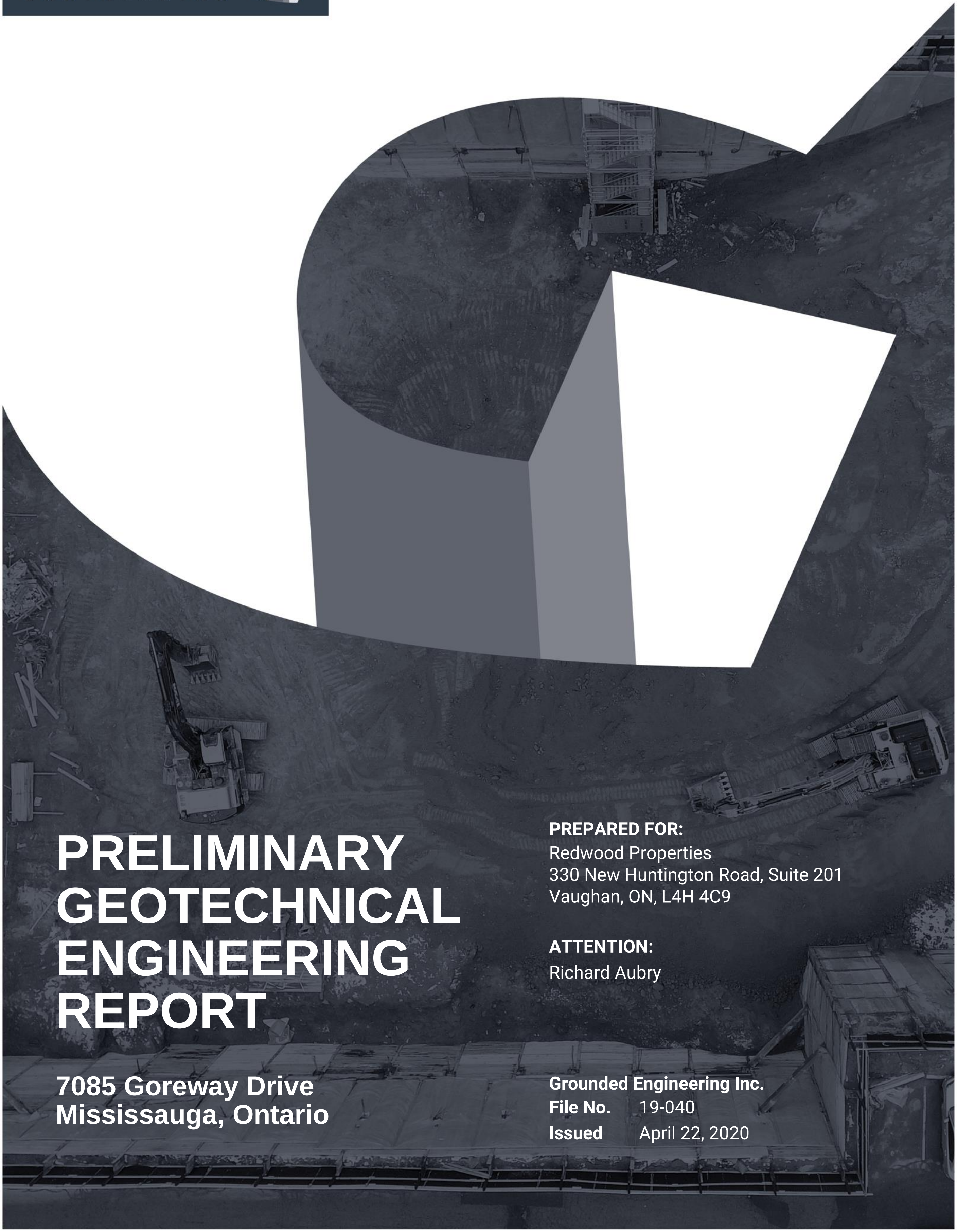

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

7085 Goreway Drive
Mississauga, Ontario

PREPARED FOR:
Redwood Properties
330 New Huntington Road, Suite 201
Vaughan, ON, L4H 4C9

ATTENTION:
Richard Aubry

Grounded Engineering Inc.
File No. 19-040
Issued April 22, 2020

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FIGURES

APPENDICES

1 Introduction

Redwood Properties has retained Grounded Engineering Inc. ("Grounded") to provide preliminary geotechnical engineering design advice in advance of the subsurface investigation for their proposed development at 7085 Goreway Drive, in Mississauga, Ontario.

The proposed project includes demolishing the existing retail structure and constructing two 18 to 16-storey residential towers connected by a 2-storey podium, and a block of townhouses. The new structures will have three levels of shared underground parking (P3) with a Finished Floor Elevation (FFE) at Elev. 156.7 m. As the site backs onto the unconfined valley of a branch of Mimico Creek. Although the valleylands are regulated by TRCA, a slope stability opinion or analysis is not required since there is no defined top of bank. The development limits of the site will be regulated by the position of the flood plain as determined by others.

Grounded has been provided with the following reports and drawings to assist in our preliminary geotechnical engineering assessment:

- IBI Group, "OPA/Rezoning Submission Draft", Project No. 120212, dated September 6, 2019.
- Soil Engineers Ltd., "Geotechnical Investigation, Proposed Property Acquisition, 7085 Goreway Drive, City of Mississauga", Reference No. 1609-S061, dated October 17, 2016.

Grounded has been provided with factual borehole information from other consultants as listed above. Those borehole logs are provided in a professional engineer's signed and sealed report. As such, this borehole information (appended) is taken as factual for present purposes.

Based on the borehole findings, geotechnical engineering advice for the proposed development is provided for foundations, seismic site classification, earth pressure design, slab on grade design, and basement drainage. Construction considerations including excavation, groundwater control, and shoring design advice are also provided.

This preliminary geotechnical engineering report is appropriate for due diligence and planning purposes only. Additional boreholes, wells, and a detailed geotechnical engineering report will be required at for detailed design.

Grounded Engineering must conduct the on-site evaluation of founding subgrade as foundation and slab construction proceeds. This is a vital and essential part of the geotechnical engineering function and must not be grouped together with other "third-party inspection services". Grounded will not accept responsibility for foundation performance if Grounded is not retained to carry out all the foundation evaluations during construction.

To facilitate TRCA permitting of development adjacent to a slope, a visual slope inspection was completed and an opinion of the slope stability has been provided.

2 Ground Conditions

The borehole results are detailed on the attached borehole logs, created by other consultants in 2016. Our assessment of the relevant stratigraphic units is intended to highlight the strata as they relate to geotechnical engineering. The ground conditions will vary between and beyond the borehole locations.

The stratigraphic boundary lines shown on the borehole logs are assessed from non-continuous samples supplemented by drilling observations. These stratigraphic boundary lines represent transitions between soil types and should be regarded as approximate and gradual. They are not exact points of stratigraphic change.

Elevations are referenced relative to a geodetic datum.

Asphalt and granular thicknesses reported here are observed in individual borehole locations through the top of the open borehole. Thicknesses may vary between and beyond the boreholes.

2.1 Soil Stratigraphy

The following soil stratigraphy summary is based on the borehole results and the geotechnical laboratory testing.

2.1.1 Surficial and Earth Fill

The boreholes were advanced through a pavement structure, consisting of 80 to 180 mm of asphaltic pavement over 250 to 620 mm of aggregate.

Underlying the pavement structure, the boreholes encountered 0.7 to 1.7 m of earth fill or weathered soil (Elev. 164.0 to 166.2 m). The earth fill comprises silty clay and is brown to grey. Standard Penetration Test (SPT) results (N-Values) in the earth fill indicate a very stiff consistency on average.

2.1.2 Native Soils

Underlying the earth fill, a cohesive deposit of silty clay was encountered extending to a depth of 7.2 m (Elev. 158.6 m) in Borehole 1. All other boreholes were terminated in the cohesive deposit. The cohesive deposit is sometimes described as a glacial till, with occasional wet silt and sand seams. In general, the cohesive deposit is brown transitioning to grey at 3.0 to 4.5 m below existing grade (Elev. 161.2 to 163.4 m). SPT N-Values in the cohesive deposit indicate a very stiff to hard consistency.

Underlying the cohesive deposit in Borehole 1, a sandy silt till was encountered at 7.2 m depth (Elev. 158.6 m). The borehole was terminated in this unit (Elev. 157.7 m). This unit is grey. The SPT N-Values in the sandy silt till indicates this unit is very dense.

2.2 Groundwater

No groundwater monitoring wells are currently installed on site and no historic groundwater monitoring data is available from the site. A branch of Mimico Creek is roughly 30 m away from the site and has a water level about 3 m below the general site elevation.Based on this and a review of the borehole logs, the groundwater table is expected around 5 m below existing grade (Elev. 160.5 ±m) in the cohesive glacial till, which will generally preclude the free flow of groundwater. There may also be discrete zones of groundwater within the earth fill, perched on the less-permeable glacial till soils. There may be wet seams or sands and silts that will produce limited water.

Grounded has prepared a preliminary hydrogeological report for this site (File No. 19-040-206).

3 Visual Slope Inspection and Slope Opinion

A visual inspection of the valleylands was conducted at the property on January 22nd, 2020 by Jory Hunter, and by Jason Crowder of February 5, 2020. Photographs of the valleylands with locations shown on the attached Figure 2. An MNR slope rating chart was completed for the subject slope. Based on the slope rating chart, the slope has a rating of 13, which indicates a low potential for instability.

For the purposes of discussion, Goreway Drive runs from north to south. The subject slope is present about 30 m south of the south property line. There is no identifiable slope crest, since this is an unconfined valley system. The gradual slope has a height of no more than 2 ±m and an inclination of flatter than 3H:1V in all locations. Mimico Creek is present greater than 15 m from the toe of slope.

The tableland is occupied by an existing 1-storey building, with asphalt laneways and parking. There is a fence approximately at the slope crest on the south side of the property. No erosion was observed in the tableland.

The slope is vegetated with grass and young trees. No concentrated drainage was observed over the slope. No erosion was observed on the slope face. A public pathway (“Martin Greenway”) is present in the valleyland. The public path is in a good state of maintenance.

Mimico Creek flows from the east to the west in a meandering fashion. The banks of the creek are bare, and there is some evidence of undercutting.

The detailed visual slope inspection is summarized in the following table:

Item	Visual Observations within Study Area
Structures at Risk?	No
Valleyland Height	2 ±m
Valleyland Inclination	flatter than 3H:1V

Item	Visual Observations within Study Area
Distance, structure to slope	Building is 10 ±m from valleyland
Seepage or wet ground?	None observed
Watercourse within 15 m?	No
Vegetation	Grass and young trees
Fallen/leaning trees?	No
Surficial erosion features	None observed
Slide features	None observed
Downspouts?	None observed
Retaining Walls or Structures?	Fence at the edge of valleyland, no retaining walls, pedestrian trail near creek
Drain pipes on slope?	None observed
Storm Water Outfalls?	None observed
MNR Slope Rating	21 (i.e. low potential)

Based on the observations made on site and lack of erosion features, it is Grounded's opinion that the slope is stable in its current configuration and has a low potential for instability.

4 Preliminary Geotechnical Engineering Recommendations

Based on the factual data (including boreholes by others) summarized above, we are providing the following preliminary geotechnical engineering design recommendations. Contractors must review the factual data while bidding or scoping services for this project and must provide their own opinion as to means, methods, and schedule.

Based on the factual data summarized above, preliminary geotechnical engineering recommendations are provided. These preliminary recommendations are for due diligence purposes only. They must be supplemented and confirmed by additional boreholes, wells, and a detailed geotechnical engineering report at the detailed design stage.

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

4.1 Preliminary Foundation Design Parameters

The proposed project includes demolishing the existing structure and constructing two 18 to 16-storey towers connected by a 2-storey podium, and a block of townhouses. The new structures will have three levels of shared underground parking (P3) with an FFE at Elev. 156.7±m. The groundwater table is estimated at Elev. 160.5 ±m.

It is assumed that the founding subgrade will consist of very stiff to hard cohesive glacial till or very dense cohesionless glacial till. Conventional spread footing foundations supported by these soils may be designed using a maximum factored geotechnical resistance at ULS of 500 kPa. The net geotechnical reaction at SLS is 300 kPa, for an estimated total settlement of 25 mm.

The geotechnical reaction at SLS refers to a settlement which, for practical purposes, is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

Excavations for typical footings will be nominally 1.5± m below FFE, to as much as 3 m below FFE for the elevator core. Foundation excavations may extend up to 4 ±m below the prevailing groundwater table. The soil at the founding elevation is expected to consist of glacial till with a high percentage of fines that generally preclude the free flow of water. Dewatering prior to excavation is not anticipated to be required.

The lowest levels of unheated underground parking structures two or more levels deep are still warmer than typical outdoor winter temperatures in the Greater Toronto Area. Interior foundations with 900 mm of frost cover perform adequately, as do perimeter foundations with 600 mm of frost cover. Where foundations are next to ventilation shafts or are exposed to typical outdoor temperatures, 1.2 m of earth cover (or equivalent insulation) is required for frost protection.

Footings stepped from one elevation to another should be offset at a slope not steeper than 7 vertical to 10 horizontal.

The founding subgrade must be cleaned of all unacceptable materials and approved by Grounded prior to pouring concrete for the footings. Such unacceptable materials may include disturbed or caved soils, ponded water, or similar as indicated by Grounded during founding subgrade inspection. During the winter, adequate temporary frost protection for the footing bases and concrete must be provided if construction proceeds during freezing weather conditions.

4.2 Preliminary Earthquake Design Parameters

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

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

Below the nominal founding elevations we expected to find very stiff to hard or very dense native soils. Based on this information, the site designation for seismic analysis is **Class C**, per Table 4.1.8.4.A of the Ontario Building Code. Tables 4.1.8.4.B and 4.1.8.4.C. of the same code provide the applicable acceleration- and velocity-based site coefficients.

4.3 Preliminary Earth Pressure Design Parameters

At this site, the design parameters for structures subject to unbalanced earth pressures are as follows:

Stratigraphic Unit	γ	φ	K_a	K_o	K_p
Compact Granular Fill Granular ‘B’ (OPSS 1010)	21	32	0.31	0.47	3.26
Existing Earth Fill	19	29	0.35	0.52	2.88
Cohesive soils and Glacial Tills	21	32	0.31	0.47	3.26
Cohesionless Glacial Tills	21	36	0.25	0.41	3.85

γ = soil bulk unit weight (kN/m^3)
φ = internal friction angle (degrees)
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)

These earth pressure parameters assume that grade is horizontal behind the retaining structure. If retained grade is inclined, these parameters do not apply and must be re-evaluated.

The following equation can be used to calculate the unbalanced earth pressure imposed on walls:

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

P = horizontal pressure (kPa) at depth h
h = the depth at which P is calculated (m)
K = earth pressure coefficient
h_w = height of groundwater (m) above depth h
γ = soil bulk unit weight (kN/m^3)
γ' = submerged soil unit weight (γ - 9.8 kN/m^3)
q = total surcharge load (kPa)

If the wall backfill is drained such that hydrostatic pressures on the wall are effectively eliminated, this equation simplifies to:

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

Where walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Water from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. This is discussed in Section 4.5.

The possible effects of frost on retaining earth structures must be considered. In frost-susceptible soils, pressures induced by freezing pore water are basically irresistible. Insulation typically addresses this issue. Alternatively, non-frost-susceptible backfill may be specified.

Foundation resistance to sliding is proportional to the friction between the soil subgrade and the base of the footing. The factored geotechnical resistance to friction (**R_f**) at ULS provided in the following equation:

$$R_f = \Phi N \tan \varphi$$

R_f = frictional resistance (kN)
Φ = reduction factor per CFEM Ed. 4 (0.8)
N = normal load at base of footing (kN)
φ = internal friction angle (see table above)

4.4 Preliminary Slab on Grade Design Parameters

At the proposed FFE at Elev. 156.7 ±m, we expect that undisturbed native soil will provide adequate subgrade for the support of a conventional slab on grade. The modulus of subgrade reaction for slab-on-grade design supported by undisturbed native soils is 40,000 kPa/m.

Given the nature of the soils at this site, recompaction or proof rolling of the undisturbed subgrade will weaken the subgrade materials. These activities should be specifically prohibited when preparing the subgrade. The subgrade should be cut neat and inspected by Grounded prior to placement of the capillary moisture break and construction of the slab. Disturbed or otherwise unacceptable material (as determined by Grounded) must be subexcavated and replaced with Granular B (OPSS 1010) compacted to a minimum of 98% SPMDD.

The slab on grade must be provided with a drainage layer and capillary moisture break, which is achieved by forming the slab on a minimum 300 mm thick layer of 19 mm clear stone (OPSS 1004) vibrated to a dense state.

If the subgrade soil are sands and silts, it is recommended that the drainage layer is separated from soil subgrade by a min. 150 mm of Granular A (OPSS 1010) compacted to 98% of SPMDD. A non-woven geotextile (Terrafix 360R or equivalent as approved by Grounded) is to be placed on the surface of the compacted Granular A. The subfloor drains are then laid directly on the flat subgrade and backfilled with a minimum 300 mm thick layer of layer of 19 mm clear stone (OPSS 1004) vibrated to a dense state. The subdrains must be sloped so that they positively discharge to the sumps.

Subfloor drainage details are included in Section 4.5.

4.5 Preliminary Long-Term Groundwater and Seepage Control

To limit seepage to the extent practicable, exterior grades adjacent to foundation walls should be sloped at a minimum 2 percent gradient away from the wall for 1.2 m minimum.

For a conventional drained basement approach, perimeter and subfloor drainage are required for the underground structure. Subfloor drainage collects and removes the seepage that infiltrates under the floor. Perimeter drainage collects and removes seepage that infiltrates at the foundation walls.

Subfloor drainage pipes are to be spaced at an average 3 m (measured on-centres). If subdrain elevation conflicts with top of footing elevation, footings should be lowered as necessary.

The walls of the substructure are to be fully drained to eliminate hydrostatic pressure. Where drained basement walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Seepage from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. A layer of waterproofing placed between the drain core product and the basement wall should be considered to protect interior finishes from moisture.

Typical basement drainage details are appended.

The perimeter and subfloor drainage systems are critical structural elements since they eliminate hydrostatic pressure from acting on the basement walls and floor slab. The sumps that ensure the performance of these systems must have a duplexed pump arrangement providing 100% redundancy, and they must be on emergency power. The sumps should be sized by the mechanical engineer to adequately accommodate the estimated volume of water seepage.

The permanent dewatering requirements are provided in Grounded’s preliminary Hydrogeological Report (File No. 19-040-206).

5 Considerations for Construction

5.1 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. For practical purposes:

- The earth fill is a Type 3 soil
- The clays and glacial tills are Type 2 soils

In accordance with the regulation's requirements, the soil must be suitably sloped and/or braced where workmen must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes by soil type are stipulated 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 Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

Larger obstructions (e.g. buried concrete debris, other obstructions) not directly observed in the boreholes are likely present in the earth fill. Similarly, larger inclusions (e.g. cobbles and boulders) may be encountered in the native soils. The size and distribution of these obstructions cannot be predicted with boreholes, as the split spoon sampler is not large enough to capture particles of this size. Provision must be made in excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

5.2 Short-Term Groundwater Control

Considerations pertaining to groundwater discharge quantities and quality are discussed in Grounded's hydrogeological report for the site, under separate cover.

For preliminary design purposes, the stabilized groundwater table is at about Elev. 160.5 ±m. The water table is present in the cohesive native soils. The lowest (P3) FFE is at about Elev. 156.7 m. Therefore, bulk excavation and foundation excavations will extend below the prevailing groundwater table, in cohesive soils that will generally preclude the free flow of water.

Due to the cohesive soils at the site, dewatering in the form of well points or eductors are not expected to be required during construction. Groundwater may be allowed to drain into the excavation and then pumped out. The volume of seepage anticipated in open excavations is limited to the extent that temporary pumping from the excavations is expected to sufficiently control groundwater seepage. Regardless, excavation delays will occur as seepage (however limited) is controlled. These delays should be anticipated in the construction schedule.

5.3 Earth-Retention Shoring Systems

The site is bounded by Goreway Drive to the west, Fire Station to the North, and parkland to the east and south. No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. Underpinning guidelines are appended.

5.3.1 Lateral Earth Pressure Distribution

If the shoring is supported with a single level of earth anchor or bracing, a triangular earth pressure distribution like that used for the basement wall design is appropriate.

Where multiple rows of lateral supports are used to support the shoring walls, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors. A multi-level supported shoring system can be designed based on an earth pressure distribution with a maximum pressure defined by:

$$\boldsymbol{P = 0.8\,K[\gamma H + q] + \gamma_w h_w}$$

P = maximum horizontal pressure (kPa)
K = earth pressure coefficient (see Section 3.3)
H = total depth of the excavation (m)
h_w = height of groundwater (m) above the base of excavation
γ = soil bulk unit weight (kN/m3)
q = total surcharge loading (kPa)

Where shoring walls are drained to effectively eliminate hydrostatic pressure on the shoring system (e.g. pile and lagging walls), $\boldsymbol{h_w}$ is equal to zero.

In cohesive soils, the lateral earth pressure distribution is trapezoidal, uniformly increasing from zero to the maximum pressure defined in the equation above over the top and bottom quarter (H/4) of the shoring.

5.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in very stiff to hard or very dense soils. Soldier pile toes resist horizontal movement due to the passive earth pressure acting on the toe below the base of excavation.

5.3.3 Lateral Bracing Elements

The shoring system at this site will require lateral bracing. If feasible, the shoring system should be supported by pre-stressed soil anchors (tiebacks) extending into the subgrade of the adjacent properties. To limit the movement of the shoring system as much as is practically possible, tiebacks are installed and stressed as excavation proceeds. The use of tiebacks through adjacent properties requires the consent (through encroachment agreements) of the adjacent property owners.

Post-grouted anchors in the very stiff to hard or very dense native soils can be made such that an anchor will safely carry up to 70 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm).

At least one prototype anchor must be performance-tested to 200% of the design load to demonstrate the anchor capacity and validate design assumptions. Given the potential variability in soil conditions or installation quality, all production anchors must also be proof-tested to 133% of the design load.

The very stiff to hard or very dense soils below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on competent soils at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 250 kPa.

5.4 Site Work

To better protect wet undisturbed subgrade, excavations exposing wet soils must be cut neat, inspected, and then immediately protected with a skim coat of concrete (i.e. a mud mat).

The effects of work on site can greatly impact soil integrity. Care must be taken to prevent this damage. Site work carried out during periods of inclement weather may result in the subgrade becoming disturbed, unless a granular working mat is placed to preserve the subgrade soils in their undisturbed condition. Subgrade preparation activities should not be conducted in wet weather and the project must be scheduled accordingly.

If site work causes disturbance to the subgrade, removal of the disturbed soils and the use of granular fill material for site restoration or underfloor fill will be required at additional cost to the project.

It is construction activity itself that often imparts the most severe loading conditions on the subgrade. Special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during placement of the granular base and other work may be required, especially if construction is carried out during unfavourable weather.

Adequate temporary frost protection for the founding subgrade must be provided if construction proceeds in freezing weather conditions. The subgrade at this site is susceptible to frost damage. Depending on the project context, consideration should be given to frost effects (heaving, softening, etc.) on exposed subgrade surfaces.

5.5 Engineering Field Review

By issuing this report, Grounded Engineering has assumed the role of Geotechnical Engineer of Record for this site.

The proposed structure will be founded on conventional spread footings. All foundation installations must be reviewed in the field by Grounded, the Geotechnical Engineer of Record, as they are constructed. The on-site review of the condition of the founding subgrade as the foundations are constructed is as much a part of the geotechnical engineering design function as the design itself; it is also required by Section 4.2.2.2 of the Ontario Building Code. If Grounded is not retained to carry out foundation engineering field review during construction, then Grounded accepts no responsibility for the performance or non-performance of the foundations, even if they are constructed in general conformance with the engineering design advice contained in this report.

The long-term performance of a slab on grade is highly dependent upon the subgrade support and drainage conditions. Strict procedures must be maintained during construction to ensure that uniform moisture and density conditions are achieved in the subgrade to the extent possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Grounded at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

A visual pre-construction survey of adjacent lands and buildings is recommended to be completed prior to the start of any construction. This documents the baseline condition and can prevent unwarranted damage claims. Any shoring system, regardless of the execution and design, has the potential for movement. Small changes in stress or soil volume can cause cracking in adjacent buildings.

6 Limitations and Restrictions

To protect the slope, site development and construction activities should be designed in a manner that does not erode the surface slope. Of particular importance, site drainage and grading must not produce concentrated overland flow directed towards the slope crest or face. Although concentrated overland flow must not be allowed to flow over the slope, but a minor sheet flow may be acceptable. A healthy vegetative cover should be created and maintained on the slope.

This report provides specifications which are to be used as technical specifications only. These technical specifications do not cover contract issues (quantities, insurance, other tender specifications, etc.) and as such must not be regarded as final tender specifications. The technical specifications provided in this report may form part of a complete set of tender documents prepared by others.

This preliminary geotechnical engineering feasibility study is intended for due diligence purposes only. At detailed design, site-specific boreholes, groundwater monitoring wells, and updated detailed geotechnical engineering advice are required. Once completed, the future detailed geotechnical engineering report by Grounded Engineering would then supersede this preliminary report.

6.1 Investigation Procedures

The geotechnical engineering analysis and advice provided here are based on factual data obtained from investigations at this site conducted by other consultants as described above. This previous consultant subsurface information is provided in a professional engineer’s signed and sealed geotechnical report, and as such this borehole information is taken as factual for present purposes.

A carefully conducted, fully comprehensive investigation and sampling scope of work carried out under the most stringent level of oversight may still fail to detect certain ground conditions. As such, users of this report must be aware of the risks inherent in using engineered field investigations to observe and record subsurface conditions. As a necessary requirement of working with discrete test locations, Grounded has assumed that the conditions between test locations are the same as the test locations themselves, for the purposes of providing geotechnical engineering advice.

It is not possible to design a field investigation with enough test locations that would provide complete subsurface information, nor is it possible to provide geotechnical engineering advice that completely identifies or quantifies every element that could affect construction, scheduling, or tendering. Contractors undertaking work based on this report (in whole or in part) must make their own determination of how they may be affected by the subsurface conditions, based on their own analysis of the factual information provided and based on their own means and methods. Contractors using this report must be aware of the risks implicit in using factual information at discrete test locations to infer subsurface conditions across the site and are directed to conduct their own investigations as needed.

6.2 Site and Scope Changes

Natural occurrences, the passage of time, local construction, and other human activity all have the potential to directly or indirectly alter the subsurface conditions at or near the project site. Contractual obligations related to groundwater or stormwater control, disturbed soils, frost protection, etc. must be considered with attention and care as they relate this potential site alteration.

This report provides preliminary geotechnical engineering advice intended for use by the owner and their retained design team for due diligence only. These preliminary interpretations, design parameters, advice, and discussion on construction considerations are not complete. A detailed site-specific geotechnical investigation must be conducted by Grounded during detailed design to confirm and update the preliminary recommendations provided here.

6.3 Report Use

The authorized users of this report are Redwood Properties and their design team, for whom this report has been prepared. Grounded Engineering Inc. maintains the copyright and ownership of this document. Reproduction of this report in any format or medium requires explicit prior authorization from Grounded Engineering Inc.

The City of Mississauga and Region of Peel may also make use of and rely upon this report, subject to the limitations as stated.

7 Closure

If the design team has any questions regarding the discussion and advice provided, please do not hesitate to contact our office. We trust that this report meets your requirements at present.

For and on behalf of our team,

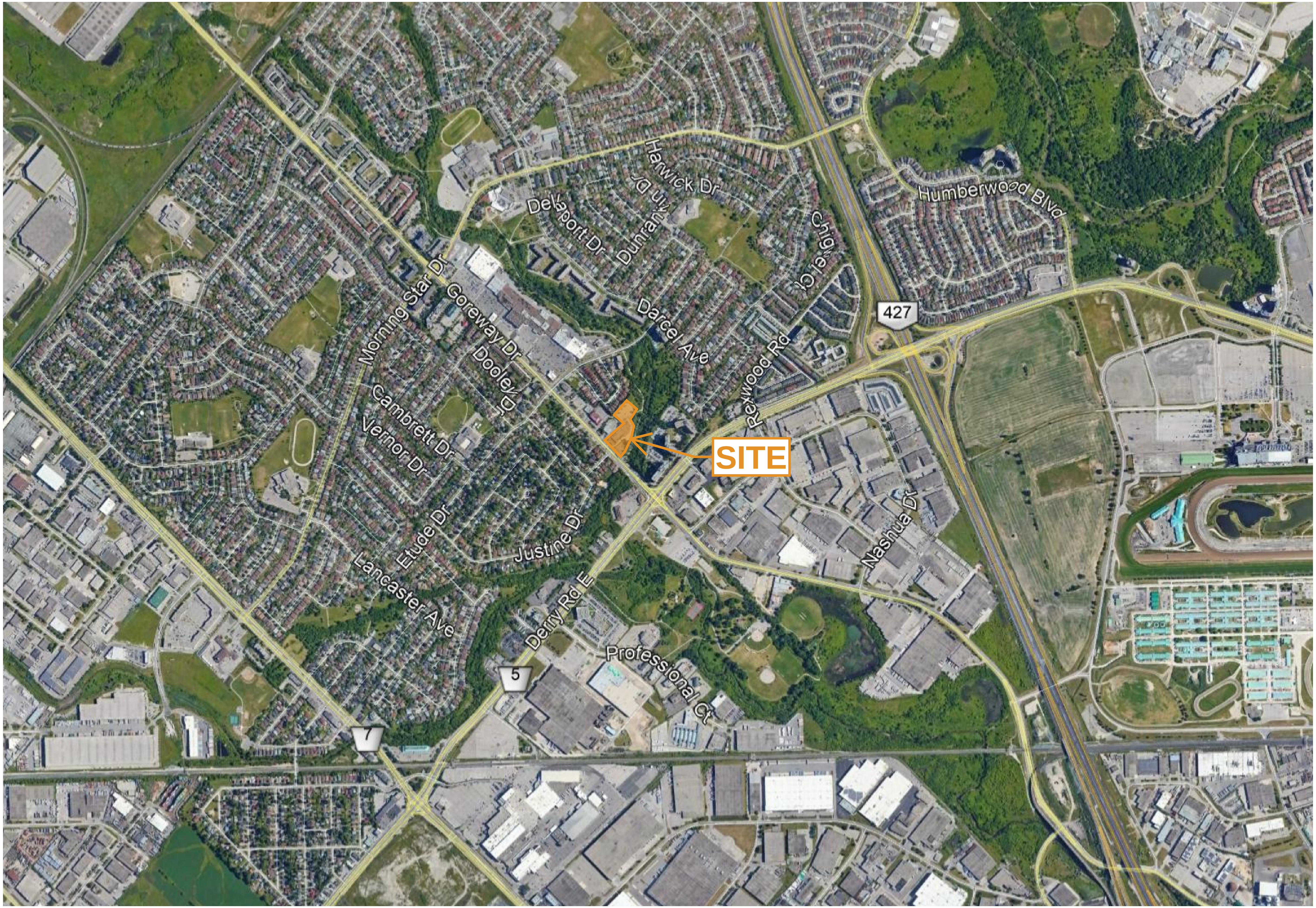
GROUNDED ENGINEERING

LICENSED PROFESSIONAL ENGINEER
J. J. CROWDER
100077148
22/04/2020
PROVINCE OF ONTARIO

Jory Hunter, B.Sc.(Eng.), EIT

Jason Crowder, Ph.D., P.Eng.
Principal

FIGURES



GROUNDED
ENGINEERING

12 Banigan Drive, Toronto, Ont., M4H 1E9
www.groundedeng.ca

LEGEND

— SITE

Note

Reference
Google Earth, 2020

Project
REDWOOD ON GOREWAY

7085 GOREWAY DRIVE,
MISSISSAUGA, ONTARIO, L4T 3X6

Figure Title
SITE LOCATION PLAN

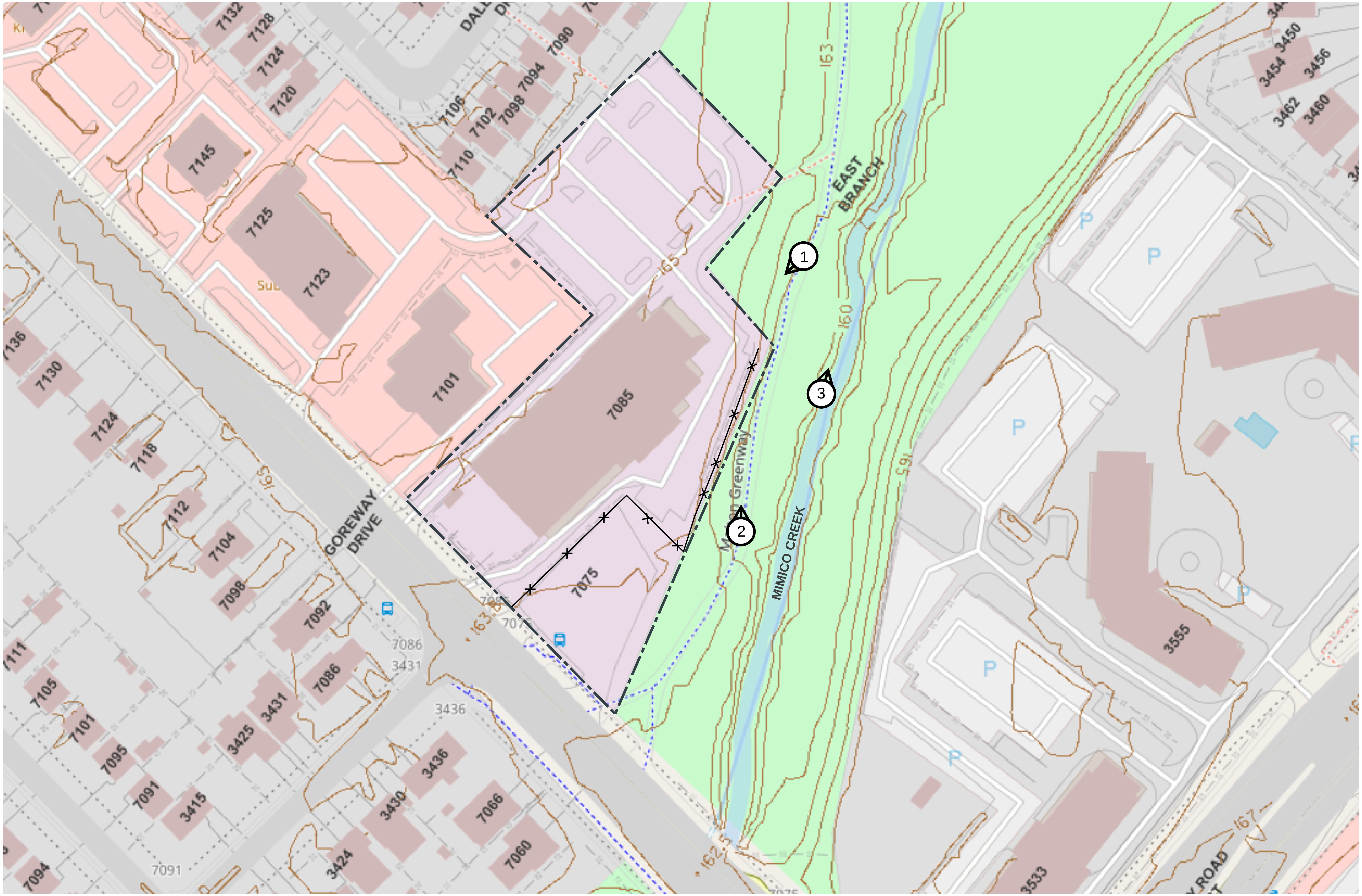
North
PROJECT

Date
APRIL 2020

Scale
N.T.S.

Job No
19-040

Figure No
FIGURE 1



GROUNDED
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12 Banigan Drive, Toronto, Ont., M4H 1E9
www.groundedeng.ca

LEGEND

- - — SITE
—✕ FENCE
① PHOTOGRAPH LOCATION

Note

Reference
Mississauga Maps, 2020
KRCMAR, DWG Name 17-103BT01, Job No 17-103, Date June 2017

Project

REDWOOD ON GOREWAY

7085 GOREWAY DRIVE,
MISSISSAUGA, ONTARIO, L4T 3X6

Figure Title

PHOTOGRAPH AND SITE FEATURES PLAN

North

PROJECT

Date
APRIL 2020

Scale
N.T.S.

Job No
19-040

Figure No
FIGURE 2

APPENDIX A

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
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October 17, 2016 Reference No. 1609-S061

Redwood Properties
330 New Huntington Road, Suite 201
Woodbridge, Ontario
L4H 4C9

Attention: Mr. Richard Aubry

Re: Geotechnical Investigation
Proposed Property Acquisition
7085 Goreway Drive
City of Mississauga

Dear Sir:

In accordance with your written authorization dated September 13, 2016, we have completed a borehole investigation for the captioned project and herein present our findings and recommendations.

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for future land development. This investigation is preliminary in nature and the results must be further reviewed once the site grading and details of the proposed development are finalized to assess the requirement for additional borehole investigation.

FIELD WORK

The field work, consisting of 6 boreholes to a depth of 8.1 m, was performed on September 23 and 26, 2016, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The subject site is an existing supermarket, situated northwest of Highway 427 and Derry Road East, in the City of Mississauga. The investigated areas are asphalt-paved, located at the building perimeter and at the existing parking lot. The ground surface is relatively flat and level, with minor undulations.

The holes were advanced at intervals to the sampling depths by a truck- or track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms”, were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The relative density of the granular strata and the consistency of the cohesive strata are inferred from the ‘N’ values. Split-spoon samples were recovered for soil classification and laboratory testing.

The field work was supervised and the findings were recorded by a Geotechnical Technician.

The geodetic elevation at each of the borehole locations was obtained by Soil Engineers Ltd. using hand-held Global Navigation Satellite System (GNSS) surveying equipment (Trimble Geoexplorer 6000), accurate to within 0.1 m.

SUBSURFACE CONDITIONS

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

The investigation has disclosed that beneath the existing pavement structure, and a layer of earth fill in places, the site is underlain by strata of silty clay, silty clay till and sandy silt till.

Pavement Structure (All Boreholes)

The revealed pavement structure consists of an asphaltic concrete layer, 80 to 180 mm in thickness, overlying a layer of granular fill, 250 to 620 mm thick. The granular fill consists of gravel with silty sand and silt. The water content values range from 4% to 12%, with a median of 6%, indicating that the granular fill is in a damp to wet condition.

A grain size analysis was performed on 1 sample of the granular fill. The result is plotted on Figure 7 and it shows that the sample meets the Gradation Requirements of the OPS Specifications for Granular 'B'. Further sampling and testing of the granular fill material should be conducted to assess its suitability for reuse as a granular sub-base for pavement construction. Nonetheless, it can be used as general backfill, bedding material, or subgrade stabilization.

Earth Fill (Boreholes 2, 3, 5 and 6)

The earth fill was found extending to depths ranging from 0.7 to 1.7 m below the pavement surface. The fill consists of silty clay material.

The obtained ‘N’ values range from 7 to 17, with a median of 12 blows per 30 cm of penetration, indicating that the fill was randomly placed with nominal compaction and has since partially self-consolidated. Its relative density is non-uniform and, in places, loose; therefore, it is unsuitable to support structures sensitive to settlement.

The natural water content values range from 16% to 22%, with a median of 20%, indicating that the fill is in a moist to very moist, generally very moist condition, which corresponds with our sample examinations.

A grain size analysis was performed on 1 representative sample of the earth fill; the result is plotted on Figure 8.

Due to its unknown history and non-uniform density, the earth fill is considered to be unsuitable for supporting structures. For structural use, the fill must be subexcavated, inspected, sorted free of any deleterious material, if detected, and properly compacted.

One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by laboratory testing and/or test pits.

Silty Clay (Boreholes 1, 2, 5 and 6)

The silty clay was encountered at various depths and it is laminated with sand and silt seams and layers, showing that it is a glaciolacustrine deposit. The clay layer is weathered to a depth of 0.7 m below the pavement surface at Borehole 1.

The obtained 'N' values range from 14 to 47, with a median of 22 blows per 30 cm of penetration, indicating that the consistency of the clay is stiff to hard, being generally very stiff.

The natural water content values range from 10% to 24%, with a median of 19%, indicating that the silty clay is in a damp to very moist, generally moist condition, which corresponds with our sample examinations.

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

- High frost susceptibility and high soil-adfreezing potential.
- Low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, an estimated percolation rate of 80 + min/cm, and runoff coefficients of:

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

- A cohesive-frictional soil, its shear strength is derived from consistency and augmented by the internal friction of the silt. Its shear strength is moisture dependent.

- In excavation, the clay will be prone to sloughing if it is exposed for prolonged periods in steep cuts. This would generally be initiated by infiltrating precipitation or groundwater seeping out from the silt and fine sand layers.
- A very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 2500 ohm·cm.

Silty Clay Till (All Boreholes)

The silty clay till was encountered at various depths and extends to the maximum investigated depth at Boreholes 2, 3, 4, 5 and 6. It consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties. The structure of the clay till is heterogeneous and amorphous, showing it is a glacial deposit that has been reworked in places by the past glaciation. The clay till is weathered to depths of 2.2 m and 1.4 m below the pavement surface at Boreholes 3 and 4, respectively.

The samples were found to contain occasional wet sand and silt seams and layers. The till is embedded with occasional cobbles and boulders.

The obtained ‘N’ values range from 11 to 62, with a median of 35 blows per 30 cm of penetration, showing the consistency of the clay till is stiff to hard, being generally hard. The stiff clay till occurs within the weathered zone.

The Atterberg Limits of 3 representative samples and the natural water content values of all the samples were determined; the results are plotted on the Borehole Logs and summarized below:

Liquid Limit	25%, 28% and 30%
Plastic Limit	16% and 17%
Natural Water Content	9% to 19% (median 13%)

The results show that the clay till is a cohesive material with low plasticity. The natural water content value generally lies below its plastic limits, confirming the generally hard consistency of the till as determined by the ‘N’ values.

Grain size analyses were performed on 3 representative samples of the silty clay till. The results are plotted on Figure 9.

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

- High frost susceptibility and low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, an estimated percolation rate of 80 min/cm, and runoff coefficients of:

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

- A cohesive soil, its shear strength is primarily derived from consistency which is inversely related to its moisture content. It contains sand; therefore, its shear strength is augmented by internal friction.
- It will generally be stable in a relatively steep cut; however, prolonged exposure will allow the fissures in the weathered zone and the wet sand and

silt seams and layers to become saturated, which may lead to localized sloughing.

- A very poor pavement-supportive material, with an estimated CBR value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 ohm·cm.

Sandy Silt Till (Borehole 1)

The sandy silt till was generally encountered at the lower zone of the stratigraphy and extends to the maximum investigated depth. It consists of a random mixture of soil particle sizes ranging from clay to gravel, with the silt being the predominant fraction. Its structure is heterogeneous, indicating it is a glacial deposit.

Hard resistance to augering was encountered in places, indicating the presence of cobbles and boulders. Occasional wet sand and silt seams and layers were also found in the till mantle.

The obtained ‘N’ value is 50 blows per 8 cm of penetration, showing that the relative density of the till is very dense.

The natural water content was determined, and the result is plotted on the Borehole Log; the value is 14%, showing the sandy silt till is in a moist condition.

A grain size analysis was performed on the till sample and the result is plotted on Figure 10.

The deduced engineering properties pertaining to the project are given below:

- Moderately high frost susceptibility and moderately low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-6} cm/sec, depending on the clay and silt content, an estimated percolation rate of 50 to 65 min/cm, and runoff coefficients of:

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

- A frictional-cohesive soil, its shear strength is density dependent and is augmented by cementation and cohesion.
- It will slough slowly if submerged in an unconfined state, or from an open-face cut under seepage conditions, particularly in the zone where wet sand and silt layers are prevalent.
- A fair pavement-supportive material, with an estimated CBR value of 8% to 10%.
- Moderately low corrosivity to buried metal, an estimated electrical resistivity of 5000 ohm·cm.

GROUNDWATER CONDITIONS

Groundwater and cave-in were encountered at depths 6.4 m and 6.7 m, respectively, below the prevailing pavement surface at Borehole 5; all other boreholes remained dry upon completion of field work. The measured groundwater level has likely resulted from infiltrated precipitation that was trapped in the fissures of the earth fill or in the sand and silt layers embedded in the till. The groundwater level will fluctuate with the seasons.

The colour changes from brown to grey at depths of 3.0 m and 4.5 m below the prevailing ground surface, indicating that the brown soils in the upper zone have oxidized.

The groundwater yield from the silty clay and tills, due to their low to relatively low permeability, will be small and limited.

ASSESSMENT AND RECOMMENDATIONS

Based on the borehole findings, the geotechnical considerations pertaining to the general construction of the project are presented herein:

The revealed subsurface condition is suitable for development of low-density residences and/or low- or mid-rise buildings. For high-rise buildings with multiple levels of underground parking, it is recommended that deeper boreholes be drilled to determine the founding conditions beneath the basement/underground parking.

The existing earth fill is not suitable to support foundation loads. Where earth fill is required to raise the site or where extended footings are necessary, the existing earth fill can be replaced with and/or upgraded to engineered fill status for normal footings, slab-on-grade and underground services construction. Conventional footings bearing on engineered fill can be designed with a Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Bearing Pressure (ULS) of 250 kPa.

The native subsoil is suitable for the construction of normal spread and strip footings. The foundations should be placed beneath the earth fill and weathered soil, onto the sound natural soils. The recommended soil bearing pressures for use in the footing design, together with the corresponding suitable founding levels, are presented in the following table:

BH No.	**Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Bearing Pressure (ULS) and Suitable Founding Levels**					
	150 kPa (SLS) 250 kPa (ULS)		**300 kPa (SLS) 480 kPa (ULS)**		**400 kPa (SLS) 640 kPa (ULS)**	
	Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**	**Depth (m)**	**El. (m)**
1	1.0 or +	164.8 or -	1.6 or +	164.2 or -	4.6 or +	161.2 or -
2	1.6 or +	164.8 or -	2.4 or +	164.0 or -	4.6 or +	161.8 or -
3	2.0 or +	163.7 or -	-	-	2.4 or +	163.3 or -
4	1.0 or +	164.5 or -	2.4 or +	163.1 or -	-	-
5	1.0 or +	165.9 or -	-	-	2.4 or +	164.5 or -
6	-	-	1.6 or +	164.4 or -	-	-

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

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

For basement construction, perimeter subdrains and dampproofing of the foundation walls may be required. All the subdrains must be encased in a fabric filter to protect them against blockage by silting, and must be connected to a positive outlet.

Some of the occurring soils are frost susceptible and with high soil-adfreezing potential. Special measures must be incorporated into the building construction to prevent serious damage due to soil adfreezing.

The design of the foundations should meet the requirements specified in the latest Ontario Building Code, and the structure should be designed to resist an earthquake force using Site Classification ‘D’ (stiff soil).

Due to the presence of the earth fill and weathered soil, the footing subgrade must be inspected by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the subgrade conditions are compatible with the foundation design requirements.

For slab-on-grade construction, the existing earth fill and weathered soil must be subexcavated, inspected and properly recompacted to at least 98% of its maximum Standard Proctor dry density. The slab should be constructed on a granular base, 20 cm thick, consisting of 20-mm Crusher-Run Limestone, or equivalent, compacted to its maximum Standard Proctor dry density.

A Modulus of Subgrade Reaction of 30 MPa/m can be used for the design of the floor slab founded on engineered fill or on sound natural soils.

A Class ‘B’ bedding, consisting of compacted 20-mm Crusher-Run Limestone, is recommended for the construction of the underground services. Where water-bearing sand and silt seams and layers are present, the sewer joints should be leak-proof, or wrapped with an appropriate waterproof membrane to prevent subgrade migration.

Based on the borehole findings, the recommended pavement design is given in the following table:

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder	50	HL-8
Granular Base	150	20-mm Crusher-Run Limestone or equivalent
Granular Sub-base		50-mm Crusher-Run Limestone or equivalent
Parking	300	
Access Roads/Fire Route	400	

The existing asphaltic concrete can be pulverized and mixed with Granular ‘A’ and reused as Granular ‘A’ or ‘B’ provided the gradation meets the OPS Specifications. The existing granular fill, if carefully salvaged, can be reused for subgrade stabilization or structural backfill. In using the granular fill as granular sub-base for road pavement construction, it should be further assessed by laboratory testing on bulk samples collected during construction.

In preparation of the subgrade, the surface should be proof-rolled. The weathered soil and any soft subgrade should be subexcavated and replaced by properly compacted, organic-free earth fill or granular materials. Subdrains should be properly installed below the concrete curbs or gutters on both sides of the roadway. The subdrains should be connected to catch basins where water can be removed.

The recommended soil parameters for the project design are given in the following table:

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**	**Estimated Bulk Factor**	
	Bulk	**Loose**	**Compacted**
Earth Fill and Weathered Soil	20.5	1.20	1.00
Sound Tills	22.0	1.33	1.05
Silty Clay	20.5	1.30	0.98

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_o**	**Passive K_p**
Earth Fill and Weathered Soil	0.45	0.55	2.22
Silty Clay and Sound Tills	0.40	0.50	2.50

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

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

The tills contain occasional boulders. Extra effort and a properly equipped backhoe will be required for excavation.

For excavation purposes, the types of soils are classified in the following table:

Material	**Type**
Sound Tills	2
Earth Fill, Silty Clay and Weathered Soil	3

The groundwater yield from the silty clay and tills, due to their low to relatively low permeability, is expected to be small and limited and can generally be controlled by pumping from sumps.

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

This geotechnical investigation report is preliminary in nature. The above recommendations must be further reviewed once the detail design for the project is available. If required, additional borehole investigation will need to be carried out for the project.

LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Redwood Properties, and for review by their designated agents, financial institutions, and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement. The material in it reflects the judgment of Frank Lee, P.Eng., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, and/or any reliance on decisions to be made based on it are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

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ENCLOSURES

Borehole Logs	Figures 1 to 6
Grain Size Distribution Graphs	Figures 7 to 10
Borehole Location Plan	Drawing No. 1
Subsurface Profile	Drawing No. 2

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test
□	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres

1lb = 0.454 kg

1 inch = 25.4 mm

1ksf = 47.88 kPa

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Job Number: 1609-S061

LOG OF BOREHOLE NO.: 1

Figure No.: 1

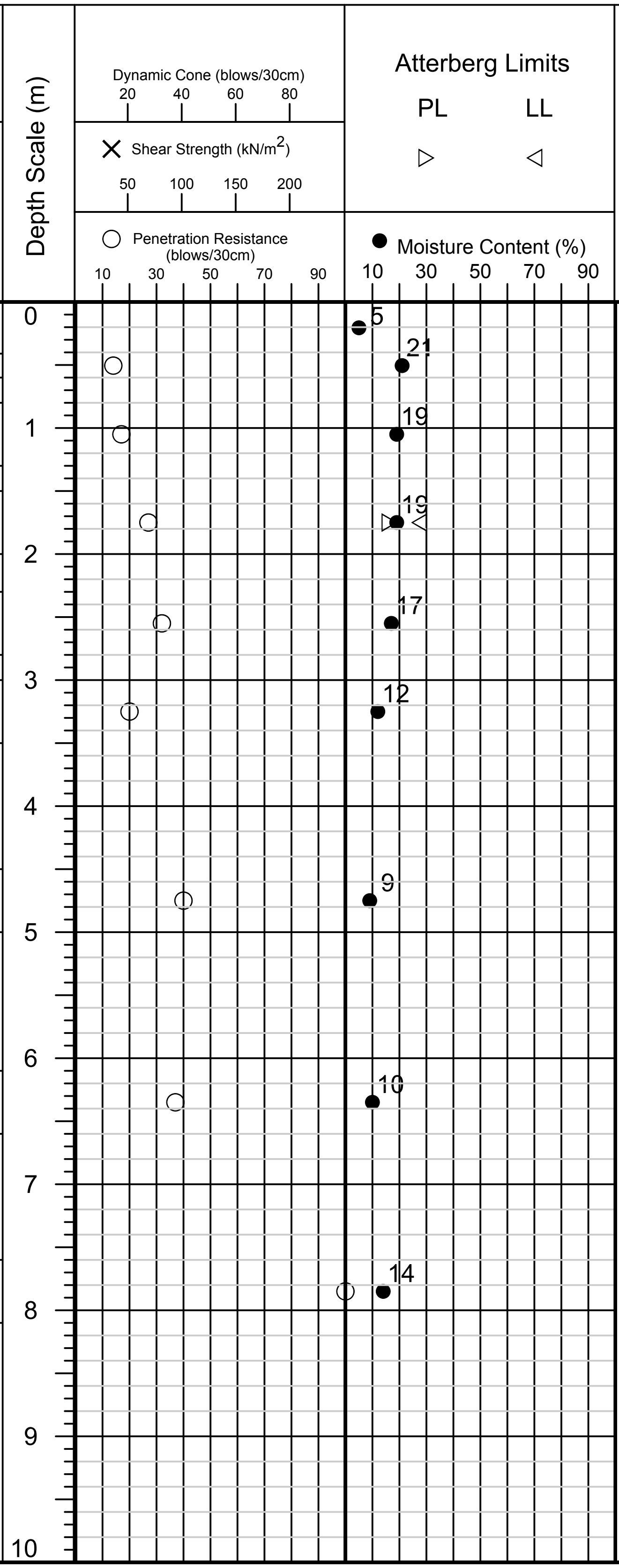
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 26, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
165.8	Pavement Surface			
0.0	80 mm **ASPHALTIC CONCRETE** 330 mm **GRANULAR, Fill**	1A	DO	
	Brown, stiff to very stiff	1B	DO	14
	weathered			
	SILTY CLAY	2	DO	17
164.4 1.4	Very stiff to hard	3	DO	27
		4	DO	32
	brown grey	5	DO	20
	SILTY CLAY, Till occ. wet sand and silt seams and layers, cobbles and boulders			
		6	DO	40
		7	DO	37
158.6 7.2	Grey, very dense **SANDY SILT, Till**	8	DO	50/8
157.7 8.1	END OF BOREHOLE			



Water Level

Dry on completion

SOIL ENGINEERS LTD.

Job Number: 1609-S061

LOG OF BOREHOLE NO.: 2

Figure No.: 2

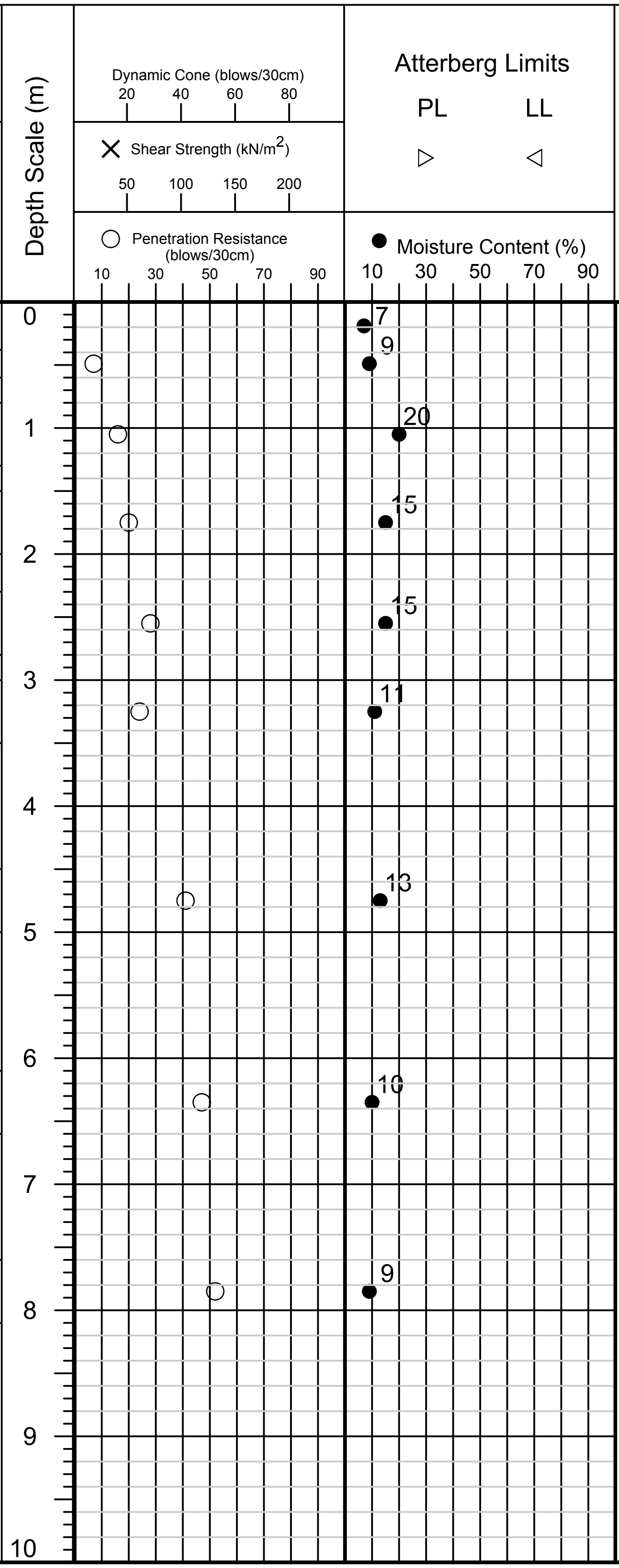
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 23, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
166.4	Pavement Surface			
0.0	80 mm **ASPHALTIC CONCRETE** 620 mm **GRANULAR, Fill**	1A	DO	
		1B	DO	7
	Brown **SILTY CLAY, Fill**	2	DO	16
165.0 1.4	Very stiff to hard	3	DO	20
		4	DO	28
	SILTY CLAY, Till brown / grey occ. wet sand and silt seams and layers, cobbles and boulders	5	DO	24
		6	DO	41
160.6 5.8	Grey, hard **SILTY CLAY**	7	DO	47
159.2 7.2	Grey, hard **SILTY CLAY, Till**	8	DO	52
158.3 8.1	END OF BOREHOLE			



Water Level

Dry on completion

SOIL ENGINEERS LTD.

Job Number: 1609-S061

LOG OF BOREHOLE NO.: 3

Figure No.: 3

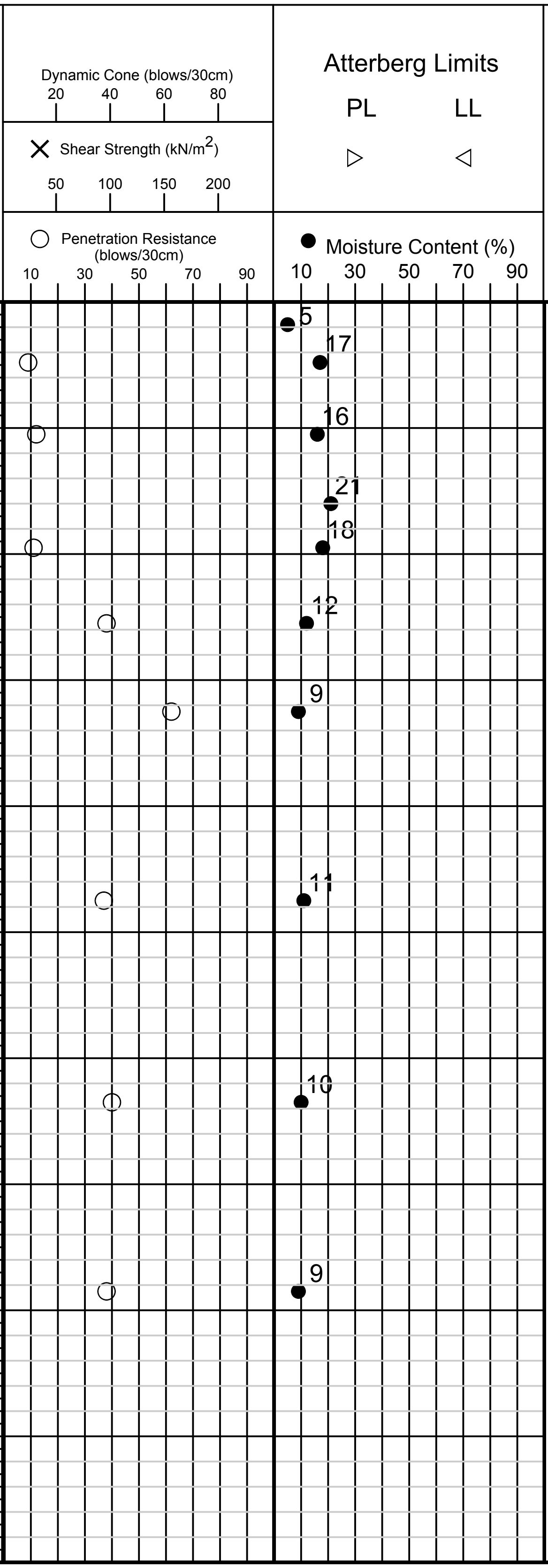
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 23, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Water Level
165.7	Pavement Surface					
0.0	100 mm **ASPHALTIC CONCRETE** 250 mm **GRANULAR, Fill**	1A	DO		0	
		1B	DO	9		
	Brown/grey **SILTY CLAY, Fill**	2	DO	12	1	
164.0		3A	DO			
1.7	Stiff to hard	3B	D0	11	2	
	weathered	4	DO	38		
		5	DO	62	3	
	SILTY CLAY, Till occ. wet sand and silt seams and layers, cobbles and boulders				4	
	brown grey	6	DO	37	5	Dry on completion
					6	
		7	DO	40	7	
157.6		8	DO	38	8	
8.1	END OF BOREHOLE				9	
					10	



SOIL ENGINEERS LTD.

Job Number: 1609-S061

LOG OF BOREHOLE NO.: 4

Figure No.: 4

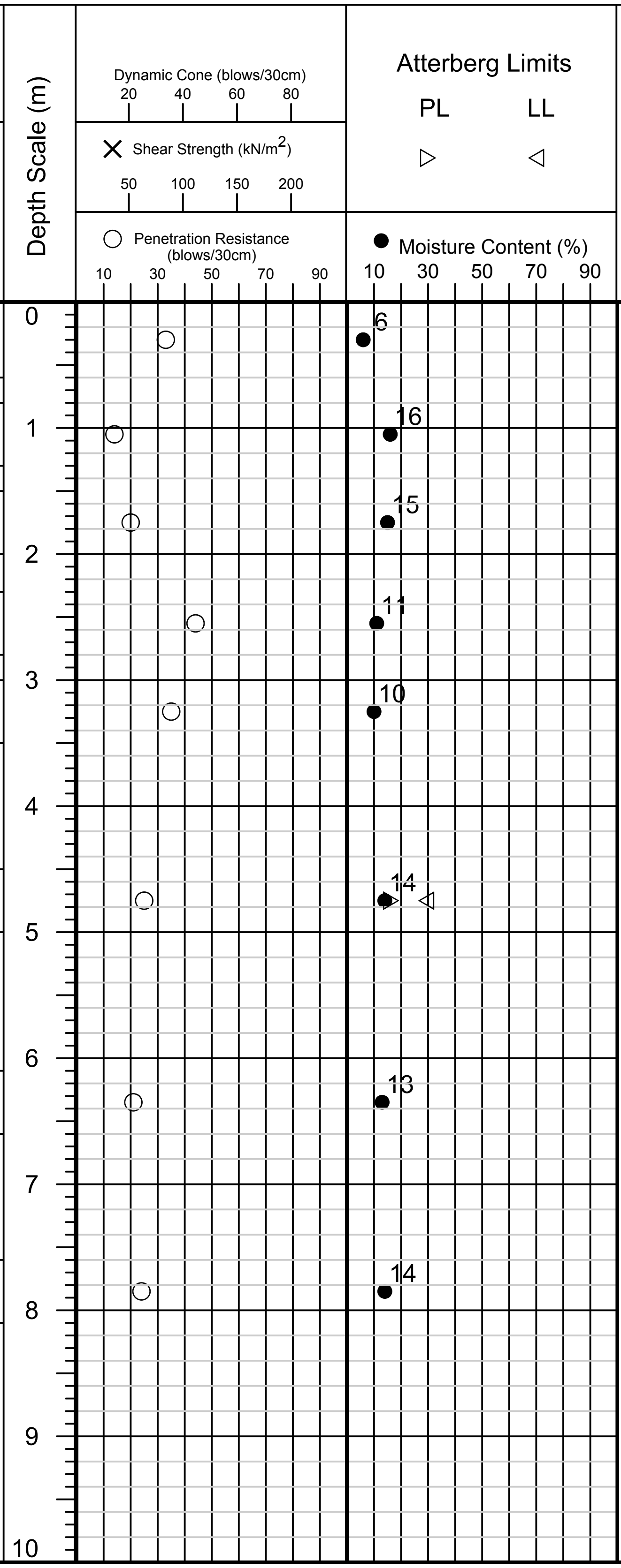
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 26, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
165.5	Pavement Surface			
0.0	180 mm **ASPHALTIC CONCRETE** 520 mm **GRANULAR, Fill**	1	DO	33
	Stiff to hard	2	DO	14
	weathered	3	DO	20
	SILTY CLAY, Till occ. wet sand and silt seams and layers, cobbles and boulders brown	4	DO	44
	grey	5	DO	35
		6	DO	25
		7	DO	21
		8	DO	24
157.4 8.1	END OF BOREHOLE			



Water Level

Dry on completion

SOIL ENGINEERS LTD.

Job Number: 1609-S061

LOG OF BOREHOLE NO.: 5

Figure No.: 5

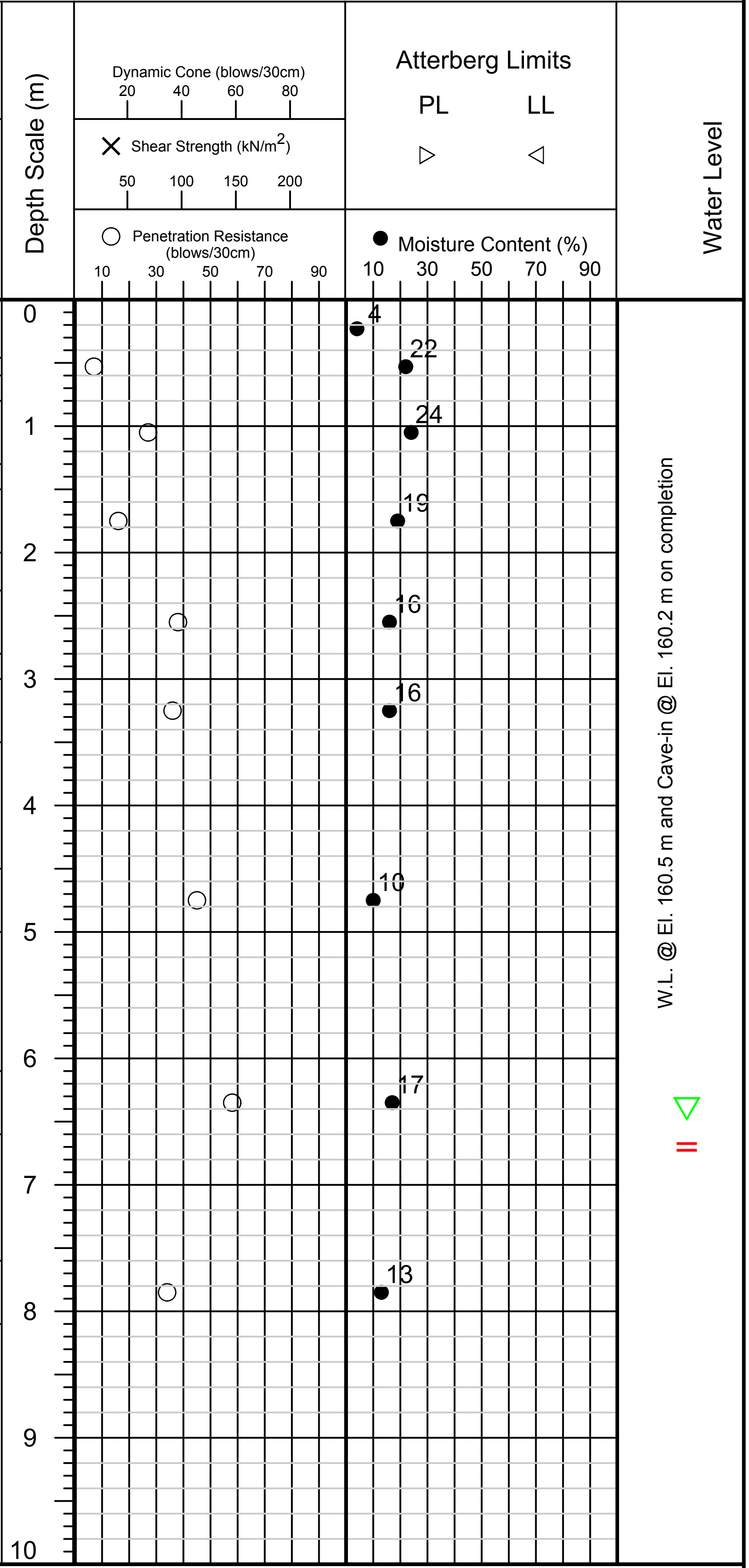
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 23, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
166.9	Pavement Surface			
0.0	130 mm **ASPHALTIC CONCRETE** 330 mm **GRANULAR, Fill**	1A	DO	
	Brown **SILTY CLAY, Fill**	1B	DO	7
166.2 0.7	Brown, stiff to very stiff **SILTY CLAY** occ. wet sand and silt seams and layers	2	DO	27
		3	DO	16
164.8 2.1	Hard	4	DO	38
		5	DO	36
	SILTY CLAY, Till occ. wet sand and silt seams and layers, cobbles and boulders brown grey	6	DO	45
		7	DO	58
		8	DO	34
158.8 8.1	END OF BOREHOLE			



SOIL ENGINEERS LTD.

Job Number: 1609-S061

LOG OF BOREHOLE NO.: 6

Figure No.: 6

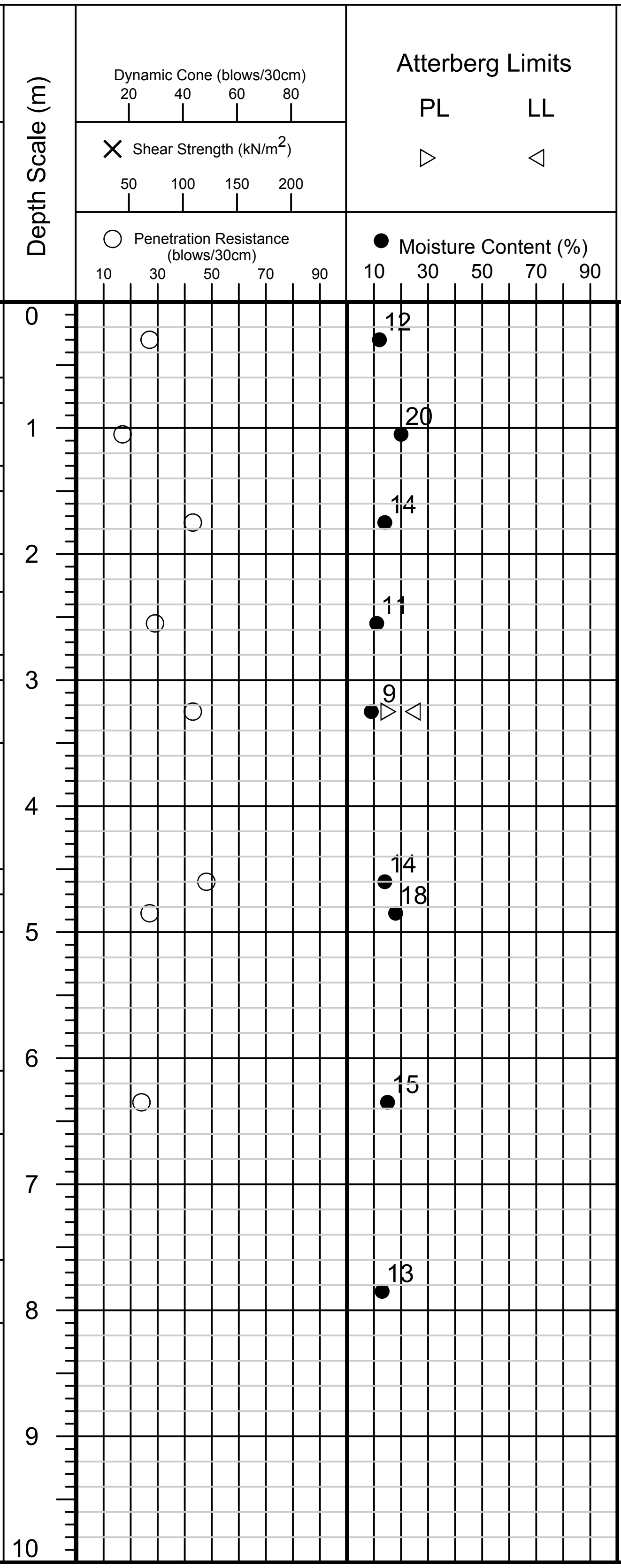
Project Description: Proposed Property Acquisition

Job Location: 7085 Goreway Drive, City of Mississauga

Method of Boring: Flight-Auger

Drilling Date: September 26, 2016

Elevation (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Water Level
166.0	Pavement Surface				
0.0	80 mm **ASPHALTIC CONCRETE** 620 mm **GRANULAR, Fill**	1	DO	27	
	Brown **SILTY CLAY, Fill**	2	DO	17	
164.6 1.4	Brown, hard **SILTY CLAY**	3	DO	43	
163.9 2.1	Very stiff to hard	4	DO	29	
	brown grey	5	DO	43	
	SILTY CLAY, Till occ. wet sand and silt seams and layers, cobbles and boulders				Dry on completion
		6A	DO		
	sandy silt layer	6B	DO	48	
		7	DO	27	
		8	DO	24	
157.9 8.1	END OF BOREHOLE				



SOIL ENGINEERS LTD.

Page: 1 of 1

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

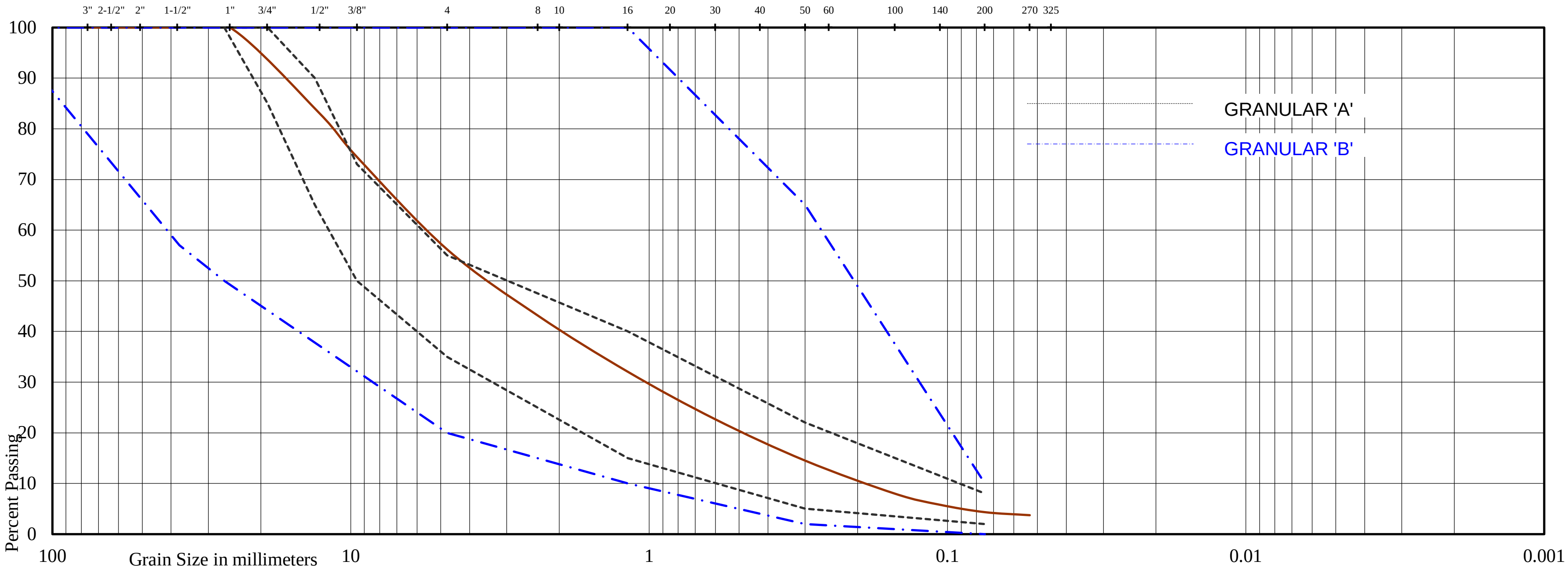
Reference No: 1609-S061

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Property Acquistion

Location: 7085 Goreway Drive, City of Mississauga

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 7

Estimated Permeability (cm./sec.) = 10^{-2}

Borehole No: 2

Sample No: 1A

Depth (m): 0.2

Elevation (m): 166.2

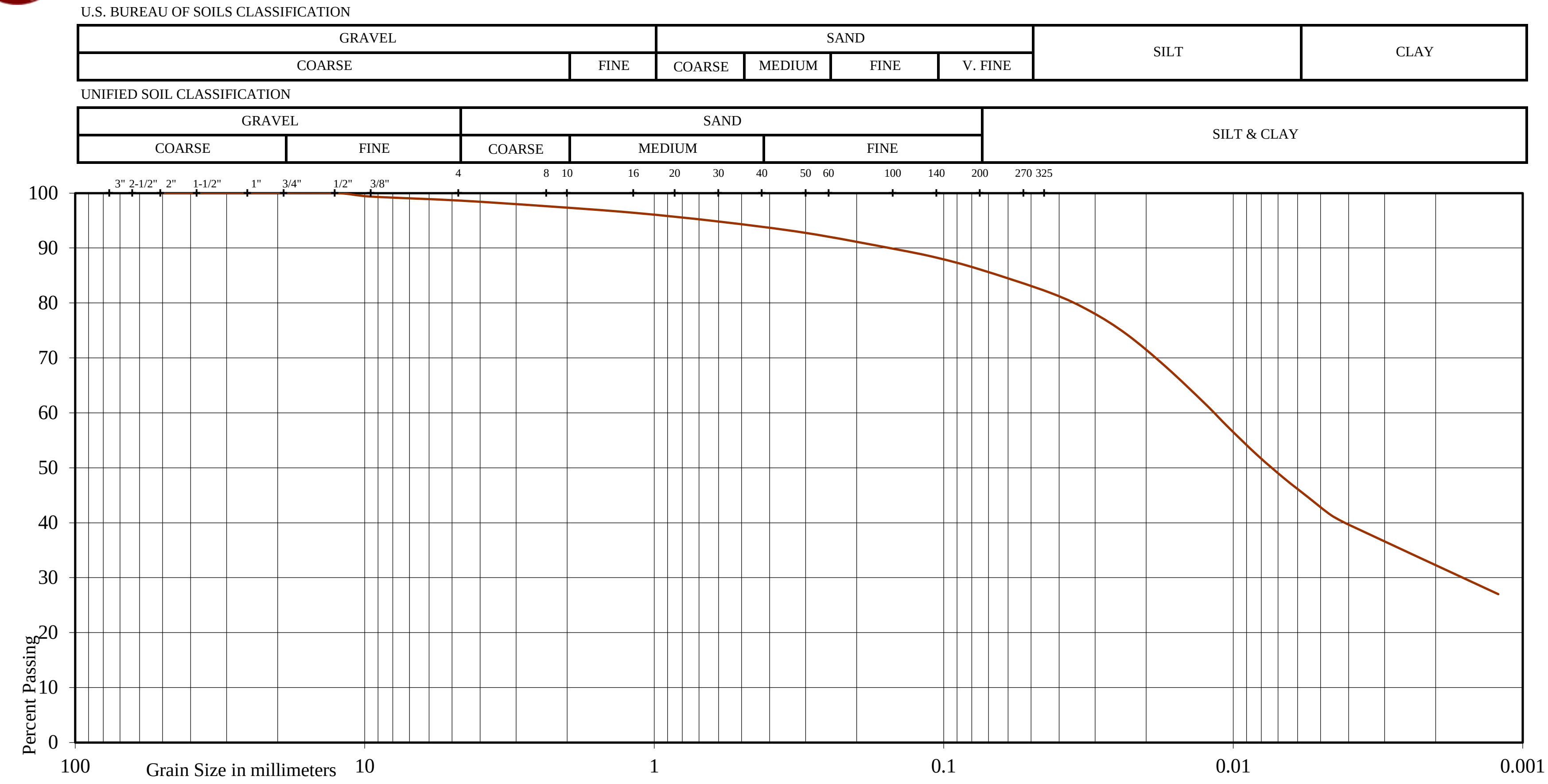
Classification of Sample [& Group Symbol]: GRANULAR, Fill

Figure: 7

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1609-S061



Project: Proposed Property Acquistion

Location: 7085 Goreway Drive, City of Mississauga

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 2

Plasticity Index (%) = -

Sample No: 2

Moisture Content (%) = 20

Depth (m): 1.1

Estimated Permeability

Elevation (m): 165.3

(cm./sec.) = 10^{-7}

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

some sand, a tr. of gravel

Figure: 8

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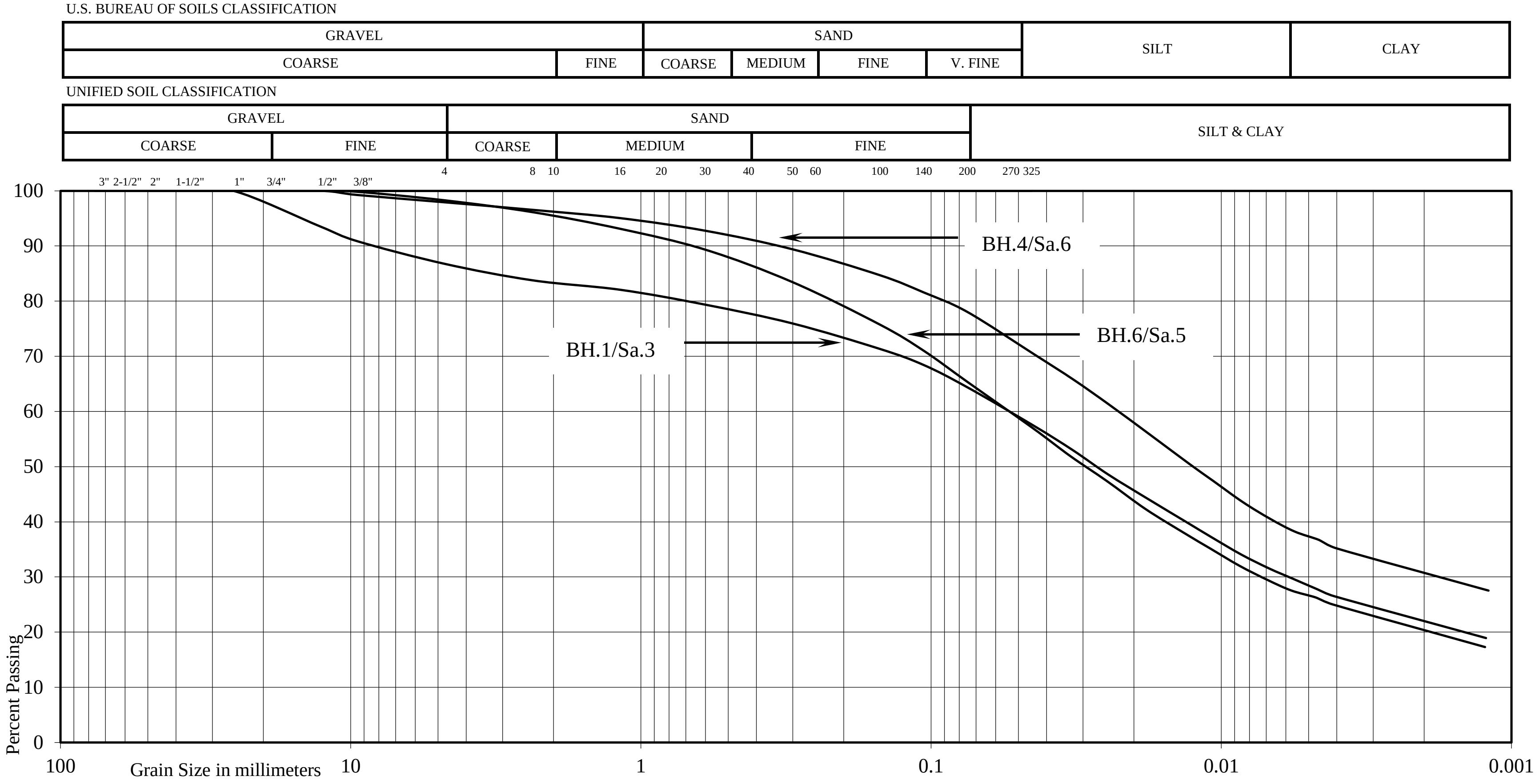
GRAIN SIZE DISTRIBUTION

Reference No: 1609-S061



Project: Proposed Property Acquistion

Location: 7085 Goreway Drive, City of Mississauga

Borehole No:	1	4	6
Sample No:	3	6	5
Depth (m):	1.7	4.7	3.3
Elevation (m):	164.1	160.8	162.7

BH./Sa.	1/3	4/6	6/5
Liquid Limit (%) =	28	30	25
Plastic Limit (%) =	17	17	16
Plasticity Index (%) =	11	13	9
Moisture Content (%) =	19	14	9
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

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

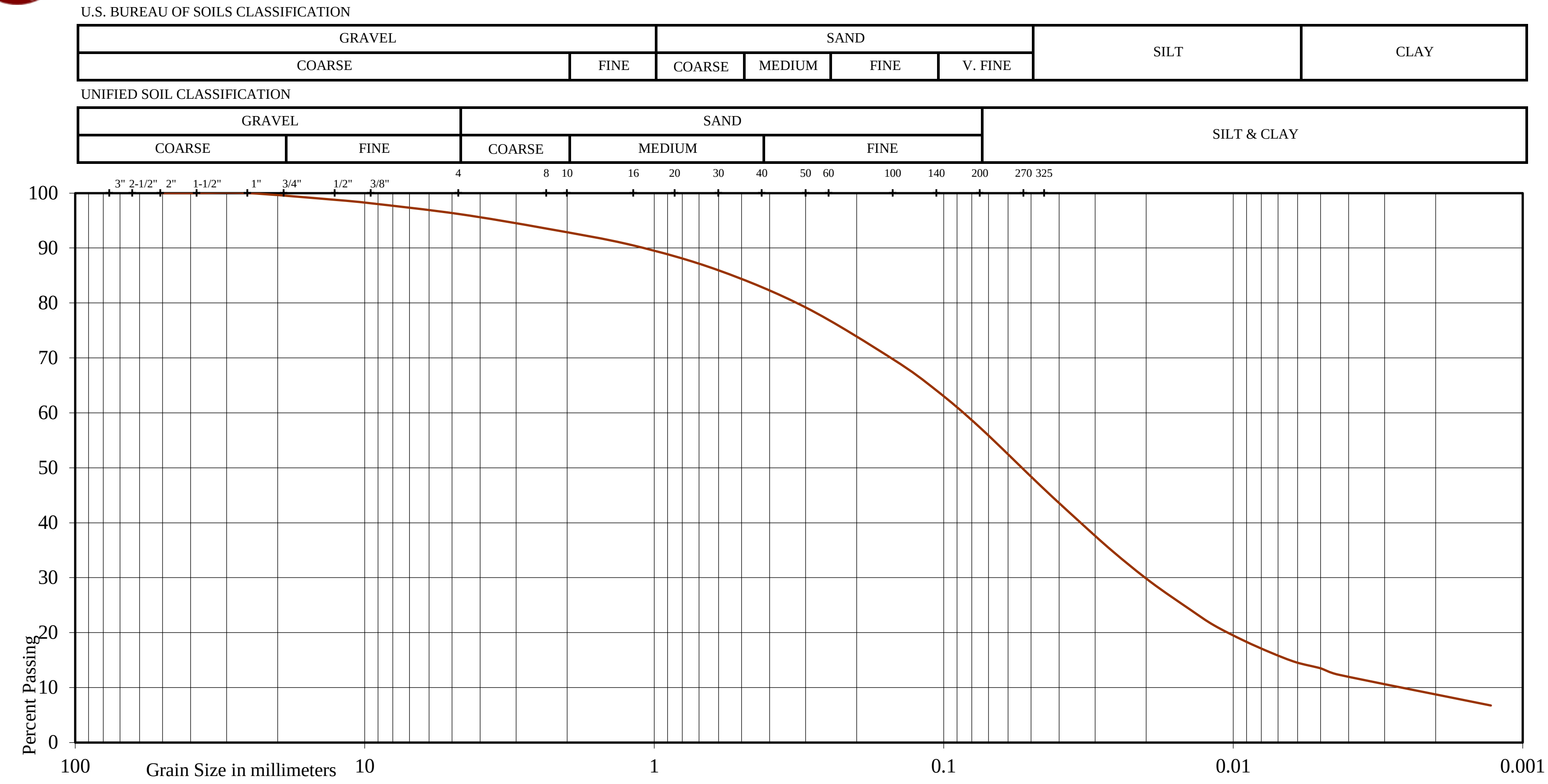
some sand to sandy, a tr. to some gravel

Figure: 9

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1609-S061



Project: Proposed Property Acquistion

Location: 7085 Goreway Drive, City of Mississauga

Borehole No: 1

Sample No: 8

Depth (m): 7.9

Elevation (m): 157.9

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 14

Estimated Permeability

(cm./sec.) = 10^{-6}

Classification of Sample [& Group Symbol]: SANDY SILT, Till
trs. of clay and gravel

Figure: 10

BOREHOLE LOCATION PLAN

Ref. No.: 1609-S061

Date: October, 2016

Drawing No.: 1

Scale: NTS Horiz.:

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CONSULTING ENGINEERS

GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

Subsurface Profile
Drawing No. 2
Scale: As Shown

Job Number: 1609-S061
Report Date: October, 2016
Job Location: 7085 Goreway Drive, City of Mississauga

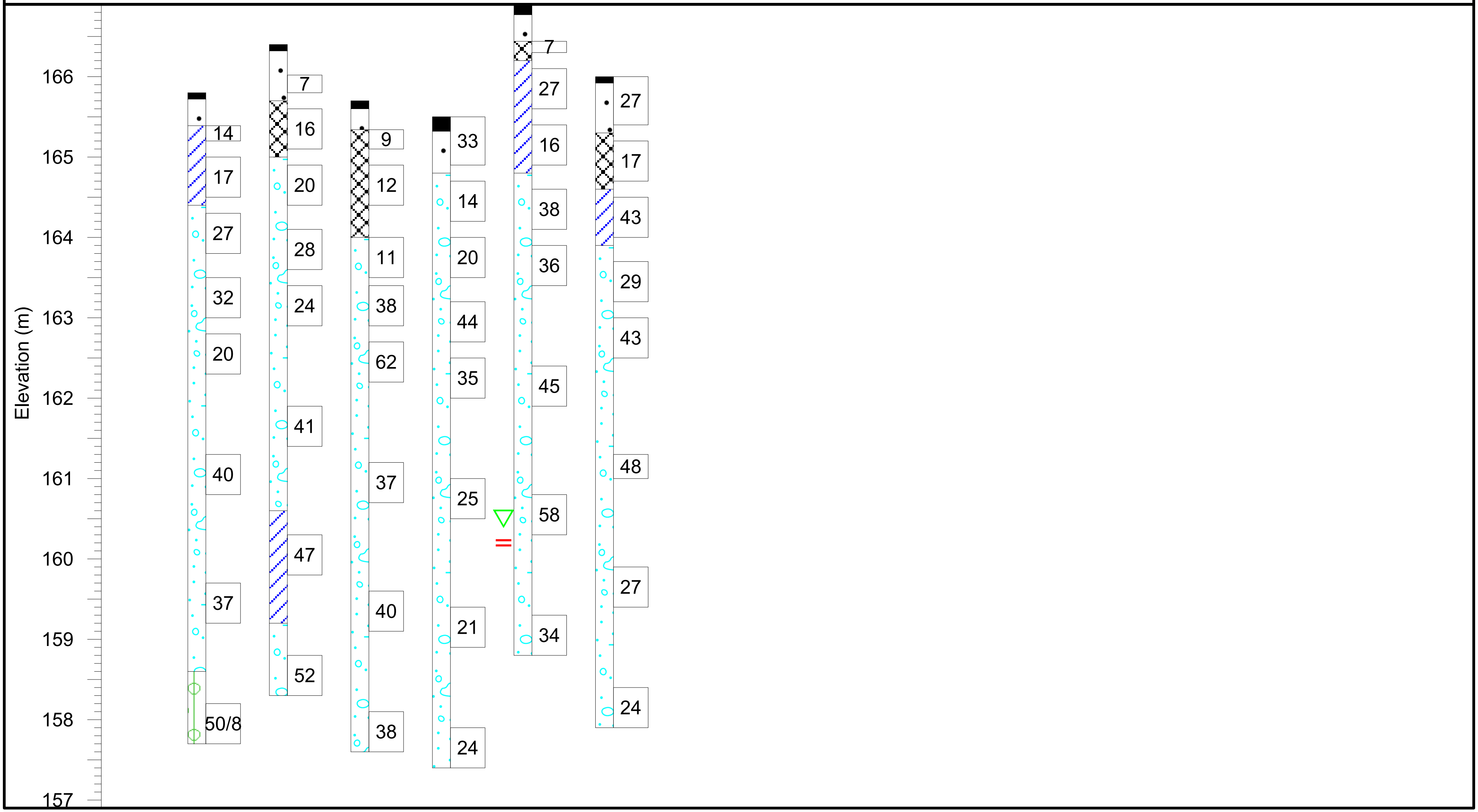
Project Description: Proposed Property Acquisition

Legend

= CAVE IN ▽ WL (END OF DRILLING) ▼ WL (STABILIZED)

TOPSOIL	FILL	SANDY SILT	SILTY CLAY TILL
CONCRETE	SAND	SANDY SILT TILL	SHALE
■ PAVEMENT	SILTY SAND	SILT	PEAT
GRANULAR	SILTY SAND TILL	SILTY CLAY	ALLUVIUM

BH No.	1	2	3	4	5	6
El.	165.8	166.4	165.7	165.5	166.9	166



APPENDIX B

Photograph 1

Position:	Valleyland
Direction/Object:	Up slope, towards property
Description:	The slope is present approximately at the edge of the property line. The existing building structure is visible in the tableland. The slope has an approximate height of 2 ±m and is vegetated with grass and young trees. No erosion was observed.

Photograph 2

Position:	Valleyland
Direction/Object:	Along pathway at slope toe
Description:	There is a metal fence along the slope crest, in a good state of maintenance. A public pathway known as “Malton Greenway” is present along the entire length of the toe of slope.

Photograph 3

Position:	Mimico Creek
Direction/Object:	Upstream
Description:	Mimico Creek is present approximately 15-25 ±m from the toe of slope. The bank of the creek is bare, with some erosion and undercutting. The creek flows from the north to the south in a meandering fashion.

APPENDIX C

SLOPE RATING CHART

GROUNDED ENGINEERING

Site Location: **7085 Goreway Dr, Mississauga**

File No. **19-040**

Property Owner:

Inspection Date: **April 9, 2020**

Inspected By: **T. Ali**

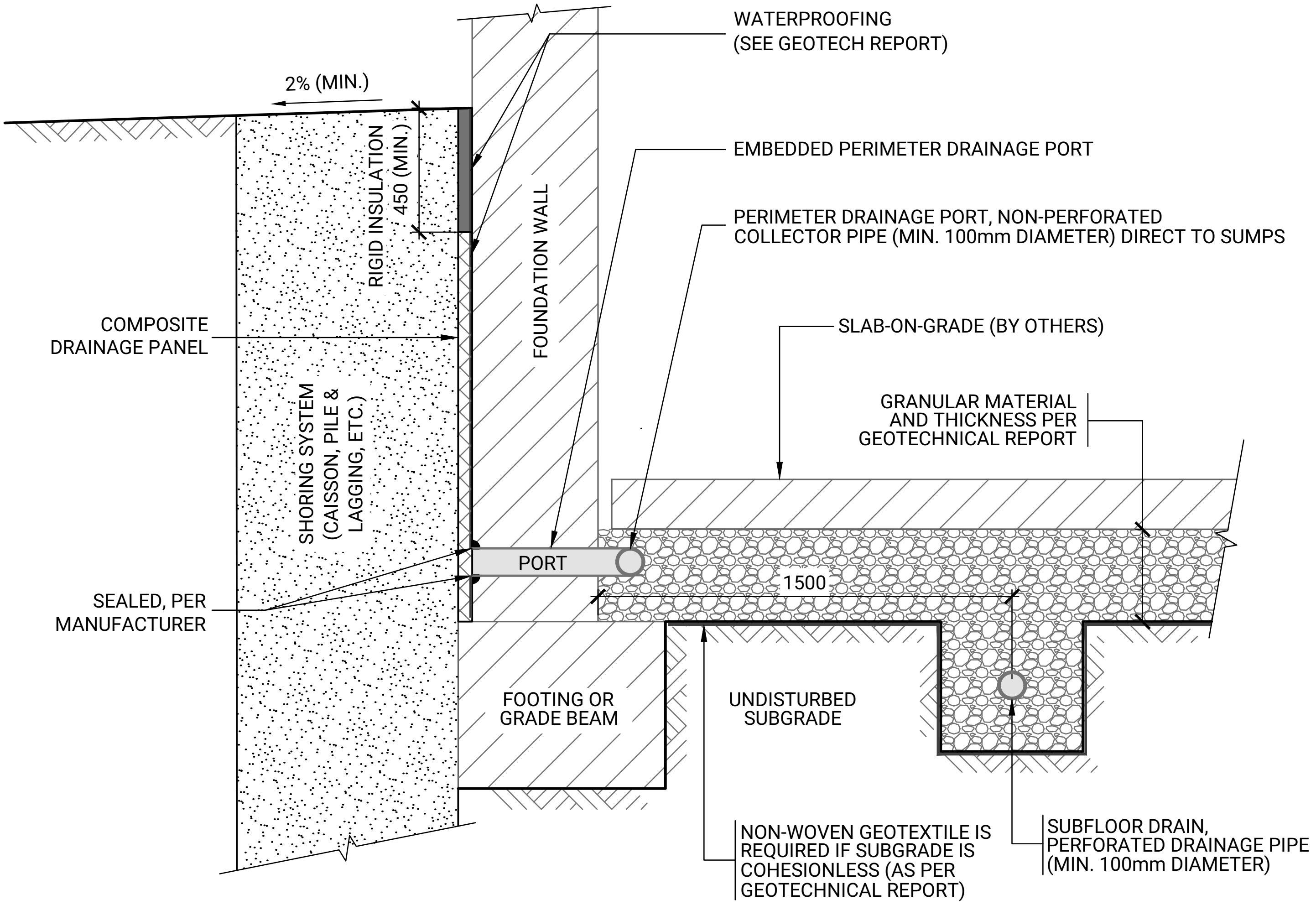
Weather: **sunny, 2 deg C**

				Rating Value
1.	**SLOPE INCLINATION**			
		degrees	**horiz. : vert.**	
	a)	18 or less	3 : 1 or flatter	[✓ 0]
	b)	18 - 26	2 : 1 to 3 : 1	6
	c)	more than 26	steeper than 2 : 1	16
2.	**SOIL STRATIGRAPHY**			
	a)	Shale, Limestone, Granite (Bedrock)		0
	b)	Sand, Gravel		6
	c)	Glacial Till		[✓ 9]
	d)	Clay, Silt		12
	e)	Fill		16
	f)	Leda Clay		24
3.	**SEEPAGE FROM SLOPE FACE**			
	a)	None or Near bottom only		[✓ 0]
	b)	Near mid-slope only		6
	c)	Near crest only or, From several levels		12
4.	**SLOPE HEIGHT**			
	a)	2 m or less		[✓ 0]
	b)	2.1 to 5 m		2
	c)	5.1 to 10 m		4
	d)	more than 10 m		8
5.	**VEGETATION COVER ON SLOPE FACE**			
	a)	Well vegetated; heavy shrubs or forested with mature trees		0
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		[✓ 4]
	c)	No vegetation, bare		8
6.	**TABLE LAND DRAINAGE**			
	a)	Table land flat, no apparent drainage over slope		[✓ 0]
	b)	Minor drainage over slope, no active erosion		2
	c)	Drainage over slope, active erosion, gullies		4
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**			
	a)	15 metres or more from slope toe		[✓ 0]
	b)	Less than 15 metres from slope toe		6
8.	**PREVIOUS LANDSLIDE ACTIVITY**			
	a)	No		[✓ 0]
	b)	Yes		6
				TOTAL
				13

	SLOPE INSTABILITY RATING	**RATING VALUES TOTAL**	**INVESTIGATION REQUIREMENTS**
[✓ 1.]	Low potential	< 24	Site inspection only, confirmation, report letter.
2.	Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.
3.	Moderate potential	> 35	Boreholes, piezometers, lab tests, surveying, detailed report.

NOTES:
a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

APPENDIX D



SUBFLOOR DRAINAGE SYSTEM

1. THE SUBFLOOR DRAINS SHOULD BE SET IN PARALLEL ROWS, IN ONE DIRECTION, AND SPACED AS PER THE GEOTECHNICAL REPORT.
2. THE INVERT OF THE PIPES SHOULD BE A MINIMUM OF 300 MM BELOW THE UNDERSIDE OF THE SLAB-ON-GRADE.
3. A CAPILLARY MOISTURE BARRIER (I.E. DRAINAGE LAYER) CONSISTING OF A MINIMUM 200 MM LAYER OF CLEAR STONE (OPSS MUNI 1004) COMPACTED TO A DENSE STATE (OR AS PER THE GEOTECHNICAL REPORT). WHERE VEHICULAR TRAFFIC IS REQUIRED, THE UPPER 50 MM OF THE CAPILLARY MOISTURE BARRIER MAY BE REPLACED WITH GRANULAR A (OPSS MUNI 1010) COMPACTED TO A MINIMUM 98% SPMDD.
4. A NON-WOVEN GEOTEXTILE MUST SEPARATE THE SUBGRADE FROM THE SUBFLOOR DRAINAGE LAYER IF THE SUBGRADE IS COHESIONLESS. THE NON-WOVEN GEOTEXTILE MAY CONSIST OF TERRAFIX 360R OR AN APPROVED EQUIVALENT.

PERIMETER DRAINAGE SYSTEM

1. FOR A DISTANCE OF 1.2 M FROM THE BUILDING, THE GROUND SURFACE SHOULD HAVE A MINIMUM 2% GRADE.
2. PREFABRICATED COMPOSITE DRAINAGE PANEL (CONTINUOUS COVER, AS PER MANUFACTURER'S REQUIREMENTS) IS RECOMMENDED BETWEEN THE BASEMENT WALL AND RIGID SHORING WALL. THE DRAINAGE PANEL MAY CONSIST OF MIRADRAIN 6000 OR AN APPROVED EQUIVALENT.
3. PERIMETER DRAINAGE IS TO BE COLLECTED IN NON-PERFORATED PIPES AND CONVEYED DIRECTLY TO THE BUILDING SUMPS.
4. PERIMETER DRAINAGE PORTS SHOULD BE SPACED A MAXIMUM 3 M ON-CENTRE. EACH PORT SHOULD HAVE A MINIMUM CROSS-SECTIONAL AREA OF 1500 MM^2.

GENERAL NOTES

5. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
6. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
7. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC RECOMMENDATIONS.
8. THE FINAL BASEMENT DRAINAGE DESIGN SHOULD BE REVIEWED BY THE GEOTECHNICAL ENGINEER TO CONFIRM THE DESIGN IS ACCEPTABLE.

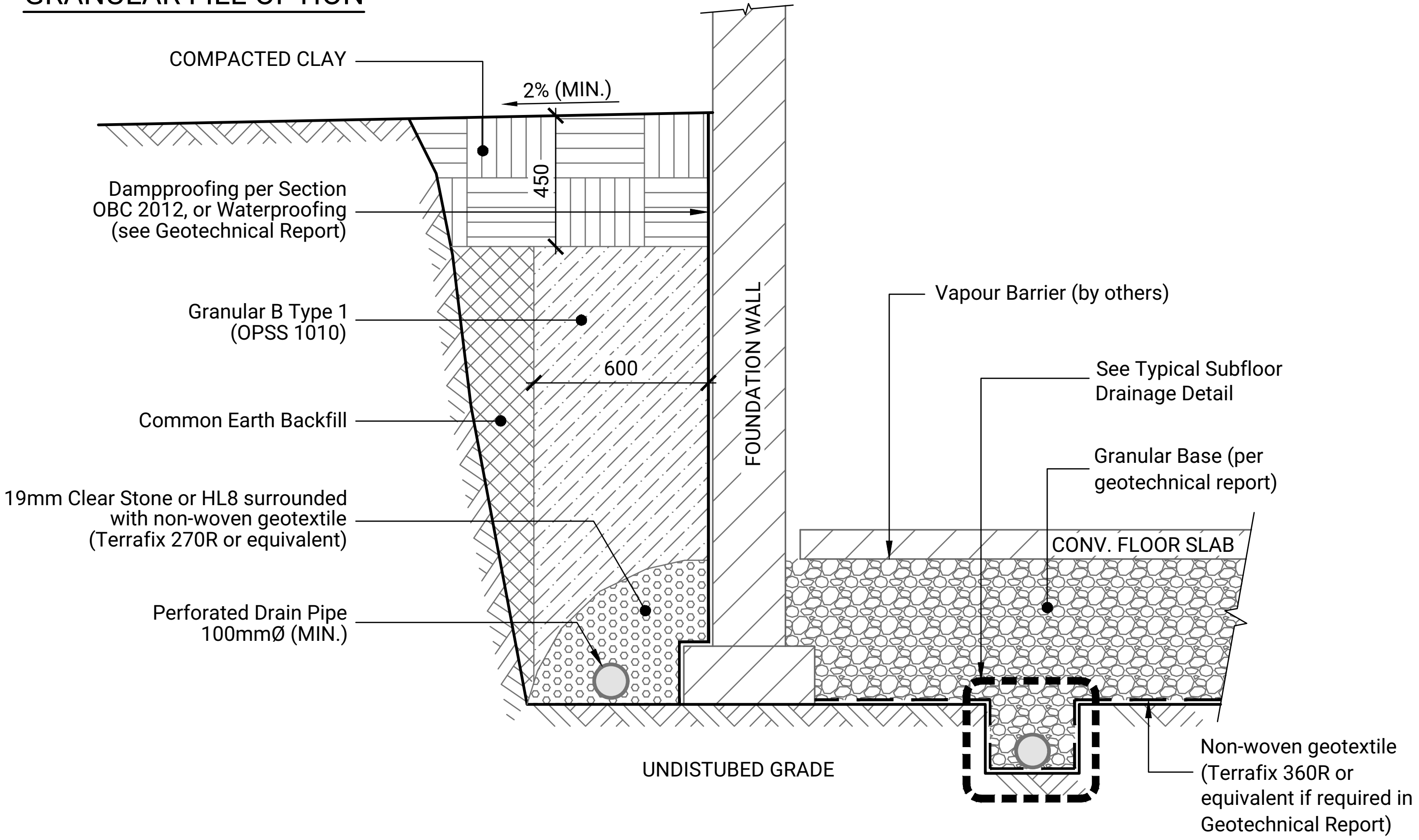
*THE DRAWING PROVIDED IS NOT TO SCALE

GROUNDED
ENGINEERING

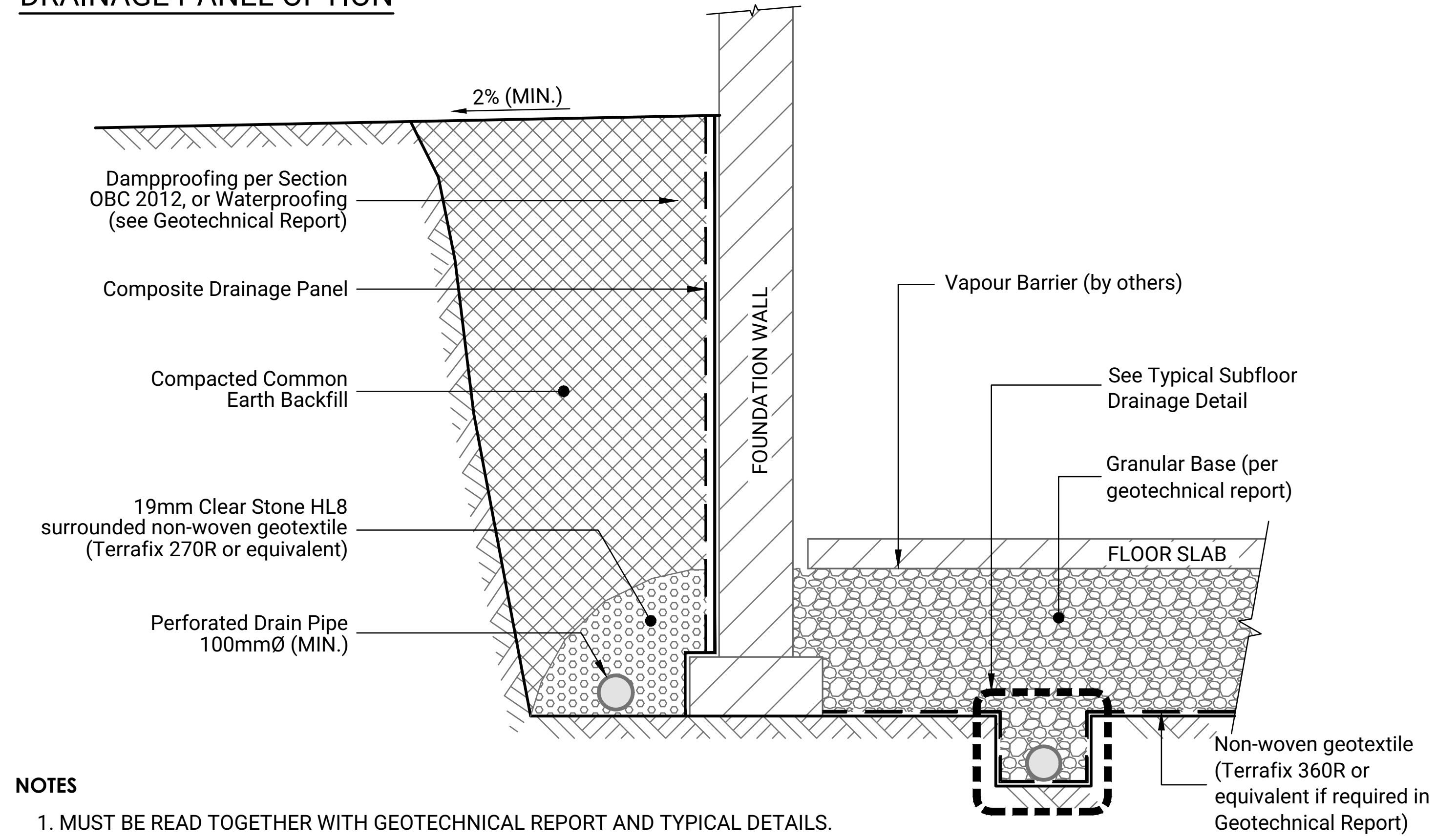
Title

BASEMENT DRAINAGE SHORING SYSTEM
TYPICAL DETAILS

GRANULAR FILL OPTION



DRAINAGE PANEL OPTION



NOTES

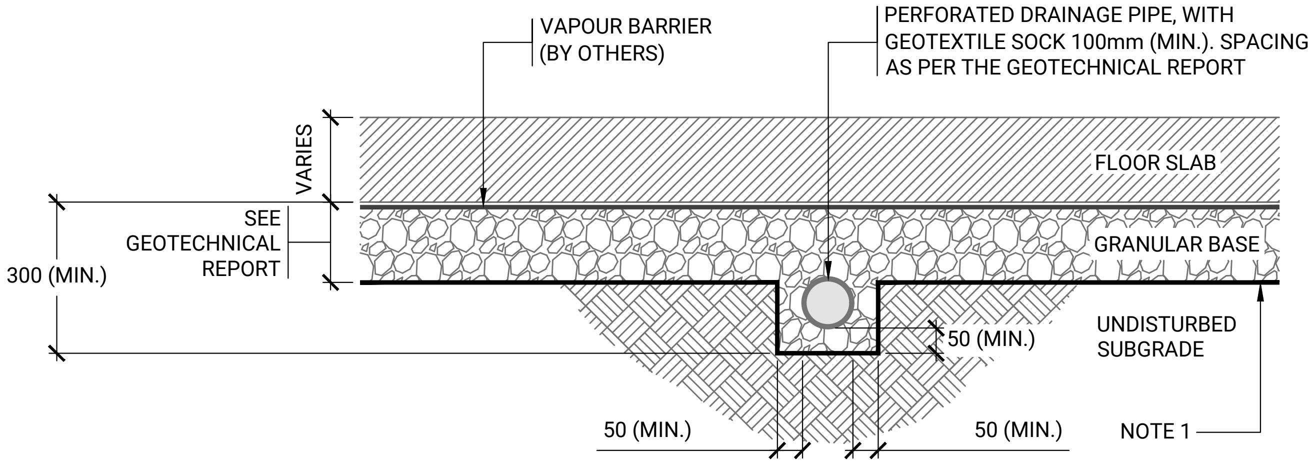
1. MUST BE READ TOGETHER WITH GEOTECHNICAL REPORT AND TYPICAL DETAILS.

*THE DRAWING PROVIDED IS NOT TO SCALE

GROUNDED
ENGINEERING

Title

BASEMENT DRAINAGE
TYPICAL DETAIL



NOTES

1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N).
2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

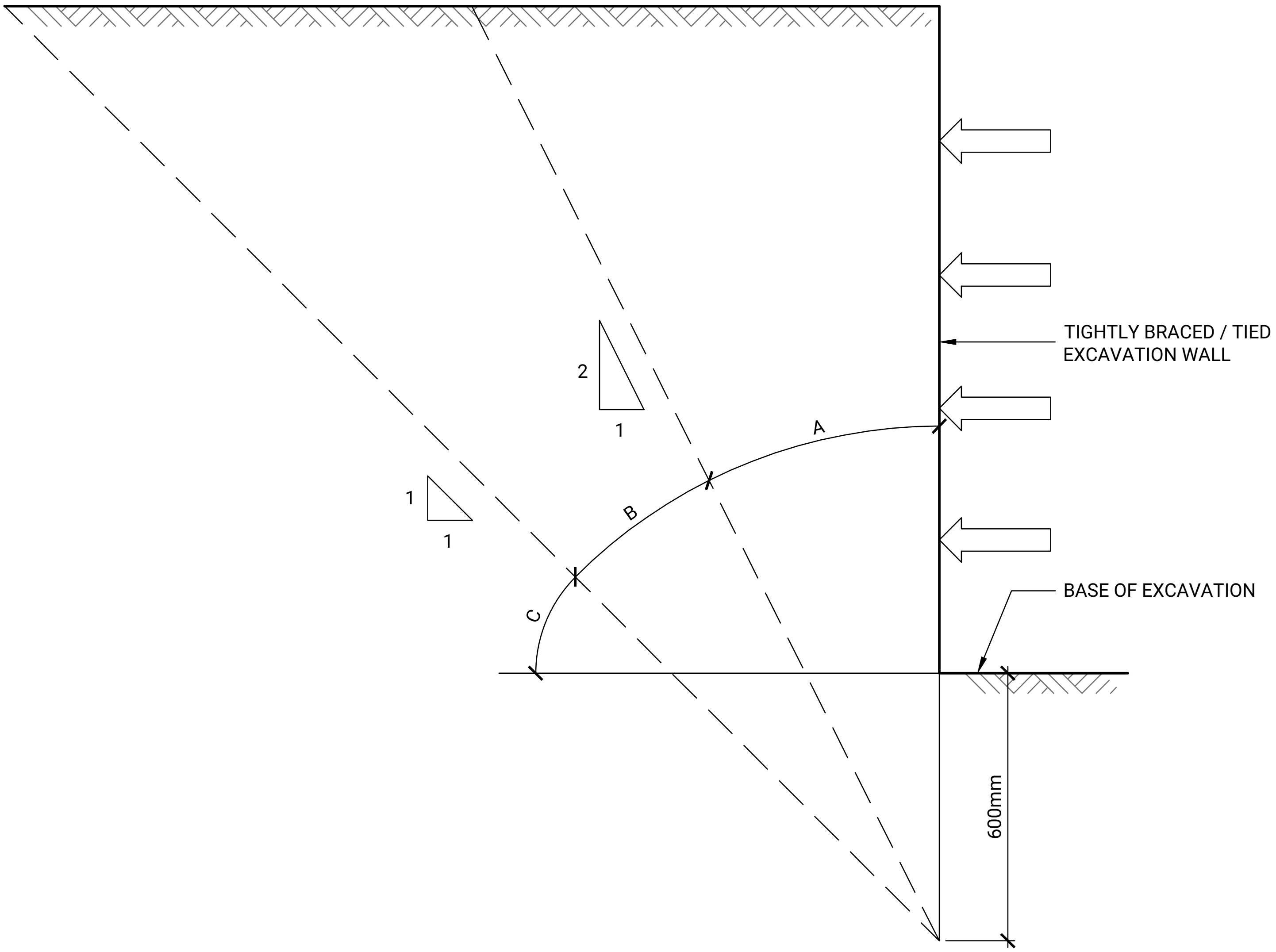
*THE DRAWING PROVIDED IS NOT TO SCALE

GROUNDED
ENGINEERING

Title

BASEMENT SUBDRAIN
TYPICAL DETAIL

APPENDIX E



ZONE A: FOUNDATIONS WITHIN THIS ZONE OFTEN REQUIRE UNDERPINNING. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATIONS MUST BE CONSIDERED.

ZONE B: FOUNDATION WITHIN THIS ZONE OFTEN DO NOT REQUIRE UNDERPINNING. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATIONS MUST BE CONSIDERED.

ZONE C: FOUNDATIONS WITHIN THIS ZONE USUALLY DO NOT REQUIRE UNDERPINNING.

NOTES

1. USER'S GUIDE - NBC 2005 STRUCTURAL COMMNETARIES (PART 4 OF DIVISION B) - COMMENTARY K.

*THE DRAWING PROVIDED IS NOT TO SCALE

GROUNDED
ENGINEERING

Title

GUIDELINES FOR UNDERPINNING SOILS