Geotechnical Engineering

Environmental Engineering

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Materials Testing

Building Science

Noise and Vibration Studies

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Geotechnical Investigation
Proposed Industrial Building
155 Iber Road
Ottawa, Ontario

Prepared For

Power-Tek Group

April 27, 2021

Report: PG5713-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Power-Tek Group to conduct a geotechnical investigation for the proposed Industrial building to be located at 155 Iber Road in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2). The objective of the investigation was to:

❏ determine the subsoil and groundwater conditions at this site by means of boreholes.

❏ provide geotechnical recommendations for the 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 our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed industrial development will consist of a single storey building of slab-on-grade construction. It is further understood that associated access roads, parking areas and landscaped areas will occupy the remainder of the site. The site is also anticipated to be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the geotechnical investigation was conducted on March 5, 2021 and consisted of 3 boreholes advanced to a maximum depth of 3.8 m below the existing ground surface.

A previous investigation was completed at the subject site by Paterson on December 18, 2000, consisting of a total of 5 test pits. Two (2) of the test pits conducted at that time, test pit TP 2 and TP 3, are in the vicinity of the proposed warehouse and were excavated to a maximum depth of 3.7 m below the existing ground surface.

The test hole locations were selected by Paterson and distributed in a manner to provide general coverage of the subject site taking into consideration existing site features and underground utilities. The approximate locations of the boreholes are shown on Drawing PG5713-1 - Test Hole Location Plan included in Appendix 2.

All boreholes were advanced using a low clearance , track-mounted drill rig, which was operated by a two person crew. All test pits were excavated using a hydraulic shovel backhoe. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths and at the selected locations, and sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. All samples were visually inspected and initially classified on site and subsequently placed in sealed plastic bags. All samples were transported to our laboratory for further examination and classification. The depths at which the auger and split-spoon samples were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

A Standard Penetration Test (SPT) was conducted at each borehole 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.

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

Sample Storage

All samples from the current investigation will be stored in the laboratory for a period of one (1) month after issuance of this report. They will then be discarded unless we are otherwise directed.

Groundwater

The observed groundwater levels were recorded in the field. Ground 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 borehole locations and ground surface elevation at each borehole location were surveyed in the field by Paterson using a high precision GPS unit. The ground surface elevations at the borehole locations are referenced to a geodetic datum. The location of the test holes and ground surface elevations at each borehole location are presented on Drawing PG5713-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soils samples were recovered from the subject site and visually examined in our laboratory to by a geotechnical engineer to review the results of the field logging. The results are presented in the Soil Profile and Test Data sheets provided in Appendix 1.

3.4 Analytical testing

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

4.0 Observations

4.1 Surface Conditions

The subject site is currently occupied by an office building located in the southern portion of the site and surrounded by associated asphalt and parking areas. A gravel surfaced storage area was observed at the north end of the site, which was occupied by large equipment and storage containers at the time of the current field investigation.

The subject site is bordered to the east by a school and associated schoolyard, to the north and south by commercial buildings and to the west by Iber Road. The existing ground surface across the subject site is relatively flat with an approximate geodetic elevation of 103 to 104 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile at the test hole location was generally observed to consist of a fill layer, consisting of crushed stone with brown silty sand to silty clay and trace organics. At the time of the previous investigation, a thin layer of topsoil was encountered at the ground surface. However, it is understood that the topsoil has been stripped from the majority of the subject site prior to the current field investigation.

A loose to dense to glacial till deposit was encountered underlying the topsoil at all test holes locations. The glacial till consisted of brown silty sand to sandy silt, with some to trace gravel, cobbles, boulders, and trace clay, becoming grey in colour by approximately 2.8 m below the existing ground surface.

Practical refusal to augering was encountered at all test holes at depths between 2.8 and 3.8 m below the existing ground surface. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock at the subject site consists of interbedded limestone and dolomite of the Gull River formation with an overburden thickness of 3 to 4 m.

4.3 Groundwater

Groundwater level readings were recorded on March 15, 2021. The groundwater level readings are presented in the Soil Profile and Test Data sheets in Appendix 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 color, moisture levels and consistency of the recovered samples. Based on these observations, the long-term groundwater level is expected between 2 to 3 m depth. However, 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 Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1	103.97	0.39	103.58	March 15, 2021
BH 2	103.67	0.52	103.15	March 15, 2021
BH 3	104.12	0.45	103.67	March 15, 2021

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is expected that the proposed industrial building will be founded on conventional shallow footings bearing on an undisturbed sandy silt to silty sand and/or glacial till bearing surface.

Where the footing subgrade consists of silty sand which is observed to be in a loose state of compactness, the material should be proof compacted using suitable vibratory equipment making several passes under dry conditions and above freezing temperatures and which is approved by Paterson at the time of construction.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, such as those containing organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. It is anticipated that existing fill within the proposed building footprint, free of deleterious material and significant amounts of organics, and approved by the geotechnical consultant at the time of construction can be left in place below the proposed building footprint outside of lateral support zones for the footings. However, it is recommended that the existing fill layer be proof-rolled by a vibratory roller making several passes under dry and above freezing conditions and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

Fill Placement

Fill used for grading beneath the proposed building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery. 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).

Site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to at least 95% of their respective SPMDD.

5.3 Foundation Design

Conventional Spread Footings

Footings placed directly on an undisturbed, compact sandy silt and/or glacial till bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **120 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.

Footings placed on a soil bearing surface and designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

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 sandy silt or glacial till bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity as the soil.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D**. If a higher seismic site class is required (Class C), a site specific shear wave velocity test may be completed to accurately determine the applicable seismic site classification for foundation design of the proposed building addition, as presented in Table 4.1.8.4.A of the Ontario Building Code 2012.

Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code 2012 for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the existing fill, sandy silt, or glacial till subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for slab-on-grade. Where the subgrade consists of existing fill or sandy silt, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as Granular B Type II.

For slab-on-grade areas, it is recommended that the upper 200 mm of sub-slab fill consist OPSS Granular A crushed stone. All backfill material within the footprints of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

A sub-slab drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should also be provided under the basement slab areas. This is discussed further in Subsection 6.1.

5.6 Pavement Structure

Car only parking areas, access lanes and heavy truck parking/loading areas are anticipated at this site. The proposed flexible pavement structures are shown in Tables 2 and 3.

Table 2 - Recommended Flexible 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 fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Flexible Pavement Structure - Access Lanes and Heavy Truck Parking/loading Areas	
Thickness (mm)	**Material Description**
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

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. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used where a flexible pavement structure is to be used for this project. 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.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the catch basins storm sewer.

It is also 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 sub-slab drainage pipe. The perimeter drainage pipe should direct water to sump pit(s) within the lower basement area.

Foundation Backfill

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 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

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m thick soil cover should be provided for adequate frost protection of heated structured, or an equivalent combination of soil cover and foundation insulation.

Exterior unheated footings, such as those for isolated exterior piers and loading docks, 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

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

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

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

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.

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 99% of the material’s SPMDD.

It should generally be possible to re-use the site excavated materials above the cover material if the operations are carried out in dry weather conditions.

Where hard surface ares are considered above the trench backfill, the trench backfill material within the frost zone, (about 1.5 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick lifts and compacted to 95% of the materials SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and 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 of 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, 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 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, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

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

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a low to slightly aggressive corrosive environment.

7.0 Recommendations

It is a requirement for the foundation data provided herein to be applicble that the following material testing and observation program be performed by the geotechnical consultant.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials used.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to placing backfilling materials.

☐ Field density tests to determine the level of compaction achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

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

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Power-Tek Group or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

O. Canton

Owen Canton, E.I.T.

LICENSED PROFESSIONAL ENGINEER
April 28, 2021
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David J. Gilbert, P.Eng.

Report Distribution:

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- ☐ Paterson Group

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Warehouse Buidling
155 Iber Road - Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE 2021 March 5

FILE NO. PG5713

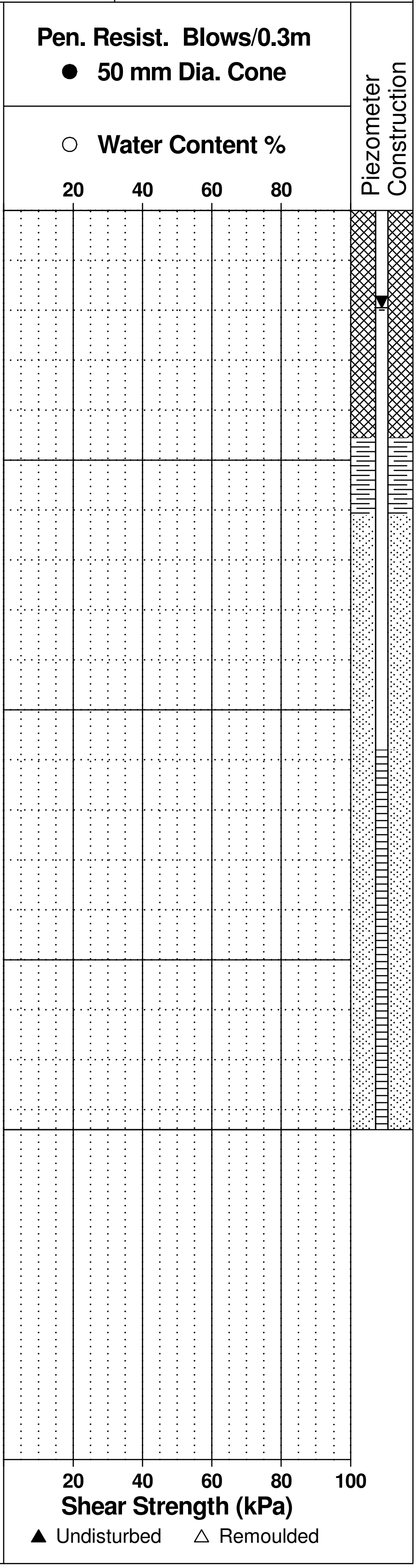
HOLE NO. BH 1-21

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.97
FILL: Crushed stone with silty sand and trace organics						
0.33	AU	1				
GLACIAL TILL: Dense to compact brown silty sand to sandy silt with gravel, trace clay, cobbles and boulders					1	102.97
	SS	2	38	6		
	SS	3	46	17	2	101.97
	SS	4	54	23		
2.74						
GLACIAL TILL: Loose grey silty sand with gravel, trace cobbles and boulders					3	100.97
	SS	5	75	7		
3.68						

End of Borehole

Practical refusal to augering at 3.68 m depth

(GWL @ 0.39 m depth - March 15, 2021)



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Warehouse Buidling
155 Iber Road - Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5713

REMARKS

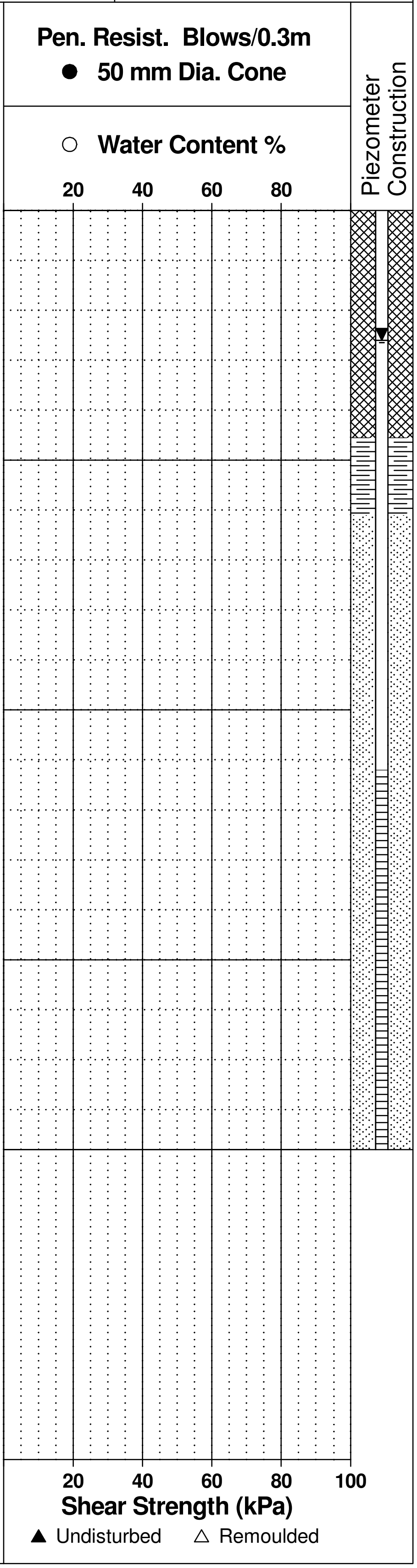
HOLE NO. BH 2-21

BORINGS BY CME-55 Low Clearance Drill

DATE 2021 March 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Crushed stone with brown silty clay, some sand		AU	1		
0.53					
GLACIAL TILL: Loose to compact brown sandy silt trace clay, gravel, cobbles and boulders		SS	2	58	12
		SS	3	50	37
		SS	4	67	28
- Grey by 2.9 m depth		SS	5	42	15
3.76					
End of Borehole Practical refusal to augering at 3.76 m depth (GWL @ 0.52 m depth - March 15, 2021)					

DEPTH (m)	ELEV. (m)
0	103.67
1	102.67
2	101.67
3	100.67



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Warehouse Buidling
155 Iber Road - Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE 2021 March 5

FILE NO. PG5713

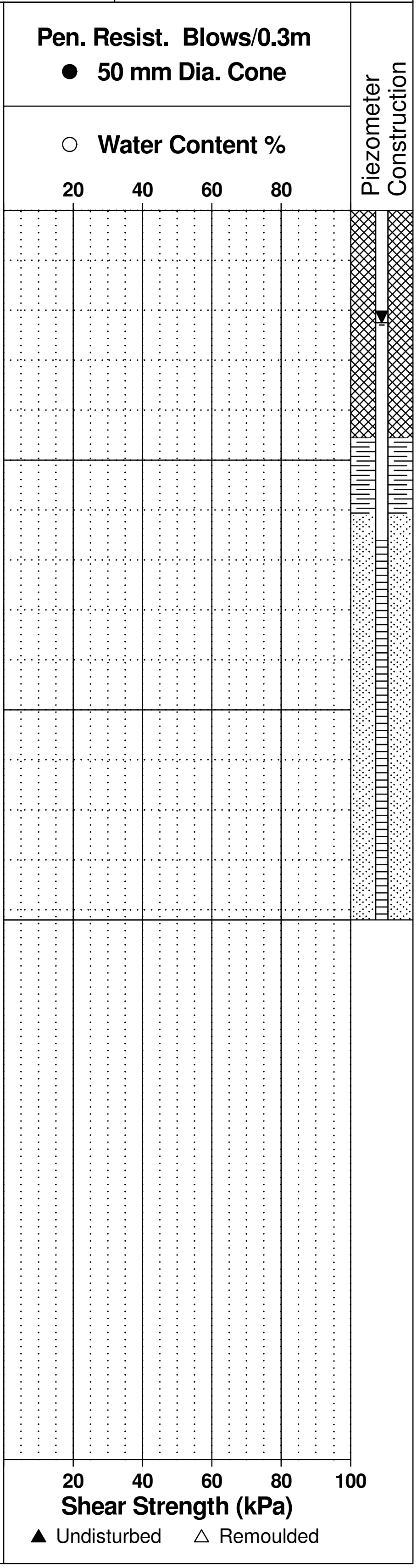
HOLE NO. BH 3-21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Crushed stone with brown silty sand	AU	1		
0.48				
GLACIAL TILL: Compact brown silty sand to sandy silt with gravel, trace clay, cobbles and boulders	SS	2	46	35
	SS	3	71	26
	SS	4	45	37
2.84				
End of Borehole				

DEPTH (m)	ELEV. (m)
0	104.12
1	103.12
2	102.12

Practical refusal to augering at 2.84 m depth

(GWL @ 0.45 m depth - March 15, 2021)



JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Geotechnical and Environmental Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Proposed Office Building, Iber Road
Stittsville, Ontario

DATUM TBM - Top of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

BORINGS BY Backhoe

DATE 18 DEC 00

FILE NO. G8079

HOLE NO. TP 2

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.25					0	98.64
	G	2			1	97.64
Compact, brown to grey SANDY SILT, occasional gravel, cobbles and boulders					2	96.64
					3	95.64
3.66 End of Test Pit Refusal on inferred bedrock @ 3.66m depth (TP dry upon completion)						

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

PIEZOMETER CONSTRUCTION

JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Geotechnical and Environmental Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Proposed Office Building, Iber Road
Stittsville, Ontario

DATUM TBM - Top of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

BORINGS BY Backhoe

DATE 18 DEC 00

FILE NO. G8079

HOLE NO. TP 3

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 %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	98.42		
TOPSOIL									
0.30									
						1	97.42		
Compact, brown to grey **SANDY SILT**, some gravel, cobbles, and boulders									
						2	96.42		
						3	95.42		
3.35									
End of Test Pit TP terminated on inferred bedrock @ 3.35m depth (TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the 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

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 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)

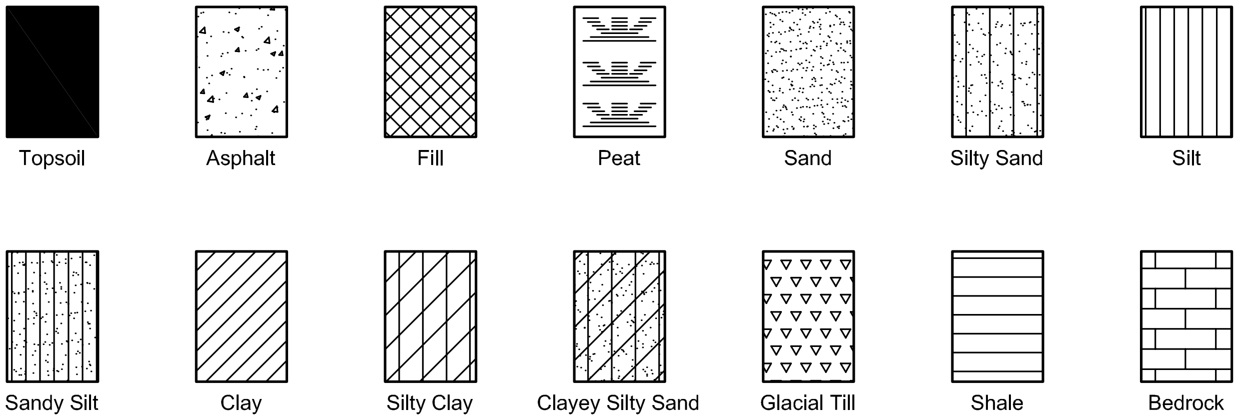
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

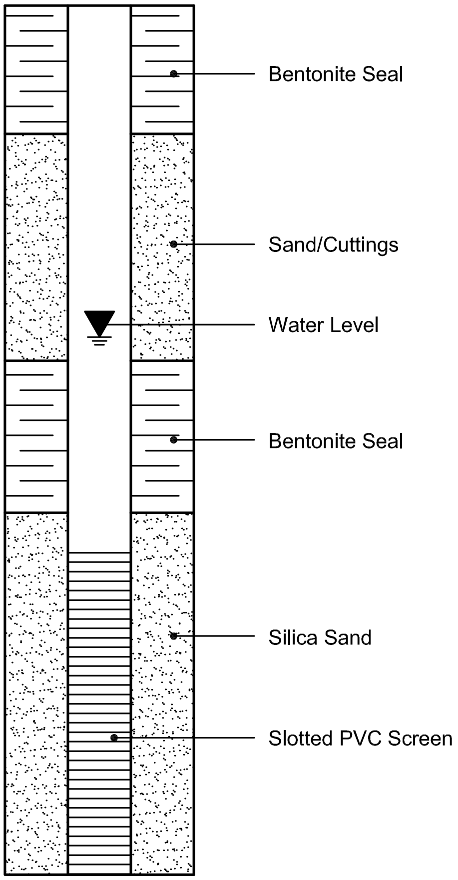
SYMBOLS AND TERMS (continued)

STRATA PLOT

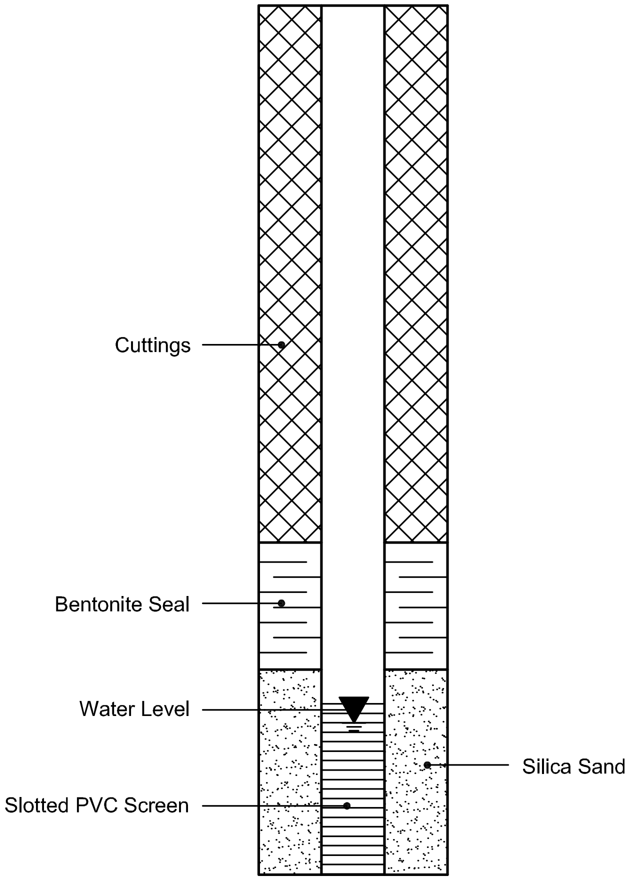


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 31969

Report Date: 15-Mar-2021

Order Date: 10-Mar-2021

Project Description: PG5713

Client ID:		BH3-SS3	-	-	-
Sample Date:		05-Mar-21 13:00	-	-	-
Sample ID:		2111394-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	92.9	-	-	-
General Inorganics					
pH	0.05 pH Units	7.93	-	-	-
Resistivity	0.10 Ohm.m	55.0	-	-	-
Anions					
Chloride	5 ug/g dry	30	-	-	-
Sulphate	5 ug/g dry	53	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG5713-1 - TEST HOLE LOCATION PLAN

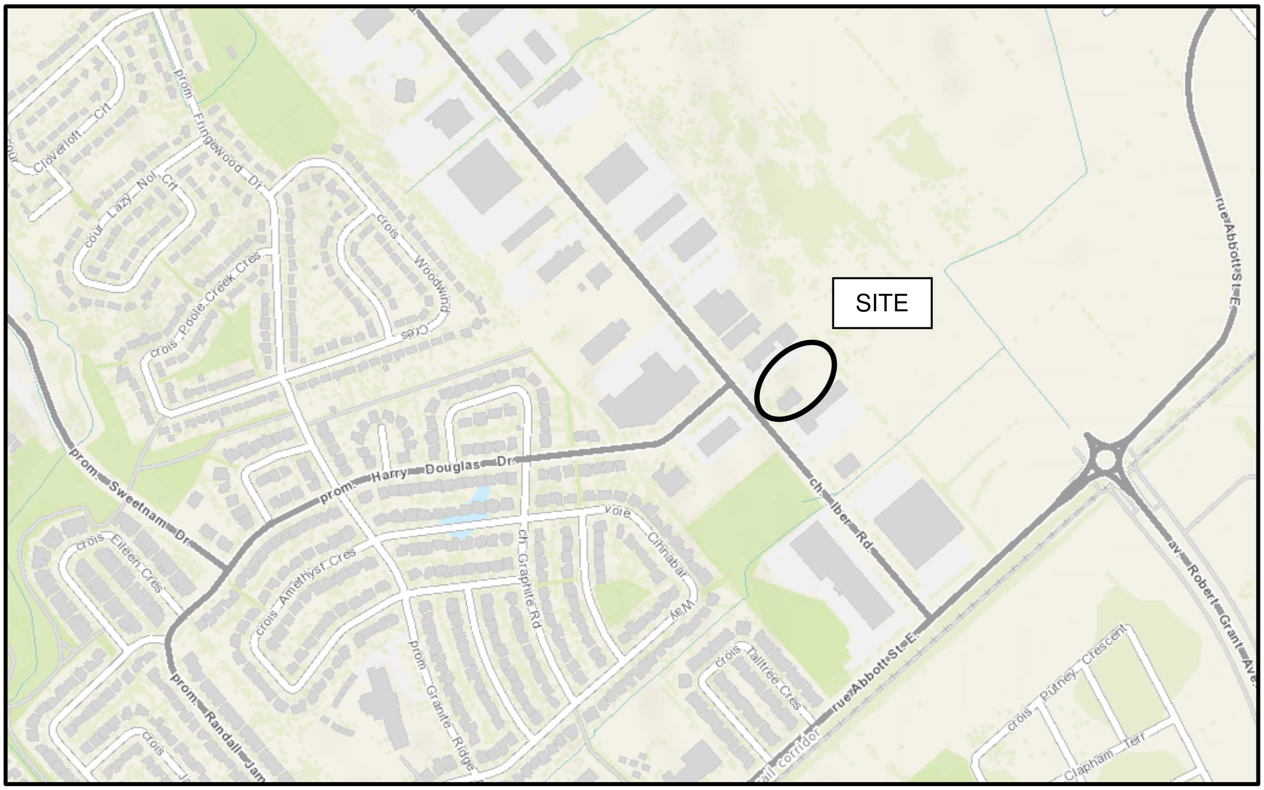
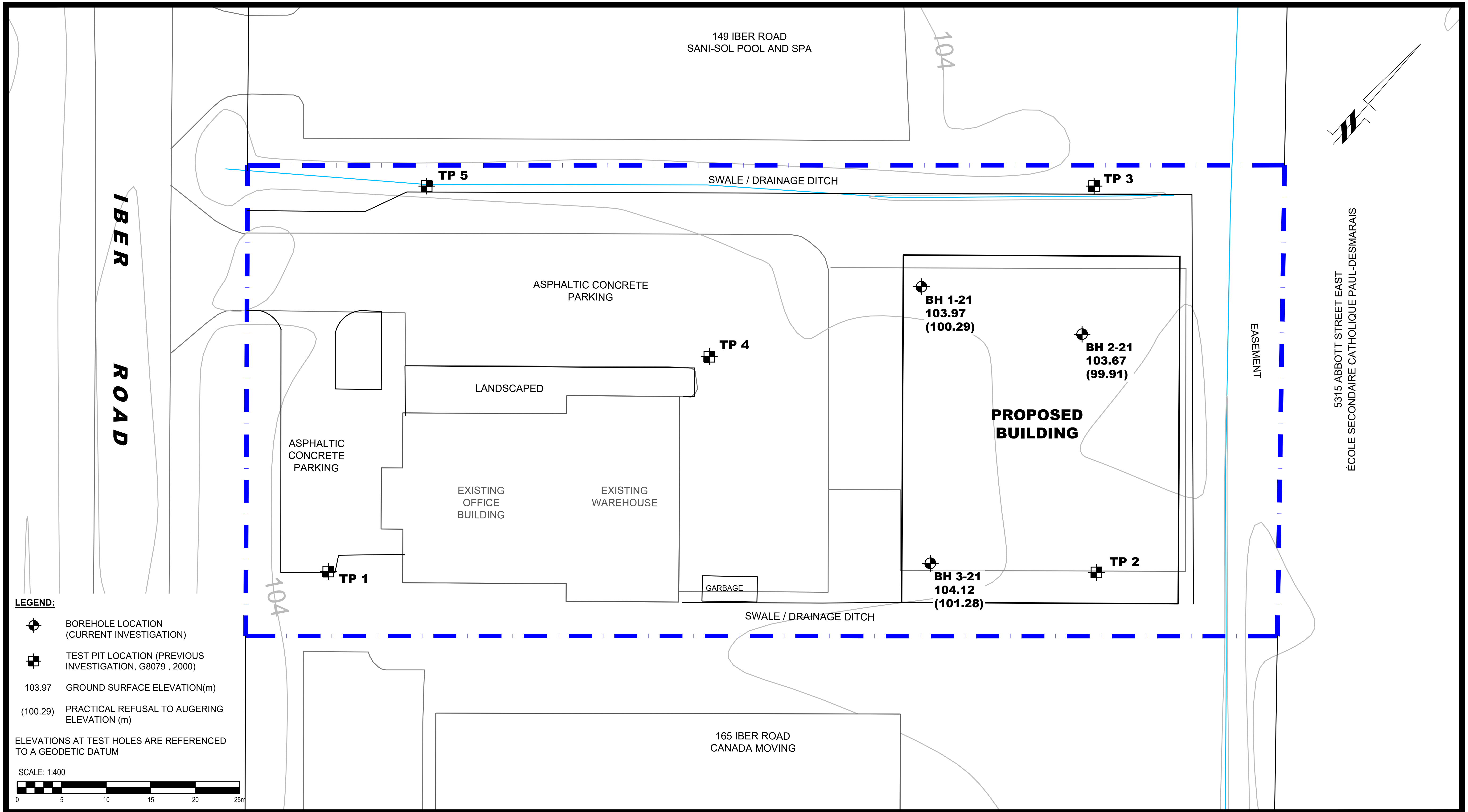


FIGURE 1

KEY PLAN

patersongroup



LEGEND:

⌖ BOREHOLE LOCATION (CURRENT INVESTIGATION)

▨ TEST PIT LOCATION (PREVIOUS INVESTIGATION, G8079 , 2000)

103.97 GROUND SURFACE ELEVATION(m)

(100.29) PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

ELEVATIONS AT TEST HOLES ARE REFERENCED TO A GEODETIC DATUM

SCALE: 1:400

0 5 10 15 20 25m

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NO.	REVISIONS	DATE	INITIAL
0			

POWER-TEK GROUP

GEOTECHNICAL INVESTIGATION - PROPOSED WAREHOUSE BUILDING
155 IBER ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:400	Date: 03/2020
Drawn by: RCG	Report No.: PG5713-1
Checked by: OC	Dwg. No.: PG5713-1
Approved by: DJG	Revision No.: 0

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