PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT
51 TANNERY STREET
MISSISSAUGA, ONTARIO

Prepared for:

OHE CONSULTANTS

PATRIOT ENGINEERING LTD.
Consulting Engineers

Project 37105
February 1, 2017

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DRAWINGS

PATRIOT
ENGINEERING LTD.
Consulting Engineers

Project 37105

February 1, 2017

OHE Consultants
311 Matheson Boulevard East
Mississauga, Ontario, L4Z 1X8

Attention: Mr. Mike Grayhurst, P.Eng.

Preliminary Geotechnical Investigation
Proposed Development
51 Tannery Street
Mississauga, Ontario

1.0 INTRODUCTION

On behalf of OHE Consultants, Patriot Engineering Ltd., has carried out a geotechnical investigation at the above project site to determine the soil and groundwater conditions in order to provide geotechnical recommendations for type of foundations, safe soil bearing pressures, excavations and backfill procedures, re-use of excavated soils, drainage, slab-on-grade floor construction, earthquake design parameters and earth pressure coefficients. Authorization to proceed with this investigation was provided by Mr. Mike Grayhurst, of OHE Environmental Inc., on behalf of the owners.

At this time, the location of the proposed building(s) on the site is not known. Furthermore, the number of storeys, type of construction, the structural loads and whether the proposed structure will contain a basement is also not known. This investigation was carried out to assess the general soil conditions at the site for a real estate transaction. In this regard, we have designated this geotechnical investigation as being preliminary.

The site is located approximately 1000m south and 500m west from the intersection of Queen Street South and Britannia Road West, in Mississauga, Ontario. The majority of the terrain is gently sloping towards the south direction with an approximately 1m drop midway through the site. Currently, there are several buildings on the property. The surface is covered with vegetation consisting of grass, shrubs and trees. The surface also contains areas paved with asphalt and gravel.

2.0 FIELDWORK

The fieldwork for this investigation took place on January 20, 2017, and consisted of advancing a total of six (6) boreholes. From these, five (5) boreholes (Boreholes 103, 105, 106, 107 and 108) were carried out using solid stem augers and one borehole (Borehole 101) was carried out using a direct push machine with percussion hammer. The direct push machine does not provide 'N' values (blows/300mm). It was used by OHE Consultants for their environmental work that was being carried out at the same time as the geotechnical investigation. The soil samples from Borehole 101 were shared with Patriot Engineering Ltd. Although this borehole may not be used to estimate the insitu soil strength, it provided us with verification of the local uniformity of the soil conditions within the site. Borehole 101 was advanced to a depth of 4.8m, while Borehole 105 was drilled to 7.8m depth. The remaining four boreholes were drilled to a depth of 8.1m.

The ground surface elevations for the boreholes were determined by members of our field engineering staff and referenced at:

> City of Mississauga bench mark at Station No. 00819638004. It is located on the north face of the foundation wall of the limehouse brick building at Tannery Road and Queen Street South. The tablet is set horizontally 490mm east of the northwest corner and 50mm below the brick work.

The elevation at this point is understood to be at Elev. 163.423m.

The approximate borehole locations are shown on the Site Plan, Figure 1.

The scope of work for the geotechnical investigation for this project is as it is presented in this report, which is being provided on the assumption that the applicable codes and standards will be met. If there are any changes in the design features relevant to the geotechnical analysis, or if there are any apparent deviations of the report from relevant codes and standards, our office should be contacted to review the design.

3.0 SUBSURFACE CONDITIONS

The detailed stratigraphy encountered in the boreholes is presented on the Borehole Logs, Drawings 2 to 7, inclusive.

In general, Boreholes 101, 103 and 108 were drilled from a paved region at the site and initially advanced through asphalt that varied in thickness from 35mm to 40mm. The asphalt was followed by a granular fill that consisted of loose to compact, brown, moist, crusher run limestone. Its thickness ranged from 60mm to 80mm. Boreholes 105 and 106 were drilled from a granular fill covered area that varied in thickness from 50mm to 200mm. This granular fill layer consisted of compact, brown, moist, crusher run limestone. While Borehole 107 was drilled from a grass covered region, initially advancing through a topsoil layer, which was approximately 100mm in thickness. Below the topsoil layer in Borehole 107 and the granular fill layer in Boreholes 103 and 106, a fill layer was next encountered. It consisted of brown/reddish brown, slightly moist to very moist, sandy silt. Some clay, traces of gravel, cobbles, topsoil brick fragments, asphalt and wood pieces, as well as, isolated pockets of topsoil were also present within this material. The "N" values (blows/foot) that were recorded within this material ranged from 6 to 17, revealing relative densities that were loose to compact. The moisture contents ranged from 3% to 21%. The topsoil/organics that were detected within the fill layer, appeared to be infrequent, isolated and of insignificant concentrations.

Beneath the granular fill, at Borehole 108 and following the sandy silt fill layer at Borehole 106, a fill layer was present and consisted of firm to very stiff, brown/reddish brown, moist to very moist, clayey silt. This layer also contained some sand, traces of gravel, cobbles, brick fragments, asphalt and wood pieces. At Borehole 101, similar clayey silt fill was encountered. The moisture contents varied from 16.0% to 38.0%. The depth of the fill layer inside the boreholes varied from 0.3m to 4.9m below existing grade.

Underlying the fill layer at all the boreholes, native, brown/grey, slightly moist to moist, sandy silt till layer was encountered. Some clay, plus traces of sand, cobbles and shale fragments, as well as, isolated wet sand seams were also observed within this material. The "N" values (blows/foot) that were recorded in this layer ranged from 14 to well over 50, revealing compact to very dense relative densities. This is based on Boreholes 103, 105, 106, 107 and 108, as the drilling method used for Borehole 101 did not provided 'N' values. The moisture contents that were recorded within this layer fell between 5% and 15%. Grain size distribution test results from a sample that was obtained from this material is shown on Figure 7. This sample is composed of 5.4% Gravel, 26.0% Sand, 51.7% Silt and 16.9% Clay.

Below the overburden soils, Boreholes 103, 105 and 107, then encountered shale bedrock and were terminated in it. These boreholes penetrated the shale bedrock to depths ranging from approximately 0.15m to 0.4m. The shale was weathered and grey in colour. Based on the geology of the area, the shale is of the Georgian Bay formation, which is usually grey and mainly weathered on the upper strata.

At the borehole locations, the top surface of the shale bedrock varied slightly and was generally situated between Elev. 149.3m and Elev. 150.9m. Based on the site topography at the time of our investigation, this translated to approximate depths of 7.65m to 7.7m below the existing grade surface.

The short term groundwater levels that were recorded inside the boreholes upon completion of drilling are indicated below in Table 1. These groundwater level readings are also shown on the individual borehole logs.

Table 1
Measured Short Term Groundwater Levels Upon Completion of Drilling

Borehole No.	Depth of Borehole (m)	Borehole Surface Elevation (m)	Approximate Depth of Groundwater Level Below Existing Ground (m)	Approximate Groundwater Elevation (m)
101	4.8	157.1	DRY	-
103	8.1	157.0	5.6	151.4
105	7.8	157.0	4.4	152.6
106	8.1	156.8	4.3	152.5
107	8.1	158.6	7.3	151.3
108	8.1	159.6	DRY	-

Long term groundwater levels have not been established and some seasonal fluctuations and higher water levels should be anticipated.

The soil and groundwater conditions presented in this report have been deducted from soil sampling that was largely noncontinuous and therefore, should not be taken to represent exact planes of geological change. Furthermore, the geotechnical recommendations and comments provided in this report have been based on boreholes that were widely spaced. Therefore, the soil and groundwater conditions between the boreholes could vary significantly. The interpretation between boreholes and the recommendations in this report must therefore be checked through field inspections, provided by our office during the construction stages, to validate the information for use.

4.0 GEOTECHNICAL RECOMMENDATIONS

The number of boreholes required to determine the localized underground conditions between boreholes that would affect construction costs, sequencing, equipment, scheduling construction techniques, and the like, would be much greater than that which was carried our for design purposes. Contractors and/or subcontractors bidding on or undertaking the work should, in this light, decide on their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them and their scope of work.

4.1 Caisson Foundations

From our investigation, Borehole 103 contained the least amount of fill which was approximately 0.4m below existing grade. While the remaining boreholes exhibited significantly deeper zones of fill material that ranged from 2.1m to 4.9m below the existing grade. Subsequently, competent native soils suitable for bearing purposes ranged from 2.4m to 5.5m below existing grade. Such depths are considered to be excessive when contemplating the use of conventional spread footings. As a result, conventional spread footings is not a favourable solution.

For the soil conditions encountered at this site, it is our opinion that a deep foundation method consisting of caisson foundations in combination with grade beams to support the building loads, is considered to be a suitable solution.

The caissons should be straight shafted and have a minimum diameter of 750mm, and possibly larger to facilitate hand cleaning and inspection. They must penetrate the very dense sandy silt till a minimum of 1.5m depth.

Based on the soil and groundwater conditions encountered at the borehole locations, the proposed structure may be founded on caisson foundations advanced into the very dense, sandy silt till below the approximate elevations indicated on Table 2. The following soil bearing pressures that are shown on the same Table 2 are recommended:

Table 2
Soil Bearing Pressures of Caisson Foundations

Borehole No.	Serviceability Limit State (kPa)	Factored Bearing Capacity at Ultimate Limit State (kPa)	Approximate Founding Elevation (m)	Approximate Founding Depth Below Existing Ground (m)
103	750	900	Below 151.0	Below 6.0
105	750	900	Below 150.8	Below 6.2
106	750	900	Below 150.4	Below 6.4
107	750	900	Below 153.6	Below 5.0
108	750	900	Below 153.4	Below 6.2

Provided that the foundation bases are not disturbed by excavation, surface water inflow, or freezing and thawing action, foundations designed with the serviceability condition SLS pressures shown above in Table 2, should not exceed the total and differential settlements of 25mm (1inch) and 20mm (3/4 inch), respectively.

The bearing level for caissons must be at least three base diameters below the lowest adjacent floor level.

The caisson bases must also be stepped along a line of 7 vertical to 10 horizontal where founding elevations are variable and must be designed with tip elevations that do not interfere with adjacent foundation systems, underground services and the like.

All caissons should be fully cased and constructed with a temporary steel liner which is adequately sealed into the very dense, silty sand till in order to facilitate hand cleaning and inspection. Special provisions as needed, such as extra steel liners, rock chopping tools, slurry drilling and pumps should be made by specialist caisson contractor as water conditions area expected to be encountered. Prior to breaking the seal between the temporary casing and the founding strata, the static head of plastic concrete shall be sufficiently above the groundwater head to prevent water and caving soils entering the hole during the withdrawal of the casing.

The concrete supplied for the caissons should be approved 150mm slump high strength mix meeting CSA requirements. The proposed concrete mix design should be reviewed by our office prior to placement.

The caisson foundation bases shall be cleaned after drilling. All caissons must be inspected by a geotechnical engineer from our office to ensure adequate founding levels and bearing pressures prior to proper concrete placement and liner withdrawal.

All new grade beams and foundations exposed to freezing ground conditions must be provided with a minimum of 1.2m (4 ft.) of soil cover or equivalent.

New footings and/or grade beams shall be stepped along a line of 7 vertical to 10 horizontal where founding grades are variable.

In light of the wet and water bearing sand seams present in the boreholes, groundwater conditions are anticipated to be encountered with caisson excavations at this site. An allowance must be made for slurry drilling and properly filtered sumps plus high capacity pumps, as needed. It is recommended that unit costs be included in the contract documents for such items.

It is recommended that the foundation drawings be reviewed by our office for general conformance with our geotechnical recommendations.

Higher bearing pressures are expected in the shale bedrock. However, this must be substantiated by coring into the shale bedrock.

4.2 Alternate Foundation Method Using Helical Piers

An alternate foundation method for the soil conditions encountered at the site that we recommend is Helical Pier foundations in Combination with grade beams. The Helical Piers should be supplied by Chance, or equivalent.

The installation of helical pier foundations will transfer the building loads to deeper zones where the soil conditions are more favorable for bearing purposes.

Helical Piers may be founded below all topsoil, fill, loosened and deleterious soils into the native, undisturbed, very dense, sandy silt till.

The design load sustained by the individual Helical Piers should be provided by the Structural Engineer.

Besides the soil conditions encountered, the capacity of a helical pier also depends on the type and size selected, plus the number of helices. Therefore, the manufacturer/supplier will finalize the selection of the pier size, which will achieve this design capacity that is specified by the structural engineer. The general specifications for the installation and testing will also be provided by the manufacturer/supplier.

A compression load test shall be carried out on a minimum of one Helical Pier, to verify its capacity. It must be carried out under the supervision of our office.

All Helical Pier installation work should be inspected on a full-time basis by a geotechnical engineer from our office to insure that they have been installed into the specified native soils at adequate depths and achieved the designated torque requirements.

Any new grade beams and foundations must be stepped along a line of 7 vertical to 10 horizontal where founding grades are variable and must not interfere with adjacent foundation systems, underground services and the like.

All new foundations exposed to freezing ground conditions must be provided with a minimum of 1.2m (4 ft.) of soil cover or equivalent.

It is recommended that the foundation drawings be reviewed by our office for general conformance with our geotechnical recommendations.

4.3 Slab-On-Grade Floor

It is noted that fill materials were detected in the boreholes, which extend up to a depth of approximately 4.9m below existing grade. The existing fill materials appear to be uniform in structure as indicated by our samples. Therefore, the fill materials are considered to be suitable as a subgrade. The concrete floor shall then be constructed by conventional slab-on-grade techniques provided that the subgrade is adequately prepared, inspected and approved by a geotechnical engineer. The subgrade is expected to consist of compact, sandy silt fill and/or stiff, clayey silt fill. The exposed subgrade must also be stripped of all topsoil, organics, vegetation, loose, wet and deleterious materials and heavily proofrolled and compacted under geotechnical supervision to a minimum of 98% Standard Proctor maximum dry density. Any weak spots encountered on the exposed subgrade must also be subexcavated and removed. The subgrade must then be raised to the desired level using OPSS approved Granular B Type I (sand and gravel) material placed in 300m (1ft.) loose lifts and compacted to a minimum of 98% Standard Proctor maximum dry density.

The amount of organics/topsoil appeared minor in the samples, however, during construction if it becomes greater, then any such localized areas must be excavated and removed.

A moisture barrier consisting of at least 200mm (8 inch) thick of 20mm (3/4 inch) of OPSS Granular A crusher run limestone must be provided under proposed floor slab. It shall be compacted to at least 98% Standard Proctor maximum dry density.

A poly vapour barrier shall be installed between the above mentioned moisture barrier and the floor slab. The manufacturer's specifications must be followed.

A Modulus of Subgrade Reaction (Ks) of 24, 400 KN/m3 (90 pci) is suggested for designing the floor slab.

4.4 Earthquake Design Parameters

In accordance to the Ontario Building Code, the site's classification of Seismic Response would be Class C. Also, the Acceleration Coefficient, Fa = 1.0 and the Velocity Coefficient, Fv = 1.0, are applicable to this site.

4.5 Earth Pressures (Applicable Only if the Structure will Contain a Basement)

All subsurface walls must be waterproofed and designed to resist a horizontal soil pressure, p, at any depth, h, as given by the following expression:

$$p = k(\gamma h + q)$$

where p = earth pressure at depth, h

k = earth pressure coefficient
use 0.55 for rigid walls

γ = unit weight of the soil
use 21.5 kN/m^3 (137 pcf)

h = depth to point of interest, m (ft)

q = all surcharge, kPa (psf)

This expression assumes that the placement of free draining backfill material and the installation of perimeter drainage will reduce the hydrostatic pressure to a negligible quantity. If this cannot be achieved, provisions must be made for the hydrostatic pressure.

4.6 Excavation and Backfill

No major groundwater problems are anticipated with the excavations to building foundation base elevations on this site. Surface water inflows and any seepage from perched water levels should be handled adequately with properly filtered sumps and peripheral ditches in slightly oversized excavations.

All temporary shallow excavations shall be cut at 45 degrees above the horizontal. Some sloughing of the upper zones may require shallower slopes in localized areas. All excavations must be made to conform to regulations set out in the Occupational Health and Safety Act. Using the classification system described in the Occupational Health and Safety Act, the fill soils on site can be classified as Type 3. The native soils can also be considered as Type 3. Any wet and saturated soils, or soils located below the groundwater level are classified as Type 4.

Excavations must not be cut below an imaginary line drawn downward from existing/neighboring foundations or underground services at 7 vertical to 10 horizontal, otherwise adequate temporary shoring and/or underpinning will be required.

Backfilling of foundations should be carried out with approved native material or OPSS approved Granular B Type I (sand and gravel) material provided that it can be placed in maximum 300mm (1 ft.) loose lifts and compacted to a minimum of 95% Standard Proctor maximum dry density. The upper 1.2m (4 ft.) of backfill should be compacted to a minimum of 98% Standard Proctor maximum dry density.

Backfilling of underslab interior building excavations should be made with approved OPSS Granular B Type I (sand and gravel) material, placed in maximum 300mm (1 ft.) loose lifts and compacted to at least 98% Standard Proctor maximum dry density.

Backfilling of service trenches under proposed pavement areas shall be carried out using approved native soils or OPSS approved Granular B Type I (sand and gravel) material provided it can be placed in maximum 300mm (1 ft.) loose lifts and compacted to a minimum of 95% Standard Proctor maximum dry density. The upper 1.2m (4 ft.) of backfill should be compacted to a minimum of 98% Standard Proctor maximum dry density.

The suitability and reuse of the onsite material as backfill should be inspected and assessed during the initial stages of construction. Materials that have been approved for reuse should be maintained within 2% of their optimum moisture content. Tarps may be required to cover and protect the approved material.

5.0 Pavement Structures

It is anticipated that the proposed development may require the construction of flexible pavement areas with light duty car parking and heavy duty access routes.

The pavement areas may be constructed on an adequately prepared subgrade consisting of compact, sandy silt fill, stiff, clayey silt fill and/or native, compact to very dense, sandy silt till. It must be inspected and approved by a geotechnical engineer. The subgrade must be stripped of all topsoil, vegetation, loose, wet and deleterious materials and then proofrolled and compacted under geotechnical supervision to a minimum of 98% Standard Proctor maximum dry density. Any weak or soft areas encountered at the exposed subgrade surface must be further subexcavated and removed. The grade must then be raised using approved onsite organic free materials and/or approved OPSS Granular B Type I (sand and gravel) material, placed in maximum 300mm loose lifts and compacted to a minimum of 98% Standard Proctor maximum dry density. It is important to maintain stringent construction control procedures for ensuring that uniform subgrade moisture and density conditions are achieved.

Based on the subgrade characteristics and normal anticipated traffic loading, the pavement structures noted in Table 3 are recommended:

Table 3
Recommended Pavement Thicknesses

Material	Light Duty	Heavy Duty
HL 3 Surface Asphalt	30mm	40mm
HL 8 Binder Asphalt	40mm	80mm
Granular Basecourse OPSS Granular "A" Consisting of 20mm Crusher Run Limestone	150mm	150mm
Granular Subbase OPSS Granular "B" Type II Consisting of 50mm Crusher Run Limestone	200mm	350mm
Total Combined Thickness	420mm	620mm
Granular Base Equivalents (GBE)	425mm	625mm

The final subgrade should be shaped and crowned to allow drainage to adequately spaced catch basins installed with subdrains or perimeter swales or ditches leading to a positive outlet. Figure 9 shows a typical subdrain detail. We emphasize the need for adequate drainage. Catch basins must contain subdrains for drainage infiltration from the granular basecourse into these drainage structures. Subdrains should be installed along the driveway and parking lot areas plus be installed to extend between catch basins.

All granular components shall be placed in maximum 300mm loose lifts and compacted to a minimum of 98% Standard Proctor maximum dry density. The asphalt components shall be placed and compacted to 97% Marshall density as measured by nuclear density metres.

The finished pavement surface should be free of depressions and should be sloped to provide effective surface drainage towards the catch basins. Also, surface water should not be allowed to pond adjacent to the outside edges of the pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent the subgrade from softening. This is particularly important at the heavy duty pavement areas.

Frost action can often cause differential movement to take place between the pavement and catch basins and/or manholes. As a result, it is recommended that these structures be backfilled with granular material such as approved OPSS Granular B, placed in 300mm loose lifts and compacted to a minimum of 98% Standard Proctor maximum dry density. Hand controlled light compaction equipment shall be used when backfilling these structures to avoid damaging them.

In order to minimize the adverse effects of settlement, it is recommended that the surface course asphalt be delayed for approximately one year after the binder asphalt is placed, where practical.

The quality, performance and life expectancy of the finished parking lot is highly dependent upon adequate subgrade preparation, the quality and proper placement of the pavement components and the compaction level achieved. Therefore, it is important that geotechnical inspections be carried out during all phases of construction to ensure construction practice is compatible with design requirement.

After the location of the proposed structure(s) on the property will be determined, we then recommend that an additional geotechnical investigation to be carried out to address the subsurface conditions at these specific locations containing these structures.

We trust this report will assist you with your proposed development. Should you have any questions, please do not hesitate to contact our office.

Sincerely,
PATRIOT ENGINEERING LTD.

Milkias Woldegiorgis, B.A.Sc., EIT

Larry Galimanis, P.Eng.
Principal/Consulting Engineer

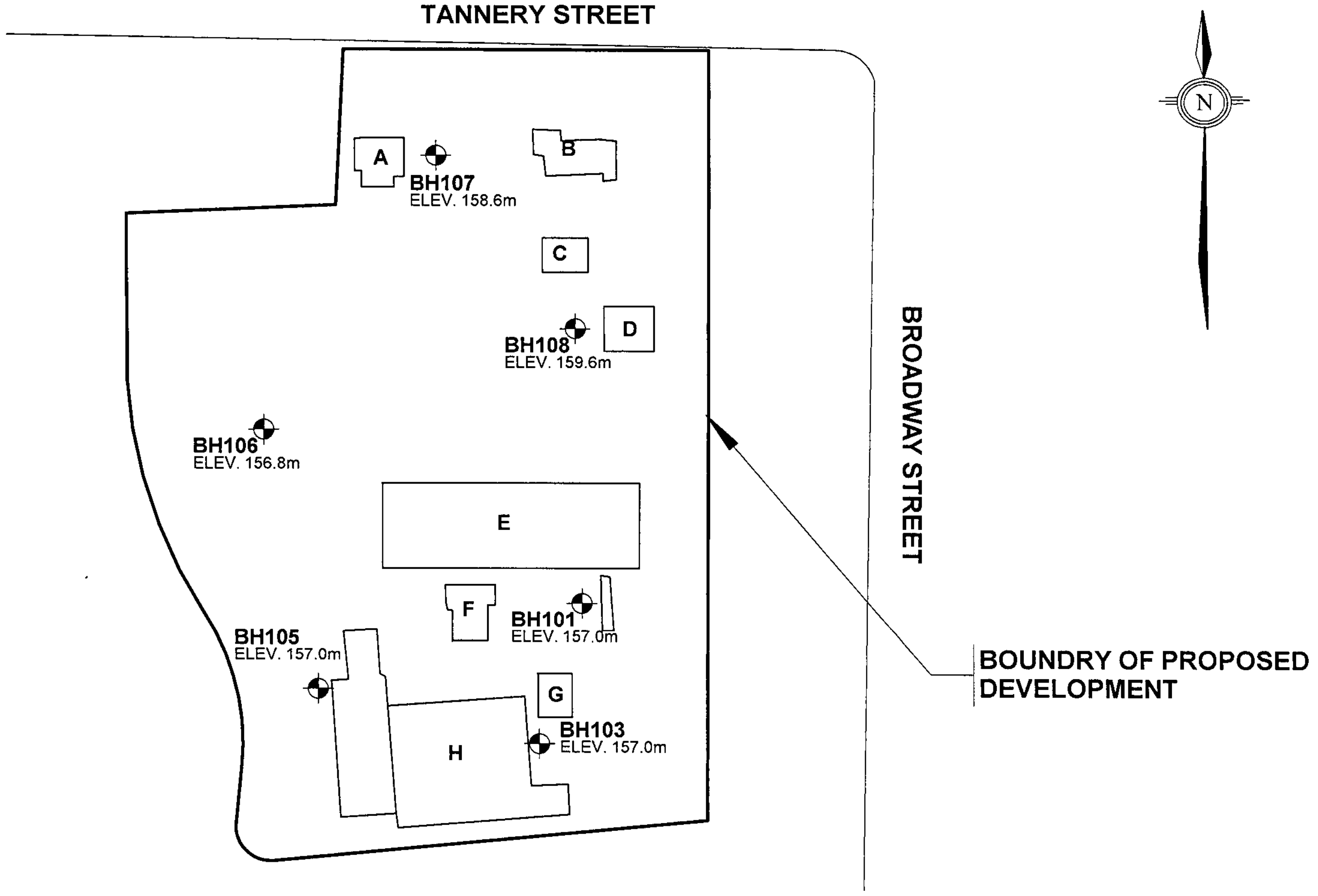
LICENSED PROFESSIONAL ENGINEER
L. GALIMANIS
PROVINCE OF ONTARIO

Distribution: Mr.Mike Grayhurst, OHE Consultants (4)

FIGURE 1: SITE PLAN SHOWING THE APPROXIMATE BOREHOLE LOCATIONS

PROPOSED DEVELOPMENT

51 TANNERY STREET, MISSISSAUGA, ONTARIO



REFERENCE:

SITE PLAN INFORMATION ADAPTED FROM PROPOSED BOREHOLE/MONITORING WELL LOCATIONS DRAWING NO. A4, PREPARED BY OHE CONSULTANTS DATED DECEMBER 2016.

	Name	Date
Drawn By	M.W.	Jan '16
Checked By	L.G.	Jan '16
Revisions		
Scale	REDUCED FROM ORIGINAL	

PATRIOT ENGINEERING LTD.
Consulting Engineers

Project: 37105

Figure: 1

Project No: 37105

Borehole #: BH101

Project: Propose Development

Borehole Location: See Figure 1

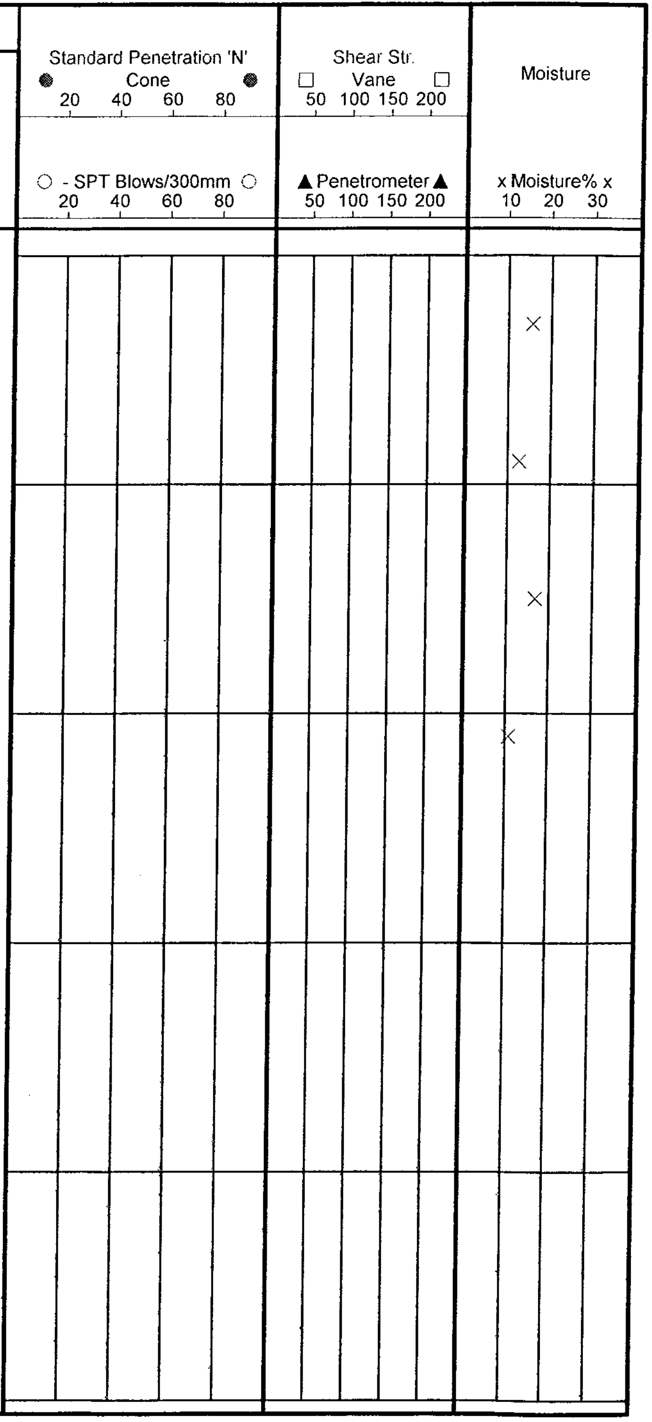
Location: 100 Emby Drive, Mississauga, Ontario

Project Engineer: L.G.

Client: OHE Consultants

Drawing No.: 2

SUBSURFACE PROFILE				SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
		Ground Surface	157.0				
0		***ASPHALT - 35mm*** ***GRANULAR FILL - 60mm CRUSHER RUN LIMESTONE*** brown, moist ***FILL - CLAYEY SILT*** brown, moist, some sand, trace gravel, trace rootlets, trace asphalt fragments		SS1	*	100	
1				SS2	*	100	
2			154.6				
3		***SANDY SILT TILL*** brown becoming grey below 4.0m depth, moist to slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, oxidized		SS3	*	100	
4				SS4	*	100	
			152.2				
5		***END OF BOREHOLE*** Notes: 1. Borehole was advanced using continuous neumatic hammer sampling method to a depth of 4.8m on January 20, 2017. 2. Borehole was found to be dry upon completion of driling.					
6							
7							
8							
9							
10							



Drill Method: S/S Continuous

Drill Date: January 20, 2017

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Phone: (416) 293-7716 Fax: (416) 293-6722
e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

Borehole #: BH101

Borehole Location: See Figure 1

Project Engineer: L.G.

Drawing No.: 2

SUBSURFACE PROFILE				SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
		Ground Surface	157.0				
0		***ASPHALT - 35mm***					
		GRANULAR FILL - 60mm CRUSHER RUN LIMESTONE brown, moist		SS1	*	100	
1		***FILL - CLAYEY SILT*** brown, moist, some sand, trace gravel, trace rootlets, trace asphalt fragments					
2			154.6	SS2	*	100	
3		***SANDY SILT TILL*** brown becoming grey below 4.0m depth, moist to slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, oxidized		SS3	*	100	
4			152.2	SS4	*	100	
5		***END OF BOREHOLE*** Notes: 1. Borehole was advanced using continuous neumatic hammer sampling method to a depth of 4.8m on January 20, 2017. 2. Borehole was found to be dry upon completion of driling.					
6							
7							
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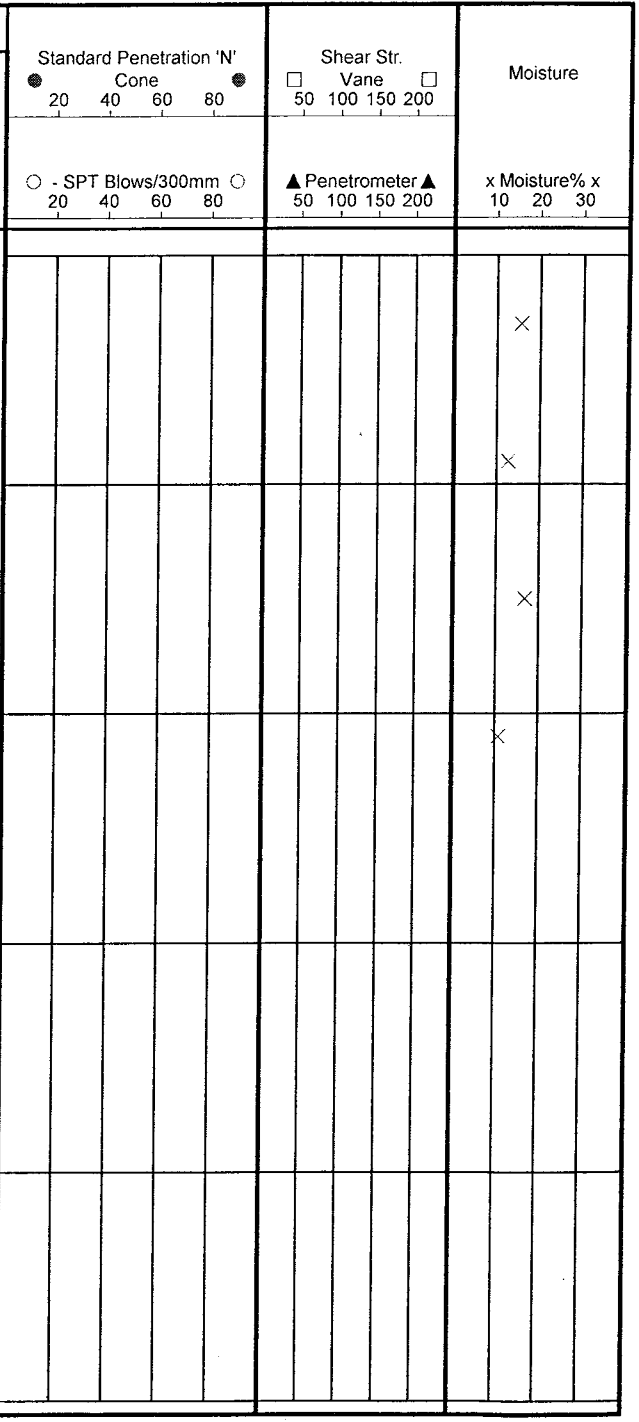

Drill Method: S/S Continuous

Drill Date: January 20, 2017

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80 Nashdene Road., Unit 62, Toronto, ON, M1V 5E4
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e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

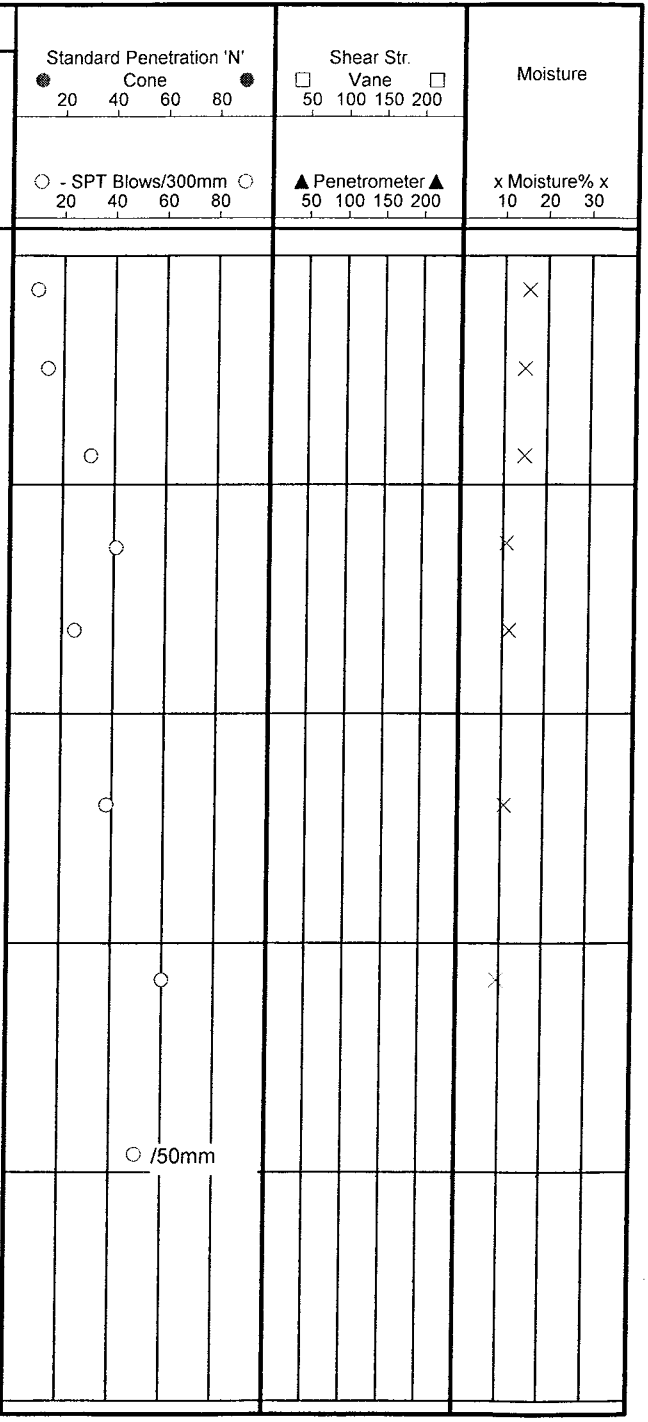
Borehole #: BH103

Borehole Location: See Figure 1

Project Engineer: L.G.

Drawing No.: 3

SUBSURFACE PROFILE				SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
		Ground Surface	157.0				
0		***ASPHALT - 40mm***					
		GRANULAR FILL - 80mm CRUSHER RUN LIMESTONE compact, brown, moist	156.6	SS1	10	80	
1		***FILL - SANDY SILT*** compact, brown, moist, some clay, trace gravel		SS2	14	85	
2		***SANDY SILT TILL*** compact to very dense, brown becoming grey below 2.3m depth, moist to slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, isolated wet sand seams, oxidized		SS3	31	90	
3				SS4	41	90	
				SS5	25	90	
4–5				SS6	38	95	
6				SS7	60	95	
7			149.3				
8		***SHALE*** weathered, grey, Georgian Bay Formation	148.9	SS8	50	75	
		END OF BOREHOLE					
9		See next page for notes....					
10							



Drill Method: S/S Auger

Drill Date: January 20, 2017

PATRIOT ENGINEERING LTD.
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e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

Project No: 37105

Borehole #: BH103

Project: Propose Development

Borehole Location: See Figure 1

Location: 51 Tannery Street, Mississauga, Ontario

Project Engineer: L.G.

Client: OHE Consultants

Drawing No.: 3

SUBSURFACE PROFILE				SAMPLE				Standard Penetration 'N' ● Cone ● 20 40 60 80 ○ - SPT Blows/300mm ○ 20 40 60 80	Shear Str. ☐ Vane ☐ 50 100 150 200 ▲ Penetrometer ▲ 50 100 150 200	Moisture x Moisture% x 10 20 30
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)			
		Notes: 1. Borehole was advanced using solid stem augers to a depth of 8.1m on January 20, 2017. 2. Short term groundwater level measured at 5.6m depth upon completion of drilling.								
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Drill Method: S/S Auger

Drill Date: January 20, 2017

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e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

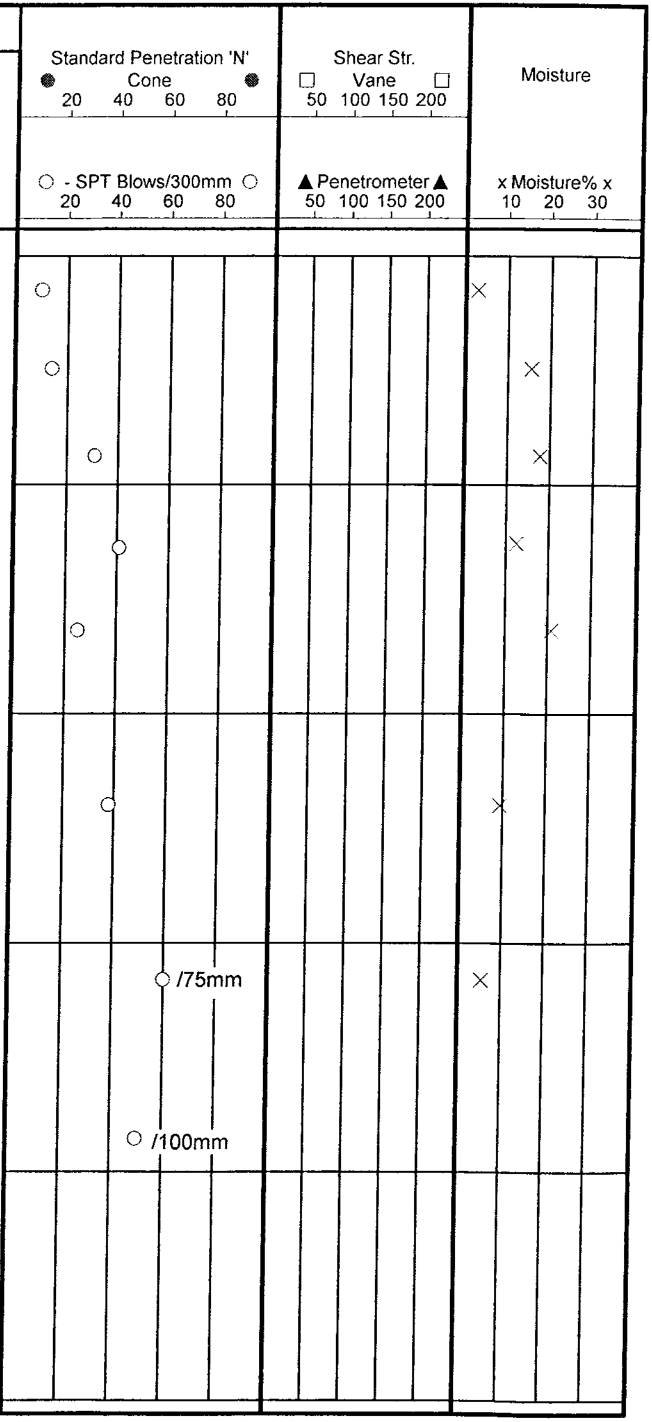
Borehole #: BH105

Borehole Location: See Figure 1

Project Engineer: L.G.

Drawing No.: 4

SUBSURFACE PROFILE				SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
		Ground Surface	157.0				
0		**GRANULAR FILL - 200mm CRUSHER RUN LIMESTONE** dense, brown, moist	156.8	SS1	50*	50	
1		**FILL - SANDY SILT** compact to loose, brown, slightly moist to very moist, some clay, trace gravel, trace cobbles, trace topsoil, isolated pockets of topsoil, trace brick fragments, trace asphalt fragments, trace wood pieces		SS2	19	95	
				SS3	11	95	
2				SS4	17	85	
3				SS5	6	90	
4		**SANDY SILT TILL** dense to very dense, grey, slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, isolated wet sand seams	153.0				
5				SS6	37	90	
6				SS7	50	85	
7			149.3				
		SHALE weathered, grey, Georgian Bay Formation	149.2	SS8	50	75	
8		**END OF BOREHOLE**					
9		See next page for notes....					
10							



Drill Method: S/S Auger

Drill Date: January 20, 2017

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Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

Borehole #: BH105

Borehole Location: See Figure 1

Project Engineer: L.G.

Drawing No.: 4

SUBSURFACE PROFILE				SAMPLE				Standard Penetration 'N' ● Cone ● 20 40 60 80 ○ - SPT Blows/300mm ○ 20 40 60 80	Shear Str. ☐ Vane ☐ 50 100 150 200 ▲ Penetrometer ▲ 50 100 150 200	Moisture x Moisture% x 10 20 30
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)			
		Notes: 1. Borehole was advanced using solid stem augers to a depth of 7.8m on January 20, 2017. 2. Short term groundwater level measured at 4.4m depth upon completion of drilling. *Boulder was encountered at this level, 'N' values appear to be higher								
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Drill Method: S/S Auger

Drill Date: January 20, 2017

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Checked by: L.G.

Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

Borehole #: BH106

Borehole Location: See Figure 1

Project Engineer: L.G.

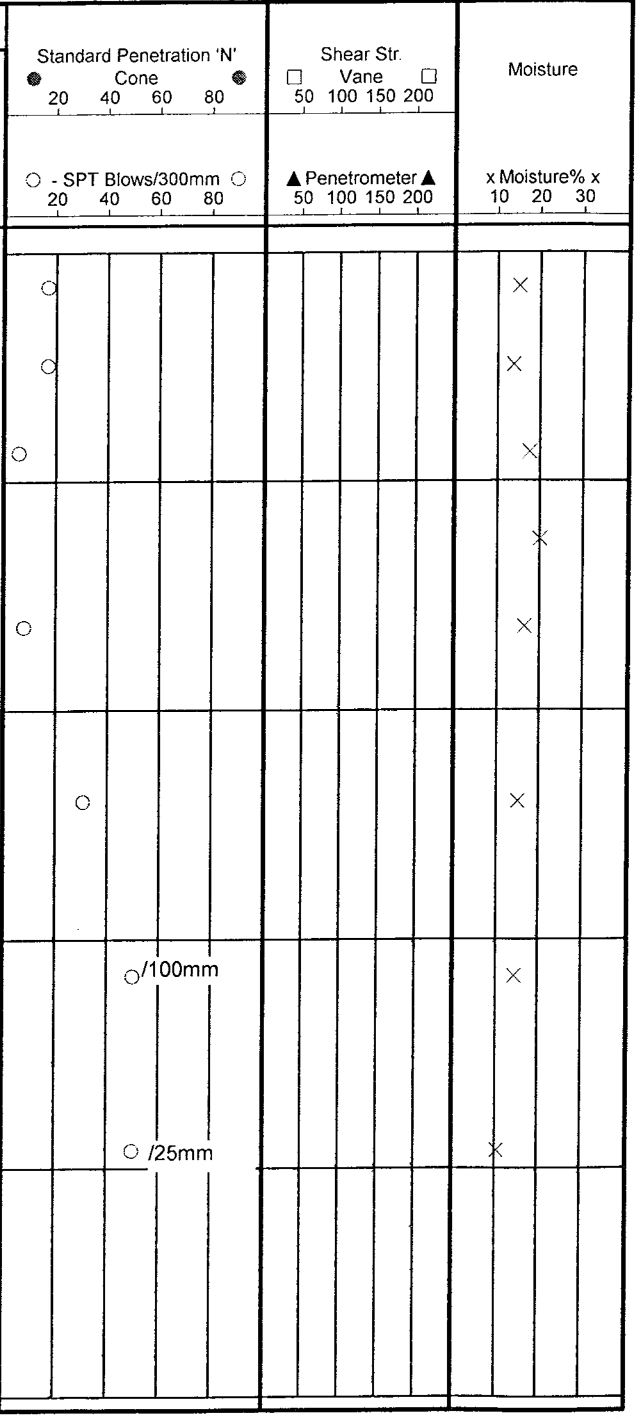
Drawing No.: 5

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)
0	Ground Surface	156.8
0 – 0.7	***GRANULAR FILL - 50mm CRUSHER RUN LIMESTONE*** compact, brown, moist	
0.7 – 1.3	***FILL - SANDY SILT*** compact, reddish brown, moist, some clay, trace gravel, trace cobbles	155.5
1.3 – 4.8	***FILL - CLAYEY SILT*** soft to very stiff, reddish brown, moist to very moist, some sand, trace gravel, trace cobbles, trace rootlets, trace asphalt fragments, trace wood pieces	152.0
4.8 – 8.0	***SANDY SILT TILL*** dense to very dense, moist, some clay, trace gravel, trace cobbles, trace shale fragments, isolated wet sand seams, isolated pockets of clay	148.8
8.0	***END OF BOREHOLES*** See next page for notes....	

SAMPLE

Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
SS1	17	90	
SS2	17	90	
SS3	6	85	
SS4	*	*	
SS5	8	80	
SS6	31	95	
SS7	50	100	
SS8	50	100	



Drill Method: S/S Auger

Drill Date: January 20, 2017

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Checked by: L.G.

Project No: 37105

Borehole #: BH106

Project: Propose Development

Borehole Location: See Figure 1

Location: 51 Tannery Street, Mississauga, Ontario

Project Engineer: L.G.

Client: OHE Consultants

Drawing No.: 5

SUBSURFACE PROFILE				SAMPLE				Standard Penetration 'N' ● Cone ● 20 40 60 80 ○ - SPT Blows/300mm ○ 20 40 60 80	Shear Str. ☐ Vane ☐ 50 100 150 200 ▲ Penetrometer ▲ 50 100 150 200	Moisture x Moisture% x 10 20 30
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)			
11 12 13 14 15 16 17 18 19 20		Notes: 1. Borehole was advanced using solid stem augers to a depth of 8.1m on January 20, 2017. 2. Short term groundwater level measured at 4.3m depth upon completion of drilling. *Auger sample obtained.								

Drill Method: S/S Auger

Drill Date: January 20, 2017

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Datum: Geodetic

Checked by: L.G.

Project No: 37105

Borehole #: BH107

Project: Propose Development

Borehole Location: See Figure 1

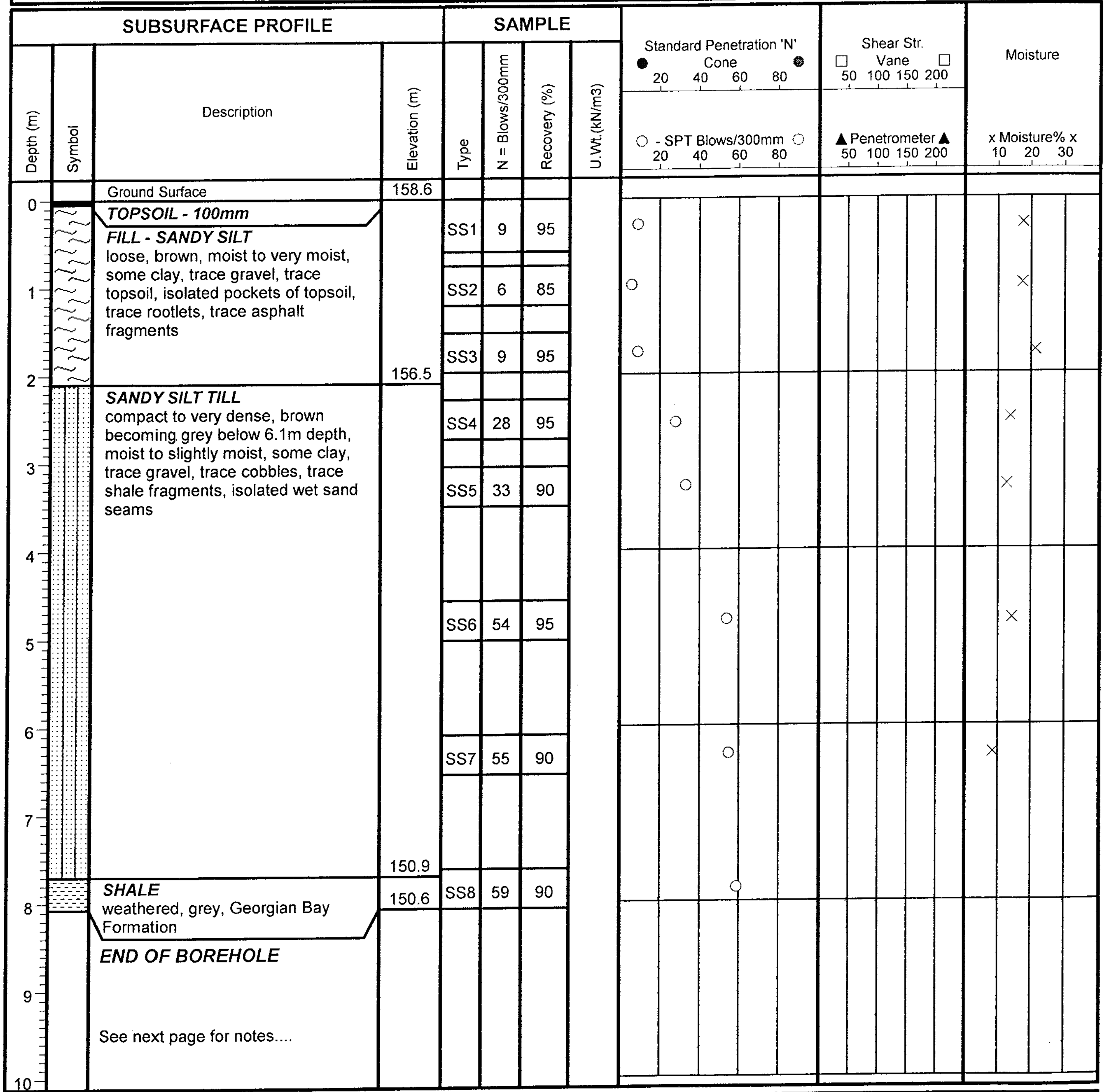
Location: 51 Tannery Street, Mississauga, Ontario

Project Engineer: L.G.

Client: OHE Consultants

Drawing No.: 6

SUBSURFACE PROFILE		SAMPLE			
Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
Ground Surface	158.6				
TOPSOIL - 100mm					
FILL - SANDY SILT loose, brown, moist to very moist, some clay, trace gravel, trace topsoil, isolated pockets of topsoil, trace rootlets, trace asphalt fragments		SS1	9	95	
		SS2	6	85	
		SS3	9	95	
	156.5				
SANDY SILT TILL compact to very dense, brown becoming grey below 6.1m depth, moist to slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, isolated wet sand seams		SS4	28	95	
		SS5	33	90	
		SS6	54	95	
		SS7	55	90	
	150.9				
SHALE weathered, grey, Georgian Bay Formation	150.6	SS8	59	90	
END OF BOREHOLE					
See next page for notes....					



Drill Method: S/S Auger

Drill Date: January 20, 2017

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Project No: 37105

Project: Propose Development

Location: 51 Tannery Street, Mississauga, Ontario

Client: OHE Consultants

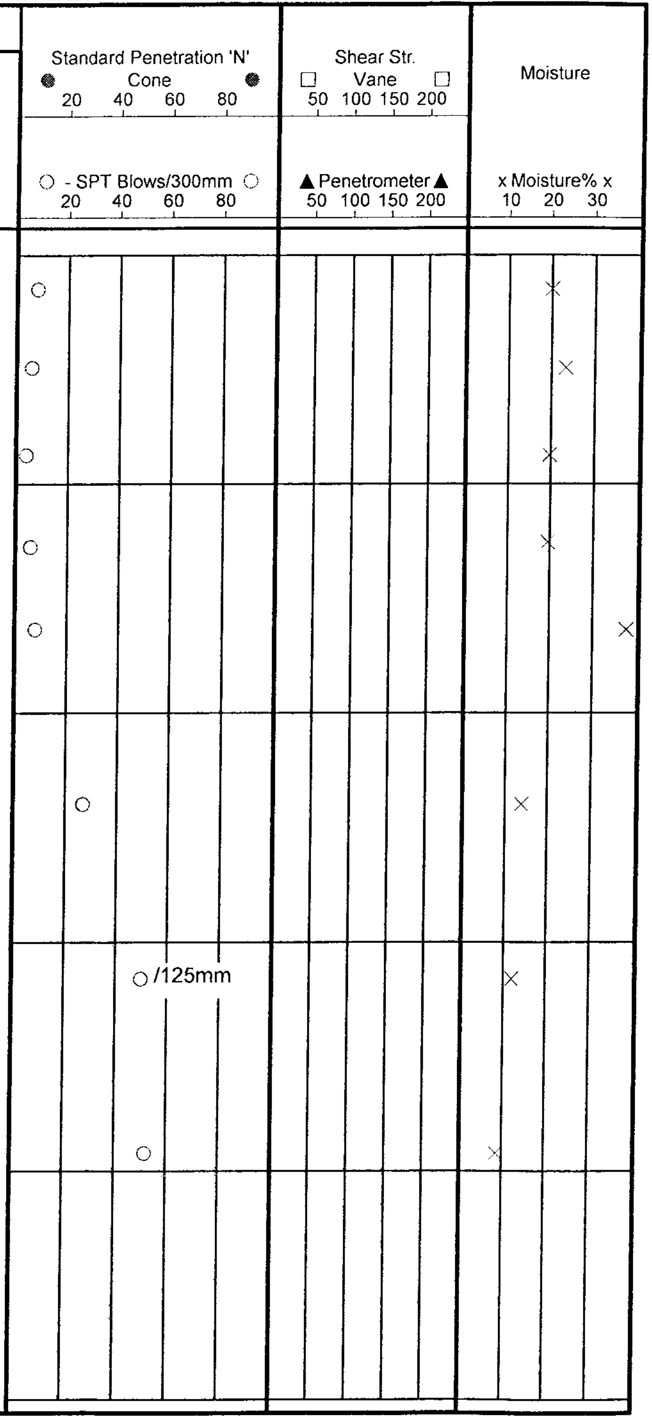
Borehole #: BH108

Borehole Location: See Figure 1

Project Engineer: L.G.

Drawing No.: 7

SUBSURFACE PROFILE				SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Type	N = Blows/300mm	Recovery (%)	U.Wt.(kN/m3)
0		Ground Surface	159.6				
		ASPHALT - 40mm					
		GRANUAR FILL - 70mm CRUSHER RUN LIMESTONE loose, brown, moist		SS1	8	85	
1		***FILL - CLAYEY SILT*** firm, reddish brown, moist to very moist, some sand, trace gravel, trace cobbles, trace rootlets, trace brick fragments		SS2	6	90	
2				SS3	4	90	
3				SS4	6	85	
				SS5	8	90	
4			155.7				
5		***SANDY SILT TILL*** compact to very dense, brown becoming grey below 7.6m depth, moist to slightly moist, some clay, trace gravel, trace cobbles, trace shale fragments, isolated wet sand seams		SS6	27	95	
6				SS7	50	65	
7							
8			151.6	SS8	52	90	
9		***END OF BOREHOLE*** Notes: 1. Borehole was advanced using solid stem augers to a depth of 8.1m on January 20, 2017. 2. Borehole was found to be dry upon completion of drilling.					
10							



Drill Method: S/S Auger

Drill Date: January 20, 2017

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Datum: Geodetic

Checked by: L.G.

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	5.4	1.2	11.4	13.4	51.7	16.9

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5212	0.0485	0.0352	0.0082				

Material Description	USCS	AASHTO
○ Sandy silt, some clay, trace gravel		

Project No. 37105 **Client:** OHE Consultants

Project: Proposed Development, 100 Emby Drive, Mississauga, Ontario

○ **Source:** BH108 SS6 **Depth:** 15' to 16'.5 **Sample No.:** R3781

Remarks:

○Date of Sampling:
January 20, 2017

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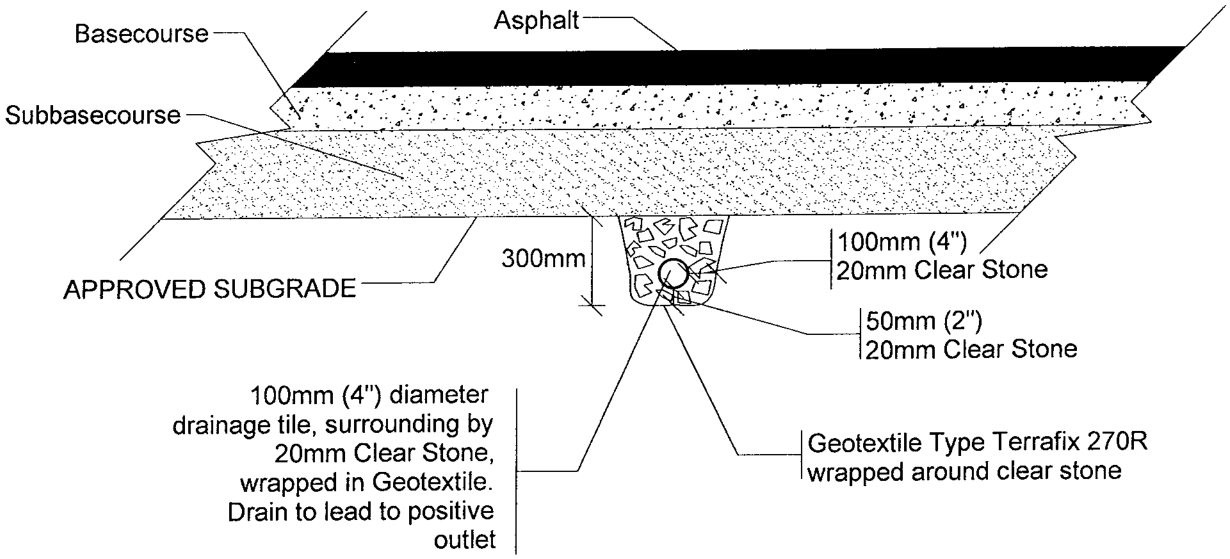
Figure 8

TYPICAL SUBDRAIN DETAIL



Drawn By	Name	Date
Checked By		
Revisions		
Scale	N.T.S.	

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Consulting Engineers

Project: 37105

Figure: 9

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EXPLANATION OF THE FORM BORING LOG

PENETRATION RESISTANCE

Standard Penetration Resistance 'N'-The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3m , into subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The description of the soil is based on visual examination of the samples and laboratory tests. Each stratum is described according to the following classification and terminology:

Classification*	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	less than 0.002 mm	less than 0.002 mm
Silt	from 0.002 to 0.075 mm	from 0.002 mm to #200 sieve
Sand	from 0.075 to 4.75 mm	from #200 sieve to #4 sieve
Gravel	from 4.75 to 75 mm	from #4 sieve to 3 in.
Cobbles	from 75 to 200 mm	from 3 in. to 8 in.
Boulders	larger than 200 mm	over 8 in.

Terminology	Proportion
Trace, or occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

* Unified Soil Classification System (ASTM D2487-75).

The relative density of cohesionless soils and the consistency of cohesive soils are defined by the following:

Relative Density	Penetration Resistance "N" Blows 0.3 m or Blows foot
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

Consistency	Underdrained Shear Strength**	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000

** The compressive strength obtained from the quick (Q) triaxial test is equal to twice the shear strength of the clay.