McCormick Park Developments Inc.

Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Residential Development
177 Armstrong Street and 268 Carruthers Avenue Ottawa, Ontario

Project Number
OTT-00252997-B0

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Date Submitted:
November 5, 2019

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Legal Notification

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario. (Figure 1). The terms and conditions of the assignment have been outlined in EXP's Proposal dated March 18, 2019. This work was authorized by Mr. Jean Desjardins of McCormick Park Developments Inc. via our signed work authorization form dated March 22, 2019.

The proposed residential development will consist of two (2) to three (3) storey stacked townhouse buildings with basements. The development will have outdoor paved access roads and parking lots and landscaped areas. The elevation of the lowest floor (basement floor) was not known at the time of the preparation of this report.

Phase One and Two Environmental Site Assessments (ESAs) of the site were completed by EXP and are presented under separate covers.

The investigation has revealed that the subsurface conditions comprise of fill underlain by shallow limestone bedrock contacted at 0.5 m to 1.3 m depths (Elevation 64.0 m to 62.8 m). The groundwater level ranges from 4.7 m to 5.7 m depths (Elevation 59.8 m to 58.4 m).

There is no restriction to raising the grades at the site from a consolidation settlement perspective. The subsurface soils are not considered to be liquefiable during a seismic event.

The geotechnical investigation revealed that the subsurface conditions at the site are well suited to supporting the proposed buildings, by strip and spread footings set on the shallow sound limestone bedrock below any weathered and fractured/detached zones and designed for a factored geotechnical resistance at ultimate limit state (ULS) of 1000 kPa. Settlements of footing designed for the above recommended factored geotechnical resistance at ULS and properly constructed are expected to be less than 10 mm.

The site is classified as Class C for seismic site response for footings set on limestone bedrock as recommended above. A higher site class of B or A may be used if a multi-channel analysis shear wave survey is undertaken at the site. The subsurface soils are not considered to be liquefiable during a seismic event.

The lowest level floor slab of the proposed buildings may be constructed as a slab-on-grade provided they are set on a bed of well packed 19 mm clear stone at least 300 mm thick placed on bedrock or on a 300 mm thick engineered fill base set on the bedrock surface and compacted to 98 percent standard Proctor maximum dry density (SPMDD). A perimeter drainage system is required for buildings with a basement. The finished ground floor slab however should be set at least 150 mm higher than the finished exterior grade. The finished exterior grade should be sloped away from the building to prevent ponding of surface water close to the exterior walls of the buildings.

Excavation of the fill may be undertaken using conventional equipment and should be completed in accordance with the Occupational health and Safety Act (OHSA). If space restrictions prevent open cut

excavations, the excavations may be undertaken within the confines of a prefabricated support system (trench box) for the installation of underground services and an engineered support system for the proposed building excavations.

Excavation of the limestone bedrock may be undertaken using a hoe ram for removal of small quantities of the bedrock; however, this process is expected to be very slow. Alternatively, the bedrock may be excavated by line drilling and blasting technique. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

Vibration monitoring during the blasting operations should be carried out in the adjacent surrounding structures and infrastructure to ensure that the blasting meets the limiting vibration criteria at all times. Blasting operations should be carried out in accordance with City of Ottawa Special Provisions (S.P.) No. F-1201, which also provides limiting vibration criteria. A pre-construction and pre-blast condition survey of all adjacent surrounding structures and infrastructure should be conducted prior to start of blasting. If adjacent structures are deemed to be heritage buildings, special limiting vibration criteria is required.
Excavations may be dewatered by conventional sump pumping techniques.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed buildings and in the service trenches will need to be imported and should preferably conform to the specifications provided in the attached report.

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

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1 Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario. (Figure 1). The terms and conditions of the assignment have been outlined in EXP's Proposal dated March 18, 2019. This work was authorized by Mr. Jean Desjardins of McCormick Park Developments Inc. via our signed work authorization form dated March 22, 2019.

The proposed residential development will consist of two (2) to three (3) storey stacked townhouse buildings with basements. The development will have outdoor paved access roads and parking lots and landscaped areas. The elevation of the lowest floor (basement floor) was not available at the time of the preparation of this report.

This geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the eight (8) borehole and monitoring well locations on site;

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC) and assess the potential for liquefaction of the subsurface soils during a seismic event;

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

d) Make recommendations on the most suitable type of foundations, founding depth and bearing pressure at Serviceability Limit State (SLS) and factored geotechnical resistance at Ultimate Limit State (ULS) of the founding strata and comment on the anticipated total and differential settlements of the recommended foundation type;

e) Comment on slab-on-grade construction and permanent drainage requirements;

f) Provide lateral earth pressure parameters (for static and seismic conditions) for the subsurface (basement) walls of the proposed townhouse buildings;

g) Discuss excavation conditions and dewatering requirements during construction;

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

i) Recommend pavement structure thickness for access roads and parking areas; and

j) Comment on subsurface concrete requirements and corrosion potential of subsurface soil and bedrock to buried metal structures/members.

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.

Phase One and Two Environmental Site Assessments (ESAs) were undertaken concurrently with this geotechnical investigation by EXP. Reference is made to the Phase One and Two Environmental Site Assessment reports presented under separate covers.

2 Available Geotechnical Information

A previous geotechnical investigation was undertaken at 177 Armstrong Street in 2013 and 2014 by Houle Chevrier Engineering Ltd. This geotechnical investigation was for a proposed residential four (4) storey apartment building with one (1) level of underground parking. The findings from the 2014 geotechnical investigation is referenced in the following report:

- *Geotechnical Investigation, Proposed Residential Development, 177 Armstrong Street, Ottawa, Ontario* dated July 14, 2014 and prepared by Houle Chevrier Engineering Ltd.

The 2014 geotechnical investigation included the placement of two (2) boreholes at 177 Armstrong Street. The borehole locations are shown on the Borehole Location Plan, Figure 2, and the borehole logs are provided in Appendix A.

The borehole information indicates the subsurface conditions consist of a surficial pavement structure underlain by fill to 0.9 m and 1.8 m depths (Elevation 63.4 m and 62.6 m). Interbedded limestone and shale bedrock was contacted beneath the fill at 0.9 m and 1.8 m depths (Elevation 63.4 m and 62.6 m). Groundwater levels were at 2.0 m and 4.8 m depths (Elevation 62.4 m and 59.6 m).

3 Site Description

The subject site is located at 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON. The site is occupied by four (4) buildings. The main/southwest part of the site at 177 Armstrong Street is occupied by two (2) buildings; a residential two-storey with a basement in the southwest portion and a single storey commercial building in the southeast portion of the site. The northeast part of the site at 268 Carruthers Avenue is occupied by a two-storey residential building in the southwest corner of the property and a single bay garage building along the north side of the property. It is our understanding that the four (4) buildings will be demolished to accommodate the proposed development.

The site is generally flat with ground surface elevations from Elevation 64.01 m to Elevation 64.76 m at the eight (8) borehole/monitoring well locations.

4 Procedure

4.1 Fieldwork

The fieldwork for the geotechnical investigation was undertaken on June 11 and August 30, 2019 and comprised the drilling of eight (8) boreholes and monitoring wells (BHs 1 to 5 and MWs 6 to 8). The boreholes and monitoring wells were advanced to auger refusal and termination depths ranging from 0.4 m to 6.1 m (Elevation 63.6 m to 58.0 m). The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole and monitoring well locations and elevations were established on site by EXP. Prior to drilling the boreholes, the borehole and monitoring well locations were cleared of any public and private underground services by USL-1 Cable Locators. The locations of the boreholes and monitoring wells are shown on the Borehole Location Plan, Figure 2.

The boreholes and monitoring wells were drilled by a CME-75 truck-mounted drill rig equipped with continuous flight hollow-stem auger and rock coring equipment. Standard penetration tests (SPTs) were performed in all the boreholes and monitoring wells at a 0.75 m depth interval and soil samples retrieved by the split-barrel sampler. The presence of the bedrock was proven in all of the boreholes and monitoring wells except Borehole Nos. 2 and 5 by conventional coring techniques using an NQ size core barrel. A record of the wash water return, colour of wash water and any sudden drops of the drill rods were kept during rock coring operations.

Water levels were measured in some of the open boreholes upon completion of drilling. In addition, long-term groundwater monitoring installation consisting of a 19-mm diameter PVC (polyvinyl chloride) standpipe and 32 mm diameter monitoring well with screened sections were installed in Borehole Nos. 1 and 4 and in Monitoring Well Nos. 6 to 8. The installation configuration is documented on the respective borehole and monitoring well logs. All the boreholes and monitoring wells were backfilled upon completion of the fieldwork.

4.2 Laboratory Testing Program

All soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified accordingly. Similarly, all rock cores were placed in core boxes, identified and visually examined and logged. On completion of the fieldwork, all the soil samples and rock cores were transported to the EXP laboratory located in the City of Ottawa.

The soil samples and rock cores were visually examined in the laboratory by a senior geotechnical engineer. The soil samples were classified in accordance with the Unified Soil Classification System (USCS). The rock cores were visually examined and logged in accordance with Section 3.2 of the 2006 Canadian Foundation Engineering Manual (Fourth Edition, CFEM) and photographs taken of the rock cores.

A summary of the soil sample and rock core laboratory testing program is shown in Table I. The laboratory testing program for selected soil samples and rock cores were undertaken in accordance with the American Society for Testing and Materials (ASTM). The laboratory testing program for the corrosion analyses was undertaken in accordance with the procedures referenced in Appendix C.

Table I: Summary of Laboratory Testing Program

Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	10
Grain Size Analysis	3
Bedrock Cores	
Unit Weight Determination	18
Unconfined Compressive Strength Test	18
Corrosion Analyses (pH, sulphate, chloride and resistivity)	3

5 Subsurface Conditions

A detailed description of the geotechnical conditions encountered in the eight (8) boreholes and monitoring wells is given on the borehole and monitoring well logs, Figure Nos. 3 to 10 inclusive. The borehole and monitoring well 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 also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes and monitoring wells were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil and rock boundaries indicated on the borehole and monitoring well logs are inferred from non-continuous sampling and observations during drilling operations. These boundaries 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 the borehole and monitoring well logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole and monitoring well logs indicates the following subsurface soil and bedrock conditions with depth and groundwater levels.

5.1 Pavement Structure

Borehole No. 5 and Monitoring Well No. 6 are located in a paved area. The pavement structure consists of 25 mm and 35 mm thick asphaltic concrete underlain by 350 mm and 375 mm thick granular base layer. The standard penetration test (SPT) N-value of the granular base layer is 8 indicating the base layer is in a loose state.

5.2 Fill

Fill was surficially contacted in Borehole Nos. 1 to 4 and Monitoring Well Nos. 7 and 8. The fill consists of a 75 mm to 250 mm thick surficial granular base underlain by sand with silt to silty sand with gravel fill to depths ranging from 0.5 m to 1.3 m (Elevation 64.0 m to 63.2 m). The fill contains cobbles in Monitoring Well No. 6. The fill in Borehole No. 2 and Monitoring Well No. 8 contain brick debris and topsoil respectively. The standard penetration test (SPT) N-value of the fill ranges from 13 to 51 indicating the fill is in a compact to very dense state. In Borehole Nos. 2 and 3, the N values are 50 for 75 mm and 100 mm of sampler penetration. These high N values may be a result of the sampler meeting refusal on possible cobbles or boulders. The moisture content of the fill is 5 percent to 27 percent.

Grain size analysis was conducted on three (3) samples of the fill and the results are summarized in Table II.

Table II: Summary of Results from Grain-size Analysis – Fill Samples					
Borehole/Monitoring Well No. (BH/MW) - Sample No.	**Depth (m)**	**Grain-size Analysis (%)**			**Soil Classification (USCS)**
		Gravel	**Sand**	**Fines (Silt and Clay)**	
BH No. 4 – SS2	0.8 – 1.2	8	82	10	Well Graded Sand with Silt (SW-SM)
MW No. 7 – SS1	0.0 – 0.6	20	65	15	Silty Sand with Gravel (SM)
MW No. 8 – SS1	0.0 – 0.6	43	43	14	Silty Sand with Gravel (SM)

Based on a review of the results from the grain size analysis, the fill may be classified as a well graded sand with silt (SW-SM) to silty sand with gravel (SM). The fill may contain cobbles and/or boulders.

5.3 Inferred Boulders or Weathered Bedrock

In Borehole No. 4 and Monitoring Well No. 7, inferred boulders or weathered bedrock was encountered beneath the fill at 0.9 m and 1.2 m depths (Elevation 63.6 m and 63.2 m). The inferred boulders or weathered bedrock extends to 1.2 m and 1.6 m depths (Elevation 63.3 m and 62.8 m).

5.4 Limestone Bedrock

Auger refusal was met in all the boreholes and monitoring wells at 0.4 m to 1.3 m depths (Elevation 64.0 m to 62.8 m) on inferred boulders or bedrock. The presence of the bedrock was confirmed by coring the bedrock in Borehole Nos. 1,3 and 4 and in Monitoring Well Nos. 6 to 8. The bedrock was contacted at 0.5 m to 1.3 m depths (Elevation 64.0 m to 62.8 m).

The bedrock geology map (Map 1508A – Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, printed by the Surveys and Mapping Branch, 1979) indicates the site is underlain by limestone bedrock (with some shaley partings) of the Ottawa formation.

A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 22 percent to 100 percent and 0 percent to100 percent indicating very poor to excellent quality bedrock. Photographs of the rock cores are shown in Appendix B.

Results of unconfined compressive and unit weight tests conducted on selected sections of rock cores are summarized in Table III.

Table III: Results of Unconfined Compressive Tests on Rock Core Samples			
Borehole/Monitoring Well No. (BH/MW)	**Depth (m)**	**Compressive Strength (MPa)**	**Unit Weight of Bedrock (kg/m^3)**
BH1 – Run 1	1.9 – 2.1	143	2647
BH1 – Run 1	2.6 – 2.8	129	2618
BH1 – Run 2	3.3 – 3.5	168	2625
BH3 – Run 1	0.7 – 0.9	121	2642
BH3 – Run 2	1.3 – 1.5	134	2626
BH3 – Run 2	2.0 – 2.2	119	2619
BH4 – Run 2	2.3 – 2.5	92	2600
BH4 – Run 2	3.0 – 3.2	108	2636
BH4 – Run 3	4.0 – 4.2	102	2656
MW6 – Run 1	0.9 – 1.2	80	2665
MW6 – Run 2	2.0 – 2.1	111	2506
MW6 – Run 4	2.6 – 2.7	95	2671
MW6 – Run 5	3.5 – 3.6	141	2681
MW6 – Run 6	4.9 – 5.0	179	2683
MW8 – Run 2	1.7 – 1.8	147	2695
MW8 – Run 3	2.5 – 2.7	154	2672
MW8 – Run 4	4.2 – 4.3	130	2626
MW8 – Run 5	4.9 – 5.1	139	2511

The unconfined compressive strength test results range from 80 MPa to 168 MPa and the rock may be classified as strong to very strong in accordance with the Canadian Foundation Engineering Manual (CFEM), Fourth Edition, 2006.

5.5 Groundwater Levels

A summary of a set of groundwater level measurements taken on September 19, 2019 in the standpipes and monitoring wells is shown in Table IV.

Table IV: Summary of Groundwater Level Measurements			
Borehole/Monitoring Well No. (BH/MW)	**Ground Surface Elevation (m)**	**Date of Measurement (elapsed time in days from date of installation)**	**Groundwater Depth Below Ground Surface (Elevation), m**
BH 1	64.76	September 19,2019 (100 days)	Dry
BH 4	64.43	September 19, 2019 (100 days)	4.7 (59.8)
MW 6	64.08	September 19, 2019 (20 days)	5.7 (58.4)
MW 7	64.54	September 19,2019 (20 days)	5.7 (58.9)
MW 8	64.3	September 19, 2019 (20 days)	4.7 (59.6)

Water levels were determined in the boreholes and monitoring wells 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.

6 Grade Raise Restrictions

Since the subsurface soils at the site consist of cohesionless sand and gravel soils that are not susceptible to consolidation settlement, there is no restriction to raising the grades at the site from a consolidation settlement perspective.

7 Seismic Site Classification and Liquefaction Potential of Subsurface Soils

It is recommended to support the proposed building on footings designed to bear on the sound bedrock. In this case and in accordance with Table 4.1.8.4 A of the 2012 Ontario Building Code (OBC), the site is classified as Class C for seismic site response. A higher site class of B or A may be used if a multi-channel analysis shear wave survey is undertaken at the site.

The subsurface soils are not considered to be liquefiable during a seismic event.

8 Foundation Considerations

The geotechnical investigation revealed that the subsurface conditions at the site are well suited to supporting the proposed buildings, by strip and spread footings set on the shallow limestone bedrock contacted at 0.5 m to 1.3 m depths (Elevation 64.0 m to 62.8 m) in Borehole Nos. 1, 3, 4 and Monitoring Well Nos. 6 to 8.

Strip and spread footings should be set on the sound limestone bedrock below any weathered and fractured/detached zones of the bedrock and may be designed for a factored geotechnical resistance at ultimate limit state (ULS) of 1000 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The Serviceability Limit State (SLS) bearing pressure of the bedrock, required to produce 25 mm settlement of the structure will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design.

Settlements of footing designed for the above recommended factored geotechnical resistance at ULS and properly constructed are expected to be less than 10 mm.

The bedrock depth may vary from that indicated on the borehole and monitoring well logs at the locations of the existing buildings on site. For example, the fill thickness and depth to bedrock may be deeper or shallower than shown on the borehole and monitoring well logs at locations close to and/or within the footprint of existing buildings and underground service trenches. Therefore, any excavation below the design underside of new footings should be backfilled with 15 MPa lean mix concrete.

All the footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the ULS value and that the footing beds have been properly prepared.

A minimum of 1.2 m of earth cover for heated structures should be provided to the footings founded on sound bedrock to protect them from damage due to frost penetration. The frost cover should be increased to 1.5 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 1.8 m. Equivalent rigid insulation may be used instead of the required soil cover or a combination of rigid insulation and soil cover may be used to achieve the required frost protection.

9 Floor Slab and Drainage Requirements

The lowest level floor slab of the proposed buildings may be constructed as a slab-on-grade provided they are set on a bed of well compacted 19 mm clear stone at least 300 mm thick placed on bedrock or on a 300 mm thick engineered fill base set on the bedrock surface and compacted to 98 percent standard Proctor maximum dry density (SPMDD). 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.

A perimeter drainage system is required for buildings with a basement. An underfloor drainage system is likely not required since the lowest slab is anticipated to be above the groundwater level. It is recommended that once the basement floor elevation of the proposed buildings is known, EXP be contacted to review and confirm whether or not an underfloor drainage system is required.

The finished ground floor slab however should be set at least 150 mm higher than the finished exterior grade. The finished exterior grade should be sloped away from the building to prevent ponding of surface water close to the exterior walls of the buildings.

10 Subsurface Walls

The subsurface basement walls of the proposed buildings should be backfilled with free draining material, such as Ontario Provincial Standard Specification (OPSS) 1010 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. The expressions below assume free draining backfill material, a perimeter drainage system, level backfill surface behind the wall and vertical face on the back side of the wall.

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

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

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 = 0.50

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

h = depth of point of interest below top of backfill, m

q = surcharge load stress, kPa

In addition to the lateral static earth thrust, the subsurface walls would be subjected to dynamic thrust from the soil during a seismic event. The soil dynamic thrust (Δ_{Pe}) may be computed from the equation given below:

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b$$

where Δ_{Pe} = dynamic thrust in kN/m of wall

H = height of wall, m

γ = unit weight of backfill material = 22 kN/m^3

$\frac{a_h}{g}$ = seismic coefficient = 0.32

F_b = thrust factor = 1.0

The dynamic thrust does not take into account the surcharge load. The resultant force acts approximately at 0.63H above the base of the wall.

All subsurface walls should be waterproofed.

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11 Excavations and De-Watering Requirements

Excavations for the construction of the proposed buildings are anticipated to extend through the fill and into the limestone bedrock.

Excavation of the fill may be undertaken using conventional equipment capable of removing cobbles, boulders and debris within the fill. All excavation work should be completed in accordance with the Occupational health and Safety Act (OHSA). Excavations within the fill soil may be undertaken as open cut provided the sidewalls of the excavation are cut back at 1H:1V from the bottom of the excavation. If space restrictions prevent open cut excavations, the excavations may be undertaken within the confines of a prefabricated support system (trench box) for the installation of underground services and an engineered support system for the proposed building excavations.

The contractor must review the site plan and surrounding properties to determine if a shoring system for the excavation is required for the execution of the construction of the proposed buildings. The contractor must also determine if underpinning of foundations of adjacent existing buildings and infrastructure is required. The prefabricated support system and engineered support system should be designed and installed in accordance with the OHSA and the 2006 Canadian Foundation Engineering Manual (Fourth Edition).

The shoring system as well as adjacent settlement sensitive structures should be monitored for movement on a periodic basis prior to, during and following construction operations.

It is anticipated that test pit excavations at the site may be required to establish the founding level of foundations of some of the existing adjacent structures for underpinning/shoring requirements.

Excavation of the limestone bedrock may be undertaken using a hoe ram for removal of small quantities of the bedrock; however, this process is expected to be very slow. Alternatively, the bedrock may be excavated by line drilling and blasting technique. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The bedrock is expected to be weathered and fractured in the upper levels. The weathered/fractured and sound bedrock may be excavated at near vertical slope, subject to examination by a geotechnical engineer. Depending on the excavation depth within the bedrock, rock slope stabilization measures such as rock bolting in combination with a wire mesh system and/or shotcrete may be required.

To prevent damage to adjacent surrounding structures and infrastructure, the hoe ramming and blasting operations should be carefully planned and closely monitored. For blasting, it is recommended that the blasting contractor should retain the services of a blasting specialist to provide a blasting plan. The contractor should have a licensed blaster on site at all times during the blasting operations and a vibration engineer on retainer.

Vibration monitoring during the blasting operations should be carried out in the adjacent surrounding structures and infrastructure to ensure that the blasting meets the limiting vibration criteria at all times. Blasting operations should be carried out in accordance with City of Ottawa Special Provisions (S.P.) No. F-1201, which also provides limiting vibration criteria. A pre-construction and pre-blast condition survey of all adjacent surrounding structures and infrastructure should be conducted prior to start of construction and blasting operations. If adjacent structures are deemed to be heritage buildings, special limiting vibration criteria is required.

Seepage of surface water and subsurface water into the excavations are anticipated. It should be possible to collect water entering the excavations at low points and to remove it by conventional sump pumping techniques. In areas of high infiltration or in areas where more permeable soils may exist, a higher seepage rate should be anticipated. Therefore, high capacity pumps to keep the excavation dry may be required.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

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 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.

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

The material to be excavated from the site is anticipated to consist of sand and granular fill and limestone bedrock. The overburden may be re-used in for general grading purposes in the general area of the site provided it is free of organics, cobbles, boulders and debris. Any topsoil encountered should be removed and discarded. Excavated bedrock is not suitable for use as backfill and should be discarded.

Therefore, it is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed buildings and in the service trenches will need to be imported and should preferably conform to the following specifications:

- Engineered fill, underfloor fill including backfilling in service trenches inside the building - OPSS 1010 (as amended by SSP110S13) for Granular B Type II (50 mm minus) placed in 300 mm thick lifts with each lift compacted to 98 percent SPMDD beneath the floor slab;
- Backfill against exterior subsurface walls - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and compacted to 95 percent SPMDD;
- Trench backfill outside building area, and fill placement to subgrade level for pavement - OPSS 1010 Select Subgrade Material (SSM), 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 compacted to minimum 95 percent SPMDD; and
- Landscaped areas - Clean fill that is free of organics and deleterious material and is placed in 300 mm thick lifts with each lift compacted to 92 percent of the SPMDD.

13 Access Roads and Parking Areas

The subgrade at the site is expected to be bedrock or engineered fill comprising of material conforming to OPSS 1010 select subgrade material (SSM). Pavement structure thicknesses required for the access roads and parking areas were computed and are shown on Table V below. 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	Computed Pavement Structure	
		Light Duty Traffic - Parking Areas	Heavy Duty traffic - Access Roads / Fire-Routes
Asphaltic Concrete (PG 58-34)	92 to 97% MRD	65mm – SP12.5 or HL3	40 mm SP12.5 or HL3 50 mm SP19 or HL8
Granular A Base (crushed limestone)	100% SPMDD*	150 mm	150 mm
Granular B Type II Sub-base (crushed limestone)	100% SPMDD*	300 mm (Overburden) 200 mm (Bedrock)	400 mm (Overburden) 300 mm (Bedrock)
SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698 MRD denotes Maximum Relative Density, ASTM D2041 Asphaltic Concrete in accordance with OPSS 1150/ 1151			

Additional comments on the construction of parking area and access roads are as follows:

1. As part of the subgrade preparation for the areas to be paved, the areas 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 finished pavement surface should be free of depressions and should be sloped to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

3. Transition zone should be provided in areas where subgrade changes from overburden to bedrock. EXP can provide additional recommendation in areas where this case arises.

4. 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 from 92 percent to 97 percent of the maximum relative density (MRD) 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 Subsurface Concrete Requirements and Corrosion Potential of Subsurface Soils

Chemical tests limited to pH, sulphate, chloride and electrical conductivity (resistivity) were undertaken on selected sections of bedrock cores and the results are shown in Table VI. The laboratory certificate of analysis is provided in Appendix C.

Table VI: Corrosion Analyses on Selected Rock Core Samples

Borehole/Monitoring Well No. – Run Number	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
BH1 – Run 1	1.7-1.8	8.60	0.0013	0.0111	3070
MW6 -Run 4	2.7 – 2.8	7.83	0.0012	0.0099	3450
MW8 – Run 3	2.7-2.9	7.88	0.0016	0.0104	3450

The results indicate the limestone bedrock samples have a negligible sulphate attack on subsurface concrete. The concrete mix design should be in accordance with CSA A.23.1-14.

Based on a review of the resistivity test results, the limestone bedrock samples are considered to be moderately corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be undertaken to protect buried steel elements from corrosion.

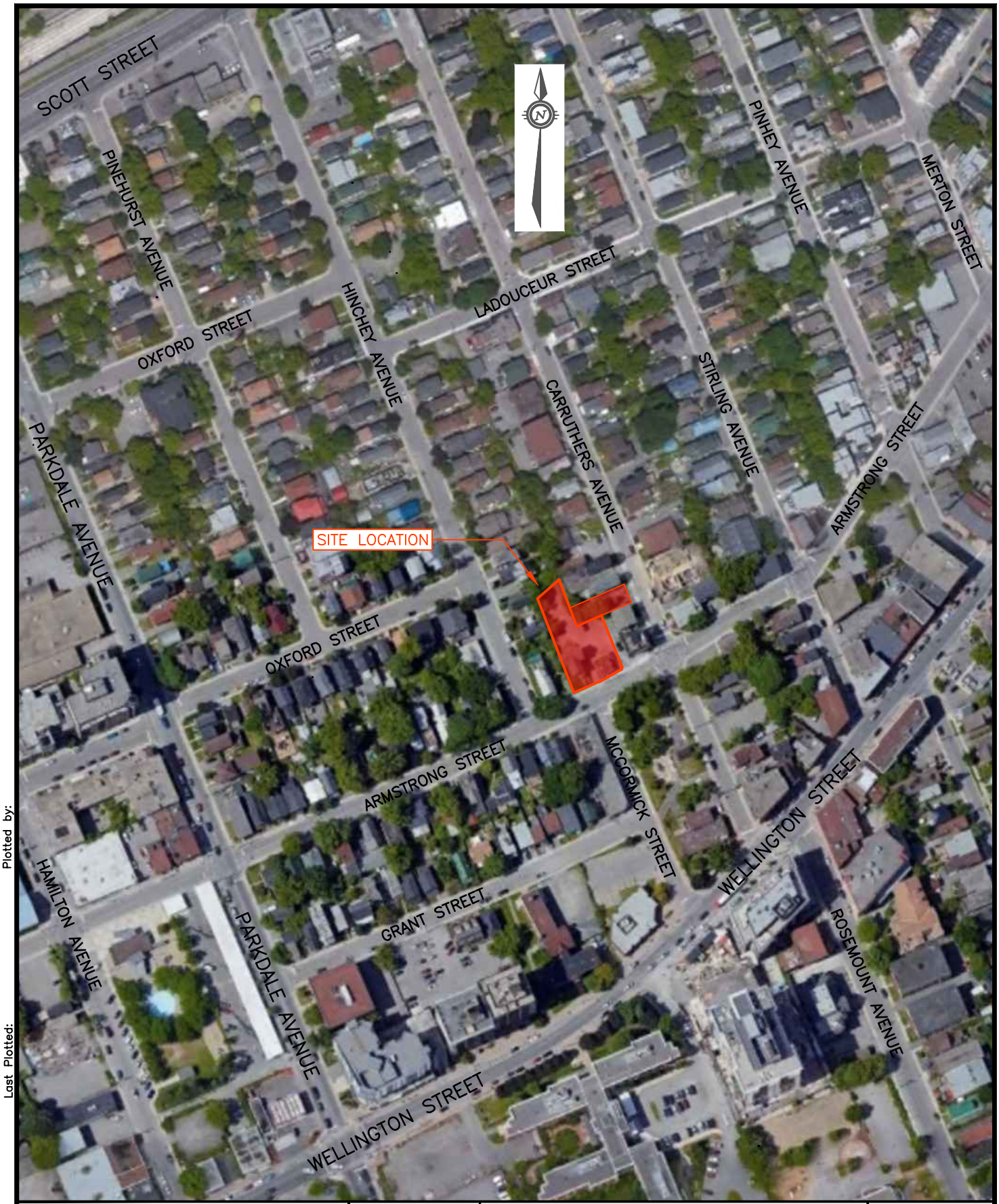
15 General Comments

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes and monitoring wells required to determine the localized underground conditions between boreholes and monitoring wells 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 monitoring well 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. Reference is made to the Phase One and Two Environmental Site Assessment reports completed for this site by EXP and reported under separate covers.

We trust this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

FIGURES



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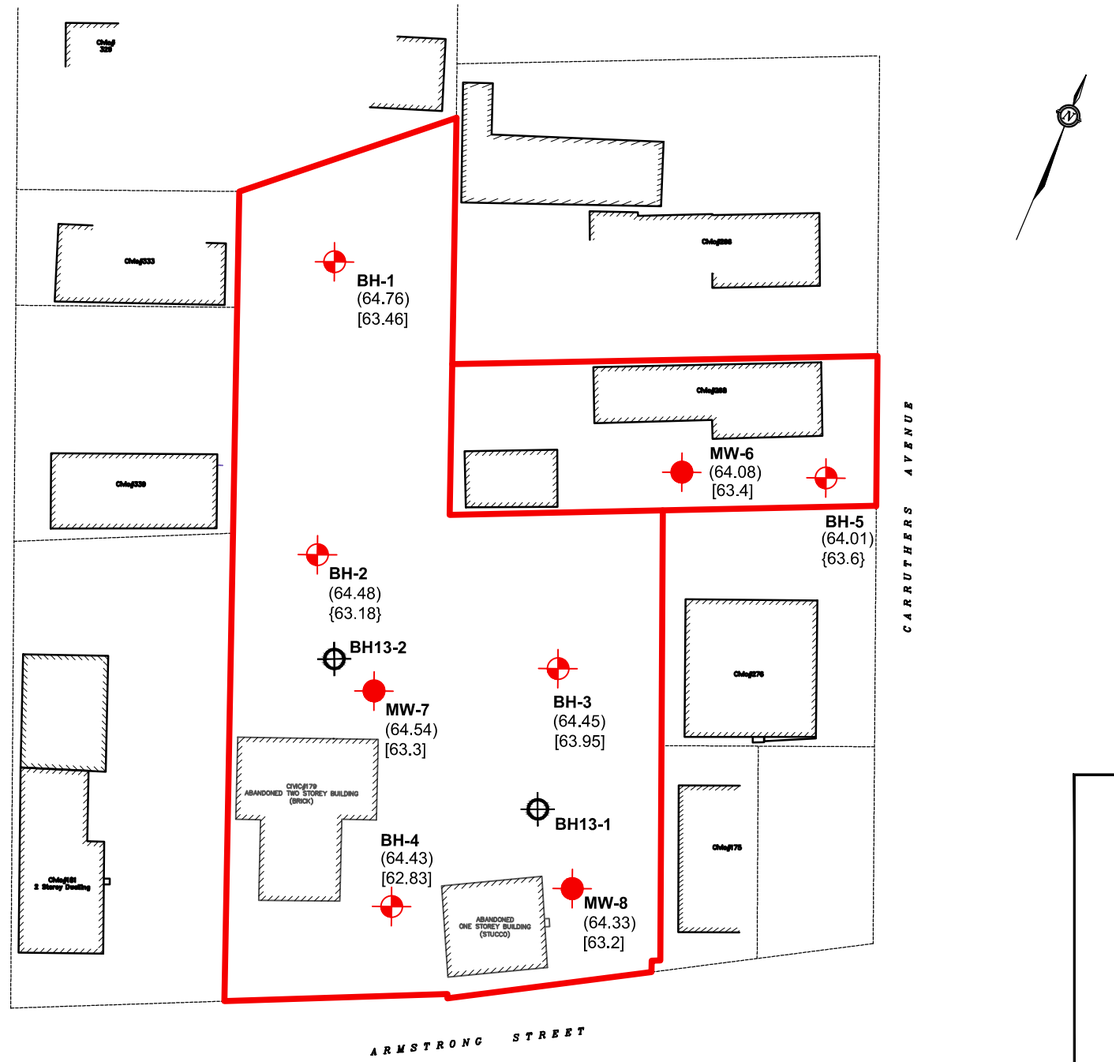
DESIGN	S.P.
DRAWN	G.C.
DATE	NOV. 2019
FILE NO	OTT-00252997-B0

PROPOSED RESIDENTIAL DEVELOPMENT
177 ARMSTRONG ST. &
268 CARRUTHERS AVE., OTTAWA, ON

SITE LOCATION PLAN

SCALE	N.T.S.
SKETCH NO	FIG 1



LEGEND

BH-1	BOREHOLE NUMBER AND LOCATION
MW-6	MONITORING WELL NUMBER AND LOCATION
(64.76)	GROUND ELEVATION
[63.46]	BEDROCK ELEVATION
{63.55}	AUGER REFUSAL ELEVATION
BH13-1	BOREHOLE NUMBER AND LOCATION BY HOULE CHEVRIER (2014)

0 4m 8m 16m

HORIZONTAL 1:400

NOTES:
1. THE BOUNDARIES, SOIL, AND ROCK 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 CORES 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 FAIRHALL, MOFFAT & WOODLAND LTD., PROJECT Y30100 DATED OCT. 9, 2018

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
www.exp.com

DESIGN	S.P.
DRAWN	G.C.
DATE	NOV. 2019
FILE NO	OTT-00252997-B0

PROPOSED RESIDENTIAL DEVELOPMENT
177 ARMSTRONG ST. &
268 CARRUTHERS AVE., OTTAWA, ON

BOREHOLE LOCATION PLAN

SCALE 1:400

SKETCH NO FIG 2

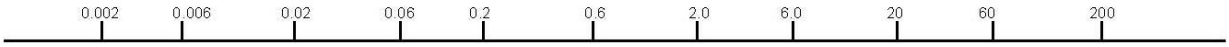
Filename: P:\Projects\GeoTechnical\250000\252000\252997 Geo Inv 177-179 Armstrong Ave\O - DRAWINGS\252997-A0 FIG 2 (CLEAN)-rotated.dwg
Last Saved: Nov 5, 2019 1:20 PM Last Plotted: Nov 5, 2019 1:41 PM Plotted by: NugentM

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 1

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'June 11, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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
		GRANULAR FILL ~ 100 mm Crushed gravel, grey, damp	64.76 / 64.7	0
		FILL Silty sand with gravel, brown and grey, damp to moist, (compact to dense)		1
			63.5	
		LIMESTONE BEDROCK Aphanitic to fine grained, grey, (very poor to fair quality) Highly fractured from 1.3 m to 2.0 m depths		2
		200 mm thick weathered zone at 3.8 m depth		3
			60.7	4
		Borehole Terminated at 4.1 m Depth		

Standard Penetration Test N Value: 20 40 60 80 — Shear Strength 50 100 150 200 kPa — 32 — 21

Combustible Vapour Reading (ppm): 250 500 750 — Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60 — 5 — 0

SAMPLES	Natural Unit Wt. kN/m³
SS1	
SS2	
Run 1	
Run 2	

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe with slotted section installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	N/A	N/A
15 Days	Dry	-
100 Days	Dry	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.3 - 2.6	94	19
2	2.6 - 4.1	100	58

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

Log of Borehole BH 2

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'June 11, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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
		GRANULAR FILL ~ 100 mm Crushed gravel, grey, damp	64.48	0				
		FILL Silty sand with gravel, brick debris, possible cobbles and boulders, brown and grey, moist, (compact)	64.4		13	5	SS1	
				1	50 for 75 mm	0	SS2	
			63.2					
		Auger Refusal at 1.3 m Depth						

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. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	1.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

Log of Borehole BH 3

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'June 11, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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 (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)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL ~ 100 mm Crushed gravel, grey, damp	64.45 / 64.4	0	50 for 100 mm	0	SS1	
		FILL Silty sand with gravel, possible cobbles and boulders, brown and black, damp to moist	64.0					
		LIMESTONE BEDROCK Aphanitic to fine grained, grey, (fair to good quality)		1			Run 1	
		Highly weathered from 0.6 m to 0.7 m depths						
		200 mm long diagonal fracture at 2.3 m depth		2			Run 2	
			62.0					
		Borehole Terminated at 2.5 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	N/A	2.5

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.6 - 1.3	93	83
2	1.3 - 2.5	100	65

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

Log of Borehole BH 4

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 'June 11, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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 ▲

Depth	SOIL DESCRIPTION	Geodetic Elevation m	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
0	**GRANULAR FILL** ~ 250 mm Crushed gravel, grey, damp	64.43	16 (20 40 60 80 / 50 100 150 200 kPa)	× (250 500 750 / 20 40 60)	SS1	
	FILL Silty sand with gravel, brown to black and grey, moist, (compact)	64.1				
1	**FILL** Sand with silt, brown, moist, (compact)	63.7	14	×	SS2	
	INFERRED BOULDERS OR WEATHERED BEDROCK	63.2	50 for 25 mm		SS3	
2	**LIMESTONE BEDROCK** Aphanitic to fine grained, grey, (very poor to fair quality) Highly weathered bedrock from 1.6 m to 1.8 m depths Highly fractured from 1.8 m to 2.3 m depths	62.8			Run 1	
3					Run 2	
4						
5		59.76			Run 3	
	Borehole Terminated at 5.5 m Depth	58.9				

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe with slotted section installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	N/A	N/A
15 Days	4.7	-
100 Days	4.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.6 - 2.3	85	0
2	2.3 - 4	97	65
3	4 - 5.5	100	71

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

Log of Borehole BH 5

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'August 30, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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
		ASPHALTIC CONCRETE ~25 mm	64.01	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		GRANULAR FILL ~ 375 mm	63.9		**50 for 50 mm**		SS1	
		Crushed gravel with sand, grey, damp	63.6					
		Auger Refusal at 0.4 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	0.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

Log of Borehole MW 6

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 'August 30, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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
		ASPHALTIC CONCRETE ~35 mm	64.08	0
		GRANULAR FILL ~ 350 mm Crushed gravel, grey, damp, (loose)	64.0	
		FILL Silty sand with gravel and cobbles, brown and grey, moist	63.7	
		LIMESTONE BEDROCK Aphanitic to fine grained, occasional fractures, grey, (very poor to excellent quality)	63.4	1
		Highly fractured with voids from 0.7 m to 2.5 m depths		2
		Void from 1.5 m to 2.1 m depths		3
▽			58.43	4
		Borehole Terminated at 6.1 m Depth	58.0	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

8 ○ 0 □

SAMPLES	Natural Unit Wt. kN/m³
SS1	
Run 1	
Run 2	
Run 3	
Run 4	
Run 5	
Run 6	

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well with screened section installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
20 Days	5.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.7 - 1.4	39	0
2	1.4 - 2.2	22	0
3	2.2 - 2.5	100	0
4	2.5 - 3.3	100	92
5	3.3 - 4.9	100	95
6	4.9 - 6.1	100	100

Log of Borehole MW 7

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 9

Page. 1 of 1

Date Drilled: 'August 30, 2019

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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 with gravel, brown and grey, moist, (compact)	64.54	0	17	15	SS1	
					50 / Refusal	10	SS2	
		INFERRED BOULDERS OR WEATHERED BEDROCK	63.6	1				
		LIMESTONE BEDROCK Aphanitic to fine grained, grey, (fair to excellent quality)	63.3				Run 1	
		Highly weathered from 1.2 m to 1.3 m depths		2			Run 2	
		Occasional 25 mm thick voids from 1.8 m to 3.1 m depths		3			Run 3	
		A 150 mm thick rubble zone at 3.9 m depth		4			Run 4	
▼				5			Run 5	
			58.88 58.7					
		Borehole Terminated at 5.8 m Depth						

LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well with screened section installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
20 Days	5.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.2 - 1.5	90	50
2	1.5 - 1.8	100	100
3	1.8 - 3.1	84	63
4	3.1 - 4.2	96	83
5	4.2 - 5.8	97	60

Log of Borehole MW 8

Project No: OTT-00252997-B0

Project: Proposed Residential Development

Location: 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: 'August 30, 2019

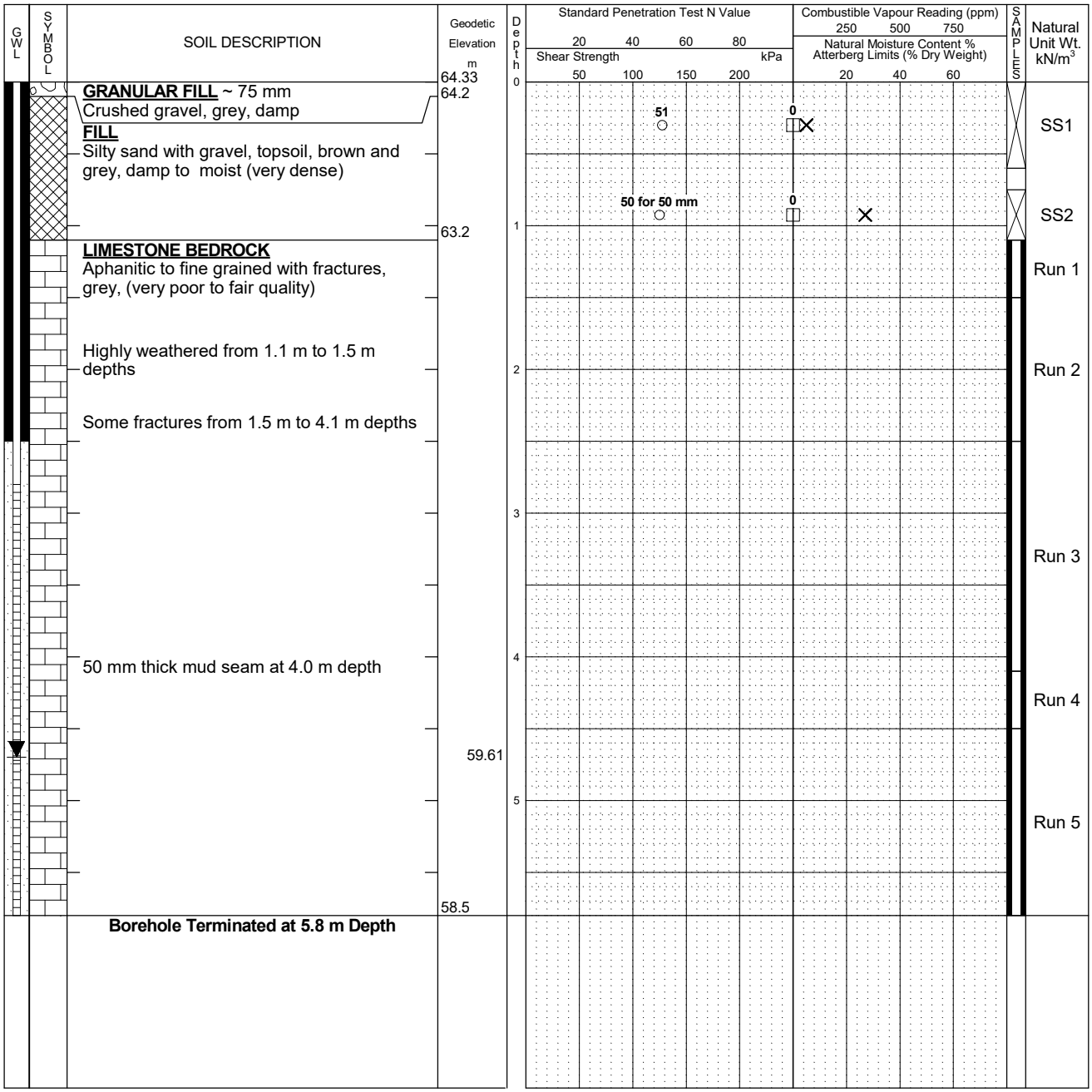
Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.L. Checked by: I.T.

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 ▲



LOG OF BOREHOLE BOREHOLE LOGS 1 TO 8 OTT-00252997-B0.GPJ TROW OTTAWA.GDT 10/31/19

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well with screened section installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00252997-B0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
20 Days	4.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.1 - 1.5	81	0
2	1.5 - 2.5	95	60
3	2.5 - 4.1	100	75
4	4.1 - 4.5	89	56
5	4.5 - 5.8	94	53

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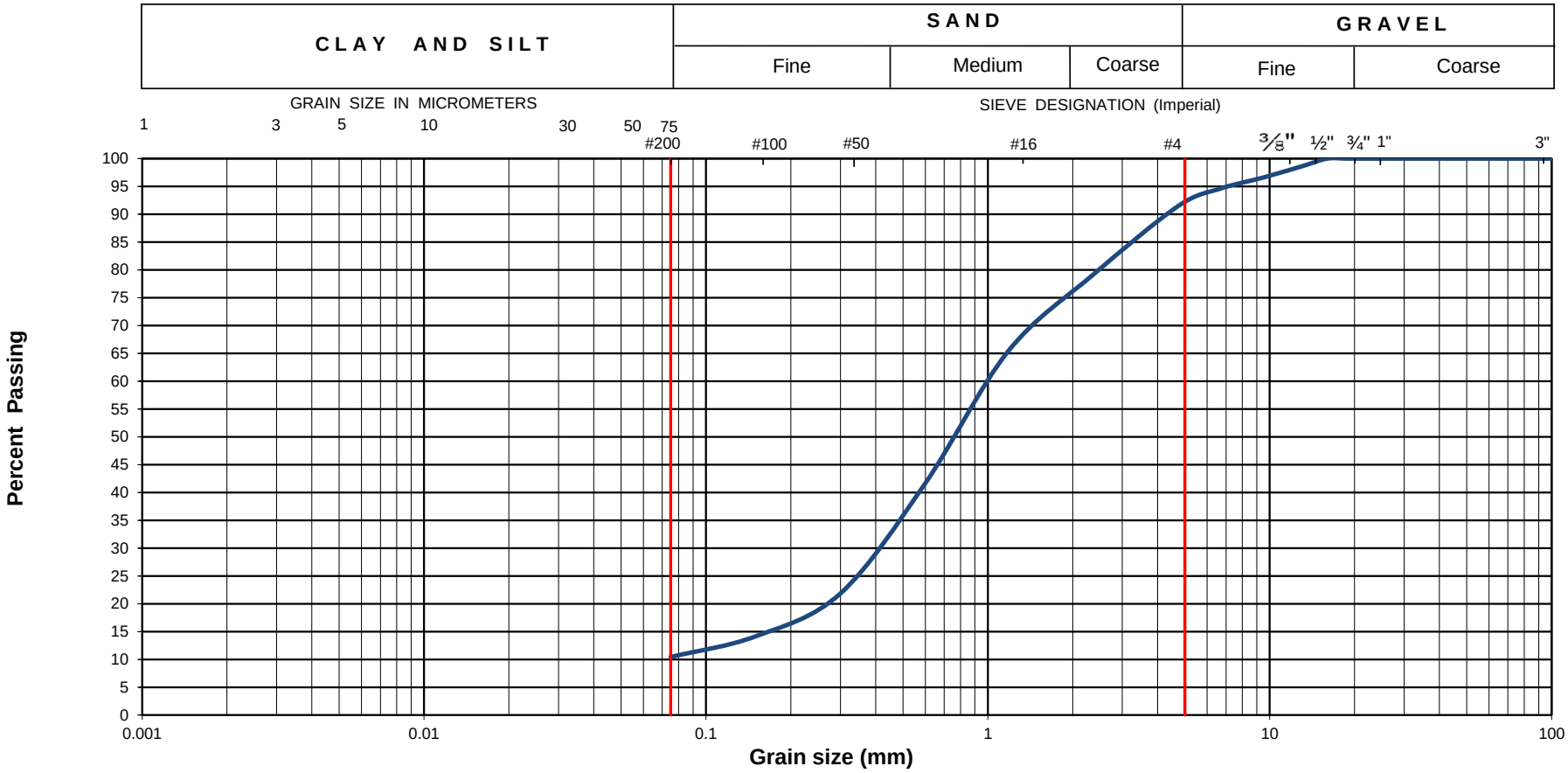
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

Unified Soil Classification System



EXP Project No.:	**OTT-00252997-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**McCormick Park Developments Inc.**	**Project Location :**	**177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.**						
Date Sampled :	**June 11, 2019**	**Borehole No:**	**BH4**	**Sample:**	**SS2**	**Depth (m) :**	**0.8-1.2**		
Sample Composition :		**Gravel (%)**	**8**	**Sand (%)**	**82**	**Silt & Clay (%)**	**10**	**Figure :**	**11**
Sample Description :	**FILL: Well Graded Sand with Silt (SW-SM)**								

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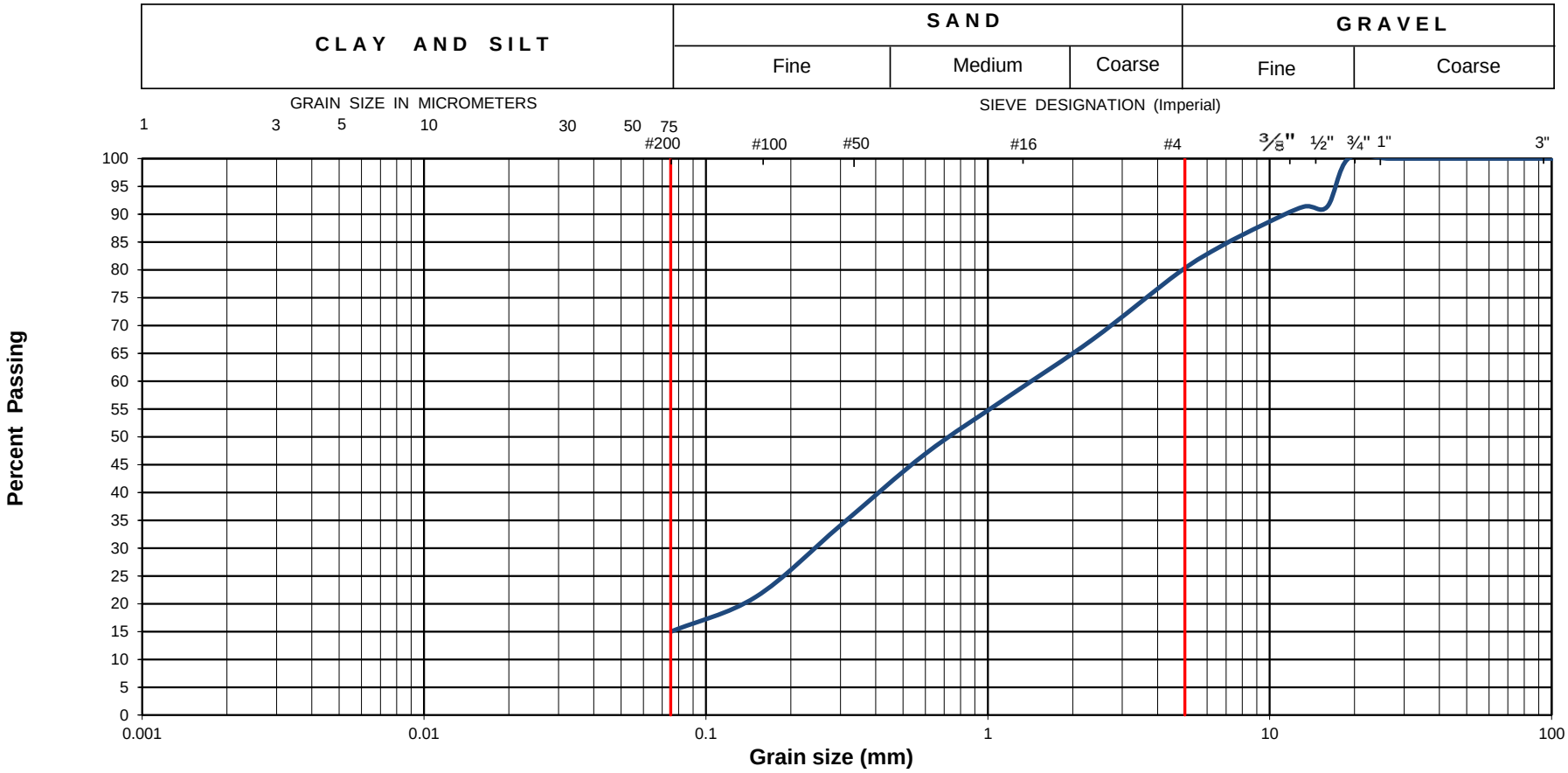
Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

Unified Soil Classification System



EXP Project No.:	**OTT-00252997-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**McCormick Park Developments Inc.**	**Project Location :**	**177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.**						
Date Sampled :	**August 30, 2019**	**Borehole No:**	**MW7**	**Sample:**	**SS1**	**Depth (m) :**	**0-0.6**		
Sample Composition :		**Gravel (%)**	**20**	**Sand (%)**	**65**	**Silt & Clay (%)**	**15**	**Figure :**	**12**
Sample Description :		**FILL: Silty Sand with Gravel (SM)**							

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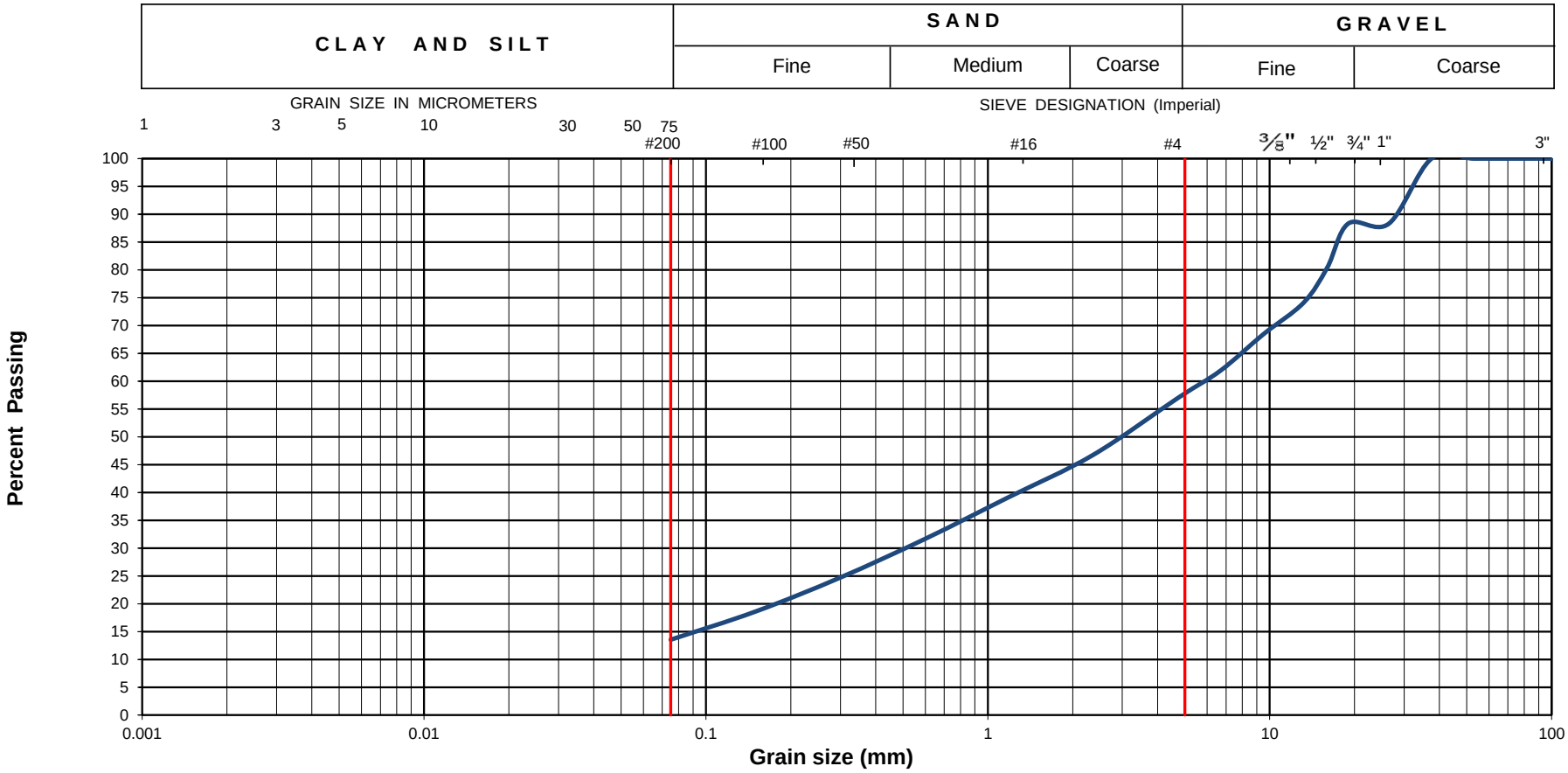
Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

Unified Soil Classification System



EXP Project No.:	**OTT-00252997-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**McCormick Park Developments Inc.**	**Project Location :**	**177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.**						
Date Sampled :	**September 3, 2019**	**Borehole No:**	**MW8**	**Sample:**	**SS1**	**Depth (m) :**	**0-0.6**		
Sample Composition :		**Gravel (%)**	**43**	**Sand (%)**	**43**	**Silt & Clay (%)**	**14**	**Figure :**	**13**
Sample Description :	**FILL: Silty Sand with Gravel (SM)**								

Appendix A: Available Geotechnical Information

PROJECT: 13-006

RECORD OF BOREHOLE 13-1

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

BORING DATE: January 23, 2013

SPT HAMMER: Jack Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat. V - + Q - ● / rem. V - ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-7} 10^{-6} 10^{-5} 10^{-4}) / WATER CONTENT, PERCENT (Wp W Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Air Hammer Casing 115 mm Diameter	Ground Surface		64.35							
		Aphaltic concrete		0.05							Protective flushmount encaed in cement
		Grey brown sand and gravel (GRANULAR FILL MATERIAL)			1	S.T.					Bentonite seal
1				63.44							
	Air Rock Hammer 80 mm Diameter Open Hole	Grey interbedded limestone and shale (BEDROCK)		0.91							
2											
3											Filter sand
											3.05 metres long, 38 mm diameter well screen.
4											Groundwater level measured at 2.09 metres below ground surface on May 30, 2014
5											
6				58.25							
		End of borehole		6.10							
7											
8											
9											
10											

DEPTH SCALE

1 to 50

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

BOREHOLE RECORD 2012 WITH LAB WC GINT 13-006 BH LOGS JAN 23, 2013.GPJ 7/14/14

PROJECT: 13-006

RECORD OF BOREHOLE 13-2

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

BORING DATE: January 23, 2013

SPT HAMMER: Jack Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat. V - +, rem. V - ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-7} 10^{-6} 10^{-5} 10^{-4}) / WATER CONTENT, PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Air Hammer Casing, 115 mm Diameter	Ground Surface		64.42							
		Asphaltic Concrete		0.05							
		Grey sand and gravel (GRANULAR FILL MATERIAL)		64.17 / 0.25							
1		Brown silty sand, trace organic material and glass debris (FILL MATERIAL)			1	S.T.					
					2	S.T.					
2	Air Rock Hammer, 80 mm Diameter Open Hole	Grey interbedded limestone and shale (BEDROCK)		62.59 / 1.83							
3											
4											
5											
6				58.32							
		End of borehole		6.10							
7											
8											
9											
10											

PIEZOMETER OR STANDPIPE INSTALLATION:
- Protective flushmount encased in cement
- Bentonite seal
- Filter sand
- 3.05 metre long, 38 mm diameter well screen
- Groundwater level measured at 5.10 metres below ground surface on May 30, 2014

DEPTH SCALE

1 to 50

Houle Chevrier Engineering

LOGGED: M.L.

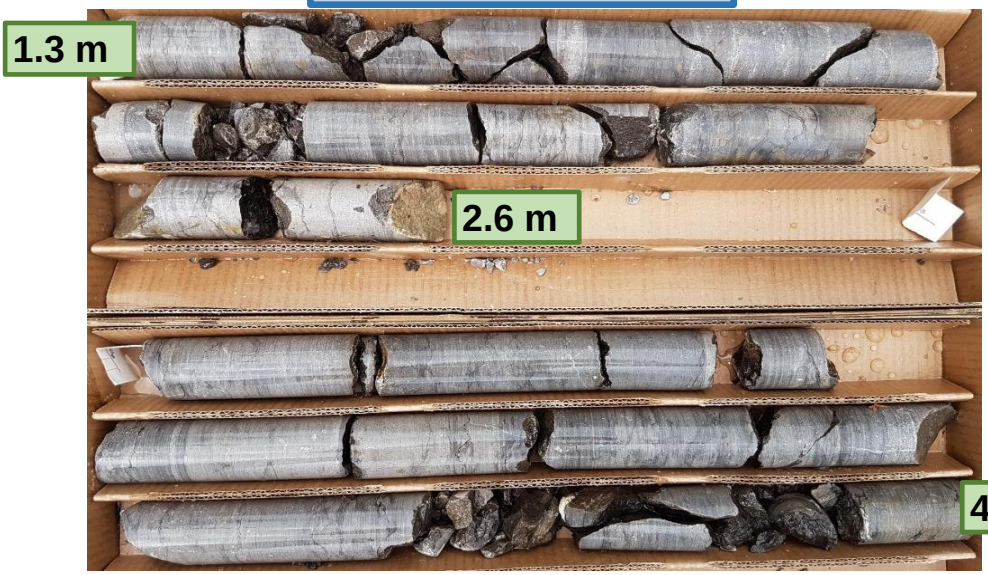
CHECKED:

BOREHOLE RECORD 2012 WITH LAB WC GINT 13-006 BH LOGS JAN 23, 2013.GPJ 7/14/14

Appendix B: Bedrock Core Photographs

DRY BEDROCK CORES

WET BEDROCK CORES



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t: +1.613.688.1899 | f: +1.613.225.7337
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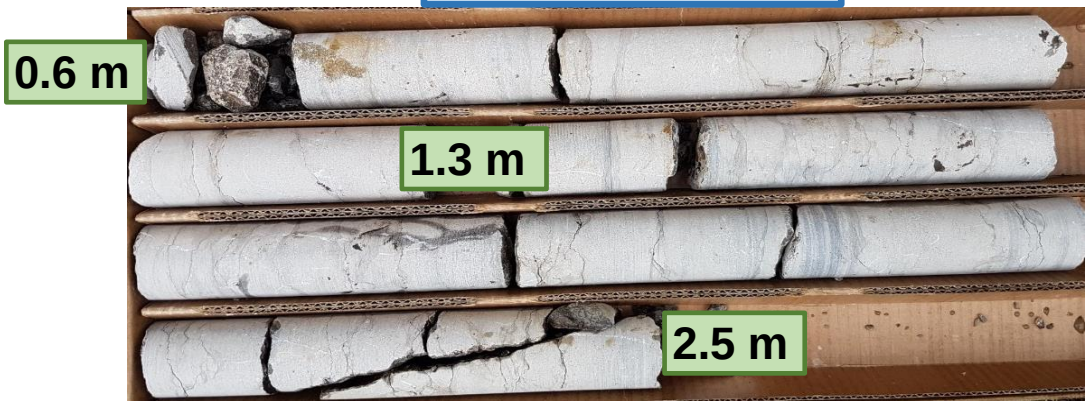
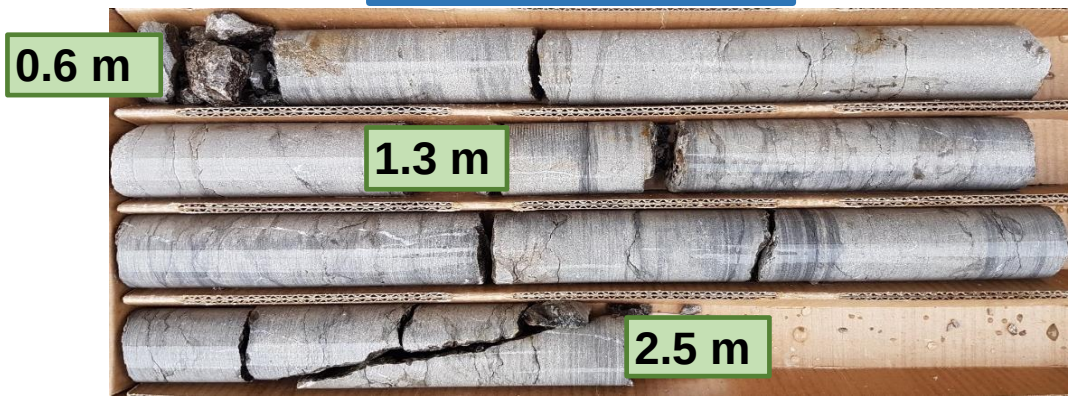
borehole no.	core runs	PROJECT	project no.
BH-1	Run 1: 1.3m - 2.6m Run 2: 2.6m - 4.1m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored Jun 11, 2019		ROCK CORE PHOTOGRAPHS	FIG B-1

DRY BEDROCK CORES



WET BEDROCK CORES



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borehole no.	core runs	PROJECT	project no.
BH-3	Run 1: 0.6m - 1.3m Run 2: 1.3m - 2.5m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored Jun 11, 2019		ROCK CORE PHOTOGRAPHS	FIG B-2

DRY BEDROCK CORES

WET BEDROCK CORES

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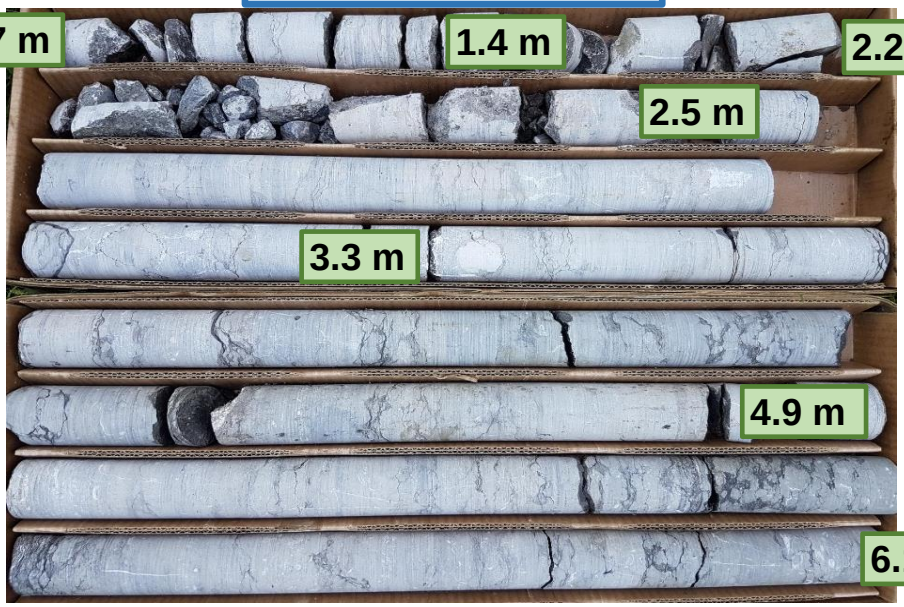
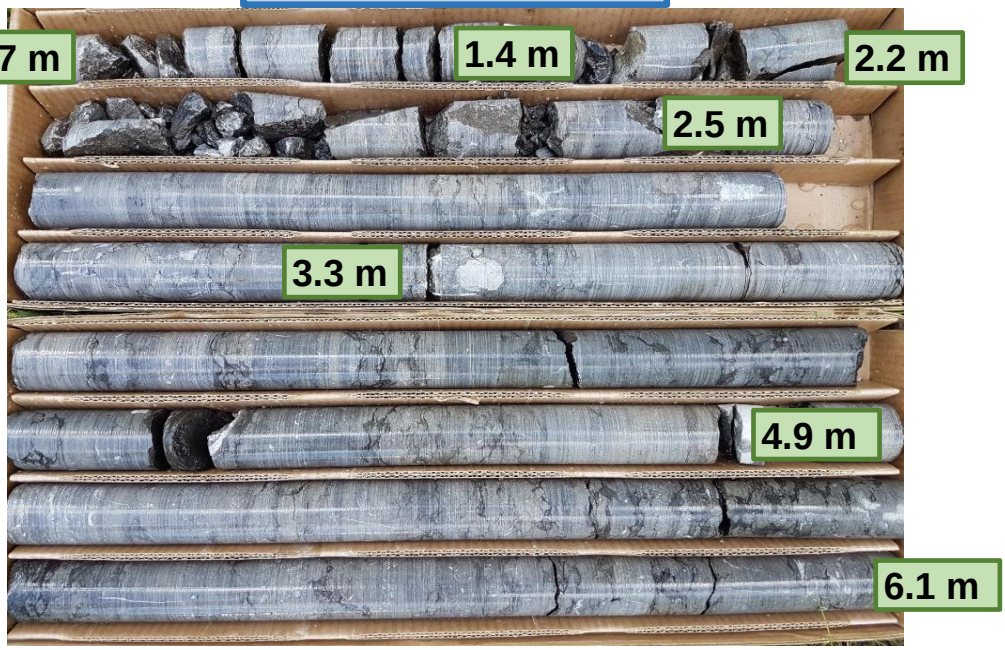
borehole no.	core runs	PROJECT	project no.
BH-4	Run 1: 1.6m - 2.3m Run 2: 2.3m - 4.0m Run 3: 4.0m - 5.5m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored Jun 11, 2019		ROCK CORE PHOTOGRAPHS	FIG B-3

DRY BEDROCK CORES



WET BEDROCK CORES



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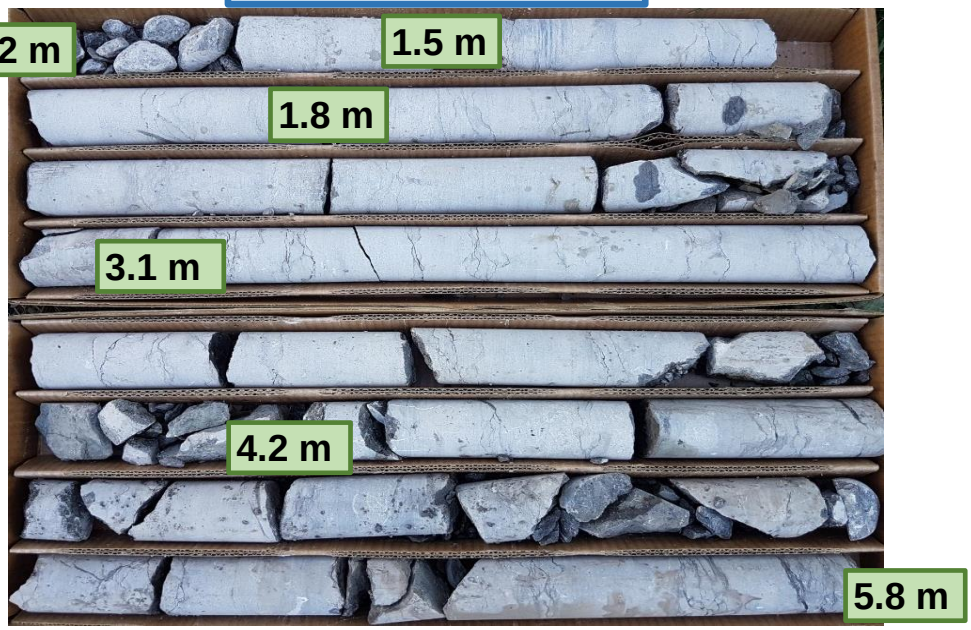
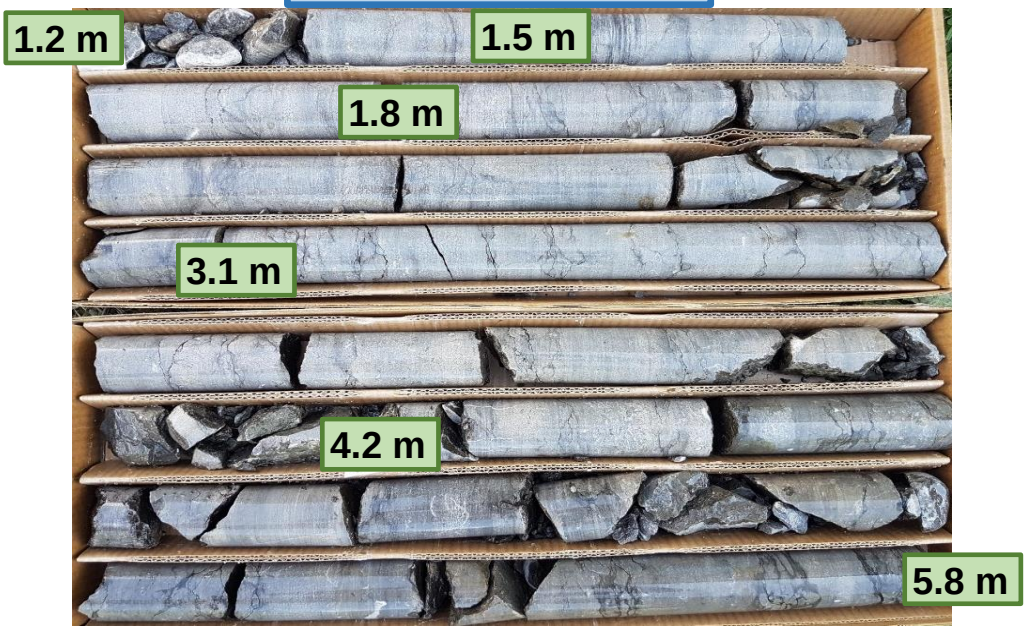
borehole no.	core runs	PROJECT	project no.
MW-6	Run 1: 0.7m - 1.4m Run 2: 1.4m - 2.2m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored	Run 3: 2.2m - 2.5m Run 4: 2.5m - 3.3m Run 5: 3.3m - 4.9m Run 6: 4.9m - 6.1m	ROCK CORE PHOTOGRAPHS	FIG B-4
Aug 30, 2019			

DRY BEDROCK CORES



WET BEDROCK CORES



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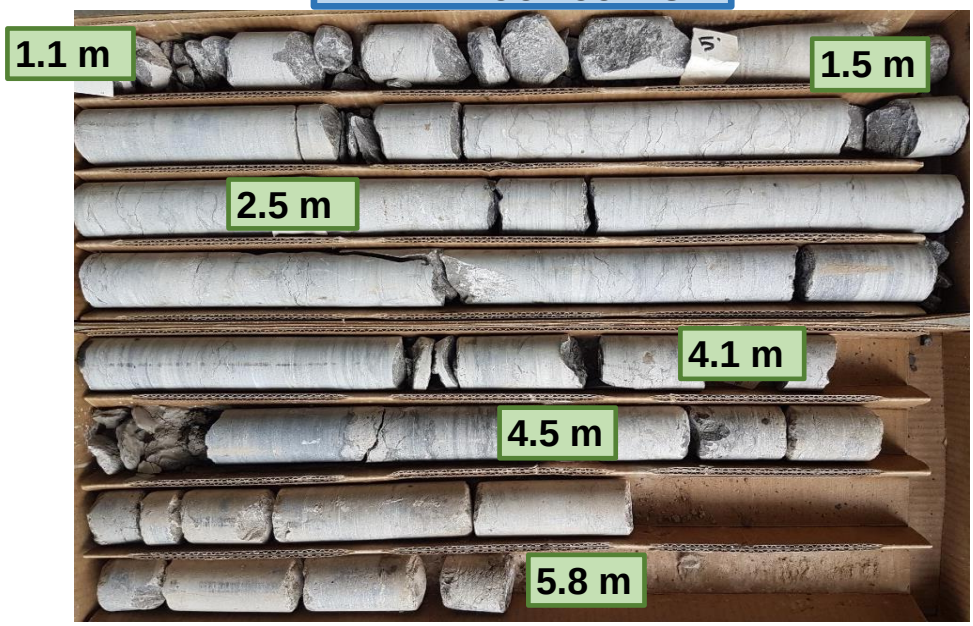
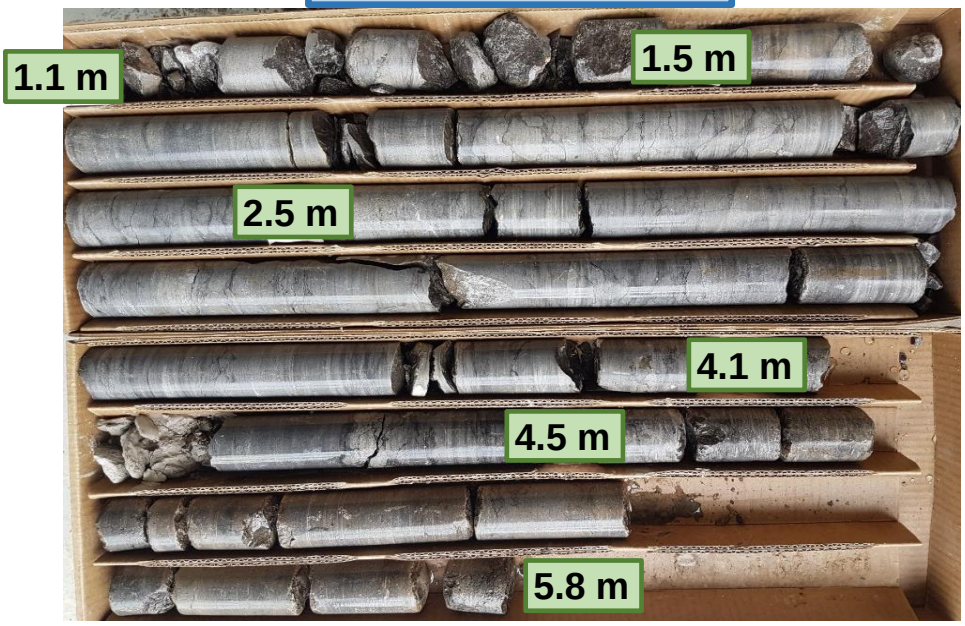
borehole no.	core runs	PROJECT	project no.
MW-7	Run 1: 1.2m - 1.5m Run 2: 1.5m - 1.8m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored	Run 3: 1.8m - 3.1m Run 4: 3.1m - 4.2m Run 5: 4.2m - 5.8m	ROCK CORE PHOTOGRAPHS	FIG B-5
Aug 30, 2019			

DRY BEDROCK CORES



WET BEDROCK CORES



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borehole no.	core runs	PROJECT	project no.
MW-8	Run 1: 1.1m - 1.5m Run 2: 1.5m - 2.5m	Proposed Residential Development 177 Armstrong Street and 268 Carruthers Avenue, Ottawa, ON.	OTT-00252997-A0
date cored Sep 03, 2019	Run 3: 2.5m - 4.1m Run 4: 4.1m - 4.5m Run 5: 4.5m - 5.8m	ROCK CORE PHOTOGRAPHS	FIG B-6

Appendix C: Laboratory Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899

ATTENTION TO: Susan Potyondy

PROJECT: OTT-252997-AO

AGAT WORK ORDER: 19Z524155

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Oct 04, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 19Z524155

PROJECT: OTT-252997-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Susan Potyondy

SAMPLING SITE:179 Armstrong/268 Carruthers

SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2019-09-30

DATE REPORTED: 2019-10-04

Parameter	Unit	G / S	RDL	BH6 Run 4 8'10"-9'2" Soil 2019-08-30 571946	BH8 Run 3 9'0"-9'5" Soil 2019-09-03 571947
SAMPLE DESCRIPTION:				8'10"-9'2"	9'0"-9'5"
SAMPLE TYPE:				Soil	Soil
DATE SAMPLED:				2019-08-30	2019-09-03
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.83	7.88
Resistivity (2:1) (Calculated)	ohm.cm		1	3450	3450
Chloride (2:1)	µg/g		2	99	104
Sulphate (2:1)	µg/g		2	12	16

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

571946-571947 Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

pH was determined on the 0.01M CaCl2 extract obtained from 2:1 leaching procedure (2 parts extraction fluid:1 part wet soil).

Resistivity is a calculated parameter.

Certified By: Vivine Basily

AGAT Laboratories

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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z524155

PROJECT: OTT-252997-AO

ATTENTION TO: Susan Potyondy

SAMPLING SITE:179 Armstrong/268 Carruthers

SAMPLED BY:exp

Soil Analysis

RPT Date: Oct 04, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
pH, 2:1 CaCl2 Extraction	571850		7.42	7.49	0.9%	NA	100%	80%	120%						
Chloride (2:1)	571946	571946	99	99	0.0%	< 2	90%	70%	130%	91%	70%	130%	107%	70%	130%
Sulphate (2:1)	571946	571946	12	12	0.0%	< 2	110%	70%	130%	108%	70%	130%	115%	70%	130%

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Certified By: Nivine Basily

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z524155

PROJECT: OTT-252997-AO

ATTENTION TO: Susan Potyondy

SAMPLING SITE:179 Armstrong/268 Carruthers

SAMPLED BY:exp

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Exp Services
Contact: Susan Potyondy
Address: 2650 Queensview Drive Suite 100
Ottawa ON K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Susan.Potyondy@exp.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One) ☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Laboratory Use Only

Work Order #: 1975241155
Cooler Quantity: One
Arrival Temperatures: 19.5 19.5 19.6
LT-12.6/12.9
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: (on ice)

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: OTT-252997-A0
Site Location: 179 Armstrong / 268 Carruthers
Sampled By: Exp
AGAT Quote #: PO:
Please note: if quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Field Filtered - Metals, Hg, CrVI	O. Reg 153	Metals and Inorganics ☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphate	Chlorides	Electro Resistivity		
BH6 Run 4 8'10"-9'2"	Aug30/19																						✓	✓	✓	✓		
BH8 Run 3 9'0"-9'5"	Sep13/19																						✓	✓	✓	✓		

Samples Relinquished By (Print Name and Sign): Ryan DiGiuseppe	Date: Sept 27/19	Time: 5:30	Samples Received By (Print Name and Sign): Courtney Gilbert	Date: 2019-09-30	Time: 10h17
Samples Relinquished By (Print Name and Sign): UPS to FedEx	Date: 2019-09-30	Time: 16h00	Samples Received By (Print Name and Sign):	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign): Shaumin Oct1/19	Date: 9:55	Time: am

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N°: T 078084

Document ID: DIV-78-1511.015

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899

ATTENTION TO: Maxime Leroux

PROJECT: OTT-252997-A0

AGAT WORK ORDER: 19Z479228

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

DATE REPORTED: Jun 19, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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MISSISSAUGA, ONTARIO
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Certificate of Analysis

AGAT WORK ORDER: 19Z479228

PROJECT: OTT-252997-A0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Maxime Leroux

SAMPLING SITE:177-179 Fraser Armstrong St, Ottawa ON

SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2019-06-13

DATE REPORTED: 2019-06-19

			SAMPLE DESCRIPTION:	BH1 Run1 1.
			SAMPLE TYPE:	5-1.7m
			DATE SAMPLED:	Rock
				2019-06-11
Parameter	Unit	G / S	RDL	270128
pH (2:1)	pH Units		N/A	8.60
Resistivity (2:1)	ohm.cm		1	3070
Chloride (2:1)	µg/g		2	111
Sulphate (2:1)	µg/g		2	13

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

270128 pH, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part solid sample). Resistivity is a calculated parameter.
As this analysis was performed on a sample matrix which is outside of the scope of our test method it is deemed non-routine and therefore, no information is available for Accuracy, Precision or Measurement Uncertainty.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z479228

PROJECT: OTT-252997-A0

ATTENTION TO: Maxime Leroux

SAMPLING SITE:177-179 Fraser Armstrong St, Ottawa ON

SAMPLED BY:exp

Soil Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
pH (2:1)	270128	270128	8.60	8.61	0.1%	N/A	101%	90%	110%	NA			NA		
Chloride (2:1)	277731		9	10	NA	< 2	105%	70%	130%	109%	70%	130%	104%	70%	130%
Sulphate (2:1)	277731		1770	1770	0.0%	< 2	99%	70%	130%	107%	70%	130%	90%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL

Certified By:

Amanjot Bhela

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
AMANJOT BHELA
CHEMIST

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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http://www.agatlabs.com

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z479228

PROJECT: OTT-252997-A0

ATTENTION TO: Maxime Leroux

SAMPLING SITE:177-179 Fraser Armstrong St, Ottawa ON

SAMPLED BY:exp

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 19z479228

Cooler Quantity: one - no ice

Arrival Temperatures: 21.3 | 21.3 | 21.5
6° | 16° | 16°3

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Exp Services
Contact: Maxime Leroux
Address: 2650 Queensview drive Suite 100
Ottawa ON K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Maxime.Leroux@exp.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use ☐ Sanitary ☐ Storm
Region (Indicate One) ☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: OTT-252797-A0
Site Location: 177-179 Armstrong st, Ottawa ON
Sampled By: exp
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides); ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR)	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphate	Chlorides	Electrical Resistivity
BH 1 Run 1 1.5-1.7m	June 11/19																			✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign): Ryan D'Giuseppe	Date: June 12/19	Time: 6:30pm	Samples Received By (Print Name and Sign): Berthelet	Date: 19-06-13	Time: 9h33
Samples Relinquished By (Print Name and Sign): LOOP FedEx	Date: 19-06-13	Time: 16h00	Samples Received By (Print Name and Sign): Simi	Date: 19/6/14	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:

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N°: T 078056

List of Distribution

Report Distributed To:

jeanhdesjardins56@gmail.com

Bruce.thomas@exp.com