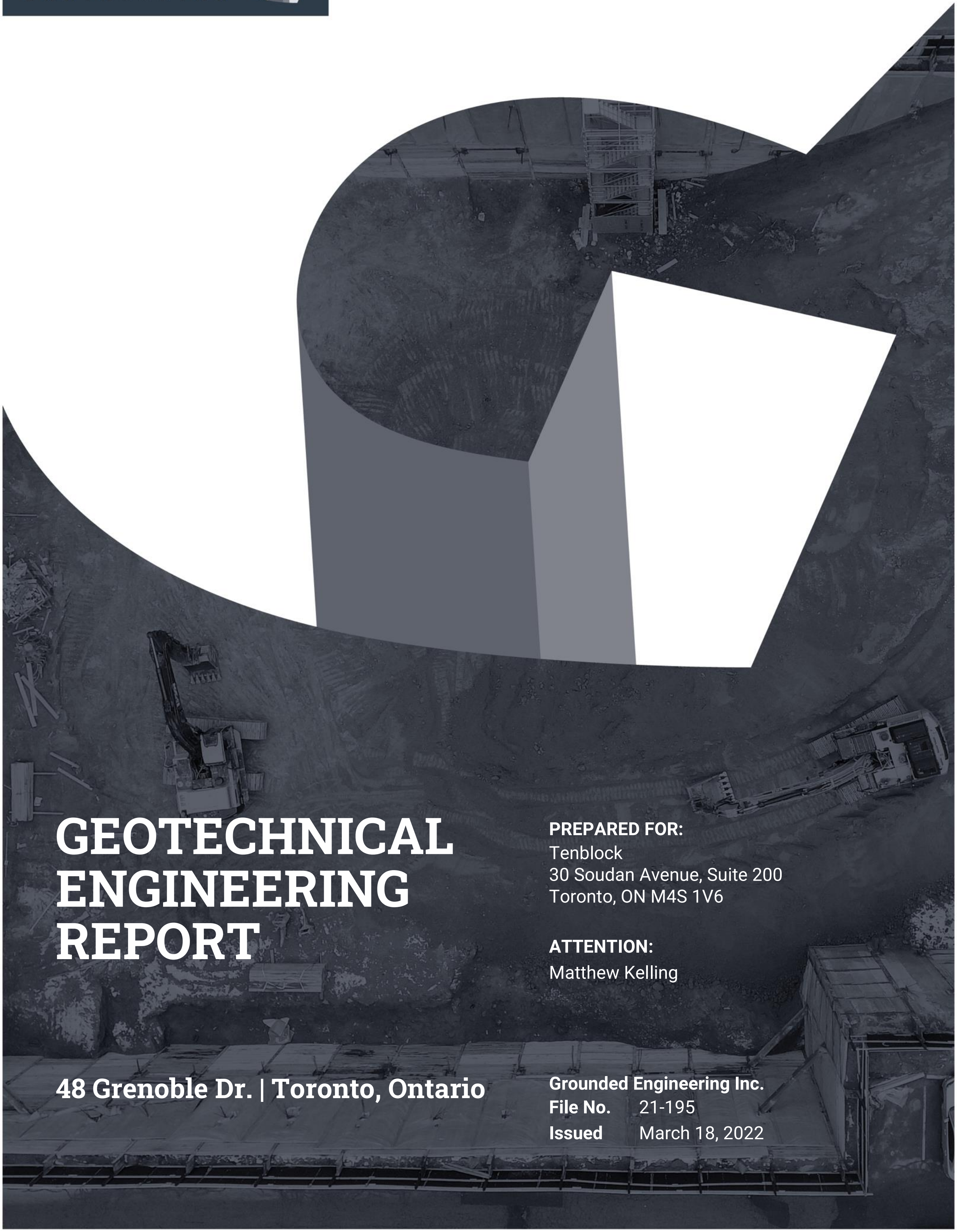

GEOTECHNICAL ENGINEERING REPORT

PREPARED FOR:
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Grounded Engineering Inc.
File No. 21-195
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APPENDICES

1 Introduction

Tenblock has retained Grounded Engineering Inc. ("Grounded") to provide geotechnical engineering design advice for their proposed development at 48 Grenoble Dr., in Toronto, Ontario.

The proposed project includes demolishing the existing structure and constructing two high-rise towers with associated low-rise podium structures. There are four underground parking levels proposed for the development, set at a lowest (P4) Finished Floor Elevation (FFE) of 114.0± m.

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

- Site survey, prepared by R. AVIS Surveying Inc, Project No. 3487-0 (August 5, 2021).
- Architectural drawings, "48 Grenoble Drive, Toronto, Ontario"; Project No 211033, March 18, 2022 (Issued for ZBA1 and SPA1), prepared by Diamond Schmitt.

Grounded's subsurface investigation of the site to date includes twelve (12) boreholes (Boreholes 1 to 12) which were advanced from January 21st to February 11th, 2022. Boreholes 10 to 12 were advanced as hand-augered boreholes within the parkland conveyance, and are relevant to the environmental engineering for this project.

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, basement drainage, and pavement design. Construction considerations including excavation, groundwater control, and geostructural engineering 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.

Elevations are measured relative to geodetic datum (as established on the site survey). The horizontal coordinates are provided relative to the Universal Transverse Mercator (UTM) geographic coordinate system.

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

2.1 Soil Stratigraphy

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

A summary of the relevant stratigraphic units is provided as follows. The summary elevations are provided for general guidance only. Details are provided on the borehole logs and in the following subsections. In general, seven main stratigraphic units were encountered on site as follows:

1. earth fill, overlying
2. an “**upper sands**” unit extending down to about Elev. 120-122± m, overlying
3. an “**upper glacial till**” unit extending down to about Elev. 108-114± m, overlying
4. a “**silts and clays**” unit extending down to about Elev. 101± m, overlying
5. a “**sands”** unit extending down to about Elev. 91-93± m, overlying
6. a “**lower glacial till”** extending down to about Elev. 86± m, overlying
7. **bedrock** of the Georgian Bay Formation.

There is groundwater within the upper glacial tills at about Elev. 117.0± m, and infiltrated stormwater within the earth fill and upper sands.

Boreholes 10 to 12 were advanced as hand-augered boreholes within the parkland conveyance, and are relevant to the environmental engineering for this project.

2.1.1 Surficial and Earth Fill

Boreholes 1 to 3 and 6 to 9 encountered an asphalt pavement structure overlying a 50 to 100 mm thick aggregate layer. Boreholes 4, 5 and 10 to 12 encountered 75 to 150 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 3.0 metres below grade (Elev. 125.4 to 124.4 metres). The earth fill varies in composition but generally consists of sandy silt to silty sand, with trace clay and trace gravel. It contains construction debris, cinders, rock fragments, and organics. 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 compact.

Boreholes 10 to 12 reached target investigation depth within the earth fill.

2.1.2 Upper Sands

Underlying the fill materials, Boreholes 1 to 9 encounter an undisturbed native deposit of cohesionless sands and gravels with trace silt and trace clay (the “upper sands” unit). The gravel content varies from some gravel to gravelly. This unit was encountered at 0.8 to 3.0 metres below grade (Elev. 125.4 to 124.4 ±m) and extends down to depths of 4.6 to 7.6 metres below grade (Elev. 122.8 to 119.9± m).

The upper sands unit is generally brown and moist to wet. The base of this unit frequently contains infiltrated stormwater and is described as wet. Standard Penetration Test (SPT) results (N-Values) measured in the earth fill range from 12 to 34 blows per 300 mm of penetration (“bpf”), indicating a relative density ranging from compact to dense.

2.1.3 Upper Glacial Till

Underlying the upper sands unit, Boreholes 1 to 9 encounter an undisturbed native glacial till deposit with a variable matrix of sandy silt to clayey silt soils, with trace gravel. These soils are grouped together as the “**upper glacial till**” unit, which is typically cohesionless but also includes cohesive soils (e.g. Borehole 1). This unit was encountered at 4.6 to 7.6 metres below grade (Elev. 122.8 to 119.9± m) and extends down to depths of 13.7 to 19.8 metres below grade (Elev. 113.9 to 107.3 ±m).

The upper till is generally grey, and moist to wet. Silt partings were frequently observed within the cohesive soils. SPT N-values measured in this unit range from 13 to over 50 bpf.

2.1.4 Silts and Clays

Underlying the upper glacial till unit, Boreholes 1 to 9 encounter a deposit of silty clay to silt and clay. These soils are grouped together as the “**silts and clays**” unit. This unit was encountered at 13.7 to 19.8 metres below grade (Elev. 113.9 to 107.3 ±m). The base of this unit was observed in Boreholes 7, 8, and 9, at a depth of 25.9 metres below grade (Elev. 101.6 to 101.2 ±m).

The silts and clays unit is generally grey, and moist with occasional wet zones. SPT N-values measured in this unit range from 19 to over 50 bpf.

Boreholes 1 to 6 reached target investigation depth within this unit.

2.1.5 Lower Sands

Underlying the silts and clays unit, Boreholes 7 to 9 encounter an undisturbed native cohesionless deposit of sand to silty sand (the “**lower sands**” unit). This unit was encountered at 25.9 metres below grade (Elev. 101.6 to 101.2 ±m) and extends down to depths of 35.1 to 36.6 metres below grade (Elev. 92.4 to 90.8 ±m).

The lower sands unit is generally grey, and wet. SPT N-values measured in this unit were consistently over 50 bpf (very dense).

2.1.6 Lower Glacial Till

Underlying the lower sands unit, Boreholes 7 to 9 encounter an undisturbed native cohesionless glacial till deposit with a matrix of sandy silt (the "**lower till**" unit). It contains some gravel and some clay. This unit was encountered at 35.1 to 36.6 metres below grade (Elev. 92.4 to 90.8 ±m) and extends down to depths of 39.6 to 41.3 metres below grade (Elev. 87.9 to 86.1 ±m).

The lower glacial till is generally grey, and moist to wet. SPT N-values measured in this unit were over 50 bpf (very dense).

2.2 Bedrock

Inferred bedrock was observed in Boreholes 7, 8, and 9 underlying the lower glacial till at a depth of 39.6 metres below grade (Elev. 87.9 to 87.5 ±m). Bedrock was confirmed by rock cores recovered in Boreholes 7, 8 and 9, starting at 39.6 to 41.3 m depth (Elev. 86.0 to 87.8± m) down to depths of 42.9 to 46.1 m below grade (Elev. 81.2 to 84.2± m).

Boreholes 7 to 9 were terminated at target investigation depth in sound bedrock.

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, which comprises thin to medium bedded grey shale and limestone of Ordovician age. The fissile shale is interbedded with non-fissile calcareous shale, limestone, dolostone, and calcareous sandstone (conventionally grouped together as "limestone") which are typically laterally discontinuous. Per the appended terminology, the Georgian Bay shale is typically classified as "weak" whereas the limestone interbedding is classified as "medium strong to strong". The percentage of strong limestone beds in each run is reported on the rock core logs. The overall percentage of limestone found in Boreholes 7, 8, and 9 was 9%, 14% and 7%, respectively.

Joints occurring within the shale are closely to very closely spaced, 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

Rock core samples were submitted for testing of unconfined compressive strength (ASTM D7012) and elastic moduli in uniaxial compression (ASTM D7012). The detailed rock laboratory testing results are appended. The test results are summarized as follows:

Borehole ID	Core ID	Depth (m)	Bulk Density (kg/m^3)	UCS (MPa)	Young's Modulus, E (GPa)	Lithology
BH8	R3	42.5 to 42.8	2587	10.6*	Not measured	Shale
BH9	R3	43.8 to 44.2	2837	9.8*	Not measured	Shale

"" Delamination occurred during rock failure. Result is likely an underestimate.*

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 up to 0.8 metres thick.   Weathered and sound bedrock elevations are summarized as follows:

Borehole	**Ground Surface Elevation (m)**	**Partially Weathered (Zone II) Bedrock**		**Unweathered/Sound (Zone I) Bedrock**	
		Depth (m)	**Elevation (m)**	**Depth (m)**	**Elevation (m)**
7	127.1	39.6	87.5	40.5	86.7
8	127.5	39.6	87.9	40.0	87.5
9	127.4	41.3	86.1	41.6	85.8

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 was typically 0% in the weathered bedrock and varies between 37% and 95% in the sound bedrock.

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.

There are near-vertical joint sets within this shale that are typically very widely spaced at over 2 m apart. There are also several faults typically referred to as “shear zones” found within the formation, which are observed as zones of rock rubble within the cores. These faults defy discovery in conventional vertical boreholes.

The jointing and crush zones in the rock are related to the state of stress in the deposit. Research in the Greater Toronto Area has revealed that the bedrock contains locked-in horizontal stresses that could be remnants of the foreshortening that occurred in the earth’s crust during continental glaciation several thousand years ago. Documented experiments have indicated that the major principal stress is of the order of 2 MPa in the upper 1 to 2 metres of the deposit where the rock is weathered and contains more fractures. Intact rock can have an internal major principal stress as high as 4 to 5 MPa. The major and minor principal stresses are horizontal and may be oriented in any direction. The empirical approach to vertical stress below the top of bedrock is to use a uniform pressure distribution below the top of bedrock elevation that is equal to the maximum earth pressure calculated for the lowest level of soil in the profile.

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.

2.3 Groundwater

On completion of drilling, the boreholes were filled with drill fluid (from mud rotary drilling) and measuring the unstabilized groundwater level after drilling was not practical. Monitoring wells were installed in Boreholes 1 to 9, 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.	Depth of well (m)	Strata Screened	Stabilized Water Level		
			Date	Depth (mbgs)	Elev. (masl)
1	15.2	Upper Till	Feb 18, 2022	13.5	113.4
2	18.9	Silts and Clays	Feb 18, 2022	16.1	111.0
3	18.3	Upper Till / Silts and Clays	Feb 23, 2022	16.5	111.2
4	19.8	Silts and Clays	Feb 23, 2022	14.8	112.8
5	16.8	Upper Till	Feb 23, 2022	**10.6**	**117.0**
6	18.3	Silts and Clays	Feb 18, 2022	17.5	107.7
7	42.9	Bedrock / Lower Till	Feb 24, 2022	30.3	96.8
8	33.5	Lower Sands	Feb 23, 2022	31.0	96.5
9	46.1	Bedrock	Feb 24, 2022	30.4	97.0

Groundwater levels fluctuate with time depending on the amount of precipitation and surface runoff, and may be influenced by known or unknown dewatering activities at nearby sites.

The design groundwater table for engineering purposes is Elev. 117.0 ±m. Grounded has prepared a hydrogeological report for this site (File No. 21-195). The City of Toronto Maximum Anticipated Groundwater Level is provided in the hydrogeological report.

The groundwater table is in the upper glacial till unit. This deposit has a low permeability and will yield seepage in the long-term. There is also groundwater in the lower sands at about Elev. 97 ±m. This unit will yield free-flowing water if penetrated.

There is water within discrete fractures in the bedrock, as well as infiltrated stormwater perched in the earth fill and upper native soils which is flowing down towards the groundwater table.

2.4 Pressuremeter Testing

In situ pressuremeter testing (PMT) was conducted by Grounded Engineering using an N-size Texam Pressuremeter. Our equipment is lab calibrated before every project, and field calibrated on each day of field testing. The raw data is corrected for membrane stiffness and system volume loss to obtain a corrected plot of probe pressure versus change in probe volume, from which we obtain a pressuremeter modulus. Calibrations and data correction are in accordance with ASTM D4719. The field test data are appended.

The PMT modulus is converted to an equivalent Young's modulus using the following simplified relationship:

$$E_{PMT} / \alpha = E$$

E_{PMT} = Pressuremeter Modulus (MPa)
α = Menard Factor (unitless)
E = Young's Modulus (MPa)
E_{ur} = Young's Modulus, unload-reload (MPa)

There are many ways to derive alpha. We use a first principle derivation which assumes the soil behaves according to the general orthotropic elastic equations. This is checked against the Menard table and the Pressiorama chart.

The detailed pressuremeter test results are appended, and the estimated Young's Modulus results are also shown on the attached Borehole Logs and Subsurface Profile. The test results are summarized as follows:

Borehole	Depth of Test (m)	Elevation of Test (m)	E (MPa)	E_{ur} (MPa)	Engineering Unit	Notes
8	13.0	114.6	*28**	42	Upper Till	Pocket appears to be disturbed
8	16.0	111.5	*43**	64	Upper Till	Pocket appears to be disturbed
8	19.1	108.5	36	80	Upper Till	Pocket appears to be disturbed
8	22.1	105.4	115	256	Silts and Clays	n/a
9	22.1	105.3	76	241	Silts and Clays	n/a
7	32.8	94.2	250	1671	Lower Sands	n/a
7	35.8	91.3	130	969	Lower Till	n/a

* estimated from undisturbed unload-reload loop

2.5 Corrosivity and Sulphate Attack

Five (5) 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*. The results are summarized as follows:

Parameter	BH 2 SS 7	BH 3 SS 11	BH 4 SS 11	BH 6 SS 6	BH 7 SS 7
Soluble Sulphate (SO_4) in soil sample	84 µg/g < 0.1 %	127 µg/g < 0.1 %	87 µg/g < 0.1 %	91 µg/g < 0.1 %	100 µg/g < 0.1 %
Class of Exposure	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Negligible**

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 results are summarized as follows:

Parameter	AWWA C-105 Standard – Assigned Points									
	BH 2 SS 7		BH 3 SS 11		BH 4 SS 11		BH 6 SS 6		BH 7 SS 7	
	Result	Points	Result	Points	Result	Points	Result	Points	Result	Points
Resistivity (ohm.cm)	3450	0	4200	0	4220	0	2250	0	3500	0
pH	7.79	0	7.87	0	7.90	0	7.88	0	7.61	0
Redox Potential (mV)	251	0	251	0	245	0	257	0	253	0
Sulfides (%)	0.35	2	0.31	2	0.53	2	0.22	2	<0.20	2
Moisture (%)	18.50	2	16.50	2	9.52	2	9.21	2	22.60	2
Corrosion protection recommended?	No		No		No		No		No	
Resistivity less than 2000 ohm.cm?	No		No		No		No		No	

The analytical results only provide an indication of the potential for corrosion. All five 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 five 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

The proposed project includes constructing two high-rise towers with associated low-rise podium structures. There are four underground parking levels proposed for the development, set at a lowest (P4) Finished Floor Elevation (FFE) of 114.0± m. Spread footing or raft foundations could conservatively extend up to 2.5 m below FFE for present purposes.

3.1.1 Spread Footings

Foundations made for the proposed P4 level will bear on undisturbed very dense/hard subgrade. Conventional spread footings made to bear on this soil may be designed using a maximum factored geotechnical resistance at ULS of 600 kPa. The net geotechnical reaction at SLS is 400 kPa, for an estimated total settlement of 25 mm.

Spread footing foundations must be at least 1500 mm wide and must be embedded a minimum of 1000 mm below FFE. These minimum requirements apply 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.

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

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.

3.1.2 Raft Foundation

The spread footing capacities provided above are not sufficient for the support of the high-rise tower. Further, the City will likely require this basement to be designed as a fully watertight structure with no permanent dewatering.

A raft foundation can also be considered for the support of structural loads, with waterproofed foundation walls designed to withstand hydrostatic forces (lateral and uplift). A 23 x 34 m raft underlying each tower is considered in the discussion below.

Assuming a P4 FFE of 114± m, a raft would be founded at or below Elev. 112.5± m, on undisturbed subgrade.

The preliminary raft design parameters are provided assuming a *uniform load* at the base of the raft. In reality, raft loads are non-uniform; they will be highest around the core and will decrease away from the core. Consequently, detailed raft design is an iterative process between the structural and geotechnical engineers. The preliminary parameters below are provided as the initial step in determining raft feasibility (a structural task).

Bulk excavation to underside of raft elevation (Elev. 112.5 m or lower) will induce a reduction in effective stress of 255 kPa, which is the unload stress. Utilizing preliminary soil stiffness parameters, analysis of a *uniformly* loaded raft foundation shows that a uniform total SLS bearing pressure of 255 kPa (which is recompression) applied at the base of the raft will generate around 15 mm of settlement. For 25 mm of total settlement, the total uniform SLS bearing pressure is 320 kPa. Each additional increase of 140 kPa (which is now virgin loading) generates an additional 25 mm of settlement. Thus, a total (gross) *uniform* geotechnical reaction at SLS of 460 kPa will generate 50 mm of settlement.

The modulus of subgrade reaction for design of a raft slab is a function of the size of the raft, the applied load, and whether loading is within the recompression range or the virgin range. On the basis of our preliminary stiffness parameters and the assumption of uniform raft loading, the preliminary modulus of subgrade reaction appropriate for raft design at this site is about 5,800 kPa/m for loads over 255 kPa SLS.

Settlement parameters can be improved by modelling the real non-uniform loading at the base of the raft. Detailed raft design is an iterative process between the structural and geotechnical engineers. Once a draft structural design is completed by the structural engineer, the resulting non-uniform raft pressure distribution is provided to us (typically as a contour plot). Grounded will then use finite element modelling to determine the real settlement more accurately at each point under the raft. The detailed settlement distribution and MSRs under the raft are then sent back to the structural engineer, and the structural design is modified as necessary.

The maximum factored geotechnical resistance of this raft foundation at ULS is 4,000 kPa for design purposes.

It is recommended that a professional dewatering contractor be consulted to review the subsurface conditions and to design a site-specific dewatering system. It will be necessary to positively dewater the site to a minimum 1.2 m below proposed founding elevation prior to excavation to preserve the in situ integrity of the native soils. If the subsurface is not dewatered prior to excavation, the native soils will become disturbed by the ingress of groundwater and the above recommendations for bearing capacity will not be valid.

During construction, the subgrade at founding elevation should be cut neat, inspected, and immediately protected by a minimum 200 mm thick mud slab (comprising lean concrete) to provide a working surface. The subsurface must not be proofrolled as this activity would further weaken these soils. The raft slab is then constructed on top of the mud slab. Prior to pouring the mud mat and foundation, the foundation subgrade must be cleaned of all deleterious materials such as softened, disturbed or caved materials, or standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the raft foundation base and concrete must be provided.

As the raft slab is to be fully waterproofed, the structure must be designed to resist uplift and lateral hydrostatic pressure on foundation walls. During construction, it will be necessary to consider the potential uplift pressure on the underside of a raft foundation due to hydrostatic forces. Positive dewatering operations during construction must begin prior to excavation and must continue until such time as the structural dead load exceeds the potential uplift forces (with suitable partial factors (LRFD) included in this assessment). A design groundwater elevation of 117 m is to be used.

Differential settlement is related to real non-uniform raft load distribution and must be assessed as part of the detailed design process. Differential settlement may become an issue if two different foundation types (conventional spread footings and deep foundations) are used to support structures with different column loads (e.g. towers and adjacent podiums) on a shared underground parking structure. Likewise, differential settlement issues may become apparent if different foundation types are designed using two different SLS criteria. Net geotechnical reactions at SLS have been provided for both foundations systems, which will occur as load is applied and is linear and non-recoverable. The tolerance for differential settlement is related to the structural design and is specified by the structural engineer as a function of column spacing.

To avoid this issue, Grounded may be consulted regarding adjustment of the construction schedule such that podium and towers experience similar post-construction settlement. If the scheduling approach is not preferred, the alternative would be to construct the entire structure simultaneously floor-by-floor and to leave a delay strip between the structures supported on different foundation types. Once the buildings are completed, the delay strip is then closed.

3.1.3 End-Bearing Caissons on Rock

End-bearing caissons may also be considered for the support the proposed structure. As the stabilized groundwater table is above P4 FFE, the City is likely to require that this basement be made fully watertight. If that is the case, a thinner caisson-supported raft (acting as a single pile cap) would be required to make this structure watertight.

End-bearing caissons made to bear on unweathered (sound) bedrock may be designed using a maximum factored geotechnical resistance at ULS of 12 MPa. The geotechnical reaction at SLS is 8 MPa. Unweathered bedrock was identified in Boreholes 7 to 9 and summarized above.

In addition to the displacement of the rock, there will be compression of the concrete caisson shaft under loading which will increase the apparent settlement at the structure level.

Top of weathered shale and the depth of the sound bedrock must be confirmed through Grounded's geotechnical engineering supervision during caisson installation.

There are zones of fill material and native soils which are sufficiently wet and permeable such that augered boreholes for caissons made into these soils will be unstable. It is therefore necessary to advance temporarily cased holes to prevent excess caving and seepage during caisson installation. The steel liners are required to preclude water seepage, and also to allow cleaning of the base and evaluation of the founding bedrock surface prior to concrete placement.

Caissons should be separated from each other by at least 2.5 times the largest caisson diameter (measured centre to centre) to avoid inducing additional settlement from group effect. Caissons placed closer than this will induce group effects, and a reduced bearing capacity will apply, which is dependent on caisson sizing, bearing stratum, founding elevation, and separation distance. If this situation is unavoidable from a structural engineering perspective, we can calculate the expected settlement for existing caissons in this situation on request.

Caisson foundations at different elevations must be designed such that the higher caissons are set below a line drawn up at 10 horizontal to 7 vertical from the closest edge of the lower caisson.

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

At this site it will also be necessary to control the bases of any drill holes extending below Elev. 100 m to protect them against loss of ground, upheave, and basal disturbance due to the ingress of groundwater from the lower aquifer. This may include pre-advancing casing, the use of drilling muds, or other means and methods as deemed necessary by the contractor.

Caissons with these capacities have historically been hand-cleaned and base inspected. To eliminate the requirement for hand cleaning and end inspecting each caisson, the following construction methodology must be utilized:

The following construction methodology must be utilized for the caissons:

- All caisson excavations are to be inspected on a full-time basis by Grounded per the OBC.
- Caissons designed to bear on sound rock are to be initially advanced to the top of sound bedrock as identified in Boreholes 7 to 9 (but may vary across the site), and as confirmed by Grounded through observation of the drilling and auger cuttings at each location.
- Once the top of sound bedrock elevation is established for a given caisson by Grounded, the caisson must then be advanced an additional 1-2 m deeper, to be sure that the caisson

is seated in the sound bedrock. This also provides some additional sidewall adhesion resistance (i.e. side shear).

- Auger, cleanout bucket, or one-eyed bucket cleaning of the hole base is to then take place in each caisson hole, and visually inspected by Grounded to ensure that auger cleaning has been carried out as thoroughly as practically possible.
- Place 30 MPa (min.) concrete to a minimum depth of 600 mm in the base of the hole (volume to be determined based on caisson diameter) to be stirred with the auger without advancing the auger any further for about 5-10 minutes.
- The auger spun concrete is then removed and wasted, leaving no more than 100 mm depth of concrete at the base of the caisson.
- Tremie placement of concrete is required wherever the drill holes have more than 150 mm of water in the base or are full of polymer or other drilling fluids.
- Complete construction of the caisson to cut off elevation.

Based on the selected construction method for caissons at the site, Grounded recommends sonic caliper, crosshole logging, or another similar test be carried out down a number of the caissons on site as they are constructed. Grounded generally recommends carrying such tests on the first five (5) caissons, and 10% of the caissons thereafter. The structural engineer should specify the number of tests to verify the quality of the contractor’s installation.

Grounded reserves the right to increase the number of sonic caliper and crosshole sonic logging tests subject to the results of the initial respective tests.

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, rafts, and pile caps) of 112± metres, the boreholes observe very stiff to hard cohesive soils, and dense to very dense cohesionless soils. Bedrock is at around Elev. 87± m. Based on this information, the site designation for seismic analysis is **Class C**, per Table 4.1.8.4.A of the Ontario Building Code (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.MUNI 1010)	21	32	0.31	0.47	3.25
Existing Earth Fill	19	29	0.35	0.52	2.88
Upper Sands	20	35	0.27	0.43	3.69
Upper Till	21	36	0.26	0.41	3.85
Silts and Clays	22	32	0.31	0.47	3.25
Lower Sands	20	42	0.20	0.33	5.04

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 City of Toronto may require this basement to be fully waterproofed, according to their new policy. In this case, the full height of the basement walls should be waterproofed and designed to withstand horizontal hydrostatic pressure below Elev. 117 m.

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

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

$$\boldsymbol{R_f = \Phi N \tan\varphi}$$

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

3.4 Slab on Grade Design Parameters

The slab-on-grade parameters provided here apply to a conventional slab on grade and drained basement approach only. If a fully waterproofed raft foundation approach is adopted (with no permanent drainage system), design parameters are provided in Section 3.1.

At the proposed P4 elevation, the undisturbed native soils will provide adequate subgrade for the support of a conventional drained slab on grade. The modulus of subgrade reaction for slab-on-grade design supported by undisturbed native soils is 40,000 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.MUNI 1004) vibrated to a dense state.

If this basement structure is made as a conventional drained structure, a permanent drainage system including subfloor drains is required (see Section 3.5).

Prior to placement of the capillary moisture break and construction of the slab, the cut subgrade be cut and inspected by Grounded for obvious exposed loose or disturbed areas, or for areas containing excessive deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 percent SPMDD).

3.5 Long-Term Groundwater and Seepage Control

The requirement for a permanent basement drainage system depends on whether a fully watertight approach is adopted for this site. Grounded's Hydrogeological Report (File No. 21-195) provides further discussion on this.

If a raft foundation is required, the structure can be fully watertight and designed to withstand hydrostatic pressures, with no permanent drainage system. The full height of the basement walls should be waterproofed (no drainage) and designed to withstand hydrostatic pressure (horizontal and uplift) using a static groundwater table at Elev. 117± m.

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

For a conventional drained basement approach, perimeter and subfloor drainage systems 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. The exterior faces of foundation walls should be provided with a layer of waterproofing to protect interior finishes.

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.

If any water is to be discharged to the storm or sanitary sewers, the City of Toronto will require a Permit to Discharge in the short term, and a Discharge Agreement in the long-term. The City will likely prohibit long-term discharge in light of their recent policy change.

4 Considerations for Construction

4.1 Excavations

Excavations must be carried out in accordance with the *Occupational Health and Safety Act – Regulation 213/91 – Construction Projects (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 and upper sands are Type 3 soils
- The upper till is a Type 2 soil

In accordance with the regulation’s requirements, the soil must be suitably sloped and/or braced where workers must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes (of no more than 3 m in height) 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. Any excavation slopes greater than 3 m in height should be checked by Grounded for global stability issues.

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.

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.

For practical purposes, the groundwater table at this site may be assumed to be at Elev. 117 m. Excavations will generally be made below the groundwater table, in relatively low permeability native soils that preclude the free flow of water into excavations.

Cohesionless wet zones were encountered in several of the boreholes. If these cohesionless zones are penetrated, some seepage from these wet zones should be anticipated. However, these zones are likely of limited extent and are not horizontally continuous layers. Seepage from these zones may be allowed to drain into the excavation and then controlled by a conventional sump pump arrangement. Nevertheless, delays in excavation will occur as the seepage is controlled and these delays should be anticipated in the construction schedule.

A watertight basement is likely to be required. During construction, it will be necessary to consider the potential uplift pressure on the underside of a raft foundation due to hydrostatic forces. Positive dewatering operations during construction must begin prior to excavation and must continue until such time as the structural dead load exceeds the potential uplift forces (with suitable partial factors (LRFD) included in this assessment). A design groundwater elevation of 117 m is to be used in this assessment.

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.

The City of Toronto will require a Discharge Agreement in the short term, if any water is to be discharged to the storm or sanitary sewers during construction.

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 with active dewatering prior to and during construction.

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. 117 m must be accounted for. There is infiltrated stormwater perched in the earth fill and upper sand which may accumulate behind a caisson wall. This hydrostatic pressure needs to be accounted for in shoring design.

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.

4.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in the upper till or silt and clay units. Soldier pile toes resist horizontal movement due to the passive earth pressure acting on the toe below the base of excavation.

There are zones of soil in the subgrade that are wet, cohesionless, and permeable. Augered holes for piles made into these soils will be prone to caving and blowback. Temporarily cased holes 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, pre-advancing liners deeper than the augured holes, mud/slurry/polymer drilling techniques, or other methods as deemed necessary by the shoring contractor are required.

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 dense/hard subgrade below Elev. 120 to 122± m, it is expected that post-grouted anchors can be made such that an anchor will safely carry up to 70 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm).

At least one prototype anchor 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 dense/hard subgrade below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on these undisturbed native soils at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 300 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.

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.

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 maintain the integrity of 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 hollow stem augers and mud rotary drilling equipment. Rock coring will be carried out with HQ size diamond bit core drilling barrels. 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 Tenblock and their design team, for whom this report has been prepared. Grounded Engineering Inc. maintains the copyright and ownership of this document. Reproduction of this report in any format or medium requires explicit prior authorization from Grounded Engineering Inc.

The City of Toronto 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,

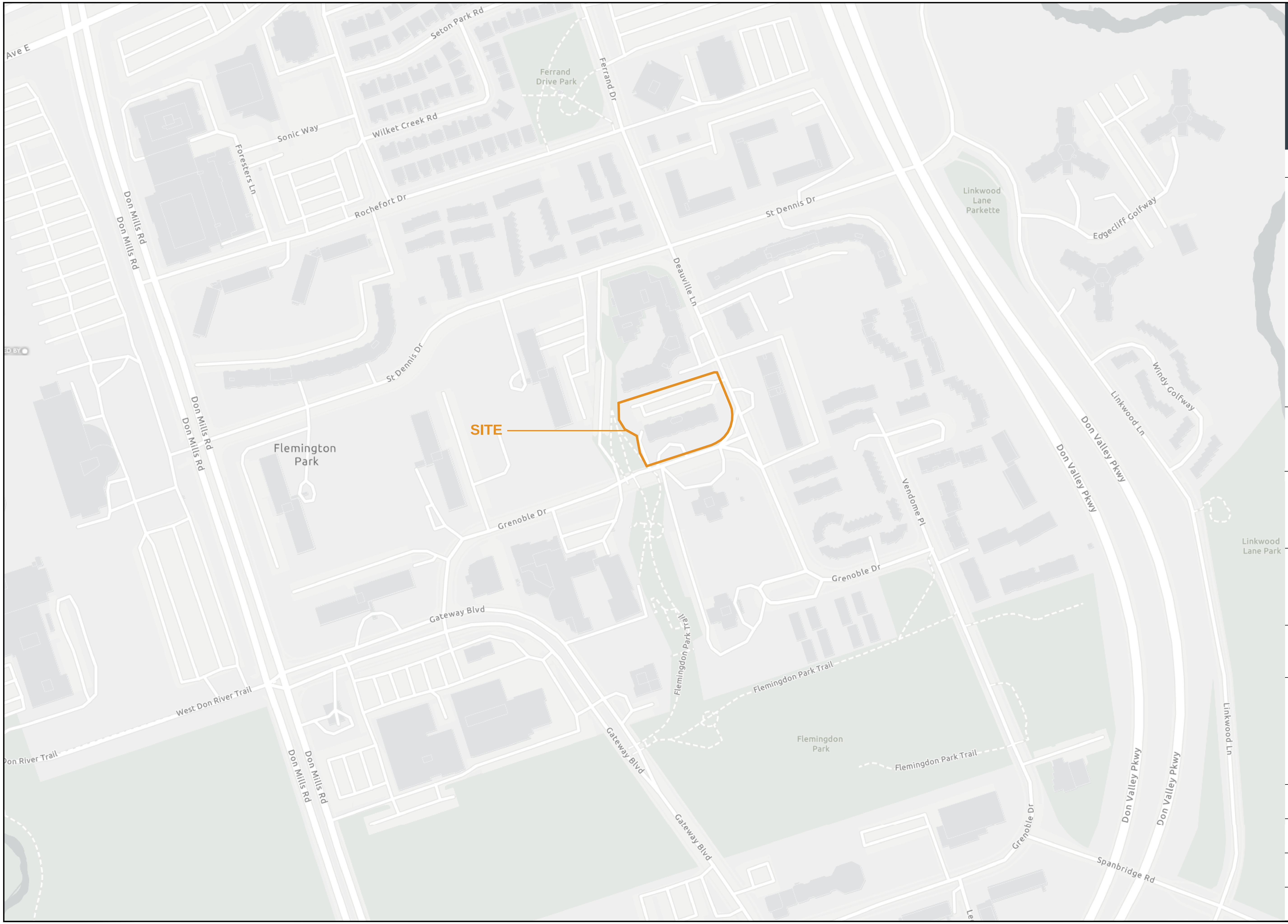
GROUNDED
ENGINEERING

LICENSED PROFESSIONAL ENGINEER
M. DIEZ DE AUX
100159147
18/03/2022
PROVINCE OF ONTARIO

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

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

FIGURES



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LEGEND

— APPROXIMATE PROPERTY BOUNDARY

Note

Reference

ArcGIS My Map 2021

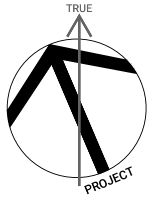
Project

48 GRENOBLE DRIVE, TORONTO, ONTARIO

Figure Title

SITE LOCATION PLAN

North



Date

MARCH 2022

Scale

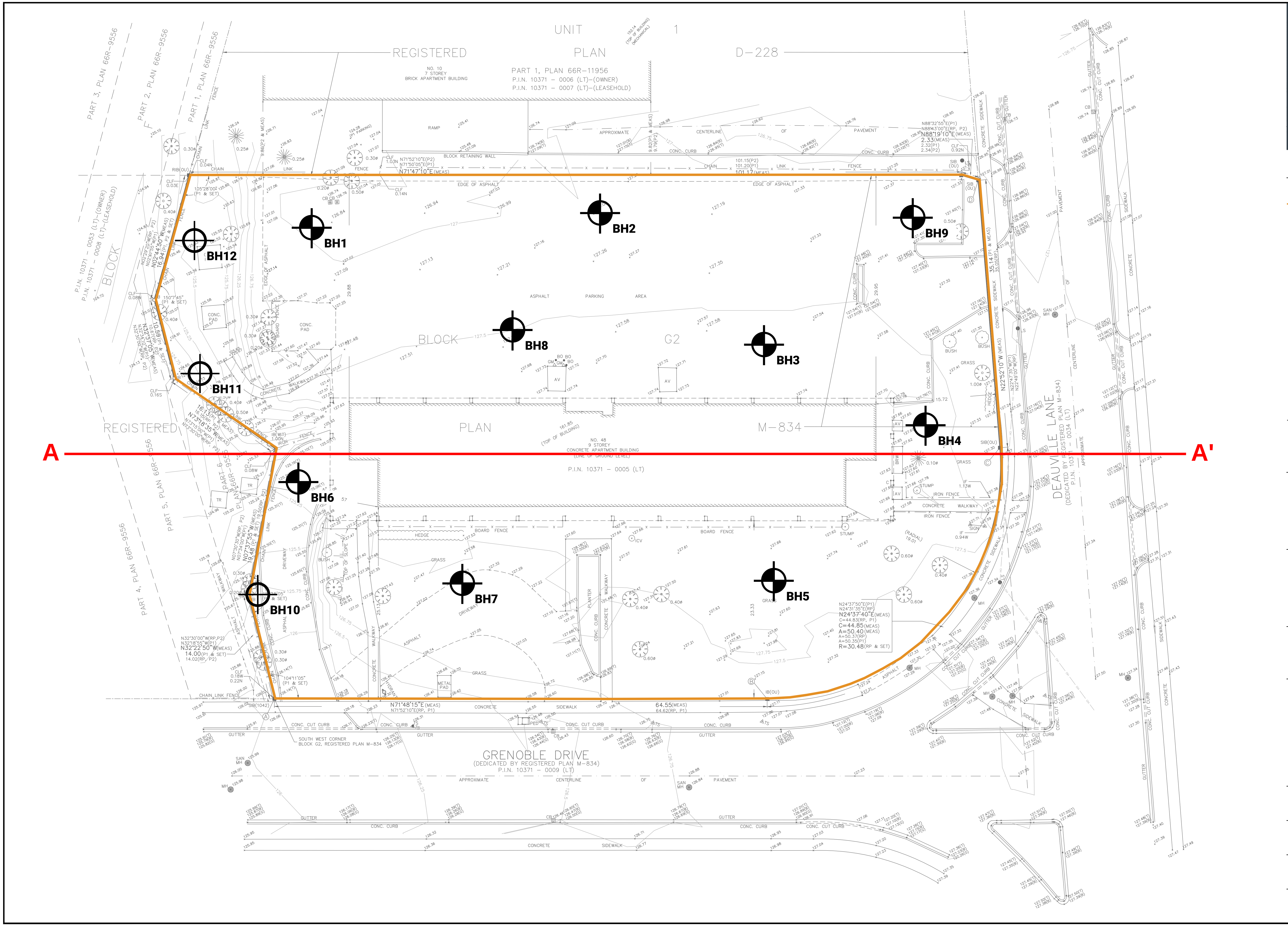
NTS

Job No

21-195

Figure No

FIGURE 1



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LEGEND

APPROXIMATE PROPERTY BOUNDARY

MONITORING WELL/BOREHOLE BY GROUNDED

Note

Reference

Survey Drawing no. 3487-OT.
Project no. 3487-0.
Dated August 4, 2021.
Prepared by R.AVIS Surveying Inc.

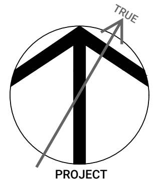
Project

48 GRENOBLE DRIVE
TORONTO, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN (Existing Condition)

North



Date

MARCH 2022

Scale

0m 5m 10m

Job No

21-195

Figure No

FIGURE 2

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⊕ ⊕ MONITORING WELL/BOREHOLE BY GROUNDED

Note

Reference

Arch Drawings
Project no. 211033.
March 18, 2022.
Prepared by Diamond Schmitt.

Project

48 GRENOBLE DRIVE
TORONTO, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN (Proposed Condition)

North

Date

MARCH 2022

Scale

0m 5m 10m

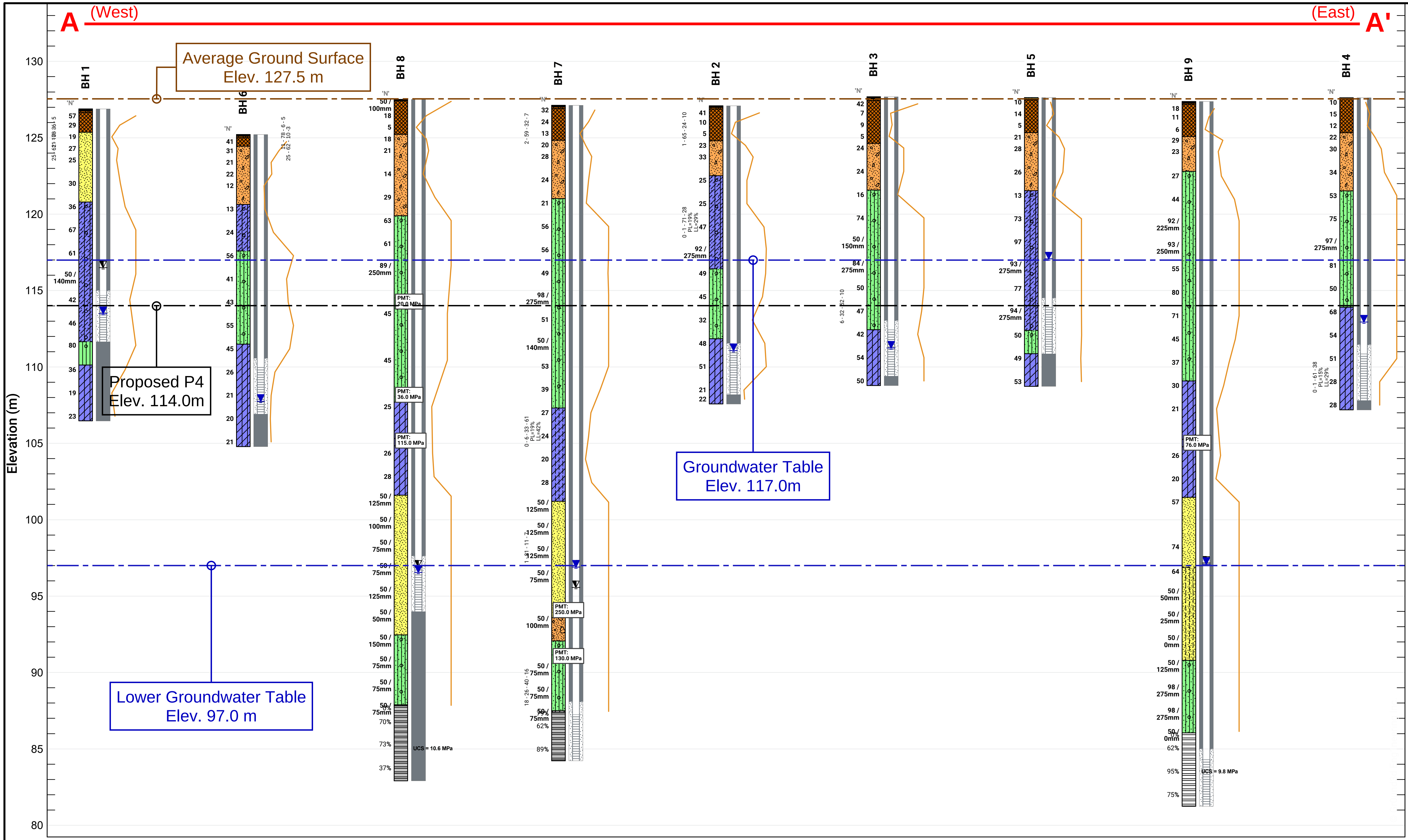
Job No

21-195

Figure No

FIGURE 3

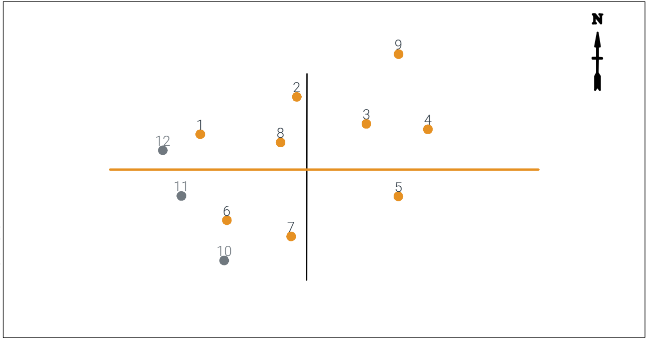
MONITORING WELL/BOREHOLE
BY GROUNDED



Boreholes Equally Spaced

SITE MAP

Alignment: EW



LITHOLOGY GRAPHIC LEGEND

- Asphalt
- Aggregate
- Fill
- Sand
- Clayey Silt Till
- Silty Till
- Silt and Clay
- Gravelly Sand
- Sandy Silt Till
- Topsoil
- Silty Clay
- Sand and Gravel
- Bedrock (inferred)
- Bedrock (cored)
- Silty Sand
- Shale

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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

▽ water level, unstabilized
▼ water level, stabilized

Project
**48 GRENOBLE DRIVE
TORONTO, ON**

Figure Title
**SUBSURFACE
CROSS-SECTION**

EW

Date
MARCH 2022

Scale
AS INDICATED

Job No
21-195

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.

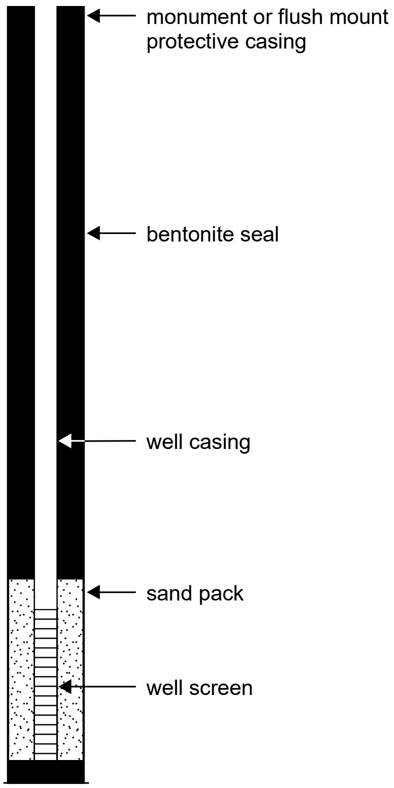
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

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

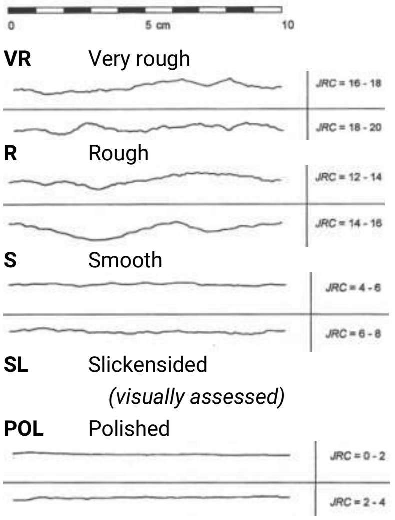
Coating

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.)



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

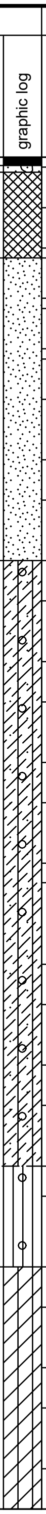
Date Started : Jan 24, 2022
Position : E: 634377, N: 4841782 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 1

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

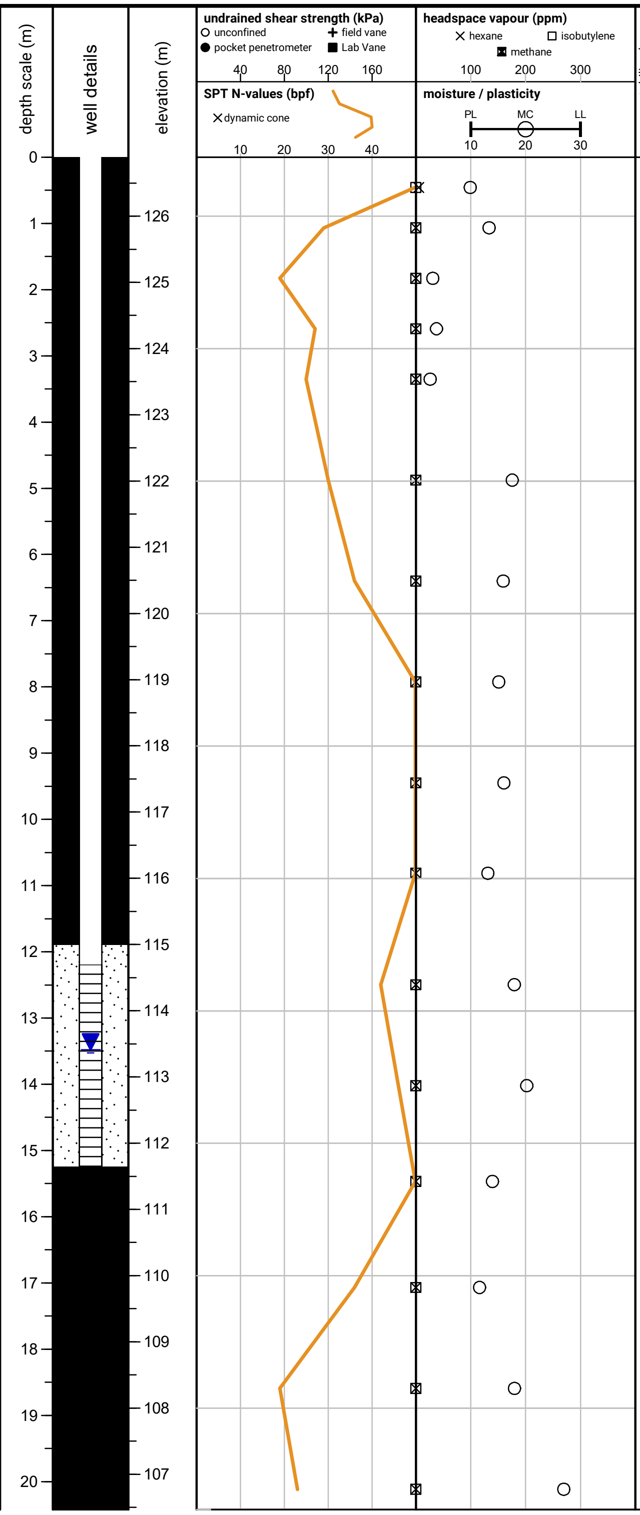
drill method : CME 75

drill method	elev depth (m)	description
	126.9	**GROUND SURFACE**
hollow stem augers OD=215 mm		125mm **ASPHALT**
		100mm **AGGREGATE**
		FILL, sandy silt, trace clay, trace gravel, trace rock fragments, trace organics, very dense, brown, moist ...at 0.8 m, compact
	125.4 1.5	**SAND**, trace silt, trace clay, some gravel to gravelly, compact, brown, moist
mud rotary small OD=100 mm		...at 4.6 m, wet, dense
	120.8 6.1	**CLAYEY SILT**, some sand, trace gravel, hard, grey, moist (GLACIAL TILL)
		...at 9.1 m, trace sand
		...at 10.7 m, silt partings
	111.7 15.2	**SILT**, trace clay, trace sand, trace gravel, very dense, grey, wet (GLACIAL TILL)
	110.1 16.8	**SILT AND CLAY**, trace sand, hard, grey, moist
		...at 18.3 m, very stiff
		...at 19.8 m, wet
	106.5 20.4	**END OF BOREHOLE**



samples

number	type	SPT N-value
1	SS	57
2	SS	29
3	SS	19
4	SS	27
5	SS	25
6	SS	30
7	SS	36
8	SS	67
9	SS	61
10	SS	50 / 140mm
11	SS	42
12	SS	46
13	SS	80
14	SS	36
15	SS	19
16	SS	23



unstabilized water level

lab data and comments — grain size distribution (%) (MIT)

comments	GR	SA	SI	CL
SS1: BTEX, PAHs, PHCs				
SS2: EC/SAR, H-Ms, Metals, ORPs, pH, VOCs	11	78	6	5
SS3: PAHs	25	62	10	3
SS4: EC/SAR, H-Ms, Metals, ORPs, pH				
SS7: BTEX, PHCs				
SS8: VOCs				

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 2, 2022	10.5	116.4
Feb 18, 2022	13.5	113.4

Tech : FR/AJ | **PM** : KM/SP | **Rev** : KB

GROUNDED
ENGINEERING

Date Started : Jan 26, 2022
Position : E: 634413, N: 4841796 (UTM 17T)
Elev. Datum : Geodetic

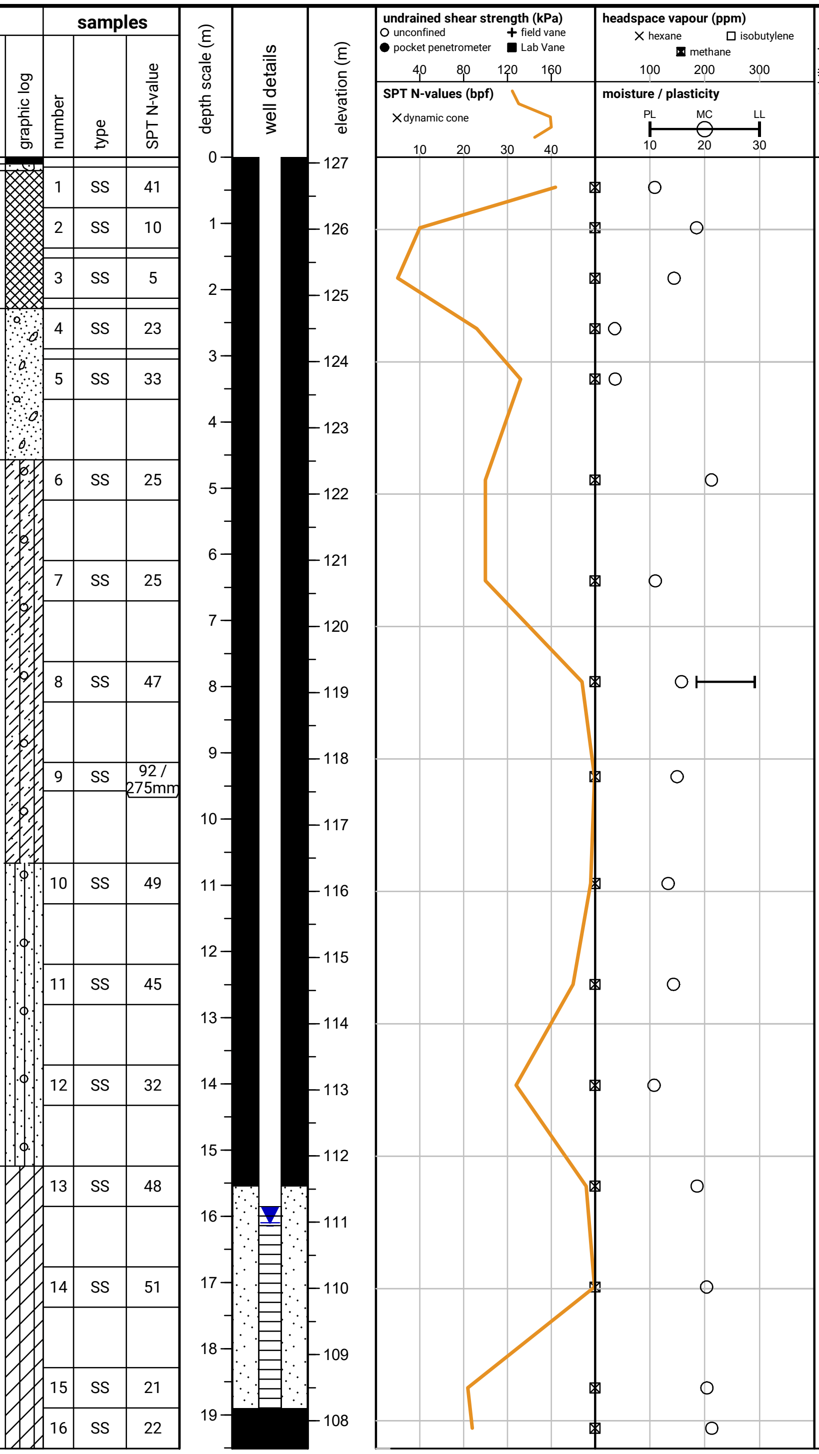
BOREHOLE LOG 2

File No. : 21-195

Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock

drill method : CME 75	elev depth (m)	stratigraphy description	samples number	type	SPT N-value
	127.1	**GROUND SURFACE**			
hollow stem augers OD=215 mm		100mm **ASPHALT**			
		100mm **AGGREGATE**	1	SS	41
		FILL, silty sand, some clay, trace gravel, trace organics, dense, brown, moist ...at 0.8 m, loose, dark brown	2	SS	10
			3	SS	5
	124.8 2.3	**GRAVELLY SAND**, some silt, trace clay, compact to dense, brown, moist	4	SS	23
mud rotary small OD=100 mm			5	SS	33
	122.5 4.6	**CLAYEY SILT**, sandy, trace gravel, very stiff, brown to grey, moist (GLACIAL TILL)	6	SS	25
		...at 6.1 m, some sand, grey	7	SS	25
		...at 7.6 m, trace sand, hard	8	SS	47
			9	SS	92 / 275mm
	116.4 10.7	**SANDY SILT**, some clay, trace gravel, dense, grey, moist (GLACIAL TILL)	10	SS	49
			11	SS	45
			12	SS	32
	111.9 15.2	**SILT AND CLAY**, trace sand, hard, grey, moist	13	SS	48
			14	SS	51
		...at 18.3 m, wet, very stiff	15	SS	21
			16	SS	22
	107.6 19.5	**END OF BOREHOLE**			



lab data and comments	grain size distribution (%) (MIT) GR	SA	SI	CL
SS1: BTEX, PAHs, PHCs				
SS2: EC/SAR, H-Ms, Metals, ORPs, pH	1	65	24	10
SS3: VOCs				
SS4: PAHs				
SS5: EC/SAR, H-Ms, Metals, ORPs, pH				
SS7: BTEX, PHCs				
SS8: VOCs	0	1	71	28

END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 18, 2022	16.1	111.0

Tech : FR/AJ | **PM** : KM/SP | **Rev** : MD

Date Started : Jan 28, 2022
Position : E: 634439, N: 4841786 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 3

File No. : 21-195

Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock

drill method : CME 75

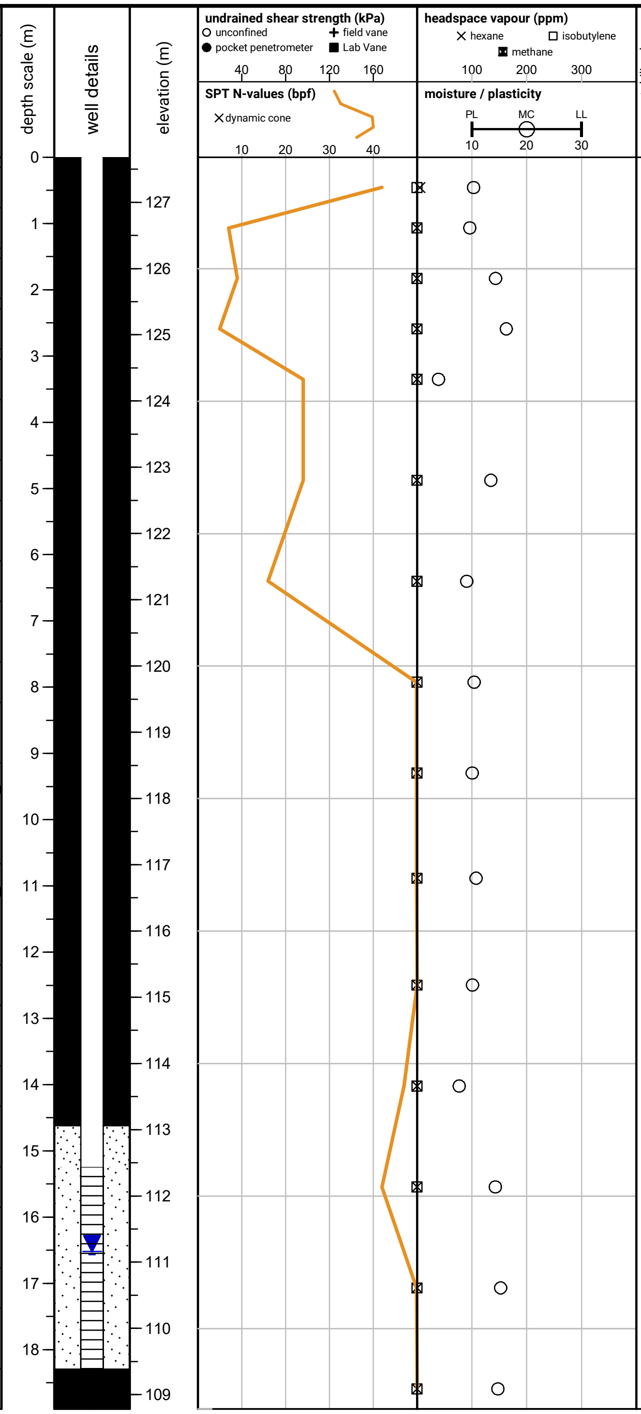
- hollow stem augers OD=215 mm (0 to 3.0 m)
- mud rotary small OD=100 mm (3.0 to 18.9 m)

stratigraphy

elev depth (m)	description
127.7	**GROUND SURFACE**
	125mm **ASPHALT**
	100mm **AGGREGATE**
	FILL, silty sand, some clay, trace gravel, dense, brown, moist ...at 0.8 m, trace cinders, loose
124.7 3.0	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist
121.6 6.1	**SANDY SILT**, some clay, trace gravel, compact, grey, moist (GLACIAL TILL) ...at 7.6 m, very dense ...at 13.7 m, dense
112.5 15.2	**SILT AND CLAY**, trace sand, hard, grey, moist
108.8 18.9	**END OF BOREHOLE**

samples

number	type	SPT N-value	lab data and comments	GR	SA	SI	CL
1	SS	42	SS1: BTEX, PAHs, PHCs				
2	SS	7	SS2: EC/SAR, H-Ms, Metals, ORPs, pH				
3	SS	9	SS3: VOCs				
4	SS	5					
5	SS	24	SS5: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH				
6	SS	24					
7	SS	16	SS7: BTEX, PAHs, PHCs				
8	SS	74	SS8: VOCs				
9	SS	50 / 150mm					
10	SS	84 / 275mm					
11	SS	50					
12	SS	47		6	32	52	10
13	SS	42					
14	SS	54					
15	SS	50					



Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 23, 2022	16.5	111.2

file: 21-195 gint.gpj

Tech : FR/AJ | **PM** : KM/SP | **Rev** : MD

GROUNDED
ENGINEERING

Date Started : Jan 31, 2022
Position : E: 634462, N: 4841784 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 4

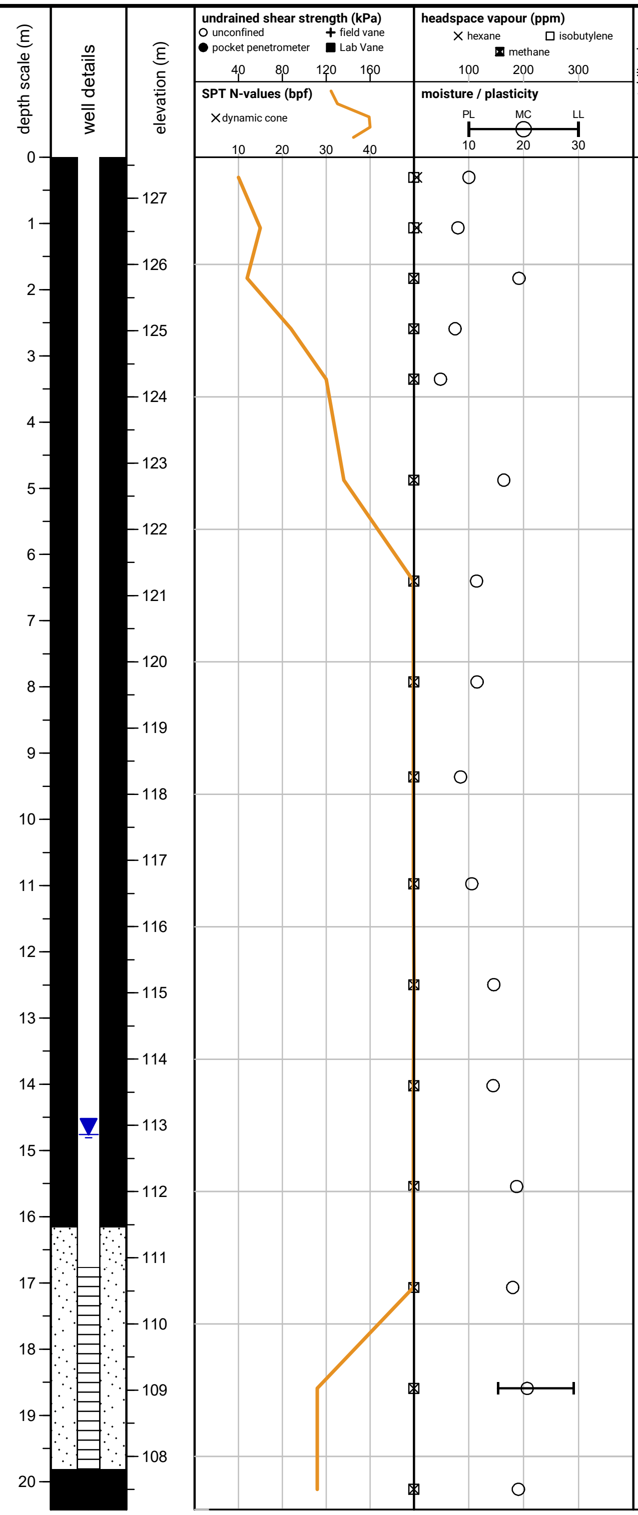
File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : CME 75

elev depth (m)	description	graphic log
127.6	**GROUND SURFACE**	
	100mm **TOPSOIL**	
	FILL, silty sand, some clay, trace gravel, trace organics, compact, brown, moist	▨
125.3 2.3	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist ...at 4.6 m, dense, wet	
121.5 6.1	**SANDY SILT**, trace clay, trace gravel, very dense, grey, moist (GLACIAL TILL)	
113.9 13.7	**SILT AND CLAY**, trace sand, hard, grey, moist ...at 18.3 m, very stiff, wet	
107.2 20.4	**END OF BOREHOLE**	

Drill method by depth: hollow stem augers OD=215 mm (0 to 2.3 m); mud rotary small OD=100 mm (2.3 to 20.4 m)

number	type	SPT N-value	lab data and comments
1	SS	10	SS1: BTEX, PAHs, PHCs
2	SS	15	SS2: EC/SAR, H-Ms, Metals, ORPs, pH, VOCs
3	SS	12	
4	SS	22	SS4: PAHs
5	SS	30	SS5: EC/SAR, H-Ms, Metals, ORPs, pH
6	SS	34	
7	SS	53	SS7: BTEX, PHCs
8	SS	75	
9	SS	97 / 275mm	SS9: VOCs
10	SS	81	
11	SS	50	
12	SS	68	
13	SS	54	
14	SS	51	
15	SS	28	grain size distribution (%) (MIT) GR SA SI CL: 0 1 61 38
16	SS	28	



END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 23, 2022	14.8	112.8

file: 21-195 gint.gpj

Tech : FR | **PM** : KM/SP | **Rev** : KB

GROUNDED ENGINEERING

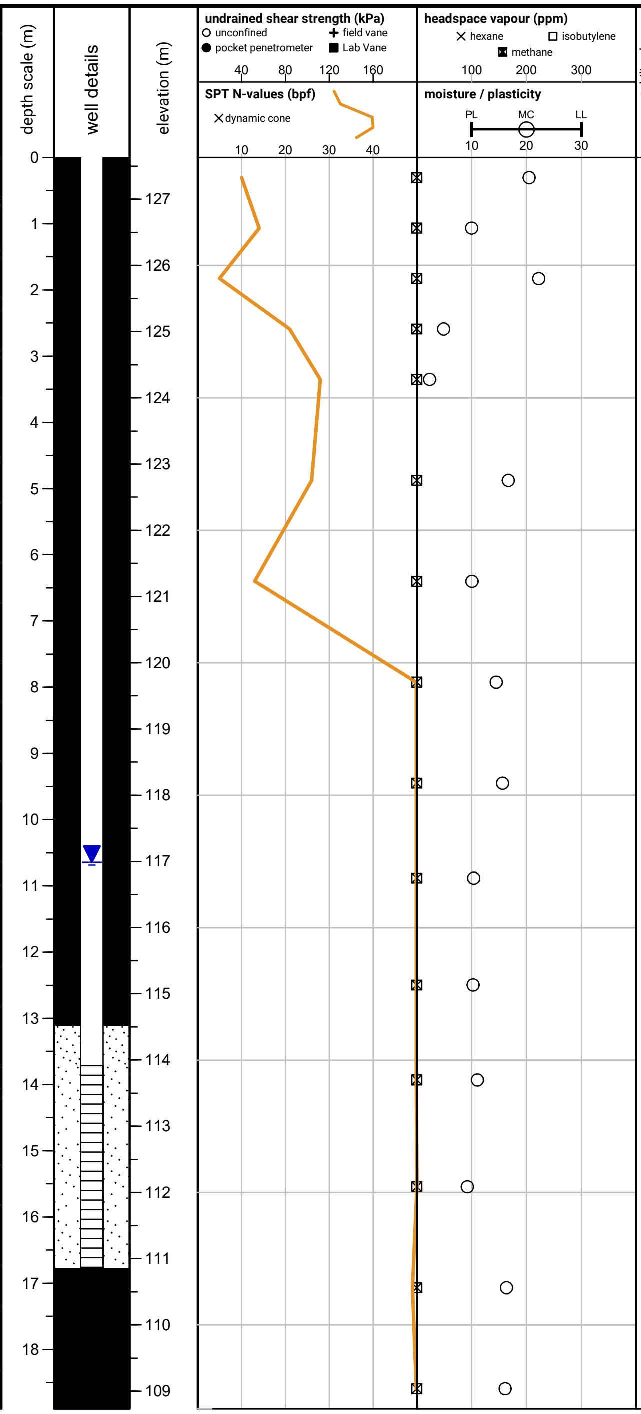
Date Started : Feb 8, 2022
Position : E: 634451, N: 4841759 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 5

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : CME 55

elev depth (m)	stratigraphy: description	drill method	samples: number	type	SPT N-value	lab data and comments
127.6	**GROUND SURFACE**					
	150mm **TOPSOIL**	hollow stem augers OD=215 mm	1	SS	10	SS1: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH
	FILL, silty sand, some clay, trace gravel, trace organics, loose to compact, dark brown, moist		2	SS	14	SS2: BTEX, PHCs, VOCs
			3	SS	5	
125.3 2.3	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist		4	SS	21	SS4: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH
		mud rotary small OD=100 mm	5	SS	28	
	...at 4.6 m, some clay, wet		6	SS	26	
121.5 6.1	**CLAYEY SILT**, some sand, trace gravel, stiff, grey, moist (GLACIAL TILL)		7	SS	13	SS7: BTEX, PHCs, VOCs
	...at 7.6 m, silt partings, hard		8	SS	73	
			9	SS	97	
			10	SS	93 / 275mm	
			11	SS	77	
	...at 13.7 m, sandy		12	SS	94 / 275mm	
112.4 15.2	**SANDY SILT**, some clay, trace gravel, very dense, grey, moist (GLACIAL TILL)		13	SS	50	
110.8 16.8	**SILT AND CLAY**, trace sand, hard, grey, moist		14	SS	49	
			15	SS	53	
108.7 18.9						



END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 23, 2022	10.6	117.0

Tech : FR | **PM** : KM/SP | **Rev** : MD

Date Started : Feb 7, 2022
Position : E: 634387, N: 4841750 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 6

File No. : 21-195

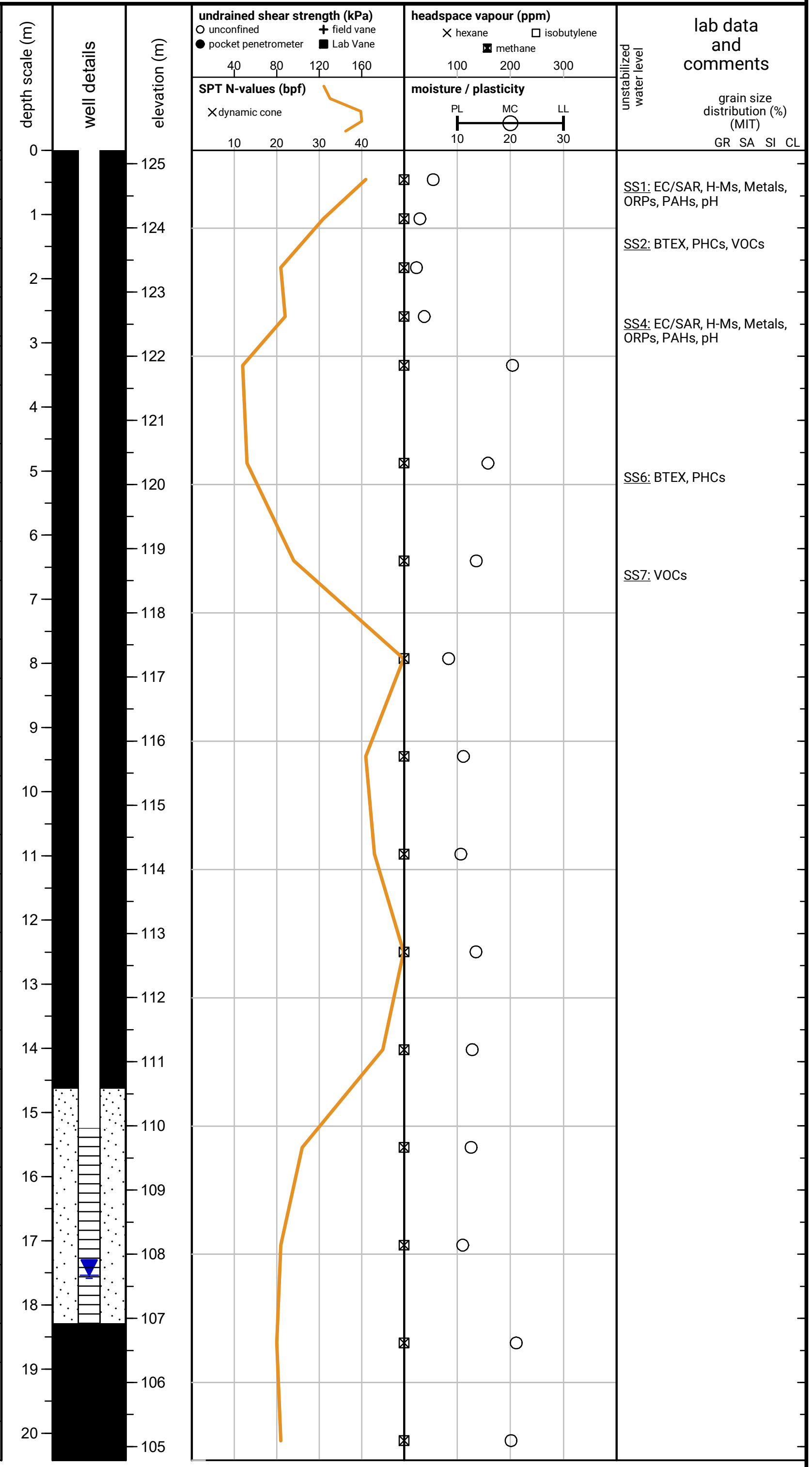
Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock

drill method : CME 55

drill method	elev depth (m)	stratigraphy description
hollow stem augers OD=215 mm	125.2	**GROUND SURFACE**
		100mm **ASPHALT**
		100mm **AGGREGATE**
	124.4 0.8	**FILL**, silty sand, some clay, trace gravel, trace organics, dense, brown, moist
		GRAVELLY SAND, some silt, trace clay, dense, brown, moist ...at 2.3 m, compact
mud rotary small OD=100 mm		...at 3.0 m, wet
	120.6 4.6	**CLAYEY SILT**, trace sand, trace gravel, with silt partings, stiff to very stiff, grey, moist (GLACIAL TILL)
	117.6 7.6	**SANDY SILT**, trace clay, trace gravel, very dense, grey, moist (GLACIAL TILL) ...at 9.1 m, dense
	111.5 13.7	**SILT AND CLAY**, trace sand, hard to very stiff, grey, moist ...at 15.2 m, trace sand ...at 18.3 m, wet
	104.8 20.4	**END OF BOREHOLE**

number	type	SPT N-value	lab data and comments
1	SS	41	SS1: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH
2	SS	31	SS2: BTEX, PHCs, VOCs
3	SS	21	
4	SS	22	SS4: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH
5	SS	12	
6	SS	13	SS6: BTEX, PHCs
7	SS	24	SS7: VOCs
8	SS	56	
9	SS	41	
10	SS	43	
11	SS	55	
12	SS	45	
13	SS	26	
14	SS	21	
15	SS	20	
16	SS	21	



END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 18, 2022	17.5	107.7

file: 21-195 gint.gpj

Tech : FR | **PM** : KM/SP | **Rev** : KB

BOREHOLE LOG 7

GROUNDED ENGINEERING

Date Started : Feb 1, 2022
Position : E: 634411, N: 4841744 (UTM 17T)
Elev. Datum : Geodetic

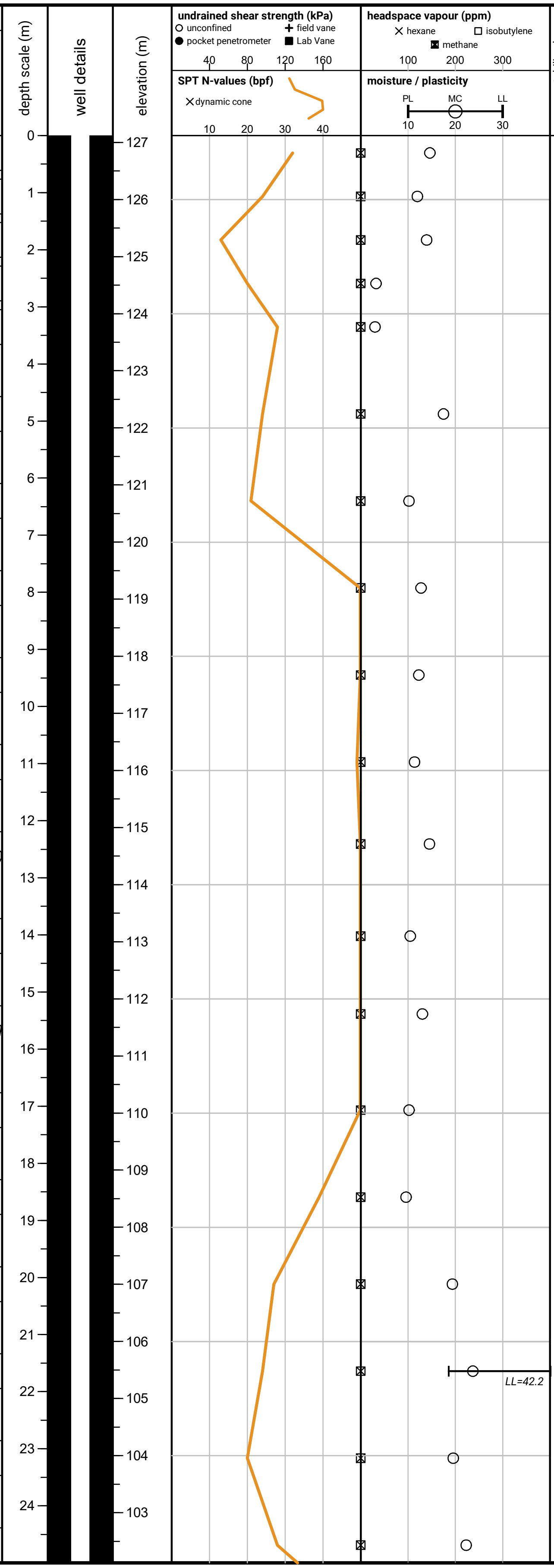
File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : CME 55
hollow stem augers OD=215 mm
mud rotary small OD=100 mm

elev depth (m)	description	graphic log
127.1	**GROUND SURFACE**	
	100mm **ASPHALT**	
	100mm **AGGREGATE**	
	FILL, silty sand, trace clay, trace gravel, trace organics, trace cinders, dense to compact, dark brown with orange, moist	
124.8 2.3	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist ...at 4.6 m, wet	
121.0 6.1	**SANDY SILT**, trace clay, trace gravel, compact, grey, moist (GLACIAL TILL) ...at 7.6 m, trace clay, very dense to dense ...at 13.7 m, silt partings	
107.3 19.8	**SILTY CLAY**, trace sand, very stiff, grey, wet ...at 24.4 m, wet	

number	type	SPT N-value	lab data and comments
1	SS	32	SS1: BTEX, PAHs, PHCs
2	SS	24	SS2: EC/SAR, H-Ms, Metals, ORPs, pH 2 59 32 7
3	SS	13	SS3: VOCs
4	SS	20	SS4: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH
5	SS	28	
6	SS	24	SS6: BTEX, PHCs, VOCs
7	SS	21	
8	SS	56	SS8: VOCs
9	SS	56	
10	SS	49	
11	SS	98 / 275mm	
12	SS	51	
13	SS	50 / 140mm	
14	SS	53	
15	SS	39	
16	SS	27	
17	SS	24	0 6 33 61
18	SS	20	
19	SS	28	

grain size distribution (%) (MIT): GR SA SI CL



Page 1 of 2

Tech : FR | **PM** : KM/SP | **Rev** : KB

(continued next page)

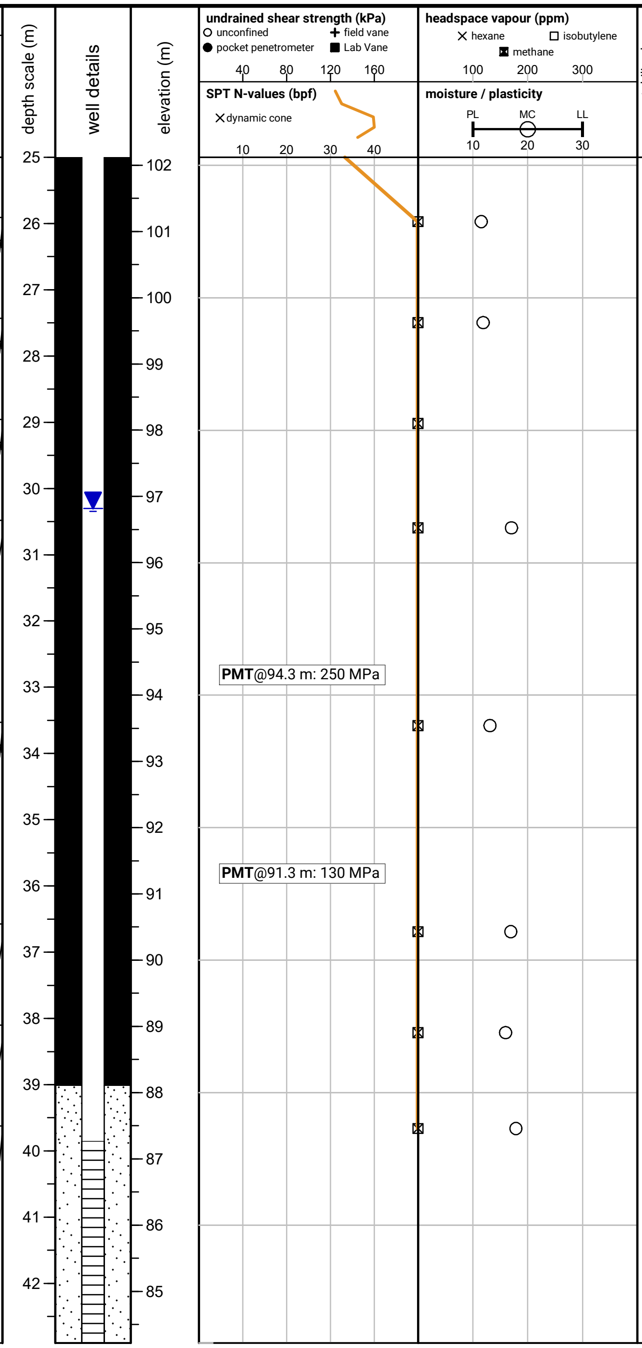
GROUNDED ENGINEERING

Date Started : Feb 1, 2022
Position : E: 634411, N: 4841744 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 7

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : CME 55	elev depth (m)	stratigraphy description *(continued)*	samples number	type	SPT N-value	lab data and comments grain size distribution (%) (MIT) GR SA SI CL
mud rotary small OD=100 mm		**SILTY CLAY**, trace sand, very stiff, grey, wet *(continued)*				
	101.2 25.9	**SAND**, some silt, trace clay, trace gravel, very dense, grey, wet	20	SS	50 / 125mm	
			21	SS	50 / 125mm	
			22	SS	50 / 125mm	1 81 11 7
			23	SS	50 / 75mm	
			1	PMT		
	93.6 33.5	**SAND AND GRAVEL**, some silt, trace clay, very dense, grey, wet	24	SS	50 / 100mm	
	92.0 35.1	**SANDY SILT**, some gravel, some clay, very dense, grey, moist (GLACIAL TILL)	2	PMT		
			25	SS	50 / 75mm	
		...at 38.1 m, trace shale fragments	26	SS	50 / 75mm	18 26 40 16
	87.5 39.6	**INFERRED BEDROCK**, shale and limestone fragments	27	SS	50 / 75mm	
Rock coring (HQ) OD=96 mm	87.4 39.7	**GEORGIAN BAY FORMATION** (See rock core log for details)	1	RUN		
			2	RUN		...at 40.5 m, top of sound bedrock
			3	RUN		
	84.2 42.9					



END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

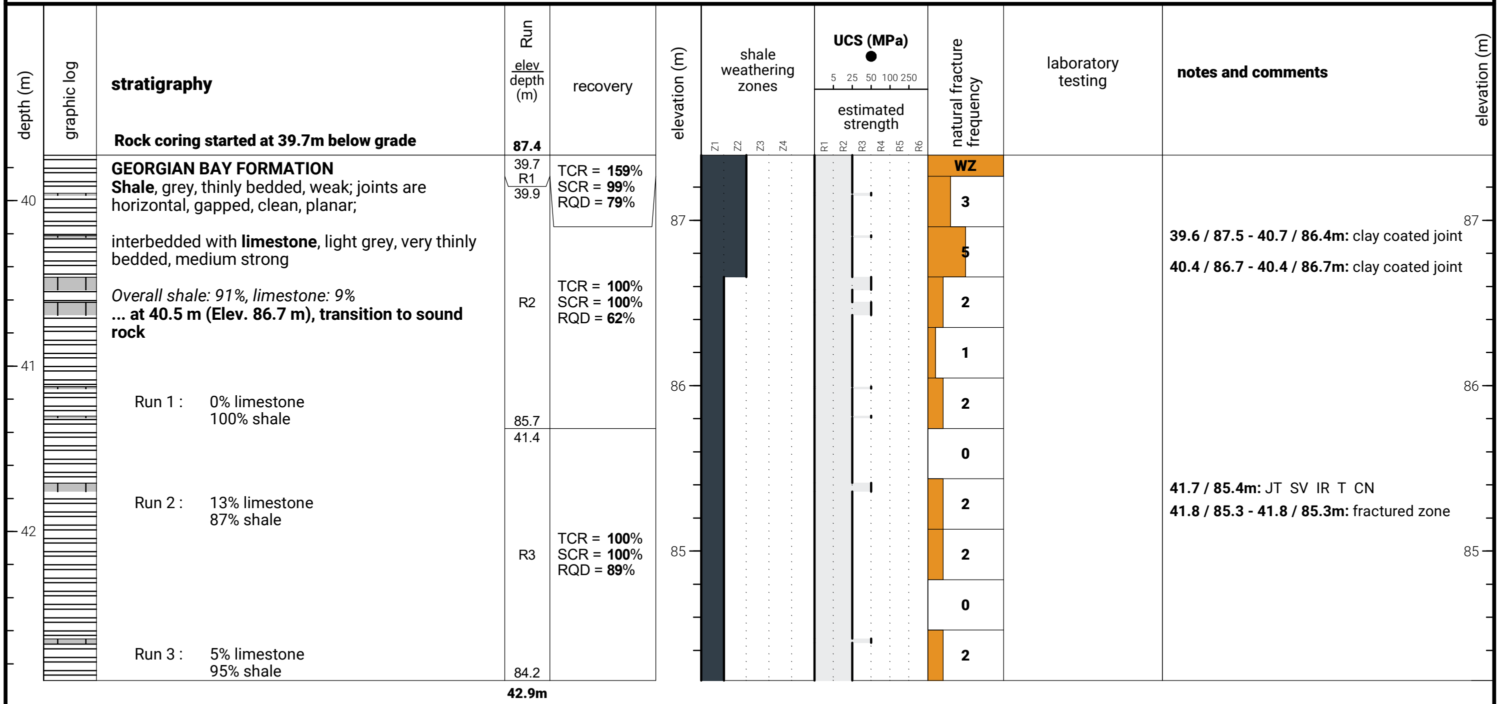
GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 18, 2022	31.6	95.5
Feb 24, 2022	30.3	96.8

Date Started : Feb 1, 2022
Position : E: 634411, N: 4841744 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 7

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock



stratigraphy

Rock coring started at 39.7m below grade

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded, weak; joints are horizontal, gapped, clean, planar;

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

Overall shale: 91%, limestone: 9%
... at 40.5 m (Elev. 86.7 m), transition to sound rock

Run 1 : 0% limestone
100% shale

Run 2 : 13% limestone
87% shale

Run 3 : 5% limestone
95% shale

Run elev / depth (m)	recovery
87.4	
39.7 R1 39.9	TCR = **159%** SCR = **99%** RQD = **79%**
R2	TCR = **100%** SCR = **100%** RQD = **62%**
85.7 41.4	
R3	TCR = **100%** SCR = **100%** RQD = **89%**
84.2 **42.9m**	

END OF COREHOLE

notes and comments

39.6 / 87.5 - 40.7 / 86.4m: clay coated joint
40.4 / 86.7 - 40.4 / 86.7m: clay coated joint
41.7 / 85.4m: JT SV IR T CN
41.8 / 85.3 - 41.8 / 85.3m: fractured zone

file: 21-195 gint.gpj

GROUNDED ENGINEERING

Date Started : Feb 7, 2022
Position : E: 634407, N: 4841779 (UTM 17T)
Elev. Datum : Geodetic

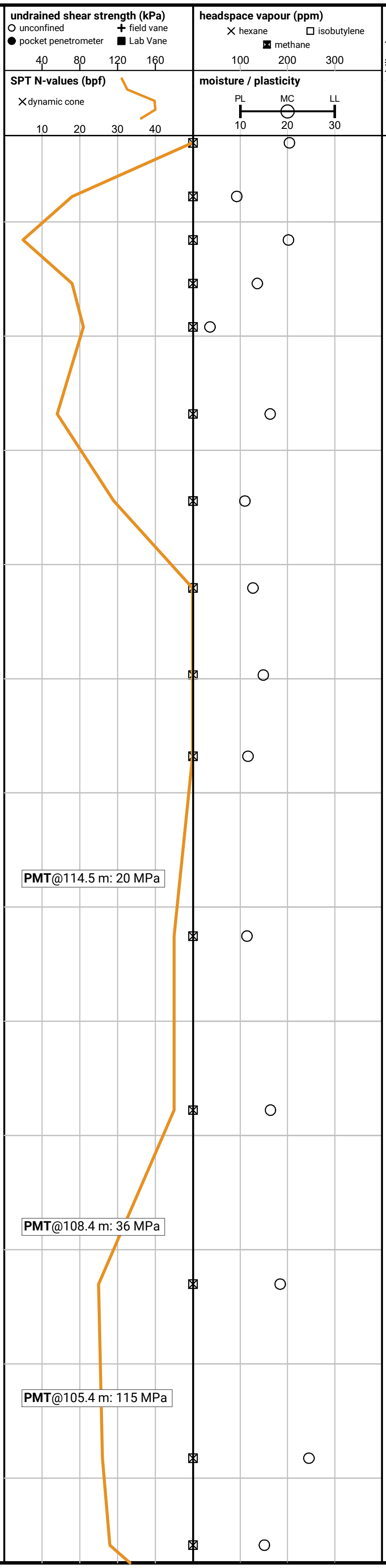
BOREHOLE LOG 8

File No. : 21-195 | **Project** : 48 Grenoble Drive, Toronto, ON | **Client** : Tenblock

drill method : Truck-mounted rig
hollow stem augers OD=215 mm
mud rotary small OD=100 mm

elev depth (m)	description
127.5	**GROUND SURFACE**
	50mm **ASPHALT**
	50mm **AGGREGATE**
	FILL, silty sand, some clay, trace gravel, trace asphalt, very dense, dark brown, wet ...at 0.8 m, compact, moist ...at 1.5 m, loose
125.2 2.3	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist ...at 4.6 m, wet ...at 6.1 m, silty sand, some gravel, grey
119.9 7.6	**SANDY SILT**, trace clay, trace gravel, very dense to dense, grey, moist (GLACIAL TILL) ...at 10.7 m, sand seam ...at 16.8 m, some clay
107.7 19.8	**SILT AND CLAY**, trace sand, very stiff, grey, moist ...at 22.9 m, wet ...at 24.4 m, sandy

number	type	SPT N-value	lab data and comments
1	SS	50 / 100mm	SS1: PAHs
2	SS	18	SS2: EC/SAR, H-Ms, Metals, ORPs, pH
3	SS	5	SS3: BTEX, PHCs, VOCs
4	SS	18	SS4: PAHs
5	SS	21	SS5: EC/SAR, H-Ms, Metals, ORPs, pH
6	SS	14	
7	SS	29	SS7: BTEX, PHCs
8	SS	63	SS8: VOCs
9	SS	61	
10	SS	89 / 250mm	
1	PMT		
11	SS	45	
2	PMT		
12	SS	45	
3	PMT		
13	SS	25	
4	PMT		
14	SS	26	
15	SS	28	



depth scale (m) | well details | elevation (m) | unstabilized water level | grain size distribution (%) (MIT) GR SA SI CL

(continued next page)

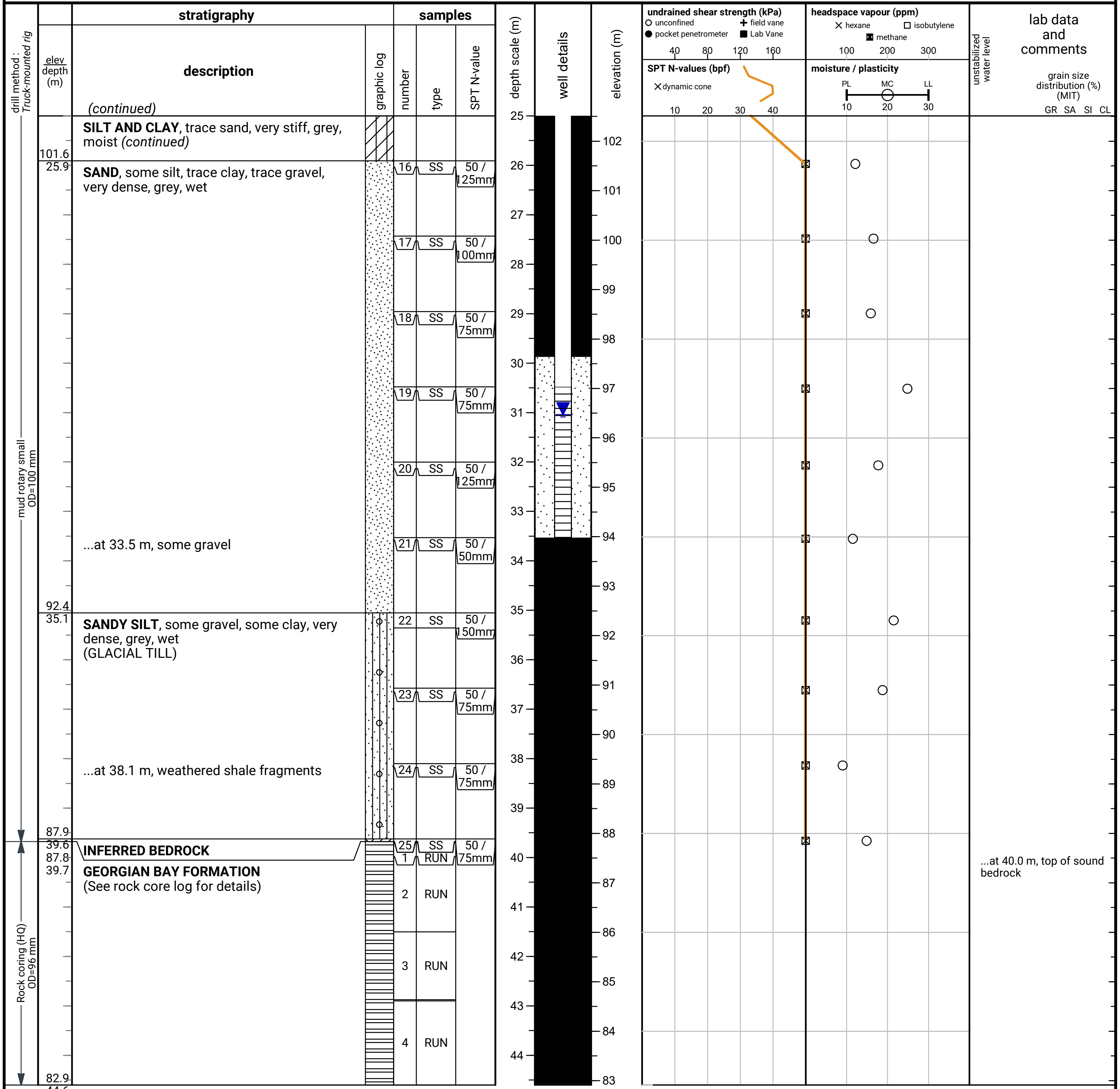
Date Started : Feb 7, 2022
Position : E: 634407, N: 4841779 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 8

File No. : 21-195

Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock



elev depth (m)	description
	(continued)
	SILT AND CLAY, trace sand, very stiff, grey, moist *(continued)*
101.6 25.9	**SAND**, some silt, trace clay, trace gravel, very dense, grey, wet ...at 33.5 m, some gravel
92.4 35.1	**SANDY SILT**, some gravel, some clay, very dense, grey, wet (GLACIAL TILL) ...at 38.1 m, weathered shale fragments
87.9 39.6	**INFERRED BEDROCK**
87.8 39.7	**GEORGIAN BAY FORMATION** (See rock core log for details)
82.9 44.6	**END OF BOREHOLE**

number	type	SPT N-value
16	SS	50 / 125mm
17	SS	50 / 100mm
18	SS	50 / 75mm
19	SS	50 / 75mm
20	SS	50 / 125mm
21	SS	50 / 50mm
22	SS	50 / 150mm
23	SS	50 / 75mm
24	SS	50 / 75mm
25	SS	50 / 75mm
1	RUN	
2	RUN	
3	RUN	
4	RUN	

...at 40.0 m, top of sound bedrock

END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 18, 2022	30.7	96.8
Feb 23, 2022	31.0	96.5

Tech : OM | **PM** : KM/SP | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Feb 7, 2022
Position : E: 634407, N: 4841779 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 8

File No. : 21-195
Project : 48 Grenoble Drive, Toronto, ON
Client : Tenblock

stratigraphy

Rock coring started at 39.7m below grade

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded, weak; joints are horizontal, gapped, clean, planar;

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

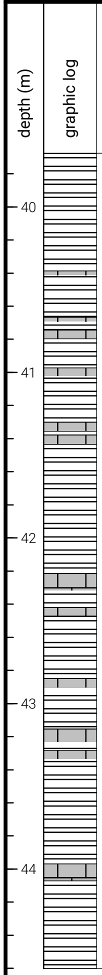
Overall shale: 86%, limestone: 14%
... at 40.0 m (Elev. 87.5 m), transition to sound rock

Run 2 : 17% limestone, 83% shale

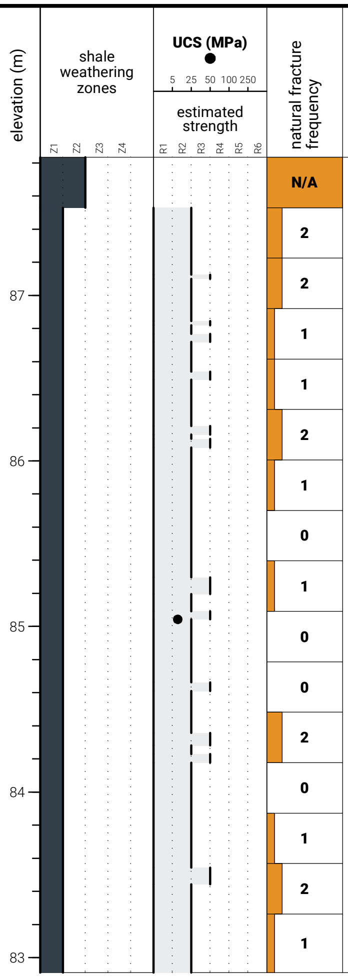
Run 3 : 15% limestone, 85% shale

Run 4 : 13% limestone, 87% shale

END OF COREHOLE



Run	elev / depth (m)	recovery
	87.8	
R1	39.7 – 40.0	TCR = **0%** SCR = **0%** RQD = **0%**
R2	86.0	TCR = **97%** SCR = **87%** RQD = **70%**
R3	41.5 – 84.6	TCR = **89%** SCR = **87%** RQD = **73%**
R4	42.9 – 82.9	TCR = **99%** SCR = **61%** RQD = **37%**
	44.6m	



laboratory testing

El. 85.0m: UCS = 10.6 MPa

notes and comments

R1 not recovered

40.9 / 86.6m: clay coated joint

43.9 / 83.6m: FC SV

44.5 / 83.0m: FC SV

elevation (m): 87, 86, 85, 84, 83

file: 21-195 gint.gpi

Tech : OM | **PM** : KM/SP | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Feb 11, 2022
Position : E: 634451, N: 4841812 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 9

File No. : 21-195

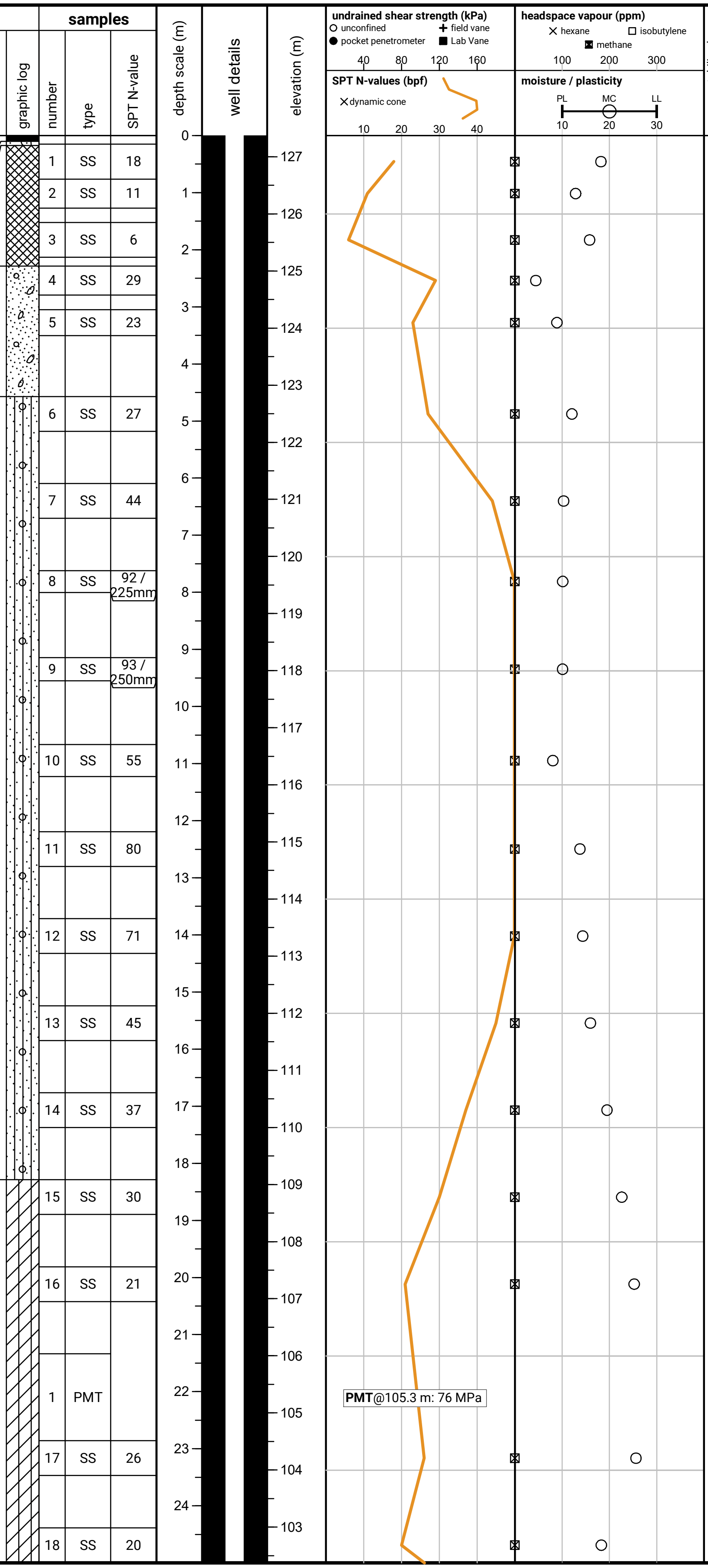
Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock

drill method : CME 55

drill method	elev depth (m)	description	graphic log
	127.4	**GROUND SURFACE**	
hollow stem augers OD=215 mm		100mm **ASPHALT**	
		80mm **AGGREGATE**	
		FILL, silty sand, some clay, trace gravel, trace organics, trace brick fragments, compact, dark brown, moist ...at 1.5 m, loose	
	125.1 2.3	**GRAVELLY SAND**, some silt, trace clay, compact, brown, moist	
mud rotary small OD=100 mm	122.8 4.6	**SANDY SILT**, some clay, trace gravel, compact, grey, moist (GLACIAL TILL) ...at 6.1 m, dense ...at 7.6 m, trace clay, very dense to dense ...at 16.8 m, some clay	
	109.1 18.3	**SILT AND CLAY**, trace sand, very stiff, grey, wet ...at 24.4 m, some sand	

number	type	SPT N-value
1	SS	18
2	SS	11
3	SS	6
4	SS	29
5	SS	23
6	SS	27
7	SS	44
8	SS	92 / 225mm
9	SS	93 / 250mm
10	SS	55
11	SS	80
12	SS	71
13	SS	45
14	SS	37
15	SS	30
16	SS	21
1	PMT	
17	SS	26
18	SS	20



unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH

SS2: BTEX, PHCs, VOCs

SS4: EC/SAR, H-Ms, Metals, ORPs, PAHs, pH

SS6: BTEX, PHCs

SS7: VOCs

file: 21-195 gint.gpj

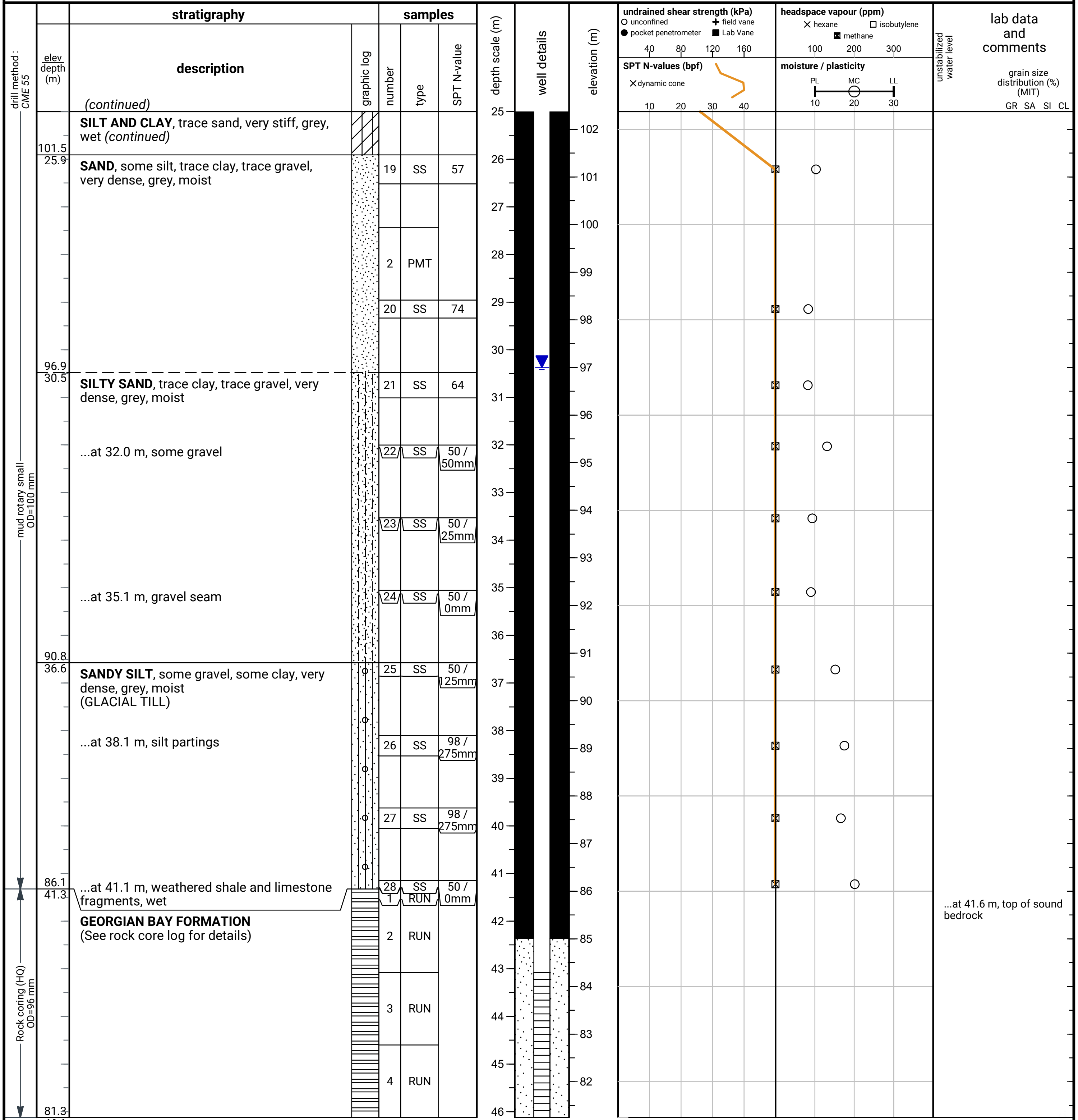
Tech : FR | **PM** : KM/SP | **Rev** : MD

(continued next page)

Date Started : Feb 11, 2022
Position : E: 634451, N: 4841812 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 9

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock



drill method : CME 55

depth (m)	drill method
25.0 to 41.3	mud rotary small OD=100 mm
41.3 to 46.1	Rock coring (HQ) OD=96 mm

elev depth (m)	description
	SILT AND CLAY, trace sand, very stiff, grey, wet *(continued)*
101.5 25.9	**SAND**, some silt, trace clay, trace gravel, very dense, grey, moist
96.9 30.5	**SILTY SAND**, trace clay, trace gravel, very dense, grey, moist ...at 32.0 m, some gravel ...at 35.1 m, gravel seam
90.8 36.6	**SANDY SILT**, some gravel, some clay, very dense, grey, moist (GLACIAL TILL) ...at 38.1 m, silt partings ...at 41.1 m, weathered shale and limestone fragments, wet
86.1 41.3	**GEORGIAN BAY FORMATION** (See rock core log for details)
81.3 46.1	**END OF BOREHOLE**

number	type	SPT N-value
19	SS	57
2	PMT	
20	SS	74
21	SS	64
22	SS	50 / 50mm
23	SS	50 / 25mm
24	SS	50 / 0mm
25	SS	50 / 125mm
26	SS	98 / 275mm
27	SS	98 / 275mm
28	SS	50 / 0mm
1	RUN	
2	RUN	
3	RUN	
4	RUN	

...at 41.6 m, top of sound bedrock

END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 18, 2022	30.3	97.1
Feb 24, 2022	30.4	97.0

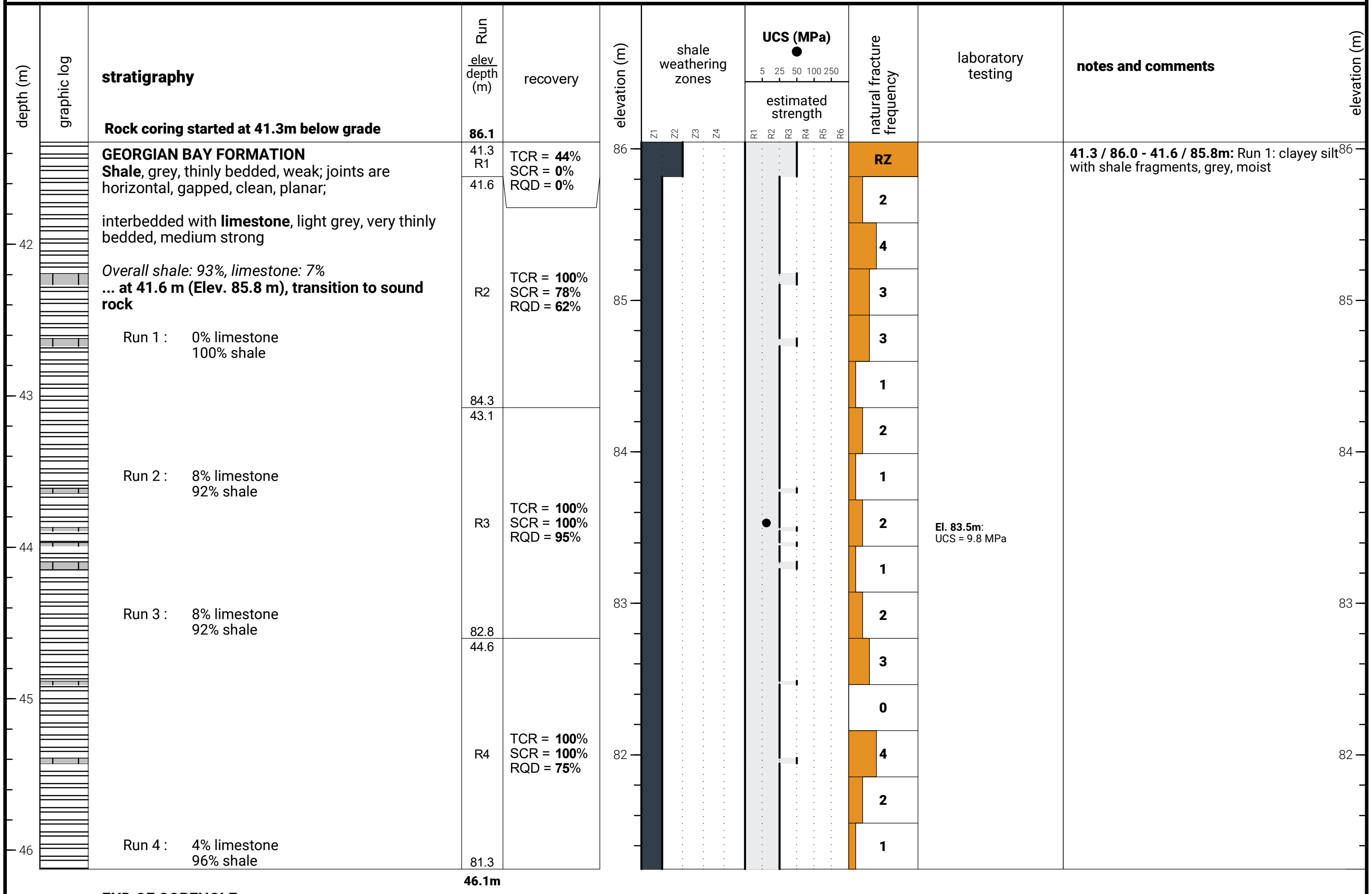
Date Started : Feb 11, 2022
Position : E: 634451, N: 4841812 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 9

File No. : 21-195

Project : 48 Grenoble Drive, Toronto, ON

Client : Tenblock



stratigraphy

Rock coring started at 41.3m below grade

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded, weak; joints are horizontal, gapped, clean, planar;

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

Overall shale: 93%, limestone: 7%
... at 41.6 m (Elev. 85.8 m), transition to sound rock

Run 1 : 0% limestone
100% shale

Run 2 : 8% limestone
92% shale

Run 3 : 8% limestone
92% shale

Run 4 : 4% limestone
96% shale

END OF COREHOLE

Run	elev / depth (m)	recovery
	86.1	
R1	41.3 – 41.6	TCR = **44%** SCR = **0%** RQD = **0%**
R2	41.6 – 84.3	TCR = **100%** SCR = **78%** RQD = **62%**
R3	43.1 – 82.8	TCR = **100%** SCR = **100%** RQD = **95%**
R4	44.6 – 81.3	TCR = **100%** SCR = **100%** RQD = **75%**
	46.1m	

laboratory testing

El. 83.5m:
UCS = 9.8 MPa

notes and comments

41.3 / 86.0 - 41.6 / 85.8m: Run 1: clayey silt with shale fragments, grey, moist

file: 21-195 gint.gpj

Tech : FR | **PM** : KM/SP | **Rev** : MD

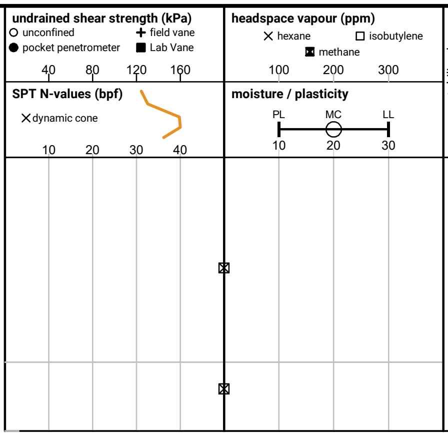
GROUNDED ENGINEERING

Date Started : Jan 21, 2022
Position : E: 634386, N: 4841735 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 10

File No. : 21-195
Project : 48 Grenoble Drive, Toronto, ON
Client : Tenblock

drill method : *Manual methods*	elev depth (m)	stratigraphy: description	graphic log	samples: number	samples: type	samples: SPT N-value	depth scale (m)	well details	elevation (m)	unstabilized water level	lab data and comments grain size distribution (%) (MIT) GR SA SI CL
hand augers	125.7	**GROUND SURFACE**					0.0				
		75mm **TOPSOIL**									
		FILL, silty sand, some clay, trace gravel, trace organics, brown, moist							125.5		
				1	GS		0.5				GS1: BTEX, EC/SAR, H-Ms, Metals, ORPs, PCBs, pH, PHCs
				2	GS				125.0		GS2: PCBs
	124.7 1.0										



END OF BOREHOLE

Dry and open upon completion of drilling.

file: 21-195 gint.gpj

Tech : FR | **PM** : KM/SP | **Rev** : MD

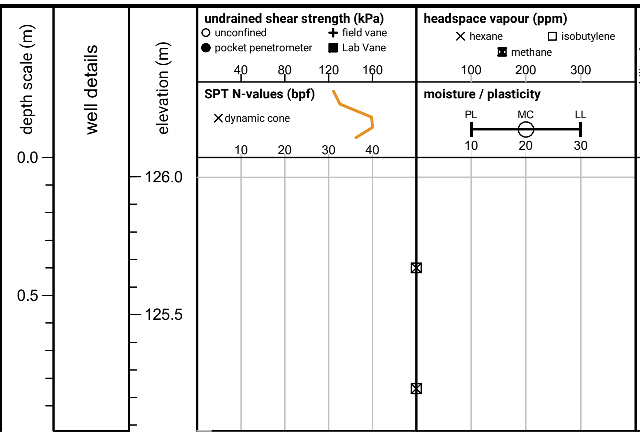
GROUNDED ENGINEERING

Date Started : Jan 21, 2022
Position : E: 634370, N: 4841759 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 11

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : *Manual methods*	elev depth (m)	stratigraphy description	graphic log	samples number	type	SPT N-value	lab data and comments
	126.1	**GROUND SURFACE**					
hand augers		75mm **TOPSOIL**					
		FILL, sandy silt, trace clay, trace gravel, trace organics, brown, wet		1	GS		GS1: BTEX, EC/SAR, H-Ms, Metals, ORPs, PCBs, pH, PHCs
		...at 0.7 m, moist		2	GS		GS2: PCBs
	125.1 1.0						



END OF BOREHOLE

Dry and open upon completion of drilling.

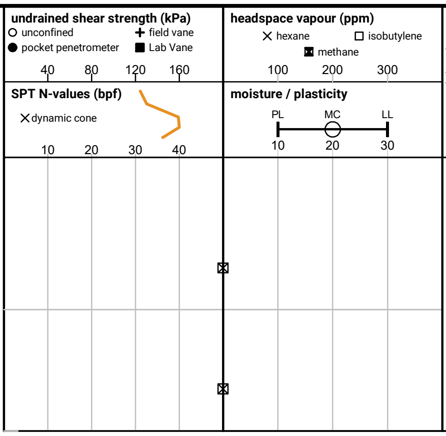
GROUNDED ENGINEERING

Date Started : Jan 21, 2022
Position : E: 634363, N: 4841776 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 12

File No. : 21-195 **Project** : 48 Grenoble Drive, Toronto, ON **Client** : Tenblock

drill method : *Manual methods*	elev / depth (m)	stratigraphy: description	graphic log	samples: number	samples: type	samples: SPT N-value	depth scale (m)	well details	elevation (m)	unstabilized water level	lab data and comments / grain size distribution (%) (MIT) GR SA SI CL
	125.6	**GROUND SURFACE**					0.0				
hand augers		75mm **TOPSOIL**							125.5		
		FILL, sandy silt, trace clay, trace gravel, trace organics, brown, moist		1	GS		0.5		125.0		GS1: BTEX, EC/SAR, H-Ms, Metals, ORPs, PCBs, pH, PHCs
				2	GS						GS2: PCBs
	124.6 1.0										



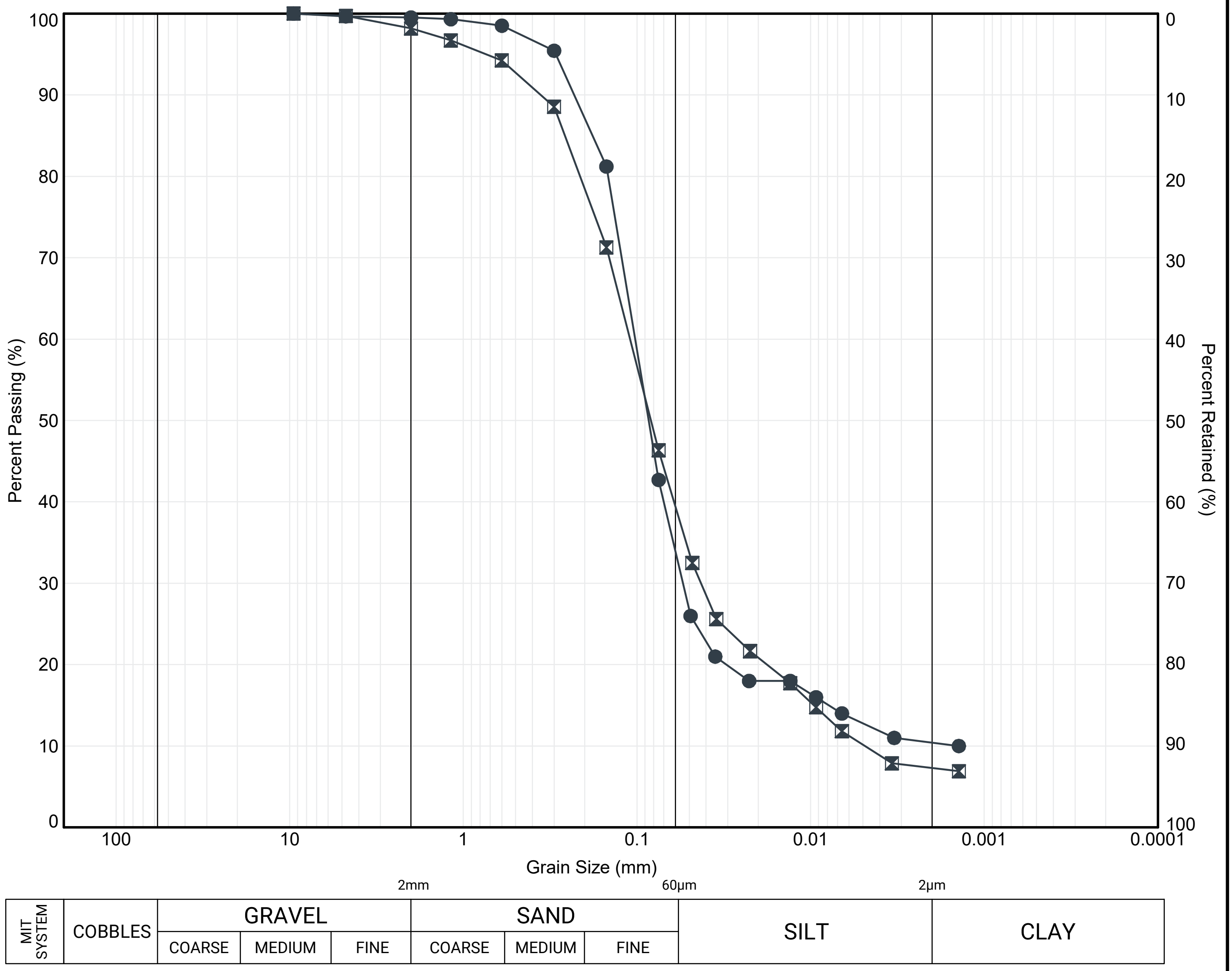
END OF BOREHOLE

Dry and open upon completion of drilling.

file: 21-195 gint.gpi

Tech : FR | **PM** : KM/SP | **Rev** : MD

APPENDIX B



MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**2**	SS3	1.8	125.3	1	65	24	10
☒	**7**	SS3	1.8	125.3	2	59	32	7

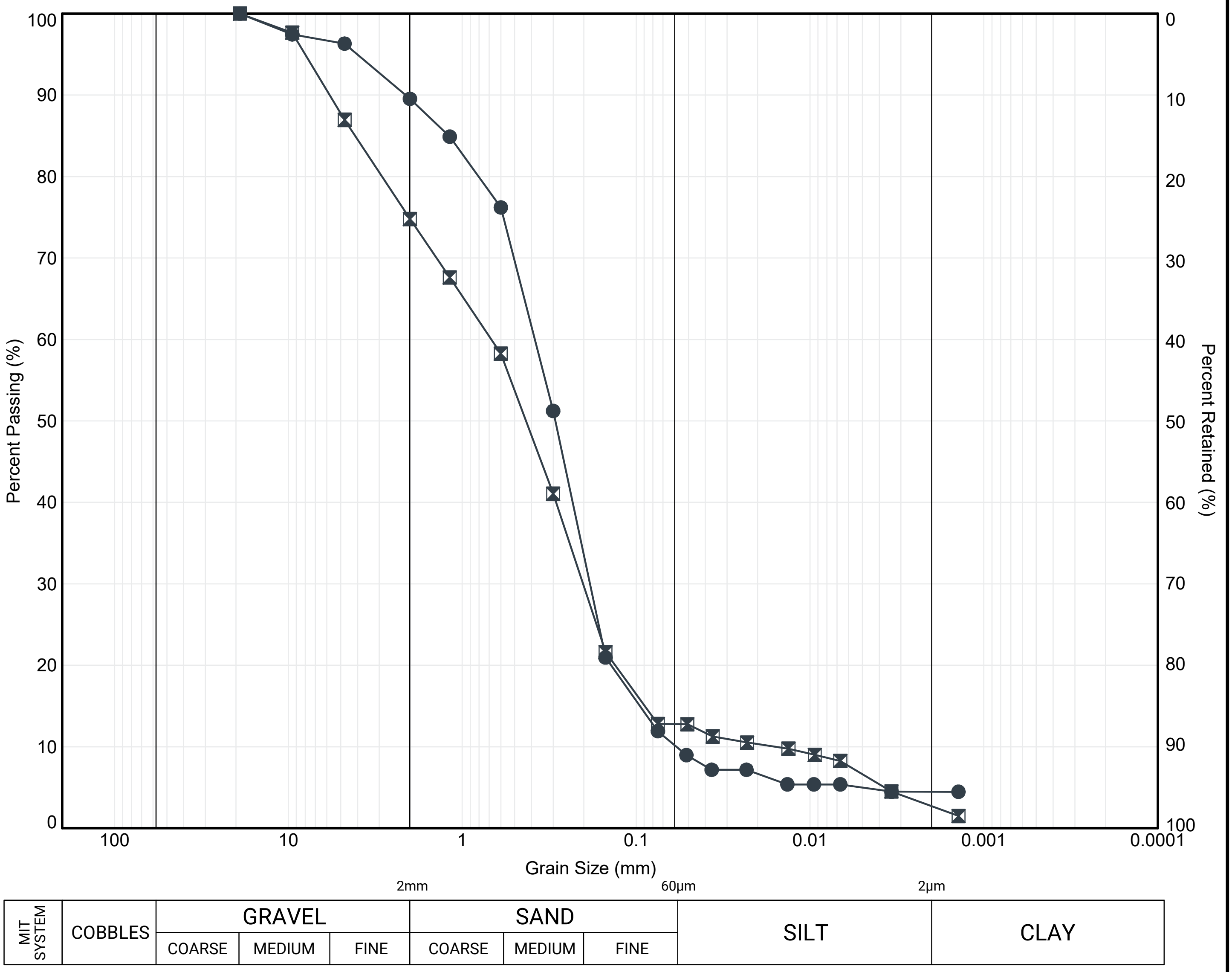
GROUNDED
ENGINEERING

Title:

GRAIN SIZE DISTRIBUTION
EARTH FILL

File No.: **21-195**

file: 21-195 gint.gpi



MIT SYSTEM

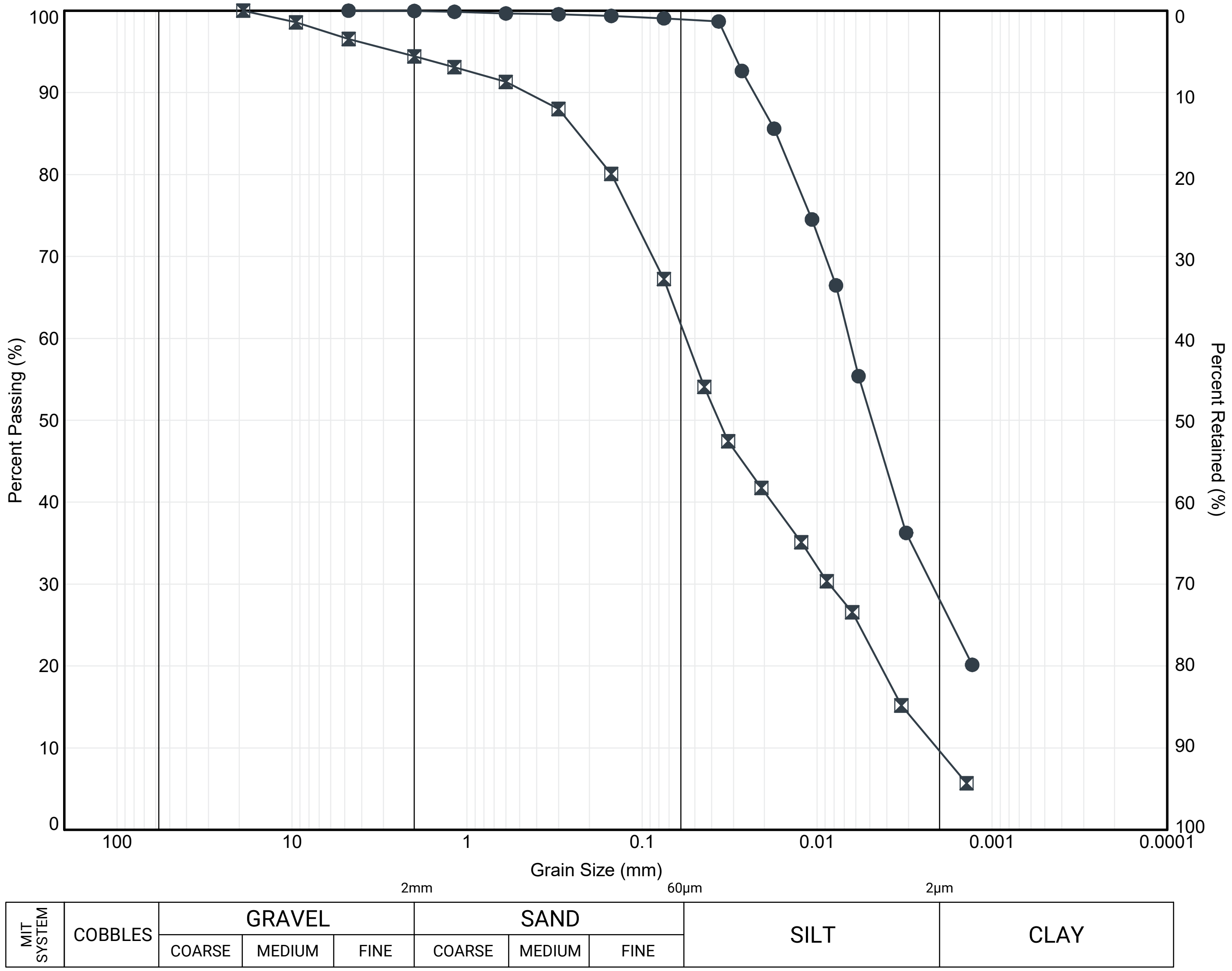
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**1**	SS3	1.8	125.1	11	78	6	5
☒	**1**	SS4	2.6	124.3	25	62	10	3

GROUNDED
ENGINEERING

Title:

GRAIN SIZE DISTRIBUTION
UPPER SANDS

File No.: **21-195**



					MIT SYSTEM			
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**2**	SS8	7.9	119.2	0	1	71	28
☒	**3**	SS12	14.0	113.7	6	32	52	10

GROUNDED
ENGINEERING

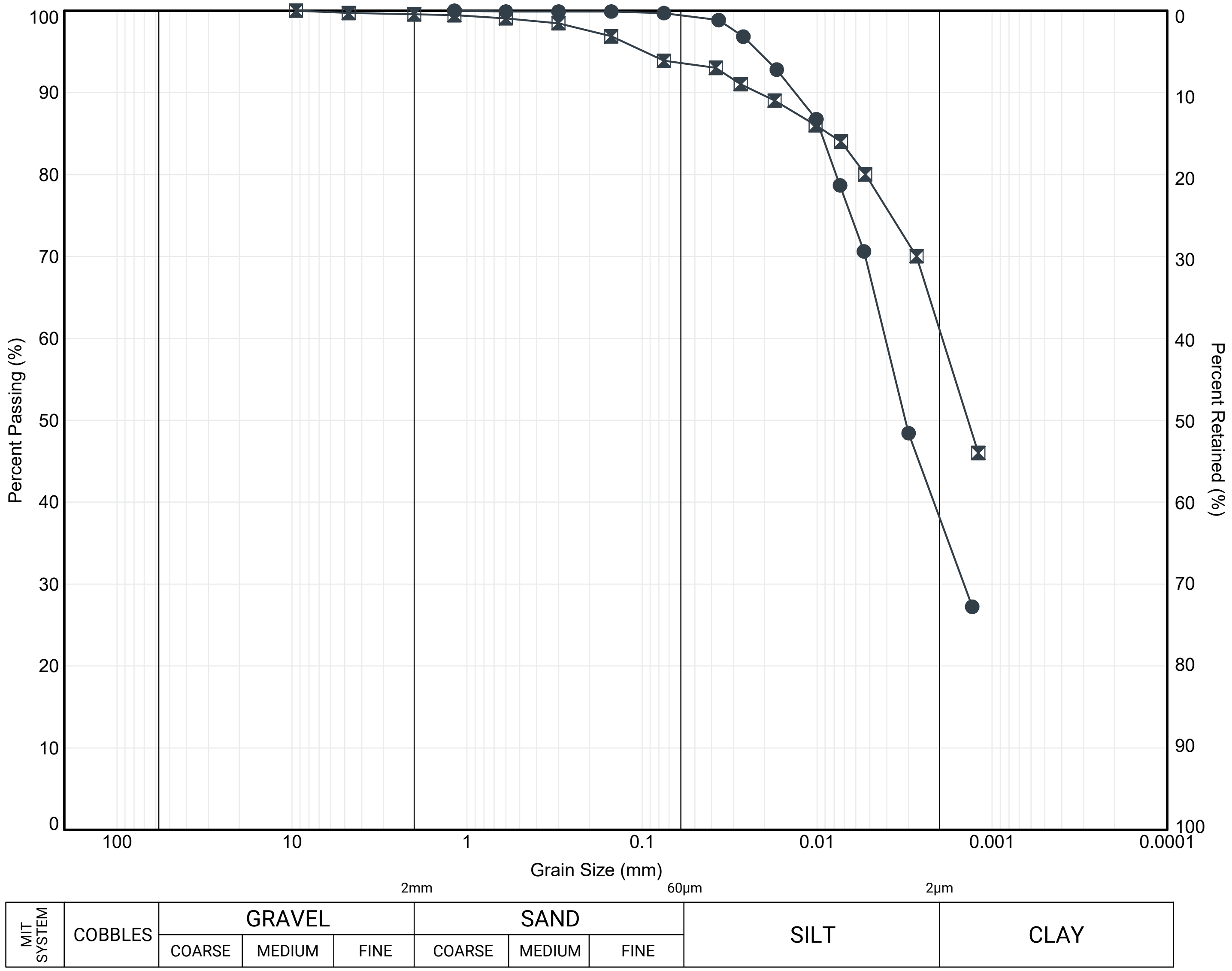
Title:

GRAIN SIZE DISTRIBUTION
UPPER TILLS

File No.:

21-195

file: 21-195 gint.gpj



MIT SYSTEM

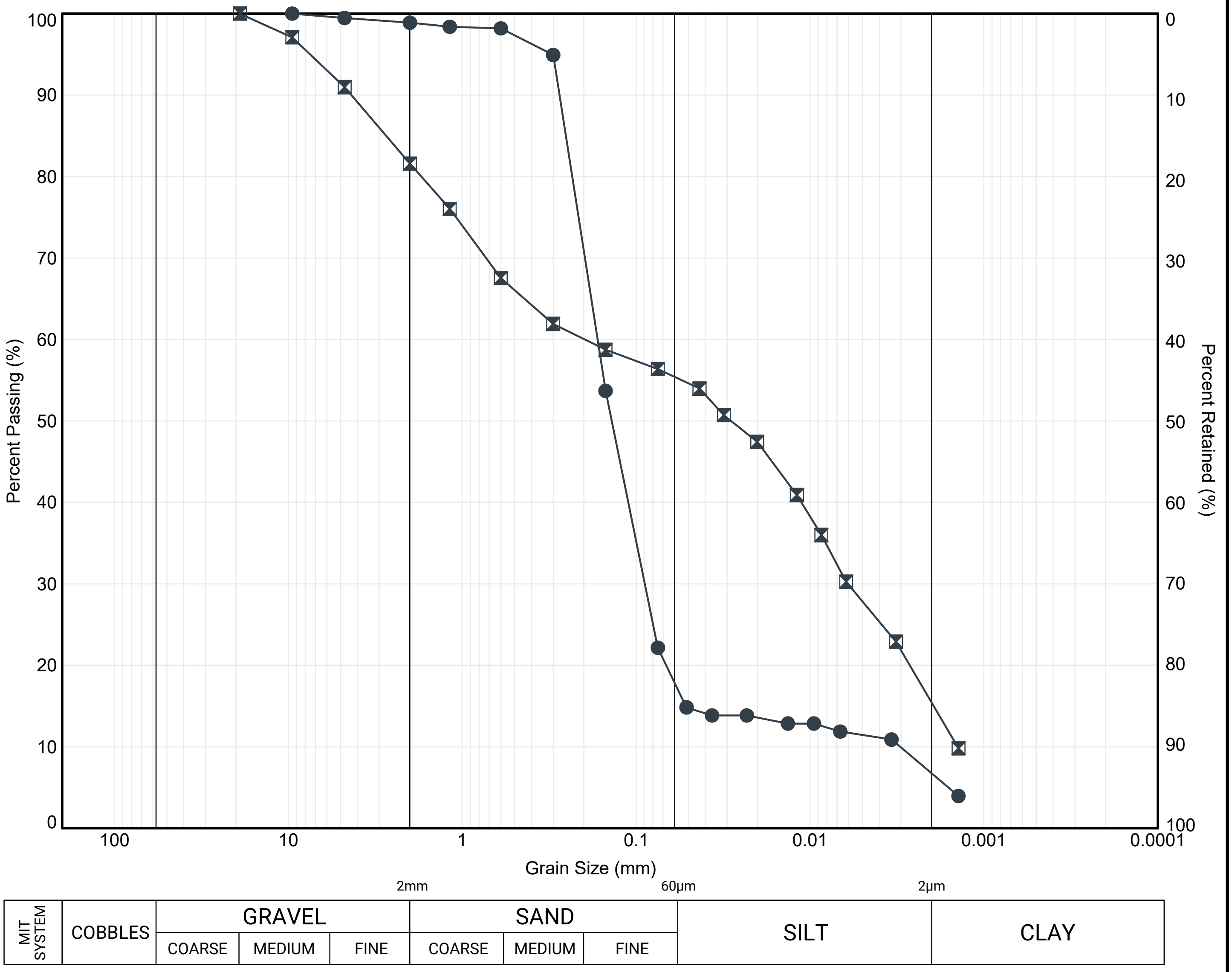
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**4**	SS15	18.6	109.0	0	1	61	38
☒	**7**	SS17	21.6	105.5	0	6	33	61

GROUNDED
ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
SILTS AND CLAYS

File No.: **21-195**

file: 21-195 gint.gpi



					MIT SYSTEM			
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**7**	SS22	29.0	98.1	1	81	11	7
☒	**7**	SS26	38.2	88.9	18	26	40	16

GROUNDED
ENGINEERING

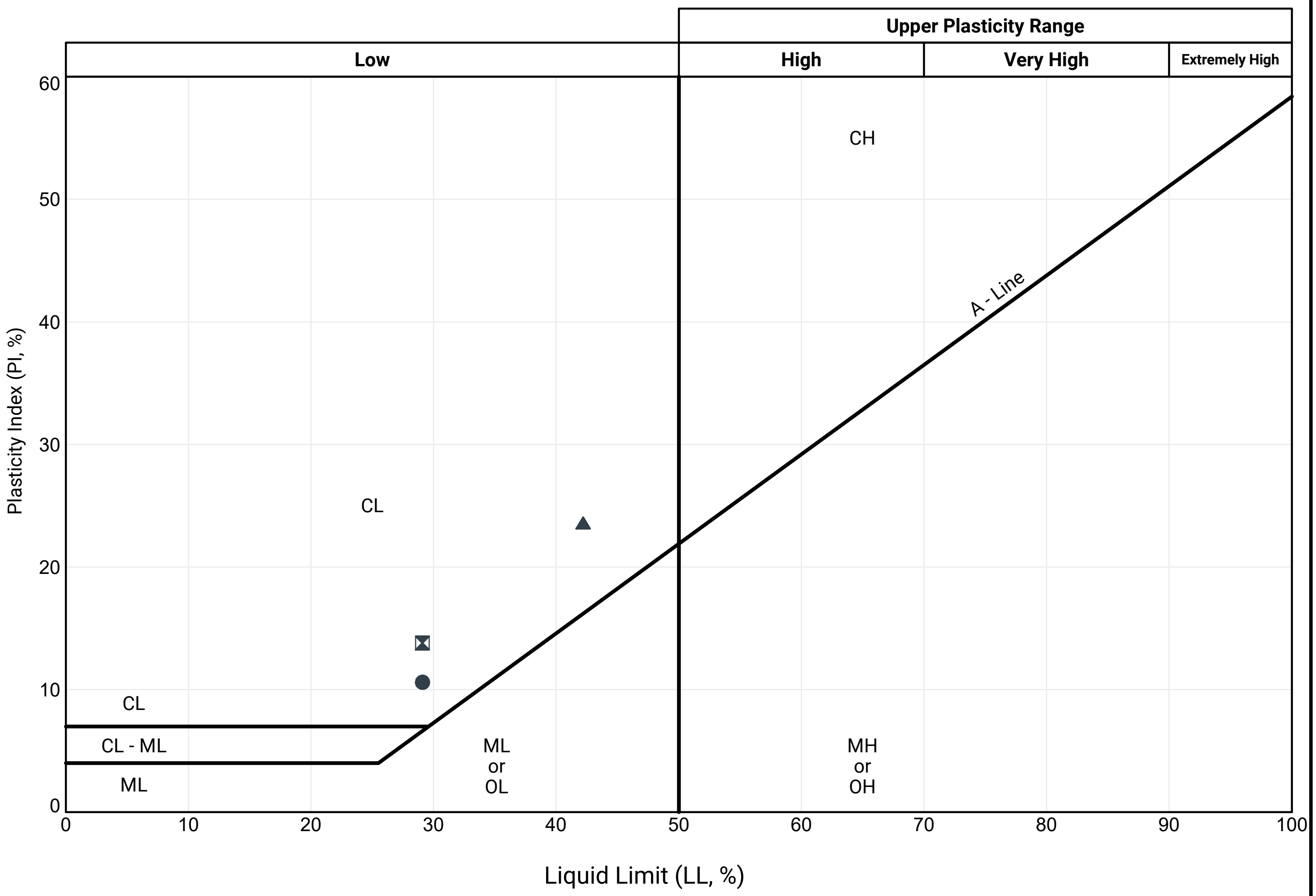
Title:

GRAIN SIZE DISTRIBUTION
LOWER COHESIONLESS

File No.:

21-195

file: 21-195 gint.gpi



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	**2**	SS8	7.9	119.2	29	19	11
⧗	**4**	SS15	18.6	109.0	29	15	14
▲	**7**	SS17	21.6	105.5	42	19	23

GROUNDED
ENGINEERING

Title:

ATTERBERG LIMITS CHART

File No.: **21-195**

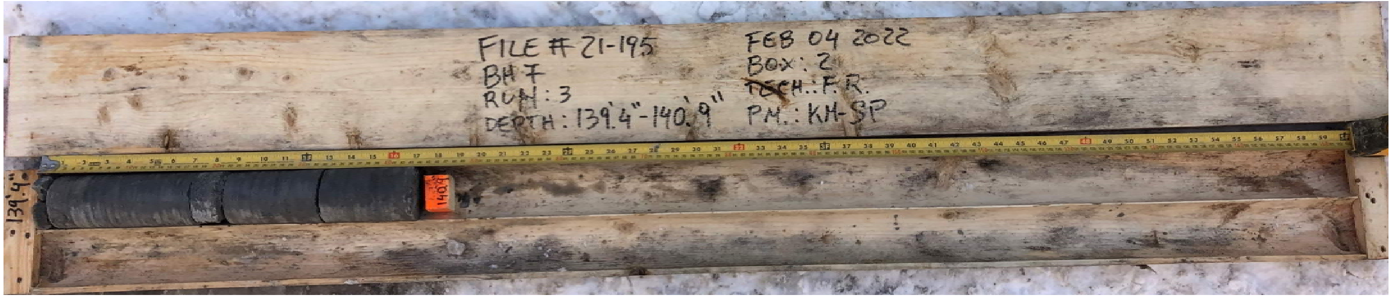
file: 21-195 gint.gpj

APPENDIX C

Borehole 7 – Box 1

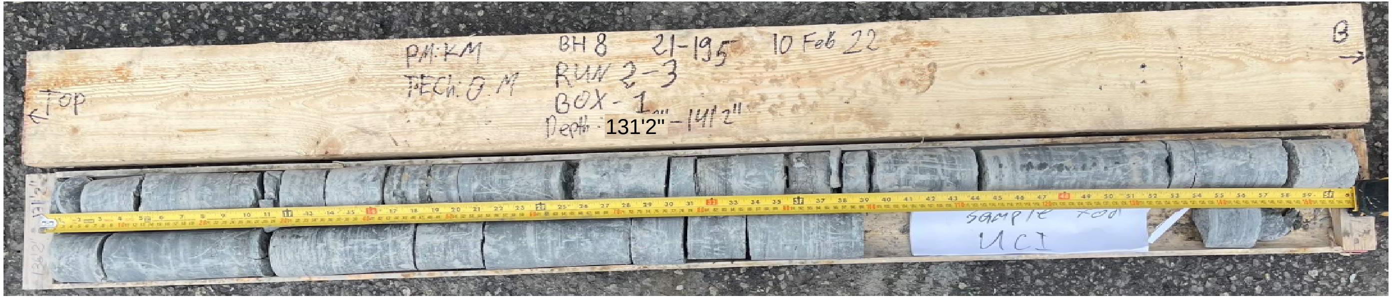
Depth: 39.6 to 42.5 m below grade (Elev. 87.5 to 84.6 m)

Borehole 7 – Box 2



Depth: 42.5 to 42.9 m below grade (Elev. 84.6 to 84.2 m)

Borehole 8 – Box 1

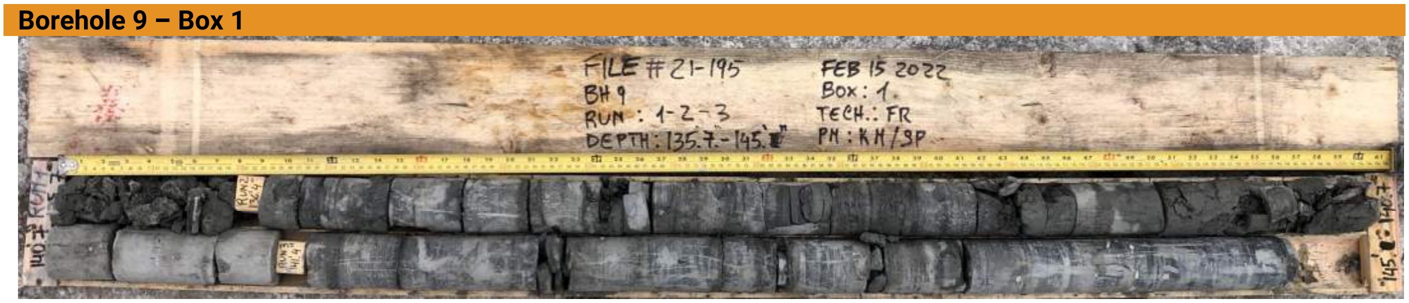


Depth: 39.7 to 43.0 m below grade (Elev. 87.8 to 84.5 m)

Borehole 8 – Box 2

Depth: 43.0 to 44.6 m below grade (Elev. 84.5 to 82.9 m)

Borehole 9 – Box 1



Depth: 41.3 to 44.2 m below grade (Elev. 86.1 to 83.2 m)

Borehole 9 – Box 2

Depth: 44.2 to 46.1 m below grade (Elev. 83.2 to 81.3 m)

APPENDIX D

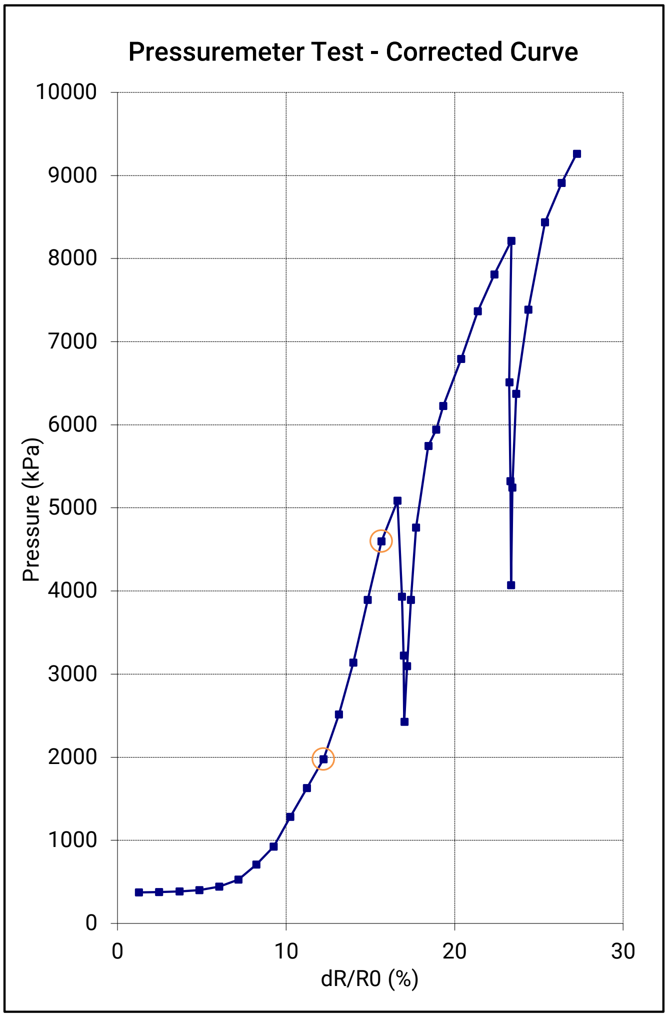
TEXAM Pressuremeter Test Results

Project name:	**[21-195] 48 Grenoble Dr, Toronto**
Borehole name:	**BH7**
Test date: (dd/mm/yyyy)	03/02/2022
Test number:	21-195_bh7_107
Probe Designation	N Probe (76 mm OD)

Drilling Method:	Mud Rotary Drilling
Test depth:	32.8 m
Test Elev:	94.4 m
Poisson's ratio:	0.33
Probe initial volume:	1624 cm^3

Raw Readings		Corrected Readings			
Pressure kPa	Volume cm³	Pressure kPa	Volume cm³	DR/R_0 %	
54	41.9	373	41.2	1.26	
65	81.7	378	80.9	2.46	
76	122.4	386	121.5	3.67	
94	162.3	400	161.2	4.84	
141	203.5	444	201.8	6.03	
227	244.0	528	241.2	7.17	
410	283.3	708	278.3	8.23	
628	322.5	924	314.8	9.26	
990	362.3	1284	350.1	10.25	
1336	402.0	1628	385.6	11.24	
1687	441.8	1978	421.1	12.22	◄
2225	481.9	2516	454.6	13.13	
2849	521.3	3139	486.4	13.99	
3605	561.9	3894	517.7	14.84	
4310	601.1	4599	548.3	15.65	◄
4799	642.8	5087	584.0	16.60	
3643	639.3	3931	594.6	16.88	
2935	634.3	3223	598.3	16.98	
2139	625.9	2427	599.7	17.01	
2811	640.5	3099	606.1	17.18	
3607	659.0	3894	614.7	17.41	
4476	681.2	4763	626.3	17.71	
5460	721.2	5746	654.3	18.44	
5655	741.5	5941	672.2	18.90	
5940	761.3	6226	688.5	19.33	
6508	802.7	6794	729.5	20.38	
7081	841.8	7366	768.5	21.37	
7527	881.0	7811	807.7	22.36	
7932	921.1	8216	847.9	23.37	
6228	916.1	6512	842.8	23.24	
5040	906.9	5324	845.1	23.30	
3788	893.5	4072	847.1	23.35	◄Er
4960	911.0	5244	850.2	23.43	
6091	932.4	6375	859.1	23.65	◄Er
7103	961.7	7387	888.4	24.38	
8153	1001.7	8436	928.5	25.36	
8628	1041.9	8911	968.7	26.35	
8980	1079.0	9263	1005.7	27.25	

Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719


Pressuremeter Test - Corrected Curve

Interpreted Test Results

Epmt:	115,605 kPa
Ep-ur	772,656 kPa
Ey:	**250 MPa**
Ey-ur:	**1671 MPa**
Pl:	12,198 kPa
Ep / Pl:	9.5
Py:	4,599 kPa
Poh (est.) :	**340 kPa**
K_0 (est):	**0.66**

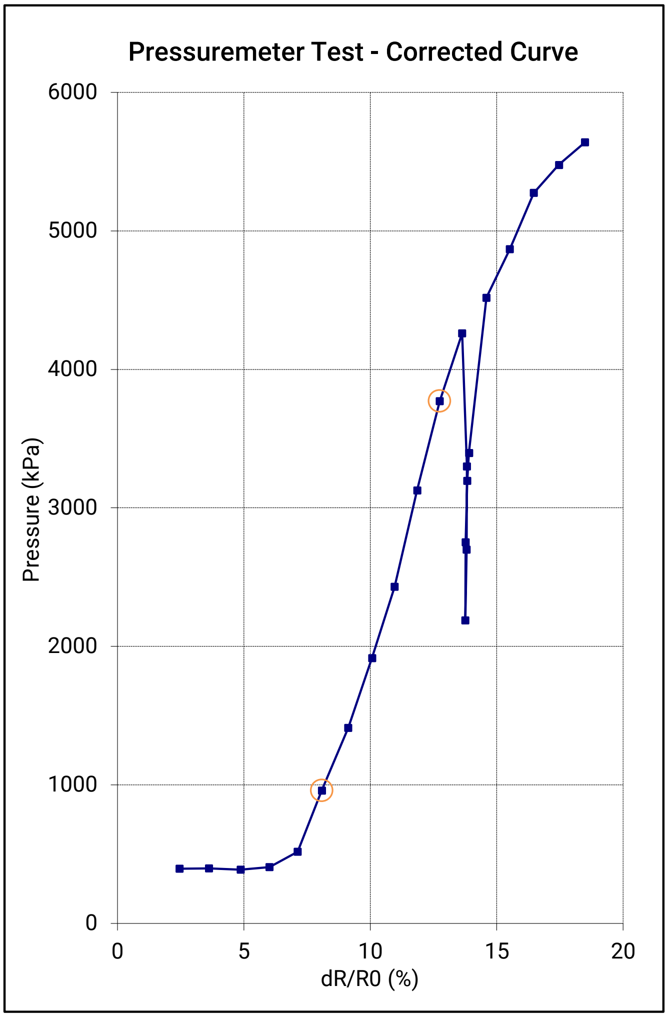
TEXAM COMPANION V.3.4.25

TEXAM Pressuremeter Test Results

GROUNDED ENGINEERING

Project name:	**[21-195] 48 Grenoble Dr, Toronto**	Drilling Method:	Mud Rotary Drilling
Borehole name:	**BH7**	Test depth:	35.8 m
Test date: (dd/mm/yyyy)	03/02/2022	Test Elev:	91.3 m
Test number:	21-195_bh7_117	Poisson's ratio:	0.33
Probe Designation	N Probe (76 mm OD)	Probe initial volume:	1624 cm^3

Raw Readings		**Corrected Readings**			
Pressure kPa	**Volume cm³**	**Pressure kPa**	**Volume cm³**	**DR/R_0 %**	
53	81.1	396	80.5	2.45	
59	120.4	399	119.7	3.62	
52	162.4	388	161.8	4.86	
74	201.8	407	200.9	6.01	
188	241.9	519	239.6	7.12	
631	280.7	959	273.0	8.08	◀
1087	323.2	1413	309.9	9.12	
1592	362.9	1916	343.4	10.06	
2109	401.2	2431	375.3	10.95	
2805	442.1	3126	407.7	11.85	
3450	482.6	3771	440.3	12.74	◀
3941	521.2	4261	472.9	13.63	
2979	516.4	3299	479.9	13.82	
2379	508.5	2699	479.3	13.80	
1868	500.4	2188	477.5	13.75	◀Er
2433	508.0	2753	478.1	13.77	
2876	515.7	3196	480.4	13.83	
3076	520.7	3396	483.0	13.90	◀Er
4199	560.0	4518	508.5	14.59	
4549	598.8	4867	543.0	15.51	
4957	639.6	5275	578.8	16.46	
5160	679.8	5477	616.6	17.46	
5325	721.6	5641	656.3	18.49	



Interpreted Test Results

Epmt:	88,521 kPa
Ep-ur	657,781 kPa
Ey:	**130 MPa**
Ey-ur:	**969 MPa**
Pl:	8,303 kPa
Ep / Pl:	10.7
Py:	3,771 kPa
Poh (est.) :	**375 kPa**
K_0 (est):	**0.68**

Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719

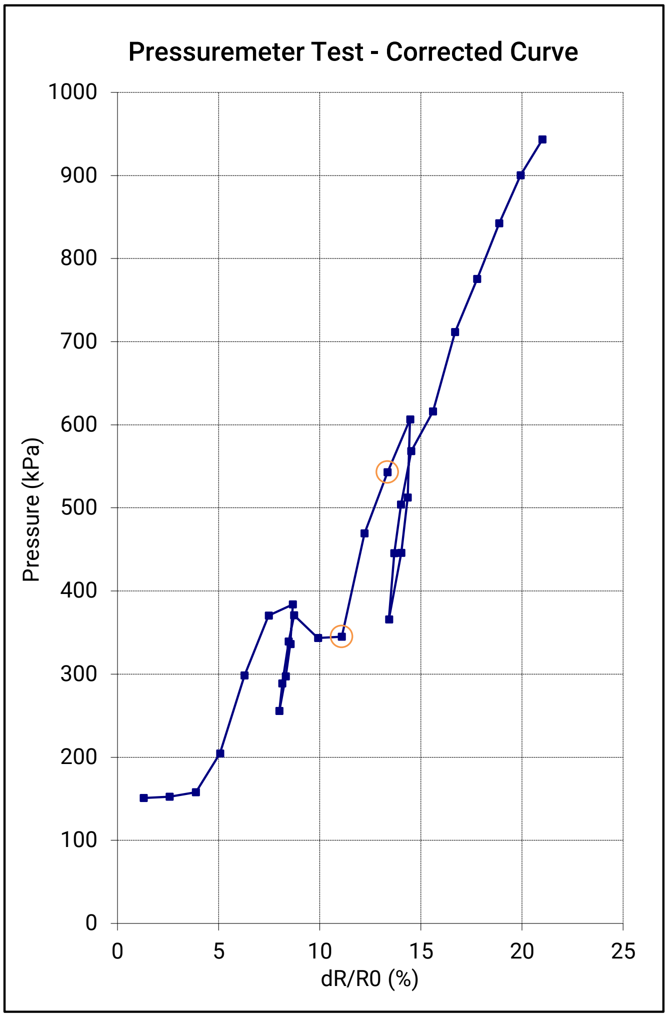
TEXAM COMPANION V.3.4.25

TEXAM Pressuremeter Test Results

Project name: **[21-195] 48 Grenoble Dr, Toronto**
Borehole name: **BH8**
Test date: (dd/mm/yyyy) 07/02/2022
Test number: 21-195 BH8-42
Probe Designation N Probe (76 mm OD)

Drilling Method: Mud Rotary Drilling
Test depth: 13.0 m
Test Elev: 114.6 m
Poisson's ratio: 0.33
Probe initial volume: 1534 cm^3

Raw Readings		Corrected Readings			
Pressure kPa	Volume cm³	Pressure kPa	Volume cm³	DR/R_0 %	
34	40.2	151	39.8	1.29	
41	80.4	153	80.0	2.58	
50	121.4	158	120.9	3.87	
100	160.3	205	159.3	5.07	
197	200.4	299	198.4	6.27	
272	240.3	371	237.7	7.47	
287	280.2	384	277.4	8.67	
239	275.7	336	273.4	8.55	
200	267.6	298	265.6	8.31	
158	256.9	256	255.4	8.01	
191	261.7	289	259.8	8.14	
242	272.8	339	270.4	8.46	
274	282.0	371	279.3	8.73	
248	321.4	343	318.9	9.91	
251	361.2	345	358.8	11.08	◄
377	401.1	470	397.4	12.21	
452	441.0	543	436.6	13.34	◄
517	480.8	607	475.7	14.46	
423	475.5	513	471.4	14.34	
356	464.2	446	460.7	14.03	
275	441.9	366	439.2	13.42	◄Er
355	451.7	446	448.2	13.68	
414	463.8	504	459.8	14.01	
479	482.4	568	477.7	14.52	◄Er
527	520.7	616	515.5	15.59	
623	560.6	712	554.5	16.69	
688	600.6	776	593.9	17.78	
756	640.8	843	633.4	18.87	
815	680.1	901	672.1	19.93	
859	720.1	944	711.7	21.00	



Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719

Interpreted Test Results

Ep-ur 27,692 kPa

Ey-ur: **42 MPa**

Pl: 1,311 kPa
Ep / Pl: 10.0
Py: 543 kPa

Poh (est.) : **151 kPa**
K_0 (est): **0.56**

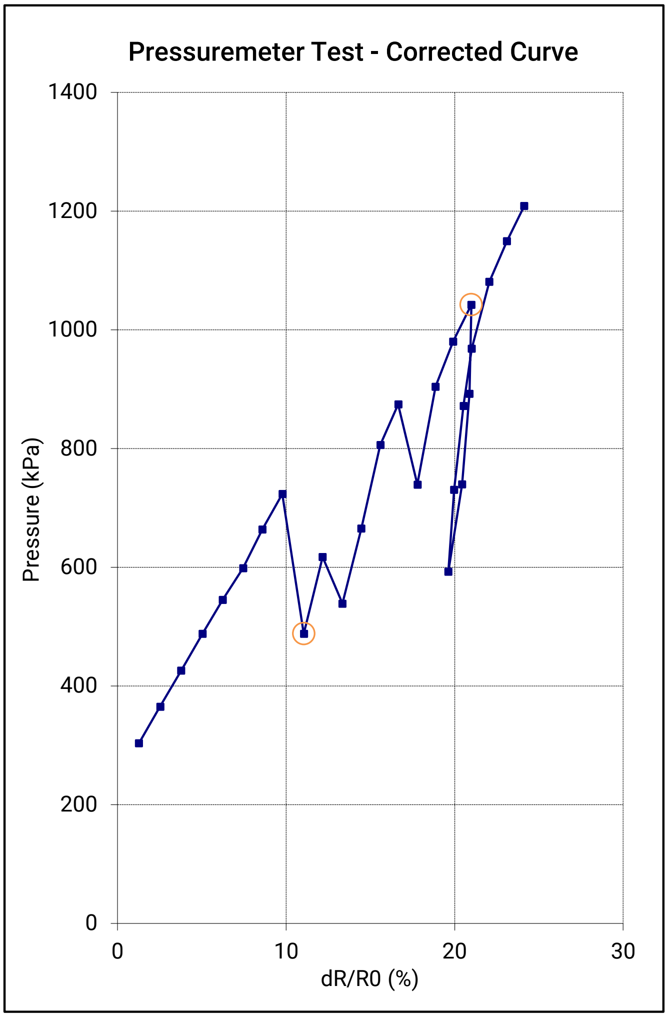
TEXAM COMPANION V.3.4.25

TEXAM Pressuremeter Test Results

GROUNDED
ENGINEERING

Project name:	**[21-195] 48 Grenoble Dr, Toronto**	Drilling Method:	Mud Rotary Drilling
Borehole name:	**BH8**	Test depth:	16.0 m
Test date: (dd/mm/yyyy)	07/02/2022	Test Elev:	111.5 m
Test number:	21-195 BH8-52	Poisson's ratio:	0.33
Probe Designation	N Probe (76 mm OD)	Probe initial volume:	1534 cm^3

Raw Readings		**Corrected Readings**			
Pressure kPa	**Volume cm³**	**Pressure kPa**	**Volume cm³**	**DR/R$_0$ %**	
157	40.5	304	39.0	1.26	
224	80.7	365	78.5	2.53	
288	120.8	426	117.9	3.77	
354	162.3	488	158.8	5.05	
414	201.3	545	197.2	6.24	
470	241.5	598	237.0	7.45	
537	280.4	664	275.1	8.60	
598	320.6	723	314.7	9.78	
364	361.3	488	357.7	11.05	◀
495	400.4	617	395.6	12.16	
418	440.4	539	436.3	13.34	
546	481.1	665	475.8	14.47	
687	522.2	806	515.5	15.59	
756	560.8	874	553.4	16.66	
622	600.5	739	594.4	17.80	
788	640.7	904	633.0	18.86	
865	680.2	980	671.7	19.92	
928	720.5	1042	711.4	20.99	◀
778	714.7	893	707.1	20.88	
625	697.2	740	691.1	20.44	
477	665.8	593	661.2	19.63	◀Er
615	679.9	730	673.9	19.98	
757	701.7	872	694.3	20.53	
854	720.8	968	712.5	21.02	◀Er
967	760.3	1081	750.8	22.05	
1036	800.3	1149	790.1	23.09	
1096	840.1	1209	829.4	24.13	



Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719

Interpreted Test Results

Ep-ur	42,560 kPa
Ey-ur:	**64 MPa**
Pl:	1,483 kPa
Ep / Pl:	5.8
Py:	1,042 kPa
Poh (est.) :	**300 kPa**
K$_0$ (est):	**0.92**

TEXAM Pressuremeter Test Results

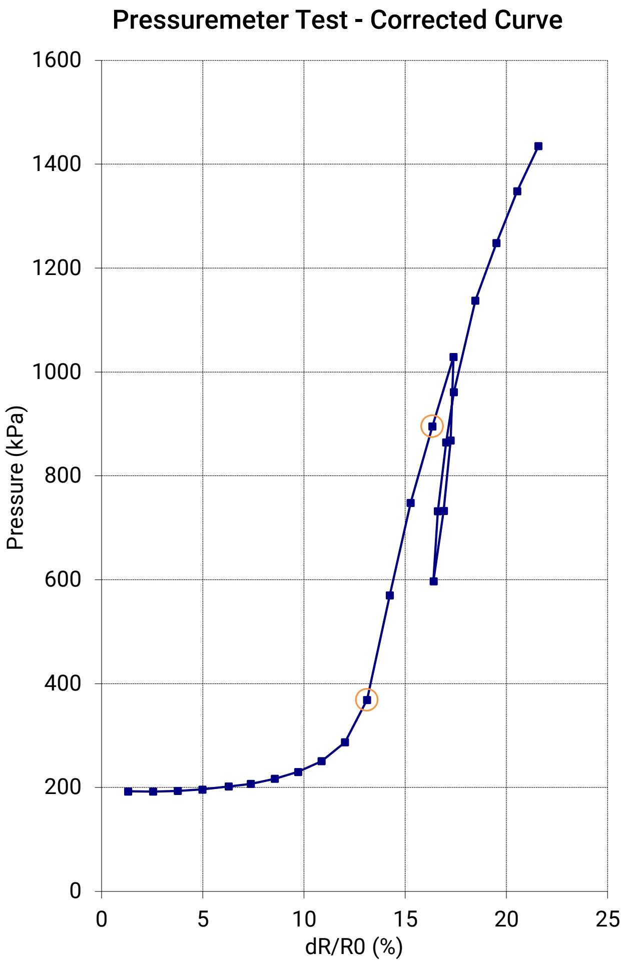
GROUNDED ENGINEERING

Project name:	**[21-195] 48 Grenoble Dr, Toronto**	Drilling Method:	Mud Rotary Drilling
Borehole name:	**BH8**	Test depth:	19.1 m
Test date: (dd/mm/yyyy)	08/02/2022	Test Elev:	108.5 m
Test number:	21-195 BH8-62	Poisson's ratio:	0.33
Probe Designation	N Probe (76 mm OD)	Probe initial volume:	1570 cm^3

Raw Readings		**Corrected Readings**			
Pressure kPa	**Volume cm³**	**Pressure kPa**	**Volume cm³**	**DR/R_0 %**	
16	41.6	193	41.5	1.31	
21	80.7	192	80.6	2.53	
26	120.5	194	120.2	3.76	
32	160.2	196	159.9	4.97	
41	203.7	202	203.3	6.28	
49	240.2	207	239.9	7.37	
60	280.7	217	280.2	8.56	
75	320.2	230	319.6	9.71	
97	360.5	251	359.7	10.87	
135	401.0	287	399.9	12.02	
218	440.4	369	438.6	13.11	◀
421	482.1	570	478.8	14.24	
599	520.6	748	515.8	15.27	
747	560.7	895	554.7	16.34	◀
882	600.1	1029	593.1	17.38	
721	593.6	868	587.9	17.24	
585	580.0	733	575.4	16.90	
449	560.4	597	556.9	16.39	◀Er
584	569.4	732	564.8	16.61	
717	585.3	865	579.6	17.01	
814	600.3	961	593.8	17.40	◀Er
991	640.7	1137	632.8	18.45	
1103	680.7	1248	671.9	19.50	
1204	720.1	1348	710.5	20.53	
1291	760.5	1435	750.2	21.57	

Time before recording readings : 15 sec.

Method for estimating Pl : 1/V vs P as per ASTM D4719


Pressuremeter Test - Corrected Curve

Interpreted Test Results

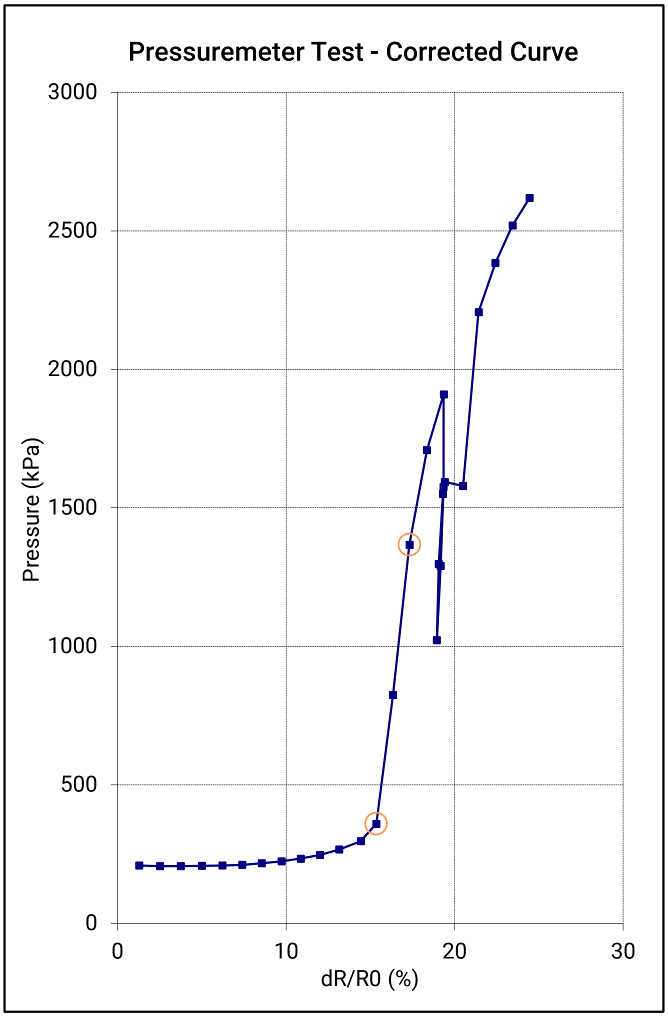
Epmt:	24,927 kPa
Ep-ur	55,289 kPa
Ey:	**36 MPa**
Ey-ur:	**80 MPa**
Pl:	2,450 kPa
Ep / Pl:	10.2
Py:	895 kPa
Poh (est.) :	**193 kPa**
K_0 (est):	**0.54**

TEXAM Pressuremeter Test Results

GROUNDED ENGINEERING

Project name:	**[21-195] 48 Grenoble Dr, Toronto**	Drilling Method:	Mud Rotary Drilling
Borehole name:	**BH8**	Test depth:	22.1 m
Test date: (dd/mm/yyyy)	08/02/2022	Test Elev:	105.4 m
Test number:	21-195 BH8-72	Poisson's ratio:	0.33
Probe Designation	N Probe (76 mm OD)	Probe initial volume:	1570 cm^3

Raw Readings		**Corrected Readings**			
Pressure kPa	**Volume cm³**	**Pressure kPa**	**Volume cm³**	**DR/R_0 %**	
21	40.5	209	40.4	1.28	
24	80.3	207	80.1	2.52	
28	120.2	207	119.9	3.75	
33	161.5	209	161.3	5.01	
37	201.5	210	201.2	6.22	
42	241.2	212	240.9	7.40	
49	280.3	217	279.9	8.55	
58	320.7	225	320.2	9.73	
69	360.4	234	359.8	10.87	
84	400.6	248	399.9	12.02	
105	440.9	267	440.1	13.15	
137	486.9	298	485.9	14.43	
200	520.8	360	519.2	15.36	◄
665	560.4	825	555.1	16.35	
1208	600.4	1367	590.8	17.32	◄
1551	641.2	1709	628.9	18.35	
1753	680.3	1910	666.3	19.35	
1419	677.0	1576	665.8	19.34	
1134	668.7	1291	659.7	19.17	
865	657.8	1022	650.9	18.94	◄Er
1140	664.4	1297	655.4	19.06	
1394	675.6	1551	664.5	19.30	
1437	680.3	1594	668.9	19.42	◄Er
1424	720.7	1580	709.4	20.50	
2051	760.8	2206	744.6	21.42	
2230	800.5	2385	782.8	22.42	
2365	840.6	2519	821.8	23.43	
2465	880.6	2619	861.0	24.44	


Pressuremeter Test - Corrected Curve

Interpreted Test Results	
Epmt:	79,464 kPa
Ep-ur	177,195 kPa
Ey:	**115 MPa**
Ey-ur:	**256 MPa**
Pl:	5,255 kPa
Ep / Pl:	15.1
Py:	1,367 kPa
Poh (est.) :	**200 kPa**
K_0 (est):	**0.51**

Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719

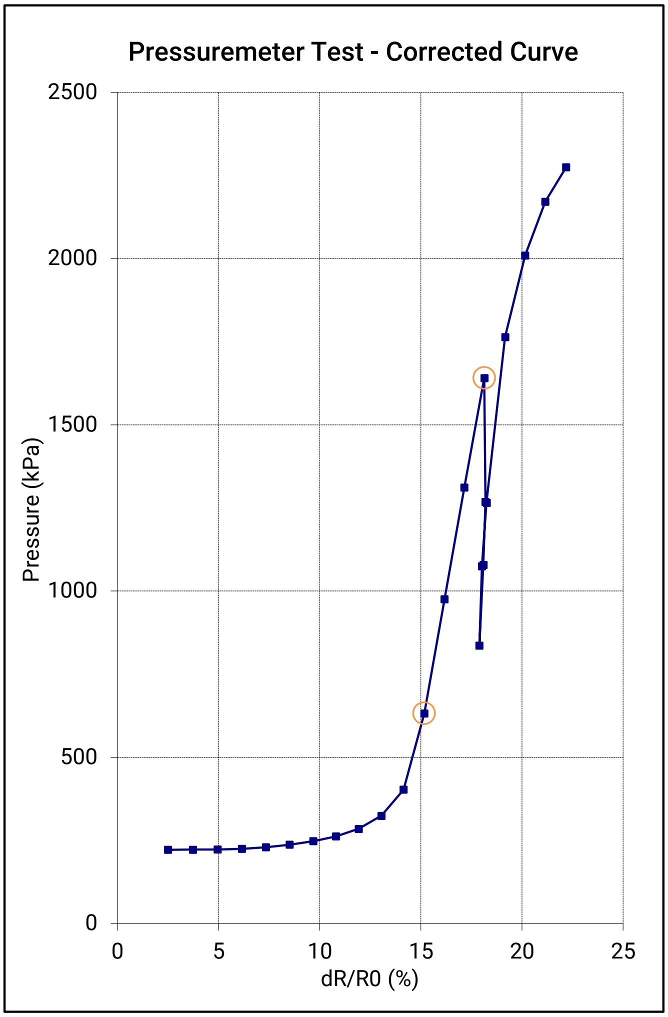
TEXAM COMPANION V.3.4.25

TEXAM Pressuremeter Test Results

GROUNDED ENGINEERING

Project name:	**[21-195] 48 Grenoble Dr, Toronto**	Drilling Method:	Mud Rotary Drilling
Borehole name:	**BH9**	Test depth:	22.1 m
Test date: (dd/mm/yyyy)	11/02/2022	Test Elev:	105.3 m
Test number:	21-195 BH9-72	Poisson's ratio:	0.33
Probe Designation	N Probe (76 mm OD)	Probe initial volume:	1578 cm^3

Raw Readings		Corrected Readings			
Pressure kPa	**Volume cm³**	**Pressure kPa**	**Volume cm³**	**DR/R_0 %**	
39	80.2	222	79.8	2.50	
43	120.3	222	119.8	3.73	
47	160.6	223	160.0	4.95	
52	200.4	225	199.8	6.14	
60	240.8	230	240.1	7.34	
69	280.8	237	280.0	8.51	
81	321.3	248	320.4	9.68	
97	360.5	262	359.4	10.80	
121	400.0	285	398.7	11.92	
162	440.4	324	438.6	13.05	
242	480.7	403	478.0	14.15	
472	520.2	632	515.1	15.17	◄
816	560.6	976	551.7	16.17	
1153	600.2	1312	587.6	17.15	
1483	640.4	1641	624.3	18.13	◄
1110	638.6	1268	626.5	18.19	
921	632.6	1079	622.5	18.09	
678	622.6	836	615.2	17.89	◄Er
917	629.9	1075	619.9	18.02	
1108	640.5	1266	628.4	18.25	◄Er
1607	680.4	1764	662.9	19.17	
1854	720.5	2010	700.3	20.16	
2016	760.3	2171	738.3	21.15	
2120	800.4	2275	777.3	22.17	



Time before recording readings : 15 sec.
Method for estimating Pl : 1/V vs P as per ASTM D4719

Interpreted Test Results

Epmt:	52,775 kPa
Ep-ur	167,237 kPa
Ey:	**76 MPa**
Ey-ur:	**241 MPa**
Pl:	4,918 kPa
Ep / Pl:	10.7
Py:	1,641 kPa
Poh (est.) :	**215 kPa**
K_0 (est):	**0.55**

TEXAM COMPANION V.3.4.25

APPENDIX E

GEOMECHANICA

Geomechanica Inc.
Suite 900 – 390 Bay St.
Toronto Ontario
Canada M5H 2Y2

March 3, 2022

Ms. Katrina Morgenroth
Grounded Engineering
1 Banigan Drive
Toronto, ON
Canada, M4H 1E9

Re: UCS Testing
(Grounded Project No. 21-195)

Dear Ms. Morgenroth:

On February 16th, 2022, a series of two (2) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Grounded personnel. These samples were identified as being from Grounded project 21-195. From these samples, two (2) Uniaxial Compressive Strength (UCS) test specimens were prepared and tested.

Details regarding the steps of specimen preparation and testing along with the test results are presented in the accompanying laboratory report and summary spreadsheet.

Sincerely,

Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: bryan.tatone@geomechanica.com

Rock Laboratory Testing Results

A report submitted to:

Katrina Morgenroth
Grounded Engineering Inc.
1 Banigan Drive
Toronto, Ontario
Canada, M4H 1G3

Prepared by:

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March 3, 2022
Project number: 21-195

Abstract

This document summarizes the results of rock laboratory testing, including 2 Uniaxial Compressive Strength (UCS) tests. The UCS values along with photographs of specimens before and after testing are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing of HQ-sized core specimens. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.150 mm/min (Figure 1).The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of the specimen to obtain flat (within ±0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimens to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and tangent Young's modulus.

Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, and the minimum length:diameter criteria were met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C.

1.2 Results

The results of UCS testing are summarized in Table 1. Please note that addition specimen details and measurements are provided in the summary spreadsheet that accompanies this report.

Table 1: Summary of UCS test results.

Sample	Depth (ft' in")	Bulk density ρ (g/cm^3)	UCS (MPa)	Lithology	Failure description
BH 8, Run 3	139' 4" - 140' 7"	2.587	10.6	Shale	1, 2
BH 9	143' 10" - 145' 0"	2.837	9.8	Shale	1, 2

[1] Axial splitting failure
[2] Specimen emitted pore water upon loading

1.3 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.

Appendices

Specimen sheets

- BH 8, Run 3
- BH 9

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	21-195
Sample	BH 8, Run 3	**Depth**	139’ 4” - 140’ 7”

Specimen parameters	
Diameter (mm) [a]	60.67
Length (mm) [a]	130.12
Bulk density ρ (g/cm^3)	2.587
UCS (MPa)	10.6
Lithology	Shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Axial splitting failure; [2] Specimen emitted pore water upon loading;

Prior to testing

After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	BSAT/HS	**Date**	2022-03-02

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	21-195
Sample	BH 9	**Depth**	143’ 10” - 145’ 0”

Specimen parameters

Diameter (mm) [a]	60.27
Length (mm) [a]	128.83
Bulk density ρ (g/cm^3)	2.837
UCS (MPa)	9.8
Lithology	Shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [1] Axial splitting failure; [2] Specimen emitted pore water upon loading;

Prior to testing

After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	BSAT/HS	**Date**	2022-03-02

APPENDIX F

Grounded Engineering Inc
ATTN: KATRINA MORGENROTH
1 BANIGAN DR
TORONTO ON M4H 1G3

Date Received: 14-FEB-22
Report Date: 25-FEB-22 09:20 (MT)
Version: FINAL

Client Phone: 647-265-0889

Certificate of Analysis

Lab Work Order #: L2685477

Project P.O. #:	NOT SUBMITTED
Job Reference:	21-195
C of C Numbers:	20-947548
Legal Site Desc:	48 GRENOBLE DR, TORONTO

Amanda Overholster

Amanda Overholster
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2685477-1 BH3-SS11 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.238		0.0040	mS/cm		24-FEB-22	R5729190
% Moisture	16.5		0.25	%	17-FEB-22	17-FEB-22	R5727271
pH	7.87		0.10	pH units		18-FEB-22	R5727633
Redox Potential	251		-1000	mV		18-FEB-22	R5727711
Resistivity	4200		1.0	ohm*cm		24-FEB-22	
Leachable Anions & Nutrients							
Chloride	7.7		5.0	ug/g	23-FEB-22	23-FEB-22	R5728613
Anions and Nutrients							
Sulphate	127		20	ug/g	23-FEB-22	23-FEB-22	R5728613
Inorganic Parameters							
Acid Volatile Sulphides	0.31		0.20	mg/kg	17-FEB-22	17-FEB-22	R5727313
L2685477-2 BH4-SS11 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.237		0.0040	mS/cm		24-FEB-22	R5729190
% Moisture	9.52		0.25	%	17-FEB-22	17-FEB-22	R5727271
pH	7.90		0.10	pH units		18-FEB-22	R5727633
Redox Potential	245		-1000	mV		18-FEB-22	R5727711
Resistivity	4220		1.0	ohm*cm		24-FEB-22	
Leachable Anions & Nutrients							
Chloride	21.5		5.0	ug/g	23-FEB-22	23-FEB-22	R5728613
Anions and Nutrients							
Sulphate	87		20	ug/g	23-FEB-22	23-FEB-22	R5728613
Inorganic Parameters							
Acid Volatile Sulphides	0.53		0.20	mg/kg	17-FEB-22	17-FEB-22	R5727313
L2685477-3 BH6-SS6 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.444		0.0040	mS/cm		24-FEB-22	R5729190
% Moisture	9.21		0.25	%	17-FEB-22	17-FEB-22	R5727271
pH	7.88		0.10	pH units		18-FEB-22	R5727633
Redox Potential	257		-1000	mV		18-FEB-22	R5727711
Resistivity	2250		1.0	ohm*cm		24-FEB-22	
Leachable Anions & Nutrients							
Chloride	145		5.0	ug/g	23-FEB-22	23-FEB-22	R5728613
Anions and Nutrients							
Sulphate	91		20	ug/g	23-FEB-22	23-FEB-22	R5728613
Inorganic Parameters							
Acid Volatile Sulphides	0.22		0.20	mg/kg	17-FEB-22	17-FEB-22	R5727313
L2685477-4 BH7-SS7 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2685477-4 BH7-SS7 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.286		0.0040	mS/cm		24-FEB-22	R5729190
% Moisture	22.6		0.25	%	17-FEB-22	17-FEB-22	R5727271
pH	7.61		0.10	pH units		18-FEB-22	R5727633
Redox Potential	253		-1000	mV		18-FEB-22	R5727711
Resistivity	3500		1.0	ohm*cm		24-FEB-22	
Leachable Anions & Nutrients							
Chloride	87.9		5.0	ug/g	23-FEB-22	23-FEB-22	R5728613
Anions and Nutrients							
Sulphate	100		20	ug/g	23-FEB-22	23-FEB-22	R5728613
Inorganic Parameters							
Acid Volatile Sulphides	<0.20		0.20	mg/kg	17-FEB-22	17-FEB-22	R5727313
L2685477-5 BH2-SS7 Sampled By: KAT on 10-FEB-22 @ 17:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.290		0.0040	mS/cm		24-FEB-22	R5729190
% Moisture	18.5		0.25	%	17-FEB-22	17-FEB-22	R5727271
pH	7.79		0.10	pH units		18-FEB-22	R5727633
Redox Potential	251		-1000	mV		18-FEB-22	R5727711
Resistivity	3450		1.0	ohm*cm		24-FEB-22	
Leachable Anions & Nutrients							
Chloride	51.3		5.0	ug/g	23-FEB-22	23-FEB-22	R5728613
Anions and Nutrients							
Sulphate	84		20	ug/g	23-FEB-22	23-FEB-22	R5728613
Inorganic Parameters							
Acid Volatile Sulphides	0.35		0.20	mg/kg	17-FEB-22	17-FEB-22	R5727313

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

20-947548

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2685477 Report Date: 25-FEB-22

Client: Grounded Engineering Inc
1 BANIGAN DR
TORONTO ON M4H 1G3
Contact: KATRINA MORGENROTH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R5728613								
WG3699000-11 CRM		**AN-CRM-WT**						
Chloride			100.8		%		70-130	23-FEB-22
WG3699000-12 DUP		**WG3699000-13**						
Chloride		11.3	10.2		ug/g	9.5	30	23-FEB-22
WG3699000-10 LCS								
Chloride			102.2		%		80-120	23-FEB-22
WG3699000-9 MB								
Chloride			<5.0		ug/g		5	23-FEB-22
EC-WT	**Soil**							
Batch R5729190								
WG3699064-4 DUP		**WG3699064-3**						
Conductivity		0.260	0.249		mS/cm	4.3	20	24-FEB-22
WG3699064-2 IRM		**WT SAR4**						
Conductivity			101.3		%		70-130	24-FEB-22
WG3699606-1 LCS								
Conductivity			94.5		%		90-110	24-FEB-22
WG3699064-1 MB								
Conductivity			<0.0040		mS/cm		0.004	24-FEB-22
MOISTURE-WT	**Soil**							
Batch R5727271								
WG3697173-2 LCS								
% Moisture			100.4		%		90-110	17-FEB-22
WG3697173-1 MB								
% Moisture			<0.25		%		0.25	17-FEB-22
PH-WT	**Soil**							
Batch R5727633								
WG3697192-1 DUP		**L2685476-1**						
pH		8.32	8.17	J	pH units	0.15	0.3	18-FEB-22
WG3697798-1 LCS								
pH			7.04		pH units		6.9-7.1	18-FEB-22
REDOX-POTENTIAL-WT	**Soil**							
Batch R5727711								
WG3697880-1 CRM		**WT-REDOX**						
Redox Potential			101.3		%		90-110	18-FEB-22
WG3697198-1 DUP		**L2685477-1**						
Redox Potential		251	264		mV	5.0	25	18-FEB-22
SO4-WT	**Soil**							

Quality Control Report

Workorder: L2685477 Report Date: 25-FEB-22

Client: Grounded Engineering Inc
1 BANIGAN DR
TORONTO ON M4H 1G3
Contact: KATRINA MORGENROTH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R5728613								
WG3699000-11 CRM		**AN-CRM-WT**						
Sulphate			110.8		%		60-140	23-FEB-22
WG3699000-12 DUP		**WG3699000-13**						
Sulphate		335	334		ug/g	0.4	25	23-FEB-22
WG3699000-10 LCS								
Sulphate			103.3		%		70-130	23-FEB-22
WG3699000-9 MB								
Sulphate			<20		ug/g		20	23-FEB-22
SULPHIDE-WT	**Soil**							
Batch R5727313								
WG3697430-3 DUP		**L2685747-2**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	17-FEB-22
WG3697430-2 LCS								
Acid Volatile Sulphides			79.1		%		70-130	17-FEB-22
WG3697430-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	17-FEB-22

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

www.alsglobal.com

Ch Analytical Request Form

L2685477-COFC

COC Number: 20 - 947548

Page 1 of 1

Report To Contact and company name below will appear on the final report

Company: Grounded Engineering Inc.
Contact: Katrina Morgenroth
Phone: 289 686 74U22

Company address below will appear on the final report

Street: 1 Banigan Dr
City/Province: Nork York, Ontario
Postal Code:

Invoice To Same as Report To ☒ YES ☐ NO
Copy of Invoice with Report ☒ YES ☒ [✓ NO]
Company:
Contact:

Select Report Format: ☒ PDF ☒ EXCEL ☐
Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Kmorgenroth@groundedeng.ca
Email 2
Email 3

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Turnaround Time (TAT) Requested

Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #:
Job #: 21 - 195
PO / AFE:
LSD: 48 Grenoble Dr, Toronto

Oil and Gas Required Fields (client use)

AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (ALS use only): L2685477

ALS Contact:

Sampler: Kat

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	TCLP	Corrosivity Suite	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH3 - SS 11	10-Feb-22	5PM	Soil	1		X			
	BH4 - SS 11	↓	↓	↓	1		X			
	BH 6 - SS6				1		X			
	BH 7 - SS7				1		X			
	BH2 - SS7				1		X			
	TCLP	10-Feb-22	4PM	Soil	2	X				

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				4.9			

SHIPMENT RELEASE (client use)
Released by: Katrina Morgenroth Date: 2022/02/10 Time: 5PM

INITIAL SHIPMENT RECEPTION (ALS use only)
Received by: Date: Time:

FINAL SHIPMENT RECEPTION (ALS use only)
Received by: Date: 14-Feb-22 Time: 10:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

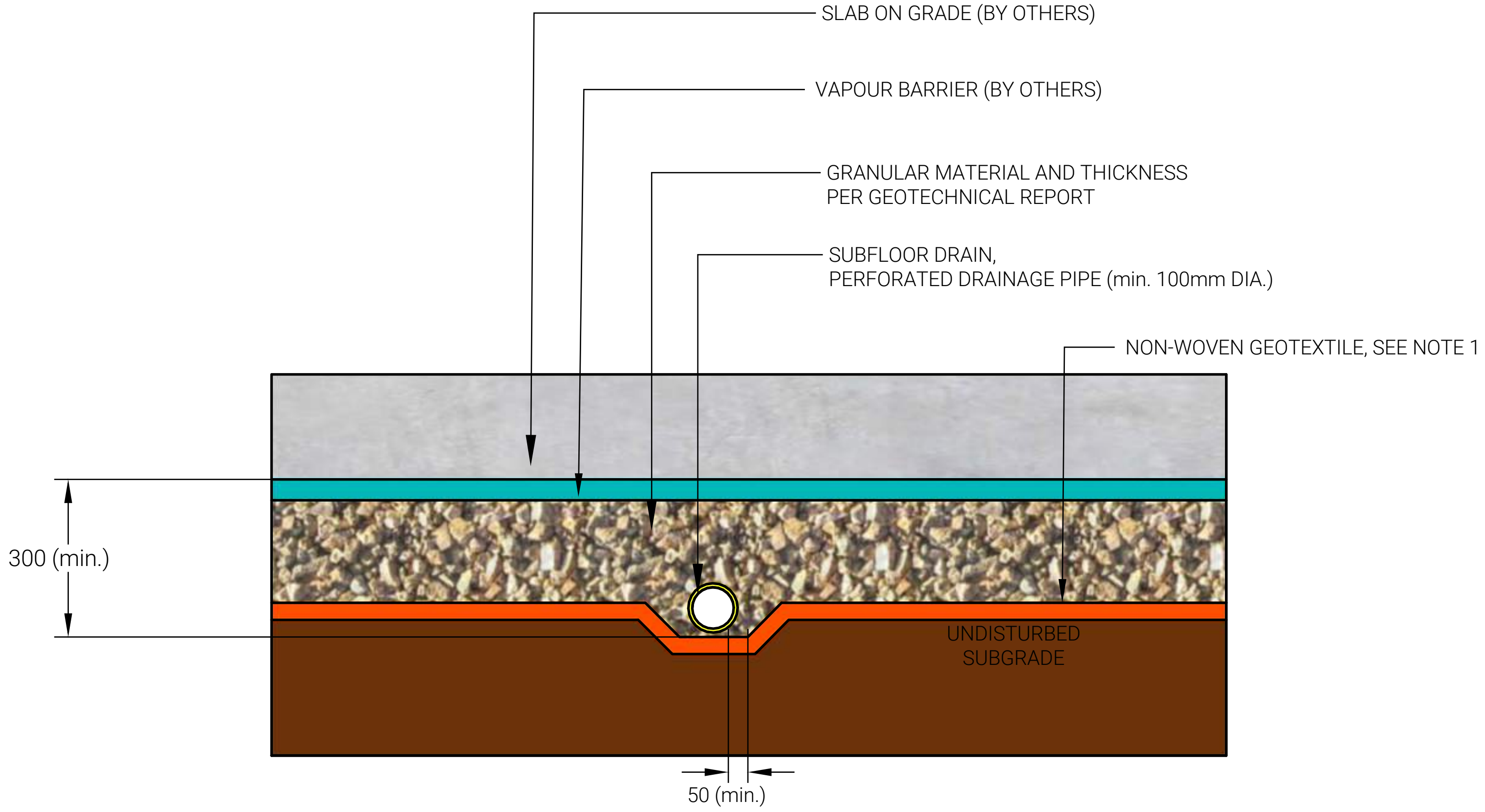
AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

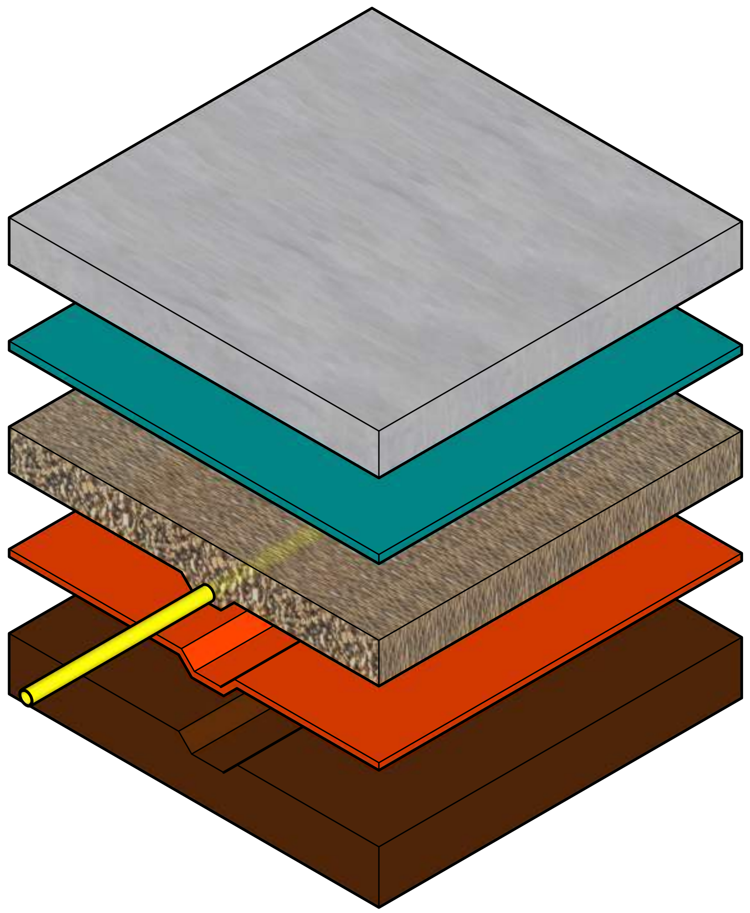
1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

APPENDIX G

OBJECTS ARE COLOR-CODED
BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC VIEW

NOTES

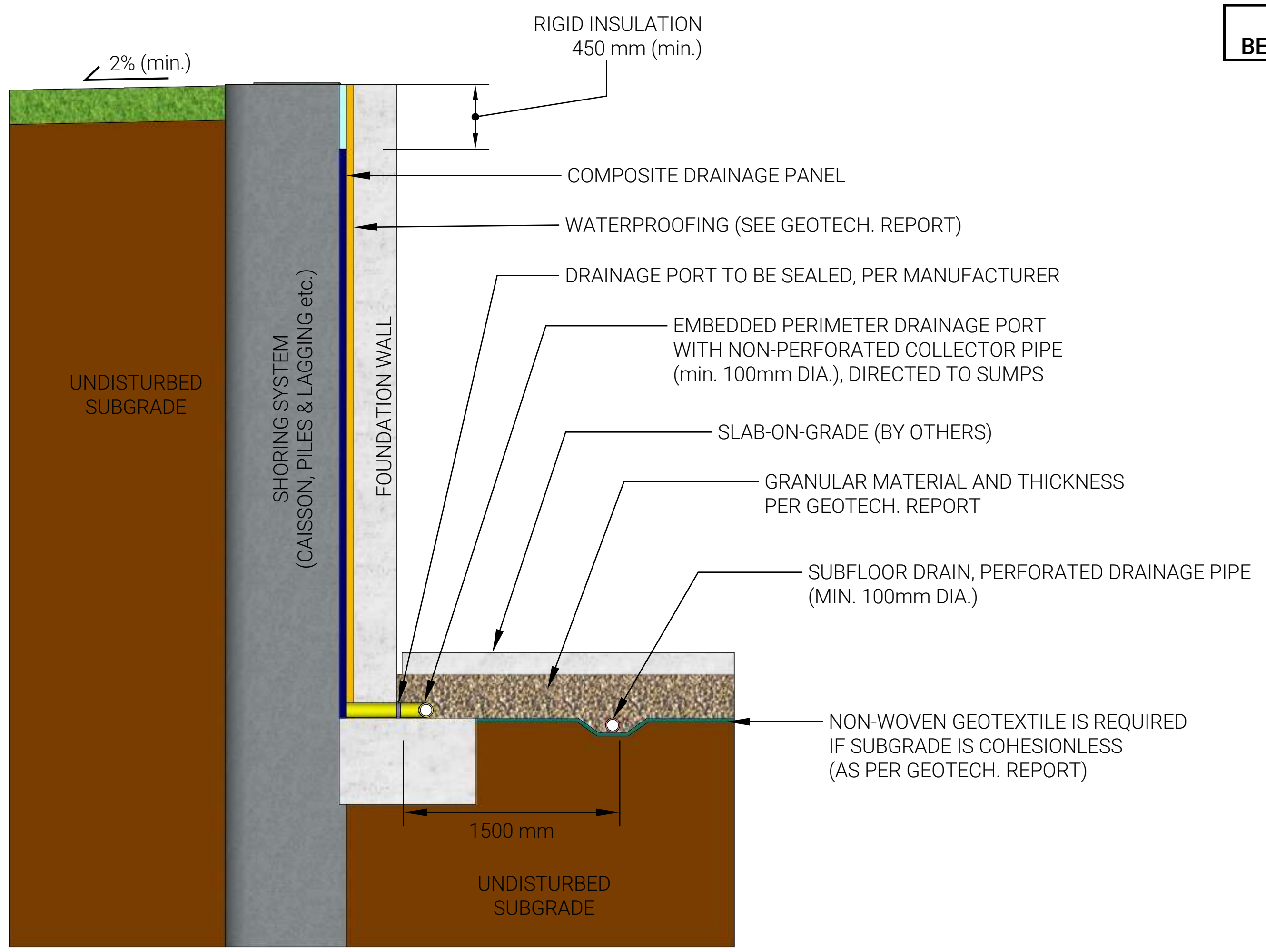
1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N).

2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

GROUNDED ENGINEERING

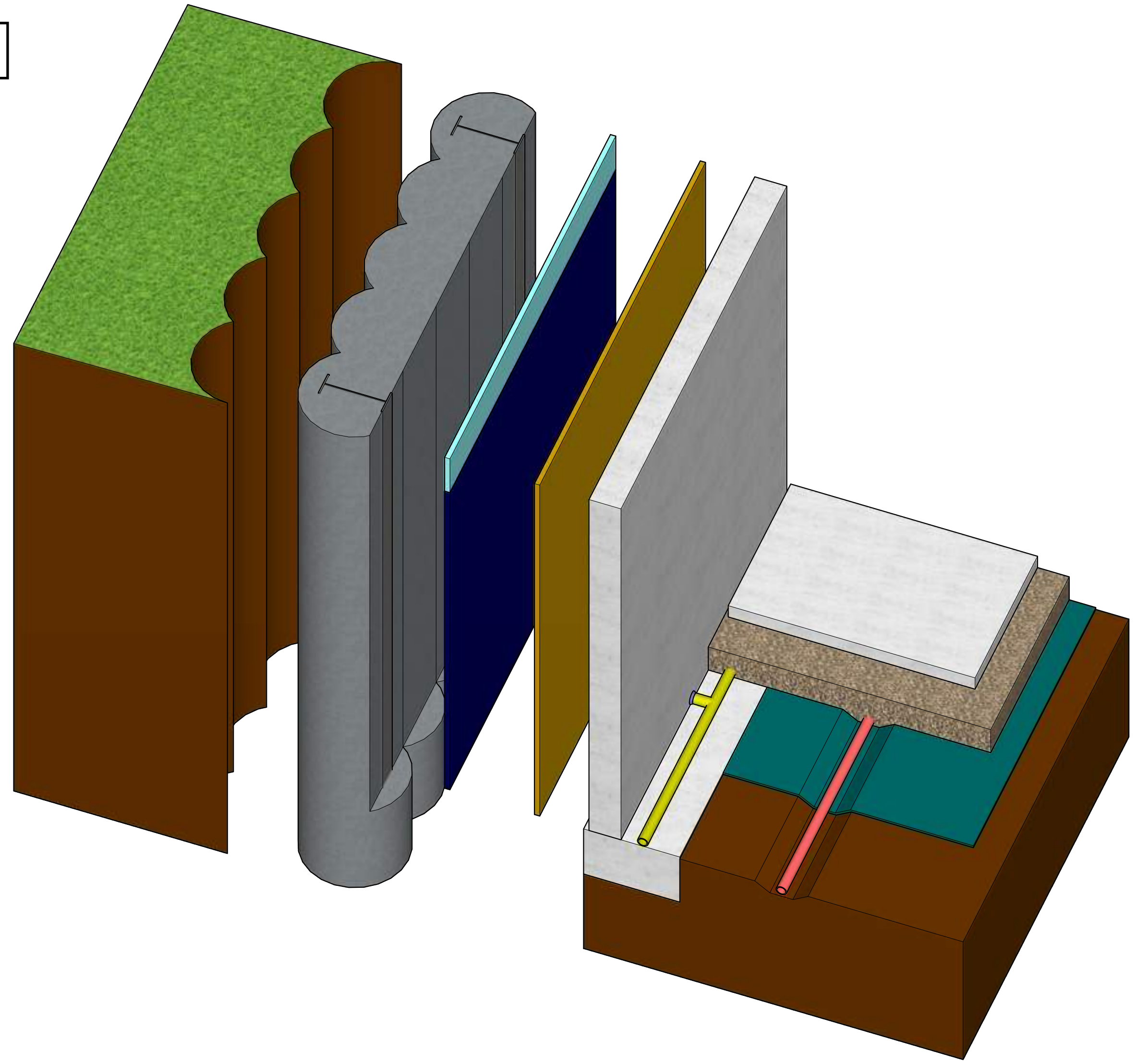
Title

BASEMENT SUBDRAIN TYPICAL DETAIL



SECTIONAL VIEW

OBJECTS ARE COLOR-CODED
BETWEEN TWO VIEWS FOR CLARITY



ISOMETRIC VIEW

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 300mm 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 1.2m 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 3m ON-CENTRE. EACH PORT SHOULD HAVE A MINIMUM CROSS-SECTIONAL AREA OF 1500 mm2.

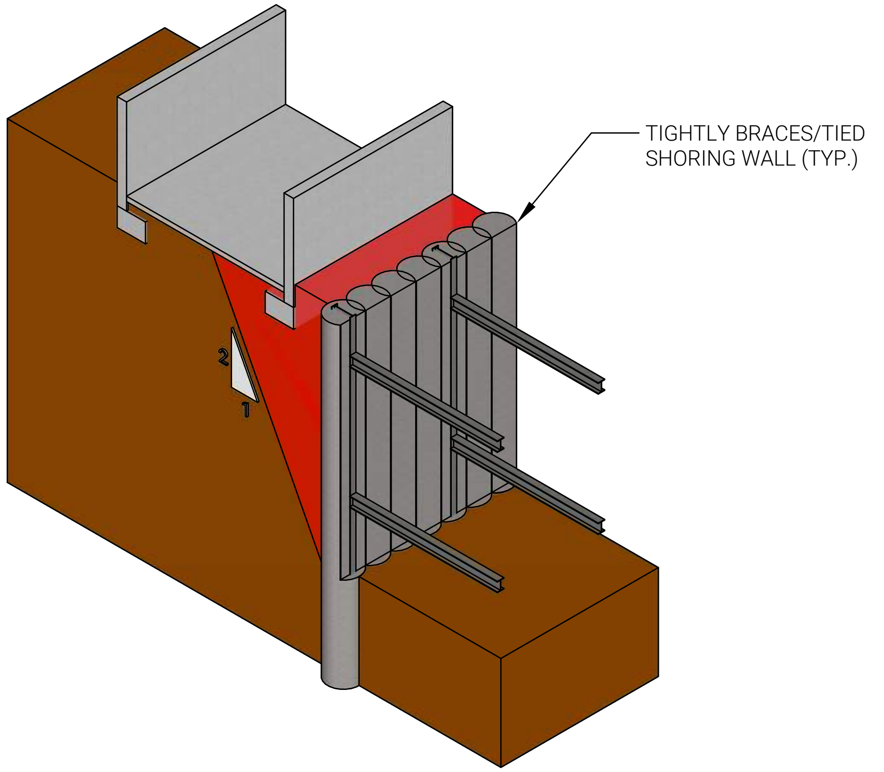
GENERAL NOTES

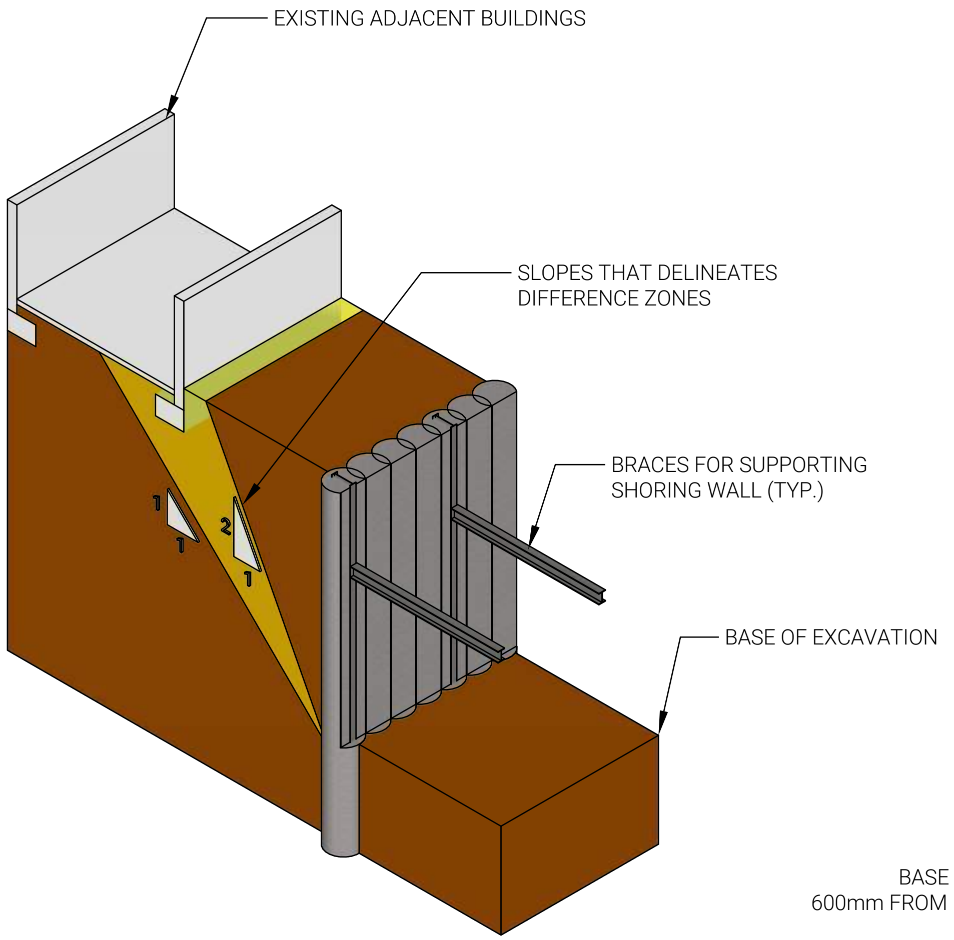
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC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

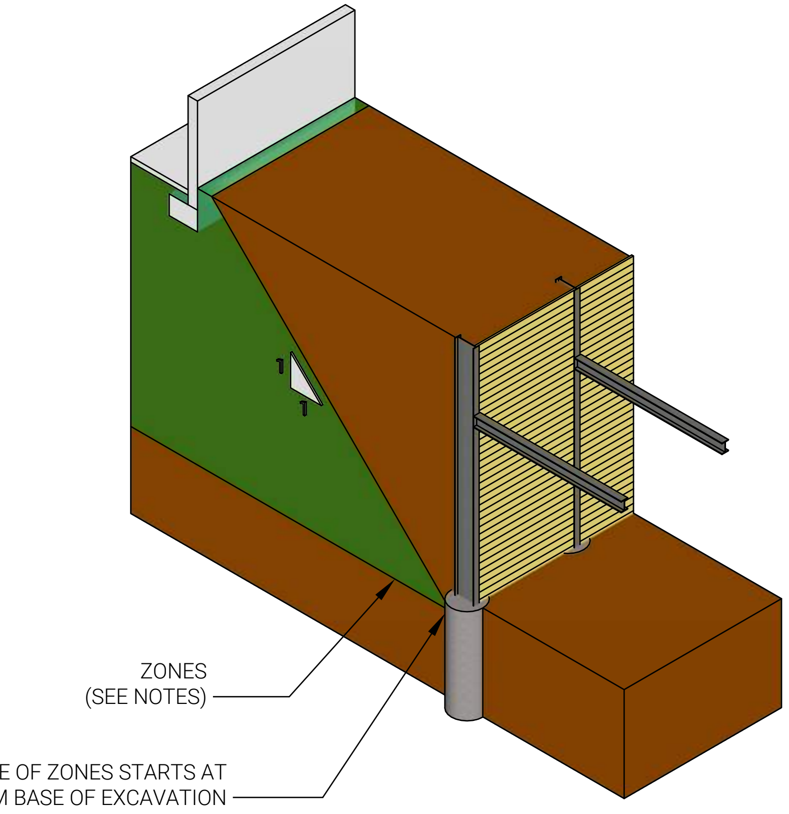
GROUNDED
ENGINEERING

Title

BASEMENT DRAINAGE SHORING SYSTEM TYPICAL DETAILS







ZONE A (RED)

FOUNDATIONS WITHIN THIS ZONE OFTEN REQUIRE UNDERPINNING OR SHORING SYSTEM. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATION MUST BE CONSIDERED

ZONE B (YELLOW)

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

ZONE C (GREEN)

FOUNDATIONS WITHIN THIS ZONE USUALLY DO NOT REQUIRE UNDERPINNING OR SHORING SYSTEM

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

GROUNDED ENGINEERING

Title

EXCAVATION ZONE OF INFLUENCE GUIDELINES