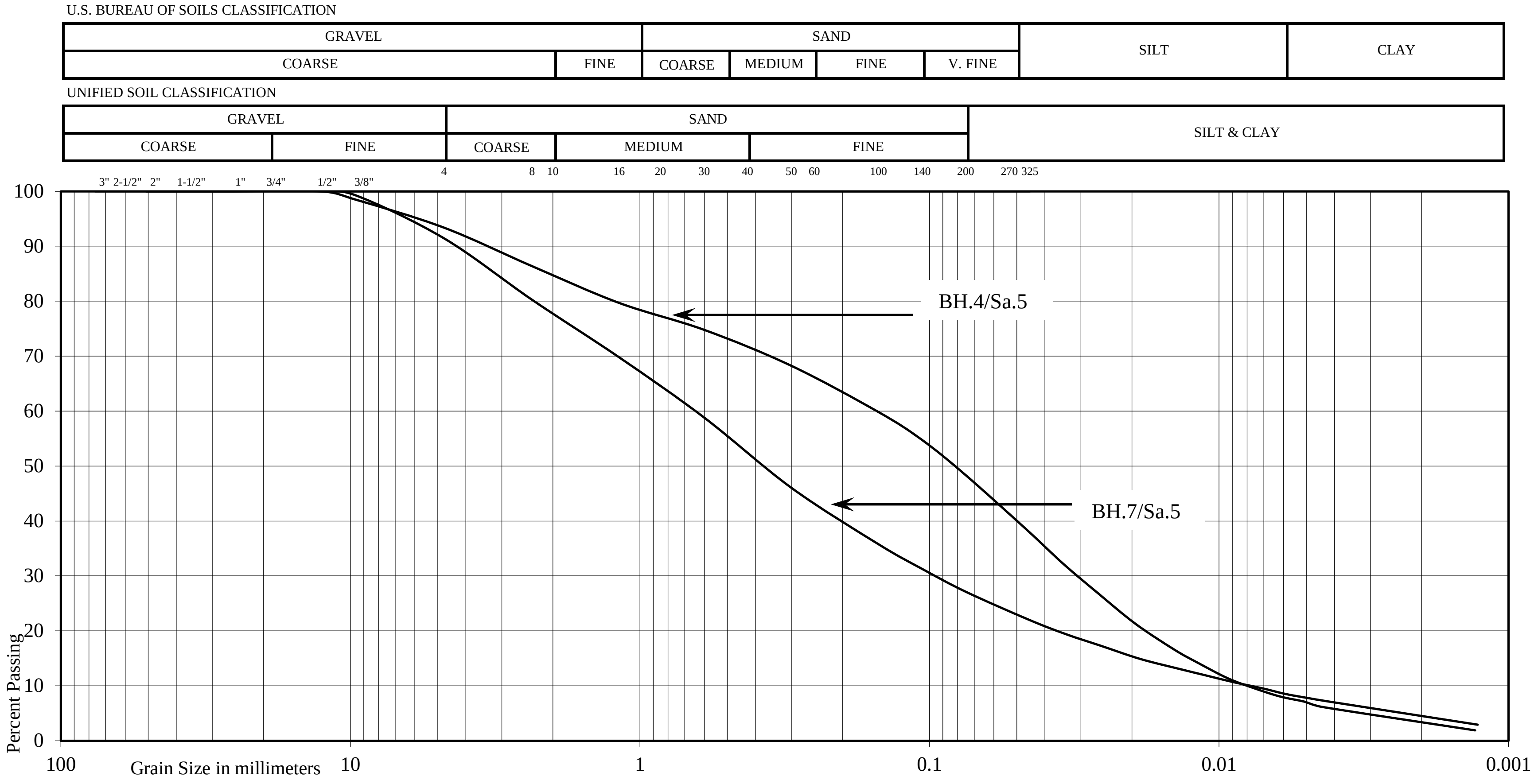
WATER LEVEL

Dry on completion

GRAIN SIZE DISTRIBUTION

Soil Engineers Ltd.

Reference No: 1406-S151



Project: Proposed Residential Development

Location: 6620 Rothschild Trail, City of Mississauga

Borehole No:	4	7
Sample No:	5	5
Depth (m):	3.3	3.3
Elevation (m):	178.4	175.4

BH./Sa.	4/5	7/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	14	8
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-4}

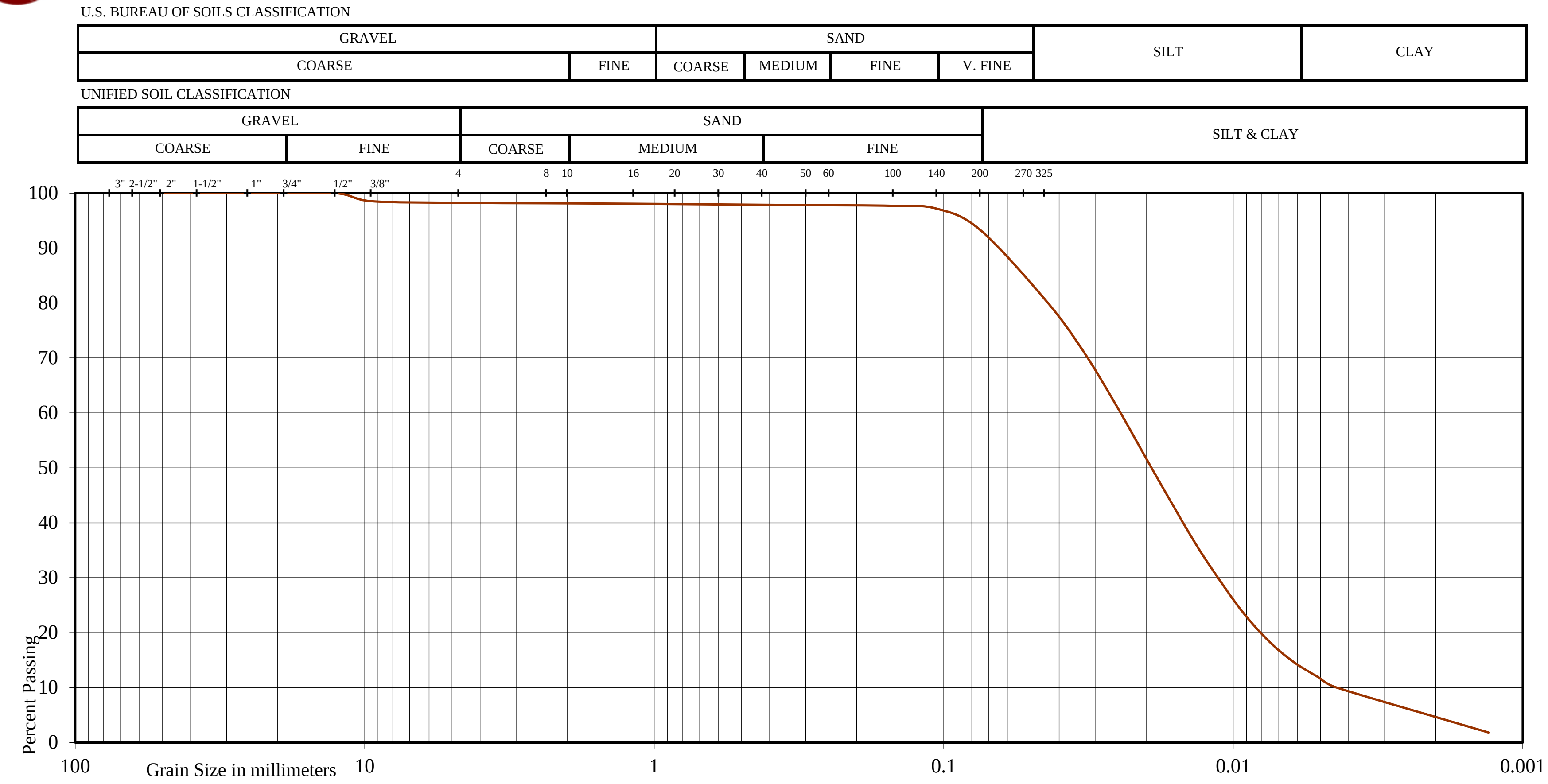
Classification of Sample [& Group Symbol]: SILTY SAND, Till
some silt

Figure: 8

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1406-S151



Project: Proposed Residential Development

Location: 6620 Rothschild Trail, City of Mississauga

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 6

Plasticity Index (%) = -

Sample No: 6

Moisture Content (%) = 22

Depth (m): 4.8

Estimated Permeability

Elevation (m): 176.6

(cm./sec.) = 10^{-5}

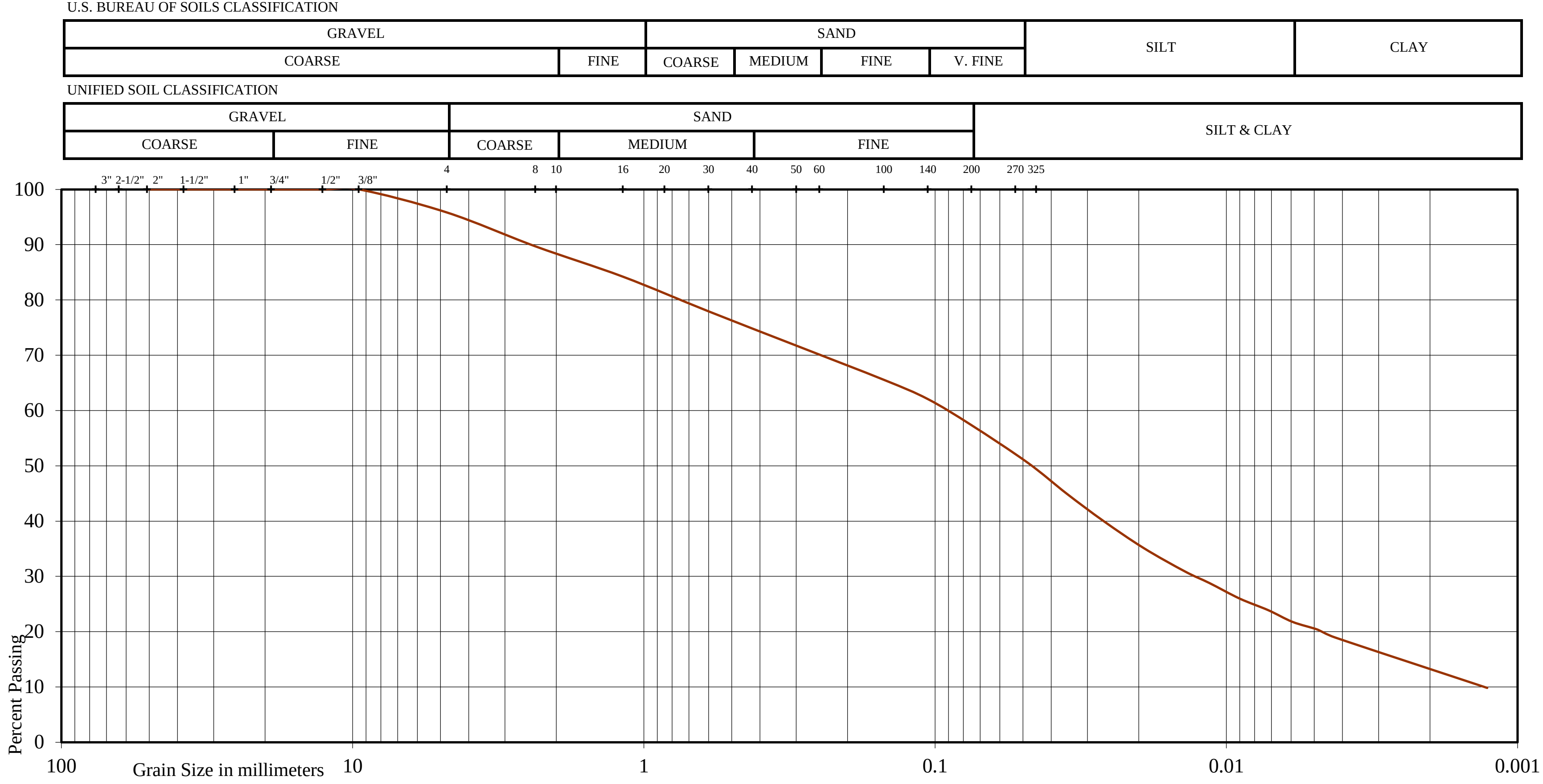
Classification of Sample [& Group Symbol]: SILT

Figure: 9

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

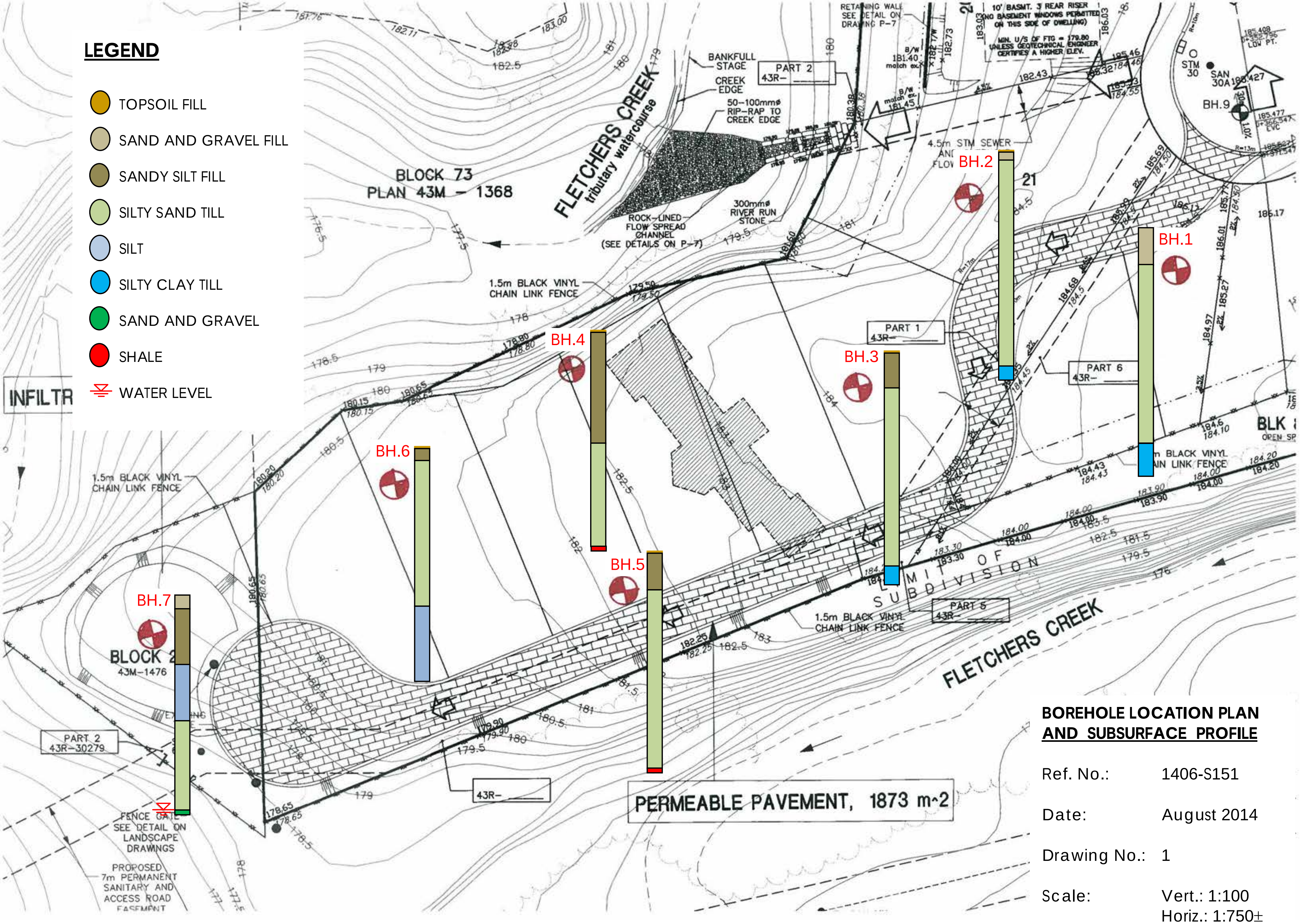
Reference No: 1406-S151



Project:	Proposed Residential Development		
Location:	6620 Rothschild Trail, City of Mississauga	Liquid Limit (%) =	20
		Plastic Limit (%) =	14
Borehole No:	3	Plasticity Index (%) =	6
Sample No:	6	Moisture Content (%) =	11
Depth (m):	4.7	Estimated Permeability	
Elevation (m):	179.3	(cm./sec.) =	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY, Till

Figure: 10



BOREHOLE LOCATION PLAN AND SUBSURFACE PROFILE

Ref. No.:	1406-S151
Date:	August 2014
Drawing No.:	1
Scale:	Vert.: 1:100 Horiz.: 1:750±

SOIL ENGINEERS LTD.