Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Materials Testing

Building Science

Archaeological Services

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Geotechnical Investigation

Proposed Commercial Building
5123 Hawthorne Road
Ottawa, Ontario

Prepared For

Fuller Mariani Building Solutions

April 27, 2020

Report PG5306-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Fuller Mariani Building Solutions to conduct a geotechnical investigation for the proposed commercial building to be located within Parts 3 and 4 of Block 2 at 5123 Hawthorne Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were to:

- ❑ determine the subsurface soil and groundwater conditions by means of boreholes.
- ❑ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The current report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains the geotechnical findings and recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

It is understood that the proposed development is located along the Somme Street Part 4 of Block 2 of the overall site. Although, drawings were not available during the preparation of this report, it is understood that the proposed development will consist of a slab-on-grade commercial building and an associated warehouse. Associated at-grade parking areas, access lanes and landscaped areas are further anticipated.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The geotechnical investigation was completed using the relevant test holes completed for Phase II - Environmental Site Assessment of the overall site and boreholes completed by others. The locations of the test holes are presented on Drawing PG5306-1 - Test Hole Location Plan included in Appendix 2.

Sampling and In Situ Testing

Soil samples were recovered using a 50 mm diameter split-spoon sampler or the auger flights. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. Practical refusal was reached in all boreholes, followed by coring of the bedrock in BH 1 and BH 4, in order to access the groundwater table. All samples were transported to the laboratory. Upon recovery, all soil samples were immediately sealed in appropriate containers to facilitate the preliminary screening procedure. The depths at which the split-spoon, auger, and rock core samples were recovered from the test holes are presented as **"SS"**, **"AU"**, and "**RC"**, 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 in 2 test holes, BH 2 and BH 3, and 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.

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

Groundwater

Groundwater monitoring wells were installed at 3 relevant test holes BH 1, BH 3 and BH 4 to permit the monitoring of water levels subsequent to the sampling program completion.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report and will be discarded unless otherwise directed.

3.2 Field Survey

The test hole locations were selected and determined in the field by Paterson personnel to provide general coverage of Part 4 of 5123 Hawthorne Road. Ground surface elevations at test hole locations are provided by the client (Tomlinson).

The location and ground surface elevation at each test hole location are presented on Drawing PG5306-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in the laboratory to review the field logs.

4.0 Observations

4.1 Surface Conditions

The subject site is bordered to the north by Somme Street, to the west by an existing office building for Renewi Canada Limited and a storm water management pond, to the south and east by undeveloped land. A drainage ditch is present at the northern boundary of the subject site. The subject site is currently undeveloped and the ground surface across the site is grass covered. The existing ground surface across the site is relatively flat with a slight downslope towards the east / southeast direction.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile at the test hole locations consists of fill material which extends to approximate depths of 0.6 to 3.6 m below the existing ground surface. The fill material was observed to consist of a mix of clay, silt, sand, gravel and some organics with occasional pieces of asphaltic concrete and plastic.

A loose to compact, native brown silt/silty sand with occasional gravel was encountered underlying the fill material.

Practical refusal to augering was encountered in all boreholes at depths ranging from approximately 0.6 to 4.7 m below the existing ground surface on inferred bedrock. Bedrock was confirmed by coring in BH 1 and BH 4. The bedrock consisted of dolostone and sandstone.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, bedrock in the area of the subject site consists of interbedded sandstone and dolomite from the March Formation.

4.3 Groundwater

Groundwater levels were measured at monitoring wells installed at test holes BH 1, BH 3, BH 4 on December 16, 2019. Our groundwater measurements are presented in Table 1 below. The groundwater elevation is subjected to seasonal fluctuations and could vary at the time of construction.

Table 1 - Summary of Groundwater Levels			
Borehole Number	Measured Groundwater Level		Recording Date
	Depth (m)	Elevation (m)	
Groundwater Levels - (Report PE4827-1 dated January 9, 2020)			
BH 1	1.32	90.41	December 16, 2019
BH 3	1.10	88.27	December 16, 2019
BH 4	1.26	88.17	December 16, 2019

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed buildings. It is expected that the proposed buildings be constructed with conventional shallow footings bearing on the undisturbed, compact silt/silty sand, or an engineered fill pad placed over an approved fill subgrade, or clean, surface sounded bedrock.

To adequately distribute the foundation loads in areas where the existing fill is encountered below the building footprint, it is recommended to sub-excavate at least 500 mm below design underside of footing elevation. A minimum 500 mm thick pad, consisting of a Granular B Type II, compacted to 98% of its SPMDD should be placed up to design underside of footing level. Prior to placement of the abovenoted engineered fill pad, it is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel over the sub-excavated area below the proposed footings.

For areas where a fill layer is encountered below the granular layer for the floor slab, it is recommended to sub-excavate 500 mm below the underside of floor slab granulars and reinstate with a select subgrade material in maximum 225 mm loose lifts and compacted to a minimum 98% of its SPMDD. It is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel prior to placement of the select subgrade material. Any poor performing areas noted during the proof-rolling program should be removed and reinstated with a select subgrade fill compacted to 98% of its SPMDD under dry and above freezing temperatures.

The proof-rolling program should also be completed across paved areas to ensure that any poor performing soils are removed prior to pavement structure placement.

Bedrock removal may be required for the installation of site services, dependent on the depths of the proposed structures and utilities.

Based on the geotechnical investigation, there were no sensitive silty clay layers encountered across the site. Therefore, the subject site will not be subjected to grade raise restrictions.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, asphalt or fill, containing organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures.

Bedrock Removal

Should bedrock removal be required, hoe ramming is an option where the bedrock is weathered and/or where only small quantities of bedrock need to be removed. Where large quantities of bedrock need to be removed, line drilling and controlled blasting may be required. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations.

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 conducted prior to commencing construction.

The extent of the survey should be determined by the blasting consultant and sufficient to respond to any inquiries/claims related to the blasting operations.

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

Vibration Considerations

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

The following construction equipments could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause or the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters determine the permissible vibrations, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and

50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed buildings.

Fill Placement

Fill used for grading beneath the proposed buildings should consist of a select subgrade material or 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).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. 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.

5.3 Foundation Design

Shallow Foundation

Footings placed on an undisturbed, compact silt/silty sand, or on an engineered fill over the undisturbed, compact silt/silty sand or approved fill layer, can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **180 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 15 mm, respectively.

Footings placed on clean, surface sounded bedrock can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **1,500 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance at ULS.

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.

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

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 silt/silty sand above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil. Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending horizontally and vertically from the footing perimeter at a minimum of 1H:6V (or shallower) passes through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete.

5.4 Design for Earthquakes

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

5.5 Slab-on-Grade Construction

With the removal of all topsoil and fill, containing deleterious or organic materials, within the footprint of the proposed building, the native soil and/or approved fill pad will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 300 mm of sub-slab fill should consist of an OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. be removed and reinstated with an engineered fill, such as Granular B Type II.

The upper 200 mm of sub-slab fill should consist of an OPSS Granular A material for slab-on-grade construction. All backfill material within the proposed buildings footprints should be placed in a maximum 300 mm loose lifts and compacted to a minimum of 98% of the SPMDD.

5.6 Permeable Pavement Structure

The recommended permeable paver specifications along with the joint filling material, recommended bedding and base course specifications are provided in the Techo-Block specification sheet attached in Appendix 1. The recommended granular subbase course for a permeable pavement structure and approved subgrade material is presented below for car only parking areas, access lanes and heavy truck parking areas are shown in Tables 2 and 3.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
400	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Table 3 - Recommended Pavement Structure
Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
550	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular subbase should be placed in a maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended for the proposed buildings. The system should consist of a 100 to 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 19 mm clear stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

The majority of the site excavated soil is considered to be frost susceptible and not recommended for placement as backfill against the foundation walls, unless placed in conjunction with a drainage geocomposite (Miradrain G100N or Delta Drain 6000) connected to the perimeter foundation drainage system, which has a positive outlet. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be placed for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a combination of soil cover and foundation insulation should be provided.

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

6.3 Excavation Side Slopes

The excavation side slopes in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the beginning of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below local 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.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & 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.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its 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 minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

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.

Groundwater Control for Building Construction

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. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions should be provided if winter construction is considered for this project.

The subsurface conditions mainly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters, 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 buildings 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 that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

7.0 Recommendations

For the foundation design data provided to be applicable a materials testing and observation services program is required to be completed. The following aspects be performed by the geotechnical consultant:

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

A report confirming the construction has been conducted in general accordance with the 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 the report are in accordance with Paterson's present understanding of the project. Paterson request permission to review our recommendations when the drawings and specifications are completed.
A geotechnical investigation of this nature is a limited sampling of a site. Should any conditions at the site be encountered which differ from the test locations, Paterson 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. The recommendations are not intended for contractors bidding on or constructing the project. The contractors 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 Fuller Mariani Building Solutions or their agents is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Faisal I. Abou-Seido, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Fuller Mariani Building Solutions (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

BOREHOLE LOGS BY OTHERS

TECHO-BLOC SPECIFICATIONS FOR PERMEABLE PAVERS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
Ottawa, Ontario

DATUM Ground surface elevations provided by the client.

FILE NO. PG5306

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** December 10, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE						0	91.73		
FILL: Grey crushed stone		AU	1						
		SS	2			1	90.73		
						1.50			
TOPSOIL						1.80			
		SS	3			2	89.73		
Brown **SANDY SILT**						2.54			
		RC	1			3	88.73		
BEDROCK: Dolostone, some quartz crystals									
		RC	2			4	87.73		
						4.80			
End of Borehole									
(GWL @ 1.32m - Dec. 16, 2019)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
Ottawa, Ontario

DATUM Ground surface elevations provided by the client.

FILE NO. PG5306

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** December 10, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.32
FILL: Brown sandy silt, trace gravel and organics		AU	1				
0.60							
FILL: Grey-brown silty sand, some gravel, piece of asphalt		SS	2	100	24	1	89.32
1.50							
Loose to compact, brown **SILT,** occasional sand and gravel		SS	3	67	17	2	88.32
		SS	4	71	7	3	87.32
		SS	5	67	2		
		SS	6	79	21	4	86.32
4.42							
End of Borehole							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**
○ **Water Content %**

20 40 60 80

Monitoring Well Construction

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
Ottawa, Ontario

DATUM Ground surface elevations provided by the client.

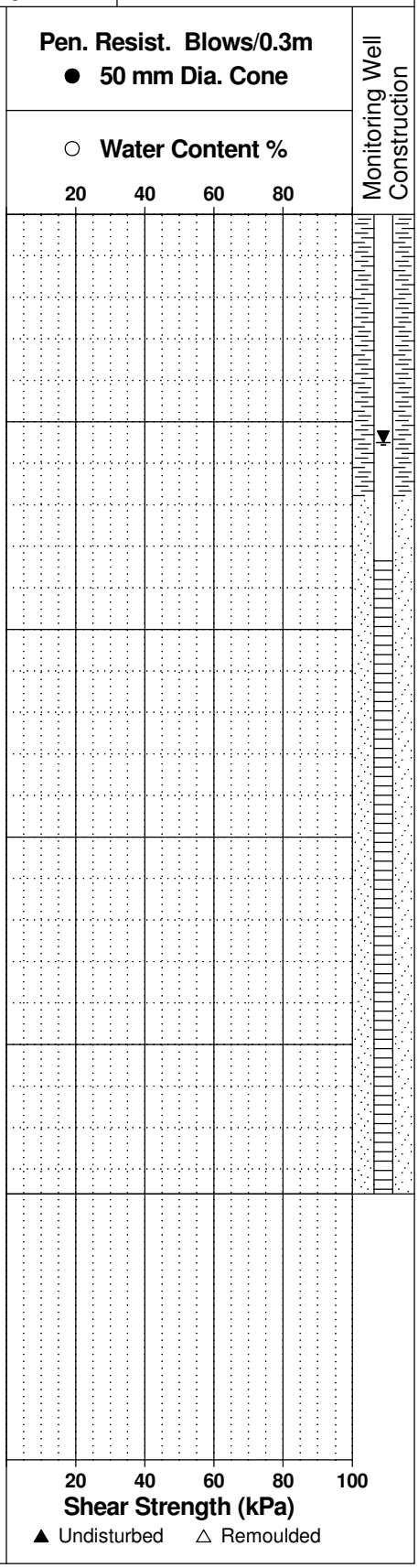
FILE NO. PG5306

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** December 10, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.37
FILL: Brown sandy silt, trace organics and plastic		AU	1				
0.60							
FILL: Grey-brown silty sand, some gravel, pieces of asphalt		SS	2	33	13	1	88.37
1.68							
SHALEY FILL		SS	3	54	5	2	87.37
		SS	4	67	50		
		SS	5	54	6	3	86.37
3.66							
Loose to compact, brown **SILT,** occasional sand and gravel		SS	6	33	5	4	85.37
		SS	7	100	50+		
4.72							
End of Borehole							
(GWL @ 1.10m - Dec. 16, 2019)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
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DATUM Ground surface elevations provided by the client.

FILE NO. PG5306

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** December 10, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE						0	89.43		
FILL: Grey crushed stone		AU	1						
0.61									
BEDROCK: Dolostone, some quartz crystals		RC	1			1	88.43		
1.73									
		RC	2			2	87.43		
BEDROCK: Sandstone						3	86.43		
		RC	3			4	85.43		
4.72									
End of Borehole									
(GWL @ 1.26m - Dec. 16, 2019)									

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

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

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

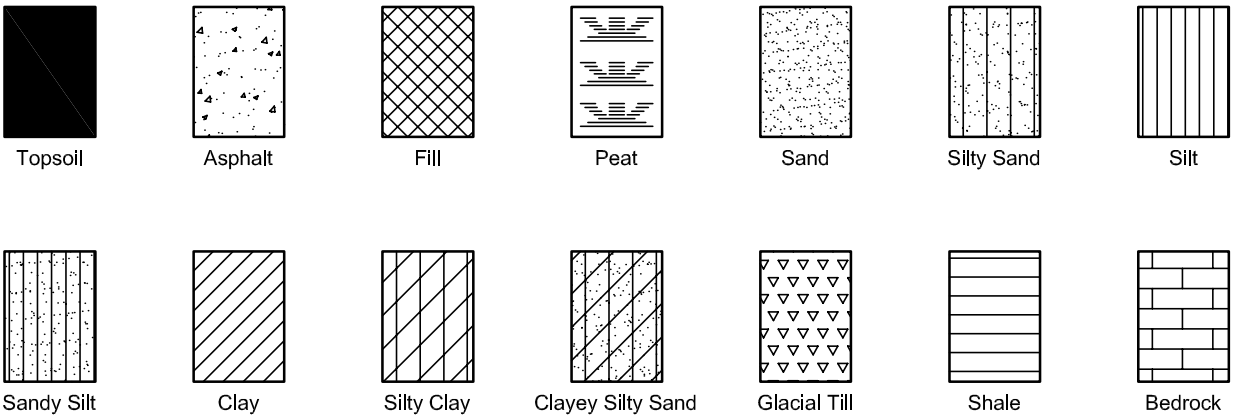
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

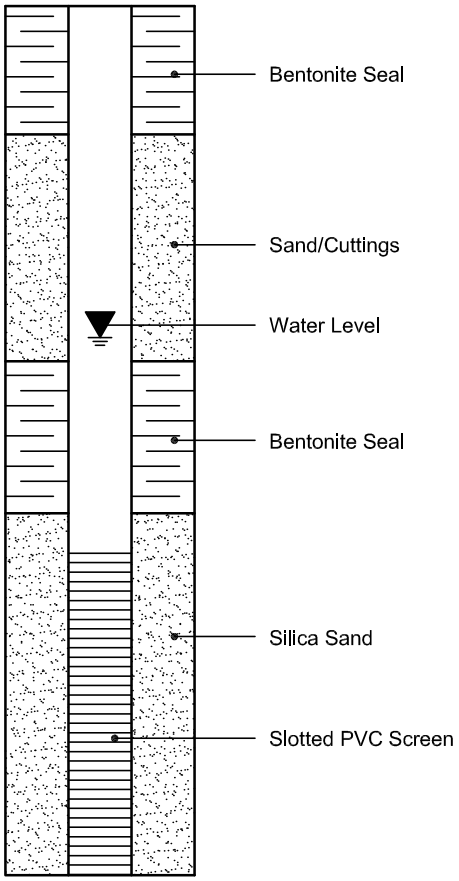
SYMBOLS AND TERMS (continued)

STRATA PLOT

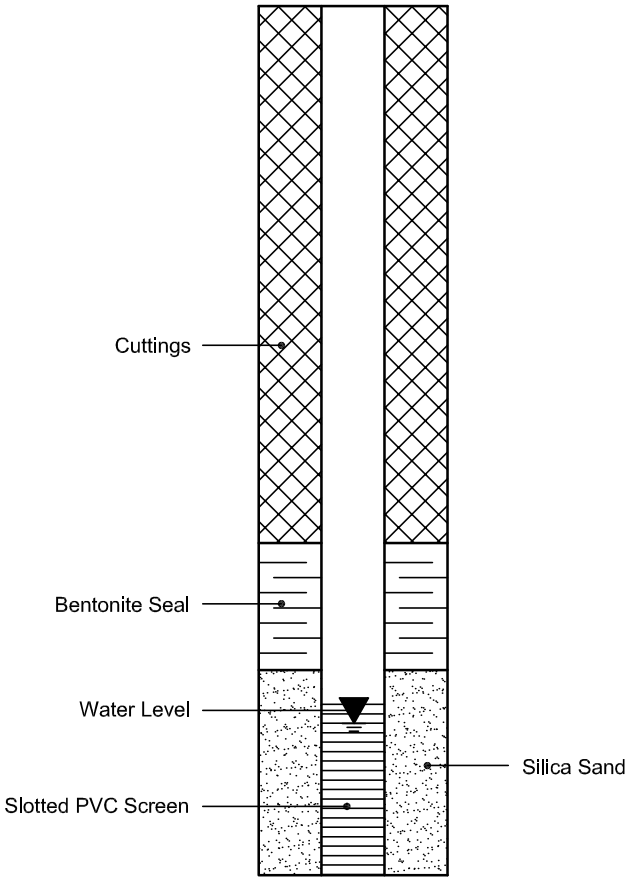


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



REFERENCE No.: T020556-A1

ENCLOSURE No.: 8

INSPEC·SOL

BOREHOLE No.: B2-1

ELEVATION: 90.43 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.

PROJECT: Geotechnical Investigation

LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario

DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett

DATE (START): October 27, 2008 DATE (FINISH): October 27, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- w Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.43		GROUND SURFACE			%	ppm	N	
			FILL- sandy silt, some gravel and organics, compact, brown, moist						
1.0	89.24				SS1	58		14	
			End of Borehole Auger Refusal Assumed Bedrock						
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

NOTES:

BOREHOLE LOG T020556-A1-BH(OCT-31-08).GPJ INSPEC_SOL.GDT 5/12/09

REFERENCE No.: T020556-A1

ENCLOSURE No.: 9

INSPEC·SOL

BOREHOLE No.: B2-2

ELEVATION: 88.57 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.

PROJECT: Geotechnical Investigation

LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario

DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett

DATE (START): October 28, 2008 DATE (FINISH): October 28, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- w Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	88.57		GROUND SURFACE			%	ppm	N	
			FILL- sand, some gravel, organics, loose, blackish brown, moist		SS1	38		8	
1.0	87.15		End of Borehole Auger Refusal Assumed Bedrock						
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

NOTES:

BOREHOLE LOG T020556-A1-BH(OCT-31-08).GPJ INSPEC SOL.GDT 5/12/09

REFERENCE No.: T020556-A1

ENCLOSURE No.: 10

INSPEC·SOL

BOREHOLE No.: B2-3

ELEVATION: 82.92 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.

PROJECT: Geotechnical Investigation

LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario

DESCRIBED BY: B.Beveridge CHECKED BY: J Bennett

DATE (START): October 28, 2008 DATE (FINISH): October 28, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		MONITOR WELL	SAMPLE DATA				
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK		State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD
meters	82.92		GROUND SURFACE	84.14 / 84.04			%	ppm	N
			TOPSOIL- organics, very soft, black, moist	WL 0.46 / 0.56					
1.0	82.06		SANDSTONE- Nepean formation, tan, light grey seams, fine grained salicious, slightly weathered, hard, close partings, 2 open separations, 1/2"(12.5mm) sand filling			RC1	85		81
2.0	80.53		End of Borehole	2.39					
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

SCALE FOR TEST RESULTS
50kPa 100kPa 150kPa 200kPa
10 20 30 40 50 60 70 80 90

NOTES:

BOREHOLE LOG T020556-A1-BH(OCT-31-08).GPJ INSPEC_SOL.GDT 5/12/09

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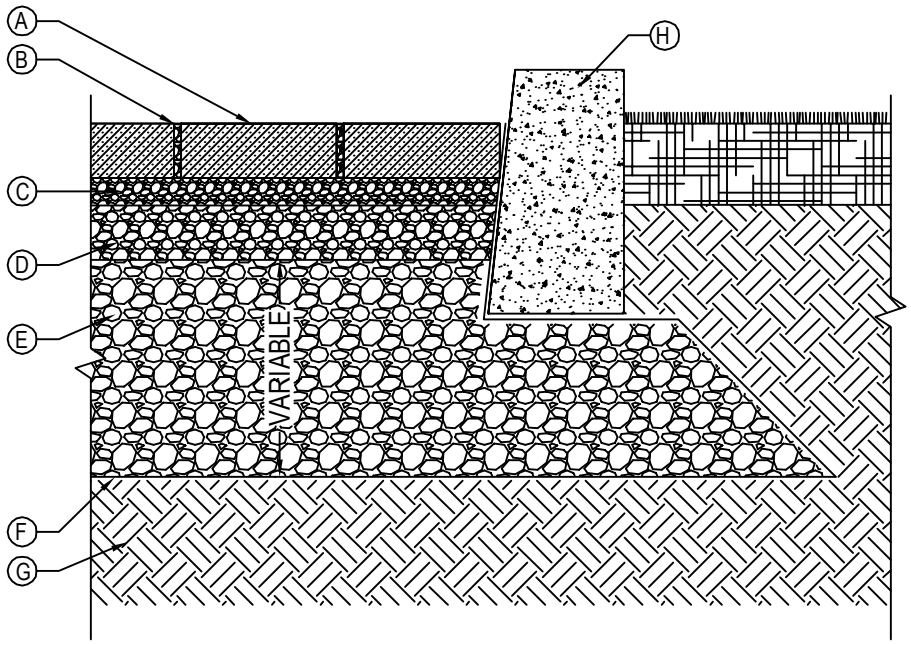


SECTION
CASE NO 1 - FULL INFILTRATION

LEGEND:
- (A) PERMEABLE PAVER FROM TECHO-BLOC, 2 3/8" TO 3 15/16" (60 TO 100 MM) THICK INFLO, MISTA RANDOM, PURE, VICTORIEN PERMEABLE, VILLAGIO OR VILLAGIO GRANDE CONFORMING TO ASTM C 936
- (B) JOINT FILLING MATERIAL, NO. 8 (FOR INFLO, PURE AND VILLAGIO) OR NO. 9 STONE (FOR MISTA RANDOM, VICTORIEN PERMEABLE AND VILLAGIO GRANDE) CONFORMING TO ASTM D 448
- (C) BEDDING COURSE, 2" (50 MM) THICK NO. 8 STONE CONFORMING TO ASTM D 448
- (D) BASE COURSE, 4" (100 MM) THICK NO. 57 STONE CONFORMING TO ASTM D 448
- (E) SUBBASE COURSE, THICKNESS AS PER DESIGN NO. 2 STONE CONFORMING TO ASTM D 448
- (F) GEOTEXTILE
- (G) SUBGRADE
- (H) EDGE RESTRAINT

NOTES:
1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWING.
3. THIS DRAWING IS INTENDED FOR USE BY ARCHITECTS, ENGINEERS, CONTRACTORS, CONSULTANTS AND DESIGN PROFESSIONALS FOR PLANNING PURPOSES ONLY. THIS DRAWING MAY NOT BE USED FOR CONSTRUCTION.
4. ALL INFORMATION CONTAINED HEREIN WAS CURRENT AT THE TIME OF DEVELOPMENT BUT MUST BE REVIEWED AND APPROVED BY THE PRODUCT MANUFACTURER TO BE CONSIDERED ACCURATE.
5. CONTRACTOR'S NOTE: FOR PRODUCT AND COMPANY INFORMATION VISIT www.CADdetails.com/info AND ENTER REFERENCE NUMBER 5058-007.

PERMEABLE PAVERS

PERMEABLE PAVERS (FULL INFILTRATION)

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG5306-1 - TEST HOLE LOCATION PLAN

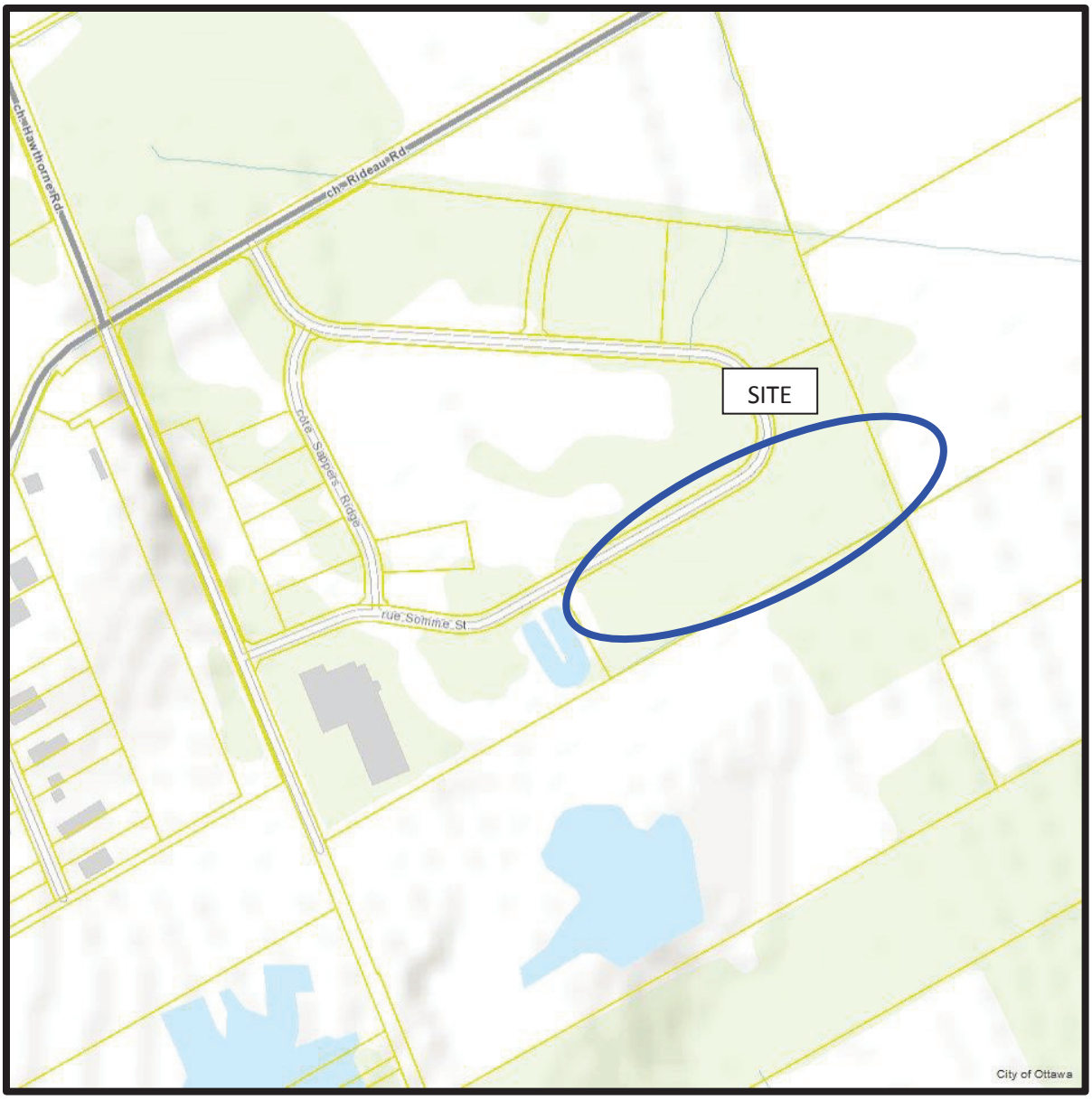
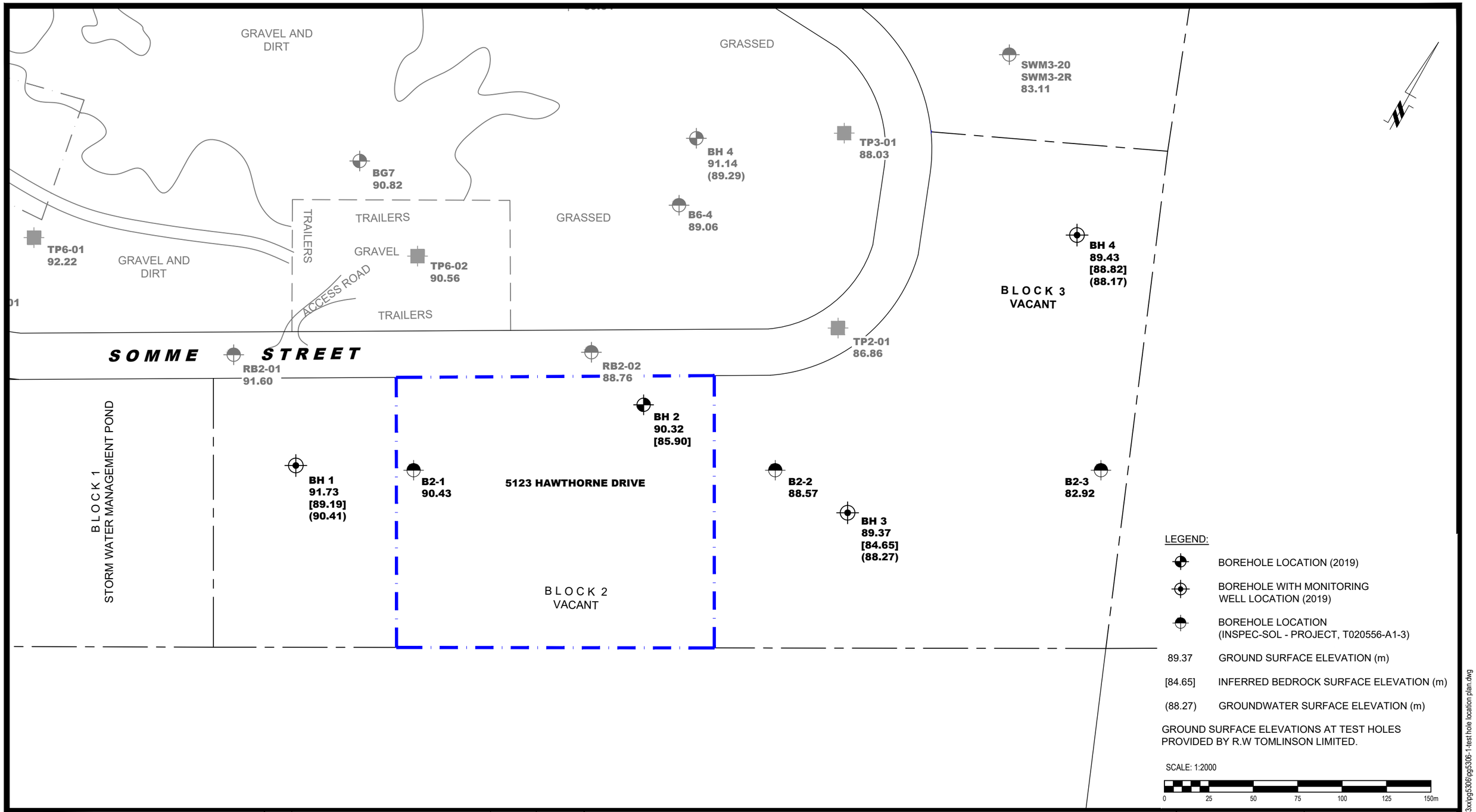


FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL

FULLER MARIANI BUILDING SOLUTIONS

GEOTECHNICAL INVESTIGATION
5123 HAWTHORNE DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 04/2020
Drawn by: YA	Report No.: PG5306-1
Checked by: YT	Dwg. No.: PG5306-1
Approved by: FA	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5306\pg5306-1-test hole location plan.dwg