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A REPORT TO
BALBIR BABRA & HARVINDER BABRA

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

44-45 LONGVIEW PLACE

CITY OF MISSISSAUGA

REFERENCE NO. 2006-S167

AUGUST 2020

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TABLE OF CONTENTS

TABLES

DIAGRAMS

ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization dated June 22, 2020, from Mr. Harvinder Babra, a geotechnical investigation was carried out at a parcel of land at 44 to 45 Longview Place, in the City of Mississauga, 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 findings and resulting geotechnical 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 site is a grass-covered open field, situated at end of Longview Place Drive, in the City of Mississauga. The investigated area is relatively flat and level.

The proposed project consists of the construction of 3 residential homes, each with a normal basement.

3.0 FIELD WORK

The field work, consisting of 6 boreholes to a depth of 6.2 m, was performed on July 8 and 13, 2020, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The hole was 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 with reference to the spot elevations shown on the site plan provided by the client.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, Figures 1 to 6, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2, and the engineering properties of the disclosed soils are discussed herein.

This investigation has disclosed that beneath a veneer of topsoil, the site is underlain by a stratum of silty clay till which beds onto shale bedrock at a depth of 2.9 m.

4.1 Topsoil (All Boreholes)

The revealed topsoil is 8 cm to 18 cm thick. It is dark brown in colour, indicating that it contains 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 and must be removed. Due to its humus content, it may produce volatile gases and generate an offensive odour under anaerobic conditions. Therefore, the topsoil must not be buried below any structures or deeper than 1.2 m below the finished grade, so that it will not have an adverse impact on the environmental well-being of the developed areas.

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

4.2 Silty Clay Till (All Boreholes)

The silty clay till consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties. The structure of the till is heterogeneous, showing it is a glacial deposit. The clay till is weathered to a depth of 0.7 m below the ground surface.

Sample examination shows the till contains sand and silt seams and layers which are often wet. Hard resistance to augering was encountered in places, showing the till is embedded with occasional cobbles and boulders.

The consistency of the silty clay till was found to be stiff to very stiff, being generally very stiff; this is confirmed by the 'N' values which range 9 to 32, with a median of 23 blows per 30 cm of penetration.

The natural water content values range from 10% to 27%, with a median of 12%, indicating that the clay till is in a moist to very moist condition, which corresponds with our sample examinations.

Grain size analyses were performed on 2 samples of the silty clay till; the results are plotted on Figure 7.

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

- High frost susceptibility and low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, an estimated percolation rate of 90 min/cm, and runoff coefficients of:

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

- A cohesive soil, its shear strength is primarily derived from consistency which is inversely related to its moisture content. It contains sand; therefore, its shear strength is augmented by internal friction.
- It will generally be stable in a relatively steep cut; however, prolonged exposure will allow the weathered layers and the wet sand and silt seams and layers to become saturated, which may lead to localized sloughing.
- A poor pavement-supportive material, with an estimated California Bearing Ratio value of 3%.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 ohm·cm.

4.3 **Shale Bedrock** (All Boreholes)

The shale bedrock was encountered at a depth of 2.9 m below the prevailing ground surface. It is reddish-brown in color indicating that it is of the Queenston formation, consisting predominantly of thin- to thickly-bedded mudstone with occasional hard, limy shale and sandstone bands.

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

The encountered bedrock can be penetrated by power-augering with some difficulty in grinding through the hard layers. Standard Penetration Tests performed in the shale gave values range from 50 blows per 5 cm to 77 blows per 23 cm. The water content values of the samples range from 6% to 22%, with a median of 8%.

Occasional clay layers were found in the shale spoil obtained from the auger; they are the result of a shale reversion.

The shale has a low permeability, and occasional pockets of groundwater are known to be trapped in its fissures. This water may be under a moderate artesian pressure, but upon release through excavation, the water will often drain readily, with a limited yield.

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.

The excavated spoil will contain large amounts 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.

In sound shale excavation, 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.

4.4 **Compaction Characteristics of the Revealed Soils**

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied.

As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	**Determined Natural Water Content (%)**	**Water Content (%) for Standard Proctor Compaction**	
		100% (optimum)	**Range for 95% or +**
Silty Clay Till	10 to 27 (median 12)	16	12 to 21
Weathered Broken Shale	6 to 22 (median 8)	10	7 to 17

Based on the above values, the silty clay till is generally suitable for 95% or + Standard Proctor compaction. The weathered broken shale will require wetting for structural compaction.

The silty clay till and the weathered broken shale (with sizes less than 15 cm) should be compacted using a heavy-weight, kneading-type roller. The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

When compacting the very stiff silty 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 pavement subgrade be carried out on the wet side of the optimum. This would allow a wider latitude of lift thickness. Wetting of the till will be necessary to achieve this requirement.

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 or bedding of the underground services 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.

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 or shale fragments over 15 cm in size is mixed with the material, it must either be sorted or must not be used for structural backfill.

5.0 GROUNDWATER CONDITIONS

No groundwater was encountered and all boreholes remained dry upon completion of field work. Cave-in was encountered at depths of 5.5 m and 5.8 m at Boreholes 1 and 2, respectively.

The groundwater yield from the silty clay till, if any, due to its low permeability, will be small and limited in quantity. It should be noted that groundwater under subterranean artesian pressure may occur, in places, within the shale bedrock, which is considered to be a poor aquifer. Therefore, the yield of groundwater will be appreciable initially; however, if allowed to drain freely, it will often dissipate or be depleted with time.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a veneer of topsoil, the site is underlain by a stratum of stiff to very stiff, generally very stiff silty clay till that beds onto shale bedrock at a depth of 2.9 m. The surficial native soil layer is weathered to a depth of 0.7 m below the prevailing ground surface.

No groundwater was encountered, and all boreholes remained dry upon completion of field work. Cave-in was encountered at depths of 5.5 m and 5.8 m at Boreholes 1 and 2, respectively.

The geotechnical findings which warrant special consideration are presented below:

1. The topsoil must be removed for house construction.
2. The sound natural soil is suitable for normal spread, strip and drilled footings construction. The footings should be placed below the weathered soil onto the sound native soil.
3. Slab-on-grade must be placed on sound native soil. Where weathered, soft or loose soils occur, they must be subexcavated, assessed, aerated and properly compacted prior to the placement of the slab.
4. A Class ‘B’ bedding, consisting of compacted 20-mm Crusher-Run Limestone, is recommended for the construction of the underground services.
5. Due to the presence of topsoil and weathered soil, the foundation subgrade must be inspected by either a geotechnical engineer, or a geotechnical technician under the

supervision of a geotechnical engineer, to ensure that the subgrade conditions are compatible with the foundation design requirements.

6. Excavation into the very stiff silty clay till and the weathered shale will require extra effort and a backhoe equipped with a rock-ripper. For excavation into the sound shale, the use of a pneumatic hammer may be required for efficient rock removal.
7. Large shale fragments, rock slabs and boulders over 15 cm in size are unsuitable for use as structural backfill and must be wasted.
8. The excavated shale may be suitable for use in trench backfill but must be properly broken up during excavation and properly piled to allow the spoil to disintegrate under weathering for 2 to 3 winters prior to structural use. Continuous addition of water will be required for proper compaction.
9. The shale is generally considered to be a poor aquifer. The yield from the shale bedrock may be appreciable initially but the groundwater will be spent if it drains continuously.

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 House Foundations

Based on the borehole findings, recommended soil pressures of 150 kPa (SLS) and 250 kPa (ULS) can be used for the design of normal spread and strip footings founded at a depth of 1.0 or + m below the prevailing ground surface.

The recommended soil pressures (SLS) for normal foundations incorporate a safety factor of 3. The total and differential settlements of the footings founded on soil are estimated to be 25 mm and 15 mm, respectively, and will be minimal if the footing is founded on shale.

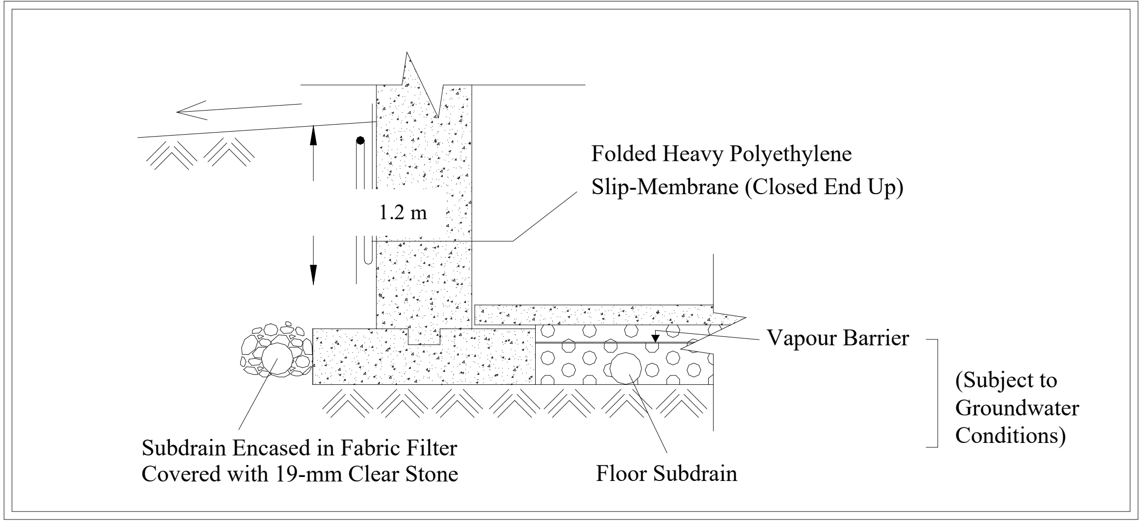
Foundations exposed to weathering, and in unheated areas, should have at least 1.2 m of earth cover for protection against frost action.

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 ‘C’ (very dense soil or soft rock).

Due to the presence of topsoil and weathered soil, the footing subgrade must be inspected by a geotechnical consultant to ensure that the subgrade conditions are compatible with the foundation design requirements.

As previously discussed, the occurring soil is high in frost heave and soil-adfreezing potential. In order to alleviate the risk of frost damage, the basement and foundation walls must be constructed of concrete and either backfilled with non-frost-susceptible pit-run granular, or shielded with a polyethylene slip-membrane. Where groundwater seepage occurs during excavation, floor subdrains should be installed and should be connected to sump-wells or to foundation subdrains. In this case, a vapour barrier should also be installed to prevent wetting of the floor from moisture upfiltration. These requirements can be further assessed at the time of construction. 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 necessity to implement the above recommendations should be further assessed by a geotechnical engineer at the time of construction.

6.2 Slab-On-Grade

For slab-on-grade construction, the weathered soil and any soft or loose soil should be subexcavated, sorted free of topsoil and any deleterious materials, aerated and properly compacted prior to the placement of the slab. Any new material for raising the grade should consist of organic-free soil compacted to at least 98% of its maximum Standard Proctor dry density.

The slab should be constructed on a granular base, 20 cm thick, consisting of 20-mm Crusher-Run Limestone, or equivalent, compacted to its maximum Standard Proctor dry density.

A Modulus of Subgrade Reaction of 25 MPa/m can be used for the design of the floor slab on sound natural soil.

The exterior grades must be designed to slope away from the building envelope.

6.3 **Underground Services**

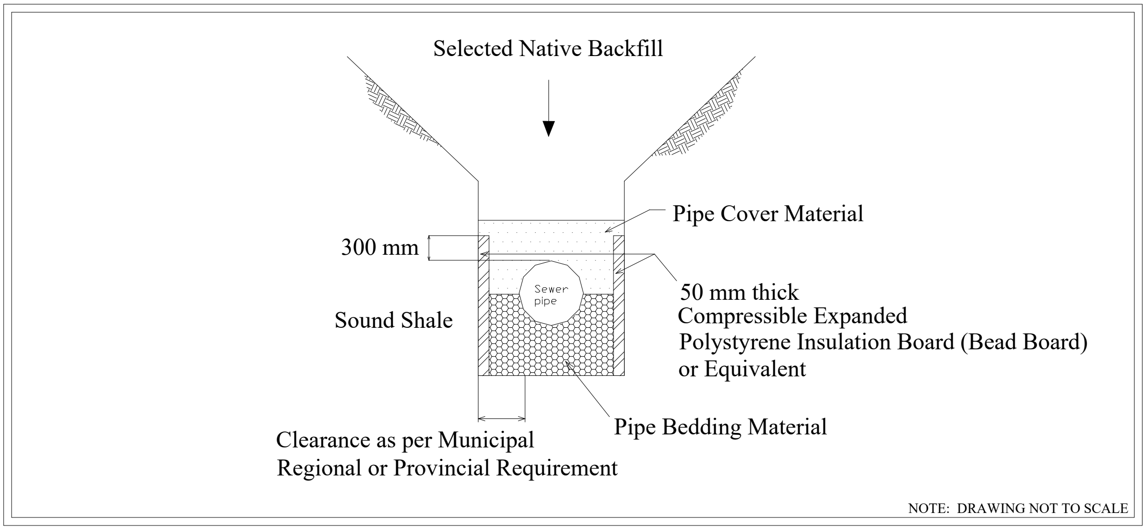
The subgrade for the underground services should consist of natural soil or compacted organic-free earth fill. Where weathered or loose soil is encountered, it must be subexcavated and replaced with properly compacted bedding material.

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

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

Where the pipe is to be placed in sound shale and due to the residual stress relief phenomenon and the swelling characteristics of the shale, the trench sides should be sloped rather than vertical. The side slopes shall be no steeper than 2 vertical:1horizontal and the rock face can be lined with 50-mm compressible Styrofoam, or equivalent. This will act as a cushioning layer to reduce the residual stress exerted on the buried structure. The bedding material should have a minimum thickness of 20 cm. Backfill between the pipes and the rock face lined with Styrofoam should consist of moderately compacted sand fill and should be carried to 0.3 m above the crown of the pipe. The recommended scheme is illustrated in Diagram 2.

Diagram 2 - Sewer Installation in Sound Shale



6.4 **Trench Backfilling**

The backfill in the trenches and excavated areas 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 material 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 a wider latitude of lift thickness. Wetting of the dry soil and weathered broken shale will be necessary to achieve this requirement.

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

The narrow trenches 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 soil have a water content on the dry side of the optimum, it would be impossible to wet the soil due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as when the trench box is removed, or when backfill consists of shale mixture. 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, anti-seepage collars should be provided.

6.5 Pavement Design for Driveways

Based on the borehole findings, the recommended pavement structure for the light-duty driveways is given in Table 3.

Table 3 - Pavement Design for Driveways

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	75	HL-4
Granular Base	300	Granular 'A' or equivalent

Prior to construction of the granular base, the subgrade should be inspected and proof-rolled in order to detect any soft spots, which should then be subexcavated and replaced with compacted inorganic soils.

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

The area adjacent to the driveways should be graded to drain any surface water away from the driveway.

Along the perimeter of the driveway where surface runoff may drain onto the pavement, or water may seep into the granular base, a swale or subdrain system should be installed. Subdrains, consisting of filter-wrapped weepers, should be connected to the catch basins and storm manholes and backfilled with free-draining granular material.

6.6 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	**Loose**	**Compacted**
Weathered Shale Bedrock	23.0	1.50	1.10
Weathered Soil	21.0	1.20	1.00
Sound Till	21.5	1.33	1.03
Lateral Earth Pressure Coefficients			
	Active K_a	**At Rest K_o**	**Passive K_p**
Weathered Shale	0.25	0.35	4.00
Silty Clay Till	0.40	0.50	2.50

6.7 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91.

Excavations in excess of 1.2 m should be sloped at 1 vertical:1 horizontal for stability.

In the shale bedrock, a steeper vertical cut can be allowed, provided the bedding plane of the rock is horizontal. Loose rocks protruding from the excavation must be removed for safety.

Excavation into the weathered shale or the very stiff till containing boulders will require extra effort and the use of a heavy-duty backhoe equipped with a rock-ripper. Excavation of the sound shale can be carried out by a heavy-duty backhoe equipped with a pneumatic chisel.

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

Table 5 - Classification of Soils for Excavation

Material	Type
Sound Shale Bedrock	1
Sound Till and weathered Shale Bedrock	2
Weathered Soil	3

The yield of groundwater from the silty clay till, due to its low permeability, is expected to be small and limited and can generally be controlled by pumping from sumps. The yield from the shale will be appreciable initially but will decrease and become spent with time if pumped continuously.

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

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Balbir Babra & Harvinder Babra, 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 Frank Lee, P.Eng., and Bernard Lee, 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.

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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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JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

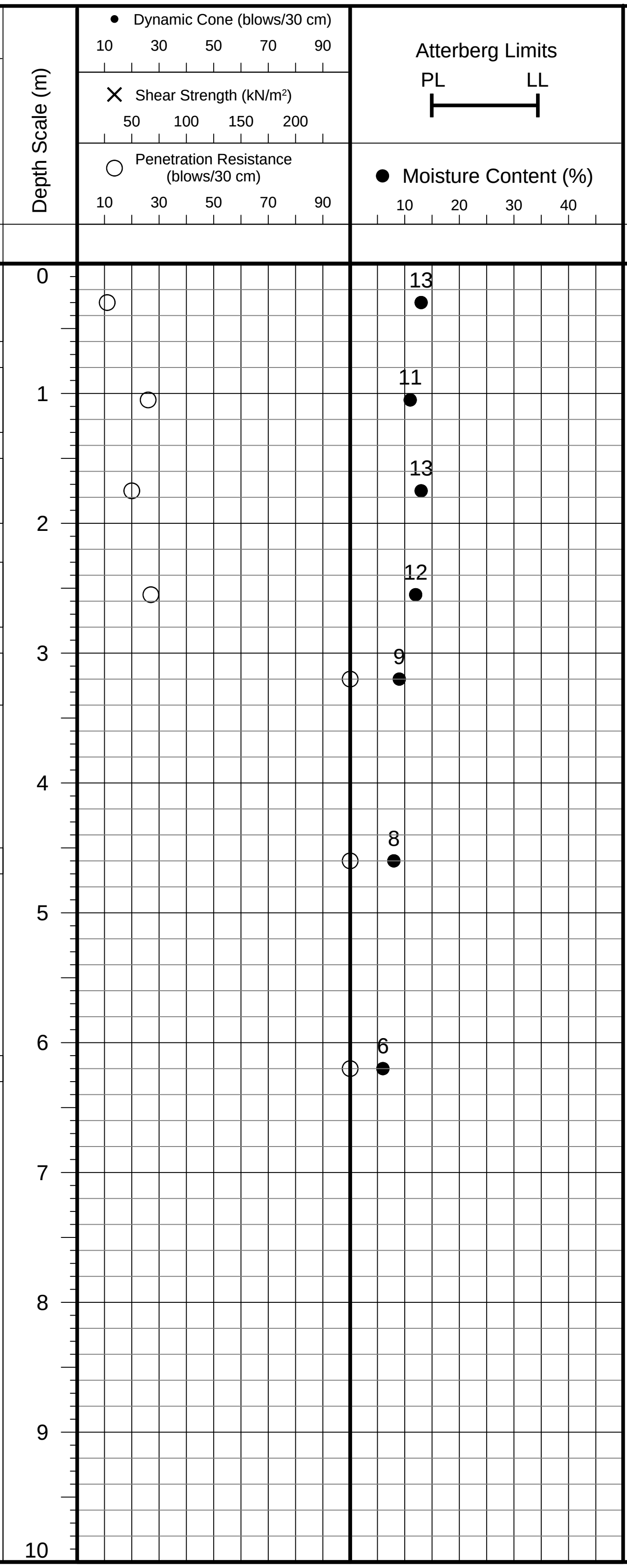
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 8, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
197.6 0.0	Ground Surface			
	13 cm TOPSOIL			
	Brown, stiff to very stiff weathered	1	DO	11
	SILTY CLAY TILL occ. wet sand and silt seams and layers cobbles and boulders	2	DO	26
		3	DO	20
		4	DO	27
194.7 2.9	Reddish-brown	5	DO	77/23
	SHALE BEDROCK (WEATHERED)	6	DO	50/5
		7	DO	50/5
191.3 6.3	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Cave-In @ El.192.1 m on completion

Soil Engineers Ltd.

JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

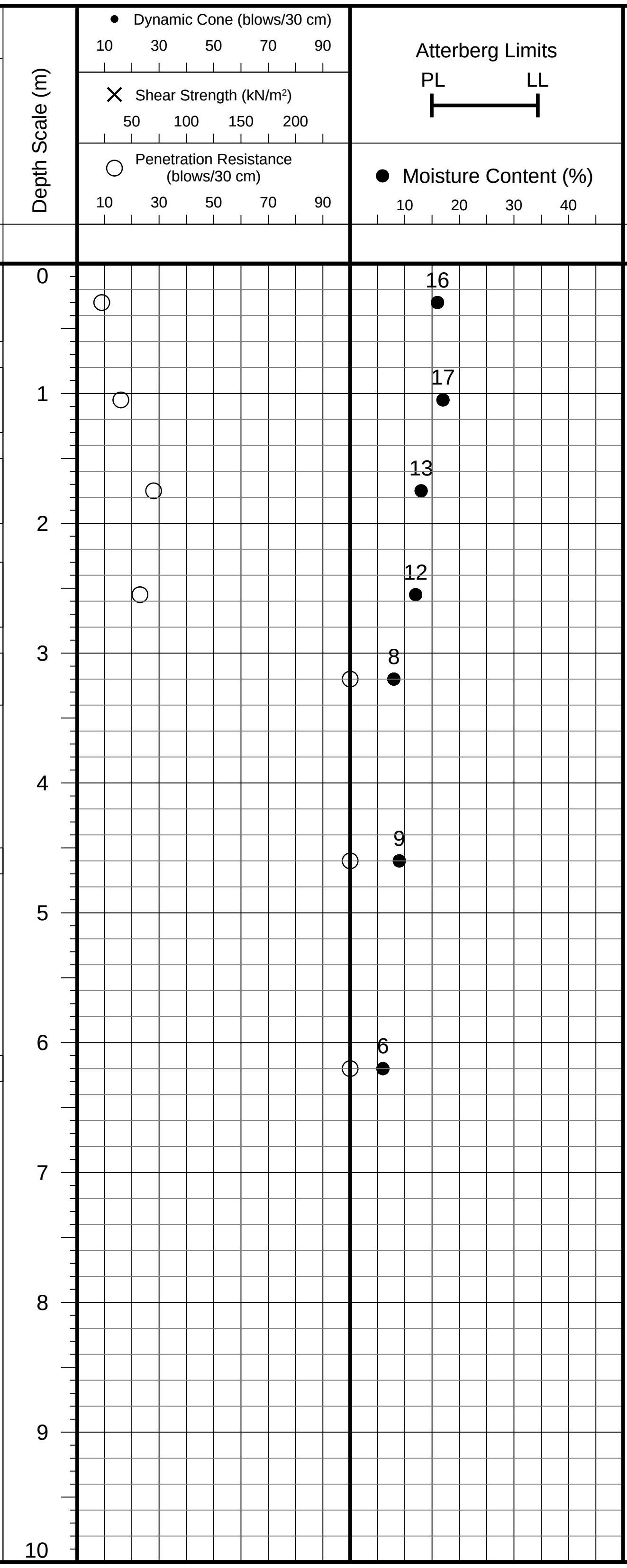
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 8, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
197.5 0.0	Ground Surface **18 cm TOPSOIL**			
	Brown, stiff to very stiff weathered **SILTY CLAY TILL** occ. wet sand and silt seams and layers cobbles and boulders	1	DO	9
		2	DO	16
		3	DO	28
		4	DO	23
194.6 2.9	Reddish-brown **SHALE BEDROCK** (WEATHERED)	5	DO	78/20
		6	DO	50/5
		7	DO	50/5
191.2 6.3	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Cave-In @ El.191.7 m on completion

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JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

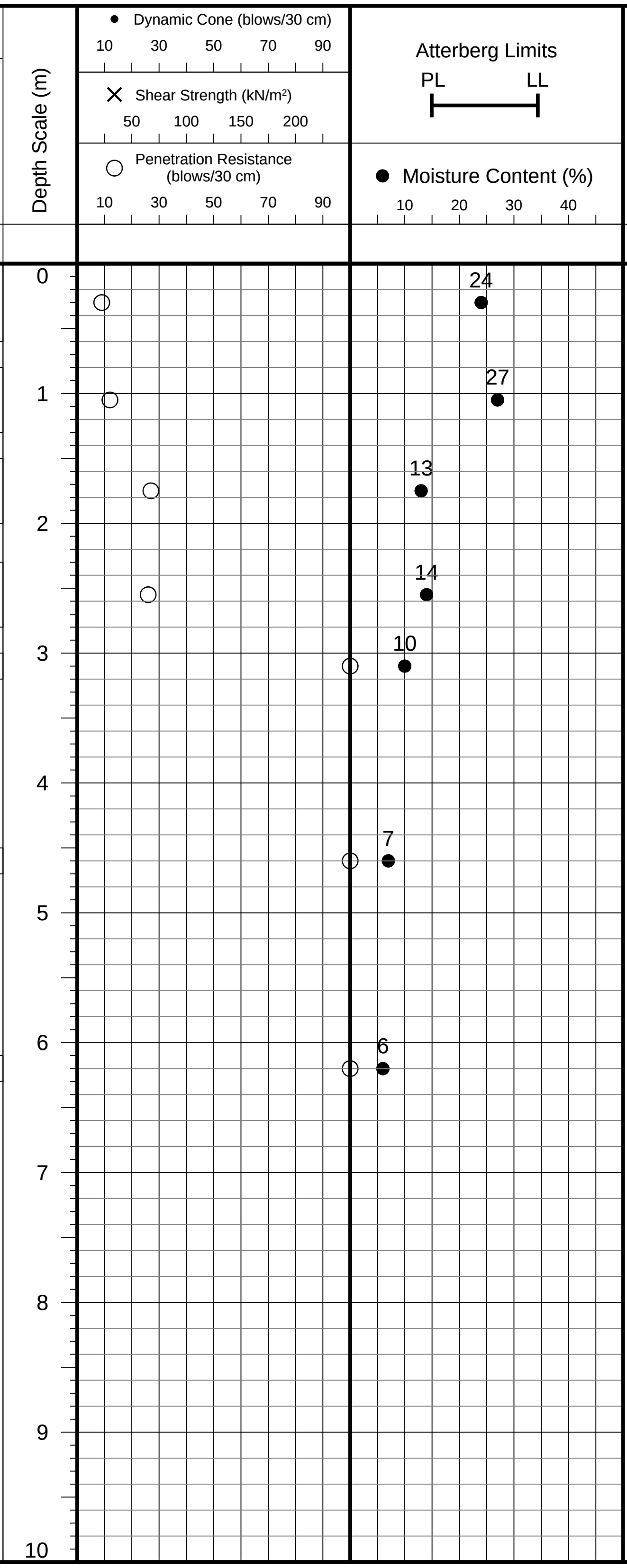
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 13, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
197.6	Ground Surface				
0.0	**13 cm TOPSOIL**				Dry on completion
	Brown, stiff to very stiff weathered	1	DO	9	
	SILTY CLAY TILL	2	DO	12	
	occ. wet sand and silt seams and layers cobbles and boulders	3	DO	27	
		4	DO	26	
194.7 2.9	Reddish-brown	5	DO	50/8	
	SHALE BEDROCK (WEATHERED)	6	DO	50/8	
		7	DO	50/8	
191.3 6.3	**END OF BOREHOLE**				



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JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

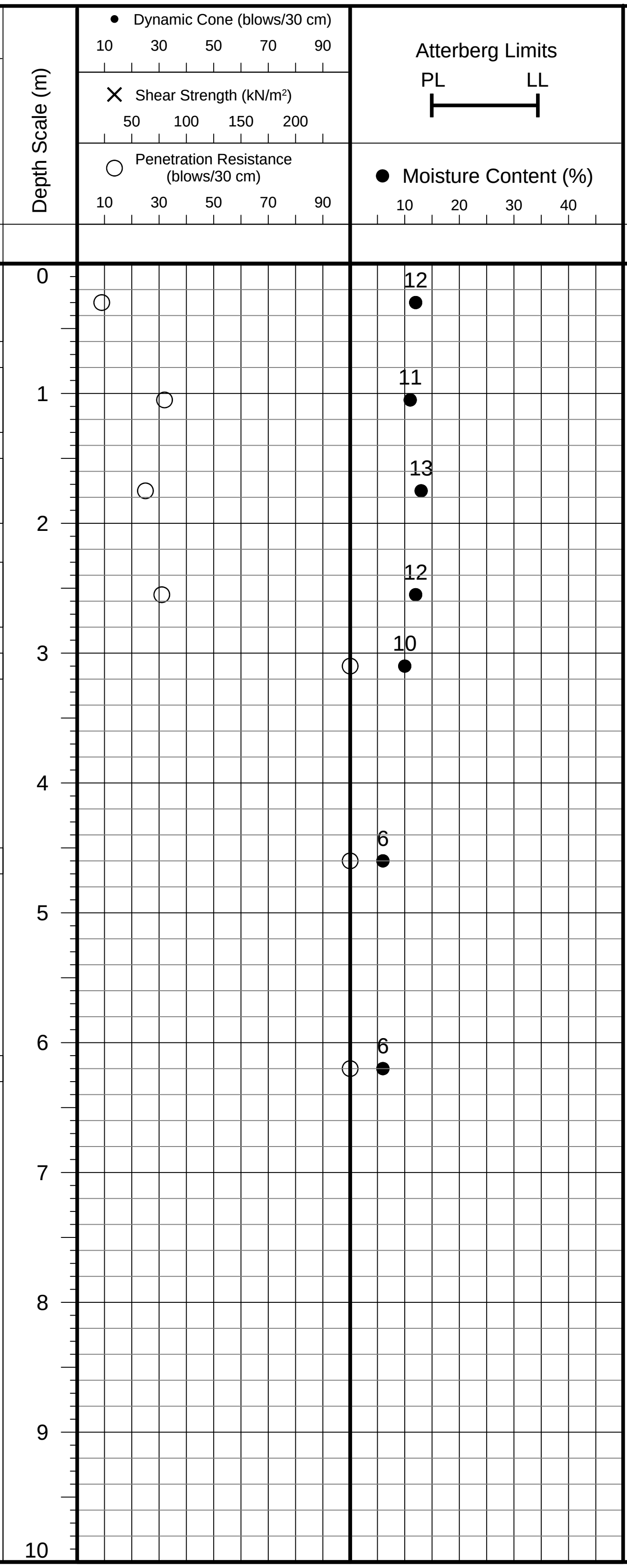
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 8, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
197.4 0.0	Ground Surface **18 cm TOPSOIL**				Dry on completion
	Brown, stiff to very stiff weathered	1	DO	9	
	SILTY CLAY TILL	2	DO	32	
	occ. wet sand and silt seams and layers cobbles and boulders	3	DO	25	
		4	DO	31	
194.5 2.9	Reddish-brown	5	DO	50/5	
	SHALE BEDROCK (WEATHERED)	6	DO	50/8	
		7	DO	50/8	
191.1 6.3	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

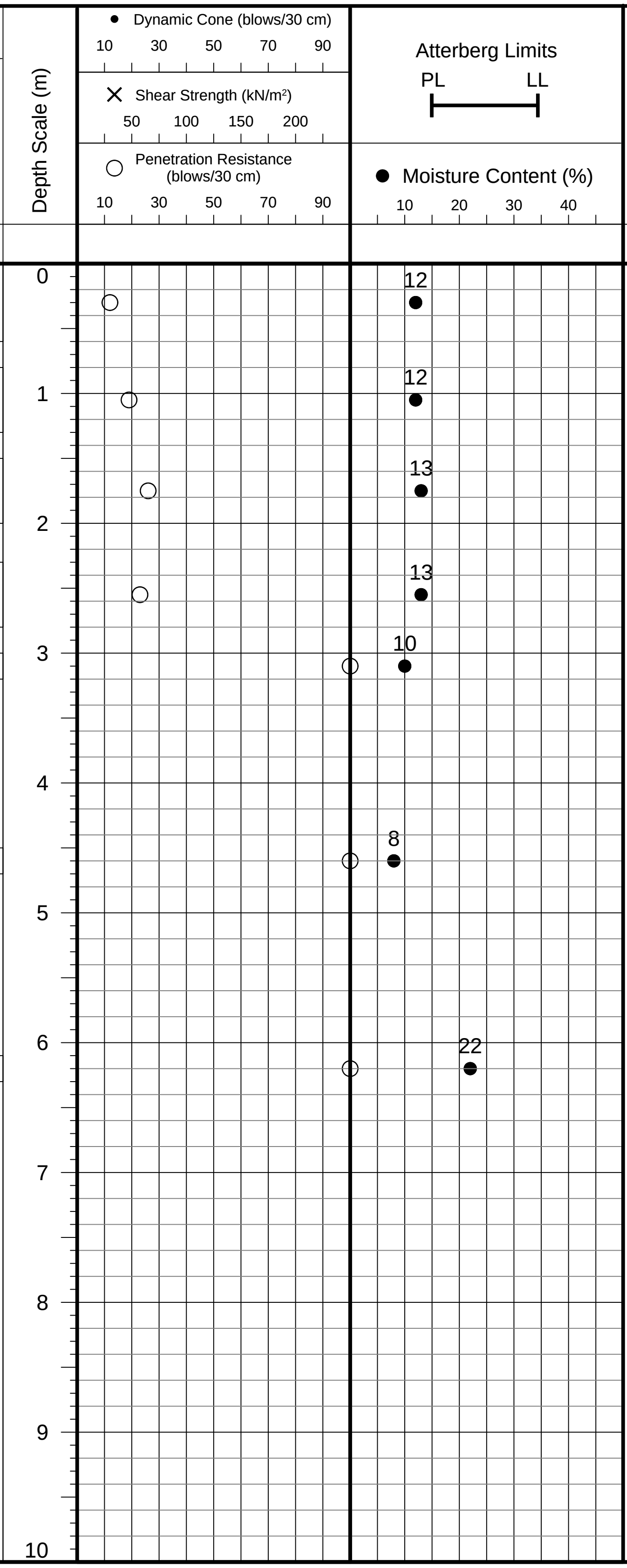
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 13, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
197.2	Pavement Surface			
0.0	**8 cm TOPSOIL**			
	Brown, stiff to very stiff	1	DO	12
	weathered			
	SILTY CLAY TILL	2	DO	19
	occ. wet sand and silt seams and layers cobbles and boulders	3	DO	26
		4	DO	23
194.3 2.9	Reddish-brown	5	DO	50/8
	SHALE BEDROCK (WEATHERED)	6	DO	50/5
		7	DO	50/5
190.9 6.3	**END OF BOREHOLE**			



WATER LEVEL: Dry on completion

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JOB NO.: 2006-S167

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

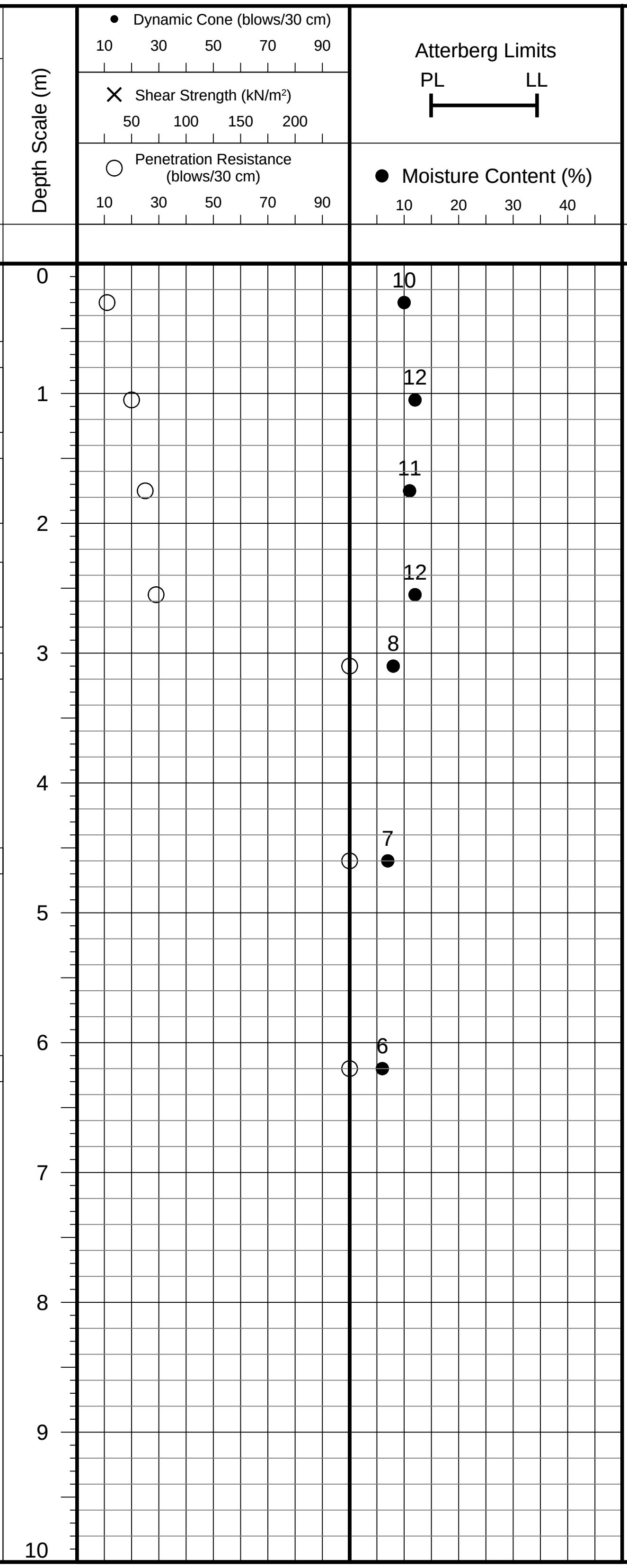
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

DRILLING DATE: July 8, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)	WATER LEVEL
196.8	Ground Surface					
0.0	**18 cm TOPSOIL**					Dry on completion
	Brown, stiff to very stiff	1	DO	11	10	
	weathered					
	SILTY CLAY TILL	2	DO	20	12	
	occ. wet sand and silt seams and layers cobbles and boulders	3	DO	25	11	
		4	DO	29	12	
193.9 2.9	Reddish-brown	5	DO	50/13	8	
	SHALE BEDROCK (WEATHERED)	6	DO	50/8	7	
190.5 6.3		7	DO	50/5	6	
	END OF BOREHOLE					



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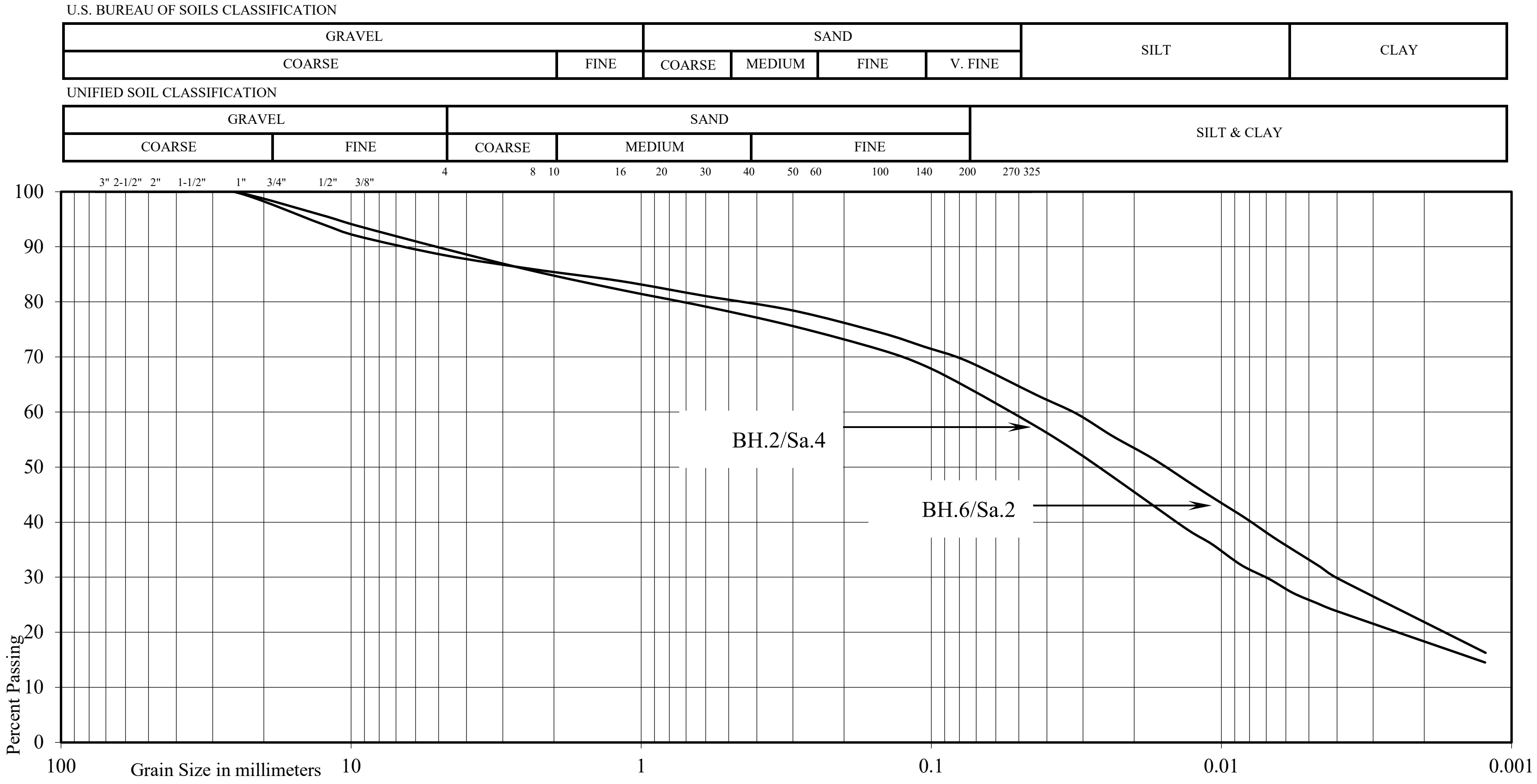
GRAIN SIZE DISTRIBUTION

Reference No: 2006-S167



Project: Proposed Residential Development

Location: 44-45 Longview Place, City of Mississauga

Borehole No:	2	6
Sample No:	4	2
Depth (m):	2.5	1.1
Elevation (m):	195.0	195.7

BH./Sa.	2/4	6/2
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	12	12
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY TILL, some sand to sandy , some gravel

Figure: 7

BH Location Plan

Soil Engineers Ltd.
Reference No. 2006-S167
Drawing No. 1

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SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2006-S167
REPORT DATE: August 2020
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: 44-45 Longview Place
City of Mississauga

LEGEND

▨ TOPSOIL ▨ SILTY CLAY TILL ▤ SHALE

CAVE-IN ≡