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Geotechnical Investigation

Proposed Mixed-Use Development
1520-1526 Stittsville Main Street
Ottawa, Ontario

Prepared For

Inverness Homes

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Report: PG5418-1

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Inverness Homes to conduct a geotechnical investigation for the proposed mixed-use development to be located at 1520-1526 Stittsville Main Street in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objectives of the geotechnical investigation were to:

- ☐ determine the subsoil and groundwater conditions at this site by means of test holes.

- ☐ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project. This report contains geotechnical findings and includes recommendations pertaining to the design and construction of the proposed development as they are understood at the time of writing this report.

2.0 Proposed Development

It is understood that the proposed development will consist of two (2) multi-storey, mixed-use buildings which will have 1 level of shared underground parking. It is further understood that at-grade parking areas, access lanes and landscaped areas will be located to the south of the proposed buildings. The subject site is also anticipated to be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the investigation was carried out on July 22 and 23, 2020. At that time, twelve (12) boreholes were advanced to a maximum depth of 9.0 m below the existing ground surface. Previous geotechnical investigations were also undertaken by Paterson at the subject site, which included advancing 5 and 3 boreholes in 2011 and 2019, respectively, to a maximum depth of 9.6 m. The test hole locations were distributed across the site in a manner to provide general coverage of the subject site. The locations of the test holes are shown on Drawing PG5418-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were put down using a track-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler or from the auger flights. The split-spoon and auger samples were classified on site, placed in sealed plastic bags, and transported to the laboratory for further review. The depths at which the split-spoon and auger samples were recovered from the boreholes are shown as SS and AU, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Diamond drilling was carried out at BH 1-19, BH 2-19, BH 3-19, and BH 3-20 to assess the bedrock quality. A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are shown on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the ratio, in percentage, of the length of the bedrock sample recovered over the length of the drilled section. The RQD value is the ratio, in percentage, of the total length of intact rock pieces longer than 100 mm in one drilled section over the length of the drilled section. These values are indicative of the quality of the bedrock.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

A 32 mm diameter PVC groundwater monitoring well was installed at BH 3 and a 51 mm diameter PVC groundwater monitoring well was installed at BH 1, BH 2, and BH 12. Flexible polyethylene standpipes were installed at the remaining boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The borehole locations were selected by Paterson personnel to provide general coverage of the site. The boreholes were located in the field by Paterson. The ground surface elevations at the test hole locations were determined by Paterson and are referenced to a geodetic datum. The test hole locations and the ground surface elevation at each test hole location are presented on Drawing PG5418-1 - Test Hole Location Plan included in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently occupied by a an abandoned 2-storey building located at the northwest end of the site, and a 1-storey building located in the central portion of the site. The remainder of the site consists of a gravel parking area of the eastern portion of the site.

The subject site is bordered to the north, northwest, and south by commercial properties, to the southwest by residential properties, and to the east by Stittsville Main Street. The existing ground surface across the site is relatively level at approximate geodetic elevation 121.5 m.

Based on available historical photographs of the subject site, a building was located in the northeast portion of the site fronting onto Stittsville Main Street as recently as 2014, and was no longer present in 2017. Reference should be made to the aerial photographs in Figure 2 - Aerial Photograph - 2014 and Figure 3 - Aerial Photograph - 2017 which illustrate the former and present site conditions, respectively.

4.2 Subsurface Profile

Overburden

Generally, the soil conditions encountered at the test hole locations consist of topsoil or a 0.4 to 2.3 m thick layer of fill underlying the ground surface. The fill was generally observed to consist of a loose to dense, brown silty sand with varying amounts of crushed stone, brick, concrete, wood and coal.

Underlying the topsoil and/or fill, a silty sand to sandy silt deposit was encountered, which was generally loose in the upper portion of the deposit, becoming compact to dense at approximate depths of 2 to 3 m.

A glacial till deposit was encountered underlying the silty sand/sandy silt at approximate depths of 3.7 to 5.3 m. The glacial till was generally observed to consist of a dense, brown silty sand with gravel, cobbles, and boulders.

Practical refusal to the augers was encountered at approximate depths ranging from 4.2 to 7 m, generally increasing west to east across the site.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Bedrock was cored at BH 3-20, BH 1-19, BH 2-19, and BH 3-19 to depths of up to 9.6 m, and was observed to consist of grey limestone with interbedded shale. Based on the RQD values, the upper portion of the bedrock core was generally noted to be of very poor to fair quality, becoming good to excellent quality with depth.

Based on available geological mapping, the bedrock in this area consists of interbedded limestone and dolostone of the Gull River Formation with an overburden drift thickness of 5 to 6 m depth.

4.3 Groundwater

The measured groundwater levels in the boreholes are presented in Table 1 and are also shown on the Soil Profile and Test Data sheets in Appendix 1.

Table 1 - Summary of Groundwater Level Readings

Borehole Number	Ground Elevation, m	Groundwater Levels, m		Recording Date
		Depth	Elevation	
BH 1-20	121.77	5.39	116.38	August 6, 2020
BH 2-20	121.23	5.42	115.81	August 6, 2020
BH 3-20	121.78	5.10	116.68	August 6, 2020
BH 4-20	121.61	Dry	-	August 11, 2020
BH 5-20	121.47	Dry	-	August 11, 2020
BH 6-20	121.52	Dry	-	August 11, 2020
BH 7-20	121.71	Dry	-	August 11, 2020
BH 8-20	121.50	Dry	-	August 11, 2020
BH 9-20	121.23	3.41	117.82	August 11, 2020
BH 10-20	121.46	Dry	-	August 11, 2020
BH 11-20	121.03	2.42	118.61	August 11, 2020
BH 12-20	121.14	Dry	-	August 11, 2020
BH 1-19	121.82	5.07	116.75	August 6, 2020
BH 2-19	121.53	5.15	116.38	August 6, 2020

Long-term groundwater level can also be estimated based on the observed moisture levels, colour and consistency of the recovered soil samples. Based on these observations, it is estimated the long-term groundwater table can be expected between between an approximate 4 to 5 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is recommended that the proposed buildings be founded on conventional spread footings bearing on the undisturbed, compact to dense silty sand/sandy silt.

Alternatively, conventional spread footings could also be supported on lean concrete trenches which are placed directly over the clean, surface sounded bedrock.

Dependent on the founding depths of the proposed buildings and site services, bedrock removal may be required.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Existing foundation walls and other construction debris should be entirely removed from within the building perimeter. Under paved areas, existing construction remnants should be excavated to a minimum of 1 m below final grade.

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where the bedrock is weathered and/or where only small quantities of the bedrock need to be removed. Sound bedrock may be removed by line drilling, controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm per second during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipment could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards.

Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill placed for grading beneath the structure(s) or other settlement sensitive areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to the delivery to the site. The engineered fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the materials Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavate soil can be placed as general landscaping fill where surface settlement is a minor concern. The backfill should be spread in thin lifts and, at minimum, compacted by the tracks of the spreading equipment to minimize voids. If the non-specified fill is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundations walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Lean Concrete Filled Trenches

Where the foundations are designed to bear on bedrock which is encountered below the underside of footing elevation, consideration should be given to excavating vertical, zero-entry trenches to expose the underlying bedrock surface and backfilling with lean concrete (minimum 15 mPa**,** 28-day compressive strength). Typically, the excavation sidewalls will be used as the form to support the concrete. The additional width of the concrete poured against the undisturbed trench sidewall will suffice in providing a direct transfer of the footing load to the underlying bedrock.

The effectiveness of this operation will depend on the ability of maintaining vertical trenches until the lean concrete can be poured. It is suggested that once the bottom of the excavation is exposed, an assessment should be completed to determine water infiltration and stability of the excavation sidewalls extending to the bedrock surface.

The trench should be at least 300 mm wider than all sides of the footing at the base of the excavation. The excavation bottom should be relatively clean using the hydraulic shovel only. Once approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation.

5.3 Foundation Design

Bearing Resistance Values

Footings placed on the undisturbed, compact to dense silty sand/sandy silt can be designed using a bearing resistance value at serviceability limit states (SLS) of **250 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **375 kPa**, incorporating a geotechnical resistance factor of 0.5.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious material, such as loose, frozen or disturbed soil, whether in situ or not, have been removed in dry conditions, prior to the placement of concrete for footings.

Footings placed on a soil bearing surface and designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

Footings placed directly on clean, surface sounded bedrock, or on lean concrete filled trenches placed directly over the clean, surface sounded bedrock, can be designed using a factored bearing resistance value at Ultimate Limit States (ULS) of **1,000 kPa**, incorporating a geotechnical resistance factor of 0.5.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings bearing on a sound bedrock bearing surface and designed using the bearing resistance values noted above will be subjected to negligible potential post-construction total and differential settlements.

Bedrock/Soil Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the sub-excavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels.

Adequate lateral support is provided to a compact to dense silty sand/sandy sit bearing surface above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A heavily fractured, weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or flatter).

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered at this site. A higher seismic site class may be applicable, such as Class A or B, provided the footings are within 3 m of the bedrock surface. However, this would need to be confirmed by performing a seismic shear wave velocity test at the subject site. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

The basement area for the proposed buildings will mostly be parking and the recommended pavement structure noted in Subsection 5.7 will be applicable. However, if storage or other uses of the lower level will require a concrete floor slab, the upper 200 mm of sub-slab fill should consist of 19 mm clear crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

A subfloor drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear stone under the lowest level floor slab. This is discussed further in Subsection 6.1.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a bulk (drained) unit weight of 20 kN/m^3.

Where undrained conditions are anticipated (i.e. below the groundwater level), the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Two distinct conditions, static and seismic, should be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) could be calculated with a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure with a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) could be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions could be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Structure

The recommended pavement structures for the subject site are shown in Tables 2 and 3 below.

Table 2 - Recommended Flexible Pavement Structure - At-Grade Parking Areas

Thickness (mm)	Material Description
50	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil	

Table 3 - Recommended Flexible Pavement Structure
Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be sub-excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD with suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed buildings. The system should consist of a 150 mm diameter, perforated and corrugated plastic pipe which is surrounded on all sides by 150 mm of 19 mm clear crushed stone and placed at the footing level around the exterior perimeter of the structures. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Subfloor Drainage

Subfloor drainage is recommended to control water infiltration for the proposed structures. For design purposes, Paterson recommends 150 mm diameter perforated, corrugated, pipes be placed at approximate 6 m centres underlying the lowest level slab. The spacing of the subfloor drainage system should be confirmed at the time of completing the excavation when water infiltration/accumulation can be better assessed.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as Delta Drain 6000) connected to the drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are recommended to be protected against the deleterious effects of frost action. A minimum of 1.5 m of soil cover (or equivalent) should be provided.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure. Such exterior structures require additional frost protection, such as 2.1 m of soil cover, or a reduced thickness of soil cover if rigid insulation is used.

It has been our experience that insufficient soil cover is typically provided to footings located in areas where minimal soil cover is available, such as entrance ramps to underground parking garages. Paterson should review design drawings prior to construction to ensure proper frost protection is provided in these areas.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled.

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation sides. Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not remain exposed for extended periods of time.

Temporary Shoring

Temporary shoring may be required to support the overburden soils. The design and approval of the shoring system will be the responsibility of the shoring contractor and the shoring designer who is a licensed professional engineer and is hired by the shoring contractor. It is the responsibility of the shoring contractor to ensure that the temporary shoring is in compliance with safety requirements, designed to avoid any damage to adjacent structures and include dewatering control measures. In the event that subsurface conditions differ from the approved design during the actual installation, it is the responsibility of the shoring contractor to commission the required experts to re-assess the design and implement the required changes. Furthermore, the design of the temporary shoring system should take into consideration a full hydrostatic condition which can occur during significant precipitation events.

The temporary shoring system may consist of a soldier pile and lagging system or steel sheet piles which could be cantilevered, anchored or braced. The shoring system is recommended to be adequately supported to resist toe failure.

Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below. The earth pressures acting on the shoring system may be calculated using the following parameters.

Table 4 - Soil Parameters

Parameters	Values
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Dry Unit Weight (γ), kN/m^3	20
Effective Unit Weight (γ), kN/m^3	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible. The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be calculated full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. The bedding should be increased to a thickness of 300 mm of Granular A where bedrock is encountered at the subgrade level. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A.

The bedding and cover materials should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 99% of the SPMDD.

The site excavated silty sand may be placed above cover material if the excavation operations are completed in dry weather conditions and the site excavated material is approved by the geotechnical consultant.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

6.5 Groundwater Control

Infiltration levels are anticipated to be low through the sides of the excavation and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) Category 3 may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, anticipated between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project, where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a slightly aggressive corrosive environment.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- A review of architectural and structural drawings to ensure adequate frost protection is provided to the subsoil.
- Inspection of all foundation drainage systems
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Inverness Homes or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

O. Canton

Owen Canton, E.I.T.

LICENSED PROFESSIONAL ENGINEER
Aug. 21, 2020
S. S. DENNIS
100519516
Scott Dennis
PROVINCE OF ONTARIO

Scott Dennis

Scott Dennis, P. Eng.

Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 22, 2020

FILE NO. PG5418

HOLE NO. BH 1-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty sand with crushed stone 0.66	AU	1		
FILL: Red-brown silty sand, trace organics 1.37	SS	2	54	5
Compact, brown **SILTY SAND**	SS	3	46	12
	SS	4	54	17
	SS	5	58	33
	SS	6	50	28
5.18	SS	7	67	24
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders 5.94	SS	8	67	55

DEPTH (m)	ELEV. (m)
0	121.77
1	120.77
2	119.77
3	118.77
4	117.77
5	116.77

End of Borehole

Practical refusal to augering at 5.94m depth.

(GWL @ 5.39m - Aug. 6, 2020)

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

20 40 60 80

Monitoring Well Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 22, 2020

FILE NO. PG5418

HOLE NO. BH 2-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	121.23
TOPSOIL 0.18	AU	1				
Loose to compact, brown **SILTY SAND**	SS	2	54	6	1	120.23
	SS	3	46	4	2	119.23
	SS	4	58	14	3	118.23
3.80	SS	5	79	18		
Dense, brown **SANDY SILT**	SS	6	67	45	4	117.23
	SS	7	62	40	5	116.23
5.77	SS	8	76	50+		
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders 5.94						

End of Borehole

Practical refusal to augering at 5.94m depth.

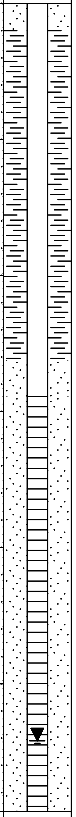
(GWL @ 5.42m - Aug. 6, 2020)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Monitoring Well Construction



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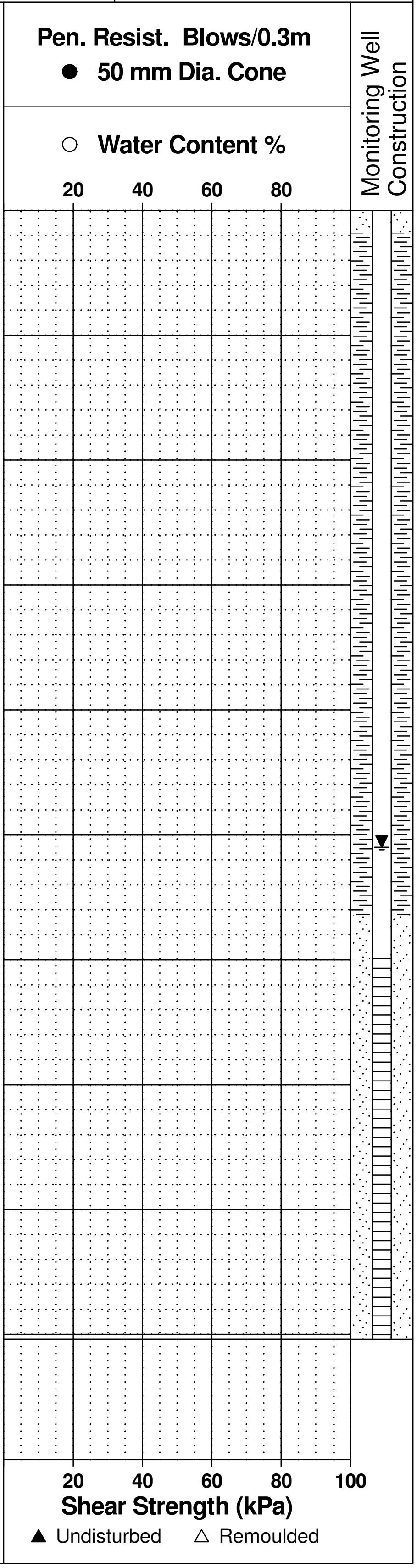
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY CME-55 Low Clearance Drill
DATE July 22, 2020
FILE NO. PG5418
HOLE NO. BH 3-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty sand with crushed stone	AU	1		
	SS	2	17	10
	SS	3	25	6
2.29				
Compact, brown **SILTY SAND**	SS	4	42	23
	SS	5	75	24
	SS	6	58	22
	SS	7	71	24
5.49				
BEDROCK: Very poor to fair quality, grey limestone with interbedded shale	RC	1	100	56
	RC	2	60	0
	RC	3	100	60
9.04				
End of Borehole				
(GWL @ 5.10m - Aug. 6, 2020)				

DEPTH (m)	ELEV. (m)
0	121.78
1	120.78
2	119.78
3	118.78
4	117.78
5	116.78
6	115.78
7	114.78
8	113.78
9	112.78



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 22, 2020

FILE NO. PG5418

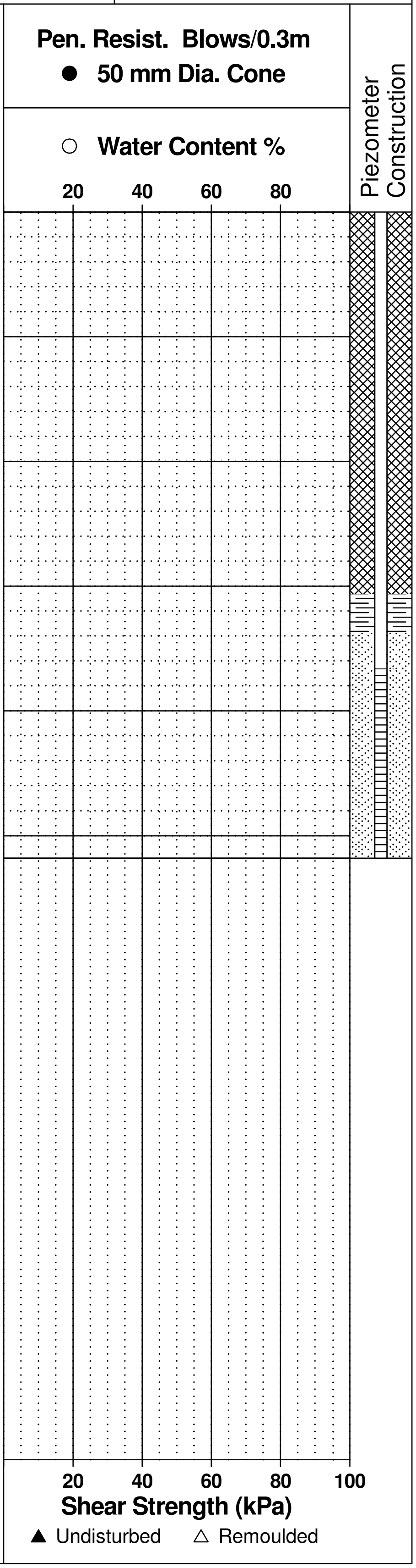
HOLE NO. BH 4-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
FILL: Brown sand with gravel — 0.53	AU	1		
FILL: Brown silty sand with gravel, some cobbles, concrete, trace brick, wood — 2.13	SS	2	29	23
	SS	3	12	50+
Compact, brown **SILTY SAND** — 5.18	SS	4	58	16
	SS	5	54	21
	SS	6	62	27
	SS	7	75	21

End of Borehole

(Piezometer blocked at 3.94m depth - August 11, 2020)

DEPTH (m)	ELEV. (m)
0	121.61
1	120.61
2	119.61
3	118.61
4	117.61
5	116.61



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 22, 2020

FILE NO. PG5418

HOLE NO. BH 5-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	121.47
FILL: Brown silty sand with gravel, trace organics (0.38)		AU	1				
Compact, brown **SILTY SAND**		SS	2	54	6	1	120.47
		SS	3	50	13	2	119.47
		SS	4	54	20		
		SS	5	79	33	3	118.47
		SS	6	58	33	4	117.47
(5.18)		SS	7	79	28	5	116.47
End of Borehole							

(Piezometer blocked at 4.26m depth - August 11, 2020)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 23, 2020

FILE NO. PG5418

HOLE NO. BH 6-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	121.52
FILL: Brown silty sand with gravel, trace organics — 0.38	AU	1				
	SS	2	54	9	1	120.52
	SS	3	67	18	2	119.52
Compact to dense, brown **SILTY SAND**	SS	4	71	28	3	118.52
	SS	5	62	26	4	117.52
	SS	6	79	25	5	116.52
— 5.11	SS	7	62	31		

End of Borehole

Practical refusal to augering at 5.11m depth.

(Piezometer blocked at 4.12m depth - August 11, 2020)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

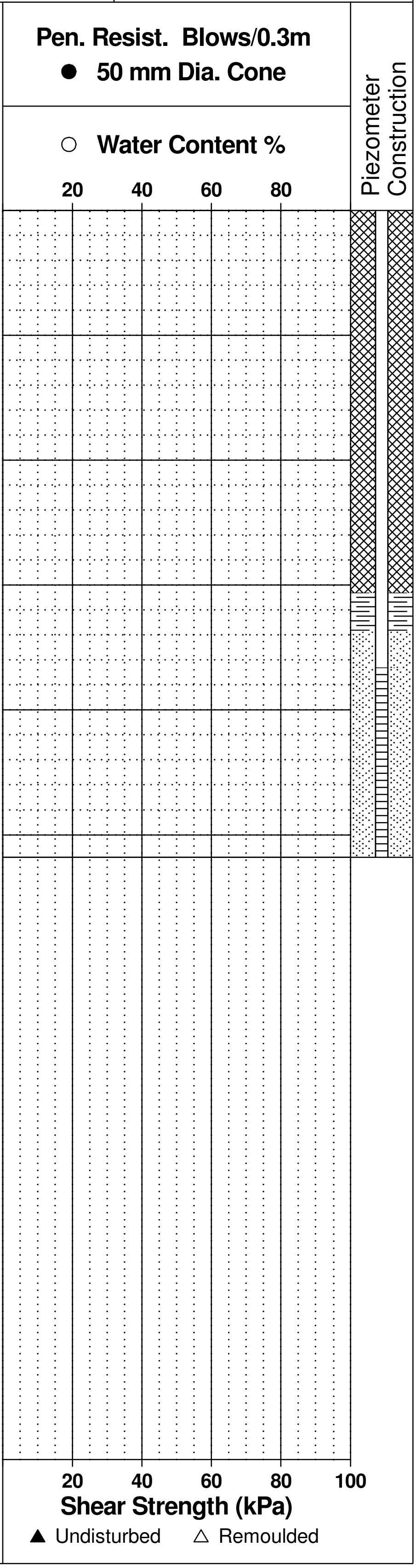
BORINGS BY CME-55 Low Clearance Drill

DATE July 23, 2020

FILE NO. PG5418

HOLE NO. BH 7-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.10						0	121.71
		AU	1				
Loose to dense, brown **SILTY SAND**		SS	2	50	5	1	120.71
		SS	3	50	8	2	119.71
		SS	4	75	26	3	118.71
		SS	5	75	28		
4.57		SS	6	83	33	4	117.71
Compact, brown **SANDY SILT** 5.18		SS	7	92	28	5	116.71
End of Borehole							
(Piezometer blocked at 4.23m depth - August 11, 2020)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 23, 2020

FILE NO. PG5418

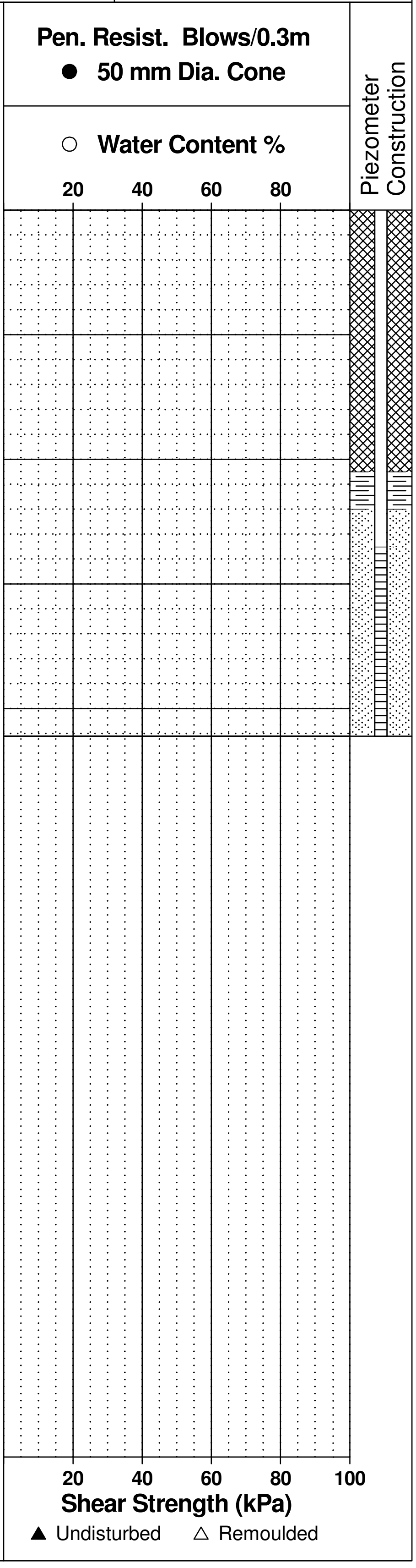
HOLE NO. BH 8-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	121.50
FILL: Topsoil with sand, some gravel, organics and boulders (0.51)	AU	1				
Loose to compact, brown **SILTY SAND**	SS	2	50	5	1	120.50
	SS	3	42	3	2	119.50
	SS	4	50	18	3	118.50
(3.81)	SS	5	58	23		
Dense, brown **SANDY SILT** (4.19)	SS	6	75	50+	4	117.50
GLACIAL TILL: Brown silty sand with weathered bedrock (4.22)						

End of Borehole

Practical refusal to augering at 4.22m depth.

(Piezometer blocked at 4.02m depth - August 11, 2020)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG5418**

REMARKS

HOLE NO. **BH 9-20**

BORINGS BY CME-55 Low Clearance Drill

DATE July 23, 2020

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	121.23
TOPSOIL 0.15	AU	1				
Loose to compact, brown **SILTY SAND**	SS	2	50	6	1	120.23
	SS	3	75	8	2	119.23
	SS	4	62	13	3	118.23
	SS	5	54	18	4	117.23
4.57	SS	6	58	32		
Dense, brown **SANDY SILT,** trace gravel 5.18	SS	7	79	31	5	116.23

End of Borehole

(GWL @ 3.40m - Aug. 11, 2020)

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 23, 2020

FILE NO. PG5418

HOLE NO. BH10-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	121.46
TOPSOIL 0.13	AU	1				
Loose, red-brown **SILTY SAND,** trace gravel 1.37	SS	2	58	6	1	120.46
Loose to compact, brown **SILTY SAND** 4.57	SS	3	50	4	2	119.46
	SS	4	58	8	3	118.46
	SS	5	79	28		
	SS	6	67	30	4	117.46
Dense, brown **SANDY SILT,** trace clay 5.00	SS	7	59	50+	5	116.46

End of Borehole

Practical refusal to augering at 5.00m depth.

(Piezometer blocked at 4.43m depth - August 11, 2020)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

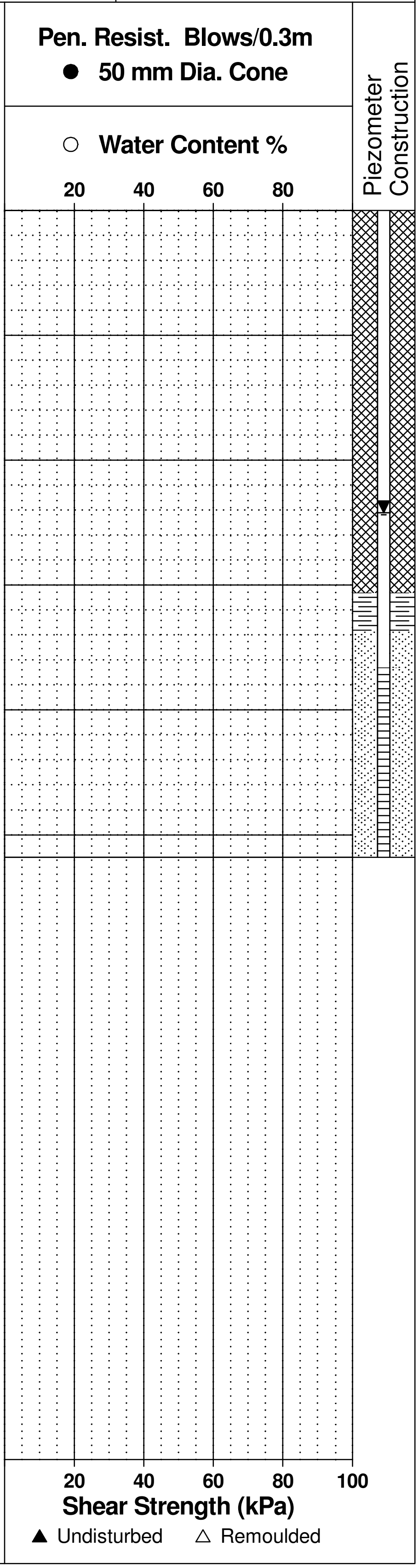
DATE July 22, 2020

FILE NO. PG5418

HOLE NO. BH11-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.18		AU	1		
Loose to compact, red-brown **SILTY SAND**		SS	2	42	5
- brown by 1.4m depth		SS	3	75	10
3.05		SS	4	75	14
Compact to dense, grey **SANDY SILT,** trace clay		SS	5	71	27
4.57		SS	6	58	32
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders 5.18		SS	7	46	31
End of Borehole					
(GWL @ 2.42m - Aug. 11, 2020)					

DEPTH (m)	ELEV. (m)
0	121.03
1	120.03
2	119.03
3	118.03
4	117.03
5	116.03



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
1520, 1524 and 1526 Stittsville Main Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 22, 2020

FILE NO. PG5418

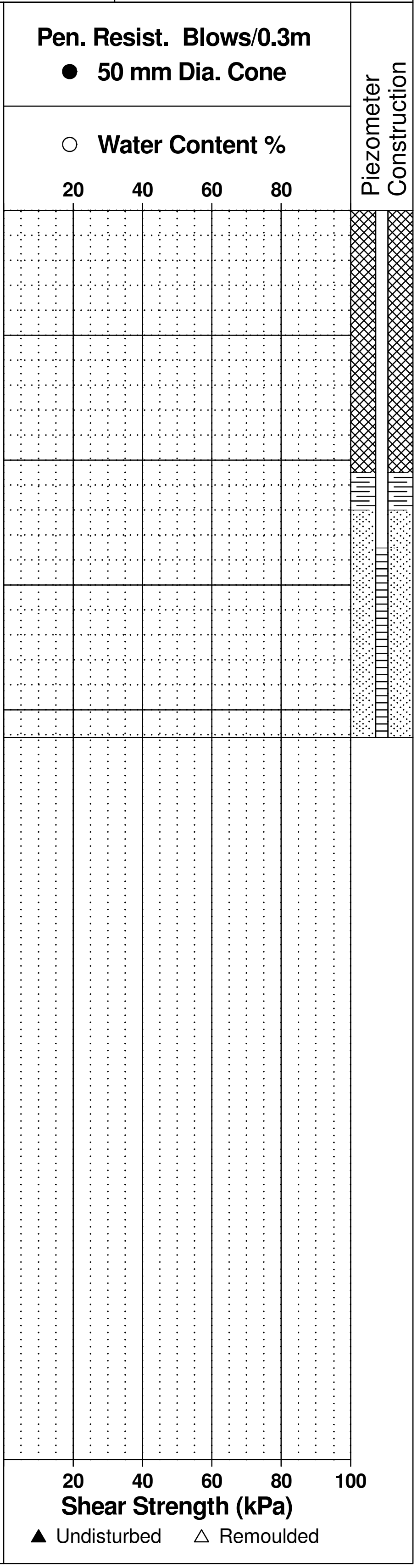
HOLE NO. BH12-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	121.14
TOPSOIL 0.20		AU	1				
Loose, brown **SILTY SAND,** some gravel 1.52		SS	2	8	8	1	120.14
Loose to compact, brown **SILTY SAND** 3.81		SS	3	50	5	2	119.14
		SS	4	58	10	3	118.14
		SS	5	62	18		
GLACIAL TILL: Dense, brown silty sand with weathered bedrock 4.22		SS	6	50	50+	4	117.14

End of Borehole

Practical refusal to augering at 4.22m depth.

(Piezometer blocked at 4.44m depth - August 11, 2020)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1520 Stittsville Main Street
Ottawa, Ontario

DATUM TBM - Top of Bell Canada manhole cover located on sidewalk, east side of Stittsville Main Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 June 3

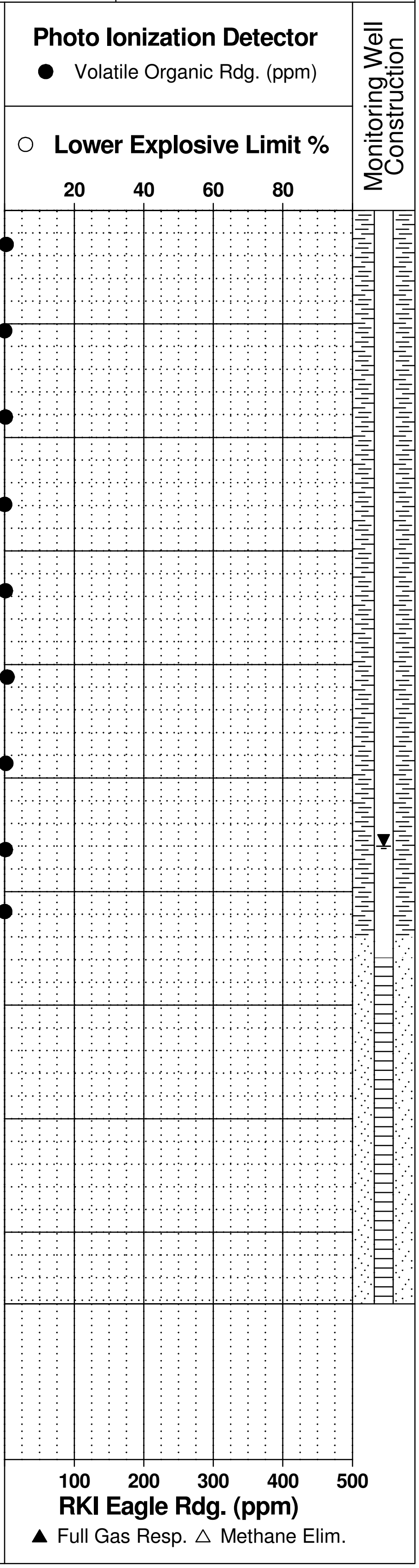
FILE NO. PE4629

HOLE NO. BH 1

SOIL DESCRIPTION	
GROUND SURFACE	
FILL: Brown sand with cobbles	2.29
Compact, light brown **SAND**	5.30
Compact, grey-brown **SILTY SAND**	6.25
BEDROCK: Grey limestone with shale	9.63
End of Borehole	
(GWL @ 5.60m - June 11, 2019)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	1	58	2
SS	2	38	2
SS	3	67	11
SS	4	83	17
SS	5	67	18
SS	6	79	15
SS	7	83	26
SS	8	8	50+
RC	1		
RC	2		
RC	3	94	82

DEPTH (m)	ELEV. (m)
0	100.14
1	99.14
2	98.14
3	97.14
4	96.14
5	95.14
6	94.14
7	93.14
8	92.14
9	91.14



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1520 Stittsville Main Street
Ottawa, Ontario

DATUM TBM - Top of Bell Canada manhole cover located on sidewalk, east side of Stittsville Main Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 June 3

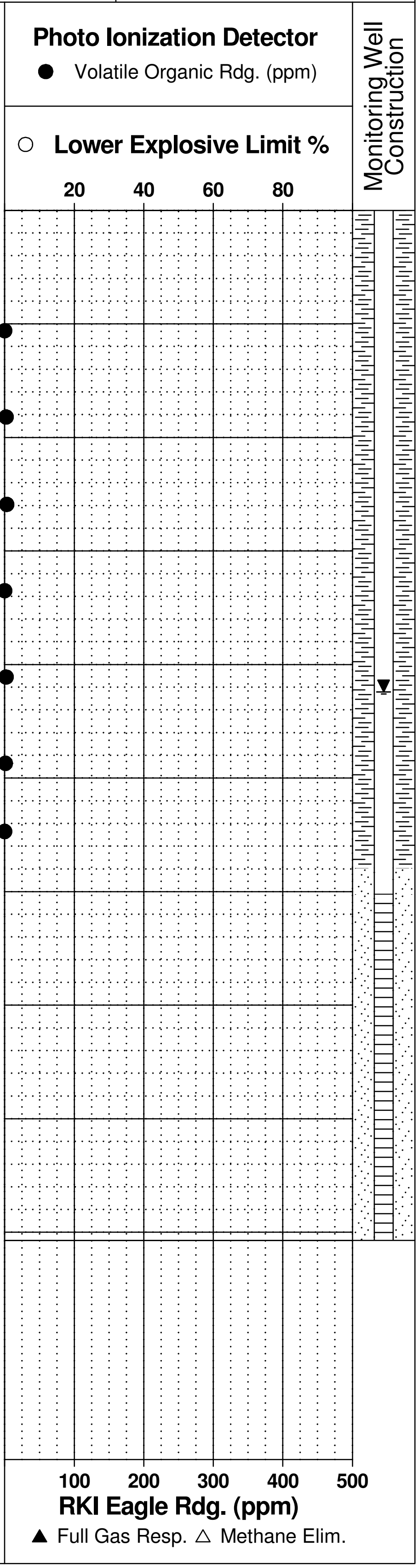
FILE NO. PE4629

HOLE NO. BH 2

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.86
FILL: Brown sand with brick	SS	1	42	2	1	98.86
	SS	2	12	5		
2.13					2	97.86
	SS	3	75	8		
					3	96.86
	SS	4	67	13		
Loose to compact, light brown **SAND**						
	SS	5	58	19	4	95.86
	SS	6	71	18	5	94.86
5.61	SS	7	100	50+		
					6	93.86
	RC	1	82	60		
					7	92.86
BEDROCK: Grey limestone with shale						
	RC	2	100	97	8	91.86
9.07	RC	3	100	100	9	90.86

End of Borehole

(GWL @ 4.56m - June 11, 2019)



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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1520 Stittsville Main Street
Ottawa, Ontario

DATUM TBM - Top of Bell Canada manhole cover located on sidewalk, east side of Stittsville Main Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

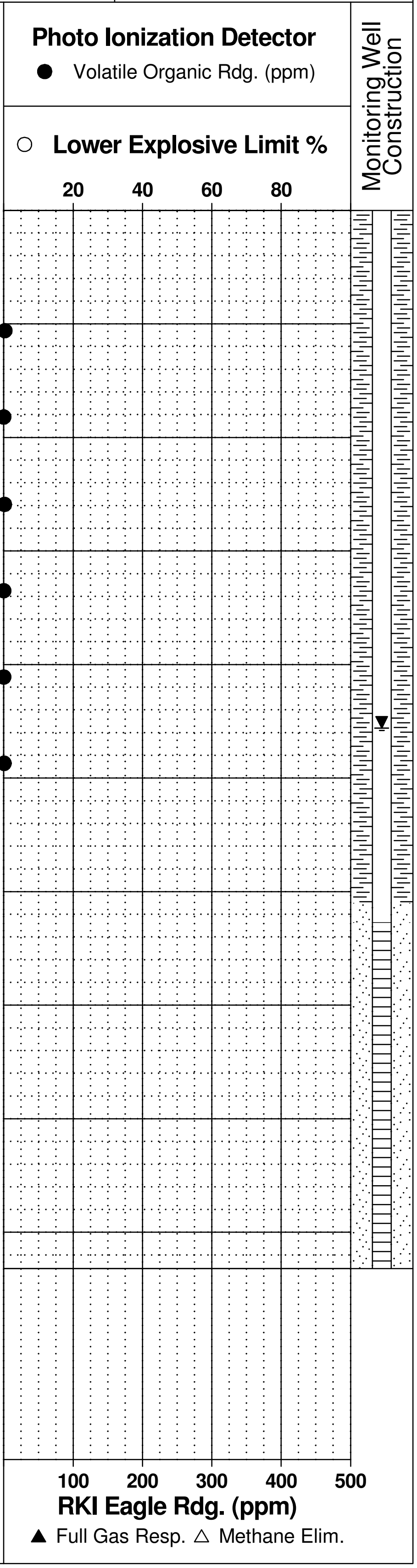
DATE 2019 June 3

FILE NO. **PE4629**

HOLE NO. **BH 3**

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Compact, light brown **SAND**	SS	1	62	11
	SS	2	62	16
	SS	3	79	20
	SS	4	62	21
- grey-brown by 3.8m depth	SS	5	71	24
	SS	6	79	25
5.84				
BEDROCK: Grey limestone with shale	RC	1	100	71
	RC	2	100	73
	RC	3	100	92
9.32				
End of Borehole (GWL @ 4.24m - June 11, 2019)				

DEPTH (m)	ELEV. (m)
0	99.85
1	98.85
2	97.85
3	96.85
4	95.85
5	94.85
6	93.85
7	92.85
8	91.85
9	90.85



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
1524 and 1526 Main Street
Ottawa, Ontario

DATUM

REMARKS

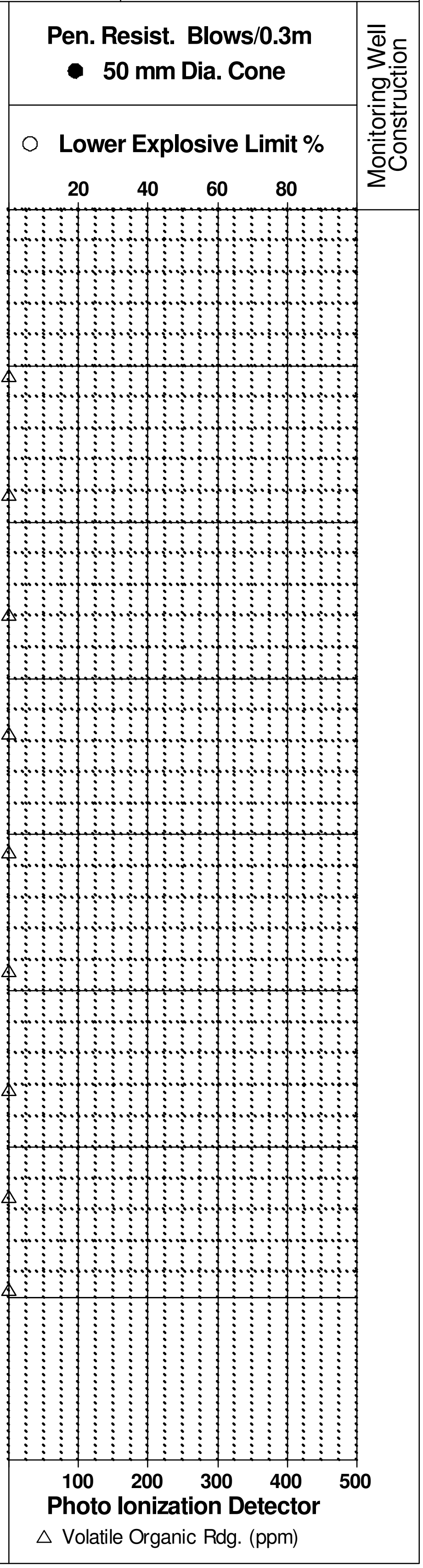
BORINGS BY CME 75 Power Auger

DATE 9 Nov 11

FILE NO. PE2459

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with gravel, occasional pieces of coal		SS	1	25	16	1	
1.45							
Loose to compact, brown **SILTY SAND**		SS	2	33	5	2	
		SS	3	50	7	3	
		SS	4	58	25		
		SS	5	50	21	4	
		SS	6	58	32	5	
5.26							
Dense to very dense, grey-brown **SILTY SAND-GRAVEL** with cobbles		SS	7	67	42	6	
		SS	8	82	50+		
6.96		SS	9	75	50+		
End of Borehole Practical refusal to augering @ 6.96m depth							



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SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
1524 and 1526 Main Street
Ottawa, Ontario

DATUM

REMARKS

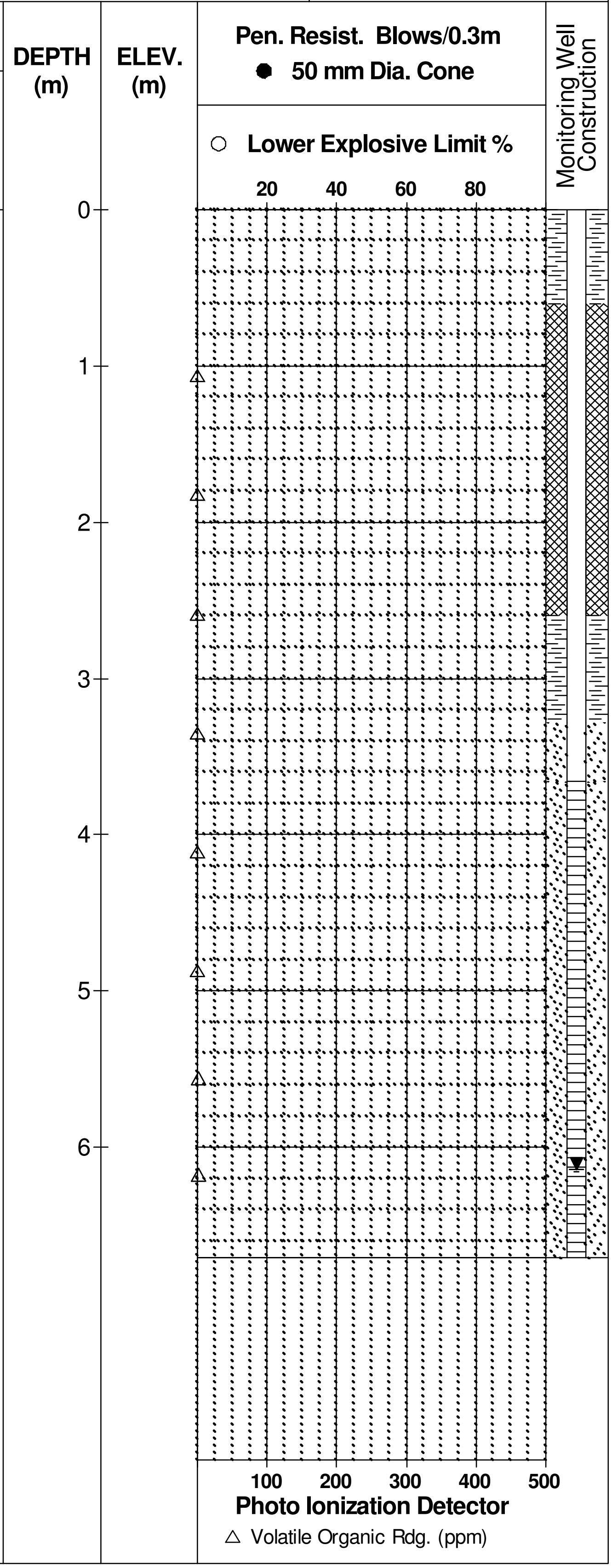
BORINGS BY CME 75 Power Auger

DATE 9 Nov 11

FILE NO. PE2459

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with gravel		SS	1	33	17
		SS	2	17	12
2.21					
Compact, brown **SILTY SAND**		SS	3	67	14
		SS	4	58	20
		SS	5	58	18
		SS	6	67	26
5.26					
Very dense, grey **SILTY SAND-GRAVEL** with cobbles		SS	7	67	50+
		SS	8	100	50+
6.71					
End of Borehole Practical refusal to augering @ 6.71m depth (GWL @ 6.14m-Nov. 14/11)					



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
1524 and 1526 Main Street
Ottawa, Ontario

DATUM

REMARKS

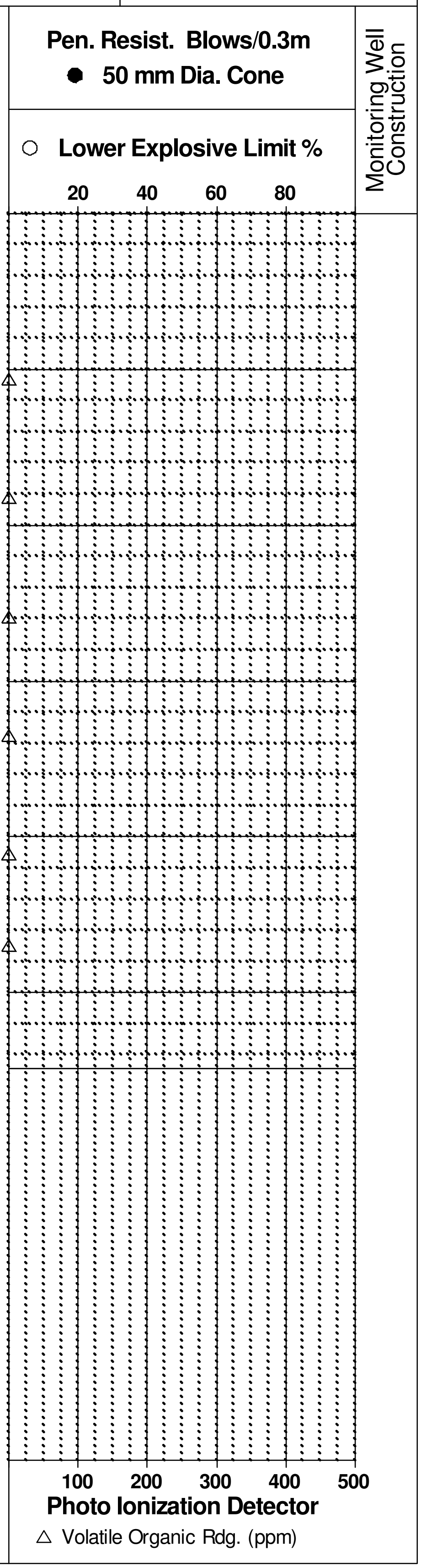
BORINGS BY CME 75 Power Auger

DATE 9 Nov 11

FILE NO. PE2459

HOLE NO. BH 3

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
FILL: Brown silty sand with gravel — 0.60						
Loose to compact, brown **SILTY SAND**	SS	1	50	6	1	
	SS	2	42	2	2	
	SS	3	67	6	3	
	SS	4	67	15		
— 4.50	SS	5	58	21	4	
Very dense, grey-brown **SILTY SAND-GRAVEL** with cobbles — 5.49	SS	6	80	50+	5	
End of Borehole Practical refusal to augering @ 5.49m depth						



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SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
1524 and 1526 Main Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 75 Power Auger

DATE 9 Nov 11

FILE NO. PE2459

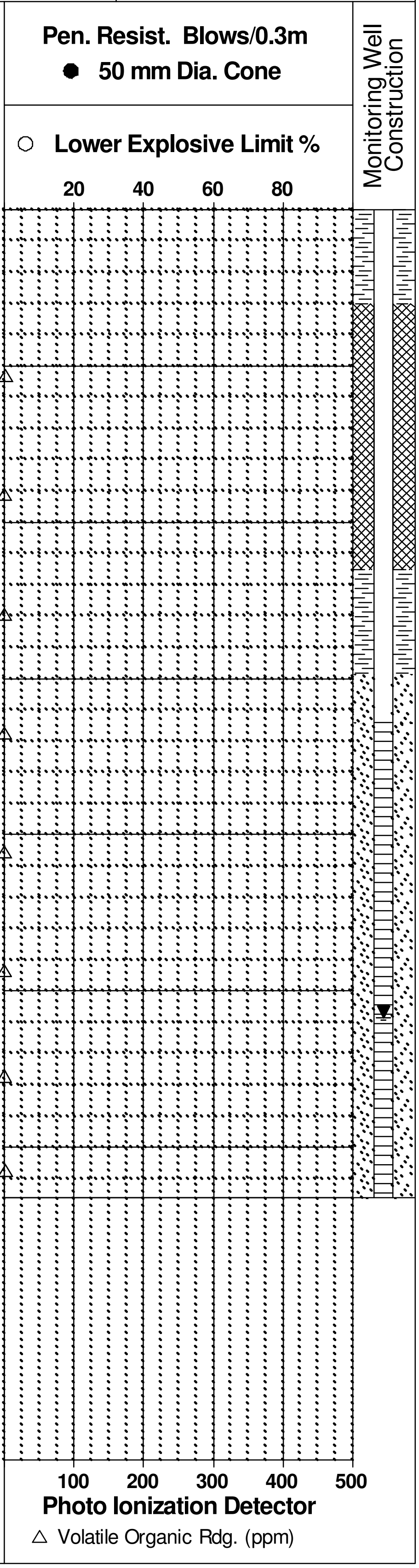
HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand, trace gravel and boulders		SS	1	33	7	1	
1.45							
Compact, brown **SILTY SAND**		SS	2	67	13	2	
		SS	3	67	16	3	
		SS	4	75	21		
3.73							
Dense to very dense, brown **SILTY SAND-GRAVEL** with cobbles		SS	5	58	46	4	
		SS	6	75	37	5	
		SS	7	59	50+		
		SS	8	75	50+	6	
6.32							

End of Borehole

Practical refusal to augering @ 6.32m depth

(GWL @ 5.12m-Nov. 9/11)



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
1524 and 1526 Main Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 75 Power Auger

DATE 9 Nov 11

FILE NO. PE2459

HOLE NO. BH 5

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.25						
Loose to compact, brown **SILTY SAND**	SS	1	42	3	1	
	SS	2	42	5	2	
	SS	3	92	21		
- grey-brown by 3.0m depth					3	
	SS	4	75	22		
	SS	5	67	20	4	
4.50						
Dense to very dense, grey **SILTY SAND-GRAVEL** with cobbles and shale fragments	SS	6	75	32	5	
	SS	7	67	50		
	SS	8	44	50+	6	
6.81						
End of Borehole Practical refusal to augering @ 6.81m depth						

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Lower Explosive Limit %**
20 40 60 80

100 200 300 400 500
Photo Ionization Detector
△ Volatile Organic Rdg. (ppm)

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity: $S_t < 2$
Medium Sensitivity: $2 < S_t < 4$
Sensitive: $4 < S_t < 8$
Extra Sensitive: $8 < S_t < 16$
Quick Clay: $S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW - Thin wall tube or Shelby tube, generally recovered using a piston sampler
G - "Grab" sample from test pit or surface materials
AU - Auger sample or bulk sample
WS - Wash sample
RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic Limit, % (water content above which soil behaves plastically)
PI - Plasticity Index, % (difference between LL and PL)

Dxx - Grain size at which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

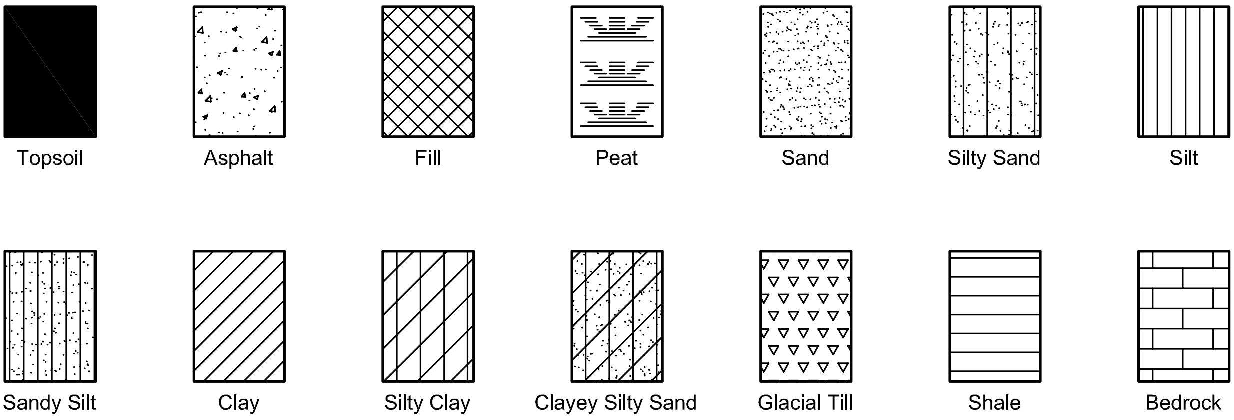
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

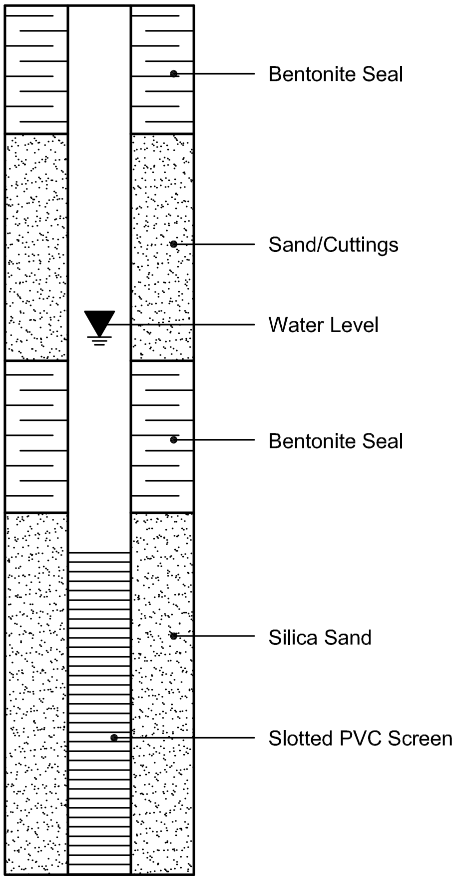
SYMBOLS AND TERMS (continued)

STRATA PLOT

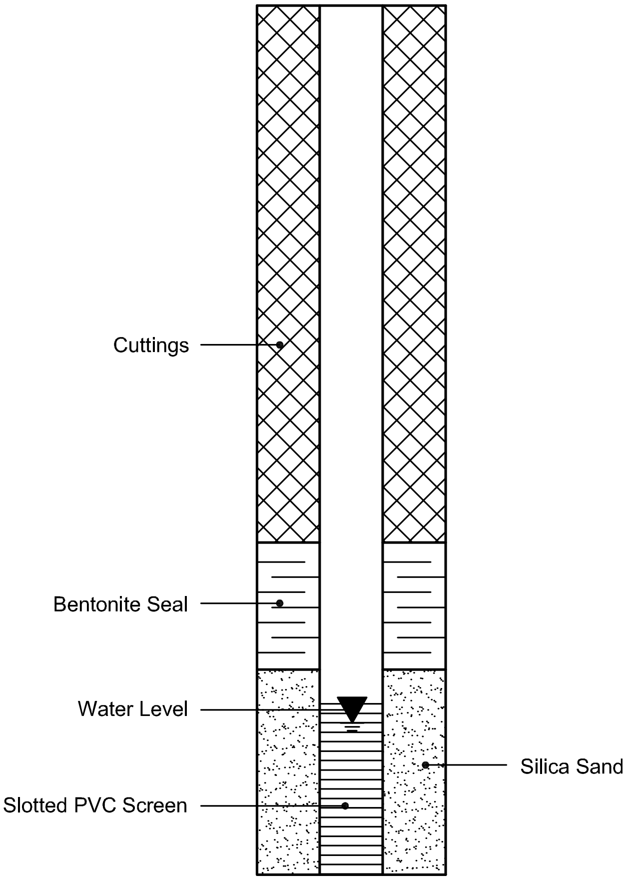


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 30462

Report Date: 29-Jul-2020

Order Date: 23-Jul-2020

Project Description: PE4767

	Client ID:	BH10-20-SS5	-	-	-
	Sample Date:	23-Jul-20 09:30	-	-	-
	Sample ID:	2030452-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	92.4	-	-	-
General Inorganics					
pH	0.05 pH Units	7.80	-	-	-
Resistivity	0.10 Ohm.m	125	-	-	-
Anions					
Chloride	5 ug/g dry	11	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 - AERIAL PHOTOGRAPH - 2014

FIGURE 3 - AERIAL PHOTOGRAPH - 2017

DRAWING PG5418-1 - TEST HOLE LOCATION PLAN

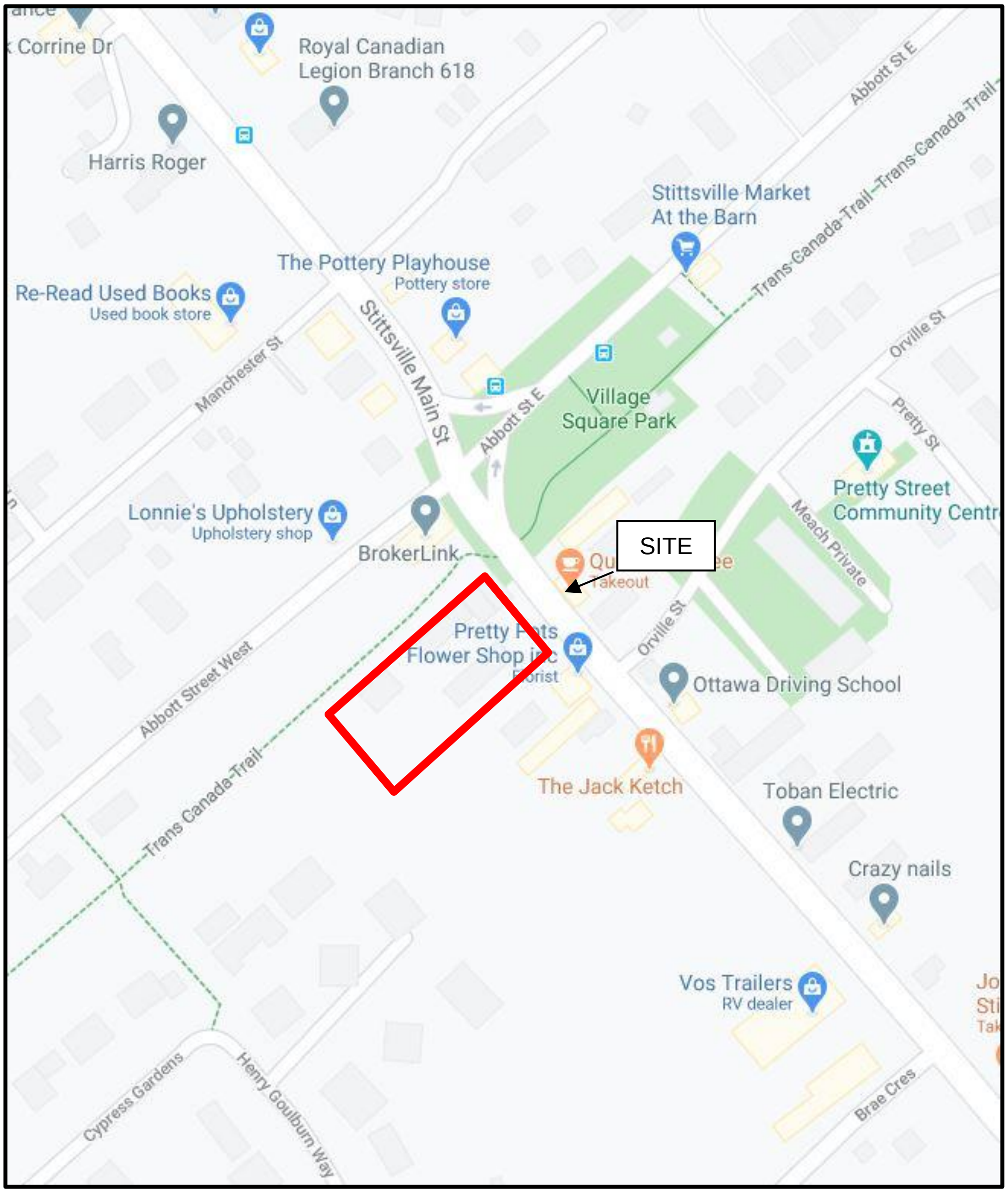


FIGURE 1

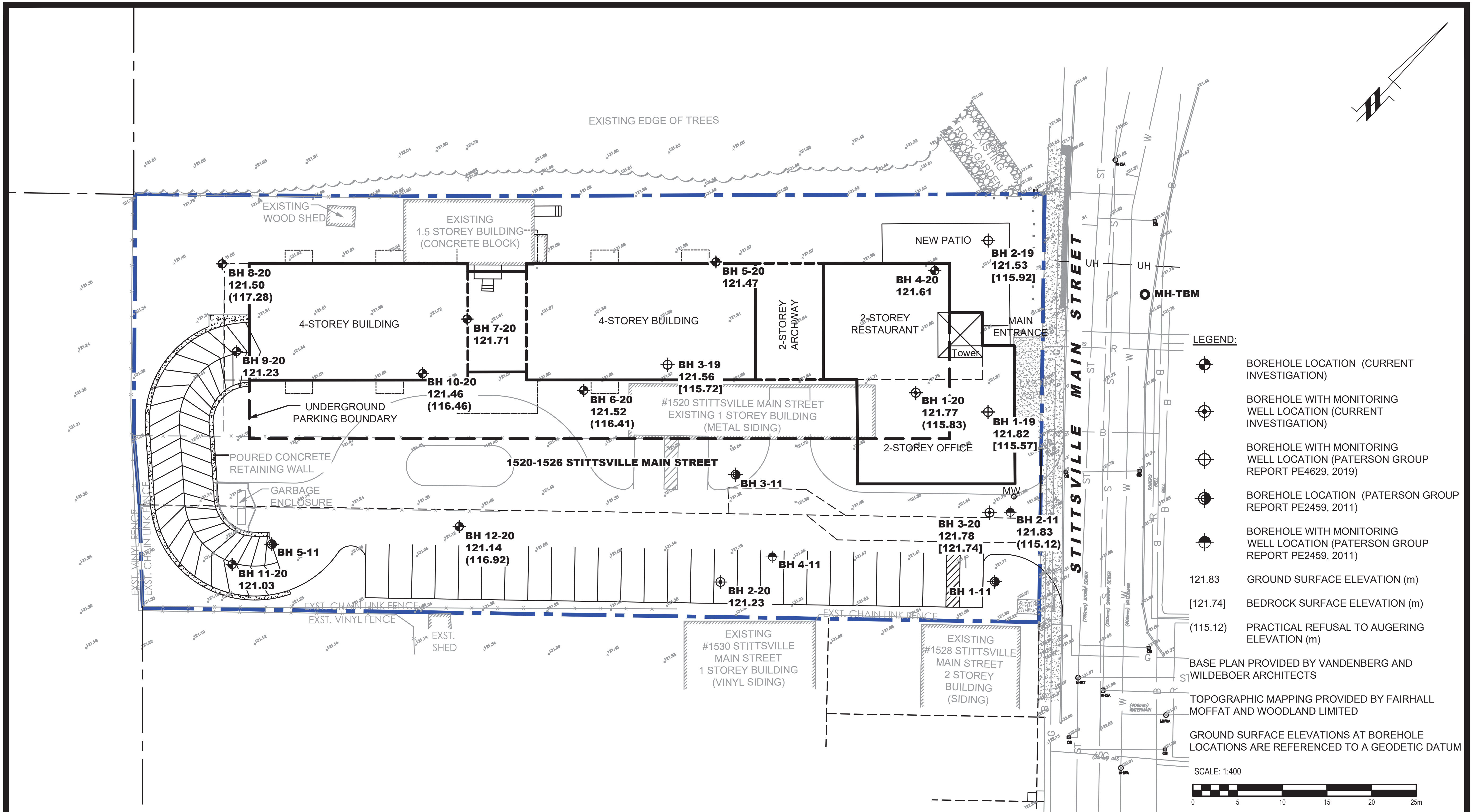
KEY PLAN

FIGURE 2

Aerial Photograph - 2014

FIGURE 3

Aerial Photograph - 2017



LEGEND:

⊕	BOREHOLE LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE WITH MONITORING WELL LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE WITH MONITORING WELL LOCATION (PATERSON GROUP REPORT PE4629, 2019)
⊕	BOREHOLE LOCATION (PATERSON GROUP REPORT PE2459, 2011)
⊕	BOREHOLE WITH MONITORING WELL LOCATION (PATERSON GROUP REPORT PE2459, 2011)
121.83	GROUND SURFACE ELEVATION (m)
[121.74]	BEDROCK SURFACE ELEVATION (m)
(115.12)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

BASE PLAN PROVIDED BY VANDENBERG AND WILDEBOER ARCHITECTS

TOPOGRAPHIC MAPPING PROVIDED BY FAIRHALL MOFFAT AND WOODLAND LIMITED

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM

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NO.	REVISIONS	DATE	INITIAL

INVERNESS HOMES

GEOTECHNICAL INVESTIGATION

PROPOSED MULTI-STOREY BUILDING - 1520-1526 STITTSVILLE MAIN STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:400

Date: 08/2020

Drawn by: YA

Report No.: PG5418-1

Checked by: DP

Dwg. No.: PG5418-1

Approved by: SD

Revision No.:

p:\autocad drawings\geotechnical\pg54xx\pg5418\pg5418-1-test hole location plan.dwg