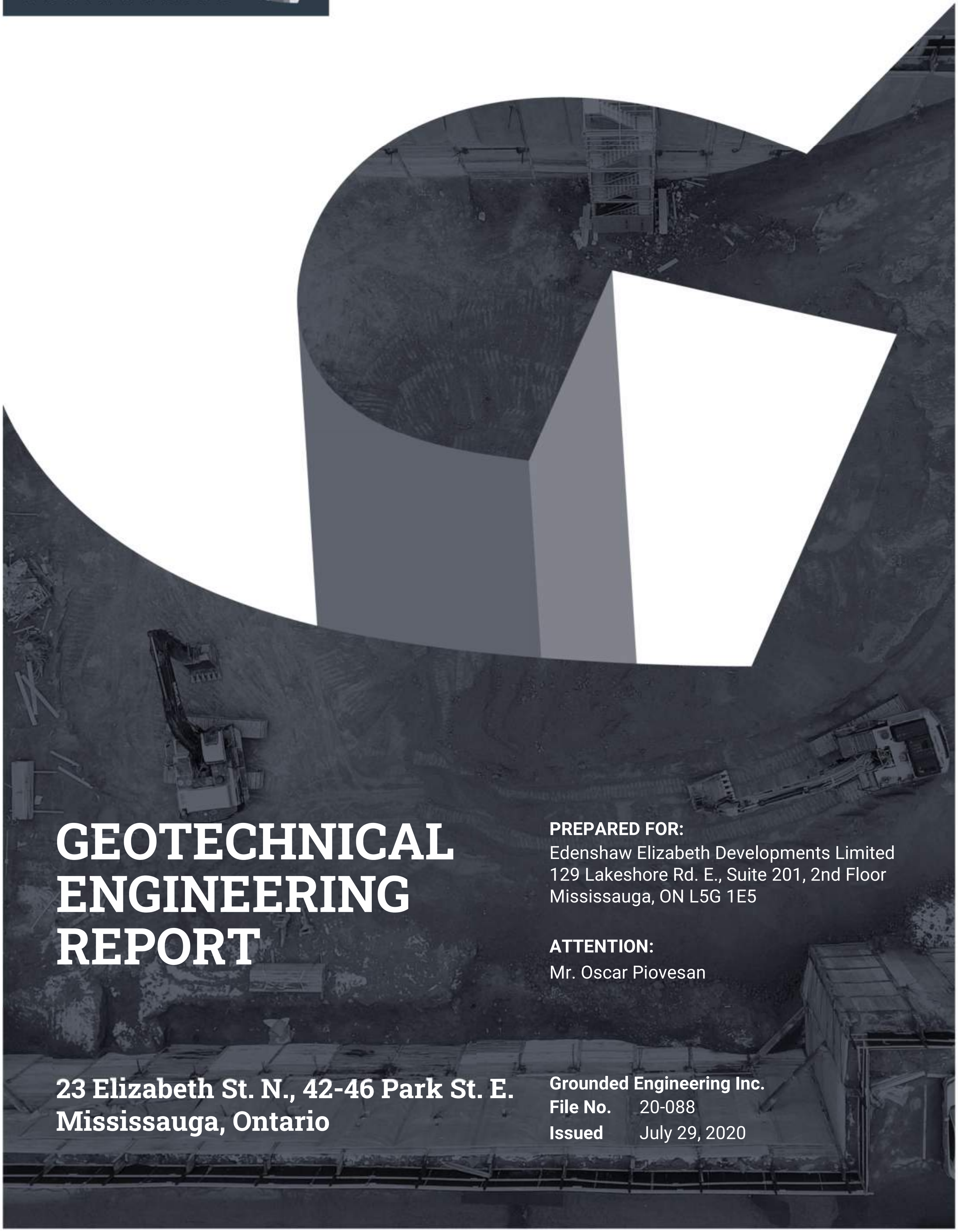

GEOTECHNICAL ENGINEERING REPORT

PREPARED FOR:
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Grounded Engineering Inc.
File No. 20-088
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1 Introduction

Edenshaw Elizabeth Developments Limited has retained Grounded Engineering Inc. (“Grounded”) to provide geotechnical engineering design advice for their proposed development at 23 Elizabeth St. N., 42-46 Park St. E., in Mississauga, Ontario.

The proposed project includes demolishing the existing structures and constructing a 22-storey residential building with a P6 underground parking structure beneath the entire site. The lowest portion of the P6 level is set approximately 20 m depth. Proposed ground floor is set at Elev. 81 m, implying a lowest Finished Floor Elevation (FFE) of 61± m. Foundations are assumed to be 1 to 2 m below lowest FFE.

Grounded has been provided with the following drawings to assist in our geotechnical scope of work:

- IBI Group Architects Inc., “42-46 Park St. East and 23 Elizabeth Street, Port Credit, Mississauga, Ontario”; Project 121643, dated May 1, 2020 (Rezoning Submission).

Grounded’s subsurface investigation of the site to date includes four (4) boreholes (Boreholes 1 to 4) which were advanced from May 25 to June 3, 2020.

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

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

2 Ground Conditions

The borehole results are detailed on the attached borehole logs. Our assessment of the relevant stratigraphic units is intended to highlight the strata as they relate to geotechnical engineering. The ground conditions reported here will vary between and beyond the borehole locations.

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

The boreholes were surveyed for horizontal coordinates and geodetic elevations with a Trimble R10 Receiver connected to the Global Navigation Satellite System and the Can-Net Virtual Reference Station Network.

2.1 Soil Stratigraphy

The following soil stratigraphy summary is based on the borehole results and the geotechnical laboratory testing. A cross-section showing stratigraphy and engineering units is appended.

2.1.1 Surficial and Earth Fill

Borehole 1 encountered a 25 mm thick asphaltic concrete layer with 150 mm of aggregate layer beneath. Boreholes 2 to 4 encountered 100 mm of topsoil at ground surface.

Underlying the surficial materials, the boreholes observed a layer of earth fill that extends to depths of 0.8 to 1.1 metres below grade (Elev. 82.7 to 80.3 metres). The earth fill varies in composition but generally consists of silty sand, with trace gravel and trace rootlets. The earth fill is typically dark brown to brown, and moist. Due to inconsistent placement and the inherent heterogeneity of earth fill materials, the relative density of the earth fill varies but is on average loose.

2.1.2 Silt and Sand

Underlying the fill materials, the boreholes encountered an undisturbed native silt and sand deposit with a matrix that varies from silt to silt and sand. This silt and sand layer was encountered at 0.8 to 1.1 metres below grade (Elev. 82.7 to 80.3 m) and extends down to depths of 3.0 to 7.6 m below grade (Elev. 75.9 to 78.2 m).

The silt and sand contains trace gravel and trace clay (37 to 89% fines content). It is generally orangey brown to grey, and moist. Standard Penetration Test (SPT) results (N-Values) measured in the silty sand unit range from 7 to over 50 blows per 300 mm of penetration (“bpf”), indicating a relative density ranging from loose to very dense (on average, dense).

2.1.3 Glacial Till

Underlying the silt and sand unit, all the boreholes encountered an undisturbed native glacial till deposit. The upper portion of the till has a matrix of cohesive silty clay (encountered in all but Borehole 3). The till transitions to a cohesive sandy silt till. The till was encountered at 3.0 to 6.1 metres below grade (Elev. 76.8 to 78.2 m).

The upper cohesive till is generally grey, and moist to wet. The upper till contains trace to some gravel and trace sand. SPT N-values measured in this unit range from 16 to 32 bpf (on average very stiff), with one sample in BH1 at 3m depth that had an SPT-N value of 0 bpf (very soft).

The lower cohesionless sandy silt till is generally grey, and moist to wet. This layer contains some clay and some gravel. SPT N-values measured in this portion of the till range from 34 to over 88 bpf (on average very dense).

2.1.4 Bedrock

The top of inferred bedrock was encountered at depths ranging from 7.6 to 10.4 m in all boreholes across the site (Elev. 72.9 to 74.2± m). Boreholes 2 to 4 inferred the top of weathered bedrock through auger cuttings, split spoon samples, and auger grinding/resistance observations. Boreholes 2 to 4 were terminated due to auger and sampler refusal (at target investigation depth) at elevations ranging from Elev. 72.8 to 73.8 m.

Borehole 1 recovered rock core from Elev. 71.0 to 58.0 m, to observe the depth to top of sound bedrock and bedrock quality at founding elevation.

Detailed core logs are included with the corresponding borehole logs. Photographs of the recovered rock core and a guide of rock core terminology are appended. The rock core terminology sheet defines many of the descriptive terms used below.

The bedrock beneath the site is the Georgian Bay Formation (“GBF”), which broadly comprises thin to medium bedded grey shale and limestone of Ordovician age. The shale is interbedded with calcareous shale, limestone, dolostone, and calcareous sandstone (conventionally grouped together as “limestone”) which are typically laterally discontinuous. Per the appended terminology, the shale is typically classified as “weak” whereas the limestone interbedding is classified as “strong”. The percentage of strong limestone beds in each run is reported on the rock core logs. The overall percentage of limestone found in Borehole 1 was 10%.

Joints occurring within the shale are gapped to open, and typically weathered with a veneer to coating of clay. Widely-spaced subvertical joints (closed, planar, clean) were also observed within the shale.

A summary of the engineering properties of the Georgian Bay Formation is presented in the Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects* (March 1983). The relevant parameters from that document are as follows:

	Uniaxial Compressive Strength (MPa)	Young’s Modulus (GPa)	Dynamic Modulus (GPa)	Poisson’s Ratio
Average	28	4	19	0.19
Range	8 to 41	0.5 to 12	6 to 38	0.1 to 0.25

Directly below the overburden soils, the uppermost portion of bedrock is typically weathered. The MTO (Ontario Ministry of Transportation and Communications document RR229, *Evaluation of*

Shales for Construction Projects) provides a *typical weathering profile of a low durability shale* reproduced from Skempton, Davis, and Chandler, which characterizes weathered versus unweathered shale as follows:

	Zone	**Description**	**Notes**
Fully Weathered	IVb	Soil-like matrix only	indistinguishable from glacial drift deposits, slightly clayey, may be fissured
Partially Weathered	IVa	Soil-like matrix with occasional pellets of shale less than 3 mm dia.	little or no trace of rock structure, although matrix may contain relic fissures
	III	Soil-like matrix with frequent angular shale particles up to 25 mm dia.	moisture content of matrix greater than the shale particles
	II	angular blocks of unweathered shale with virtually no matrix separated by weaker chemically weathered but intact shale	spheroidal chemical weathering of shale pieces emanating from relic joints and fissures, and bedding planes
Unweathered (Sound)	I	shale	regular fissuring

In glacial till overburden soils directly overlying bedrock, a zone of till with fragmented shale is often observed and interpreted as either the lowest portion of the till, or as partially weathered Zone III rock. This interpretation is subjective and depends on the investigator. There is occasionally a concentration of boulders in the soil just above the bedrock that can be mistakenly identified as bedrock where rock coring is not performed. Weathering Zones III and IV are frequently not present due to glacial scouring action, which often removes these zones from the bedrock surface.

The bedrock surface as indicated on the Borehole Logs from this investigation is intended to be consistently interpreted as the surface of Zone II. Based on examination of the rock cores from this site, the partially weathered rock (Zone II) is approximately 2.8 metres thick at the location of Borehole 1. Weathered and sound bedrock elevations are summarized as follows:

Borehole	**Ground Surface Elevation (m)**	**Partially Weathered (Zone II) Bedrock**		**Unweathered/Sound (Zone I) Bedrock**		**Confirmation Method**
		Depth (m)	**Elevation (m)**	**Depth (m)**	**Elevation (m)**	
1	81.2	7.6	73.6	10.4	70.8	Rock Coring
2	81.4	8.5	72.9	n/a*	n/a*	Inferred by SPT sample, auger grinding, auger refusal
3	83.5	10.4	73.1	n/a*	n/a*	Inferred by SPT sample, auger grinding, auger refusal
4	83.3	9.1	74.2	n/a*	n/a*	Inferred by SPT sample, auger grinding, auger refusal
*****No rock core was recovered; therefore sound bedrock was not observed*						

Rock Quality Designation (RQD) is an index measurement that refers to the total length of pieces of sound core in a core run that are at least 100 mm in length, expressed as a percentage of the total length of that core run. Only natural discontinuities are used in assessing RQD. The RQD of the recovered rock cores varied between 11 and 100%, but was 80 to 100% in the unweathered (sound) portion of the bedrock in Borehole 1.

RQD underrepresents the competency of the Georgian Bay Formation and is not appropriate for horizontally bedded fissile shale. In this formation, the RQD is typically low due to the fissility of the shale as well as the closely spaced horizontal bedding planes. Our results are typical of this formation.

The Georgian Bay Formation has been known to issue gases when penetrated. There are instances where both methane and hydrogen sulphide gas emissions have been detected in excavations made in the Georgian Bay Formation. While there was no specific indication of gas emissions from the boreholes made in this investigation, the potential for gas emissions from this formation is recognized as a design issue to be addressed.

2.2 Groundwater

The depth to groundwater and caved soils was measured in each of the boreholes immediately following the drilling. Borehole 1 was filled with drill fluid (from rock coring) on completion and measuring the unstabilized groundwater level after drilling was not practical. Monitoring wells were installed in each of the boreholes, and stabilized groundwater levels were measured in each of the monitoring wells one week after the completion of drilling.

The groundwater observations are shown on the Borehole Logs and are summarized as follows.

Borehole No.	**Borehole depth (m)**	**Upon completion of drilling**		**Strata Screened**	**Water Level in Well, Depth/Elev. (m)**				
		Depth to cave (m)	**Unstabilized water level (m)**		**Jun 5, 2020**	**Jun 10, 2020**	**Jun 12, 2020**	**Jun 18, 2020**	**July 20, 2020**
1	21.8	n/a	filled with drill water	Bedrock	4.8/ **76.3**	7.7/ **73.4**	12.7/ **68.4**	12.7/ **68.5**	12.6/ **68.6**
2	44.3	n/a	Dry	Glacial Till (Silty Clay to Sandy Silt)	5.0/ **76.4**	5.0/ **76.4**	4.9/ **76.5**	4.9/ **76.5**	4.7/ **76.7**
3	21.8	8.7	6.1	Silty Sand to Glacial Till (Sandy Silt)	3.3/ **80.2**	3.7/ **79.7**	4.0/ **79.4**	3.7/ **79.8**	4.0/ **79.5**
4	9.5	8.7	4.6	Silty Sand to Glacial Till (Silty Clay to Silty Sand)	2.9/ **80.5**	2.9/ **80.4**	3.0/ **80.4**	3.0/ **80.3**	3.5/ **79.9**

Groundwater levels fluctuate with time depending on the amount of precipitation and surface runoff. At this site, the design groundwater table is at Elev. 80.5± m.

Grounded has prepared a hydrogeological report for this site (File No. 20-088).

2.3 Corrosivity and Sulphate Attack

Three (3) soil samples were submitted for corrosivity testing parameters (pH, Resistivity, Electrical Conductivity, Redox Potential, Sulphate, Sulphide and Chloride). The Certificate of Analyses is appended.

The soil samples were analysed for soluble sulphate concentration and compared to the Canadian Standard CAN3/CSA A23.1-M94 Table 3, *Additional Requirements for Concrete Subjected to Sulphate Attack*. Based on this table, the test result of 1 sample (BH1 SS6) indicates that the water-soluble sulphate concentrations in the soil subgrade is 0.34 percent. As such, the Class of exposure is S-2 for this sample.

The other sample results indicate negligible potential for sulphate attack on concrete.

Corrosivity parameters are also used for assessing soil corrosivity applicable to cast iron alloys, according to the 10-point soil evaluation procedure described in the American Water Work Association (AWWA) C-105 standard. The analytical results only provide an indication of the potential for corrosion. All three samples scored less than 10 points and corrosion protective measures are therefore not recommended for cast iron alloys. A more recent study by the AWWA has suggested that soil with a resistivity of less than about 2000 ohm.cm should be considered aggressive. All three samples had resistivity measurements exceeding 2000 ohm.cm.

3 Geotechnical Engineering Recommendations

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

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

3.1 Foundation Design Parameters

Foundations made for the proposed lowest P6 FFE (Elev. 61± m) will bear on undisturbed sound bedrock. Conventional spread footings made to bear on sound bedrock may be designed using a maximum factored geotechnical resistance at ULS of 10,000 kPa. The net geotechnical reaction at SLS is 6,000 kPa, for an estimated total settlement of 25 mm.

Spread footing foundations for columns must not be less than 1000 mm and must be embedded a min. 600 mm below FFE, which applies in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to a settlement which, for practical purposes, is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

For footings stepped from one level to another in sound bedrock there must be a minimum of 300 mm between the edge of any footing and the top of a sloped 2V:1H rock cut down to another footing.

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

The founding subgrade must be cleaned of all unacceptable materials and approved by Grounded prior to pouring concrete for the footings. Such unacceptable materials may include disturbed or caved soils, ponded water, or similar as indicated by Grounded during founding subgrade inspection. During the winter, adequate temporary frost protection for the footing bases and concrete must be provided if construction proceeds during freezing weather conditions. The bedrock surface can weather and deteriorate on exposure to the atmosphere or surface water; hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

3.2 Earthquake Design Parameters

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

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

Below the nominal founding elevation (for spread footings or grade beams) of 60± metres, the boreholes observe sound Georgian Bay Formation bedrock. Based on this information, the site designation for seismic analysis is **Class B**, per Table 4.1.8.4.A of the Ontario Building Code (2012). Tables 4.1.8.4.B and 4.1.8.4.C. of the same code provide the applicable acceleration- and velocity-based site coefficients.

3.3 Earth Pressure Design Parameters

At this site, the design parameters for structures subject to unbalanced earth pressures such as basement walls and retaining walls are shown in the table below.

Stratigraphic Unit	γ	φ	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS 1010)	21	32	0.31	0.47	3.26
Existing Earth Fill	19	29	0.35	0.52	2.88
Silt and Sand	20	32	0.31	0.47	3.25
Upper Clayey Silt Till	22	30	0.30	0.50	3.00
Lower Sandy Silt Till	22	40	0.22	0.36	4.60
Sound Bedrock	26	28	n/a		

γ = soil bulk unit weight (kN/m^3)
φ = internal friction angle (degrees)
K_a = active earth pressure coefficient (Rankine, dimensionless)
K_o = at-rest earth pressure coefficient (Rankine, dimensionless)
K_p = passive earth pressure coefficient (Rankine, dimensionless)

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

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

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

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

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

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

Where walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Water from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. This is discussed in Section 3.5.

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

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

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

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

3.3.1 Rock Swell

The earth pressure design approach for foundation walls below the top of bedrock is empirical and assumes a uniform pressure distribution below the top of bedrock elevation equal to the maximum earth pressure calculated for the lowest level of soil overtop. This approach is conventional and likely conservative, but it is practical insofar as it acknowledges that requirement of having a foundation wall of a consistent width at the lower levels.

However, this approach does not recognize the potential for pressures on the basement wall due to **time-dependent rock swell** that results when locked-in horizontal stresses are released. For structures deeper than 2 m below the top of sound rock, rock swell must also be considered.

The simplest approach to dealing with rock swell is through scheduling. If there is a 120-day gap between rock excavation and construction of the structure that will restrain the rock, experience on similar structures indicates the rock will de-stress and swell, and no significant stresses are imposed on the structural wall. This requirement typically only impacts the lowest basement levels in bedrock, acknowledging the 120-day window.

If the construction schedule does not allow for the 120-day gap described above, mitigation measures will be required. For structures subjected unbalanced rock swell pressure (i.e. lowest one or two levels of exterior foundation walls, sumps, elevator pits, other features cast directly against the rock face), rock squeeze effects can be addressed by providing a crushable layer between the rock and the concrete, such as 50 mm thick 220 Ethafoam Polyethylene Foam planks. The subject walls are typically designed for the 50% compressive strength resistance of the foam. At 50% compression, a 220 Ethafoam plank provides 124 kPa of resistance. At 10% compression (which allows for concrete placement), this material provides 50 kPa of resistance.

Deeper protrusions (sumps, elevator pits, etc.) are typically not constrained by the property lines or adjacent footings and can be over-excavated. In this case the rock can be over-excavated by a minimum 600 mm. Precast pits and sumps are then placed and backfilled with 19 mm clear stone (OPSS 1004). The clear stone backfill then accommodates the rock swell.

Rock squeeze effects are not relevant to foundation excavations as the earth pressures exerted on foundation elements are balanced, and concrete is strong enough to balance the swell pressure and render it null.

3.4 Slab on Grade Design Parameters

At the proposed lowest P6 elevation, the undisturbed bedrock will provide adequate subgrade for the support of a conventional slab on grade. The modulus of subgrade reaction for slab-on-grade design supported by a drainage layer resting on undisturbed bedrock is 80,000 kPa/m.

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

The use of excavated bedrock spoil to restore subgrade elevations is to be specifically prohibited. This bedrock spoil cannot be adequately compacted to provide support for the slab on grade and is not to be reused below any settlement sensitive areas.

A permanent drainage system including subfloor drains is required (see Section 3.5). Subfloor drains are typically installed in trenches below the capillary moisture break drainage layer per the typical detail appended. If trenches are to be avoided for whatever reason, the subfloor drainage system can be incorporated into the capillary moisture break and drainage layer. In this case, the subfloor drains are laid directly on the flat subgrade and backfilled with a minimum 300 mm thick layer of HL8 coarse aggregate (OPSS 1150) or HPB, vibrated to a dense state. Any solid collection pipes must be sloped so that they positively discharge to the sumps.

The subgrade should be cut neat and inspected by Grounded prior to placement of the capillary moisture break and construction of the slab. Disturbed or otherwise unacceptable material (as determined by Grounded) must be subexcavated and replaced with Granular B (OPSS 1010) compacted to a minimum of 98% SPMDD.

3.5 Long-Term Groundwater and Seepage Control

To limit seepage to the extent practicable, exterior grades adjacent to foundation walls should be sloped at a minimum 2 percent gradient away from the wall for 1.2 m minimum. The exterior faces of foundation walls should be provided with a layer of waterproofing to protect interior finishes.

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

Subfloor drainage pipes are to be spaced at an average 6 m (measured on-centres). If subdrain elevation conflicts with top of footing elevation, footings should be lowered as necessary.

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

Typical basement drainage details are appended.

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

The permanent dewatering requirements are provided in Grounded's Hydrogeological Report (File No. 20-088).

4 Considerations for Construction

4.1 Excavations

Excavations must be carried out in accordance with the *Occupational Health and Safety Act and Regulations for Construction Projects, November 1993 (Part III - Excavations, Section 222 through 242)*. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes:

- The earth fill is a Type 3 soil
- The wet sands are Type 4 soils, or Type 3 soils if dewatered
- The glacial tills are Type 2 soils

In accordance with the regulation's requirements, the soil must be suitably sloped and/or braced where workmen must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes by soil type are stipulated as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

Bedrock is not considered a soil under the Act. Vertical excavations made in sound bedrock are generally self-supporting provided the rock bedding is horizontally oriented. If deemed necessary, rock bolts can be used to anchor a layer of protective mesh that will protect workers from loose rock spalling from the face of excavation. The rock face must be inspected by Grounded to determine that no other support system is required to prevent the spalling of loose rock, and to confirm that all loose spall material at risk of falling upon a worker is removed (Section 233 of the above noted regulations).

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

Excavations will penetrate weathered and sound bedrock. This bedrock is a rippable rock that typically does not require blasting. Effective techniques in this formation include the use of hoe ramming equipment, rippers, and line drilling in areas where good excavation control is required.

Georgian Bay Formation bedrock is a rippable rock that can be removed with conventional excavation equipment once it has been broken by ripper tooth or hoe ram. Creating detailed excavation shapes for foundations etc. is normally accomplished by hoe ram. The removal of rock from a vertical face without over-excavation, which can happen inadvertently by dislodging additional rock, is largely dependent on machine operator skill. If excavation faces must be made neat (such as beside an existing footing), a line of excavation can be provided by line drilling the rock a series of closely-spaced vertical holes (100 mm diameter, spaced at 300 mm on centre) to provide a preferential vertical break path for the excavation face.

Georgian Bay Formation bedrock contains beds of harder limestone. When excavating this bedrock, it should be expected that these beds will be encountered. Hard layers of limestone interbedded within the shale are normally broken with hoe mounted hydraulic rams before excavation.

Limestone beds may also be found to straddle the founding elevation, in which case the entire thickness of the hard limestone layer must be removed to expose founding subgrade as it is not possible to remove part of one of these layers. This will in turn result in excess rock removal not intrinsic to the project requirements. The risk and responsibility for the excess rock removal under these circumstances, and the supply and placement of the extra concrete to restore the foundation grade, must be addressed in the contract documents for foundations, excavation, and shoring contractors.

4.2 Short-Term Groundwater Control

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

Should the excavation be supported using permeable soldier pile and lagging shoring, positive dewatering will be required on a continuous ongoing basis during construction. Failure to dewater prior to excavation will result in unrecoverable disturbance of the subgrade, which will potentially create loss-of-ground issues adjacent to the site. Dewatering will take some time to accomplish prior to the start of excavation.

It is recommended that a professional dewatering contractor be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to assess the factual data and to provide recommendations on dewatering system requirements.

To better control groundwater during construction, a fully continuous interlocking concrete caisson wall socketed a minimum 2 m into bedrock below Elev. 70.8± m may be considered as an alternative approach to shoring the excavation. The shoring cut-off wall approach will provide a fully continuous temporary groundwater cut-off barrier (i.e. piles and fillers), which will enable the site to be dewatered during construction without inducing more flow into the excavation. Dewatering inside an excavation protected by a cut-off barrier wall can likely conducted using conventional sump arrangements.

If caisson walls are advanced as cut-off walls on all sides of the excavation, the site may be excavated without exceeding the discharge limit for groundwater but may still need to be exceeded during precipitation events. The City of Mississauga / Region of Peel will still require an agreement to discharge to the sewer, and a PTTW may still be desired for stormwater management during construction.

Precipitation events will be the primary contributor of water entering the excavation if a caisson wall socketed into the bedrock is used to cut off the groundwater. Large precipitation events will create volumes of water which will then need to be pumped out of the excavation. This dewatering can be staged over the course of multiple days so as not to exceed the limit for water removal without an ESAR posting; otherwise, an ESAR posting can be obtained in advance of construction to avoid possible delays.

4.3 Earth-Retention Shoring Systems

No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided.

Underpinning guidelines are appended.

Continuous interlocking caisson wall shoring is to be used where the excavation must be constructed as a rigid shoring system. Caisson wall shoring preserves the support capabilities and integrity of the soil beneath existing foundations of adjacent buildings, in a state akin to the at-rest condition. Otherwise, excavations can be supported using conventional soldier pile and lagging walls where they cannot be sloped.

4.3.1 Lateral Earth Pressure Distribution

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

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

$\boldsymbol{P = 0.8\,K[\gamma H + q] + \gamma_w h_w}$ … in cohesive soils
$\boldsymbol{P = 0.65\,K[\gamma H + q] + \gamma_w h_w}$ … in cohesionless soils

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

Where shoring walls are drained to effectively eliminate hydrostatic pressure on the shoring system (e.g. pile and lagging walls), $\boldsymbol{h_w}$ is equal to zero. For the design of impermeable shoring, a design groundwater table at Elev. 80.5 m must be accounted for.

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

Where the excavation penetrates the bedrock, the rock excavation is nominally self-supporting in a vertical face, provided the rock bedding is horizontally oriented. The requirement for extending lagging into partially weathered rock depends on the quality of the excavation cut and the degree of weathering.

4.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in sound bedrock. The maximum factored vertical geotechnical resistance at ULS for the design of a pile embedded in the sound bedrock is 10 MPa. The maximum factored lateral geotechnical resistance at ULS of the undisturbed rock is 1 MPa.

The soils at this site are cohesionless, wet, and permeable. Augered holes for piles made into these soils will be prone to caving and blowback. Temporarily cased holes advanced to the bedrock surface are required to prevent borehole caving during installations in drilled holes. To prevent groundwater issues (groundwater inflow, caving and blowback into the drill holes, disturbance to placed concrete, etc.) during drilling and installation, construction methods such as utilizing temporary liners, mud/slurry drilling techniques, or other methods as deemed necessary by the shoring contractor are required.

Exposed bedrock of the Georgian Bay Formation deteriorates with time. Within 12 months of exposure, excavation faces made within this bedrock flake and recede as much as 300 mm, generally in the form of coin-size shale particles dropping from the face on a constant basis. The deteriorated rock loses internal integrity and bearing capability. Solider piles for the shoring system are typically advanced at least 1 metre below the base of the excavation (to be confirmed by the geostructural engineer) to accommodate this weathering and still ensure that the required lateral and vertical bearing resistances can be utilized.

4.3.3 Lateral Bracing Elements

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

In the native soil subgrade, it is expected that post-grouted anchors can be made such that an anchor will safely carry up to 60 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm). Conventional earth anchors made in Georgian Bay Formation bedrock can be designed using a working adhesion of 620 kPa.

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

The bedrock below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on very dense soils at an inclination of 45 degrees can be designed using a maximum factored geotechnical resistance at ULS of 2500 kPa.

4.4 Site Work

To better protect wet undisturbed subgrade, excavations exposing wet soils must be cut neat, inspected, and then immediately protected with a skim coat of concrete (i.e. a mud mat). Wet sands are susceptible to degradation and disturbance due to even mild site work, frost, weather, or a combination thereof.

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

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

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

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

The exposed Georgian Bay Formation deteriorates with time. Exposed excavation faces have been found to flake and recede as much as 300 mm with 12 months exposure. This recession generally takes the form of coin size shale particles dropping from the face on a constant basis. The deteriorated rock loses internal integrity and bearing capability. If bedrock is to be exposed for prolonged periods of time, it is recommended that a skim coat of concrete be used to protect the surface of bedrock from slaking and other degradation resulting from weathering.

4.5 Engineering Review

By issuing this report, Grounded Engineering has assumed the role of Geotechnical Engineer of Record for this site. Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

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

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

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

5 Limitations and Restrictions

Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

5.1 Investigation Procedures

The geotechnical engineering analysis and advice provided are based on the factual borehole information observed and recorded by Grounded. The investigation methodology and engineering analysis methods used to carry out this scope of work are consistent with conventional standard practice by Grounded as well as other geotechnical consultants, working under similar conditions and constraints (time, financial and physical).

Borehole drilling services were provided to Grounded by a specialist professional contractor. The drilling was observed and recorded by Grounded's field supervisor on a full-time basis. Drilling was conducted using conventional drilling rigs equipped with solid stem augers, hollow stem augers and rock coring. As drilling proceeded, groundwater observations were made in the boreholes. Based on examination of recovered borehole samples, our field supervisor made a record of borehole and drilling observations. The field samples were secured in air-tight clean jars and bags and taken to the Grounded soil laboratory where they were each logged and reviewed by the geotechnical engineering team and the senior reviewer.

The Split-Barrel Method technique (ASTM D1586) was used to obtain the soils samples. The sampling was conducted at conventional intervals and not continuously. As such, stratigraphic interpolation between samples is required and stratigraphic boundary lines do not represent exact depths of geological change. They should be taken as gradual transition zones between soil or rock types.

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

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

5.2 Site and Scope Changes

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

The geotechnical engineering advice provided in this report is based on the factual observations made from the site investigations as reported. It is intended for use by the owner and their retained design team. If there are changes to the features of the development or to the scope, the interpreted subsurface information, geotechnical engineering design parameters, advice, and discussion on construction considerations may not be relevant or complete for the project. Grounded should be retained to review the implications of such changes with respect to the contents of this report.

5.3 Report Use

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

The local municipal/regional governing bodies may also make use of and rely upon this report, subject to the limitations as stated.

6 Closure

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

For and on behalf of our team,

GROUNDED ENGINEERING

LICENSED PROFESSIONAL ENGINEER
M. DIEZ DE AUX
100159147
29/7/2020
PROVINCE OF ONTARIO

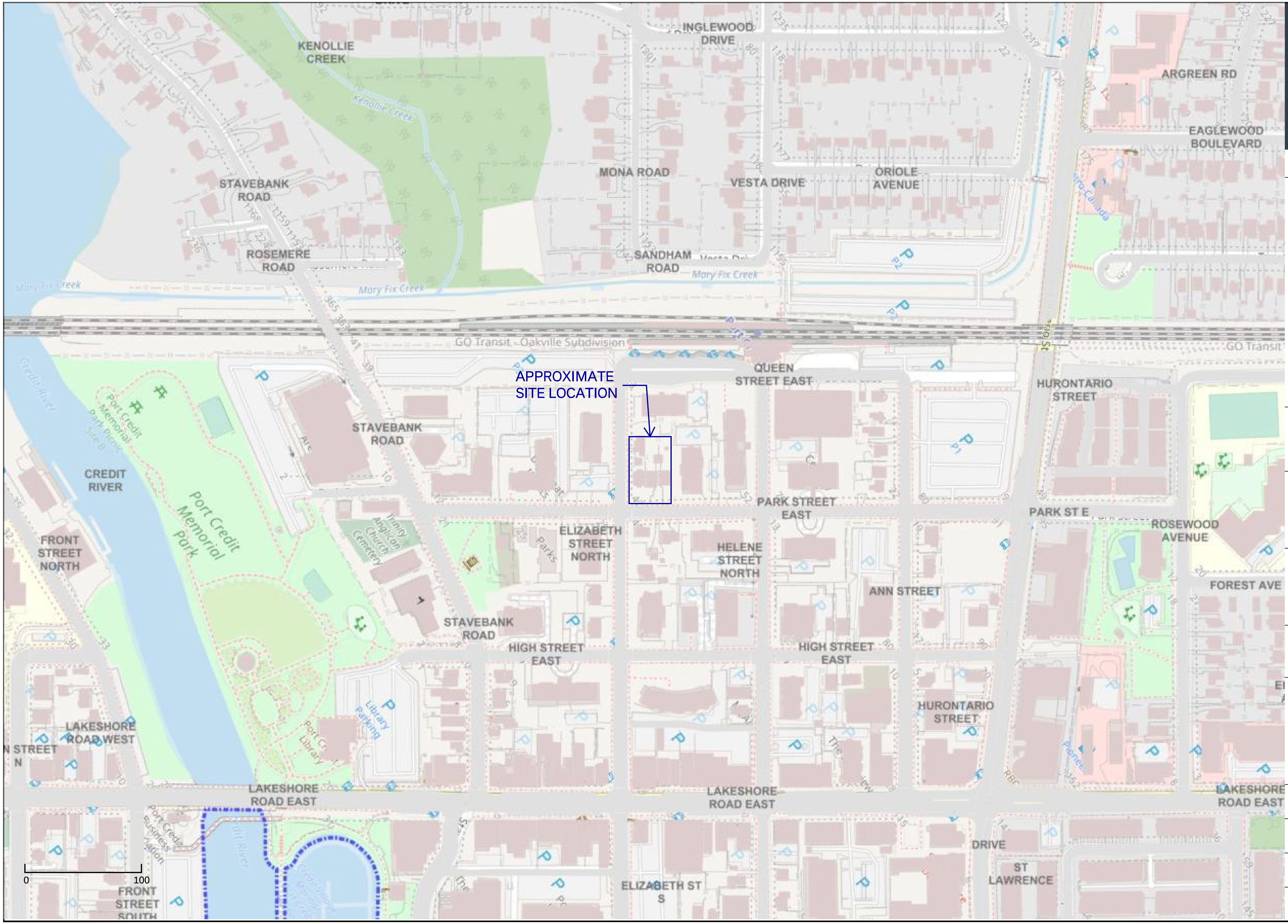
Jessie Hui Chung Wu, M. Env. Sc.

Michael Diez de Aux, M.A.Sc., P.Geo., P.Eng.
Associate

LICENSED PROFESSIONAL ENGINEER
J. J. CROWDER
100077148
29/7/2020
PROVINCE OF ONTARIO

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

FIGURES



GROUNDED
ENGINEERING

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

LEGEND

APPROXIMATE SITE BOUNDARY

Note

Reference
City of Mississauga Interactive Map

Project
23 ELIZABETH ST. N. 42, 44, 46 PARK ST. E.
MISSISSAUGA ONTARIO

Figure Title
SITE LOCATION PLAN

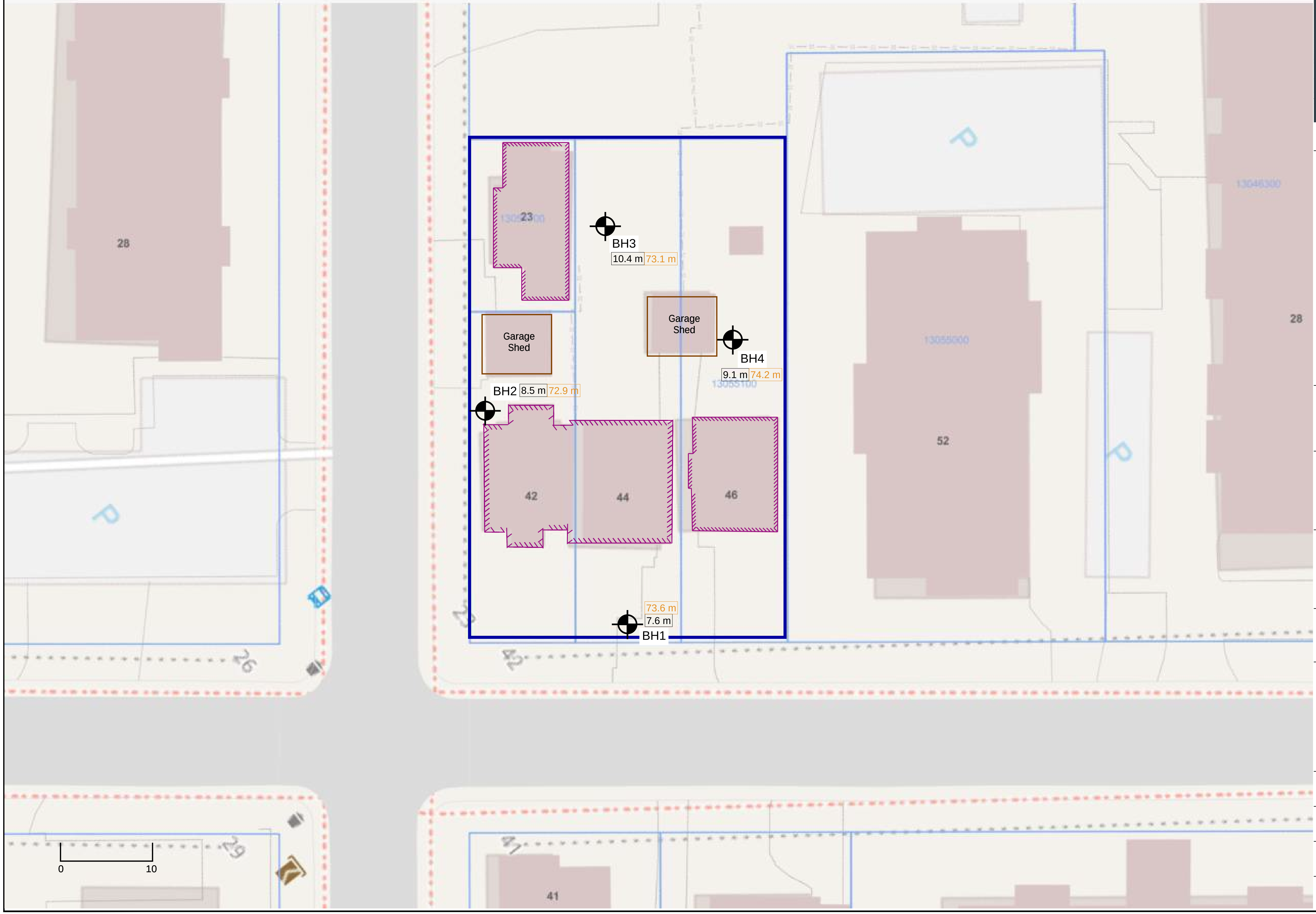
North
TRUE
PROJECT

Date
JULY, 2020

Scale
AS INDICATED

Job No
20-088

Figure No
FIGURE 1



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LEGEND

—	PROPERTY BOUNDARY
▨	CURRENT BUILDING CONFIGURATION
⊕	GROUNDED BOREHOLE WITH MONITORING WELLS (2020)
6.2 m	DEPTH TO ZONE II WEATHERED BEDROCK
6.2 m	ELEV. TO ZONE II WEATHERED BEDROCK (GROUNDED 2020)

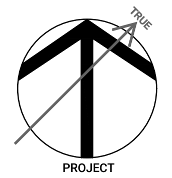
Note

Reference
City of Mississauga Interactive Map

Project
23 ELIZABETH ST. N.,
42, 44, 46 PARK ST. E.
MISSISSAUGA ONTARIO

Figure Title
BOREHOLE LOCATION PLAN - EXISTING CONDITION

North

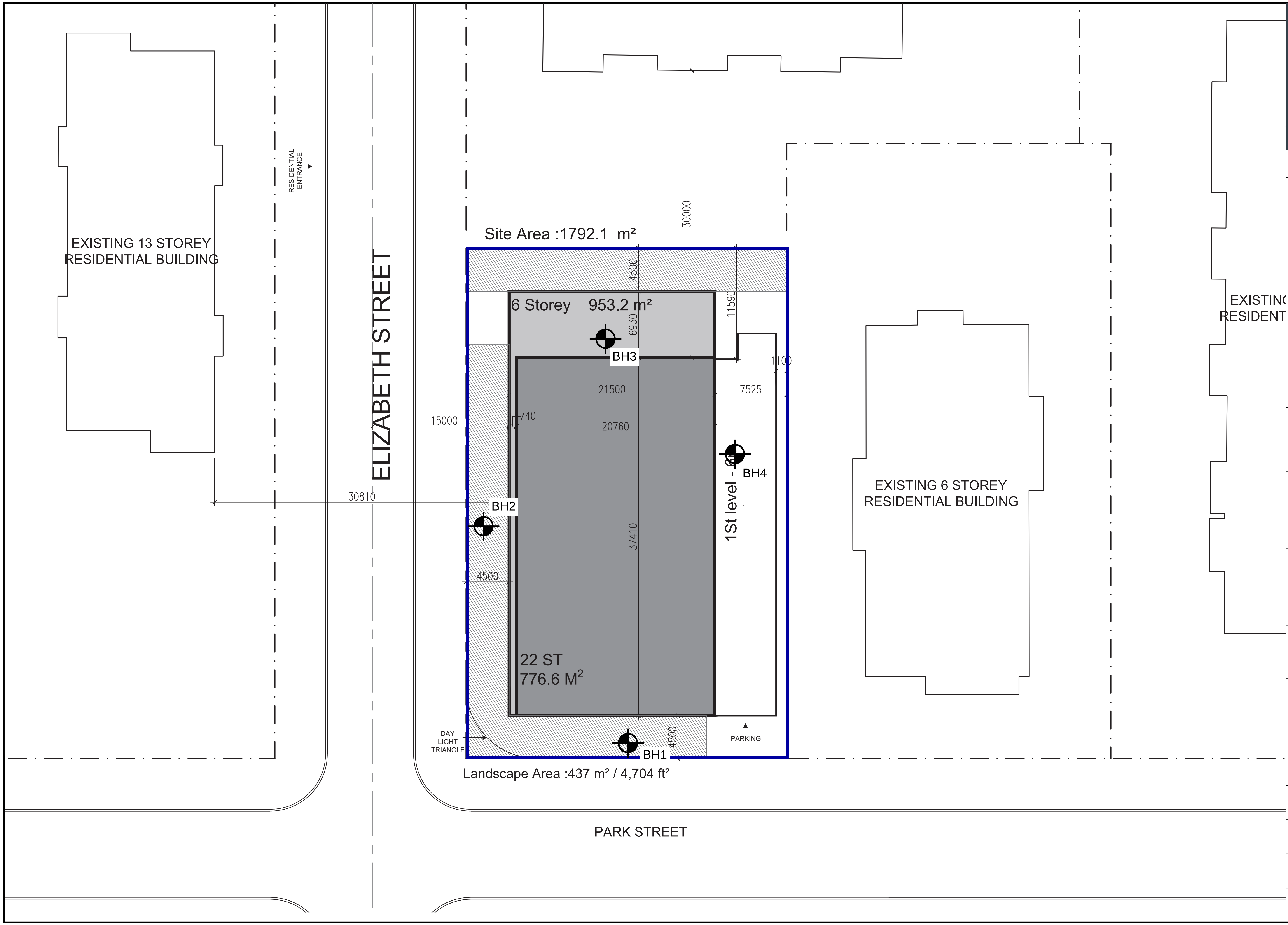


Date
JULY, 2020

Scale
AS INDICATED

Job No
20-088

Figure No
FIGURE 2



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LEGEND

— PROPERTY BOUNDARY

⌖ GROUNDED BOREHOLE WITH MONITORING WELLS (2020)

Note

Reference

A102 - SITE PLAN ELIZABETH-PARK STREET JULY 17, 2019
IBI GROUP

Project

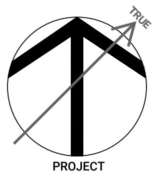
23 ELIZABETH ST. N., 42, 44, 46 PARK ST. E.

MISSISSAUGA, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - PROPOSED CONDITION

North



Date

JULY, 2020

Scale

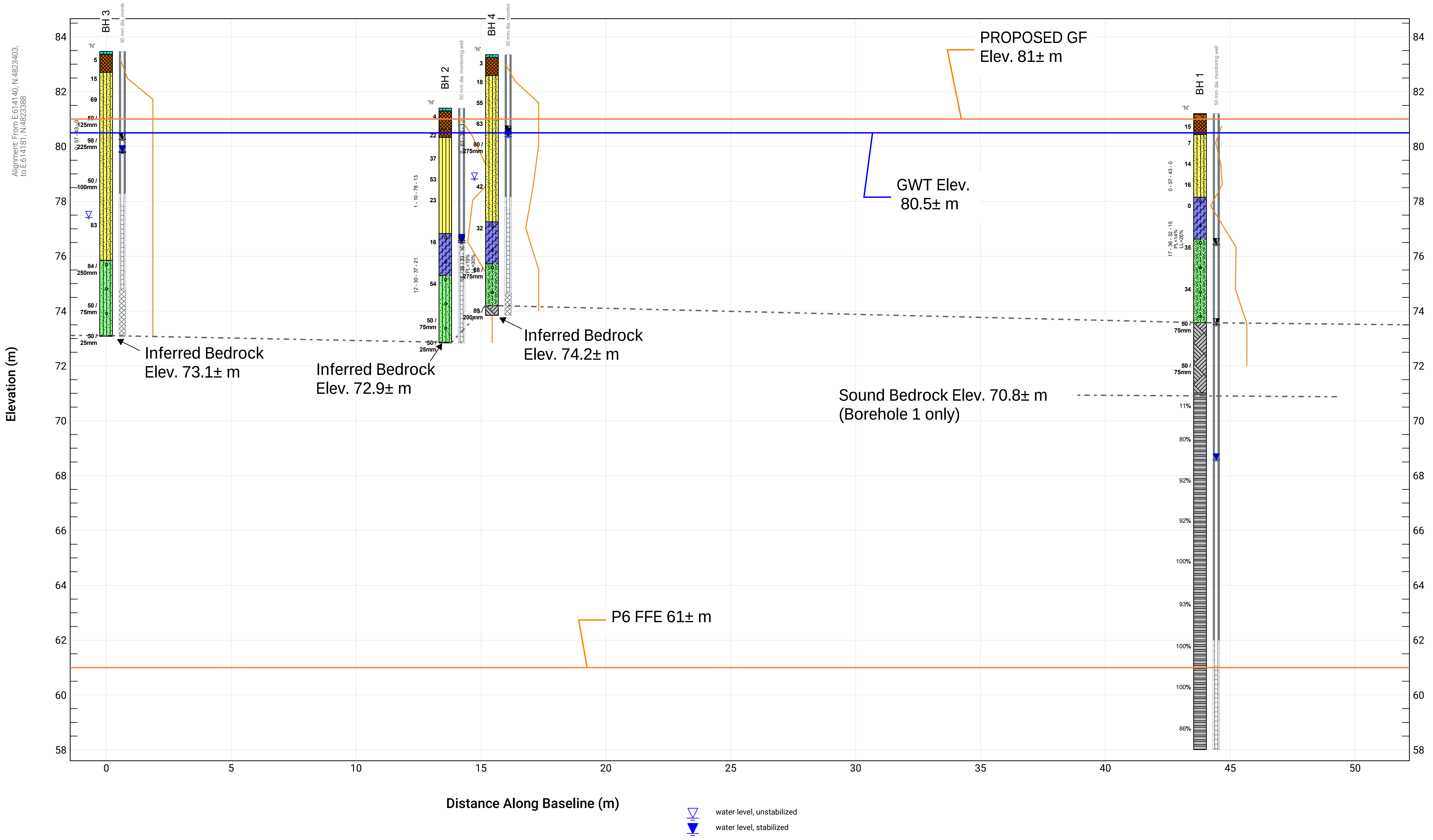
1:200

Job No

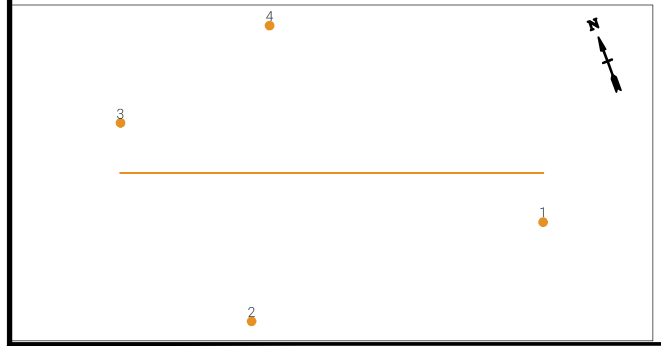
20-088

Figure No

FIGURE 3



SITE MAP



LITHOLOGY GRAPHIC LEGEND

- ■ Asphalt
- ▨ Silty Clay Till
- ▨ Topsoil
- ▨ Aggregate
- ▨ Silty Sand Till
- ▥ Silt
- ▩ Fill
- ▨ Bedrock
- ▨ Sandy Silt Till
- ▥ Silt and Sand
- ▤ Bedrock (cored)

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LEGEND

- 🟫 FILL
- 🟧 GRAVELS (gravel to gravelly sand)
- 🟨 SILT TO SAND (not till)
- 🟩 COHESIONLESS TILLS
- 🟦 COHESIVE SOILS (clayey silt to clay, incl. tills)
- 🟦 DISTURBED/REWORKED SOILS

Note

Reference

Project

23 ELIZABETH ST. N.,
42, 44, 46 PARK ST. E.
MISSISSAUGA ONTARIO

Figure Title

CROSS SECTION

North

Date
JULY 2020

Scale
AS INDICATED

Job No
20-088

Figure No
FIGURE 4

APPENDIX A

BOREHOLE LOG TERMINOLOGY

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

PI: plasticity index

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ 1st water level measurement

▼ 2nd water level measurement most recent

▼ water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

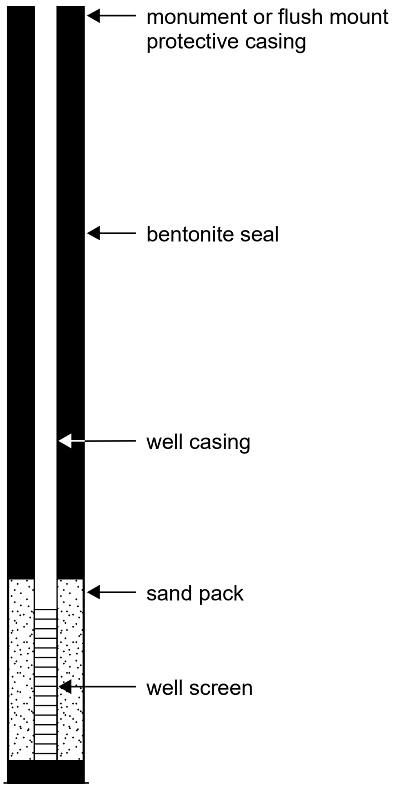
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



ROCK CORE TERMINOLOGY (MTO SHALE)

TCR	**Total Core Recovery** the total length of recovery (soil or rock) per run, as a percentage of the drilled length
SCR	**Solid Core Recovery** the total length of sound full-diameter rock core pieces per run, as a percentage of the drilled length
RQD	**Rock Quality Designation** the sum of all pieces of sound rock core in a run which are 10 cm or greater in length, as a percentage of the drilled length

Natural Fracture Frequency (typically per 0.3 m) The number of natural discontinuities (joints, faults, etc.) which are present per 0.3m. Ignores mechanical or drill-induced breaks, and closed discontinuities (e.g. bedding planes).

LOGGING DISCONTINUITIES

Discontinuity Type

BP	bedding parting
CL	cleavage
CS	crushed seam
FZ	fracture zone
MB	mechanical break
IS	infilled seam
JT	Joint
SS	shear surface
SZ	shear zone
VN	vein
VO	void

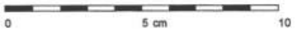
Coating

CN	Clean
SN	Stained
OX	Oxidized
VN	Veneer
CT	Coating (>1 mm)

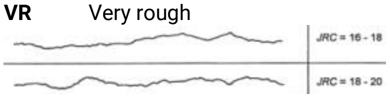
Dip Inclination

H	horizontal/flat	0 - 20°
D	dipping	20 - 50°
SV	sub-vertical	50 - 90°
V	vertical	90±°

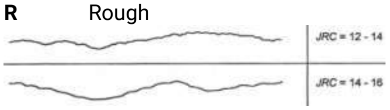
Roughness (Barton et al.)



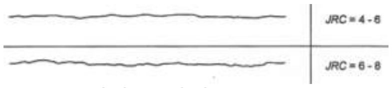
VR Very rough



R Rough



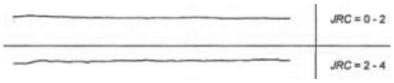
S Smooth



SL Slickensided

(visually assessed)

POL Polished



Spacing in Discontinuity Sets

(*ISRM 1981*)

VC	very close	< 60 mm
C	close	60 – 200 mm
M	mod. close	0.2 to 0.6 m
W	wide	0.6 to 2 m
VW	very wide	> 2 m

Aperture Size

T	closed / tight	< 0.5 mm
GA	gapped	0.5 to 10 mm
OP	open	> 10 mm

Planarity

PR	Planar
UN	Undulating
ST	Stepped
IR	Irregular
DIS	Discontinuous
CU	Curved

GENERAL

Degree of Weathering (*after MTO, RR229 Evaluation of Shales for Construction Projects*)

Zone	Degree	Description
Z1	unweathered	shale, regular jointing
Z2	partially weathered	angular blocks of unweathered shale, no matrix, with chemically weathered but intact shale
Z3		soil-like matrix with frequent angular shale fragments < 25mm diameter
Z4a		soil-like matrix with occasional shale fragments < 3mm diameter
Z4b	fully weathered	soil-like matrix only

Strength classification (*after Marinos and Hoek, 2001; ISRM 1981b*)

Grade		UCS (MPa)	Field Estimate (Description)
R6	extremely strong	> 250	can only be chipped by geological hammer
R5	very strong	100 - 250	requires many blows from geological hammer
R4	strong	50 - 100	requires more than one blow from geological hammer
R3	medium strong	25 - 50	can't be scraped, breaks under one blow from geological hammer
R2	weak	5 - 25	can be peeled / scraped with knife with difficulty
R1	very weak	1 - 5	easily scraped / peeled, crumbles under firm blow of geo. hammer
R0	extremely weak	< 1	indented by thumbnail

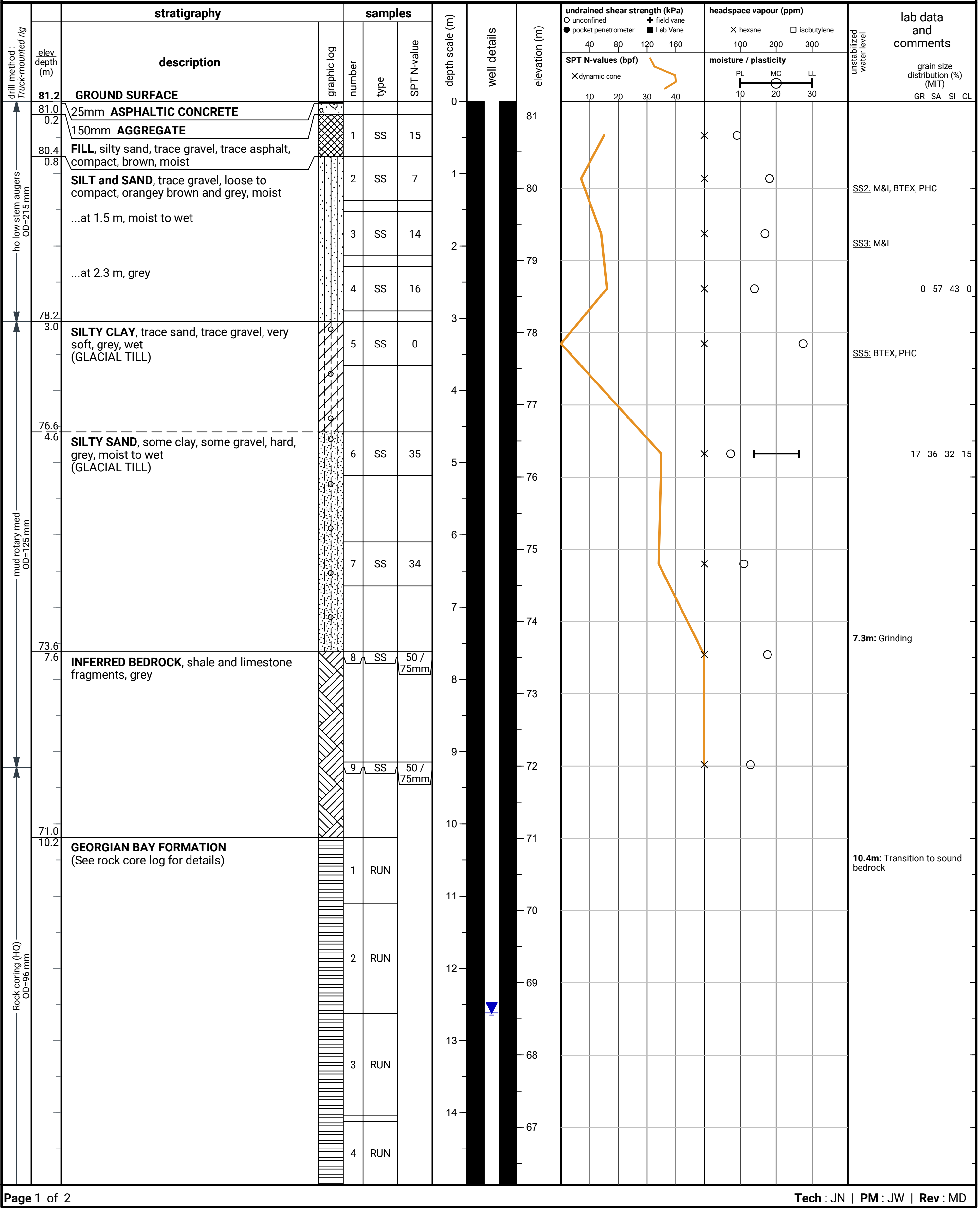
Bedding Thickness (*Q. J. Eng. Geology, Vol 3, 1970*)

Very thickly bedded	> 2 m
Thickly bedded	0.6 – 2m
Medium bedded	200 – 600mm
Thinly bedded	60 – 200mm
Very thinly bedded	20 – 60mm
Laminated	6 – 20mm
Thinly Laminated	< 6mm

Date Started : Jun 2, 2020
Position : E: 614179, N: 4823383 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 1

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited



elev depth (m)	description	number	type	SPT N-value	lab data and comments	grain size distribution (%) (MIT) GR SA SI CL
81.2	**GROUND SURFACE**					
81.0 0.2	25mm **ASPHALTIC CONCRETE**					
	150mm **AGGREGATE**					
80.4 0.8	**FILL**, silty sand, trace gravel, trace asphalt, compact, brown, moist	1	SS	15		
	SILT and SAND, trace gravel, loose to compact, orangey brown and grey, moist	2	SS	7	SS2: M&I, BTEX, PHC	
	...at 1.5 m, moist to wet	3	SS	14	SS3: M&I	
78.2 3.0	...at 2.3 m, grey	4	SS	16		0 57 43 0
76.6 4.6	**SILTY CLAY**, trace sand, trace gravel, very soft, grey, wet (GLACIAL TILL)	5	SS	0	SS5: BTEX, PHC	
	SILTY SAND, some clay, some gravel, hard, grey, moist to wet (GLACIAL TILL)	6	SS	35		17 36 32 15
73.6 7.6		7	SS	34	7.3m: Grinding	
	INFERRED BEDROCK, shale and limestone fragments, grey	8	SS	50 / 75mm		
71.0 10.2		9	SS	50 / 75mm		
	GEORGIAN BAY FORMATION (See rock core log for details)	1	RUN		10.4m: Transition to sound bedrock	
		2	RUN			
		3	RUN			
		4	RUN			

file: 20-088.gpj

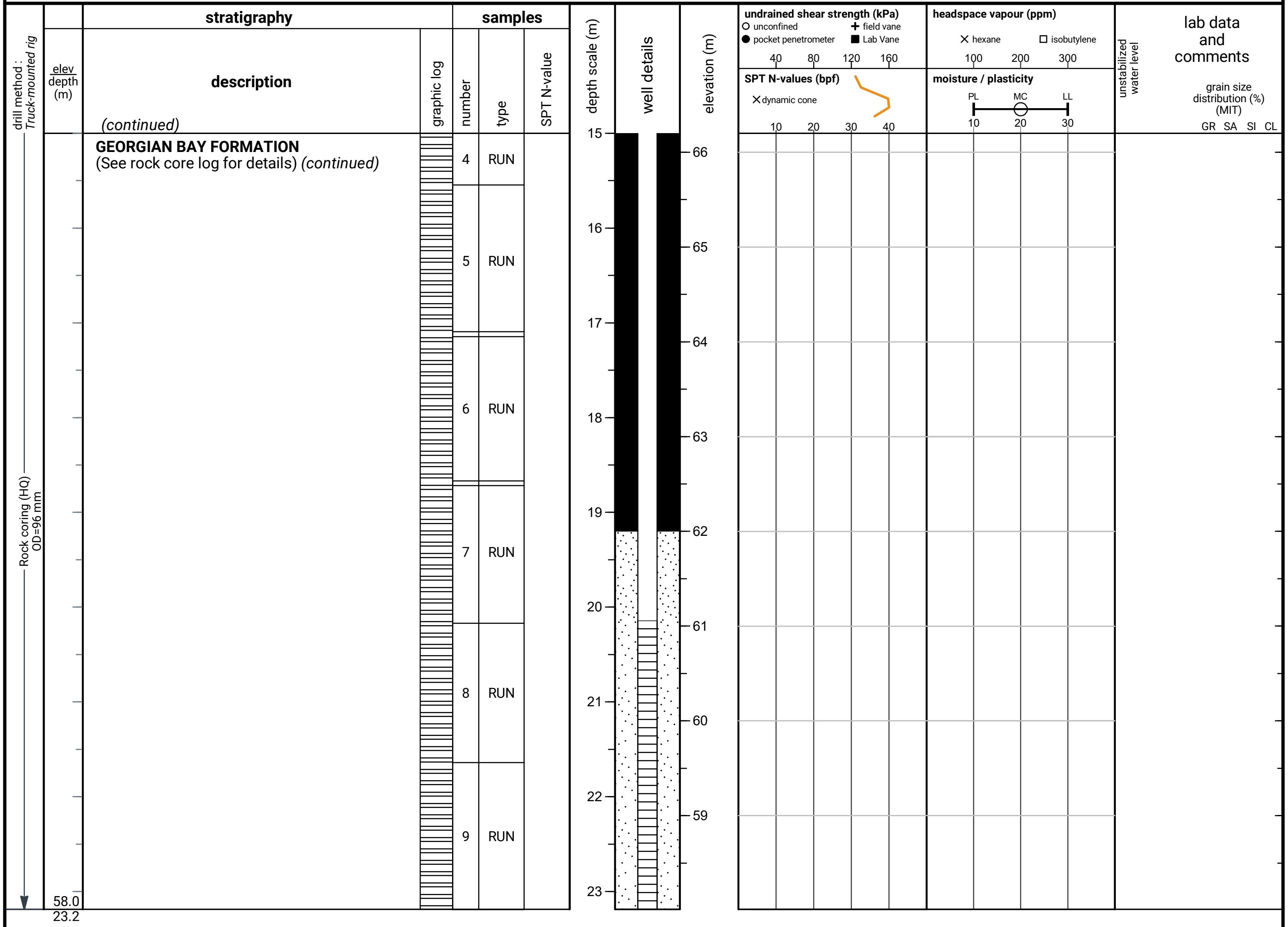
Tech : JN | **PM** : JW | **Rev** : MD

(continued next page)

Date Started : Jun 2, 2020
Position : E: 614179, N: 4823383 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 1

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited



GEORGIAN BAY FORMATION
(See rock core log for details) *(continued)*

number	type
4	RUN
5	RUN
6	RUN
7	RUN
8	RUN
9	RUN

58.0
23.2

END OF BOREHOLE

Filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2020	4.8	76.4
Jun 10, 2020	7.7	73.5
Jun 12, 2020	12.7	68.5
Jun 18, 2020	12.7	68.5
Jul 20, 2020	12.6	68.6

GROUNDED ENGINEERING

Date Started : Jun 2, 2020
Position : E: 614179, N: 4823383 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 1

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited

stratigraphy

Rock coring started at 10.2m below grade

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded, weak; joints are horizontal, gapped to open;

interbedded with **limestone**, light grey, thinly bedded, medium strong

Overall shale: 90%, limestone: 10%

Run 1 : 12% limestone
88% shale

Run 2 : 6% limestone
94% shale

Run 3 : 5% limestone
95% shale

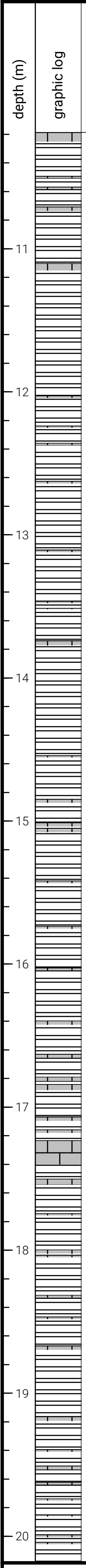
Run 4 : 7% limestone
93% shale

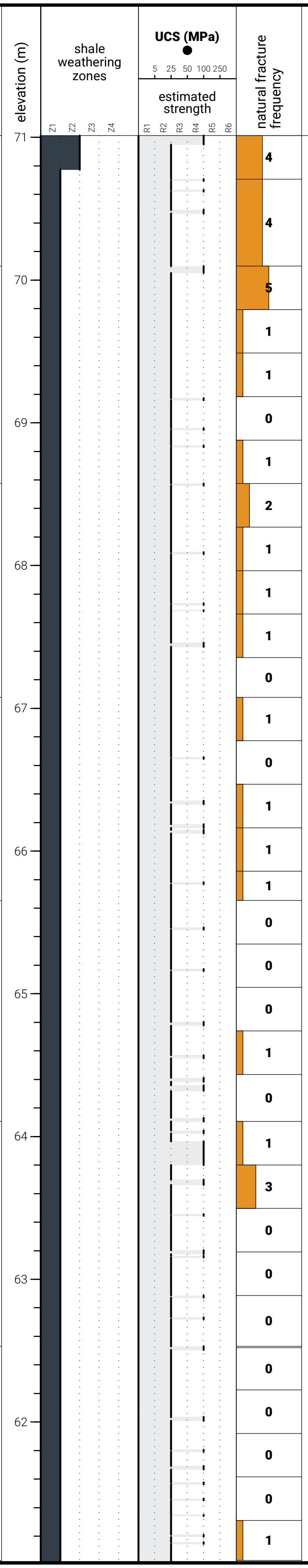
Run 5 : 11% limestone
89% shale

Run 6 : 19% limestone
81% shale

Run 7 : 10% limestone
90% shale

Run	elev depth (m)	recovery
R1	71.0 10.2 70.1	TCR = **58%** SCR = **42%** RQD = **11%**
R2	11.1 68.6	TCR = **95%** SCR = **90%** RQD = **80%**
R3	12.6 67.1	TCR = **100%** SCR = **92%** RQD = **92%**
R4	14.1 65.7	TCR = **100%** SCR = **95%** RQD = **92%**
R5	15.5 64.1	TCR = **100%** SCR = **100%** RQD = **100%**
R6	17.1 62.5	TCR = **100%** SCR = **98%** RQD = **93%**
R7	18.7 61.0	TCR = **100%** SCR = **100%** RQD = **100%**





laboratory testing

notes and comments

10.4 / 70.8m: Transition to sound bedrock

10.7 / 70.5m: 15" lost core at the end of the run

elevation (m)
70
69
68
67
66
65
64
63
62

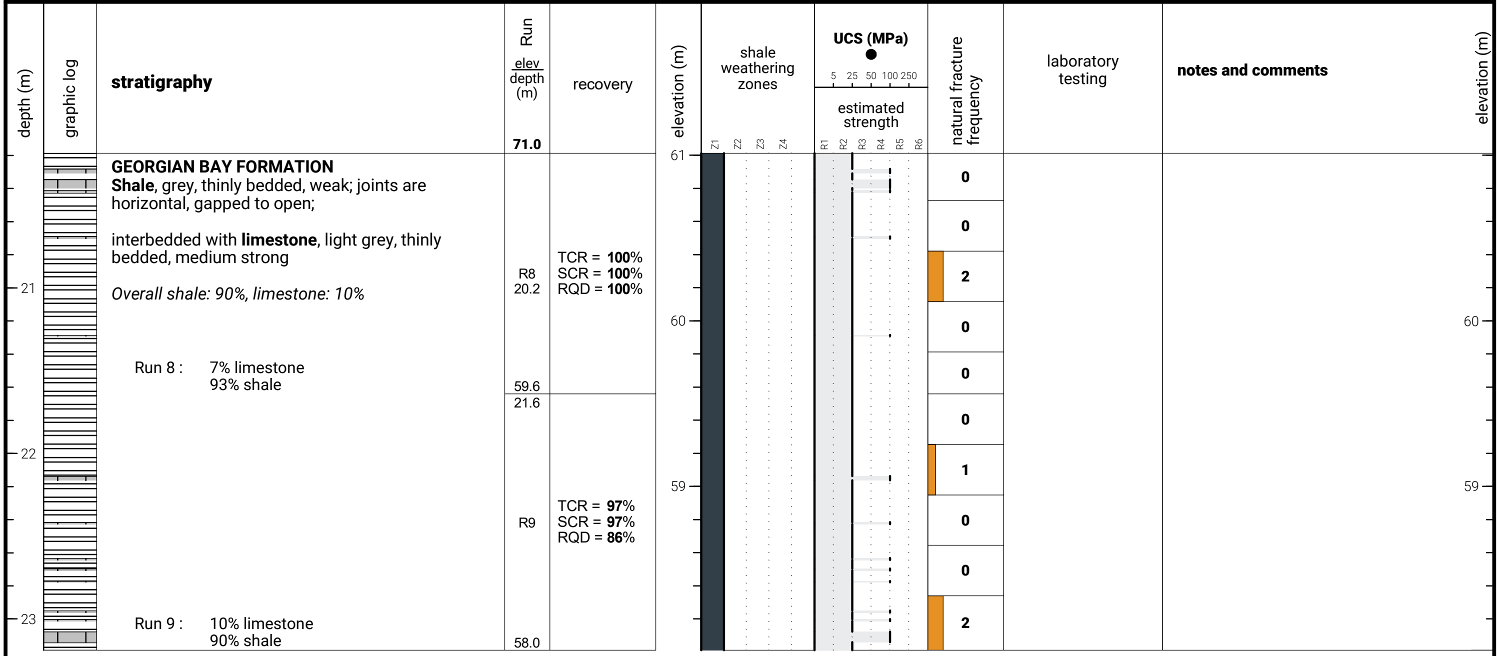
file: 20-088.gpj

Page 1 of 2 *(continued next page)* **Tech** : JN | **PM** : JW | **Rev** : MD

Date Started : Jun 2, 2020
Position : E: 614179, N: 4823383 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 1

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited



GEORGIAN BAY FORMATION
Shale, grey, thinly bedded, weak; joints are horizontal, gapped to open;

interbedded with **limestone**, light grey, thinly bedded, medium strong

Overall shale: 90%, limestone: 10%

Run 8 : 7% limestone
93% shale

R8
20.2
59.6

TCR = **100%**
SCR = **100%**
RQD = **100%**

21.6
R9
58.0

TCR = **97%**
SCR = **97%**
RQD = **86%**

Run 9 : 10% limestone
90% shale

23.2m

END OF COREHOLE

file: 20-088.gpj

Tech : JN | **PM** : JW | **Rev** : MD

Date Started : Jun 2, 2020
Position : E: 614147, N: 4823384 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 2

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited

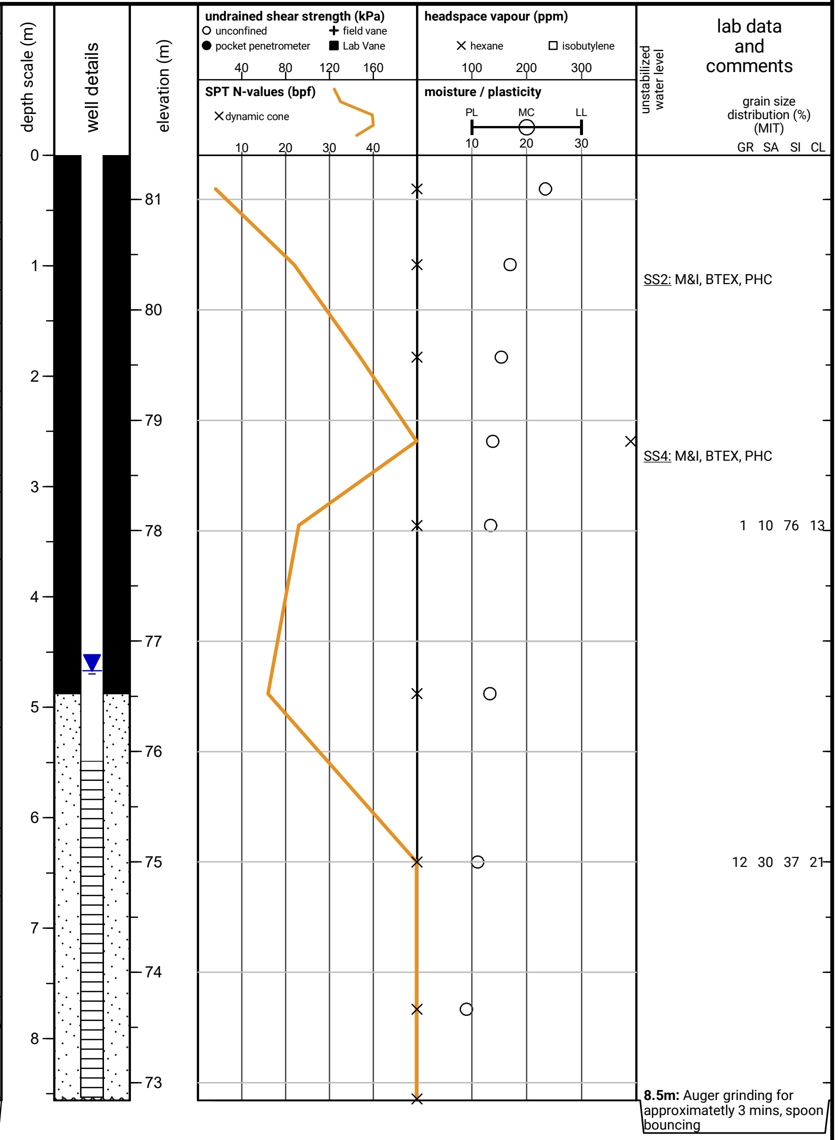
drill method : *Mini Mole* — solid stem augers OD=150 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
81.4	**GROUND SURFACE**				
	100mm **TOPSOIL**				
	FILL, silty sand, trace gravel, trace rootlets, organic odour, very loose, dark brown, moist		1	SS	4
80.6 0.8	**FILL**, silty sand, trace slag, compact, dark brown, moist		2	SS	22
80.3 1.1	**SILT**, some sand, trace clay, compact, orangey brown, moist ...at 1.5 m, dense		3	SS	37
	...at 2.3 m, some clay, very dense		4	SS	53
	...at 3.0 m, grey compact		5	SS	23
76.8 4.6	**SILTY CLAY**, some gravel, trace sand, very stiff, grey, moist to wet (GLACIAL TILL)		6	SS	16
75.3 6.1	**SANDY SILT**, some clay, some gravel, very dense, grey, moist (GLACIAL TILL)		7	SS	54
			8	SS	50 / 75mm
72.9 72.8 8.6	**INFERRED BEDROCK**		9	SS	50 / 25mm

END OF BOREHOLE
Auger refusal

Dry and open upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen



SS2: M&I, BTEX, PHC

SS4: M&I, BTEX, PHC

1 10 76 13

12 30 37 21

8.5m: Auger grinding for approximately 3 mins, spoon bouncing

GROUNDWATER LEVELS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2020	5.0	76.5
Jun 10, 2020	5.0	76.5
Jun 12, 2020	4.9	76.5
Jun 18, 2020	4.9	76.5
Jul 20, 2020	4.7	76.7

Date Started : May 25, 2020
Position : E: 614142, N: 4823408 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 3

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited

drill method : *Mini Mole* — solid stem augers OD=150 mm

stratigraphy

elev depth (m)	description
83.5	**GROUND SURFACE**
	100mm **TOPSOIL**
	FILL, silty sand, trace gravel, trace rootlets, organic odour, loose, dark brown, moist
82.7 0.8	**SILT and SAND**, trace clay, trace rootlets, compact, orangey brown, moist
	...at 1.5 m, very dense
	...at 3.0 m, greyish brown
	...at 4.6 m, grey
75.9 7.6	**SANDY SILT**, some clay, some gravel, very dense, grey, moist (GLACIAL TILL)
73.1 73.1 10.4	**INFERRED BEDROCK**, shale and limestone fragment, grey

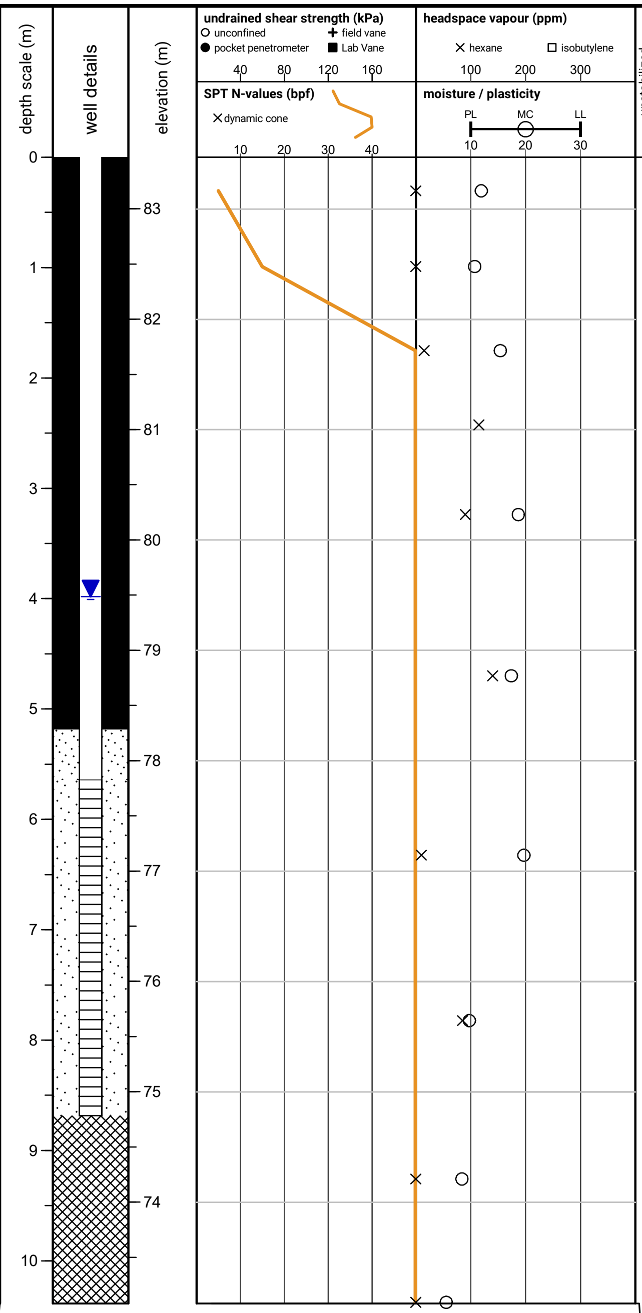
END OF BOREHOLE
Auger refusal

Unstabilized water level measured at 6.1 m below ground surface; caved to 8.7 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

samples

number	type	SPT N-value	lab data and comments	grain size distribution (%) (MIT) GR SA SI CL
1	SS	5		
2	SS	15		
3	SS	69		
4	SS	50 / 125mm	SS4: M&I, BTEX, PHC	
5	SS	98 / 225mm		0 57 43 0
6	SS	50 / 100mm	SS6: M&I, BTEX, PHC	
7	SS	83		
8	SS	84 / 250mm		
9	SS	50 / 75mm		
10	SS	50 / 25mm		



unstabilized water level ∇ (at 6.1 m)

10.4m: Auger grinding for approximately 5 mins, spoon bouncing, bedrock confirmation spoon filled with caving sands, unable to extract 2nd bedrock sample

GROUNDWATER LEVELS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2020	3.3	80.2
Jun 10, 2020	3.7	79.7
Jun 12, 2020	4.0	79.4
Jun 18, 2020	3.7	79.8
Jul 20, 2020	4.0	79.5

file: 20-088.gpj

GROUNDED ENGINEERING

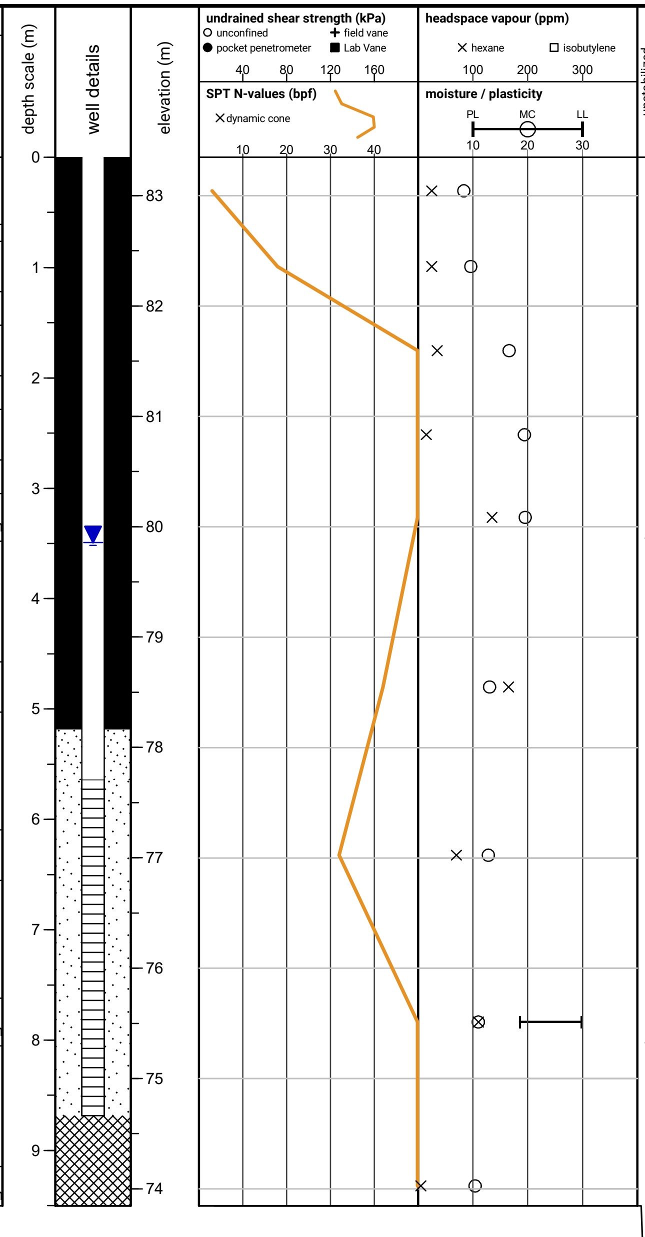
Date Started : May 25, 2020
Position : E: 614160, N: 4823412 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 4

File No. : 20-088 **Project** : 23 Elizabeth Street North, Mississauga **Client** : Edenshaw Elizabeth Developments Limited

drill method : *Mini Mole* — solid stem augers OD=150 mm

elev depth (m)	description	number	type	SPT N-value	lab data and comments (grain size distribution (%) (MIT) GR SA SI CL)
83.3	**GROUND SURFACE**				
	100mm **TOPSOIL**				
	FILL, silty sand, trace gravel, trace rootlets, very loose, orangey brown, moist	1	SS	3	
82.5 0.8	**SILT and SAND**, trace clay, trace rootlets, compact, orangey brown, moist	2	SS	18	
	...at 1.5 m, silty sand, greyish brown, very dense	3	SS	55	
		4	SS	63	
		5	SS	80 / 275mm	0 63 36 1 SS5: M&I, BTEX, PHC
	...at 4.6 m, grey	6	SS	42	
77.2 6.1	**SILTY CLAY**, some sand, trace gravel, hard, grey, moist (GLACIAL TILL)	7	SS	32	
75.7 7.6	**SILTY SAND**, some clay, some gravel, very dense, grey, moist (GLACIAL TILL)	8	SS	88 / 275mm	15 36 33 16 SS8: M&I, BTEX, PHC
74.2 9.1	**INFERRED BEDROCK**, shale and limestone fragment, grey	9	SS	89 / 200mm	
73.8 9.5					



9.4m: Auger grinding for approximately 5 mins
9.5m: Spoon refusal, bedrock confirmation spoon filled with caving sands, unable to extract 2nd bedrock sample

END OF BOREHOLE
Auger refusal

Unstabilized water level measured at 4.6 m below ground surface; caved to 8.7 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

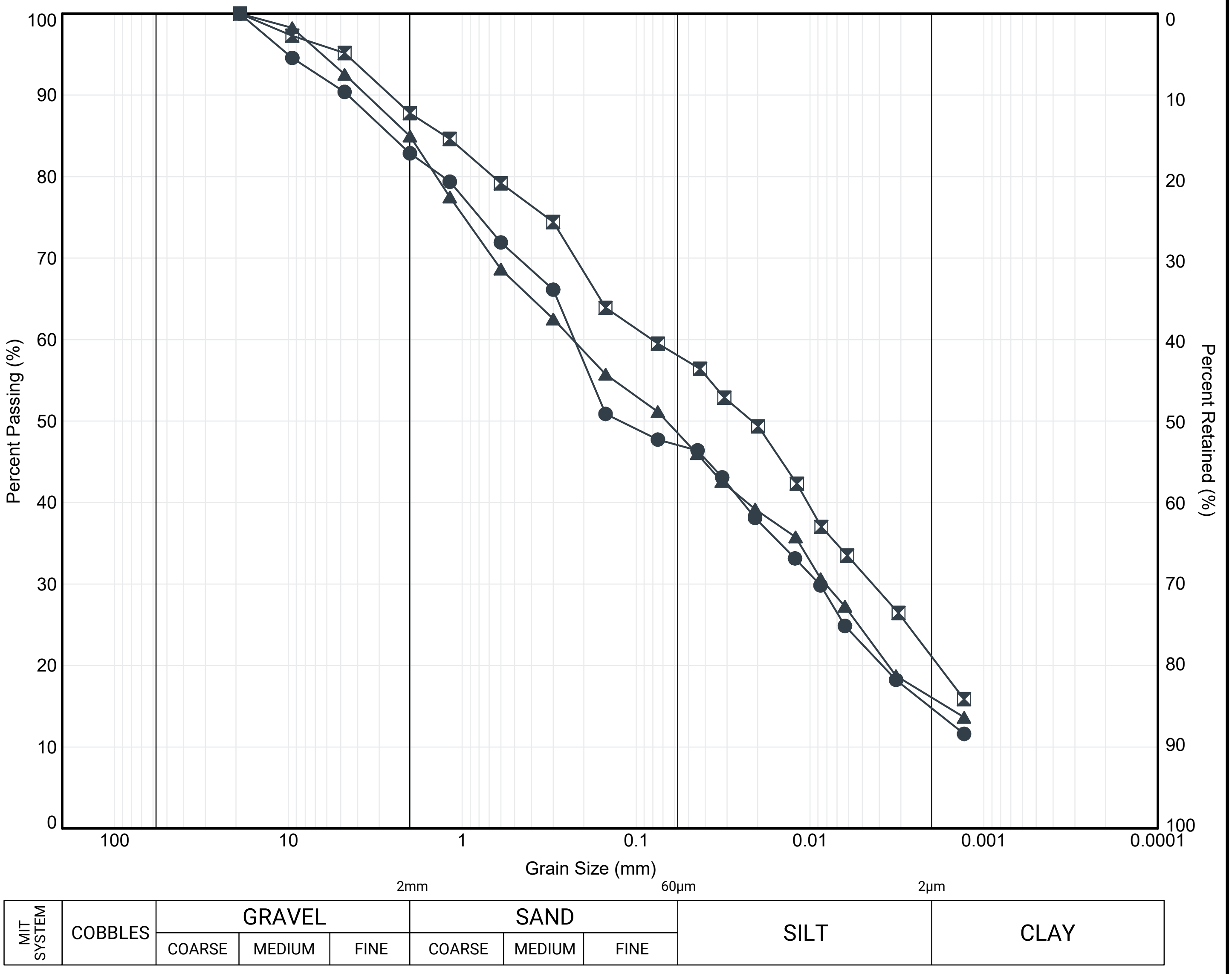
GROUNDWATER LEVELS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2020	2.9	80.5
Jun 10, 2020	2.9	80.4
Jun 12, 2020	3.0	80.4
Jun 18, 2020	3.0	80.3
Jul 20, 2020	3.5	79.9

file: 20-088.gpj

Tech : JN | **PM** : JW | **Rev** : MD

APPENDIX B



					MIT SYSTEM			
	Borehole	**Sample**	**Depth (m)**	**Elev. (m)**	**Gravel (%)**	**Sand (%)**	**Silt (%)**	**Clay (%)**
●	**1**	SS6	4.9	76.3	17	36	32	15
☒	**2**	SS7	6.4	75.0	12	30	37	21
▲	**4**	SS8	7.8	75.5	15	36	33	16

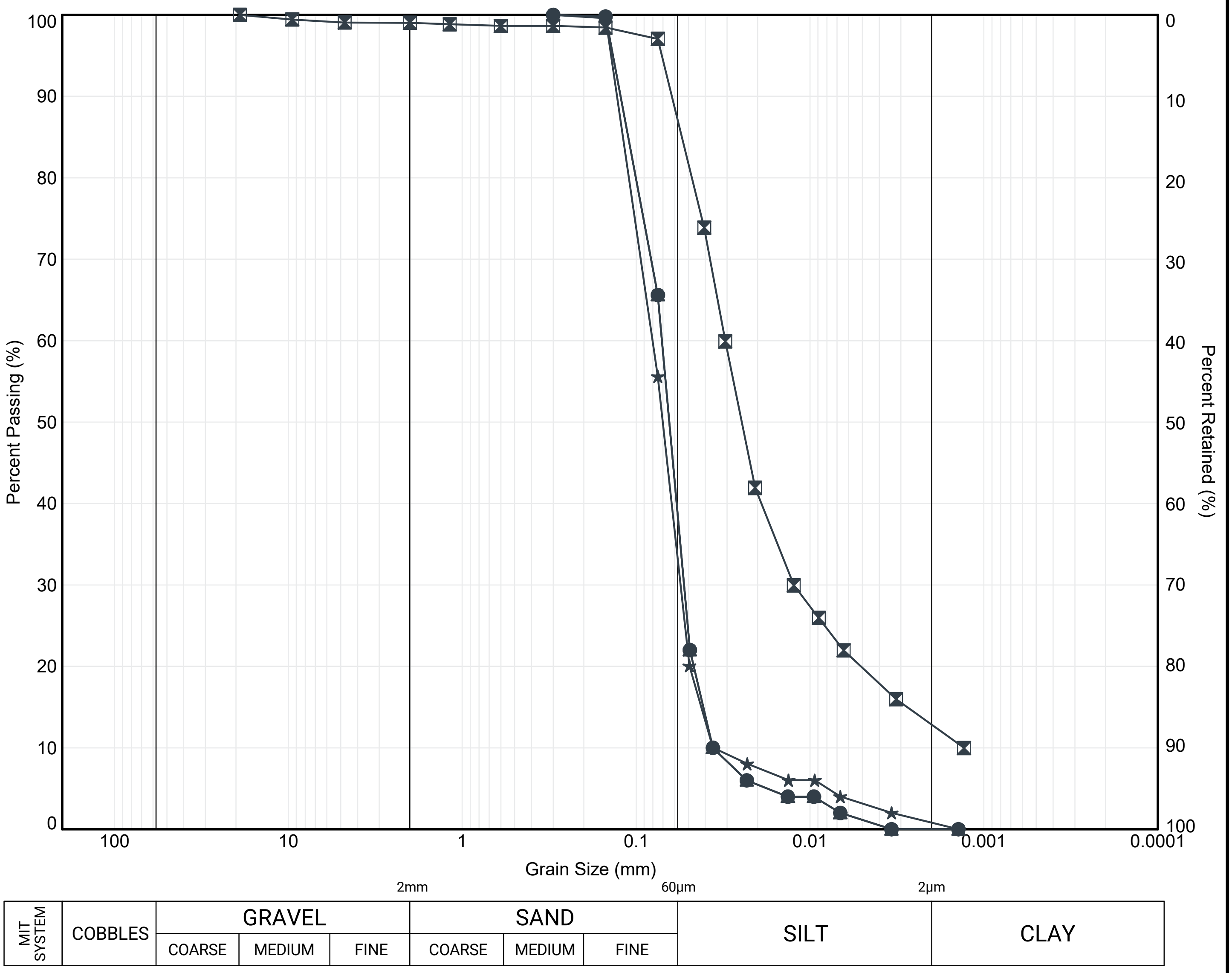
GROUNDED ENGINEERING

Title:

GRAIN SIZE DISTRIBUTION
SILT TILL

File No.:

20-088

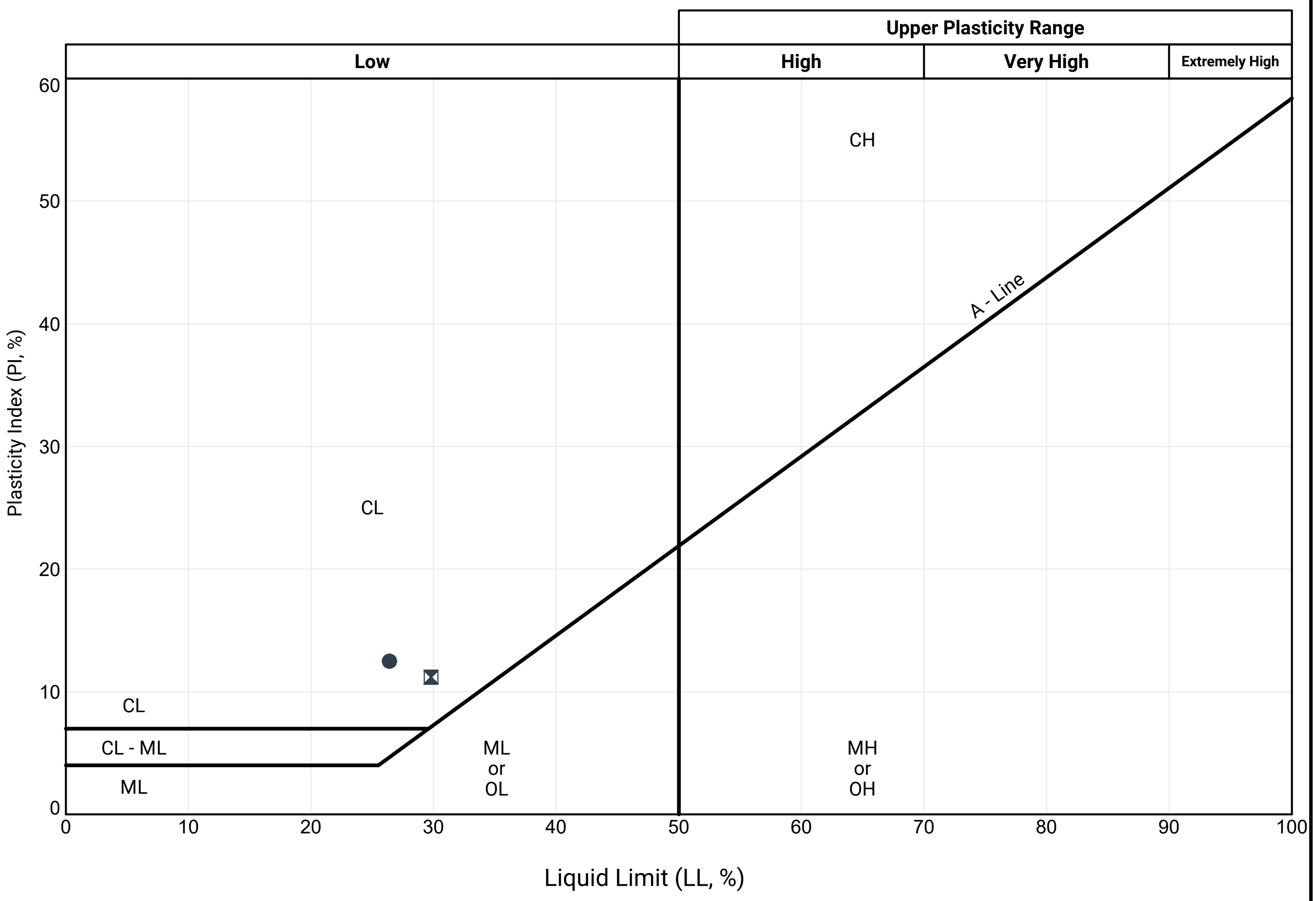


					MIT SYSTEM			
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**1**	SS4	2.6	78.6	0	57	43	0
☒	**2**	SS5	3.4	78.0	1	10	76	13
▲	**3**	SS5	3.2	80.2	0	57	43	0
★	**4**	SS5	3.3	80.1	0	63	36	1

Title:

GRAIN SIZE DISTRIBUTION
SILT AND SAND

File No.: **20-088**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	1	SS6	4.9	76.3	26	14	12
☒	4	SS8	7.8	75.5	30	19	11

GROUNDED ENGINEERING

Title:

ATTERBERG LIMITS CHART

File No.: **20-088**

APPENDIX C

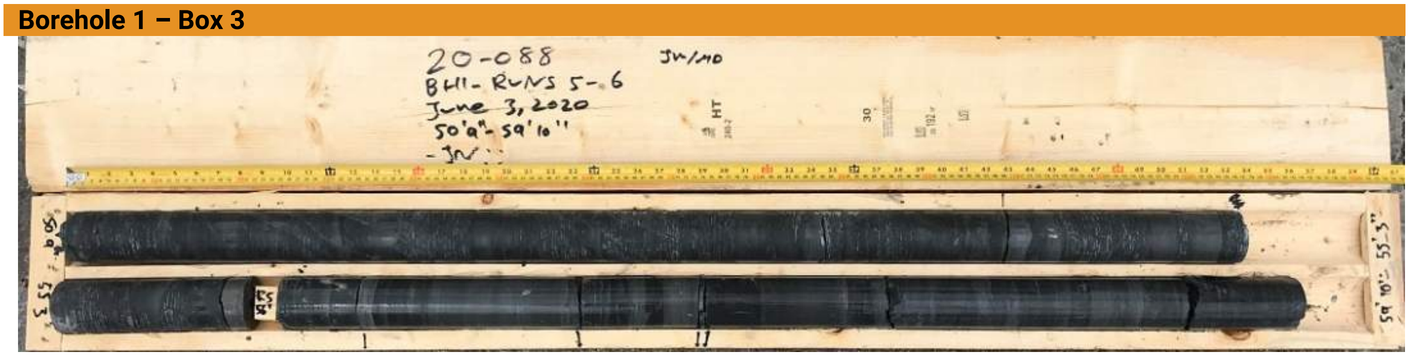
Borehole 1 – Box 1

Depth: 10.2 to 12.6 m below grade (Elev. 71 to 68.6 m)

Borehole 1 – Box 2

Depth: 12.6 to 15.5 m below grade (Elev. 68.6 to 65.7 m)

Borehole 1 – Box 3



Depth: 15.5 to 18.2 m below grade (Elev. 65.7 to 63 m)

Borehole 1 – Box 4

Depth: 18.2 to 20.9 m below grade (Elev. 63 to 60.3 m)

Borehole 1 – Box 5

Depth: 20.9 to 23.2 m below grade (Elev. 60.3 to 58 m)

APPENDIX D

FINAL REPORT

CA14916-MAY20 R1

20-088

Prepared for

Grounded Engineering Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Grounded Engineering Inc.
Address	12 Banigan Drive Toronto, Ontario M4H1E9, Canada
Contact	Jessie Wu
Telephone	647-264-7909
Facsimile	
Email	jwu@groundedeng.ca
Project	20-088
Order Number	
Samples	Soil (2)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA14916-MAY20
Received	05/26/2020
Approved	06/02/2020
Report Number	CA14916-MAY20 R1
Date Reported	06/02/2020

COMMENTS

Temperature of Sample upon Receipt: 5 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:012651

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

PACKAGE: - **Corrosivity Index** (SOIL)

Sample Number	5	6
Sample Name	BH3-SS7	BH4-SS3
Sample Matrix	Soil	Soil
Sample Date	25/05/2020	25/05/2020

Corrosivity Index

Parameter	Units	RL		Result	Result
Corrosivity Index	none	1		4	4
Soil Redox Potential	mV	-		305	243
Sulphide	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		8.82	8.53
Resistivity (calculated)	ohms.cm	-9999		7300	4520

PACKAGE: - **General Chemistry** (SOIL)

Sample Number	5	6
Sample Name	BH3-SS7	BH4-SS3
Sample Matrix	Soil	Soil
Sample Date	25/05/2020	25/05/2020

General Chemistry

Parameter	Units	RL		Result	Result
Conductivity	uS/cm	2		137	221

PACKAGE: - **Metals and Inorganics** (SOIL)

Sample Number	5	6
Sample Name	BH3-SS7	BH4-SS3
Sample Matrix	Soil	Soil
Sample Date	25/05/2020	25/05/2020

Metals and Inorganics

Parameter	Units	RL		Result	Result
Moisture Content	%	0.1		15.9	15.5
Sulphate	µg/g	0.4		49	87

FINAL REPORT

Client: Grounded Engineering Inc.
Project: 20-088
Project Manager: Jessie Wu
Samplers: Jason Ngo

PACKAGE: **- Other (ORP)** (SOIL)

		Sample Number	5	6
		Sample Name	BH3-SS7	BH4-SS3
		Sample Matrix	Soil	Soil
		Sample Date	25/05/2020	25/05/2020
Parameter	**Units**	**RL**	**Result**	**Result**
Other (ORP)				
Chloride	µg/g	0.4	21	13

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0511-MAY20	µg/g	0.4	<0.4	ND	20	96	80	120	110	75	125
Sulphate	DIO0511-MAY20	µg/g	0.4	<0.4	ND	20	92	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0031-MAY20	%	0.04	< 0.04	ND	20	98	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0419-MAY20	uS/cm	2	< 0.002	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0419-MAY20	pH Units	0.05	NA	0		101			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 012651
Page 1 of 2

Laboratory Information Section - Lab use only

Received By: N.mymryk.
Received Date: 05 / 26 / 20 (mm/dd/yy)
Received Time: 14 : 00 (hr : min)
Received By (signature):
Custody Seal Present: Yes ☒ No ☐
Custody Seal Intact: Yes ☒ No ☐
Cooling Agent Present: Yes ☒ No ☐ Type: Ice Pack.
Temperature Upon Receipt (°C) 5 . 5 . 5
LAB LIMS #: CA-14916 MAY

REPORT INFORMATION

Company: Grounded Eng
Contact: Jessie Wu
Address: 12 Banigan Dr.
Toronto, ON M4H 1E9
Phone: 647-264-7909
Fax:
Email: jwu@groundedeng.ca

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

Quotation #:
P.O. #:
Project #: 20-088
Site Location/ID:

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture: ☒ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☒ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	M & I: Metals & Inorganics incl CrVI, CN,Hg pH,(B(HWS),EC,SAR-soil) (Cl, Na-water)	M & I: Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	M & I: ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni, Se,Ag,Tl,U,V,Zn	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs Total ☐ Aroclor ☐	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other (please specify)	Other	Other	Other	Soil Corrosivity Suite	Sewer Use: Specify pkg:	Water Characterization Pkg General ☐ Extended ☐	TCLP Specify TCLP tests ☐M&I ☐VOC ☐PCB ☐B(a)P ☐ABN ☐Ignit.	COMMENTS:
1	BH3-SS7	May 25, 20	7pm	1	S																	X				
2	BH4-SS3	↓	↓	↓	↓																	↓				
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										

Observations/Comments/Special Instructions

Sampled By (NAME): Jason Ngo Signature: Date: May / 25 / 20 (mm/dd/yy) Pink Copy - Client
Relinquished by (NAME): Jason Ngo Signature: Date: May / 25 / 20 (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.2
Date of Issue: 09 Sept, 2019

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

FINAL REPORT

CA14779-JUN20 R1

20-088 23 Elizabeth St N, Mississauga

Prepared for

Grounded Engineering Inc.

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Grounded Engineering Inc.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	12 Banigan Drive Toronto, Ontario M4H1E9. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Jessie Wu	Telephone	705-652-2143
Telephone	647-264-7909	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	jwu@groundedeng.ca	SGS Reference	CA14779-JUN20
Project	20-088 23 Elizabeth St N, Mississauga	Received	06/03/2020
Order Number		Approved	06/09/2020
Samples	Soil (1)	Report Number	CA14779-JUN20 R1
		Date Reported	06/09/2020

COMMENTS

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:012655

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

PACKAGE: **- Corrosivity Index** (SOIL)

Sample Number 5
Sample Name BH1-SS6
Sample Matrix Soil
Sample Date 02/06/2020

Parameter	Units	RL		Result
Corrosivity Index				
Corrosivity Index	none	1		8
Soil Redox Potential	mV	-		150
Sulphide	%	0.04		0.34
pH	pH Units	0.05		9.05
Resistivity (calculated)	ohms.cm	-9999		8400

PACKAGE: **- General Chemistry** (SOIL)

Sample Number 5
Sample Name BH1-SS6
Sample Matrix Soil
Sample Date 02/06/2020

Parameter	Units	RL		Result
General Chemistry				
Conductivity	uS/cm	2		119

PACKAGE: **- Metals and Inorganics** (SOIL)

Sample Number 5
Sample Name BH1-SS6
Sample Matrix Soil
Sample Date 02/06/2020

Parameter	Units	RL		Result
Metals and Inorganics				
Moisture Content	%	0.1		11.0
Sulphate	µg/g	0.4		53

PACKAGE: **- Other (ORP)** (SOIL)

Sample Number	5
Sample Name	BH1-SS6
Sample Matrix	Soil
Sample Date	02/06/2020

Parameter	**Units**	**RL**		**Result**
Other (ORP)				
Chloride	µg/g	0.4		6.2

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0136-JUN20	µg/g	0.4	<0.4	10	20	96	80	120	99	75	125
Sulphate	DIO0136-JUN20	µg/g	0.4	<0.4	8	20	93	80	120	98	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0013-JUN20	%	0.04	< 0.04	7	20	113	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0112-JUN20	uS/cm	2	< 2	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0112-JUN20	pH Units	0.05	NA	0		101			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 012655

Page 2 of 2

Laboratory Information Section - Lab use only

Received By: Oleg Mozhiv
Received Date: 6 / 3 / 20 (mm/dd/yy)
Received Time: 13 : 20 (hr : min)

Received By (signature):
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☑ No ☐

Cooling Agent Present: Yes ☑ No ☐ Type: ice
Temperature Upon Receipt (°C) 7. 7. 7

LAB LIMS #: CA14779-Jun20

REPORT INFORMATION

Company: Grounded Engineering
Contact: Jessie Wu
Address: 12 Banigan Dr.
Toronto, ON M4H 1E9
Phone: 647-264-7909
Fax:
Email: jwu@groundedeng.ca

INVOICE INFORMATION

☒ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

Quotation #:
P.O. #:
Project #: 20-058
Site Location/ID: 23 Elizabeth St. N. Mississauga

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium
☐ Table ____ ☐ Fine

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

						M & I				SVOC		PCB	PHC		VOC		Pest	Other (please specify)							TCLP	COMMENTS:
	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics incl CrVI, CN,Hg pH,(B(HWS),EC,SAR-soil) (Cl, Na-water)	Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni, Se,Ag,Tl,U,V,Zn	PAHs only	SVOCs all incl PAHs, ABNs, CPs	PCBs Total ☐ Aroclor ☐	F1-F4 + BTEX	F1-F4 only no BTEX	VOCs all incl BTEX	BTEX only	Pesticides Organochlorine or specify other					Soil Corrosivity Suite	Sewer Use: Specify pkg:	Water Characterization Pkg General ☐ Extended ☐	Specify TCLP tests ☐M&I ☐VOC ☐PCB ☐B(a)P ☐ABN ☐Ignit.	
1	BH1-SS6	Jn 2,20	4pm	1	S																	X				
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										

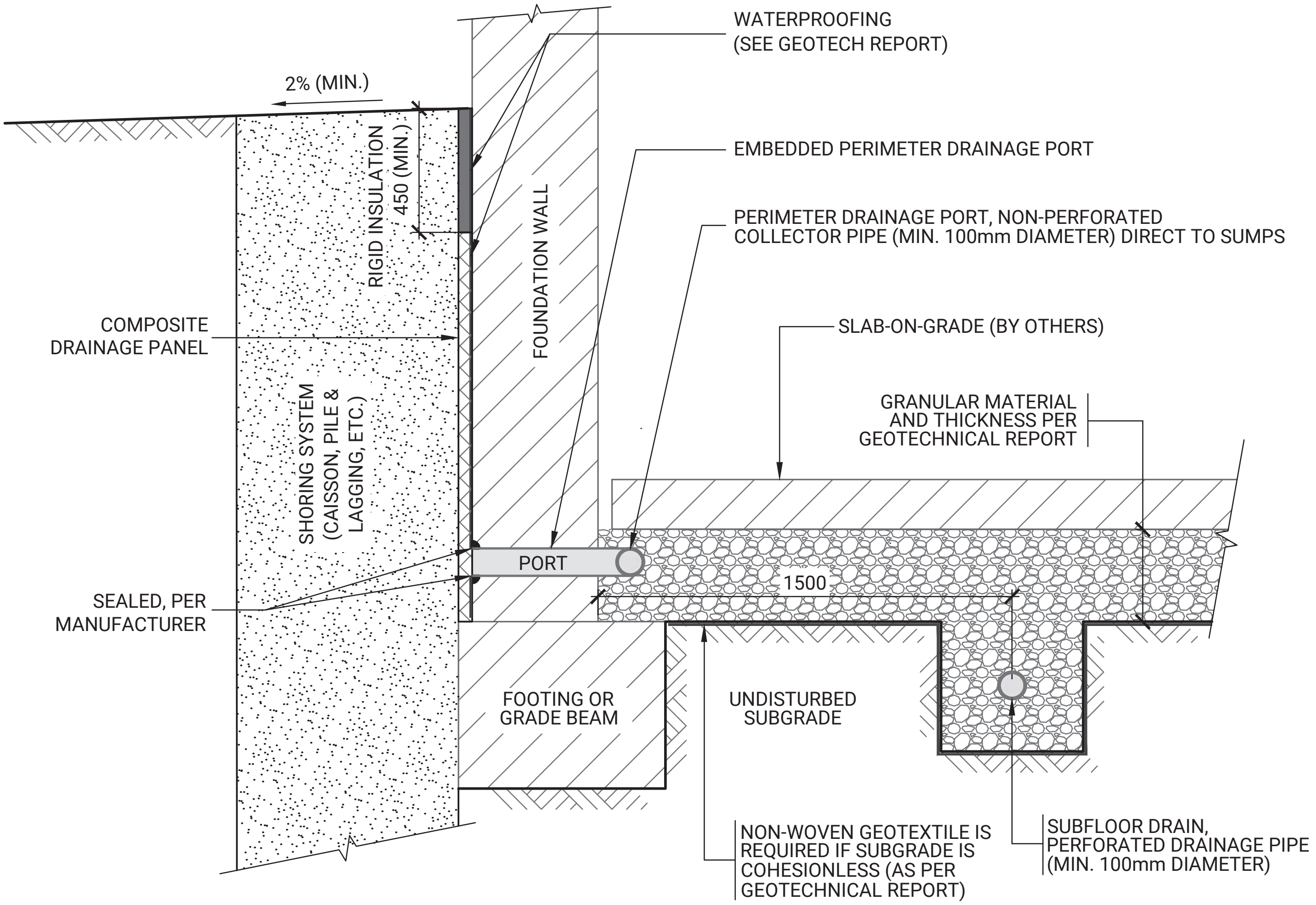
Observations/Comments/Special Instructions

Sampled By (NAME): Jason Ngo
Relinquished by (NAME): Jason Ngo Signature: Date: Jn / 2 / 20 (mm/dd/yy) Pink Copy - Client
Signature: Date: Jn / 2 / 20 (mm/dd/yy) Yellow & White Copy - SGS

Version #: 1.2
Issue: 09 Sept, 2019

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at [illegible] com/terms and conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

APPENDIX E



SUBFLOOR DRAINAGE SYSTEM

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

PERIMETER DRAINAGE SYSTEM

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

GENERAL NOTES

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

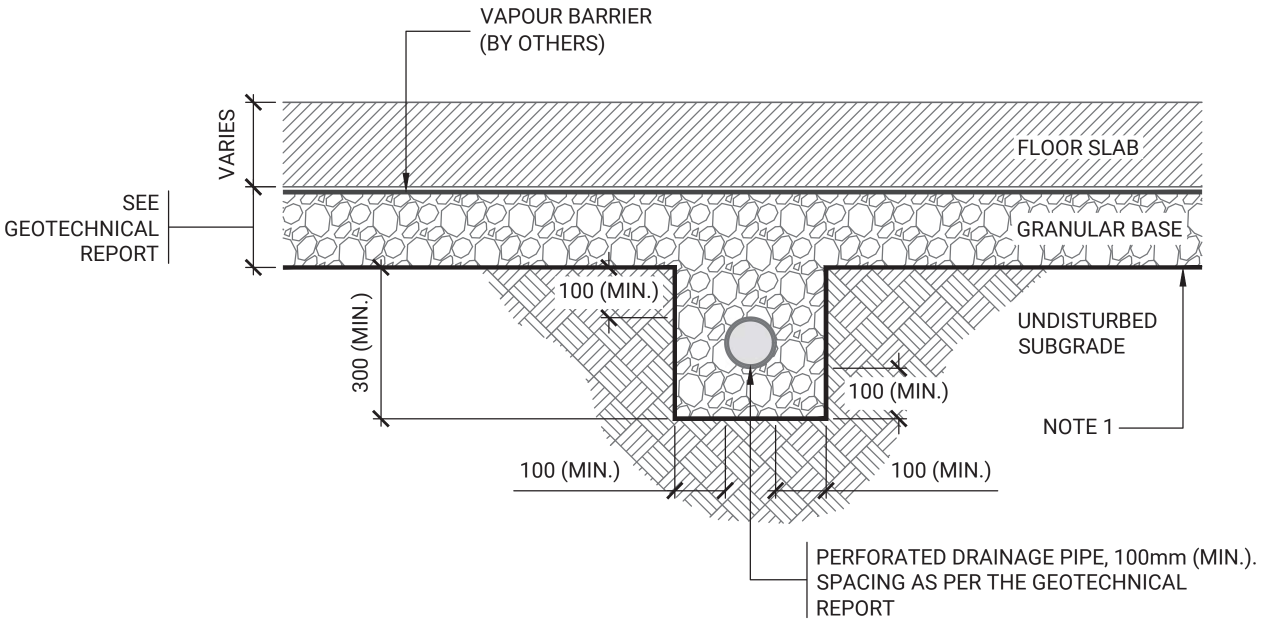
THE DRAWING PROVIDED IS NOT TO SCALE

Plot: 04Feb2020-9:13am

GROUNDED
ENGINEERING

Title

BASEMENT DRAINAGE SHORING SYSTEM
TYPICAL DETAILS



NOTES

1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (TERRAFIX 360R OR APPROVED EQUIVALENT).
2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

THE DRAWING PROVIDED IS NOT TO SCALE

Plot: 04Feb2020-9:52am

GROUNDED
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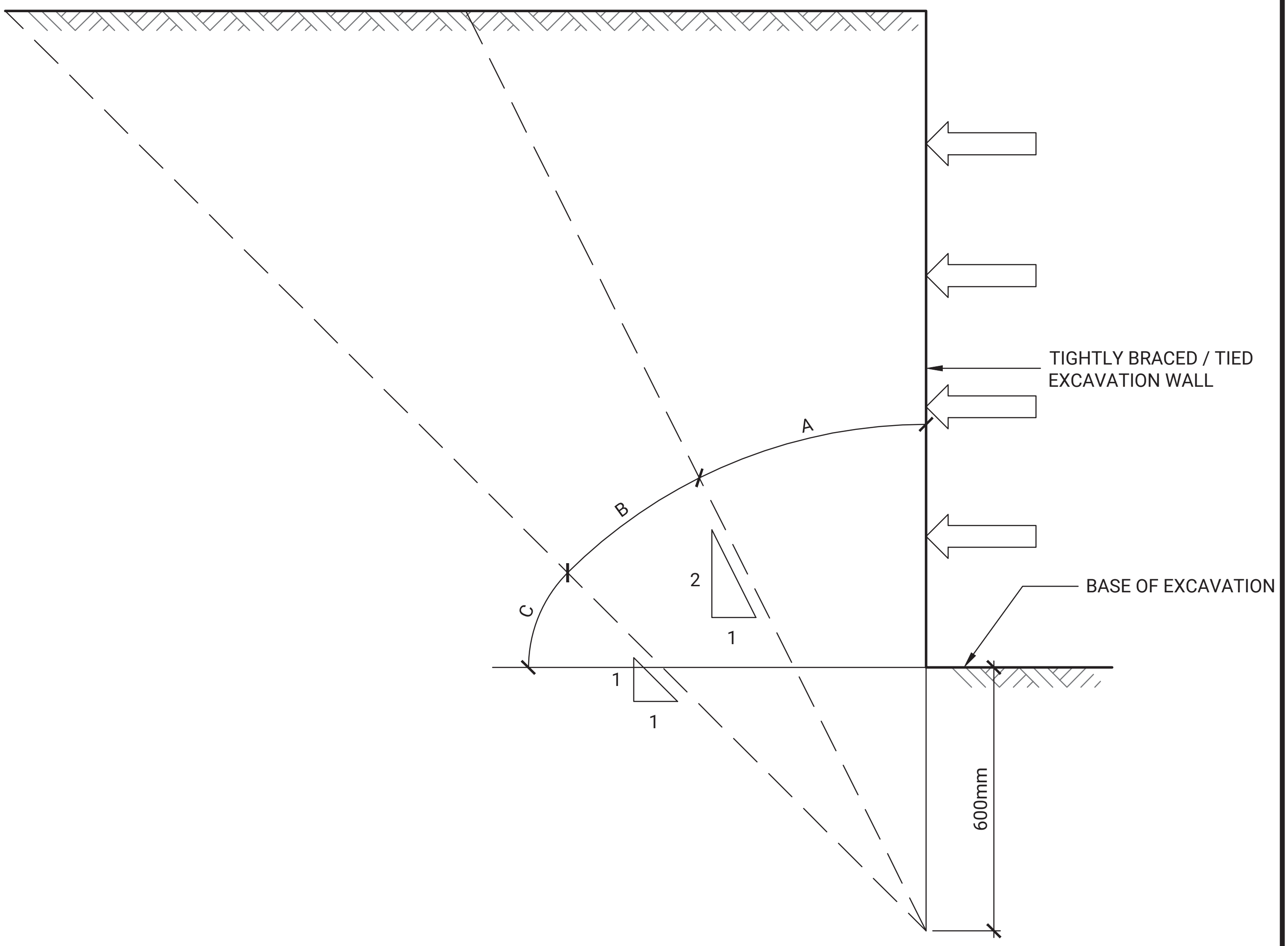
Title

BASEMENT SUBDRAIN TYPICAL DETAIL

APPENDIX F



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

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

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

NOTES

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

THE DRAWING PROVIDED IS NOT TO SCALE

Plot: 03Feb2020-1:07pm

GROUNDED
ENGINEERING

Title

GUIDELINES FOR UNDERPINNING SOILS