

# 99 Cartwright Avenue Toronto, Ontario

Proposed Building Addition  
Updated Geotechnical Investigation Report

The Sterling Hall School c/o CS&P Architects Inc.  
January 19, 2026  
02210387.006



**eNGLOBE**

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# 1 Introduction

Englobe Corp. (Englobe, formerly known as Terraprobe Inc.) was retained by The Sterling Hall School c/o CS&P Architects Inc. to conduct a subsurface investigation and provide geotechnical engineering design recommendations for the proposed additions on the west side of the existing school building at The Sterling Hall School located at 99 Cartwright Avenue, in the City of Toronto.

This report encompasses the results of the geotechnical investigation conducted for the proposed additions to determine the prevailing subsurface soil and groundwater conditions, and based on this information, provides geotechnical engineering design recommendations for the foundations, earth pressure, seismic parameters, floor slab and drainage and pavement recommendation. Geotechnical comments are also included on pertinent construction aspects, excavation, backfill and groundwater control.

Englobe has also conducted a hydrogeological and environmental study for this property. The findings of the study are reported under a separate cover.



## 2 Site and Project Description

The Sterling Hall School (project site) is located on the west side of Paul David Street and between Cartwright Avenue and Bentworth Avenue. The project site currently consists of a school campus building, playground area, asphalt driveway/parking lots and landscaped areas. The general location of the subject site is shown on Figure 1.

It is understood that the school will expand to the adjacent properties at 109 Cartwright Avenue and 130 Bentworth Avenue, Toronto. The following drawings were provided for our review in preparation of this report,

- *Site Plan, Drawing No.: A1.10, Project No.: 21032*, dated November 15, 2022, prepared by CS&P Architects.
- *Floor Plan - Lower Level, Drawing No.: A2.10, Project No.: 21032*, dated June 19, 2024, prepared by CS&P Architects.

The design drawings indicate that the existing building at 109 Cartwright Avenue will be demolished to facilitate the building addition at west side of the school, consisting of a two-storey building with a partial basement. The finished floor elevation (FFE) of the proposed building addition would be set at about 184.0 m. Based on the email communication with client, *dated: February 2, 2023, Subject: Sterling Hall School - Geotechnical*, it was understood that the finished floor elevation (FFE) of the partial basement level would be set at about 181.75 m. In addition, an asphalt parking lot including driveways and fire-routes would be constructed at the property located at 130 Bentworth Avenue





## 3 Investigation Procedure

The field investigation of the site was conducted on December 20 to 22, 2022 and consisted of advancing a total of twelve (12) exploratory boreholes. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figures 2A and 2B).

The boreholes were drilled by a specialist drilling contractor using a track-mounted drill rig power auger. The borings were advanced using continuous flight solid stem augers, and were sampled at 0.75 m and 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 boreholes and test pits samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties. Laboratory tests consisted of moisture content determination on all samples; and a Sieve and Hydrometer analysis on selected native soil samples. The measured natural moisture 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 are also summarized in Section 4.4 of this report, and appended.

Ground water levels were monitored in the open boreholes upon completion of drilling. Monitoring wells consisting of 50 mm diameter PVC tubing were installed in all boreholes to facilitate groundwater monitoring and hydrogeological study purposes. The results of groundwater monitoring are summarized in Section 4.5 of this report. The detailed results of the borehole investigation are presented in Appendix A (Borehole Logs).

The borehole ground surface elevations were surveyed by Terraprobe. 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 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 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 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 surficial topsoil layer was encountered in Borehole 3. The thickness of topsoil layer was about 100 mm. The topsoil was dark brown in colour and predominantly consisted of sandy silt matrix.

An asphalt pavement structure was encountered in Boreholes 1, 2, 4 through 9 and comprised of 50 to 80 mm thick asphaltic concrete underlain by 75 to 275 mm thick aggregate layer.

A concrete slab structure with thickness varying from 90 mm to 100 mm was encountered in Boreholes 10 and 11 at the ground surface. The concrete slab was underlain by an aggregate layer with thickness ranging from about 100 mm to 180 mm.

The above topsoil, pavement and concrete slab 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/concrete slab structure thickness present across the site for quantity estimation and costing purposes.

## 4.2 Earth Fill

Earth fill materials, consisting of clayey silt with some sand and trace amounts of gravel and organics were encountered beneath the surficial layers in all the boreholes and extended to 0.8 to 2.3 m depth below grade.

Standard Penetration Test results (N-values) obtained from the cohesive earth fill zone typically ranged from 4 to 20 blows per 300 mm of penetration, indicating a firm to very stiff consistency. The in-situ moisture contents of the earth fill samples ranged from 9 to 26 percent by mass, indicating a moist to locally wet (typically moist) condition.

## 4.3 Glacial Till

Sandy silt to silt and sand till deposit, with some clay and trace amounts of gravel was encountered beneath the earth fill zone in all the boreholes and extended to the full depth of investigation (i.e. about 6.6 m to 14.5 m depth below grade).

The upper zone of the glacial till layer, extending to a depth ranging from 1.5 m to 3.0 m depth below grade in Boreholes 2, 3, 4, 6 and 11 was weathered/disturbed. The composition of the weathered and disturbed soil is generally similar to that of the underlying undisturbed soil but contained trace amounts of organic inclusions.

The results of the Standard Penetration Test (N-values) obtained from the undisturbed till deposit ranged from 12 to over 50 blows per 300 mm of penetration, indicating a compact to very dense relative density. The in-situ moisture contents of the glacial till samples ranged from 6 to 16 percent by mass, indicating a moist to wet (typically moist) condition.

It should be noted that the glacial till deposit may contain larger size particles (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for the particles of this size.

## 4.4 Geotechnical Laboratory Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples, while 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 is presented as follow:

| Borehole No.<br>Sample No. | Sampling<br>Depth<br>below<br>Grade (m) | Percentage (by mass) |      |      |      | Descriptions<br>(MIT System)             |
|----------------------------|-----------------------------------------|----------------------|------|------|------|------------------------------------------|
|                            |                                         | Gravel               | Sand | Silt | Clay |                                          |
| Borehole 3, Sample 3       | 1.8                                     | 1                    | 36   | 45   | 18   | SILT AND SAND<br>some clay, trace gravel |
| Borehole 6, Sample 5       | 3.3                                     | 1                    | 35   | 46   | 18   | SILT AND SAND<br>some clay, trace gravel |
| Borehole 11, Sample 4      | 2.5                                     | 9                    | 33   | 43   | 15   | SANDY SILT<br>some clay, trace gravel    |

## 4.5 Groundwater

Observations pertaining to the depth of ground water level and caving were made in all the open boreholes upon completion of drilling and are noted on the enclosed borehole logs. Ground water level measurements in the monitoring wells installed in all the boreholes were taken on January 6, 2023 and noted on the enclosed borehole logs. A summary of measured ground water levels is provided below,

| Borehole No. |    | Depth of Boring below Grade (m) | Depth to Cave below Grade (m) | Water Level Depth/Elevation (m) at the Time of Drilling | Water Level Depth/Elevation (m) in Monitoring Well January 6, 2023 |
|--------------|----|---------------------------------|-------------------------------|---------------------------------------------------------|--------------------------------------------------------------------|
| 1            |    | 8.2                             | Open                          | Dry                                                     | 6.9/176.4                                                          |
| 2            |    | 6.6                             | Open                          | Dry                                                     | 1.6/181.8                                                          |
| 3            |    | 8.1                             | Open                          | Dry                                                     | 0.8/182.7                                                          |
| 4            | W1 | 7.6                             | Open                          | Dry                                                     | 1.1/182.6                                                          |
|              | W2 | 14.5                            | 14.0                          | 13.9                                                    | 11.6/172.1                                                         |
| 5            |    | 8.1                             | Open                          | Dry                                                     | 6.2/177.3                                                          |
| 6            |    | 8.1                             | Open                          | Dry                                                     | 0.8/182.7                                                          |
| 7            |    | 8.1                             | Open                          | Dry                                                     | 6.5/176.4                                                          |
| 8            |    | 8.1                             | Open                          | Dry                                                     | 0.6/183.1                                                          |
| 9            |    | 6.6                             | Open                          | Dry                                                     | 0.7/182.8                                                          |
| 10           |    | 6.6                             | Open                          | Dry                                                     | 0.8/182.5                                                          |
| 11           |    | 6.6                             | Open                          | Dry                                                     | 0.5/182.8                                                          |

For practical purposes, the stabilized design groundwater table at the site is at Elev. 183 ±m (about 1 ±m below average ground floor grade).

Construction dewatering at adjacent sites, existing building drains or dewatering systems, and seasonal fluctuations may cause significant changes to the depth of the groundwater table over time. Additional information pertaining to groundwater at the site is discussed in the hydrogeological report by Englobe under a separate cover (02210387.0200).



## 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 based on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. The Ontario Building Code may require additional considerations beyond the recommendations provided in this report, and must be followed. 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 Englobe should be retained to review the implications of these changes with respect to the contents of this report.

The foundation installations must be reviewed in the field by Englobe. The on-site review of the condition of the foundation subgrade as the foundations are constructed is an integral part of the geotechnical engineering design function, and is not to be considered as third-party inspection services. If Englobe is not retained to carry out all of the foundation evaluations during construction, then Englobe accepts no responsibility for the performance of the foundations.

### 5.1 Foundation Design Parameters

The proposed redevelopment would include to facilitate the building addition at west side of the school, consisting of a two-storey building with a partial basement. It is understood that the finished floor elevation (FFE) of the partial basement level would be set at Elev.181.75 ±m. In addition, an asphalt parking lot including driveways and fire-routes would be constructed at the property located at 130 Bentworth Avenue.

Boreholes 3 to 7 advanced within or in close proximity to the proposed building addition footprint encountered the surficial layer at the ground surface underlain by the earth fill zone and/or weathered/disturbed soil zone, extending from 0.8 m to 1.5 m depth below grade (Elev. 182.0 to 182.2 m), which is in turn underlain by the undisturbed sandy silt to silt and sand till deposit extending to the full depth of the investigation.

The stabilized design groundwater table at the site may be taken at Elev. 183 ±m (about 1 ±m below average ground floor grade).

In accordance with the City of Toronto's *Foundation Drainage Policy*, the long-term discharge of the foundation drainage is not permitted to the City's sewer systems. Based on the subsurface conditions, the preliminary design information and project site conditions, it is recommended that the underground parking structure be fully waterproofed with no foundation drainage system.

Considering that the partial basement excavation (FFE at Elev. 181.75 ±m) would extend about 1.25 m below the stabilized groundwater table, Englobe recommends two types of foundation systems as follows,

- Conventional spread footing (for unexcavated areas); and
- Raft foundation (for partial basement area)

### 5.1.1 Conventional Spread Footing Foundation

The existing earth fill and weathered/disturbed soil materials are unsuitable to support the proposed addition foundations. Based on the borehole information within or in close proximity to the proposed addition footprints, the foundations may be supported on the undisturbed sandy silt to silt and sand till of compact to very dense relative density. A net geotechnical reaction of 200 kPa (Serviceability Limit States, SLS) and factored geotechnical resistance of 300 kPa (Ultimate Limit States, ULS) may be used for the design of conventional spread footing foundations (for vertical and concentric loads) supported on the underlying competent undisturbed sandy silt to silt and sand till of compact to very dense relative density.

The geotechnical reaction(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.

The minimum width of the continuous strip footings must be 500 mm and the minimum size of isolated footings must be 900 mm × 900 mm regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. Footing sizes for houses and small buildings are provided in Division B, Part 9 of Ontario Building Code and must be followed regardless of footing sizes provided above.

The new foundation level must match the existing footings level where they meet the existing building line and then can be stepped up at 10 horizontal to 7 vertical steps as required, extending away from the existing building.

### 5.1.2 Raft Foundation

The partial basement area may be supported on the raft foundation. For the purpose of conducting preliminary analysis of a raft foundation, an approx. 29 m × 11 m raft under the partial basement area is considered in the discussion below. The raft thickness is not available during the report preparation. For design purposes, the raft thickness is estimated to be 0.75 ±m (to be confirmed by the structural engineer). The foundation subgrade is expected to consist of compact to dense sandy silt to silt and sand till deposit.

The bearing capacity of the raft is total of the net soil bearing capacity at foundation level and the net unloading due to excavation. Utilizing preliminary design parameters for a uniformly loaded raft foundation, a geotechnical reaction at SLS of 150 kPa (total allowable raft pressure for 25 mm of settlement), and a geotechnical reaction at SLS of 250 kPa (total allowable raft pressure for 50 mm of settlement) were recommended for the preliminary structural raft design.

The maximum factored geotechnical resistance at ULS should be limited to 900 kPa for raft foundation design purposes.

The modulus of subgrade reaction for design of a raft slab is a nonlinear function of the total applied load and the resulting settlement. The modulus of subgrade reaction appropriate for the design of a raft supported on the undisturbed compact to dense sandy silt to silt and sand till deposit is 6,000 kPa/m for 25 mm of settlement and 5,000 kPa/m for 50 mm of settlement.

The raft design parameters are provided on the basis of a uniform load imparted on the irregular shaped foundation. In reality, raft loads will likely be concentrated around the core and will decrease away from the core. In addition, the actual raft configuration may be different than the above assumed raft shape. Consequently, detailed raft foundation design is typically an iterative process between the structural and geotechnical engineers. Once the preliminary structural design is completed using the preliminary modulus of subgrade reaction provided above, the resulting non-uniform stresses at the base of the raft must be assessed by Englobe to determine the amount of settlement generated by non-uniform structural loading. The settlement results are then forwarded to the structural engineer, and loads are redistributed as needed.

The basement FFE will be below the water table, and will require temporary dewatering. The implications of this are discussed in Section 7.2. As the permanent dewatering is completely avoided, the below-grade structure would be designed as a fully waterproofed structure with no permanent dewatering by utilizing a raft foundation to carry structural loads, with waterproofed foundation walls designed to withstand hydrostatic forces.

During construction, the subgrade at founding elevation should be cut neat, inspected, and immediately protected by a minimum 200 mm thick mud slab (comprising lean concrete) to provide a working surface.

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

### 5.1.3 Foundation Installation

The foundation installations must be reviewed in the field by Englobe. The on-site review of the condition of the foundation subgrade as the foundations are constructed is an integral part of the geotechnical engineering design function, and is not to be considered as third-party inspection services. If Englobe is not retained to carry out all of the foundation evaluations during construction, then Englobe accepts no responsibility for the performance of the foundations.

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. All footings must be designed to bear at least 0.3 m into the undisturbed native soil stratum.

The new foundation level must match the adjacent footing levels of the existing building along the east, west and south limit of the new building and then can be stepped away at 10 horizontal to 7 vertical steps as required, extending away from the existing building. The new footings stepped from one level to another should be also designed at a slope not exceeding 10 horizontal to 7 vertical in conjunction with the above bearing pressures.

Prior to pouring concrete for the footings, the footing subgrade must be cleaned of all deleterious materials such as softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided. If incompetent soils are encountered at the proposed bearing depths during foundation excavation or due to inadequate dewatering, sub-excavation to competent soil subgrade is required under the direction of the geotechnical engineer.

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 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 groundwater level (m)
- $\gamma$  = the bulk unit weight of soil (kN/m<sup>3</sup>)
- $\gamma_w$  = the bulk unit weight of water (9.8 kN/m<sup>3</sup>)
- $\gamma'$  = 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 ( $\tan \phi$ ) 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              |
|-----------|----------------------------------------------|--------------------|
| $\phi$    | angle of internal friction                   | degrees            |
| $\gamma$  | bulk unit weight of soil                     | kN/ m <sup>3</sup> |
| $K_a$     | active earth pressure coefficient (Rankine)  | dimensionless      |
| $K_o$     | at-rest earth pressure coefficient (Rankine) | dimensionless      |
| $K_p$     | passive earth pressure coefficient (Rankine) | dimensionless      |

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

| Stratum/Parameter                            | $\gamma$<br>(kN/m <sup>3</sup> ) | $\Phi$<br>(degree) | $K_a$ | $K_o$ | $K_p$ |
|----------------------------------------------|----------------------------------|--------------------|-------|-------|-------|
| Earth Fill                                   | 19.0                             | 28                 | 0.36  | 0.53  | 2.77  |
| Undisturbed Sandy Silt to Silt and Sand Till | 21.0                             | 32                 | 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.

## 5.3 Earthquake Design Parameters

The Ministry of Municipal Affairs and Housing (MMAH) has adopted the 2024 Ontario Building Code (OBC) that came into effect on January 1, 2025. The 2024 OBC is further harmonized with 2020 National Building Code (NBC) of Canada for the earthquake design analysis. This includes the use of the new 6<sup>th</sup> Generation Seismic Hazard Model for determining seismic hazard which was developed for the 2020 NBC.

The 2024 OBC provides seismic hazard values based on Site Designation. The Site Designation ( $X$ ) shall be  $X_V$ , where  $V$  is the value of the average shear wave velocity,  $\bar{V}_{S30}$ , calculated from in-situ measurements of the shear wave velocity in top 30 m of the ground profile except for the four (4) specific ground profiles as set out in the Table 4.1.8.4.-A of 2024 OBC, where Site Designation shall be determined in accordance with Table 4.1.8.4.-A.

The 2024 OBC also provided alternative methods to determine the Site Designation ( $X_S$ ), if  $\bar{V}_{S30}$  calculated from in situ measurements is not available. In this case, the Site Designation shall be  $X_S$ , where  $S$  is the original Site Class determined using energy-corrected average standard penetration resistance ( $\bar{N}_{60}$ ) or the average undrained shear strength ( $\bar{S}_u$ ) in the top 30 m of the site stratigraphy below the foundation level in accordance with Table 4.1.8.4.-B (with associated notes). There are six site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). Note that providing a Site Designation based on a Site Class approach (i.e., without direct measurement of shear wave velocities) will generally result in higher seismic demand for the site.

In-situ shear wave velocities were not measured at this site, therefore the Site Designation was determined based on the Site Class approach using energy-corrected average Standard Penetration Resistance ( $\bar{N}_{60}$ ) or the average Undrained Shear Strength ( $\bar{S}_u$ ), as applicable, in accordance with Table 4.1.8.4.-B (and associated notes). Based on this approach, the Site Designation for seismic analysis may be taken as  $X_D$ , as per 2024 Ontario Building Code.

We strongly recommend that a site-specific Multichannel Analysis of Surface Waves (MASW) should be considered to determine the Site Designation for this site as the Site Designation based on  $\bar{V}_{S30}$  will likely result in a lower seismic demand than Site Designation  $X_D$  determined using the Site Class approach. The project structural engineer can advise if an in-situ shear wave velocity measurement (such as a MASW test) is advantageous for the subject project.

## 5.4 Basement Floor Slab

The excavated surface should be assessed by a qualified geotechnical engineer. For a fully waterproofed basement area, raft slab design parameters are provided in Section 5.1.2.

For the conventional spread footing in the slab-on-grade area, the following subgrade parameters are recommended for the design of the floor slab supported on earth fill compacted to 98 percent of Standard Proctor Maximum Density (SPMDD) or the undisturbed glacial deposit:

$$\begin{aligned} K_s &= 18,000 \text{ kPa/m (compacted fill)} \\ K_s &= 35,000 \text{ kPa/m (undisturbed till)} \end{aligned}$$

For the basement on the raft foundation, the raft slab design parameters are provided in Section 5.1.2.

Prior to the construction of the slab, it is recommended that the subgrade be cut-neat, approved and inspected under the supervision of Englobe for obvious loose or disturbed areas as exposed, or for

areas containing excessively deleterious materials or moisture. All sub-excavated areas shall be replaced with Granular B placed as compacted fill (in lifts 150 mm thick or less and compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density, SPMDD).

It is necessary that building basement slab be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 150 mm layer of 19 mm stone (OPSS.MUNI 1004) compacted by vibration to a dense state. A geotextile (Terrafix 360R or equivalent) must be installed to separate subgrade from the granular base.

The substructure will be fully waterproofed and designed to withstand hydrostatic pressures as necessary, with no permanent drainage.

## 5.5 Basement Drainage

A separate Hydrogeological Study has been prepared by Englobe for this site, which provides the approximate amount of daily temporary (construction) and permanent groundwater collection and discharge.

The groundwater levels measured in the monitoring wells installed within or in close proximity to the proposed building addition footprints (Boreholes 3 to 7) ranged from Elev. 172.1 to 182.7 m. The design groundwater table at the site may be taken at Elev. 183.0 ±m. The design groundwater level was noted to be about 1.75 m above the basement FFE.

As previously noted, the City of Toronto does not permit the long-term discharge to the City's sewer system, therefore, the building would need to be designed as a fully waterproofed structure to withstand hydrostatic pressures with no permanent drainage system.

The exterior grade around the building 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.



## 6 Pavement

The site plan illustrates that the site would include an asphalt parking lot, including driveways and fire-routes.

### 6.1 Asphalt Pavement Design

The flexible pavement thickness design is provided in the following table,

| Pavement Structural Layers                          | Light-Duty Pavement (mm) | Heavy-Duty Pavement (mm) |
|-----------------------------------------------------|--------------------------|--------------------------|
| HMA Surface Course, TS 1151 SP 12.5                 | 40                       | 40                       |
| HMA Binder Course, TS 1151 SP 19.0                  | 50                       | 60                       |
| Granular Base Course, TS 1010 Granular A            | 150                      | 150                      |
| Granular Subbase Course, TS 1010 Granular B Type II | 300                      | 400                      |
| Total Pavement Thickness                            | 540                      | 650                      |

### 6.2 General Pavement Recommendations

SP 12.5 B and SP 19.0 B hot mix asphalt mixes should be designed, produced and placed in conformance with TS 1151 and TS 310 requirements and pertinent City's standards. These Superpave mixes should be designed for Traffic Category B.

Granular base and subbase materials should meet the requirements of TS 1010. Granular materials should be compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD).

SP 12.5 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 TS 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.

## 6.3 Pavement Drainage

For asphalt pavements, full-length subdrains should be installed beneath the curb in accordance with the City of Toronto's *T-216-02-8 Roadway Subdrains* drawing and the subdrain pipe should be connected to a positive outlet. Subdrains should consist of 150 mm diameter perforated plastic pipe wrapped with a knitted geotextile sock and placed in a trench excavated 300 mm wide and 300 mm deep in the subgrade. The backfill around the subdrain should consist of OPSS.MUNI 1004 19 mm Clear Stone or the City of Toronto equivalent, provided that the clear stone is wrapped entirely in a geotextile fabric. The subdrain pipe should be connected to a positive outlet.

## 6.4 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed soils should be stripped from the subgrade areas. The exposed subgrade is expected to consist of earth fill material 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 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  $\pm 2$  percent of OMC. Fill material should be placed and compacted in accordance with TS 501 and the subgrade should be compacted to 95 percent of SPMDD. The final subgrade surface should be sloped at least 3 percent to provide positive drainage.



# 7 Design Considerations for Constructability

## 7.1 Excavations

The boreholes data indicate that the earth fill materials, weathered/disturbed 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, November 1993 (Part III - Excavations, Section 222 through 242)*. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

The native soils encountered in the boreholes are classified as Type 2 Soil above and Type 3 Soil below ground water level while earth fill materials encountered in the boreholes are classified as Type 3 Soil 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 steepest safe 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.

The overburden soils can be removed by conventional excavation equipment. Excavations at this site may encounter construction debris, deleterious materials and other obstructions in the earth fill and native cobble/boulder obstructions in the native soil deposits. Larger-sized particles (cobbles and boulders) that are not specifically identified in the boreholes may be present in the native soils. The size and distribution of cobbles/boulders/obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. The risk and responsibility for the removal and disposal of cobbles/boulders/obstructions must be addressed in the contract documents for foundations, excavations and shoring contractors.

## 7.2 Groundwater Control

Englobe has completed a Hydrogeological Report under a separate cover for this site to provide groundwater control measures and estimate(s) of groundwater discharge volumes. Refer to Englobe Hydrogeological Report for further groundwater control and other information (02210387.0200).

Water levels measured on January 6, 2023 the monitoring wells showed groundwater levels ranging between Elev. 172.1 to 183.1 m.

The soil stratigraphy within the partial basement excavation generally consists of the relatively low permeability glacial till deposit, which should preclude significant amounts of free-flowing groundwater seepage into the excavation in the short-term. However, perched groundwater seepage emanating from relatively permeable silt/sand lenses typically found within the glacial till due to its mode of deposition and the earth fill zone. The amount of perched water seepage is expected to increase with the depth of excavation and can be controlled by continuous pumping from filtered sumps at the base of the excavation.

For excavations extending near or below the prevailing groundwater level, it may be necessary to lower the groundwater level and maintain it at least 1 m 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 localized groundwater control to preserve the subgrade integrity to provide support to foundations and utilities, and a working platform, as needed. Provision for localized groundwater control during excavation should be included in the project specifications and contractor bid package.

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, Englobe 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.

The Ministry of the Environment and Climate Change (MOECC) has recently made changes to the requirement for Permit to Take Water approvals for construction related activities. Under the revised requirements, specific construction-related water-taking activities are eligible for Environmental Activity and Sector Registry (EASR). The trigger volume for EASR registration is a water taking of more than 50,000 litres/day. This includes the groundwater that is collected in the open excavation as well as any precipitation and/or surface runoff that enters the excavation.

## 7.3 Backfill

The earth fill materials containing excessive amounts of organic inclusion should not be reused as backfill in settlement-sensitive areas, such as beneath the floor slabs, trench backfill and pavement areas. However, these materials may be stockpiled and reused for landscaping purposes.

The existing earth fill materials are considered suitable (with selection and sorting as required) for backfill provided the moisture content of these soils is within  $\pm 2$  percent of the OMC. It should be noted that there will 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  $\pm 2$  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 be replaced with imported material which can be readily compacted.

The existing earth fill will likely require selection and sorting to be reused as backfill. The selection and sorting must be conducted under the supervision of a geotechnical engineer. The site soils will be best compacted with a heavy sheep foot type roller.

The backfill should consist of clean earth and should be placed in lifts of 150mm thickness or less, and heavily compacted to a minimum of 95 percent SPMDD at a water content close to optimum (within 2 percent). The upper 600 mm of the pavement subgrade must be compacted to a minimum of 98 percent 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 the wet periods (i.e. spring and fall) of the year.

## 7.4 Quality Control

The Ontario Building Code stipulates that engineering review of the subsurface conditions is required on a continuous basis during the installation of earth retaining structures. Englobe 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. Englobe 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. If Englobe is not retained to carry out foundation evaluations during construction, then Englobe 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. Englobe 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. Englobe 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.

Englobe 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. Englobe is certified by the Canadian Welding Bureau under W178.1-1996.





## 8 Limitations and Risk

### 8.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Englobe 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 Englobe.

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. Englobe 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 Englobe 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.

### 8.2 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 Englobe 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. Englobe 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 The Sterling Hall School c/o CS&P Architects Inc. and their retained design consultants and is not for use by others. This report is copyright of Englobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Englobe Inc. and The Sterling Hall School c/o CS&P Architects Inc. who are the authorized users.

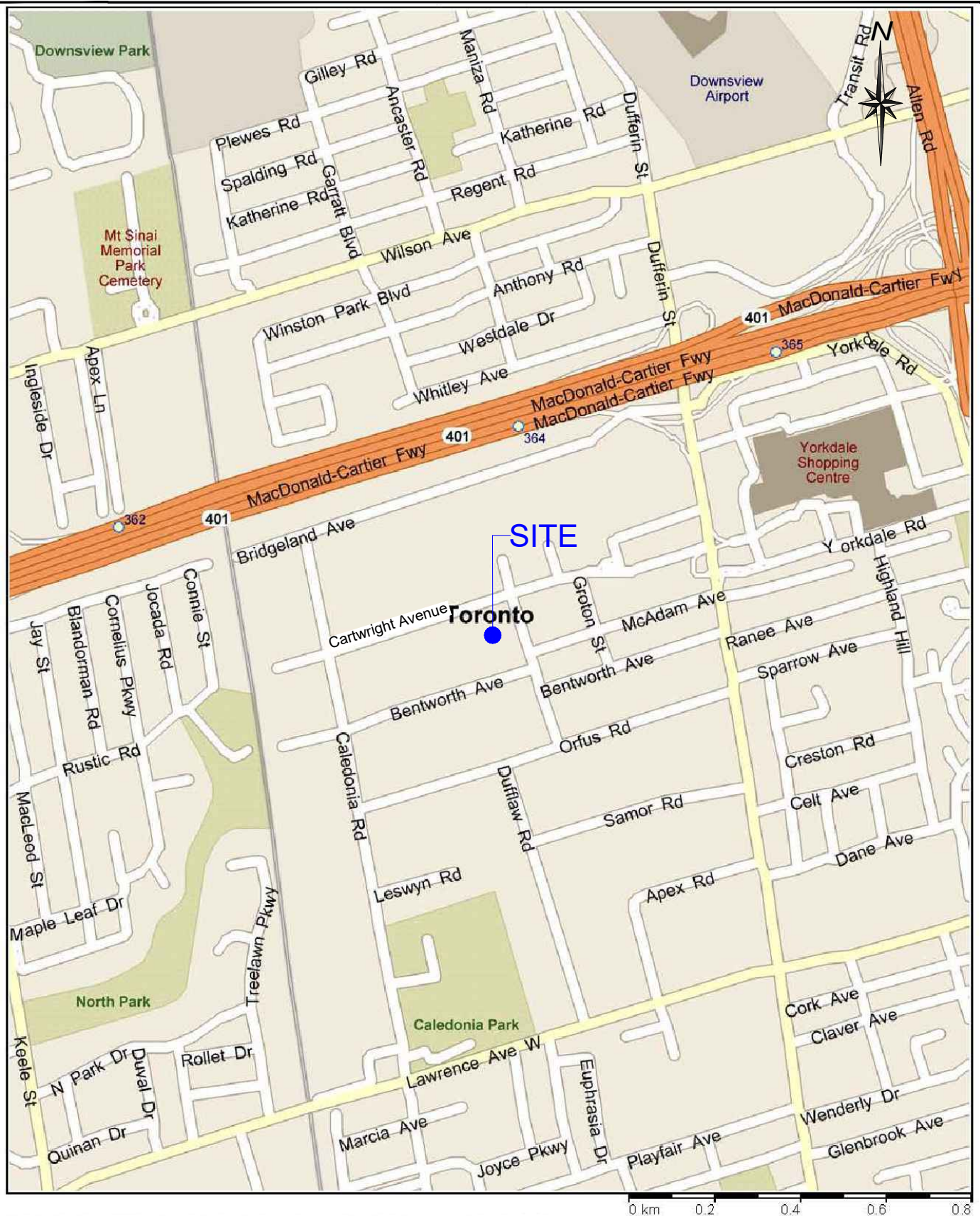
It is recognized that the regulatory agencies, in their capacities as the planning and building authorities under Provincial statutes, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

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.

# Figures



eNGLOBE



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

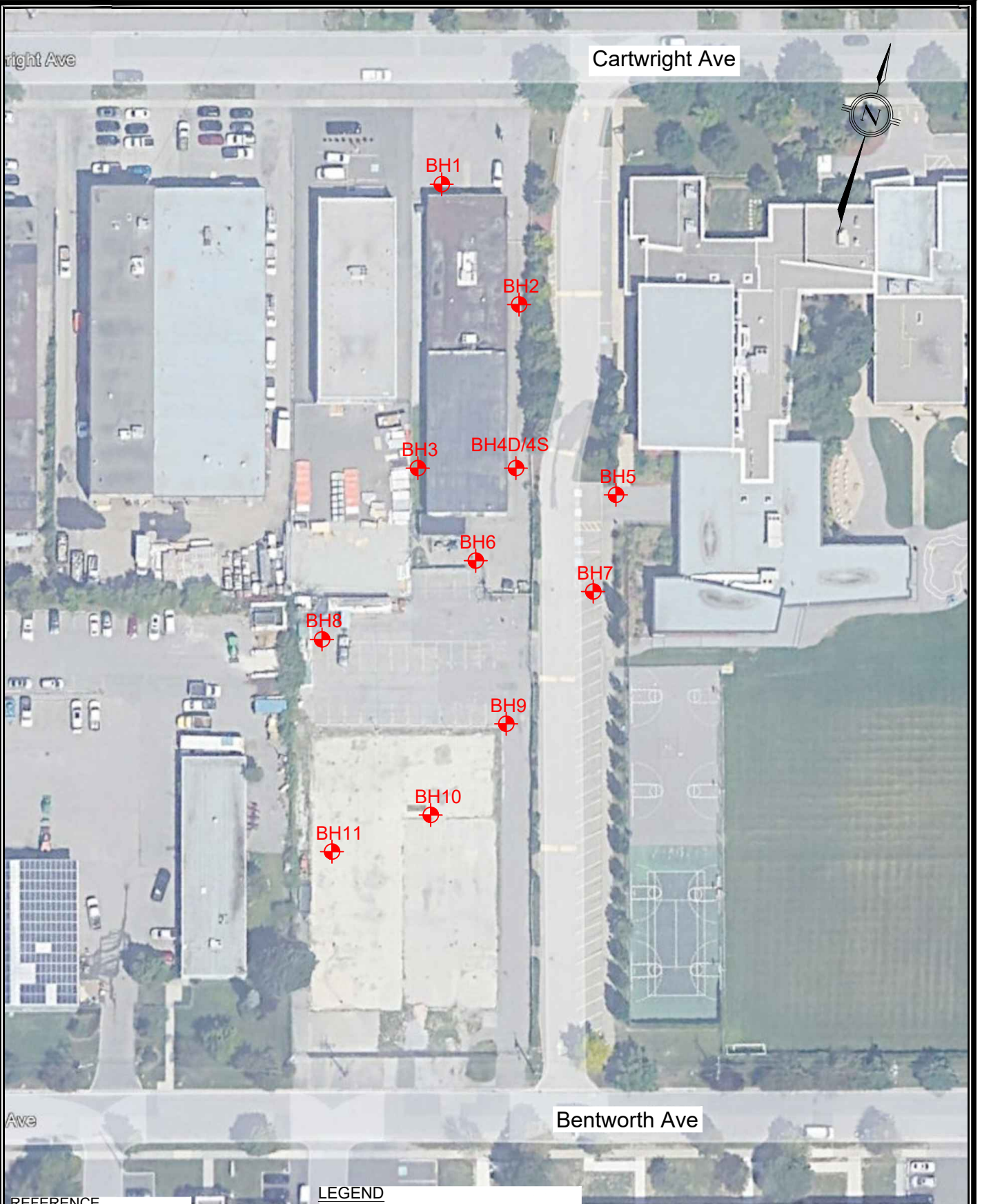
File. No.:

02210387.100

FIGURE :

1





**Terraprobe**

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

Title:

**BOREHOLE LOCATION PLAN**  
**EXISTING CONDITION**

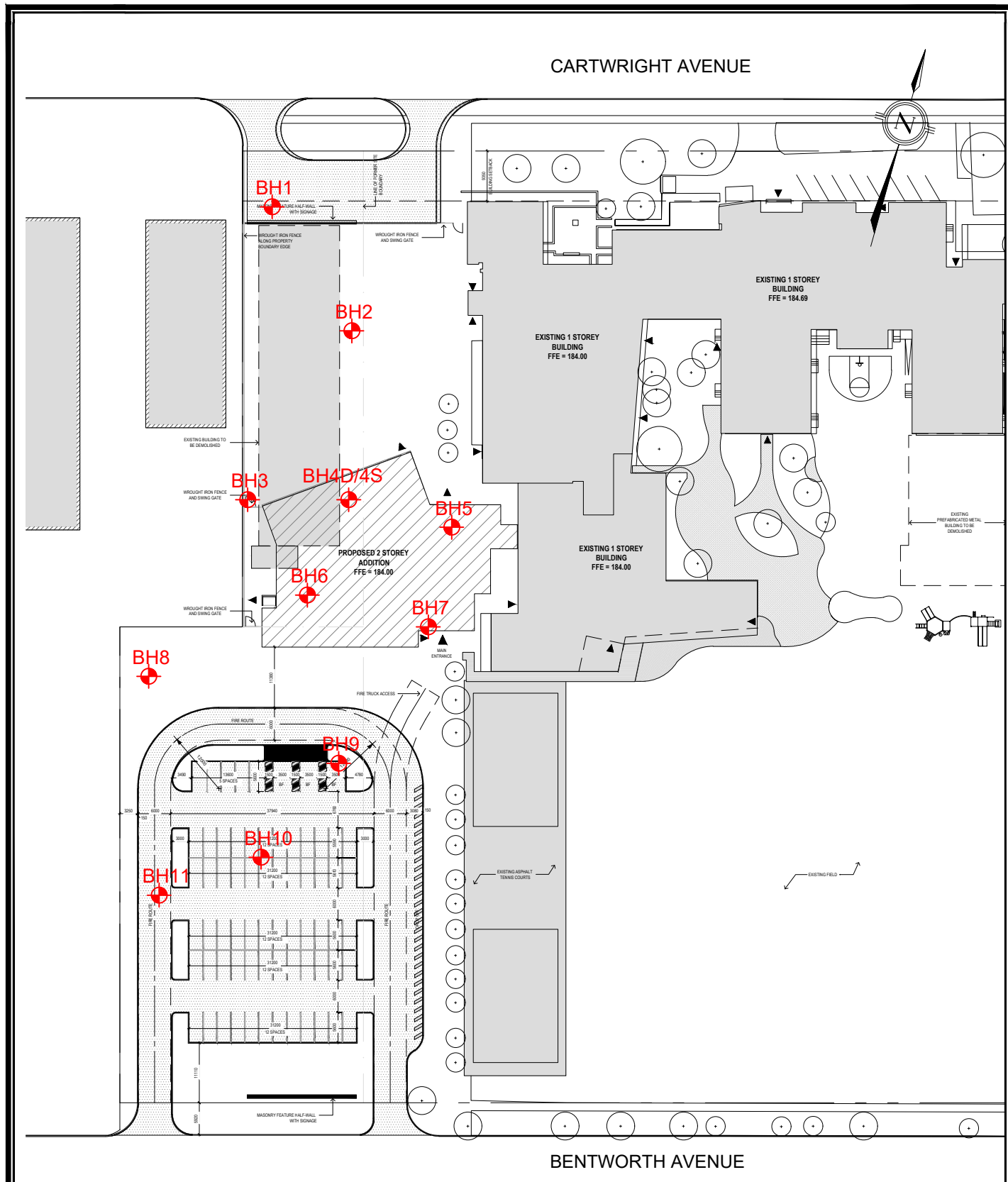
File. No.:

02210387.100

FIGURE :

**2A**

Y:\Shared\CA\Terraprobe\Brampton\1 - Project Files\2022-Englob\02210387.100 - 99 Cartwright Avenue, North York\0100 - Geotechnical Investigation\A. Dwg. Logs\AutoCAD\02210387.100 Figure 2B.dwg, DWG to PDF.pc3, kumai, kumai



#### REFERENCE

Site Plan

Proj. No.: 21032, Dwg. No.: A1.10

By: CS&P Architects

#### LEGEND

Approximate Borehole Location

SCALE 8 0 20m



**Terraprobe**

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

Title:

**BOREHOLE LOCATION PLAN**  
PROPOSED CONDITION

File No.:

02210387.100

FIGURE :

**2B**

# Appendix A

## Borehole Logs



**eNGLOBE**

| SAMPLING METHODS |              | PENETRATION RESISTANCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AS               | Auger sample | <p><b>Standard Penetration Test (SPT)</b> N-value (penetration resistance) is defined as the number of blows required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.) with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).</p> <p><b>Dynamic Cone Penetration Test (DCPT)</b> resistance is defined as the number of blows required to advance a conical steel point 50 mm (2 in.) base diameter tapered 60° to the apex and attached to 'A' size drill rods for a distance of 0.3 m (12 in.), with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).</p> |
| GS               | Grab sample  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| SS               | Split spoon  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ST               | Shelby tube  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| WS               | Wash sample  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| RC               | Rock core    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| SC               | Soil core    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| COHESIONLESS SOILS |                       | COHESIVE SOILS |                       |                                      | MINOR SOIL CONSTITUENTS    |             |
|--------------------|-----------------------|----------------|-----------------------|--------------------------------------|----------------------------|-------------|
| Relative Density   | N-value<br>Blows/0.3m | Consistency    | N-value<br>Blows/0.3m | Undrained<br>Shear Strength<br>(kPa) | Modifier (e.g)             | % by weight |
| Very loose         | < 5                   | Very soft      | < 2                   | < 12                                 | <i>trace</i> (trace silt)  | < 10        |
| Loose              | 5 – 10                | Soft           | 2 – 4                 | 12 – 25                              | <i>some</i> (some silt)    | 10 – 20     |
| Compact            | 10 – 30               | Firm           | 4 – 8                 | 25 – 50                              | (ey) or (y) (sandy)        | 20 – 35     |
| Dense              | 30 – 50               | Stiff          | 8 – 15                | 50 – 100                             | <i>and</i> (sand and silt) | > 35        |
| Very dense         | > 50                  | Very stiff     | 15 – 30               | 100 – 200                            |                            |             |
|                    |                       | Hard           | > 30                  | > 200                                |                            |             |

## TESTS AND SYMBOLS

|                  |                                           |                                                                                     |                                                             |
|------------------|-------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------|
| MH               | combined sieve and hydrometer analysis    |  | Unstabilized water level                                    |
| w,               | water content                             |  | 1 <sup>st</sup> water level measurement                     |
| w <sub>L</sub> , | liquid limit                              |  | 2 <sup>nd</sup> water level measurement                     |
| w <sub>P</sub> , | plastic limit                             |  | Most recent water level measurement                         |
| I <sub>P</sub> , | plasticity index                          |  | Undrained shear strength from field vane (with sensitivity) |
| k                | coefficient of permeability               | C <sub>c</sub>                                                                      | compression index (normally consolidated range)             |
| γ                | soil unit weight, bulk                    | C <sub>r</sub>                                                                      | recompression index (overconsolidated range)                |
| G <sub>s</sub>   | specific gravity                          | C <sub>v</sub>                                                                      | coefficient of consolidation                                |
| φ'               | effective angle of internal friction      | m <sub>v</sub>                                                                      | coefficient of compressibility (volume change)              |
| c'               | effective cohesion                        | e                                                                                   | void ratio                                                  |
| C <sub>u</sub>   | undrained shear strength (φ = 0 analysis) |                                                                                     |                                                             |

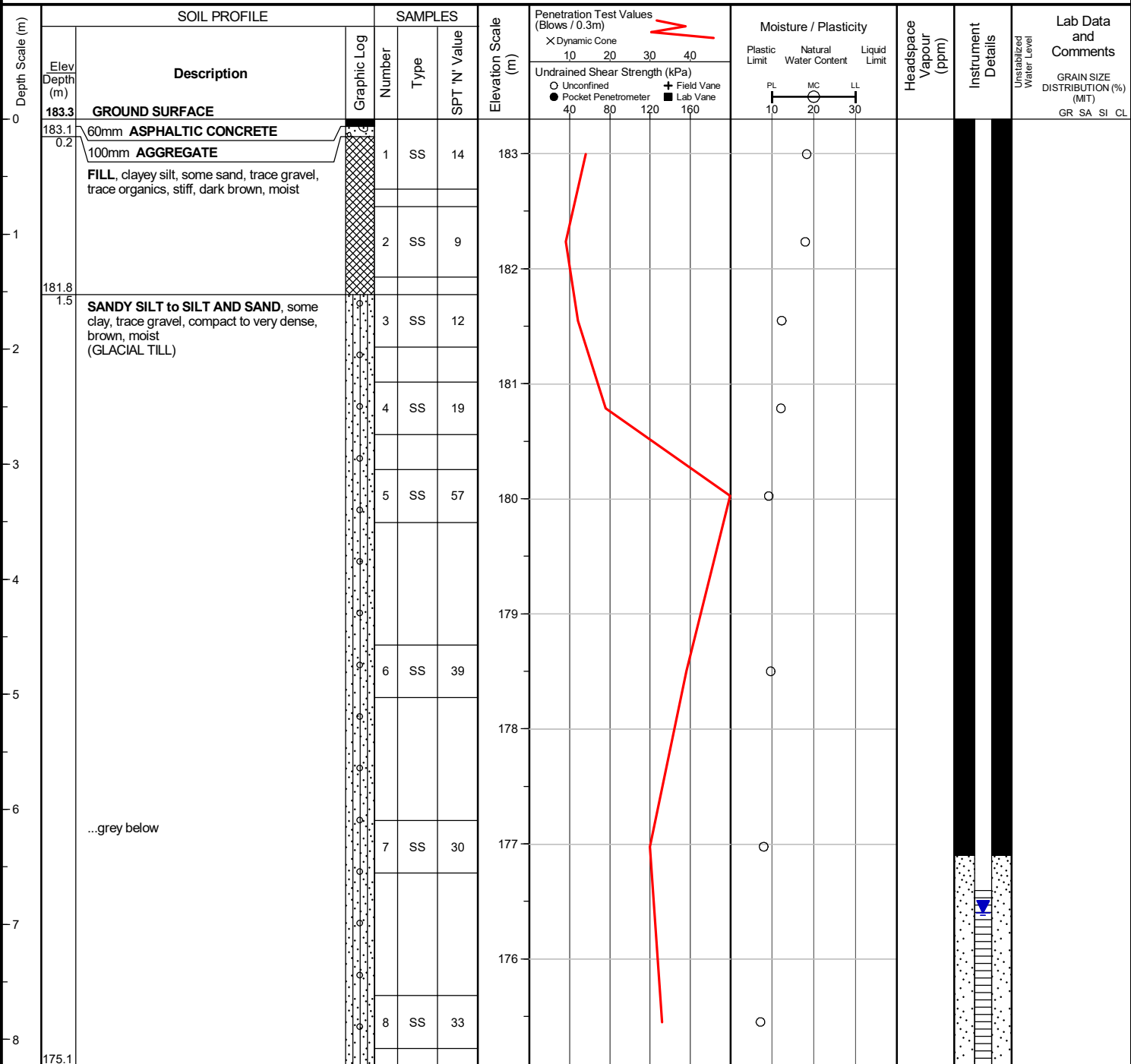
## FIELD MOISTURE DESCRIPTIONS

|              |                                                                                                                                     |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Dry</b>   | refers to a soil sample with a moisture content well below optimum ( $w < w_{opt}$ ), absence of moisture, dusty, dry to the touch. |
| <b>Moist</b> | refers to a soil sample with a moisture content at or near optimum ( $w \approx w_{opt}$ ), no visible pore water.                  |
| <b>Wet</b>   | refers to a soil sample with a moisture content well above optimum ( $w > w_{opt}$ ), has visible pore water.                       |



|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 20, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623636, N: 4842151 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



Borehole was dry and open upon completion of drilling.

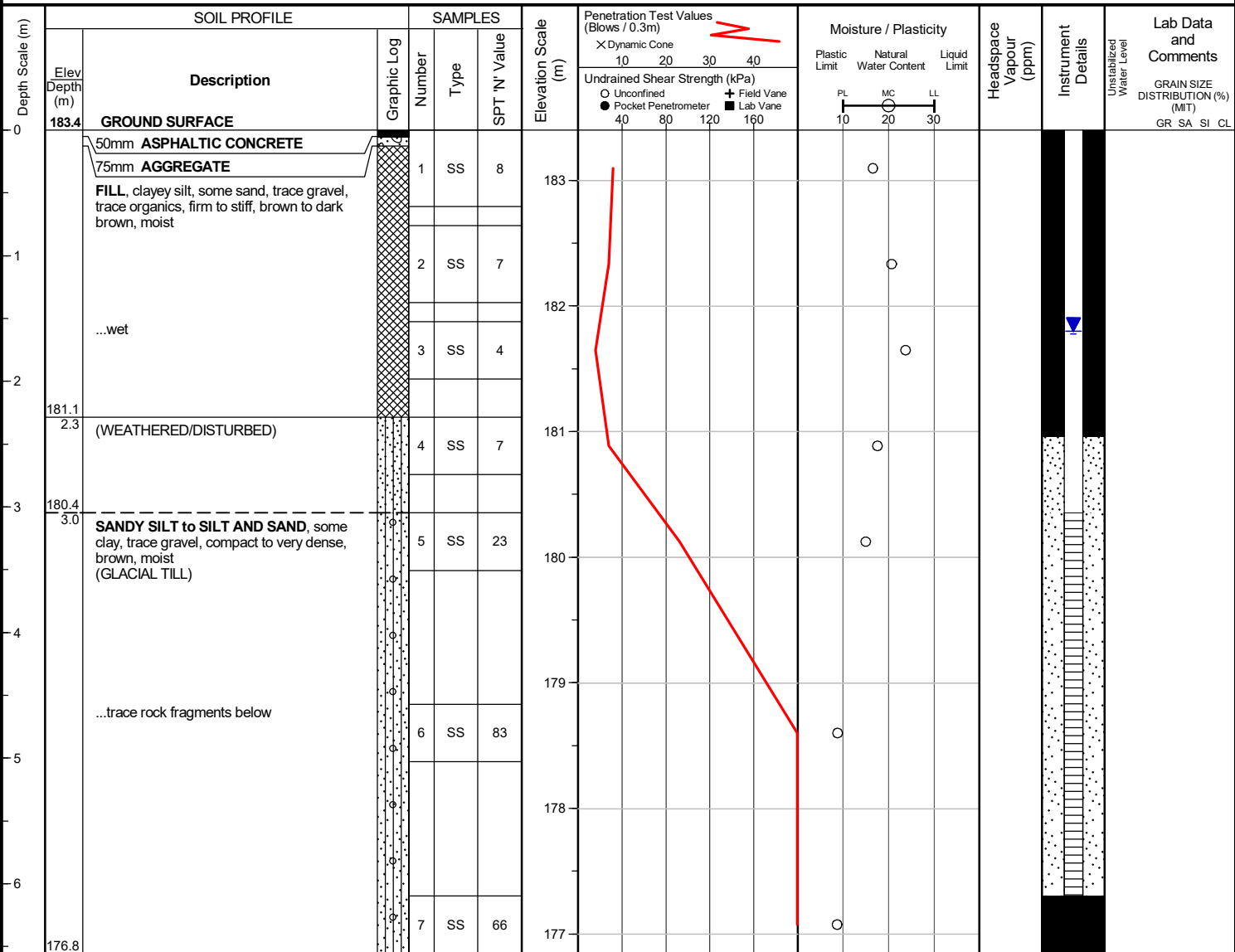
50 mm dia. monitoring well installed.

**WATER LEVEL READINGS**

|             |                        |                      |
|-------------|------------------------|----------------------|
| <u>Date</u> | <u>Water Depth (m)</u> | <u>Elevation (m)</u> |
| Jan 6, 2023 | 6.9                    | 176.4                |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 20, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623658, N: 4842132 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**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) |
|-------------|-----------------|---------------|
| Jan 6, 2023 | 1.6             | 181.8         |



Originated by : RS

Compiled by : OH

Checked by : RS

Drilling Method : Solid stem augers

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

| <u>Date</u> | <u>Water Depth (m)</u> | <u>Elevation (m)</u> |
|-------------|------------------------|----------------------|
| Jan 6, 2023 | 0.8                    | 182.7                |

Project No. : 02210387.000      Client : The Sterling Hall School      Originated by : RS  
 Date started : December 20, 2022      Project : 99 Cartwright Avenue      Compiled by : OH  
 Sheet No. : 1 of 2      Location : Toronto, Ontario      Checked by : RS

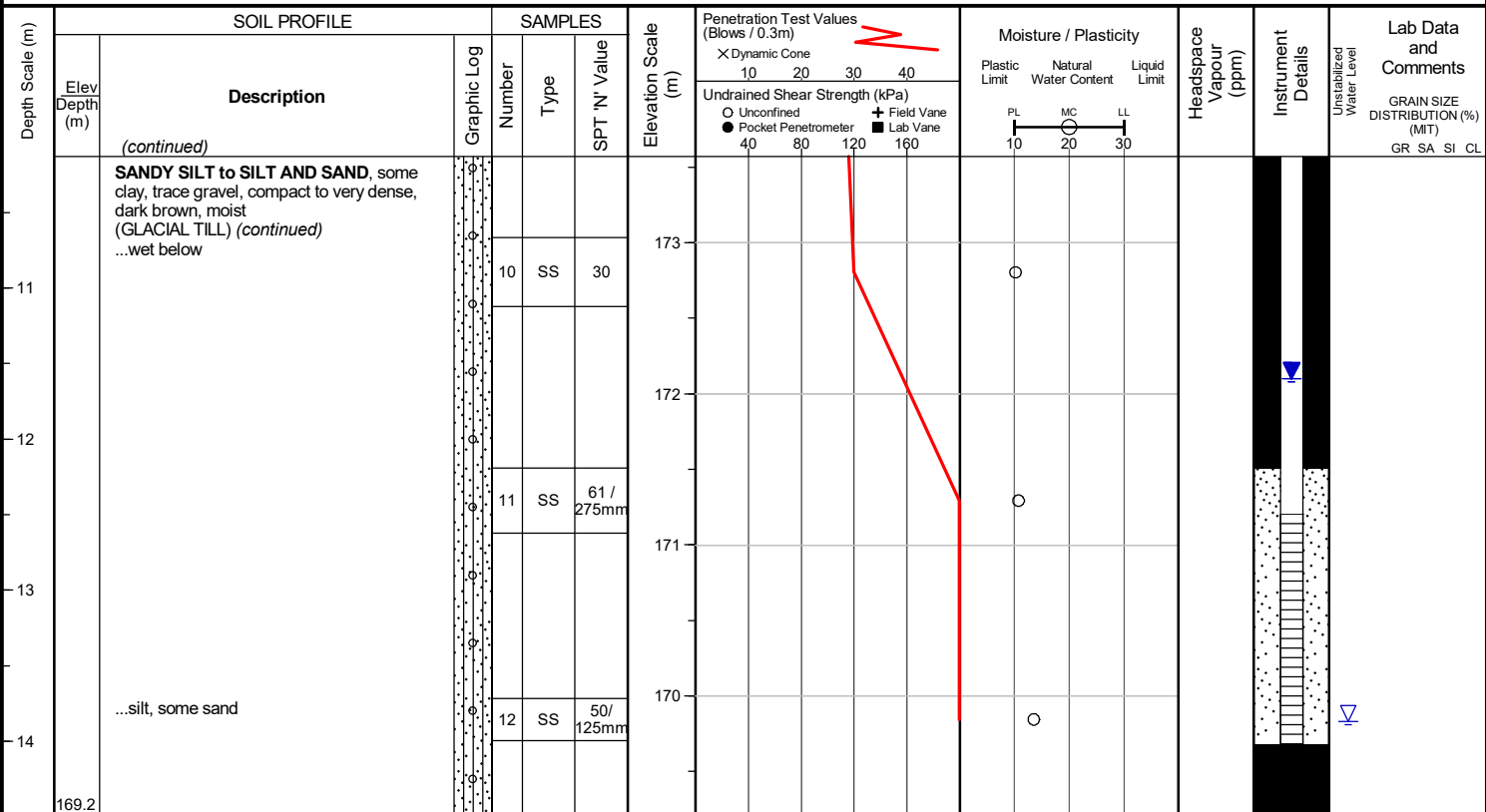
Position : E: 623667, N: 4842101 (UTM 17T)      Elevation Datum : Geodetic  
 Rig type : Track-mounted      Drilling Method : Solid stem augers

| Depth Scale (m) | SOIL PROFILE   |                                                                                                                 |             | SAMPLES |      |               | Elevation Scale (m) | Penetration Test Values (Blows / 0.3m) |                                | Moisture / Plasticity |                       |              | Headspace Vapour (ppm) | Instrument Details | Lab Data and Comments |
|-----------------|----------------|-----------------------------------------------------------------------------------------------------------------|-------------|---------|------|---------------|---------------------|----------------------------------------|--------------------------------|-----------------------|-----------------------|--------------|------------------------|--------------------|-----------------------|
|                 | Elev Depth (m) | Description                                                                                                     | Graphic Log | Number  | Type | SPT 'N' Value |                     | Dynamic Cone                           | Undrained Shear Strength (kPa) | Plastic Limit         | Natural Water Content | Liquid Limit |                        |                    |                       |
| 0               | 183.7          | GROUND SURFACE                                                                                                  |             |         |      |               |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 183.4          | 50mm ASPHALTIC CONCRETE                                                                                         |             | 1       | SS   | 20            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 183.3          | 275mm AGGREGATE                                                                                                 |             |         |      |               |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 182.9          | FILL, clayey silt, some sand, trace gravel, trace organics, very stiff, dark brown, moist (WEATHERED/DISTURBED) |             | 2       | SS   | 14            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 182.2          | SANDY SILT to SILT AND SAND, some clay, trace gravel, compact to very dense, dark brown, moist (GLACIAL TILL)   |             | 3       | SS   | 20            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 181.5          | ...trace rock fragments                                                                                         |             | 4       | SS   | 16            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 180.8          | ...grey below                                                                                                   |             | 5       | SS   | 30            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 179.8          | ...trace rock fragments                                                                                         |             | 6       | SS   | 23            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 178.8          | ...trace rock fragments                                                                                         |             | 7       | SS   | 21            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 177.8          | ...trace rock fragments                                                                                         |             | 8       | SS   | 21            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 176.8          | ...trace rock fragments                                                                                         |             | 9       | SS   | 28            |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 175.8          | ...trace rock fragments                                                                                         |             |         |      |               |                     |                                        |                                |                       |                       |              |                        |                    |                       |
|                 | 174.8          | ...trace rock fragments                                                                                         |             |         |      |               |                     |                                        |                                |                       |                       |              |                        |                    |                       |

(continued next page)

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 20, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 2 of 2               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623667, N: 4842101 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



## END OF BOREHOLE

Unstabilized water level measured at 13.9 m below ground surface; borehole caved to 14.0 m below ground surface upon completion of drilling.

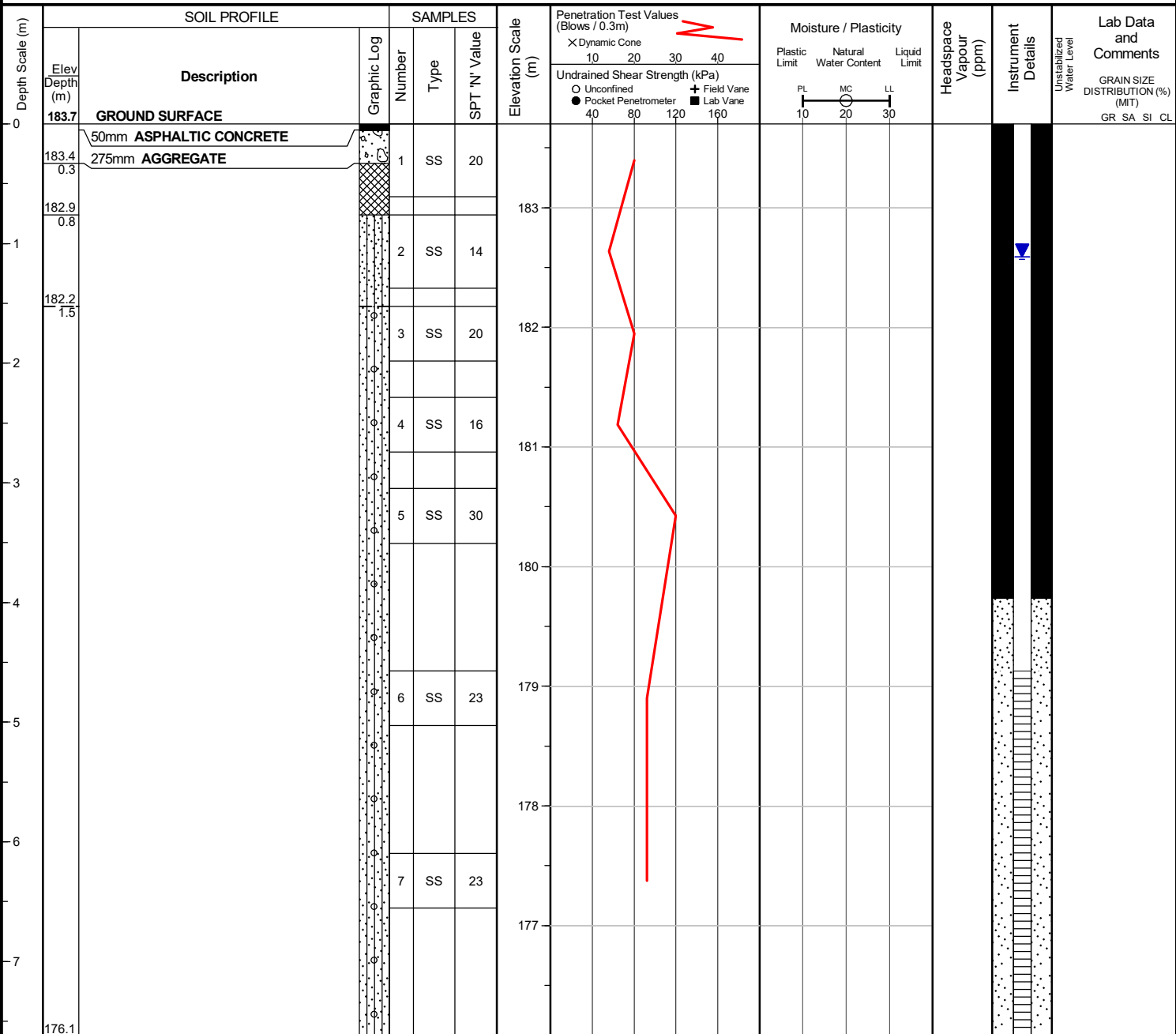
50 mm dia. monitoring well installed.

## WATER LEVEL READINGS

| Date        | Water Depth (m) | Elevation (m) |
|-------------|-----------------|---------------|
| Jan 6, 2023 | 11.6            | 172.1         |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 20, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623668, N: 4842103 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

|             |                        |                      |
|-------------|------------------------|----------------------|
| <u>Date</u> | <u>Water Depth (m)</u> | <u>Elevation (m)</u> |
| Jan 6, 2023 | 1.1                    | 182.6                |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 21, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623688, N: 4842103 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |

| Depth Scale (m) | SOIL PROFILE   |                                                                                                               |             | SAMPLES |      |               | Elevation Scale (m) | Penetration Test Values<br>(Blows / 0.3m)<br>X Dynamic Cone<br>Undrained Shear Strength (kPa)<br>○ Unconfined    ● Pocket Penetrometer<br>+ Field Vane    ■ Lab Vane | Moisture / Plasticity |                       |              | Headspace Vapour (ppm) | Instrument Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|-----------------|----------------|---------------------------------------------------------------------------------------------------------------|-------------|---------|------|---------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|--------------|------------------------|--------------------|---------------------------------------------------------------------------|
|                 | Elev Depth (m) | Description                                                                                                   | Graphic Log | Number  | Type | SPT 'N' Value |                     |                                                                                                                                                                      | Plastic Limit         | Natural Water Content | Liquid Limit |                        |                    |                                                                           |
| 0               | 183.5          | <b>GROUND SURFACE</b>                                                                                         |             |         |      |               |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
| 0.2             | 183.3          | 80mm <b>ASPHALTIC CONCRETE</b>                                                                                |             |         |      |               |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                | 145mm <b>AGGREGATE</b>                                                                                        |             | 1       | SS   | 7             |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                | <b>FILL</b> , clayey silt, some sand, trace gravel, trace organics, firm to stiff, dark brown, moist ...brown |             | 2       | SS   | 14            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 | 182.0          |                                                                                                               |             |         |      |               |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 | 1.5            | <b>SANDY SILT to SILT AND SAND</b> , some clay, trace gravel, compact to dense, brown, moist (GLACIAL TILL)   |             | 3       | SS   | 22            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                |                                                                                                               |             | 4       | SS   | 37            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                | ...brownish grey                                                                                              |             | 5       | SS   | 34            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                |                                                                                                               |             | 6       | SS   | 27            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                | ...grey below                                                                                                 |             | 7       | SS   | 34            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
|                 |                |                                                                                                               |             | 8       | SS   | 38            |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |
| 8               | 175.4          |                                                                                                               |             |         |      |               |                     |                                                                                                                                                                      |                       |                       |              |                        |                    |                                                                           |

**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

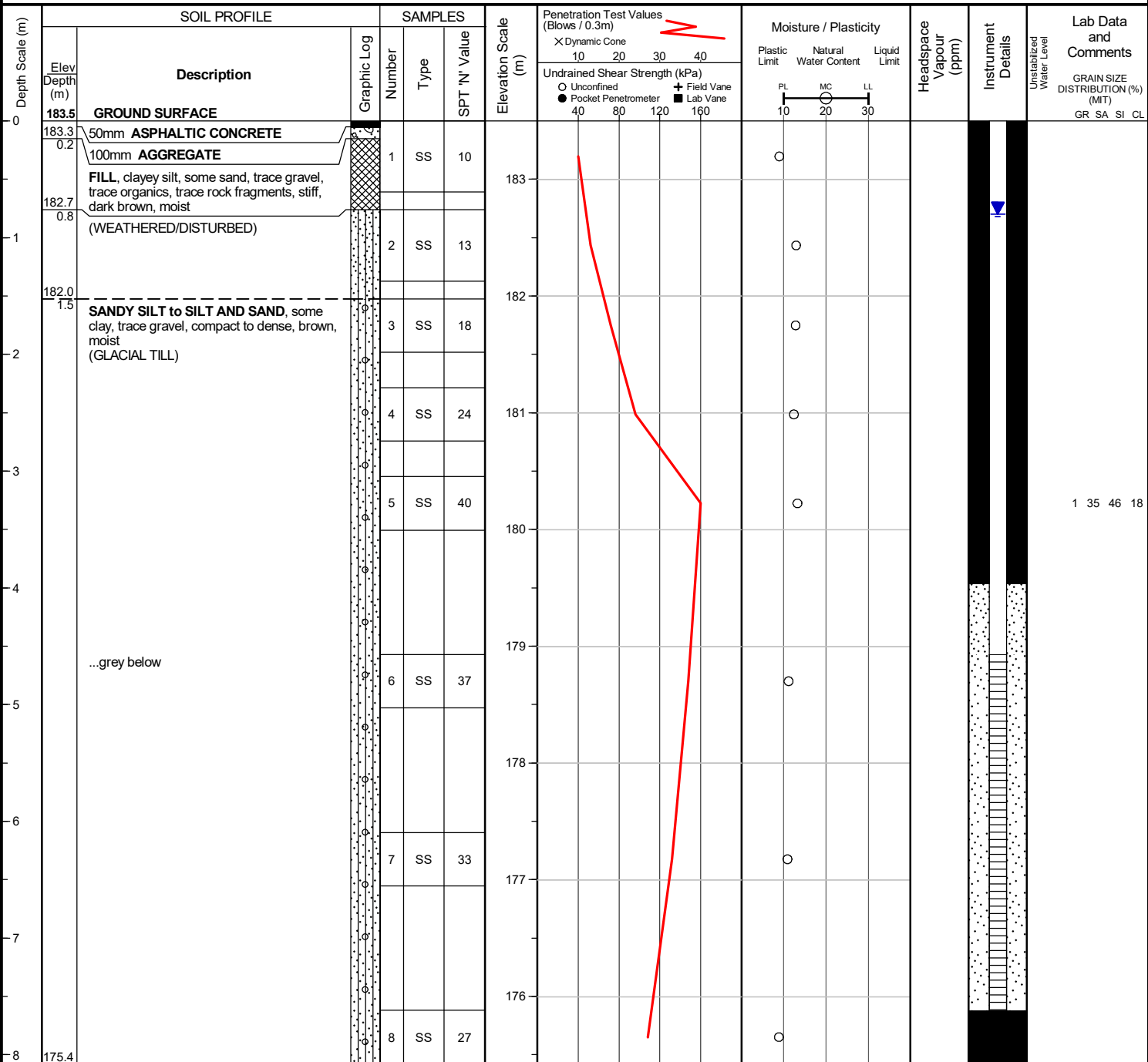
50 mm dia. monitoring well installed.

WATER LEVEL READINGS

| Date        | Water Depth (m) | Elevation (m) |
|-------------|-----------------|---------------|
| Jan 6, 2023 | 6.2             | 177.3         |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 20, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623665, N: 4842083 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

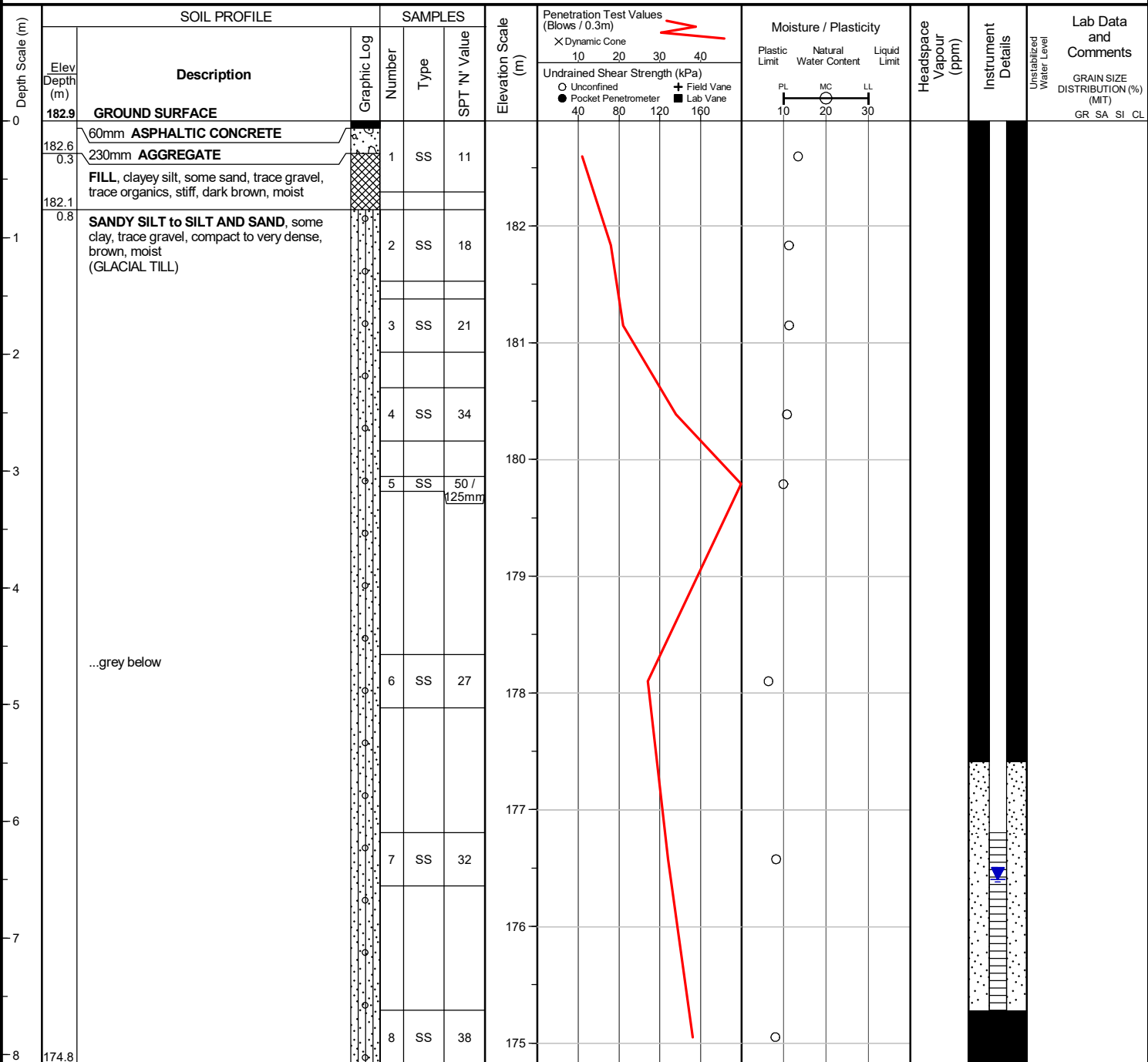
50 mm dia. monitoring well installed.

WATER LEVEL READINGS  
**Date**    **Water Depth (m)**    **Elevation (m)**  
 Jan 6, 2023    0.8    182.7



|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 21, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623688, N: 4842087 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**END OF BOREHOLE**

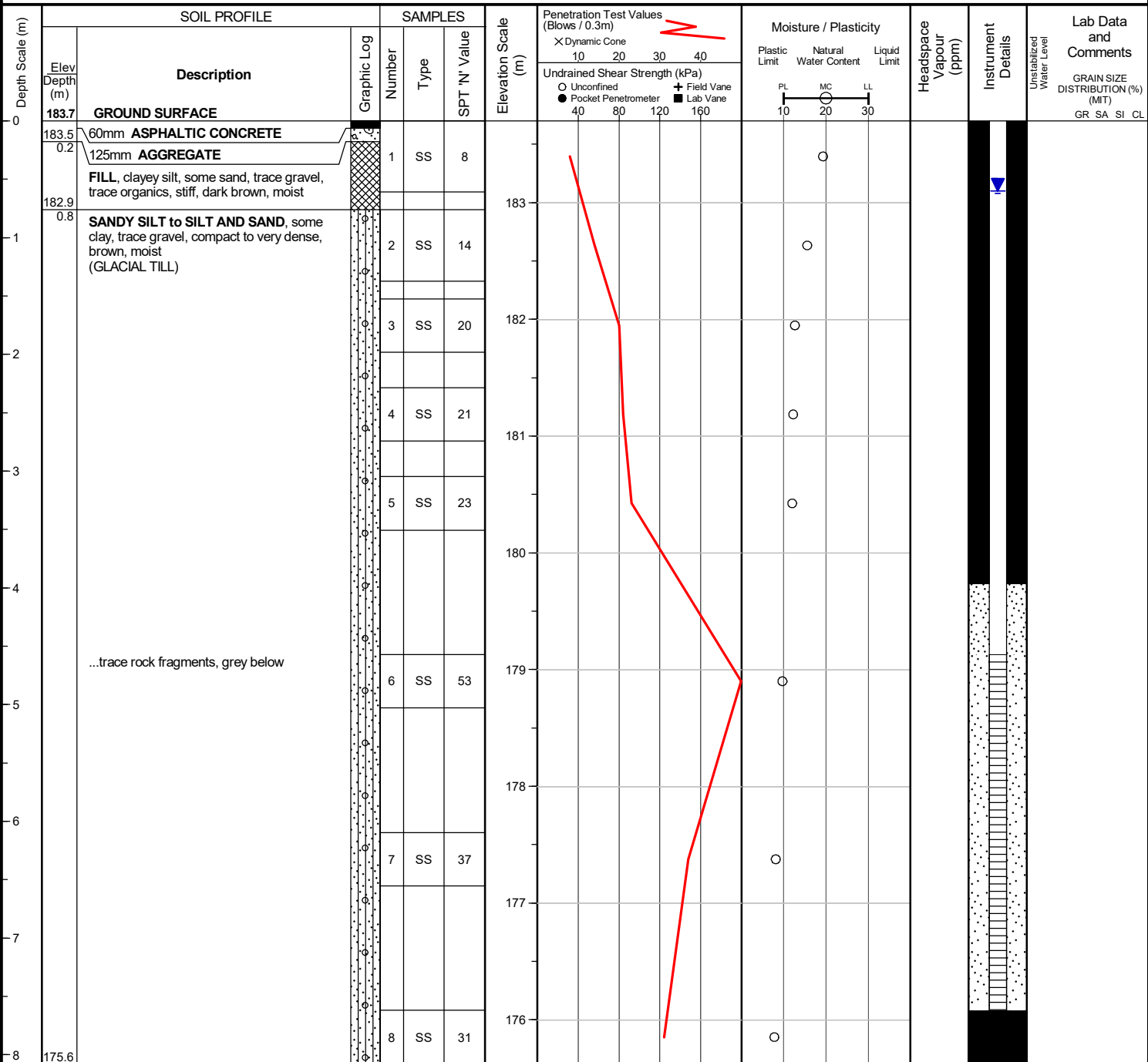
Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS  
**Date**    **Water Depth (m)**    **Elevation (m)**  
 Jan 6, 2023    6.5    176.4

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 22, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623643, N: 4842059 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

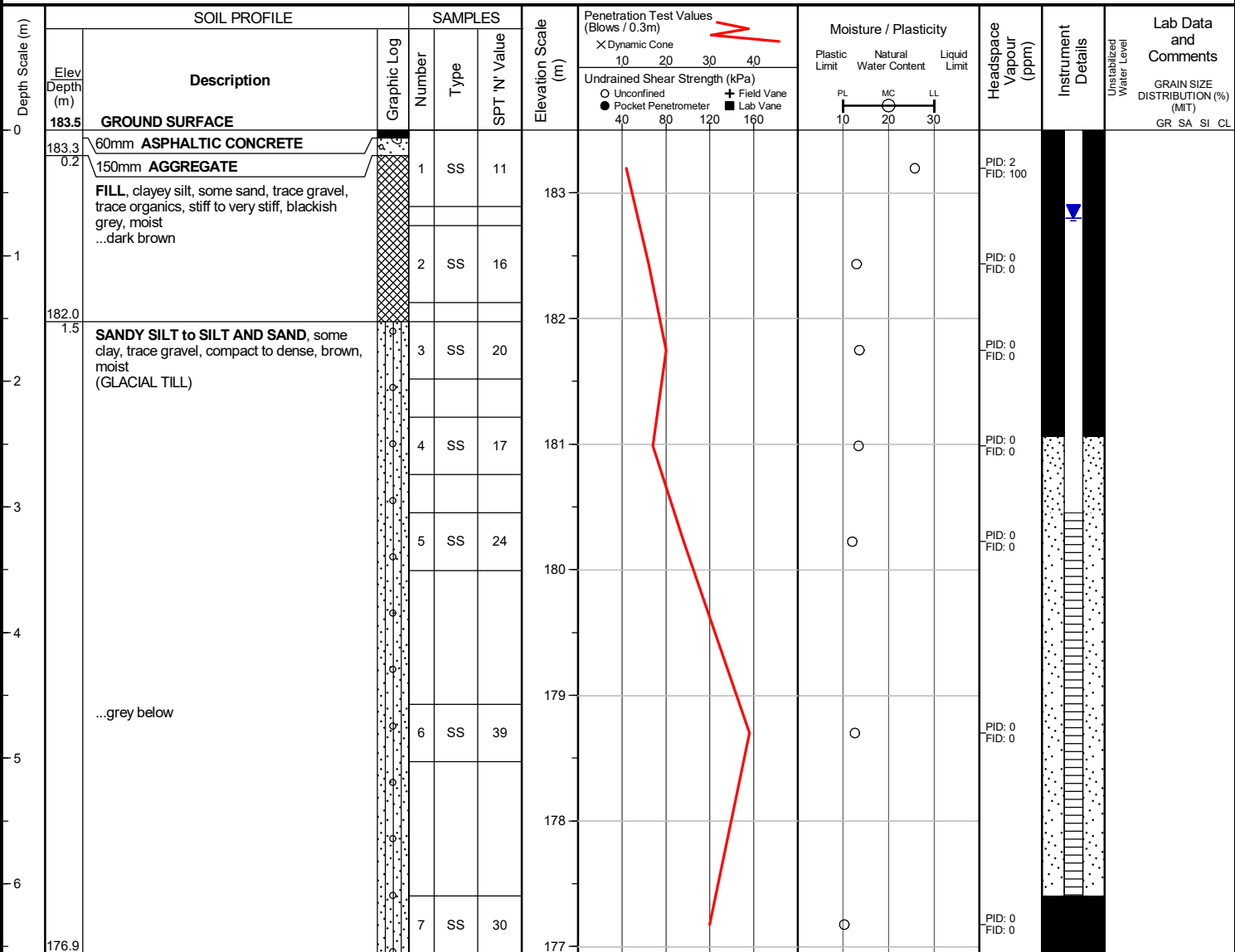
50 mm dia. monitoring well installed.

WATER LEVEL READINGS

|             |                        |                      |
|-------------|------------------------|----------------------|
| <u>Date</u> | <u>Water Depth (m)</u> | <u>Elevation (m)</u> |
| Jan 6, 2023 | 0.6                    | 183.1                |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 21, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623679, N: 4842056 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

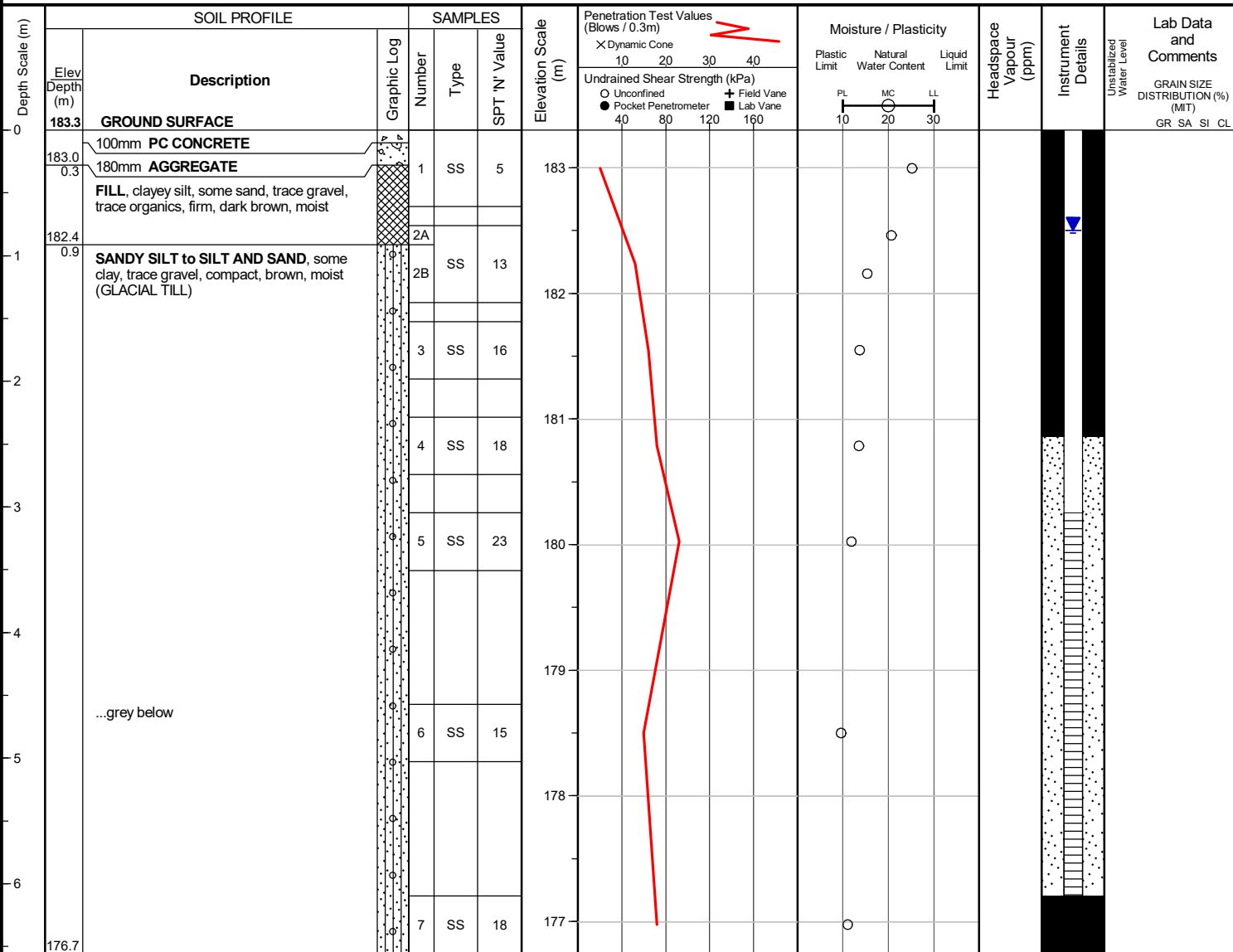
50 mm dia. monitoring well installed.

**WATER LEVEL READINGS**

| Date        | Water Depth (m) | Elevation (m) |
|-------------|-----------------|---------------|
| Jan 6, 2023 | 0.7             | 182.8         |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 22, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |  |
|--------------------------------------------|-------------------------------------|--|
| Position : E: 623671, N: 4842034 (UTM 17T) | Elevation Datum : Geodetic          |  |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |  |



**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

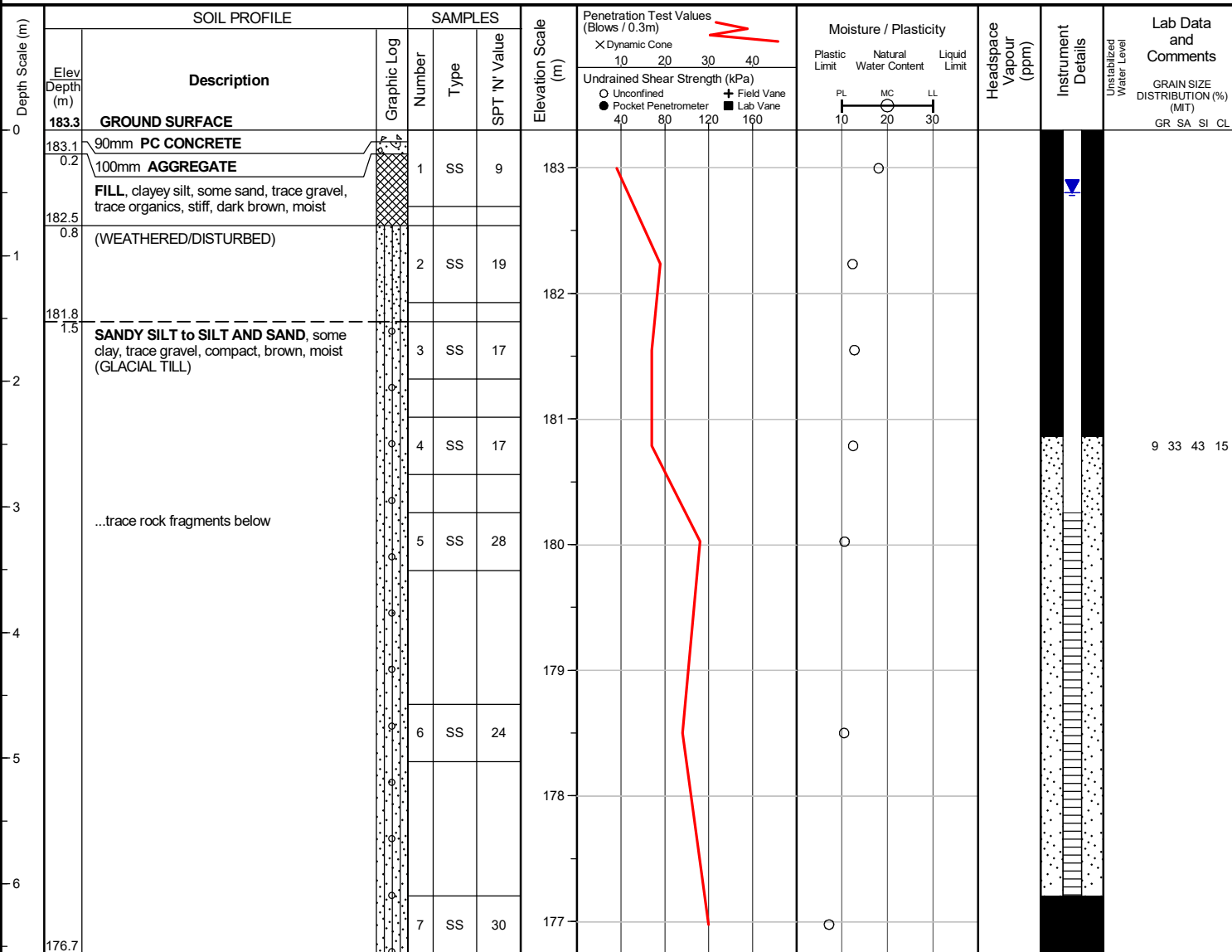
50 mm dia. monitoring well installed.

WATER LEVEL READINGS

| Date        | Water Depth (m) | Elevation (m) |
|-------------|-----------------|---------------|
| Jan 6, 2023 | 0.8             | 182.5         |

|                                  |                                   |                    |
|----------------------------------|-----------------------------------|--------------------|
| Project No. : 02210387.000       | Client : The Sterling Hall School | Originated by : RS |
| Date started : December 22, 2022 | Project : 99 Cartwright Avenue    | Compiled by : OH   |
| Sheet No. : 1 of 1               | Location : Toronto, Ontario       | Checked by : RS    |

|                                            |                                     |
|--------------------------------------------|-------------------------------------|
| Position : E: 623658, N: 4842023 (UTM 17T) | Elevation Datum : Geodetic          |
| Rig type : Track-mounted                   | Drilling Method : Solid stem augers |



**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

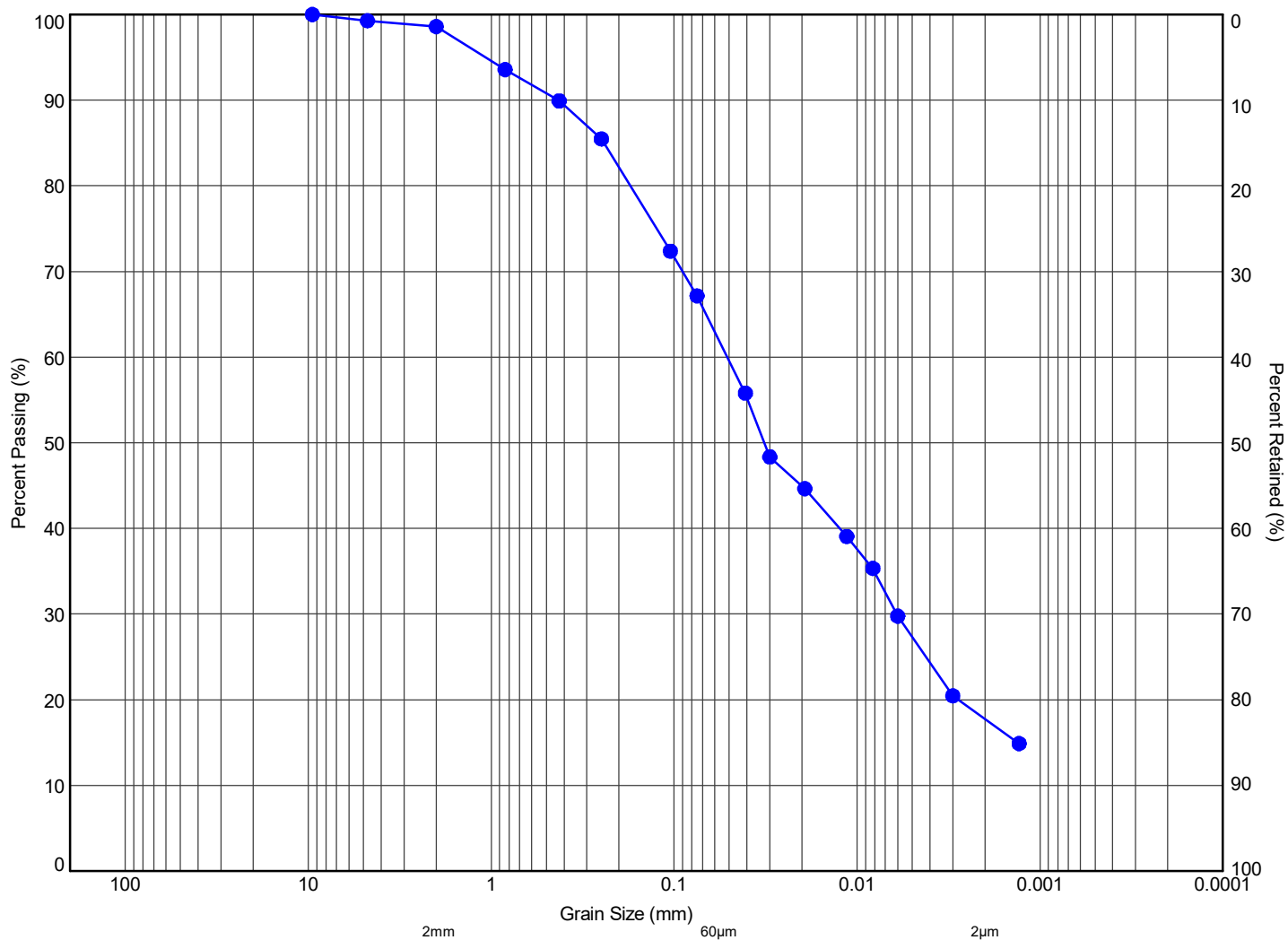
|             |                        |                      |
|-------------|------------------------|----------------------|
| <u>Date</u> | <u>Water Depth (m)</u> | <u>Elevation (m)</u> |
| Jan 6, 2023 | 0.5                    | 182.8                |

# Appendix B

## Geotechnical Laboratory Test Results



**eNGLOBE**



| 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, %) |
|---------|--------|-----------|-----------|------------|----------|----------|----------|------------|
| 3       | SS3    | 1.8       | 181.7     | 1          | 36       | 45       | 18       |            |



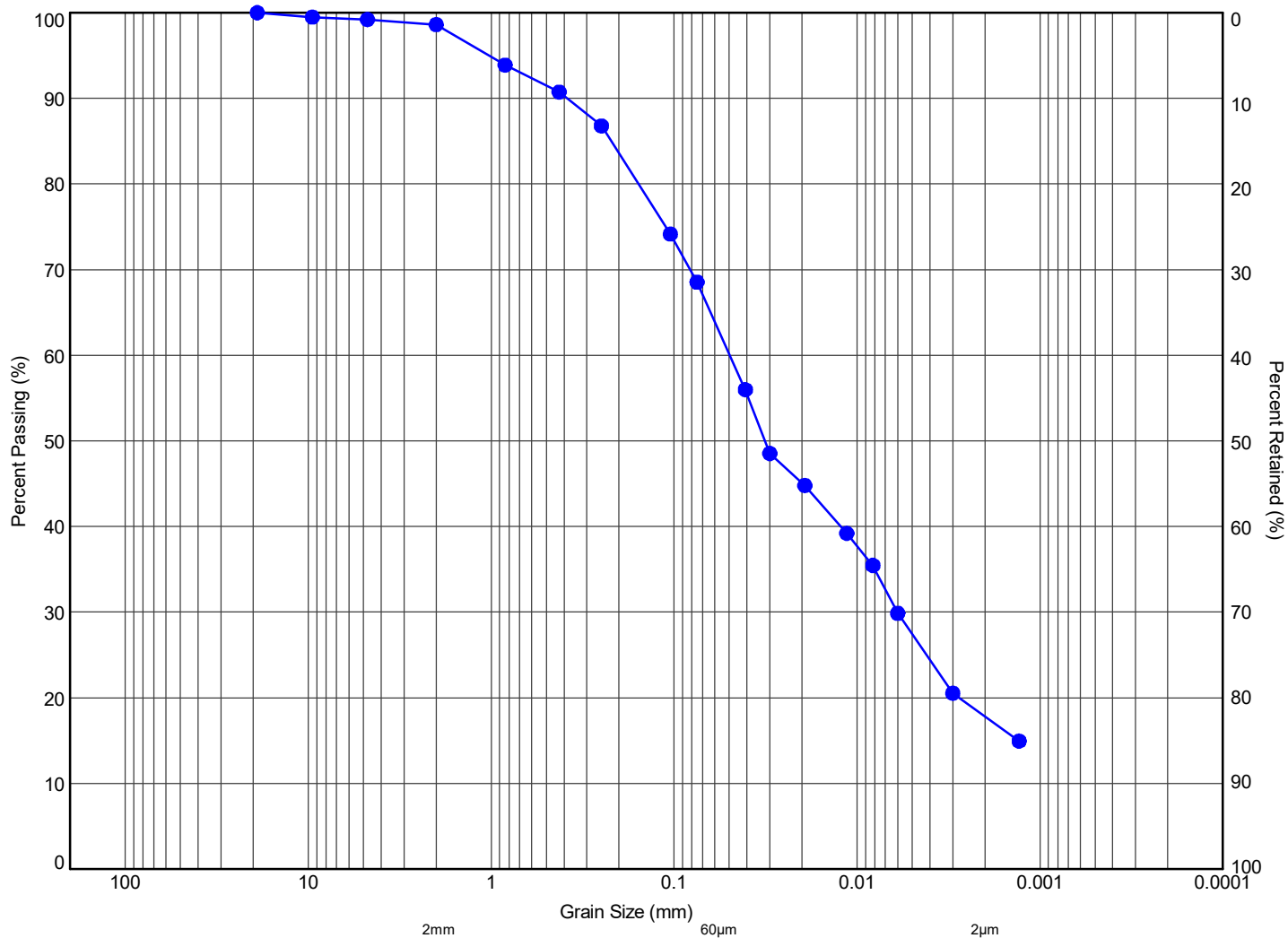
11 Indell Lane, Brampton Ontario L6T 3Y3  
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION  
SANDY SILT, SOME CLAY, TRACE GRAVEL**

File No.:

**02210387.000**



| 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, %) |
|---------|--------|-----------|-----------|------------|----------|----------|----------|------------|
| 6       | SS5    | 3.3       | 180.2     | 1          | 35       | 46       | 18       |            |



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

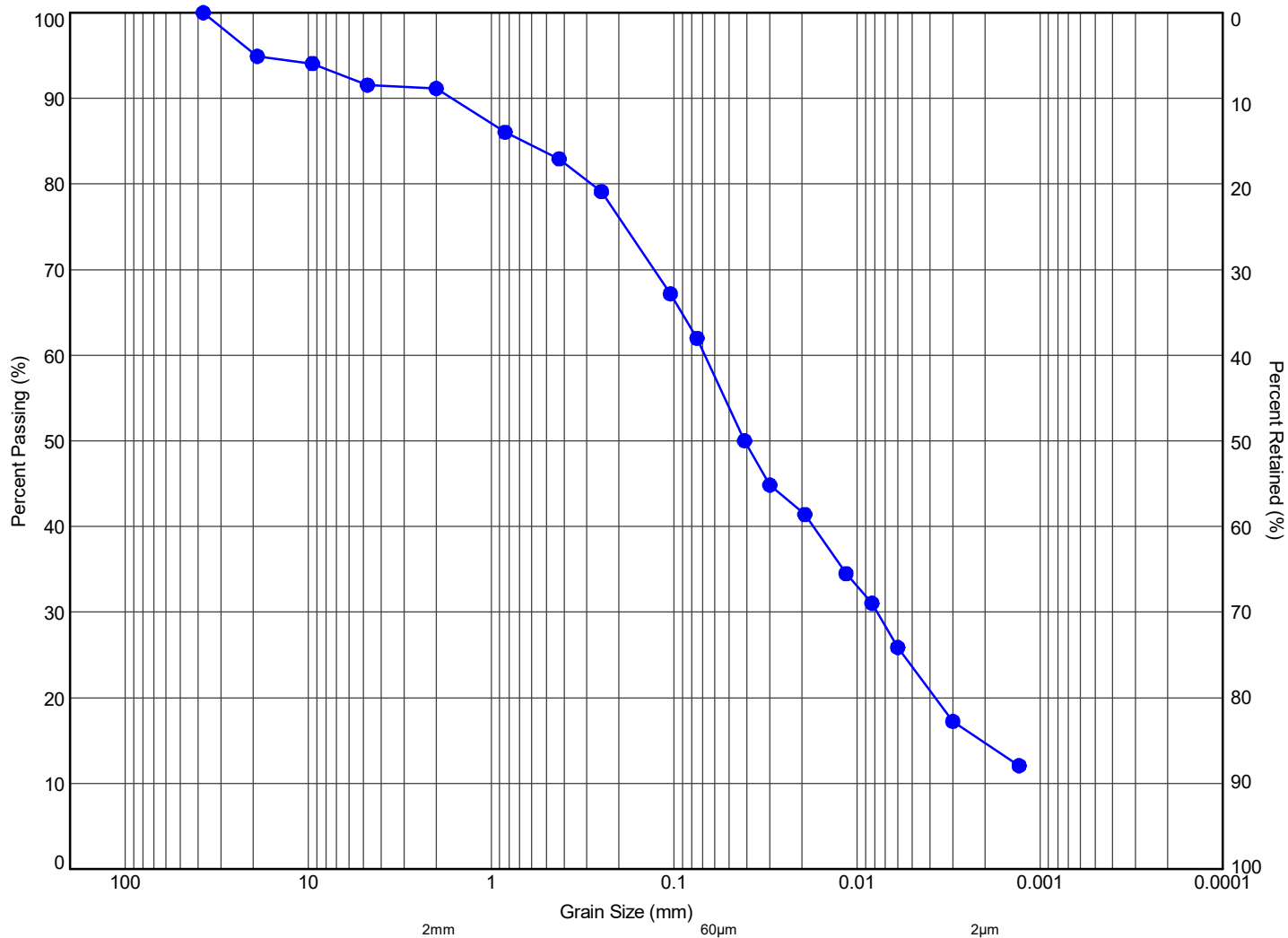
Title:

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

File No.:

**02210387.000**





| 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, %) |  |
| ● 11       | SS4    | 2.5       | 180.8     | 9          | 33       | 43       | 15       |            |  |



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

Title:

**GRAIN SIZE DISTRIBUTION  
SANDY SILT, SOME CLAY, TRACE GRAVEL**

File No.:

**02210387.000**