Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Geotechnical Investigation

Proposed Residential Development
200 Baribeau Street
Ottawa, Ontario

Prepared For

Boulet Construction c/o Urban Logic Research and Advisory

July 15, 2019

Report: PG4951-1

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Table of Contents

Page

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Boulet Construction c/o Urban Logic and Research Advisory to conduct a geotechnical investigation for the proposed residential development to be located at 200 Baribeau Street in Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2).

The objectives of the investigation were to:

❏ to determine the subsurface soil and groundwater conditions based on boreholes.

❏ to provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

Although detailed development plans are not available at this time, it is understood that the proposed development will consist of residential townhouses. It is further understood that the proposed townhouses will consist of slab on grade construction or will contain 1 basement level.

Associated paved access lanes, vehicle parking areas and landscaped areas are also anticipated as part of the proposed residential development.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the initial investigation was conducted on April 22, 2019. At that time a total of five (5) boreholes were advanced to a maximum depth of 5.9 m. Additionally, a supplemental investigation was carried out on June 19, 2019, where a total of twelve (12) boreholes were advanced to a maximum depth of 4.9 m. The boreholes were distributed in a manner to address environmental concerns and to provide general coverage of the subject site taking into considerations site features. The locations of the test holes are shown on Drawing PG4951-1 - Test Hole Location Plan included in Appendix 2.

The boreholes completed for the initial and supplemental investigations, listed above, were advanced using a truck-mounted auger drill rig and a geoprobe drill rig, respectively. Both were operated by a two person crew. All fieldwork was conducted under the full-time supervision of personnel from our geotechnical division under the direction of a senior engineer. The testing procedure consisted of augering to the required depths at the selected locations and sampling 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.

All soil samples were visually inspected and initially classified on site. The split-spoon samples were placed in sealed plastic bags. All samples were transported to our laboratory for examination and classification. The depths at which the split-spoon and auger samples were recovered from the test holes are shown as SS, AU, respectively, on the Soil Profile and Test Data sheets presented 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.

All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for visual inspection.

Overburden thickness was evaluated during the course of the site investigations by dynamic cone penetration testing (DCPT) at BH 4. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed at the borehole were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets and Borehole Logs by Others in Appendix 1.

Groundwater

Monitoring wells were installed in three (3) boreholes (BH 1 through BH 3) to permit groundwater monitoring and sampling. Each groundwater monitoring well consisted of the following:

- ❑ 1.5 to 3 m long slotted 32 mm diameter PVC screen sealed at strategic depths.
- ❑ 32 mm diameter PVC riser pipe from the top of screen to the ground surface.
- ❑ No.3 silica sand backfill within annular space around screen.
- ❑ Betonite hole plug directly above PVC slotted screen to approximatley 300 mm from the ground surface.
- ❑ Clean backfill from top betonite plug to ground surface.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific well installation details.

3.2 Field Survey

The borehole locations and elevations were surveyed in the field by Paterson. The ground surface elevations at the borehole locations were referenced to a temporary benchmark (TBM), consisting of the top spindle of the fire hydrant located near the southeast corner of Landry Street and Baribeau Street. An arbitrary elevation of 100.00 m was assigned to the TBM.

The locations of the boreholes, TBM, and ground surface elevation at the boreholes, are presented on Drawing PG4951-1 Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually 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 samples. 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 single-storey school structure fronting onto the eastern boundary of the site. The remainder of the site generally consists of asphalt-paved parking and recreational areas, with a grassed field located in the southwest corner of the site. The site is bordered to the north by Landry Street, to the east by Baribeau Street, and to the south and west by residential properties.

The ground surface across the subject site is generally flat and at grade with the surrounding properties.

4.2 Subsurface Profile

Overburden

The subsurface profile encountered at the borehole locations generally consisted of an approximate 1.2 to 2.3 m thickness of fill underlying the asphalt surface. The fill was generally observed to consist of a loose to dense, brown silty sand with crushed stone and construction debris such as brick, mortar, ash, slag, glass and plastic.

At boreholes BH 1, BH 5, BH 6, BH 9, BH 13, and BH 14, the fill was underlain by a topsoil layer with a thickness of 0.5 to 0.7 m which consisted of a brown silty sand to sandy silt with organics.

Further, at boreholes BH 1, BH 5, BH 6, BH 11, and BH 12, a layer of loose grey silty sand to sandy silt was encountered between the fill and topsoil, with thicknesses ranging from 0.7 to 1 m.

Underlying the fill, topsoil, and/or silty sand, a glacial till deposit was encountered at approximate depths ranging from 1.5 to 3.8 m below the existing ground surface. The glacial till was observed to consist of a compact to dense, grey to brown silty clay with sand and gravel to silty sand with gravel and occasional cobbles and boulders.

Bedrock

Practical refusal to the DCPT was encountered at 6.4 m below ground surface at BH4. 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.

Based on available geological mapping, the bedrock in this area consists of shale of the Billings Formation.

4.3 Groundwater

Groundwater levels (GWL) were measured on April 25, 2019 in the monitoring wells. The measured GWL readings are presented in Table 1. It should be noted that the groundwater levels can fluctuate periodically throughout the year and higher levels could be encountered at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH1	98.70	1.55	97.15	April 25, 2019
BH2	98.69	1.45	97.24	April 25, 2019
BH3	98.57	0.82	97.75	April 25, 2019

Note: The ground surface elevations at the borehole locations were referenced to a temporary benchmark (TBM), consisting of the top spindle on a fire hydrant located near the southeast corner of Landry Street and Baribeau Street. An arbitrary elevation of 100.00 m was assigned to the TBM (not Geodetic datum).

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is expected that the proposed buildings will be founded on conventional shallow footings placed on the undisturbed glacial till.

Where fill, topsoil, and or loose silty sand to sandy silt are encountered at the underside of footing, the fill, topsoil, and/or loose silty sand to sandy silt should be sub-excavated to the surface of the undisturbed glacial till and replaced with engineered fill to the proposed founding elevation. The lateral limits of the engineered fill placement should be in accordance with our lateral support recommendations provided in Subsection 5.3.

5.2 Site Grading and Preparation

Stripping Depth

Surficial topsoil, and fill containing significant amounts of organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. It is anticipated that the existing fill and lower topsoil within the proposed building footprints, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprints outside of lateral support zones for the footings. However, it is recommended that the existing fill layer be proof-rolled several times and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

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

Fill Placement

Fill used for grading beneath the building 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 material. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, the material should be compacted in thin lifts to a minimum density of 95% of the respective SPMDD.

Backfill against foundation walls should consist of free-draining, non frost susceptible granular materials. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against the foundation walls, unless used in conjunction with a composite drainage blanket connected to the perimeter foundation drainage system.

5.3 Foundation Design

Bearing Resistance Values

Footings placed on an undisturbed glacial till bearing surface, or on engineered fill placed directly over the undisturbed glacial till bearing surface, can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**. A geotechnical factor of 0.5 was applied to the bearing resistance value at ULS.

The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The bearing resistance values at SLS for shallow footing bearing on the abovenoted soils will be subjected to potential post-construction total and differential settlements of 25 and 15 mm, respectively.

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 glacial till bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity as the soil.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C**. 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/Slab on Grade Construction

With the removal of any surficial topsoil, and fill containing singificant amounts of deleterious or organic materials, the existing fill or undisturbed glacial till subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for basement floor slab or slab on grade construction. Where the slab subgrade consists of existing fill, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as Granular B Type II.

For any basement slabs, should the slab subgrade consist of the topsoil layer, this material should be sub-excavated down to the undisturbed glacial till and reinstated using an engineered fill such as OPSS Granular A or Granular B Type II.

It is also recommended that the upper 500 mm of sub-floor fill below slab on grade areas consist of OPSS Granular A crushed stone. For basement slab areas, it is recommended that the upper 500 mm of sub-floor fill consist of 19 mm clear crushed stone. All backfill materials within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for any 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.

Lateral Earth Pressures

The static horizontal earth pressure (p_o) can be calculated using 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 having 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 Earth Pressures

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}) can 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. Note that the vertical seismic coefficient is assumed to be zero.

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

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas, local roadways and arterial roadways with bus traffic.

**Table 2 - Recommended Pavement Structure
Car Only Parking Areas/Driveways**

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 - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil	

Table 3 - Recommended 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
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils 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 local roadways and parking areas.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Should basement levels be provided for the proposed structures, then a perimeter foundation drainage system should be provided. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Sub-slab Drainage

For any basement areas, sub-slab drainage will be required to control water infiltration. For preliminary design purposes, we recommend that 100 or 150 mm perforated pipes be placed at approximate 6 m centres. The spacing of the sub-slab drainage system should be confirmed at the time of completing the excavation when water infiltration 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 greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

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 proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the 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. It is assumed that sufficient room will be available for the greater part of the excavations to be undertaken by open-cut methods (i.e. 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 subsoil at this site 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 be kept away 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.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A should be used for bedding of sewer and water pipes when placed on a soil subgrade. 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 (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

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 minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. 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) 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 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, typically 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. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, 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 also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of an aggressive environment for exposed ferrous metals at this site.

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ 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 Paterson's present understanding of the project. Our recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the 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 Boulet Construction c/o Urban Logic Research and Advisory or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
July 15, 2019
S. S. DENNIS
100519516
PROVINCE OF ONTARIO

Nicholas F. Giamberardino, EIT

Scott S. Dennis, P.Eng.

Report Distribution:

- ❏ Boulet Construction c/o Urban Logic Research and Advisory (3 copies)
- ❏ Paterson Group (1 copy)

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
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 April 22

FILE NO. PG4951

HOLE NO. BH 1

SOIL DESCRIPTION	Bottom Depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.08				
FILL: Brown silty sand with gravel, trace clay, brick and glass	2.29	AU	1		
		SS	2	58	5
		SS	3	21	2
TOPSOIL: Brown silty sand with gravel, trace clay	3.05	SS	4	71	1
Very loose, brown **SILTY SAND**	3.81	SS	5	58	1
GLACIAL TILL: Compact to dense, brown silty sand, some gravel	5.94	SS	6	79	18
		SS	7	75	36
		SS	8	83	41
End of Borehole					
(GWL @ 1.55m - April 25, 2019)					

DEPTH (m)	ELEV. (m)
0	98.70
1	97.70
2	96.70
3	95.70
4	94.70
5	93.70

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

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 April 22

FILE NO. PG4951

HOLE NO. BH 2

SOIL DESCRIPTION	Bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.69
Asphaltic concrete	0.08						
FILL: Crushed stone	0.23	AU	1				
FILL: Brown silty sand, trace mortar, plastic - trace clay and glass by 0.6m depth	1.52	SS	2	62	7	1	97.69
FILL: Topsoil, brown silty sand with organics, trace plastic, brick	2.29	SS	3	67	2	2	96.69
GLACIAL TILL: Dense to compact, brown silty sand, some gravel, occasional cobbles and boulders, trace clay	3.80	SS	4	50	35	3	95.69
		SS	5	58	12		
GLACIAL TILL: Brown silty clay, some sand, trace gravel	5.18	SS	6	62	13	4	94.69
		SS	7	54	13	5	93.69
End of Borehole							
(GWL @ 1.45m - April 25, 2019)							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 April 22

FILE NO. PG4951

HOLE NO. BH 3

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.57
Asphaltic concrete	0.05						
FILL: Brown silty sand, some clay, trace gravel	1.52	AU	1				
		SS	2	50	4	1	97.57
GLACIAL TILL: Brown silty sand with gravel, trace clay	5.18	SS	3	42	11	2	96.57
		SS	4	88	10	3	95.57
		SS	5	83	20	4	94.57
		SS	6	83	22		
		SS	6	100	50+	5	93.57
End of Borehole							

(GWL @ 0.82m - April 25, 2019)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

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

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 April 22

FILE NO. PG4951

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Monitoring Well Construction
GROUND SURFACE						0	98.51		
FILL: Brown silty sand, trace clay and gravel — 0.28		AU	1						
FILL: Brown silty sand, some gravel, trace clay, brick and mortar		SS	2	62	3	1	97.51		
		SS	3	58	19	2	96.51		
— 2.29									
GLACIAL TILL: Brown silty clay with sand, trace gravel		SS	4	42	5	3	95.51		
		SS	5	88	14				
— 3.66									
Dynamic Cone Penetration Test commenced at 3.66m depth.						4	94.51		
Inferred **GLACIAL TILL**						5	93.51		
						6	92.51		
— 6.35									
End of Borehole									
Practical DCPT refusal at 6.35m depth									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 April 22

FILE NO. PG4951

HOLE NO. BH 5

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.08				
FILL: Brown silty sand, some crushed stone, trace clay	0.30	AU	1		
FILL: Brown silty clay, some sand and gravel	1.83	SS	2	42	6
		SS	3	62	4
TOPSOIL: Brown silty sand with organics	2.29				
Loose, brown **SILTY SAND**	3.05	SS	4	79	3
GLACIAL TILL: Brown silty sand with gravel, some clay	3.66	SS	5	38	15
End of Borehole					

DEPTH (m)	ELEV. (m)
0	98.56
1	97.56
2	96.56
3	95.56

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.66
Asphaltic concrete (0.05)							
FILL: Brown silty sand with gravel, trace brick and mortar (1.83)		SS	1				
		SS	2			1	97.66
		SS	3				
TOPSOIL (2.44)		SS	4			2	96.66
Grey SANDY SILT (3.15)		SS	5			3	95.66
GLACIAL TILL: Brown silty clay with sand and gravel (4.88)		SS	6				
		SS	7			4	94.66
		SS	8				
End of Borehole							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH 7

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
Asphaltic concrete	0.10					
FILL: Brown silty sand with brick, mortar, trace clay	1.22		SS	1		
			SS	2		
Brown **SILTY SAND,** some organics	2.13		SS	3		
GLACIAL TILL: Brown silty sand with clay and gravel	4.88		SS	4		
			SS	5		
			SS	6		
			SS	7		
			SS	8		
End of Borehole						

DEPTH (m)	ELEV. (m)
0	98.69
1	97.69
2	96.69
3	95.69
4	94.69

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH 8

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.43
Asphaltic concrete	0.08						
FILL: Brown sand with silt, some gravel	0.51	SS	1				
FILL: Brown sand with gravel	0.99	SS	2			1	97.43
Concrete	1.22						
FILL: Brown silty sand with brick, trace organics	1.83	SS	3				
Dark brown **SILTY SAND** with organics	2.08	SS	4			2	96.43
GLACIAL TILL: Grey-brown silty clay with sand, gravel and cobbles	3.66	SS	5			3	95.43
		SS	6				
End of Borehole							

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

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE						0	98.18		
TOPSOIL 0.30		SS	1						
FILL: Brown sand with gravel, trace asphalt, mortar, glass, plastic, ash and cinders 1.22		SS	2			1	97.18		
TOPSOIL with dark brown silty sand 1.83		SS	3						
GLACIAL TILL: Grey-brown silty sand with clay, gravel, cobbles and boulders 2.44		SS	4			2	96.18		
End of Borehole									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE						0	98.71		
Asphaltic concrete 0.13									
FILL: Brown silty sand with gravel, brick, mortar, slag		SS	1						
		SS	2			1	97.71		
		SS	3						
2.44		SS	4			2	96.71		
GLACIAL TILL: Brown silt clay with sand and gravel		SS	5			3	95.71		
3.66		SS	6						
End of Borehole									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH11

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE							0	98.72		
Asphaltic concrete	0.13									
FILL: Brown silty sand with gravel, trace mortar, slag	1.27		SS	1						
			SS	2			1	97.72		
TOPSOIL: Dark brown silty sand with organics	1.83		SS	3						
Grey **SILTY SAND**	2.44		SS	4			2	96.72		
End of Borehole										

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH12

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.41
Asphaltic concrete	0.08						
FILL: Brown silty sand with gravel, mortar, brick, ash	1.42	SS	1				
		SS	2			1	97.41
Grey-brown **SILTY SAND** with gravel	2.44	SS	3				
		SS	4			2	96.41
End of Borehole							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE						0	98.69		
Asphaltic concrete — 0.08									
FILL: Brown silty sand with gravel, trace asphalt, mortar, slag		SS	1						
		SS	2			1	97.69		
— 1.83		SS	3						
TOPSOIL — 2.44		SS	4			2	96.69		
GLACIAL TILL: Grey silty clay with sand and gravel		SS	5			3	95.69		
— 3.66		SS	6						
End of Borehole									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.63
Asphaltic concrete 0.08						
FILL: Brown silty sand with gravel, trace mortar, brick, ash	SS	1				
	SS	2			1	97.63
1.32						
TOPSOIL	SS	3				
1.88						
GLACIAL TILL: Grey silty clay with sand and gravel	SS	4			2	96.63
	SS	5			3	95.63
	SS	6				
3.66						
End of Borehole						

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.25
TOPSOIL 0.15							
FILL: Brown silty sand with gravel, trace brick, mortar		SS	1				
		SS	2			1	97.25
1.22							
Grey **SILTY CLAY** with sand		SS	3				
1.68							
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles						2	96.25
		SS	4				
2.44							
End of Borehole							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe

DATE 2019 June 19

FILE NO. PG4951

HOLE NO. BH16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE						0	98.39		
Asphaltic concrete 0.13									
FILL: Brown silty sand with gravel, trace ash, brick, asphalt		SS	1						
		SS	2			1	97.39		
1.12									
Brown **SILTY SAND** with organics 1.62		SS	3						
GLACIAL TILL: Grey silty sand with gravel		SS	4			2	96.39		
2.44									
End of Borehole									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
200 Baribeau Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located near the southwest corner of Landry Street and Baribeau Street. Assumed elevation = 100.00m.

REMARKS

BORINGS BY Geoprobe **DATE** 2019 June 19

FILE NO. PG4951

HOLE NO. BH17

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.36
TOPSOIL	0.15						
FILL: Brown silty sand with gravel, concrete, ash, slag, brick	1.22	SS	1				
		SS	2			1	97.36
Dark brown **SILTY SAND** with organics	1.52						
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders	1.88	SS	3				
		SS	4				
End of Borehole Practical refusal to augering at 1.88m depth							

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

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 strength of cohesionless soils is the relative density, 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.

Relative Density	'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 vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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 is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

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 NXL size core. However, it can be used on smaller core sizes, such as BX, 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
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture 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 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

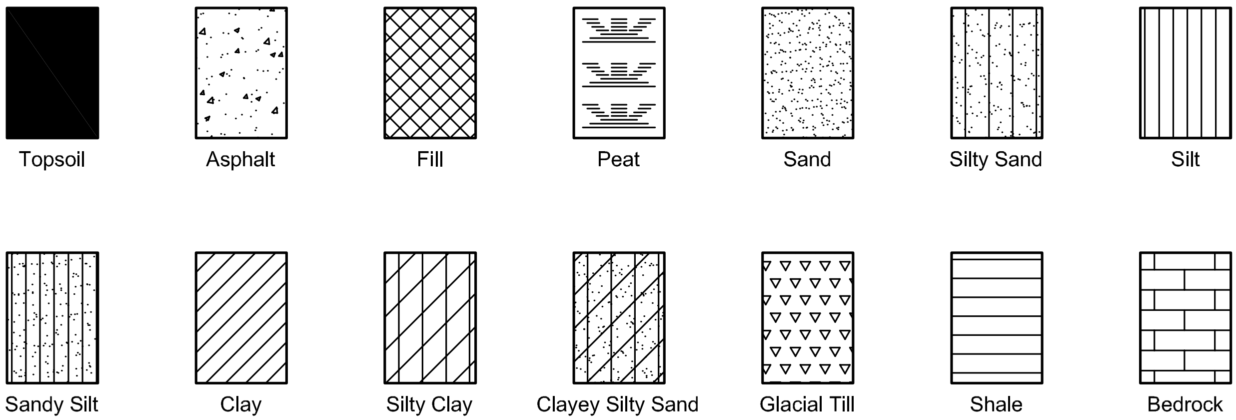
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

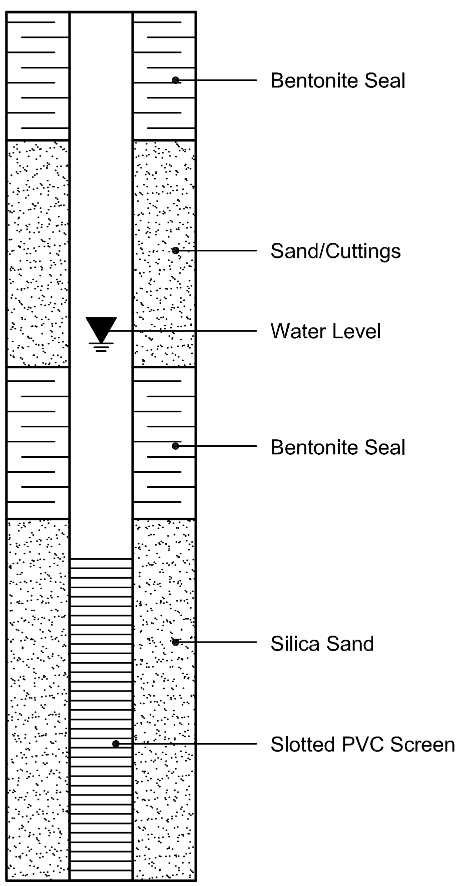
SYMBOLS AND TERMS (continued)

STRATA PLOT

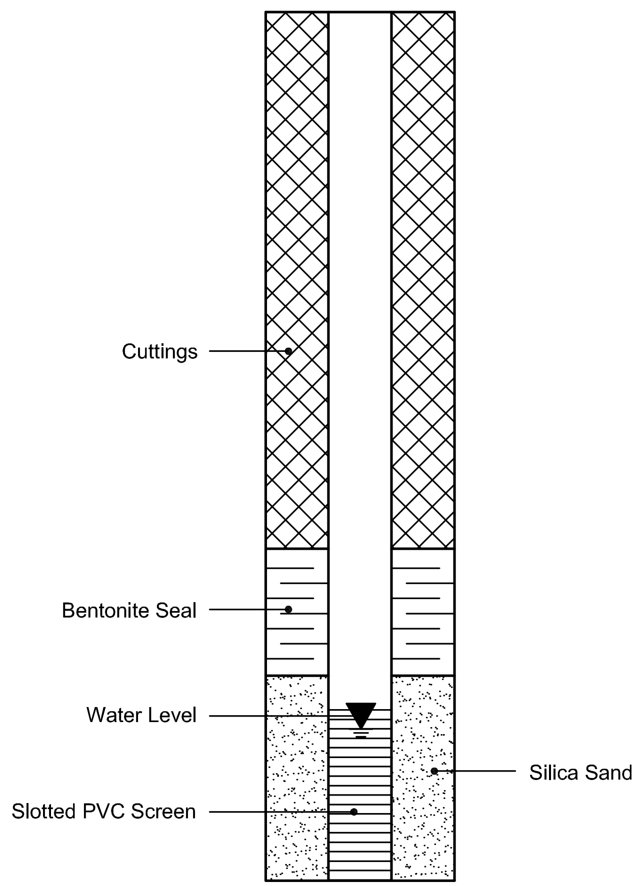


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PARACEL LABORATORIES LTD.

Order #: 1927268

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26990

Report Date: 08-Jul-2019

Order Date: 3-Jul-2019

Project Description: PG4951

	Client ID:	BH4-SS2	-	-	-
	Sample Date:	22-Apr-19 12:00	-	-	-
	Sample ID:	1927268-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	79.0	-	-	-
General Inorganics					
pH	0.05 pH Units	7.90 [1]	-	-	-
Resistivity	0.10 Ohm.m	3.47	-	-	-
Anions					
Chloride	5 ug/g dry	1010 [1]	-	-	-
Sulphate	5 ug/g dry	738 [1]	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG4951-1 - TEST HOLE LOCATION PLAN

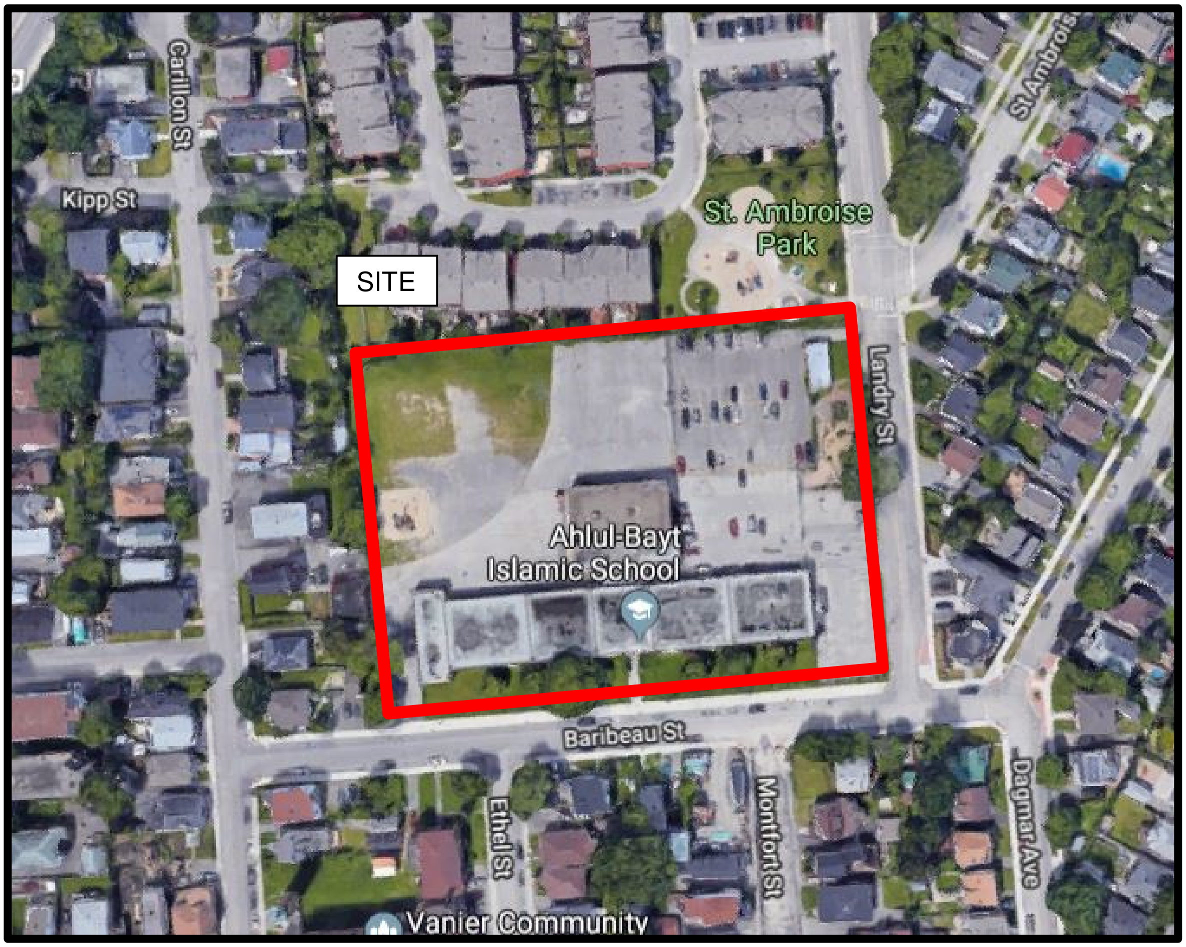
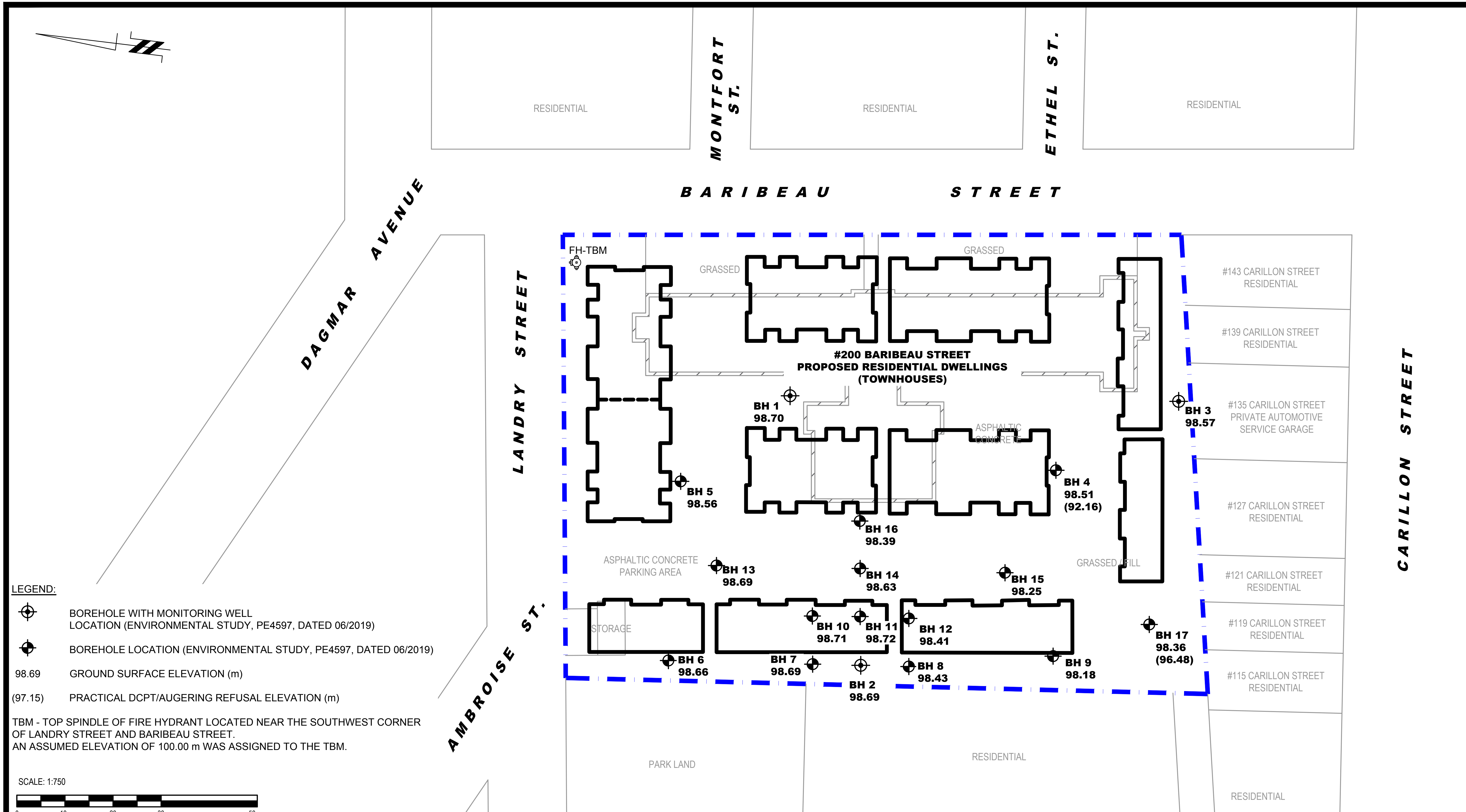


FIGURE 1

KEY PLAN



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
0			

BOULET CONSTRUCTION C/O URBAN LOGIC RESEARCH AND ADVISORY

GEOTECHNICAL INVESTIGATION
200 BARIBEAU STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750	Date: 06/2019
Drawn by: YA	Report No.: PG4951-1
Checked by: NG	**PG4951-1**
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg49xx\pg4951\pg4951-1-thlp.dwg