patersongroup

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Geotechnical Engineering
Environmental Engineering
Archaeological Studies
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Studies

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December 6, 2012
File: PG2823-LET.01

Taggart Realty
708-225 Metcalfe Street
Ottawa, Ontario
K2P 1P9

Attention: **Mr. Jeff Parkes**

Subject: **Preliminary Geotechnical Investigation**
Proposed Commercial Development
20 Cope Drive - Ottawa

Dear Sir,

Further to your request, Paterson Group (Paterson) conducted a preliminary geotechnical investigation for the proposed commercial development to be located at 20 Cope Drive, in the City of Ottawa. Details of the proposed development were not available at the time of writing this report.

1.0 Field Investigation

The field program for this investigation was conducted on November 7, 2012, and consisted of six (6) test pits advanced to a maximum depth of 4 m. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The borehole locations are shown on Drawing PG2823-1 - Test Hole Location Plan attached to the present letter.

2.0 Field Observations

The subject site is undeveloped, tree covered and approximately 1 to 2 m lower than Eagleson Road. The ground surface across the subject site slopes downward to the south.

The subsurface profile encountered at the test hole locations consisted of topsoil overlying a stiff to very stiff silty clay deposit. Reference should be made to the Soil Profile and Test Data sheets attached to the present letter for specific details of the soil profile encountered at the test pit locations.

Based on field observations, the long-term groundwater table is anticipated at a 3 to 3.5 m depth. Groundwater levels fluctuate seasonally and may be encountered at higher or lower levels during construction.

Based on available geological mapping, the bedrock in the immediate area consists of interbedded limestone and dolomite of the Gull River formation with an overburden thickness of 5 to 10 m depth.

3.0 Design and Construction Precautions

From a geotechnical perspective, the subject site is considered adequate for the proposed development. It is expected that lightly loaded structures will be founded on conventional shallow spread footings.

Due to the presence of a silty clay deposit, a preliminary permissible grade raise restriction of 1.5 m is recommended for the subject site. However, a higher permissible grade raise may be available for the subject site provided additional boreholes are completed to confirm the shear strength properties of the underlying silty clay deposit.

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

Site Grading and Preparation

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any building and other settlement sensitive structures.

Fill used for grading beneath the proposed building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery to the site. It 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 building should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Foundation Design

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed over 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) **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS. The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 15 mm, respectively.

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Above the groundwater level, adequate lateral support is provided to a silty clay or engineered fill 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.

Design for Earthquakes

The proposed building can be designed using a seismic site response **Class D** as defined in the Ontario Building Code 2006 (OBC 2006; Table 4.1.8.4.A) for shallow foundations considered at this site. The soils underlying the site are not susceptible to liquefaction.

Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, such as those containing organics, within the footprint of the proposed building, the native soil surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 150 to 200 mm of sub-slab fill consist of an OPSS Granular A crushed stone material. All backfill materials should be placed in maximum 300 mm thick loose layers and compacted to 98% of its SPMDD.

Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, 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.

Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation 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 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.

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.

The rate of flow of groundwater into the excavation through the silty clay should be low due to the relative impervious nature of these materials. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

Winter Construction

Precautions should be considered if construction occurs during the winter. The subsurface soil conditions 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. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during winter without introducing frost in the excavation subgrade base or walls. Precautions should be considered if such activities are to be completed during sub-zero temperatures.

4.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. A full geotechnical investigation should be completed to provide detailed design information for the proposed building, once development details are finalized.

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, we request that we be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Taggart Realty or their agents, without review by this firm for the applicability of our recommendations to the altered use of the report.

Best Regards,

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Carlos P. Da Silva, P.Eng.

Attachments

☐ Soil Profile and Test Data sheets
☐ Figure 1 - Key Plan
☐ Drawing PG2823-1 - Test Hole Location Plan

Report Distribution

☐ Taggart Realty (3 copies)
☐ Paterson Group (1 copy)

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

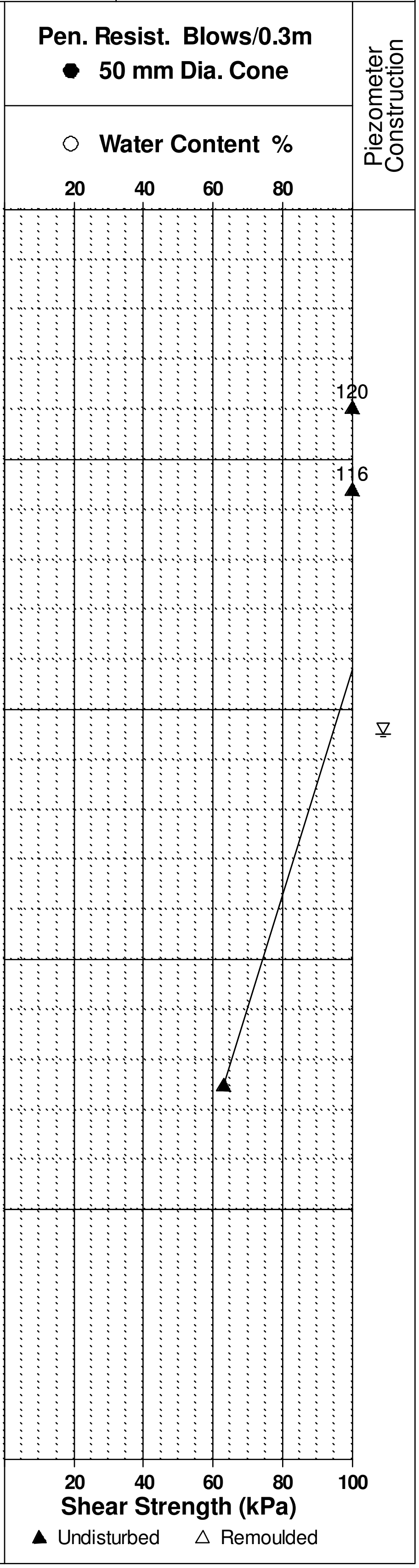
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.25	■	G	1				
Very stiff to stiff, brown **SILTY CLAY,** trace gravel and cobbles	▨	G	2				
	▨					1	
	▨	G	3				
	▨	G	4				
2.40	▨					2	
Stiff, grey-brown **SILTY CLAY** with sand seams	▨	G	5				
- grey by 3.4m depth	▨					3	
4.00	▨	G	6				
End of Test Pit (Groundwater infiltration at 2.1m depth)						4	



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

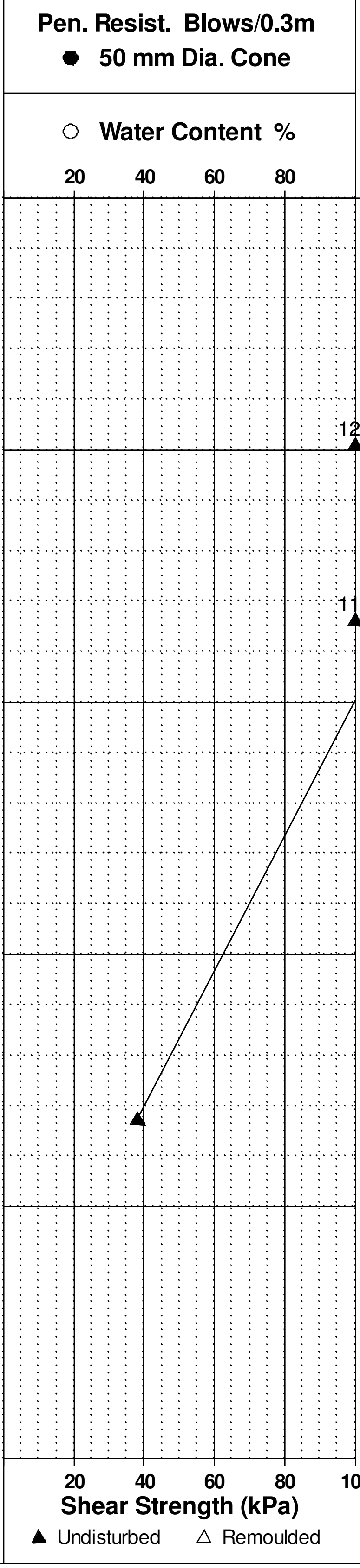
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
TOPSOIL 0.23	■							
	▨	G	1			1		
Very stiff to stiff, brown **SILTY CLAY** with rootlets and sand seams	▨	G	2					
	▨	G	3			2		
- grey-brown by 2.9m depth - firm and grey by 3.1m depth	▨	G	4			3		
4.00	▨	G	5			4		
End of Test Pit (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

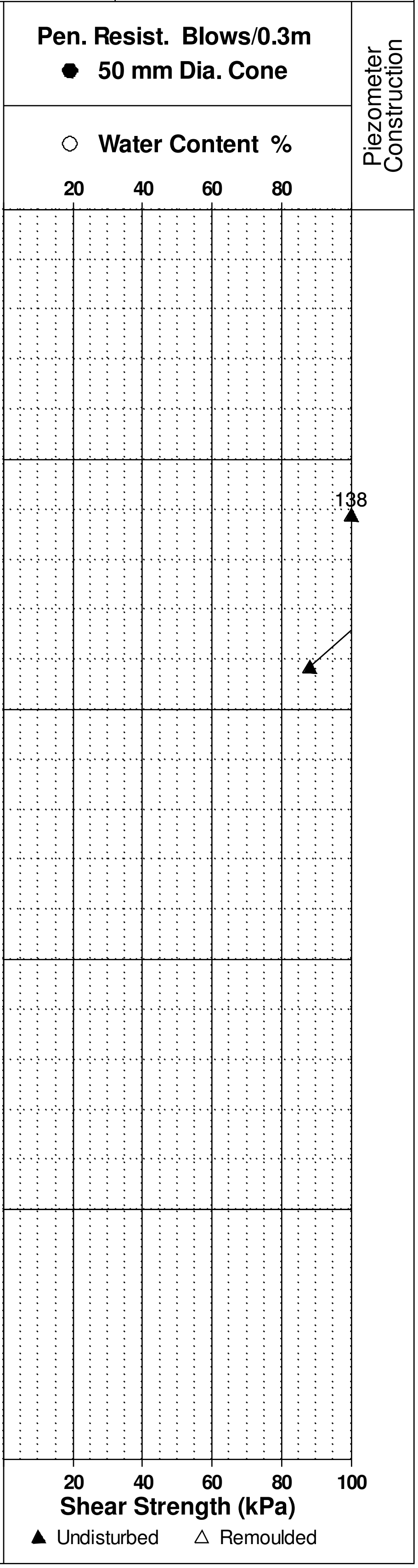
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.23	■						
	▨					1	
Very stiff to stiff, brown **SILTY CLAY,** trace rootlets, sand seams and cobbles	▨	G	1				
	▨	G	2			2	
2.84	▨	G	3				
Stiff to firm, grey **SILTY CLAY**	▨					3	
4.00	▨	G	4			4	
End of Test Pit (TP dry upon completion)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

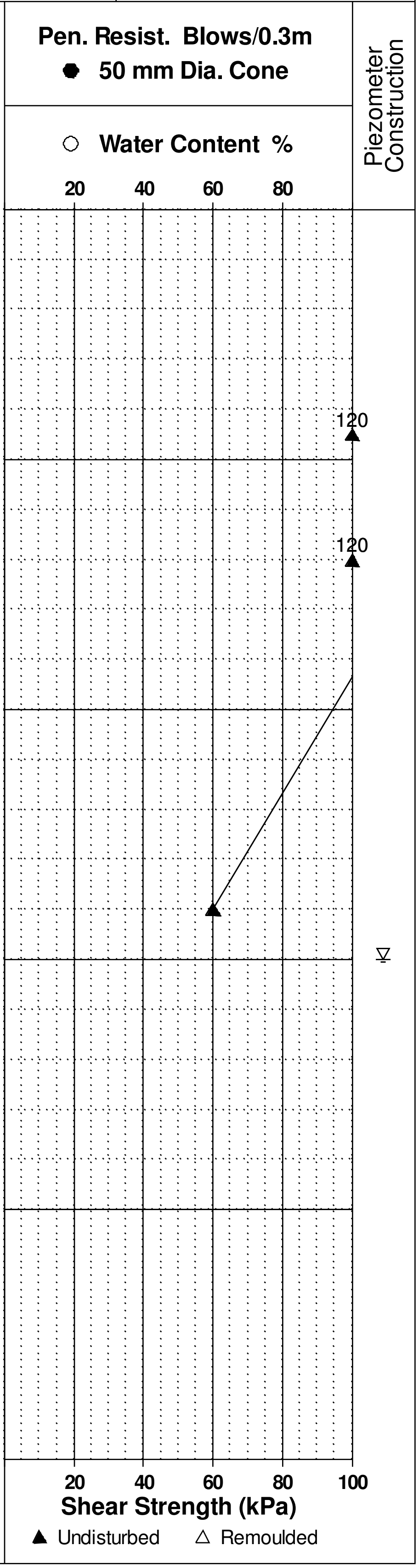
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.28	■						
Very stiff to stiff, brown **SILTY CLAY,** trace sand and rootlets	▨					1	
	▨	G	1				
	▨	G	2			2	
	▨	G	3				
3.20	▨					3	
Stiff, grey **SILTY CLAY**	▨	G	4				
4.00	▨					4	
End of Test Pit (Long term GWL @ 3.0m depth based on field observations)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

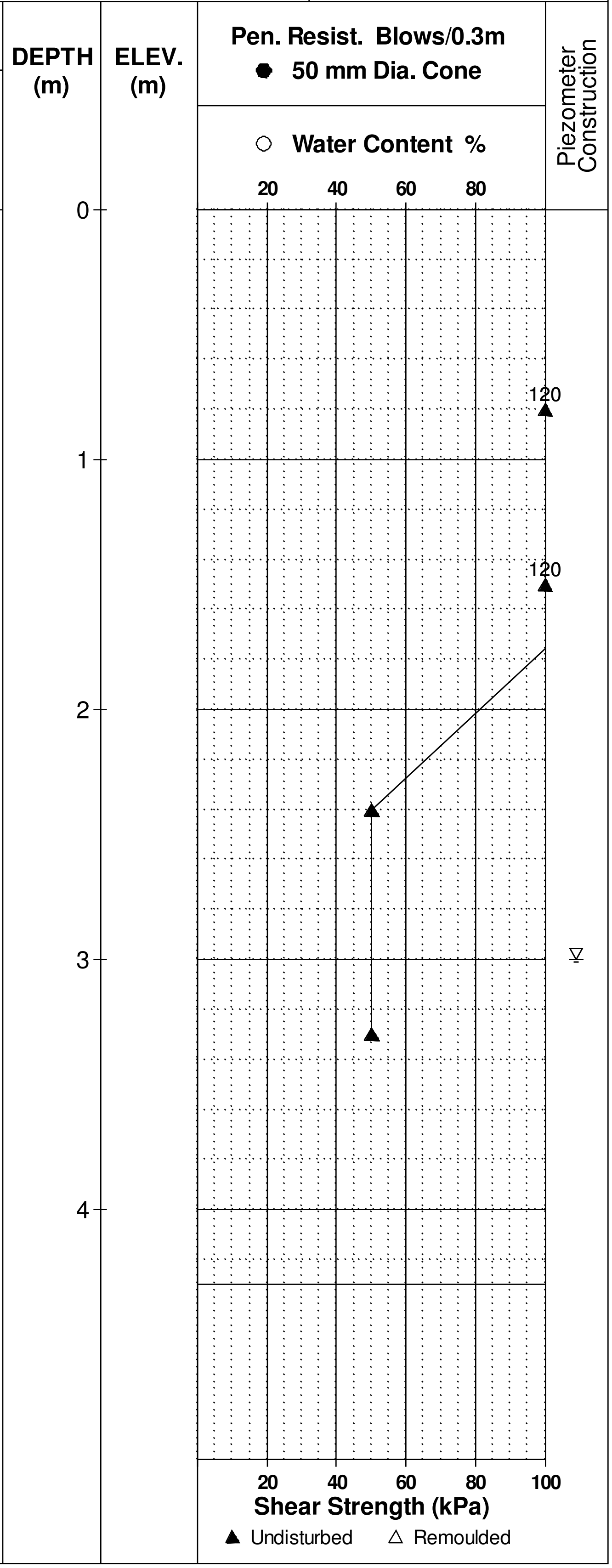
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL	■				
0.28					
Very stiff to stiff, brown **SILTY CLAY,** trace sand and rootlets	▨	G	1		
	▨	G	2		
	▨	G	3		
3.20					
Firm, grey **SILTY CLAY**	▨				
4.30					
End of Test Pit (Long term GWL @ 3.0m depth based on field observations)					



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - 20 Cope Drive
Ottawa, Ontario

DATUM

REMARKS

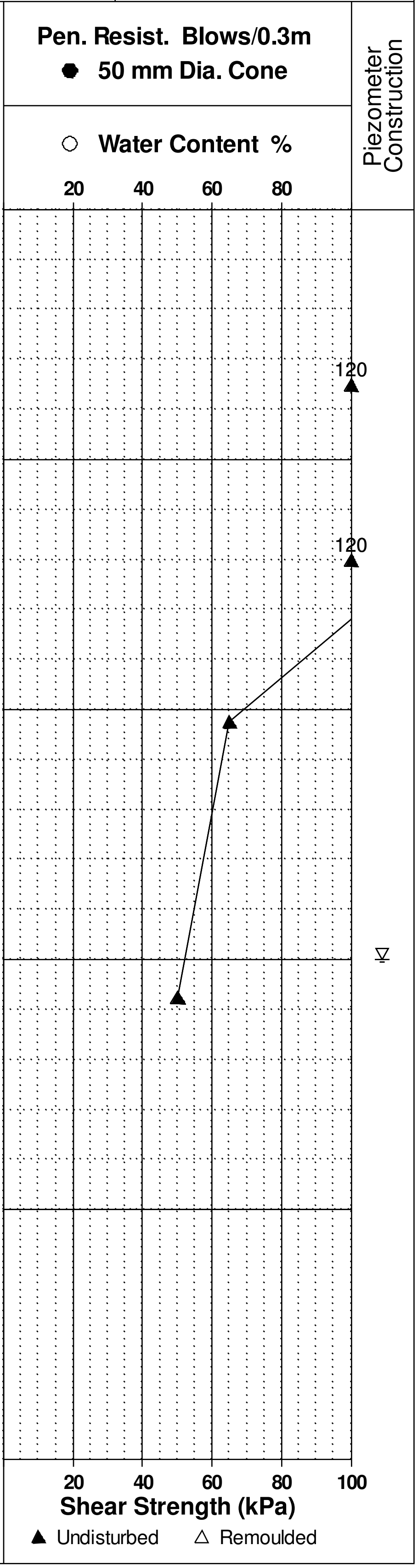
BORINGS BY Backhoe

DATE November 7, 2012

FILE NO. PG2823

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.18	■						
Very stiff to stiff, brown **SILTY CLAY,** trace sand 3.15	▨	G G G	1 2 3			1 2 3	
Stiff, grey **SILTY CLAY** 4.00	▨	G	4			4	
End of Test Pit (Long term GWL @ 3.0m depth based on field observations)							



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)

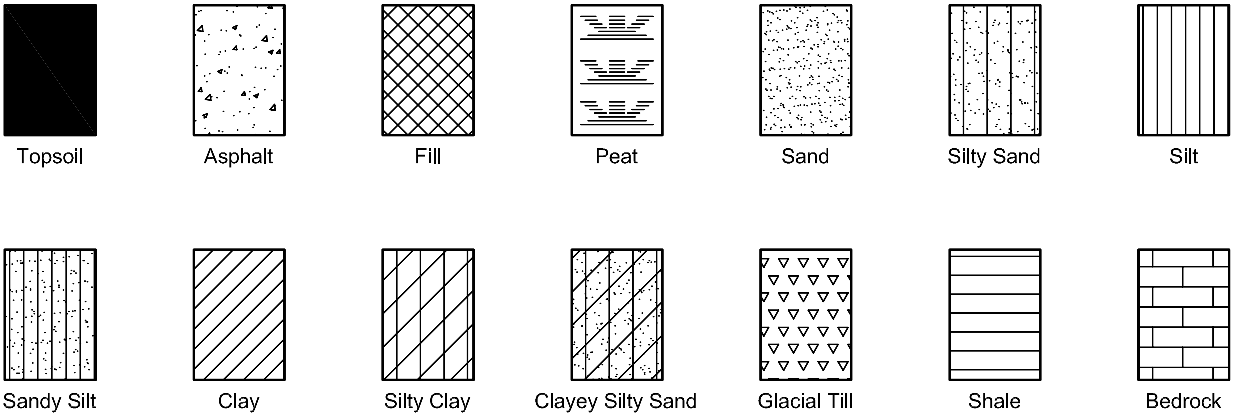
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

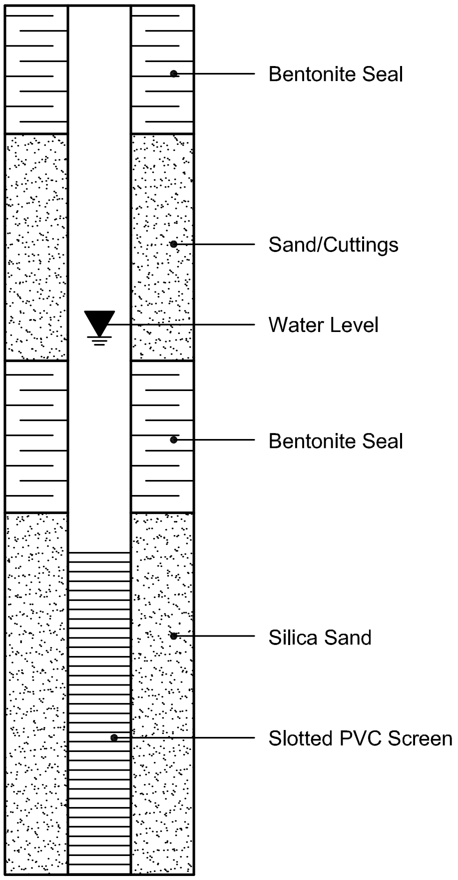
SYMBOLS AND TERMS (continued)

STRATA PLOT

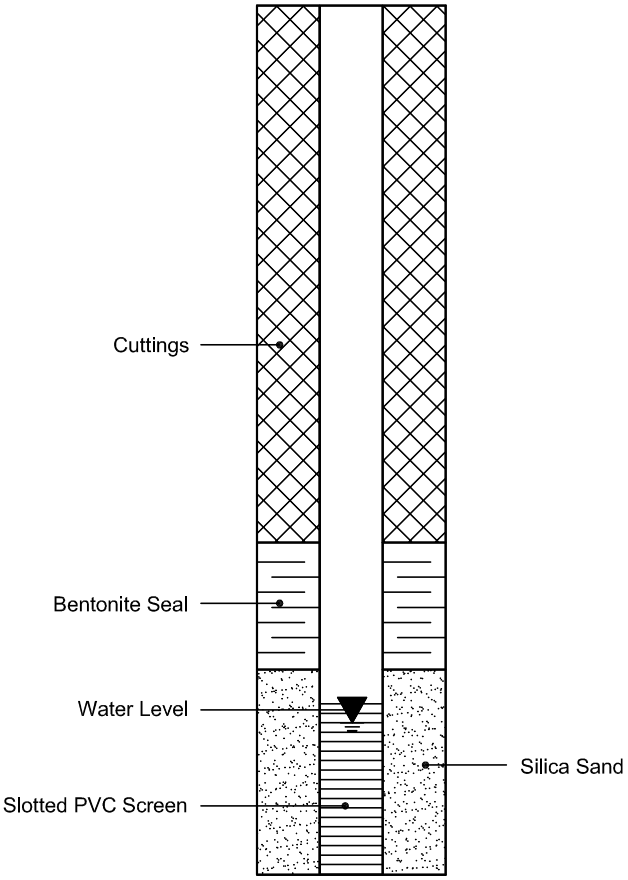


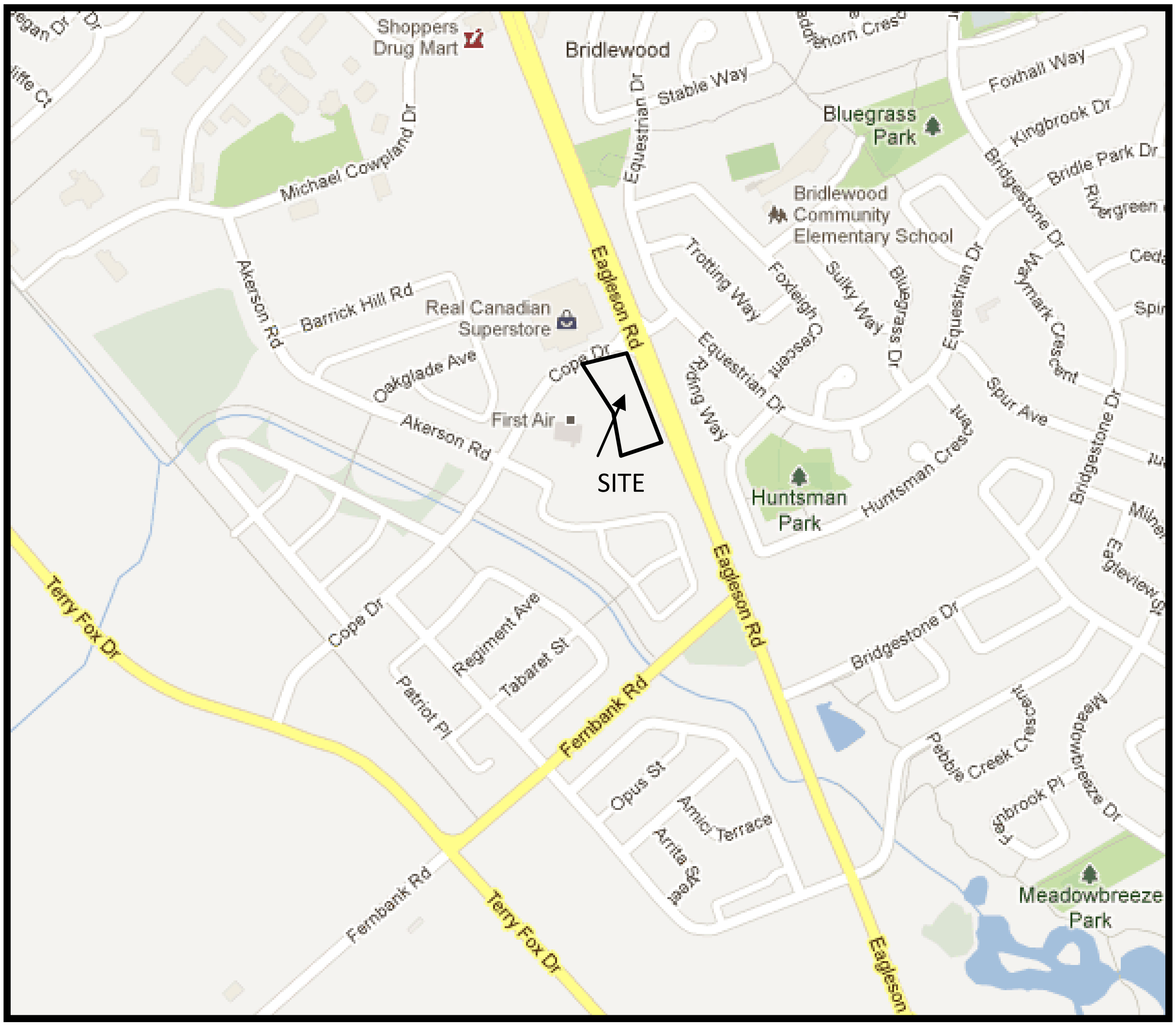
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



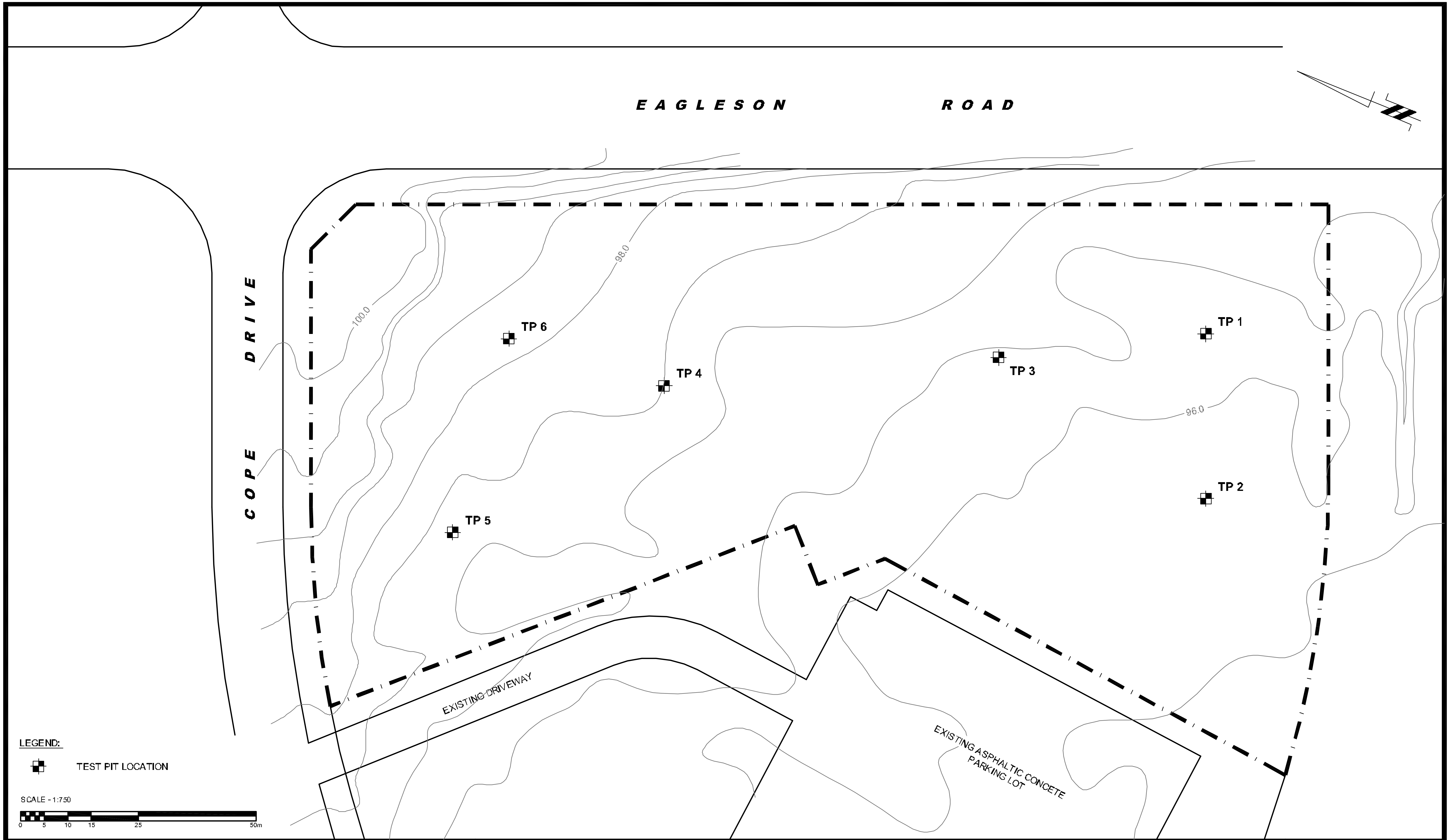
PIEZOMETER CONSTRUCTION





<u>FIGURE 1</u>

KEY PLAN



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Scale: 1:750
Des.: YM
Dwn: MPG
Chkd: DG

TAGGART REALTY

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROP. COMMERCIAL DEVELOPMENT - 20 COPE DRIVE
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. PG2823-1
Report No.: PG2823-1
Date: 11/2012

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