Geotechnical Engineering

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Materials Testing

Building Science

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Preliminary Geotechnical Investigation

Future Development Lands
1075 March Road
Ottawa, Ontario

Prepared For

7089121 Canada Inc

April 19, 2013

Report: PG2878-3

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by 7089121 Canada Inc to conduct a preliminary geotechnical investigation for the future development lands to be located at 1075 March Road in the City of Ottawa (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 test holes.
- ❏ Provide geotechnical recommendations pertaining to 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.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation.

2.0 PROPOSED DEVELOPMENT

Details of the development were not available at the time of issuance of this report. It is anticipated that the proposed development will consist of low rise residential and commercial buildings. It is further anticipated that the development will be municipally serviced and include local roadways, parking and landscaped areas.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

The field investigation was completed on March 21, 2012, which consisted of twelve (12) test pits advancing to a maximum depth of 4.3 m. The test holes were distributed in a manner to provide general coverage of the proposed development. The locations were determined in the field by Paterson personnel taking into consideration site features and underground services. Locations of the test holes are shown in Drawing PG2878-3 - Test Hole Location Plan included in Appendix 2.

Test pits were excavated using a hydraulic shovel. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The excavation procedures consisted of advancing each test hole to the required depths at the selected locations and sampling the overburden. Sampling and testing the overburden was completed in general accordance with ASTM D5434-12 - Guide for Field Logging of Subsurface Explorations of Soil and Rock.

Sampling and In Situ Testing

Soil samples from the test pits were recovered from the side walls of the open excavation and all soil samples were initially classified on site. All samples were transported to our laboratory for further examination and classification. The depths at which the grab samples were recovered from the test holes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Undrained shear strength testing, using a hand held vane apparatus, was carried out at regular intervals of depth in cohesive soils.

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

Groundwater

Open hole groundwater infiltration levels were observed at the time of excavation at each test pit location. Our observations are presented in the Soil Profile and Test Data sheets in Appendix 1.

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 test pit locations were selected by Paterson and located and surveyed in the field by Annis O'Sullivan Vollebekk. All ground surface elevations at the test hole locations are referenced to a geodetic datum. The test pit locations completed for investigation are presented on Drawing PG2878-3 - 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. The subsurface soils were classified in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

3.4 Analytical Testing

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

4.0 OBSERVATIONS

4.1 Surface Conditions

The subject site is currently undeveloped, agricultural land. The ground surface across the site is relatively flat and a shallow ditch was noted across the subject site.

4.2 Subsurface Profile

Generally, the subsoil conditions at the test hole locations consist of topsoil underlain by very stiff brown silty clay and/or glacial till. Practical refusal to excavation was noted throughout the subject site.

Specific details of the soil profile at each test hole location can be seen on the Soil Profile and Test Data sheets in Appendix 1.

Based on available geological mapping (NR Can), the subject site is located in an area where the bedrock consists of interbedded sandstone and dolostone of the March formation. The overburden drift thickness is estimated to be between 1 to 3 m.

4.3 Groundwater

Groundwater levels (GWL) were measured in the test pits upon completion of the field program. All test pits were noted to be dry upon completion, except TP 35 and TP 36 where groundwater was noted at a 2.7 and 2.6 m depth, respectively. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 DISCUSSION

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the anticipated development. It is expected that low rise wood framed buildings could be founded on conventional shallow footings placed on an undisturbed, stiff silty clay, compact glacial till or surface-sounded bedrock bearing surface.

A permissible grade raise restriction is required for the proposed residential development where the silty clay layer is present below the proposed buildings.

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

5.2 Site Grading and 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.

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.

Bedrock Removal

It is expected that line-drilling in conjunction with hoe-ramming or controlled blasting may required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

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

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

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

Excavation side slopes in sound bedrock can be carried out using almost vertical side walls. A minimum 1 m horizontal ledge, should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system. However, should the entire area be required to accommodate the parking garage, drilled piles into the weathered portion of the bedrock can be used to support the upper levels of the excavation and can be placed at the property boundary.

Vibration Considerations

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

The following construction equipments could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system using soldier piles or sheet piling will require the use of this equipment. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). It should be noted that these guidelines are for today's construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill 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. 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. 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

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 state (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit state (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 **225 kPa**. Footings placed on a clean, weathered bedrock can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **750 kPa**.

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 clean, weathered bedrock surface consists of one from which all topsoil, soils, deleterious materials and loose rock have been removed prior to concrete placement.

Footings designed using the 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 value at ULS.

A **permissible grade raise restriction of 2 m** is recommended for areas where building foundations are founded over a silty clay deposit. Areas effected by a permissible grade raise restriction due to the presence of a silty clay deposit are indicated in Drawing PG2878-4 - Permissible Grade Raise Plan - Housing in Appendix 2. Footings bearing on a dense glacial till or bedrock surface 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 stiff silty clay or compact 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.

The bearing resistance value given for footings at SLS will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered within the west and central portion of the subject site. A higher site class, such as site Class A or B may be applicable for the subject site, but would need to be confirmed with site specific shear wave velocity testing.

Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2006 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill from within the footprint of the proposed buildings, the native soil surface or approved engineered fill surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. 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 200 mm of sub-floor fill consists of 19 mm clear crushed stone. All backfill material 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.

6.0 DESIGN AND CONSTRUCTION PRECAUTIONS

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, 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 site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

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.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

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

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to a minimum of 95% of the material’s SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used.

Trench backfill material within the frost zone (approximately 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce 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

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.

Pumping of more than 50,000 L/day to an off site receptor requires a temporary Ontario Ministry of Environment (MOE) permit to take water (PTTW). During service installation for the proposed development, it is anticipated that a PTTW should be taken to avoid any delays at the time of construction. At least 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

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. Additional information could be provided, if required.

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 chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

7.0 RECOMMENDATIONS

It is a requirement for the foundation design data provided herein to be applicable that the following material testing and observation program 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 the completion of a satisfactory inspection program by the geotechnical consultant.

8.0 STATEMENT OF LIMITATIONS

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available. Also, our recommendations should be reviewed when the project drawings and specifications are complete.

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 7089121 Canada 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.

Stephanie Boisvenue, B.Eng.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
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PROVINCE OF ONTARIO

Report Distribution:

- ☐ 7089121 Canada Inc (3 copies)
- ☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425287; 5023780

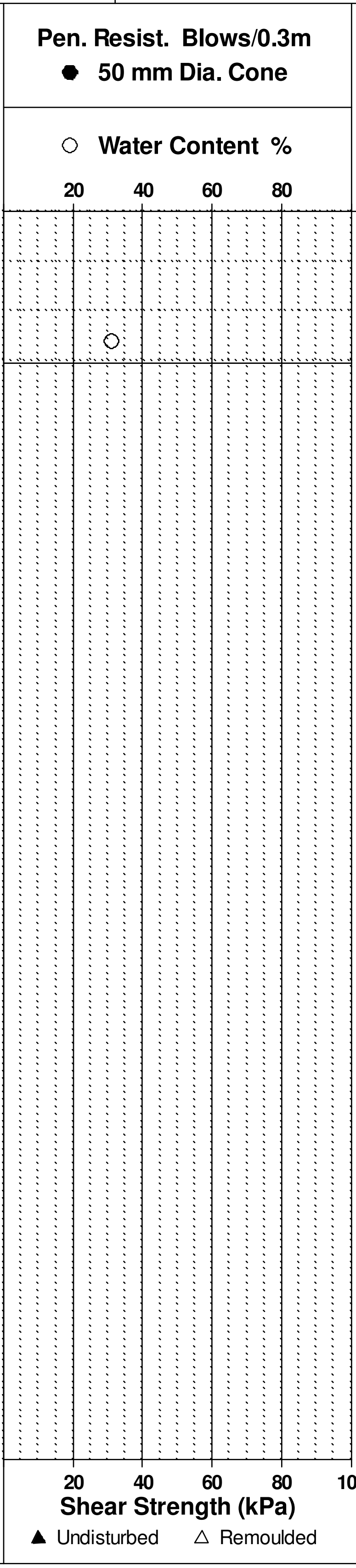
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	89.66	
TOPSOIL 0.30	■							
Very stiff to stiff, brown **SILTY CLAY** 0.61	▨	G	1					
End of Test Pit Practical refusal to excavation on possible bedrock surface at 0.61m depth (TP dry upon completion)								



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425362; 5023727

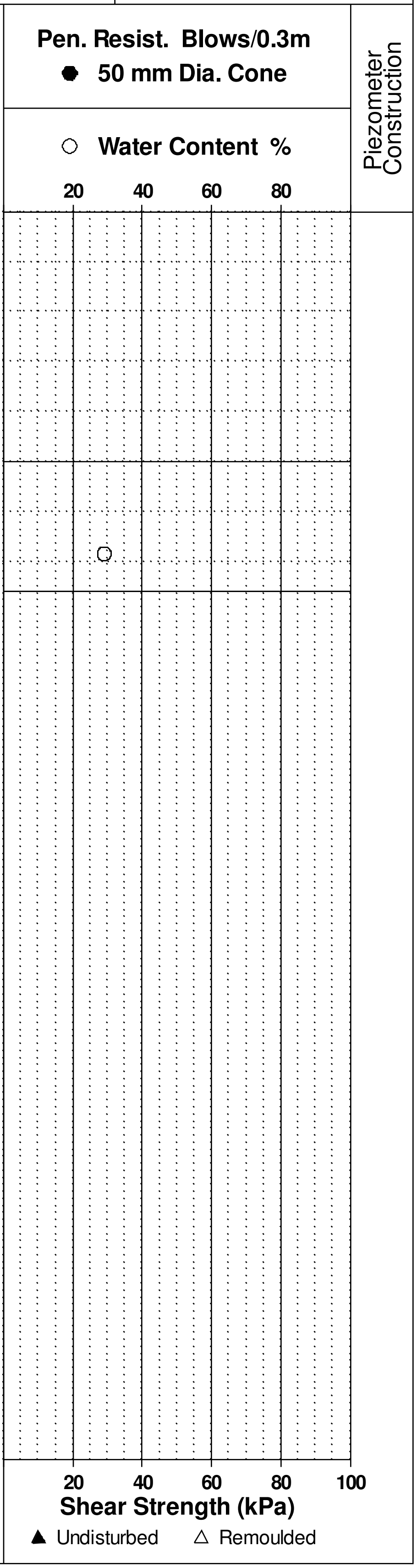
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP26

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.74
TOPSOL 0.60	■						
Very stiff to stiff, brown **SILTY CLAY** 1.22	▨					1	88.74
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 1.52	^^^	G	1				
End of Test Pit Practical refusal to excavation on possible bedrock surface at 1.52m depth (TP dry upon completion)							



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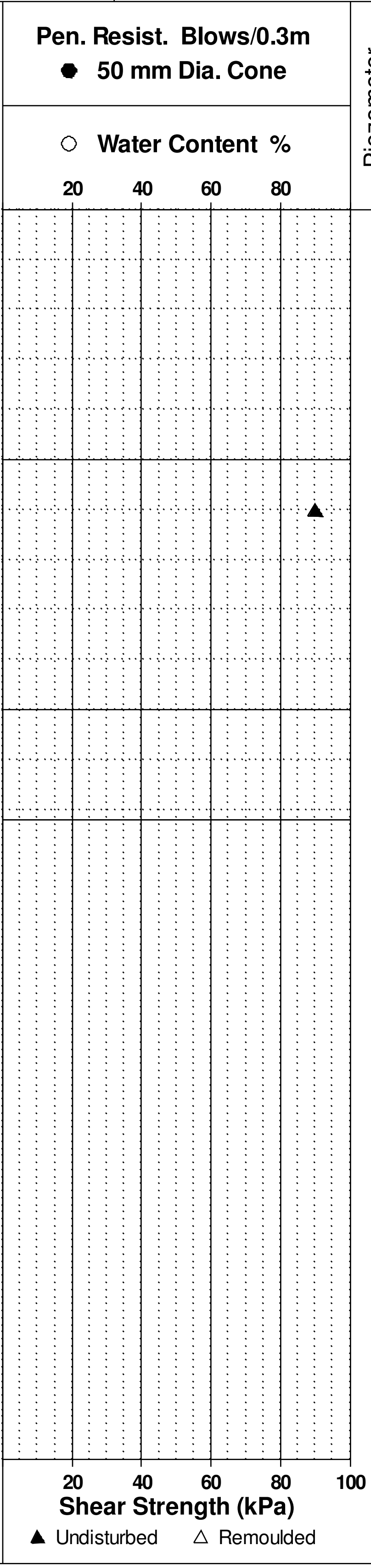
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.
REMARKS 18T 0425446; 5023599
BORINGS BY Hydraulic Excavator
DATE March 21, 2013
FILE NO. PG2878
HOLE NO. TP27

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	88.96	
TOPSOIL 0.60								
Very stiff to stiff, brown **SILTY CLAY,** trace sand						1	87.96	
2.44						2	86.96	
End of Test Pit Practical refusal to excavation on possible bedrock surface at 2.44m depth (TP dry upon completion)								



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425582; 5023702

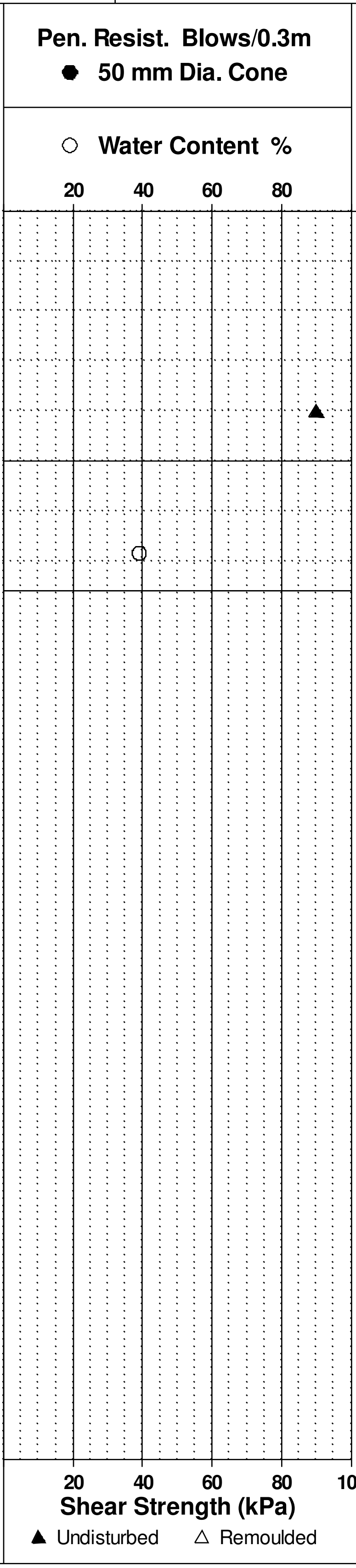
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP28

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.85
TOPSOIL 0.41							
Very stiff to stiff, brown **SILTY CLAY** 1.52		G	1			1	85.85
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 1.52m depth (TP dry upon completion)							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425480; 5023826

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP29

SOIL DESCRIPTION		STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
			TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE							0	86.13
TOPSOIL	0.41							
Firm to stiff, brown **SILTY CLAY**	1.07						1	85.13
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	1.52		G	1				

End of Test Pit

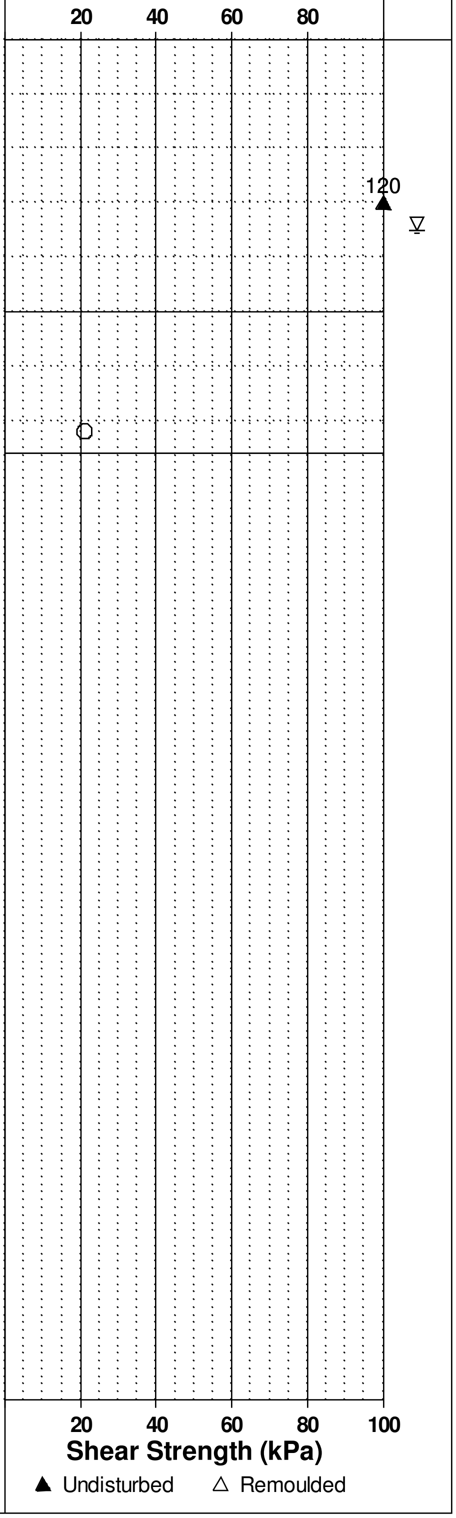
Practical refusal to excavation on possible bedrock surface at 1.52m depth

(GWL @ 0.7m depth based on field observations)

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

○ Water Content %

Piezometer Construction



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425420; 5023875

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

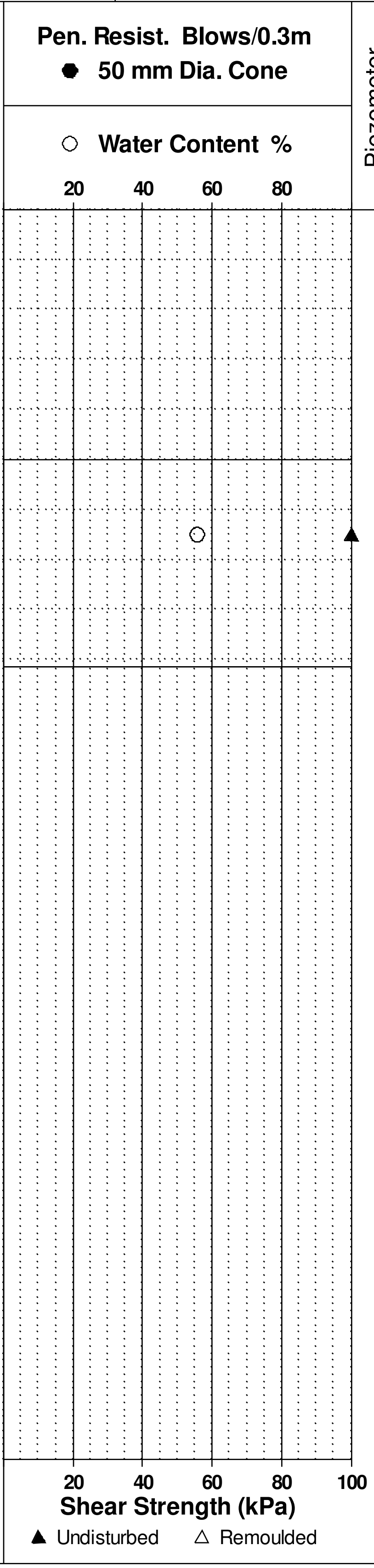
HOLE NO. TP30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.42
TOPSOIL 0.38	■						
Very stiff to stiff, brown **SILTY CLAY,** trace sand	▨					1	85.42
	▨	G	1				
1.83	▨						

End of Test Pit

Practical refusal to excavation on possible bedrock surface at 1.83m depth

(TP dry upon completion)



Piezometer Construction

patersongroup Consulting Engineers

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SOIL PROFILE AND TEST DATA

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DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425562; 5023981

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP31

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	88.37		
TOPSOIL 0.41									
Stiff, brown **SILTY CLAY,** some sand, trace gravel 0.81									
End of Test Pit Practical refusal to excavation on possible bedrock surface at 0.81m depth (TP dry upon completion)									

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

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DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425629; 5023917

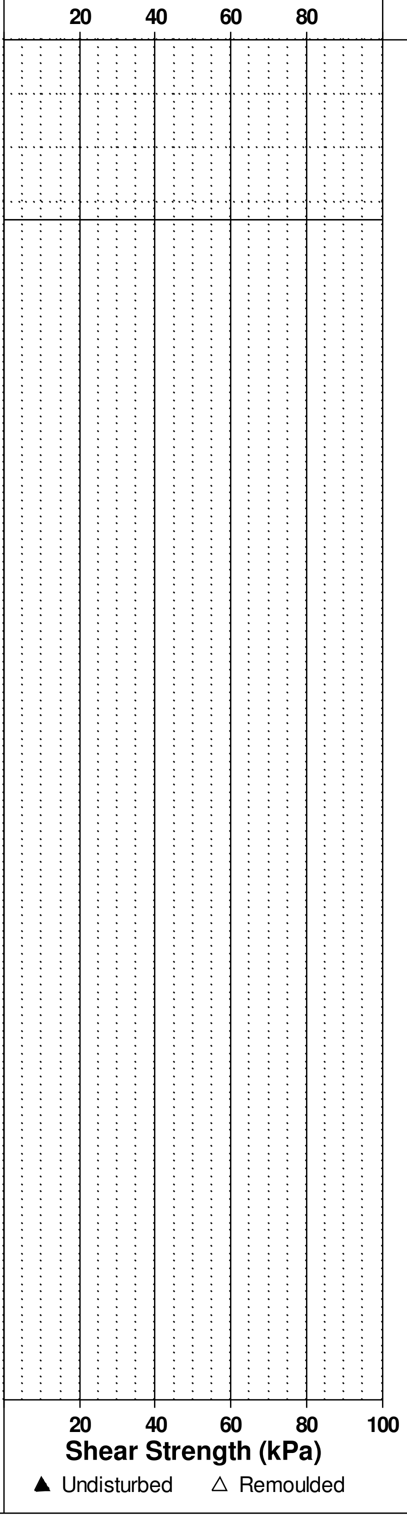
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP32

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
GROUND SURFACE						0	86.81		
TOPSOIL 0.66	■								
End of Test Pit Practical refusal to excavation on possible bedrock surface at 0.66m depth (TP dry upon completion)									



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425702; 5023822

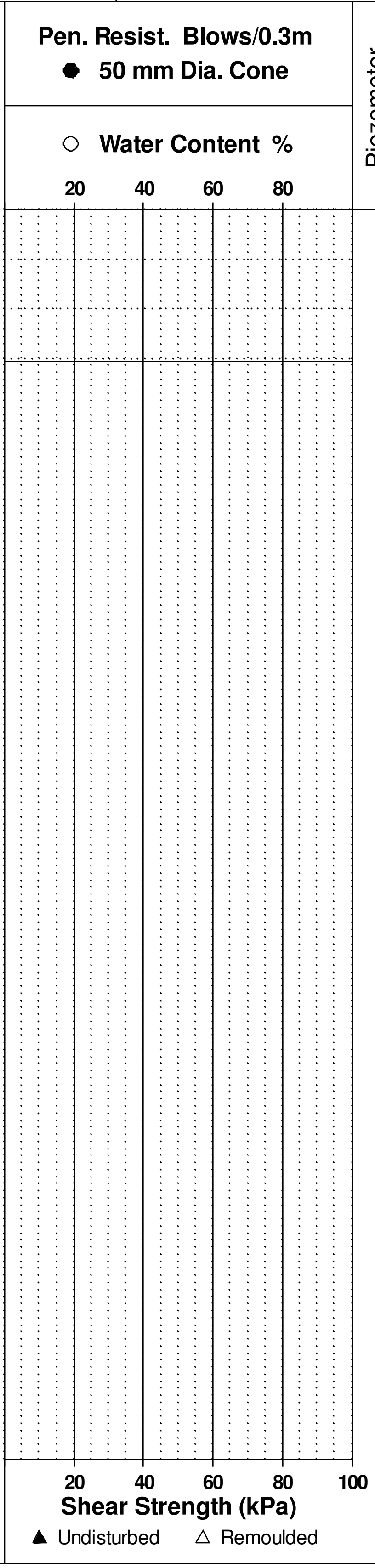
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP33

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.00
TOPSOIL 0.61	■						
End of Test Pit Practical refusal to excavation on possible bedrock surface at 0.61m depth (TP dry upon completion)							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425799; 5023895

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

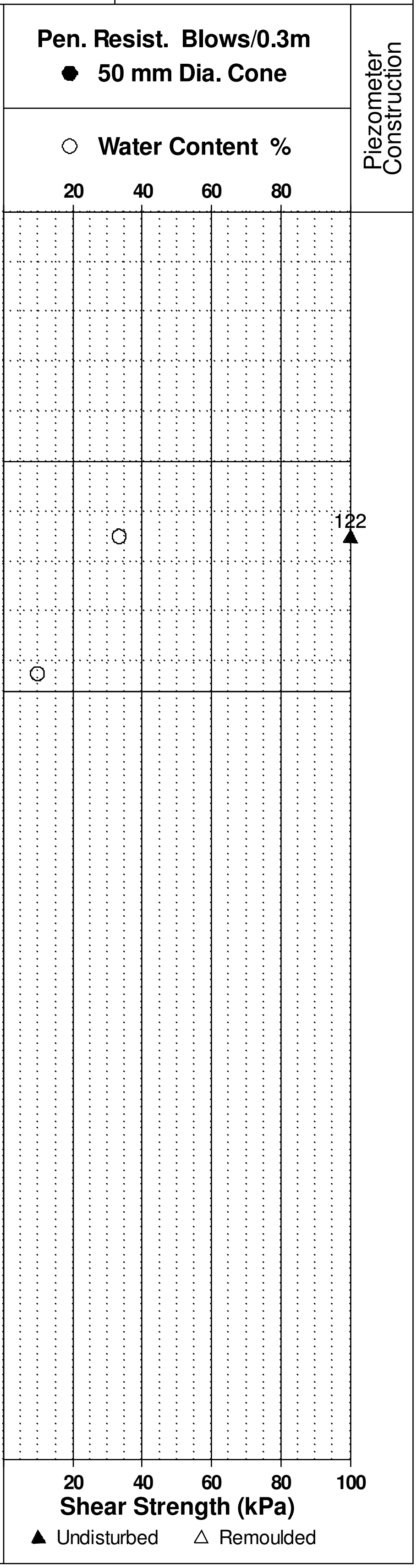
HOLE NO. TP34

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.02
TOPSOIL 0.41							
Hard to very stiff, brown **SILTY CLAY**						1	83.02
		G	1				
1.52							
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulder,		G	2				
1.92							

End of Test Pit

Practical refusal to excavation on possible bedrock surface at 1.92m depth

(TP dry upon completion)



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425826; 5024040

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

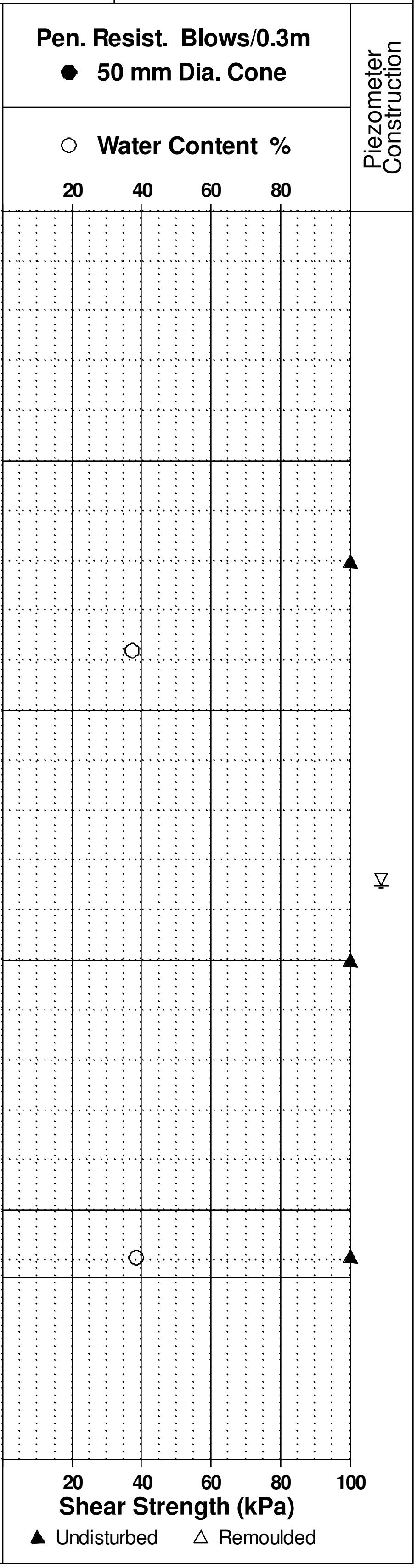
FILE NO. PG2878

HOLE NO. TP35

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.99
TOPSOIL 0.46	■						
	▨					1	81.99
	▨	G	1				
Hard to very stiff, brown **SILTY CLAY**	▨					2	80.99
	▨					3	79.99
	▨					4	78.99
4.27	▨	G	2				

End of Test Pit
Practical refusal to excavation on possible bedrock surface at 4.27m depth

(GWL @ 2.7m depth based on field observations)



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425699; 5024001

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

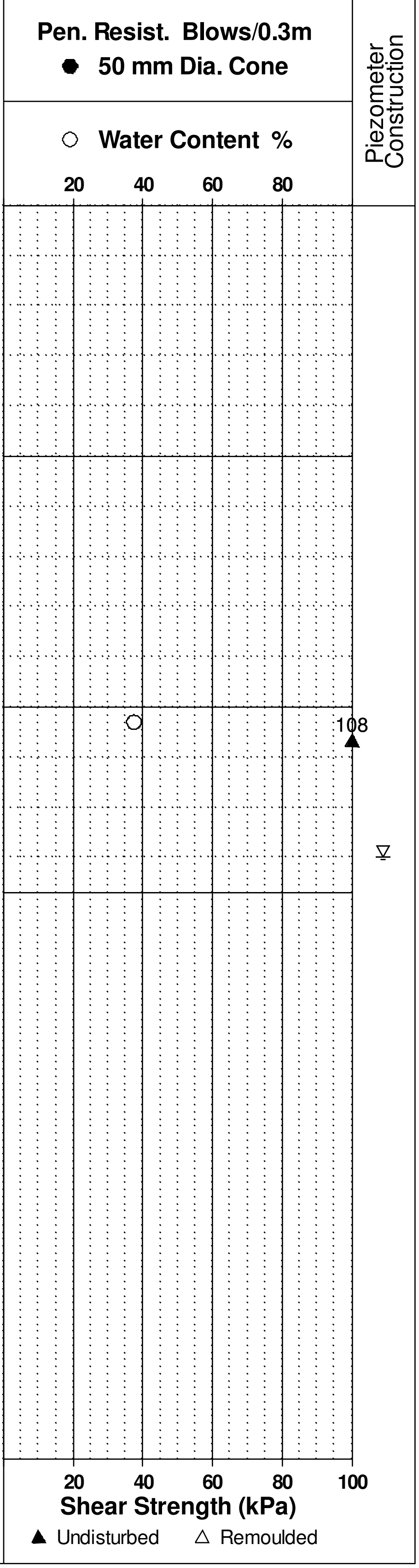
HOLE NO. TP36

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.76
TOPSOIL	■						
0.41						1	83.76
Hard to very stiff, brown **SILTY CLAY**	▨	G	1			2	82.76
2.74							

End of Test Pit

Practical refusal to excavation on possible bedrock surface at 2.74m depth

(GWL @ 2.6m 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 = $(D30)^2 / (D10 \times D60)$
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)

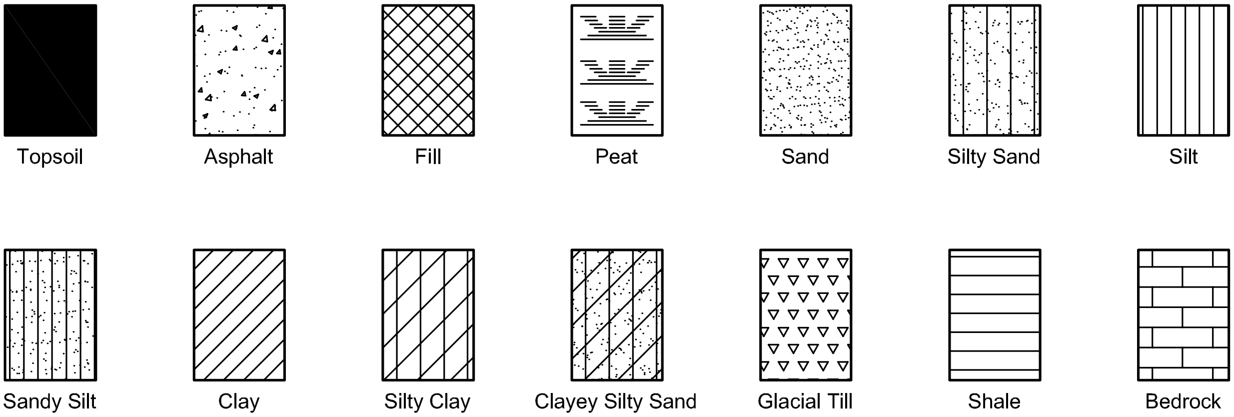
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

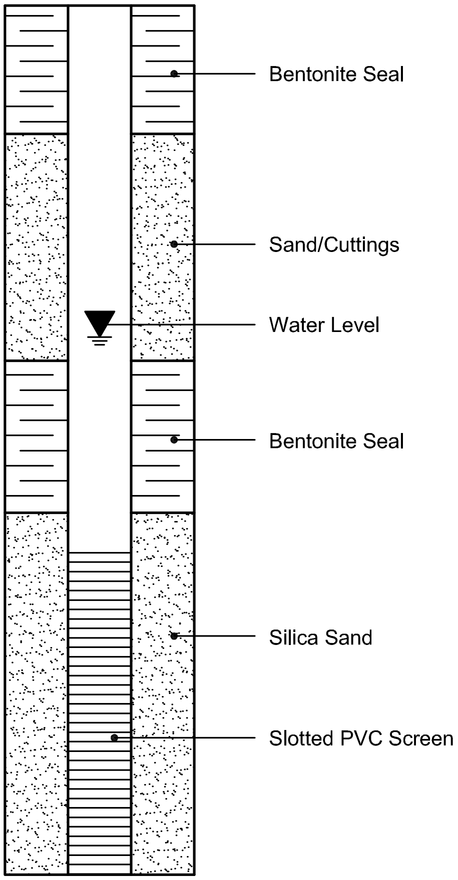
SYMBOLS AND TERMS (continued)

STRATA PLOT

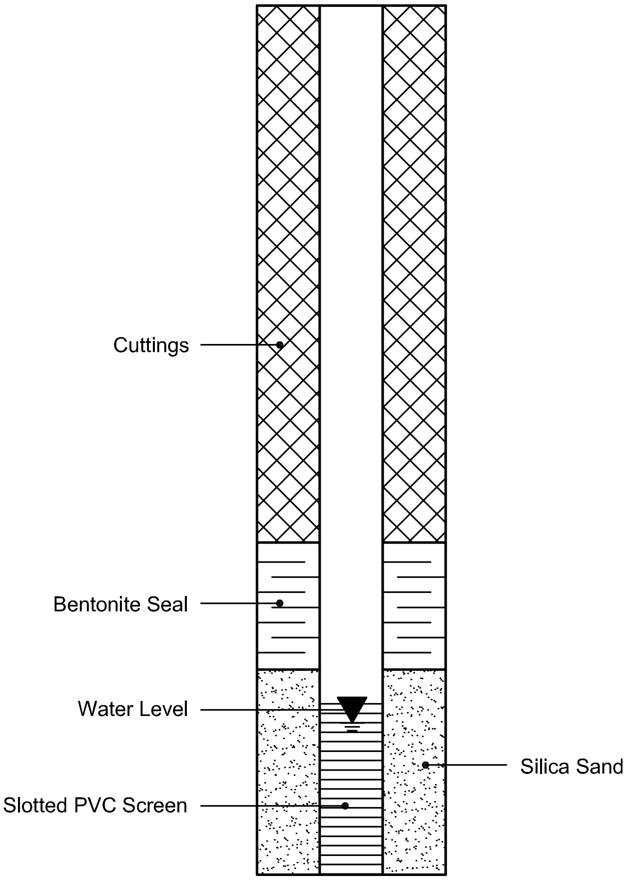


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Order #: 1312271

Certificate of Analysis

Report Date: 27-Mar-2013
Order Date:22-Mar-2013

Client: **Paterson Group Consulting Engineers**
Client PO: 13814
Project Description: PG2878

Client ID:			TP30-G1	-	-
Sample Date:			21-Mar-13	-	-
Sample ID:			1312271-02	-	-
	MDL/Units		Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.		62.4	-	-
General Inorganics					
pH	0.05 pH Units		7.18	-	-
Resistivity	0.10 Ohm.m		67.2	-	-
Anions					
Chloride	5 ug/g dry		<5	-	-
Sulphate	5 ug/g dry		75	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2878-3 - TEST HOLE LOCATION PLAN

DRAWING PG2878-4 - PERMISSIBLE GRADE RAISE PLAN - HOUSING

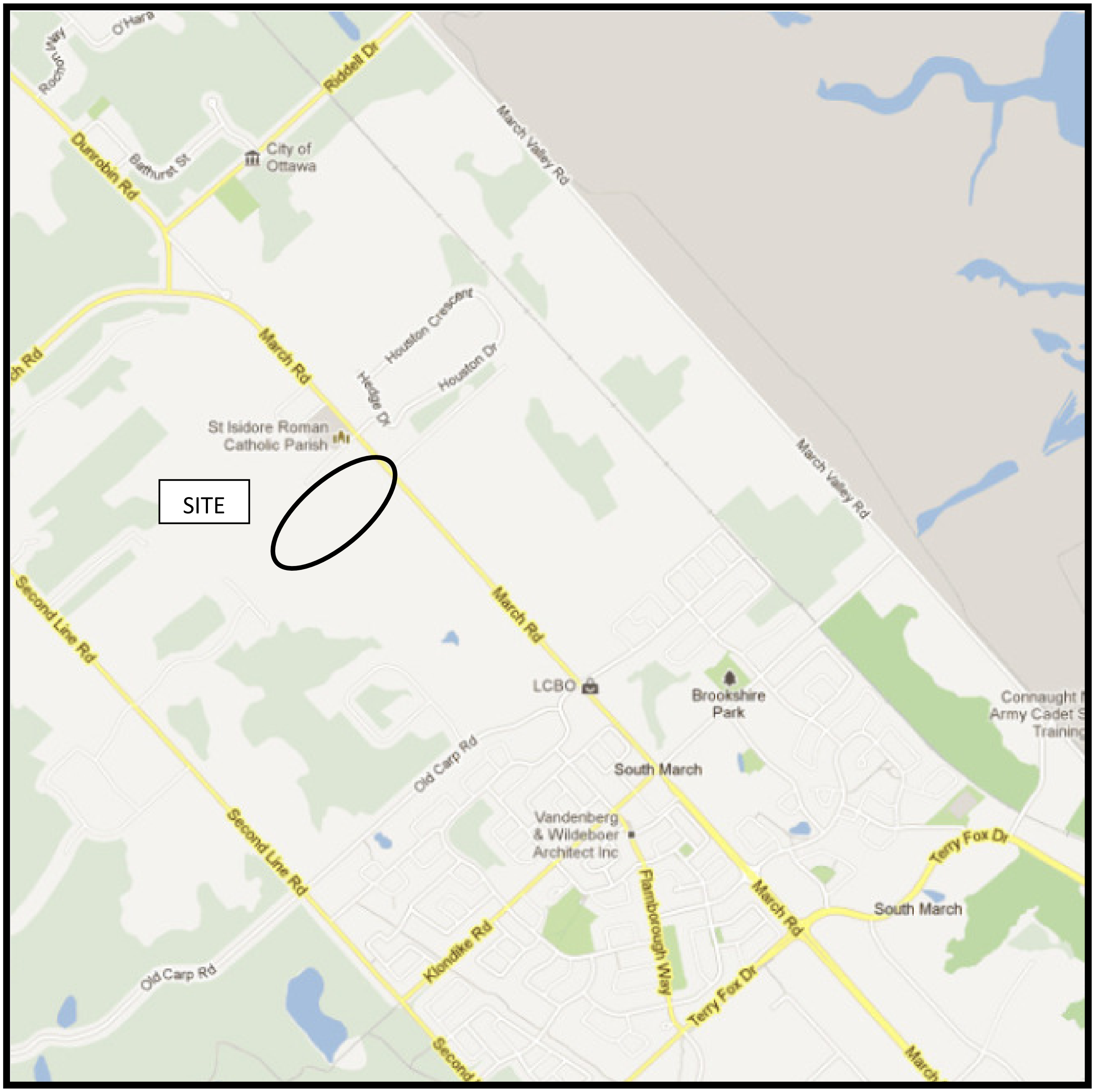
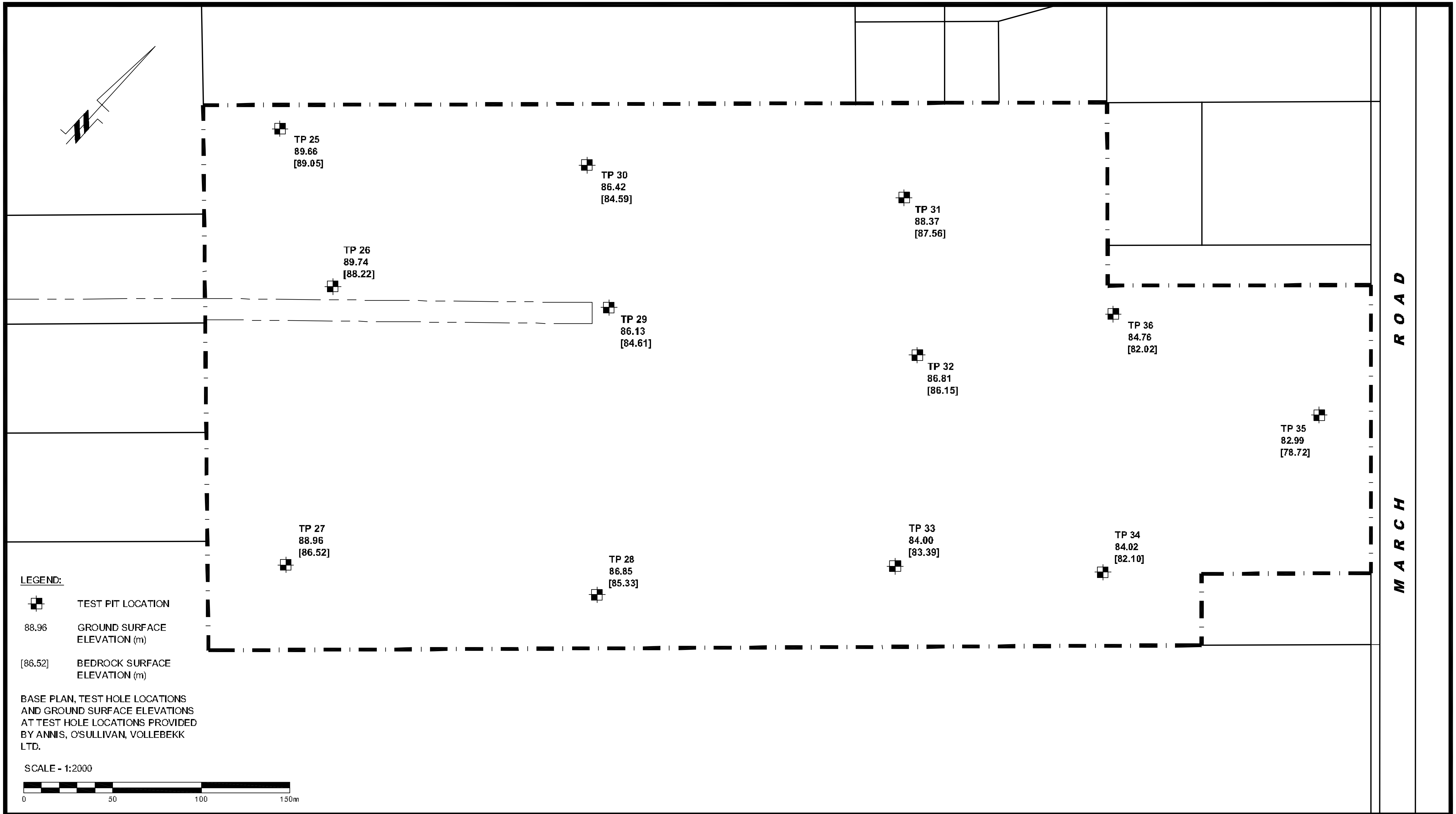


FIGURE 1

KEY PLAN



LEGEND:

⊞	TEST PIT LOCATION
88.96	GROUND SURFACE ELEVATION (m)
[86.52]	BEDROCK SURFACE ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

SCALE - 1:2000

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consulting engineers
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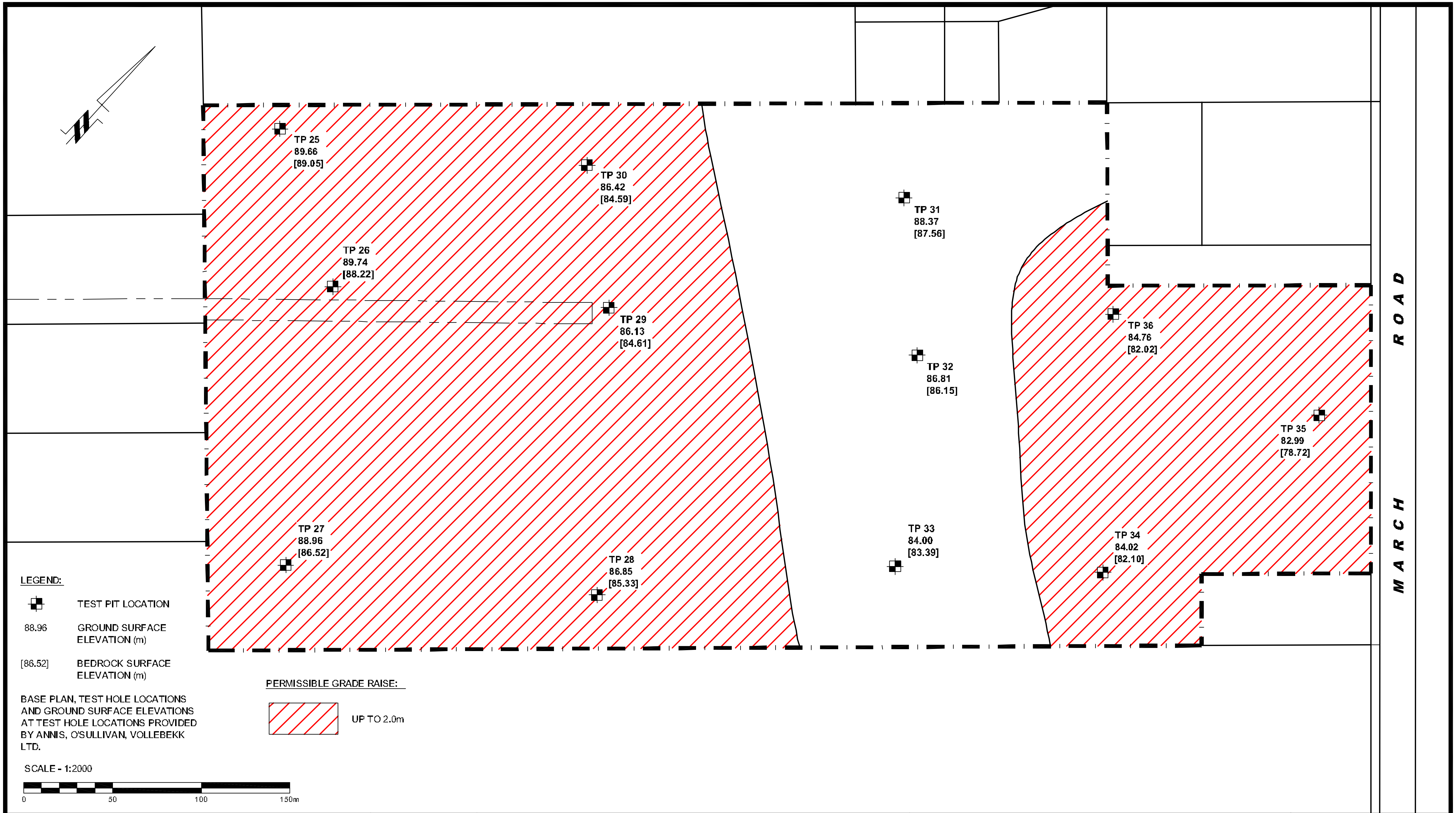
Scale: 1:2000
Des.: SB
Dwn: MPG
Chkd: DG

7089121 CANADA INC.
PRELIMINARY GEOTECHNICAL INVESTIGATION
KANATA NORTH URBAN EXPANSION AREA
1075 MARCH ROAD
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. **PG2878-3**
Report No.: PG2878-1
Date: 04/2013

11x17



LEGEND:

⊞	TEST PIT LOCATION
88.96	GROUND SURFACE ELEVATION (m)
[86.52]	BEDROCK SURFACE ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

SCALE - 1:2000

PERMISSIBLE GRADE RAISE:

▨ UP TO 2.0m

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Scale:	1:2000
Des.:	SB
Dwn:	MPG
Chkd:	DG

7089121 CANADA INC.
PRELIMINARY GEOTECHNICAL INVESTIGATION
KANATA NORTH URBAN EXPANSION AREA
1075 MARCH ROAD
OTTAWA, ONTARIO

PERMISSIBLE GRADE RAISE PLAN - HOUSING

Dwg. No.	PG2878-4
Report No.:	PG2878-1
Date:	04/2013

11x17