2650 Queensview Drive
Ottawa, Ontario, K2B 8H6, CANADA
T: 1.613.688.1899 • www.**exp**.com

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Mr. Domenic Saikaley
Development Consultant
100 Argyle Avenue, Suite 300
Ottawa, Ontario K2P 1B6

Via email: domenic@smartlivingcanada.com

Project Name:	Geotechnical Investigation Proposed Residential Development 229-247 Beechwood Avenue, Ottawa, ON
Project Number:	OTT-00238207-A0

Dear Sir:

Exp Services Inc. (**exp**) is pleased to present the results of the geotechnical investigation recently completed for the proposed residential development to be located at 229-247 Beechwood Avenue, Ottawa, ON. Authorization to proceed with this work was provided by Takyan Developments.

1. Introduction

The site consists of two (2) parcels of land; Parcel A located at 229 and 231-235 Beechwood Avenue and Parcel B located at 241, 245 and 247 Beechwood Avenue in the City of Ottawa, Ontario. The two (2) parcels of land are separated by a paved City-owned laneway, formerly known as Carsdale Avenue. The laneway is not part of the site currently under investigation. The subject parcels of land are currently occupied by two 2-storey residential buildings that will be demolished to accommodate a three-storey building on each of the two (2) parcels of land. Preliminary conceptual plans indicate the new buildings will have shallow basements extending to 1.8 m below the final grade. The preliminary plans do not indicate the elevations of the final grades of the site.

The geotechnical investigation was undertaken to:

a.) Establish the geotechnical and groundwater conditions at the borehole locations;

b.) Establish grade-raise restrictions on the site;

c.) Provide seismic site classification in accordance with requirements of 2012 Ontario Building Code (OBC) and comment on the liquefaction potential of the on-site soils;

d.) Make recommendations regarding the most suitable type of foundations, founding depth, serviceability limit state (SLS) bearing pressure and factored geotechnical resistance at ultimate limit state (ULS) of the founding soil/bedrock;

e.) Estimate anticipated total and differential settlements of the most suitable foundations;

f.) Discuss slab-on-grade construction and permanent drainage requirements;

g.) Discuss excavation conditions and de-watering requirements during construction;

h.) Provide pipe bedding requirements;

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

j.) Comment on the lateral earth pressure (static and seismic conditions) against subsurface walls;

k.) Recommend pavement structure thickness for the parking lots and access roadways; and

l.) Provide recommendations for subsurface concrete requirements and comment on the corrosion potential of the subsurface soil 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 results 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.

A Phase II Environmental Site Assessment (ESA) was undertaken by **exp** in conjunction with this geotechnical investigation and the results are reported under separate cover.

2. Site Description

The site is located on the west side of the intersection at Beechwood Avenue and Jolliet Avenue in the City of Ottawa, Ontario (Figure 1). The site is surrounded by Beechwood Avenue to the east, Corona Avenue to the north, Black Maple Private to the south and existing residences on the west side.

The site consists of two (2) parcels of land identified as Parcels A and B. Parcel A includes the two (2) properties located at 229 and 231-235 Beechwood Avenue and Parcel B includes the three (3) properties located at 241, 245 and 247 Beechwood Avenue. Parcels A and B are separated by a City-owned paved laneway located between the two (2) parcels of land. The laneway was formerly known as Carsdale Avenue. Parcel A is currently occupied by two 2-storey residential buildings with storage sheds in the backyards and asphalt driveway/parking lot south of 229 Beechwood Avenue. There is a small parking lot on the north side of 231-235 Beechwood Avenue, which is connected to the City-owned laneway. Parcel B is currently occupied by three 2-storey residential buildings, each with a storage shed in the backyard. There is a small paved parking lot south of 241 Beechwood Avenue that connects to the City-owned laneway. Between 245 and 247 Beechwood Avenue, there is a paved driveway/parking area.

The ground surface of the site is set higher than Beechwood Avenue and gradually slopes down in an easterly direction towards Beechwood Avenue. The ground surface elevations at the borehole locations range from Elevation 61.0 to 58.7 m.

3. Procedure

The fieldwork for the geotechnical investigation was undertaken on June 26 and 27, 2017 and comprised the drilling of a total of five (5) boreholes extending to depths ranging from 1.8 m to 6.1 m below the existing ground surface. The fieldwork was supervised on a full-time basis by a representative from **exp**.

The borehole locations were established on site by **exp**. The geodetic elevations of the boreholes were established by **exp** and based on the geodetic benchmark defined as the northwest corner of the outdoor concrete slab located on the north side of 231-235 Beechwood Avenue. The geodetic elevation of the benchmark is provided on the survey plan titled, "Part 1, Plan of Lots 10, 11, 12, 24, 25, 26, Part of Rear Passage, Registered Plan 4M-30, City of Ottawa", dated June 14, 2017 and prepared by Annis, O'Sullivan Vollebekk Ltd. The borehole locations were cleared of any underground services by USL-1 Cable Locators. The borehole locations and elevations are shown on the Borehole Location Plan, Figure 2.

Borehole Nos. 1 to 4 were drilled using a truck-mounted CME-55 drill rig equipped with continuous flight hollow-stem augers and rock coring equipment to split-spoon sampler refusal and termination depths of 2.4 m to 6.1 m. Borehole No. 5 was advanced by manual augering technique to an auger refusal depth of 1.8 m below existing grade. In Borehole Nos. 1 to 4, standard penetration tests were performed in the boreholes on a continuous basis and at a 0.75 m depth interval with soil samples retrieved by split-barrel sampler in accordance with ASTM-1586. Borehole Nos. 1 to 4 were drilled to auger/spoon refusal depth of 1.8 m to 3.0 m. Borehole No. 1 was cased below the refusal depth and advanced further using washboring and core-drilling techniques to a termination depth at 6.1 m. A record of the wash water colour, drill water recovery and any sudden drops of the drill rods were kept when coring the bedrock. Borehole Nos. 3 and 4 were advanced unsampled below the refusal depth by tri-cone method to a termination depth of 6.1 m. In Borehole No. 5, auger samples of the soil were collected on a continuous basis to the auger refusal depth of 1.8 m.

Water levels were measured in the open boreholes on completion of drilling. In addition, a long-term groundwater monitoring well installation consisting of 31 mm diameter polyvinyl chloride (PVC) pipe was placed in Borehole Nos. 1, 3, 4 and 5 in accordance with **exp** standard practice. The installation configuration is documented on the respective borehole log.

The boreholes were logged and representative soil samples were obtained, preserved in plastic bags and identified. Similarly, the bedrock cores were placed in core boxes, identified, visually examined and logged. On completion of the fieldwork, all the soil samples and rock cores were transported to the **exp** laboratory in the City of Ottawa. All the soil samples and rock cores were visually examined in the laboratory by a senior geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing the following tests on selected soil samples and rock core:

Natural Moisture Content (ASTM D2216-10) of Soil…….. 16 tests

Grain-Size Analysis of Soil……... 1 test

Unconfined Compressive Strength Test of Rock Core……..... 1 test

pH, Sulphate, Chloride and Electrical Resistivity of Soil and Bedrock…….. 2 tests

4. Subsurface Soil and Groundwater Conditions

A detailed description of the geotechnical conditions encountered in the boreholes is presented in the borehole logs, Figure Nos. 3 to 7 inclusive. 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 location where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the location where sampling was conducted.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling. 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 logs forms an integral part of this report and should be read in conjunction with this report.

A review of the borehole logs indicates the following soil stratigraphy with depth and groundwater conditions.

4.1 Topsoil

A 125 mm and 180 mm thick surficial topsoil layer was encountered in Borehole Nos. 2 and 5, respectively.

4.2 Asphaltic Concrete

A 50 mm and 150 mm thick layer of asphaltic concrete was encountered at surface in Borehole Nos. 1, 3 and 4.

4.3 Fill

The topsoil and asphaltic concrete are underlain by fill in all boreholes. The fill extends to depths of 0.8 m and 1.8 m; i.e. Elevation 58.7 m to 56.9 m in Borehole Nos. 1 and 3. The fill is heterogeneous in nature consisting of sand, sand and silt to sand and gravel. The fill contains crusher run limestone, debris of bricks, silty clay layers/pockets, topsoil, organic matter and roots. It is in a very loose to dense state as indicated by the standard penetration test (SPT) N-values ranging from 1 to 46. The natural moisture content of the fill is 4 to 34 percent.

4.4 Topsoil

A 75-mm thick buried topsoil layer was contacted beneath the fill in Borehole No. 3.

4.5 Sand

A native sand was encountered beneath the topsoil layer in Borehole No. 3 and extends to a 1.5 m depth; i.e. Elevation 58.0 m. The sand is in a loose state as indicated by the SPT N-value of 6. The native sand has a moisture content of 27 percent.

4.6 Glacial Till

The native sand in Borehole No. 3 is underlain by glacial till. The glacial till contains cobbles and boulders. Based on the SPT N-values of 29 and 39, the till is in a compact to dense state. The natural moisture content of the glacial till is 8 and 11 percent.

The results of a grain-size analysis performed on one (1) sample of the till from Borehole No. 3 is given on Figure 8. A review of this figure indicates the till contains 12 percent clay, 26 percent silt, 26 percent sand and 36 percent gravel. Based on the results from the grain-size analysis, the till may be described as silty sandy gravel till with some clay.

4.7 Shale Bedrock

Beneath the fill in Borehole No. 1, shale bedrock was encountered at a 1.8 m depth, i.e. Elevation 56.9 m. The borehole was terminated within the shale bedrock at a 6.1 m depth, i.e. Elevation 52.6 m. In Borehole Nos. 3 and 4, bedrock is inferred at depths of 3.0 and 2.3 m, i.e. Elevation 58.2 and 56.5 m respectively. In Borehole Nos. 2 and 5, split-spoon sampler and hand auger refusal depths likely occurred on inferred cobbles and/or boulders at 2.4 and 1.8 m depths, i.e. Elevation 58.6 and 58.8 m respectively. Review of published bedrock geology maps indicates the site is located near a transition zone between shale from the Billings Formation and limestone from the Eastview or Ottawa Formations. The maps also indicate the site is located southwest of and in close proximity to the approximate location of a major fault.

Based on a review of the recovered rock cores from Borehole No. 1, the bedrock is shale of the Billings Formation. A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 100 percent and 0 to 34 percent respectively was obtained when core drilling the bedrock. On this basis, the bedrock may be defined as having a very poor to poor quality. It is noted that the bedrock was moderately to highly fractured within the investigated depth. It also contains a 130-mm thick dark grey to black silty clay seam at 3.8 m depth approximately below the ground surface and 2 m below the bedrock surface. Based on the close proximity of the site to a major fault, there is a possibility that minor faults may be located at or near the site which may account for the very poor to poor quality of the bedrock.

The unconfined compressive strength test completed on one (1) recovered core from Borehole No. 1 (Run No. 2; 2.7-2.8 m depth) indicated the test section of the rock core has an unconfined compressive strength of 56 MPa. Based on the Canadian Foundation Engineering Manual (CFEM), 4th Edition, 2006, the rock may be classified as being ‘strong’ rock. The unit weight of the bedrock is 2570 kg/m^3.

The shale bedrock of the Billings Formation is prone to deterioration when exposed to the elements. It also heaves due to a complex mechanism caused in part by bio-oxidation of sulphides in the rock, which then reacts with calcite seams to form expanding gypsum. This occurs when oxygen is permitted to enter the rock, usually by the lowering of the groundwater table and is accelerated by the presence of heat.

4.8 Groundwater

Water level observations were made by **exp** in the monitoring wells installed in the boreholes following the completion of drilling. The groundwater level observations are summarized in Table I.

Table I: Summary of Groundwater Levels				
Borehole No.	**Ground Surface Elevation (m)**	**Date of Groundwater Level Measurement (Number of Days After Drilling)**	**Depth (m)**	**Elevation (m)**
BH-1	58.70	July 7, 2017 (15 days)	2.8	55.9
BH-3	59.49	July 7, 2017 (14 days)	1.8	57.7
BH-4	60.50	July 7, 2017 (14 days)	1.8	59.5
BH-5	60.63	July 7, 2017 (14 days)	1.0	59.6

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

5. Grade Raise Restrictions

The geotechnical investigation revealed the site is underlain by cohesionless fill consisting of sand, sand and silt to sand and gravel, and cohesionless native glacial till underlain by shale bedrock and inferred cobbles and/or boulders. Cohesive clayey soils were not encountered in the boreholes. Therefore, there are no grade raise restrictions at the site.

6. Seismic Considerations

6.1 Seismic Site Classification

The sub-soil and groundwater conditions at the site have been examined in relation to Section 4.1.8.4 of the Ontario Building Code (OBC) 2012. The subsoil at the site comprise of very loose to dense fill and/or compact to dense till to 0.8 m to 3 m depth underlain by shale bedrock. The foundations for the proposed buildings will be founded on the glacial till, an engineered fill pad or on the shale bedrock. The average 'N' value of the till was computed as 34. The average 'N' value of the bedrock was assumed as 100. The weighted average 'N' value of the sand till and the shale bedrock to 30 m depth was computed as 90. On this basis, the site has been classified as Class C for seismic site response in accordance with Section 4.1.8.1 of the 2012 Ontario Building Code (OBC).

6.2 Liquefaction Potential of On-Site Soils

The foundations and floor slab for the proposed buildings will be founded on the glacial till, an engineered fill pad or on the shale bedrock. The groundwater levels range from 1.0 to 2.8 m depths; i.e. Elevation 59.6 m to 55.9 m and is located 1.0 m below the surface of the shale bedrock and 300 mm below the surface of the glacial till. Below the groundwater level, the glacial till is in a compact state. It is therefore concluded that the on-site native glacial till is not susceptible to liquefaction during a seismic event.

7. Foundation Considerations

The investigation has revealed that the geotechnical conditions at the site are suitable for supporting the proposed buildings, with or without a basement, on strip and spread footings designed to bear on the native glacial till, an engineered fill pad or on the shale bedrock. The existing fill, buried topsoil and loose sand from Borehole No. 3 are not suitable for supporting the footings.

It is recommended that in the early stages of the final design process, an additional geotechnical investigation consisting of boreholes and/or test pits should be conducted to further delineate the lateral and vertical (depths) extent of the fill, glacial till and shallow bedrock across the site.

7.1 Footings on Glacial Till or Engineered Fill Pad

The proposed buildings may be supported by strip and spread footings set on an engineered fill pad constructed as noted below, or on the native glacial till and may be designed for a serviceability limit state (SLS) bearing pressure and factored geotechnical resistance at ultimate limit state (ULS) of 150 kPa and 225 kPa, respectively.

Settlements of the footings designed for the recommended SLS bearing pressure value and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

7.1.1 *Engineered Fill Pad Construction*

It is noted that following the demolition of the existing buildings and sheds, all construction debris, asphalt, topsoil, fill and disturbed materials should be removed from the footprints of the proposed new buildings down to the native glacial till or shale bedrock. The area of the excavation for the footings should extend to a sufficient distance beyond the limits of the footprints of the proposed new buildings to accommodate a 1.0 m wide bench of engineered fill around the perimeter of the structure, which is thereafter sloped at an inclination of 1H to 1V down to the glacial till or bedrock. The exposed glacial till or shale bedrock subgrade should be examined by a geotechnical engineer. Following approval of the subgrade for the engineered fill pad, engineered fill required to raise the grades to the underside of the footings and lowest floor slab level should consist of free draining OPSS 1010 Granular B, Type II material placed in 300 mm thick lifts and each lift compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) under the footings and to 98 percent of the SPMDD under the slab on grade. The engineered fill should be placed under the full-time supervision of a geotechnician working under the direction of a geotechnical engineer. In-place density tests should be undertaken on each lift of the engineered fill to ensure that it is properly compacted prior to placement of subsequent lift.

As indicated in Section 4.7, the shale bedrock of the Billings formation has a potential to swell and rapidly deteriorate when exposed to the elements. For the engineered fill pad to be constructed on the shale bedrock subgrade, once the shale bedrock has been exposed, it should be examined by a geotechnical engineer and the approved exposed bedrock surface covered within hours of exposure with the OPSS Granular B Type II engineered fill material.

7.2 Foundations on Shale Bedrock

The proposed buildings may be supported by strip and spread footings designed to bear on the weathered shale bedrock. The SLS bearing pressure of the weathered shale bedrock is 500 kPa and the factored geotechnical resistance at ULS is 750 kPa.

Settlements of the footings founded on the weathered shale bedrock and designed to the recommended SLS bearing pressure are expected to be less than 10 mm.

As indicated in Section 4.7, the shale bedrock of the Billings Formation is prone to swelling under certain conditions of heat and humidity. It is also prone to rapid deterioration especially from below the groundwater table when exposed to the elements. Therefore, the bedrock exposed in the footings beds should be cleaned of any soil or deleterious materials, examined by a geotechnical engineer and the approved exposed bedrock covered with a skim coat of concrete within hours of its first exposure. Alternatively, the shale surface may be kept wet at all times. For reasons given previously, the concrete for the footing should be poured flush with the rock surface. Alternatively, the shale exposed in the sides of the footing trenches may be sealed by spraying gunnite.

All the footing beds should be thoroughly examined by a geotechnical engineer to ensure the shale bedrock is capable of supporting the recommended SLS bearing pressure value and to locate and map any minor fault zones, which may contain concentrated zones of fractured bedrock and may require special foundation treatment. Where fractured rock is encountered in a fault zone, sub-excavation may be undertaken to the underlying more competent bedrock. Alternatively, the footings may be re-designed to a reduced SLS bearing pressure value.

7.3 General Comments

In areas where the footings may be founded partly on the bedrock and partly on the engineered fill or glacial till, it is recommended that a transition zone be provided at the interface of the two (2) materials to minimize the high stress concentration and maintain foundation differential settlements between the two (2) founding materials to within the values provided in Section 7.1 and 7.2. Once final foundation design and additional information regarding subsurface soil and bedrock conditions are available, **exp** should be contacted to provide transition zone detail.

Footings adjacent to any existing buildings should be designed in such a way that they will not exert any additional loads on the existing footings and subsurface walls.

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

A minimum of 1.5 m of earth cover should be provided to all the exterior footings of heated structures to protect them from damage due to frost penetration. Footings of unheated structure should be provided with a cover of 2.1 m if snow would not be cleared from their vicinity. If the snow would be cleared from the vicinity of the footings, they should be provided with 2.4 m of earth cover. Where earth cover is less than the required, an equivalent combination of earth fill and rigid polystyrene insulation (such as Styrofoam HI-

40) should be provided. **Exp** can provide additional information regarding earth fill/rigid insulation combination of frost protection, if required.

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

8. Floor Slab and Drainage Requirements

The lowest level floor of the proposed buildings may be constructed as a slabs-on-grade provided they are set on a bed of well compacted 19 mm clear stone at least 300 mm thick constructed on a minimum 300 mm thick engineered fill pad consisting of OPSS Granular A compacted to 98 percent SPMDD. The engineered fill pad should be placed on an approved subgrade. 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.

For buildings with a basement, a perimeter drainage system should be installed. For buildings without a basement, a perimeter drainage system is not required, provided the floor slab is set 150 mm above the final grades surrounding the building and the final grades are sloped away from the building to prevent surface ponding of water close to the exterior walls of the buildings.

The need for an underfloor drainage system for buildings with or without basements will have to be assessed once final design details, such as the elevation of the lowest floor slab, are available.

The shale bedrock is known to heave due to a complex mechanism caused in part by the bio-oxidation of sulphides in the rock which then react with the calcite seams to form expanding gypsum. This occurs when oxygen is permitted to enter the rock, usually by lowering the water table. Cracking of the floor slab due to heaving of the shale has occurred in some structures in Ottawa. Therefore, the groundwater table at the site should be maintained above the shale surface. The invert of any drains of a permanent drainage system should be set at least 150 mm above the shale bedrock surface. In addition, a mud coat of concrete at least 75 mm (3 inches) thick should be placed on the surface of the shale as a seal prior to placement of the granular fill. Weep holes should be provided in the skim concrete layer to facilitate drainage. Any granular fill to be placed under the floor slab should be compacted to at least 98 percent of the standard Proctor maximum dry density (SPMDD). Any elevator pits and sumps should be constructed as watertight structures instead of trying to locally depress the groundwater table around them, which may result in de-watering of the shale.

9. Excavations and De-watering Requirements

9.1 Excavations

Excavations for the construction of new building foundations and the installation of new underground services at the site are expected to extend to depths ranging from 2 to 3 m below the existing ground surface. The excavations will be undertaken predominantly through the fill and into the glacial till and shale bedrock. These excavations are expected to be below the groundwater table.

The soils at the site may be excavated with conventional mechanical equipment capable of removing construction debris (including possible reinforced concrete) within the fill as well as cobbles and boulders within the fill and glacial till. Shallow excavation into the shale bedrock may be undertaken with a large mechanical shovel and hoe ram in combination with line drilling; progress may be slow and time consuming. Deep excavations into the shale bedrock would require the use of line drilling and blasting techniques. The blasting should be carried out by an experienced contractor under the supervision of a blasting specialist to ensure that integrity of any existing structures and underground services is not adversely affected. A condition survey of the existing structures, groundwater wells and services in the vicinity of the work area should be undertaken prior to commencement of construction. Vibrations generated by blasting operations should be monitored and should not exceed 50 mm per second at the property boundaries or City of Ottawa requirements. The most appropriate method of excavating the shale bedrock can be confirmed once building design details are available and an additional geotechnical investigation has been completed.

The excavations at the site may be undertaken as open-cut provided they meet the requirements of the Ontario Occupational Health and Safety Act. The soils are classified as Type 3 and must be cut back at 1H:1V from the bottom of the excavation. For excavations below the groundwater level, the side slopes should be flattened to a gradient ranging from 2 to 3H:1V from the bottom of the excavation. If space restrictions prevent open-cut excavation, the excavations will have to be undertaken within the confines of an engineered support system designed and constructed in accordance with the above regulation. If shoring is required, this office should be contacted to provide the required soil/rock parameters and recommendations for the design and construction of the shoring system.

Underground services at the site may be installed within the confines of a pre-fabricated support system (such as a trench box), which is designed and installed in accordance with the above regulation.

Excavations at the site are not expected to experience a base-heave type of failure.

The bedrock may be excavated with near vertical sides, subject to examination by a geotechnical engineer. Some scaling back of the bedrock face, such as to 1H:1V, may be required in areas of weathered bedrock. Exposed faces of the shale bedrock (weathered and sound) below the groundwater level should be protected from deterioration achieved by methods discussed in Sections 7 and 8 of this letter report.

9.2 De-watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps.

It has been assumed that the maximum excavation depth at the site will be approximately 2 m to 3 m and would necessitate groundwater removal from the site. It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction de-watering purposes. Prior to March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment and Climate Change (MOECC) for groundwater takings related to construction de-watering, where taking volumes in excess of 50 m^3/day, but less than 400 m^3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction de-watering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MOECC instead of applying for a PTTW.

To be eligible for the new EASR process, the construction de-watering taking must be less than 400 m^3/day under normal conditions. The water taking can be groundwater, storm water, or a combination of both. It should be noted that the 30-consecutive day limit on the water taking under the old Category 2 PTTW process has been removed in the new EASR process. Also, it should be noted that the EASR process requires two technical studies be prepared by a Qualified Person, prior to any water taking. These studies include a Water Taking Report, which provides assurance that the taking will not cause any unacceptable impacts, and a Discharge Plan, which provides assurance that the discharge will not result in any adverse impacts to the environment. A significant advantage of the new EASR process over the former Category 2 PTTW process, is that the groundwater taking may begin immediately after completing the on-line registration of the taking and paying the applicable fee, assuming the accompanying technical studies have been completed. The former PTTW process typically took more than 90 days, which had the potential to impact construction schedules. **Exp** can provide assistance during the EASR/PTTW process, if required.

Although this investigation has estimated the groundwater levels at the time of the field work, and commented on de-watering and general construction problems, conditions may be present which are difficult to establish from standard boring techniques and which may affect the type and nature of de-watering procedures used by the contractor in practice. 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.

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.

10. Earth Pressures

The subsurface walls of the proposed buildings should be backfilled with free draining material, such as OPSS Granular B Type II and provided with a permanent drainage system to prevent the build-up of hydrostatic pressure behind the walls. The subsurface walls will be subjected to lateral static earth pressure as well as lateral dynamic earth pressure during a seismic event.

The lateral static earth force that the subsurface walls would be subjected to may be computed from the following equation:

$$P_0 = \frac{1}{2} K_0 \gamma H^2$$

where P_0 = 'at rest' lateral earth force kN

K_0 = earth pressure coefficient = 0.50

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

H = height of wall, (m)

The lateral force due to seismic loading may be computed from the equation given below:

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

where ΔP_E = resultant force due to seismic activity; acts at 0.6 H from the footing base

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

H = height of wall, (m)

The lateral earth forces noted above do not take into account any surcharge, which may be acting close to the subsurface walls. Any surcharge acting close to the subsurface walls should be taken into consideration when designing the subsurface walls.

11. Pipe Bedding Requirements

It is recommended that the bedding for the underground services including material specifications, thickness of cover material and compaction requirements conform to City of Ottawa specifications and/or Ontario Provincial Standard Specifications and Drawings (OPSS and OPSD).

For guidance, the pipe bedding may consist of 300 mm thick well graded, crushed stone, such as OPSS Granular A. The bedding material may be placed along the sides and on top of the pipe to provide a minimum cover of 300 mm. The bedding should be compacted to at least 95 percent SPMDD.

The bedding thickness may be increased in areas where the subgrade is very loose/soft or becomes disturbed. Trench base stabilization techniques, such as removal of loose/soft material, placement of crushed stone sub-bedding (OPSS Granular B Type II material), completely wrapped in a non-woven geotextile, may also be used if trench base disturbance becomes a problem in wet or soft/very loose areas.

The invert of sections of the underground service pipes may be founded partly on the shale bedrock and partly on engineered fill or glacial till. In this case, transition zone treatment will be required to minimize bending stress in the service pipe. Transition zone treatment may be undertaken in the form of cutting back the surface of the bedrock from the soil/rock interface at 3H:1V and backfilling the transition zone area with extra bedding material compacted to 95 percent SPMDD.

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

The material to be excavated from the site is anticipated to comprise of topsoil, asphalt, fill, glacial till and shale bedrock. Select portions of the glacial till may be re-used in the backfilling of the service trenches situated outside the building, subject to further examination and testing prior to construction. The remaining materials are not suitable for backfilling purposes and should be discarded or used in the landscaped area for general grading purposes.

Based on the geotechnical investigation, all material required for backfilling against subsurface walls, footing and service trenches would have to be imported and should conform to the specifications given below:

(a) Engineered Fill under footings, underfloor fill and backfilling of footings and service trenches in the interior of the building – OPSS 1010 Granular B, Type II placed in 300 mm thick lifts with each lift compacted to 100 percent under the footing and to 98 percent SMPDD under the floor slab.

(b) Backfill against the exterior subsurface walls of the building, OPSS 1010 Granular B, Type II placed in 300 mm thick lifts with each lift compacted to 95 percent SPMDD.

(c) Trench backfill outside building area and for pavement subgrade to raise the grade– 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 with each lift compacted to minimum 95 percent SPMDD.

The sides of the excavations for the utility trenches and subsurface basement walls that extend into the shale bedrock below the groundwater should be sprayed with gunnite to prevent deterioration and heave of the shale bedrock. For the underground services, an alternative to gunnite is to backfill the portion of the trenches in the bedrock below the groundwater level using clay or concrete.

13. Subsurface Concrete Requirements

A soil sample and a rock core section from the boreholes were submitted to AGAT Laboratories Ltd. for pH, sulphate, chloride and electrical resistivity testing. The test results are summarized below in Table II and shown in Appendix A.

Table II: Results of Chemical Tests on Soil and Rock Samples						
Borehole No.	Sample No. (Depth)	Soil/Rock Type	Lab Test Results			
			pH	Sulphates (%)	Chlorides (%)	Electrical Resistivity (ohm-cm)
2	Run No. 1 (1.3 m)	Shale Bedrock	7.97	0.0210	0.0004	3,140
3	SS 3 (1.5-2.1 m)	Till: Silty Sandy Gravel	7.78	0.0165	0.0103	2,230

A review of Table II indicates that the on-site native glacial till and shale bedrock contain less than 0.1 percent sulphates and less than 0.04 percent chlorides. These concentrations of sulphates and chlorides in the soil would have a negligible potential of sulphate and chloride attack on subsurface concrete. The concrete should be designed in accordance with Table Nos. 3 and 6 of CSA A.23-1-14. The concrete should be dense, well-compacted and cured.

The electrical resistivity measurements indicate the soil and rock are moderately corrosive to steel members/structures. The degree of corrosion should be considered in the design and installation of underground/buried steel members/structures. A corrosion specialist should be consulted to provide comments and recommendations regarding corrosion protection.

14. Pavement Structure Design

Pavement structure thicknesses required for the proposed residential development were computed. The road subgrade is expected to be existing fill, till and/or OPSS select subgrade material (SSM). The pavement structures are shown on Table No. III. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and pavement functional design life of eight to ten years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table No. III: Recommended Pavement Structure Thicknesses		
Pavement Layer	**Compaction Requirements**	**Pavement Structure Thickness**
		SSM/Till Subgrade
Asphaltic Concrete	92-97% MRD	65 mm HL-3
OPSS Granular "A" Base (crushed limestone)	100% SPMDD	150 mm
OPSS Granular "B" Sub-Base, Type II	100% SPMDD	400 mm
SPMDD - Denotes standard Proctor maximum dry density; ASTM-D698. *MRD – Denotes Maximum Relative Density; ASTM-D2041.* *Any subgrade fill must be compacted to 98% SPMDD for at least the upper 300 mm.*		

As part of the subgrade preparation, the proposed pavement areas should be stripped of topsoil and other obviously unsuitable material. Fill required to raise the grades to design subgrade elevations should conform to OPSS select subgrade material (SSM) and should be placed and compacted to 95 percent of the SPMDD. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved backfill compacted to 95% SPMDD (ASTM D698-12e2).

The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

The asphaltic concrete used and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted to 92 to 97 percent of the Maximum Relative Density (ASTM D2041). Asphalt placement should be in accordance with OPSS 310 and OPSS 313. It is recommended that **exp** be retained to review the final pavement structure design and drainage plans prior to construction to ensure they are consistent with the recommendations of this report.

15. Additional Geotechnical Investigation

It is recommended that in the early stages of the final design process, an additional geotechnical investigation consisting of boreholes and/or test pits be conducted to further delineate the lateral and vertical (depths) extent of the fill, glacial till and shallow bedrock across the site.

16. General Closure

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

We trust that the information contained in this letter will be satisfactory for your purposes. Should you have any questions, please contact this office.

Sincerely,

exp Services Inc.

Susan Potyondy, P.Eng.
Senior Project Manager, Geotechnical Services
Earth and Environmental

Ismail Taki, M.Eng., P.Eng.
Manager, Geotechnical Services
Earth and Environmental

Attachments:

FIGURES
- *Figure 1: Site Location Plan*
- *Figure 2: Borehole Location Plan*
- *Figures 3 to 7: Borehole Logs*
- *Figure 8: Grain-size Distribution Curve*

APPENDIX A: Certificate of Laboratory Analysis

FIGURES

0 200m 400m 800m

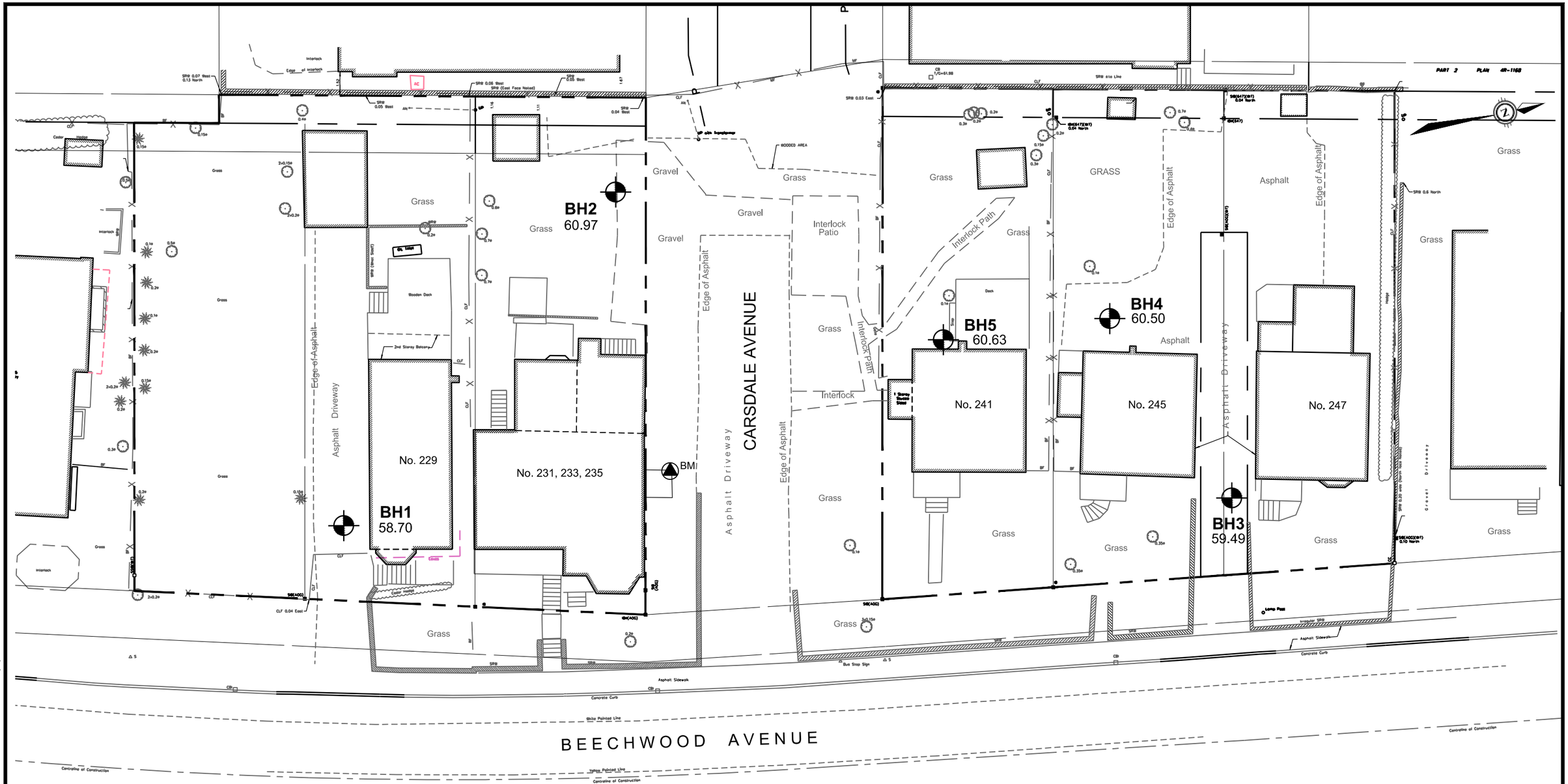
HORIZONTAL 1:20,000

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada
www.exp.com

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

scale 1:20,000	CLIENT: TAKYAN DEVELOPMENTS	project no. OTT-00238207-A0
date JUNE 2017	TITLE: SITE LOCATION PLAN GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, 229 - 247 BEECHWOOD AVENUE, OTTAWA, ON	FIG 1
drawn by M.N.		

Filename: r:\230000\238000\238207-a0 229-247 beechwood\238207-a0 fig 1-2 bh plan.dwg
Last Saved: 7/24/2017 10:50:00 AM
Last Plotted: 8/4/2017 3:09:42 PM Plotted by: NugentM Pen Table:: trow standard, july 01, 2004.ctb



NOTES :

1. THE BOUNDARIES AND SOIL/ ROCK TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL AND ROCK SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL 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.
6. BASE PLAN OBTAINED FROM ANNIS O'SULLIVAN VOLLEBEKK LTD., PART 1, PLAN OF LOTS 10, 11, 12, 24, 25, 26 PART OR REAR PASSAGE (AS CLOSED BYJUDGE'S ORDER LT476512 AND JUDGE'S ORDER LT113018) REGISTERED PLAN 4M-30, CITY OF OTTAWA. SURVEY COMPLETED ON JUNE 14, 2017.

LEGEND

BH1 58.70 — BOREHOLE NUMBER, LOCATION AND ELEVATION

BM — GEODETIC BENCHMARK - CONCRETE SLAB LOCATED ON NORTH SIDE OF 231-235 BEECHWOOD AVENUE

0 2m 4m 10m

HORIZONTAL 1:250

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada
www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale	1:250
date	JUNE 2017
drawn by	M.N.
CLIENT:	TAKYAN DEVELOPMENTS
TITLE:	BOREHOLE LOCATION PLAN GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, 229 - 247 BEECHWOOD AVENUE, OTTAWA, ON
project no.	OTT-00238207-A0
	FIG 2

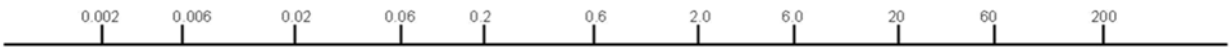
Filename: r:\23000\238000\238207-a0 229-247 beechwood\238207-a0 fig 1-2 bh plan.dwg
Last Saved: 7/24/2017 10:50:00 AM
Last Plotted: 8/4/2017 3:09:16 PM Plotted by: NugentM Pen Table:: trow standard, july 01, 2004.ctb

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

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



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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

UNIFIED SOIL CLASSIFICATION

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

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

Log of Borehole BH 1

Project No: OTT-00238207-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 229-247 Beechwood Avenue, Ottawa, ON

Figure No. 3

Page. 1 of 1

Date Drilled: 'June 26, 2017

Drill Type: Truck CME-55

Datum: Geodetic

Logged by: MD Checked by: ZG

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 m	Depth
		ASPHALT ~50 mm	58.7	0
		FILL Sand and gravel, some silt, crusher run limestone, grey to brown, moist to wet, (very loose to compact)	58.7	
		SHALE BEDROCK Dark grey shale, moderately to highly fractured, weathered at the surface (very poor to poor quality)	56.9	2
		130 mm thick dark grey to black stiff silty clay seam at 3.8 m depth.	55.9	3
		Borehole Terminated at 6.1 m Depth	52.6	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

1
10
50/100 mm

SAMPLES: RUN 1, RUN 2, RUN 3, RUN 4, RUN 5, RUN 6

Natural Unit Wt. kN/m³

LOG OF BOREHOLE BH LOGS - 238207-A0 229-247 BEECHWOOD AVENUE.GPJ TROW.OTTAWA.GDT 7/24/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 31-mm diameter slotted standpipe was installed in the borehole at 6.1 m depth and sealed from 2.7 m depth to ground surface
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00238207-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	1.4	
15 days	2.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.75 - 2.24	100	0
2	2.24 - 3.58	100	18
3	3.58 - 3.91	100	0
4	3.91 - 5.05	100	19
5	5.05 - 5.79	100	34
6	5.8 - 6.1	100	0

Log of Borehole BH 2

Project No: OTT-00238207-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 229-247 Beechwood Avenue, Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'June 26, 2017

Drill Type: Truck CME-55

Datum: Geodetic

Logged by: MD Checked by: ZG

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 m	Depth	Standard Penetration Test N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~125 mm	60.97	0				
		FILL Sand and gravel, some silt to silty, crusher run limestone, grey to brown, moist to wet, (loose to compact)	60.9		7			
				1	14			
					17			
		Shale fragments at 2.4 m Depth		2				
			58.6		50/100 mm			
		Split Spoon Sampler Refusal at 2.4 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

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole backfilled with bentonite upon completion
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00238207-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 238207-A0 229-247 BEECHWOOD AVENUE.GPJ TROW.OTTAWA.GDT 7/24/17

Log of Borehole BH 3

Project No: OTT-00238207-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 229-247 Beechwood Avenue, Ottawa, ON

Figure No. 5

Page. 1 of 1

Date Drilled: 'June 27, 2017

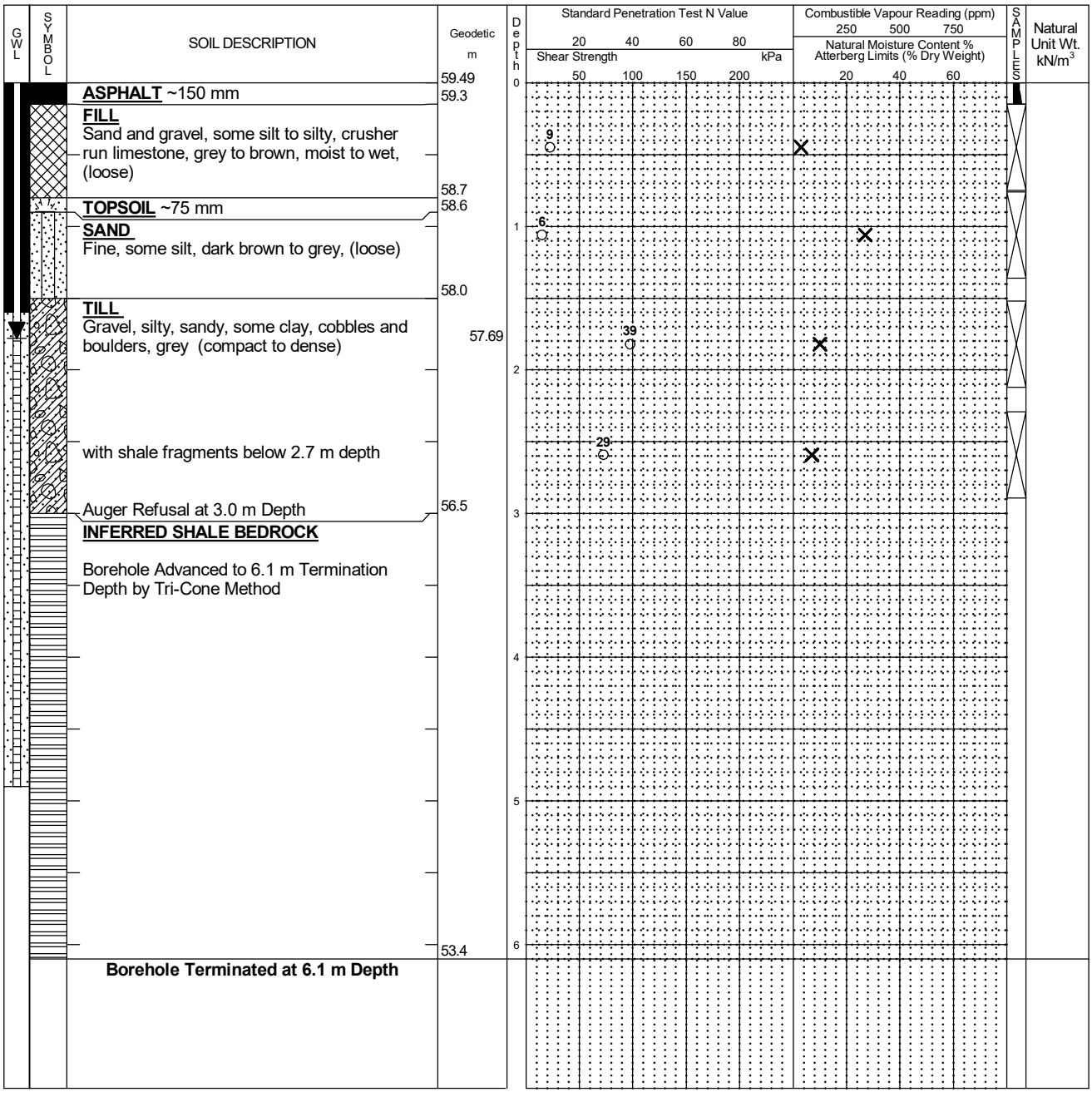
Drill Type: Truck CME-55

Datum: Geodetic

Logged by: MD Checked by: ZG

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 - 238207-A0 229-247 BEECHWOOD AVENUE.GPJ TROW.OTTAWA.GDT 7/24/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 31-mm diameter slotted standpipe was installed in the borehole at 4.9 m depth and sealed from 1.5 m depth to ground surface
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00238207-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	3.1	
14 days	1.8	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 4

Project No: OTT-00238207-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 229-247 Beechwood Avenue, Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'June 27, 2017

Drill Type: Truck CME-55

Datum: Geodetic

Logged by: MD Checked by: ZG

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 m	Depth
		ASPHALT ~150 mm	60.5	0
		FILL Sand and silt, some silt, debris of brick, organic matter and roots, grey to brown, moist to wet, (loose to dense)	60.4	
		Shale fragments below 1.8 m depth	58.7	2
		Auger Refusal at 2.3 m Depth	58.2	
		INFERRED SHALE BEDROCK Borehole Advanced to 6.1 m Termination Depth by Tri-Cone Method		
		Borehole Terminated at 6.1 m Depth	54.4	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
SAMPLES
Natural Unit Wt. kN/m³

7 17 46

LOG OF BOREHOLE BH LOGS - 238207-A0 229-247 BEECHWOOD AVENUE.GPJ TROW.OTTAWA.GDT 7/24/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 31-mm diameter slotted standpipe was installed in the borehole at 4.4 m depth and sealed from 1.1 m depth to ground surface
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00238207-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
14 days	1.8	

CORE DRILLING RECORD

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

Log of Borehole BH 5

Project No: OTT-00238207-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 229-247 Beechwood Avenue, Ottawa, ON

Date Drilled: 'June 27, 2017

Drill Type: Manual Equipment

Datum: Geodetic

Logged by: MD Checked by: ZG

Figure No. 7

Page. 1 of 1

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 m	Depth
		TOPSOIL ~180 mm	60.63	0
		FILL Sand, some gravel to gravelly, some silt, organic matter, roots, silty clay pockets, grey to brown, moist to wet	60.5	
		FILL Silty clay, trace sand and gravel, roots, grey, moist to wet	60.0	
			59.63	1
		Auger Refusal at 1.8 m Depth	58.8	

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 31-mm diameter slotted standpipe was installed in the borehole at 1.8 m depth and sealed at the ground surface
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00238207-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
14 days	1.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 238207-A0 229-247 BEECHWOOD AVENUE.GPJ TROW.OTTAWA.GDT 7/24/17

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

Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

MTO Test Method LS - 702, Rev. No. 19

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Exp Project No.:	**OTT-00238207**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**	
Client :	**Takyan Developments**	**Project Location :**	**229-247 Beechwood Avenue, Ottawa, ON**	
Date Sampled :	**June 27, 2017**	**Borehole No.:**	**3**	**Sample No.: SS4**	**Depth (m) : 2.3-2.9**
Sample Description :	**GLACIAL TILL: Silty Sandy Gravel, with some Clay**			**Figure : 8**

APPENDIX A: Certificate of Laboratory 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: Zohra Guetif; Ismail Taki

PROJECT: OTT-00238207-A0

AGAT WORK ORDER: 17Z233145

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Jul 18, 2017

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

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

Certificate of Analysis

AGAT WORK ORDER: 17Z233145

PROJECT: OTT-00238207-A0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Zohra Guetif; Ismail Taki

SAMPLING SITE:229 Beechwood Ave, Ottawa

SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2017-07-04 **DATE REPORTED: 2017-07-18**

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: BH#3 SS3 5'-7.5'	BH#2 Run #1 4'2"
			SAMPLE TYPE:	Soil	Rock
			DATE SAMPLED:	2017-06-27	2017-06-26
				8525413	8525416
pH, 2:1 CaCl2 Extraction	pH Units			7.78	7.97
Chloride (2:1)	µg/g		2	103	4
Sulphate (2:1)	µg/g		2	165	210
Resistivity (2:1)	ohm.cm		1	2230	3140

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

8525413-8525416 EC/Resistivity, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Amanjot Bhela

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: 17Z233145

PROJECT: OTT-00238207-A0

ATTENTION TO: Zohra Guetif; Ismail Taki

SAMPLING SITE:229 Beechwood Ave, Ottawa

SAMPLED BY:exp

Soil Analysis

RPT Date: Jul 18, 2017			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	8551017		7.71	7.69	0.3%	<	101%	80%	120%	NA			NA		
Chloride (2:1)	8559695		3	4	NA	< 2	106%	70%	130%	102%	70%	130%	102%	70%	130%
Sulphate (2:1)	8559695		102	113	10.2%	< 2	95%	70%	130%	103%	70%	130%	106%	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

AGAT Laboratories

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 17Z233145

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ATTENTION TO: Zohra Guetif; Ismail Taki

SAMPLING SITE:229 Beechwood Ave, Ottawa

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
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
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER

AGAT Laboratories

ISM

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 intended for human consumption)

Report Information:

Company: exp Services Inc. Ottawa
Contact: Zohra. Guetif @exp.com
Address: 2650 Queensview dr. Unit 100
Ottawa ON K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: zohra.guetif@exp.com
2. Email: ismail.taki@exp.com

Project Information:

Project: CTT-00238207-A0
Site Location: 229 Beechwood ave. Ottawa
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:

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)

☐ 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

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 17T233145
Cooler Quantity: one
Arrival Temperatures: 23.0 | 23.1 | 23.0 → 86 | 79 | 84
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes:

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

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; 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	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphate	Chlorides	Electrical Resistivity
BH#3 SS3 5'-7.5'	June 27		1	~~Rocks~~ Soil																		✓	✓	✓	✓
BH#2 run#1 4'2"	June 26			rock																		✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Jeff MacMillan	June 30/17	4:45	Linda Berthelet	4-July-17	8h00
(B/O) to FedEx	4 July 17	16h00	Simo	17/7/5	905

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