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Geotechnical Investigation – 49 South Service Road, Mississauga, ON

Palmer Project #

2204701

Prepared For

Edenshaw SSR Developments Limited

October 13, 2022

October 13, 2022

Roman Tsap
Edenshaw SSR Developments Limited
201-129 Lakeshore Rd E
Mississauga, ON L5G 1E5

Dear Roman:

Re: Geotechnical Investigation – 49 South Service Road, Mississauga, ON
Project #: 2204701

Palmer is pleased to submit the attached report describing the results of our geotechnical investigation for the project at the subject site ("the Site") at 49 South Service Road, Mississauga, Ontario.

The report provides site information from site investigation, laboratory testing, records reviews, and our interpretations/recommendations for your consideration.

Thank you for the opportunity to be of service on this project. We trust that this report will be satisfactory for your current needs. If you have any questions or require further information, please contact our office at your convenience. This report is subject to the statement of limitations provided at the end of this report.

Yours truly,

Palmer

Matthew D. St Denis., P.Eng.
Team Lead, Geotechnical Engineering

Table of Contents

Drawings

Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

1. Introduction

Palmer was retained by Edenshaw SSR Developments Limited (the Client) to undertake a geotechnical investigation to support the proposed development at the Site, located at 49 South Service Road, Mississauga, Ontario.

The objective of this geotechnical investigation was to determine the subsurface conditions at the location of the proposed new multi-storey buildings with up to 5 levels of underground parking by means of four (4) exploratory boreholes. From the findings in the boreholes, Palmer makes engineering recommendations for the following:

1. Foundation
2. Floor slab and permanent drainage
3. Excavations and backfilling
4. Earth pressures
5. Temporary shoring
6. Seismic considerations
7. Geotechnical quality of excavated soil

The report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report deals with geotechnical issues only. Hydrogeological and environmental assessments for the subject property are provided in separate Palmer reports.

This report has been prepared for the Client and its designers. Use of this report by third party without Palmer’s consent is prohibited. The limitations of the report presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2. Site and Regional Geology

The Site is located in south of Queen Elizabeth Way and east of Hurontario Street, Mississuaga, Ontario. The study area is situated within the Iroquois Plain physiographic region of Southern Ontario (Chapman and Putnam, 1984). The topography of this region is typically undulating till plains and lacustrine deposits. The Site currently consists of low-rise buildings and paved parking lots.

A review of available online surficial geology mapping indicated that the overburden materials of the site are comprised of coarse textured glaciolacustrine deposits of sand, gravel, and minor silt and clay (Ontario Geological Survey, 2010). Bedrock geology mapping indicated that the site is underlain by materials comprised of shale, limestone, dolostone and siltstone of the Georgian Bay Formation (Ontario Geological Survey, 2011).

3. Field and Laboratory Work

The field work for the geotechnical investigation was carried out from May 26 to June 1, 2022 by drilling specialists subcontracted to Palmer, during which time four (4) boreholes (BH22-1 to BH22-4) were advanced for geotechnical purposes. The locations of boreholes are shown on the Borehole Location Plan, **Drawing 1**. The boreholes were drilled to depths ranging from 8.5 to 25.0m below existing ground surface (Elev. 91.3 to 74.6m).

The boreholes were advanced with a track-mounted power auger drilling rig, where soil stratigraphy was recorded by observing the quality and changes of augered materials which were retrieved from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler 300mm depth into the undisturbed soil (SPT 'N' values) gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the borehole logs (Refer to **Appendix A**). The field work for this investigation was supervised by Palmer engineering staff, who also logged the boreholes and cared for the recovered samples.

Groundwater condition observations were made in the boreholes during drilling and upon completion of drilling. Four (4) monitoring wells were installed to determine stabilized groundwater level, one (1) at each of the boreholes. The stabilized groundwater levels were measured on June 2 and/or July 14, 2022. The monitoring wells installation and groundwater data is summarized in the individual borehole logs and in **Table 1**.

All soil samples obtained during this investigation were brought to our laboratory for further examination. These soil samples will be stored for a period of two (2) months after the day of issuing the draft report, after which time they will be discarded unless Palmer is advised otherwise in writing. In addition to visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of five (5) selected soil samples were conducted and the results are presented in **Appendix B**.

The approximate elevations at the as drilled borehole locations were surveyed using differential GPS unit. The elevations at the as-drilled borehole locations were not provided by a professional surveyor and should be considered as approximate. Contractors performing the work should confirm the elevations prior to construction. The locations plotted on **Drawing 1** were based on the survey and should be considered as approximate.

In addition to the geotechnical boreholes, six (6) boreholes (BH22-5 to BH22-10) were advanced at the Site on June 22, 2022 for environmental assessment purposes. The approximate locations of these boreholes are also shown on the Borehole Location Plan, **Drawing 1**. The logs for these boreholes are presented for reference in **Appendix E**.

4. Subsurface Conditions

The geotechnical borehole locations (BH22-1 to BH22-4) are shown on **Drawing 1**. General notes on sample description are presented in **Appendix A**. The subsurface conditions in the boreholes are presented in the individual borehole logs (**Enclosures 1** to **4** inclusive, **Appendix A**). The subsurface conditions in the boreholes are summarized in the following paragraphs.

4.1 Soil Conditions

Topsoil

A 100mm thick layer of surficial topsoil was encountered at Borehole BH22-1. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

Asphaltic Concrete

Asphaltic concrete with thickness of about 100mm was encountered surficailly at Boreholes BH22-2 to BH22-4.

Fill Materials

Fill Materials consisting of silt, silty sand, and sand and gravel were encountered below topsoil or asphaltic concrete in all boreholes, and extended to depths ranging from about 1.5 to 3.0m below existing ground surface (Elev. 98.3 to 96.6m). For the cohesionless fill materials, SPT 'N' values ranging from 3 to 12 blows per 300mm penetration indicated very loose to compact compactness condition. The in-situ moisture contents measured in the fill samples ranged from approximately 3% to 21%.

Silty Sand to Sandy Silt

Silty sand to sandy silt deposits were encountered below fill materials in all boreholes, and extended to depths ranging from about 6.7 to 7.2m below existing ground surface (Elev. 93.2 to 92.5m). SPT 'N' values ranging from 4 to greater than 50 blows per 300mm penetration indicated loose to very dense compactness condition. The natural moisture contents measured in the soil samples ranged from approximately 14% to 24%.

Grain size analyses were conducted on three (3) samples (BH22-1/SS6, BH22-2/SS7, and BH21-3/SS5) from the silty sand deposit. The results are presented on individual borehole logs and in **Appendix B**, with the following fractions:

Gravel: 0 to 1%
Sand: 64 to 76%
Silt: 20 to 32%
Clay: 3 to 4%

Grain size analysis was conducted on one (1) sample (BH22-3/SS7) from the sand and silt deposit. The results are presented on individual borehole log and in **Appendix B**, with the following fractions:

Gravel: 3%
Sand: 36%
Silt: 57%
Clay: 4%

Grain size analysis was conducted on one (1) sample (BH22-4/SS6) from the sandy silt deposit. The results are presented on individual borehole log and in **Appendix B**, with the following fractions:

Gravel: 3%
Sand: 30%
Silt: 60%
Clay: 7%

Sand and Gravel

Sandy silt deposit was encountered below sand deposit in Borehole BH22-4, and extended to the depth of about 8.4m below existing ground surface (Elev. 91.3m). SPT 'N' value of greater than 50 blows per 300mm penetration indicated very dense compactness condition. The natural moisture content measured in the soil sample was approximately 7%.

Sandy Silt Till/Shale Complex

Sandy silt till/shale complex was encountered below sand deposit in Borehole BH22-2, and extended to the depth of about 7.7m below existing ground surface (Elev. 92.1m).

The "till/shale complex" consists of a heterogeneous, very dense soil matrix, containing extensive broken bedrock (shale) slabs and fragments. SPT 'N' values of greater than 50 blows per 300 mm penetration indicated very dense compactness condition. The natural moisture content measured in the soil sample was approximately 8%.

The "till/shale complex" exists as a transitional deposit between the bedrock and the overlying till deposits. These deposits have characteristics of both the till deposits and of the shale bedrock. The deposits are very difficult to auger through due to the fragmented shale/limestone content.

Shale Bedrock

Shale bedrock was encountered below the till/shale complex in Borehole BH22-2 or below sand and gravel deposit in Borehole BH22-4, at depths ranging from about 7.7 to 8.4m below existing ground surface (Elev. 92.1 to 91.3m). The shale bedrock was proven by rock coring in these two (2) boreholes.

The shale bedrock of Georgian Bay Formation at the Site primarily consists of typically highly weathered to slightly weathered, grey to light grey, fine to very fine grained, fissile, weak to medium strong shale bedrock interbedded with slightly weathered to fresh, grey, fine grained, medium strong to very strong limestone layers. The inferred bedrock surface varies from 7.7 to 8.4m below the existing ground surface (Elev. 92.1 to 91.3m). It should be noted that it is often difficult to distinguish where the bedrock begins at locations where the bedrock surface is weathered. As such, the inferred depths/elevations of bedrock surface at the borehole locations should not be considered accurate to better than ±1.5m. It is known that the Georgian Bay Formation shale deteriorates when exposed to the atmosphere and water.

Based on the variation of the bedrock depths encountered in the boreholes, variation of bedrock depths should be anticipated beyond the boreholes. The descriptive terms used on the record of rock cores and throughout this report are explained on the "Explanation of Terms Used in the Bedrock Core Log" sheet in **Appendix A**. In general, the conventions of the International Society for Rock Mechanics (ISRM) are adopted herein. Photographs of the rock cores are presented in **Appendix C**. Detailed descriptions of the index properties and results of laboratory testing are presented in the following paragraphs.

Total Core Recovery (TCR)

The total core recovery indicates the total length of recovered rock core is expressed as a percentage of the actual length of core run (usually 1.5 m). The total core recovery from retrieved rock cores ranged from 55% to 100% in the investigation, with an average value of 98%. Typically, TCR values greater than 90% are considered good.

Solid Core Recovery (SCR)

The solid core recovery is the total length of solid, cylindrical pieces of recovered rock core, expressed as a percentage of the actual length of core run (usually 1.5 m). The solid core recovery ranged from 31% to 100% with an average value of 91%. The SCR index was generally influenced by the orientation of the fractures; SCR was low when fractures oblique to the borehole axis were intercepted.

Rock Quality Designation (RQD)

The rock quality designation index is obtained by measuring the length of recovered rock core pieces which are longer than 100 mm and expressing their sum length as a percentage of the actual length of core run (usually 1.5 m). RQD is a function of the frequency of joints, bedding plane partings and fractures in rock cores. On the basis of the recorded RQD values which range from 10% to 100%, the rock quality (based on Deere’s classification system) ranges from “very poor” to “excellent”, and the average value of approximately 75% suggests a rock of generally “fair” quality.

Hard Layers

When recovering the core samples, the thickness of interbedded “hard” limestone layers were measured and their aggregate expressed as a percentage of the actual length of core run. “Hard layers” are defined herein as distinct stronger rock layers or lenses which have unconfined compressive strengths exceeding that of the bulk of rock mass. However, this is a subjective index based on visual examination and relatively basic index strength tests. The measured thicknesses of individual hard layers of the rock cores were typically less than 100 mm in the investigation. This rock formation, however, is known to contain very strong shaly limestone/limestone layers up to 1000 mm in thickness. Encountering such thick layers should be anticipated at the site. Percentage of hard layers ranged from 3% to 32%, with an average value of 10% from the retrieved rock cores. The hard layers are mainly limestone and may vary significantly in thickness over a short distance.

Fracture Index

The fracture index is a measure of the frequency of fracturing and bedding plane separations. It is expressed as the number of fractures per 0.3 m length of rock core run. Breaks which were obviously induced by drilling are excluded. A continuous vertical fracture, regardless of its length, is counted as one fracture. The recorded values ranged between 0 to over 25 with an average of 3 in the investigation. It was observed that the planes of weaknesses along which the cores tended to break consisted mainly of the horizontal bedding joints.

Weathering

In general, weathering in the bedrock occurred at the bedrock surfaces and joint surfaces. The degree of weathering was generally slightly to moderately weathered, with occasional rock core sections being highly weathered.

Uniaxial Compressive Strength (UCS)

Four (4) rock samples were tested for UCS and the results are presented in **Appendix D**. The test results ranged from 24.2 to 42.1 MPa, indicating that the shale samples (with limestone layers) ranged from “weak” to “medium strong” rock under the ISRM strength convention.

4.2 Groundwater Conditions

Four (4) monitoring wells (50mm dia.) were installed to determine stabilized groundwater level. The stabilized groundwater levels were measured on June 2 and/or July 14, 2022. The monitoring well installation details and the measured groundwater levels are summarized in **Table 1** and shown in the individual borehole logs.

Table 1: Monitoring Well Details and Water Levels

Monitoring Well ID	Screen Interval (mBGS)*	June 2, 2022		July 14, 2022	
		Water Level Depth (mBGS)	Water Level Elevation (m)	Water Level Depth (mBGS)	Water Level Elevation (m)
BH22-1	3.0 ~ 6.1	2.9	97.0	-	-
BH22-2	21.3 ~ 24.4	3.7	96.1	-	-
BH22-3	3.0 ~ 6.1	3.2	96.4	-	-
BH22-4	9.1 ~ 12.2	-	-	4.6	95.1

*: mBGS = meter below ground surface

-: water level was not measured on this date

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to weather events.

5. Discussion and Recommendations

It is understood that the proposed development will consist of a high-rise multi-storey building with up to five (5) levels of basement. Based on 5 levels of basement, the lowest finished floor elevation (FFE) is anticipated to be approximately 15 to 17.5m below existing grade. Footing bases are anticipated to be constructed about 1 to 2m lower than the lowest FFE. Based on the conceptual site plan provided by the Client, all geotechnical boreholes were drilled within or near the footprint of the proposed buildings.

5.1 Foundation Design Considerations

Based on the results of this investigation, the proposed building can be founded on conventional shallow spread and/or continuous strip footings bearing in sound bedrock. For the sound shale bedrock encountered at the Site, a factored geotechnical resistance of 2500 kPa at Ultimate Limit States (ULS) can be used for design. The factored resistance at ULS will govern the design since the sound shale is considered non yielding and the loading required to produce 25 mm of axial deformation is greater than the factored resistance at ULS. Higher capacities may be available upon further strength testing of the rock and review of final foundation depths.

Alternatively, raft foundations may be considered for the proposed buildings. A waterproof wrapping system wrapping the entire raft foundation and foundation walls to at least 1.0 m above the highest groundwater table at the Site could be considered in conjunction with raft foundations.

A value of 500/B MN/m^3 can be used for the modulus of subgrade reaction (k), where B is the width of footing or width of wall/pile in metres.

All footing bases must be inspected by qualified geotechnical personnel prior to pouring concrete.

Bearing capacity at Serviceability Limit States (SLS) is not expected to govern the design.

It should be noted that consideration must be given in the structural design to minimize the differential settlement of the raft foundation (i.e. the rigidity of the raft designed properly to control the differential settlement). The analyses of the total and differential settlement of the raft foundation must be carried out to evaluate the potential maximum settlement, which shall be considered in selecting the appropriate waterproof materials if required, that can tolerate the anticipated potential maximum settlement. It should also be noted that the total and differential settlement of the raft foundation may cause cracking of the mud slabs that protect the waterproof materials and potentially cause cracking in the raft foundations. As such, it may be prudent to place a layer of clear stones under the floor slabs in case any minor water seepage may seep through the waterproof system.

In the vicinity of existing buried utilities, all footings must be lowered to undisturbed native soils, or alternatively the utilities must be structurally bridged. Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

Where it is necessary to place footings on bedrock at different levels, the upper footing must be founded below an imaginary 1 horizontal to 1 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

The shale bedrock weathers rapidly between wetting and drying cycles. In view of this, it is suggested that a lean concrete mat slab be placed immediately after the excavation is complete to keep the shale intact, unless the footings are cast immediately after excavating.

It should be noted that the recommended bearing resistances have been estimated by Palmer from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions become available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections to validate the information for use during the construction stage.

5.2 Frost Protection

All foundations exposed to seasonal freezing conditions must have at least 1.2 metres of soil cover for frost protection.

There is no official regulation governing the required soil cover for frost protection of footings below unheated basement floors. Certainly, it will not be greater than the 1.2m required for exterior footings. Unconfirmed experience suggests that shallower depths of soil cover of 0.9m for interior column footings and 0.6m for wall footings have been adequate in case of 2 or more levels of basement. Adjacent to air shafts and entrance/exit doors, a footing depth of 1.2m below floor level is required or, alternatively, insulation must be provided.

It is also emphasized that underfloor drainage and/or an adequate free draining gravel base is required to minimize the risk of floor dampness. Floor dampness could lead to temporary icing and the risk of accidents.

5.3 Floor Slab and Permanent Drainage

With five levels of underground parking, the floor slab can be supported on the sound shale bedrock provided that all loose materials are removed. The foundation and underground parking may be designed as a water-tight structure, assuming the hydrostatic water pressure as 1.0m higher than the highest measured from nearby monitoring wells. However, a moisture barrier consisting of at least 300 mm of 19 mm clear crushed stone should be installed under the floor slab, in case minor water seepage may migrate through the waterproof system. Where a raft foundation is used a moisture barrier consisting of a 300 mm thick layer of 19 mm clear crushed stone and subdrains should be installed between the top of the raft and the underside of the floor slab.

If the foundation and underground parking are not designed to be water-tight, a perimeter drainage system will be required. Typical drainage and backfill recommendations for the underground parking structures are illustrated on **Drawings 2** to **4** for open cut and shored excavations.

Special care should be taken to ensure compaction around columns and adjacent to foundation walls. Unless the foundations are designed to account for the floor slab loads, the floor slabs should be structurally separated from the foundation walls and columns. Sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for differential settlement of the floor slabs.

Where the backfill against the exterior walls is to support settlement sensitive structures, such as concrete slabs, pavements or walkways, it should be uniformly compacted to at least 98% of SPMDD.

5.4 Elevator Pits

The elevator pits can be designed as water-tight structures, and water pressure on the pit walls and the slab should be taken into consideration by the design engineer, assuming the water table at about 0.3m below the adjacent basement floor if a subfloor drainage system is considered. If there is no subfloor drainage system, the water pressure on the pit wall and the slab should be considered to be at least 1.0m higher than the highest measured groundwater table.

Should it be required by the designer, a drainage system at the base level of the elevator pits may also be considered together with the watertight design of the elevator pits, in case of possible minor water seepage migrating through the waterproof system.

5.5 Excavations

Based on five levels of underground parking, it is anticipated that the excavations will continue to a depth up to 19.5m below the existing ground surface. Excavation of the overburden material can be carried out with heavy hydraulic excavators. According to the results of this investigation, the excavations are generally anticipated to be carried out through the fill materials and native cohesionless deposits, and would extend into sound shale bedrock. Provisions must be made in the excavation contract for the removal of possible obstructions in the fill materials.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the existing fill materials and loose to compact cohesionless deposits would be classified as Type 3 soils above groundwater table and Type 4 soils below groundwater table. The dense to very dense cohesionless depoists would be classified as Type 2 soils above groundwater table and Type 4 soils below groundwater table.

Provided adequate groundwater control is achieved, it is anticipated that the majority of the foundation excavations at the Site could consist of temporary open cuts with side slopes of 1 horizontal to 1 vertical (1H: 1V) to the base of the excavation above the groundwater table. However, depending on the construction procedures adopted by the contractor and weather conditions at the time of construction, some local flattening of the slopes may be required. Where side slopes of excavations are to be steepened, then a positive excavation support system should be considered.

Excavation in Bedrock

The bedrock can generally be excavated without blasting. Blasting should not be considered due to the surrounding roadways and buildings and the potential presence of the methane gas. It should be noted that the excavation of bedrock is expected to be very slow and laboured and will be a challenge for excavation equipment. Productivity of the excavation will be low. The top weaker portion of the bedrock can generally be removed with a powerful excavator equipped with a rock bucket and rock teeth, assisted by hoe ramming. The removal of the underlying fresh and stronger rock and especially the hard layers (i.e. limestone) or the bedrock with rock quality is “fair”, “good” or “excellent” (i.e. RQD > 50%), however, may be arduous and time consuming, and may require use of impact breakers and line-drilling. The relative ease/difficulty in excavation of bedrock will also depend on the size (width) and depth of the excavation.

It should be noted that “hard” layers in the shale bedrock should be expected as mentioned in this report. These “hard” layers encountered in the rock core samples were relatively thin. However, thicker hard layers have been reported to be as much as up to 1000 mm in the same bedrock formation. Should the thicker hard layers be encountered in the shale, it will pose significant difficulties on the rock excavation, especially when blasting is not allowed. It is recommended that Non-Standard Specifications Provisions (NSSPs) be included in the Contract Documents to warn the Contractor of these conditions.

The excavation into fresh, sound bedrock can be done using near-vertical sidewalls (10V:1H) provided that:

- All OHSA requirements regarding worker safety are met during the course of the work.
- The rock face is scaled of all loose and potentially spalling material (including slaked rock as the excavation faces dry out over time).
- For the bedrock is to be exposed for a long period of time, the surface should be fully covered with at least 60 mm of fibre-reinforced shotcrete or protective mesh.

The Georgian Bay Formation is known to contain pockets of combustible gas (methane). Appropriate care, mechanical forced venting and monitoring are essential in all confined bedrock excavation. In some areas of the GTA, this gas has been found to migrate up into the overlying soils.

It should be noted that no excavation shall extend below the foundation of the existing adjacent structure without adequate alternative support being provided.

5.6 Backfilling

The existing fill in the boreholes is generally not suitable for re-use as backfill. The native soils free from topsoil and organics can be used as general construction backfill. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. Depending on the time of construction and weather, some excavated material may be too wet to compact and will require aeration prior to its use.

Under floor fill should be compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD). The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular “B” should be used. Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

It is preferable that the native soils be re-used from approximately the position at which they are excavated so that frost response characteristics of the soils after construction remain essentially similar to presently existing.

It is expected that any seepage above the groundwater table can be removed by pumping from sumps in the excavation area. However, significant seepage should be expected once the excavations extend below the prevailing groundwater tables in the cohesionless deposits. Depending upon the actual thickness and extent of these deposits, the prevailing groundwater level at the time of construction, “active, advance” dewatering measure using well points/eductors should be required to maintain the stability of the base and side slopes of the excavations in these areas. These “active dewatering” measures would have to be installed and then operated for a week or two in advance of excavation work progressing to these areas. A contractor specializing in dewatering should be retained to design the active dewatering systems.

It should be noted that if the construction dewatering system/sumps result in a water taking of more than 50,000 L/day but less than 400,000 L/day, a registration should be made in the Environmental Activity and Sector Registry (EASR). If a water taking is more than 400,000 L/day, a permit to take water (PTTW), issued by the MECP, will be required. A separate Hydrogeological Investigation by Palmer provides discussions on the dewatering requirements.

5.7 Temporary Shoring and Ground Movement Monitoring

In view of the anticipated five levels parking structure of the subject buildings at a depth of up to 19.5m below the existing ground surface and the fact that the proposed structures will extend close to the property lines, it is anticipated that the proposed excavations will be supported by a temporary shoring system. In consideration of the predominant sandy/silty soils encountered in all boreholes, a continuous cut-off caisson wall may be considered to reduce the groundwater seepage during the temporary dewatering stage.

The shoring walls should be designed by a specialist shoring design Engineer. The shoring system must be designed in accordance with the 4th Edition of the Canadian Foundation Engineering Manual. The soil parameters estimated to be applicable for this design are provided in **Table 2**.

Table 2: Recommended Geotechnical Parameter for Design

Soil Types	Unit Weight, γ (kN/m^3)	Internal Angle of Friction, φ (°)	Active Earth Pressure Coefficient, k_a	At-Rest Earth Pressure Coefficient, k_o	Passive Earth Pressure Coefficient, k_p
New Granular Fill	21	32	0.31	0.47	3.25
Silt/Silty sand/Sand and gravel Fill	19	26	0.39	0.56	2.56
Loose to Compact Silty sand to Sandy silt	20	28	0.36	0.53	2.77
Dense to Very Dense Silty sand to Sandy silt/Sand and gravel/Till shale complex	22	34	0.28	0.60	3.54

Soil Types	Unit Weight, γ (kN/m³)	Internal Angle of Friction, φ (°)	Active Earth Pressure Coefficient, k_a	At-Rest Earth Pressure Coefficient, k_o	Passive Earth Pressure Coefficient, k_p
Georgian Bay Formation (weathered)	24	26	-	-	-
Georgian Bay Formation (sound)	26	26	-	-	-

The caissons should be installed in pre-augered holes drilled into the sound bedrock. The concrete strength must be specified by the shoring designer. No loss of ground should be permitted during augering for caissons and the drilling contractor should be warned of the potential for occasional obstructions within the fill materials. Temporary liners would be required to help prevent the sandy/silty zones from caving during the installation period and to help control water seepage expected from the wet cohesionless deposits into the drilled holes. In order to install the shoring system, dewatering at the Site may be required.

The contiguous concrete caisson walls could be supported by tie-back anchors or struts. For post tensioned pressure-grouted soil anchors installed into the compact to very dense soils encountered at the Site, the allowable (SLS) bond stress between grout and soil can be assumed to be 80 kPa, but in no case should the bonded length be less than 6m.

The top anchor must not be placed lower than 3.0 meters below the top of ground surface. Casings will be required for the anchors when penetrating through sandy/silty deposits to prevent from soil caving. Bond values are suggested but these values are arbitrary since the contractor's installation procedures will determine the actual soil to concrete bond value. Hence, the contractor must decide on a capacity and confirm its availability. The actual capacity (bond resistance) of the anchors should be established by full scale pull-out tests ("performance test") at each anchor level in accordance with CFEM (4th edition), testing to 200% of working load. Each installed anchor must be proof loaded to 1.33 times the design working load, in accordance with Post-Tensioning Institute (PTI) guidelines. The ground anchors should be double-corrosion protected (i.e. PTI Class I). Adhesion on the behind the shoring system must be neglected when designing this shoring system.

Construction caisson walls need to be designed for hydrostatic water pressure, taken as 1.0m higher than the highest measured from nearby monitoring wells. The top of the excavation lining should be raised up above the grade in consideration of the risk of flooding. Surcharge load due to construction machinery and traffic must be considered.

If shoring is to be carried out over the winter months or if the excavation is to be left open for any period during below zero temperature, shored walls must be protected against frost penetration by means of insulation or heated hoarding.

For contiguous concrete caisson shoring, the rate of groundwater seepage is expected to be slow to moderate and can be handled by gravity drainage and pumping from filtered sumps established at the base of the excavation.

Movement of the shoring system is inevitable. Vertical movement will result from the vertical load on the shoring system resulting from the inclined tiebacks and inward horizontal movement results from earth and water pressures. The magnitude of this movement can be controlled by sound construction practices.

Monitoring of shored wall deflections by means of survey targets is recommended in areas where settlements could damage existing utilities, infrastructures, or buildings. To ensure that movements of the shoring are within an acceptable range, vertical and horizontal targets on the caissons should be located and surveyed before excavation begins. Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results will enable directions to be given to improve the shoring. The movement should be monitored throughout the construction period.

Temporary dewatering could be an issue with regards to surrounding ground settlements due to the sandy or silty soils which exist within the zone of influence. It is recommended that its impact be studied in the detailed design stage.

5.8 Preconstruction Condition Survey

It is recommended that a preconstruction survey of the neighbouring buildings and other nearby utilities and structures be carried out prior to commencing excavation. In addition, the types and conditions of all adjacent structures and underground services should be reviewed by the structural and geotechnical design engineer(s). Each utility owner should be contacted to establish deformation limits. The deformation should be monitored throughout the construction period.

5.9 Lateral Earth Pressure

5.9.1 Lateral Earth Pressure in Soil

The lateral earth pressure acting on the permanent rigid walls of the underground structures in overburden soils can be evaluated by the following formula:

$$\mathbf{P_h = K (\gamma\ h + q)}$$

where P_h = Lateral earth pressure acting at depth “h” (kPa)

K = Earth pressure coefficient at rest for a horizontal ground surface condition, as shown in **Table 2**

γ = Unit weight of backfill, as shown in **Table 2**

h = Depth below finished grade of the point of interest (m)

q = Equivalent value of surcharge on the ground surface (kPa)

Below the water table, the submerged unit weight of the soil should be used and the full hydrostatic water pressure should be added. If the ground surface is not horizontal, the uneven portion can be treated as an equivalent surcharge load.

5.9.2 Lateral Earth Pressure in Rock

Structures which extend below the surface of the bedrock and the walls of which are poured in direct contact with the bedrock will be subject to “rock squeeze”. The permanent structure should NOT be designed to resist these displacements. Consideration should be given to placing a layer of granular backfills (such as clear crushed stone) or a layer of compressible material (e.g. EPS GeoSpan Compressible Fill) between the structure and the rock surface.

5.10 Seismic Considerations

The 2012 Ontario Building Code (OBC 2012) came into effect on January 1, 2014 and contains updated seismic analysis and design methodology. The seismic site classification methodology outlined in the code is based on the subsurface conditions within the upper 30 m below existing grade.

The conservative site classification is based on physical borehole information obtained at depths of less than 30 m and based on general knowledge of the local geology and physiography. In this regard, Palmer’s drilling program included boreholes drilled to depths up to 25.0 m below the existing ground surface. Based on the borehole information and our local experience, a Site Class B may be used for the design for this site.

Should optimization of the site class be recommended by the structural engineer, a field seismic shear wave velocity test should be considered to confirm the classification.

5.11 Geotechnical Quality of Excavated Materials

Reference to the borehole logs suggests that the excavated materials with respect to their compaction characteristics can be divided into four groups:

- **Group 1** comprises the pavement granular base/subbase materials encountered near the surface, and sand and gravel soils. These materials are expected to have good compaction characteristics and could be reused as construction backfill provided that they are carefully segregated from the more silty or clayey soil strata. Some drying of the sand will likely be required. There are limited quantities of these materials available.

- **Group 2** soils comprise the cohesionless to low plasticity sandy silt, sand and silt, silty sand, and sand, and sandy silt till/shale complex. The compaction of these soils will require a very tight control of their moisture content during placement and compaction. At moisture contents more than 3% below the optimum, the soil will likely be dusty and “flour” like while at moisture contents ±1% higher than optimum, the soil will be “spongy” and will “pump”.

- **Group 3** comprises the excavated shale. These materials could be used as backfill provided they are crushed to the sizes similar to Granular “A” or “B”. Ripped or mechanically excavated bedrock may be too coarsely graded and open graded for reuse as compacted fill.

- **Group 4** soils consist of unsuitable materials because of their high moisture or organic inclusions, including all existing fill materials. These soils should be either disposed off-site or should be used only in “soft” landscaping areas where they can be placed with nominal compaction, and where surface settlements are tolerable.

As a general requirement, all backfill material should be placed in 200 to 300mm thick loose lifts and compacted to at least 96% of SPMDD, at a placement moisture content within ±2% of the optimum. Below future pavements, the backfill must be Granular “A” or “B” material, and the top 1.5m of subgrade backfill below the underside of the pavement structure should be compacted to 98% of SPMDD. Where a free-draining backfill is needed or where the backfill is needed for structural support of overlying structures, the site soils will not be suitable and OPSS Granular “A” or “B” sand and gravel will be required. Similarly, during work in the autumn, winter and spring months, re-use of the excavated soils as compacted fill may not be practical and imported OPSS Granular “B” should be used.

6. Certification

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

This report was prepared and reviewed by the undersigned:

Prepared By:

LICENSED PROFESSIONAL ENGINEER
Z. PAN
100504260
PROVINCE OF ONTARIO

Ted Pan, M.Eng., P.Eng.
Geotechnical Engineer

Reviewed By:

LICENSED PROFESSIONAL ENGINEER
M. D. ST DENIS
100122550
Oct 13, 2022
PROVINCE OF ONTARIO

Matthew D. St Denis., P.Eng.
Team Lead, Geotechnical Engineering

7. References

ASTM International. 2018. ASTM D1586 / D1586M-18, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils.

Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual, 4th Edition.

Chapman, L.J. and Putnam, D.F. 1984. Physiography of southern Ontario; Ontario Geological Survey.

Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release— Data 128 – Revised.

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

Terzaghi, K. 1955. Evaluation of coefficients of subgrade reaction. Geotechinique, Vol. 5, No. 4 and Vol. 6, No. 2.

General Comments and Limitations of Report

Palmer should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Palmer will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes and test pits required to determine the localized underground conditions between boreholes and test pits affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Palmer at the time of preparation. Unless otherwise agreed in writing by Palmer, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Palmer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Drawings

LEGEND

⊕ Monitoring Well, Geotechnical (Palmer, 2022)

⊕ Monitoring Well, EDD (Palmer, 2022)

☐ Subject Site

Key Map

0 5 10 20 30 40 50

METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:1,000
Page Size: Letter (8.5 x 11 inches)

Drawn: CV
Checked: WC
Date: Aug 23, 2022

NORTH

Source Notes:
Imagery (2020) provided by Peel Region map service.
Contains information licensed under the Open Government Licence – Ontario.

CLIENT

Edenshaw SSR Developments Limited

PROJECT

49 South Service Road

TITLE

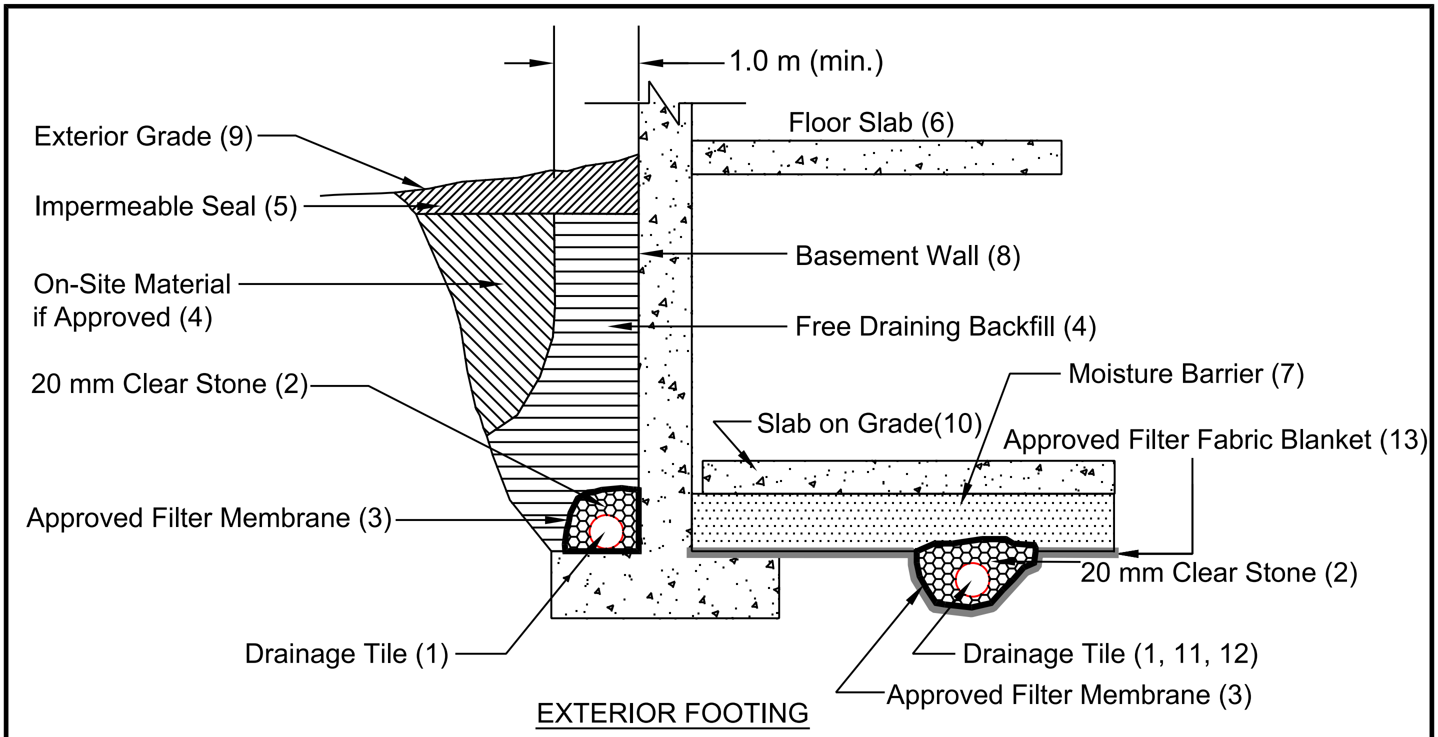
Borehole Location Plan

Palmer™

REF. NO. 2204701-MR-301-1

Drawing 1

Document Path: G:\Shared drives\Projects 2022\22047 - Edenshaw Developments\2204701 - Edenshaw - 49 S. Service Rd\GIS\1_Workspace\Task 3 - HydroG Figures\2204701-MR-301-1 (Fig 1 - Site Location Map).mxd

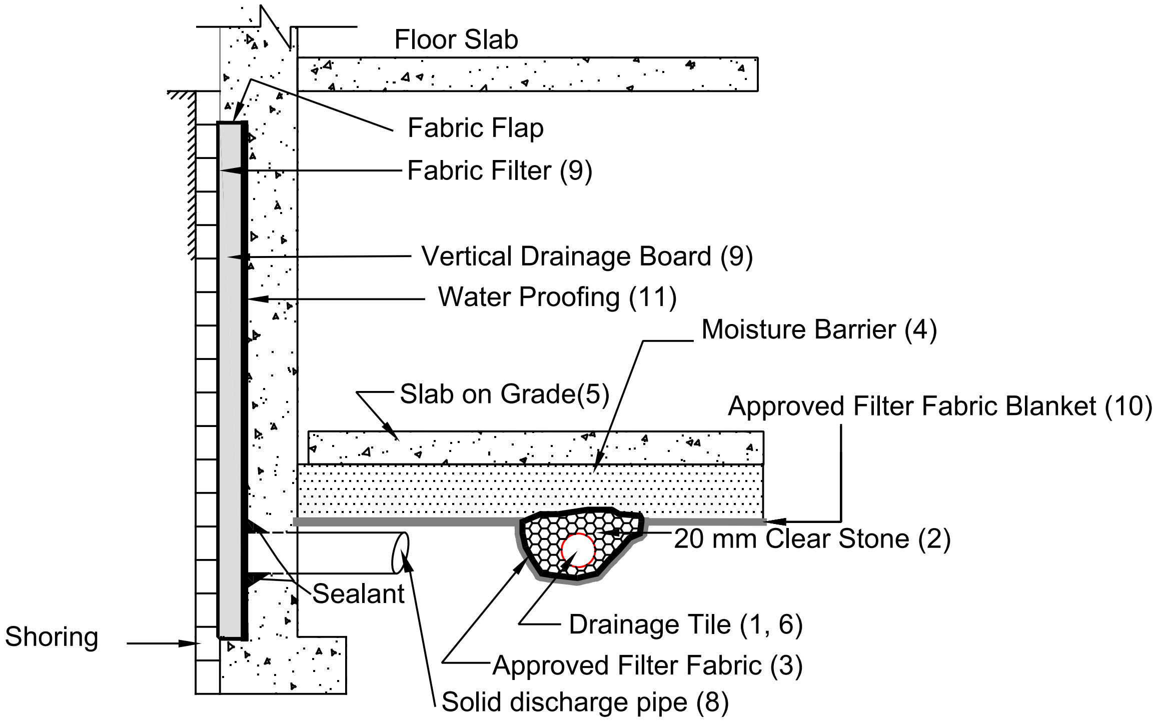


Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)



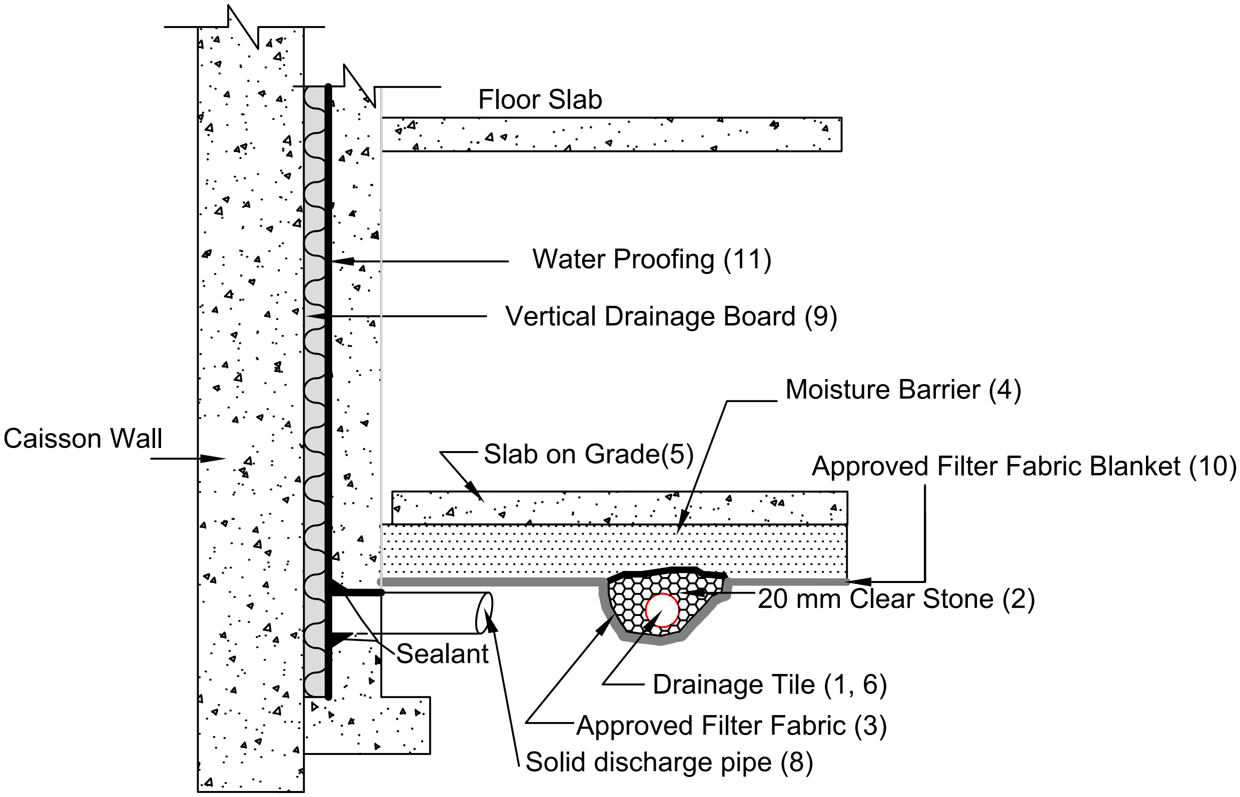
EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System

(not to scale)



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or eqivalent with filter cloth should be continous from bottom to 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS

Shored Underground Parking/Basement wall with Underfloor Drainage System

(not to scale)

Appendix A

Geotechnical Borehole Logs

Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by PECG also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO SILT (NONPLASTIC)	FINE	MEDIUM	CRS.	FINE	COARSE
	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60^o cone attached to “A” size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	>35%

Soil Description

a) Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

b) Cohesionless Soils

Density Index (Relative Density)	SPT “N” Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

Explanation of Terms Used in the Bedrock Core Log

Strength (ISRM)

Term	Grade	Description	Unconfined Compressive Strength (MPa)	(psi)
Extremely weak rock	RO	Indented by thumbnail	0.25-1.0	36-145
Very weak	R1	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0-5.0	145-725
Weak rock	R2	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0-25	725-3625
Medium Strong	R3	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25-50	3625-7250
Strong rock	R4	Specimen require more than one blow of geological hammer to fracture it	50-100	7250-14500
Very strong rock	R5	Specimen requires many blows of geological hammer to fracture it	100-250	14500-36250
Extremely strong rock	R6	Specimen can only be chipped with geological hammer	>250	>36250

Bedding (Geological Society Eng. Group Working Party, 1970. Q.J. of Eng. Geol. Vol. 3)

Term	Bed Thickness	
Very thickly bedded	>2 m	>6.5 ft
Thickly bedded	600 mm-2 m	2.00-6.50 ft
Medium bedded	200 mm-600 mm	0.65-2.00 ft
Thinly bedded	60 mm-200 mm	0.20-0.65 ft
Very thinly bedded	20 mm-60 mm	0.06-0.20 ft
Laminated	6 mm-20 mm	0.02-0.06 ft
Thinly laminated	<6 mm	<0.02 ft

TCR (Total Core Recovery)

Sum of lengths of rock core recovered from a core run, divided by the length of the core run and expressed as a percentage.

SCR (Solid Core Recovery)

Sum length of solid, full diameter drill core recovered expressed as a percentage of the total length of the core run.

RQD (Rock Quality Designation, after Deere, 1968)

Sum of lengths of pieces of rock core measured along centreline of core equal to or greater than 100 mm from a core run, divided by the length of the core run and expressed as a percentage. Core fractured by drilling is considered intact. RQD normally quoted for N-size or H-size core.

RQD(%)	Rock Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very poor

Weathering (ISRM)

Term	Grade	Description
Fresh	W1	No visible sign of rock material weathering
Slightly weathered	W2	Discolouration indicates weathering of rock material and discontinuity surface. All the rock material may be discoloured by weathering and may be somewhat weaker than in its fresh condition
Moderately weathered	W3	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a framework or as corestone
Highly weathered	W4	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones
Completely weathered	W5	All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact
Residual soil	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported

(FI) Fracture Index

Expressed as the number of discontinuities per 300mm (1 ft). Excludes drill-induced fractures and fragmented zones. Reported as “>25" if frequency exceeds 25 fractures/0.3m.

Broken Zone

Zone of full diameter core of very low RQD which may include some drill-induced fractures.

Fragmented Zone

Zone where core is less than full diameter and RQD = 0.

Discontinuity Spacing (ISRM)

Term	Average Spacing	
Extremely widely spaced	>6 m	>20.00 ft
Very widely spaced	2 m-6 m	6.50-20.00 ft
Widely spaced	600 mm-2 m	2.00-6.50 ft
Moderately spaced	200 mm-600 mm	0.65-2.00 ft
Closely spaced	60 mm-200 mm	0.20-0.65 ft
Very closely spaced	20 mm-60 mm	0.06-0.20 ft
Extremely closely spaced	<20 mm	>0.06 ft

Note: Excludes drill-induced fractures and fragmented rock.

Discontinuity Orientation

Discontinuity, fracture and bedding plane orientations are cited as the acute angle measured with respect to the core axis. Fractures perpendicular to the core axis are at 90° and those parallel to the core axis are at 0°.

Palmer™

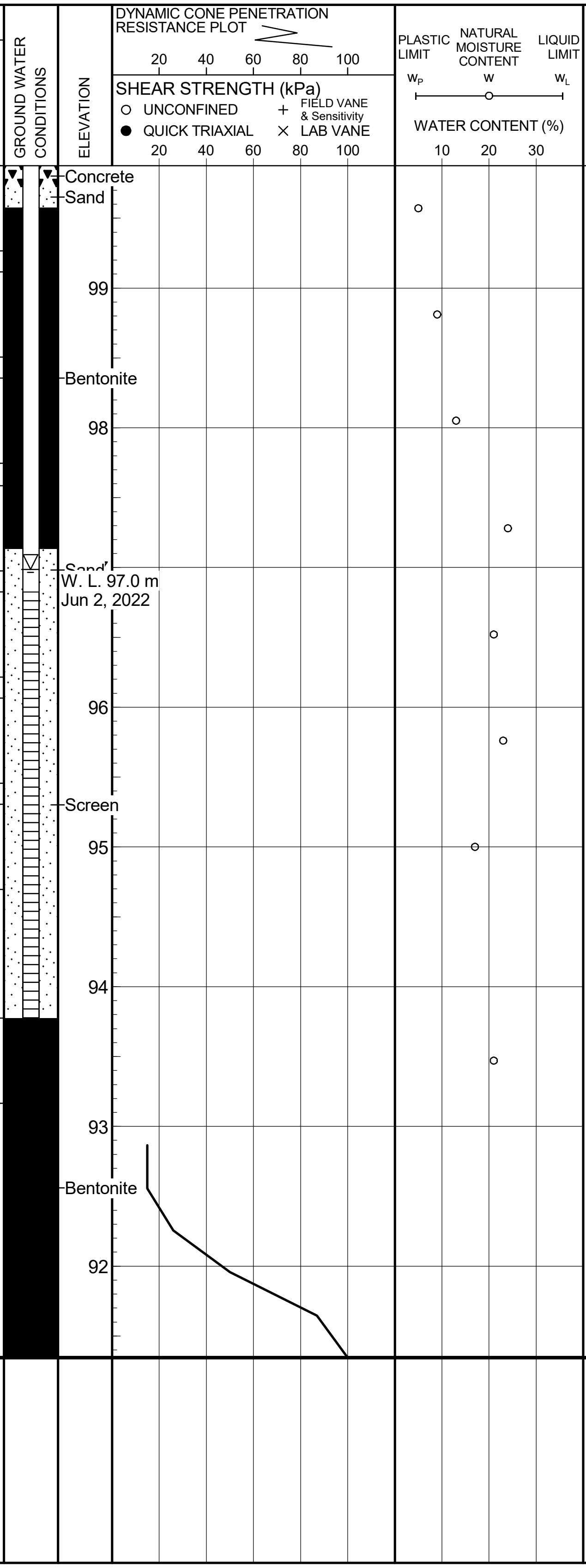
LOG OF BOREHOLE BH22-1

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 150mm
Date: Jun 1, 2022

REF. NO.: 2204701
ENCL NO.: 1

SOIL PROFILE		SAMPLES			REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	GR SA SI CL
99.9	Ground Surface				
99.8 0.1	**TOPSOIL:** 100mm				
	FILL: silty sand, trace clay, trace gravel, brown, moist to wet, loose contains rootlets	1	SS	8	
		2	SS	7	
		3	SS	4	
97.7 2.2	**SILTY SAND:** trace clay, grey to brown, moist to wet, compact to dense wet below 2.3m	4	SS	24	Wet spoon below
		5	SS	36	
		6	SS	31	0 64 32 4
		7	SS	44	
		8	SS	26	
93.2 6.7	**UNSAMPLED:** Advanced dynamic cone penetration test				
91.3 8.5	**END OF BOREHOLE** 1. Upon completion of drilling, one (1) 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (BGS) June 2, 2022 2.89m				Dynamic cone refusal



0_SOIL-ROCK-APRIP 5-2022_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER SOIL - 2018 1DIG 2204701 49 S SERVICE RD BH LOG 20220812.GPJ 22-8-12

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-2

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

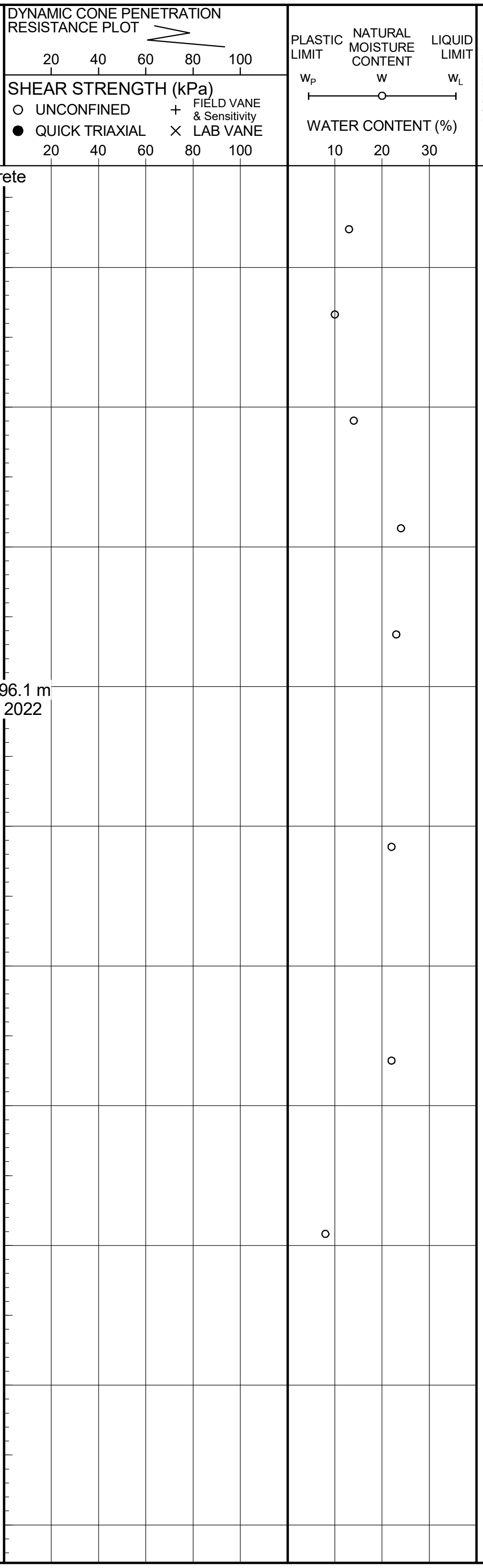
Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 27, 2022

REF. NO.: 2204701
ENCL NO.: 2

ELEV (m)	DEPTH (m)	DESCRIPTION
99.7		Ground Surface
99.6	0.1	**ASPHALT:** 100 mm
		FILL: silty sand, trace clay, trace gravel, brown, moist to wet, loose to compact
98.3	1.5	**SILTY SAND:** trace clay, trace gravel, brown, moist to wet, loose to compact wet below 2.7m
92.6	7.2	**SANDY SILT TILL/SHALE COMPLEX:** trace clay, trace gravel, grey, wet, very dense
92.1	7.7	**ROCK CORING STARTS, REFER TO ROCK CORE LOG**

SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	12	
2	SS	5	
3	SS	4	
4	SS	6	
5	SS	9	Wet spoon below
6	SS	15	
7	SS	21	0 71 25 4
8	SS	50/ initial 50mm	Spoon bouncing

GROUND WATER CONDITIONS: Concrete; Sand; W. L. 96.1 m Jun 2, 2022



POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-2

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 27, 2022

REF. NO.: 2204701
ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							
	ROCK CORING STARTS, REFER TO ROCK CORE LOG(Continued)					Bentonite						

Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Elevation: 88, 87, 86, 85, 84, 83, 82, 81, 80

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

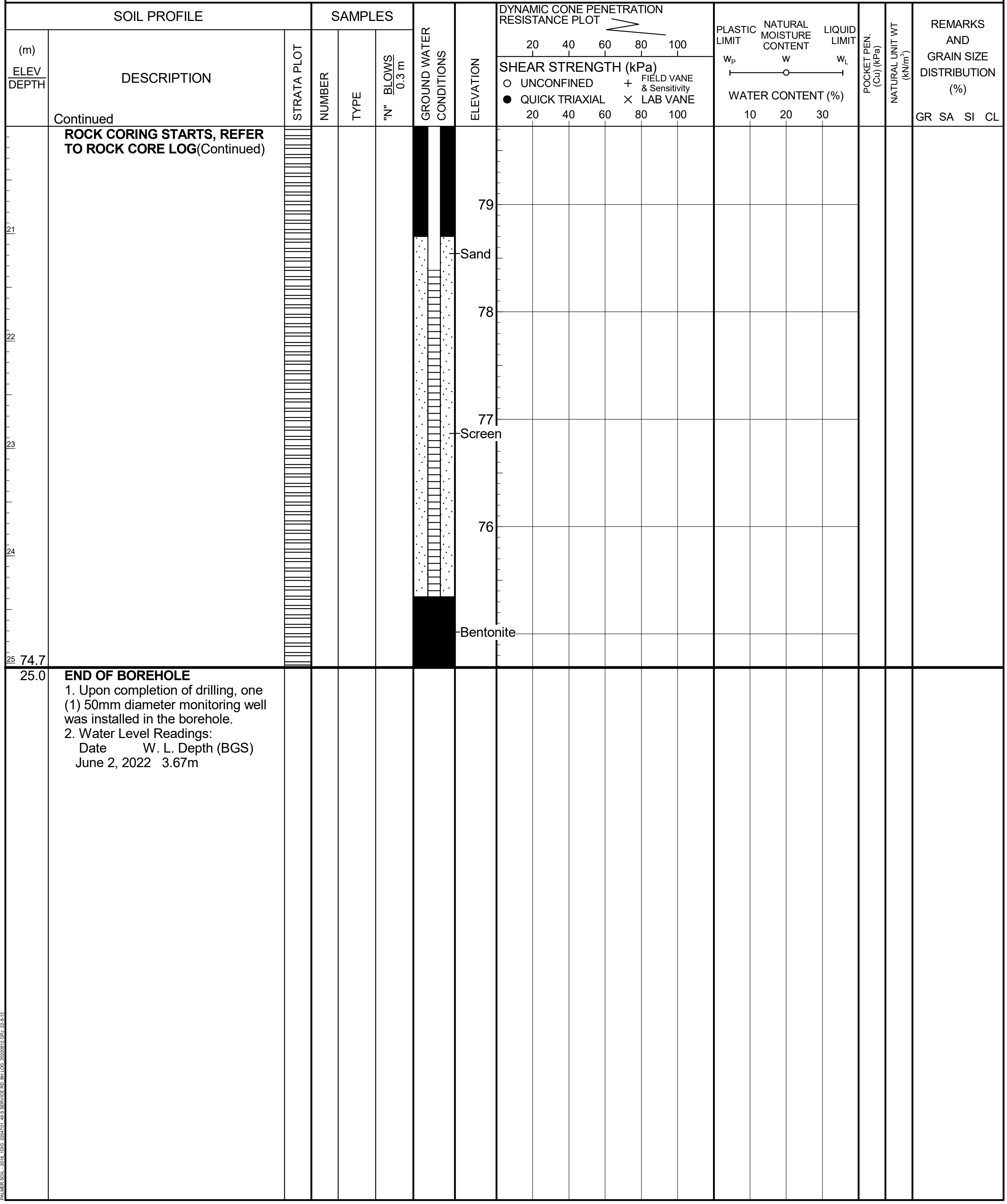
GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-2

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 27, 2022

REF. NO.: 2204701
ENCL NO.: 2



ROCK CORING STARTS, REFER TO ROCK CORE LOG(Continued)

74.7
25.0

END OF BOREHOLE
1. Upon completion of drilling, one (1) 50mm diameter monitoring well was installed in the borehole.
2. Water Level Readings:
Date W. L. Depth (BGS)
June 2, 2022 3.67m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF ROCK CORE BH22-2

PROJECT: Geotechnical Investigation - 49 South Service Road

CLIENT: Edenshaw Developments

LOCATION: City of Mississauga, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring

Diameter: 205mm/96mm

Date: May-27-2022

REF. NO.: 2204701

ENCL NO.: 2

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
92.2	Rock Surface															
92.0 7.5 7.7 91.5	**GEORGIAN BAY FORMATION** Highly weathered shale to complex, grey, weak **GEORGIAN BAY FORMATION** Moderately weathered to slightly weathered, laminated to thinly bedded, grey and light grey, weak to medium strong **SHALE** (95~97%), thinly laminated to medium bedded with slightly weathered to fresh, grey, medium strong to very strong **LIMESTONE** (3~5%).		1	HQ	100	58	8	38	23 6 1	Soft Layer: 7.54m - 7.70m Fragment Zone: 8.12m - 8.16m Hard Layer: 8.16m - 8.20m Limestone	W4					
8.2 90.0			2	HQ	100	87	5	35	15 7 6 3 8	Soft Layer: 9.08m - 9.12m Fragment Zone: 8.20m - 8.25m 8.31m - 8.52m 9.55m - 9.64m	W3-W2					
9.7 88.5			3	HQ	55	50	3	10	5 6 7 0 0	Lost Zone: 10.57m - 11.25m Fragment Zone: 10.47m - 10.52m						
11.3 86.9	**GEORGIAN BAY FORMATION** slightly weathered, laminated to thinly bedded, grey and light grey, weak to medium strong **SHALE** (88~93%), thinly laminated to medium bedded with slightly weathered to fresh, grey, medium strong to very strong **LIMESTONE** (7~12%).		4	HQ	100	98	12	75	3 6 3 3 1	Fragment Zone: 11.25m - 11.27m						
12.8 85.4			5	HQ	100	99	10	92	1 2 2 1 2							
14.3 83.9			6	HQ	100	99	8	96	0 5 1 1 1	Soft Layer: 14.80m - 14.85m						
15.8 82.4			7	HQ	100	100	7	95	2 2 2 1 1							
17.3									2	Fracture: 17.85m - 18.18m: 90° - 75°						

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

θ = angle to the core axis

E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF ROCK CORE BH22-2

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May-27-2022

REF. NO.: 2204701
ENCL NO.: 2

(m) ELEV DEPTH	ROCK DESCRIPTION Continued	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
	GEORGIAN BAY FORMATION slightly weathered, laminated to thinly bedded, grey and light grey, weak to medium strong **SHALE** (88~93%), thinly laminated to medium bedded with slightly weathered to fresh, grey, medium strong to very strong **LIMESTONE** (7~12%). *(continued)*		8	HQ	100	100	8	88	2 3 0 2	Fracture: 17.85m - 18.18m: 90° - 75° *(continued)*	W2-W1					
80.8 18.9			9	HQ	100	100	12	91	1 0 1 2 12	Soft Layer: 20.21m - 20.33m						
79.3 20.4			10	HQ	100	100	10	100	1 0 0 0 1	Hard Layer: 20.44m - 20.52m Limestone						
77.8 22.0			11	HQ	100	100	8	95	0 1 0 2 1						24.2	
76.3 23.5			12	HQ	100	100	8	100	0 1 1 1 1	Hard Layer: 24.57m - 24.64m Limestone					42.1	
74.7 25.0	**END OF BOREHOLE** 1. Upon completion of drilling, a 50 mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) June 2, 2022 3.67m															

0_SOIL-ROCK-APRIP 5-2022_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER ROCK 1 DECI 2018 2204701 49 S SERVICE RD BH LOG 20220812.GPJ 22-8-12

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

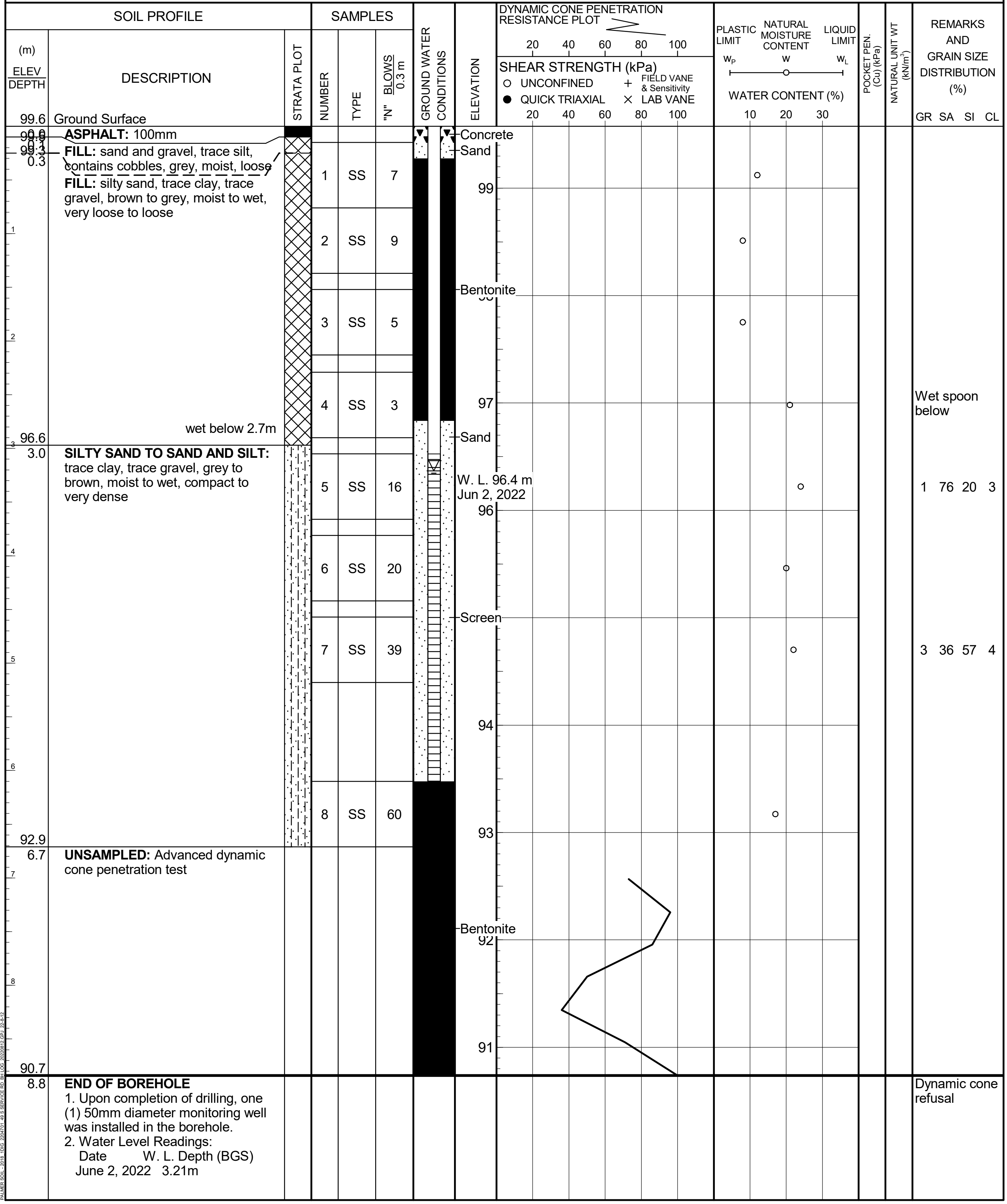
E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH22-3

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 150mm
Date: Jun 1, 2022

REF. NO.: 2204701
ENCL NO.: 3



(m) ELEV DEPTH	DESCRIPTION	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
99.6	Ground Surface	
99.5 0.1	**ASPHALT:** 100mm	
99.3 0.3	**FILL:** sand and gravel, trace silt, contains cobbles, grey, moist, loose **FILL:** silty sand, trace clay, trace gravel, brown to grey, moist to wet, very loose to loose wet below 2.7m	Wet spoon below
96.6 3.0	**SILTY SAND TO SAND AND SILT:** trace clay, trace gravel, grey to brown, moist to wet, compact to very dense	
92.9 6.7	**UNSAMPLED:** Advanced dynamic cone penetration test	
90.7 8.8	**END OF BOREHOLE** 1. Upon completion of drilling, one (1) 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (BGS) June 2, 2022 3.21m	Dynamic cone refusal

SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GR	SA	SI	CL
1	SS	7				
2	SS	9				
3	SS	5				
4	SS	3				
5	SS	16	1	76	20	3
6	SS	20				
7	SS	39	3	36	57	4
8	SS	60				

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-4

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 26, 2022

REF. NO.: 2204701
ENCL NO.: 4

SOIL PROFILE

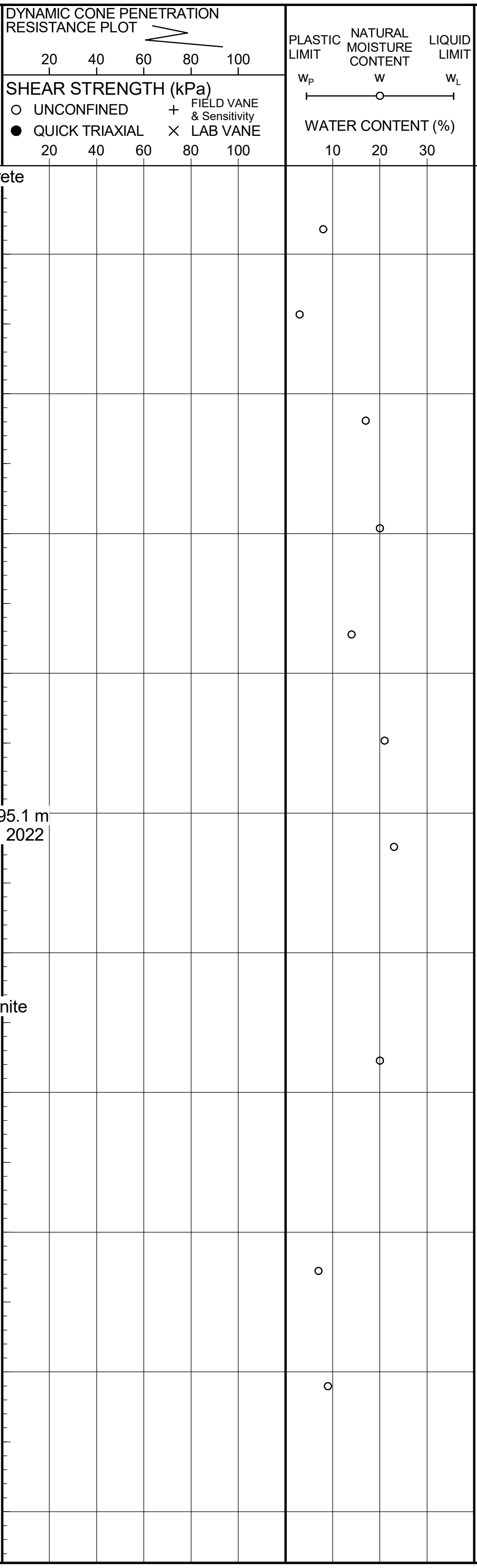
(m) ELEV DEPTH	DESCRIPTION
99.6	Ground Surface
99.5 0.1	**ASPHALT:** 100 mm **FILL:** sand and gravel, trace clay, trace silt, contains boulder fragments, contains brick fragments, redish brown, moist, loose to compact
98.2 1.5	**FILL:** silt, trace clay, trace sand, trace gravel, brown, moist, loose
97.4 2.2	**FILL:** silty sand, trace clay, brown, saturated, compact
96.7 3.0	**SILTY SAND TO SANDY SILT:** trace clay, trace gravel, brown, saturated, compact to loose
92.5 7.2	**SAND AND GRAVEL:** trace silt, contains boulder fragments, brown, moist, very dense
91.3 8.4	**WEATHERED SHALE:** grey, moist, very dense
90.7 8.9	**ROCK CORING STARTS, REFER TO ROCK CORE LOG**

SAMPLES

NUMBER	TYPE	"N" BLOWS/0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	9	
2	SS	11	
3	SS	5	
4	SS	11	Wet spoon below
5	SS	20	
6	SS	26	3 30 60 7
7	SS	25	
8	SS	9	
9	SS	65	
10	SS	76/ 250mm	

GROUND WATER CONDITIONS: Concrete; Sand; W. L. 95.1 m Jul 14, 2022; Bentonite

ELEVATION: 99, 98, 97, 96, 94, 93, 92, 91, 90



POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

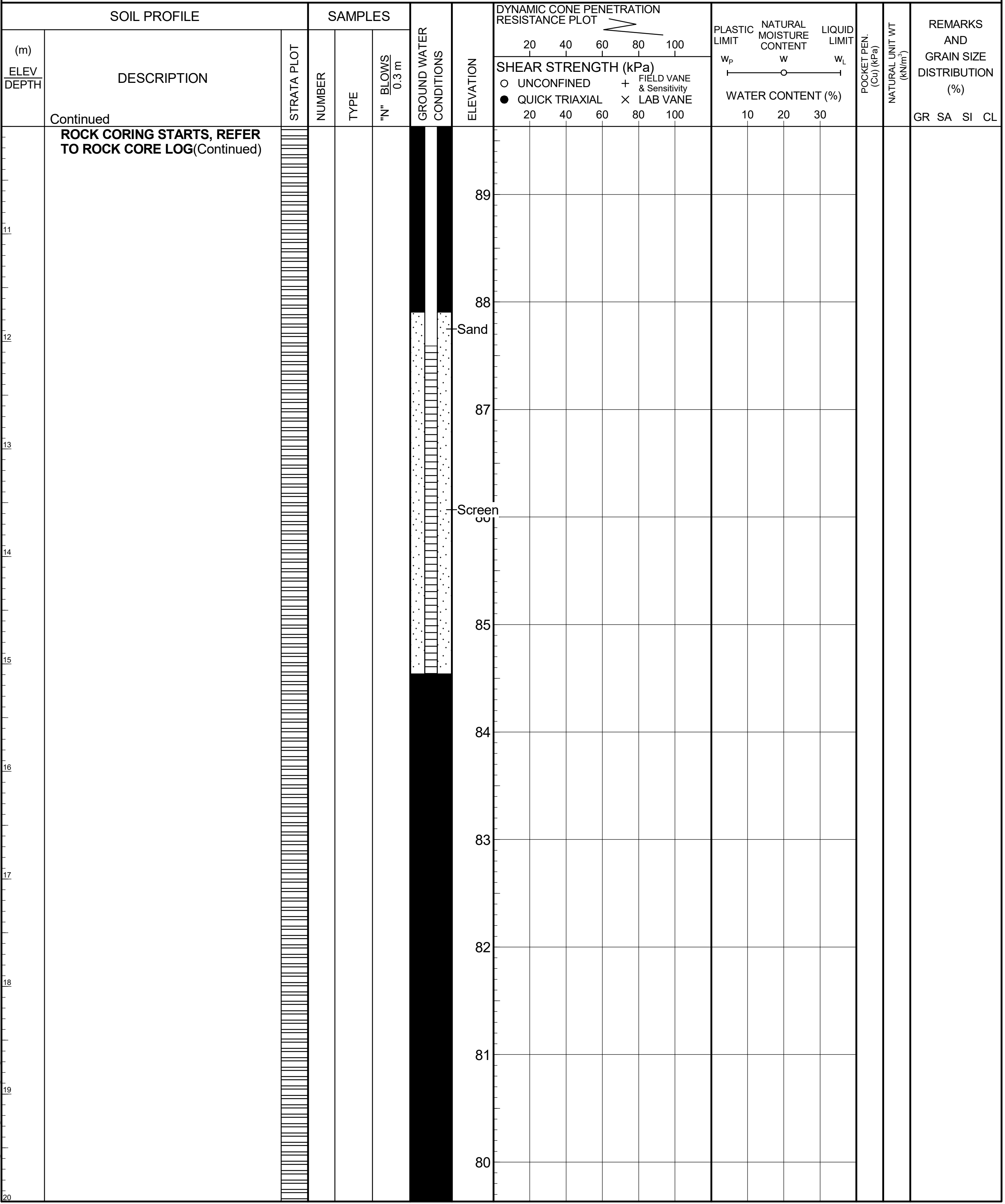
GRAPH NOTES: +³, ×³: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-4

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 26, 2022

REF. NO.: 2204701
ENCL NO.: 4



ROCK CORING STARTS, REFER TO ROCK CORE LOG(Continued)

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GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

LOG OF BOREHOLE BH22-4

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May 26, 2022

REF. NO.: 2204701
ENCL NO.: 4

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
21 22 23 24 74.6	**ROCK CORING STARTS, REFER TO ROCK CORE LOG**(Continued)					Bentonite	79 78 77 76 75					
25.0	**END OF BOREHOLE** 1. Upon completion of drilling, one (1) 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (BGS) July 14, 2022 4.57m											

0_SOIL-ROCK-APRIP 5-2022_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER SOIL - 2018 1DIG 2204701 49 S SERVICE RD BH LOG 20220812.GPJ 22-8-12

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF ROCK CORE BH22-4

PROJECT: Geotechnical Investigation - 49 South Service Road

CLIENT: Edenshaw Developments

LOCATION: City of Mississauga, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring

Diameter: 205mm/96mm

Date: May-26-2022

REF. NO.: 2204701

ENCL NO.: 4

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
			NUMBER	SIZE												
90.7	Rock Surface															
90.7 8.9 89.9	**GEORGIAN BAY FORMATION** Highly weathered shale to complex, grey, weak **SHALE** (27%), thinly laminated to medium bedded with highly weathered, grey **SOFT LAYER** (73%).		1	HQ	100	31	4	13	>25 15 17	Soft Layer: 8.94m - 9.29m 9.46m - 9.72m Hard Layer: 9.72m - 9.75m Limestone	W4-W3					
9.8 88.4	**GEORGIAN BAY FORMATION** slightly weathered, laminated to thinly bedded, grey and light grey, weak to medium strong **SHALE** (68~94%), thinly laminated to medium bedded with slightly weathered to fresh, grey, medium strong to very strong **LIMESTONE** (6~32%).		2	HQ	100	97	3	37	5 4 6 6 1	Fragment Zone: 9.86m - 9.91m Fracture: 10.47m - 10.95m: 90°	W2-W1					
11.3 86.8			3	HQ	100	86	32	43	1 8 2 4 3	Hard Layer: 11.68m - 11.76m 11.91m - 12.00m 12.18m - 12.24m 12.33m - 12.45m						
12.8 85.3			4	HQ	100	100	8	91	4 3 0 4 0	Hard Layer: 13.05m - 13.09m 13.30m - 13.34m						
14.3 83.8			5	HQ	100	98	11	95	2 2 1 1 0	Fracture: 14.45m - 14.51m: 90° Hard Layer: 14.45m - 14.51m 14.63m - 14.69m 15.08m - 15.13m						
15.9 82.3			6	HQ	100	98	15	98	0 1 1 1 1	Hard Layer: 16.18m - 16.32m 17.00m - 17.10m						
17.4 80.7			7	HQ	100	100	10	93	1 0 1 1 0	Hard Layer: 18.75m - 18.80m						

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

θ = angle to the core axis

E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF ROCK CORE BH22-4

PROJECT: Geotechnical Investigation - 49 South Service Road
CLIENT: Edenshaw Developments
LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Hollow Stem Augers/Rock Coring
Diameter: 205mm/96mm
Date: May-26-2022

REF. NO.: 2204701
ENCL NO.: 4

(m) ELEV DEPTH	ROCK DESCRIPTION Continued	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
18.9	**GEORGIAN BAY FORMATION** slightly weathered, laminated to thinly bedded, grey and light grey, weak to medium strong **SHALE** (68~94%), thinly laminated to medium bedded with slightly weathered to fresh, grey, medium strong to very strong **LIMESTONE** (6~32%). *(continued)*		8	HQ	100	92	22	45	3 3 2 3 1	Fracture: 18.92m - 19.02m: 75° Fragment Zone/Soft Layer: 19.94m - 19.99m 20.06m - 20.11m Hard Layer: 18.92m - 19.02m 19.44m - 19.58m 19.82m - 19.90m *(continued)*					40.4	
79.2 20.5			9	HQ	100	100	14	100	1 0 1 1 0	Fracture joint: 20.52m - 20.60m Hard layer: 20.52m - 20.60m						
77.7 22.0			10	HQ	100	100	8	92	0 0 0 1 2						25	
76.1 23.5			11	HQ	100	100	6	100	1 0 1 1 0							
74.6 25.0	**END OF BOREHOLE** 1. Upon completion of drilling, a 50 mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) July 14, 2022 4.57m															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

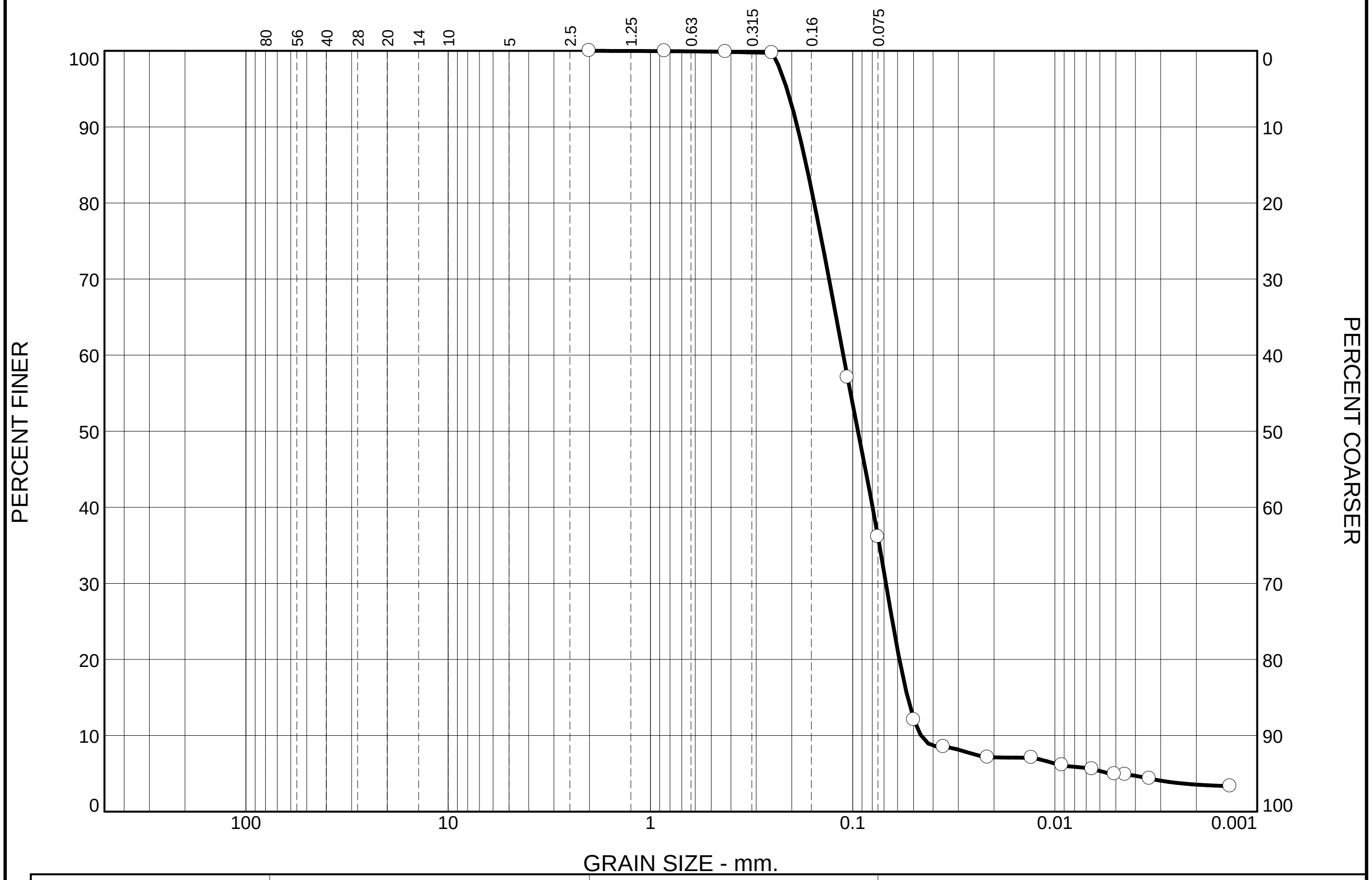
θ = angle to the core axis

E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

Appendix B

Geotechnical Lab Testing Results

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	0	0	64	32	4

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1696	0.1113	0.0941	0.0685	0.0535	0.0459	0.92	2.42

Material Description	USCS	AASHTO
○ SILTY SAND trace clay		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG PRJ #2204701

○ **Sample Number:** BH 22-1, SS 6

Terrapex

Toronto, Ontario

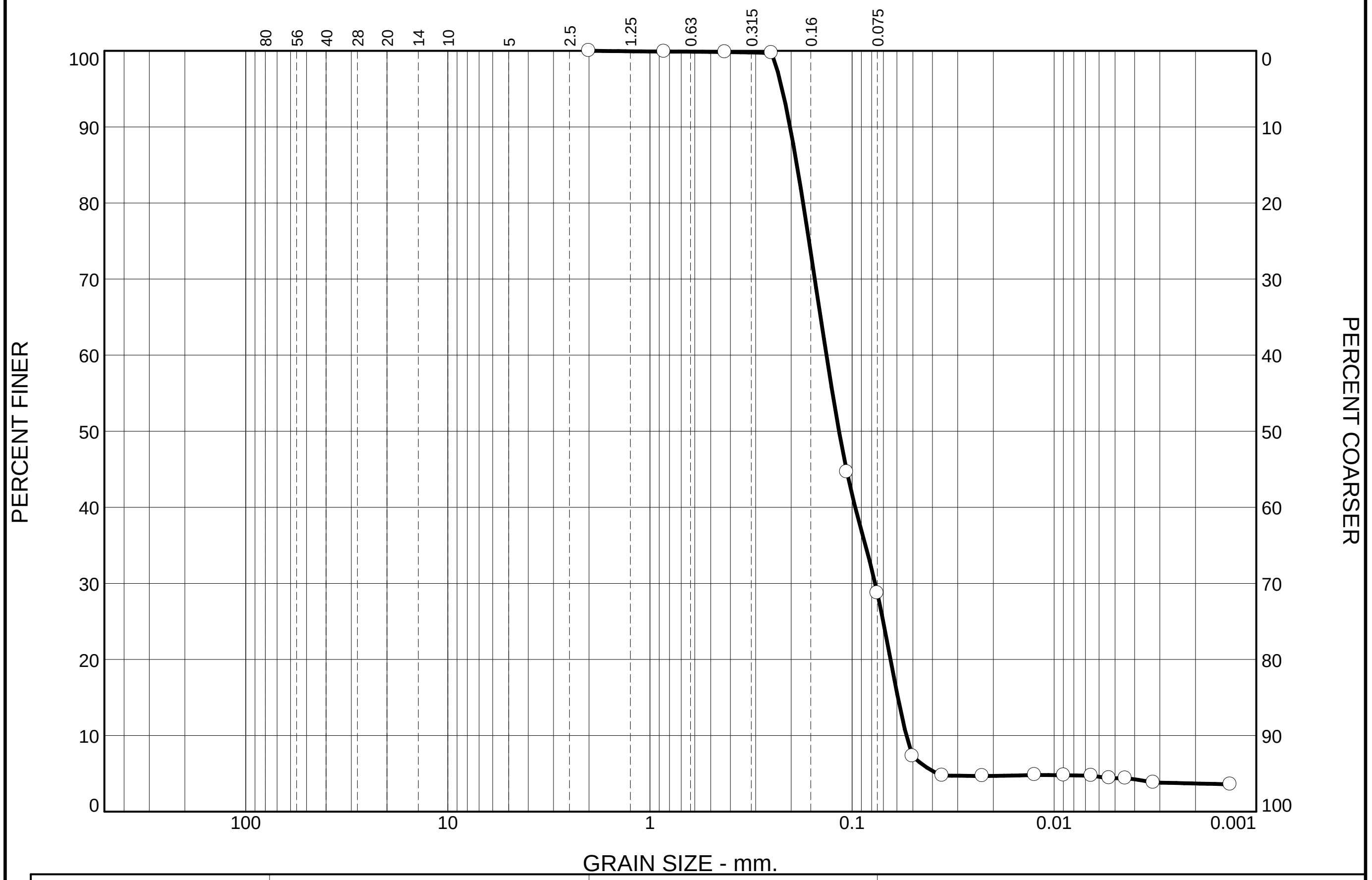
Remarks:

○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test Date: July 25, 2022

Figure 1

Tested By: AM/TH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	0	0	71	25	4

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1874	0.1339	0.1160	0.0769	0.0593	0.0538	0.82	2.49

Material Description	USCS	AASHTO
○ SILTY SAND trace clay		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG PRJ #2204701

○ **Sample Number:** BH 22-2, SS 7

Terrapex

Toronto, Ontario

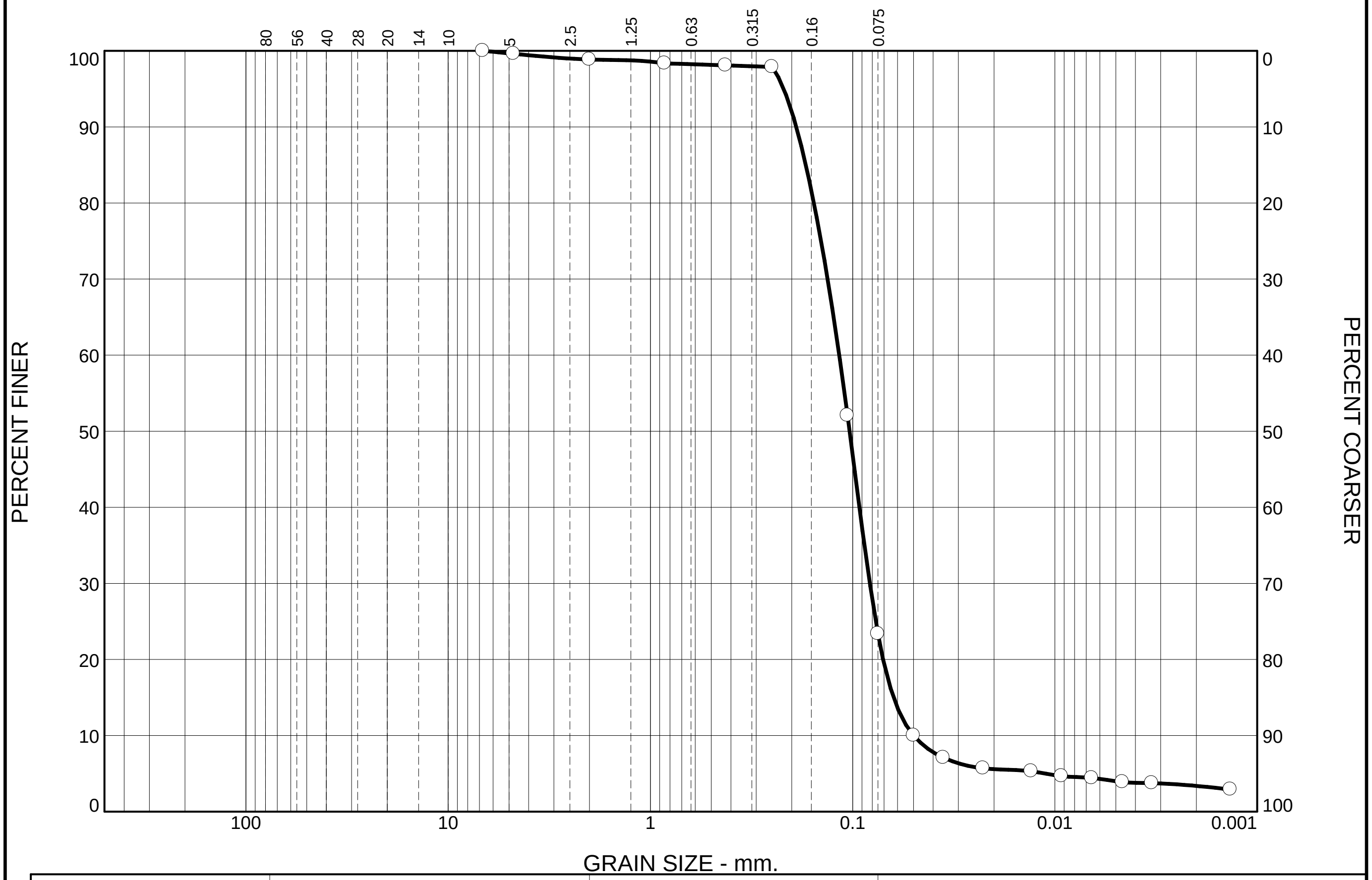
Remarks:

○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test Date: July 25, 2022

Figure 2

Tested By: AM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	1	1	75	20	3

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1704	0.1165	0.1035	0.0823	0.0628	0.0499	1.16	2.34

Material Description	USCS	AASHTO
○ SILTY SAND trace clay trace gravel		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG PRJ #2204701

○ **Sample Number:** BH 22-3, SS 5

Terrapex

Toronto, Ontario

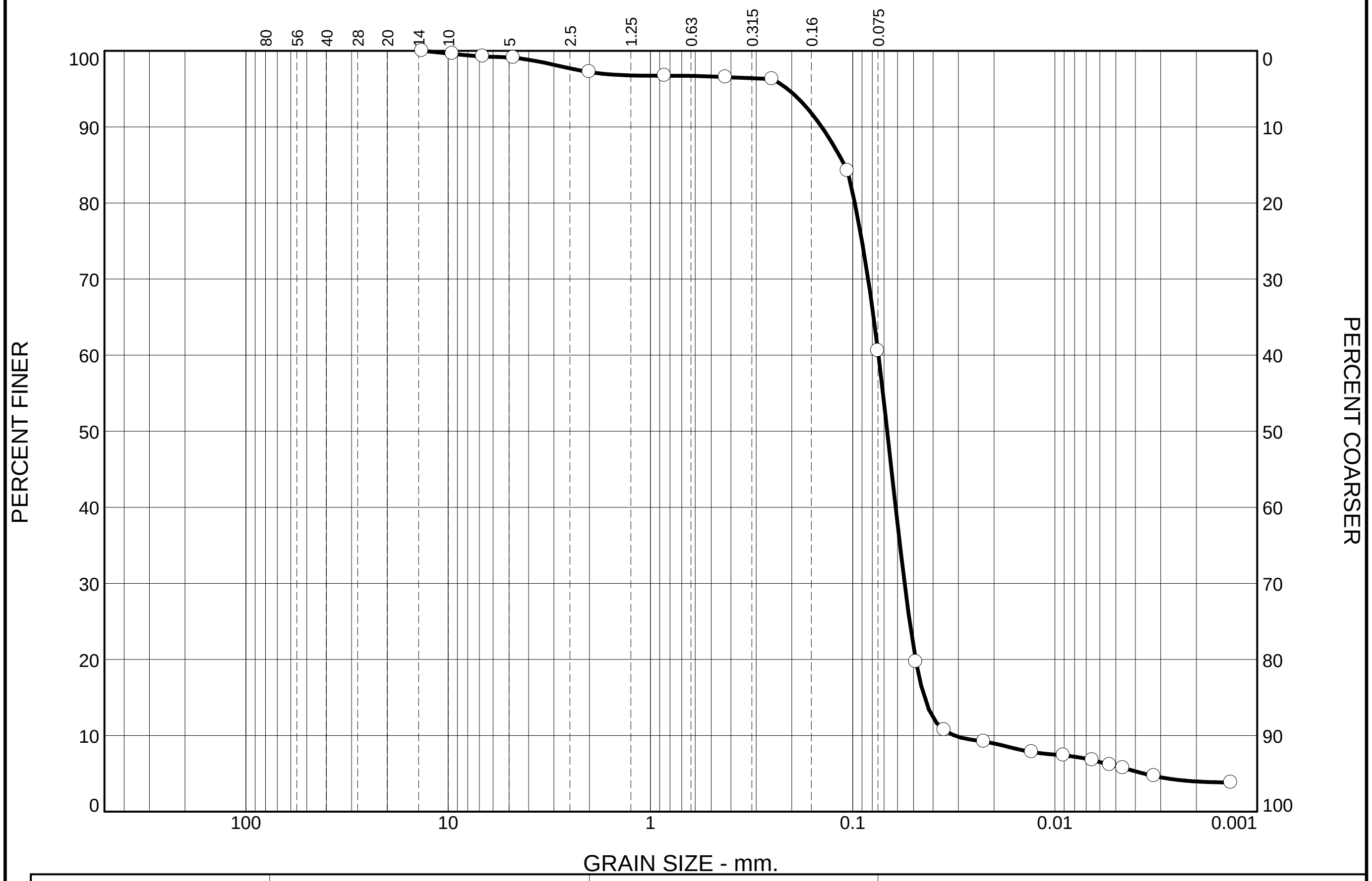
Remarks:

○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test Date: July 25, 2022

Figure 3

Tested By: AM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	3	0	36	57	4

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1097	0.0745	0.0674	0.0554	0.0442	0.0313	1.32	2.38

Material Description	USCS	AASHTO
○ SAND AND SILT trace gravel and trace clay		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG PRJ #2204701

○ **Sample Number:** BH 22-3, SS 7

Remarks:

○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test Date: July 25, 2022

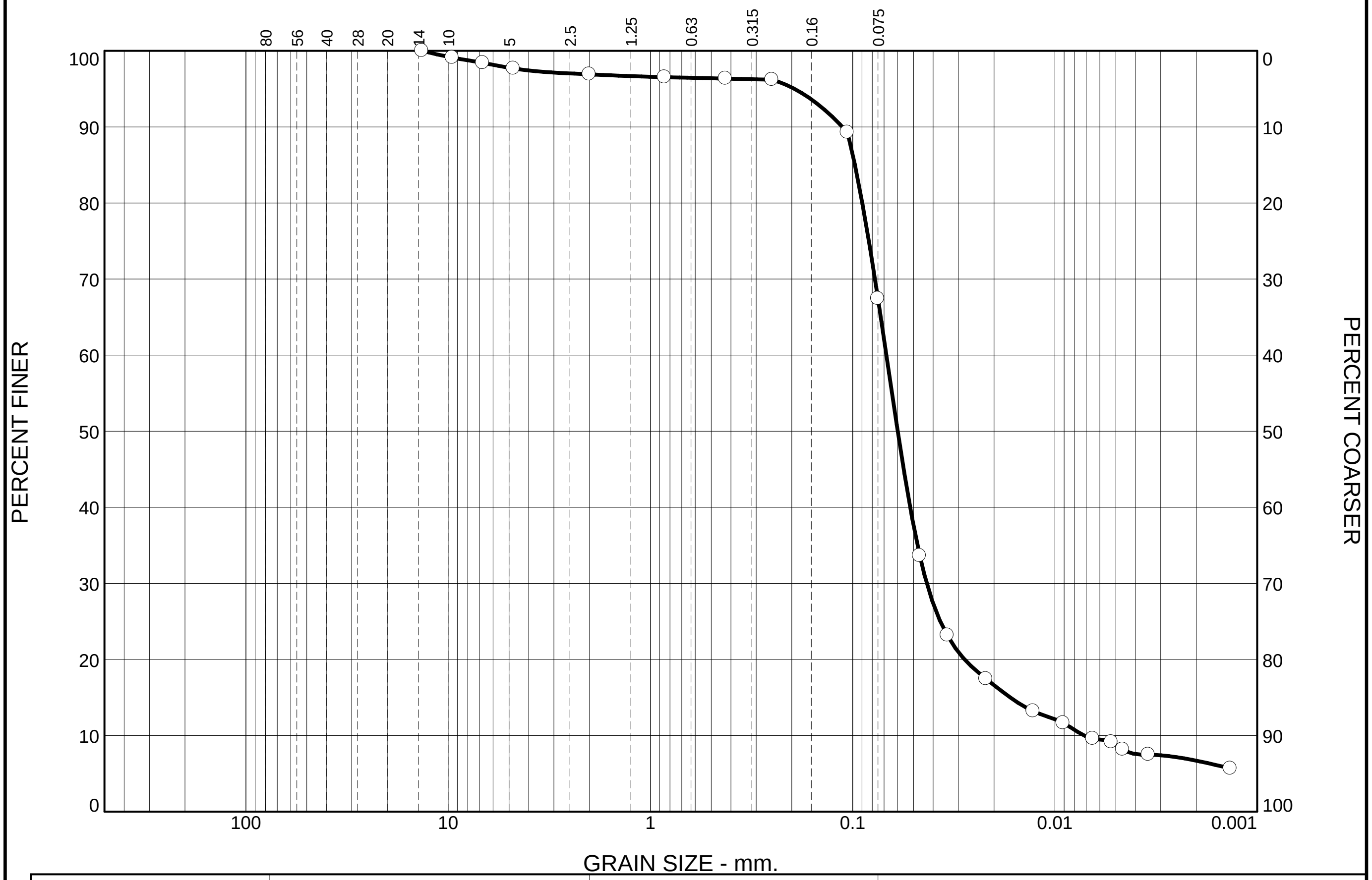
Terrapex

Toronto, Ontario

Figure 4

Tested By: AM/TH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	3	1	29	60	7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0974	0.0681	0.0598	0.0430	0.0166	0.0072	3.79	9.52

Material Description	USCS	AASHTO
○ SANDY SILT trace clay trace gravel		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG PRJ #2204701

○ **Sample Number:** BH 22-4, SS 6

Terrapex

Toronto, Ontario

Remarks:

○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test Date: July 25, 2022

Figure 5

Tested By: AM/TH

Appendix C

Rock Core Photographs

2204701
BH 22-2
Run1: 24’9” ~ 26’11” (7.54m ~ 8.20m)
Run2: 26’11” ~ 31’11” (8.20m ~ 9.73m)

2204701
BH 22-4
Run7: 57’ ~ 62’1” (17.37m ~ 18.92m)
Run8: 62’1” ~ 67’1” (18.92m ~ 20.45m)

2204701
BH 22-4
Run9: 67’1” ~ 72’ (20.45m ~ 21.95m)
Run10: 72’ ~ 77’2” (21.95m ~ 23.52m)

2204701
BH 22-4
Run11: 77’2” ~ 82’ (23.52m ~ 24.99m)

2204701
BH 22-2
Run3: 31’11” ~ 36’11” (9.73m ~ 11.25m)
Run4: 36’11” ~ 41’11” (11.25m ~ 12.78m)

2204701
BH 22-2
Run5: 41’11” ~ 46’10.5” (12.78m ~ 14.29m)
Run6: 46’10.5” ~ 51’10” (14.29m ~ 15.80m)

2204701
BH 22-2
Run7: 51’10” ~ 56’10” (15.80m ~ 17.32m)
Run8: 56’10” ~ 62’0.5” (17.32m ~ 18.91m)

2204701
BH 22-2
Run9: 62’0.5” ~ 66’11” (18.91m ~ 20.40m)
Run10: 66’11” ~ 72’ (20.40m ~ 21.95m)

2204701
BH 22-2
Run11: 72’ ~ 77’ (21.95m ~ 23.47m)
Run12: 77’ ~ 82’2” (23.47m ~ 25.04m)

2204701
BH 22-4
Run1: 29’4” ~ 32’ (8.94m ~ 9.75m)
Run2: 32’ ~ 36’11” (9.75m ~ 11.25m)

2204701

BH 22-4

Run3: 36’11” ~ 41’11.5” (11.25m ~ 12.79m)

Run4: 41’11.5” ~ 47’ (12.79m ~ 14.33m)

2204701
BH 22-4
Run5: 47’ ~ 52’ (14.33m ~ 15.85m)
Run6: 52’ ~ 57’ (15.85m ~ 17.37m)

Appendix D

Rock Core Testing Results

GEOMECHANICA

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

July 21, 2022

Mr. Teddy Ou
Palmer Environmental Consulting Group Inc.
74 Berkeley Street
Toronto, Ontario
Canada M5A 2W7

Re: UCS Testing
(Palmer Project No. 2204701)

Dear Mr. Ou:

On July 12th, 2022, a series of four (4) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Palmer Personnel. These samples were identified as being from Palmer project 2204701 (49 South Service Road). From these samples, four (4) Uniaxial Compressive Strength (UCS) tests were completed.

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

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:
Teddy Ou
Palmer
74 Berkeley Street
Toronto, Ontario
Canada, M5A 2W7

Prepared by:
Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng
Geomechanica Inc.
#900-390 Bay St.
Toronto ON
M5H 2Y2 Canada
Tel: +1-647-478-9767
lab@geomechanica.com

July 21, 2022
Project number: 2204701

Abstract

This document summarizes the results of rock laboratory testing, including 4 Uniaxial Compressive Strength (UCS) tests. The UCS values and Young's modulus 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. 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 0.15 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 a cylindrical specimen 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).

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, was met for all specimens unless noted otherwise in Table 1. The minimum length:diameter criteria was not met for any specimens as samples of appropriate length were not available. Testing of the specimens followed ASTM D7012-14 Method C.

1.2 Results

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

Table 1: Summary of Uniaxial Compression test results.

Sample	Depth (ft' in")	Bulk density ρ (g/cm^3)	UCS (MPa)	Lithology	Failure description
BH22-2, R11	73' 11.5" - 74' 8"	2.629	24.2	Shale and Limestone	1
BH22-2, R12	77' 11.5" - 78' 6"	2.645	42.1	Shale and Limestone	2, 3
BH22-4, R8	66' 1" - 66' 7.5"	2.637	40.4	Shale and Limestone	2, 4, 5
BH22-4, R10	72' 7" - 73' 1.5"	2.628	25.0	Shale	1, 3

[1] Inclined shear fracture and axial splitting failure

[2] Axial splitting failure

[3] Specimen emitted pore water upon loading

[4] Localized crushing near platen

[5] Failure localized in softer shale layer

1.3 Specimen photographs

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

Appendices

Specimen sheets

- BH22-2, R11
- BH22-2, R12
- BH22-4, R8
- BH22-4, R10

Uniaxial Compression Test

Client	Palmer	**Project**	2204701
Sample	BH22-2, R11	**Depth**	73’ 11.5” - 74’ 8”

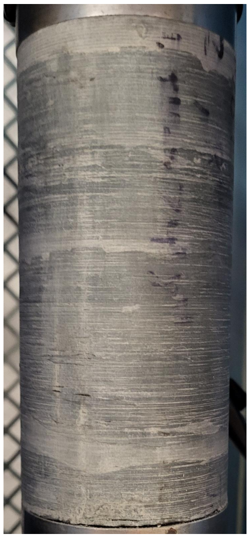
Specimen parameters

Diameter (mm) [a]	63.22
Length (mm) [a]	130.70
Bulk density ρ (g/cm^3)	2.629
UCS (MPa)	24.2
Lithology	Shale and Limestone
Failure description [b]	1

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

[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-07-13

Uniaxial Compression Test

Client	Palmer	**Project**	2204701
Sample	BH22-2, R12	**Depth**	77’ 11.5” - 78’ 6”

Specimen parameters

Diameter (mm) [a]	63.15
Length (mm) [a]	130.56
Bulk density ρ (g/cm^3)	2.645
UCS (MPa)	42.1
Lithology	Shale and Limestone
Failure description [b]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Axial splitting failure; [3] Specimen emitted pore water upon loading;

Prior to testing

After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-07-13

Uniaxial Compression Test

Client	Palmer	**Project**	2204701
Sample	BH22-4, R8	**Depth**	66’ 1” - 66’ 7.5”

Specimen parameters

Diameter (mm) [a]	63.05
Length (mm) [a]	129.86
Bulk density ρ (g/cm^3)	2.637
UCS (MPa)	40.4
Lithology	Shale and Limestone
Failure description [b]	2, 4, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Axial splitting failure; [4] Localized crushing near platen; [5] Failure localized in softer shale layer;

Prior to testing

After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-07-13

Uniaxial Compression Test

Client	Palmer	**Project**	2204701
Sample	BH22-4, R10	**Depth**	72’ 7” - 73’ 1.5”

Specimen parameters

Diameter (mm) [a]	63.02
Length (mm) [a]	130.39
Bulk density ρ (g/cm^3)	2.628
UCS (MPa)	25.0
Lithology	Shale
Failure description [b]	1, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [3] Specimen emitted pore water upon loading;

Prior to testing

After testing

Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-07-13

Appendix E

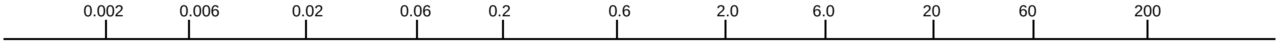
EDD Borehole Logs

Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by PECG also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO SILT (NONPLASTIC)	FINE	MEDIUM	CRS.	FINE	COARSE
	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	>35%

Soil Description

a) Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

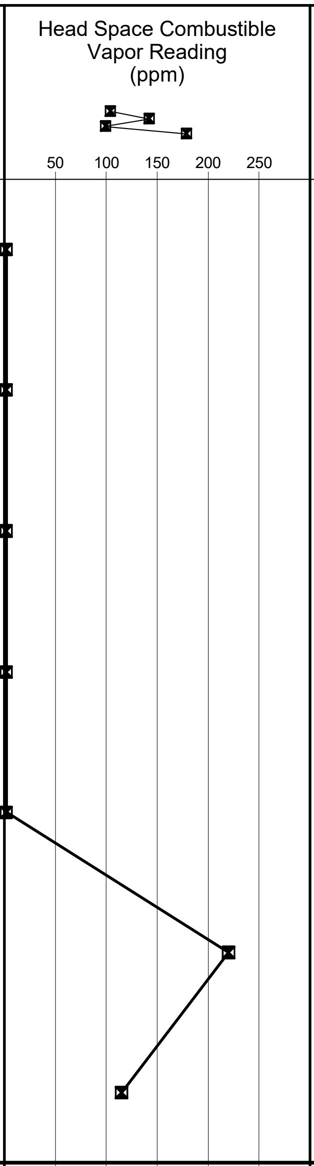
LOG OF BOREHOLE BH22-5

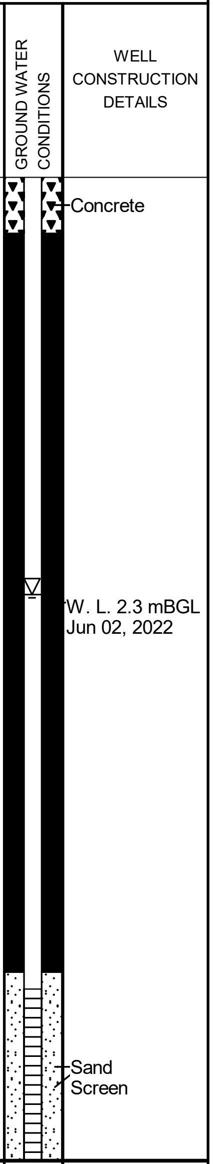
PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

REF. NO.: 2204701
ENCL NO.: 1
ORIGINATED BY SB & BF
CHECKED BY KN

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS
	Ground Surface				
0.0	**ASPHALT:** 100mm				
0.2	**SILTY SAND:** brown silty sand, trace gravel, fill	1	SS		
		2	SS		
		3	SS		
2.3	**SILTY SAND:** brown silty sand, trace gravel, wet, fill	4	SS		
3.1	**SILTY SAND:** brown silty sand, trace gravel, wet, fill note, black asphalt fragments	5	SS		
3.8	**SILTY SAND:** greyish brown,silty sand, wet , native	6	SS		Analysis: PHC/BTEX+ duplicate
		7	SS		
5.3	**END OF BOREHOLE**"Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 2.26 mBGS"				





GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3 , × 3 : Numbers refer to Sensitivity ○ ⁸=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH22-6

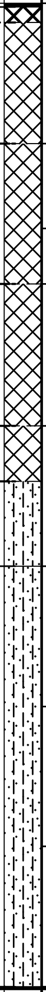
1 OF 1

PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

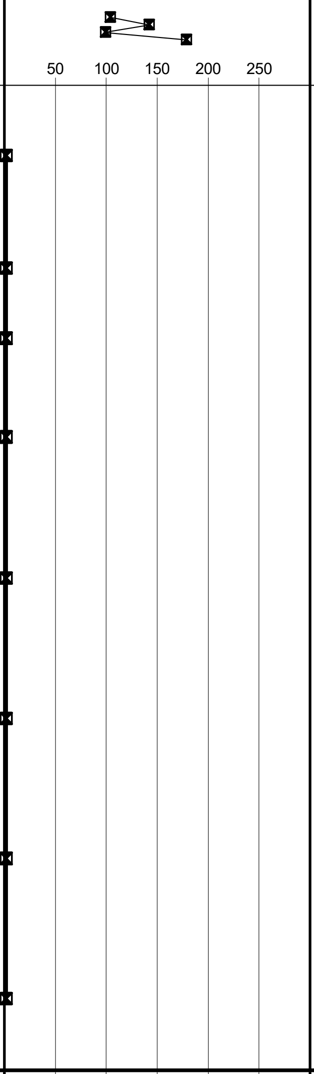
Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

REF. NO.: 2204701
ENCL NO.: 2
ORIGINATED BY SB & BF
CHECKED BY KN

(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS
	Ground Surface				
0.0	**ASPHALT:** 76 mm				
0.1	**SILTY SAND:** brown silty sand, trace gravel, fill **SANDY GRAVEL:** grey sandy gravel, fill	1	SS		
0.8	**SILTY SAND:** brown silty sand, trace gravel, trace clay, fill	2	SS		
	note, black staiing and PHC odours	3	SS		
1.5	**SILTY SAND:** brown silty sand, trace gravel, wet, fill note, plastic fragments	4	SS		
2.3	**SILTY SAND:** brown,silty sand, wet, fill				
2.6	**SILTY SAND:** greyish brown,silty sand, wet, native	5	SS		
3.1	**SILTY SAND:** greyish brown,silty sand, wet, native	6	SS		Analysis: PHC/BTEX
		7	SS		
		8	SS		
5.3	**END OF BOREHOLE**"Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 2.71 mBGS"				

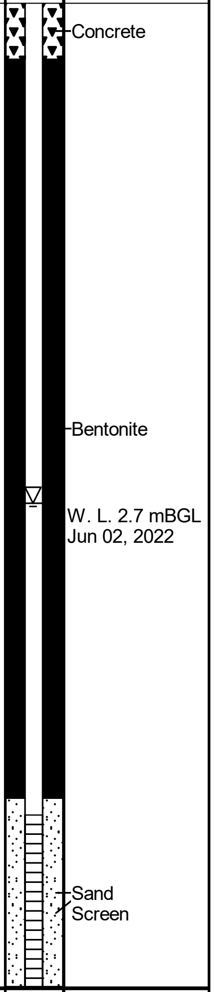


Head Space Combustible Vapor Reading (ppm)



GROUND WATER CONDITIONS

WELL CONSTRUCTION DETAILS



GROUNDWATER ELEVATIONS
Measurement 1st ∇ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3 : Numbers refer to Sensitivity ○ 8=3% Strain at Failure

LOG OF BOREHOLE BH22-7

PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

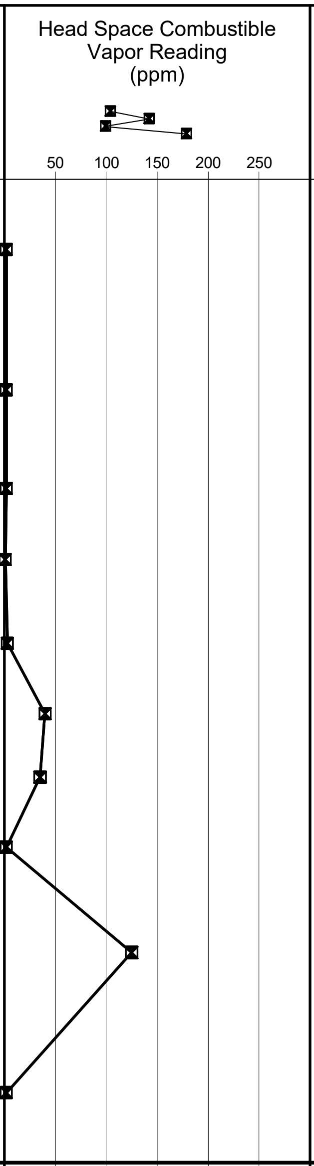
REF. NO.: 2204701
ENCL NO.: 3
ORIGINATED BY SB & BF
CHECKED BY KN

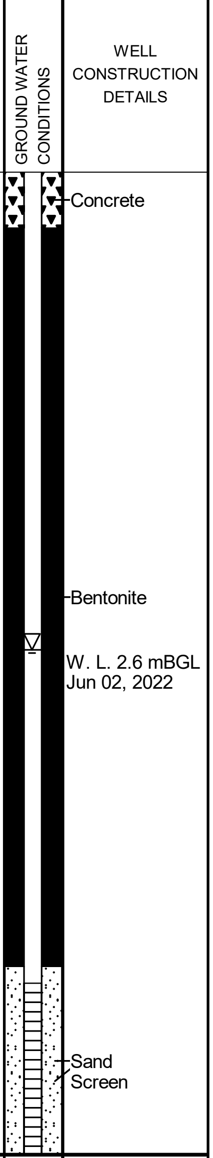
SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
	Ground Surface
0.0	**ASPHALT:** 100mm
0.2	**SILTY SAND:** brown silty sand, trace gravel, fill
1.8	**SILTY SAND:** black silty sand, fill
2.3	**SILTY SAND:** grey silty sand, trace clay, fill
2.7	**SILTY CLAY:** black silty clay, trace roots, fill
3.1	**SILTY CLAY:** grey silty clay, fill
3.4	**SANDY SILT:** black sandy silt, fill note, black staining, slight odour
3.8	**SANDY SILT :** greyish brown, sandy silt, trace clay, native
5.3	**END OF BOREHOLE**"Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 2.59 mBGS"

SAMPLES

NUMBER	TYPE	SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS
1	SS		
2	SS		
3	SS		
4	SS		
5	SS		
6	SS		
7	SS		
8	SS		Analysis: PHC/BTEX
9	SS		
10	SS		





GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3 : Numbers refer to Sensitivity ○ 3=3% Strain at Failure

Palmer™

LOG OF BOREHOLE BH22-8

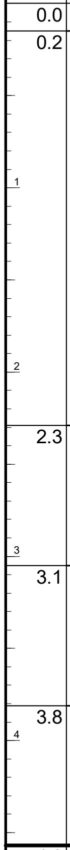
1 OF 1

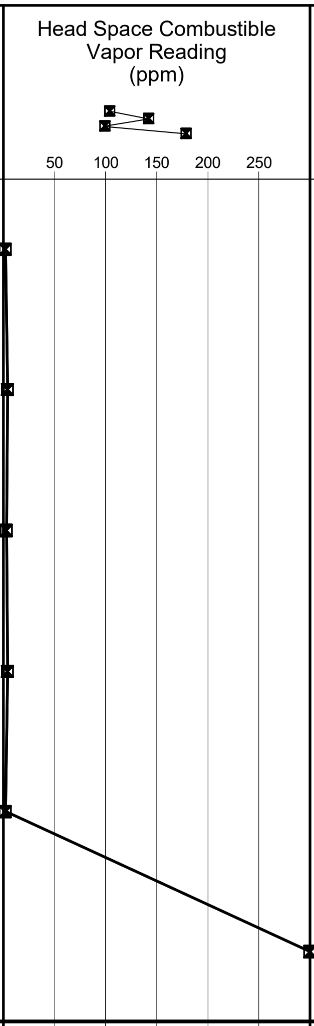
PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

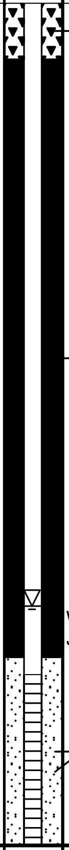
Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

REF. NO.: 2204701
ENCL NO.: 4
ORIGINATED BY SB & BF
CHECKED BY KN

SOIL PROFILE			SAMPLES					
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
	Ground Surface							
0.0	**ASPHALT:** 100mm							Concrete
0.2	**SILTY SAND:** brown silty sand, trace gravel, fill		1	SS				
			2	SS				
			3	SS				Bentonite
2.3	**SILTY SAND:** brown silty sand, trace gravel, wet, fill		4	SS				
3.1	**SILTY SAND:** brown silty sand, trace gravel, wet, fill		5	SS			▽	W. L. 3.3 mBGL Jun 02, 2022
3.8	note, black asphalt fragments		6	SS		Analysis: PHC/VOC + duplicate, metals		Sand Screen
4.6	**END OF BOREHOLE**"Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 2.26 mBGS"							







GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

Palmer™

LOG OF BOREHOLE BH22-9

1 OF 1

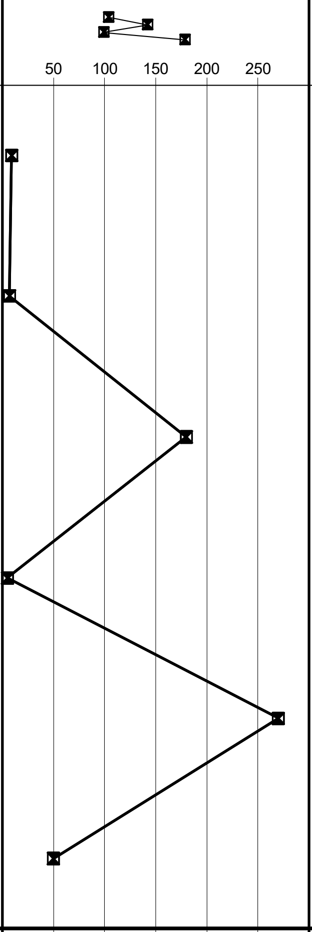
PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

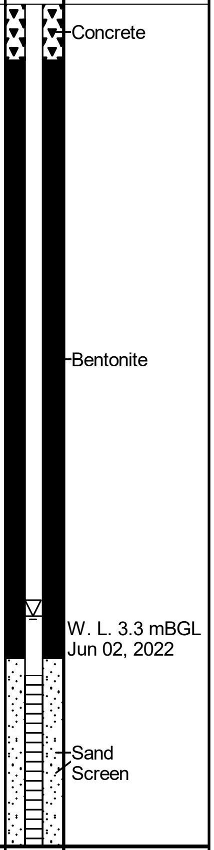
REF. NO.: 2204701
ENCL NO.: 5
ORIGINATED BY SB & BF
CHECKED BY KN

SOIL PROFILE			SAMPLES				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS
	Ground Surface						
0.0	**CONCRETE:**						
0.2	**SILTY SAND:** brown silty sand, trace gravel, fill		1	SS			
0.8	**SILTY SAND:** brown silty sand, trace gravel, boulder fragments, fill		2	SS			
1.5	**SILTY SAND:** brown silty sand, trace gravel, fill		3	SS		Analysis: PHC/VOC, metals+duplicate	
2.3	**SILTY SAND:** brown,silty sand, wet , native		4	SS			
			5	SS			
			6	SS			
4.6	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 3.32 mBGS"						

Head Space Combustible Vapor Reading (ppm)



WELL CONSTRUCTION DETAILS



PALMER-ENV_MAY-2022 (1).GLB
2-PALMER_ENV-SOIL/W VOC 0~300 PPM-2022 71 CURLEW DR LOGS ENVIRO TRIAL.GPJ 11-7-22

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 3=3% Strain at Failure

Palmer™

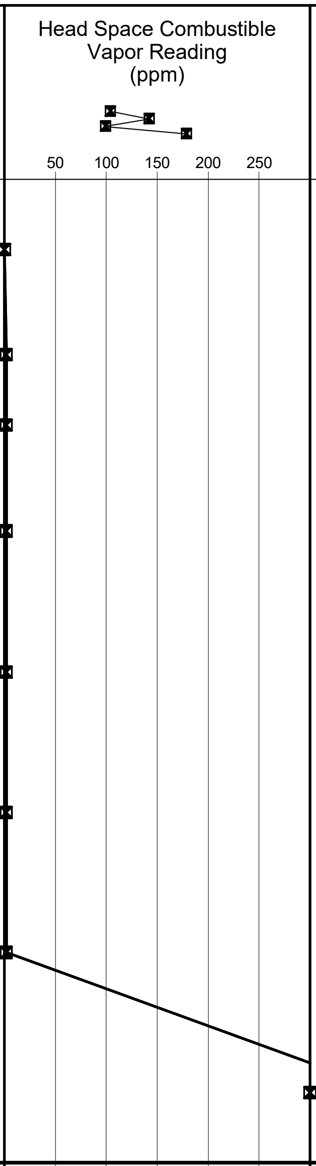
LOG OF BOREHOLE BH22-10

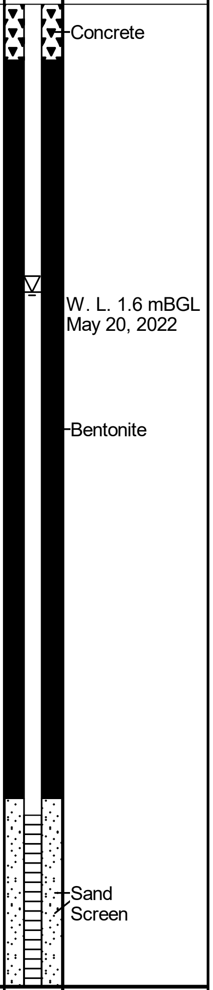
PROJECT: Phase Two ESA_49 S Service Road
CLIENT: Edenshaw SSR Developments Limited
PROJECT LOCATION: City of Mississauga, ON
DATUM: Geodetic
BH LOCATION:

Method: Solid Stem Auger
Diameter: 150 mm
Date: Jun-22-2001

REF. NO.: 2204701
ENCL NO.: 6
ORIGINATED BY SB & BF
CHECKED BY KN

SOIL PROFILE		SAMPLES		SAMPLE REMARKS	LABORATORY ANALYSIS AND REMARKS
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE		
	Ground Surface				
0.0	**ASPHALT:** 100mm				
	SILTY SAND: brown silty sand, trace gravel, fill	1	SS		
0.8	**SILTY SAND:** brown silty sand, trace gravel, trace clay, fill	2	SS		
	note, black asphalt fragments	3	SS		Analysis: pH+duplicate
1.5	**SILTY SAND:** golden brown silty sand, trace gravel, fill	4	SS		
	note, metal debris				
2.3	**SILTY SAND:** brown silty sand, trace clay, moist, fill	5	SS		Analysis: Grain Size
3.1	**SILTY SAND:** greyish brown,silty sand, wet , native	6	SS		
		7	SS		
		8	SS		Analysis: PHC/VOC, metals
5.3	**END OF BOREHOLE**"Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: June 2, 2022 W. L. Depth: 2.89 mBGS"				





GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure