SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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PROJECT NO.: SM 301114-G August 27, 2021

BURLINGTON 2020 LAKESHORE INC.
366 King Street West
Hamilton, Ontario
L8P 1B3

Attention: Mr. Darko Vranich

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2020 LAKESHORE ROAD
BURLINGTON, ONTARIO

Dear Mr. Vranich,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing and report preparation in connection with the above noted project. The scope of work was completed in general accordance with our proposal P301114r1, dated December 1, 2020 and revised on March 8, 2021. Our comments and recommendations, based on our findings at the seven borehole locations, are presented herein.

1. INTRODUCTION

We understand that the project will involve the construction of a residential building approximately 30 to 40 storeys in height, with up to four underground parking levels at the property located at 2020 Lakeshore Road in Burlington, Ontario. The purpose of this geotechnical investigation work was to further assess the subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, such as additional storeys or basement levels, this office

must be consulted to review the new design with respect to the results of this investigation.

2. PROCEDURE

A total of seven [7] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment as well as HQ diamond barrel coring equipment, under the direction of a representative of SOIL-MAT ENGINEERS. The boreholes were advanced to depths of approximately 7.6 to 20.1 metres below the existing grade from April 5th to April 8th, 2021. Upon completion of drilling all boreholes were outfitted with groundwater monitoring wells as part of the Phase 2 Environmental Site Assessment work as well as the Hydrogeological Study being undertaken by TerraDynamics Consulting Inc. The wells installed consisted of 50-millimetre diameter PVC pipe, screened in the lower 3 metres. The monitoring wells were backfilled with well filter sand up to approximately 0.3 metres above the screened portion, then with bentonite 'hole plug' to the surface and fitted with a protective steel 'flushmount' casing.

As noted above the boreholes were advanced with HQ diamond coring equipment where the Queenston Shale Bedrock stopped advancement of power auger equipment. Rock Quality Designation [RQD] was calculated for the recovered core samples, and 7 selected samples of the recovered cores were subjected to unconfined compressive strength testing at our laboratory. The detailed results of these tests can be found appended to the end of this report.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., based on accessibility over the site and clearance of underground services. The ground surface elevation at the borehole locations was referenced to a geodetic benchmark, described as the brass plaque set in the northerly most wall of City Hall, located at 426 Brant Street, Burlington. This benchmark was noted to have a

geodetic elevation of 85.61 metres, based on local benchmark information provided to our office by the City of Burlington.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 7, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed at the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is currently comprised of the lands of the Waterfront Hotel located at 2020 Lakeshore Road in Burlington, Ontario. The site surrounding the existing 7-storey hotel building is primarily asphalt surfaced with grass covered areas downhill of the elevated parking areas towards Lake Ontario. The site is bounded by Lakeshore Road to the north, Elizabeth Street to the east, and waterfront trails to the west and south. The site slopes downward from north to south with a relief of approximately 3 metres. The asphalt paved parking area has been built into a plateau before sloping down drastically at the south end towards the green space and Lake Ontario.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole Nos. 1 to 5 were advanced through the existing pavement structure, which was found to consist of approximately 75 to 100 millimetres of asphaltic concrete overlying approximately 75 to 1220 millimetres of granular base material. The pavement structure encountered at the borehole locations has been summarized as follows:

Table A – Pavement Structure

Borehole No.	1	2	3	4	5
Asphaltic Concrete (mm)	100	75	90	100	100
Granular Base (mm)	1220	75	140	360	75

Topsoil

A surficial veneer of topsoil approximately 100 and 275 millimetres in thickness was encountered at Borehole Nos. 6 and 7, respectively. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations. It is also noted that the term 'topsoil' has been used from a geotechnical point of view, and does not necessarily reflect its nutrient content or ability to support plant life.

Silty Clay/Clayey Silt Fill

Silty clay/clayey silt fill was encountered below the pavement and topsoil at all borehole locations. The fill material was reddish brown in colour, contained some sand and gravel and was generally in a firm to very stiff consistency. The fill soils were found to be variable including gravel seams, shale fragments, construction debris and occasional hydrocarbons staining. The silty clay/clayey silt fill materials encountered were proven to depths of approximately 1.5 to 7.0 metres below the surrounding ground surface, generally deeper at the south end of the parking lot and shallower at the north end of the site and on the grass covered area to the south.

Silty Clay/Clayey Silt

Native silty clay/clayey silt soil was encountered below the fill deposits at Borehole Nos. 2 to 5, and 7. The silty clay/clayey silt was brown in colour, contained trace sand and gravel and was generally in a very stiff to hard consistency. The fine grained native soil was proven to depths of approximately 2.3 to 7.9 metres below the surrounding ground surface.

Queenston Shale

Queenston Shale was encountered beneath the native silty clay/clayey silt and silty clay/clayey silt fill at all borehole locations. The Shale was red, severely weathered in the upper levels, becoming sounder with depth, and containing occasional more resistant grey layers. The degree of weathering in the upper levels of the Queenston Shale is such that it tends to exhibit the properties of a hard cohesive soil, or weak rock, as evidenced by the ability to penetrate the bedrock with the solid stem augers of the drill. As such, the transition between hard soil and weak rock is somewhat indistinct.

As noted above, the bedrock was cored in Borehole Nos. 2, 3, 5, and 6 using HQ-size diamond core barrel equipment. The Rock Quality Designation [RQD] of the recovered rock cores was determined to range from approximately 55 to 100 per cent, generally indicative of a sound quality rock mass.

Compressive strength testing was carried out on seven [7] core samples, yielding unconfined strengths in the range of approximately 20.6 to 33.8 MPa [~3,000 to 4,900 psi]. The average of the samples taken from below or near the anticipated founding elevation yielded an average strength of 28.9 MPa [4,200 psi]. The compressive testing data is summarised as follows, with the detailed results appended to this report:

TABLE B
BEDROCK COMPRESSIVE STRENGTH DATA

Borehole No.	Depth	Geodetic Elevation (m)	q_u [MPa]
2	4.62 m	78.11	23.6
2	14.45 m	68.28	33.8
2	15.77 m	66.96	31.5
3	10.46 m	72.51	20.6
3	14.71 m	68.26	20.8
5	14.10 m	67.19	29.6
6	8.28 m	72.83	28.1

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subject site to be near the boundary of coarse textured glaciolacustrine deposits, clay to silt textured till, and shallow paleozoic bedrock. This is generally consistent with our experience in the area and observations during fieldwork.

Groundwater Observations

As mentioned above, all boreholes were fitted with monitoring wells to allow for measurement of the static groundwater level. The groundwater depth was measured at the wells with the following results:

Table C
Ground Water Level Measurements

Borehole No.	Elev [m]	May 26, 2021		June 15, 2021	
		Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)
1	82.38	Dry	-	Dry	-
2	82.73	8.17	74.56	7.93	74.66
3	82.97	8.81	74.16	9.19	73.78
4	82.77	6.43	76.34	6.51	76.27
5	81.29	6.25	75.04	6.41	74.88
6	81.11	6.49	74.62	6.55	74.56
7	78.75	3.87	74.88	3.87	74.88

Based on our observations during drilling, the available data, and our experience in the area, the static groundwater level is estimated at an elevation of approximately 74 to 76 metres, generally increasing as distance from Lake Ontario increases. The groundwater elevation was observed approximately 4 to 9 metres below the existing grade and would be expected to fluctuate seasonally. It is also noted that the groundwater level would be subject to seasonal variation due to prevailing weather conditions.

4. FOUNDATION CONSIDERATIONS

It is anticipated that the founding level for the structure will extend to depths of up to 13 to 14 metres below the existing grade at Lakeshore Road, to an elevation of approximately 69 metres. The sound Queenston Shale bedrock at depth is considered very competent in terms of support conditions for the proposed structure. Based on the results of our investigations, spread footings founded on the competent Shale bedrock may be designed using the following design bearing value:

SLS = ULS = 2,800 kPa [~ 58,000 psf]

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable settlement based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect an upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. It is noted the SLS and ULS

values are the same, as in order for serviceability limits of deflection to be realised, failure of the Queenston Shale bedrock would have to occur.

All footing beds must be hand cleaned of all loose or disturbed material, ponded water, etc. prior to the placement of foundation concrete. With footings founded on the competent Shale the amount of total and differential settlements are anticipated to be negligible.

In areas where it will be necessary to have adjacent footings at different founding elevations, the lower footing should be constructed prior to the higher footing, if possible, and the higher footing should be set below an imaginary line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical. This practice will limit stress transfer from the higher footings to lower footings.

As the static groundwater level is expected to be well above the anticipated founding level, it will be necessary for the foundations and lowest-level basement floor slab to be constructed as a continuous watertight box, and designed to resist the hydrostatic pressure associated with an elevated groundwater level, considering a water level at a geodetic elevation of approximately 78 metres. In the event that a raft slab is utilised, this should be readily accommodated at the excavation base with the raft slab itself.

Should the site plan include any supplemental structures founded at depths shallower than the proposed residential building, all footings exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

It is imperative that a geotechnical engineer be retained from this office to provide geotechnical engineering services during the excavation support and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the Borehole locations.

5. LATERAL EARTH PRESSURE

The lateral earth pressures on basement walls can be estimated on the basis of a retained soil unit weight, [γ_{wet}], of 20 kN/m^3 [~127 pcf]. The coefficient of lateral earth pressure may be taken as, K_o = 0.5 in fill against rigid walls [at rest condition]. Any

additional pressures due to surcharge loading, such as adjacent structures, roadways, parked vehicles, floor slab loading, etc. must be included in the design.

6. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12 (as amended). Based on the subsurface soil conditions encountered in this investigation the applicable Site Classification for the seismic design is Site Class B – Rock, based on the average soil characteristics for the site.

The seismic data, from Supplementary Standard SB-1 of the Ontario Building Code, for Burlington are as follows.

S_a[0.2]	S_a[0.5]	S_a[1.0]	S_a[2.0]	S_a[5.0]	S_a[10.0]	PGA	PGV
0.266	0.131	0.062	0.029	0.0068	0.0027	0.172	0.102

7. EXCAVATIONS AND EXCAVATION SUPPORT CONSIDERATIONS

As noted above the proposed building is anticipated to include four basement levels. It is anticipated that excavations for the proposed foundations, sewers and other underground services will extend to depths of up to 13 to 14 metres below the present grade. The upper level of the Queenston Shale bedrock is typically highly weathered and should yield to a heavy hydraulic excavator equipped with 'rock' teeth. However, the rate of excavation should be anticipated to slow with depth, below perhaps 3 to 8 metres varying by location, as the Shale bedrock becomes sounder and less weathered. As the Shale becomes more competent, or where more resistant layers are encountered, the use of mechanical rock splitters will be required.

The base of excavations into the Queenston Shale are expected to remain solid and stable. However, the exposed Shale will be prone to surface weathering and softening. It is recommended that a thin concrete ‘mud’ slab, perhaps 50 millimetres, be placed over the base of the excavations to protect the founding soils from weathering and to provide a clean working surface for the placement of reinforcing steel, formwork, etc.

EXCAVATION SUPPORT

It is anticipated that the new structure will approach the property limits. As such it is anticipated that open cut excavations may not be suitable and the construction will

require some level of excavation support. It is noted that a preconstruction survey of adjacent above and below grade structures should be conducted to assess the appropriate shoring requirements, as well as establish a baseline condition.

Excavation side slopes will remain stable at a slope of 45 degrees to the horizontal in the upper fill materials and 60 degrees to the horizontal in the native silty clay/clayey silt for the short construction period. The side slopes in the Queenston Shale should remain stable at near vertical slopes. Where workers are required to enter the excavations the sides should be thoroughly scaled of all loose rock debris and by routinely evaluated by a Senior Engineer from this office. Consideration could be given to covering the excavation faces with heavy construction tarps or debris netting, secured at top and bottom, to direct any lose rock debris that may come loose safely to the bottom of the excavation. Notwithstanding the foregoing, however, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects.

As mentioned above, some level of excavation support will likely be required to ensure the stability of the excavation faces with little or no horizontal movement. Such support may be accomplished in a number of methods, including rock anchors, 'soldier' pile/caissons and timber lagging, or continuous caisson wall.

Caissons to support either soldier piles or a continuous caisson wall should extend a minimum of 1.5 metres beyond the final depth of excavation, and may be designed on the basis of a nominal end bearing pressure of 2,800 kPa [~58,000 psf]. Where no lateral movements are acceptable the shoring should be designed considering an 'at rest' lateral earth pressure coefficient of Ko = 0.5. Where small lateral movements can be tolerated an 'active' earth pressure coefficient of Ka = 0.25 may be considered.

The caissons should be provided with lateral bracing, either by using a waler beam and raker supports, or with rock anchors. From a contractor's point of view, rock anchors would be preferred, provided permission can be obtained from the neighbouring property owners to extend the anchors under their property. It is noted that significant movements of the shoring system may take place if rakers are used to support the shores since compression of the rakers and the footings supporting the inclined raker loads must occur before the rakes can begin to carry load. In this regard, anchors are preferred since they pre-stress the shoring system to the design load even before the excavations reach their final grade.

Regardless of which method of support is pursued for the Shale excavations the overburden soils will need to be properly cut back or additionally supported. Where space is available to cut back the overburden, the soil should be removed completely a distance of at least 300 millimetres from the face of the Shale excavation and then

sloped up. Where there is not sufficient space to accommodate cutting back of the overburden soils, they may be supported at near vertical slopes with the provision of a soldier pile [support at depth by caissons] and timber lagging system, or with shotcrete.

The excavation support must be designed as required by the Occupational Health and Safety Act and Regulations for Construction Projects and the Canadian Foundation Engineering Manual. This office should be given the opportunity to review the shoring shop drawings and design parameters before construction, and a representative of SOIL-MAT ENGINEERS should be on site to observe the installation of the shoring. The shoring must be monitored for movements, and a plan must be available before the excavations begin, to rectify the shoring system should movements become apparent.

GROUNDWATER CONTROL

As noted above the static groundwater levels in the monitoring wells have been measured at a depth of approximately 4 to 9 metres below the existing grade. Evidently excavations to the depths required will extend below the static groundwater level and thus will experience groundwater infiltration through more permeable seams in the bedrock. It is noted the Shale bedrock tends to be layered and fissured, such that permeable seams are intermittently spaced. For excavations extending a short distance below the static groundwater level, it may be possible to adequately control any water that may seep into the excavations from more permeable seams in the fill material, silty clay/clayey silt and Queenston Shale and from surface water using conventional construction 'dewatering' techniques, such as pumping from sumps in the base of the excavations. The need for multiple sumps should be anticipated. Where deeper excavations are required the rate and volume of groundwater infiltration should be anticipated to be much greater. The groundwater control requirements will be significantly influenced by the excavation shoring method implemented, being greatest for open cuts into the Shale and much less for a continuous caisson wall. More water should be expected when connections are made with existing services. Surface water should be directed away from the excavations.

A detailed hydrogeological assessment of the site is being conducted by Terra-Dynamics Consulting Inc. The findings and recommendations found in the Hydrogeological assessment will be reviewed and any relevant construction considerations included in a separate letter.

8. FLOOR SLAB CONSIDERATIONS

As noted above, the proposed basement levels will extend below the measured static groundwater level. As such it will be necessary that the perimeter foundations and lowest-level basement raft slab be constructed as a water-tight box, making use of suitable membrane systems beneath the slab and against the exterior of foundation walls. This will likely require the use of foundation wall membrane systems intended for 'blind side' or 'single face' application. The system should also incorporate a water-stop component between the raft slab and perimeter foundation walls, and consideration should be given to using a concrete waterproofing admixture in all concrete used for the foundation walls and lowest-level slab. The foundation walls and lowest-level floor slab will also be required to be designed to resist the hydrostatic pressure, considering a groundwater level at an approximate geodetic elevation of 78 metres. Elevator pits extending below the general basement floor level should also be designed to be continuously water-tight with the surrounding structure.

9. BACKFILL CONSIDERATIONS

It is expected that the majority of the material excavated to accommodate the basement levels will be transported off-site. Where required select portions of the fill material and silty clay/clayey silt soils are considered suitable for use as backfill in service trenches, etc. provided it is free of organics or any other deleterious material. The use of Queenston Shale backfill is not recommended as it will require significant effort and will be prone to ongoing settlement for many years if it is not properly graded and moisture conditioned, even if it is well compacted.

The use of free draining, well-graded granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular B, Type II (crushed limestone bedrock) is often preferred for backfill against foundation walls. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for exterior concrete sidewalks, pavement, etc. The use of alternative materials, including recycled concrete aggregates, clear stone materials, etc., may be considered, however should be reviewed and approved by our office prior to use. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

Fine-grained cohesive soils such as those encountered on site are sensitive to moisture absorption and will become practically impossible to compact using conventional compaction equipment if they become wet during the 'wet' periods of the year. After a period of heavy precipitation, any near-surface wet, or softened material, should be

allowed to air-dry or be removed and discarded. These soils are not considered to be free draining and therefore should not be used where this characteristic is necessary. They should not be used in confined spaces where access for compaction is difficult.

Backfill materials used in service trenches or to raise the subgrade elevation under exterior pavement areas should have its moisture content within 3 per cent of its optimum moisture content. In service trenches the backfill material should be compacted to a minimum of 98 per cent of its standard Proctor maximum dry density [SPMDD]. Any fill required against the basement walls should consist of free draining granular material compacted to 98 per cent of its standard Proctor maximum dry density. Where asphalt or concrete paving extends up to the building the upper 1 metre of foundation wall backfill should be compacted to 100 per cent of its standard Proctor maximum dry density. Lift thickness would depend on the material type and moisture content of the backfill material and size of the compaction equipment used by the contractor. A representative of SOIL-MAT should be retained to monitor the backfilling and compaction operations to confirm uniform compaction of the backfill material to project specification requirements.

10. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved must be cleared of all organic and otherwise unsuitable materials, and the exposed subgrade proof rolled with 3 to 4 passes of a fully-loaded tandem-axle truck in the presence of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means should be sub-excavated and replaced with suitable backfill material. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50mm clear stone, ‘rip rap’ stone, etc.] ‘punched’ into the soft areas. It may also be prudent to consider the provision of a heavy geofabric over the subgrade to act as a separator between the subgrade and granular base materials.

The need for sub-excavations of softened subgrade materials will be reduced if construction is undertaken during dry periods of the year and careful attention is paid to the compaction operations. As noted above the on-site soils are sensitive to disturbance and moisture and may present difficulty for roadway construction during ‘wet’ periods of the year. Should pavement construction be undertaken during ‘wet’ periods of the year it should be anticipated that greater stabilisation efforts will be required and/or additional depth of OPSS Granular ‘B’, Type II sub-base course material may be required.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. SOIL-MAT should be given the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.

The suggested pavement structures outlined in Table D are based on subgrade parameters estimated on the basis of visual and tactile examinations of the on-site soils and past experience. The outlined pavement structure may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

TABLE D
RECOMMENDED PAVEMENT STRUCTURES

LAYER DESCRIPTION	COMPACTION REQUIREMENTS	LIGHT DUTY SECTIONS	HEAVY DUTY [TRUCK ROUTE]
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	92 per cent Marshall MRD	65 millimetres	40 millimetres
Binder Course OPSS HL 8	92 per cent Marshall MRD		65 millimetres
Base Course OPSS Granular 'A'	100% SPMDD	150 millimetres	150 millimetres
Sub-base Course OPSS Granular 'B' Type II	100% SPMDD	300 millimetres	450 millimetres

* Marshall MRD denotes Maximum Relative Density.

* SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often,

significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honeycomb surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

11. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgement in light of the information available at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Yaroslav Mormil, P. Eng.
Project Engineer



Stephen R. Sears, B. Eng. Mgmt., P. Eng., QP_{ESA}
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 7, inclusive
Compressive Strength Test Results

Distribution: [redacted]. [1, plus pdf] Burlington 2020 Lakeshore Inc.



LEGEND

Borehole Location

BH#

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 301114-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Proposed Condominium
2020 Lakeshore Road
Burlington, Ontario

Borehole Location Plan

Project No. SM 301114-G

Date: April 2021

Drawn: MA | Checked: YM

SM 301114-G Borehole Location Plan

Drawing No. 1

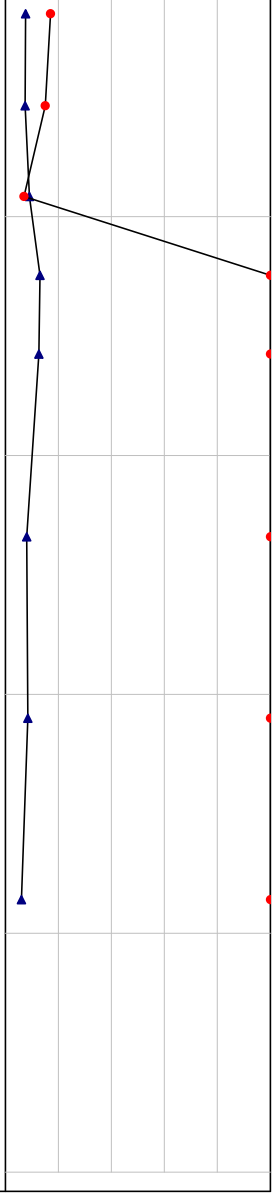
Log of Borehole No. 01

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797540
E: 597648

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	82.38	Ground Surface								
0 / 0		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 1220 millimetres of compact granular base.		SS	1	11 9 8 6	17			
3 / 1	81.06			SS	2	4 8 7 4	15			
		Silty Clay / Clayey Silt Fill Brown, some sand and gravel, occasional hydrocarbons staining, firm.		SS	3	1 2 5 4	7			
7 / 2	80.25	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.		SS	4	9 36 50/4"	100			
10 / 3				SS	5	36 50/1"	100			
13 / 4		NOTES: 1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 7.8 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client. 4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 7.42 meters (dry)		SS	6	50/2"	100			
20 / 6				SS	7	50/2"	100			
25 / 7	74.56			SS	8	50/2"	100			
26 / 8		End of Borehole								
33 / 9										

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: 7/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.73	Ground Surface							
0 / 0		**Pavement Structure** Approximately 75 millimetres of asphaltic concrete, overlying 75 millimetres of compact granular base.	SS	1	5 5 4 5	9			
3 / 1		**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, occasional staining, very stiff.	SS	2	3 11 7 8	18			
5 / 1	81.21		SS	3	3 8 10 11	18			
7 / 2		**Silty Clay / Clayey Silt** Reddish brown, trace to some sand and gravel, very stiff.							
8 / 2	80.29		SS	4	21 40 43 50/3"	83			
10 / 3		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	5	50/3"	100			
11 / 3			HQ	6	RQD=90%				
13 / 4			HQ	7	RQD=86%				
17 / 5			HQ	8	RQD=96%				
23 / 7			HQ	9	RQD=94%				
27 / 8			HQ	10	RQD=74%				
33 / 9									

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

Compressive Strength 23.6 MPa at 4.6 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
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Sheet: 1 of 2

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34				HQ	N/A	RQD=90%					
35											
36	11										
37				HQ	N/A	RQD=96%					
38											
39	12										
40											
41				HQ	N/A	RQD=97%					
42		NOTES:									
43	13	1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 17.1 metres.									
44											
45		2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
46	14			HQ	11	RQD=88%					Compressive Strength 33.8 MPa at 14.5 metres
47		3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
48											
49	15	4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 8.17 meters									
50											
51											Compressive Strength 31.5 MPa at 15.8 metres
52	16			HQ	12	RQD=98%					
53											
54											
55											
56	17 65.63	End of Borehole									
57											
58											
59	18										
60											
61											
62	19										
63											
64											
65											

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
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Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.97	Ground Surface							
0 / 0	82.74	**Pavement Structure** Approximately 90 millimetres of asphaltic concrete over 140 millimetres of compact granular base.	SS	1	9 9 9 8	18			
4 / 1	81.47	**Silty Clay / Clayey Silt Fill** Reddish brown, some sand and gravel, occasional staining, very stiff.	SS	2	9 10 10 11	20			
6 / 2		**Silty Clay/Clayey Silt** Brown, trace sand and gravel, very stiff.	SS	3	3 6 11 17	17			
8 / 2	80.21		SS	4	8 16 16 22	32			
9 / 3		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	5	50/3"	100			
13 / 4			SS	6	50/3"	100			
15 / 5			HQ	N/A	RQD=60%				
19 / 6			HQ	N/A	RQD=96%				
23 / 7			HQ	N/A	RQD=99%				
27 / 8			HQ	N/A	RQD=73%				
33									

Moisture Content w%: 10 20 30 40
Standard Penetration Test blows/300mm: 20 40 60 80

Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65	11 12 13 14 15 16 17 18 19		NOTES: 1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 15.1 metres. 2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client. 4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 8.81 meters		HQ	7	RQD=91%					Compressive Strength 20.6 MPa at 10.5 metres
					HQ	8	RQD=85%					
					HQ	9	RQD=55%					
					HQ	10	RQD=86%					Compressive Strength 20.8 MPa at 14.7 metres
49	67.86		End of Borehole									

Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Sheet: 2 of 2

Log of Borehole No. 04

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

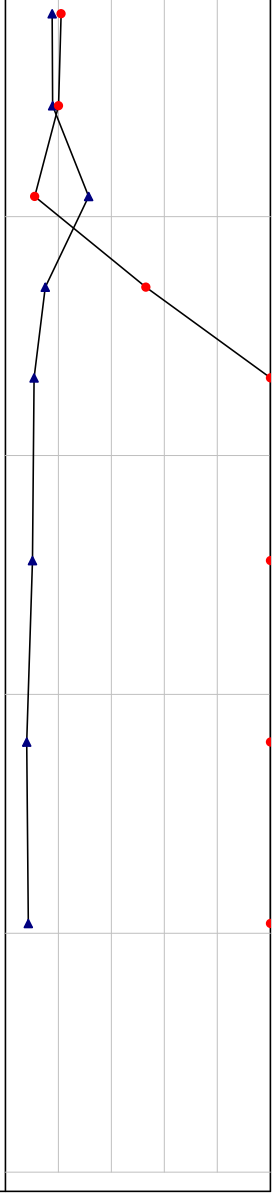
Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797596
E: 597738

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.77	Ground Surface							
0 / 0	82.31	**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 360 millimetres of compact granular base.	SS	1	13 13 8 10	21			
3 / 1	81.17	**Silty Clay / Clayey Silt Fill** Brown, occasional organics in the upper levels, some sand and gravel, very stiff.	SS	2	9 9 11 10	20			
5 / 2	80.38	**Silty Clay/Clayey Silt** Brown, trace sand and gravel, stiff.	SS	3	2 3 8 15	11			
8 / 3		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	4 21 32 50	53			
10 / 3			SS	5	45 50/2"	100			
15 / 4			SS	6	50/2"	100			
20 / 6			SS	7	50/2"	100			
25 / 7	75.15		AS	8	50/0"	100			
25 / 8		End of Borehole							

1. Borehole was advanced using solid stem auger equipment on April 6, 2021 to termination at a depth of 7.6 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 6.43 meters

Auger sample taken at 7.62 meters

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: 6/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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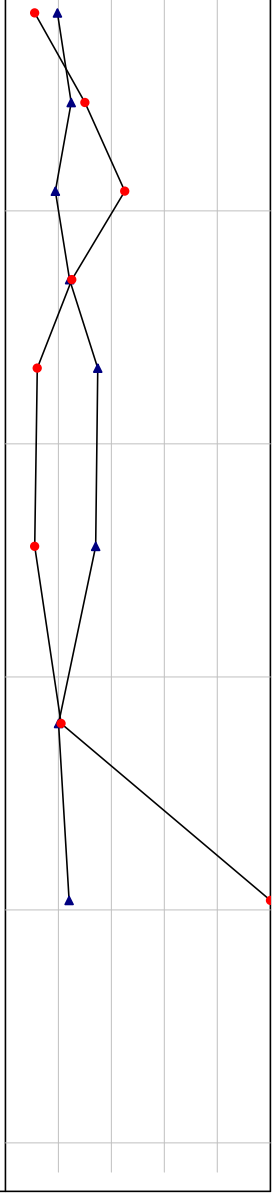
Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	81.29	Ground Surface							
0 / 0		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 75 millimetres of compact granular base.	SS	1	10 5 6 7	11			
		Silty Clay / Clayey Silt Fill Reddish brown, some sand and gravel, occasional organics, stiff to very stiff.	SS	2	5 16 14 12	30			
			SS	3	17 23 22 18	45			
			SS	4	14 16 9 8	25			
			SS	5	4 6 6 7	12			
			SS	6	7 6 5 16	11			
			SS	7	13 13 8 12	21			
25 / 8	73.37	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	8	50/1"	100			
			HQ	9	RQD=88%				
33 / 10			HQ	10	RQD=77%				

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34						10						
35												
36	11					11	Clean Up					
37												
38					HQ	12	RQD=89%					
39	12											
40												
41												
42					HQ	13	RQD=83%					
43	13											
44												
45												
46	14				HQ	14	RQD=97%					Compressive Strength 29.6 MPa at 14.1 metres
47												
48												
49	15											
50												
51												
52	16				HQ	15	RQD=91%					
53												
54			NOTES:									
55			1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 20.1 metres.									
56	17		2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
57			3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
58			4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 6.25 meters		HQ	16	RQD=101%					
59	18											
60												
61												
62	19				HQ	17	RQD=97%					
63												
64												
65												
66	20	61.15	End of Borehole									
67												

Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth ft	Depth m	Elevation (m)	Description	Sample Type	Sample Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		81.11	Ground Surface							
0–2	0		**Topsoil** Approximately 100 millimetres of topsoil.	SS	1	8 7 5 5	12			
2–7	0–2		**Silty Clay / Clayey Silt Fill** Reddish brown, occasional construction debris and organics, some sand and gravel, firm to very stiff.	SS	2	3 13 3 1	16			
				SS	3	5 12 8 3	20			
				SS	4	3 3 4 4	7			
				SS	5	4 4 3 3	7			
				SS	6	3 6 3 1	9			
				SS	7	3 3 1 7	4			
				SS	8	3 7 12 10	19			
23	7	74.11	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	9	13 18 16 50/5"	32			
				SS	10	50/2"	100			
26	8			HQ	11					
29–33	9			HQ	12	RQD=90%				

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

Compressive Strength 28.1 MPa at 8.3 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34–65	65.46		End of Borehole		HQ	13	RQD=91%					
					HQ	14	RQD=91%					
					HQ	15	RQD=93%					
					HQ	16	RQD=94%					

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 15.6 metres.

2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 6.49 meters

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 07

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797495
E: 597682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	78.75	Ground Surface							
0 / 0	78.47	**Topsoil** Approximately 275 millimetres of topsoil.							
1 / 0		**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, stiff to hard.	SS	1	4 3 3 12	6			
2 / 1			SS	2	6 11 23 12	34			
3 / 1			SS	3	6 12 15 16	27			
7 / 2			SS	4	2 3 8 10	11			
10 / 3	75.40		SS	5	3 8 10 8	18			
11 / 3		**Silty Clay / Clayey Silt** Redish brown, trace to some sand and gravel, very stiff.							
16 / 4			SS	6	4 4 15 18	19			
16 / 5	73.57								
17 / 5		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.							
20 / 6			SS	7	50/3"	100			
25 / 7	70.93		SS	8	50/2"	100			
26 / 8		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:
1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 7.8 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 3.87 meters

Drill Method: Solid Stem Auger
Drill Date: 5/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

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Core		Depth [m]	Average Diameter **D** [mm]	Average Height **H** [mm]	Dry Weight (mass) [g]	Break Load Q_{ult} [lb]	Break Load Q_{ult} [N]	Aspect Ratio Factor C_F	Cross-Sectional Area **A** [m^2]	Calculated Volume **V** [m^3]	Calculated Unit Weight γ_{conc} [kN/m^3]	Calculated Density ρ_{conc} [kg/m^3]	Unconfined Compressive Strength [MPa]
A	BH6 C1	8.3	60.0	130	1084.0	17890	79574.7	1.00	0.00283	0.00037	28.9	2949.1	28.1
B	BH2 C2	14.5	60.0	129	1088.6	21500	95632.0	1.00	0.00283	0.00036	29.3	2984.6	33.8
C	BH2 C1	4.6	60.0	122	1010.4	15020	66809.0	1.00	0.00283	0.00034	28.7	2929.1	23.6
D	BH3 C1	10.5	60.0	109	913.0	13240	58891.5	0.99	0.00283	0.00031	29.0	2962.5	20.6
E	BH3 C2	14.7	60.0	100	880.0	13600	60492.8	0.97	0.00283	0.00028	30.5	3112.4	20.8
F	BH2 C3	15.8	60.0	120	1074.5	20020	89049.0	1.00	0.00283	0.00034	31.1	3166.9	31.5
G	BH5 C1	14.1	60.0	127	999.0	18840	83800.3	1.00	0.00283	0.00036	27.3	2782.1	29.6

Date Tested: 12-Apr-21

Date received:

Project/Contract No.: 301114

Structure:

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

COMPRESSIVE STRENGTH TEST - Shale Bedrock Cores

Project No.: 301114 **Lab Number: 21-332** April 12, 2021