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Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development
673 Rideau Road
Ottawa, Ontario

Prepared For

2356349 Ontario Inc.

November 24, 2017

Report PG2852-1 Revision 1

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1.0 Introduction

Paterson Group (Paterson) was commissioned by 2356349 Ontario Inc. to conduct a geotechnical investigation for the subject site located at 673 Rideau Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

☐ determine the subsoil and groundwater conditions at this site by means of 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 proposed development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. A Phase I Environmental Site Assessment (ESA) was conducted by Paterson for the subject site. The results and recommendations of the Phase I - ESA are presented under the separate cover of Report PE2837-2 dated May 18, 2017.

2.0 Proposed Project

Based on available design plans, it is understood that current phase of the proposed development will consist of residential dwellings with associated roadways and landscaped areas.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

Field programs for the geotechnical investigation were carried out on March 1 and 4, 2013, and November 6 and 7, 2017. A total of fifteen (15) boreholes were advanced to a maximum depth of 7.4 m. The borehole locations were distributed in a manner to provide general coverage of the subject site. The approximate locations of the boreholes are shown on Drawing PG2852-1 - Test Hole Location Plan included in Appendix 2.

Boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The drilling procedure consisted of advancing each test hole 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. The depths at which the auger and split spoon samples were recovered from the test holes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

A 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. This testing was done in general accordance with ASTM D1586-11 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Undrained shear strength testing was carried out at regular depth intervals in cohesive soils. Undrained shear strength testing in boreholes was completed using a MTO field vane apparatus.

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

Subsurface conditions observed in the test holes were recorded in detail in the field. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Flexible polyethylene standpipes were installed in all 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 subject site taking into consideration existing site features. The borehole locations are presented on Drawing PG2852-1 - 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 sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.6.

4.0 Observations

4.1 Surface Conditions

The subject site consists of an approximately 25 hectare property bounded by Spratt Road to the east, an agricultural property followed by Rideau Road to the south, residential properties followed by River Road to the west, and an agricultural property to the north. The ground surface across the site slopes gradually downward to the west and consists mainly of agricultural fields.

4.2 Subsurface Profile

Generally, the soil profile at the borehole locations consists of topsoil/agricultural soils underlain by brown stiff to very stiff silty clay and a glacial till deposit, consisting of silty clay to silty sand with gravel, cobbles and boulders. Practical refusal to augering/DCPT was encountered at boreholes BH 3, BH 4, BH 3-17, BH 4-17, BH 5-17, BH 7-17, BH 8-17, and BH 9-17. Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets in Appendix 1.

Based on available geological mapping, the subject site is located in an area where the bedrock consists of dolomite of the Oxford formation with an overburden thickness between 5 and 25 m.

4.3 Groundwater

Groundwater levels (GWLs) were measured in the standpipes installed in the boreholes and the results are summarized in Table 1.

It is important to note that at the time of the groundwater level readings of test holes BH 1 through BH 5, the ground surface was wet due to the spring thaw. It is suspected that the groundwater level readings were influenced by surface water infiltrating the backfilled borehole. Therefore, the groundwater levels could vary at the time of construction. It should be further noted that water can become trapped within backfilled boreholes, which can lead to higher than normal groundwater level readings. Based on field observations, such as moisture levels and colouring, the long-term groundwater level can be determined. Based on these observations, the long-term groundwater level is anticipated to be encountered between 3 to 5 m depth.

Table 1
Summary of Groundwater Level Readings

Test Hole Number	Groundwater Depth (m)	Recording Date
BH 1	0.20	March 14, 2013
BH 2	Ground Surface	March 14, 2013
BH 3	Ground Surface	March 14, 2013
BH 4	0.93	March 14, 2013
BH 5	0.95	March 14, 2013
BH 1-17	1.30	November 10, 2017
BH 2-17	0.66	November 10, 2017
BH 3-17	1.01	November 10, 2017
BH 4-17	4.35	November 10, 2017
BH 5-17	1.88	November 10, 2017
BH 6-17	5.74	November 10, 2017
BH 7-17	3.57	November 10, 2017
BH 8-17	0.39	November 10, 2017
BH 9-17	0.73	November 10, 2017
BH 10-17	2.64	November 10, 2017

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed development. It is expected that the proposed buildings will be founded on conventional shallow footings placed on an undisturbed, stiff silty clay or compact glacial till bearing surface.

A permissible grade raise restriction is required for the proposed buildings where a silty clay layer is noted below underside of footing.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Preparation

Stripping Depth

Topsoil, and any deleterious fill, such as those containing organic materials, should be stripped from under any buildings and other settlement sensitive structures. Settlement sensitive structures include, but are not limited to, underground services and paved areas.

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming.

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 excavated stiff brown silty clay, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the silty clay, under dry conditions, should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Shallow Foundation

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**.

Footings placed on an undisturbed, compact 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 **250 kPa**.

Footings designed using the above noted bearing resistance value at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

An undisturbed soil bearing surface consists of a surface 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.

A permissible grade raise restriction of **2 to 3 m** is recommended for the proposed buildings where footings are to be placed over a stiff, silty clay bearing surface. Footings bearing on a dense glacial till are not subjected to permissible grade raise restrictions.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support. Adequate lateral support is provided to a silty clay bearing medium when a plane extending down and out from the bottom edge of the footing, at a minimum of 1.5H:1V.

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. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

5.5 Pavement Structure

For design purposes, the pavement structure presented in the following tables are recommended for the design of car only parking areas and local roadways.

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 - Local Roadways

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 this project.

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.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Where silty clay is anticipated at subgrade level, consideration should be given to installing subdrains during the pavement construction. The subdrain inverts should be approximately 300 mm below subgrade level and run longitudinal along the curblines. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. 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.

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 Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Otherwise, 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 Groundwater Control

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.

It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

A temporary Ministry of the Environment and Climate Change (MOECC) 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 MOECC.

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 MOECC review of the PTTW application.

6.5 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.

6.6 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (General Use - normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of a moderately 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.

- Grading plan review from a geotechnical perspective.
- 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 our present understanding of the project. 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 and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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 2356349 Ontario Inc. 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
Nov. 24-2017
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100116130
PROVINCE OF ONTARIO

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Report Distribution:

❏ Domicile Developments Inc. (4 copies)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS N 5011233; E 0445669

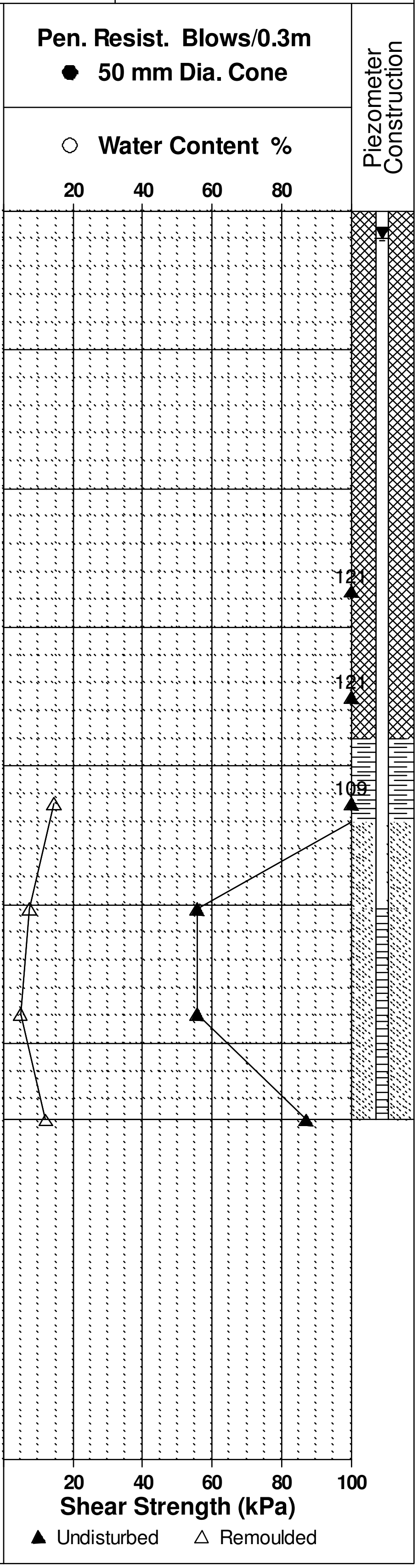
BORINGS BY CME 55 Power Auger

DATE March 4, 2013

FILE NO. PG2852

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
TOPSOIL 0.38		AU	1			0	
		SS	2	100	7	1	
		SS	3	100	4	2	
Very stiff to stiff, brown **SILTY CLAY**						3	
						4	
- grey-brown by 4.5m depth						5	
6.25						6	
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles, boulders 6.55							
End of Borehole (GWL @ 0.20m-Mar. 14, 2013)							



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS N 5011150; E 0445968

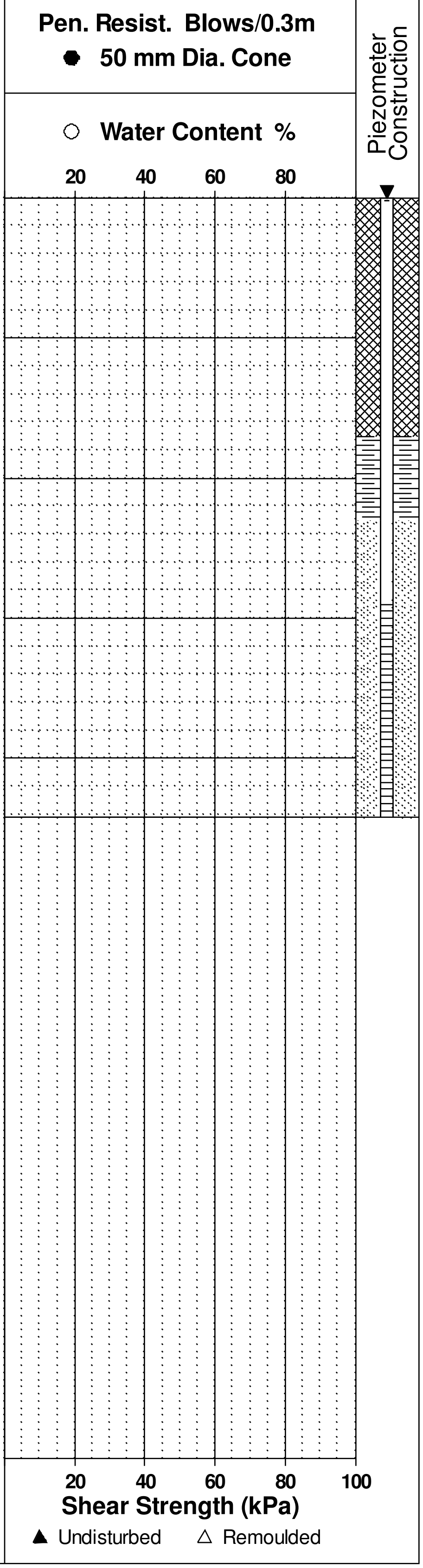
BORINGS BY CME 55 Power Auger

DATE March 1, 2013

FILE NO. PG2852

HOLE NO. BH 2

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.38	SS	1	100	23		
Stiff, brown **SILTY CLAY,** trace sand 1.45	SS	2	100	6	1	
GLACIAL TILL: Compact, brown sandy silt to silty sand with gravel, cobbles, boulders	SS	3		15	2	
	SS	4	86	50+		
	SS	5	83	26	3	
4.42	SS	6	83	22	4	
End of Borehole (Water at ground surface - March 14, 2013)						



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS N 5011434; E 0445964

BORINGS BY CME 55 Power Auger

DATE March 4, 2013

FILE NO. PG2852

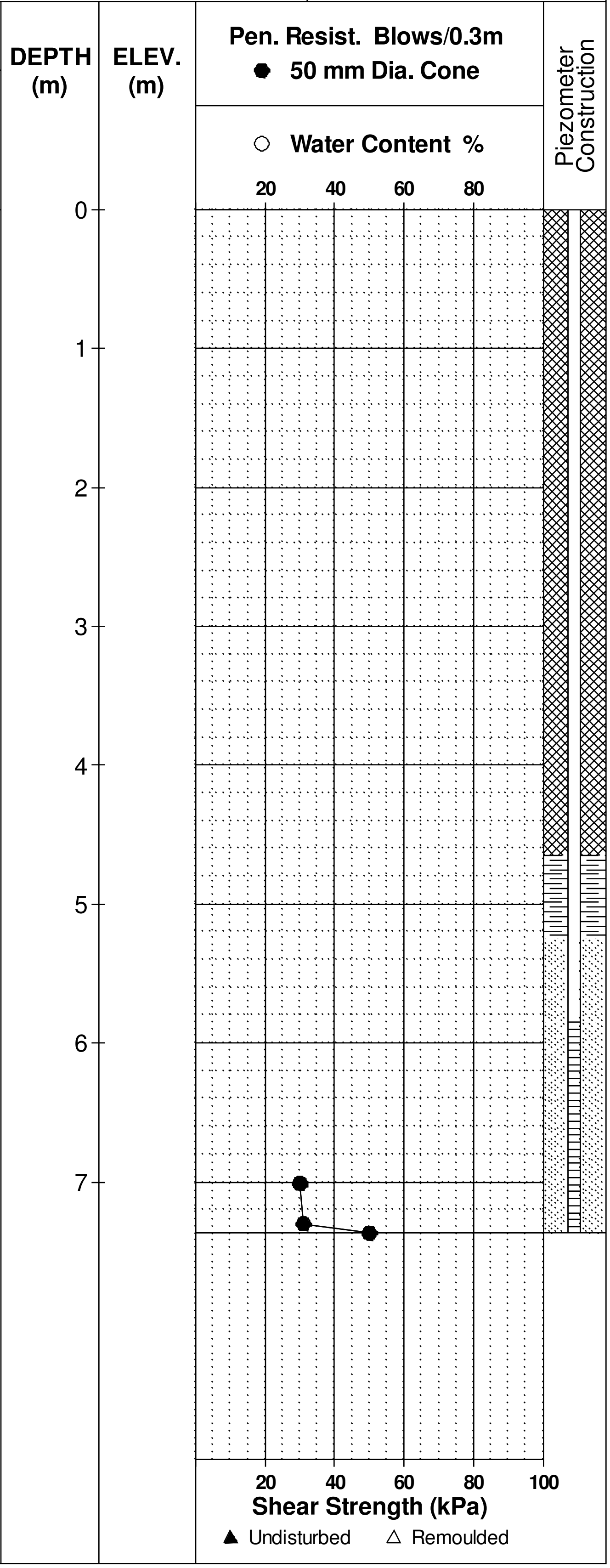
HOLE NO. BH 3

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.38	AU	1		
Stiff, brown **SILTY CLAY** 1.45	SS	2	100	9
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 2.21	SS	3	83	15
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders, trace clay 7.37	SS	4	100	17
	SS	5	75	47
	SS	6	67	29
	SS	7	58	32
	SS	8	83	29
	SS	9		30

End of Borehole

Practical DCPT refusal at 7.37m depth

(Water at ground surface - March 14, 2013)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS N 5011632; E 0446380

BORINGS BY CME 55 Power Auger

DATE March 1, 2013

FILE NO. PG2852

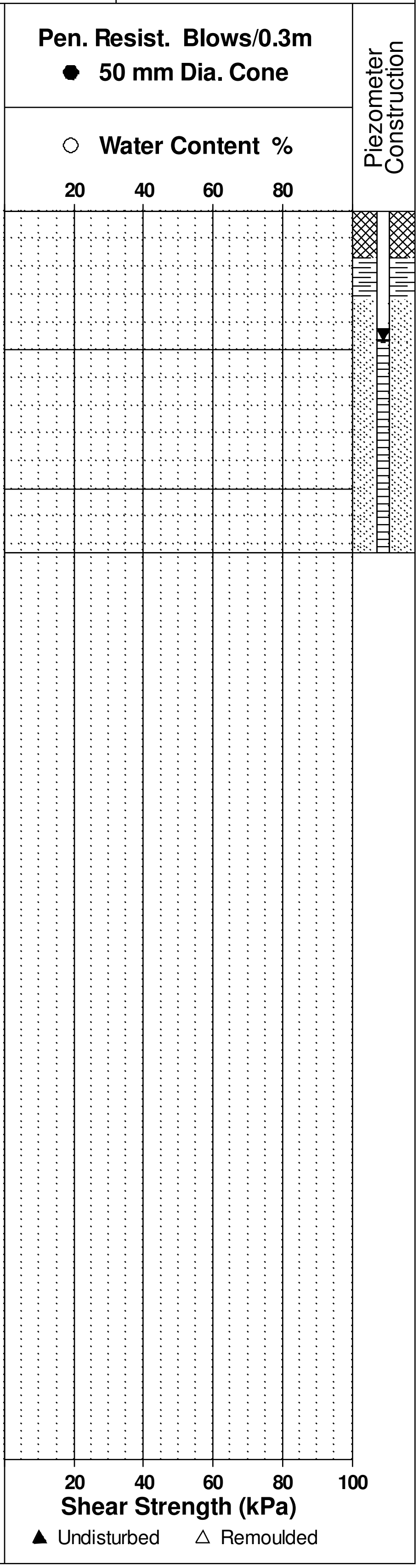
HOLE NO. BH 4

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL	0.43	AU	1				
Hard to stiff, brown **SILTY CLAY**		AU	2				
		SS	3	100	13	1	
		SS	4	100	7	2	
	2.44	SS	5	57	50+		
GLACIAL TILL: Brown silty sand, trace clay, gravel, cobbles	2.46						

End of Borehole

Practical auger refusal at 2.46m depth

(GWL @ 0.93m-Mar. 14, 2013)



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS N 5011373; E 0446375

BORINGS BY CME 55 Power Auger

DATE March 1, 2013

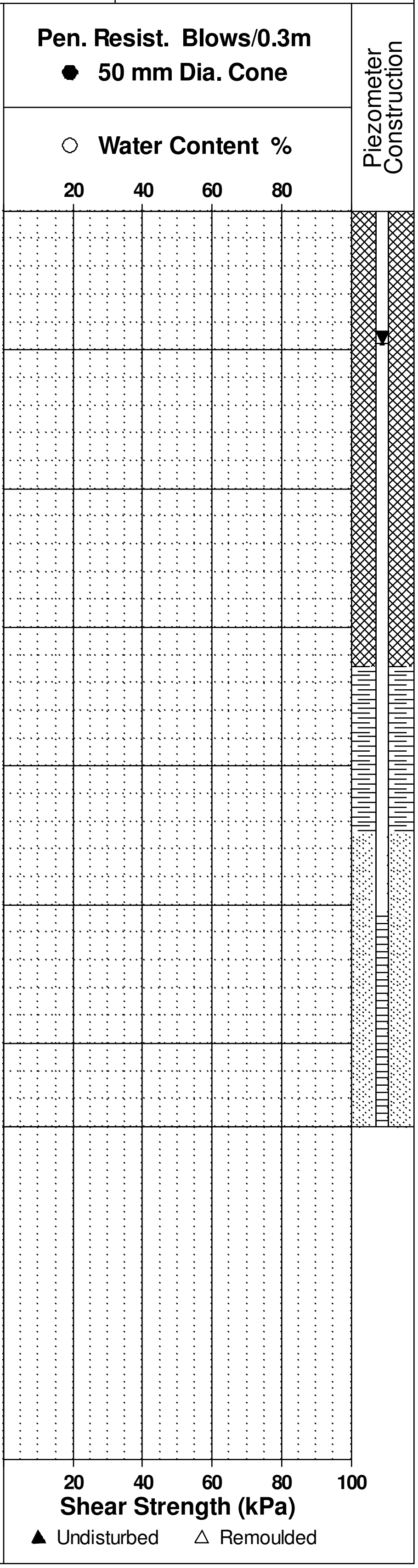
FILE NO. PG2852

HOLE NO. BH 5

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL	AU	1		
0.41				
Very stiff to stiff, brown **SILTY CLAY**	SS	2	100	7
	SS	3	100	6
2.21				
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders - sandy silt matrix by 5.3m depth	SS	4	100	26
	SS	5	100	25
	SS	6	83	22
	SS	7	100	13
	SS	8		23
6.60				
End of Borehole (GWL @ 0.95m-Mar. 14, 2013)				

DEPTH (m): 0, 1, 2, 3, 4, 5, 6

ELEV. (m)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

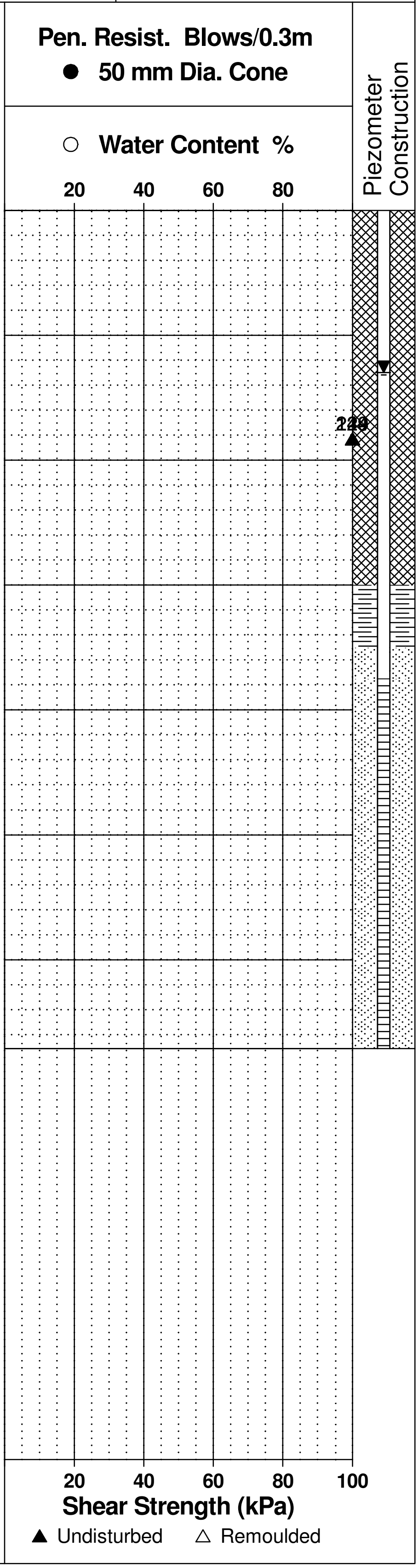
FILE NO. PG2852

HOLE NO. BH 1-17

SOIL DESCRIPTION	DEPTH TO BASE (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20				
Hard to very stiff, brown **SILTY CLAY**	2.29	SS	1		6
GLACIAL TILL: Brown silty clay, trace gravel, cobbles and boulders		SS	2	67	26
		SS	3	25	44
		SS	4	96	18
		SS	5	54	37
-grey by 5.3m depth		SS	6	71	25
	6.71	SS	7	92	23

End of Borehole

(GWL @ 1.3 m depth - Nov. 10, 2017)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

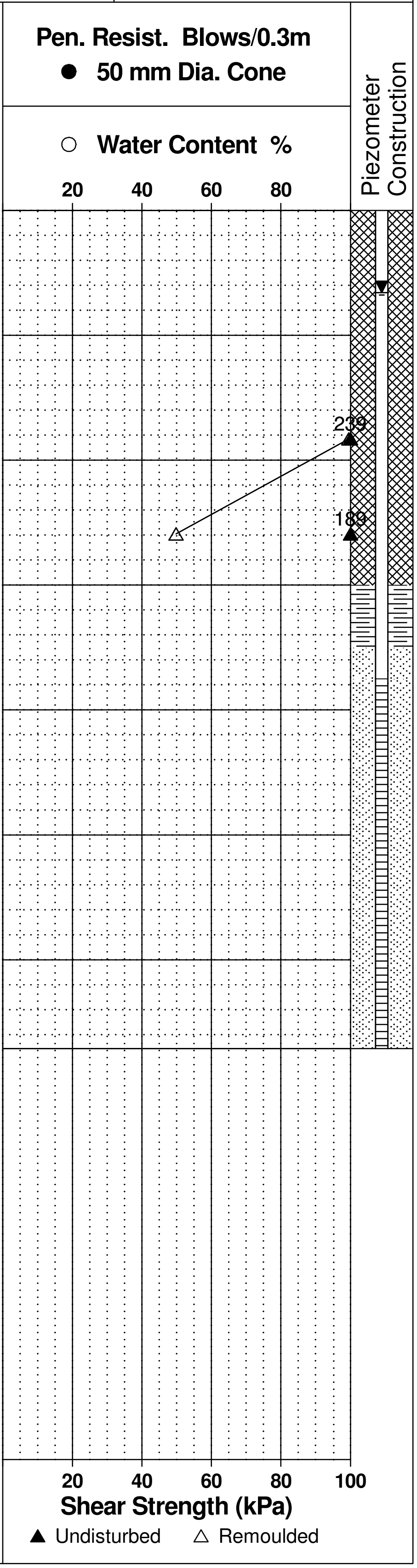
BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH 2-17

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.25						
Hard to very stiff, brown **SILTY CLAY** trace sand	SS		100	4	1	
					2	
3.05					3	
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles and boulders	SS		71	49		
	SS		67	32	4	
	SS		50	31	5	
	SS		67	45	6	
6.71	SS		100	28		
End of Borehole (GWL @ 0.66m depth - Nov 10, 2017)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

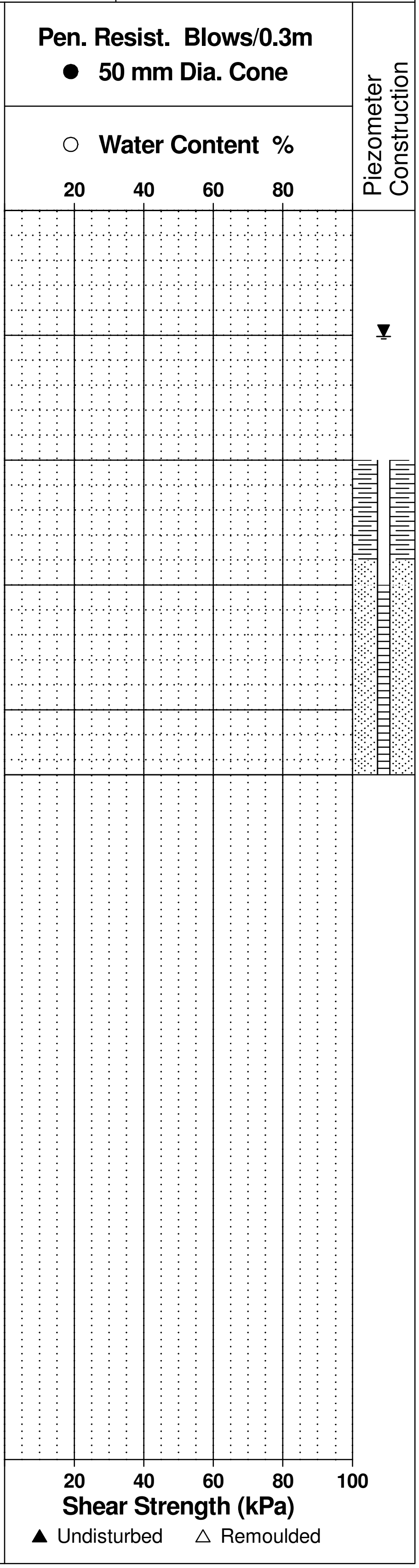
HOLE NO. BH 3-17

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.18	AU	1				
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles and boulders	SS	2	50	8	1	
	SS	3	54	28	2	
	SS	4	82	+50		
	SS	5	92	23	3	
	SS	6	83	56	4	
4.52						

End of Borehole

Practical refusal to augering @ 4.52m depth

(GWL @ 1.01 m depth - Nov. 10, 2017)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

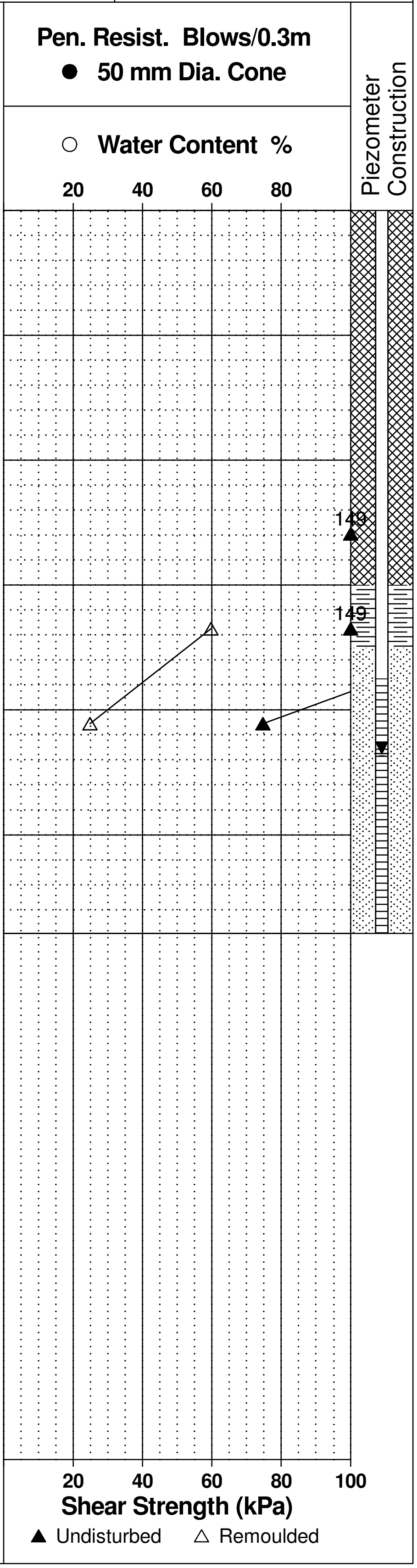
BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH 4-17

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.20						
Very stiff to stiff, brown **SILTY CLAY**, trace sand	SS	1	75	4	1	
	SS	2	100	5	2	
					3	
4.57					4	
GLACIAL TILL: Brown silty clay with sand, trace gravel	SS	3	21	8	5	
5.79	SS	4	88	+50		
End of Borehole Practical refusal to augering @ 5.79m depth (GWL @ 4.35m depth - Nov. 10, 2017)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH 5-17

SOIL DESCRIPTION	Depth of boundary (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles and boulders		SS	1	58	25
		SS	2	91	58
		SS	3	100	+50
		SS	4	100	69
		SS	5	100	+50
		SS	6	100	+50
	5.49				

End of Borehole

Practical refusal to augering @ 5.49m depth

(GWL @ 1.88m depth - Nov. 10, 2017)

DEPTH (m): 0, 1, 2, 3, 4, 5

ELEV. (m)

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
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

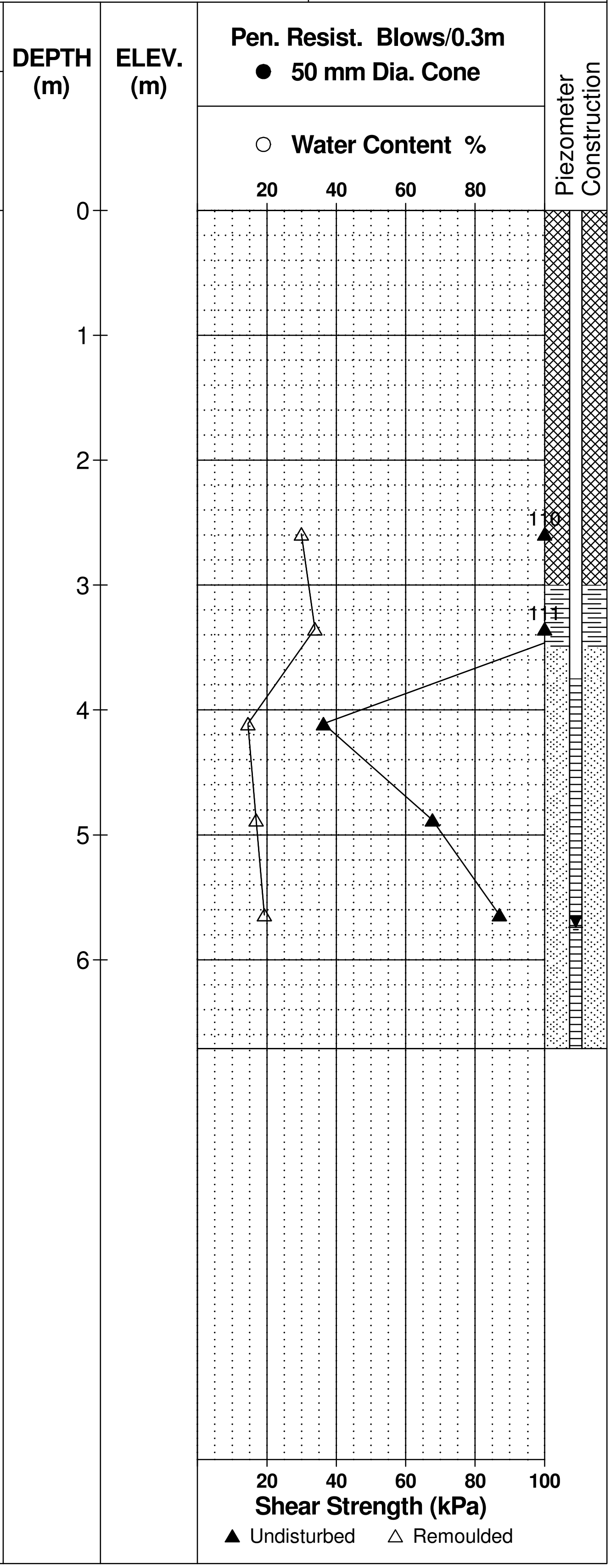
BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. **PG2852**

HOLE NO. **BH 6-17**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.20					
Very stiff to stiff, brown **SILTY CLAY**, trace sand		SS	1	100	8
		SS	2	100	5
		SS	3	100	P
		SS	4	100	P
-firm to stiff and grey by 3.66m depth		SS	5	100	P
		SS	6	100	P
		SS	7	100	P
6.71		SS	8	100	3
End of Borehole (GWL @ 5.74m depth - Nov. 10, 2017)					



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
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DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

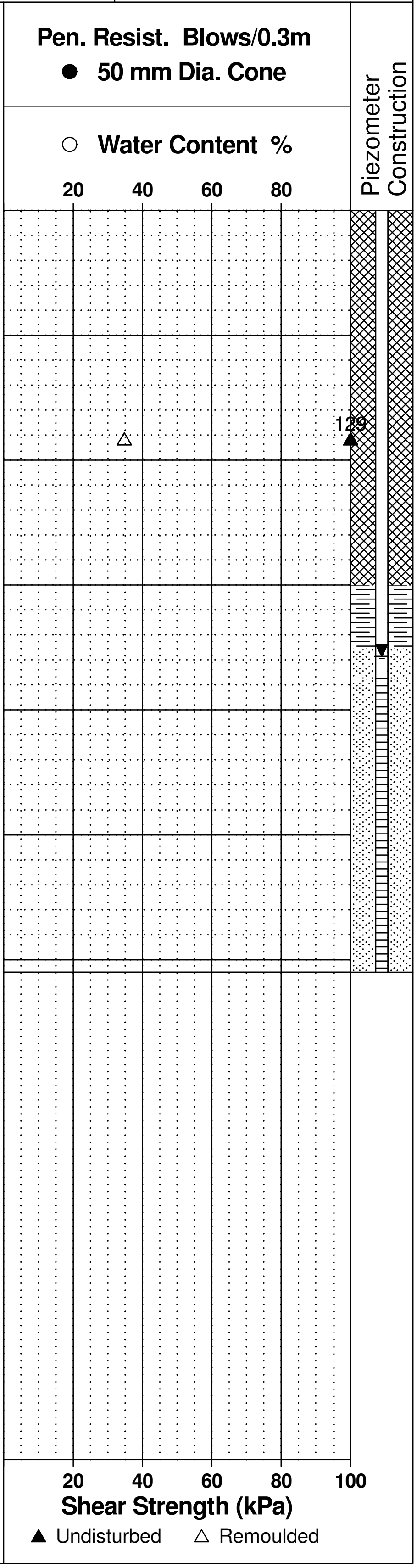
HOLE NO. BH 7-17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.18		AU	1				
Brown **SILTY CLAY**, trace sand		SS	2	100	8	1	
2.29						2	
GLACIAL TILL: Brown silty clay with sand, trace gravel and cobbles		SS	3	83	29	3	
		SS	4	67	36	4	
		SS	5	54	67	5	
		SS	6	67	46		
6.10		SS	7	83	41	6	

End of Borehole

Practical refusal to augering @ 6.10 m depth

(GWL @ 3.57m depth - Nov. 10, 2017)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH 8-17

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
TOPSOIL 0.03						
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles and boulders	SS	1	58	23	1	
	SS	2	0	+50		
	SS	3	11	+50	2	
	SS	4	88	17	3	
					4	
5.13	SS	5	100	61	5	

End of Borehole

Practical refusal to augering @ 5.13m depth

(GWL @ 0.39m depth - Nov. 10, 2017)

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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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH 9-17

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL	0.25	AU	1			0	
GLACIAL TILL: Brown silty sand, trace gravel cobbles and boulders		SS	2	79	33	1	
		SS	3	33	28	2	
		SS	4	63	45	3	
		SS	5	75	22		
		SS	6	79	46	4	
	4.88	SS	7	75	+50		

End of Borehole

Practical refusal to augering @ 4.88m depth

(GWL @ 0.73m depth - Nov. 10, 2017)

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

○ Water Content %

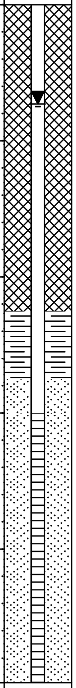
20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Development - 673 Rideau Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

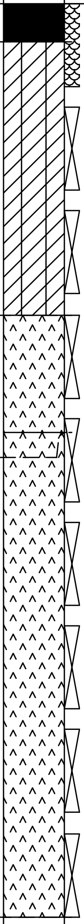
DATE 7 November 2017

FILE NO. PG2852

HOLE NO. BH10-17

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.28
Stiff, brown **SILTY CLAY**, trace sand	2.29
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles and boulders	3.15
GLACIAL TILL: Brown silty sand, trace gravel	6.71
End of Borehole	

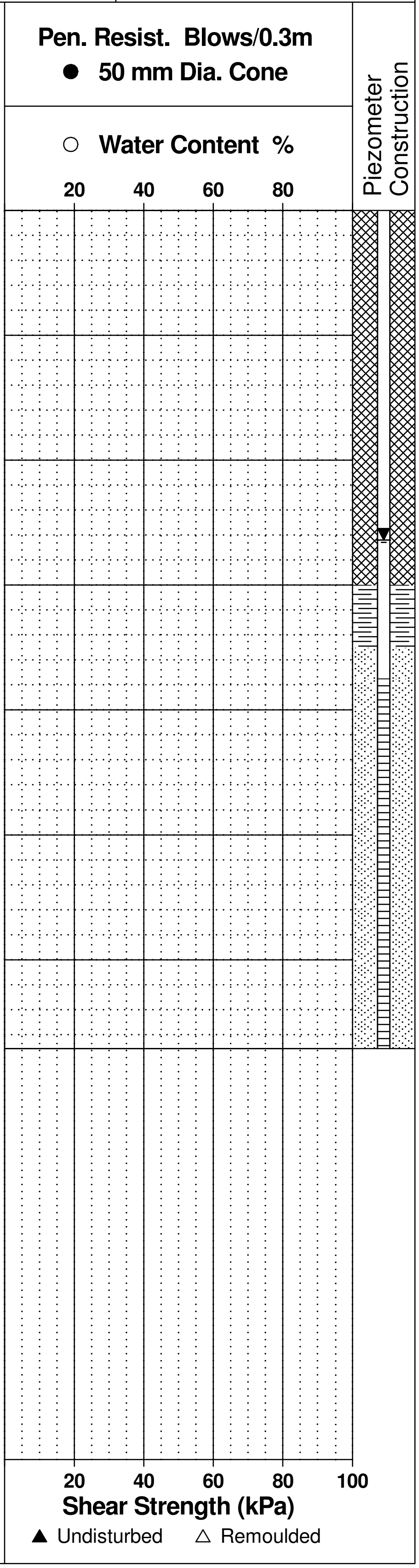
(GWL @ 2.64m depth - Nov. 10, 2017)



SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	8
SS	3	100	3
SS	4	42	9
SS	5	50	18
SS	6	54	11
SS	7	67	13
SS	8	92	10
SS	9	100	4

DEPTH (m) 0 1 2 3 4 5 6

ELEV. (m)



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 = $(D30)^2 / (D10 \times D60)$
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)

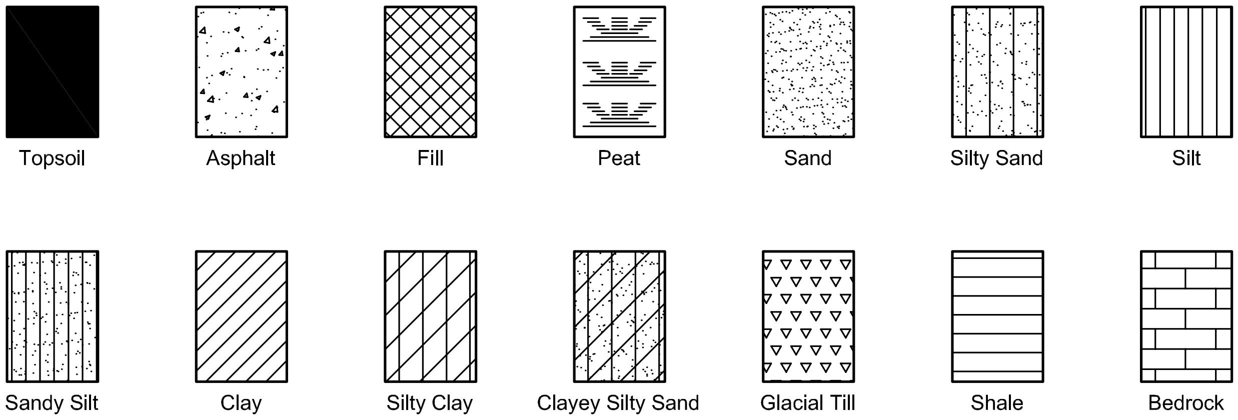
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

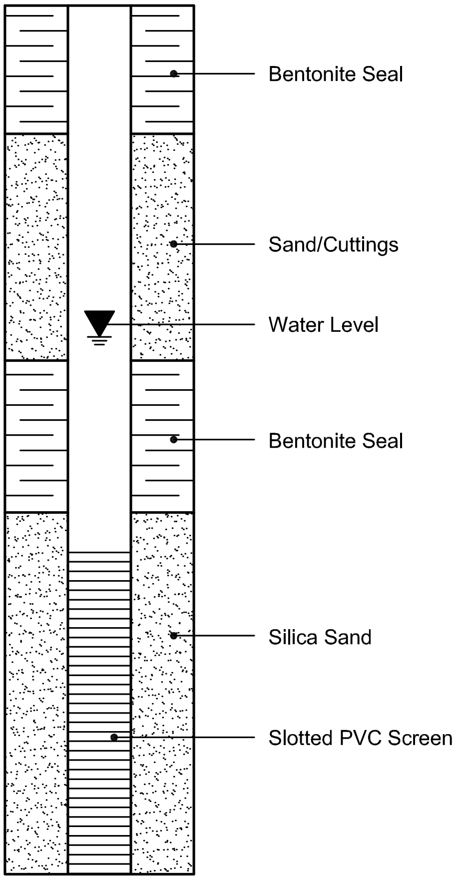
SYMBOLS AND TERMS (continued)

STRATA PLOT

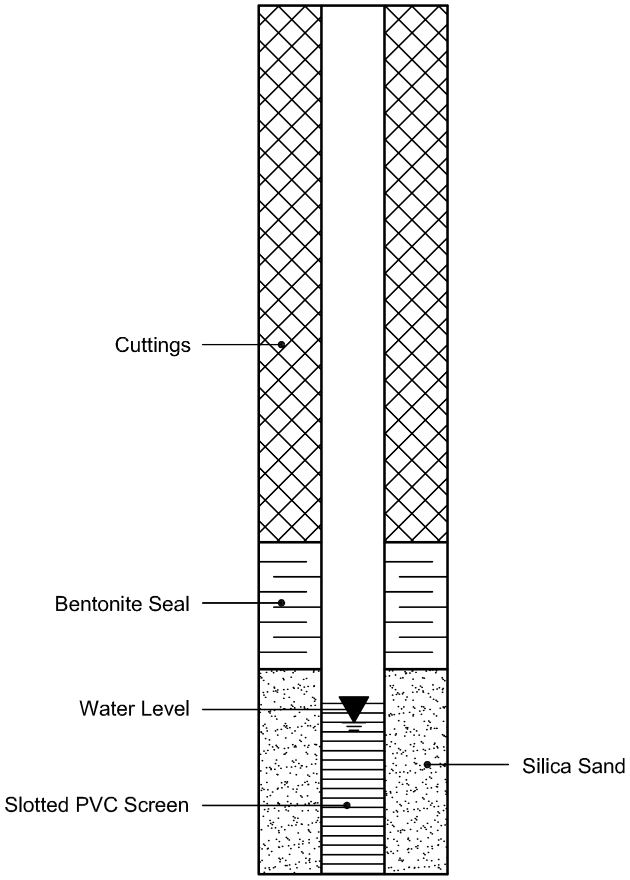


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 20-Mar-2013
Client: **Paterson Group Consulting Engineers**
Order Date:14-Mar-2013
Client PO: 13793
Project Description: PG2852

	Client ID:	BH2-SS3	-	-	-
	Sample Date:	01-Mar-13	-	-	-
	Sample ID:	1311217-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	89.3	-	-	-
General Inorganics					
pH	0.05 pH Units	7.72	-	-	-
Resistivity	0.10 Ohm.m	71.7	-	-	-
Anions					
Chloride	5 ug/g dry	9	-	-	-
Sulphate	5 ug/g dry	18	-	-	-

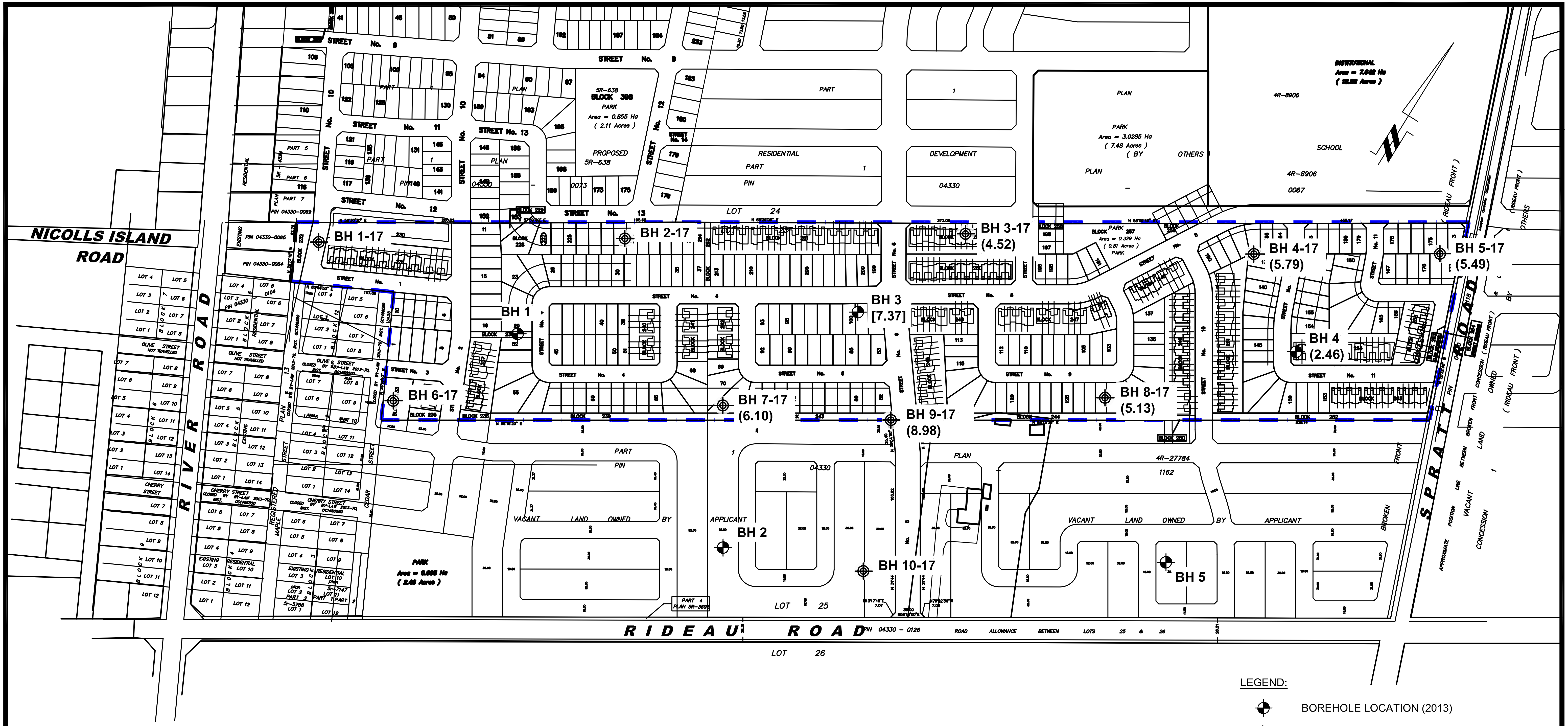
APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2852-1 - TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN



LEGEND:

⊕	BOREHOLE LOCATION (2013)
⊕	BOREHOLE LOCATION (2017)
(4.52)	PRACTICAL REFUSAL TO AUGERING DEPTH (m)
[7.37]	PRACTICAL DCPT REFUSAL DEPTH (m)

SCALE - 1:4000

0 25 50 100 200 300m

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale: 1:4000
Des.: SD
Dwn: AG
Chkd: DG

2356349 ONTARIO INC.

GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - 673 RIDEAU ROAD
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. PG2852-1
Report No.: PG2852-1R
Date: 11/2017

11x17