10886378 Canada Ltd.

Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Residential Development
1869 Maple Grove Road, Ontario

Project Number
OTT-00257188-A0

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Date Submitted:
March 30, 2020

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Legal Notification

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Executive Summary

A geotechnical investigation was undertaken for the proposed residential development to be located at the site registered by the street address of 1869 Maple Grove Road, City of Ottawa, Ontario. This work was authorized by Mr. Carmine Zayoun on behalf of 10886378 Canada Ltd.

Design Plans prepared by EXP call for the development of the site with three (3) blocks of residential townhouses, each with one basement level for a total of eighteen (18) units. Preliminary grading plans indicate the proposed underside of footings for the townhouses to range from 105.46 m to 105.62 and the finish grades outside the units to range from 107.95 m to 108.16 which would result in a grade raise of up to 1.5 m.

The fieldwork for the geotechnical investigation comprised of the drilling of five (5) boreholes to refusal/ termination depths of 0.9 to 4.3 m and two (2) probeholes to refusal depths of 1.8 m and 2.1 m below the existing ground surface. Standpipes were installed in two (2) of the boreholes for long-term monitoring of the groundwater at the site. Wash boring and core drilling was used to advance Borehole Nos. 1 and 2 below the refusal depths.

The investigation has revealed that the subsurface conditions comprise of topsoil overlain by fill and/or sandy silt glacial till, extending to refusal to augers on bedrock/inferred bedrock contacted at depths ranging between 0.9 m and 2.7 m (Elevation 106.6 m to 104.6 m). Wash boring and core drilling used to advance Borehole Nos. 1 and 2 below the refusal depths revealed that refusal was met on limestone bedrock in those two boreholes. It is not known whether refusal in the other boreholes/probeholes was met on boulders or on bedrock.

Groundwater measurements collected in standpipes installed in two of the boreholes indicate that the groundwater table is at depths of 2.4 m to 2.8 m below the existing ground surface (Elevation 104.9 m to 104.1 m). The groundwater table is subject to seasonal fluctuation and may be at higher depths during wet weather conditions.

Based on the results of the investigation and proposed design, the residential blocks are expected to be founded either on the glacial till, engineered fill or on the bedrock. Footings designed to bear on the dense glacial till/engineered fill may be designed for an SLS and USL bearing pressures of 150 kPa 225 KPa respectively. Footings designed to bear on the bedrock below any weathered or fractured zones may be designed for a bearing pressure at Ultimate Limit State (ULS) of 250 kPa. Footings should not be founded on two different subgrade materials without a provision of a transition zone or additional reinforcement.

The presence of cap rock, weathered rock and fissures should be expected at founding levels. Therefore, it is imperative that the surface of the exposed bedrock at the underside of the footings be examined by a geotechnical engineer and any fractured bedrock zones or fissured removed/cleaned prior to casting of the footings. In areas of previous underground installations (septic tank, etc.), all fill will have to be removed to surface of the bedrock or glacial till and the excavation backfilled using engineered fill prepared as discussed in detail in the main body of the report. This condition applies also to the location of the building at 1869 Maple Grove Road which will be demolished for the construction of the residential blocks.

The basement and garage floor slabs of the proposed structures may be constructed as slabs-on-grade set on a bed of 300 mm of clear stone set over bedrock or engineered fill. Perimeter drainage system is recommended for the proposed townhouse blocks.

Excavations at the site in the overburden may be undertaken as open-cut provided they are cut back at a slope of 1H to 1V. Excavation of the bedrock would require the use of line drilling and blasting technique and may be undertaken with near vertical sides. Vibrations should be monitored during construction to prevent damage to adjacent structures and services and set limits should comply to the City of Ottawa guidelines and regulations. A pre-condition survey of all the structures and services situated within proximity of the site will be required prior to commencement of construction and during the excavation of the bedrock.

Seepage of surface and sub-surface water into the excavations should be anticipated. It should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps.

The subject site is classified as **Class C** for seismic site response in relation to Section 4.1.8.4 of the 2012 Ontario Building Code (OBC 2012). A higher site class for the site may be obtained if a shear-wave measurement is completed at the site.

The pavement structure for the subdivision roadways and driveways of the subdivision are presented in Table IV of the report.

Prior to tendering, consideration should be given to excavate additional test pits throughout the site to collect additional data on the elevations of the bedrock throughout the site in order to minimize the risk of additional claims from the contractors as the result of possible variation in bedrock elevations throughout the site.

The above and other related considerations are discussed in greater detail in the report.

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1 Introduction

A geotechnical investigation was undertaken at the site of the proposed residential development to be located at the property registered by the street address of 1869 Maple Grove Road, City of Ottawa, Ontario (Figure 1). Terms and conditions for this project was outlined in EXP's Proposal dated July 11, 2019. This work was authorized by Mr. Carmine Zayoun of 10886378 Canada Ltd. via signed work authorization form on November 5, 2019.

The proposed residential development will consist of eighteen (18) residential townhomes, divided into three blocks, i.e. Blocks 1 to 3. The townhomes will be constructed with one basement level. Associated underground services, access road and surface driveways are also to be constructed as part of the proposed residential development.

Site grading plan prepared by EXP under Project Ott-00254810-A0 (Drawing C003) indicates the proposed underside of footings for the townhouses will range from 105.46 to 105.62 m and the finish grades outside the units to range from 107.95 m to 108.16 m resulting in a grade raise of up to 1.5 m.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the location of the boreholes and probeholes drilled throughout the site;

b) Comment on grade-raise restrictions for the site;

c) Make recommendations on the most suitable type of foundations, founding depth and Serviceability Limit State (SLS) bearing pressures and Ultimate Limit State (ULS) factored geotechnical resistances for the proposed residential development as well as anticipated total and differential settlements;

d) Provide lateral earth pressure parameters for subsurface basement wall design;

e) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;

f) Discuss excavation conditions and dewatering requirements during construction;

g) Provide preliminary classification of the site for seismic design in accordance with requirements of the 2012 Ontario Building Code (OBC) and assess the liquefication potential of the on-site soils in a seismic event; and,

h) Recommend pavement structure thickness for subdivision roads.

The comments and recommendations given in this report are based on the assumption that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2 Site Description

The subject site is a 55 m by 85 m parcel of land occupied by a single two-storey residential house (Figure 1) which will be demolished as part of the proposed development. The rest of the site is grassy and contains a few trees, with some trees and shrubs around the perimeter. The site is bounded by Maple Grove Rd to the south, Grenadine St to the east, and Bensinger Way to the north. The site is adjacent to existing residential developments on all sides.

The site gently slopes outwards, with geodetic elevations at the location of the boreholes and probeholes ranging from 106.7 m to 107.5 m.

3 Procedure

The fieldwork for the geotechnical investigation was undertaken on November 5 and 6, 2019 and comprised the drilling of five (5) boreholes and two probeholes, i.e. Borehole Nos. 1 to 5 and Probehole Nos. P1 and P2 to refusal/termination depths ranging between 0.9 m and 4.3 m below the existing ground surface. The boreholes/probeholes were drilled using a CME-55 track-mounted and the fieldwork was supervised on a full-time basis by a representative of EXP.

The locations and geodetic elevations of the boreholes/probeholes were established in the field by a survey crew from EXP and are shown on Figure No. 2. Prior to drilling, their locations were cleared of any public and private underground services.

Standard penetration tests were performed in the boreholes at 0.75 m depth intervals and soil samples retrieved by split-barrel sampler in accordance with ASTM 1586. In Borehole Nos. 1 and 2, washboring and core-drilling techniques were used to advance these boreholes beyond the refusal depths.

Water levels were measured in the open boreholes/probeholes upon completion of drilling. In addition, long-term groundwater monitoring installations consisting of 19 mm diameter polyvinyl chloride (PVC) pipes were installed in Borehole Nos. 1 and 5 in accordance with EXP standard practice. The installation configuration is documented on the respective borehole logs. All the boreholes and probeholes were backfilled upon completion of the fieldwork.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, all the rock cores were visually examined, placed in core boxes, identified and logged. On completion of the fieldwork, all the soil and rock samples were transported to the EXP laboratory in the City of Ottawa, Ontario where they were visually examined by a geotechnical engineer and borehole/test pit logs prepared. The engineer also assigned the laboratory testing, which consisted of performing the following tests on selected soil samples and rock cores in accordance with the American Society for Testing and Materials (ASTM).

Tests on Selected Soil Samples and Rock Core Samples:

Natural Moisture Content ..... 21 tests
Natural Unit Weight Tests on soil samples ..... 5 tests
Grain-size Analyses ..... 2 tests
Unit Weight and Unconfined Compressive Strength Tests on rock cores ..... 6 tests

4 Subsurface Soil and Groundwater Conditions

A detailed description of the geotechnical conditions encountered in the boreholes and probeholes is given on the borehole and probehole logs, Figure Nos. 3 to 9 inclusive. The logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

It should be noted that the soil and rock boundaries indicated on the boreholes/probeholes are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The “Notes on Sample Descriptions” preceding borehole and test pit logs form an integral part of this report and should be read in conjunction with this report. A review of the borehole/probehole logs indicates the following subsurface soil and groundwater conditions with depth.

4.1 Topsoil

Topsoil ranging in thickness between 150 mm and 300 mm was encountered at the surface in all the boreholes and probeholes except in Borehole No. 5.

4.2 Fill

Fill was encountered from the ground surface in Borehole No. 5 and below the topsoil in all other boreholes and extends to refusal to augers, i.e. bedrock/inferred bedrock at depths ranging from 0.8 m to 2.7 m (Elev. 106.6 m to 104.6 m) in Boreholes 1, 3 and 4 and to a depth of 1.4 m in Borehole Nos. 2 and 5 (Elev. 105.9 m to 105.3 m).

The fill is loose to very loose heterogeneous in nature and consists of a mixture of silty sand with varying amounts of clay and gravel, rootlets, oxidized stains and organic staining. Its moisture content ranged between 2 and 29 percent. Grain-size analysis performed on one fill sample revealed a soil composition of 40 percent silt and clay, 50 percent sand and 10 percent gravel (Figure 10). In areas where fill extends to refusal depths, it is possible that bedrock at these locations may have been previously excavated as part of previous earth work at the site and therefore the original bedrock levels may have been at higher levels.

4.3 Glacial Till

The fill in Borehole Nos. 2 and 5 is underlain by a compact to dense silty sand till with gravel which extends to the surface of the bedrock/inferred bedrock at depths of 1.5 m and 2.5 m (Elev. 104.9 m to 104.6 m). The moisture content of the till varied from 7 to 22 percent and its unit weight was established as 24.1 kN/m^3. Grain-size analyses performed on one sample from this deposit revealed a soil composition of 22 percent silt and clay, 57 percent sand and 21 percent gravel (Figure 11).

4.4 Bedrock

Auger refusal was met in all boreholes and probeholes at depths ranging between 0.8 m and 2.7 m (Elev. 106.6 m to 104.6 m) as summarized in Table I below. Washboring and core drilling techniques used to advance further in Borehole Nos. 1 and 2 revealed that refusal was met on limestone bedrock in these boreholes. In areas where fill extends to refusal depths, it is possible that bedrock may have been previously excavated as part of previous earth work at the site.

Table I: Summary of Auger Refusal/Bedrock Elevations in Boreholes

Borehole No.	Ground Surface Elevation	Inferred Bedrock Depth (m)	Refusal Depth (m)	Inferred Bedrock Elevation	Bedrock Confirmed by Core Drilling
BH-1	106.9	0.6	0.8	106.3	Yes
BH-2	106.7	1.8	1.8	104.9	Yes
BH-3	107.3	2.6	2.7	104.7	No (Inferred Bedrock)
BH-4	107.5	0.8	0.8	106.7	No (Inferred Bedrock)
BH-5	107.3	2.6	2.7	104.7	No (Inferred Bedrock)
P-1	107.1	1.8	1.8	105.3	No (Inferred Bedrock)
P-2	107.3	2.1	2.1	105.2	No (Inferred Bedrock)

A review of the recovered bedrock cores indicates that the bedrock underlying the site comprised of limestone. A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 60 to 100 percent and 27 to 92 percent respectively were obtained from the recovered bedrock cores. On this basis, the bedrock quality within the depth investigated may be classified as poor to excellent.

A total of six (6) rock core samples were selected for unconfined compressive strength testing and the results presented in Table II and indicate a bedrock with compressive strength ranging between 73 MPa and 152 MPa indicating “strong” to “very strong” bedrock, (Canadian Foundation engineering manual, 4th edition, 2006). The unit weight of the bedrock ranged between 2660 kN/m^3 and 2750 kN/m^3.

Table II: Results of Unconfined Compression Tests on Rock Core Samples

Borehole No. RUN No.	Depth (m)	Compressive Strength (MPa)	Unit Weight of Bedrock (KN/m^3)
BH 1 – Run 2	1.8 – 2.0	152	2693
BH 1 – Run 2	2.1 – 2.3	82	2669
BH 1 – Run 3	3.3 – 3.5	73	2660
BH 2 – Run 1	1.9 – 2.0	89	2735
BH 2 – Run 1	2.7 – 2.8	138	2750
BH 2 – Run 2	2.9 – 3.0	88	2731

Photographs of the bedrock core recovered are presented in Figure Nos. 12 and 13.

4.5 Groundwater

Water level observations were made in the boreholes and probeholes during drilling and subsequently in standpipes installed in some of the boreholes and indicates that the groundwater table at the site to range between 2.4 m and 2.8 m below the existing ground surface (Elev. 104.9 m to 104.1 m) as presented in Table III.

Table III: Groundwater Observations

Borehole No.	Ground Surface Elevation (m)	Date of Monitoring	Elapsed Time	Depth of Groundwater (m)	Elevation of Groundwater(m)
BH-01	106.9	November 29, 2019	24 days	2.8	104.1
BH-05	107.3	November 29, 2019	24 days	2.4	104.9

Water levels were determined in the boreholes at the times and under the conditions stated in the scope of services. Note that fluctuations in the level of groundwater may occur due to a seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

5 Grade Raise

The investigation has revealed the site to be underlain by 0.8 to 2.7 m thick overburden underlain by limestone bedrock.

Preliminary grading plans prepared by EXP for the subject site under Project OTT-000254810-A0, Drawings C003 dated March 2020 indicate a proposed grade raise of up to 1.5 m throughout the site. This proposed grade raise is considered acceptable from a geotechnical point of view as the site is not underlain by any compressible soils.

Site grading within the footprint of the proposed building, access road, driveways, should consist of the removal of all topsoil, organic material fill down to the surface of native silty sand / sandy and/or glacial till whichever is contacted first. In the areas of proposed roadway and driveways, it may be possible to leave some of the fill in place pending further evaluation . Following approval, the exposed subgrade should be proof rolled with a vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub-excavated and properly replaced with fill as per the requirement of Section 12.

6 Foundation Considerations

Based on the results of the investigation and proposed design grades, the residential blocks are expected to be founded either on the glacial till or on in the bedrock as summarized in Table IV below. Footings should not be founded on two different subgrade materials without a provision of a transition zone or additional reinforcement.

Table IV: Founding Elevations and Grades at Each Block

Block #	Closet Borehole	~Original Grades (m)	Designed Finished Grade	Proposed Underside of Footings Elev. (m)	Anticipated Subgrade at Founding level	Bedrock Elevation (m)
Block 1, 8 units	BH 1, 2, 3	~ 106.93	108.00	105.46	Bedrock	106.3 -104.7
Block 2, 2 units	P1	~ 107.3	108.00	105.46	Bedrock	105.3
Block 3, 8 units	BH 4, 5, P2	~ 107.3	108.16	105.62	Bedrock and till	106.7-104.6

Footings bearing on the dense glacial till/engineered fill (if required) may be designed for bearing pressures at Serviceability Limit State (SLS) and Ultimate State Limit (USL) design of 150 kPa 225 KPa respectively. Footings designed to bear on the bedrock below any weathered or fractured zones may be designed for a bearing pressure at Ultimate Limit State (ULS) of 250 kPa as the SLS does not apply to footings bearing on bedrock. The presence of cap rock, weathered rock and fissures should be expected at founding levels in the bedrock. Therefore, it is imperative that the surface of the exposed bedrock at the underside of the footings be examined by a geotechnical engineer and any fractured bedrock zones or fissured removed/cleaned prior to casting of the footings. If required, any fissures in the bedrock should be filled with flowable concrete.

In the area of the existing septic tank and previous installation, all fill should be removed down to the surface of the bedrock/glacial and the area backfilled with engineered fill comprising of OPSS 1010 Granular B Type II placed in 300 mm lifts and each lift compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D-698-12e2. This condition applies also to the location of the building at 1869 Maple Grove Road which will be demolished for the construction of the residential blocks. All construction rubbles must be removed from the site following the demolition of any structure of installation currently present on-site.

Additional reinforcement or structural joints will be required in areas where the founding medium changes from bedrock to engineered fill. This detail must be provided by the structural engineer.

All footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces can support the design bearing pressure and that the footing beds have been properly prepared as described above.

A minimum of 1.5 m of earth cover should be provided to the footings of a heated structure founded on bedrock/glacial till or engineered fill to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures.

The recommended bearing pressures have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes and test pits when foundation construction is underway. The interpretation between boreholes and test pits and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

7 Floor Slabs and Drainage Requirements

The basement and garage floor slabs of the proposed two-storey townhouse blocks may be constructed as slab-on-grades provided they are set on beds of well-compacted 19 mm clear stone at least 300 mm thick placed on bedrock or on well-compacted engineered fill. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

It is anticipated that perimeter drains would be required for the proposed residential blocks with basements. The perimeter drains may consist of 100 mm diameter perforated pipe wrapped with filter cloth (sock) and set on the footings and surrounded with 150 mm of 19 mm clear stone and properly connected to an outflow. The subsurface walls should be adequately damp proofed. Provisions of underfloor drains may be required pending the prevailing stabilized groundwater at the site. Therefore, it is recommended that additional groundwater measurements should be undertaken at the site to establish whether underfloor drainage system will be required to all or to some of the blocks.

The finished exterior grade should be sloped away from the buildings to prevent surface ponding of water close to the exterior walls.

8 Pipe Bedding Requirement

It is recommended that the bedding for the underground services including material specification, thickness of cover material and compaction requirements conform to the local requirements of the municipality and/or Ontario Provincial Standard Specification and Drawings (OPSS and OPSD).

For guidance, the pipe bedding may consist of 150 mm of OPSS 1010 Granular A for services founded on bedrock. The bedding material should be also placed along the sides and on top of the pipes to provide a minimum cover of 300 mm. The bedding, spring line and cover should be compacted to at least 98 percent the Standard Proctor Maximum Dry Density (SPMDD).

In areas where the subgrade changes from bedrock to glacial till, the bedrock should be excavated at a slope of 7H to 10V and the area backfilled with OPSS Granular A compacted to 100 percent of the SPMDD.

9 Lateral Earth Pressure against Basement Walls

The subsurface walls should be backfilled with free draining material, such as OPSS 1010 for Granular B, Type II and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0 H (q + \tfrac{1}{2} \gamma H)$$

where P = lateral earth thrust acting on the subsurface wall; kN/m

K_0 = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.5

γ = unit weight of free draining granular backfill; Granular B = 22 kN/m^3

H = Height of backfill adjacent to foundation wall, m

q = surcharge load, kPa

The lateral seismic thrust may be computed from the equation given below:

$$\Delta P_E = 0.32 \gamma H^2$$

where ΔP_E = resultant thrust due to seismic activity; kN/m

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

H = height of backfill behind wall, (m)

The ΔPE value does not consider the surcharge load. The resultant load should be assumed to act at 0.6 H from the bottom of the wall.

10 Excavations

Excavations for the construction of the residential blocks and underground services is expected to require the removal of the bedrock.

Excavations at the site must comply with the latest version of Ontario Occupational Health and Safety Act, Ontario Regulations 213/91 (January 11, 2014), i.e. excavation in the overburden should be cut back at a slope of 1H to 1V.

Excavation of the bedrock may be undertaken with near vertical sides and would require the use of line drilling and blasting techniques. To prevent any damage to the surrounding structures and services, the blasting operations would have to be carefully planned and closely monitored. It is recommended that the blasting contractor should retain the services of a blast specialist to provide him with a blasting plan. The contractor should have a licensed blaster on site always during the blasting and a vibration engineer on retainer. A condition survey of all the structures near the site should be undertaken prior to commencement of the excavation work. Vibration monitoring should be carried out during blasting operations and the vibration limits at the property boundaries should be in accordance with the City of Ottawa guidelines and regulations in the objective to prevent any damage to the existing structures or services.

Seepage of the surface and subsurface water into the excavations is anticipated in localized areas. However, it should be possible to collect any water entering the excavations in perimeter ditches or low points and to remove it by pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, higher water seepage should be anticipated. Therefore, the need of high capacity pumps to keep the excavation dry should not be overlooked.

It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction dewatering purposes. Prior to March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment and Climate Change (MOECC) for groundwater takings related to construction dewatering, where taking volumes in excess of 50 m3/day, but less than 400 m3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction dewatering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MOECC instead of applying for a PTTW.

To be eligible for the new EASR process, the construction dewatering taking must be less than 400 m3/day under normal conditions. The water taking can be groundwater, storm water, or a combination of both. It should be noted that the 30-consecutive day limit on the water taking under the old Category 2 PTTW process has been removed in the new EASR process. Also, it should be noted that the EASR process requires two technical studies be prepared by a Qualified Person, prior to any water taking. These studies include a Water Taking Report, which provides assurance that the taking will not cause any unacceptable impacts, and a Discharge Plan, which provides assurance that the discharge will not result in any adverse impacts to the environment. A significant advantage of the new EASR process over the former Category 2

PTTW process, is that the groundwater taking may begin immediately after completing the on-line registration of the taking and paying the applicable fee, assuming the accompanying technical studies have been completed. The former PTTW process typically took more than 90 days, which had the potential to impact construction schedules. EXP can provide assistance during the EASR/PTTW process, if required.

Although this investigation has estimated the groundwater levels at the time of the field work, and commented on de-watering and general construction problems, conditions may be present that are difficult to establish from standard boring and excavating techniques. These conditions may affect the type and nature of de-watering procedures used by the contractor. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to adequately engineer construction de-watering systems

11 Seismic Site Classification

Based on the subsurface conditions, the site is classified as **Class C for seismic site response** in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code (OBC 2012). A higher site class will likely be obtained if a shear-wave velocity testing is completed at the site.

The on-site soils are not susceptible to liquification in a seismic event.

12 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The material to be excavated from the site will comprise of topsoil and a small quantity of heterogenous fill, silty sand and sand and glacial till. The overburden (fill and glacial till) may be re-used in for general grading purposes in the general area of the site provided they are free of organics, cobbles and boulders. Topsoil should be removed and discarded.

It is anticipated that most of the material required for backfilling purposes will need to be imported and should preferably conform to the following specifications:

- Engineering fill under footing and basement floor – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698-12e2 under footings and to 98 percent of the SPMDD under the basement floors;

- Backfilling against exterior basement walls – OPSS 1010 Granular B Type II, placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD; and,

- Trench backfill and fill placement to subgrade level for pavement – OPSS 1010 Select Subgrade Material (SSM) OR imported **approved** compactible material free of organics, debris and with a natural moisture content within 2 percent of the optimum moisture content. It should be placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.

13 Subdivision Road and Driveways

Access to Blocks 1 and 3 will be from Bensinger Way and Maple Grove Road respectively whereas Block 2 will be accessed off Mykonos Crescent

The subgrade at the site is expected to comprise of glacial till or select subgrade material comprising of material conforming to OPSS 1010. Pavement structure thicknesses required for access road and driveways were computed and are shown on Table V. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 18 to 20 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table V: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Subdivision Roadways	
		Access Road/Heavy Duty	Driveways
Asphaltic Concrete (PG 58-34)	92 to 97% MRD	40 mm - SP12.5 50 mm - SP19	50 mm - SP12.5/HL3
Granular A Base (crushed limestone)	100% SPMDD*	150 mm	150 mm
Granular B Sub-base, Type II	100% SPMDD*	450 mm	300 mm
SPMDD* Standard Proctor Maximum Dry Density, ASTM-D698-12e2 MRD denotes Maximum Relative Density, ASTM D2041 Asphaltic Concrete in accordance with OPSS 1150/ 1151			

Additional comments on the construction of areas to be paved area are as follows:

1. As part of the subgrade preparation for the areas to be paved, the subdivision roadways should be stripped of topsoil and other obviously unsuitable material down to subgrade level. Th exposed area should be proof rolled with a vibratory roller. Any soft areas detected should be sub-excavated and replaced with approved imported material conforming to OPSS 1010 for Select Subgrade Material (SSM). Fill required to raise the grades to design elevations should conform to OPSS 1010 SSM and should be placed in 300 mm lifts and each lift compacted to 95 percent of the SPMDD.

2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. As a minimum, subdrain stubs should be installed at the catchbasin. This will ensure no water collects in the granular course, which could result in pavement failure during the

spring thaw. The location and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.

3. To minimize the problems of differential movement between the pavement and catch basins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B, Type II material. Weep holes should be provided in the catch basins/manholes to facilitate drainage of any water that may accumulate in the granular fill.

4. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

5. The granular materials used for pavement construction should conform to OPSS 1010 for Granular A and Granular B, Type II and should be compacted to 100 percent of the SPMDD (ASTM D698-12 e2). The asphaltic concrete used, and its placement should meet OPSS 1150/1151 and 310/313 requirements. It should be compacted to 92 to 97 percent of the maximum relative density in accordance with ASTM D2041.

It is recommended that EXP be retained to review the final pavement structure design and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

14 General Comments

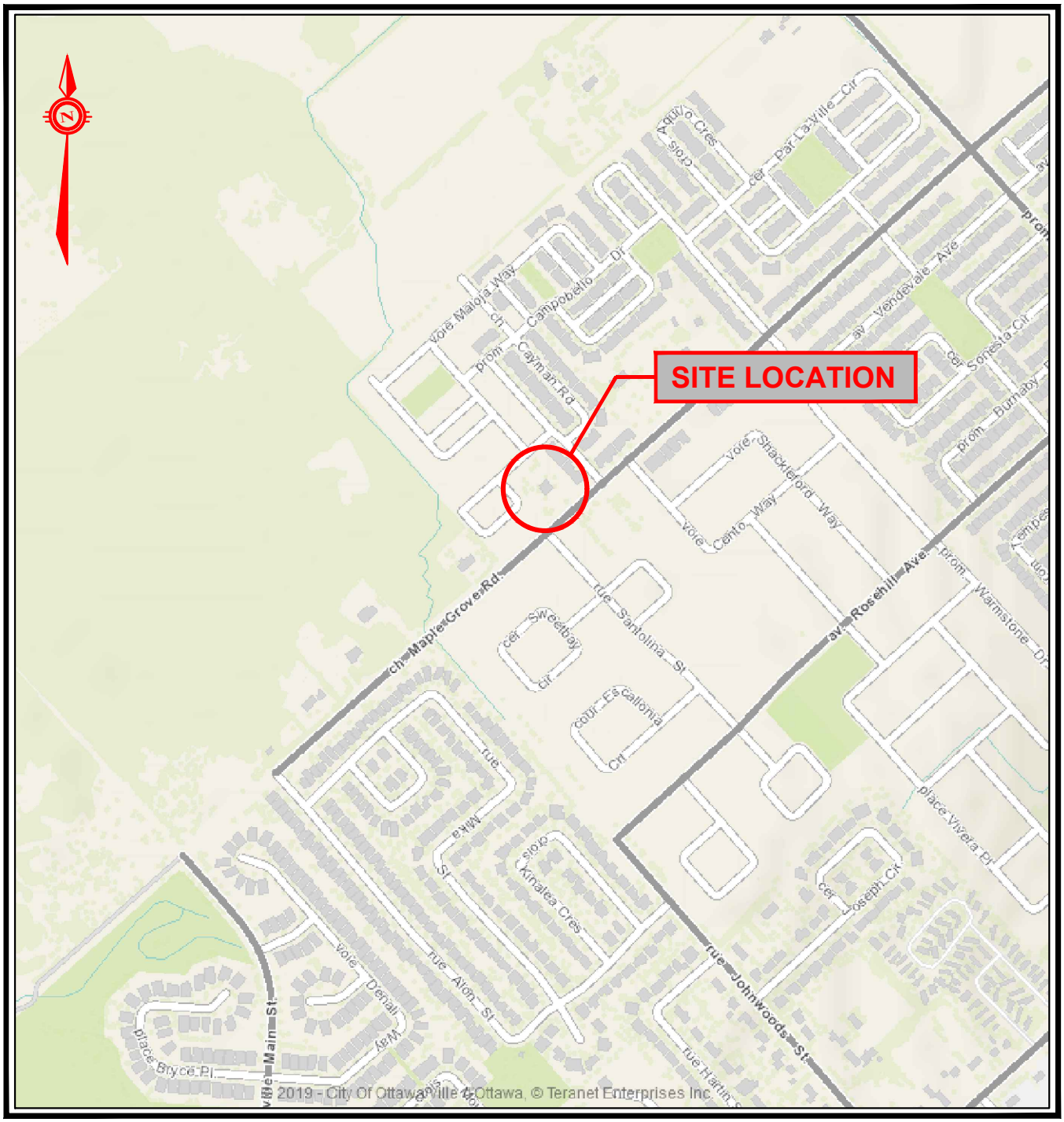
The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes and test pits required to determine the localized underground conditions, especially bedrock elevations between boreholes/probeholes affecting construction costs, techniques, sequencing, 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 interpretation of the factual borehole and test pit results to draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils and groundwater. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

Prior to tendering, consideration should be given to excavate additional test pits throughout the site to collect additional data on the elevations of the bedrock throughout the site. The purpose of the additional testpits is to minimize the risk of additional claims from the contractors as the results of possible variation in bedrock depths throughout the site..

We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

FIGURES



BACKGROUND MAP DATA FROM THE CITY OF OTTAWA, © 2019, TERANET ENTERPRISES

0 50m 100m 300m

HORIZONTAL 1:7500

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• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale: AS NOTED	CLIENT: 10886378 CANADA LTD.	project no. OTT-00257188-A0
date: NOVEMBER 2019	PROPOSED RESIDENTIAL DEVELOPMENT 1869 MAPLE GROVE ROAD, OTTAWA, ON	
drawn by: G.C.	TITLE: SITE LOCATION PLAN	FIG 1

Filename: e:\ott\ott-00257188-a0\60 execution\69 - borehole logs\257188-a0 figures.dwg
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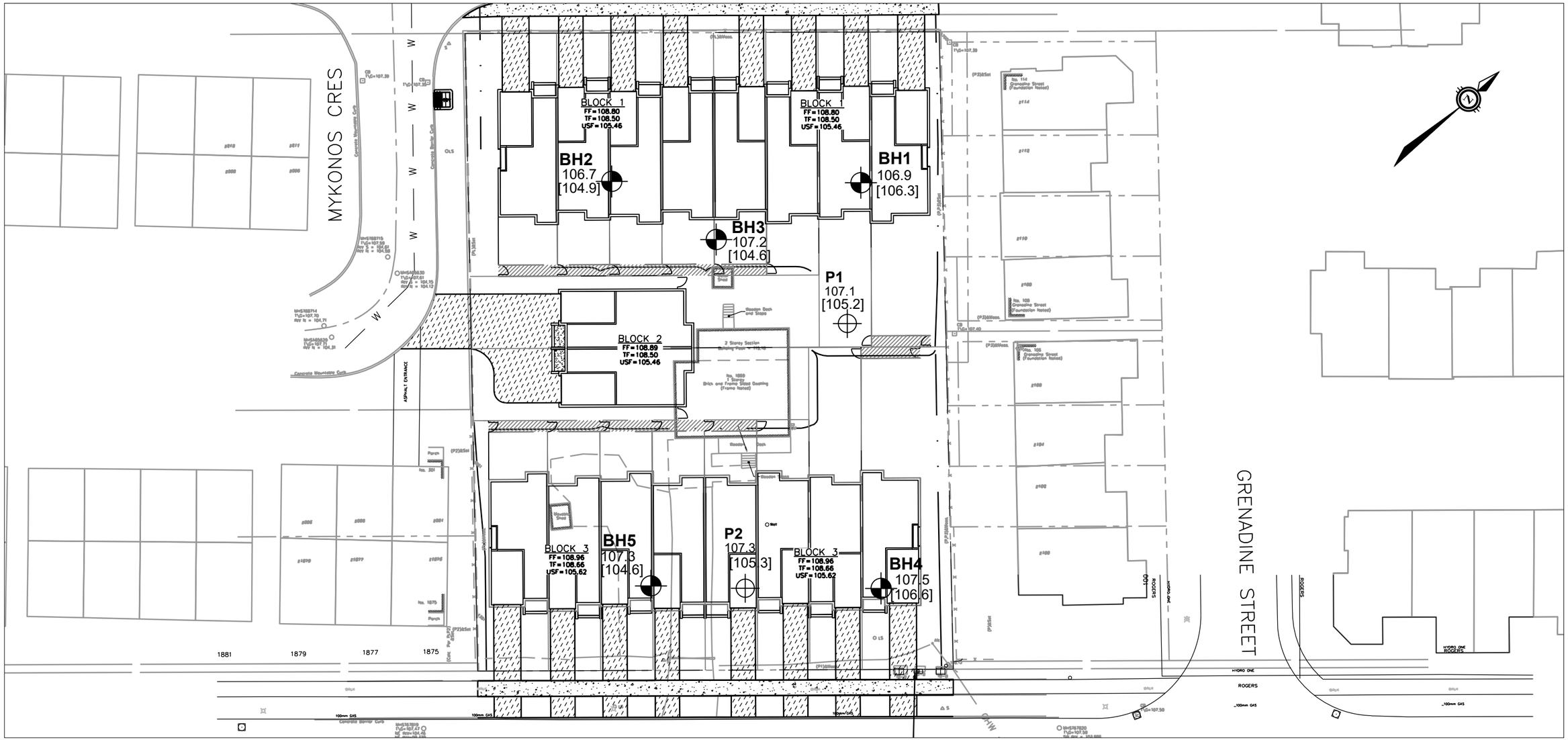

NOTES:

1. THE BOUNDARIES, ROCK TYPES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK CORE WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
5. BASE PLAN OBTAINED FROM EXP SERVICES INC. PROJECT NO. OTT-00254810-A0, DRAWING C003 "SITE GRADING PLAN" DATED MAR. 2020

LEGEND

BH1	BOREHOLE NUMBER AND LOCATION
P1	PROBEHOLE NUMBER AND LOCATION
106.9	SURFACE ELEVATION IN METERS
[106.3]	BEDROCK ELEVATION IN METERS

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www.exp.com

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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale: AS SHOWN	CLIENT: 10886378 CANADA LTD.	project no.: OTT-00257188-A0
date: MAR. 2020	TITLE: PROPOSED RESIDENTIAL DEVELOPMENT 1869 MAPLE GROVE ROAD, OTTAWA, ON	FIG 2
drawn by: G.C.		

Filename: e:\ott\ott-00257188-a0\60 execution\65 drawings\257188-a0 figures.dwg
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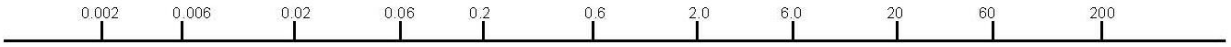
Last Plotted: 4/5/2020 12:15:20 PM Plotted by: CuiG Pen Table:: trow standard, july 01, 2004.ctb

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has 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	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	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 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.

Log of Borehole BH-01

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 3

Page. 1 of 1

Date Drilled: `November 5, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~ 300 mm	106.9	0
		FILL Silty sand, trace clay and gravel, oxidized staining, rootlets, brown, moist (loose)	106.6	
		LIMESTONE BEDROCK Interbedded limestone and shale, some fractures throughout, grey, (poor to excellent quality)	106.3	
			104.1	3
		Borehole Terminated at 4.3 m Depth	102.6	4

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

4
50 for 25 mm

SAMPLES	Natural Unit Wt. kN/m³
SS1	
Run 1	
Run 2	
Run 3	

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. 19 mm standpipe installed upon completion.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	N/A	4.3
'Nov 29, 2019	2.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.8 - 1.5	70	27
2	1.5 - 2.5	100	86
3	2.5 - 4.3	100	92

Log of Borehole BH-02

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: `November 5, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 200 mm	106.7	0				
		FILL Silty sand, trace clay and gravel, oxidized staining, rootlets, brown, moist (loose)	106.5		5		SS1	
				1	4		SS2	
		SILTY SAND WITH GRAVEL TILL Trace clay, cobbles and boulders, grey-brown, moist, (very dense)	105.3		55 for 280 mm		SS3	
		LIMESTONE BEDROCK Interbedded limestone and shale, 150 mm mud seam at 2.9 m depth, several fractures, grey, (fair to poor quality)	104.9	2			Run 1	
				3			Run 2	
		Borehole Terminated at 3.2 m Depth	103.5					

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	N/A	3.2

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.8 - 2.8	100	78
2	2.8 - 3.2	92	28

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

Log of Borehole BH-03

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 5

Page. 1 of 1

Date Drilled: `November 5, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 150 mm	107.3	0				
		FILL Silty sand, trace clay and gravel, oxidized staining, rootlets, brown, moist (very loose)	107.2		3		SS1	
				1	2		SS2	
					4		SS3	
				2	50 for 100 mm		SS4	
		WEATHERED BEDROCK	104.7					
		Auger Refusal at 2.7 m Depth	104.6					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.2	2.4

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

Log of Borehole BH-04

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: `November 6, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 300 mm	107.5	0				
		FILL Silty sand, trace clay and gravel, oxidized staining, rootlets, brown, moist (very loose)	107.2		4	×	SS1	
					50 for 25 mm	×	SS2	
		Auger Refusal at 0.9 m Depth	106.6					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	0.9

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

Log of Borehole BH-05

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 7

Page. 1 of 1

Date Drilled: `November 5, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand, trace clay and gravel, organic staining, rootlets, brown, moist (compact)	107.3	0	17		SS1	
				1	13		SS2	
		SILTY SAND WITH GRAVEL TILL Trace clay, cobbles and boulders, grey-brown, moist, (dense)	105.9	2	36		SS3	
			104.9		76 over 230 mm		SS4	24.1
		WEATHERED BEDROCK	104.7					
		Auger Refusal at 2.7 m Depth	104.6					

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. 19 mm standpipe installed upon completion.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	2.7
'Nov 29, 2019	2.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

Log of Borehole P-01

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 8

Page. 1 of 1

Date Drilled: `November 6, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		INFERRED OVERBURDEN	107.1	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
				1				
			105.3					
		Auger Refusal at 1.8 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Probehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	1.8

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

Log of Borehole P-02

Project No: OTT-00257188-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 1869 Maple Grove Road, Ottawa, ON

Figure No. 9

Page. 1 of 1

Date Drilled: `November 6, 2019

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: GC Checked by: ML

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		INFERRED OVERBURDEN	107.3	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
				1				
			105.2	2				
		Auger Refusal at 2.1 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Probehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257188-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	2.1

CORE DRILLING RECORD

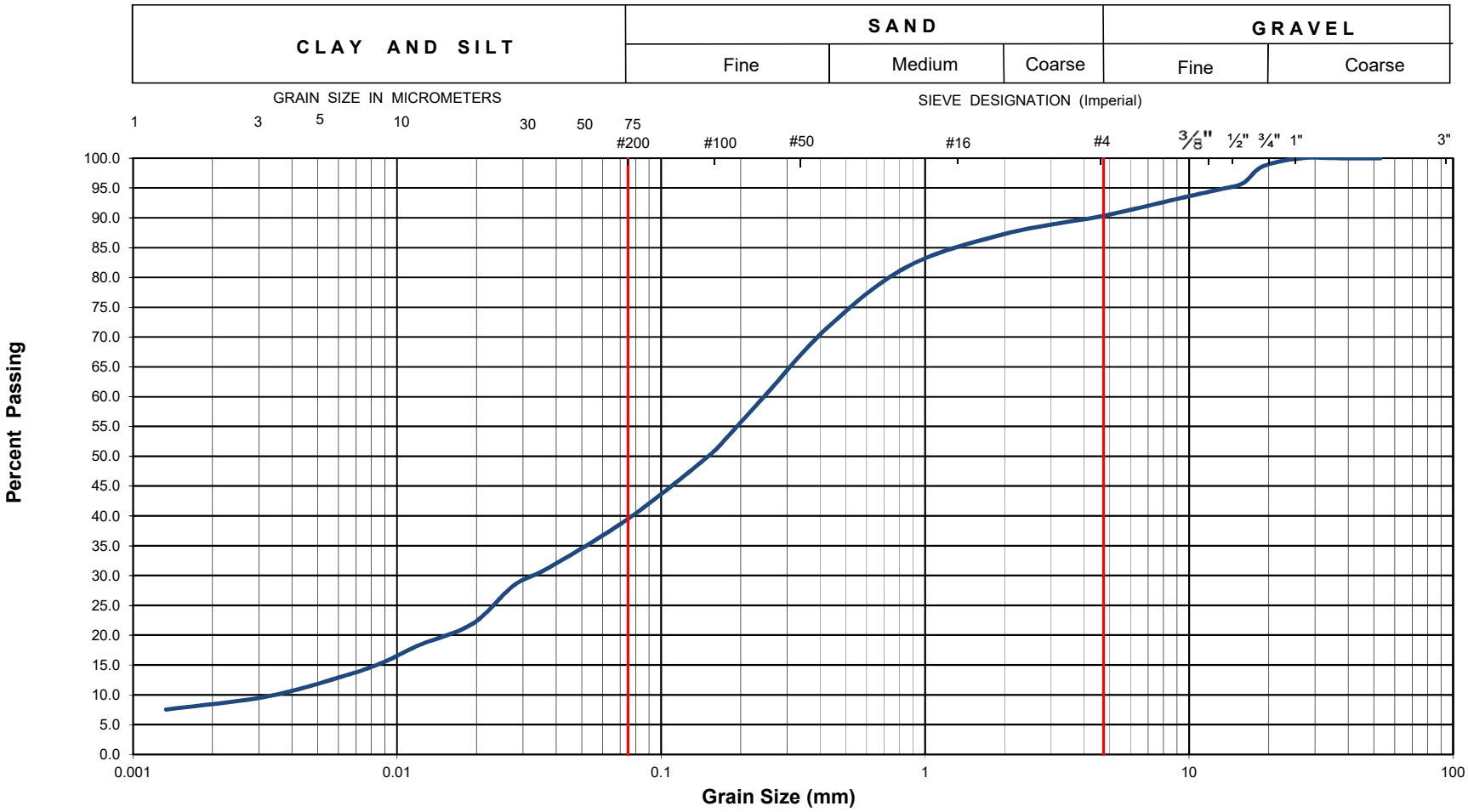
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 257188-A0.GPJ TROW OTTAWA.GDT 03/02/20

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

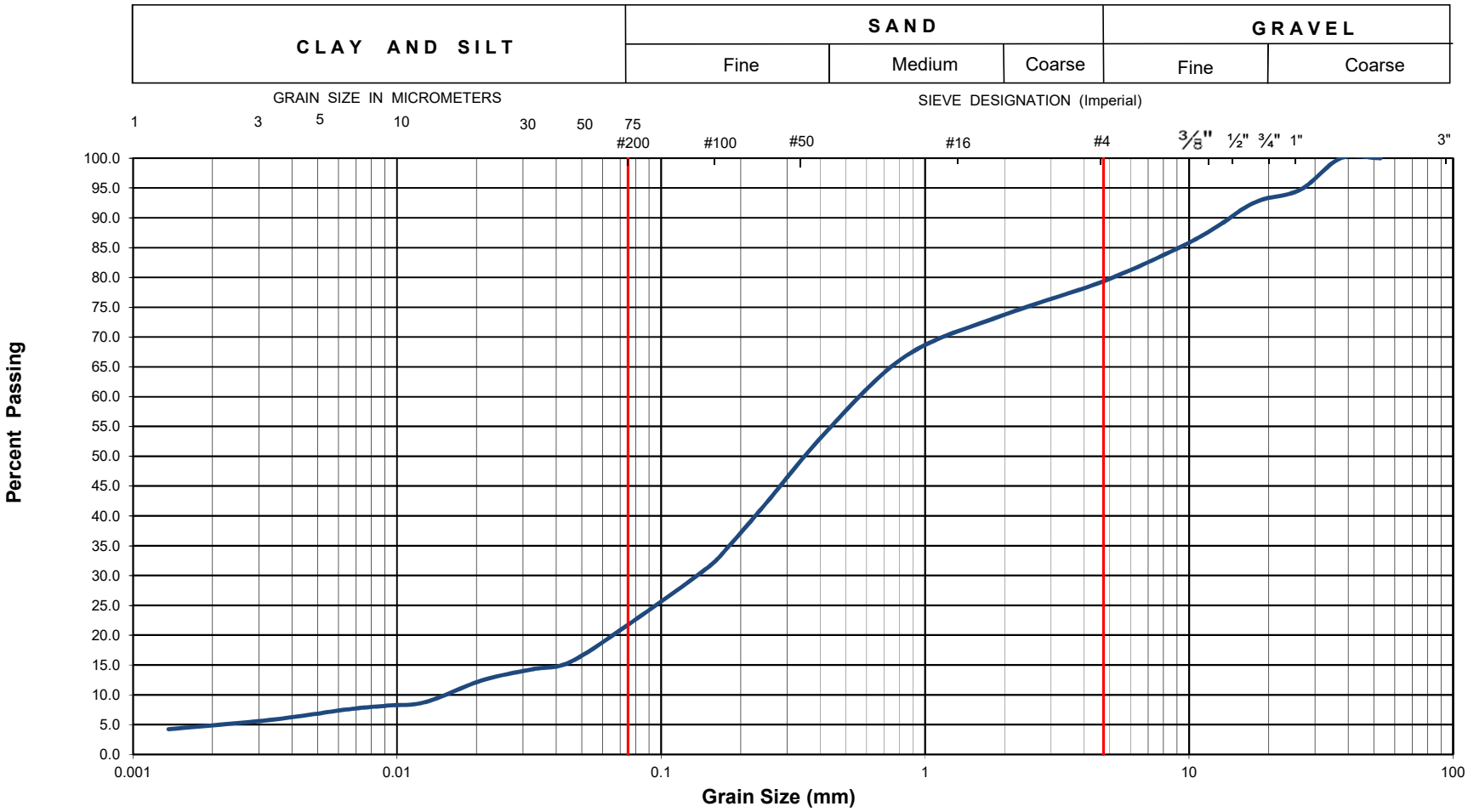


EXP Project No.:	**OTT-00257188-A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**10886378 Canada Ltd.**	**Project Location :**	**1869 Maple Grove Road, Ottawa, ON**						
Date Sampled :	**November 5, 2019**	**Borehole No:**	**BH3**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5 - 2.1**
Sample Description :		**% Silt and Clay**	**40**	**% Sand**	**50**	**% Gravel**	**10**	**Figure :**	**10**
Sample Description :		**Silty Sand (SM)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

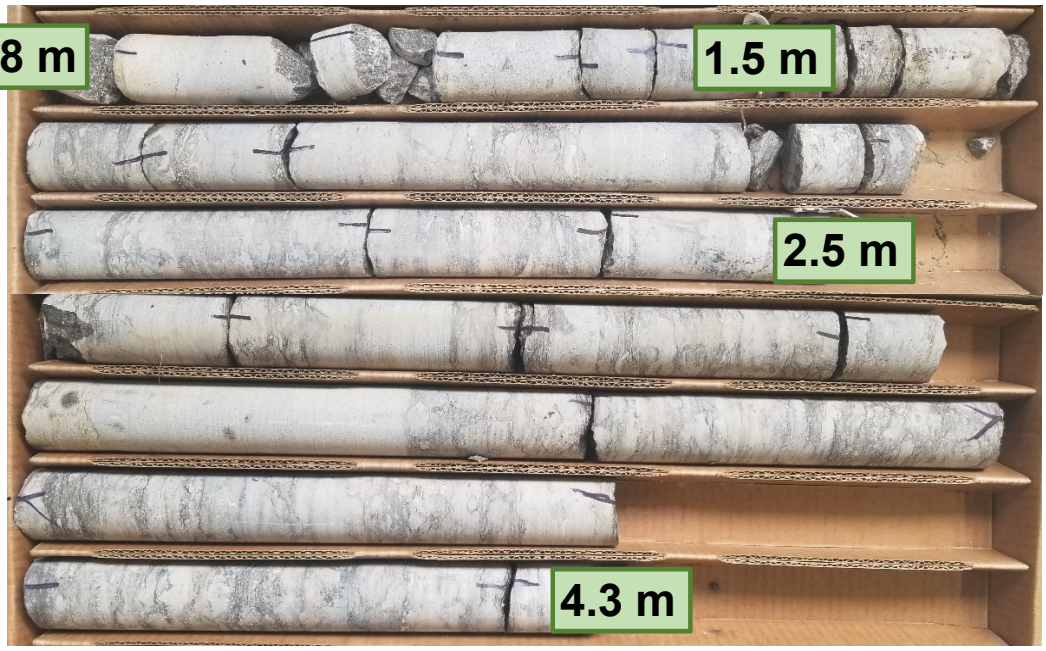
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

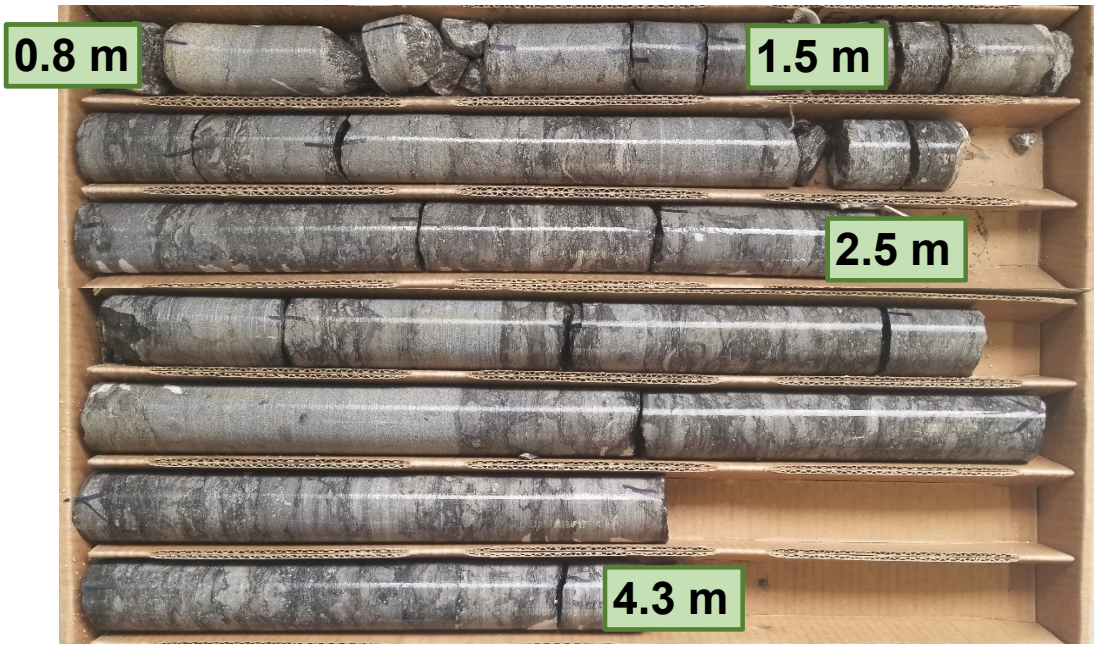


EXP Project No.:	**OTT-00257188-A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**10886378 Canada Ltd.**	**Project Location :**	**1869 Maple Grove Road, Ottawa, ON**						
Date Sampled :	**November 5, 2019**	**Borehole No:**	**BH5**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5 - 2.1**
Sample Description :		**% Silt and Clay**	**22**	**% Sand**	**57**	**% Gravel**	**21**	**Figure :**	**11**
Sample Description :		**Silty Sand with Gravel (SM)**							

DRY BEDROCK CORES



WET BEDROCK CORES



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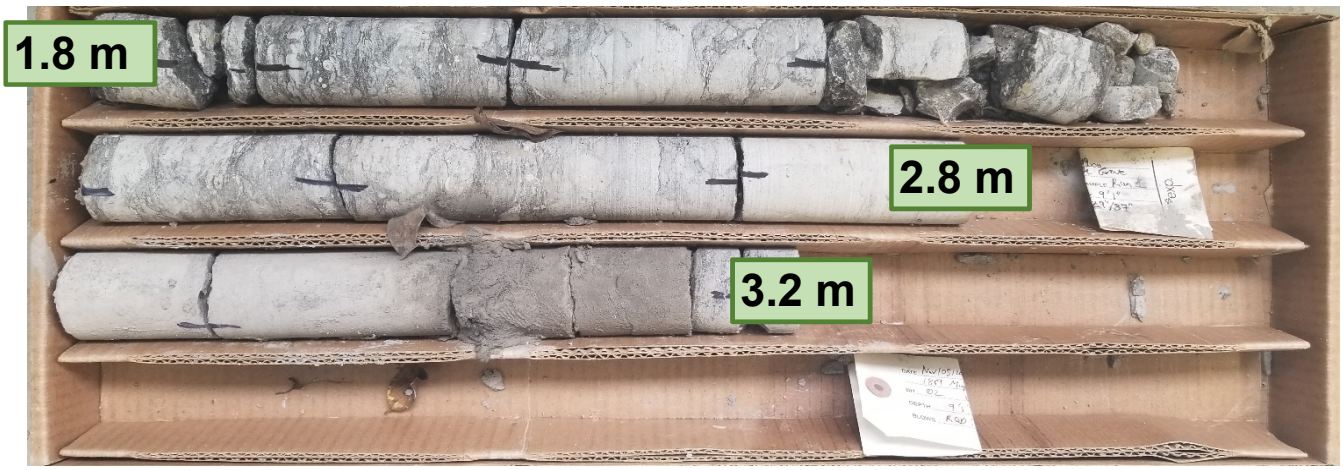
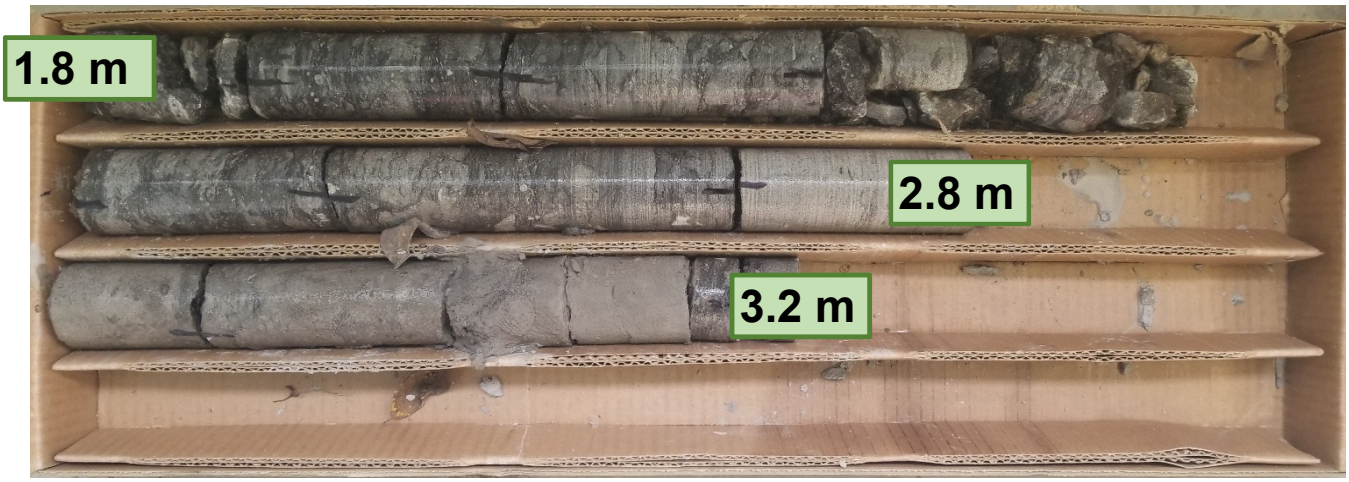
borehole no.	core runs	PROJECT	project no.
BH-01	Run 1: 0.8 m - 1.5 m Run 2: 1.5 m - 2.5 m Run 3: 2.5 m - 4.3 m	GEOTECHNICAL INVESTIGATION. 1869 MAPLE GROVE RD, Ottawa, ON	OTT-00257188-A0
date cored Nov 05, 2019		ROCK CORE PHOTOGRAPHS	FIG 12

DRY BEDROCK CORES



WET BEDROCK CORES



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borehole no.	core runs	PROJECT	project no.
BH-02	Run 1: 1.8 m - 2.8 m Run 2: 2.8 m - 3.2 m	GEOTECHNICAL INVESTIGATION 1869 MAPLE GROVE RD, OTTAWA, ON	OTT-00257188-A0
date cored Nov 05, 2019		ROCK CORE PHOTOGRAPHS	FIG 13

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