Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL REDEVELOPMENT
1575 HURONTARIO STREET
CITY OF MISSISSAUGA, ONTARIO

Prepared for: 10422967 Canada Corp.
c/o Dream Maker Development
16 McAdam Avenue
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1 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by 10422967 Canada Corp. to conduct a geotechnical investigation for a proposed residential redevelopment at 1575 Hurontario Street, in the City of Mississauga, Ontario.

This report encompasses the results of the geotechnical investigation conducted for the proposed re-development to determine the prevailing subsurface soil and ground water conditions, and on this basis, provides geotechnical design advice and engineering recommendations for the design of foundations, basement floor slab, basement drainage, pavement design, and earth pressure design parameters. Geotechnical comments are also included on pertinent construction aspects, excavation, bedding/embedment, backfill and ground water control.

Terraprobe has also conducted Phase One and Two Environmental Site Assessments and Hydrogeological Study for this property. The findings of the investigations are reported under separate covers.

2 SITE AND PROJECT DESCRIPTIONS

The project site is located in the southeast quadrant of South Service Road and Hurontario Street, in the City of Mississauga. The general location of the site is presented on Figure 1.

The site is approximately rectangular shaped parcel of land, with a total area of approximately 3,913 m^2 (0.97 acres). The site is currently vacant and covered with asphalt surface at the western portion and vegetation at the eastern portion. The site topography gently slopes down from west to east with a total elevation change (relief) of about 3 to 4 m across the site.

Based on the design drawing prepared by Kirkor Architects + Planners (Residential Development, Hurontario Street, Mississauga, Ontario, Project No. 17-094, dated September 10, 2018), the proposed development would include two stacked townhouse blocks with one level of common underground parking garage. The design drawing indicates that the finished basement floor is set at Elev. 94.3 m ±.

3 INVESTIGATION PROCEDURE

The field investigation was conducted on April 23 and 24, 2019, and consisted of drilling and sampling a total of nine (9) boreholes extending to about 2.1 to 6.7 m depth below grade. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figures 2 and 2A).

The boreholes were drilled by a specialist drilling contractor using rubber tire ATV mounted drill rig power auger. The borings were advanced using continuous flight solid and hollow stem augers, and were sampled at 0.75 m or 1.5 m intervals with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling and testing) was observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic jars, and transported to our geotechnical testing laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties. Laboratory tests consisted of water content determination on all samples and a Sieve and Hydrometer analysis on selected native soil samples; and Atterberg Limits tests on one selected cohesive soil sample. The measured natural moisture contents of individual samples and the results of the Sieve and Hydrometer analysis and Atterberg Limits tests are plotted on the enclosed Borehole Logs at respective sampling depths. The results of Sieve and Hydrometer analysis and Atterberg Limits tests are also summarized in Section 4.6 of this report, and appended.

Water levels were measured in open boreholes upon completion of drilling. Monitoring wells comprising 50 mm diameter PVC pipes were installed in selected boreholes (Boreholes 1, 2, 3 and 6) to facilitate shallow ground water monitoring. The PVC tubing was fitted with a bentonite clay seal as shown on the accompanying Borehole Logs. Water levels in the monitoring wells were measured on April 30 and May 1, 2019, about one week following the installation. The results of ground water monitoring are presented in Section 4.7 of this report.

The borehole ground surface elevations were surveyed by Terraprobe using a Trimble R10 GNSS System. The Trimble R10 system uses the Global Navigation Satellite System and the Can-Net reference system to determine target location and elevation. The Trimble R10 system is reported to have an accuracy of up to 10 mm horizontally and up to 30 mm vertically.

It should be noted that the elevations provided on the Borehole Logs are approximate only, for the purpose of relating soil stratigraphy and should not be used or relied on for other purposes.

4 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions encountered at the site.

It should be noted that the subsurface conditions are confirmed at the borehole locations only, and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.1 Surficial Layers

A topsoil layer was encountered in Boreholes 5 and 6 at the ground surface. The topsoil thicknesses were 100 and 300 mm in Boreholes 6 and 5, respectively.

A pavement structure, consisting of 45 to 70 mm thick asphaltic concrete underlain by 90 to 255 mm thick granular base course was encountered in Boreholes 1, 2, 3, 4, 7 and 8 at the ground surface.

The above topsoil and pavement structure thicknesses were measured from the borehole drilling and are approximate. We recommend that a shallow test pit investigation be carried out to determine a precise topsoil/pavement structure thickness present across the site for quantity estimation and costing purposes.

4.2 Earth Fill

Earth fill material consisting of silty sand with trace amounts of clay and gravel was encountered in each borehole with the exceptions of Boreholes 1 and 7 beneath the surficial layer and extended to the depths ranging from 0.8 to 2.3 m below grade.

Standard Penetration Test results (N-values) obtained from the earth fill zone ranged from 2 to 17 blows per 300 mm of penetration, indicating a very loose to compact relative density. The in-situ moisture contents of the earth fill samples ranged from 8 to 26%, indicating a moist condition.

4.3 Sandy Silt to Silty Sand/Sand

The matrix of sand and silt, with trace amounts of clay was encountered beneath the pavement structure or the earth fill zone in each borehole and extended to the depths ranging from 2.1 to 6.2 m below grade.

N-values obtained from the undisturbed native deposit ranged from 2 to 61 blows per 300 mm of penetration, indicating a very loose to very dense relative density. The in-situ moisture contents of the native soil samples ranged from 7 to 29%, indicating a moist to wet condition.

4.4 Silt and Clay to Clayey Silt

Silt and clay with trace amounts of gravel and sand was encountered beneath the sandy silt to silty sand deposit in Boreholes 1 to 5 and extended to 4.6 m below grade to the full depth of the investigation.

Clayey silt, sandy, with some gravel was encountered beneath the silty sand layer in borehole 6 and extended to 4.6 m depth below grade.

N-values obtained from the silt and clay to clayey silt deposit ranged from 6 to 31 blows per 300 mm of penetration, indicating a firm to hard consistency. The in-situ moisture contents of the silt samples ranged from 10 to 22%, indicating a moist condition.

4.5 Inferred Bedrock

The silt and clay to clayey silt deposits graded into shale-till complex/weathered shale (inferred Bedrock of Georgian Bay Formation) in Boreholes 5 and 6 at about 4.6 m depth below grade.

The inferred bedrock beneath the site is expected to be of the Georgian Bay Formation, which is a deposit predominantly comprising thin to medium bedded grey shale of Ordovician age. The shale contains interbedded grey calcareous shale, limestone/dolostone and calcareous sandstone (conventionally grouped together as “limestone”) which are discontinuous and nominally 25 to 125 mm thick.

The augered borehole method used at this site is conventionally accepted investigative practice. However, the interval sampling method does not define the bedrock surface with precision, particularly where the surface of the rock is weathered, weaker and easily penetrated by auger. The auger refusal is generally indicative of a presence of a relatively less weathered/sound shale and/or limestone/dolostone layers. It should be noted that confirmation and characterization of the bedrock through rock coring was not included in our scope of work. Therefore, the bedrock surface elevations at the borehole locations, as noted on the borehole logs, could not be confirmed, and were inferred from the borehole augering, auger grinding, split barrel sampler refusal and bouncing. Auger grinding or sampler refusal in this case could either be inferred as bedrock or could be due to the presence of boulders/obstruction/limestone slabs which may be present within the overburden, therefore actual bedrock surface elevations may vary from the inferred elevations noted on the borehole logs. It must be noted that inference of bedrock level based on auger grinding and/or sampler refusal does not provide bedrock level accurately. Any variation in the design bedrock level and actual bedrock level may result in significant cost implications and schedule delays (including redesign and additional construction costs) for the project.

4.6 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples, while Sieve and Hydrometer analysis and Atterberg Limits tests were conducted on selected soil samples. The test results are plotted on the enclosed Borehole Logs at respective sampling depths.

The results (graphs) of the Sieve and Hydrometer (grain size) analysis are appended and a summary of these results is presented as follow:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1, Sample 7	4.9	0	81	17	2	SAND some silt, trace clay
Borehole 3, Sample 6	4.1	0	27	64	9	SANDY SILT trace gravel

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 6, Sample 4	2.6	15	27	38	20	CLAYEY SILT sandy, some gravel
Borehole 7, Sample 2	1.1	0	88	11	1	SAND Some silt, trace clay

Atterberg Limits Test was carried out on one selected soil sample. The results were plotted on A-Line Graph (refer to enclosed Figure, Atterberg Limits Test Results) and summarized as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)	Natural Moisture Content (%)	Plasticity
Borehole 6, Sample 4	2.6	27	16	11	11	Slightly Plastic

4.7 Ground Water

Observations pertaining to the depth of water level and caving were made in the open boreholes immediately after completion of drilling, and are noted on the enclosed Borehole Logs. Monitoring well were installed in Boreholes 1, 2, 3 and 6 to facilitate ground water level monitoring and the purpose of hydrogeological study. The ground water level measurements in the monitoring wells were taken on April 30 and May 1, 2019 (about one week following the installation) and are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Borehole No.	Depth of Boring below Grade	Depth to Cave below Grade	Water Level Depth/Elevation at the Time of Drilling	Water Level Depth/Elevation in Monitoring Well on April 30, 2019	Water Level Depth/Elevation in Monitoring Well on May 1, 2019
Borehole 1	6.7 m	3.4 m	2.4 m/95.6 m	3.2 m/94.8 m	3.2 m/94.8 m
Borehole 2	6.7 m	n/a*	3.4 m/94.8 m	3.5 m/94.7 m	3.5 m/94.7 m
Borehole 3	6.7 m	n/a*	3.4 m/93.8 m	2.4 m/94.8 m	2.4 m/94.8 m
Borehole 4	6.7 m	n/a*	2.7 m/94.3 m	NMW**	NMW**
Borehole 5	6.2 m	n/a*	5.5 m/89.5 m	NMW**	NMW**
Borehole 6	6.1 m	n/a*	dry	3.8 m/90.7 m	3.8 m/90.7 m

* Cave was not measured due to casing

** Monitoring well is not installed in this borehole

The water levels noted above may fluctuate seasonally depending upon the amount of precipitation and surface runoff.

5 DISCUSSIONS AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for the use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. If there are any changes to the site development features or there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Foundation

The boreholes encountered the pavement structure or topsoil layer at the ground surface underlain by silty sand fill material extending to depths ranging from 0.8 to 2.3 m below grade, which was in turn underlain by undisturbed native soil deposits and/or inferred bedrock, extending to the full depth of the investigation.

The detailed design information is not available during preparation of this report. Based on the preliminary design drawing provided, the proposed development would include two stacked townhouse blocks with one level of common underground parking garage.

The existing earth fill material is not suitable to support proposed structure foundations. The design drawing provided indicates that the finished basement floor is set at Elev. 94.3 m ±. Based on the borehole information within the proposed townhouse footprint (Boreholes 1 to 6), the townhouse foundations may be supported on undisturbed sandy silt to silty sand deposit of compact to very dense relative density. The undisturbed native sandy silt to silty sand deposit is considered suitable to support the proposed structure foundations. A maximum net geotechnical reaction of 200 kPa (Serviceability Limit States, SLS) and a maximum factored geotechnical resistance of 300 kPa (Ultimate Limit States, ULS) is recommended for design of conventional spread footing foundations (for vertical and concentric loads) supported on the underlying competent undisturbed sandy silt to silty sand soils of compact to very dense relative density. Higher bearing pressures are also available and can be analyzed in detail based on the final building design. The final grading plan and design drawings should be reviewed by Terraprobe to better assess the design foundation elevations and to provide updated foundation bearing pressure (geotechnical reaction and resistance) recommendations prior to the development.

The underside of footing elevations must be designed to provide a minimum of 1.2 m of soil cover or equivalent insulation to the foundation subgrade for frost protection considerations in unheated areas. All footings must be designed to bear at least 0.3 m into the undisturbed native soil stratum.

The minimum width of the continuous strip footings must be 450 mm and the minimum footing area for column must be 900 mm × 900 mm regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. The geotechnical resistance(s) as recommended allow for up to 25 mm of total settlement. This settlement will occur as load is applied and is linear elastic and non-recoverable. Differential settlement is a function of spacing, loading and foundation size.

5.1.1 Foundation Installation

All exterior foundations and foundations in unheated areas must be provided with a minimum soil cover of 1.2 m or equivalent insulation for frost protection.

It is recommended that all excavated footing base must be evaluated by a qualified geotechnical engineer to ensure that the founding soils exposed at the excavation base are consistent with the design bearing pressure intended by the geotechnical engineer.

Prior to pouring foundation concrete, the foundation subgrade should be cleaned of all deleterious materials such as topsoil, fill, softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the foundation subgrade and concrete must be provided.

It is noted that the native soils tend to weather rapidly and deteriorate on exposure to the atmosphere or surface water. Hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete. Provisions should be made to minimize disturbance to the exposed foundation subgrade.

5.2 Basement Floor Slab

The modulus of subgrade reaction appropriate for the slab design constructed on undisturbed native silty sand soil subgrade is 35,000 kPa/m. The excavated surface should be assessed by a qualified geotechnical engineer.

The basement floor slab should be provided with a capillary moisture barrier and drainage layer. This can be made by placing the slab on a minimum 150 mm thick 19 mm clear stone layer (OPSS.MUNI 1004) compacted by vibration to a dense state. This material also serves as the drainage media for the subfloor drainage system. Provision of subfloor drainage is required in conjunction with the perimeter drainage of the structure.

The subfloor drainage system is an important building element, as such the storm sump which ensures the performance of this system must have a duplexed pump arrangement for 100% pumping redundancy and this pump must be provided with emergency power as needed. Basement and subfloor drainage provisions are further discussed in Section 5.4 of this report.

5.3 Earth Pressure Design Parameters

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

Where:

P = the horizontal pressure (kPa)
K = the earth pressure coefficient
h = the depth below the ground surface (m)
h_w = the depth below the ground water level (m)
γ = the bulk unit weight of soil (kN/m^3)
γ_w = the bulk unit weight of water (9.8 kN/m^3)
γ' = the submerged unit weight of the exterior soil, (γ_{sat} - γ_w)
q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$P = K[\gamma h + q]$$

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction **(R)** depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan ϕ**) expressed as **$R = N \tan \phi$**. The factored geotechnical resistance at ULS is **0.8 R**.

Passive earth pressure resistance is generally not considered as a resisting force against sliding for conventional retaining structure design because a structure must deflect significantly to develop the full passive resistance.

The average values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follow:

Parameter	Definition	Units
ϕ	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/ m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

Stratum/Parameter	Φ (degree)	γ (kN/m^3)	K_a	K_o	K_p
Earth Fill	28	19.0	0.36	0.53	2.77
Clayey Silt/Silt and Clay	30	21.0	0.33	0.50	3.00
Sandy Silt to Silty Sand/Sand	32	21.5	0.31	0.47	3.25

The above values of the earth pressure coefficients are for the horizontal backfill grade behind the wall. The earth pressure coefficients for inclined grade will vary based on the inclination of the retained ground surface.

5.4 Basement Drainage

The ground water levels measured on April 30 and May 1, 2019 in the monitoring wells installed in Boreholes 1, 2, 3 and 6 indicated that the water levels ranged from about 2.4 to 3.8 m depth below grade (Elev. 90.7 m to Elev. 94.8 m).

To assist in maintaining basement dry from seepage, it is recommended that exterior grades around the townhouses be sloped away at a 2% gradient or more, for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe with filter fabric (minimum 100 mm diameter) surrounded by a granular filter (minimum 150 mm thick), and freely outletting. The granular filter should consist of 19 mm clear stone (OPSS.MUNI 1004) surrounded by a filter fabric (Terrafix 270R or equivalent), see Figure 3 Basement Drainage Detail.

The basement wall (for basement) in case of open excavation must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the Ontario Building Code (2012). The basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material (OPSS.MUNI 1010 Granular B), or provided with a prefabricated drain material (for instance, CCW MiraDRAIN 6000 series or Terrafix Terradrain 600), see Figure 3 Basement Drainage Detail. The perimeter drain installation and outlet provisions must conform to the plumbing code requirements.

A subfloor drainage system is recommended. The sub-floor drainage system should consist of perforated pipes (minimum 100 mm diameter) located at a maximum spacing of 5.0 m centre to centre (Figure 3 Basement Drainage Detail and Figure 4 Basement Subdrain Detail). The subdrain system should be outlet to a suitable discharge point under gravity flow, or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

The size of the sump should be adequate to accommodate the water seepage. The sub-floor drainage system should be designed to prevent the possibility of back-flow. A duplex pumping arrangement (main pump with a provision of a backup pump) on emergency backup power is recommended. The pump should have sufficient capacity to accommodate a maximum peak flow of water of about 6 to 8 gallons per minute. This flow is not anticipated to be a sustained flow, but could be achieved under certain peak flow conditions.

5.5 Excavations

The boreholes data indicate that the earth fill/weathered/disturbed materials and undisturbed native soils would be encountered in the excavations. Excavations must be carried out in accordance with the *Occupational Health and Safety Act and Regulations for Construction Projects.* These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

TYPE 1 SOIL

a. is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b. has a low natural moisture content and a high degree of internal strength;
c. has no signs of water seepage; and
d. can be excavated only by mechanical equipment.

TYPE 2 SOIL

a. is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b. has a low to medium natural moisture content and a medium degree of internal strength; and
c. has a damp appearance after it is excavated.

TYPE 3 SOIL

a. is stiff to firm and compact to loose in consistency or is previously-excavated soil;
b. exhibits signs of surface cracking;
c. exhibits signs of water seepage;
d. if it is dry, may run easily into a well-defined conical pile; and
e. has a low degree of internal strength

TYPE 4 SOIL

a. is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b. runs easily or flows, unless it is completely supported before excavating procedures;
c. has almost no internal strength;
d. is wet or muddy; and
e. exerts substantial fluid pressure on its supporting system.

The earth fill material as well as undisturbed native soil deposit encountered in the boreholes are classified as Type 3 Soil above and Type 4 Soil below the prevailing ground water level.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates the steepest slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

5.6 Ground Water Control

The depth of underground parking garage excavation will affect the ground water control and management. Terraprobe has completed Hydrogeological Report (File No. 1-18-0537-46) for this site to provide ground water control measures and estimate ground water discharge volume (Refer to this report for detailed information).

The ground water levels measured on April 30 and May 1, 2019 in the monitoring wells installed in Boreholes 1, 2, 3 and 6 indicated that the water levels ranged from about 2.4 to 3.8 m below grade (Elev. 90.7 m to Elev. 94.8 m).

It is anticipated that ground water seepage may be encountered in the excavation in the western portion of the property. The ground water seepage emanating from above the static ground water table should diminish slowly and can be controlled by continuous pumping from filtered at the base of the excavation. The amount of perched water seepage is expected to increase with the depth of excavation.

For excavations extending below the prevailing ground water level, it will be necessary to lower the ground water level and maintain it below the excavation base prior to and during the subsurface construction. In order to avoid loosening and sloughing of the base and sides, consideration should be given to install a skim coat of lean concrete (mud-slab) in conjunction with positive groundwater control to preserve the subgrade integrity to provide support to foundations and utilities, and a working platform, as needed. In general, prior dewatering and ground water control provisions are required for excavations penetrating about 0.3 m or more into the ground water table in cohesionless soils. Pumping from the sumps, in general may be effective for shallow excavations, up to about 1.0 m below the ground water level.

5.6.1 Regulatory Requirements

The volume of water entering the excavation will be based on both ground water infiltration and precipitation events. Based on recent regulation changes within O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction Dewatering less than 50,000 L/day: The takings of both ground water and storm water **does not require** a Construction Dewatering Assessment Report (CDAR) and **does not require** a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of ground water and/or storm water **requires** a Construction Dewatering Assessment Report (CDAR) and **does not** require a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 400,000 L/day: The taking of ground water and/or storm water **requires** a Construction Dewatering Assessment Report (CDAR) and **requires** a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).

If it is expected that greater than 50,000 L/day of water will be pumped, a CDAR and/or a PTTW should be obtained as soon as possible in advance of construction to avoid possible delays. Depending on the construction methodology for the site servicing (trench boxes or open cut, and length of trench) and the time of year (high versus low ground water levels), there is the possibility that water taking of greater than 50,000 L/day may occur at this site.

A CDAR takes up to 1 month to complete if monitoring wells are already installed on site. Once the CDAR is completed, it is uploaded to the Environmental Activity and Sector Registry (EASR), which registers the construction dewatering with the MOECC without the need for a permit. If the results of the CDAR indicate that greater than 400,000 L/day will be pumped, a PTTW application must be submitted to the MOECC. A PTTW application can take up to an additional 3 months for the MOECC to process upon completion of the CDAR. Note that Environmental Compliance Assessments, Impact Study Reports and applicable municipal, provincial and conservation authority approvals (completed by others) will be required as part of the CDAR.

5.1 Pipe Bedding and Cover/Embedment

The design information of the underground services was not available at the time of preparation of this report. The following subsections provide preliminary geotechnical engineering information for the design of underground services with relatively shallow inverts. Trench excavation should be carried out in accordance with the *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects* (O.Reg. 213/91 with recent amendments), while trench bedding, backfilling and compaction should be carried out in accordance with OPSD 802.010, OPSD 802.030, OPSD 802.031, OPSD 802.032 and /or OPSS MUNI 401, as appropriate.

The undisturbed native soil or shale bedrock, encountered will be suitable for support of buried services that are properly bedded. Where disturbance of the trench base has occurred, due to ground water seepage, or construction traffic, the disturbed soils should be sub-excavated and replaced with suitably compacted granular material. Any accumulation of water at the base of the excavation and any soft/loose soils should be removed prior to placement of the pipe bedding/embankment. Placement of the pipe bedding/embedment must be done in dry condition.

Concrete pipe should be installed in conformance with the OPSD 802.030, OPSD 802.031, OPSD 802.032 or OPSD 802.033 requirements, as appropriate, while PVC or HDPE pipe should be installed in conformance with the OPSD 802.010 or OPSD 802.013 requirements, as appropriate. The bedding and embedment material includes OPSS.MUNI 1010 Granular A while the cover material for rigid pipes include OPSS.MUNI 1010 Granular B with 100 percent passing 26.5 mm sieve. Further detail information on bedding/embedment and cover materials can be provided at the detailed design phase.

The bedding, embedment and cover materials should be placed in layers not exceeding 200 mm in thickness and compacted to a minimum of 95 percent SPMDD or vibrated into a dense state in the case of clear stone type bedding.

5.2 Backfill

The native soils are considered suitable for backfill provided the moisture content of these soils is within 2% of the Optimum Moisture Content (OMC). It should be noted that there may be wet zones within the subsurface soils (particularly soils excavated from below the prevailing water level) which could be too wet to compact. Any soil material with 3% or higher in-situ moisture content than its OMC, could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less, and heavily compacted to a minimum of 98% SPMDD at a water content close to optimum (within 2%). The upper 1.2 m of the pavement subgrade must be compacted to a minimum of 100% SPMDD.

It should be noted that the soils encountered on the site are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that the earthworks will be difficult and may incur additional costs if carried out during wet periods (i.e. spring and fall) of the year.

5.3 Pavement

It is understood that the paved areas at this site would consist of driveway and parking lot. Design recommendations for pavement structure are provided in this section.

5.3.1 Pavement Design

The asphalt pavement design for the entrance driveway and the parking lot is provided in the following table:

Pavement Structural Layers	Parking Lot	Driveway/Fire Route
HMA Surface Course, OPSS 1150 HL 3	40 mm	40 mm
HMA Binder Course, OPSS 1150 HL 8	50 mm	85 mm
Granular Base Course, OPSS MUNI 1010 Granular A	150 mm	150 mm
Granular Subbase Course, OPSS.MUNI 1010 Granular B Type I	300 mm	350 mm
Total Thickness	540 mm	625 mm

HL 3 and HL 8 hot mix asphalt mixes should be designed, produced and placed in conformance with OPSS 1150 and OPSS.MUNI 310 requirements and the relevant City's requirements.

Both the Granular A and Granular B Type I materials should meet the requirements of OPSS.MUNI 1010 requirements and the relevant City's standards. Granular materials should be compacted to 100 percent of SPMDD.

HL3 HS hot mix asphalt is recommended as padding. Padding should be placed in lifts not exceeding 50 mm.

Performance graded asphalt cement, PG 58-28, conforming to OPSS.MUNI 1101 requirements, should be used in both HMA binder and surface courses.

A tack coat (SS1) should be applied to all construction joints prior to placing hot mix asphalt to create an adhesive bond. SS1 tack coat should also be applied between hot mix asphalt binder and surface courses.

5.3.2 Drainage

Control of water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of 3%) to provide effective drainage toward subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement.

Continuous pavement subdrains should be provided along both sides of the driveway and drained into respective catchbasins to facilitate drainage of the subgrade and granular materials. Continuous subdrains should be also provided for the parking lot/driveway pavement areas along the curb-lines/sidewalk and at all catchbasins within the parking areas. Two lengths of subdrain (each minimum of about 3 m long) should be installed at each catchbasin. The subdrain invert should be maintained at least 0.3 m below subgrade level. All subdrain arrangements should comply with the City of Mississauga Standard Drawing No. 2220.040.

5.3.3 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed/weathered soils should be stripped from the subgrade areas. The existing asphaltic concrete should be saw cut and removed. The subgrade is expected to consist of silty sand/sand materials or earth fill material, and these soils will be weakened by construction traffic when wet; especially if site work is carried out during the periods of wet weather. An adequate granular working surface would be likely required in order to minimize subgrade disturbance and protect its integrity in wet periods.

Immediately prior to placing the granular subbase, the exposed subgrade should be compacted and then proofrolled with a heavy rubber-tired vehicle (such as a loaded gravel truck). The subgrade should be inspected for signs of rutting or displacement. Areas displaying signs of rutting or displacement should be compacted and tested or the material should be excavated and replaced with the Granular B Type I. Backfill material should be placed and compacted to at least 100 percent of SPMDD. The final subgrade surface should be sloped at a grade of 3 percent to provide positive subgrade drainage.

5.4 Quality Control

Excavations on this site must be shored to preserve the integrity of the surrounding properties and structures. The Ontario Building Code 2012 stipulates that engineering review of the subsurface conditions is required on a continuous basis during the installation of earth retaining structures. Terraprobe should be retained to provide this review, which is an integral part of the geotechnical design function as it relates to the shoring design considerations. Terraprobe can provide detailed shoring design services for the project, if requested. All foundations must be monitored by the geotechnical engineer on a continuous basis as they are constructed. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code 2012. If Terraprobe is not retained to carry out foundation evaluations during construction, then Terraprobe accepts no responsibility for the performance or nonperformance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice provided in this report.

Concrete for this structure will be specified in accordance with the requirements of CAN3 - CSA A23.1. Terraprobe maintains a CSA certified concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

The requirements for fill placement on this project should be stipulated relative to SPMDD, as determined by ASTM D698. In-situ determinations of density during fill placement by Procedure Method B of ASTM D2922 are recommended to demonstrate that the contractor is achieving the specified soil density. Terraprobe is a CNSC licensed operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary.

Terraprobe can provide thorough in-house resources, quality control services for Building Envelope, Roofing and Structural Steel in accordance with CSA W178, as necessary, for the Structural and Architectural quality control requirements of the project. Terraprobe is certified by the Canadian Welding Bureau under W178.1-1996.

6 LIMITATIONS AND RISK

6.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

6.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of 10422967 Canada Corp. and their retained design consultants and is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. and 10422967 Canada Corp. who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
L ZHANG
100108605
2019-10-25
PROVINCE OF ONTARIO

Ali Rajaei, M.Eng.
EIT

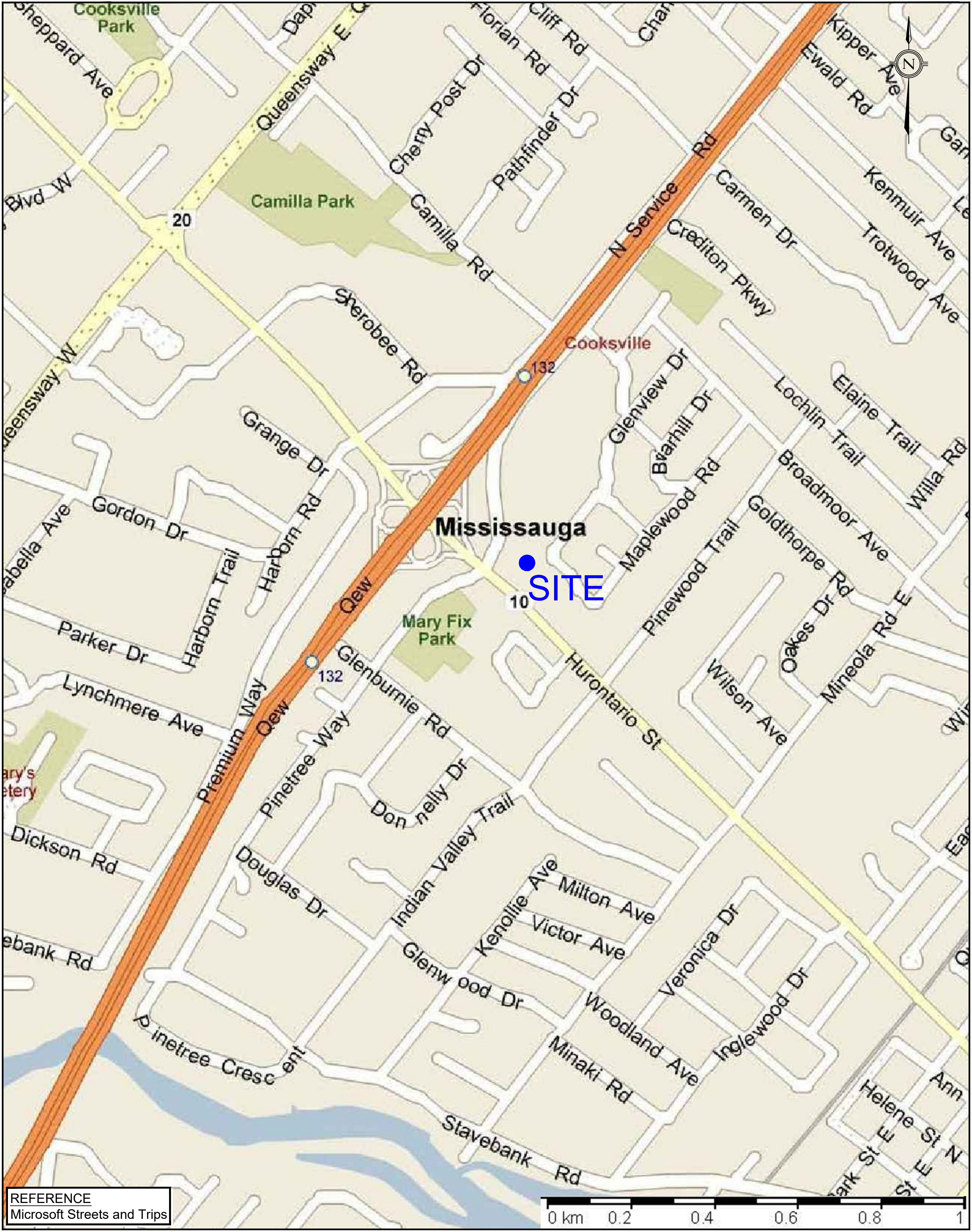
Seth Zhang, M.Eng., M.Sc., P. Eng.
Associate

ENCLOSURES

TERRAPROBE INC.

FIGURES

TERRAPROBE INC.



REFERENCE
Microsoft Streets and Trips

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SITE LOCATION PLAN

File. No.: 1-18-0537-01

FIGURE : 1

Z:\1-Project Files\2018\1-18-0537 - 1575 Hurontario Street, Mississauga\01-GEO Investigation\A. Dwgs, Logs\AutoCAD\1-18-0537 Fig 1.dwg.
Kamal

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

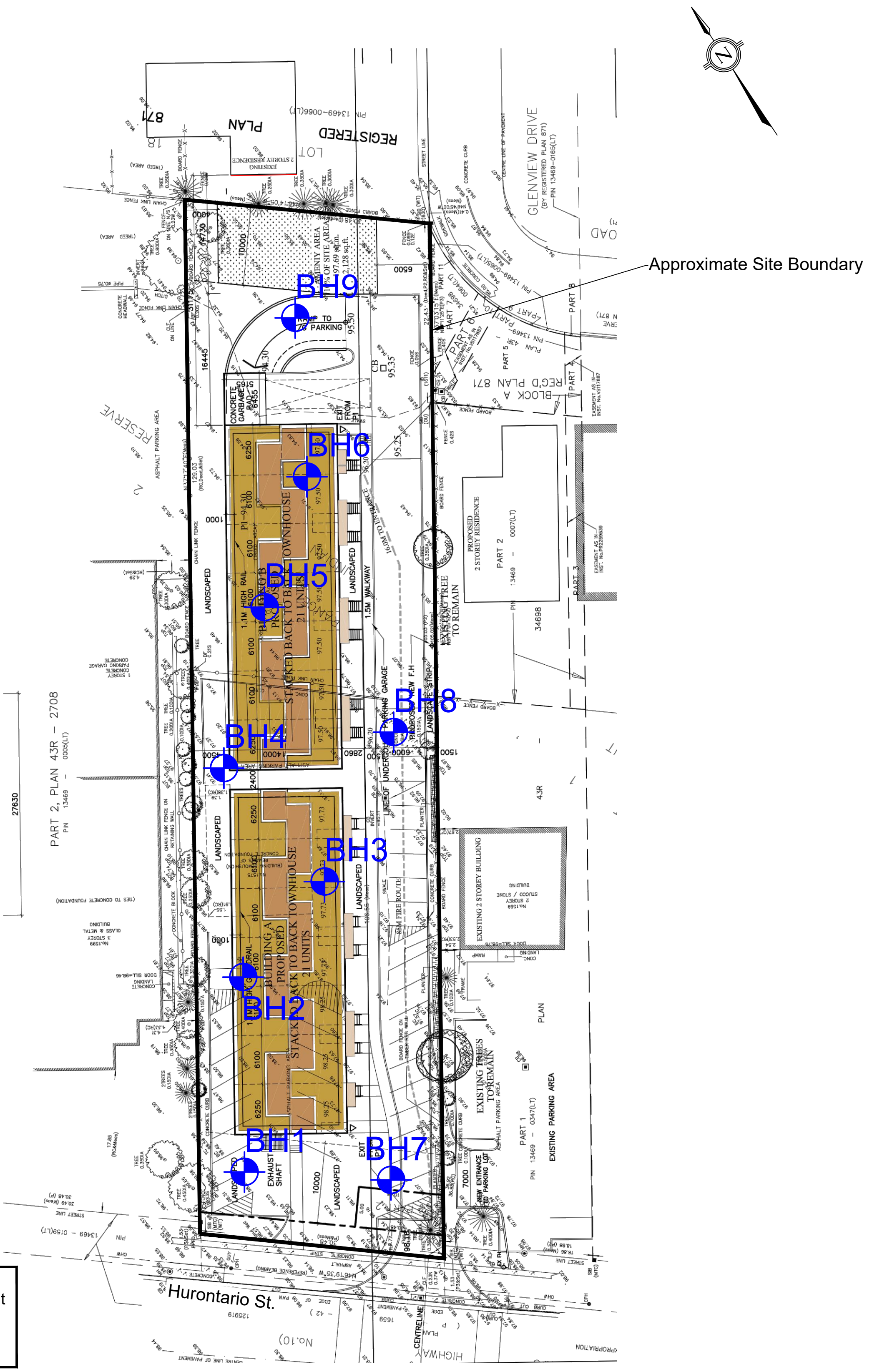
BOREHOLE LOCATION PLAN

(Existing Condition)

File. No.: 1-18-0537-01

FIGURE : 2

Z:\1-Project Files\2018\1-18-0537 - 1575 Hurontario Street, Mississauga\01-GEO Investigation\A. Dwgs, Logs\AutoCAD\1-18-0537 Figures.dwg,
Kamal



REFERENCE
Site Plan, Residential Development
Project No.: 17-094
September 10, 2018
By: Kirkor Architects + Planners

LEGEND
⊕ Approximate Borehole Location

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
BOREHOLE LOCATION PLAN
(Proposed Condition)

File. No.: 1-18-0537-01

FIGURE : 2A

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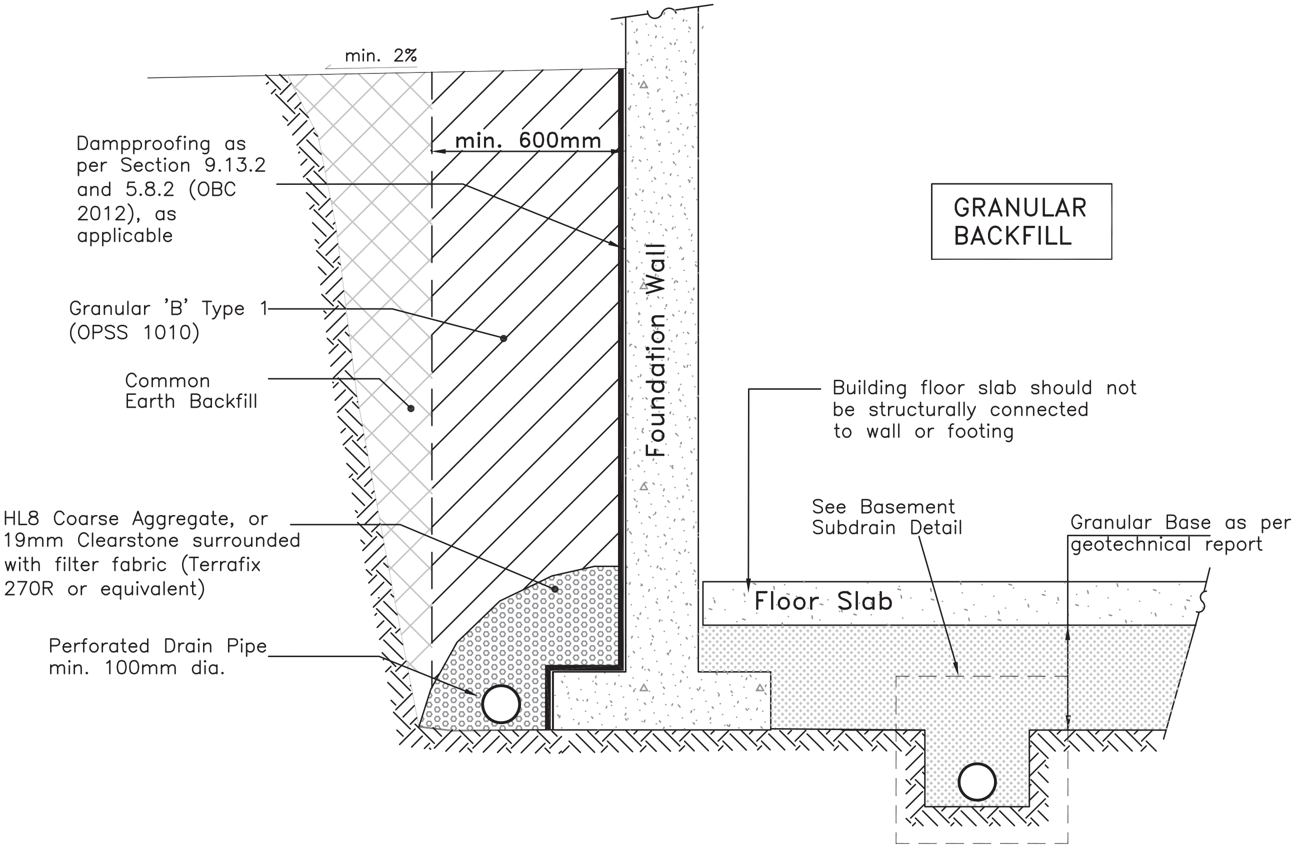
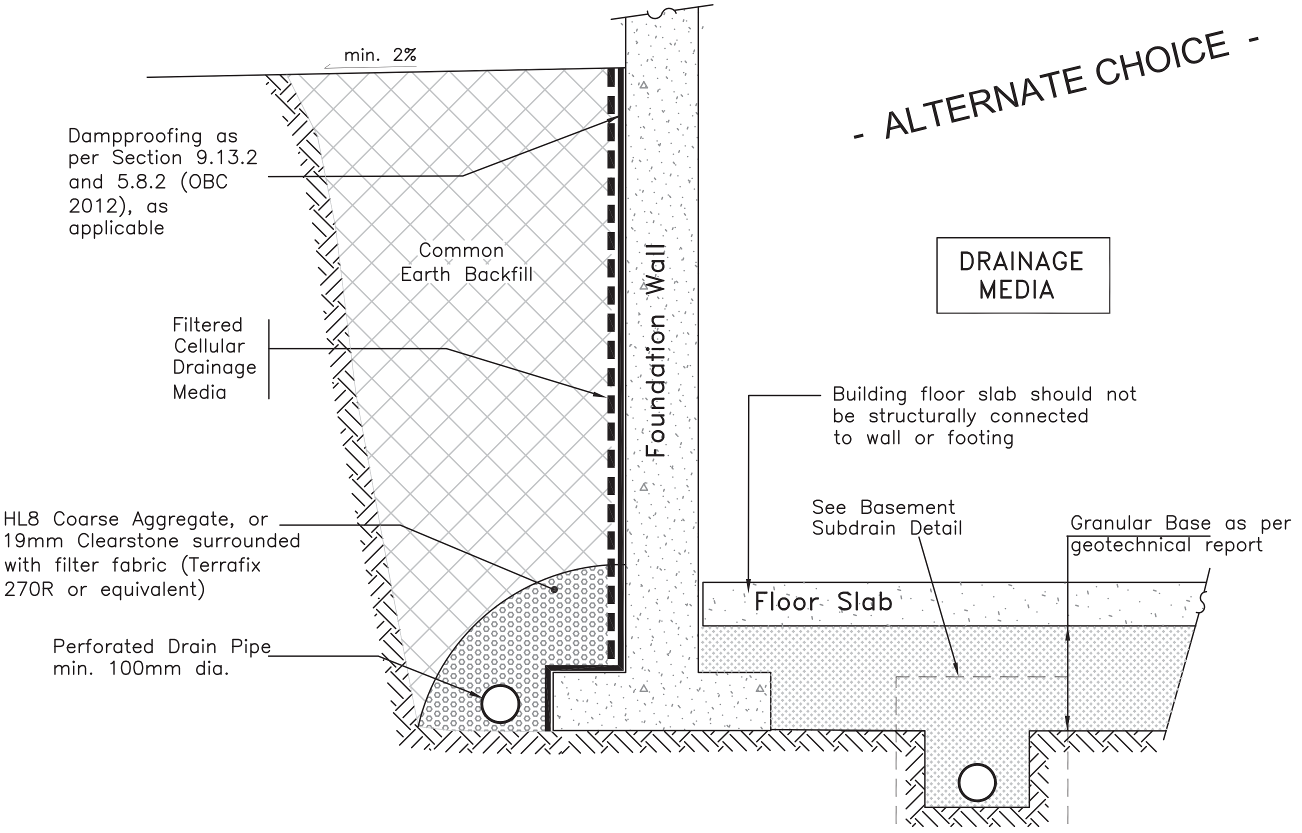
Kamal



GRANULAR BACKFILL

- ALTERNATE CHOICE -



DRAINAGE MEDIA

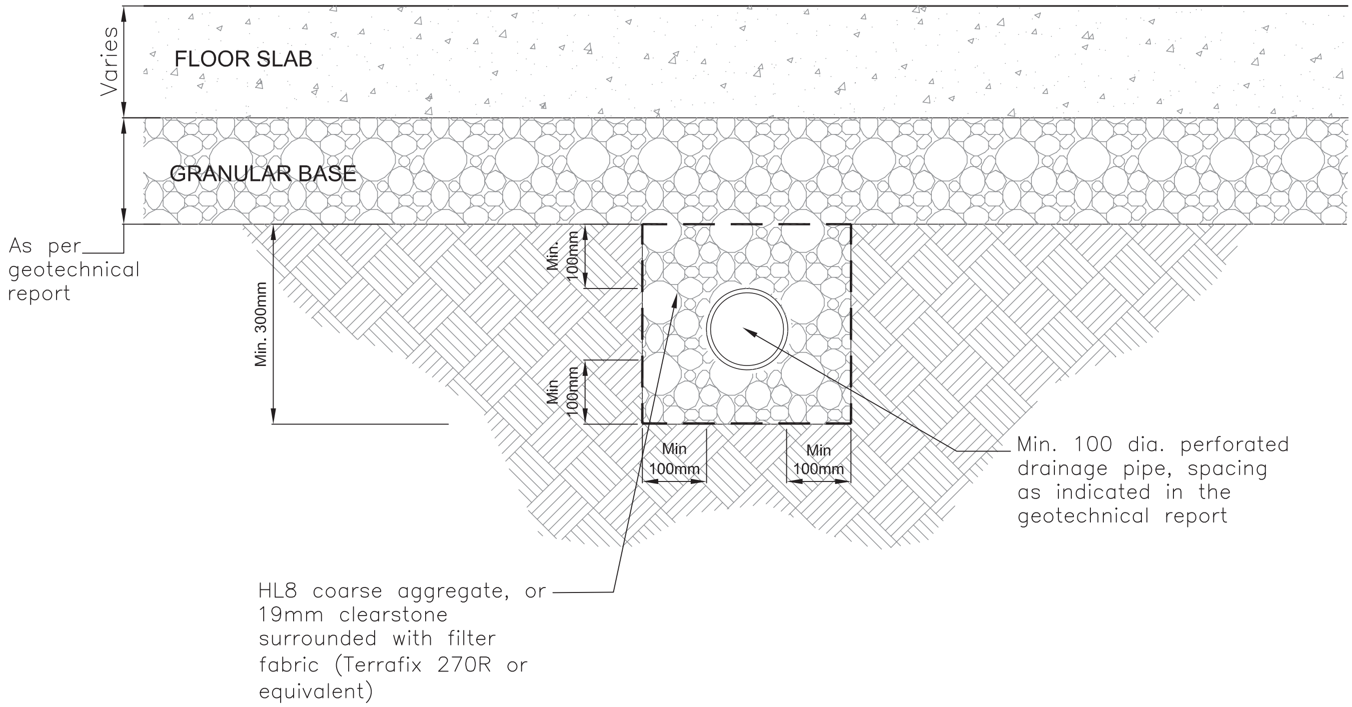
Schematic Only
Not to Scale

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: BASEMENT DRAINAGE DETAIL

File No. 1-18-0537-01

FIGURE : 3



Schematic Only
Not to Scale

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: BASEMENT FLOOR SUBDRAIN DETAIL

File No. 1-18-0537-01

Figure: 4

APPENDIX A

TERRAPROBE INC.

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at or close to plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Terraprobe

LOG OF BOREHOLE 1

Project No. : 1-18-0537
Date started : April 23, 2019
Sheet No. : 1 of 1

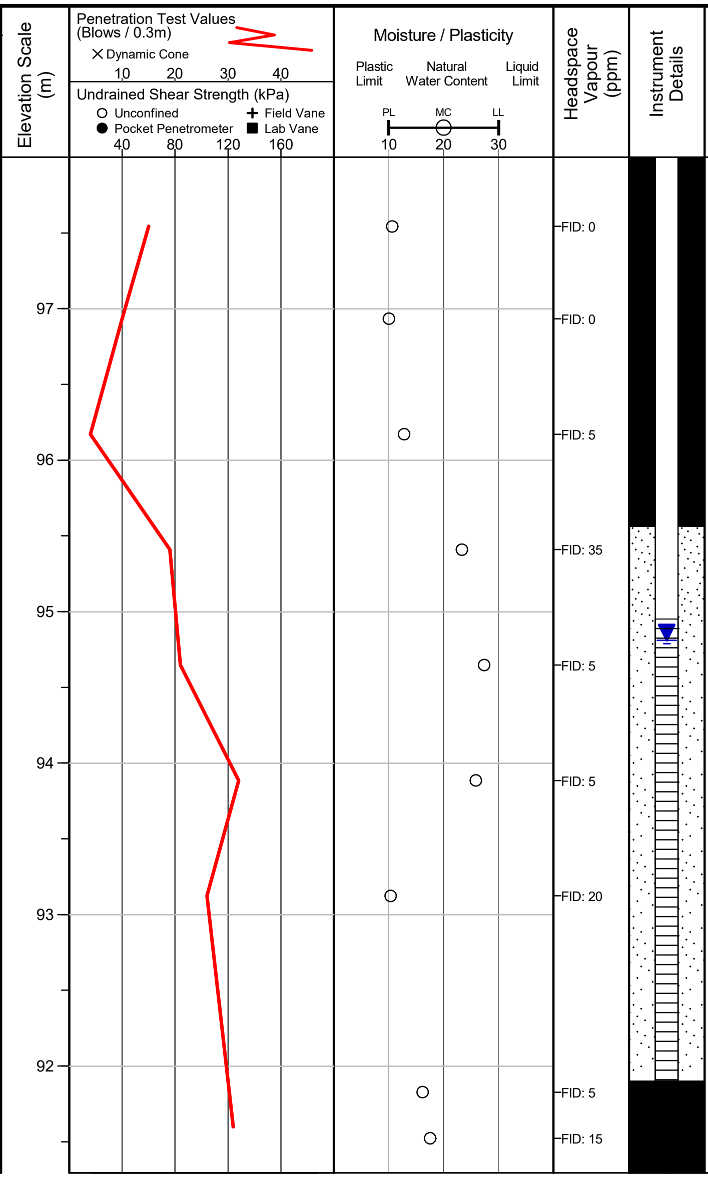
Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

Position : E: 613291, N: 4824702 (UTM 17T)
Rig type : CME 55, buggy-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description
0	98.0	**GROUND SURFACE**
		70mm **ASPHALTIC CONCRETE**
	97.8 0.2	140mm **AGGREGATE**
		SILTY SAND, trace clay, compact to dense, brown, wet
1–2		...very loose
4–5		...sand, some silt, trace clay
6	91.8 6.2	**SILT AND CLAY**, trace sand, trace gravel, hard, grey, moist
	91.3 6.7	

SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	15	FID: 0	
2	SS	10	FID: 0	SS2 Analysis: .pH
3	SS	4	FID: 5	
4	SS	19	FID: 35	SS4 Analysis: PHC
				...at 3.0m, spoon wet
5	SS	21	FID: 5	
6	SS	32	FID: 5	
7	SS	26	FID: 20	GRAIN SIZE DISTRIBUTION (%) (MIT) GR 0 SA 81 SI 17 CL 2
8A	SS	31	FID: 5	
8B			FID: 15	



END OF BOREHOLE

Unstabilized water level measured at 2.4 m below ground surface; borehole caved to 3.4 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Apr 30, 2019	3.2	94.8
May 1, 2019	3.2	94.8

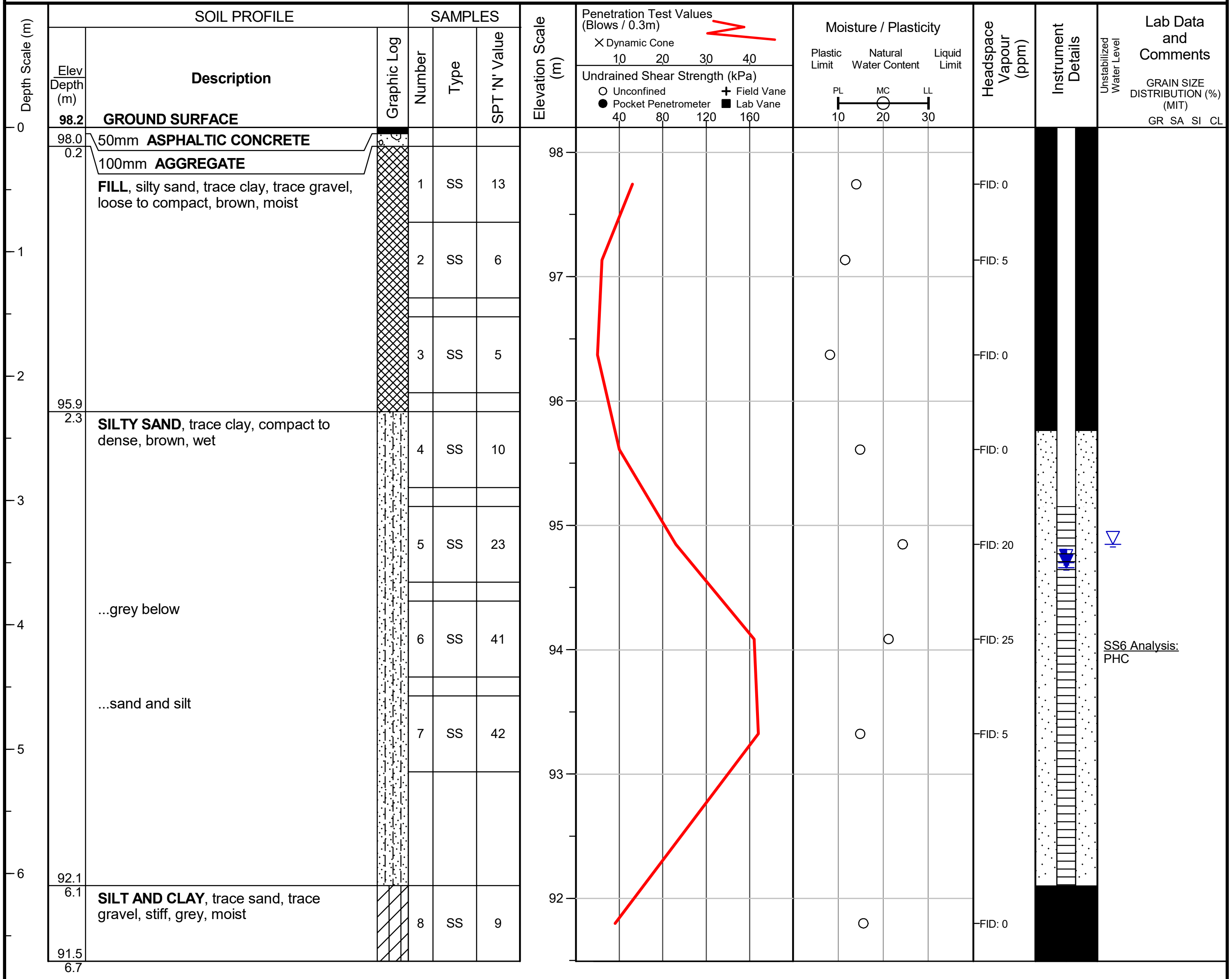
file: 1-18-0537-42 bh logs.gpj

LOG OF BOREHOLE 2

Project No.	: 1-18-0537	Client	: 10422967 Canada Corp.
Date started	: April 23, 2019	Project	: 1575 Hurontario Street
Sheet No.	: 1 of 1	Location	: Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

Position : E: 613304, N: 4824719 (UTM 17T)
Rig type : CME 55, buggy-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers



Elev Depth (m)	Description
98.2	**GROUND SURFACE**
98.0 0.2	50mm **ASPHALTIC CONCRETE**
	100mm **AGGREGATE**
	FILL, silty sand, trace clay, trace gravel, loose to compact, brown, moist
95.9 2.3	**SILTY SAND**, trace clay, compact to dense, brown, wet ...grey below ...sand and silt
92.1 6.1	**SILT AND CLAY**, trace sand, trace gravel, stiff, grey, moist
91.5 6.7	

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	13	FID: 0
2	SS	6	FID: 5
3	SS	5	FID: 0
4	SS	10	FID: 0
5	SS	23	FID: 20
6	SS	41	FID: 25
7	SS	42	FID: 5
8	SS	9	FID: 0

SS6 Analysis: PHC

END OF BOREHOLE

Unstabilized water level measured at 3.4 m below ground surface; cave not measured due to casing.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Apr 30, 2019	3.5	94.7
May 1, 2019	3.5	94.7

file: 1-18-0537-42 bh logs.gpj

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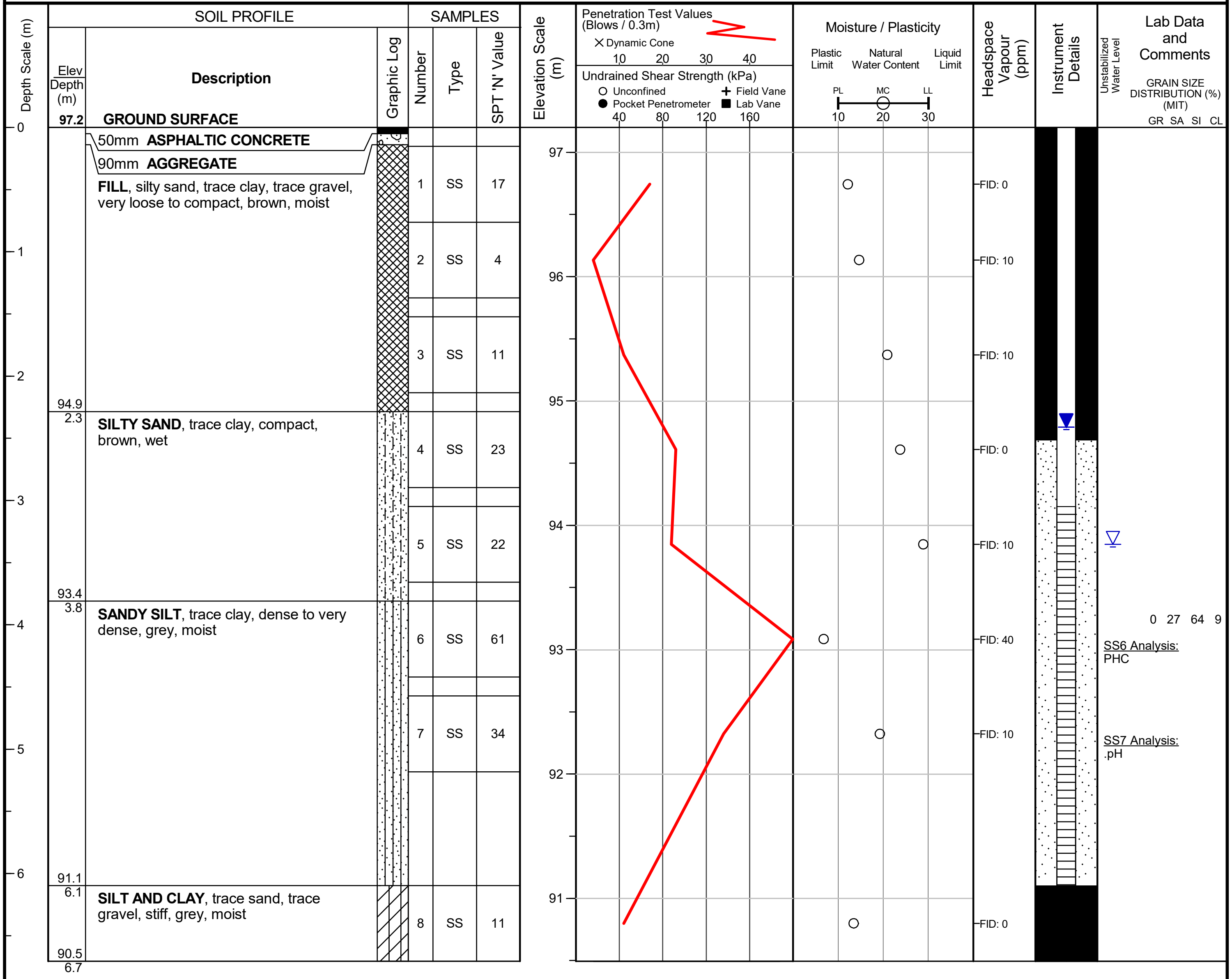
LOG OF BOREHOLE 3

Project No. : 1-18-0537
Date started : April 23, 2019
Sheet No. : 1 of 1

Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

Position : E: 613322, N: 4824722 (UTM 17T)
Rig type : CME 55, buggy-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers



Elev Depth (m)	Description
97.2	**GROUND SURFACE**
	50mm **ASPHALTIC CONCRETE**
	90mm **AGGREGATE**
	FILL, silty sand, trace clay, trace gravel, very loose to compact, brown, moist
94.9 2.3	**SILTY SAND**, trace clay, compact, brown, wet
93.4 3.8	**SANDY SILT**, trace clay, dense to very dense, grey, moist
91.1 6.1	**SILT AND CLAY**, trace sand, trace gravel, stiff, grey, moist
90.5 6.7	

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	17	FID: 0	
2	SS	4	FID: 10	
3	SS	11	FID: 10	
4	SS	23	FID: 0	
5	SS	22	FID: 10	
6	SS	61	FID: 40	0 27 64 9 SS6 Analysis: PHC
7	SS	34	FID: 10	SS7 Analysis: .pH
8	SS	11	FID: 0	

END OF BOREHOLE

Unstabilized water level measured at 3.4 m below ground surface; cave not measured due to casing.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Apr 30, 2019	2.4	94.8
May 1, 2019	2.4	94.8

file: 1-18-0537-42 bh logs.gpj

LOG OF BOREHOLE 4

Project No. : 1-18-0537
Date started : April 24, 2019
Sheet No. : 1 of 1

Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

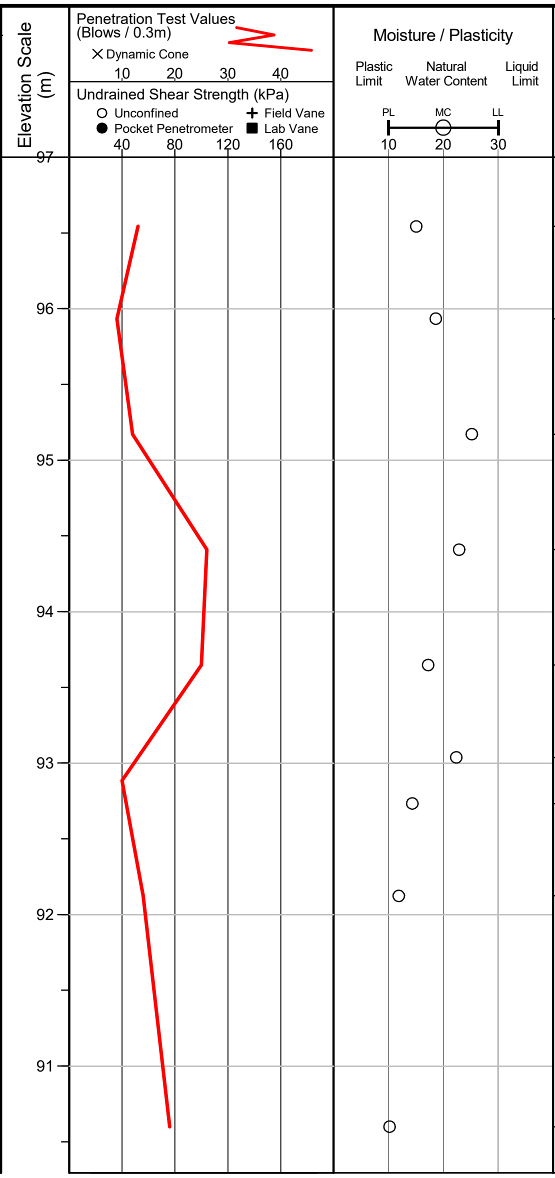
Position : E: 613322, N: 4824741 (UTM 17T)
Rig type : CME 55, buggy-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
97.0	**GROUND SURFACE**
	45mm **ASPHALTIC CONCRETE**
96.8 0.2	155mm **AGGREGATE**
	FILL, silty sand, trace clay, trace gravel, trace rootlets, loose to compact, brown, moist
94.7 2.3	**SILTY SAND**, trace clay, compact, brown, wet ...grey
92.9 4.1	**SILT AND CLAY**, trace sand, trace gravel, stiff to very stiff, grey, moist ...shale fragments
90.3 6.7	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	13	FID: 0
2	SS	9	FID: 0
3	SS	12	FID: 5
4	SS	26	FID: 70
5	SS	25	FID: 15
6A	SS	10	FID: 5
6B			FID: 0
7	SS	14	FID: 25
8	SS	19	FID: 0



Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

SS4 Analysis: PHC

END OF BOREHOLE

Unstabilized water level measured at 2.7 m below ground surface; cave not measured due to casing.

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LOG OF BOREHOLE 5

Project No. : 1-18-0537
Date started : April 24, 2019
Sheet No. : 1 of 1

Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

Position : E: 613339, N: 4824757 (UTM 17T)
Rig type : CME 55, buggy-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev (m)	Depth (m)	Description
95.0	0	**GROUND SURFACE**
		300mm **TOPSOIL**
94.7	0.3	**FILL**, silty sand, trace rootlets, loose, dark brown, moist
94.2	0.8	**SILTY SAND**, trace clay, compact, brown, wet
92.4	2.6	**SILT AND CLAY**, trace sand, trace gravel, firm to stiff, grey, moist
90.4	4.6	**INFERRED BEDROCK**, weathered shale with intermittent limestone / dolostone stringers
88.8	6.2	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	6	FID: 20
2	SS	13	FID: 25
3	SS	22	FID: 10
4A 4B	SS	14	FID: 30
5	SS	11	FID: 15
6	SS	7	FID: 15
7	SS	39	FID: 10
8	SS	50 / 75mm	FID: 0

Instrument Details

Unstabilized Water Level: ▽ 5.5 m

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Unstabilized water level measured at 5.5 m below ground surface; cave not measured due to casing.

file: 1-18-0537-42 bh logs.gpj

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LOG OF BOREHOLE 6

Project No. : 1-18-0537	Client : 10422967 Canada Corp.	Originated by : BR
Date started : April 24, 2019	Project : 1575 Hurontario Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Mississauga, Ontario	Checked by : SZ

Position : E: 613351, N: 4824764 (UTM 17T)
Elevation Datum : Geodetic
Rig type : CME 55, buggy-mounted
Drilling Method : Hollow stem augers

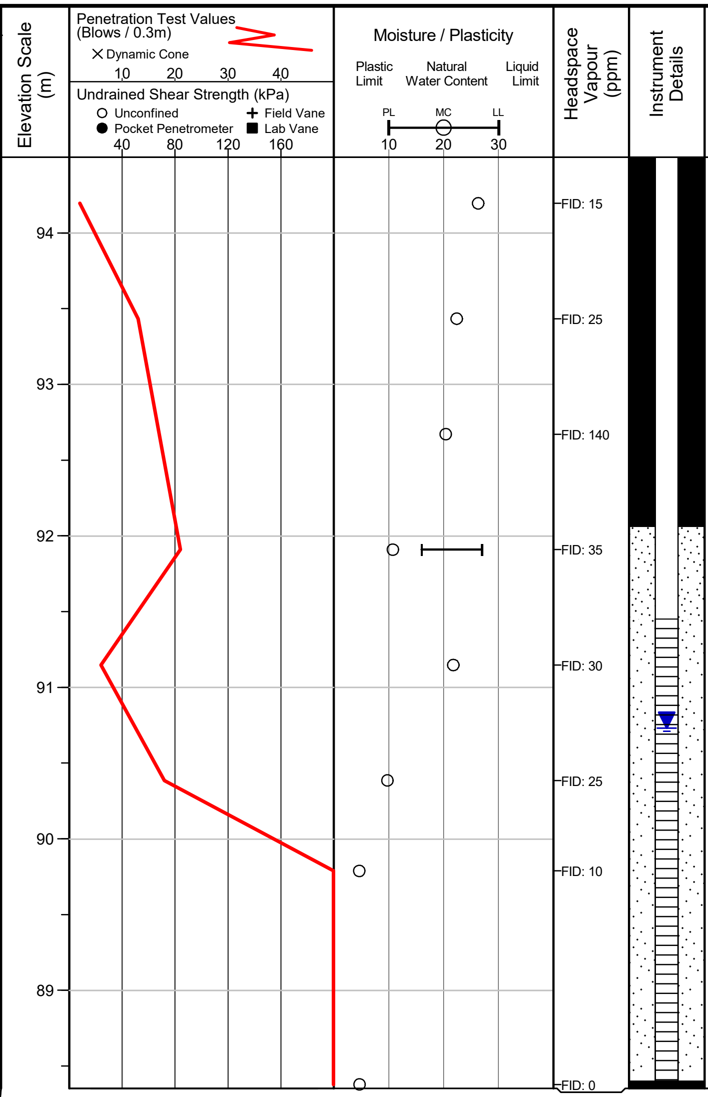
SOIL PROFILE

Elev Depth (m)	Description
94.5	**GROUND SURFACE**
	100mm **TOPSOIL**
	FILL, silty sand, trace clay, trace rootlets, very soft, brown, moist
93.7 0.8	**SILTY SAND**, trace clay, compact, brown, wet
92.2 2.3	**CLAYEY SILT**, sandy, some gravel, firm to very stiff, grey, moist ...shale fragments
89.9 4.6	**INFERRED BEDROCK**, weathered shale with intermittent limestone / dolostone stringers
88.4 6.1	

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	2	FID: 15	
2	SS	13	FID: 25	
3	SS	17	FID: 140	SS3 Analysis: PHC
4	SS	21	FID: 35	15 27 38 20
5	SS	6	FID: 30	
6	SS	18	FID: 25	
7	SS	50 / 125mm	FID: 10	
8	SS	50 / 50mm	FID: 0	

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL



END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Apr 30, 2019	3.8	90.7
May 1, 2019	3.8	90.7

file: 1-18-0537-42 bh logs.gpj

LOG OF BOREHOLE 7

Project No. : 1-18-0537
Date started : April 23, 2019
Sheet No. : 1 of 1

Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

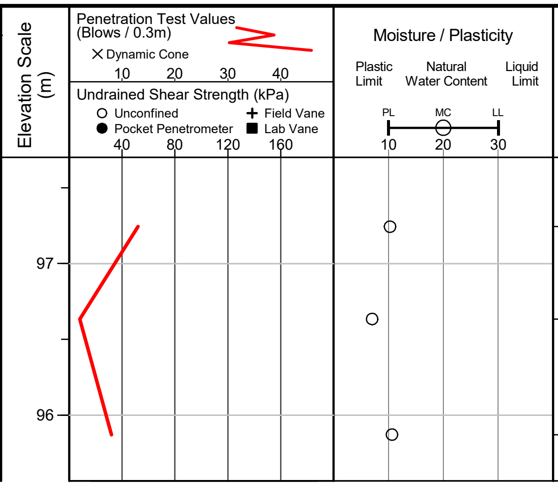
Position : E: 613304, N: 4824689 (UTM 17T)
Rig type : CME 55, buggy-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	**97.7**	**GROUND SURFACE**							
		55mm **ASPHALTIC CONCRETE**							
	97.4 0.3	255mm **AGGREGATE**							
		SAND, some silt, trace clay, very loose to compact, brown, moist	1	SS	13	FID: 0			
1			2	SS	2	FID: 0			0 88 11 1
			3	SS	8	FID: 0			
2	95.6 2.1								

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



LOG OF BOREHOLE 8

Project No. : 1-18-0537
Date started : April 23, 2019
Sheet No. : 1 of 1

Client : 10422967 Canada Corp.
Project : 1575 Hurontario Street
Location : Mississauga, Ontario

Originated by : BR
Compiled by : AR
Checked by : SZ

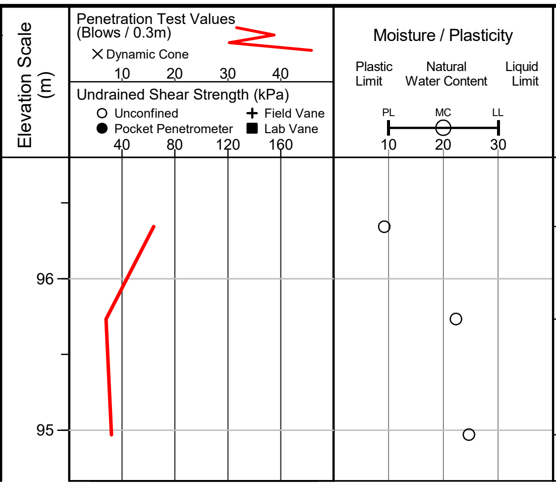
Position : E: 613334, N: 4824727 (UTM 17T)
Rig type : CME 55, buggy-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	**96.8**	**GROUND SURFACE**								
		60mm **ASPHALTIC CONCRETE**								
		120mm **AGGREGATE**								
1	96.6 0.2	**FILL**, silty sand, trace clay, trace rootlets, loose to compact, brown, moist		1 2	SS SS	16 7	FID: 5 FID: 0			
2	95.3 1.5	**SAND**, some silt, trace clay, loose, brown, moist		3	SS	8	FID: 0			
	94.7 2.1									

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



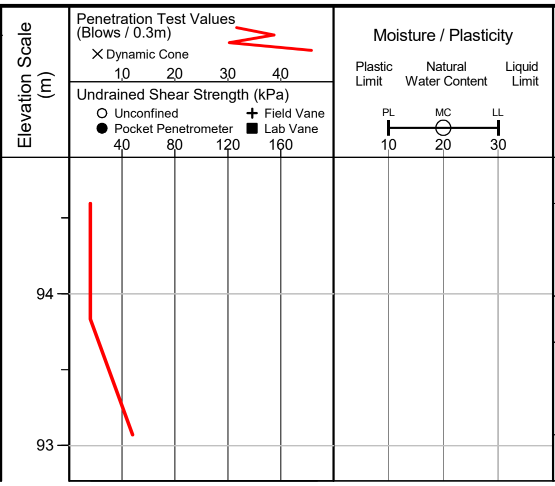
Terraprobe

LOG OF BOREHOLE 9

Project No. : 1-18-0537	Client : 10422967 Canada Corp.	Originated by : BR
Date started : April 23, 2019	Project : 1575 Hurontario Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Mississauga, Ontario	Checked by : SZ

Position : E: 613360, N: 4824776 (UTM 17T)
Elevation Datum : Geodetic
Rig type : CME 55, buggy-mounted
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	**94.9**	**GROUND SURFACE**								
		FILL, silty sand, trace clay, trace rootlets, loose, brown, moist	▩	1	SS	4	FID: 15			
1		...dark brown	▩	2A	SS	4	FID: 10			
			▩	2B			FID: 0			
	93.4 1.5	**SAND**, some silt, trace clay, compact, brown, wet	⁙	3	SS	12	FID: 10			
2	92.8 2.1									



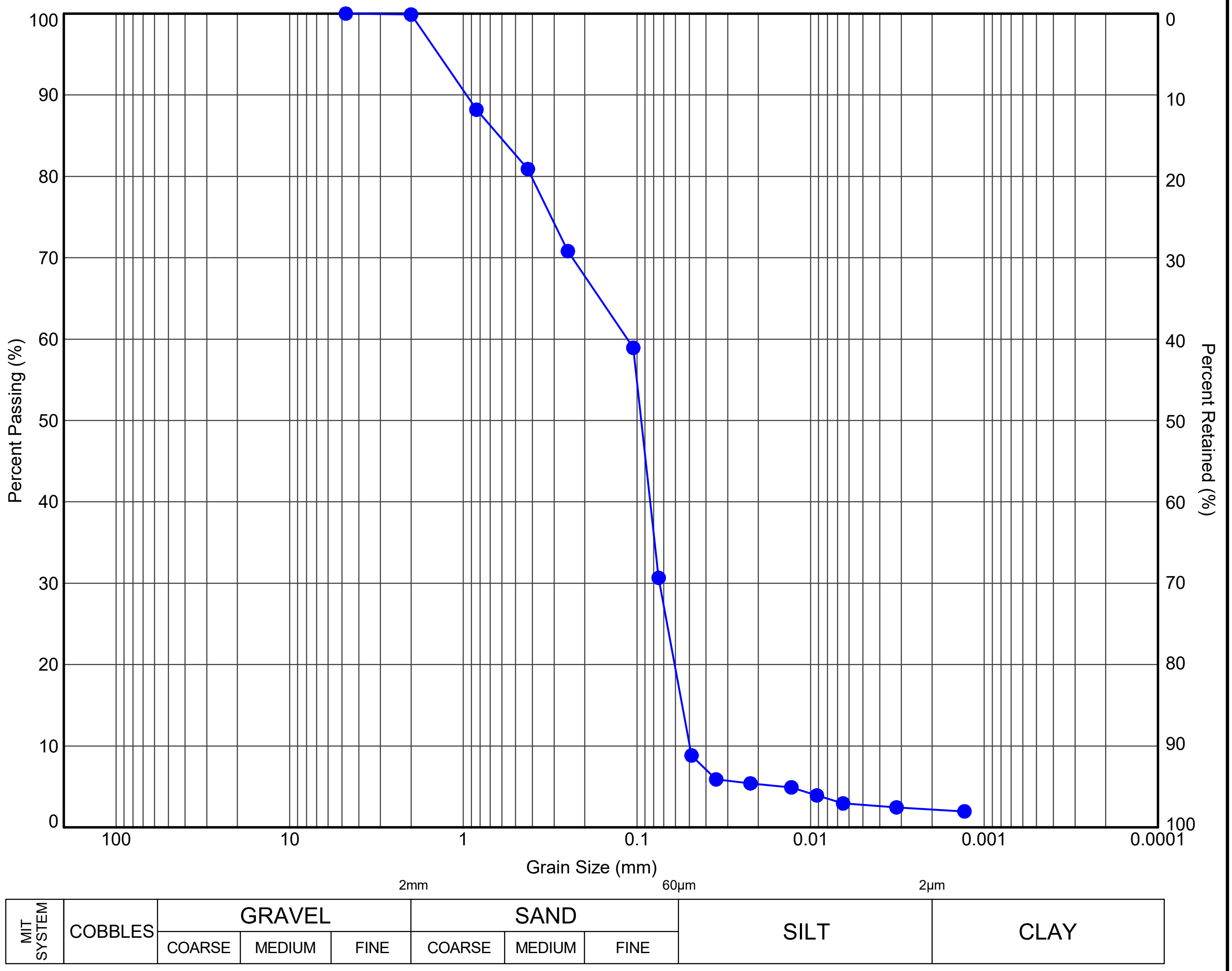
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 1-18-0537-42 bh logs.gpj

APPENDIX B

TERRAPROBE INC.



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS7	4.9	93.1	0	81	17	2	

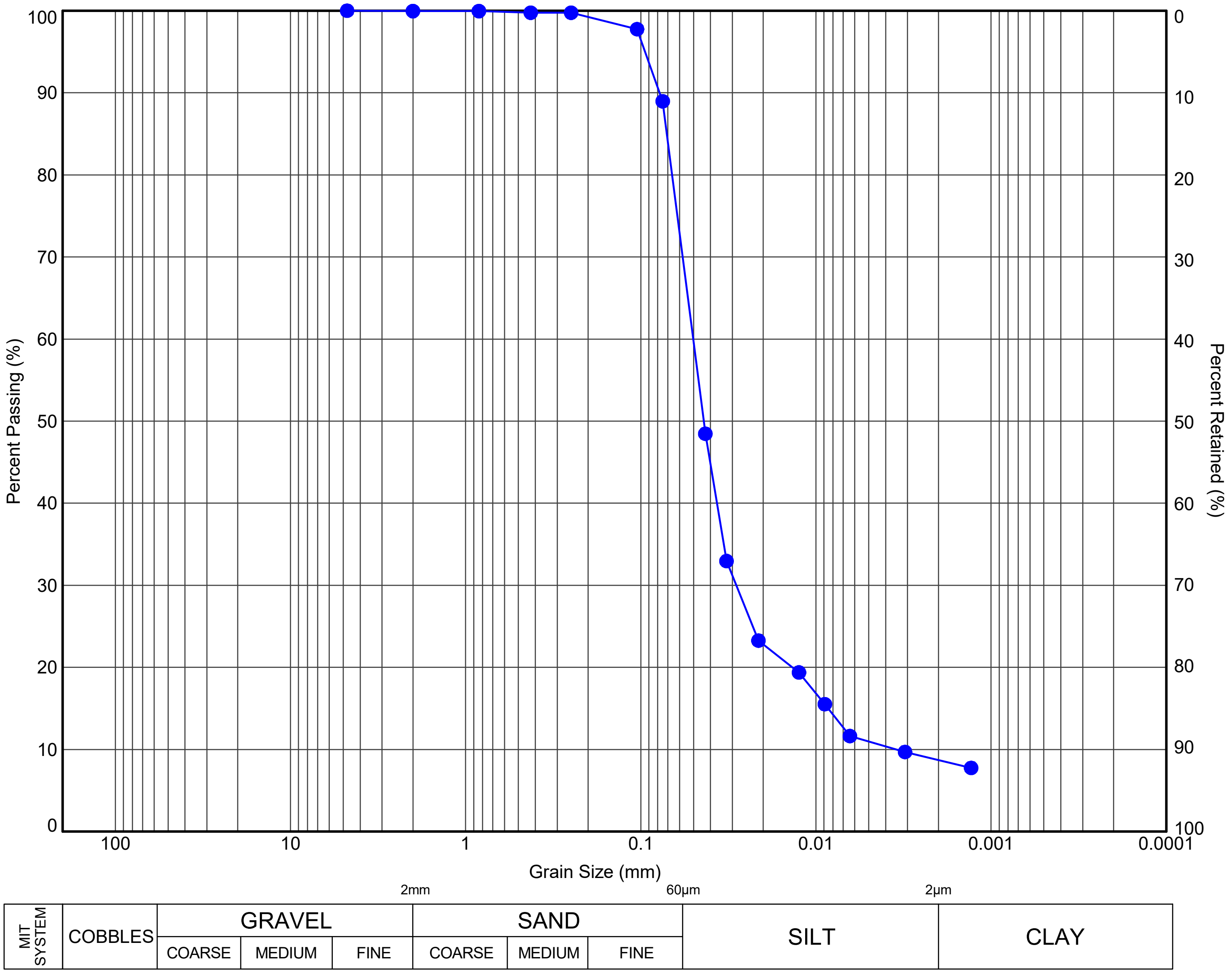
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE CLAY

File No.: **1-18-0537**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**3**	SS6	4.1	93.1	0	27	64	9	

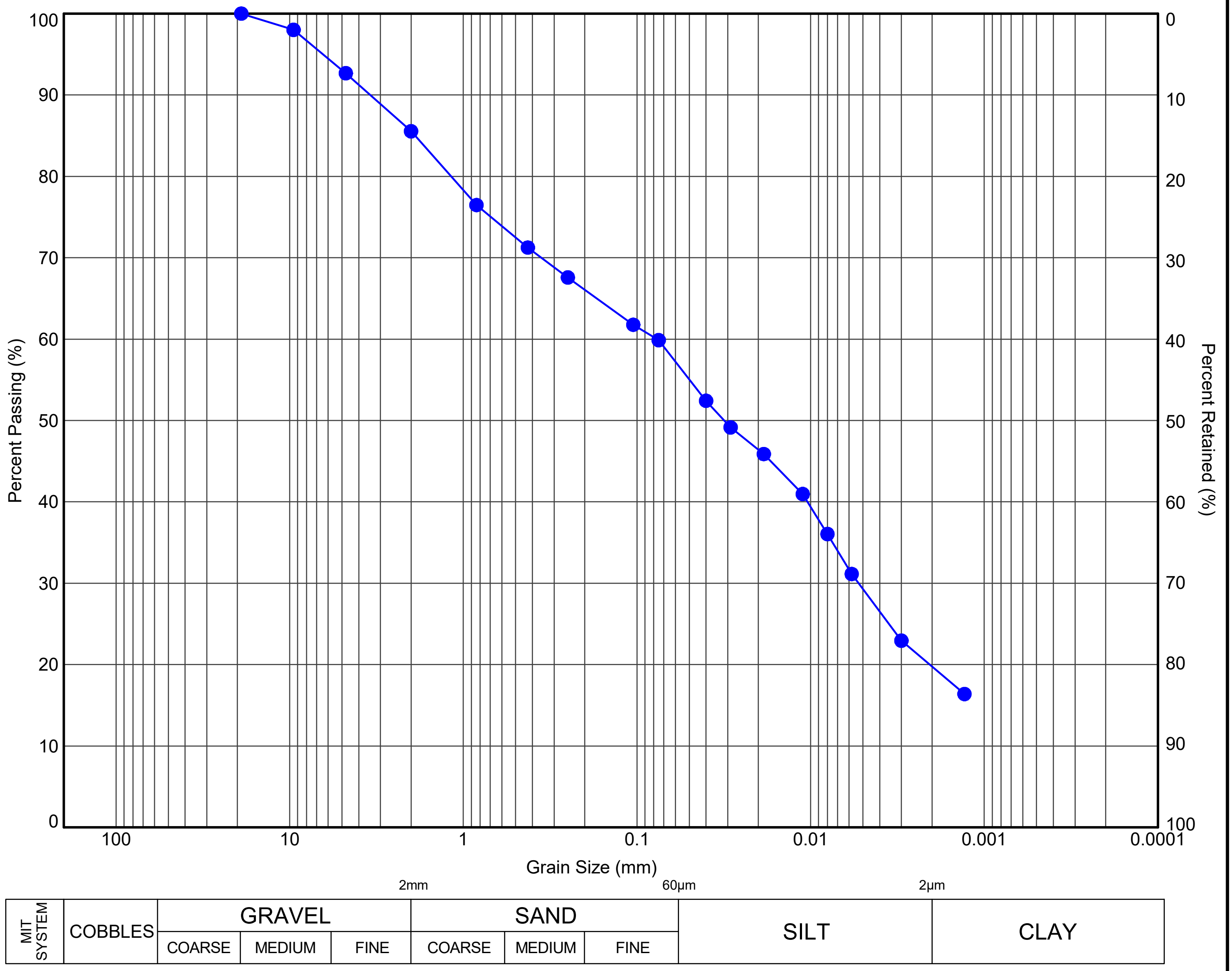
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SANDY SILT, TRACE CLAY

File No.: **1-18-0537**



	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
					MIT SYSTEM				
●	**6**	SS4	2.6	91.9	15	27	38	20	

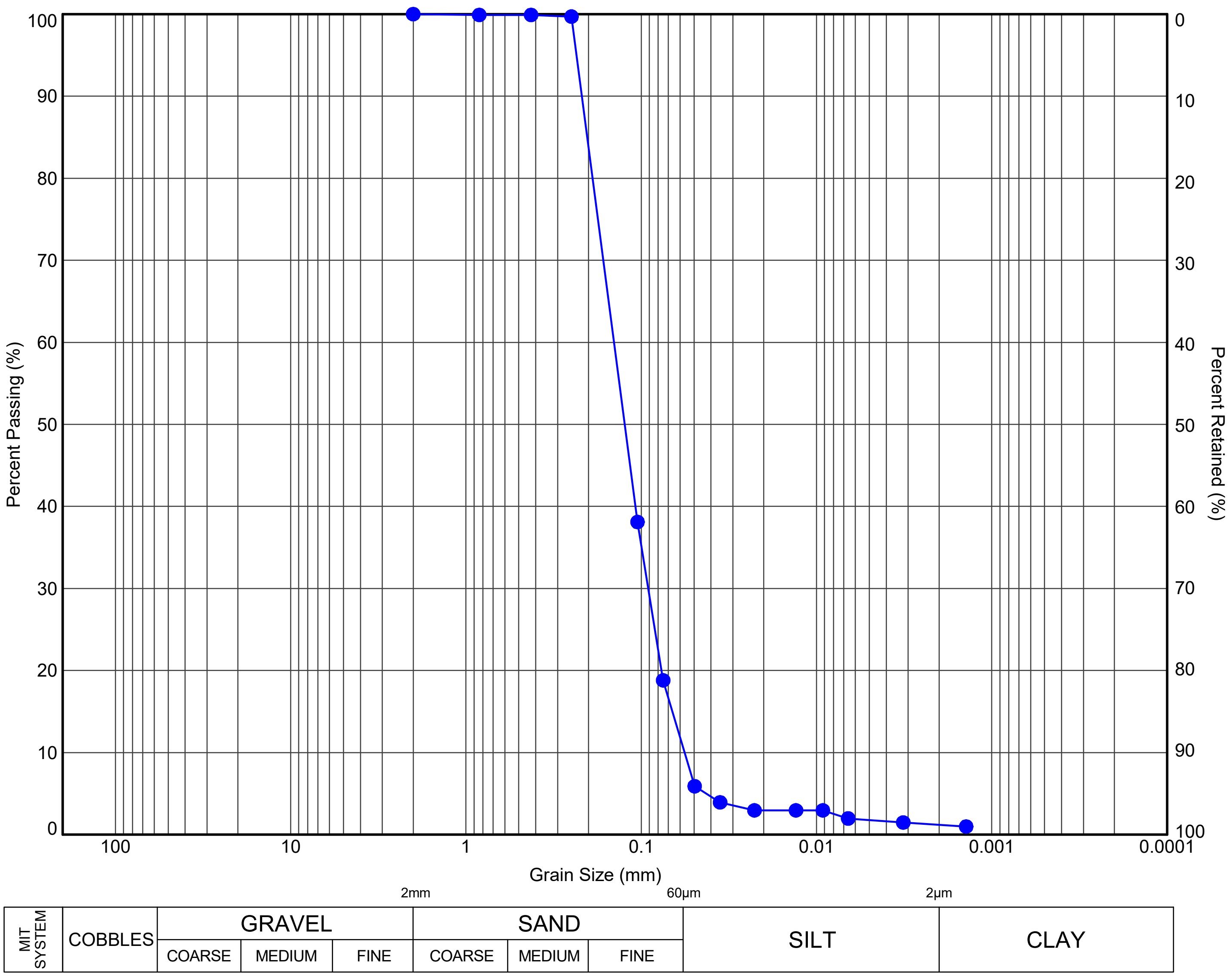
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SANDY, SOME GRAVEL

File No.: **1-18-0537**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**7**	SS2	1.1	96.6	0	88	11	1	

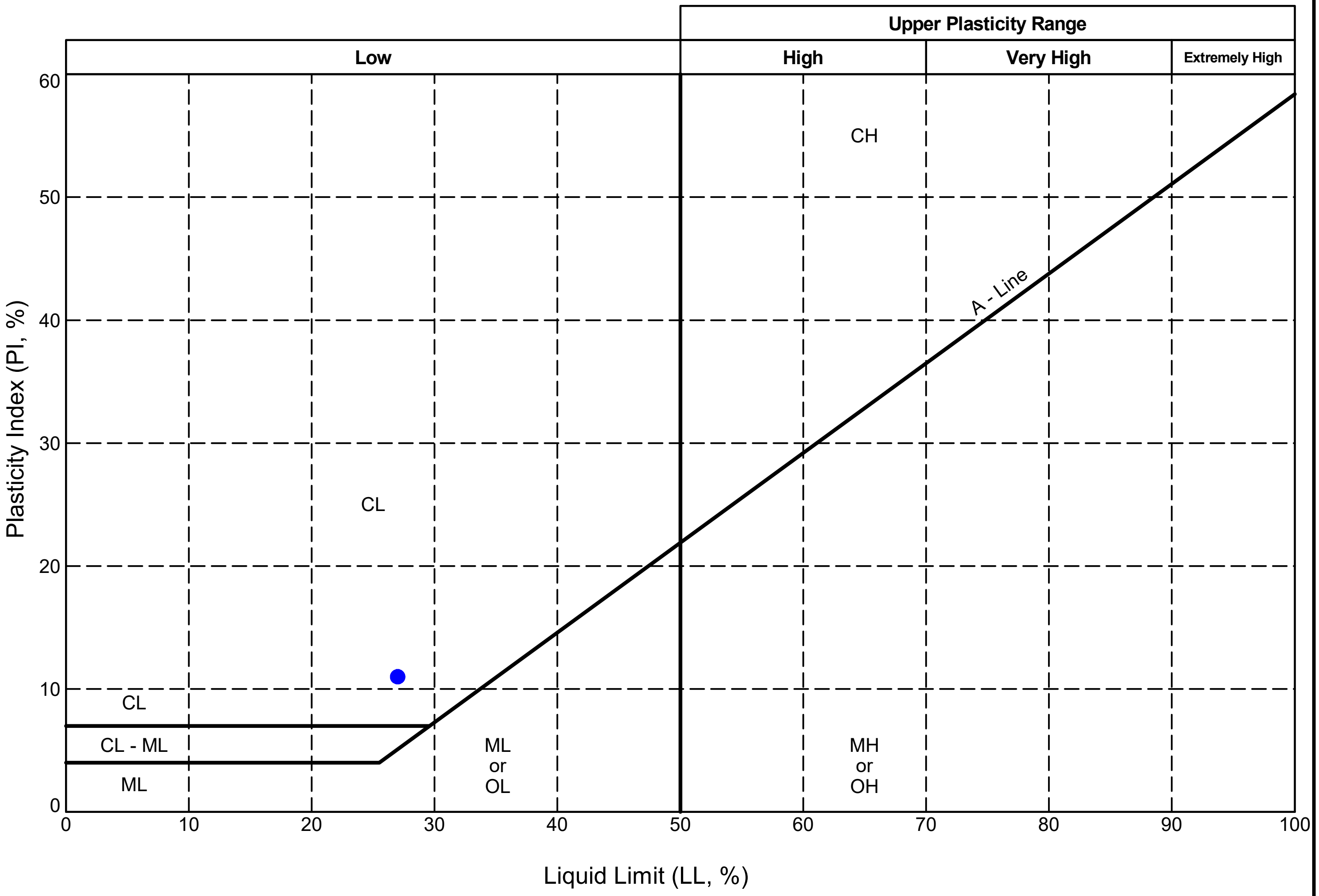
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE CLAY

File No.: **1-18-0537**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	6	SS4	2.6	91.9	27	16	11

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

ATTERBERG LIMITS CHART

File No.:

1-18-0537