Appendix 2

Geotechnical Report dated December 30-2014

patersongroup

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December 30, 2014
File: PG3172-LET.01 Rev. 2

Robertson Martin Architects
216 Pretoria Avenue
Ottawa, Ontario
L1S 1X2

Attention: **Mr. James Maddigan**

Subject: **Geotechnical Investigation**
Proposed North Perimeter Wall Rehabilitation - Phase 3
Parliament Hill - Ottawa

Dear Sir,

Paterson Group (Paterson) has prepared the following letter report to present our findings from the geotechnical investigation at the aforementioned site. The following letter report presents the findings and recommendations.

The objectives of the current investigation were to:

- to determine the subsurface soil, bedrock and groundwater conditions by means of test pits and boreholes.

- provide geotechnical recommendations for the design of the proposed north perimeter wall rehabilitation (phase 3), including construction considerations which may affect the design.

1.0 Method of Investigation

Field Program

The fieldwork for the geotechnical investigation was conducted on April 16 and 24, 2014. The geotechnical investigation consisted eighteen (18) test pit and thirteen (13) borehole locations. The test pits were excavated with a rubber tire backhoe operated by Public Works Government Services Canada (PWGSC). The test pits were completed as part of an archaeological study and Paterson reviewed the subsurface conditions at the open test pit locations.

The boreholes were completed with a track mounted drill rig supplied by a local contractor. The drilling procedure consisted of hollow stem augering to the required depths at select locations, sampling and testing the overburden. Bedrock was cored using a diamond drill bit at selected borehole locations.

Sampling and In Situ Testing

Soil samples were recovered from a 50 mm diameter split-spoon, the auger flights or grab samples. The split-spoon, auger and grab samples were classified on site and placed in sealed plastic bags. All samples were transported to the laboratory. The depths at which the split-spoon, auger and grab samples were recovered from the boreholes are presented as SS, AU and G, respectively, on the Soil Profile and Test Data sheets.

Standard Penetration Tests (SPT) were conducted and 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 sample 300 mm into the soil after the initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

Diamond drilling was completed at five locations during the current investigation (BH 2, BH 5, BH 7, BH 10 and BH 13) to confirm the bedrock quality. A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented as RC on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the ratio of the bedrock sample length recovered over the drilled section length, in percentage. The RQD value is the total length ratio of intact rock core length more than 100 mm in one drilled section over the length of the drilled section, in percentage. These values are indicative of the quality of the bedrock.

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

All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

Field Survey

The location and ground surface elevations at the borehole locations were surveyed by Paterson field personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying. The location of the test pits and boreholes and the ground surface elevations of the test hole locations are presented on Drawing PG3172-1 - Test Hole Location Plan.

2.0 Field Observations

The subsurface profile encountered at the test hole locations consisted of 25 to 50 mm thick layer of asphaltic concrete over a crushed stone granular fill layer. A silty sand fill mixed with gravel and cobbles was encountered below the abovenoted layers. Practical refusal to augering/excavation or grey limestone bedrock was encountered at all test hole locations at depths varying between 0.4 to 1.4 m. Refer to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test pit and test hole locations.

Selected photographs taken during our field inspections of the subsoil conditions encountered at the test pit locations are presented in the attached photographs.

A grey limestone bedrock was cored at BH 2, BH 5, BH 7, BH 10 and BH 13. Based on the RQD values of the recovered core samples, the upper 1 m of the bedrock varies between a poor to very poor quality. The remainder of the bedrock was noted to be of fair to excellent quality. Photographs of the recovered bedrock core are attached to the present letter report.

All boreholes and test pits were observed to be dry upon completion of the sampling program. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Also, based on available geological mapping, bedrock consists of limestone of the Lindsay Formation and is expected to range between 0 and 5 m depth in the area of the subject site.

3.0 Geotechnical Assessment

Based on our findings, it is anticipated that the proposed perimeter wall can be supported by conventional shallow footings founded directly over bedrock or a granular pad placed over an approved soil bearing surface. It is understood that the majority of the perimeter wall foundation will extend at least 300 mm below the existing bedrock surface based on current underside of footing level. It should be noted that surface-sounded bedrock, free of significant mud seams and fissures, and approved by the geotechnical consultant at the time of excavation will be considered non-frost susceptible. Therefore, the perimeter wall foundation will not require additional frost protection to compensate for the reduced soil cover where founded directly over an approved surface-sounded bedrock bearing surface.

To ensure that adequate frost protection is provided for areas where soil is encountered at subgrade level, it is recommended that the proposed footings be provided with a minimum 900 mm thick soil cover layer. It is further recommended that the proposed footing be placed over a minimum 300 mm thick granular pad, consisting of Granular A crushed stone, compacted to 98% of its SPMDD. For areas where bedrock is encountered at or above subgrade level, the recommended granular fill pad is not required.

The abovenoted design recommendations and other construction precautions are discussed in the following sections.

Site Grading, Preparation and Bedrock Removal

Asphalt, topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any settlement sensitive structures, such as the proposed wall structure.

Backfill placed for grading beneath the proposed wall structure, 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 backfill should be tested and approved prior to delivery to the site. The backfill should be placed in maximum 300 mm thick lifts and compacted to 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be placed to increase the subgrade level for areas to be paved, the backfill material should be compacted in maximum 300 mm thick to a minimum density of 95% of the SPMDD.

Based on the bedrock encountered in the area, it is expected that hoe-ramming may be required to remove the bedrock.

As a general guideline, peak particle velocity (measured at the structures) should not exceed 25 mm/s during the bedrock removal to reduce the risks of damage to the existing structures.

Foundation Design

Footings placed over a minimum 300 mm thick engineered pad over a silty sand fill bearing surface approved by the geotechnical consultant can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **175 kPa**, incorporating a geotechnical resistance factor of 0.5.

It is recommended that the engineered fill pad, consist of a Granular A crushed stone, compacted to 98% of its SPMDD and placed in maximum 300 mm loose lifts. It is further recommended that the existing silty sand subgrade be proof-rolled using adequately sized vibratory rolling equipment making several passes under dry conditions and in above freezing temperatures. Any poor performing areas should be removed and replaced with an engineered fill, such as Granular A or Granular B Type II, compacted to 98% of its SPMDD.

An acceptable 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.

Footings designed using the bearing resistance value at SLS for the abovenoted soils will be subjected to potential post construction total and differential settlements of 25 and 20 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. Adequate lateral support is provided to a soil bearing medium when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity than the in situ soil.

Footings placed on a clean, surface sounded limestone bedrock surface can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **1,000 kPa**, incorporating a geotechnical resistance factor of 0.5.

A clean, surface sounded bedrock bearing surface should be free of loose materials, and should not contain surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings designed using the abovenoted bearing resistance value at SLS placed over a bedrock surface will be subjected to negligible settlements.

Rock Anchor Design

For areas where footing thickness is reduced due to bedrock elevation, it is recommended that a series of rock anchors be placed to compensate for the reduced resistance. It is understood that a rock anchor/dowel design for a 10 kN/m load is required based on John G. Cooke & Associates (JCAL) calculations. The following design and installation recommendations have been provided for the 10 kN/m load requirement. A rock dowel with a minimum 1,200 mm length below the bedrock surface, should be placed every 2 m along the subject section of wall. A fixed length of 900 mm is recommended based on a factored bond value of 1,000 kPa, and free length of 300 mm (plus amount above bedrock into footing).

The recommended thread bar section, as follows, is considered to be acceptable for a Factored at ULS capacity of 20 kN:

Grade 517 MPa steel (F_u = 517 MPa; F_y = 415 MPa)
Dywidag #8 Reinforcing Steel ASTM A615 (Grade 75)
25 mm (1") diameter thread bar (A_S = 510 mm^2)
Maximum Factored at ULS capacity = 0.90 $As*F_y$ = 210 kN (as per DSI)
Dowel to be double corrosion protected (DCP)

Grout: Non-shrink, non-metallic cementitious, minimum compressive strength 35 MPa Drill hole should provide a minimum of 25 mm grout cover around DCP, so minimum 75 mm diameter required. The dowels should be shop fabricated to be double corrosion protected (DCP). This involves shop-installing a corrugated sleeve over the steel within the bonded (fixed) length and a smooth sleeve in the unbonded (free) portion, with the sleeve filled with grout.

Drill holes are to be flushed clean and inspected by the geotechnical consultant.

Note that the dowel depth/length provided is the embedded portion of the rock dowel below the bedrock surface. Additional length for the rock dowel will be required as per JCAL recommendations within the proposed wall footing.

Design for Earthquakes

Foundations for the proposed wall can be designed using a seismic site response **Class C** as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A). The soils underlying the site are not susceptible to liquefaction.

Protection of Footings Against Frost Action

It should be noted that surface-sounded bedrock, free of significant mud seams and fissures, and approved by the geotechnical consultant at the time of excavation will be considered non-frost susceptible. Therefore, the perimeter wall foundation will not require additional frost protection to compensate for the reduced soil cover where founded directly over an approved surface-sounded bedrock bearing surface.

Exterior unheated footings, such as those for the proposed wall structure, founded over a soil bearing surface are prone to deleterious movement associated with frost action. To ensure adequate frost protection is provided, the following recommendations should be adhered to:

- A minimum 900 mm thick soil cover should be present between the finished grade and underside of footing level.
- A minimum 300 mm thick layer of Granular A crushed stone should be placed at the proposed footing.

Lateral Earth Pressures

It is expected that the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 40 degrees and a drained unit weight of 20 kN/m^3. An interface friction angle of 30 degrees between the wall and the backfill material is applicable for the abovenoted parameters. Two (2) distinct conditions, static and seismic, must be reviewed for design calculations. The parameters for design calculations for the two (2) conditions are presented on the following pages.

Static Earth Pressures

Under static conditions, the walls may be designed using a triangular earth pressure distribution with a maximum stress value at the base of the wall equal to $K_o \gamma H$ where:

K_o - At-rest earth pressure coefficient = 0.35
γ - unit weight of the fill = 20 kN/m^3
H - height of the retained fill against the wall, m

It is understood that a maximum height differential of 300 mm is anticipated along the perimeter wall. However, due to the sloping ground surface along the slope side of the wall, it is recommended to design for a minimum 600 mm height differential to compensate for the reduced earth pressure provided by the sloping ground surface.

An additional pressure having a magnitude equal to K_oq and acting on the entire height of the wall must be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to stay at least 0.3 m away from the walls with the compaction equipment.

Seismic Earth Pressures

Seismic loading conditions influence the earth pressures that will act on earth retaining structures during seismic events. In Ottawa, the peak ground acceleration (PGA) is 0.32 for the OBC 2012.

The magnitude of seismic earth pressures acting on a structure is dependent upon the relative flexibility of the structure. Isolated free-standing retaining walls are generally flexible enough to be considered as “yielding” earth retaining structures.

The total active earth force acting on a wall under seismic conditions can be estimated using a pseudo-static approach based on the Mononobe-Okabe (M-O) Method. The seismic intensity is represented by the horizontal seismic coefficient, k_h. For yielding structures, the value of k_h can be taken to be one half of PGA. Note that the vertical seismic coefficient is taken to be zero.

The M-O Method is used to calculate the total active earth pressure (P_{AE}). The resulting force is then split into the static (active) (P_A) and seismic component (ΔP_{AE}).

The total active earth pressure (P_{AE}) can be calculated using $0.5K_{AE}\,\gamma H^2$ where:

- K_{AE} - Dynamic active earth pressure coefficient. For the conditions previously stated, K_{AE} is 0.3.
- γ - unit weight of the fill of the applicable retained soil (kN/m^3)
- H - height of the wall (m)

The static component (P_A) can be calculated using $0.5K_A\,\gamma\,H^2$ where:

- K_A = dynamic active earth pressure coefficient, 0.2
- γ = unit weight of the fill of the applicable retained soil (kN/m^3)
- H = height of the wall (m)

The dynamic seismic component (ΔP_{AE}) can be calculated by $\Delta P_{AE} = P_{AE} - P_A$.

The static component (P_A) is a conventional triangular shaped pressure distribution with the resultant located H/3 up from the wall base. The seismic component (ΔP_{AE}) is acting approximately 0.6H up from the wall base.

On this basis, the total active pressure (P_{AE}) will act from a height:

$$h = \left\{P_A(H/3)+\Delta P_{AE}(0.6H)\right\} / P_{AE}$$

The earth pressures calculated are unfactored. For the ULS case, the earth pressure loads must be factored as live loads, as per OBC 2012.

Sliding Resistance

Sliding horizontal shear resistance of the footings founded over a bedrock surface or on a rigid insulation layer over a granular fill can be computed using a horizontal shear resistance (friction) factor of 0.6 and 0.4, respectively.

Pavement Structure

The existing asphaltic concrete finished pathway is anticpated to be reinstated upon completion of the wall rehabilitation work. The proposed pavement structure presented in Table 1 is recommended for the pathway.

Table 1 - Recommended Pavement Structure - Pedestrian Pathway

Thickness (mm)	Material Description
50	**WEAR COURSE -** HL-3 or Superpave 12.5 Asphaltic Concrete
300	**BASE** - OPSS Granular A Crushed Stone
SUBGRADE - Either in situ soil, fill or OPSS Granular B Type II material placed over in situ soil or fill.	

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 II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the SPMDD using suitable compaction equipment.

Excavation Side Slopes

The side slopes of excavations in the overburden materials should either excavated to acceptable slopes from the beginning of the excavation until the structure is backfilled. Sufficient room is assumed to be available for the greater part of the excavation to be constructed as 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 excavated at 1H:1V or shallower. A shallower slope is required for excavation below groundwater level. The subsurface soil 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 maintain safe working distance from the excavation limits.

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.

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 groundwater infiltration rate into the excavation through the overburden should be low for expected founding level. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

If more than 50,000 L/day are to be pumped during the construction phase, a temporary MOE permit to take water (PTTW) will be required.

Winter Construction

Precautions should be considered if winter construction is to be completed.

Where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

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

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

4.0 Recommendations

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

- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.

Upon request, a report confirming work has been conducted in general accordance with the recommendations could be issued following the completion of a materials testing and observation program by the geotechnical consultant.

5.0 Statement of Limitations

The recommendations in this report are in accordance with Paterson's present understanding of the project. The recommendations should be reviewed when the project drawings and specifications are complete.

This geotechnical investigation is a limited sampling of the site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of 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 Robertson Martin Architects or their agents is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
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PROVINCE OF ONTARIO

Joe Forsyth, P.Eng

David J. Gilbert, P.Eng.

Attachments

- ❏ Soil Profile and Test Data sheets
- ❏ Symbols and Terms
- ❏ Test Pit and Rock Core Photographs
- ❏ Figure 1 - Key Plan
- ❏ Drawing PG3172-1 - Test Hole Location Plan

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM / REMARKS Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

FILE NO. PG3172

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.75		
Asphaltic concrete 0.05									
FILL: Dark brown silty sand with stone dust		SS	1	53	50+				
0.60									
End of Borehole Practical refusal to augering at 0.60m depth (BH dry upon completion)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

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Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY CME 55 Power Auger

DATE April 25, 2014

FILE NO. PG3172

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	87.05		
25mm Asphaltic concrete over crushed stone (0.23)									
FILL: Brown silty sand with gravel, trace clay (0.63)		AU	1						
		RC	1	83	39	1	86.05		
BEDROCK: Grey limestone with shale partings throughout - upper 0.9m noted to be weathered									
						2	85.05		
		RC	2	100	97				
(2.92)									
End of Borehole (BH dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

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BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

FILE NO. PG3172

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.11		
Asphaltic concrete 0.05									
FILL: Brown silty sand with gravel 0.23		AU	1						
FILL: Compact, brown silty sand with gravel and cobbles		SS	2	50	23				
1.17		SS	3	67	50+	1	86.11		
End of Borehole Practical refusal to augering at 1.17m depth (BH dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.18		
25mm Asphaltic concrete over crushed stone mixed with silty sand (0.20)		AU	1						
FILL: Loose to compact, brown silty sand with gravel, trace cobbles		SS	2	42	8				
		SS	3	35	50+	1	86.18		
(1.42)									
End of Borehole Practical refusal to augering at 1.42m depth (BH dry upon completion)									

Water Content % scale: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Parliament Hill, Ottawa, Ontario

DATUM / **REMARKS** Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

FILE NO. PG3172

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.32		
Asphaltic concrete 0.05									
FILL: Crushed stone 0.23									
FILL: Brown silty sand with gravel, trace clay and cobbles 0.76		AU	1						
						1	86.32		
BEDROCK: Grey limestone with shale partings and occasional calcite in-filled fractures		RC	1	97	15				
						2	85.32		
		RC	2	100	100				
3.12						3	84.32		
End of Borehole									
(BH dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

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Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.54		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Compact, brown silty sand with gravel, trace cobbles		SS	2	46	13				
1.09						1	86.54		
End of Borehole Practical refusal to augering at 1.09m depth (BH dry upon completion)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 25, 2014

FILE NO. PG3172

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.75		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Brown silty sand with gravel 0.91		AU	2						
						1	86.75		
BEDROCK: Grey limestone with shale partings throughout and occasional mud seams noted - upper 0.9m weathered		RC	1	100	0				
						2	85.75		
		RC	2	100	73				
3.08						3	84.75		
End of Borehole (BH dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	87.90		
Asphaltic concrete 0.08		AU	1						
FILL: Crushed stone with silty sand 0.18									
FILL: Compact, brown silty sand with gravel, trace cobbles		SS	2	46	10				
		SS	3	43	50+				
0.99									
End of Borehole Practical refusal to augering at 0.99m depth (BH 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

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM / **REMARKS** Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

FILE NO. PG3172

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.78		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Dense, brown silty sand with gravel and cobbles		SS	2	42	35				
0.91		SS	3	75	50+				
End of Borehole Practical refusal to augering at 0.91m depth (BH dry upon completion)									

Chart scale: 20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM / **REMARKS** Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

FILE NO. PG3172

HOLE NO. BH10

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.69
25mm Asphaltic concrete over crushed stone (to 0.23)		AU	1				
FILL: Brown silty sand with gravel, trace cobbles (0.23 to 0.59)		AU	2				
BEDROCK: Grey limestone with shale partings throughout - upper 1m noted to be weathered with occasional mud seams (0.59 to 3.02)		RC	1	92	22	1	86.69
						2	85.69
		RC	2	100	72		
End of Borehole (3.02) (BH dry upon completion)						3	84.69

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH11

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	87.63		
25mm Asphaltic concrete over crushed stone with silty sand 0.20		AU	1						
FILL: Brown silty sand with gravel, trace clay		AU	2						
0.48		SS	3	50	50+				
End of Borehole Practical refusal to augering at 0.48m depth (BH dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	87.61		
25mm Asphaltic concrete over crushed stone with silty sand — 0.13		AU	1						
FILL: Brown silty sand with gravel, some clay, trace cobbles — 0.63		AU	2						
End of Borehole Practical refusal to augering at 0.63m depth (BH dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 24, 2014

FILE NO. PG3172

HOLE NO. BH13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.27		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Brown silty sand with gravel, trace clay and cobbles 1.12		AU	2			1	87.27		
BEDROCK: Grey limestone with shale partings, occasional mud seams noted throughout - vertical fracture from 2.2 to 3.0m depth		RC	1	92	42	2	86.27		
3.22		RC	2	98	50	3	85.27		
End of Borehole (BH dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 1A

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.56
Asphaltic concrete	0.05						
FILL: Crushed stone with silty sand	0.20						
FILL: Brown silty sand with gravel and cobbles, some organics	0.81						
Weathered **BEDROCK**	1.32					1	85.56
End of Test Pit (TP dry upon completion)							

STRATA PLOT

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 2A

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	86.86		
FILL: Crushed stone with silty sand — 0.20									
FILL: Brown silty sand with gravel and cobbles, some organics — 0.65									
End of Test Pit TP terminated on bedrock surface at 0.65m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 3B

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	86.99		
Asphaltic concrete 0.05									
FILL: Crushed stone 0.13									
FILL: Brown silty sand with gravel, trace cobbles 0.51									
End of Test Pit TP terminated on bedrock surface at 0.51m depth Stone block pavers were encountered at ground surface along east side of test pit (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 4A

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	87.13		
25mm Asphaltic concrete over crushed stone — 0.13									
FILL: Brown silty sand with gravel and cobbles — 0.94									
End of Test Pit Practical refusal to excavation at 0.94m depth (TP dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 5B

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									
25mm Asphaltic concrete over crushed stone (to 0.18)						0	87.32		
FILL: Brown silty sand with gravel and cobbles (0.18 to 1.12)						1	86.32		
End of Test Pit									
TP terminated on bedrock surface at 1.12m depth along south side of the test pit. Bedrock was not encountered at north side of test pit.									
(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

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 6A

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	87.36		
25mm Asphaltic concrete over crushed stone — 0.20									
FILL: Brown silty sand with gravel and cobbles — 0.76									
End of Test Pit TP terminated on bedrock surface at 0.76m depth (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 7B

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	87.67		
25mm Asphaltic concrete over crushed stone ___ 0.13									
FILL: Brown silty sand with gravel, trace cobbles ___ 0.71									
End of Test Pit TP terminated on weathered bedrock surface at 0.71m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP 8A

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	87.78		
25mm Asphaltic concrete over crushed stone - rootlets noted throughout (0.25)									
FILL: Brown silty sand with gravel, cobbles, trace clay (0.76)									
End of Test Pit TP terminated on bedrock surface at 0.76m depth (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe **DATE** April 16, 2014

FILE NO. PG3172

HOLE NO. TP 9C

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									
Asphaltic concrete 0.05						0	87.76		
FILL: Crushed stone						1	86.76		
(TP dry upon completion) 1.60									
End of Test Pit TP terminated on top of concrete tunnel surface at 1.60m depth. Exposed face of concrete foundation below existing perimeter wall Perforated, corrugated PVC drainage pipe encountered at base of foundation wall.									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP10B

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	87.83		
Asphaltic concrete — 0.05									
FILL: Crushed stone with silty sand — 0.18									
FILL: Brown silty sand with gravel — 0.71									
End of Test Pit Test pit terminated on bedrock surface at 0.71m depth (TP dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP11A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	87.87		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.18									
FILL: Brown silty sand with gravel, trace cobbles 1.25						1	86.87		
End of Test Pit TP terminated on bedrock surface at 1.25m depth (TP dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP12D

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	87.84		
Asphaltic concrete — 0.05									
FILL: Crushed stone with silty sand — 0.53									
FILL: Brown silty sand with gravel, cobbles, trace clay — 1.12						1	86.84		
End of Test Pit TP terminated on bedrock surface at 1.12m depth A portion of the existing tunnel is exposed within the east side of test pit at 300mm 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

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP13B

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	87.71		
25mm Asphaltic concrete over crushed stone with silty sand — 0.18									
FILL: Brown silty sand with gravel, trace clay and cobbles — 0.59									
End of Test Pit TP terminated on bedrock surface at 0.59m depth (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM / **REMARKS** Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

FILE NO. PG3172

HOLE NO. TP14C

BORINGS BY Backhoe **DATE** April 16, 2014

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	87.70		
25mm Asphaltic concrete over crushed stone with silty sand — 0.18									
FILL: Brown silty sand with gravel, cobbles, trace clay — 0.91									
End of Test Pit TP terminated on top of concrete tunnel at 0.91m 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

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS supplied by Adam Kasprzak Surveying.

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP15B

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.63		
25mm Asphaltic concrete over crushed stone with silty sand — 0.13									
FILL: Brown silty sand with gravel, some clay, trace cobbles — 0.65									
End of Test Pit TP terminated on bedrock surface at 0.65m depth (TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP16E

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	87.66		
25mm Asphaltic concrete over crushed stone with silty sand — 0.13									
FILL: Brown silty sand with gravel, some clay, trace cobbles — 0.44									
End of Test Pit TP terminated on bedrock surface at 0.44m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP19A

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	88.65		
Asphaltic concrete — 0.05									
FILL: Crushed stone with silty sand — 0.20									
FILL: Brown silty sand with gravel, trace clay and cobbles — 0.58									
End of Test Pit TP terminated on bedrock surface at 0.58m 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

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

BORINGS BY Backhoe

DATE April 16, 2014

FILE NO. PG3172

HOLE NO. TP20B

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	87.76		
Asphaltic concrete — 0.05									
FILL: Crushed stone — 0.20									
FILL: Brown silty sand — 0.38									
FILL: Brown silty sand with gravel and roots — 0.71									
End of Test Pit TP terminated on bedrock surface at 0.71m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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

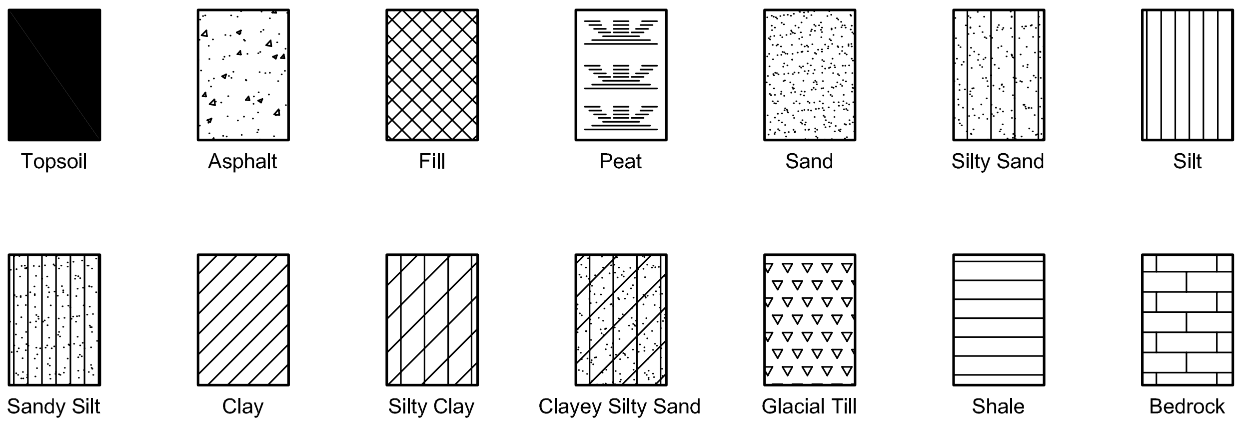
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

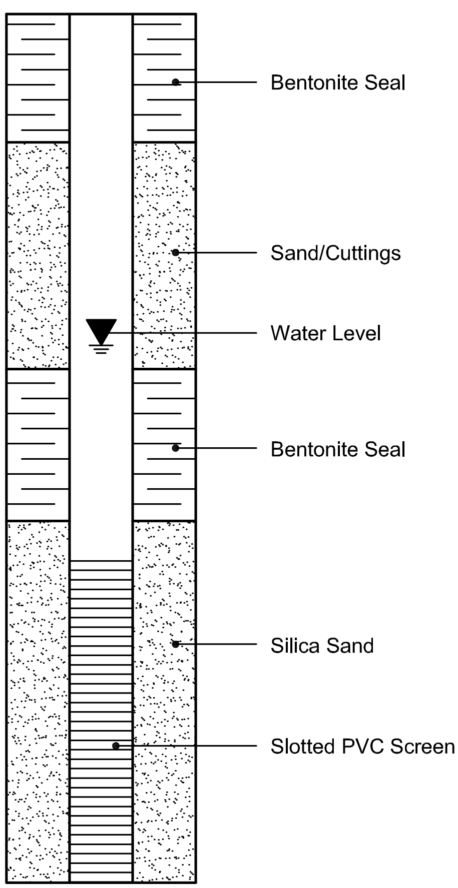
SYMBOLS AND TERMS (continued)

STRATA PLOT



MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION

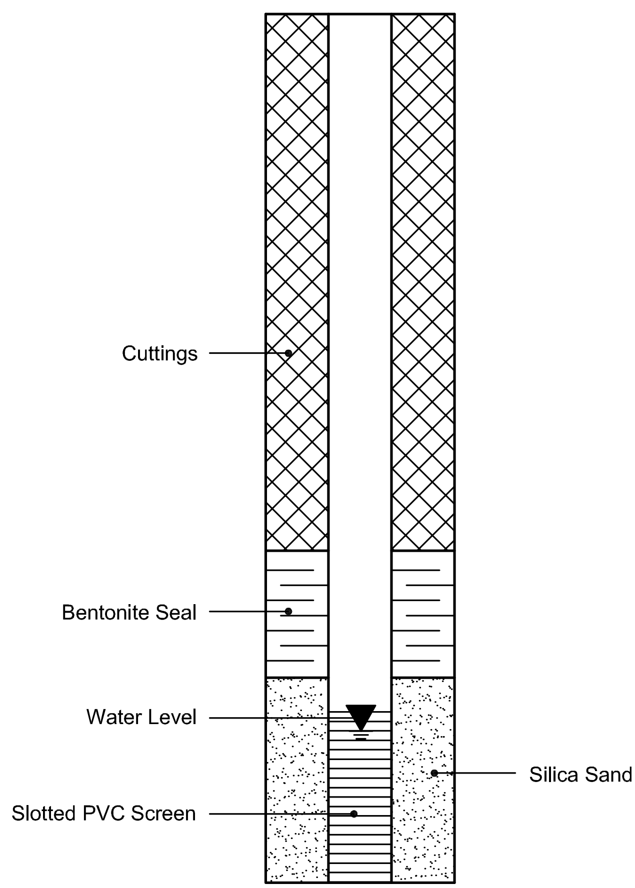


Photo 1 – Silty sand fill at base of test pit along with the existing perimeter wall foundation exposed at TP 1A.

Photo 2 – Existing foundation of monument structure exposed along east side of test pit at TP 3B.

Photo 3 - Soil profile along north side of test pit and existing wall foundation exposed at TP 7A.

Photo 4 - Exposed foundation wall and top of tunnel at TP 9C.

Photo 5 - Exposed corner of existing tunnel within east portion of TP 12D.

Photo 6 - Excavated sidewall at TP 14C.

Photo 7 - Grey limestone bedrock cored between 0.6 to 2.9 m depth at BH 2.

Photo 8 - Grey limestone bedrock cored between 0.8 to 3.1 m depth at BH 5.

Photo 9 - Grey limestone bedrock cored between 0.9 to 3.1 m depth at BH 7.

Photo 10 - Grey limestone bedrock cored between 0.6 to 3.0 m depth at BH 10.

Photo 11 - Grey limestone bedrock cored between 1.1 to 3.2 m depth at BH 13.

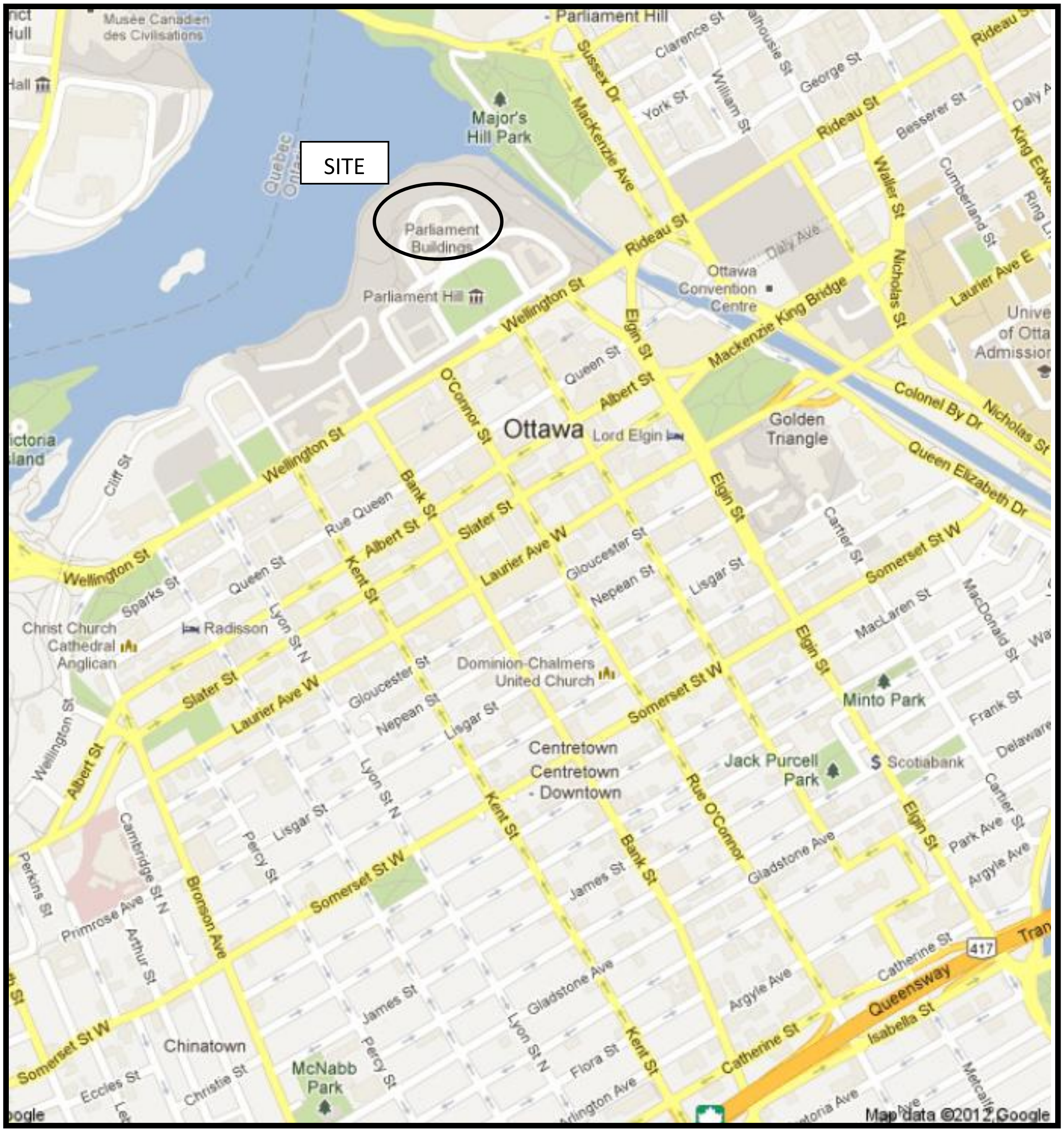


FIGURE 1

KEY PLAN

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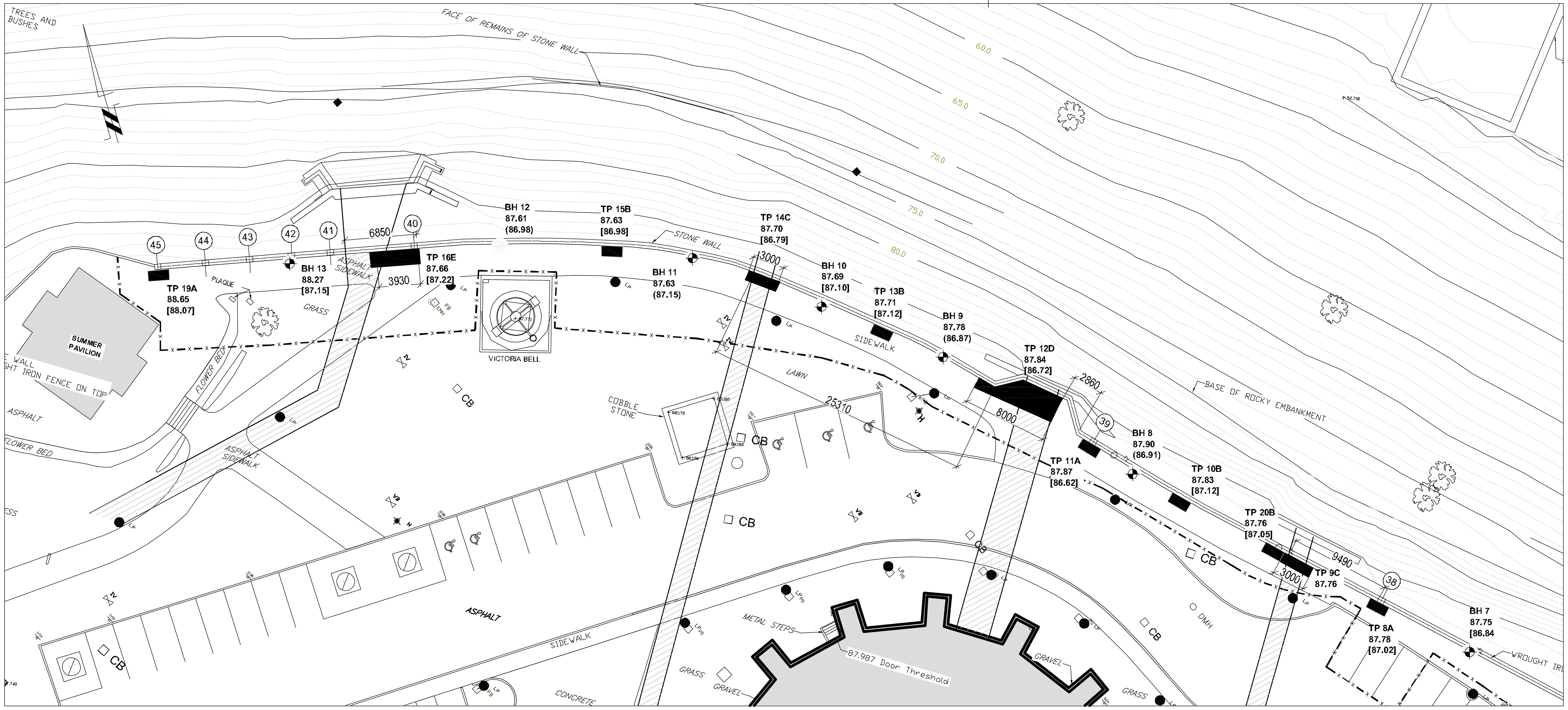
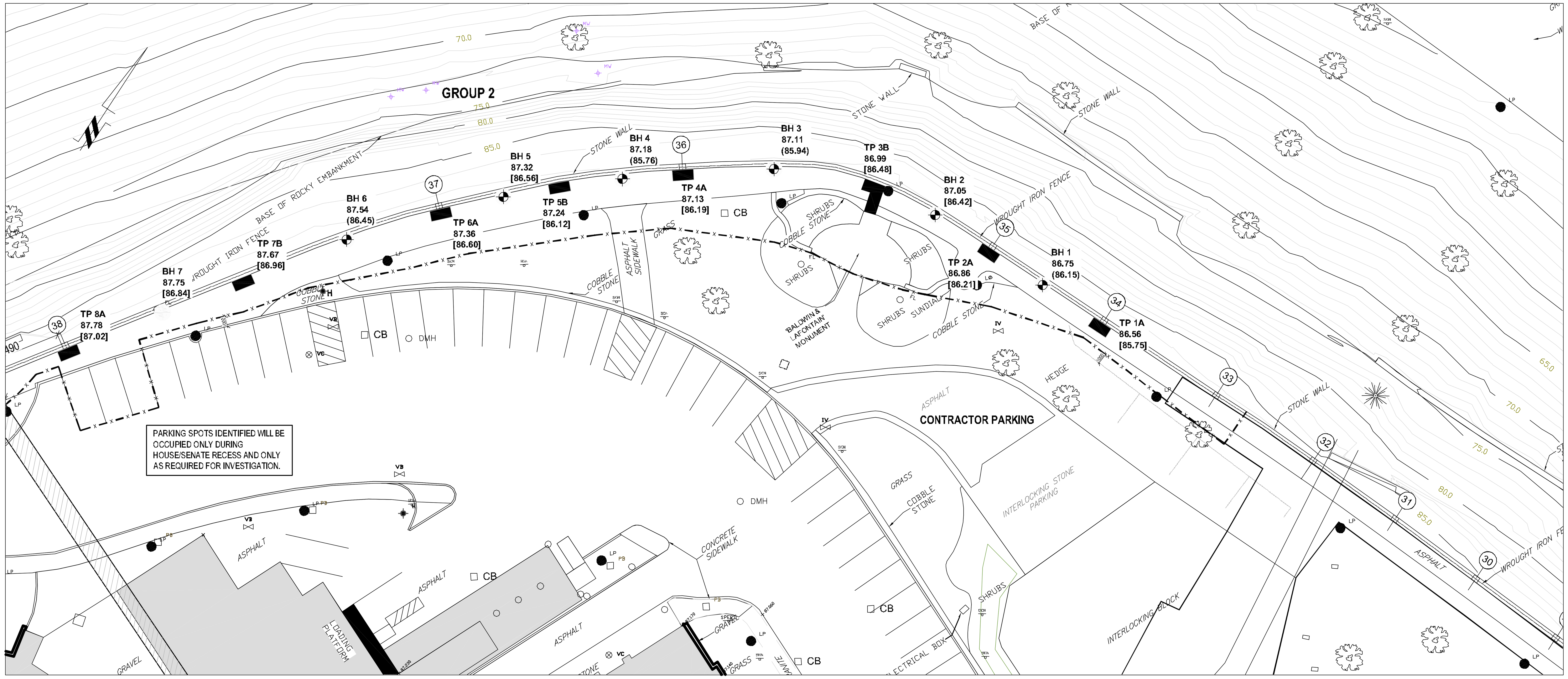


2 ENLARGED INVESTIGATIONS SITE PLAN - PIERS 38-45
A100
1 : 250



1 ENLARGED INVESTIGATIONS SITE PLAN - PIERS 33-38
A100
1 : 250

PWGSC PPB A1 (841x594)

PRINTED: Jun 04/2014 - 9:46AM BY: Mary

GENERAL NOTES

A. PROTECT MONUMENTS.

B. PROTECT LAMP POSTS, CATCH BASINS AND MANHOLES WITHIN WORK AREA.

C. MAINTAIN FIRE HYDRANTS OUTSIDE OF WORK AREA.

LEGEND

- CB CATCH BASIN
- LP LAMP POST
- H FIRE HYDRANT
- UNDERGROUND STRUCTURE
- WORK AREA
- BOREHOLE LOCATIONS
- APPROXIMATE TEST PIT LOCATIONS
- 99.95 GROUND SURFACE ELEVATION (m)
- [99.32] BEDROCK SURFACE ELEVATION (m)
- (99.05) PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

LEGEND NOTES:

GROUND SURFACE ELEVATIONS AT THE TEST HOLE LOCATIONS WERE SURVEYED BY PATERSON GROUP PERSONNEL AND REFERENCED TO A GEODETIC DATUM BASED ON TOPOGRAPHICAL INFORMATION SUPPLIED BY ADAM KASPRZAK SURVEYING.

Publics Works and Government Services Canada | Travaux publics et services gouvernementaux Canada

Parliamentary Precinct Branch | Direction générale de la Cité parlementaire

Canada

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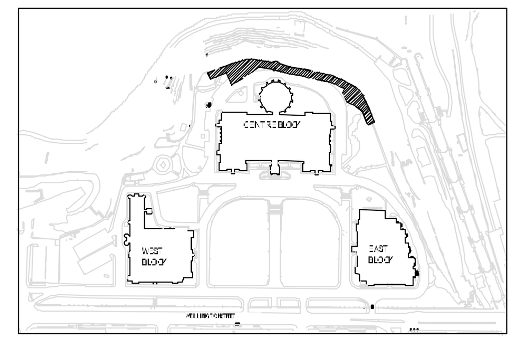

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LOGO SEAL/ SCEAU

0	GEOTECHNICAL REPORT	2014/05/13
revision		date

A detail no. / no. du détail
B location drawing no. / no. de localisation
C drawing no. / no. du dessin

project / projet

NORTH PERIMETER WALL REHABILITATION
PHASE 3
PIERS 33 TO 45

Parliamentary Precinct, Parliament Hill, Ottawa

drawing / dessin

TEST HOLE LOCATION PLAN

Designed By	RMA	Conçu par
Date	2012 / 11 / 26	(yyyy/mm/dd)
Drawn By	RMA	Dessiné par
Date	2012 / 11 / 26	(yyyy/mm/dd)
Reviewed By	JAF/DJG	Examiné par
Date	2014-05-13	(yyyy/mm/dd)
Approved By	DJG	Approuvé par
Date	2014/05/13	(yyyy/mm/dd)
Tender		Soumission
Project Manager	OLIVER GOMES	Administrateur de projets
Project no.	R.011800.030	No. du projet
Drawing no.	PG3172	No. du dessin

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