Geotechnical Investigation

Proposed Embassy Development

187 Boteler Street
Ottawa, Ontario

Prepared for Ministry of Foreign Affairs of the State of Qatar

Report PG4960-1 Revision 4 dated June 5, 2023

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1.0 Introduction

Paterson Group (Paterson) was commissioned by the Ministry of Foreign Affairs of The State of Qatar to conduct a geotechnical investigation for the proposed embassy development to be located at 187 Boteler Street in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objective of the geotechnical investigation was to:

- ❑ Determine the subsurface and groundwater conditions at the site by means of boreholes and existing soils information.

- ❑ 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. The report contains Paterson's findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

The development is understood to consist of a 4 storey embassy complex with one level of underground parking level under a portion of the proposed structure. The balance of the structure is proposed to be of a slab-on-grade construction. Associated at-grade access lanes and landscaped areas are also expected. The proposed building will also be fully municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was completed between May 28 and 29, 2019. At that time, 12 boreholes were advanced to a maximum depth of 8.5 m below existing grade. A previous investigation was completed by Stantec from April to July 2013, at which time 16 boreholes and 27 test pits were conducted on the subject site. The current investigation distributed the borehole locations in a manner to complement the existing coverage of the proposed development taking into consideration existing site features. The borehole locations are shown on Drawing PG4960-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a truck mounted drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test hole procedure consisted of augering to refusal, sampling and testing the overburden. Furthermore, rock cores were recovered from BH1, BH8 and BH12.

Sampling and In Situ Testing

Soil samples were recovered with a 50 mm diameter split-spoon sample or from the auger flights. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. All samples were transported to Paterson's laboratory. The depths at which the split-spoon and auger samples were recovered from the boreholes are presented as SS and AU, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Rock samples were recovered from BH1, BH8 and BH12 using a core barrel and diamond drilling techniques. The bedrock samples were classified on site, placed in hard cardboard core boxes and transported to Paterson's laboratory. The depths at which rock core samples were recovered from the boreholes are presented as RC on the Soil Profile and Test Data sheets in Appendix 1.

The recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented on the borehole logs. The recovery value is the length of the bedrock sample recovered over the length of the drilled section. The RQD value is the total length of intact rock pieces longer than 100 mm over the length of the core run. The values indicate the bedrock quality.

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.

Groundwater

Flexible piezometers were installed in all the boreholes to monitor the groundwater level subsequent to the completion of the sampling program. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The ground surface elevations at the test hole locations are referenced to a temporary benchmark (TBM) consisting of the top of a sanitary manhole located along the intersection of Boteler Street and Cumberland Street, south of the subject site. A geodetic elevation of 57.37 m was provided for the TBM by Fairhall, Moffatt & Woodland Ltd. The locations of the boreholes and the ground surface elevations for each borehole location are presented in Drawing PG4960-1 -Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples and bedrock cores were recovered from the subject site and visually examined in Paterson’s laboratory to review the field logs.

3.4 Analytical Testing

One 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 property is presently vacant surrounded by Boteler Street to the south, King Edward Avenue to the East, the Macdonald-Cartier Bridge approach to the North, and the embassy of the United Arab Emirates to the west.

The ground surface across the subject site is slightly sloped down towards Boteler Street. The Macdonald-Cartier Bridge approach is slightly above grade and separated from the site by an embankment to the North.

Construction debris and fill pile were noted on the surface throughout the site.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the boreholes consist of a thin layer of organic topsoil overlying a fill layer consisting of brown silty sand with gravel and cobbles extended to depths ranging from 2.4 to 6.2 m below the existing grade. Construction debris were encountered within the fill layer. A thin layer of grey clayey silt was encountered underlying the fill layer. Glacial till was encountered below the above noted layers consisting of a compact to a very dense silty sand with clay, gravel, cobbled, and boulders.

Bedrock

Bedrock was cored at BH1, BH8 and BH12. Weathered limestone bedrock was encountered at depths ranging between 3.2 and 6.2 m below the existing ground surface. Upon review of the core hole samples, the upper 3 m of the bedrock was found to be in fair to excellent quality. Based on available geological mapping, the subject site is located in an area where the bedrock consists of limestone of the Verulam Formation. The overburden drift thickness is anticipated to be between 3 to 10 m in depth.

4.3 Groundwater

Groundwater level readings were recorded on June 12, 2019, at the piezometer locations. The groundwater level readings are presented in the Soil Profile and Test Data sheets in Appendix 1, and in Table 1. It should be noted that surface water can become trapped within a backfilled borehole that can lead to higher than typical groundwater level observations.

Long-term groundwater level can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level is expected within the bedrock unit below the overburden. It should be noted that groundwater levels are subject to seasonal fluctuations, therefore the groundwater levels could vary at the time of construction.

Table 1 – Summary of Groundwater Levels

Test Hole	Ground Surface Elevation (m)	Measured Groundwater Level		Date Recorded
		Depth (m)	Elevation (m)	
BH 1	57.20	Dry	-	June 12, 2019
BH 2	58.20	Dry	-	June 12, 2019
BH 3	57.62	Dry	-	June 12, 2019
BH 4	58.30	Dry	-	June 12, 2019
BH 5	57.43	Block/Damaged	-	June 12, 2019
BH 6	58.17	Dry	-	June 12, 2019
BH 7	57.64	4.01	53.63	June 12, 2019
BH 8	58.24	Block/Damaged	-	June 12, 2019
BH 9	58.17	Dry	-	June 12, 2019
BH 10	58.18	Dry	-	June 12, 2019
BH 11	57.91	3.92	53.99	June 12, 2019
BH 12	57.45	2.51	54.94	June 12, 2019

Note: Elevation referred to a temporary benchmark (TBM) which consists of the top of a top of sanitary manhole located along the intersection of Boteler Street and Cumberland Street. A geodetic elevation of 57.37 m was provided to the TBM by Fairhall, Moffatt & Woodland Ltd.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed development. The proposed building is expected to be founded on spread footings placed directly or indirectly on a clean, surface sounded bedrock bearing surface. In deeper fill areas, it's expected that a trench will be excavated to the bedrock surface and filled with concrete to enable footings to be poured at the specified elevation.

Bedrock removal may be required to complete the underground level. Hoe ramming is an option where only small quantities of bedrock need to be removed. Line drilling and controlled blasting where large quantities of bedrock need to be removed are recommended. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations.

In addition, due to the existing of service easement that intersects the site and is situated below the proposed retaining wall for the parking ramp and sections of the proposed development, additional precautions should be taken during excavation activities to ensure that the existing service is not affected.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, asphalt, organic, deleterious fill and material should be removed from within the perimeter of the proposed building and other settlement sensitive structures. Existing fill can be left in place beneath the building to support floor slabs and pavement structures provided it's acceptable to the geotechnical engineer once the subgrade is exposed.

Fill Placement

Fill used for grading beneath the proposed building, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness.

Fill placed beneath the building and paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

Clean non-specified existing fill, along with clean site-excavated soil, can be used as general landscaping fill where a settlement of the ground surface is of minor concern. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane.

Proof Rolling

For the proposed floor slab areas, parking areas, and access lanes, proof rolling will be required in areas where the existing fill, free of deleterious materials, and approved by Paterson personnel at the time of construction is encountered at the subgrade level. The purpose of the proof rolling is to induce some of the initial settlements to reduce long term total settlements. It is recommended that the subgrade surface be proof-rolled **under dry conditions** by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by the geotechnical consultant at the time of construction.

Bedrock Removal

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

Vibration Considerations

Construction operations are the cause of vibrations, and possibly, sources of a 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 equipment could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to 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 outlined by City of Ottawa S.P. No: F-1201, vibrations limits should be limited to 20 mm/s for frequencies below or equal to 40 Hz and 50 mm/s for frequencies greater than 40 Hz. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended be completed to minimize the risks of claims during or following the construction of the proposed building.

Should blasting be utilized a pre-blast survey must be completed for the surrounding area per City of Ottawa S.P. No: F-1201 and blast notices must be distributed 15 business days prior to the commencement of blasting work.

5.3 Foundation Design

Bearing Resistance Values

Auxiliary footings placed on an undisturbed, **compact glacial till bearing surface** can be designed using a bearing resistance value at serviceability limit states (SLS) of **200 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **400 kPa**.

A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS. Footings designed using the above-noted bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

Footings placed on the fractured limestone bedrock surface sounded limestone bedrock bearing surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **2,000 kPa**, incorporating a geotechnical resistance factor of 0.5. Where the design underside of footing is slightly above the bedrock surface, footings can be placed on a concrete filled near vertical trenches extended to a surface sounded bedrock bearing surface using the same bearing resistance values. The concrete in-filled trenches should extend a minimum 150 mm beyond the footing edge in all directions.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

A factored bearing resistance value at ULS of **4,000 kPa**, incorporating a geotechnical resistance factor of 0.5, if footings are placed on **sound limestone bedrock** and the bedrock is free of seams, fractures and voids within 1.5 m below the founding level. This could be verified by completing and probing 50 mm diameter drill holes to a depth of 1.5 m below the founding level within the footing footprint(s). As an alternative to probing the bedrock, consideration can be given to reviewing the sump pits and elevator pit areas where the excavated bedrock sidewalls can be assessed by the geotechnical consultant.

Settlement

Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

Soil/Bedrock Transition

It's expected that all footings will be founded on bedrock. However, between the footings for the main building and any auxiliary footings (canopy, vent shafts, etc.) where the building is founded on bedrock the auxiliary footings on the glacial till deposit, it is recommended a 2 m transition zone composed of 0.5 m layer of nominally compacted OPSS Granular A or Granular B type II be placed directly on sound bedrock. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition should be placed in the top part of the footing and foundation walls.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or flatter).

5.4 Design for Earthquakes

Shear wave velocity testing was completed by Paterson to accurately determine the applicable seismic site classification for foundation design of the proposed building as presented in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012. Two shear wave velocity profiles from our on-site testing are presented in Appendix 2.

Field Program

The shear wave testing location is presented on Drawing PG4960-1 - Test Hole Location Plan in Appendix 2. Paterson field personnel placed 22 horizontal geophones in a straight line in a roughly east-west orientation. The 4.5 Hz horizontal geophones were mounted to the surface by means of two 75 mm ground spikes attached to the geophone land case. The geophones were spaced at 3 m intervals and connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was also connected to a computer laptop and a hammer trigger switch attached to a 12 pound dead blow hammer. The hammer trigger switch sends a start signal to the seismograph. The hammer is used to strike an I-beam seated into the ground surface, which creates a polarized shear wave. The hammer shots are repeated 4 to 8 times at each shot location to improve signal to noise ratio. The shot locations are also completed in forward and reverse directions (i.e. striking both sides of the I-beam seated parallel to the geophone array). The shot locations are located 3, 4.5 and 30 m away from the first and last geophone, and at the center of the geophone array.

Data Processing and Interpretation

Interpretation for the shear wave velocity results was completed by Paterson personnel. Shear wave velocity measurement was made using reflection/refraction methods.
The interpretation is performed by recovering arrival times from direct and refracted waves. The interpretation is repeated at each shot location to provide an average shear wave velocity, Vs_{30}, of the upper 30 m profile, immediately below the building's foundation. The layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave records to compute the bedrock depth at each location. The bedrock velocity was interpreted using the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of bedrock with depth. It should be noted that as bedrock quality increases, the bedrock shear wave velocity also increases.

The overburden and bedrock velocities were interpreted to be 365 and 2,281 m/s, respectively. As a conservative estimate, overburden thickness between bedrock and underside of footing was assumed to be 3 m as a worst-case scenario.

The Vs_{30} was calculated using the standard equation for average shear wave velocity from the Ontario Building Code (OBC) 2012, as presented below.

$$V_{s30} = \frac{Depth_{OfInterest}(m)}{\left(\frac{(Depth_{Layer1}(m)}{Vs_{Layer1}(m/s)} + \frac{Depth_{Layer2}(m)}{Vs_{Layer2}(m/s)}\right)}$$

$$V_{s30} = \frac{30m}{\left(\frac{2m}{365m/s} + \frac{28m}{2{,}281m/s}\right)}$$

$$V_{s30} = 1{,}690m/s$$

Based on the results of the seismic testing, the average shear wave velocity, Vs_{30}, for foundations placed on or within 2 m of bedrock is 1,690 m/s. Therefore, a **Site Class A** is applicable for design in this case, as per Table 4.1.8.4.A of the OBC 2012.

For foundations located between 2 and 6 m above bedrock surface, a Site Class B is applicable for design.

The soils underlying the subject site are not susceptible to liquefaction.

5.5 Slab-on-Grade Construction/Basement Slab

With the removal of the topsoil and deleterious fill, containing organic matter, within the footprint of the proposed buildings, the native soil surface or existing fill approved by Paterson as per Subsection 5.2 will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction. Any soft or poor performing 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, is recommended for backfilling below the floor slab. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD.

It is recommended that a concrete floor slab be poured over a minimum 200 mm thick layer of sub-slab fill, consisting of an OPSS Granular A crushed stone to allow drainage of any water which may have accumulated below the floor slab.

Basement Slab

Based on the anitipated depth of the proposed underground parking level, the bearing medium for the basement floor slab will mainly consist of bedrock. However, compact glacial till or fill can be expected in deeper overburden areas. If fill is encountered, Paterson will review on site the suitability of the fill material that will be left in place.

It is expected that the basement area will be mostly parking and a rigid pavement structure designed by a structural engineer will be applicable. However, if storage or other uses of the lower level where a concrete floor slab will be used it is recommended that the upper 200 mm of sub-slab fill consists of 19 mm clear crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction 30 degrees and a bulk (drained) unit weight of 20 kN/m^3.

However, undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Two distinct conditions, static and seismic, must be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the "at-rest" case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

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

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Rock Anchor Design

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or by pullout of a 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor. It should be noted that interaction may develop between the failure cones of anchors that are relatively close to one another resulting in a total group capacity smaller than the sum of the load capacity of each anchor taken individually.

A third failure mode of shear failure along the grout/steel interface should also be reviewed by a qualified structural engineer to ensure all typical failure modes have been reviewed. Typical rock anchor suppliers, such as Dywidag Systems International (DSI Canada), have qualified personnel on staff to recommend appropriate rock anchor size and materials.

It should be further noted that center to center spacing between bond lengths be at least four times the anchor hole diameter and greater than 1.2 m to lower the group influence effects. It is also recommended that anchors in close proximity to each other be grouted at the same time to ensure any fractures or voids are completely in-filled and that fluid grout does not flow from one hole to an adjacent empty one.

Anchors can be of the “passive” or the “post-tensioned” type, depending on whether the anchor tendon is provided with post-tensioned load or not prior to being put into service. To resist seismic uplift pressures, a passive rock anchor system can be used. It should be noted that a post-tensioned anchor will take the uplift load with much less deflection than a passive anchor.

Regardless of whether an anchor is of the passive or the post tensioned type, it is recommended that the anchor be provided with a bonded length, or fixed anchor length, at the base of the anchor, which will provide the anchor capacity, as well an unbonded length, or free anchor length, between the rock surface and the start of the bonded length. As the depth at which the apex of the shear failure cone develops is midway along the bonded length, a fully bonded anchor would tend to have a much shallower cone, and therefore less geotechnical resistance, than one where the bonded length is limited to the bottom part of the overall anchor.

Permanent anchors should be provided with corrosion protection. As a minimum, this requires that the entire drill hole be filled with cementitious grout. The free anchor length is provided by installing a plastic sleeve to act as a bond break.

Grout to Rock Bond

A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, can be used. A minimum grout strength of 30 MPa is recommended.

Rock Cone Uplift

As discussed previously, the geotechnical capacity of the rock anchors depends on the dimensions of the rock anchors and the configuration of the anchorage system. Based on existing bedrock information, a **Rock Mass Rating (RMR) of 66** was assigned to the bedrock, and Hoek and Brown parameters (**m and s**) were taken as **0.575 and 0.00293**, respectively.

Recommended Rock Anchor Lengths

Parameters used to calculate rock anchor lengths are provided in Table 2.

Table 2 - Parameters used in Rock Anchor Review	
Grout to Rock Bond Strength - Factored at ULS	1.0 MPa
Compressive Strength - Grout	30 MPa
Rock Mass Rating (RMR) - Good quality interbedded limestone and shale bedrock Hoek and Brown parameters	66 m=0.575 and s=0.00293
Unconfined compressive strength - limstone bedrock	50 MPa
Unit weight - Submerged Bedrock	15.2 kN/m^3
Apex angle of failure cone	60^o
Apex of failure cone	mid-point of fixed anchor length

From a geotechnical perspective, the fixed anchor length will depend on the diameter of the drill holes. Recommended anchor lengths for a 75 and 125 mm diameter hole are provided in Table 3 below.

Table 3 - Recommended Rock Anchor Lengths - Grouted Rock Anchor

Diameter of Corehole (mm)	Anchor Lengths (m)			Factored Tensile Resistance (kN)
	Bonded Length	Unbonded Length	Total Length	
75	1.3	0.7	2	300
	1.8	0.7	2.5	415
	2.4	0.6	3	555
125	1.1	0.9	2	375
	1.4	1.1	2.5	530
	1.9	1.1	3	720

It is recommended that the anchor drill hole diameter be within 1.5 to 2 times the rock anchor tendon diameter and the anchor drill holes be inspected by geotechnical personnel and should be flushed clean prior to grouting. The use of a grout tube to place grout from the bottom up in the anchor holes is further recommended.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

Horizontal Rock Anchors

Due to the poor quality of bedrock near surface and potential founding of the proposed development, bedrock stabilization may be required when the proposed foundation extends into the shale bedrock.

Horizontal rock anchors may be required at specific locations to prevent pop-outs of the bedrock, especially in areas where bedrock fractures are conducive to the failure of the bedrock surface.

The requirement for horizontal rock anchors should be evaluated during the excavation operations and should be discussed with the structural engineer during the design stage.

5.8 Pavement Structure

For design purposes, the rigid pavement structure presented in the following table could be used for the design of car only parking areas in the lower level of the parking garage.

Table 4 - Recommended Pavement Structure – Car Only Parking Areas	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE – Either in situ soils, fill approved by the geotechnical consultant or OPSS Granular B Type I or II material placed over in situ soil.	

Table 5 - Recommended Pavement Structure – Access Lanes and Heavy Truck Parking Areas	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils, fill approved by the geotechnical consultant or OPSS Granular B Type I or II material placed over in situ soil	

Table 6 - Recommended Rigid Pavement Structure - Lower Level	
Thickness (mm)	**Material Description**
125	**Rigid Concrete Pavement -** 32 MPa concrete with air entrainment
300	**BASE** - OPSS Granular A Crushed Stone
SUBGRADE - Either fill, OPSS Granular B Type II material placed over in situ soil, fill or rock	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that the composite drainage system (such as Miradrain G100N, Delta Drain 6000 or equivalent) extend down to the footing level. It is recommended that 150 mm diameter sleeves at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to sump pit(s) within the lower basement area.

Underfloor Drainage

It is anticipated that underfloor drainage will be required to control water infiltration for the underground parking levels. The spacing of the underfloor drainage system should be confirmed at the time of excavation when water infiltration can be better assessed. For design purposes, we suggest a 150 mm in diameter perforated pipe with a geotextile sock be placed at approximately each bay.

Foundation Backfilling

Above the bedrock surface, backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection Against Frost Action

The parking garage is expected to not require protection against frost action due to the founding depth. Unheated structures such as the access ramp may required to be insulated against the deleterious effect of frost action. Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with adequate foundation insulation, should be provided. More details regarding foundation insulation can be provided, if requested.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

Unsupported Side Slope

The side slopes of excavations in the soil and fill overburden materials should either be excavated at acceptable slopes or should be retained by shoring systems from the beginning of the excavation until the structure is backfilled. Insufficient room is expected for majority of the excavation to be constructed 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 excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soils are considered to be 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. A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

Temporary Shoring

Temporary shoring will be required to support the overburden soils. The design and implementation of these temporary systems will be the responsibility of the excavation contractor or the shoring contractor and their design team. Inspections and approval of the temporary system will also be the responsibility of the designer. Geotechnical information provided below is to assist the designer in completing a suitable and safe shoring system. The designer should take into account the potential for a fully saturated condition following a significant precipitation event. Any changes to the approved shoring design system should be reported immediately to the owner’s representative prior to implementation.

Temporary shoring may be required to complete the required excavations where insufficient room is available for open cut methods. The shoring requirements will depend on the depth of the excavation, the proximity of the adjacent buildings and underground structures and the elevation of the adjacent building foundations and underground services. Additional information can be provided when the above details are known.

For design purposes, the temporary system may consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below. These systems can be cantilevered, anchored or braced. The earth pressures acting on the shoring system may be calculated using the following parameters.

Table 7 - Soil Parameters for Shoring System Design

Parameters	**Values**
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Unit Weight (γ), kN/m^3	20
Submerged Unit Weight (γ), kN/m^3	13

Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure their stability. It is further recommended that the toe of the shoring be adequately supported to resist toe failure.

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or by pullout of a 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor.

The anchor derives its capacity from the bonded portion, or fixed anchor length, at the base of the anchor. An unbonded portion, or free anchor length, is also usually provided between the rock surface and the start of the bonded length. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, can be used. A minimum grout strength of 40 MPa is recommended.

It is recommended that the anchor drill hole diameter be within 1.5 to 2 times the rock anchor tendon diameter and the anchor drill holes be inspected by geotechnical personnel and should be flushed clean prior to grouting. The use of a grout tube to place grout from the bottom up in the anchor holes is further recommended.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

Soldier Pile and Lagging System

The active earth pressure acting on a soldier pile and lagging shoring system can be calculated using a rectangular earth pressure distribution with a maximum pressure of 0.65 K γ H for strutted or anchored shoring or a triangular earth pressure distribution with a maximum value of K γ H for a cantilever shoring system. H is the height of the excavation.

The active earth pressure should be used where wall movements are permissible while the at-rest pressure should be used if no movement is permissible.

The total unit weight should be used above the groundwater level while the submerged unit weight should be used below the groundwater level.

The hydrostatic groundwater pressure should be added to the earth pressure distribution wherever the submerged unit weights are used for earth pressure calculations should the level on the groundwater not be lowered below the bottom of the excavation. If the groundwater level is lowered, the total unit weight for the soil should be used full weight, with no hydrostatic groundwater pressure component.

6.4 Pipe Bedding and Backfill

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

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on soil subgrade. If the bedding is placed on bedrock, the thickness of the bedding should be increased to 300 mm for sewer pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 95% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential 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 SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. 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.

Permit to Take Water

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site mostly consist of frost susceptible materials. In 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.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. Precaution must be taken where excavations are carried in proximity of existing structures which may be adversely affected due to the freezing conditions. In particular, it should be recognized that where a shoring system is used, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

6.7 Corrosion Potential and Sulphate

The analytical testing results indicate that the sulphate content is less than 0.1%. The results indicates that Type 10 Portland Cement (i.e. normal cement) would be appropriate for this site. The chloride content and pH of the samples indicate that they are not significant factors in creating a corrosive environment, whereas the resistivity is indicative of an moderately aggressive corrosive environment.

6.8 Impacts on the Existing Underground Service and Monitoring Program

It is our understanding that the existing deep service easement that intersects the site will remain in place and sections of the proposed development will be constructed in close proximity and/or directly over the service. It is expected that future access to the existing service pipes will be required. Paterson reviewed the following design drawings, regarding the service easement as part of the geotechnical assessment:

- Site Plan – Prepared by grc architects – Job No. 1218 – Sheet No. A-001 – Revision 2, dated April 12, 2022.
- Basement Plan – Prepared by grc architects – Job No. 1218 – Sheet No. A-100 – Revision 2, dated April 12, 2022.
- Site plan Excerpt– Easement drawings presented to the City of Ottawa – Prepared by grc architects – Dated August 18, 2022.
- Outfall Sewer Section – Easement drawings presented to the City of Ottawa – Prepared by grc architects – Dated August 19, 2022.
- Foundation/Basement Floor Plan – Prepared by Cunliffe & Associates – Job No. 18-053 – Drawings No. S100 – Revision 1, dated April 12, 2022.
- Ground Floor-Concrete Plan – Prepared by Cunliffe & Associates – Job No. 18-053 – Drawings No. S101– Revision 1, dated April 12, 2022.
- Sections and Details – Prepared by Cunliffe & Associates – Job No. 18-053 – Drawings No. S302 – Revision 1, dated April 12, 2022.
- Sections and Details – Prepared by Cunliffe & Associates – Job No. 18-053 – Drawings No. S304 – Revision 1, dated April 12, 2022.

Due to the existing of the service easement that intersects the site and bedrock conditions observed, it is recommended that where the proposed footings are to be located above or in close proximity to the existing sewer, a support system is required for the footings to allow for future maintenance of the existing sewer without impacting the stability of the building or any settlement sensitive structures.

Main Structural Elements

For areas with structural elements, such as concrete retaining wall, guard house, emergency generator, adjacent to the service easement, the following is recommended in order to allow future pipe replacement work to be completed without disturbance to the proposed entrance ramp and other structural elements:

- Sub-excavate 1.0 m below design USF level. The sub-excavation should extend a minimum 1.2 m horizontally beyond the footing edge in all directions.
- The sub-excavated subgrade surface should be proof rolled using suitable compaction equipment under dry conditions and above freezing temperatures and reviewed by Paterson personnel. Poor performing areas should be removed and replaced with granular fill such as OPSS Granular A or Granular B Type II compacted to 98% of the material's SPMDD.
- Place a 200 mm thick of a minimum 17 MPa lean concrete slab (28-day strength) over the proof rolled subgrade surface. The concrete slab should extend a minimum 1.2 m horizontally beyond the footing edge in all directions.
- A minimum 800 mm thick layer of granular fill material such as OPSS Granular A or Granular B Type II should be placed over the proposed concrete slab up to the USF elevation of the proposed footings to be placed in close proximity or over the service easement. The granular materials should be placed in maximum 300 mm thick loose lifts and compacted to 98% of the material's SPMDD.
- The above-noted work should be reviewed and approved by Paterson at the time of construction.

Light Structures

For areas with lightly loaded structural elements such as fences, it is expected that these structural elements would be temporarily removed to allow for future maintenance of the existing underground service. As such, the following is recommended:

- Sub-excavate 200 mm below design USF level. The sub-excavation should extend a minimum 300 mm horizontally beyond the footing edge in all directions.
- The sub-excavated subgrade surface should be proof rolled using suitable compaction equipment under dry conditions and above freezing temperatures and reviewed by Paterson personnel. Poor performing areas should be removed and replaced with granular fill such as OPSS Granular A or Granular B Type II compacted to 98% of the material's SPMDD.
- Place a minimum 200 mm thick layer of 25 MPa lean concrete slab (28-day strength) over the proof rolled subgrade surface. The concrete slab should extend a minimum 0.3 m horizontally beyond the footing edge in all directions.
- The above-noted work should be reviewed and approved by Paterson at the time of construction.

Vibration Monitoring Program for The Existing Underground Service

To ensure no disturbance to the existing service occurs during construction of the proposed development, a monitoring program should be implemented during site construction activities, such as soil excavation, bedrock removal and installation of the shoring system and/or underpinning system to ensure the lateral support zone of the existing service easement has not been impacted. This will allow the vibration monitoring consultant, project manager and construction team to have a live feed of the vibrations and immediate alert system to stop any construction activities, if the vibrations exceed the recommended threshold.

It is recommended that at least three (3) vibration monitoring sensors will be installed directly on top of the 1,372 mm diameter existing masonry outfall sewer. A detail of the vibration monitoring installation is illustrated on the attached Figure 5 in Appendix 2.

Vibration levels at the west boundary of the site along the service easement will be continuously monitored during the excavation and blasting programs. The proposed locations of the vibration monitoring station are shown on the attached Figure 4 in Appendix 2.

It is recommended that the limits be artificially reduced in order to protect the sensitive infrastructure. Paterson recommends utilizing the following limits for the existing underground pipeline, refer to Figure 6 below for proposed vibration limits for the 1,372 mm diameter existing masonry outfall sewer:

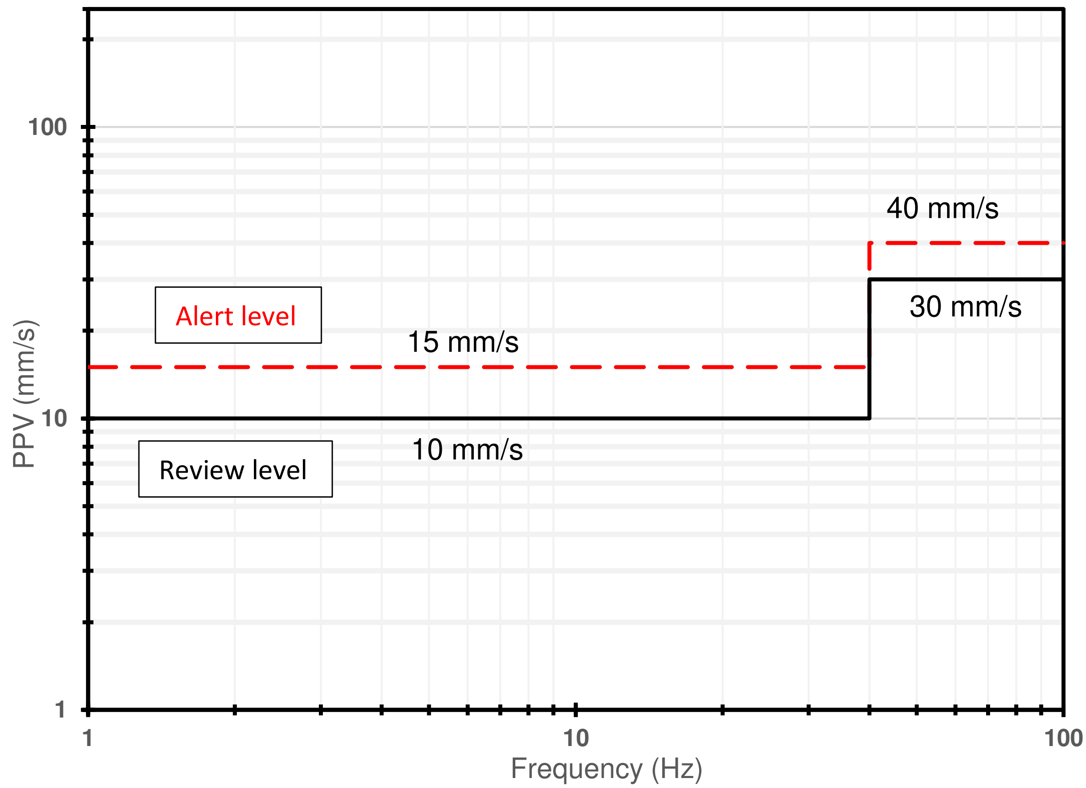

Figure 6 - Proposed Vibration Limits for 1,372 mm diameter existing masonry outfall sewer

- ❑ If the vibrations are observed to exceed the review level event (Black Line in the above chart), the contractor should be notified, and a field assessment should be completed to prevent any exceedances from occurring.

- ❑ If the recommended vibration limit is exceeded (Red dashed Line in the above chart), the monitoring consultant must notify the site superintendent and operation will be stopped.

Weekly vibration monitoring reports should be submitted to the construction manager presenting the following information:

- Vibration data.
- Summary of readings above the warning line (refer to figure 6), where applicable.

Before the monitoring program starts, a vibration response action plan should be provided by the monitoring consultant to the contractor, owner and the city of Ottawa. The contractor should implement mitigation measures for future excavation of any construction activities as necessary and provide updates on the effectiveness of the improvement. Response actions should be pre-determined prior to excavation, depending on the approach provided to protect elements. Processes and procedures should be in-place prior to completing any activities, which cause vibrations to identify issues and react in a quick manner in the event of an exceedance.

Paterson can provide an action plan if the vibration limits are exceeded. However, this would be covered under a separate contract, if granted.

The geophone sensors will be removed at the completion of construction, and the remaining hole should be backfilled with bentonite pellets and sand.

7.0 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:

- ❑ Review of the geotechnical aspects of the excavating contractor's shoring design, prior to construction.
- ❑ Review the bedrock stabilization and excavation requirements.
- ❑ Review proposed foundation drainage design and requirements.
- ❑ Vibration monitoring and geophone installation.
- ❑ Vibration action plan and design, if requested.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A geotechnical 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 immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

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 the Ministry of Foreign Affairs of the State of Qatar or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
June 5, 2023
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

Zubaida Al-Moselly, P.Eng.

Faisal I. Abou-Seido, P.Eng.

Report Distribution:

- ❑ Ministry of Foreign Affairs of the State of Qatar (email copy)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

TEST HOLE LOGS BY OTHERS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM / REMARKS TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG4960

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger

DATE 2019 May 29

SOIL DESCRIPTION	Sample TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	57.20
TOPSOIL (to 0.30)	AU	1				
FILL: Brown silty sand with gravel, cobbles and boulders (0.30 – 2.44)	SS	2	46	10	1	56.20
	SS	3	90	50+	2	55.20
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders (2.44 – 3.18)	SS	4	83	30		
	SS	5	100	50+	3	54.20
BEDROCK: Grey limestone (3.18 – 6.30)	RC	1	98	95	4	53.20
					5	52.20
	RC	2	100	90	6	51.20
End of Borehole (6.30)						

(Piezometer dry/blocked to 2.34m depth - June 12, 2019)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
★ Soil Sensitivity (St)
20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 29

FILE NO. PG4960

HOLE NO. BH 2

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	58.20
TOPSOIL 0.25	AU	1				
FILL: Brown silty sand with gravel, trace cobbles	SS	2	54	12	1	57.20
	SS	3	29	9	2	56.20
2.59	SS	4	67	18		
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, cobbles and boulders	SS	5	100	50+	3	55.20
3.50						
End of Borehole Practical refusal to augering at 3.50m depth (Piezometer dry/blocked to 2.71m depth - June 12, 2019)						

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

★ Soil Sensitivity (St)

20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

FILE NO. PG4960

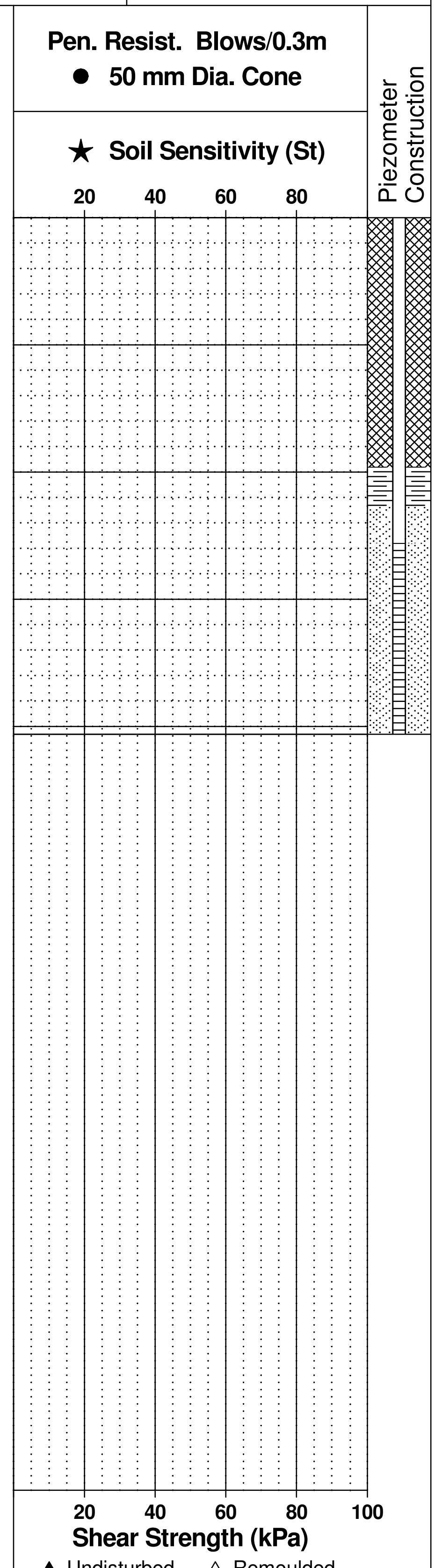
HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** 2019 May 29

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	57.62
TOPSOIL (to 0.25)		AU	1				
FILL: Brown silty sand with gravel, trace cobbles and boulders (0.25 to 2.54)		SS	2	42	16	1	56.62
		SS	3	79	7	2	55.62
GLACIAL TILL: Compact to very dense, brown sandy silt with gravel, cobbles and boulders (2.54 to 4.06)		SS	4	92	20		
		SS	5	100	50+	3	54.62
		SS	6	60	50+	4	53.62
End of Borehole (4.06)							

Practical refusal to augering at 4.06m depth

(Piezometer dry/blocked to 2.54m depth - June 12, 2019)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 29

FILE NO. PG4960

HOLE NO. BH 4

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	58.30
TOPSOIL	0.20	AU	1				
FILL: Brown silty sand with gravel, trace cobbles and boulders		SS	2	38	27	1	57.30
		SS	3	62	18	2	56.30
	3.05	SS	4	0	16		
Grey-brown **CLAYEY SILT** with sand seams	3.66	SS	5	92	43	3	55.30
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders	4.44	SS	6	88	50+	4	54.30

End of Borehole

Practical refusal to augering at 4.44m depth

(Piezometer dry/blocked to 3.60m depth - June 12, 2019)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
★ Soil Sensitivity (St)
20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 28

FILE NO. PG4960

HOLE NO. BH 5

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 / ★ Soil Sensitivity (St)	Piezometer Construction
GROUND SURFACE						0	57.43		
TOPSOIL 0.25		AU	1						
FILL: Brown silty sand with gravel		SS	2	46	25	1	56.43		
		SS	3	46	15	2	55.43		
- with wood fragments by 2.3m depth		SS	4	38	6	3	54.43		
		SS	5	54	6	4	53.43		
		SS	6	58	10				
- with cobbles and boulders by 4.6m depth		SS	7	38	11	5	52.43		
		SS	8	21	10	6	51.43		
6.17									

End of Borehole

Practical refusal to augering at 6.17m depth

(Piezometer dry/blocked to 4.61m depth - June 12, 2019)

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
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 May 29

FILE NO. PG4960

HOLE NO. BH 6

SOIL DESCRIPTION	Depth of base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	58.17
TOPSOIL	0.20	AU	1				
FILL: Brown silty sand with gravel	1.00	SS	2	62	16	1	57.17
FILL: Red sand	1.37						
FILL: Brown silty sand with gravel, trace cobbles		SS	3	50	19	2	56.17
		SS	4	50	33	3	55.17
		SS	5	12	7		
		SS	6	58	5	4	54.17
		SS	7	58	3	5	53.17
	5.72	SS	8	46	50+		

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
★ Soil Sensitivity (St)
20 40 60 80

Piezometer Construction

End of Borehole

Practical refusal to augering at 5.72m depth

(Piezometer dry/blocked to 5.46m depth - June 12, 2019)

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
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 28

FILE NO. PG4960

HOLE NO. BH 7

SOIL DESCRIPTION	Bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	57.64
TOPSOIL	0.15	AU	1				
FILL: Brown silty sand with gravel		SS	2	58	4	1	56.64
	1.83	SS	3	67	6	2	55.64
GLACIAL TILL: Compact, brown silty sand with gravel, trace cobbles and boulders		SS	4	79	12	3	54.64
		SS	5	92	17		
	4.04	SS	6	80	50+	4	53.64

End of Borehole

Practical refusal to augering at 4.04m depth

(GWL @ 4.01m - June 12, 2019)

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

★ Soil Sensitivity (St)

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 May 28

FILE NO. PG4960

HOLE NO. BH 8

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20	AU	1		
FILL: Brown silty sand with gravel	1.93	SS	2	56	50+
		SS	3	67	8
FILL: White sand	1.98				
FILL: Brown silty sand with gravel	4.37	SS	4	42	8
		SS	5	75	13
		SS	6	82	67
BEDROCK: Grey limestone	7.82	RC	1	69	33
		RC	2	100	90
		RC	3	95	95
End of Borehole					

(Piezometer dry/blocked to 0.45m depth - June 12, 2019)

DEPTH (m)	ELEV. (m)
0	58.24
1	57.24
2	56.24
3	55.24
4	54.24
5	53.24
6	52.24
7	51.24

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
★ Soil Sensitivity (St)
20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 28

FILE NO. PG4960

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	58.17
TOPSOIL (to 0.25)		AU	1				
FILL: Brown silty sand with gravel		SS	2	29	23	1	57.17
		SS	3	46	61	2	56.17
(to 3.05)		SS	4	33	10	3	55.17
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, cobbles and boulders		SS	5	75	17		
- grey-brown clayey silt with sand seams layer from 3.9 to 4.4m depth		SS	6	83	10	4	54.17
(to 5.18)		SS	7	65	50+	5	53.17

End of Borehole

Practical refusal to augering at 5.18m depth

(Piezometer dry/blocked to 4.72m depth - June 12, 2019)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
★ Soil Sensitivity (St)
20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 28

FILE NO. PG4960

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	58.18
TOPSOIL 0.20		AU	1				
FILL: Brown silty sand with gravel		SS	2	71	20	1	57.18
- with cobbles and boulders by 1.5m depth		SS	3	83	32	2	56.18
		SS	4	92	24		
3.66		SS	5	25	24	3	55.18
Grey **CLAYEY SILT,** trace sand and gravel		SS	6	46	25	4	54.18
4.67		SS	7	75	50+		

End of Borehole

Practical refusal to augering at 4.67m depth

(Piezometer dry/blocked to 3.54m depth - June 12, 2019)

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

★ Soil Sensitivity (St)

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 May 28

FILE NO. PG4960

HOLE NO. BH11

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20	AU	1		
FILL: Brown silty sand with gravel, trace cobbles and boulders		SS	2	12	4
		SS	3	46	23
	2.54	SS	4	100	14
Grey **CLAYEY SILT** with sand seams		SS	5	62	30
	3.81				
GLACIAL TILL: Grey sandy silt with gravel, trace cobbles and boulders		SS	6	83	1
	4.67	SS	7	0	50+

DEPTH (m)	ELEV. (m)
0	57.91
1	56.91
2	55.91
3	54.91
4	53.91

End of Borehole

Practical refusal to augering at 4.67m depth

(GWL @ 3.92m - June 12, 2019)

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

★ Soil Sensitivity (St)

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
178 Boteler Street
Ottawa, Ontario

DATUM / **REMARKS** TBM - Top of manhole cover, east of the intersection of Boteler Street and Cumberland Street. Geodetic elevation = 57.37m, as per Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG4960

HOLE NO. BH12

BORINGS BY CME 55 Power Auger **DATE** 2019 May 28

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	57.45
TOPSOIL	0.13	AU	1				
FILL: Brown clayey silt to silty sand with gravel		SS	2	25	8	1	56.45
		SS	3	92	14	2	55.45
		SS	4	42	13	3	54.45
		SS	5	83	9		
	4.06	SS	6	83	2	4	53.45
GLACIAL TILL: Loose to very dense, grey silty sand with gravel		SS	7	100	50+		
	4.95					5	52.45
BEDROCK: Grey limestone		RC	1	100	100	6	51.45
		RC	2	96	92	7	50.45
	8.63	RC	3	100	100	8	49.45
End of Borehole							
(GWL @ 2.51m - June 12, 2019)							

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

★ Soil Sensitivity (St)

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ 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 relative strength of cohesionless soils is the compactness condition, 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. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water 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 at 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

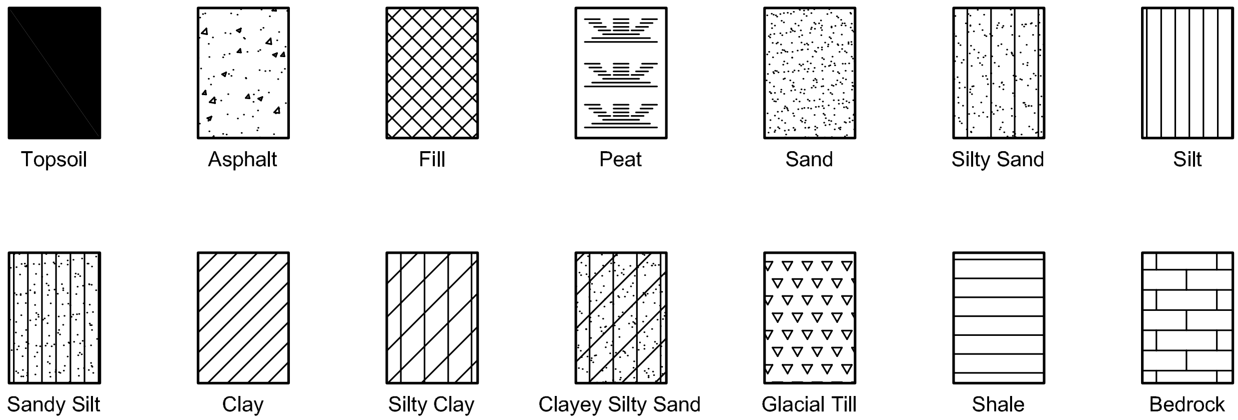
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

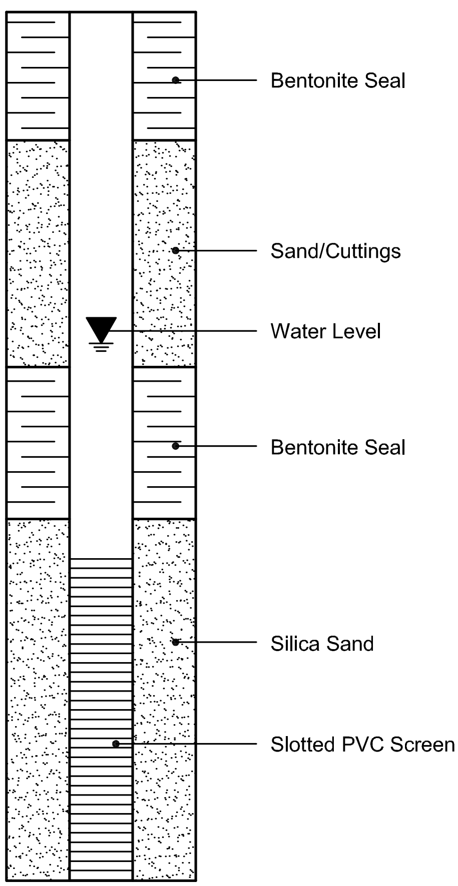
SYMBOLS AND TERMS (continued)

STRATA PLOT

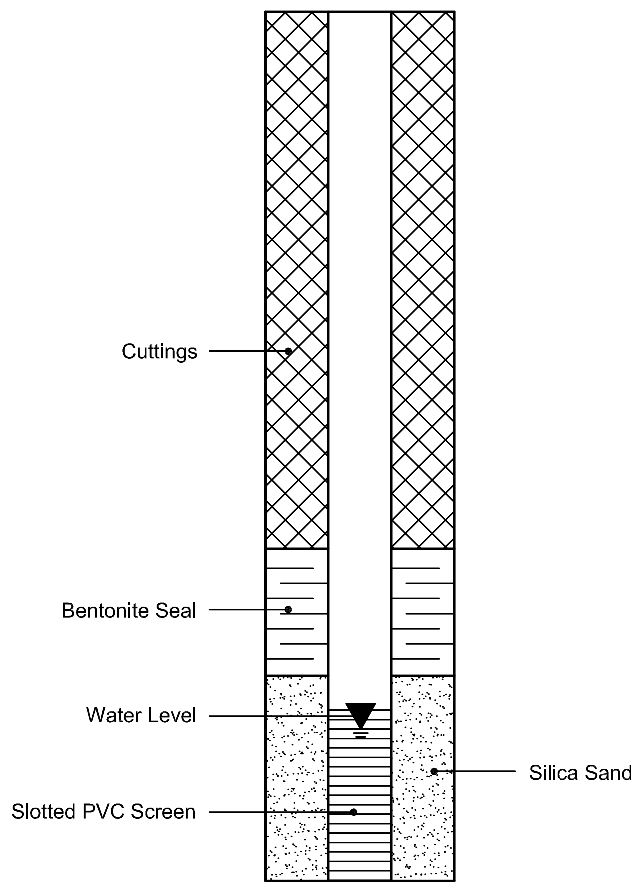


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Stantec

MONITORING WELL RECORD

MW13-1

CLIENT City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION Boteler Street — DATUM NAD 83 — COMPILED BY B.C.

DATES: BORING April 12, 2013 — WATER LEVEL April 24, 2014 — TPC ELEV. 56.42 — CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	N-VALUE	WELL CONSTRUCTION
0	56.53					
	56.2	Black/brown, dry TOPSOIL with trace organics.	SS	1		Bentonite Seal
	55.0	Dark brown, dry, sand with minor silt, FILL.	SS	2		
	54.9	Crushed rock, FILL.	SS	3		
	54.9	Light grey, dry, medium sand, FILL.	SS	4		
	53.3	Dark brown sand with minor silt, FILL.	SS	5		
		Limestone BEDROCK.				31 mm, PVC Casing, with Sandpack 31mm, Slotted PVC Screen, with Sandpack
	50.1	Borehole terminated at 6.4 m bgs. Monitoring well installed.				

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

DEPTH (m) scale 0–16; DEPTH (ft) scale 2–52.

LABORATORY ANALYSES: MW13-1 SS3 submitted for laboratory analysis of VOCs, PAHs, PHC F1 -F4, PCBs, inorganics and metals.

▽ Groundwater Level

A-

Stantec MONITORING WELL RECORD

MW13-2

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING April 15, 2013 WATER LEVEL April 24, 2014
PROJECT No. 122510670
DATUM NAD 83
TPC ELEV. 56.877
ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS (● %LEL 20/40/60/80; ▲ ppmv 100/200/300/400)	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE	WELL CONSTRUCTION
0	56.95									
	56.8	Black, dry, topsoil FILL, with trace organics.				▲	SS	1		Bentonite Seal
	55.4	Light brown, dry, silty sand with trace clay, FILL.				▲	SS	2		
	55.1	Red/grey, dry, coarse sand with trace silt, FILL. Large rock fragments and clay brick fragments.				▲	SS	3		
	53.8					▲	SS	4		
		Brown, dry silty clay, FILL.					SS	5		
		Limestone BEDROCK.		∇						31 mm, PVC Casing, with Sandpack; 31mm, Slotted PVC Screen, with Sandpack
	50.6	Borehole terminated at 6.4 m bgs. Monitoring well installed.								

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
Depth scale (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

LABORATORY ANALYSES: MW13-2 SS3 submitted for laboratory analysis of VOCs, PAHs, PHC F1-F4, PCBs, inorganics, and metals.

∇ Groundwater Level

Stantec

MONITORING WELL RECORD

MW13-3

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING April 15, 2013 WATER LEVEL April 22, 2013
PROJECT No. 122510670
DATUM NAD 83
TPC ELEV. 61.18
ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	60.22	Well decommissioned on June 13, 2013				
0		Brown, dry, silty sand with clay FILL.	SS	1		Bentonite Seal
0.9	59.3	FILL material -could not be sampled by direct push techniques -air hammered				
4.2	56.0	Dark brown, dry, silty sand with coarse light brown sand, FILL.	SS	2		
4.7	55.5		SS	3		
5.2	55.0					
6.1	54.1	Creosote odour				
		Light brown, dry, clayey silt, FILL.				
		FILL material and fractured bedrock.				
		Limestone BEDROCK.				31 mm, PVC Casing, with Sandpack 31mm, Slotted PVC Screen, with Sandpack
12.8	47.4	Borehole terminated at 12.8 m. Monitoring well installed.				

VAPOUR CONCENTRATIONS ● %LEL (20, 40, 60, 80) ▲ ppmv (100, 200, 300, 400)

DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

LABORATORY ANALYSES: MW13-3 SS1 and SS3 were submitted for laboratory analysis of PHC F1 to F4, VOCs, PAH, and metals. MW13-3 SS3 was also submitted for laboratory analysis of pH.

Stantec

MONITORING WELL RECORD

MW13-4

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING April 17, 2013
WATER LEVEL April 22, 2013
TPC ELEV. 57.33
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	WELL CONSTRUCTION
0	57.49				
	57.4	Brown/black dry topsoil, FILL, with trace organics.			Bentonite Seal
		Brown, dry silty sand FILL.	SS	1	
	56.1				
	55.9	Light grey, dry crushed rock, FILL.	SS	2	
	55.4	Brown, dry, silty sand, FILL, with coarse light brown sand.			
		Limestone BEDROCK.			
					31 mm, PVC Casing, with Sandpack
					31mm, Slotted PVC Screen, with Sandpack
10	47.5	Borehole terminated at 10.1 m bgs. Monitoring well installed.			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: MW13-4 SS1 was submitted for laboratory analysis of PHC F1 to F4, VOCs, PAH, and metals.

⊽ Groundwater Level

Stantec MONITORING WELL RECORD

MW13-7

CLIENT: City of Ottawa		PROJECT No. 122510670	ORIGINATED BY: J.U.
LOCATION: Boteler Street		DATUM: NAD 83	COMPILED BY: B.C.
DATES: BORING: April 17, 2013	WATER LEVEL: April 22, 2013	TPC ELEV. 56.96	CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	57.07	Well decommissioned on June 13, 2013				
	56.9	Black, dry TOPSOIL, with trace organics.	SS	1		Bentonite Seal
		Dark brown, dry, sandy silt, FILL, with trace clay.	SS	2		
			SS	3		
3	54.0	Limestone BEDROCK.				
~6.4						31 mm, PVC Casing, with Sandpack 31mm, Slotted PVC Screen, with Sandpack
9.75	47.3	Borehole terminated at 9.75 m bgs. Monitoring well installed.				

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: MW13-7 SS2 was submitted for laboratory analysis of PHC F1 to F4, VOCs, PAH, and metals.

A-

Stantec

BOREHOLE RECORD

BH13-8

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING: July 25, 2013 WATER LEVEL
PROJECT No. 122510670
DATUM: NAD 83
TPC ELEV.
ORIGINATED BY: J.U.
COMPILED BY: B.C.
CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE
	58.03	**No vapour readings due to limited soil recovery in borehole.**			
0		Gravel, boulders and cobble, FILL. Very low recovery.	SS	1	
			SS	2	
			SS	3	
	55.0		SS	4	
3		Dark brown SAND with gravel, trace silty clay, FILL. Low recovery	SS	5	
	53.8		SS	6	
4.3		End of borehole at 4.3 mbgs			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80) ▲ ppmv (100, 200, 300, 400)

Other column headings on the log: STRATA PLOT, WATER LEVEL, DEPTH (ft) (scale 2–52).

LABORATORY ANALYSES: BH13-8 SS6 was submitted for laboratory analysis of PHCs, BTEX, VOCs, metals, PAH, EC/SAR, PCBs. A composite of SS5 and SS6 was submitted for laboratory analysis of FOC.

Stantec

BOREHOLE RECORD

BH13-9

CLIENT: City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION: Boteler Street — DATUM: NAD 83 — COMPILED BY B.C.

DATES: BORING July 25, 2013 — WATER LEVEL — TPC ELEV. — CHECKED BY J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS (● %LEL ▲ ppmv)	SAMPLES TYPE	NUMBER	N-VALUE
0	57.87	Medium brown sand with gravel, cobbles and boulders, FILL. Some concrete debris. Low recovery.	FILL			▲	SS	1	
							SS	2	
1.5	56.4	Gravel with medium brown sand. Some coal pieces, glass fragments, and wood debris, FILL. Low recovery.	FILL			▲	SS	3	
							SS	4	
3.1	54.8	Coarse brown sand with gravel, FILL. Some silty clay above bedrock. Sample refusal.	FILL			▲	SS	5	
							SS	6	
4.1	53.8	End of borehole at 4.1 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80 (%LEL); ▲ 100, 200, 300, 400 (ppmv)

LABORATORY ANALYSES: BH13-9 SS5 was submitted for laboratory analysis of PHCs, BTEX, VOCs, metals, PAH, PCBs, EC/SAR. A composite of SS5 and SS6 was submitted for laboratory analysis of FOC. SS3 was submitted for laboratory analysis of FOC.

A-

Stantec MONITORING WELL RECORD

MW13-10

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING: July 18, 2013 WATER LEVEL: April 24, 2014
PROJECT No. 122510670 ORIGINATED BY: J.U.
DATUM: NAD 83 COMPILED BY: B.C.
TPC ELEV. 58.27 CHECKED BY: J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	58.28	Gravel, boulders and concrete debris. Some coarse brown sand, FILL. Low recovery	0–4	SS SS	1 2		Protective Casing and Bentonite Seal
1.5	56.8	Gravel with medium brown sand. Some silt and clay, FILL.	4–10	SS SS	3 4		
3.1	55.2	Brown SILT with medium sand and gravel, FILL. Damp.	10–16	SS SS SS	5 6 7		
4.9	53.4	Limestone BEDROCK.	16–38				51 mm, Schedule 40, PVC Casing, with Sandpack
11.6	46.7	End of borehole at 11.6 mbgs. Well was dry during the July 31, 2013 sampling event.					

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80) ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: MW13-10 SS7 submitted for laboratory analysis of VOCs, BTEX, PHCs, metals, PAH, EC/SAR

⊻ Groundwater Level

A-

Stantec

MONITORING WELL RECORD

MW13-11

CLIENT City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION Boteler Street — DATUM NAD 83 — COMPILED BY B.C.

DATES: BORING July 18, 2013 — WATER LEVEL April 24, 2014 — TPC ELEV. 58.05 — CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	N-VALUE	WELL CONSTRUCTION
0	58.22	Coarse gravel and cobbles with concrete debris. Some medium brown sand, FILL.	SS	1		Protective Casing and Bentonite Seal
	56.7	Red brick debris, FILL.	SS	2		
	55.9	Brown silty sand. Damp. Some gravel, FILL.	SS	3		
	55.2	Grey SILTY CLAY with dark brown silt seams. Some gravel. FILL. Damp.	SS	4		
	54.4	Brown fine SILTY SAND. Grey silty clay above bedrock. Damp.	SS	5		
	54.0	Limestone BEDROCK.	SS	6		51 mm, Schedule 40, PVC Casing, with Sandpack; 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack
	47.6	End of borehole at 10.7 mbgs.				

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

Depth scale (m): 0–16; Depth scale (ft): 2–52

LABORATORY ANALYSES: MW13-11 SS6 was submitted for laboratory analysis of BTEX, PHCs, VOCs, metals, PAH, EC/SAR. A composite of SS5 and SS6 was submitted for laboratory analysis of FOC.

∇ Groundwater Level

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART GDT 4/28/14

Stantec

MONITORING WELL RECORD

MW13-12

CLIENT: City of Ottawa | PROJECT No. 122510670 | ORIGINATED BY J.U.

LOCATION: Boteler Street | DATUM NAD 83 | COMPILED BY B.C.

DATES: BORING July 25, 2013 | WATER LEVEL April 24, 2014 | TPC ELEV. 57.877 | CHECKED BY J.P-D.

Vapour concentrations: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

Could not locate well on April 24, 2014.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	SAMPLE TYPE	NUMBER	N-VALUE	WELL CONSTRUCTION
0 – 1.5		Gravel, boulders, and concrete debris, FILL. Some medium brown sand. Low recovery	0 – 5	SS SS	1 2		Protective Casing and Bentonite Seal
1.5 – 3.0		Light brown silty sand with gravel, FILL. Damp.	5 – 10	SS SS	3 4		
3.0 – 3.8		Brown silty sand with gravel, FILL. Damp.	10 – 12.5	SS	5		
3.8 – 4.6		Light brown/grey SILTY CLAY. Wet.	12.5 – 15	SS	6		
4.6 – 10.7		Limestone BEDROCK.	15 – 35				51 mm, Schedule 40, PVC Casing, with Sandpack 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack
10.7		End of borehole at 10.7 mbgs. Well was dry during the July 31, 2013 sampling event.					

LABORATORY ANALYSES: MW13-12 SS5 was submitted for laboratory analysis of PHCs, BTEX, VOCs, metals, PAH, PCB, EC/SAR, pH. A composite of SS5 and SS6 was submitted for laboratory analysis of FOC. SS1 was submitted for laboratory analysis of FOC and pH.

Stantec

MONITORING WELL RECORD

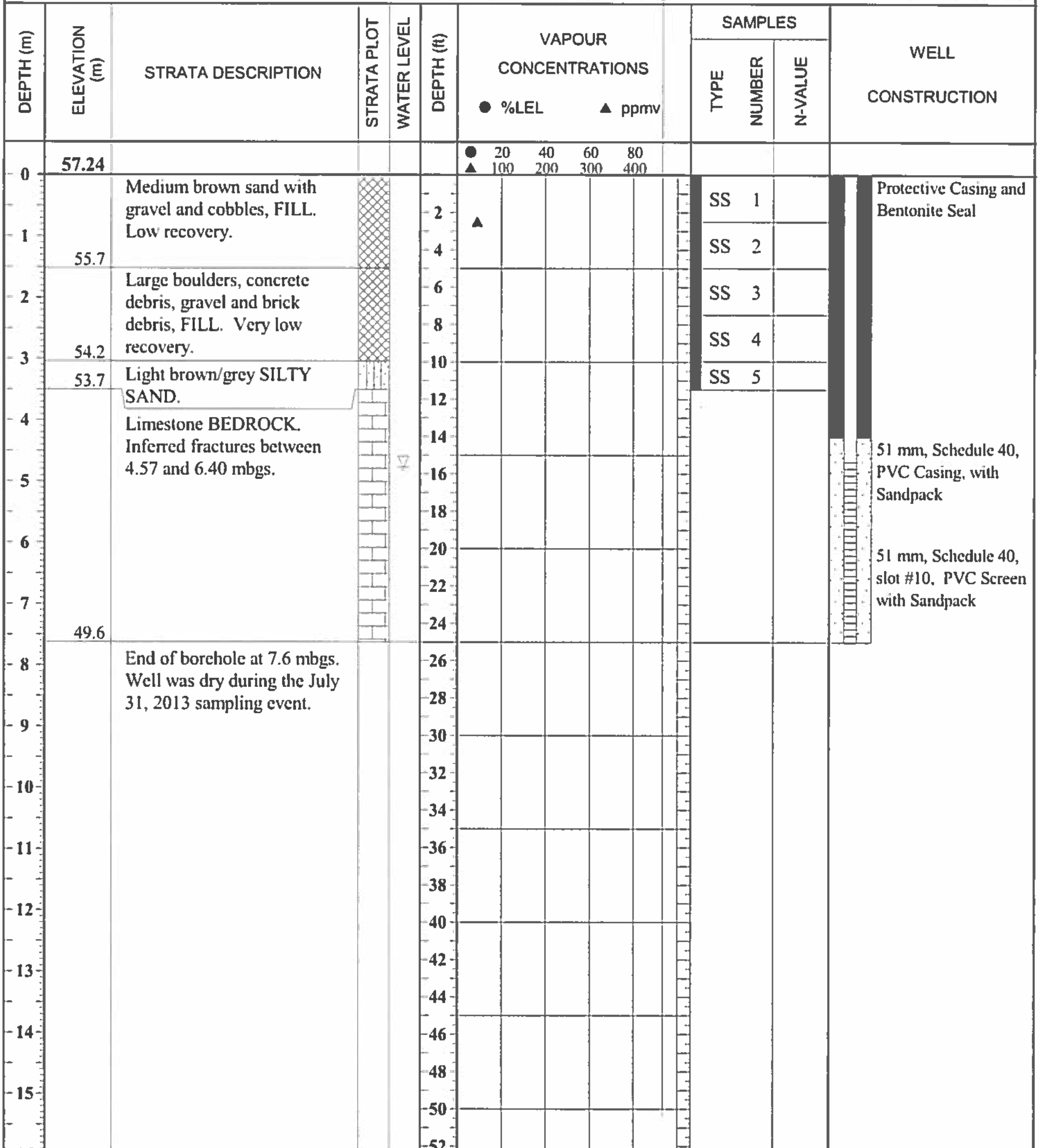
MW13-13

CLIENT City of Ottawa PROJECT No. 122510670 ORIGINATED BY J.U.

LOCATION Boteler Street DATUM NAD 83 COMPILED BY B.C.

DATES: BORING July 25, 2013 WATER LEVEL April 24, 2014 TPC ELEV. 57.205 CHECKED BY J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	NUMBER	N-VALUE	WELL CONSTRUCTION
0	57.24					
0–1.5	55.7	Medium brown sand with gravel and cobbles, FILL. Low recovery.	SS	1		Protective Casing and Bentonite Seal
			SS	2		
1.5–3.0	54.2	Large boulders, concrete debris, gravel and brick debris, FILL. Very low recovery.	SS	3		
			SS	4		
3.0–3.5	53.7	Light brown/grey SILTY SAND.	SS	5		
3.5–7.6	49.6	Limestone BEDROCK. Inferred fractures between 4.57 and 6.40 mbgs.				51 mm, Schedule 40, PVC Casing, with Sandpack; 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack
7.6		End of borehole at 7.6 mbgs. Well was dry during the July 31, 2013 sampling event.				



LABORATORY ANALYSES: MW13-13 SS5 was submitted for laboratory analysis of PHCs, BTEX, VOC, metals, PAH, EC/SAR. A composite of SS4 and SS5 was submitted for laboratory analysis of FOC. SS1 was submitted for laboratory analysis of FOC.

⊽ Groundwater Level

Stantec

MONITORING WELL RECORD

MW13-14

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 25, 2013
WATER LEVEL April 24, 2014
TPC ELEV. 56.918
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	57.07	Light brown medium sand with gravel and boulders, FILL Low recovery.		SS	1		Protective Casing and Bentonite Seal
				SS	2		
1.5	55.5	Light brown SILTY SAND. Some silty clay above bedrock. Wet. - saturated from 2.29m to 3.048m.		SS	3		
				SS	4		
				SS	5		
3.7	53.4	Limestone BEDROCK. Inferred fractures between 4.88 and 6.71 mbgs. (Groundwater level ∇ at approx. 3.8 m)					51 mm, Schedule 40, PVC Casing, with Sandpack; 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack
7.6	49.4	End of borehole at 7.6 mbgs					

Vapour concentrations: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: MW13-14 SS3 was submitted for laboratory analysis of PHCs, BTEX, VOCs, metals, PAH, EC/SAR, PCBs. A composite of SS4 and SS5 was submitted for laboratory analysis of FOC. SS1 was submitted for laboratory analysis of FOC.

∇ Groundwater Level

Stantec

MONITORING WELL RECORD

MW14-1

CLIENT City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION Boteler Street — DATUM NAD 83 — COMPILED BY B.C.

DATES: BORING March 4, 2014 — WATER LEVEL April 24, 2014 — TPC ELEV. 57.934 — CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	NUMBER	N-VALUE	WELL CONSTRUCTION
0	57.99					
0 – 0.6	57.4	Brown, SAND, silt, gravel, large rocks, FILL, dry.	SS	1		Protective Casing and Bentonite Seal, with packer installed at 7.62 metres below grade.
0.6 – 1.4	56.6	Large boulder.				
1.4 – 2.6	55.4	Dark brown, SILTY SAND, some rocks, FILL, moist. Direct push refusal, switch to air hammer until bedrock.	SS	2		
2.6 – 4.3	53.7	Dark brown, SILTY SAND, FILL, moist.	GS	3		
4.3 – 5.5	52.5	Light brown SANDY SILT, with gravel, moist, some shale fragments.	GS	4		
5.5 – 14.5	43.5	Shale bedrock. Large void encountered at approximately 13.4 m to 14.3 m.				Open hole in shale bedrock.

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

DEPTH (ft): 2 – 52

Groundwater Level (▽ at approx. 13.8 m / 45 ft)

A-

Stantec

MONITORING WELL RECORD

MW14-2

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING March 5, 2014
WATER LEVEL April 24, 2014
TPC ELEV. 57.901
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	58.01	Dark brown, SANDY SILT, with large rocks, some gravel, red staining, FILL, dry.	SS	1		Protective Casing and Bentonite Seal
1.5	56.5	Dark brown, SANDY SILT, with some medium rocks, FILL, moist.	SS	2		
3.0	55.0	Dark brown, SANDY SILT, large rocks, some black staining, FILL, moist.	SS	3		
3.8	54.2	Dark brown, SANDY SILT, with coarse grey gravel, some rocks, FILL, moist. Direct push refusal on inferred bedrock.	SS	4		
			SS	5		
5.0	53.0	Shale bedrock.				51 mm, Schedule 40, PVC Casing, with Sandpack (from approx. 11.6 m); 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack (from approx. 12.6 m to 15.7 m)
15.7	42.3	End of borehole at 15.7 mbgs.				

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

Groundwater level symbol shown at approx. 8.4 m (27.5 ft).

Groundwater Level

A-

Stantec

MONITORING WELL RECORD

MW14-3

CLIENT: City of Ottawa
PROJECT No.: 122510670
ORIGINATED BY: J.U.
LOCATION: Boteler Street
DATUM: NAD 83
COMPILED BY: B.C.
DATES: BORING: March 6, 2014
WATER LEVEL: April 24, 2014
TPC ELEV.: 57.802
CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE	WELL CONSTRUCTION
0	57.91	Grey, SILTY SAND, grey gravel and large rocks, FILL, dry.	SS	1		Protective Casing and Bentonite Seal
	56.4	Large boulder.				
	55.8	Dark brown, SILTY SAND, some rocks, FILL, dry. Direct push refusal on inferred bedrock.	SS	2		
	54.1	Shale bedrock.				51 mm, Schedule 40, PVC Casing, with Sandpack; 51 mm, Schedule 40, slot #10, PVC Screen with Sandpack
13	44.9	End of borehole at 13 mbgs.				

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

DEPTH (m): 0–16; DEPTH (ft): 2–52

▽ Groundwater Level

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 4/28/14

Stantec

BOREHOLE RECORD

BH14-4

CLIENT	City of Ottawa	PROJECT No.	122510670
LOCATION	Boteler Street	DATUM	NAD 83
DATES: BORING	March 5, 2014	WATER LEVEL	
TPC ELEV.			

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv (● 20 40 60 80; ▲ 100 200 300 400)	SAMPLES TYPE	NUMBER	N-VALUE
0		Dark brown, SILTY SAND, with large rocks, FILL, dry.	▨		2	▲	SS	1	
2		Dark brown, SILTY SAND, black staining and coal fragments, FILL, dry. Direct push refusal on inferred boulders/bedrock.	▨		6	▲	SS	2	
3		End of borehole at 2.59 mbgs.							

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

Depth scale (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

LABORATORY ANALYSES: BH14-4 SS2 was submitted for laboratory analysis of bulk and leachable PAHs.

A-

Stantec

BOREHOLE RECORD

BH14-5

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING March 5, 2014 WATER LEVEL

PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0		Brown, SILTY SAND, gravel, some rocks, FILL, dry.					SS	1	
		Brown, SILTY SAND, gravel, FILL, dry. Direct push refusal on inferred boulder/bedrock.					SS	2	
		End of borehole at 2.13 mbgs.							

LABORATORY ANALYSES: BH14-5 SS1 was submitted for laboratory analysis of bulk and leachable PAHs.

A-

Stantec

BOREHOLE RECORD

BH14-6

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING March 5, 2014 WATER LEVEL
PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.
ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0		Dark brown, SILTY SAND, with gravel, FILL, dry.					SS	1	
1		Light brown, fine SAND, with silt, FILL, dry. Direct push refusal on inferred boulder/bedrock. - wet.					SS	2	
3		End of borehole at 2.74 mbgs.							

Vapour concentration scale: ● 20 40 60 80; ▲ 100 200 300 400

LABORATORY ANALYSES: BH14-6 SS1 was submitted for laboratory analysis of bulk and leachable PAHs.

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 4/28/14

Stantec

TEST PIT RECORD

TP2

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING: July 23, 2013 WATER LEVEL:

PROJECT No. 122510670 ORIGINATED BY: J.U.
DATUM: NAD 83 COMPILED BY: B.C.
TPC ELEV. CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	58.07	Brown sand with coarse gravel and concrete debris, FILL.				● 20 40 60 80 / ▲ 100 200 300 400	SA	1	
							SA	2	
							SA	3	
2	56.1	Silt with fine SAND, trace clay.					SA	4	
	55.6	Inferred BEDROCK at 2.5 mbgs.					SA	5	

LABORATORY ANALYSES: TP2-1 and TP2-5 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

TP3

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 23, 2013 WATER LEVEL

PROJECT No. 122510670 ORIGINATED BY J.U.
DATUM NAD 83 COMPILED BY B.C.
TPC ELEV. CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE
0	58.35	Brown sand with gravel and concrete debris, some cobbles, FILL.	SA	1	
			SA	2	
			SA	3	
2	56.3		SA	4	
		Inferred BEDROCK at 2.0 mbgs.			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: TP3-1 and TP3-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP4

CLIENT City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION Boteler Street — DATUM NAD 83 — COMPILED BY B.C.

DATES: BORING July 23, 2013 — WATER LEVEL — TPC ELEV. — CHECKED BY J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE
0	58.10	Brown sand with gravel and some cobbles, FILL.	SA	1	
			SA	2	
			SA	3	
			SA	4	
2	56.1	Some wood debris, concrete debris, FILL. Some dark staining with heavy creosote odour. -Light creosote odour.	SA	5	
			SA	6	
3	55.0	Inferred BEDROCK at 3.0 mbgs.			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

DEPTH (ft): 0–36

LABORATORY ANALYSES: TP4-1 and TP4-5 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP5

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING July 23, 2013 WATER LEVEL

PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	57.22	Brown sand with gravel, some cobbles, FILL.
2	55.2	Light brown SANDY SILT, trace clay. Damp.
3	54.2	Inferred BEDROCK at 3.0 mbgs.

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

SAMPLES

TYPE	NUMBER	N-VALUE
SA	1	
SA	2	
SA	3	
SA	4	
SA	5	
SA	6	

LABORATORY ANALYSES: TP5-1 and TP5-6 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

TEST PIT RECORD

TP7

Stantec

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 23, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.06	Brown loam, some gravel, TOPSOIL.				▲	SA	1	
					2	▲	SA	2	
1	56.1	Light brown SILTY SAND. Damp.			4	▲	SA	3	
					6	▲	SA	4	
2	55.1	Moist, trace clay.			8	▲	SA	5	
		Inferred BEDROCK at 2.5 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scale (m): 0 – 11; Depth scale (ft): 2 – 36

LABORATORY ANALYSES: TP7-1 and TP7-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

TP8

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 23, 2013 WATER LEVEL
PROJECT No. 122510670 ORIGINATED BY J.U.
DATUM NAD 83 COMPILED BY B.C.
TPC ELEV. CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	N-VALUE
0	57.88	Large boulders, cobbles, gravel, and limestone slabs, FILL.			SA	1	
					SA	2	
1	56.9	Medium grey sand with gravel. Cobbles, metal, wood and glass debris present, FILL.			SA	3	
	56.4	Grey/brown silty sand with gravel and trace clay. Metal, wood and glass debris present, FILL.			SA	4	
2					SA	5	
	55.4	Inferred BEDROCK at 2.5 mbgs					

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: TP8-1 and TP8-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP9

CLIENT City of Ottawa

PROJECT No. 122510670 ORIGINATED BY J.U.

LOCATION Boteler Street

DATUM NAD 83 COMPILED BY B.C.

DATES: BORING July 23, 2013 WATER LEVEL

TPC ELEV.

CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	58.63	Brown sand with gravel with some cobbles, FILL.				▲	SA	1	
					2	▲	SA	2	
1					4	▲	SA	3	
	57.1	SILTY SAND with trace clay. Wet.							
2	56.6	Inferred BEDROCK at 2.0 mbgs.			6	▲	SA	4	

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scale (m): 0–11; Depth scale (ft): 2–36

LABORATORY ANALYSES: TP9-1 and TP9-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP10

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING: July 23, 2013 WATER LEVEL:

PROJECT No.: 122510670
DATUM: NAD 83
TPC ELEV.: 57.874

ORIGINATED BY: J.U.
COMPILED BY: B.C.
CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0		Coarse gravel, concrete and boulders, FILL.					SA	1	
					2		SA	2	
1		Brown sand with gravel, FILL.			4		SA	3	
		Some silty sand and trace clay above bedrock. -0.2m grey/black seam of sandy fill			6		SA	4	
2					8		SA	5	
		Inferred BEDROCK at 2.5 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth (m) axis: 0 to 11; Depth (ft) axis: 2 to 36.

LABORATORY ANALYSES: TP10-1 and TP10-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP11

CLIENT City of Ottawa PROJECT No. 122510670 ORIGINATED BY J.U.
LOCATION Boteler Street DATUM NAD 83 COMPILED BY B.C.
DATES: BORING July 23, 2013 WATER LEVEL TPC ELEV. CHECKED BY J.P.-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	58.00	Gravel with some brown sand, boulders and cobbles, FILL.			0–2	▲	SA	1	
						▲	SA	2	
1	57.0	Silty sand with silty clay. Red brick debris. Some pieces of broken ceramic plates and tiles, FILL. -Some silty sand.			4	▲	SA	3	
					6	▲	SA	4	
2	56.0	Inferred BEDROCK at 2.0 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Depth (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

LABORATORY ANALYSES: TP11-1 and TP11-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP12

CLIENT	City of Ottawa	PROJECT No.	122510670
LOCATION	Boteler Street	DATUM	NAD 83
DATES: BORING	July 23, 2013	WATER LEVEL	
TPC ELEV.			

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	NUMBER	N-VALUE
0	57.04	Brown sand with gravel and boulders, FILL.	SA	1	
			SA	2	
1	56.0	Red brick debris, and areas of inferred coal debris. Patches of black debris, FILL.	SA	3	
	55.5	Brown sand with gravel. Areas with black/grey sand, brick debris, metal cables, metal and wood debris, FILL.	SA	4	
2	55.0	Inferred BEDROCK at 2.0 mbgs.			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

LABORATORY ANALYSES: TP12-1 and TP12-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP13

CLIENT City of Ottawa | PROJECT No. 122510670 | ORIGINATED BY J.U.

LOCATION Boteler Street | DATUM NAD 83 | COMPILED BY B.C.

DATES: BORING July 24, 2013 WATER LEVEL | TPC ELEV. | CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	56.79	Brown sand with gravel, some cobbles, FILL.				▲	SA	1	
					2	▲	SA	2	
1	55.3				4	▲	SA	3	
	54.8	Some metal and wood debris. Grey road base material, possible ash material, FILL.			6	▲	SA	4	
2		Medium brown sand with gravel, FILL.			8	▲	SA	5	
						▲	SA	6	
3	53.3				10	▲	SA	7	
	52.8	Light brown SILTY SAND.			12	▲	SA	8	
4		Inferred BEDROCK at 4.0 mbgs.			14				

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

LABORATORY ANALYSES: TP13-1 and TP13-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Stantec

TEST PIT RECORD

TP14

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 24, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.93	Concrete blocks, cobbles, boulders, with some brown sand and gravel. Trace silty clay, FILL.	▨			▲	SA	1	
					2	▲	SA	2	
1					4	▲	SA	3	
					6		SA	4	
2	55.9	Rocky material causing caving, FILL.	▨				SA	5	
	55.4	End of testpit at 2.5 mbgs due to caving issues.			8				

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth (m) scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Depth (ft) scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

LABORATORY ANALYSES: TP14-1 was submitted for laboratory analysis of PHCs, VOCs, PAH, and metals. No other samples were submitted due to low soil quantity and many boulders.

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

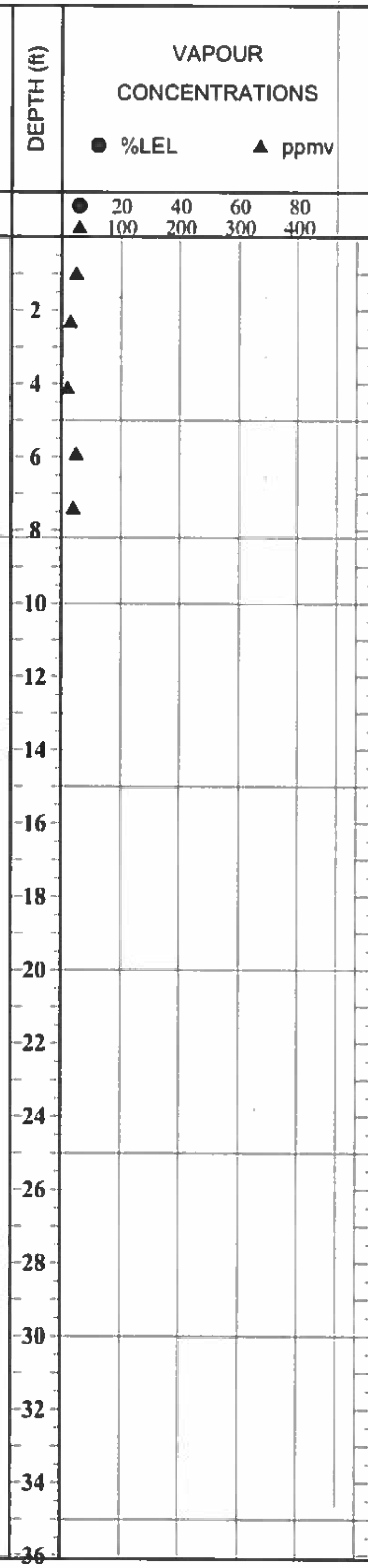
TP15

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 24, 2013 WATER LEVEL

PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	TYPE	NUMBER	N-VALUE
0	58.18	Brown sand with gravel. Some clay, FILL.	SA	1	
			SA	2	
1	57.2	Some black staining in areas. Red brick debris, FILL.	SA	3	
			SA	4	
2	56.2	Light brown SILT with fine sand.	SA	5	
	55.7	Inferred BEDROCK at 2.5 mbgs.			



LABORATORY ANALYSES: TP15-1 and TP15-2 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP16

CLIENT: City of Ottawa	PROJECT No. 122510670	ORIGINATED BY J.U.
LOCATION: Boteler Street	DATUM NAD 83	COMPILED BY B.C.
DATES: BORING July 24, 2013 WATER LEVEL	TPC ELEV.	CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	58.08	Brown sand with gravel. Trace clay. Some red brick debris, concrete, and boulders, FILL.	▨			▲	SA	1	
					2	▲	SA	2	
					4	▲	SA	3	
2	56.1	Grey/blue silty clay with debris, bricks and gravel, FILL.	▨		6	▲	SA	4	
					8	▲	SA	5	
						▲	SA	6	
3	55.1	Inferred BEDROCK at 3.0 mbgs.			10				

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

Depth scale (ft): 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

LABORATORY ANALYSES: TP16-1 and TP16-5 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

TP17

CLIENT: City of Ottawa
LOCATION: Boteler Street
DATES: BORING: July 24, 2013 WATER LEVEL:

PROJECT No. 122510670 ORIGINATED BY: J.U.
DATUM: NAD 83 COMPILED BY: B.C.
TPC ELEV.: CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.88	Coarse gravel with boulders and cobbles, low soil/sand content, FILL.				▲	SA	1	
					2		SA	2	
1	56.4				4	▲	SA	3	
		Light brown SILT with fine sand.			6	▲	SA	4	
2	55.4				8	▲	SA	5	
		Inferred BEDROCK at 2.5 mbgs.							

Vapour concentration scales: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scales: 0–11 m; 2–36 ft

LABORATORY ANALYSES: TP17-1 and TP17-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP18

CLIENT: City of Ottawa
PROJECT No. 122510670
ORIGINATED BY: J.U.

LOCATION: Boteler Street
DATUM: NAD 83
COMPILED BY: B.C.

DATES: BORING: July 24, 2013
WATER LEVEL:
TPC ELEV.:
CHECKED BY: J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	57.17	Fine brown sand with some gravel, trace silt, FILL.
1	56.2	Red brick debris with concrete. Old electrical wires, FILL.
	55.7	Concrete debris, FILL.
2	55.2	Light brown silt with fine sand. Traces of red brick debris, FILL.
3	54.2	Inferred BEDROCK at 3.0 mbgs.

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80); ▲ ppmv (100, 200, 300, 400)

SAMPLES TYPE	NUMBER	N-VALUE
SA	1	
SA	2	
SA	3	
SA	4	
SA	5	
SA	6	

LABORATORY ANALYSES: TP18-1 and 18-6 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

TP19

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 24, 2013 WATER LEVEL

PROJECT No. 122510670 ORIGINATED BY J.U.
DATUM NAD 83 COMPILED BY B.C.
TPC ELEV. CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.41	Concrete debris, boulders, red bricks. Some metal debris. FILL.				▲	SA	1	
					2	▲	SA	2	
1	56.4	Debris and brick. light brown silty sand with grey/black staining in areas, FILL. PHC/creosote odour.			4	▲	SA	3	
	55.9	Light brown SILTY SAND. Staining in areas.			6	▲	SA	4	
2	55.4	Inferred BEDROCK at 2.0 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scale (m): 0 to 11; Depth scale (ft): 2 to 36

LABORATORY ANALYSES: TP19-1 and 19-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP20

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 24, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE
0	57.94					● 20 40 60 80 ▲ 100 200 300 400			
	57.4	Concrete boulders, medium brown sand and gravel, FILL.					SA	1	
	56.9	Fine grey sand and some concrete debris, FILL.			2		SA	2	
1	55.9	Medium brown sand with red brick debris. Some inferred coal debris, FILL.			4, 6		SA	3	
2	55.4	Light brown silty sand with debris. Trace clay. Pieces of ceramic plates found, FILL.			8		SA	4	
		Inferred BEDROCK at 2.5 mbgs.					SA	5	
3					10				
4					12, 14				
5					16				
6					18, 20				
7					22, 24				
8					26				
9					28, 30				
10					32, 34				
11					36				

LABORATORY ANALYSES: TP20-1 and 20-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP21

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 24, 2013 WATER LEVEL
PROJECT No. 122510670 ORIGINATED BY J.U.
DATUM NAD 83 COMPILED BY B.C.
TPC ELEV. CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.97					● 20 40 60 80 / ▲ 100 200 300 400			
	57.5	Concrete boulders, coarse gravel, red bricks, and medium brown sand with gravel, FILL.					SA	1	
1	57.0	Medium brown sand with gravel, FILL. Fine grey sand layer with staining in areas.			2		SA	2	
	56.5	Medium black SAND. Staining heavy in areas with creosote odour. Creosote debris found, possible building materials.			4		SA	3	
2	56.0	Concrete and brick debris with some sand, FILL.			6	▲	SA	4	
	55.5	Light brown SANDY SILT.			8	▲	SA	5	
		Inferred BEDROCK at 2.5 mbgs.							
3					10				
					12				
4					14				
5					16				
					18				
6					20				
					22				
7					24				
8					26				
					28				
9					30				
					32				
10					34				
11					36				

LABORATORY ANALYSES: TP21-1 and 21-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals

Stantec

TEST PIT RECORD

TP23

CLIENT City of Ottawa
PROJECT No. 122510670 ORIGINATED BY J.U.
LOCATION Boteler Street
DATUM NAD 83 COMPILED BY B.C.
DATES: BORING July 24, 2013 WATER LEVEL
TPC ELEV.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	58.05	Cobbles, concrete debris, sand and gravel, FILL.					SA	1	
					2		SA	2	
1	57.0	Metal and wood debris, FILL.			4		SA	3	
	56.5	Light brown SILTY SAND with trace clay.			6		SA	4	
2	56.0	Inferred BEDROCK at 2.0 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth scale (m): 0 – 11; Depth scale (ft): 2 – 36

LABORATORY ANALYSES: TP23-1 and 23-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

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Stantec

TEST PIT RECORD

TP24

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 24, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P.D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.56	Brown medium sand with gravel and cobbles. Some red brick debris, metal and wood debris, FILL.					SA	1	
							SA	2	
							SA	3	
							SA	4	
2	55.6	Light brown/grey SILTY SAND. Trace clay.					SA	5	
							SA	6	
3	54.6	Inferred BEDROCK at 3.0 mbgs.							

Vapour concentration scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

LABORATORY ANALYSES: TP24-1 and 24-6 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals

Stantec

TEST PIT RECORD

TP25

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 24, 2013 WATER LEVEL

PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P.-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	NUMBER	N-VALUE
0	57.58	Medium brown sand with gravel, FILL.	SA	1	
			SA	2	
1	56.6	Electrical wires and concrete conduit debris, FILL.	SA	3	
	56.1	Medium brown sand with gravel, FILL.	SA	4	
2	55.6	Light brown/grey fine SAND with silt. Trace clay.	SA	5	
	55.1	Inferred BEDROCK at 2.5 mbgs.			

VAPOUR CONCENTRATIONS: ● %LEL (20, 40, 60, 80) ▲ ppmv (100, 200, 300, 400)

DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

LABORATORY ANALYSES: TP25-1 and 25-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP26

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 24, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	NUMBER	N-VALUE
0	57.99	Coarse grey/brown sand with gravel. Some metal debris, FILL.				▲	SA	1	
					2	▲	SA	2	
1	56.5				4	▲	SA	3	
	56.0	Light brown medium SAND.			6	▲	SA	4	
2		Inferred BEDROCK at 2.0 mbgs.							

Vapour scale: ● 20, 40, 60, 80; ▲ 100, 200, 300, 400

Depth (m) scale: 0–11; Depth (ft) scale: 2–36

LABORATORY ANALYSES: TP26-1 and 26-2 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP27

CLIENT City of Ottawa
PROJECT No. 122510670
ORIGINATED BY J.U.

LOCATION Boteler Street
DATUM NAD 83
COMPILED BY B.C.

DATES: BORING July 24, 2013
WATER LEVEL
TPC ELEV.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE
	57.40					● 20 40 60 80 / ▲ 100 200 300 400			
0 – 1.5	55.9	Medium brown sand, some gravel, concrete debris and cobble, FILL. Plastic electrical conduits near surface.				▲	SA	1	
					2	▲	SA	2	
					4	▲	SA	3	
1.5 – 2.5	54.9	Light brown SILTY SAND.			6	▲	SA	4	
					8	▲	SA	5	
2.5		Inferred BEDROCK at 2.5 mbgs.							

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Depth scale (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

LABORATORY ANALYSES: TP27-1 and 27-5 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP28

CLIENT City of Ottawa — PROJECT No. 122510670 — ORIGINATED BY J.U.

LOCATION Boteler Street — DATUM NAD 83 — COMPILED BY B.C.

DATES: BORING July 24, 2013 — WATER LEVEL — TPC ELEV. — CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS (● %LEL 20 40 60 80; ▲ ppmv 100 200 300 400)	SAMPLES TYPE	NUMBER	N-VALUE
0	57.38	Coarse brown sand with some gravel, FILL. Electrical wire debris.				▲	SA	1	
					2	▲	SA	2	
1	55.9				4	▲	SA	3	
2	54.9	Light brown fine SILTY SAND with trace clay.			6	▲	SA	4	
					8	▲	SA	5	
3		Inferred BEDROCK at 2.5 mbgs			10				

LABORATORY ANALYSES: TP28-1 and 28-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

STAN-MW 122510670 - BOTELER ST - PARCELS 1&2.GPJ SMART.GDT 9/12/13

Stantec

TEST PIT RECORD

TP29

CLIENT City of Ottawa

PROJECT No. 122510670

ORIGINATED BY J.U.

LOCATION Boteler Street

DATUM NAD 83

COMPILED BY B.C.

DATES: BORING July 24, 2013

WATER LEVEL

TPC ELEV.

CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv
0	58.05	Coarse brown sand with coarse gravel. Some cobbles, concrete and debris, FILL.				
1.5	56.6	Light brown fine SAND with silt and trace clay.				
2.5	55.6	Inferred BEDROCK at 2.5 mbgs.			8	

Vapour concentrations scale: ● 20, 40, 60, 80 (%LEL); ▲ 100, 200, 300, 400 (ppmv)

Depth scale: 0–11 m; 2–36 ft

SAMPLES TYPE	NUMBER	N-VALUE
SA	1	
SA	2	
SA	3	
SA	4	
SA	5	

LABORATORY ANALYSES: TP29-1 and 29-4 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

Stantec

TEST PIT RECORD

TP30

CLIENT City of Ottawa
LOCATION Boteler Street
DATES: BORING July 24, 2013 WATER LEVEL

PROJECT No. 122510670
DATUM NAD 83
TPC ELEV.

ORIGINATED BY J.U.
COMPILED BY B.C.
CHECKED BY J.P-D.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	VAPOUR CONCENTRATIONS ● %LEL ▲ ppmv	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES N-VALUE
0	58.44	Brown coarse sand with concrete boulders, some metal and wood debris, FILL.				● 20 40 60 80 / ▲ 100 200 300 400	SA	1	
					2		SA	2	
1	56.9				4		SA	3	
	56.4	Light brown SILTY SAND.			6		SA	4	
2		Inferred BEDROCK at 2.0 mbgs.			8				
3					10				
4					12, 14				
5					16, 18				
6					20, 22				
7					24				
8					26, 28				
9					30, 32				
10					34				
11					36				

LABORATORY ANALYSES: TP30-1 and 30-3 were submitted for laboratory analysis of PHCs, VOCs, PAH, and metals.

A-

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25599

Report Date: 14-Jun-2019

Order Date: 10-Jun-2019

Project Description: PG4960

	Client ID:	BH7 SS4	-	-	-
	Sample Date:	29-May-19 11:00	-	-	-
	Sample ID:	1924099-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	81.1	-	-	-
General Inorganics					
pH	0.05 pH Units	7.76	-	-	-
Resistivity	0.10 Ohm.m	36.2	-	-	-
Anions					
Chloride	5 ug/g dry	7	-	-	-
Sulphate	5 ug/g dry	118	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURES 2 AND 3 - SEISMIC SHEAR WAVE VELOCITY PROFILES

FIGURE 4 - VIBRATION MONITORING LOCATIONS

FIGURE 5 - CROSS SECTION OF GEOPHONE SENSOR INSTALLATION

DRAWING PG4960-1 – TEST HOLE LOCATION PLAN

TEST HOLE LOCATION PLAN BY OTHERS

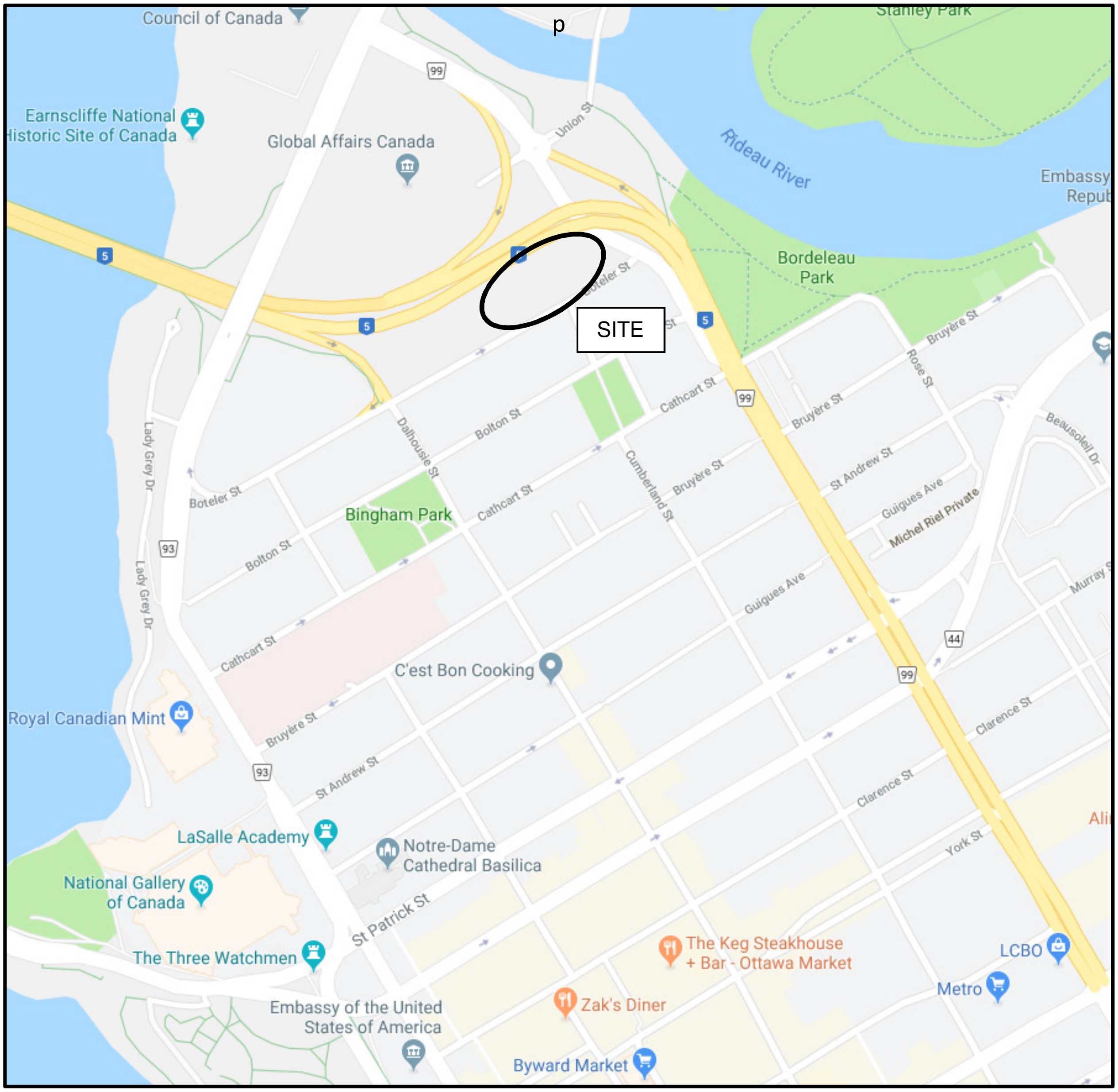


FIGURE 1

KEY PLAN

PATERSON GROUP

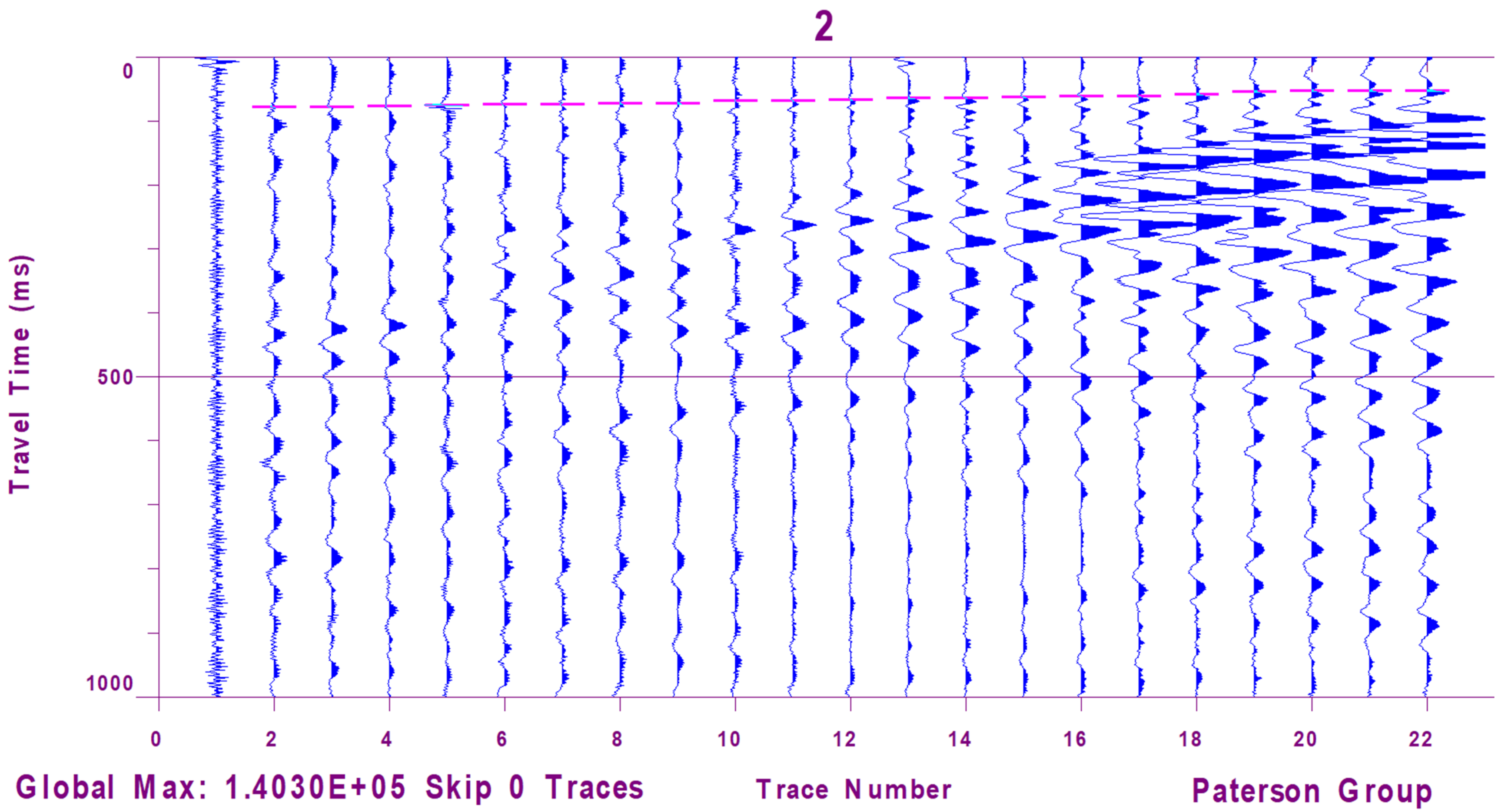


Figure 2 – Shear Wave Velocity Profile at Shot Location 93 m

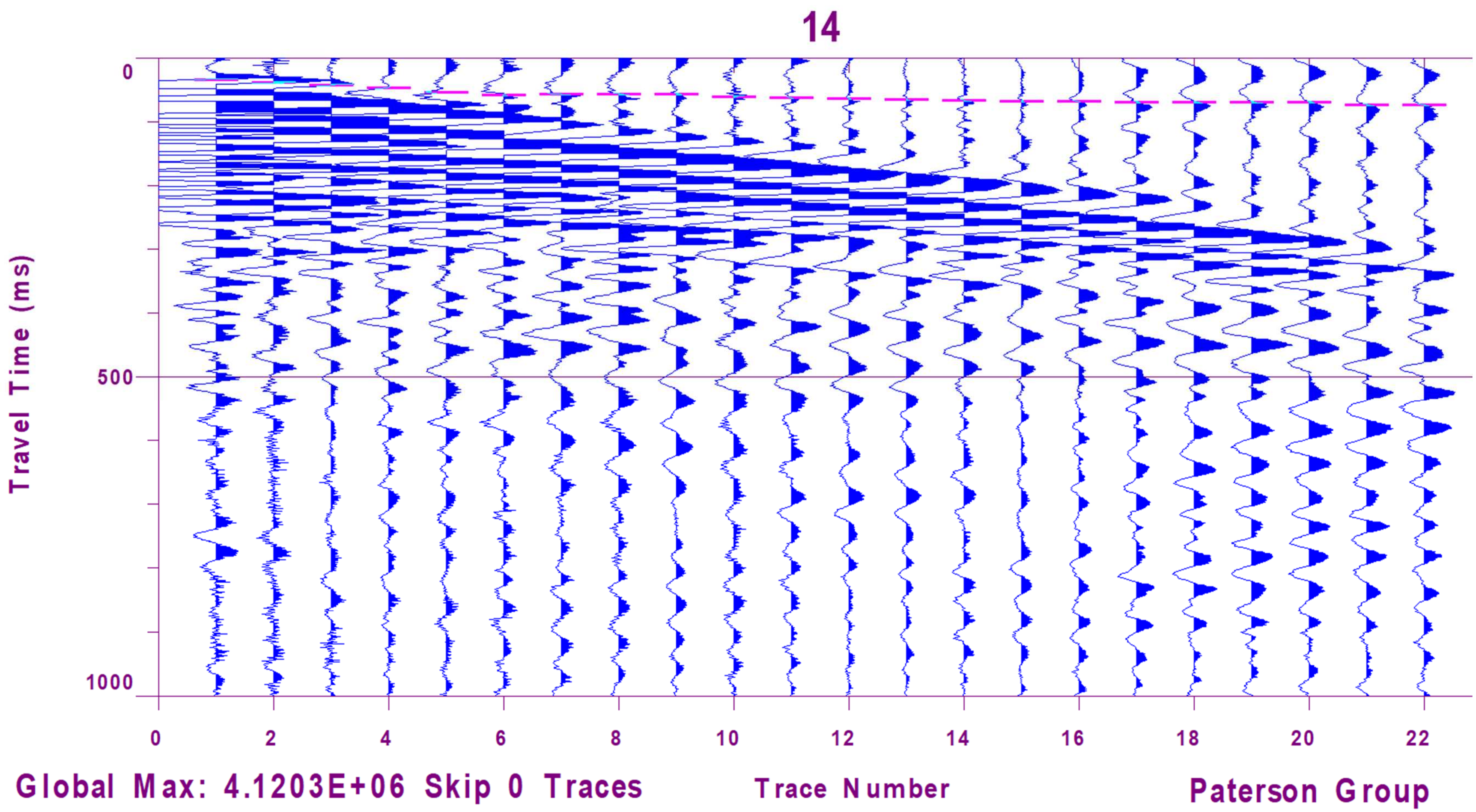
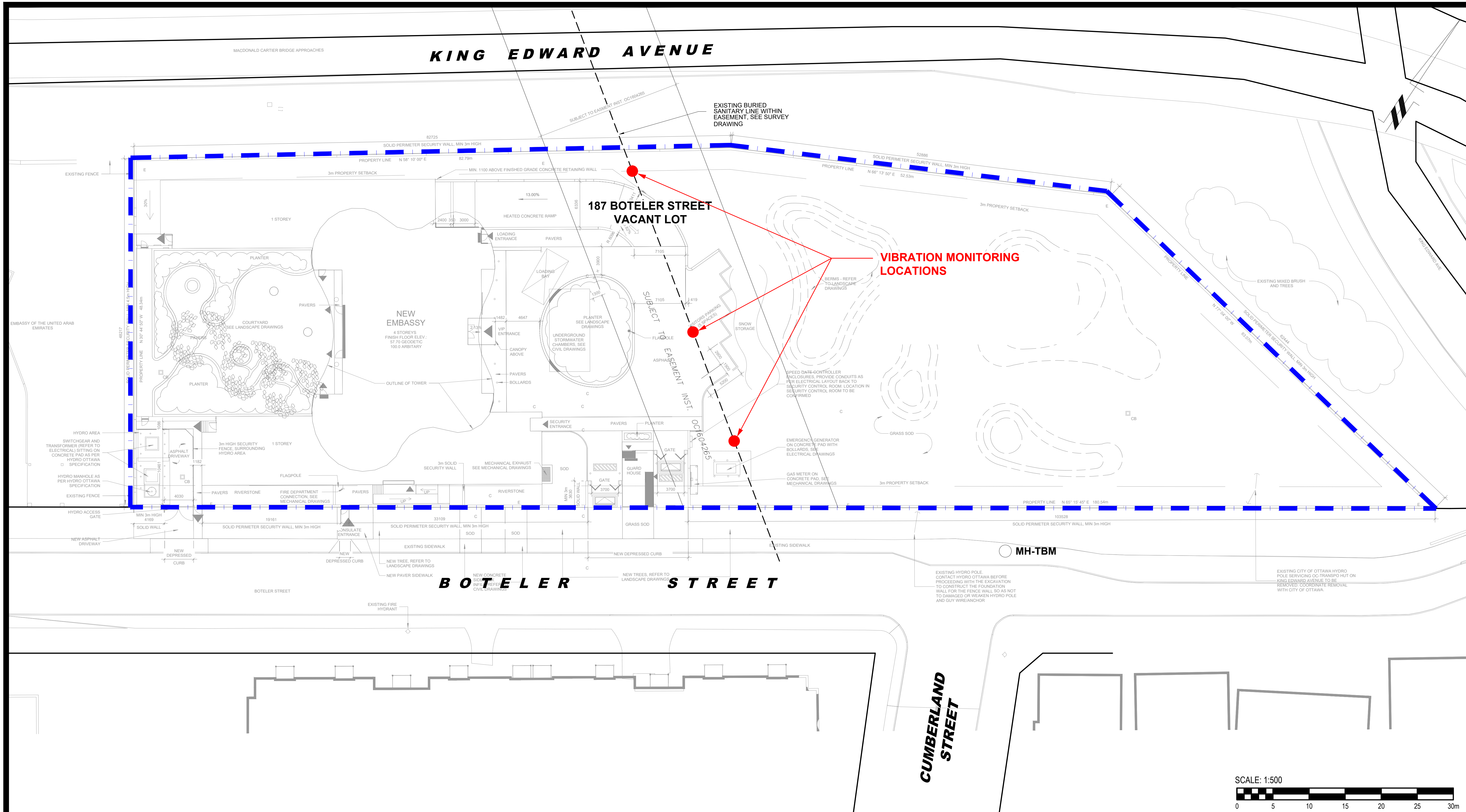


Figure 3 – Shear Wave Velocity Profile at Shot Location -4.5 m



PATERSON GROUP
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NO.	REVISIONS	DATE	INITIAL

MINISTRY OF FOREIGN AFFAIRS OF THE STATE OF QATAR

GEOTECHNICAL INVESTIGATION
PROPOSED EMBASSY DEVELOPMENT
187 BOTELER STREET

Title: **VIBRATION MONITORING LOCATIONS**

Scale: 1:500	Date: 01/2023
Drawn by: NFRV	Report No.: PG4960-1 REVISION 3
Checked by: ZA	Dwg. No.: FIGURE 4
Approved by: DJG	Revision No.:

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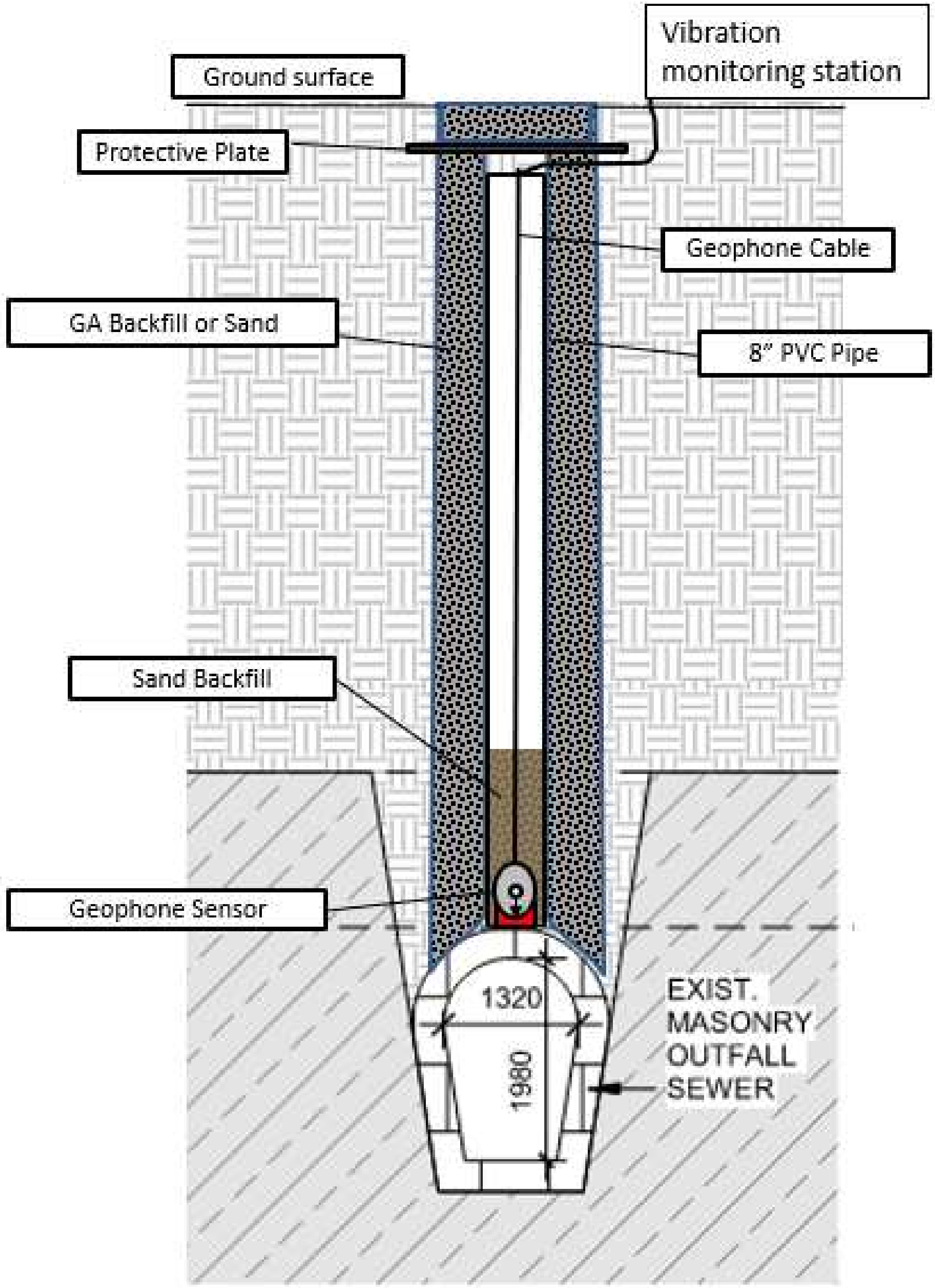
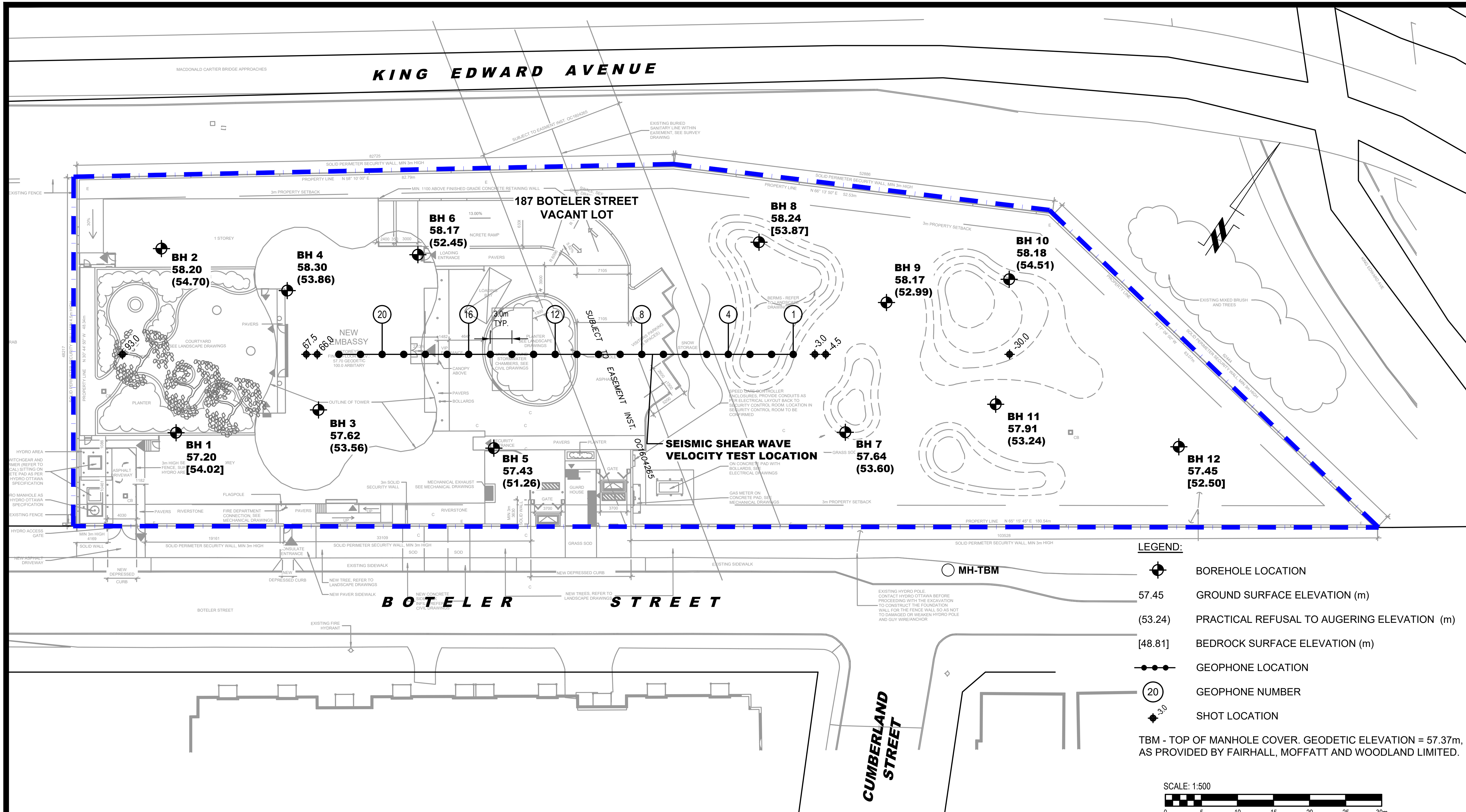


PATERSON GROUP 9 AURIGA DRIVE OTTAWA, ON K2E 7T9 TEL: (613) 226-7381	MINISTRY OF FOREIGN AFFAIRS OF THE STATE OF QATAR PROPOSED EMBASSY DEVELOPMENT 187 BOTELER STREET OTTAWA, ONTARIO	Date: 01/2023	Report No.: PG4960-1 REVISION 3
	Title: **CROSS SECTION OF GEOPHONE SENSOR INSTALLATION**	Scale: N.T.S. / Drawn by: NFRV	Drawing No.: **FIGURE 5**
		Checked by: EA / Checked by:	



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NO.	REVISIONS	DATE	INITIAL
1	CONCEPTUAL SITE PLAN ADDED	10/03/2022	JV

MINISTRY OF FOREIGN AFFAIRS OF THE STATE OF QATAR
GEOTECHNICAL INVESTIGATION
187 BOTELER STREET
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 06/2019
Drawn by: NFRV	Report No.: PG4960-1
Checked by: JV	Dwg. No.: PG4960-1
Approved by: DJG	Revision No.: 1

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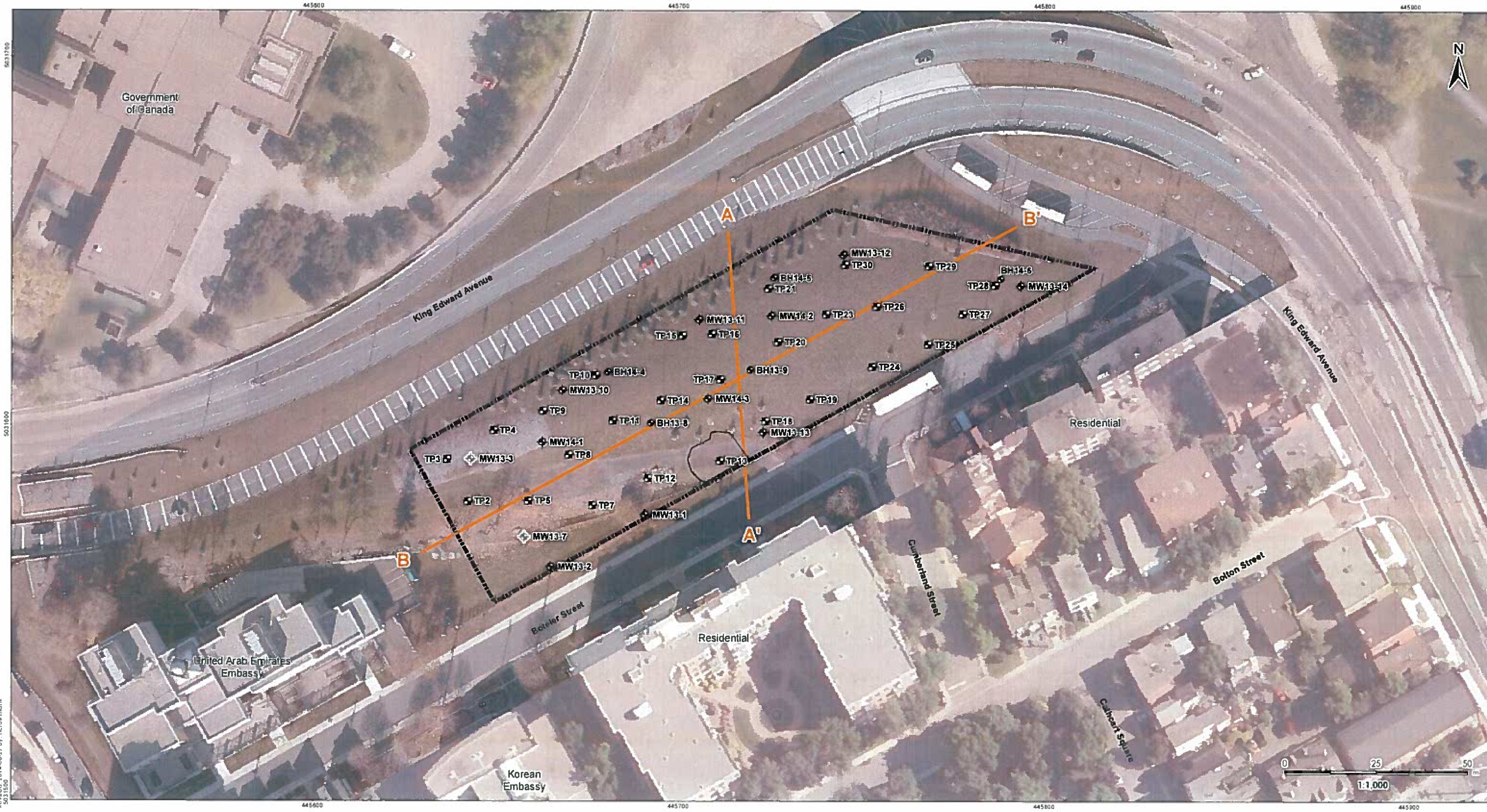

June 2014
Project No: 122510670

Stantec

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Site Airphoto: City of Ottawa, 2013.
3. Orthoimagery © First Base Solutions, Ottawa Division 2008.

Legend

- Borehole
- Monitoring Well
- Monitoring Well (Decommissioned)
- Test Pit
- Remediation Excavation Limits
- Approximate Site Property Boundary
- Cross-Section Location

Client/Project
City of Ottawa
Parts 2, 4, 5, & 6 of Plan 4R-26468
Part Lot 3 and Part Lot 7
RCP 611769
Boteler St, Ottawa, ON

Figure No.
2

Title
Sampling and Cross-Section Locations