Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
RESIDENTIAL DEVELOPMENT
1 ROSETTA STREET
HALTON HILLS, ONTARIO

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1 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Koler Builders to conduct a geotechnical investigation for a proposed residential development at 1 Rosetta Street, in the Town of Halton Hills, Ontario. The general location of the site is presented on Figure 1.

This report encompasses the results of the geotechnical investigation conducted for the proposed development site to determine the prevailing subsurface soil and ground water conditions, and on this basis, provides geotechnical engineering design advice and recommendations for the building foundations, basement floor slab, earthquake and earth pressure design parameters, basement drainage, shoring and pavement design. In addition, comments are also included on pertinent construction aspects including excavation, backfill and ground water control.

Terraprobe has also conducted hydrogeological and Phase 1 & 2 Enviromental Site Assessment studies for this site. The findings of the studies are reported under separate covers.

2 SITE AND PROJECT DESCRIPTION

The project site is bound by River Drive to the south, River Drive and Rosetta Street to the east, Rosetta Street and Caroline Street to the north and Caroline Street and St. Michaels Street to the west, in the Town of Halton Hills. The municipal address of the project site is 1 Rosetta Street, Georgetown. The project site is an irregular shaped parcel of land, covering an area of about 12,726 square meters (1.27 hectare). The project site is currently occupied by industrial buildings, parking lots and landscaped area.

It is understood that the existing structures would be demolished to facilitate redevelopment of the site to include two 12-storey towers and one 6-storey building resting on 2 levels of common underground parking garage.

3 INVESTIGATION PROCEDURE

The field investigation was conducted during the period of August 10 to September 11, 2020 and consisted of drilling and sampling a total of ten (10) boreholes within or in a close proximity to the proposed building footprints, extending to 11.7 to 23.0 m depth below grade. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figures 2A and 2B).

All the boreholes were drilled by a specialist drilling contractor using continuous flight hollow stem augers and were sampled at 0.75 m (up to 3.0 m depth) and 1.5 m (below 3.0 m depth) intervals with a conventional 50 mm diameter split barrel sampler 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 test on selected native soil samples. The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analysis are plotted on the enclosed Borehole Logs at respective sampling depths. The results of Sieve and Hydrometer analysis 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 five (5) boreholes and a nested well at Borehole 110 to facilitate ground water monitoring and for the purpose of the Hydrogeological Study. 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 September 30, 2020. 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. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T).

It should be noted that the elevations provided on the Borehole Log are approximate, 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 (Boreholes 101 to 110) 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 in 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

An asphalt pavement structure consisting of 50 to 90 mm thick asphaltic concrete underlain by 50 to 475 mm thick granular base/subbase course was encountered in Boreholes 101 to 110 with the exception of Borehole 106.

A topsoil layer was encountered at the ground surface in Borehole 106. The topsoil thickness was 300 mm.

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

4.2 Earth Fill

Earth fill materials, consisting of sand/gravelly sand, with trace amounts of silt and clay were encountered beneath the pavement structure in Boreholes 101 to 103 and extended to about 1.5 to 2.3 m depth below grade.

Earth fill materials, consisting of silty sand to sandy silt with trace to some gravel, trace amounts of clay and brick fragments and organics was encountered beneath the surficial layer borehole 104, 106 to 108 and 110 and extended to depths ranging 1.5 to 3 m below grade.

Earth fill materials, consisting of clayey silt with some sand and trace amounts of gravel was encountered beneath the asphalt pavement structure in borehole 105 and 109 and extended to depths ranging 0.8 m and 1.1 m below grade.

Standard Penetration Test results (N-values) obtained from the cohesive fill zone were 10 and 18 blows per 300 mm of penetration, indicating a stiff to very stiff consistency. The in-situ moisture content of the cohesive earth fill samples was 12 and 19 percent by mass, indicating a moist condition.

N-Value obtained from the cohesionless earth fill zone ranged was 2 to 24 blows per 300 mm of penetration, indicating a very loose to compact relative density. The in-situ moisture content of the cohesionless earth fill samples ranged from 2 to 13 percent by mass, indicating a moist condition.

4.3 Sand to Sand and Gravel

The matrix of sand and gravel with trace to some silt was encountered beneath the earth fill zone in Boreholes 101 to 108 and beneath sandy silt to sand and silt deposit in Boreholes 104, 109 and 110 and extended to depths ranging from 6.1 to 23 m below grade.

N-values obtained from the matrix of sand and gravel ranged from 3 to over 50 blows per 300 mm of penetration, indicating a very loose to very dense (typically compact to dense) relative density.

The in-situ moisture contents of the gravelly sand soil samples ranged from 1 to 11 percent by mass, indicating a moist condition.

4.4 Glacial Till

Clayey silt till deposits with some sand and trace to some gravel were encountered beneath the sand and gravel matrix in Boreholes 105, 107 and in between sand and silt layer in Borehole 110 and extended to depths ranging from 11.3 to 16.8 m below grade.

N-values obtained from the clayey silt till layer ranged from 22 to 105 blows per 300 mm of penetration indicating a very stiff to hard consistency.

Sandy silt till deposits with some clay and trace amounts of gravel were encountered beneath sand and gravel layer in Borehole 105, beneath the sand layer in Borehole 108 and beneath earth fill zone in Borehole 109 and extended to depths ranging from 2.3 to 23 m below grade.

N-values obtained from the sandy silt till layer ranged from 14 to over 50 blows per 300 mm of penetration, indicating a compact to very dense (typically dense) relative density.

The in-situ moisture contents of the till samples ranged from 5 to 16 percent by mass, indicating a moist condition.

4.5 Sandy Silt to Sand and Silt / Silty Sand

Sandy silt to silty sand deposit with trace to some clay and trace amounts of gravel and stone fragments were encountered beneath the sand and gravel matrix, the glacial till deposit or the earth fill zone in Boreholes 101, 102 and 104, and 107 to 110 and extended to depths of about 11.7 to 21.3 m.

N-values obtained from the sandy silt to silty sand deposit ranged from 13 to over 50 blows per 300 mm of penetration, indicating a compact to very dense (typically dense) relative density.

The in-situ moisture contents of the native sandy silt to silty sand samples ranged from 4 to 28 percent by mass, indicating a moist to wet condition.

4.6 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural water content determination for all samples, while a Sieve and Hydrometer analysis 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 are presented as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 101, Sample 11	9.4	8	66	19	7	SAND some silt, trace gravel, trace clay
Borehole 105, Sample 13	13.3	2	20	47	31	CLAYEY SILT sandy, trace gravel
Borehole 109, Sample 8	7.9	5	39	44	12	SILT AND SAND some clay, trace gravel

4.7 Ground Water

Observations pertaining to the depth of water level and caving were made in all boreholes immediately after completion of drilling and are noted on the enclosed Borehole Logs. Monitoring wells were installed in Boreholes 103, 104, 105, 109 and 110 to facilitate ground water level monitoring and for the purpose of the hydrogeological and environmental study. The ground water level measurements in the monitoring wells were taken on September 30, 2020 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 Wells September 30, 2020
BH 101	12.8 m	Open	Dry	Monitoring well not installed
BH 102	17.4 m	Open	Dry	Monitoring well not installed
BH 103	20.3 m	Open	Dry	Dry
BH 104	18.6 m	Open	Dry	Dry
BH 105	23.0 m	Open	Dry	21.1 m/237.6 m
BH 106	12.8 m	Open	8.2 m/252.1 m	Monitoring well not installed
BH 107	11.7 m	Open	Dry	Monitoring well not installed
BH 108	12.6 m	Open	Dry	Monitoring well not installed
BH 109	12.6 m	Open	Dry	7.3 m/253.1 m

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 Wells September 30, 2020
BH 110D	23.0 m	Open	Dry	Dry
BH 110S	9.1 m	Open	Dry	7.7 m/252.8 m

The ground water levels ranged from Elev. 237.6 m to Elev. 253.1 m. For the design purposes, the ground water level may be taken as Elev. 253± m. The water levels noted above may fluctuate seasonally depending upon the 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 Foundations

Boreholes encountered the surficial layers at the ground surface underlain by the earth fill zone extending to 1.1 to 3.0 m depth below grade, underlain by the native sand and gravel matrix or glacial till deposit or sandy silt to silty sand deposit, extending to the full depths of the investigation.

For the design purposes, the ground water level may be taken as Elev. 253± m.

It is understood that the existing structures would be demolished to facilitate redevelopment of the site to include two 12-storey and one 6-storey buildings resting on 2 levels of common underground parking structure. The detailed design drawing was not available during the preparation of this report. However, it is understood that the finished floor elevation for the second level of underground parking structure (P2) may be set at about 7.0 m depth below grade. The average existing site elevation is at Elev. 260.0± m. Therefore, the P2 FFE would be set at Elev. 253.0± m.

The P2 FFE is set at Elev. 253.0± m, which would be at the design ground water level (Elev. 253± m). Based on the soil stratigraphy, ground water seepage would be expected into the P2 excavation at some locations. The native sands, gravels and silts must be positively dewatered a minimum of 1.0 m below the lowest excavation level prior to and during construction to preserve the in-situ integrity of the native soils, otherwise the soils may become disturbed by the ingress of ground water and the bearing capacity recommendations provided below will not be valid.

Provided that the ground water level maintains at least 1.0 m below the lowest excavation level with positive dewatering, below the P2 FFE (Elev. 253.0± m), the conventional spread footing foundations made to bear on the dewatered compact to dense sand/sand and gravel/gravelly sand or compact to very dense sandy silt to sand and silt deposit can be designed using a maximum factored geotechnical resistance at ultimate limit state (ULS) of 550 kPa and a maximum net geotechnical reaction at serviceability limit state (SLS) of 350 kPa with up to a maximum footing width of 4 m. Further review is required for foundation sizes greater than 4 m to reconfirm the above recommended bearing capacity. The design bearing pressures 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

Experience suggests that the temperature in nominally unheated underground parking with two or more levels below grade and normal ventilation provisions is not as severe as the ambient open-air condition. Certainly, the earth cover required to prevent frost effects on foundations in the lower parking levels need not be any greater than 1.2 metres, and unmonitored experience in a number of structures and industry practice indicate that perimeter foundations provided with a minimum of 600 mm of soil cover perform adequately as do the interior isolated foundations with 900 mm of soil cover. Foundations located immediately adjacent to air shafts, entrance and exit doors shall be treated as exterior foundations and should be provided with a minimum of 1.2 m of soil cover or equivalent insulation to ensure that foundations are not affected by the cold air flow.

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 excavated surface should be assessed by a qualified geotechnical engineer. The modulus of subgrade reaction appropriate for the slab design constructed on native sand/gravelly sand/sand and gravel, sandy silt till, sand and silt subgrade are as follows,

- Sand, Gravelly Sand, Sand and Gravel: 70 MPa/m
- Sandy Silt Till, Sand and Silt: 40 MPa/m

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 of 200 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. Suitable geotextile (for instance OPSS.MUNI 1860 Class II non-woven geotextile) needs to be placed to separate granular base course from the subgrade to prevent migration of soil fines where the silt/sand subgrade soils are encountered.

The subfloor drainage system is an important building element, as such the storm sumps which ensure the performance of this system must have a duplexed pump arrangement for 100 percent pumping redundancy provided with emergency power. Basement and subfloor drainage provisions are further discussed in Section 5.5 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, ($\gamma_{sat} - \gamma_w$)
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 ϕ**. 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 walls subjected 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	γ	Φ	K_a	K_o	K_p
Earth Fill	18.0	28	0.36	0.53	2.77
Sand, Gravelly Sand, Sand and Gravel	21.0	32	0.31	0.47	3.25
Sandy Silt to Silty Sand	21.0	32	0.31	0.47	3.25
Glacial Till	21.0	30	0.33	0.50	3.00

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 Earthquake Design Parameters

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A. of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated on the basis of rational analysis of undrained shear strength (s_u) or penetration resistance (N-values).

$$\upsilon_{s-avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{\upsilon_{si}}}$$

Shear Wave Velocity

$$S_{u-avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{s_{ui}}}$$

Undrained Shear Strength

$$N_{avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

SPT N-values

Based on the borehole data (advanced to a maximum depth of about 23 m below grade), it is understood that the proposed buildings will generally be founded on compact to dense sand/sand and gravel/gravelly sand or compact to very dense sandy silt to sand and silt deposit. It is expected that the deeper stratigraphy in this area is at least as competent as the lowest proven strata in the boreholes. On this basis, site seismic classification may be taken as Site Class D according to Table 4.1.8.4.A of the Ontario Building Code (2012). Tables 4.1.8.4.B. and 4.1.8.4.C. of the Ontario Building Code (2012) provide the applicable acceleration and velocity based site coefficients. The applicable acceleration and velocity based site coefficients for Site Class D are provided as follows:

Site Class	Values of F_a (acceleration based coefficients)				
	$S_a(0.2) \leq 0.25$	$S_a(0.2) = 0.50$	$S_a(0.2) = 0.75$	$S_a(0.2) = 1.00$	$S_a(0.2) \geq 1.25$
D	1.3	1.2	1.1	1.1	1.0

Site Class	Values of F_v (velocity based coefficients)				
	$S_a(1.0) \leq 0.1$	$S_a(1.0) = 0.2$	$S_a(1.0) = 0.3$	$S_a(1.0) = 0.4$	$S_a(1.0) \geq 0.5$
D	1.4	1.3	1.2	1.1	1.1

It should be noted that the above site seismic designation is estimated on the basis of rational analysis of N-values obtained from the boreholes advanced at the site to a maximum depth of about 23 m below grade. A site-specific Multichannel Analysis of Surface Waves (MASW) is recommended which may improve the site seismic classification if required.

5.5 Basement Drainage

The ground water levels measured on September 30, 2020 in the monitoring wells installed in Boreholes 103, 104, 105, 109 and 110 ranged from Elev. 237.6 m to Elev. 253.1 m. For the design purposes, the ground water level may be taken as Elev. 253± m.

The exterior grade around the buildings should be sloped away at a 2 percent gradient or more for a distance of at least 1.2 m to assist in maintaining basement dry from seepage. The basement wall (for basement) must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the Ontario Building Code (2012).

Where the structure is made directly against a shored excavation, drainage is provided by forming a drained cavity with prefabricated drain material, such as CCW MiraDRAIN 6000 series (or Terrafix Terradrain 200, or approved equivalent) which can be incorporated between the shoring and the cast-in-place concrete foundation wall. The drainage composite material can be outlet into the basement sumps using a solid pipe (separate from the subfloor drainage system) to remove collected water from the building sumps. (Refer to enclosed Figure 3A Schematic Drainage Detail, Soldier Pile & Lagging Shoring System and Figure 3B Schematic Drainage Detail, Caisson Wall Shoring System)

The sub-floor drainage system should consist of perforated pipes (minimum 100 mm diameter) located at a spacing of about 5.0 m centre to centre (Refer to Figure 4 Basement Floor 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 elevator pit would likely extend 1 to 2 m deeper than the lowest basement floor level. Drainage for the elevator pit may be provided by incorporating subfloor drainage system outletting to a sump, or the elevator pit structure can be waterproofed below the lowest basement subfloor drainage system level.

The size of the sump should be adequate to accommodate the anticipated water seepage. An industrial duplex pumping arrangement (main pump with a provision of a backup pump) on emergency backup power is recommended. The pump capacity must be adequate to accommodate peak flow conditions expected during the wet seasons (i.e., spring melt and fall). Refer to the Hydrogeological report for ground water seepage rates and volumes.

The subfloor drainage system is an important building element at this site, as such the storm sump that ensures the performance of this system must have an industrial duplexed pump arrangement on emergency power, as noted above, for 100 percent pumping redundancy.

5.6 Pavement

Design recommendations for the entrance driveway pavement structure are provided in this section. For pavement structure supported on concrete deck, recommendations will be provided during the detailed design stage in consultation with the design team.

5.6.1 Pavement Design

The asphalt pavement design for the entrance driveway supported on soil subgrade is provided in the following table.

Pavement Structural Layers	Driveway
HMA Surface Course, OPSS.MUNI 1150 HL 3	40 mm
HMA Binder Course, OPSS.MUNI 1150 HL 8	80 mm
Base Course, OPSS.MUNI 1010 Granular A	150 mm
Subbase Course, OPSS.MUNI 1010 Granular B Type II	400 mm
Total Thickness	670 mm

5.6.2 Pavement Drainage

Control of water is an important factor in achieving a good pavement life. Therefore, we recommend that provisions be made to drain the new pavement subgrade and its granular layers. Continuous pavement subdrains (designed to drain into catchbasins) should also be provided along both sides of the driveway curblines. All subdrainage arrangements should conform to OPSD 216.021 requirements. The subdrain pipe should be connected to positive outlets.

5.6.3 General Pavement Recommendations

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

Granular base and subbase materials should meet gradation requirement of OPSS.MUNI 1010 and Town’s requirements. Granular materials should be compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) at ±2 percent of the optimum moisture content.

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.

5.6.4 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed/weathered soils should be stripped from the subgrade areas. The exposed subgrade is expected to consist of the earth fill materials, which 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 during wet periods.

Immediately prior to placing the granular subbase, the exposed subgrade should be proof rolled with a heavy rubber tired vehicle (such as a loaded gravel truck). The subgrade should be inspected for signs of rutting, distress and displacement. Areas displaying signs of rutting, distress and displacement should be recompacted and retested or, these materials should be locally excavated and replaced with well-compacted clean approved fill material.

The fill material may consist of either granular material or local inorganic soils provided that its moisture content is within ±2 percent of Optimum Moisture Content (OMC). Fill material should be placed and compacted in accordance with TS 501 and the subgrade should be compacted to 98 percent of SPMDD. The final subgrade surface should be sloped at least 3 percent to provide positive drainage.

5.7 Excavations

The boreholes data indicate that the earth fill 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 materials encountered in the boreholes are classified as Type 3 Soil, while the undisturbed native soils would be classified as Type 3 Soil above and Type 4 Soil below prevailing ground water level under these regulations.

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.

It should be noted that the soil at this project site may contain larger particles (cobbles and boulders) that are not specifically identified in the Borehole Logs. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of the particles of this size. Provision should be made in excavation contracts to allocate risks associated with time spent and equipment utilized to remove or penetrate such obstructions when encountered.

5.8 Ground Water Control

Terraprobe has completed Hydrogeological Report (File No. 1-20-0249-46) for this site to provide ground water control measures and estimate ground water discharge volume (Refer to this report for detailed information about ground water volumes, quality and control provisions).

The ground water levels measured on September 30, 2020 in the monitoring wells installed in Boreholes 103, 104, 105, 109 and 110 ranged from Elev. 237.6 m to Elev. 253.1 m. For the design purposes, the ground water level may be taken as Elev. 253± m.

The P2 FFE may be set at Elev. 253.0± m, which would be at the design ground water level (Elev. 253± m). Based on the soil stratigraphy, ground water seepage would be expected into the P2 excavation at some locations. The positive dewatering measure will be required to maintain the ground water level at least 1.0 m below the lowest bulk excavation. Successful dewatering of the site could be challenging due to fine grained soils. The design of a dewatering system will depend on various site-specific parameters including soil permeability, subsurface stratigraphy, height of lift, size of the work area and the prevailing depth of the groundwater table. The dewatering system for this site (as assessed and designed by a professional dewatering consultant) may consist of a well point or educator system.

The subsurface information must be provided to a professional dewatering contractor who will be responsible for the design and installation of the dewatering systems. The dewatering system must be properly installed and screened to ensure that sediment and fine soils are not removed, which could result in settlement of the ground or structures near the site. Once the dewatering method and shoring system are designed, Terraprobe should be retained to evaluate the potential impacts (i.e. settlement) to nearby structures and land caused by lowering the water table.

The dewatering system must remain functional until such time as the subfloor drainage system and sumps are fully operational.

5.8.1 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.

5.9 Backfill

The native soils are considered suitable for backfill provided the moisture content of these soils is within 3 percent of the Optimum Moisture Content (OMC). It should be noted that there may be wet zones within the subsurface soils which could be too wet to compact. Any soil material with 3 percent 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 95 percent Standard Proctor Maximum Dry Density (SPMDD) at a water content close to OMC (within 3 percent). The upper 1.2 m of the pavement subgrade must be compacted to a minimum of 98 percent SPMDD.

5.10 Shoring Design Consideration

Decisions regarding shoring methods and sequencing are the responsibility of the Contractor. Temporary shoring system design should be carried out by a licensed Professional Engineer experienced in shoring design.

The detailed design of the proposed buildings was not available at the time of preparation of this report. The site is immediately bounded by existing local roads in each direction with the exception of the northwest corner, where the existing residential dwellings are located. No excavation shall extend below a line cast as one vertical to one horizontal from foundations of the existing adjacent structures without adequate alternative support being provided. The underpinning details are provided in Figure 5.

The sections along the perimeter of the site would likely be shored to preserve the integrity of the boundary conditions using a shoring system such as soldier piles and lagging shoring and a continuous interlocking caisson wall shoring. For the sections adjacent to the existing structures (northwest corner of the site), consideration should be given to incorporate a rigid shoring system to preserve the integrity and support of the soil in a state approximating the at-rest condition. For the remaining sections, a pile and lagging shoring system may be incorporated, provided that adequate positive dewatering is important to maintain the water level at least 1 m below the lowest excavation level.

The P2 FFE extends close to or below the stabilized ground water table at Elev. 253± m and soldier pile and lagging shoring and caisson wall shoring system combination are constructed. The recommendations will need to include dewatering commentary to address the potential sloughing of the wet sand and silt soils into the excavation during the installation of lagging boards.

5.10.1 Earth Pressure Distribution

Applicable soil parameters are included in the Earth Pressure Design Parameters Section (Section 5.3).

A single level of support would be likely required for shoring system, and a triangular earth pressure distribution similar to that used for the basement wall design, is appropriate for this case,

$$\mathbf{P = K(\gamma H + q)}$$

Where: **P** = the horizontal pressure (kPa)
K = the earth pressure coefficient
H = the total depth of excavation (m)
γ = the bulk unit weight of soil (kN/m^3)
q = the complete surcharge loading (kPa)

Where multiple supports are used to support the excavation, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors.

The borehole data indicate that sand/sand and gravel/gravelly sand/sandy silt to silty sand depoists would be encountered in the excavations. For the cohesionless soils (some gravel / sand and gravel), a multi-level supported shoring system can be designed based on an earth pressure distribution consisting of a rectangular pressure distribution with a pressure defined by:

$$\mathbf{P = 0.65\ K(\gamma H + q)}$$

Where: **P** = the horizontal pressure (kPa)
K = the earth pressure coefficient
γ = the bulk unit weight of soil (kN/m^3)
H = the total depth of excavation (m)
q = the complete surcharge loading (kPa)

5.10.2 Caisson and Soldier Pile Toe Design

It is envisaged that the pile will be socketed in the sand/sand and gravel/sandy silt to silty sand strata. The horizontal resistance of the pile toes will be developed by the embedment below the base of excavation where resistance is developed from passive earth pressure. It is noted that where soils exist beneath the ground water level, the unit weight of the soil is diminished by buoyancy, and therefore, the resistance from these soils will be different depending on whether the soils are dewatered, or remain below the nominal ground water level. The design of the shoring should therefore consider the construction plan and sequence with respect to depth of ground water control.

The soils at this site are cohesionless, permeable and sufficiently wet such that augered borings made into these soils will be unstable. It is necessary to advance temporarily cased holes to prevent excess caving during the soldier pile and all augered hole installations. Drill holes for piles, utilizing temporary liners, mud polymer drilling techniques, and/or other methods as deemed necessary by the contractor may be required to prevent issues such as: groundwater inflow or loss of soil into the drill holes, and disturbance to placed concrete. It is likely that mud/polymer drilling technique will be required to stabilize against basal instability for shoring caisson installation.

5.10.3 Lateral Bracing Elements

If anchor support is necessary and determined to be feasible, the shoring system should be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. The use of anchors on adjacent properties requires the consent of the adjacent land owners, expressed in encroachment agreements.

Conventional earth anchors could be made with a continuous hollow stem augers or alternatively post-grouted wash bored anchors can be made. The design adhesion for earth anchors is controlled as much by the installation technique as the soil and therefore a proto-type anchor must be made in each anchor level executed to demonstrate the anchor capacity and validate the design assumptions. A proto-type anchor must be made to demonstrate the anchor capacity (performance tested to 200% of the design load). All production anchors must be proof-tested to 133% of the design load, to validate the design assumptions.

The subsurface soils are sufficiently cohesionless, permeable and/or wet that augered holes could experience caving. It will be necessary to advance temporarily cased holes to maintain sidewall support and to prevent the ingress of water during installation, use slurry, etc. or other means or methods deemed necessary by the contractor.

Conventional earth anchors made in the competent native sand/sandy silt to silty sand may be designed using a preliminary working adhesion of 50 kPa. Depending upon the location and elevation of the soil anchors, the post-grouted anchors made in the native sand/sandy silt to silty sand at this site may carry a transfer load of 60 to 70 kN/metre of post-grouted anchor length (for 150 mm nominal diameter of anchor) depending upon the material type as confirmed by a performance/load test.

If adjacent land owners are not agreeable to anchored support then internal bracing or rakers would be necessary. The compact to dense native soils at the proposed P2 level are suitable for the placement of raker foundations. The footings for the rakers would be made in the dense to very dense undisturbed native soils where they could be designed for a maximum factored geotechnical resistance at ULS of 250 kPa when inclined at 45 degrees.

5.11 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 non-performance 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, as well as 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 conducted 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 Koler Builders 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 Koler Builders 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 ENG...
L ZHANG
100109585
2020-10-20
PROVINCE OF ONTARIO

Md Hasanur Rashid, M. Eng, EIT
Geotechnical Engineer

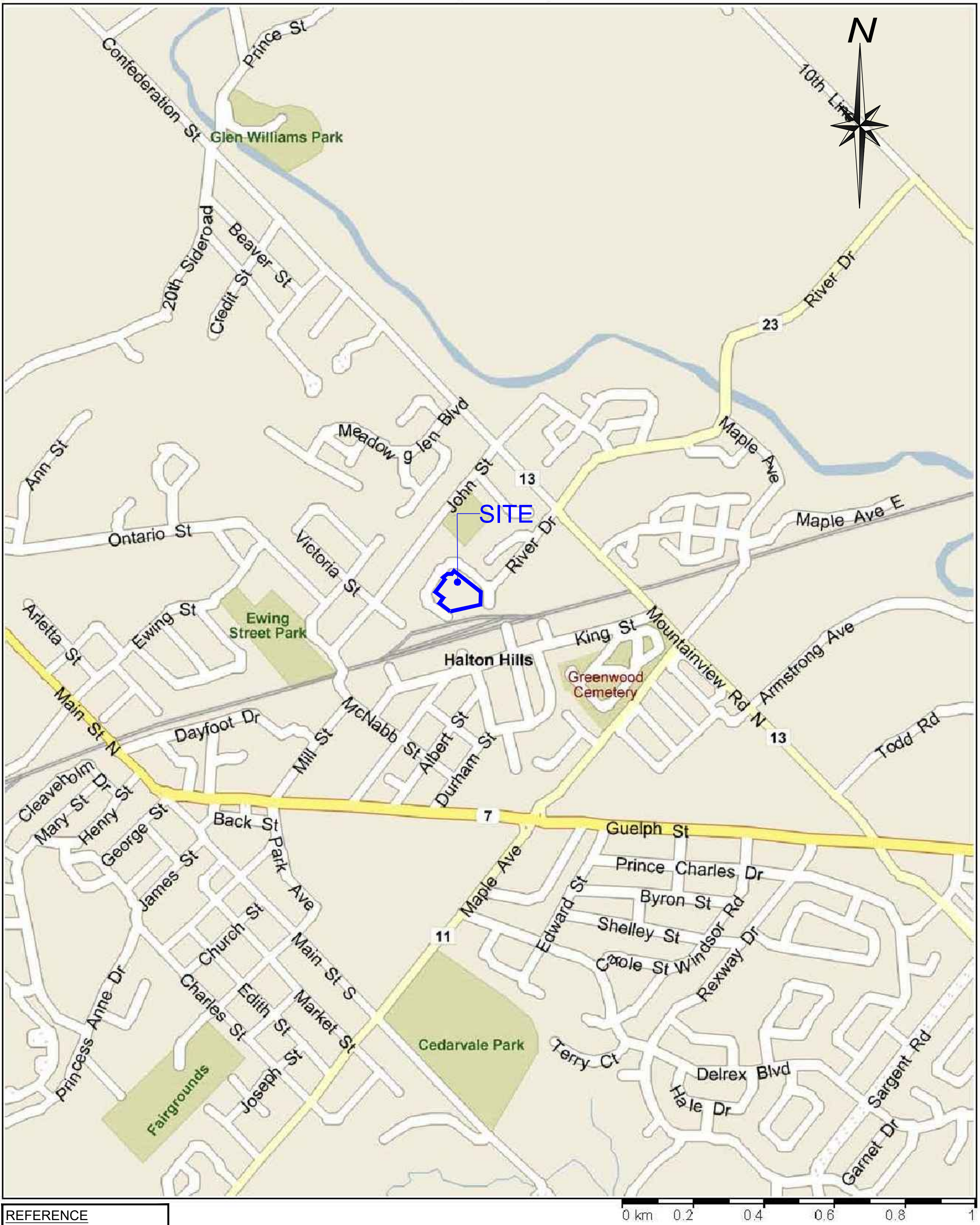
Seth Zhang, M. Eng, M.Sc., P.Eng.
Associate

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.: 1-20-0249-01

FIGURE : 1

Z:\1-Project Files\2020\1-20-0249 - 1 Rosetta Street, Halton Hills\01-Geotechnical Investigation\A. Dwgs. Logs\AutoCAD\1-20-0249-01 Figure 1 &.dwg, DWG To PDF.pc3, Kamal, 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.: 1-20-0249-01

FIGURE : 2

\\192.168.1.16\tss\1-Project Files\2020\1-20-0249 - 1 Rosetta Street, Halton Hills\01-Geotechnical Investigation\A. Dwgs, Logs\AutoCAD\1-20-0249-01 Figure 1 &.dwg,
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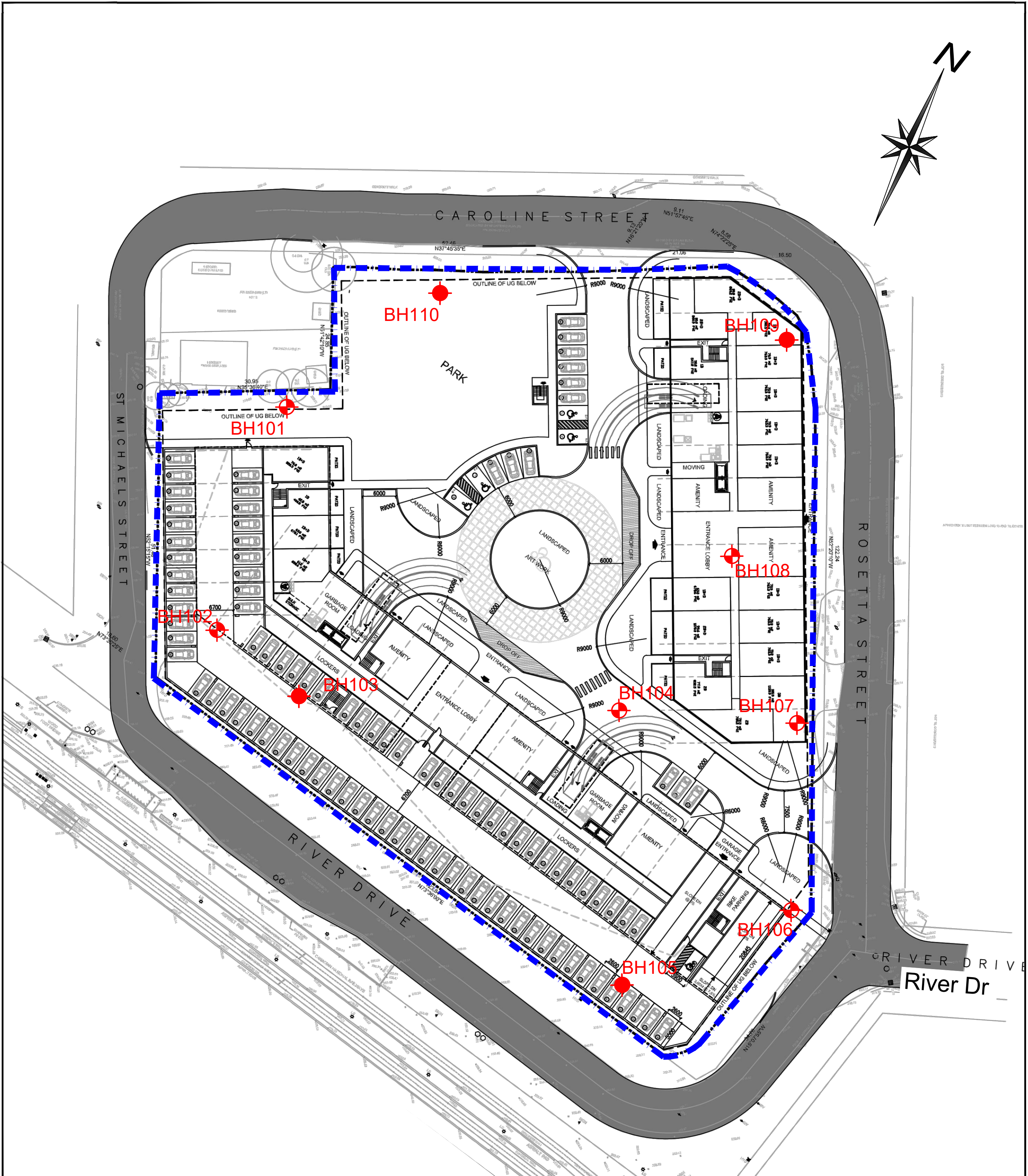

REFERENCE
Proposed Residential Buildings
Ground Floor Plan
Project No.: 17127, Dwg No.: 01
Date: May 04, 2020
By: Icon Architects

LEGEND

- ⌖ Approximate Borehole Location
- ◆ Approximate Monitoring Well Location

SCALE 8 0 20m

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
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Title:

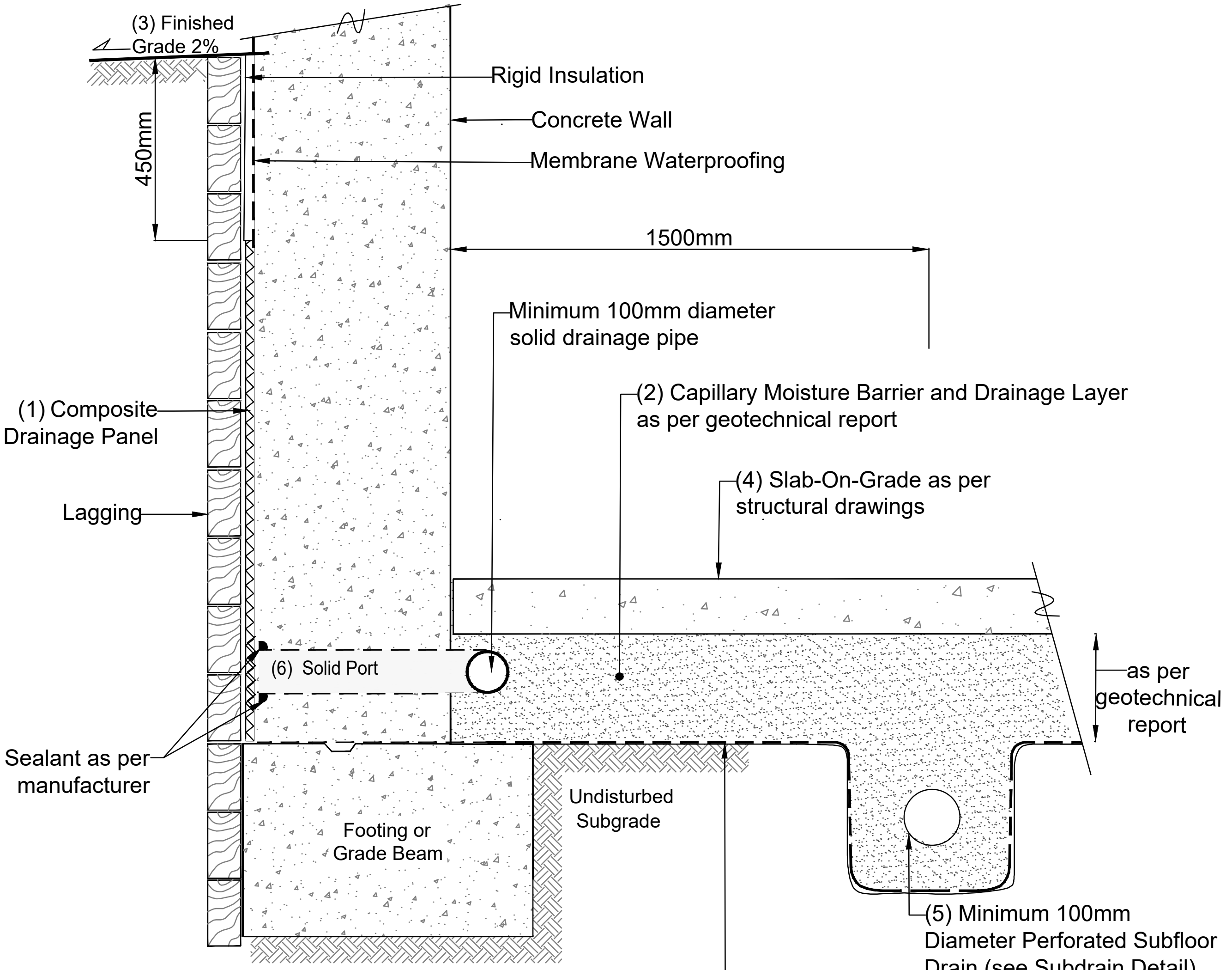
BOREHOLE LOCATION PLAN

PROPOSED CONDITION

File. No.: 1-20-0249-01

FIGURE : 2A

\\192.168.1.16\tss\1-Project Files\2020\1-20-0249 - 1 Rosetta Street, Halton Hills\01-Geotechnical Investigation\A Dwgs, Logs\AutoCAD\1-20-0249-01 Figure 1 &.dwg.
DWG To PDF.pc3, Kamal, Kamal



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.

3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.

4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.

5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.

6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.

7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).

8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S.

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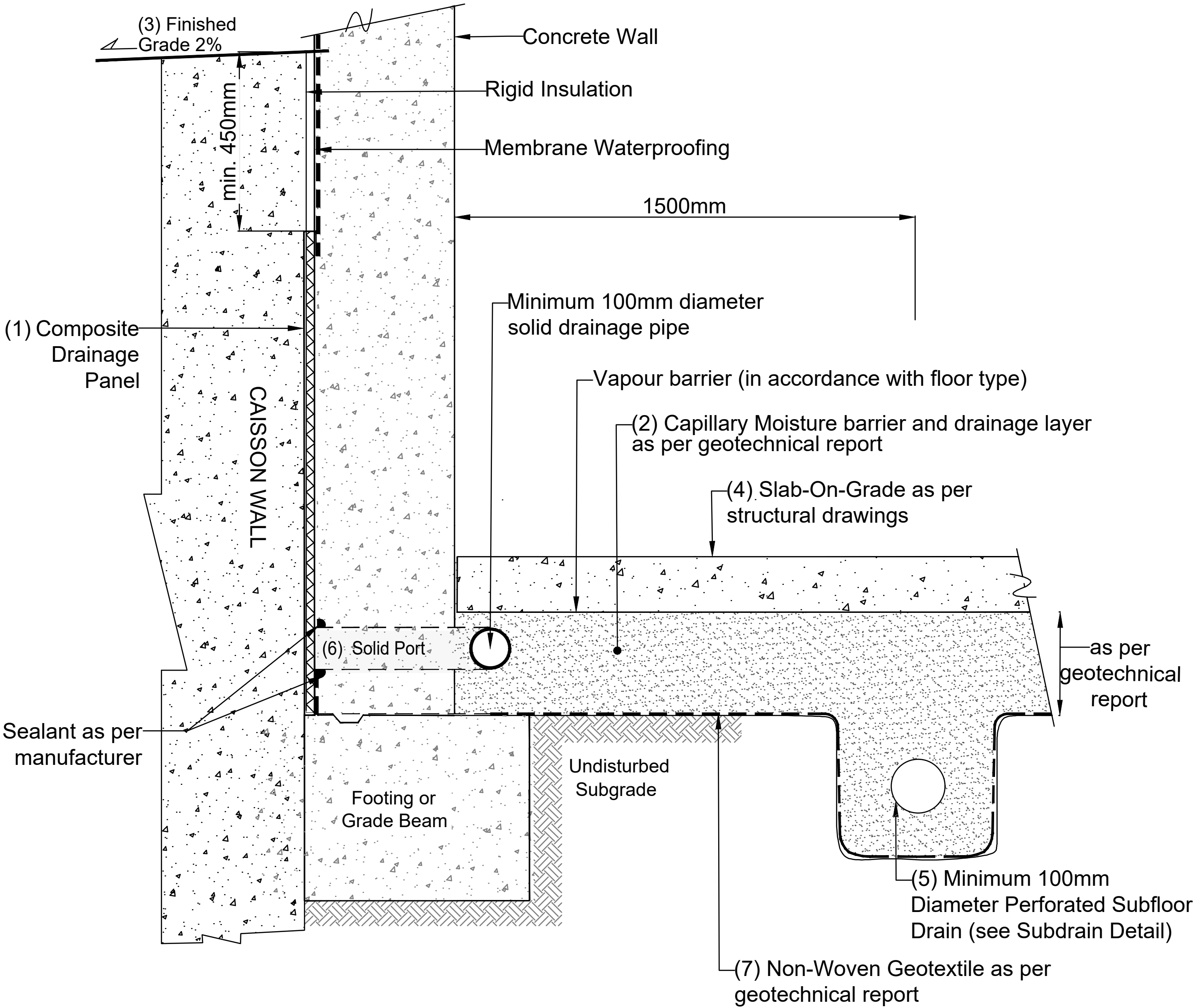
Title:

SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE & LAGGING SHORING SYSTEM
(DRAINED BASEMENT CONDITION)

\\192.168.1.16\tss\5-Reference Library\Standard GEO dwgs in PDF\1 Standard - DO NOT MODIFY (2019 IP)\CAD\DRAINAGE DETAIL SOLDIER PILE AND LAGGING SHORING SYSTEM ozzie special.dwg, Kamal



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.

3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.

4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.

5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.

6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.

7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).

8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S

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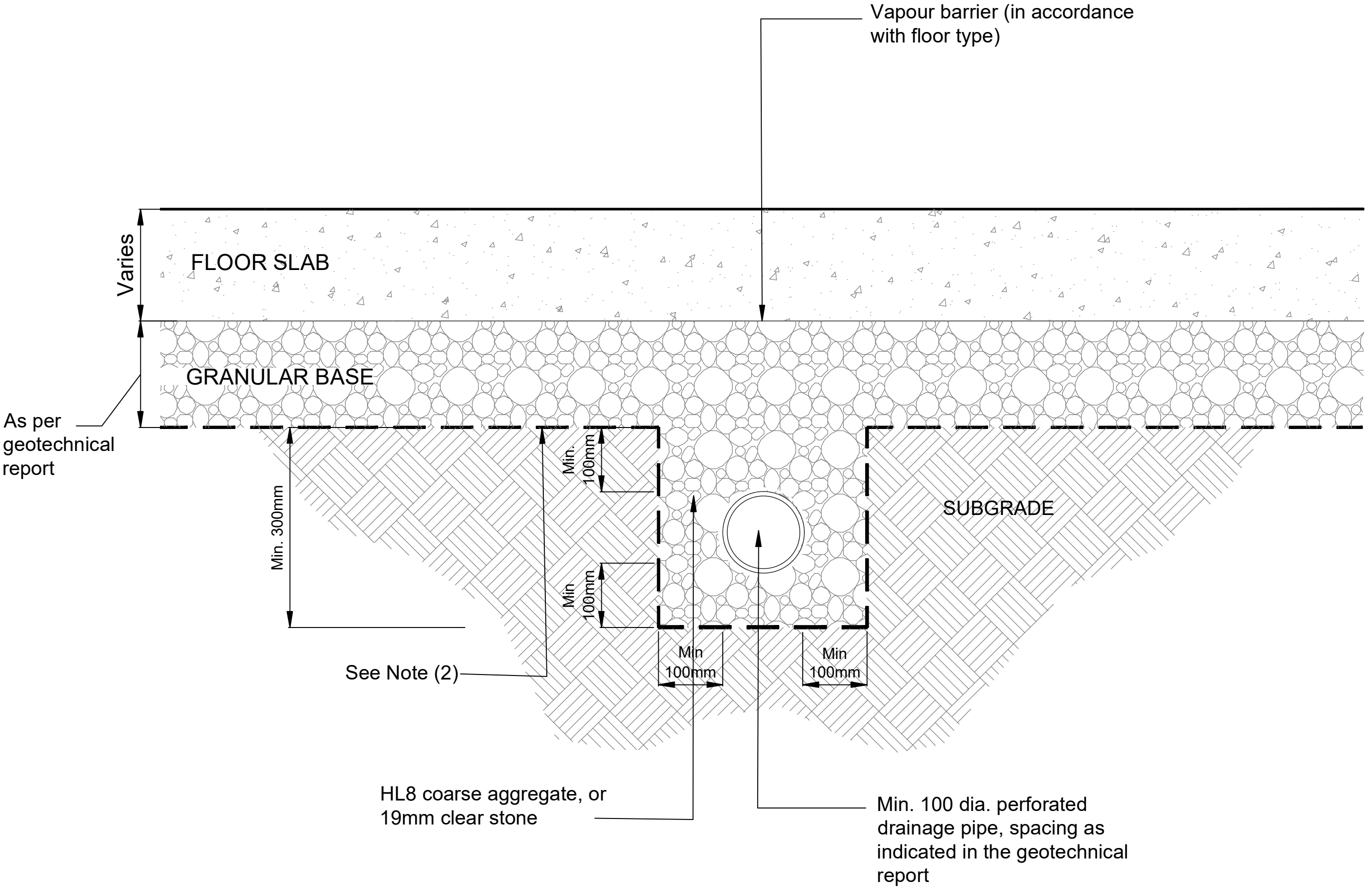
Title:

SCHEMATIC DRAINAGE DETAIL
CASSION WALL SHORING SYSTEM
(DRAINED BASEMENT CONDITION)



NOTES:

1. Typical schematic only. Must be read in conjunction with Geotechnical Report.
2. When the subgrade consists of cohesionless soil, it must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).
3. Not to Scale

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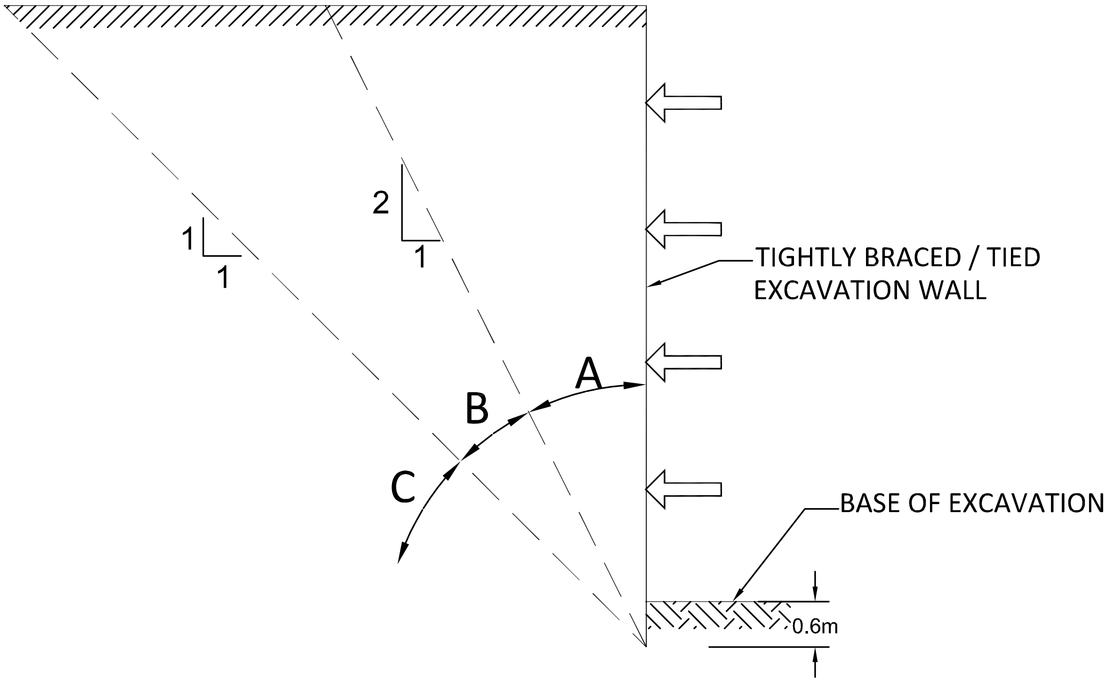
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

TYPICAL BASEMENT SUBDRAIN DETAIL



Zone A: Foundations within this zone often require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone B: Foundation within this zone often do not require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone C: Foundations within this zone usually do not require underpinning.

REFERENCE:

User's Guide - NBC 2005 Structural Commentaries
(Part 4 of Division B) - Commentary K

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Title:

GUIDELINES FOR UNDERPINNING SOILS

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 101

Project No. : 1-20-0249-01
Client : 1 Rosetta Street (Halton Hills) GP Limited
Originated by : SM

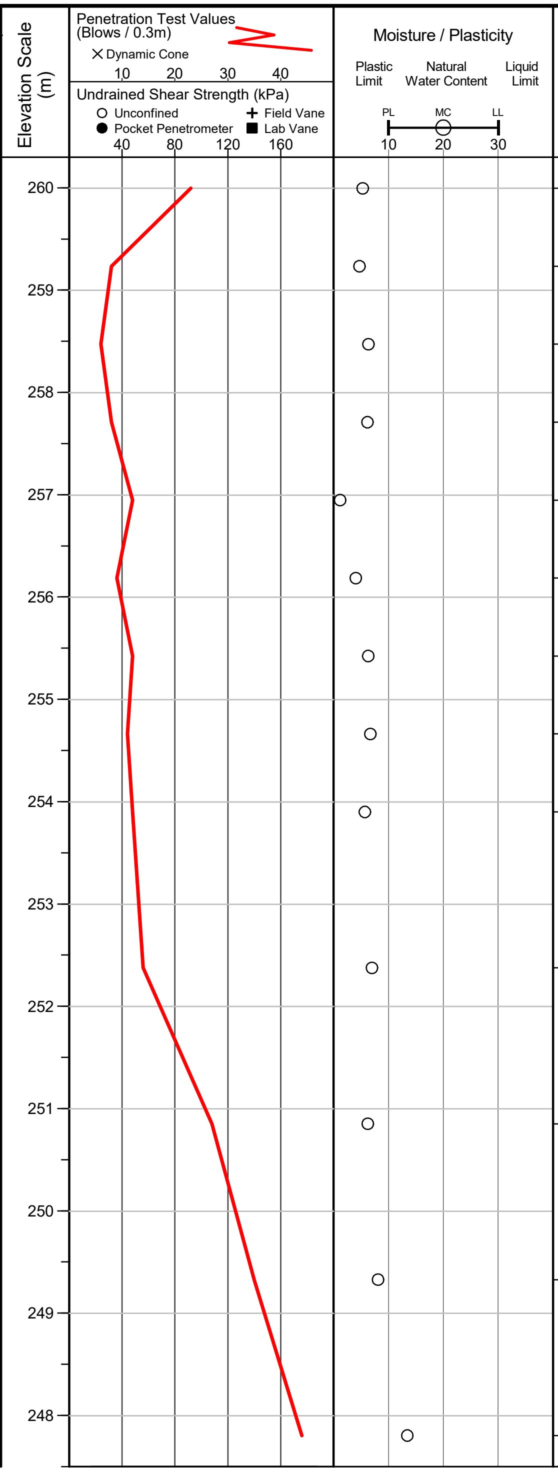
Date started : August 10, 2020
Project : 1 Rosetta Street
Compiled by : HR

Sheet No. : 1 of 1
Location : Halton Hills, Ontario
Checked by : AR

Position : E: 587169, N: 4834296 (UTM 17T)
Elevation Datum : Geodetic

Rig type : Truck-mounted
Drilling Method : Hollow stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
260.3	**GROUND SURFACE**					
	75mm **ASPHALTIC CONCRETE**					
	475mm **AGGREGATE**	1	SS	23	PID: 0	
259.7 0.6	**FILL**, sand, some gravel, trace silt, loose, brown, moist	2	SS	8	PID: 0	
		3	SS	6	PID: 0	
258.0 2.3	**SAND**, some gravel to gravelly, trace to some silt, loose to compact, brown, moist	4	SS	8	PID: 0	
		5	SS	12	PID: 0	
		6	SS	9	PID: 25	
		7	SS	12	PID: 10	
		8	SS	11	PID: 0	
		9	SS	12	PID: 0	
		10	SS	14	PID: 0	
	...trace gravel ...trace clay	11	SS	27	PID: 0	8 66 19 7
	...dense	12	SS	35	PID: 0	
249.0 11.3	**SANDY SILT**, trace clay, trace gravel, trace stone fragments, dense, brown, moist	13	SS	44	PID: 0	
247.5 12.8						



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 1-20-0249-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 102

Project No. : 1-20-0249-01	Client : 1 Rosetta Street (Halton Hills) GP Limited	Originated by : DH
Date started : September 1, 2020	Project : 1 Rosetta Street	Compiled by : HR
Sheet No. : 1 of 2	Location : Halton Hills, Ontario	Checked by : AR

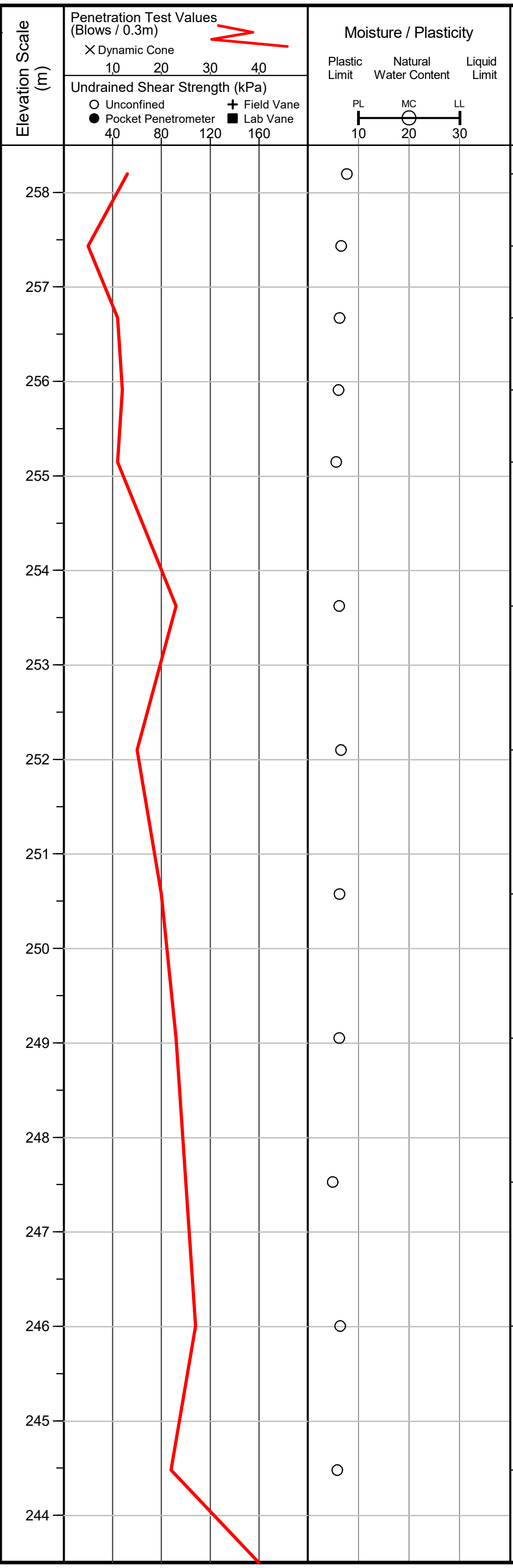
Position : E: 587185, N: 4834262 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
258.5	**GROUND SURFACE**
	65mm **ASPHALTIC CONCRETE**
	50mm **AGGREGATE**
	FILL, gravelly sand, trace clay, loose to compact, brown, moist
257.0 1.5	**SAND**, some gravel to gravelly, trace to some silt, compact to very dense, brown, moist

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	13	PID: 0
2	SS	5	PID: 10
3	SS	11	PID: 0
4	SS	12	PID: 5
5	SS	11	PID: 0
6	SS	23	PID: 0
7	SS	15	PID: 0
8	SS	20	PID: 0
9	SS	23	PID: 0
10	SS	25	PID: 0
11	SS	27	PID: 25
12	SS	22	PID: 15



Depth Scale (m): 0 – 14

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

(continued next page)

Terraprobe

LOG OF BOREHOLE 102

Project No. : 1-20-0249-01
Date started : September 1, 2020
Sheet No. : 2 of 2

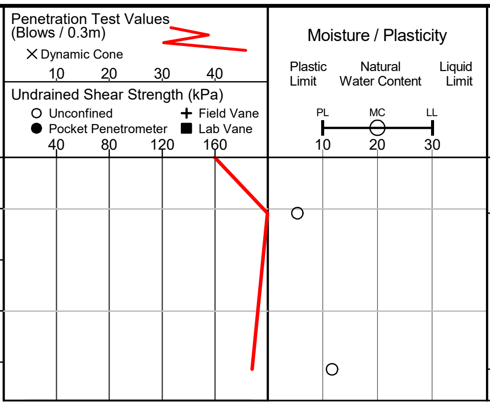
Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : DH
Compiled by : HR
Checked by : AR

Position : E: 587185, N: 4834262 (UTM 17T)
Rig type : Truck-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description *(continued)*	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
15		**SAND**, some gravel to gravelly, trace to some silt, compact to very dense, brown, moist *(continued)* ...stone fragments		13	SS	60	243	PID: 0			
16							242				
17	241.7 16.8	**SANDY SILT**, trace to some clay, trace gravel, trace stone fragments, dense, brown, moist		14	SS	47		PID: 0			
	241.1 17.4										



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

LOG OF BOREHOLE 103

Project No. : 1-20-0249-01
Date started : September 2, 2020
Sheet No. : 1 of 2

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : DH
Compiled by : HR
Checked by : AR

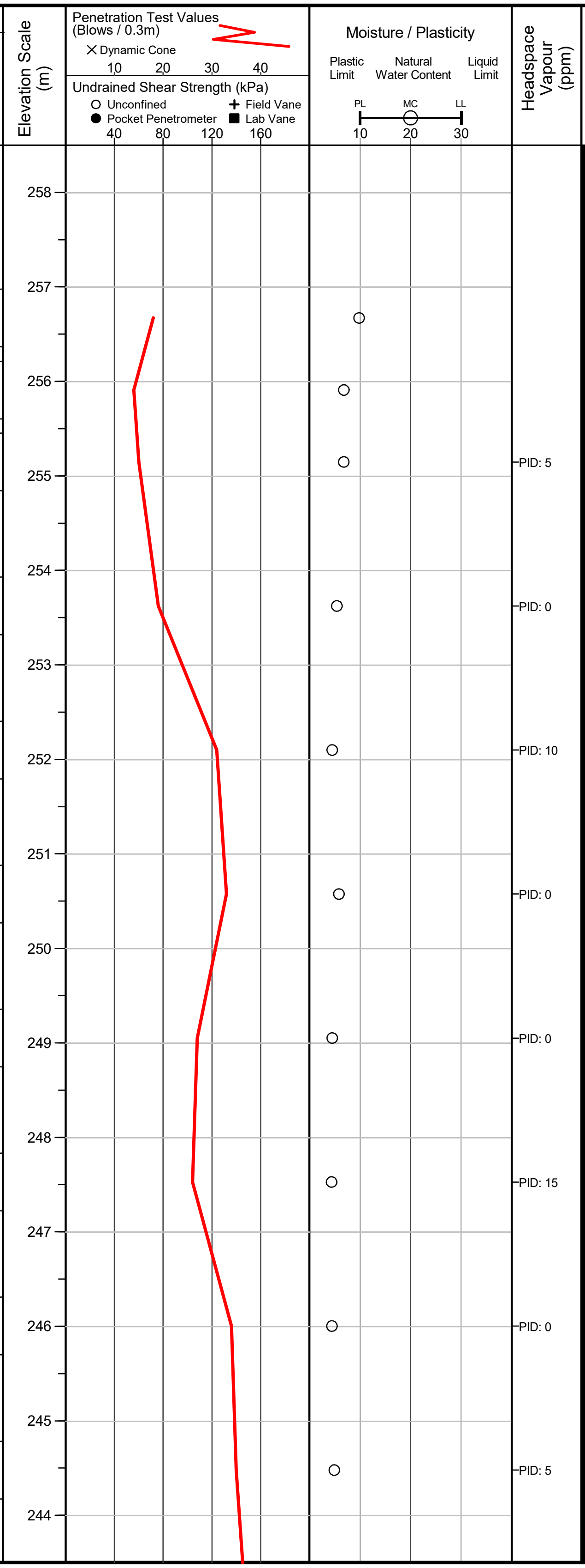
Position : E: 587204, N: 4834269 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
258.5	**GROUND SURFACE**
	50mm **ASPHALTIC CONCRETE**
	FILL, gravelly sand, trace clay, trace brick fragments, compact, brown, moist
256.2 2.3	**SAND**, some gravel to gravelly, trace to some silt, compact to dense, brown, moist

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	AS		
2	AS		
3	SS	18	
4	SS	14	
5	SS	15	PID: 5
6	SS	19	PID: 0
7	SS	31	PID: 10
8	SS	33	PID: 0
9	SS	27	PID: 0
10	SS	26	PID: 15
11	SS	34	PID: 0
12	SS	35	PID: 5



Depth Scale (m): 0–14

Graphic Log

Instrument Details

Unstabilized Water Level

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

(continued next page)

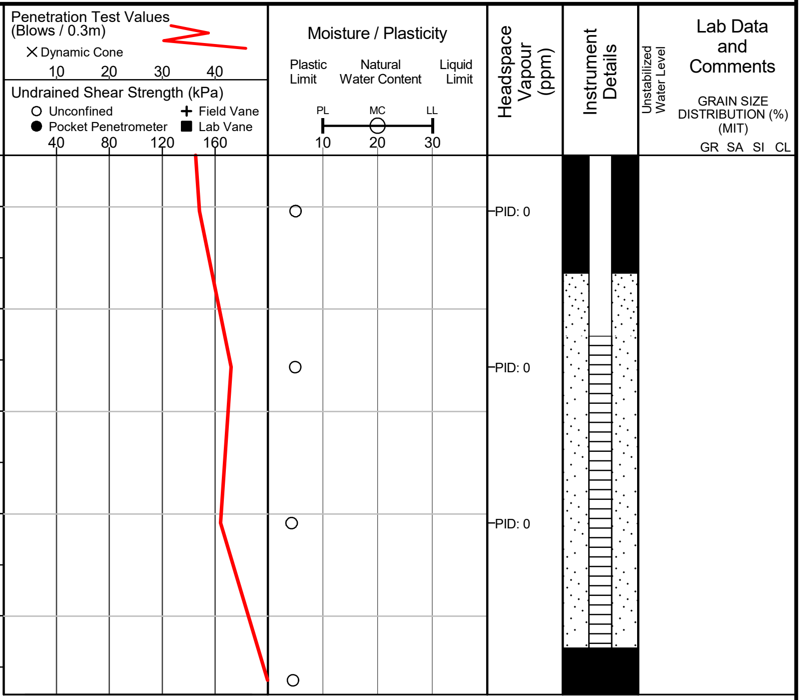
Terraprobe

LOG OF BOREHOLE 103

Project No.	: 1-20-0249-01	Client	: 1 Rosetta Street (Halton Hills) GP Limited	Originated by	: DH
Date started	: September 2, 2020	Project	: 1 Rosetta Street	Compiled by	: HR
Sheet No.	: 2 of 2	Location	: Halton Hills, Ontario	Checked by	: AR

Position : E: 587204, N: 4834269 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Truck-mounted
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Elevation Scale (m)	Headspace Vapour (ppm)
15		*(continued)* **SAND**, some gravel to gravelly, trace to some silt, compact to dense, brown, moist *(continued)* ...stone fragments below	13	SS	37	243	PID: 0
16						242	
17			14	SS	43	241	PID: 0
18			15	SS	41	240	PID: 0
19						239	
20	238.2 20.3	...very dense	16	SS	68/ 280mm		



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	dry	n/a

file: 1-20-0249-01 bh logs.gpj

LOG OF BOREHOLE 104

Project No. : 1-20-0249-01
Client : 1 Rosetta Street (Halton Hills) GP Limited
Originated by : SM
Date started : September 3, 2020
Project : 1 Rosetta Street
Compiled by : HR
Sheet No. : 1 of 2
Location : Halton Hills, Ontario
Checked by : AR

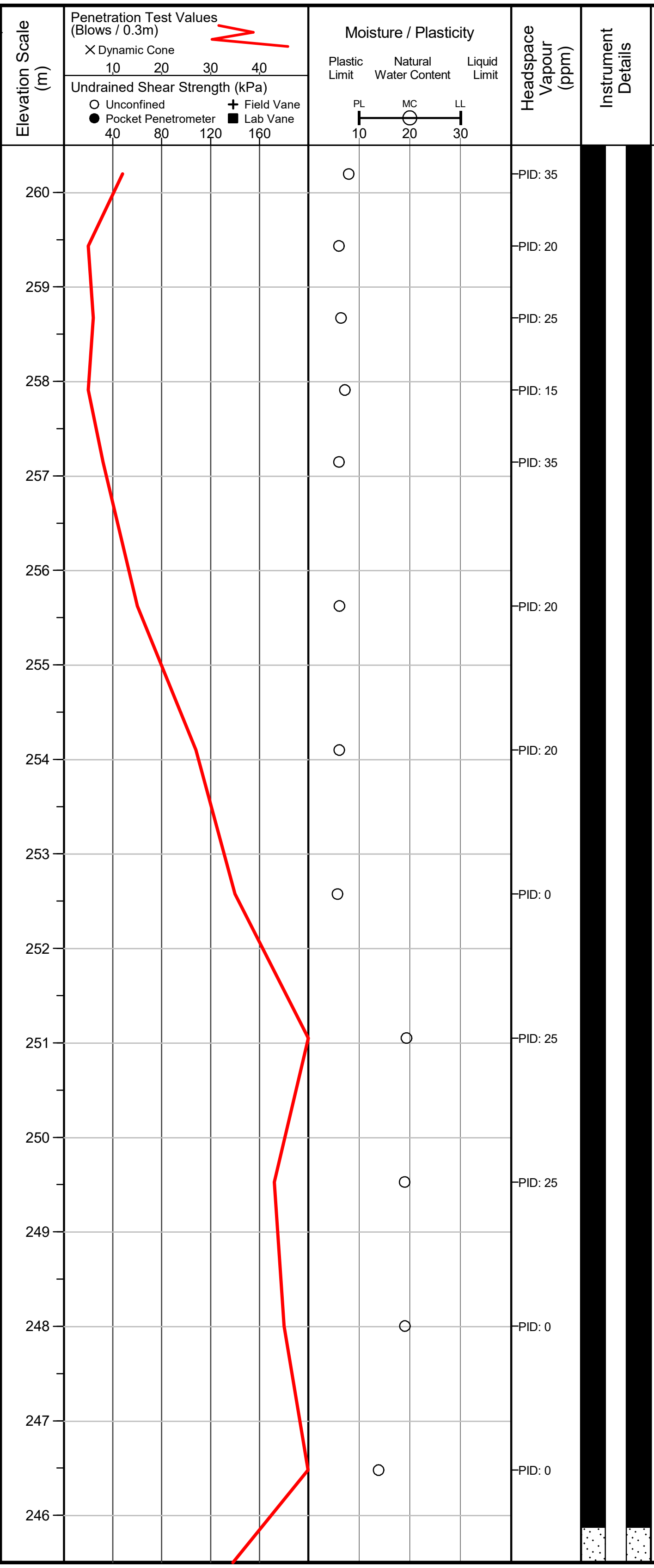
Position : E: 587242, N: 4834316 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Truck-mounted
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
260.5	**GROUND SURFACE**
260.3 0.2	90mm **ASPHALTIC CONCRETE**
	75mm **AGGREGATE**
	FILL, silty sand, trace clay, trace gravel, loose to compact, green, moist
259.0 1.5	**SAND**, some gravel to gravelly, trace to some silt, loose to compact, brown, moist
	...dense below
251.4 9.1	**SAND AND SILT**, trace clay, compact to very dense, brown, moist
	...wet

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	12	PID: 35
2	SS	5	PID: 20
3	SS	6	PID: 25
4	SS	5	PID: 15
5	SS	8	PID: 35
6	SS	15	PID: 20
7	SS	27	PID: 20
8	SS	35	PID: 0
9	SS	50	PID: 25
10	SS	43	PID: 25
11	SS	45	PID: 0
12	SS	52	PID: 0



Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

Depth Scale (m): 0 – 14

(continued next page)

LOG OF BOREHOLE 104

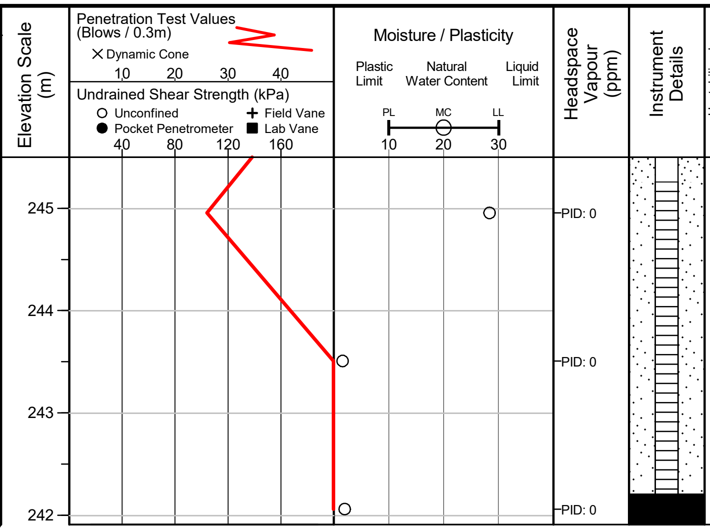
Project No. : 1-20-0249-01
Date started : September 3, 2020
Sheet No. : 2 of 2

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : SM
Compiled by : HR
Checked by : AR

Position : E: 587242, N: 4834316 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
15		*(continued)* **SAND AND SILT**, trace clay, compact to very dense, brown, moist *(continued)* ...wet	13	SS	26	PID: 0
16						
17	243.7 16.8	**SAND**, some silt, some gravel, some stone fragments, very dense, grey, moist	14	SS	91	PID: 0
18		...trace gravel	15	SS	50 / 150mm	PID: 0
	241.9 18.6	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	dry	n/a

LOG OF BOREHOLE 105

Project No. : 1-20-0249-01
Date started : August 14, 2020
Sheet No. : 1 of 2

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : DH
Compiled by : HR
Checked by : AR

Position : E: 587281, N: 4834284 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

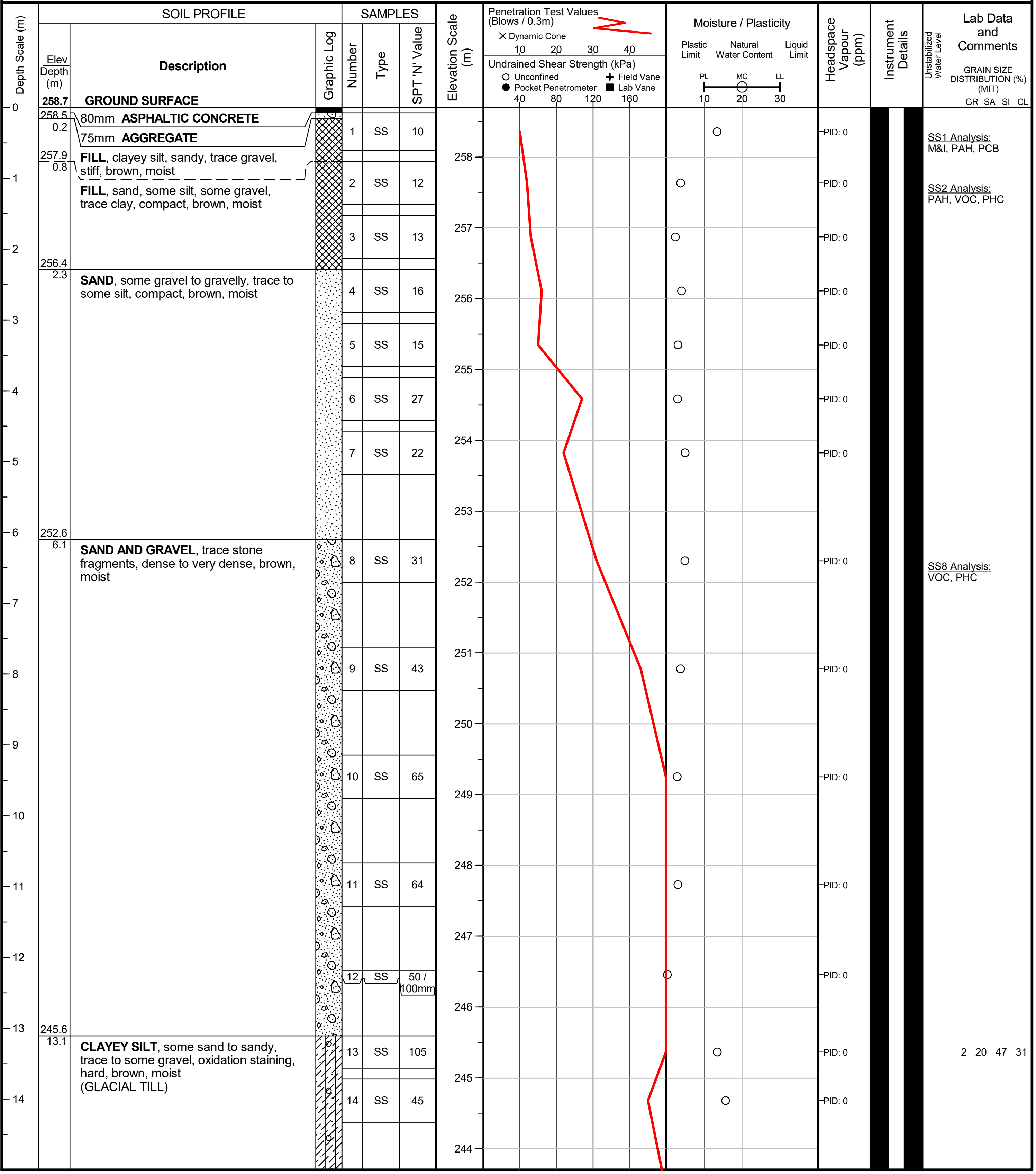
SOIL PROFILE

Elev Depth (m)	Description
258.7	**GROUND SURFACE**
258.5 0.2	80mm **ASPHALTIC CONCRETE**
	75mm **AGGREGATE**
257.9 0.8	**FILL**, clayey silt, sandy, trace gravel, stiff, brown, moist
	FILL, sand, some silt, some gravel, trace clay, compact, brown, moist
256.4 2.3	**SAND**, some gravel to gravelly, trace to some silt, compact, brown, moist
252.6 6.1	**SAND AND GRAVEL**, trace stone fragments, dense to very dense, brown, moist
245.6 13.1	**CLAYEY SILT**, some sand to sandy, trace to some gravel, oxidation staining, hard, brown, moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	10	PID: 0	SS1 Analysis: M&I, PAH, PCB
2	SS	12	PID: 0	SS2 Analysis: PAH, VOC, PHC
3	SS	13	PID: 0	
4	SS	16	PID: 0	
5	SS	15	PID: 0	
6	SS	27	PID: 0	
7	SS	22	PID: 0	
8	SS	31	PID: 0	SS8 Analysis: VOC, PHC
9	SS	43	PID: 0	
10	SS	65	PID: 0	
11	SS	64	PID: 0	
12	SS	50 / 100mm	PID: 0	
13	SS	105	PID: 0	2 20 47 31
14	SS	45	PID: 0	

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



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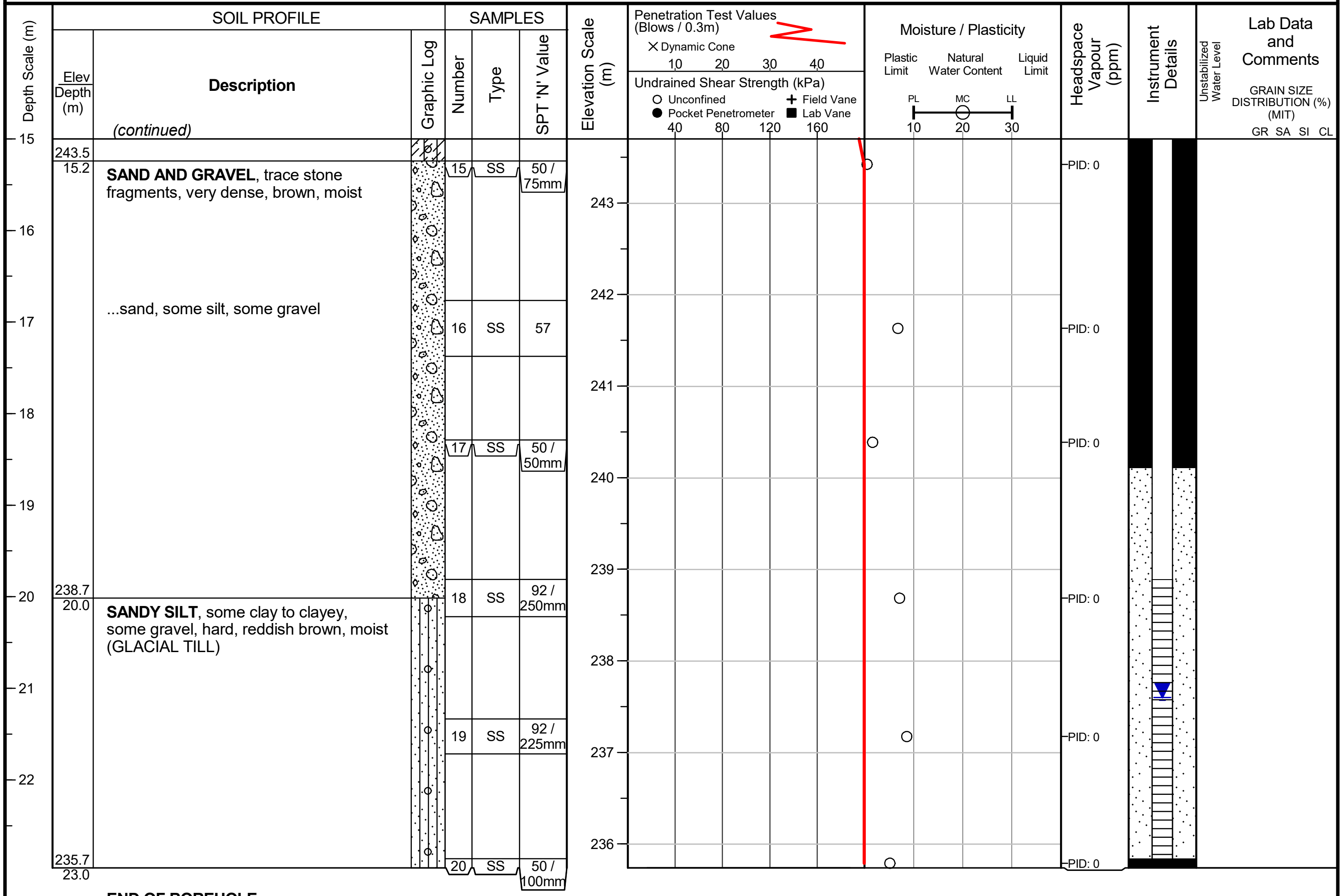
LOG OF BOREHOLE 105

Project No. : 1-20-0249-01	Client : 1 Rosetta Street (Halton Hills) GP Limited		Originated by : DH
Date started : August 14, 2020	Project : 1 Rosetta Street		Compiled by : HR
Sheet No. : 2 of 2	Location : Halton Hills, Ontario		Checked by : AR

Position : E: 587281, N: 4834284 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Truck-mounted
Drilling Method : Hollow stem augers



Elev Depth (m)	Description
243.5	
15.2	**SAND AND GRAVEL**, trace stone fragments, very dense, brown, moist ...sand, some silt, some gravel
238.7 20.0	**SANDY SILT**, some clay to clayey, some gravel, hard, reddish brown, moist (GLACIAL TILL)
235.7 23.0	**END OF BOREHOLE** Borehole was dry and open upon completion of drilling.

Number	Type	SPT 'N' Value
15	SS	50 / 75mm
16	SS	57
17	SS	50 / 50mm
18	SS	92 / 250mm
19	SS	92 / 225mm
20	SS	50 / 100mm

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	21.1	237.6

Terraprobe

LOG OF BOREHOLE 106

Project No. : 1-20-0249-01
Date started : August 12, 2020
Sheet No. : 1 of 1

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : SM
Compiled by : HR
Checked by : AR

Position : E: 587289, N: 4834316 (UTM 17T)
Rig type : Truck-mounted

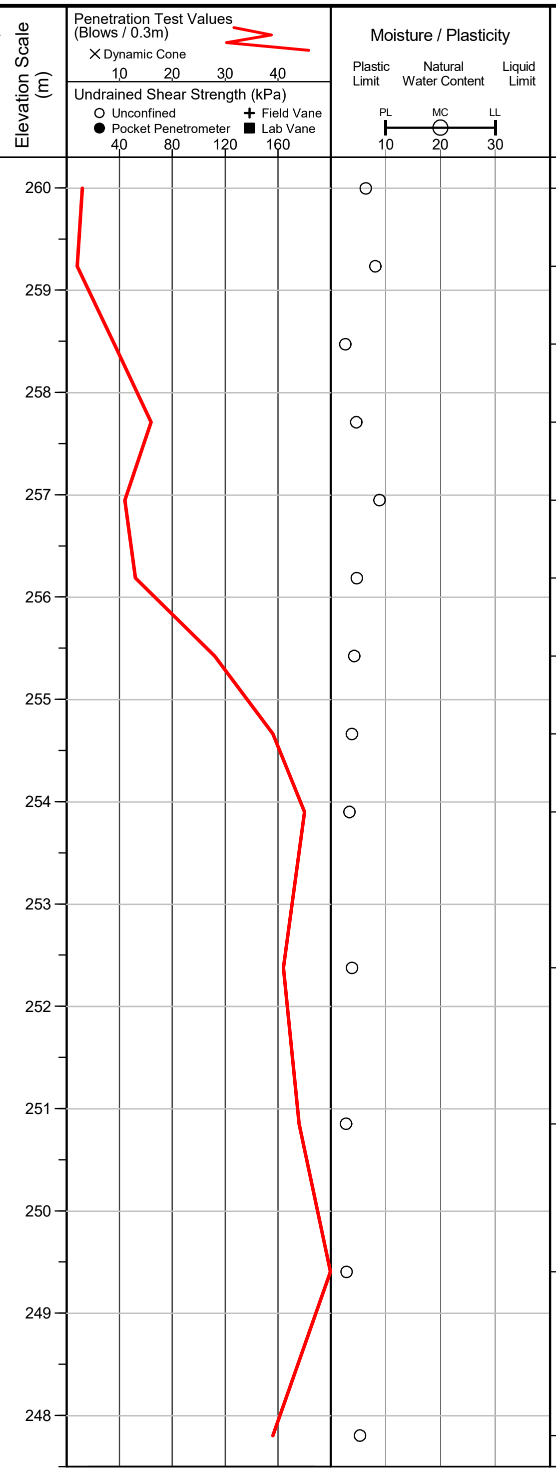
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description
0	260.3	**GROUND SURFACE**
		300mm **TOPSOIL**
	260.0 0.3	**FILL**, silty sand, trace to some gravel, trace clay, very loose to loose, brown, moist
2	258.0 2.3	**SAND**, some gravel to gravelly, trace to some silt, compact to dense, brown, moist
9	251.2 9.1	**SAND AND GRAVEL**, trace stone fragments, dense to very dense, brown, moist
	247.5 12.8	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	3	PID: 0	SS1 Analysis: M&I, PAH
2	SS	2	PID: 0	SS2 Analysis: VOC, PHC
3	SS	9	PID: 0	
4	SS	16	PID: 0	
5	SS	11	PID: 0	SS5 Analysis: M&I, PAH, VOC, PHC
6	SS	13	PID: 0	
7	SS	28	PID: 0	
8	SS	39	PID: 0	
9	SS	45	PID: 0	
10	SS	41	PID: 0	
11	SS	44	PID: 0	
12	SS	80	PID: 0	
13	SS	39	PID: 0	



Instrument Details

Unstabilized Water Level ▽ (8.2 m)

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Unstabilized water level measured at 8.2 m below ground surface; borehole was open upon completion of drilling.

file: 1-20-0249-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 107

Project No. : 1-20-0249-01
Client : 1 Rosetta Street (Halton Hills) GP Limited
Originated by : SM

Date started : August 13, 2020
Project : 1 Rosetta Street
Compiled by : HR

Sheet No. : 1 of 1
Location : Halton Hills, Ontario
Checked by : AR

Position : E: 587262, N: 4834340 (UTM 17T)
Elevation Datum : Geodetic

Rig type : Truck-mounted
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
260.4	**GROUND SURFACE**
	90mm **ASPHALT**
260.1 0.3	210mm **AGGREGATE**
	FILL, silty sand, trace to some gravel, trace clay, trace brick fragments, trace organics, loose to compact, brown, moist
258.1 2.3	**SAND**, some gravel to gravelly, trace to some silt, compact, brown, moist
249.4 11.0	**CLAYEY SILT**, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)
249.1 11.3	**SAND AND SILT**, trace clay, trace gravel, very dense, brown, moist
248.7 11.7	

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

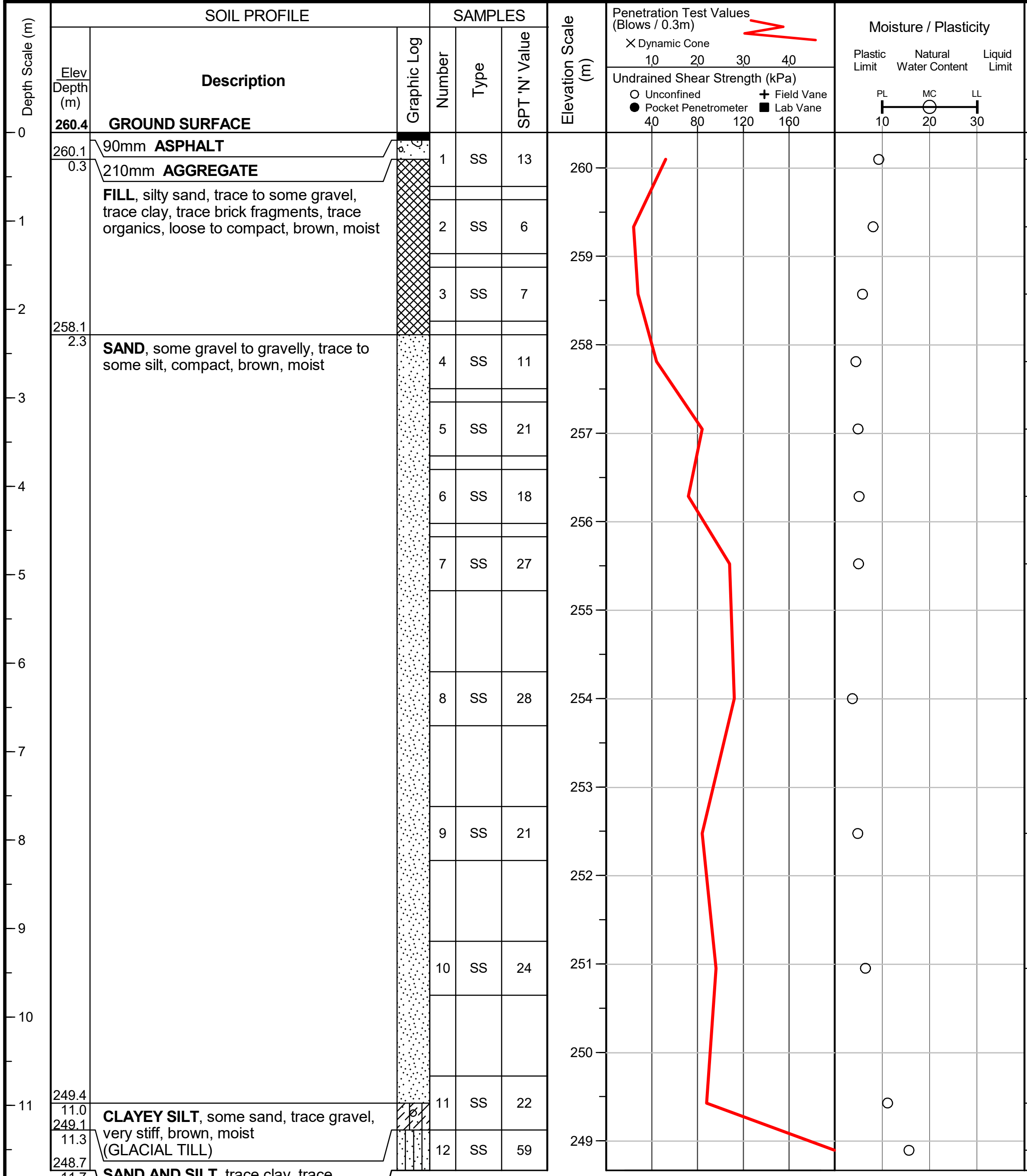
SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	13	PID: 0	
2	SS	6	PID: 0	SS2 Analysis: M&I, PAH, VOC, PHC
3	SS	7	PID: 0	
4	SS	11	PID: 0	
5	SS	21	PID: 0	SS5 Analysis: VOC, PHC
6	SS	18	PID: 0	SS6 Analysis: M&I, PAH
7	SS	27	PID: 0	
8	SS	28	PID: 0	
9	SS	21	PID: 0	
10	SS	24	PID: 0	
11	SS	22	PID: 0	
12	SS	59	PID: 0	

Instrument Details

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL



LOG OF BOREHOLE 108

Terraprobe

Project No. : 1-20-0249-01
Date started : August 19, 2020
Sheet No. : 1 of 1

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : SM
Compiled by : HR
Checked by : AR

Position : E: 587229, N: 4834350 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

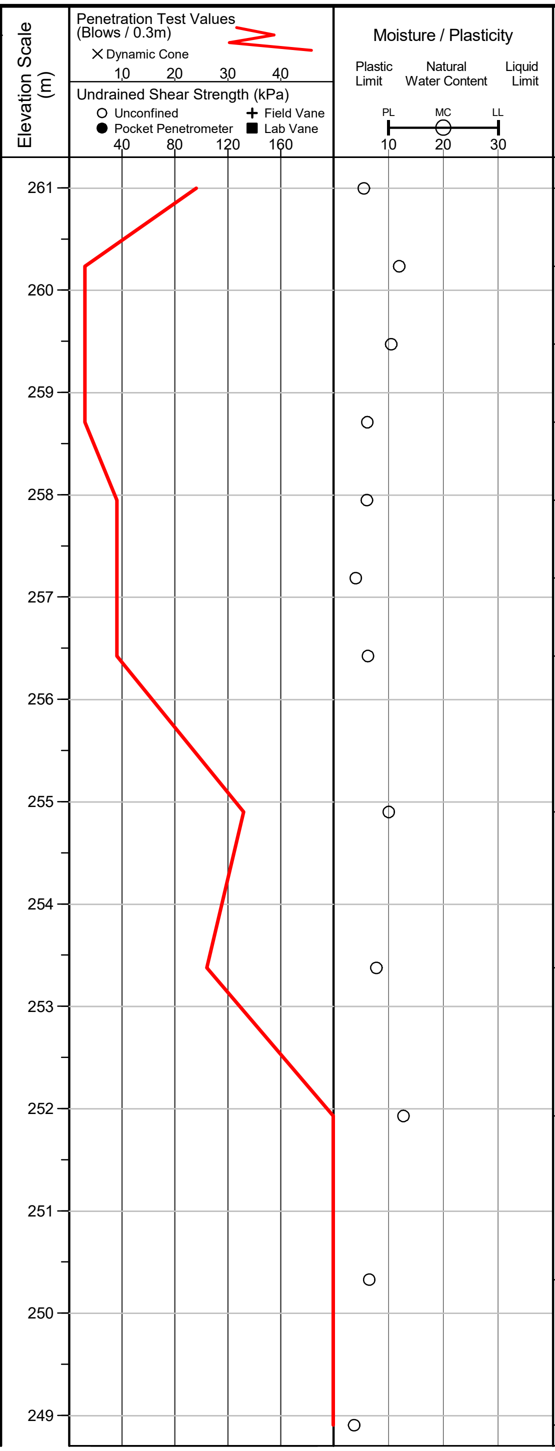
SOIL PROFILE

Elev (m)	Depth (m)	Description
261.3		**GROUND SURFACE**
261.1	0.2	80mm **ASPHALTIC CONCRETE** 80mm **AGGREGATE**
		FILL, silty sand, trace gravel, trace clay, trace organics, trace brick pieces, very loose to compact, dark brown, moist
259.0	2.3	**SAND**, some gravel to gravelly, trace to some silt, very loose to loose, brown, moist
255.2	6.1	**SANDY SILT**, some clay, trace gravel, compact to dense, grey, moist (GLACIAL TILL)
252.2	9.1	**SANDY SILT**, trace silt clay partings, very dense, brown, moist
248.7	12.6	**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	24	PID: 0
2	SS	3	PID: 10
3	SS	3	PID: 0
4	SS	3	PID: 35
5	SS	9	PID: 0
6	SS	9	PID: 0
7	SS	9	PID: 0
8	SS	33	PID: 0
9	SS	26	PID: 0
10	SS	63	PID: 0
11	SS	53	PID: 0
12	SS	92 / 250mm	PID: 0



Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

SS1 Analysis:
M&I, PAH

SS4 Analysis:
M&I, PAH, VOC, PHC

Terraprobe

LOG OF BOREHOLE 109

Project No. : 1-20-0249-01
Date started : August 18, 2020
Sheet No. : 1 of 1

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

Originated by : SM
Compiled by : HR
Checked by : AR

Position : E: 587206, N: 4834376 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

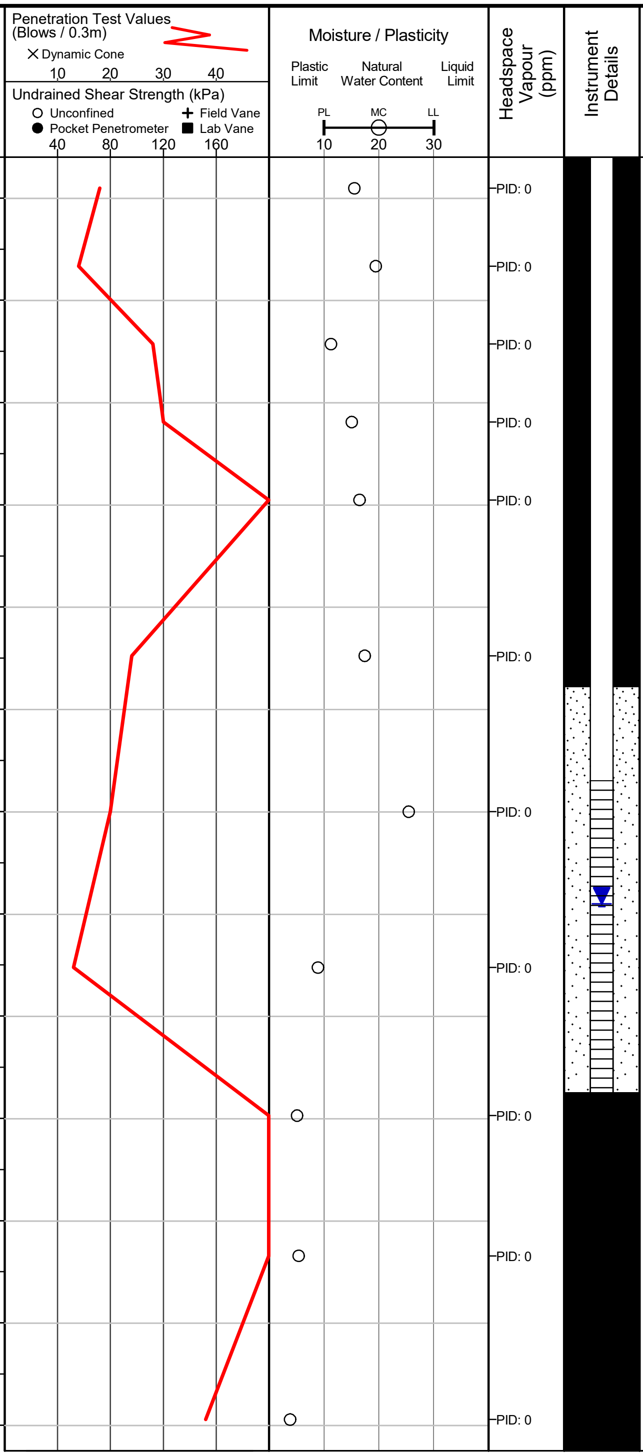
SOIL PROFILE

Elev Depth (m)	Description
260.4	**GROUND SURFACE**
260.2 0.2	80mm **ASPHALT**
	120mm **AGGREGATE**
	FILL, clayey silt, some sand, trace gravel, stiff to very stiff, brown, moist
259.3 1.1	**SANDY SILT**, some clay, trace gravel, compact, brown, moist (GLACIAL TILL)
258.1 2.3	**SAND AND SILT**, trace clay, trace gravel, compact to very dense, brown, moist ...grey, wet below ...some clay
251.3 9.1	**SAND AND GRAVEL**, some stone fragments, very dense, brown, moist
250.5 9.9	**SANDY SILT**, trace clay, trace gravel, trace stone fragments, very dense, brown, moist
248.2 12.2	**SILTY SAND**, trace gravel, dense, brown, moist
247.8 12.6	

SAMPLES

Number	Type	SPT 'N' Value	GR	SA	SI	CL
1	SS	18				
2	SS	14				
3	SS	28				
4	SS	30				
5	SS	52				
6	SS	24				
7	SS	20				
8	SS	13	5	39	44	12
9	SS	85				
10	SS	50 / 150mm				
11	SS	38				

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT)



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	7.3	253.1

LOG OF BOREHOLE 110

Project No. : 1-20-0249-01	Client : 1 Rosetta Street (Halton Hills) GP Limited	Originated by : SM
Date started : August 10, 2020	Project : 1 Rosetta Street	Compiled by : HR
Sheet No. : 1 of 2	Location : Halton Hills, Ontario	Checked by : AR

Position : E: 587160, N: 4834330 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Truck-mounted

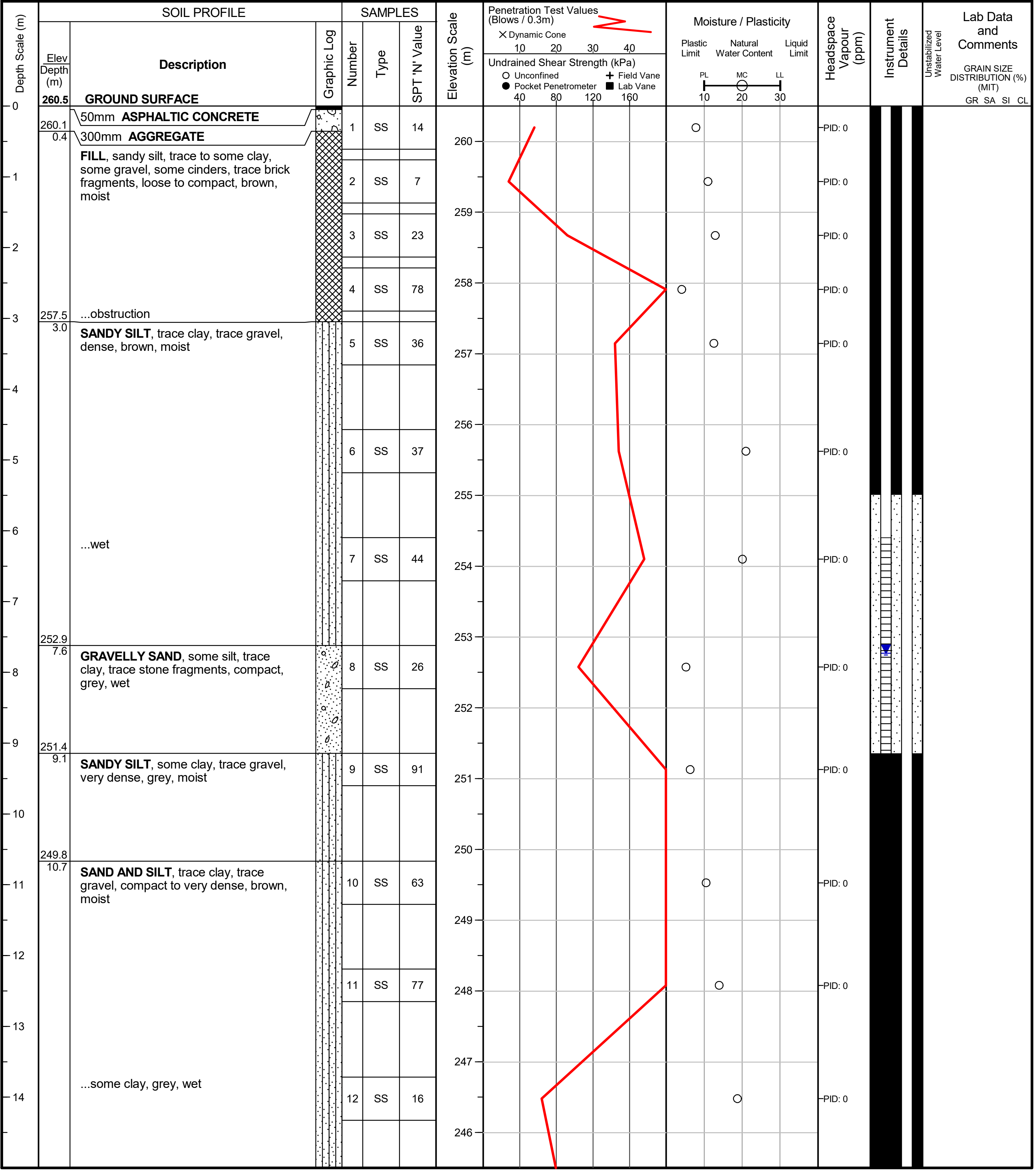
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev (m)	Depth (m)	Description
260.5		**GROUND SURFACE**
260.1	0.4	50mm **ASPHALTIC CONCRETE** 300mm **AGGREGATE**
		FILL, sandy silt, trace to some clay, some gravel, some cinders, trace brick fragments, loose to compact, brown, moist
257.5	3.0	...obstruction
		SANDY SILT, trace clay, trace gravel, dense, brown, moist
		...wet
252.9	7.6	**GRAVELLY SAND**, some silt, trace clay, trace stone fragments, compact, grey, wet
251.4	9.1	**SANDY SILT**, some clay, trace gravel, very dense, grey, moist
249.8	10.7	**SAND AND SILT**, trace clay, trace gravel, compact to very dense, brown, moist
		...some clay, grey, wet

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	14	PID: 0
2	SS	7	PID: 0
3	SS	23	PID: 0
4	SS	78	PID: 0
5	SS	36	PID: 0
6	SS	37	PID: 0
7	SS	44	PID: 0
8	SS	26	PID: 0
9	SS	91	PID: 0
10	SS	63	PID: 0
11	SS	77	PID: 0
12	SS	16	PID: 0



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LOG OF BOREHOLE 110

Project No. : 1-20-0249-01
Date started : August 10, 2020
Sheet No. : 2 of 2

Client : 1 Rosetta Street (Halton Hills) GP Limited
Project : 1 Rosetta Street
Location : Halton Hills, Ontario

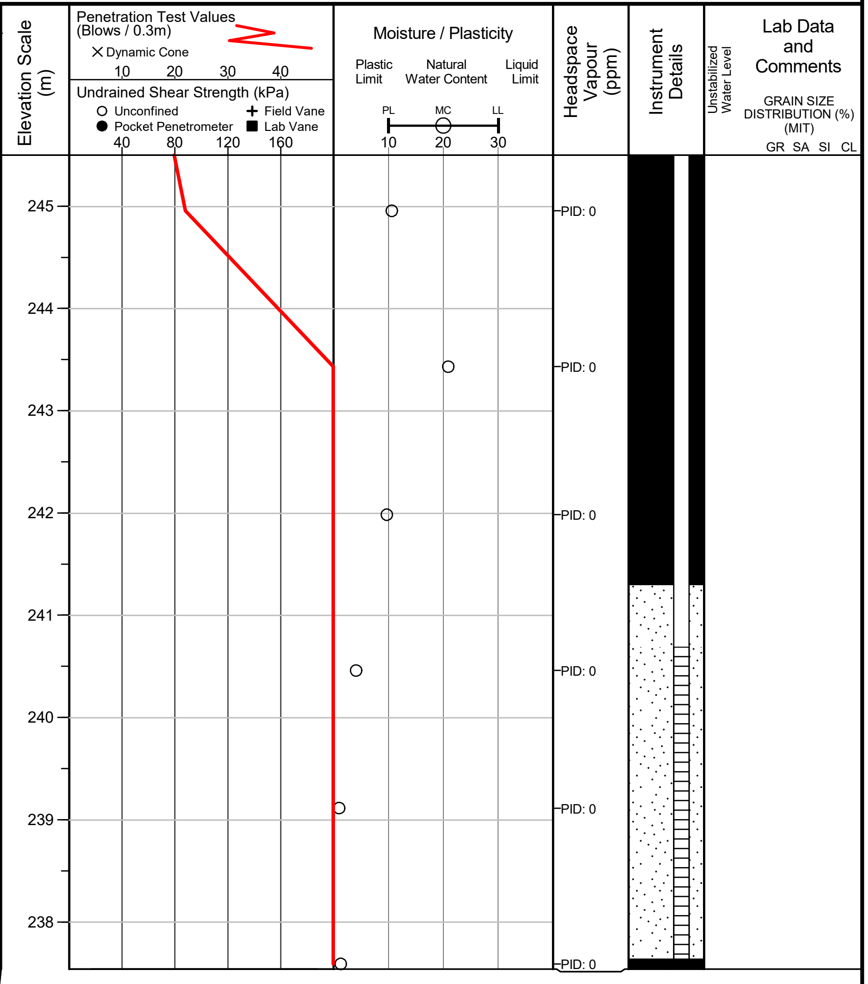
Originated by : SM
Compiled by : HR
Checked by : AR

Position : E: 587160, N: 4834330 (UTM 17T)
Rig type : Truck-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Elev Depth (m)	SOIL PROFILE Description *(continued)*	Number	Type	SPT 'N' Value
245.3 15.2	**CLAYEY SILT**, some sand, trace gravel, stiff, grey, moist (GLACIAL TILL)	13	SS	22
243.7 16.8	...silt, some clay	14	SS	63
		15	SS	74
		16	SS	60
239.2 21.3	**SAND**, some gravel, some silt, very dense, brown, moist	17	SS	50 / 100mm
237.5 23.0	...stone fragments	18	SS	50 / 100mm

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



W1 WATER LEVELS

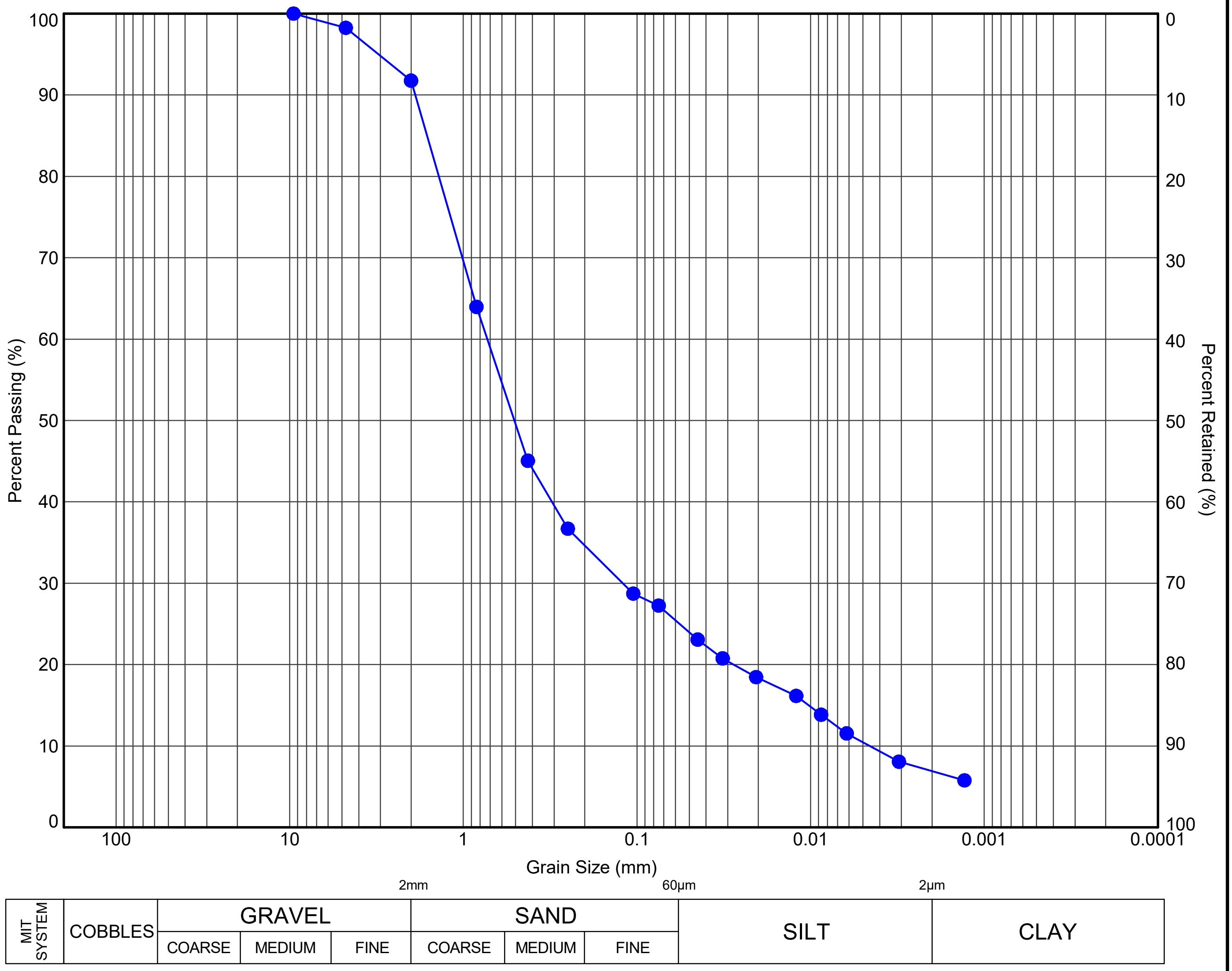
Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	7.7	252.8

W2 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Sep 30, 2020	dry	n/a

APPENDIX B

TERRAPROBE INC.



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**101**	SS11	9.4	250.9	8	66	19	7	

Terraprobe

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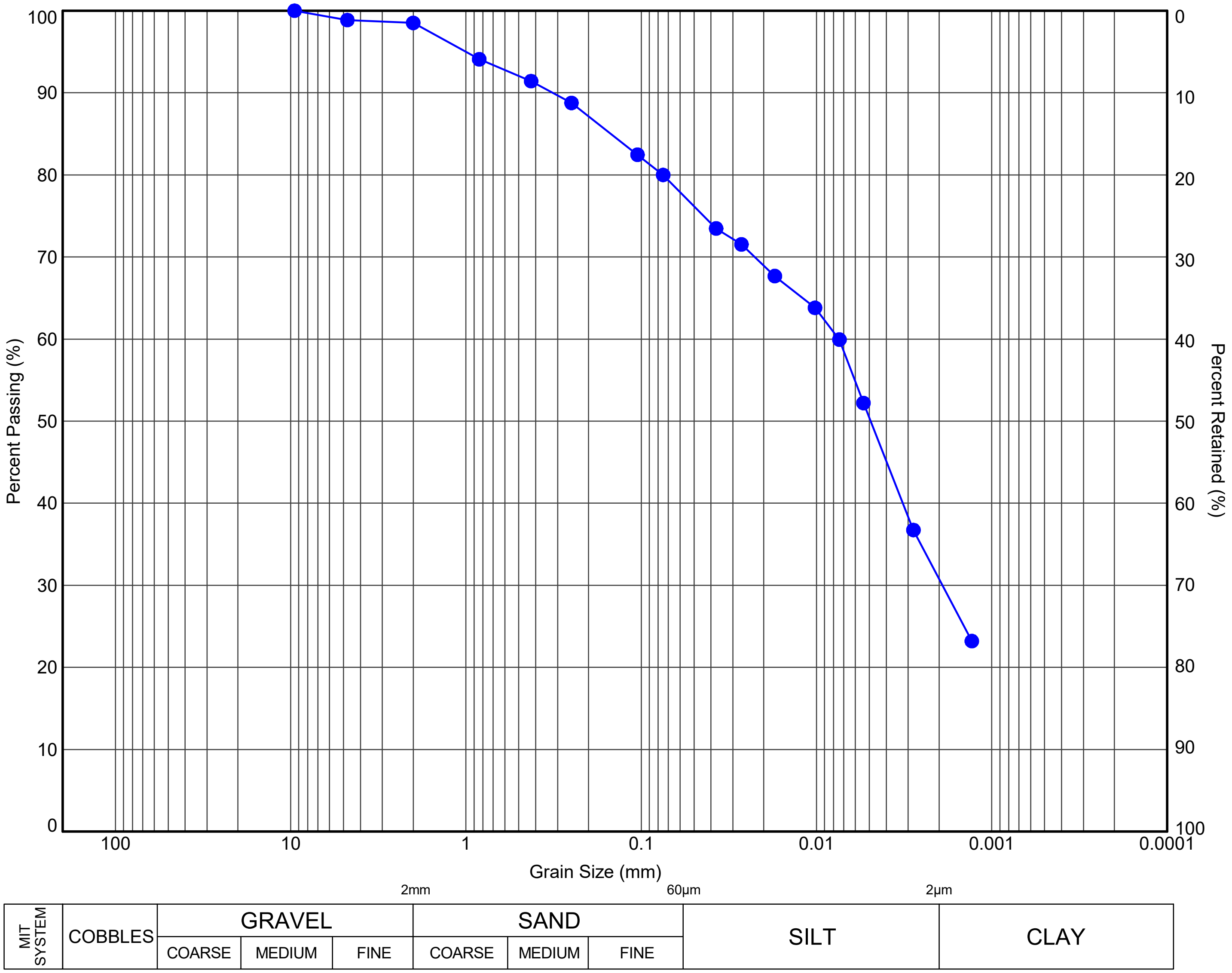
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY

File No.: **1-20-0249-01**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**105**	SS13	13.3	245.4	2	20	47	31	

Terraprobe

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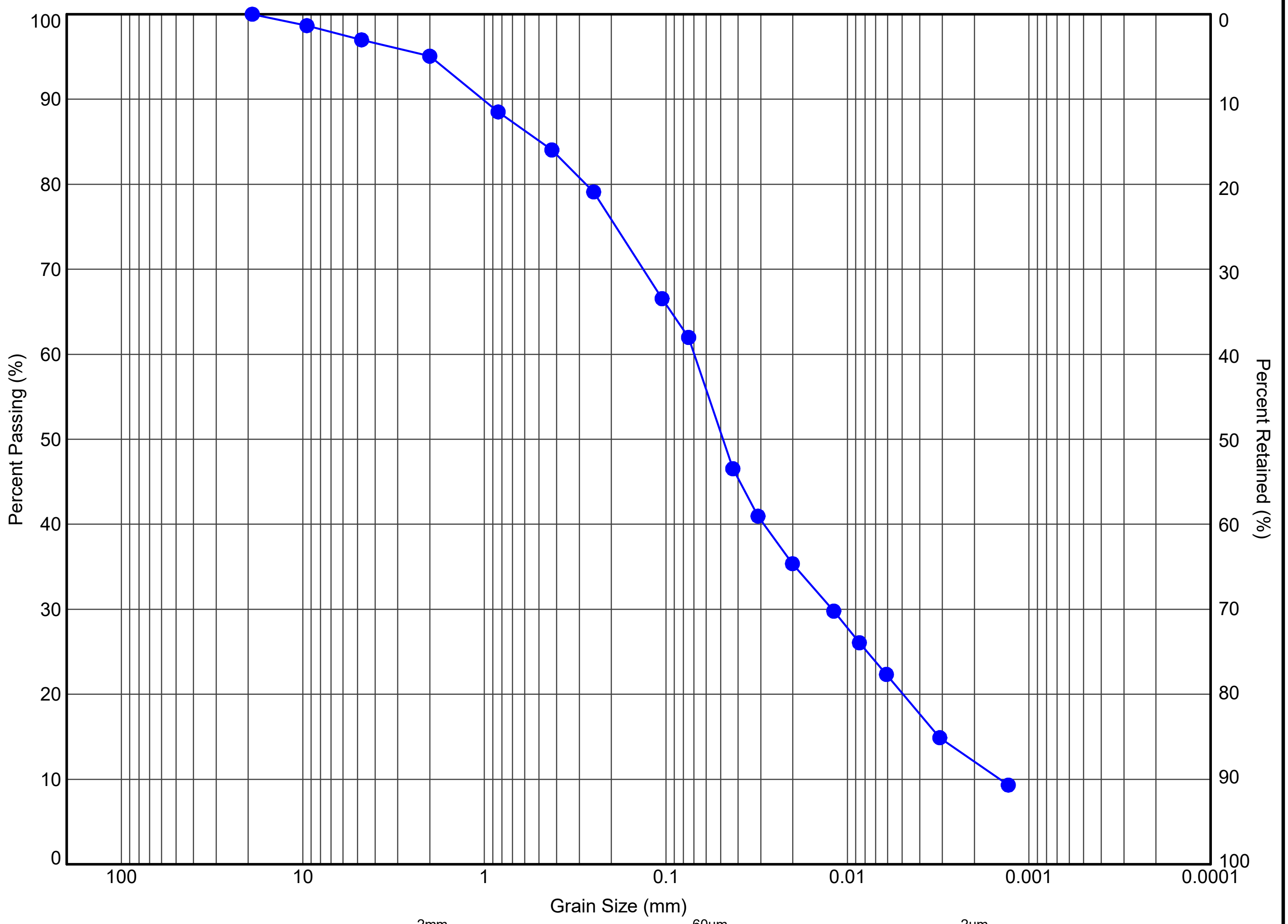
Title:

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SANDY, TRACE GRAVEL

File No.: **1-20-0249-01**



2mm 60µm 2µm

MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

				MIT SYSTEM				
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
● **109**	SS8	7.9	252.5	5	39	44	12	

Terraprobe

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Title:

GRAIN SIZE DISTRIBUTION
SILT AND SAND, SOME CLAY, TRACE GRAVEL

File No.: **1-20-0249-01**