Geotechnical Investigation
Proposed Residential Development
266 & 268 Carruthers Avenue, Ottawa, Ontario

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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 266 and 268 Carruthers Avenue, Ottawa, Ontario. (Figure 1). Terms and conditions of this assignment were outlined in EXP's Proposal dated May 30, 2022 and was authorized by Jeremy Silburt of Theberge Homes via our signed work authorization form..

The proposed residential development will consist of a 3.5 storey residential apartment building with one level of basement. The development will share outdoor amenity space, parking lots and landscaped areas with the property of 179 Armstrong Street currently under construction by the developer of this project. The elevation of the lowest floor (basement floor), ground floor and exterior grades were not available at the time of the preparation of this report.

Phase One and Two Environmental Site Assessments (ESAs) were undertaken concurrently at this site along with this geotechnical investigation by EXP and are presented under separate covers.

The investigation comprised the drilling of three (3) additional boreholes in the accessible areas of 266 Carruthers Avenue in addition to the three boreholes previously drilled in August 2019 and May 2022 at 268 Carruthers. The available borehole information has revealed the subsurface conditions to comprise of heterogenous fill underlain by shallow limestone bedrock contacted at 0.4 m to 1.6 m depths below the existing grades (Elevation 63.7 m to 62.2 m). The groundwater level was established at depths of 1.7 m to 3.4 m depths (Elevation 62.15 m to 60.62 m).

As compressible soils were not encountered at the site, there is no restriction to raising the grades at the site from a geotechnical point of view.

The geotechnical investigation has revealed that the subsurface conditions at the site are well suited to supporting the proposed building, 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.

As the removal of the bedrock may lead to low areas in certain locations below the design underside of the footings, in such cases, 15 MPa lean mix concrete must be used to raise the grades to the design underside of footing. Therefore, an allowance should be made in the contract if such event arise.

The site is classified as **Class C** for seismic site response for footings set on limestone bedrock as recommended above. In addition, the subsurface soils are not liquefiable during a seismic event. A Site Class of B or A may be available if a multi-channel analysis shear wave survey is undertaken at the site.

The lowest level floor slab of the proposed building may be constructed as a slab-on-grade provided it is 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. Requirement of any underfloor drainage system will be best established once the elevation of the lowest floor of the proposed building is known.

The finished ground floor slab 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), i.e. cut at a slope of 1H: 1V. 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 rock removal operations should be carried out at the adjacent surrounding structures and infrastructure to ensure that the vibration generated by the rock removal activities meets the limiting vibration criteria at all times. Blasting operations, if undertaken, 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 building 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.

1.0 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 266 Carruthers Avenue, Ottawa, Ontario. (Figure 1). Terms and conditions of the assignment have been outlined in EXP's Proposal dated May 30, 2022 and was authorized by Jeremy Silburt of Theberge Homes via our signed work authorization form.

The proposed residential development will consist of a 3.5 storey residential apartment building with one level of basement. The development will share outdoor amenity space, parking lots and landscaped areas with the property of 179 Armstrong Street currently under construction by the developer of this project. The elevation of the lowest floor (basement floor), ground floor and exterior grades were 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 three (3) boreholes drilled in the accessible areas of the site;

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC), as amended May 2, 2019 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 building;

g) Discuss excavation conditions and dewatering requirements during construction;

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

i) 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 and are presented under separate covers.

2.0 Site Description

The subject site is located at 266 and 268 Carruthers Avenue, Ottawa, ON and currently occupied by one (1) single family 2.5 storey with one basement level detached residential building which will be demolished to allow the construction of the proposed building. The site borders on Carruthers Avenue to the east, and residential properties to the north, west, and south.

The site is generally flat with ground surface elevations ranging from approximately Elevation 64.10 m to Elevation 63.8 m as depicted in the topographic plan of survey of Part of Lots 6 & 7 Registered Plan 83, City of Ottawa prepared by Farley, Smith, and Denis Surveying Ltd. 2022. The site generally slopes west to east towards Carruthers Avenue.

3.0 Background Information

EXP has completed previous studies on 177 Armstrong Street, which included boreholes on 268 Carruthers Avenue and the detailed results are presented in our report project number OTT-00252997-B0 dated November 5, 2019, and project OTT-00250193-P0 dated June 27, 2022. Boreholes BH5 and MW6 were completed for a geotechnical study in 2019 and borehole MW22-1 was drilled for an environmental assessment in May 2022. Logs of the previous investigations are included in Appendix A and the results are also referenced in this report.

4.0 Procedure

4.1 Fieldwork

The fieldwork for the geotechnical investigation was undertaken on July 26, 2022 and comprised the drilling of three (3) boreholes (BHs 1 to 3) in the accessible areas of the site. The boreholes were advanced to auger refusal and/or termination depths ranging from 0.5 m to 4.3 m (Elevation 63.5 m to 59.7 m). The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole locations were established on site by EXP as shown on Figure No. 2. Their ground surface elevations were estimated from the topographic survey plan prepared for the site by others and provided to exp and therefore are considered approximate. Prior to drilling the boreholes, the borehole locations were cleared of any public and private underground services by USL-1 Cable Locators.

The boreholes were drilled by a CME-55 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 at a 0.75 m depth interval and soil samples retrieved by the split-barrel sampler. The presence of the bedrock was proven in Borehole Nos. 1 and 3 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 the open boreholes upon completion of drilling. In addition, long-term groundwater monitoring installation consisting of a 19-mm diameter PVC (polyvinyl chloride) standpipe with screened sections were installed in Borehole Nos. 1 and 3. The installation configuration is documented on the respective borehole logs. All the boreholes 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 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 B.

Table I: Summary of Laboratory Testing Program	
Type of Test	**Number of Tests Completed**
Soil Samples	
Moisture Content Determination	7
Grain Size Analysis	1
Unit Weight	2
Bedrock Cores	
Unit Weight Determination	5
Unconfined Compressive Strength Test	5
Corrosion Analyses (pH, sulphate, chloride and resistivity)	1

5.0 Subsurface Conditions

A detailed description of the geotechnical conditions encountered in the three (3) boreholes is given on the borehole logs, Figure Nos. 3 to 5 inclusive. Boreholes BH5, MW6, and MW22-1 drilled in August 2019 and May 2022 for the property at 268 Carruthers Ave. are also provided in Appendix B. The borehole 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 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 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 logs indicates the following subsurface soil and bedrock conditions with depth and groundwater levels.

5.1 Pavement Structure

A 25 mm thick asphaltic concrete underlain by 125 mm thick granular base layer was contacted at each of the three boreholes. The moisture content of the granular fill is 2 percent to 2.6 percent.

Grain size analysis was conducted on one (1) sample of the granular fill. The grain size curve is shown in Figure 6 and the results are summarized in Table II.

Table II: Summary of Results from Grain-size Analysis – Granular Fill Sample

Borehole/Monitoring Well No. (BH/MW) - Sample No.	Depth (m)	Grain-size Analysis (%)			Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	
BH No. 1 – GS1	0.025 – 0.15	58	35	7	Well Graded Gravel with Silt and Sand (GW-GM)

Based on a review of the results from the grain size analysis, the granular fill may be classified as a well graded gravel with silt and sand (GW-GM).

5.2 Fill

Fill was contacted in all boreholes beneath the pavement structure and consisted of sand and gravel to clayey silt mixed with topsoil inclusions, and cobbles. The fill extended to auger refusal depths in all three boreholes ranging from 0.5 m to 1.6 m (Elevation 62.2 m to 63.7 m) and is very loose to compact as indicated by the (SPT) N-value of 2 to 18 blows for 300 mm penetration of the split spoon sampler. The moisture content of the fill is 11.8 percent to 21 percent. Its unit weight was measured to ranged between 18.7 kN/m3 and 19.5 kN/m3.

5.3 Limestone Bedrock

Refusal to augers was met in all the boreholes at depths ranging between 0.4 m to 1.6 m depths (Elevation 63.6 m to 62.2 m). The presence of the bedrock was confirmed in Borehole Nos. 1 and 3 of this study. It was also confirmed in borehole Nos. MW6 and MW22-1 of previous studies. Bedrock was proven to be present at depths of 1.7 m to 0.4 m (Elevation 63.6 m to 62.2 m).

Since fill was contacted to the surface of the bedrock in all the boreholes and was found at deeper depth in Borehole No.1 compared to Borehole Nos. 1 and 3, it is suspected that the relatively deeper depths of bedrock surface contacted at Borehole No. 1 is likely caused by previous excavation and therefore the depth of bedrock throughout the remainder of the site is Likely present at shallow depths, i..e 0.4 m or shallower in areas not previously excavated. Therefore, this must be accounted for by the contractors when estimating the volume of bedrock to be removed from site to allow the construction of the proposed development. A summary of the bedrock depth/elevation at each borehole is presented in the Table III below:

Table III: Summary of Bedrock Elevations

Borehole	Ground Surface Elevation	Refusal Depth (m)	Refusal Elevation	Bedrock Proven by Coring
BH-1	63.85	1.7	62.30	Yes
BH-2	63.95	0.5	63.45	No
BH-3	64.02	0.4	63.62	Yes
BH-5	64.01	0.4	63.61	No
MW-6	64.08	0.7	63.38	yes
MW22-1	63.65	1.5	62.15	yes

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 90 percent to 100 percent and 48 percent to 100 percent indicating 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 ten (10) selected sections of rock cores, including five (5) from previous studies are summarized in Table IV.

Table IV: 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 – 2.0	123	2632
BH1 – Run 2	3.5 – 3.6	135	2629
BH3 – Run 1	0.6 – 0.8	112	2638
BH3 – Run 2	1.4 – 1.5	124	2635
BH3 – Run 3	3.0 – 3.1	163	2652
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	140	2681
MW6 – Run 6	4.9 – 5.0	179	2683

The unconfined compressive strength test results range from 80 MPa to 179 MPa and the rock may be classified as strong to very strong in accordance with the Canadian Foundation Engineering Manual (CFEM), Fourth Edition, 2006.

5.4 Groundwater Levels

Groundwater measurements taken in standpipes installed in two of the boreholes on July 29 and August 30, 2022 are summarized in Table V below.

Table V: 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	63.85	July 29,2022 (3 days) August 30, 2022 (35 days)	3.1 (60.75) 1.7 (62.15)
BH 3	64.02	July 29, 2022 (3 days) August 30, 2022 (35 days)	3.4 (60.62) 3.1 (60.92)

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.

6.0 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 geotechnical perspective.

7.0 Seismic Site Classification and Liquefaction Potential of Subsurface Soils

The subsurface soils at the site comprised of shallow deposit of fill underlain by limestone bedrock contacted at depths of 0.4 m to 1.7 m below grade (Elevation 63.62 m to 62.15 m).

It is recommended to support the proposed building on footings 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 obtained 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.

8.0 Foundation Considerations

The geotechnical investigation revealed that the subsurface conditions at the site are well suited to support the proposed building by strip and spread footings set on the shallow limestone bedrock contacted at 0.4 m to 1.6 m depths (Elevation 63.62 m to 62.15 m) in Borehole Nos. 1, 2, and 3, and BH5, MW6, MW22-1 of previous studies, below any weathered or fractured zones.

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 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 and therefore an allowance must be made in the contract for the use of lean mix.

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.

9.0 Floor Slab and Drainage Requirements

The lowest level floor slab of the proposed building may be constructed as a slab-on-grade provided it is 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.

10.0 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.

11.0 Excavations and Dewatering 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.

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

The material to be excavated from the site is anticipated to consist of limited quantity of crushed limestone granular fill, sand and gravel to sandy clayey silt fill, and limestone bedrock. The overburden may be re-used 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. management of any excess soils generated from the site should be made as per the recommendation of the Phase II ESA completed for the site by exp.

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.

13.0 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 2	3.6 - 3.7	8.28	0.0024	0.0078	4370

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 mildly 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.

14.0 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.

Matthew Zammit, M.A.Sc., P.Eng.
Geotechnical Engineer
Earth and Environment

Ismail Taki, M.Eng., P.Eng.
Senior Manager, Eastern Region
Earth and Environment

Figures

Filename: E:\OTT\OTT-22014692-A0\60 Execution\65 Drawings\22014692-A0_Geo.dwg
Last Saved: Sep 13, 2022 4:04 PM Last Plotted: Sep 13, 2022 4:05 PM Plotted by: SeverA

0 40m 80m 160m

HORIZONTAL 1:4000

EXP Services Inc. **www.exp.com**
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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

DATE SEPTEMBER 2022	GEOTECHNICAL INVESTIGATION 266 AND 268 CARRUTHERS AVENUE, OTTAWA, ONTARIO	project no. OTT-22014692-A0
DESIGN MZ / CHECKED IT		scale 1:4,000
DRAWN BY AS	SITE LOCATION PLAN	FIG 1

266 CARRUTHERS AVENUE PROPERTY BOUNDARY

PROPOSED 3.5 STOREY APARTMENT BUILDING
BUILDING FOOTPRINT: 3,129sq.ft [290.7sq.m.]
TYPICAL FLOOR PLAN:3,595sq.ft [334sq.m]
LOT AREA: 17,001sq.ft. [1,579sq.m.]

BH-1 (63.85) [62.30]
BH-2 (63.95) {63.50}
BH-3 (64.02) [63.60]
MW22-1 (63.65) [62.20]
BH-5 (64.01) {63.6}
MW-6 (64.08) [63.4]

268 CARRUTHERS AVENUE PROPERTY BOUNDARY

177 ARMSTRONG STREET PROPERTY BOUNDARY

EXISTING 3.5 STOREY APARTMENT BUILDING
BUILDING FOOTPRINT: 570sq.m

CARRUTHERS AVENUE

258 266 268 276 (A)

CANTILEVER
LIMITING DISTANCE LINE
BALCONY ABOVE
CONCRETE SIDEWALK
HYDRO LINE
PROPERTY LINE
EXIT

GENERAL NOTES:

1. THE BOUNDARIES, ROCK, 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 CORES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. ASPHALT QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.

LEGEND

- PROPERTY(IES) BOUNDARIES
- BH-1 — BOREHOLE NUMBER AND LOCATION (*EXP*, 2022)
- MW22-1 — POST-REMEDIATION MONITORING WELL NUMBER AND LOCATION (*EXP*, 2022)
- BH-5 — PRE-REMEDIATION BOREHOLE NUMBER AND LOCATION (*EXP*, 2019)
- MW-6 — PRE-REMEDIATION MONITORING WELL / STANDPIPE NUMBER AND LOCATION (*EXP*, 2019)

(64.76) GROUND ELEVATION
[63.46] BEDROCK ELEVATION
{63.55} AUGER REFUSAL ELEVATION

0 1m 3m 6m
HORIZONTAL 1:150

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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

DATE OCTOBER 2022
DESIGN MZ | CHECKED IT
DRAWN BY AS

GEOTECHNICAL INVESTIGATION
266 AND 268 CARRUTHERS AVENUE, OTTAWA, ONTARIO

BOREHOLE LOCATION PLAN

project no. OTT-22014692-A0
scale 1:150
FIG 2

Filename: E:\OTT\OTT-22014692-A0\60 Execution\65 Drawings\22014692-A0_Geo.dwg
Last Saved: Oct 11, 2022 9:04 AM Last Plotted: Oct 11, 2022 9:04 AM Plotted by: SeverA

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		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	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-22014692-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 266 Carruthers Avenue, City of Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'July 26, 2022

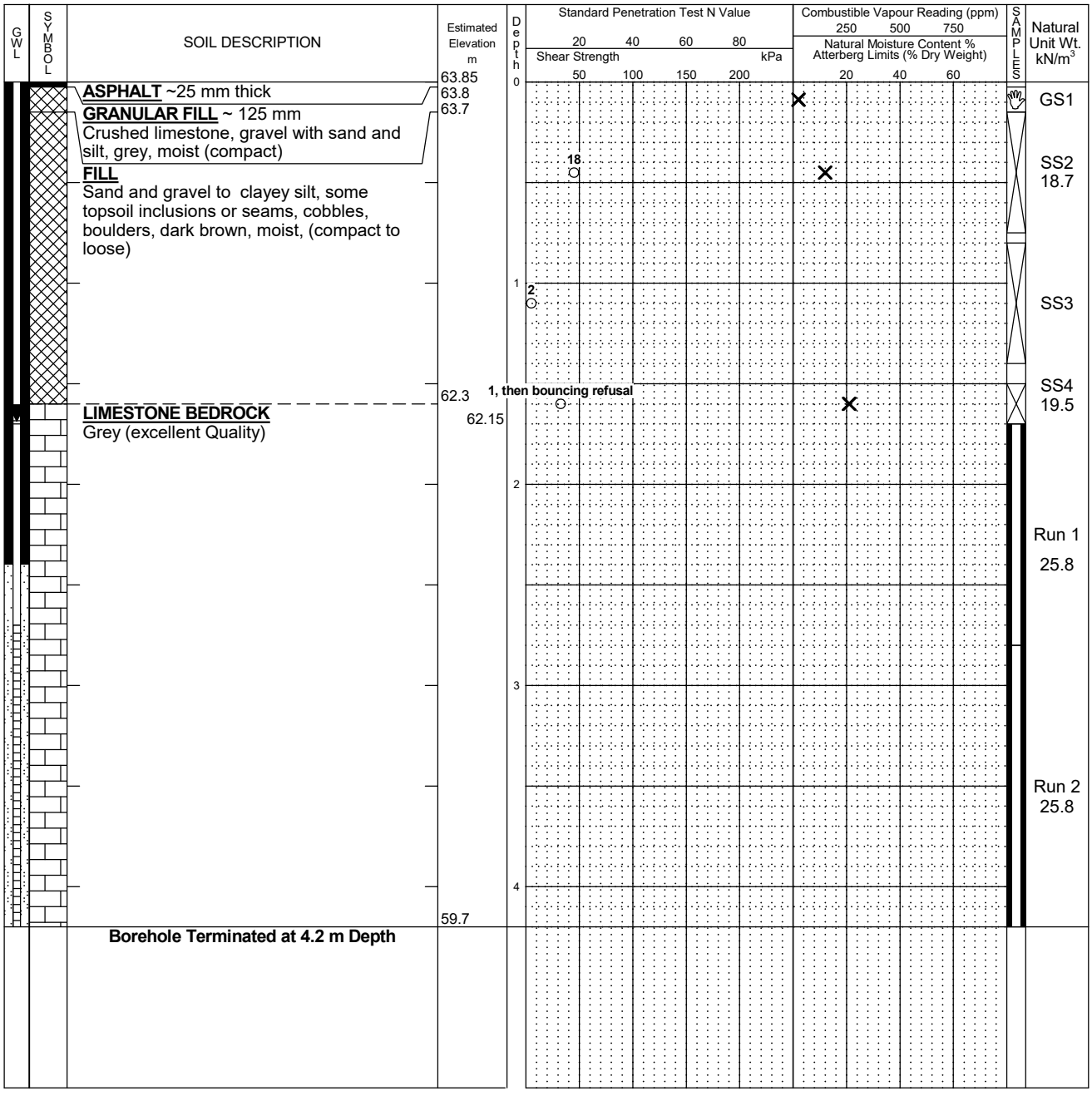
Drill Type: CME-55 Truck Mount Drill Rig

Datum: Estimated Elevation

Logged by: M.Z 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 BH LOGS 266 CARRUTHERS 22014692.GPJ TROW OTTAWA.GDT 8/31/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was 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-22014692-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	Core Water	no cave
July 29, 2022	3.1	
August 30, 2022	1.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.7 - 2.8	92	87
2	2.8 - 4.2	100	100

Log of Borehole BH-2

Project No: OTT-22014692-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 266 Carruthers Avenue, City of Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'July 26, 2022

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Estimated Elevation

Logged by: M.Z 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	Estimated 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
		ASPHALT ~25 mm thick	63.95	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60	GS1	
		GRANULAR FILL ~ 125 mm Crushed limestone, grey, moist (compact)	63.9					
		FILL Sand and gravel with topsoil, dark brown, moist (compact)	63.8		**7, then bouncing refusal**		SS2	
		Auger Refusal at 0.5 m Depth	63.5					

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22014692-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	no cave

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS 266 CARRUTHERS 22014692.GPJ TROW OTTAWA.GDT 8/31/22

Log of Borehole BH-3

Project No: OTT-22014692-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 266 Carruthers Avenue, City of Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'July 26, 2022

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Estimated Elevation

Logged by: M.Z 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	Estimated Elevation m	Depth
		ASPHALT ~25 mm thick	64.02	0
		GRANULAR FILL ~ 125 mm Crushed limestone, grey, moist (compact)	64.0	
		FILL Sand and gravel with topsoil, cobbles, dark brown, moist (loose)	63.9	
		LIMESTONE BEDROCK Grey (fair to good quality)	63.6	1
				2
			60.92	3
				4
		Borehole Terminated at 4.3 m Depth	59.7	

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

2, then bouncing refusal

SAMPLES: GS1, SS2, GS3, Run 1, Run 2, Run 3

Natural Unit Wt. kN/m³: 25.9, 25.8, 26.0

LOG OF BOREHOLE BH LOGS 266 CARRUTHERS 22014692.GPJ TROW OTTAWA.GDT 8/31/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was 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-22014692-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	Core water	no cave
July 29, 2022	3.4	
August 30, 2022	3.1	

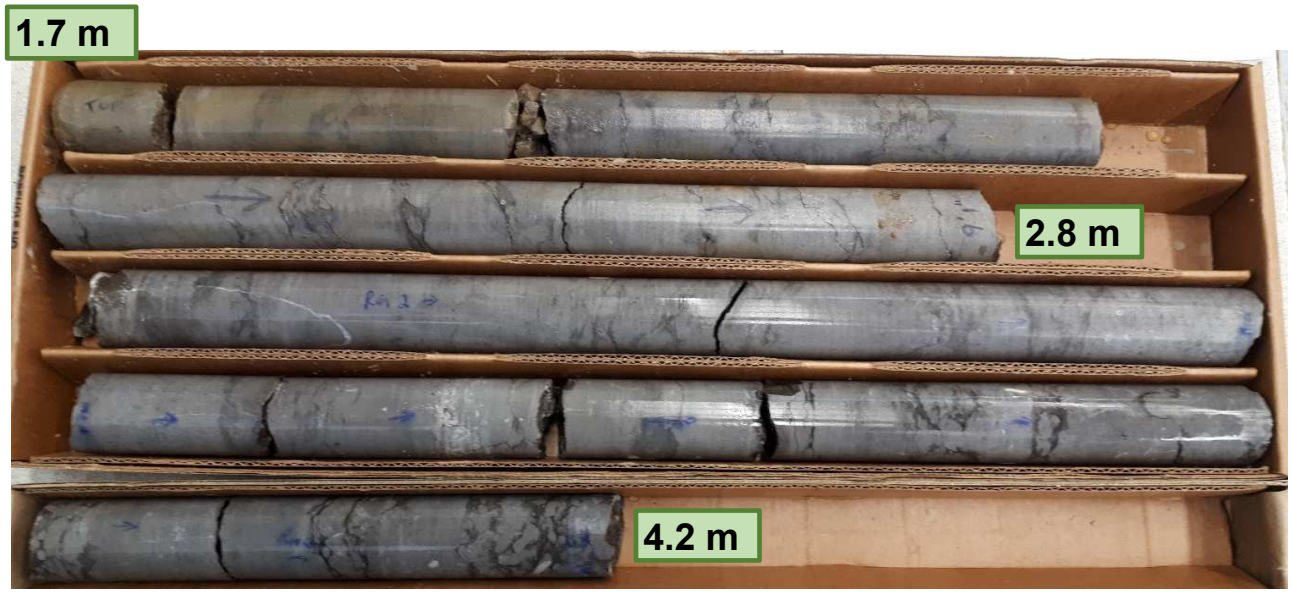
CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.4 - 1.2	90	77
2	1.2 - 2.7	97	48
3	2.7 - 4.3	95	80

Appendix A: Bedrock Core Photographs

DRY BEDROCK CORES

WET BEDROCK CORES



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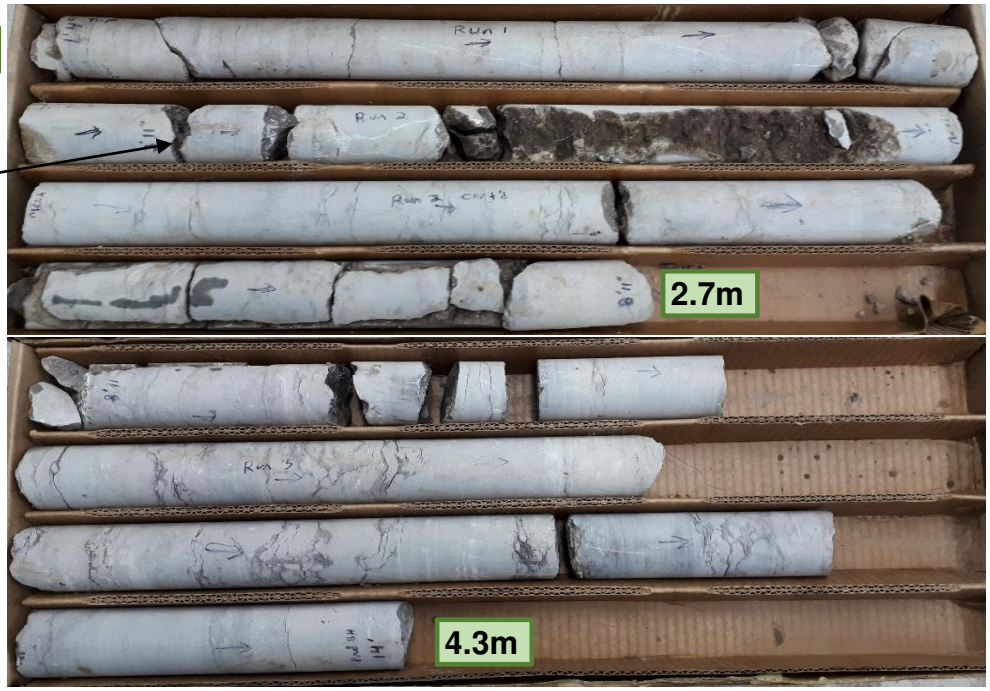
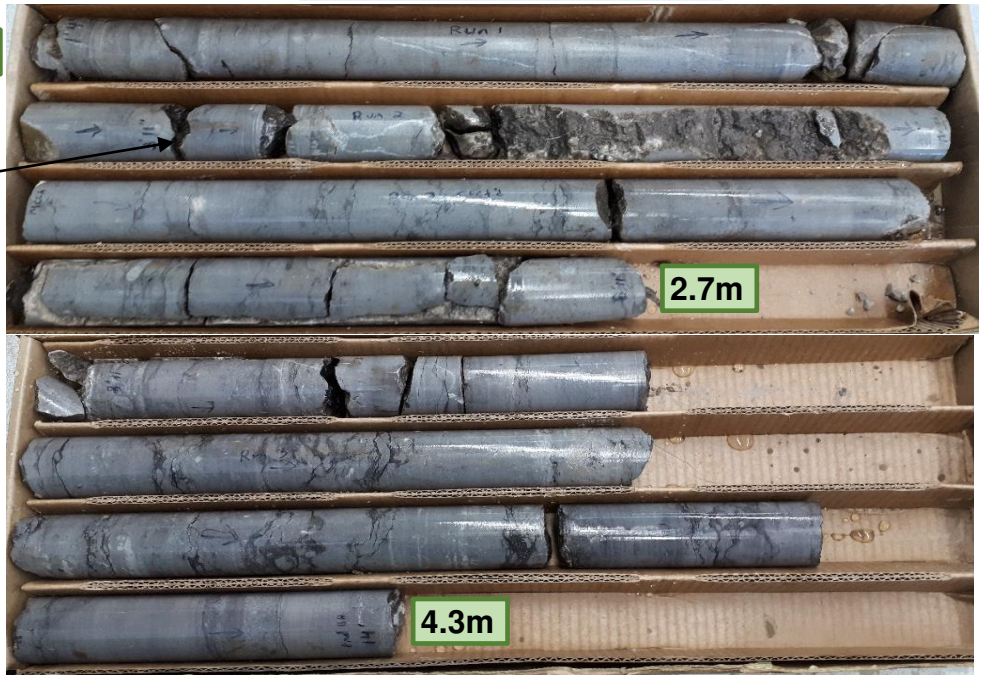
borehole no.	core runs	PROJECT	project no.
BH-1	Run 1: 1.7m - 2.8m Run 2: 2.8m - 4.2m	Proposed Residential Development 266 Carruthers Avenue, Ottawa, ON.	OTT-22014692-A0
date cored Jul 26, 2022		ROCK CORE PHOTOGRAPHS	FIG A-1

DRY BEDROCK CORES



WET BEDROCK CORES



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borehole no.	core runs	PROJECT	project no.
BH-3	Run 1: 0.4m - 1.2m Run 2: 1.2m - 2.7m Run 3: 2.7m - 4.3m	Proposed Residential Development 266 Carruthers Avenue, Ottawa, ON.	OTT-22014692-A0
date cored Jul 26, 2022		ROCK CORE PHOTOGRAPHS	FIG A-2

Appendix B: Boreholes from Previous Studies on 268 Carruthers Avenue

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. B1

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. B2

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
			64.08	0
		ASPHALTIC CONCRETE ~35 mm	64.0	
		GRANULAR FILL ~ 350 mm Crushed gravel, grey, damp, (loose)	63.7	
		FILL Silty sand with gravel and cobbles, brown and grey, moist	63.4	
		LIMESTONE BEDROCK Aphanitic to fine grained, occasional fractures, grey, (very poor to excellent quality)		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		
▽			58.43	4
			58.0	6
		Borehole Terminated at 6.1 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

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 MW22-1

Project No: OTT-22009213-B0

Project: Post Remediation Groundwater Sampling Program

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

Figure No. B3

Page. 1 of 1

Date Drilled: 'May 11, 2022

Drill Type: Geomachine Drill Rig

Datum: Geodetic Elevation

Logged by: P.O. Checked by: M.M.

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 Crushed Limestone, grey	63.65	0
				1
			62.2	
		LIMESTONE BEDROCK Grey		2
				3
				4
				5
▼			57.3 57.43	6
		Borehole Terminated at 6.31 m Depth		

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. A 37 mm diameter monitoring well was 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-22009213-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
25 days	6.2	

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 22009213.GPJ TROW OTTAWA.GDT 9/13/22

Appendix C: Laboratory Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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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: **Matthew Zammit**
PROJECT: **OTT-22014692-AO**
AGAT WORK ORDER: **22Z926394**
SOIL ANALYSIS REVIEWED BY: **Jacky Zhu, Spectroscopy Technician**
DATE REPORTED: **Aug 05, 2022**
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

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 22Z926394

PROJECT: OTT-22014692-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

SAMPLED BY:

(Soil) Inorganics Chemistry

DATE RECEIVED: 2022-07-28

DATE REPORTED: 2022-08-04

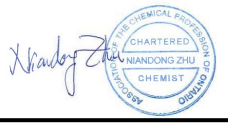
				BH1 Run 2
		SAMPLE DESCRIPTION:		11'10"-12'3"
		SAMPLE TYPE:		Rock
		DATE SAMPLED:		2022-07-26
Parameter	Unit	G / S	RDL	4148500
Chloride (2:1)	µg/g		2	78
Sulphate (2:1)	µg/g		2	24
pH (2:1)	pH Units		NA	8.28
Resistivity (2:1) (Calculated)	ohm.cm		1	4370

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

4148500 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

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: 22Z926394

PROJECT: OTT-22014692-AO

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

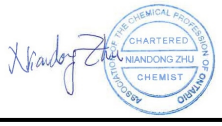
SAMPLED BY:

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
(Soil) Inorganics Chemistry															
Chloride (2:1)	4149226		3	3	NA	< 2	98%	70%	130%	102%	80%	120%	105%	70%	130%
Sulphate (2:1)	4149226		15	15	0.0%	< 2	101%	70%	130%	98%	80%	120%	104%	70%	130%
pH (2:1)	4140845		9.71	9.72	0.1%	NA	99%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:



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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22Z926394

PROJECT: OTT-22014692-AO

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION

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 #: 22Z926394

Cooler Quantity: one bag - no ice/packs (1 small)

Arrival Temperatures: 22.6 | 22.6 | 22.5
LT→ 8.3

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: Bagged Ice

Report Information:

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

Regulatory Requirements:

(Please check all applicable boxes)

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

☐ Excess Soils R406
Table ____ (Indicate One)
☐ Regulation 558
☐ CCME

☐ Sewer Use
☐ Sanitary ☐ Storm
____ Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ Indicate One

Turnaround Time (TAT) Required:

Regular TAT (Most Analysis) ☑ 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-22014692-AO
Site Location: 266 Carruthers St, Ottawa
Sampled By: EXP
AGAT ID #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

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

Report Guideline on Certificate of Analysis ☐ Yes ☐ No

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, DOC (Y/N)	O. Reg 153: Metals & Inorganics	Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	BTEX, F1-F4 PHCs	Analyze F4G if required ☐ Yes ☐ No	PAHs	Total PCBs ☐ Aroclor	VOC	O. Reg 558: Landfill Disposal Characterization TCLP: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	pH	Sulphate	Chlorides	Resistivity			Potentially Hazardous or High Concentration (Y/N)
BH 1 Run 2 11'10"-12'3"	July 26/22	AM PM	1															✓	✓	✓	✓			
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Ryan DiGiuseppe	July 27/22	6:30 pm	[signature]	JUL 28 2022	08h00
Anthony Da Silva [signature]	JUL 28 2022	16h00	Anthony Da Silva [signature]		

'22 JUL 28 8:55AM

Page ____ of ____

Nº: T 114970

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