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Geotechnical Engineering

Environmental Engineering

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Building Science

Noise and Vibration Studies

Geotechnical Investigation

Proposed Multi-Storey Buildings
Idone South Apartments
4840 Bank Street
Ottawa, Ontario

Prepared For

Regional Group

May 20, 2022

Report: PG6225-1

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Table of Contents

Appendices

Appendix 1	Soil Profile and Test Data Sheets Symbols and Terms Test Pit Logs by Others Analytical Testing Results
Appendix 2	Figure 1 - Key Plan Drawing PG6225-1 - Test Hole Location Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by Regional Group to conduct a geotechnical investigation for the proposed multi-storey buildings (Idone South Apartments) to be located at 4840 Bank Street in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

- ☐ Determine the subsoil and groundwater conditions at this site by means of boreholes.

- ☐ Provide geotechnical recommendations pertaining to 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. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of 3 multi-storey buildings of slab-on-grade construction. At finished grades, the proposed buildings will generally be surrounded by asphalt-paved access lanes and parking areas with landscaped margins. It is also understood that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out from May 16 to 17, 2022, and consisted of advancing a total of 8 boreholes to a maximum depth of 6.6 m below the existing ground surface. The borehole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground utilities and site features.

The boreholes were drilled using a track-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 drilling procedure consisted of augering to the required depths at the selected locations, and sampling the overburden.

A previous geotechnical investigation was also carried out on, and adjacent to, the subject site by others in 2008. One (1) test pit location, TP 08-1, was located within the subject site.

The borehole and test pit locations are shown on Drawing PG6225-1 - Test Hole Location Plan included in Appendix 2.

Sampling and In Situ Testing

Soil samples were recovered 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. The auger and split-spoon samples were 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 were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets presented 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.

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

Groundwater

Flexible polyethylene standpipes were installed in all borehole locations during the field investigation to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. Groundwater level observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The borehole locations were selected by Paterson to provide general coverage of the proposed development, taking into consideration the locations of previously excavated test pits, existing site features and underground utilities. The borehole locations, and ground surface elevation at each borehole location, were surveyed by Paterson using a handheld GPS, referenced to a geodetic datum, and are presented on Drawing PG6225 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. All samples will be stored in the laboratory for a period of one (1) month after issuance of this report.

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, by determining the concentration of sulphate and chloride, the resistivity, and the pH. The results are presented in Appendix 1 and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently undeveloped and is heavily forested on the western portion of the site, while the eastern portion of the site generally has a grass surface. The site fronts onto Bank Street to the east, and is bordered to the north by an existing commercial property, to the south by an existing residential property, and to the west by a residential subdivision which is currently under construction. The site generally slopes downward from the southwest corner of the site at approximate geodetic elevation 104 m, toward the northeast corner of the site at approximate geodetic elevation 101 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile at the subject site consists of topsoil which is underlain by an approximate 0.4 to 2.2 m thickness of loose to compact silty sand to sandy silt, and/or very stiff to stiff silty clay. At borehole BH 5-22, fill was observed underlying the topsoil, consisting of brown silty sand to sandy silt with trace gravel, topsoil, and wood, which extends to an approximate depth of 1.8 m.

A glacial till deposit was encountered underlying the topsoil, silty sand to sandy silt, and/or silty clay at approximate depths ranging from 0.4 to 2.5 m below the existing ground surface. The glacial till deposit was generally observed to consist of compact to very dense, brown to grey silty sand to sandy silt with gravel, cobbles and boulders.

Practical refusal to augering was encountered at depths of about 2.5 to 6.6 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 in the subject area consists of interbedded sandstone and dolomite of the March Formation with an overburden drift thickness of 3 to 5 m.

4.3 Groundwater

The groundwater levels were measured on May 19, 2022, in the installed piezometers. The measured groundwater levels are shown in Table 1 below.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Levels (m)	Groundwater Elevation (m)	Recording Date
BH 1	100.86	0.57	100.29	May 19, 2022
BH 2	102.07	2.51	99.56	May 19, 2022
BH 3	101.34	1.22	100.12	May 19, 2022
BH 4	102.49	1.77	100.72	May 19, 2022
BH 5A	102.83	0.64	102.19	May 19, 2022
BH 6	103.14	0.94	102.20	May 19, 2022
BH 7	103.60	0.52	103.08	May 19, 2022
BH 8	103.69	0.70	102.99	May 19, 2022

Note: Ground surface elevations at the borehole locations were surveyed by Paterson and are referenced to a geodetic datum.

The long-term groundwater levels can also be estimated based on the observed colour, moisture content and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level is expected to range between approximately 2.5 to 3.5 m below the existing ground surface.

However, it should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is recommended that the proposed buildings be founded on conventional spread footings bearing on the undisturbed, compact to dense silty sand to sandy silt, and/or the undisturbed, compact to dense glacial till.

Should fill be encountered at the underside of footing elevation, it should be sub-excavated to the surface of the undisturbed, compact to dense silty sand to sandy silt, and/or the undisturbed, compact to dense glacial till. Engineered fill should then be placed and compacted from the excavated surface up to the underside of footing elevation.

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 material, should completely be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

However, it is anticipated that existing fill located within the proposed building footprints, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprints, outside of the lateral support zones for the footings. However, it is recommended that the existing fill layer be proof-rolled several times under dry conditions and above freezing temperatures, and approved by Paterson personnel 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 buildings 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 buildings 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.

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.

5.3 Foundation Design

Footings bearing on the undisturbed, compact to dense silty sand to sandy silt, and/or the undisturbed, compact to dense glacial till, or on compacted engineered fill which is placed directly over these materials, 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 **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

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

Footings placed on a soil bearing surface and designed using the bearing resistance value at SLS will be subjected to potential post-construction total and differential settlement 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 glacial till or engineered fill bearing surface when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil of the same or engineered fill of the same or higher capacity as that of the bearing medium.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C**. If a higher seismic site class is required (Class A or B), and the proposed building footings are to be located within 3 m of the bedrock surface, 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, as presented in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012.

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

5.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, the existing fill or native soil subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

Where the subgrade consists of existing fill, it is recommended that the slab-on-grade subgrade be proof-rolled with a suitably sized vibratory drum roller making several passes, under dry conditions, prior to sub-slab fill placement. Any poor performing areas should be removed and replaced with an engineered fill, such as Granular B Type II.

The upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A fill. All backfill material within the footprints of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the material's SPMDD.

5.6 Pavement Design

The pavement structures for parking areas and access lanes are presented in Tables 2 and 3 below.

Table 2 - Recommended Pavement Structure – Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE – OPSS Granular B Type **I** or **II** material placed over in situ soil or engineered fill	

Table 3 - Recommended Pavement Structure – Access Lanes and Heavy Loading Area

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 – OPSS Granular B Type I or II material placed over in situ soil or engineered fill	

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

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is understood that the proposed structures will not contain below-grade space, therefore, perimeter drainage systems are not considered to be required. However, should the proposed buildings contain occupied below-grade space, it is recommended that a perimeter foundation drainage system be provided for the below-grade areas. The system should consist of a 150 mm diameter, perforated and corrugated plastic or PVC pipe which is surrounded by 150 mm of 19 mm clear crushed stone, and which is placed at the footing level around the exterior perimeter of the below-grade structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. The excavated on-site soils may be used for backfill around the exterior sides of the foundation walls, provided they are in an unfrozen state and at a suitable moisture content for compaction. 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 of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the 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 excavations at this site should either be cut back at acceptable slopes or should be retained by temporary shoring systems from the start of the excavation until the structure is backfilled. It is anticipated 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 cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level (i.e. 3H:1V). The subsoil at this site is considered to be mainly a Type 3 soil, and Type 4 when below groundwater, 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 is used 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 material should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Service 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 a soil subgrade. 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 98% of the SPMDD.

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

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) 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 loose lifts and compacted to a minimum of 98% of the material’s 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.

Groundwater Control for Building Construction

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

Impacts on Neighbouring Properties

Due to the relatively shallow depth of the compact to very dense glacial till deposit, it is anticipated that neighbouring structures are bearing on this strata, which is not susceptible to settlement from dewatering. Furthermore, it is not anticipated that the proposed construction will extend below the static groundwater level. Therefore, no adverse effects from short-term or long-term dewatering are expected for surrounding structures. The short-term dewatering during the excavation program will be managed by the excavation contractor.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

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

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost into 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 indicate that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

7.0 Recommendations

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

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

☐ Sampling and testing of the concrete and fill materials.

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

☐ Observation of all subgrades prior to backfilling.

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

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

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

All excess soils must be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management.*

8.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

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 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 the 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 Regional Group 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.

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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

TEST PIT LOGS BY OTHERS

ANALYTICAL TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 16, 2022

FILE NO. PG6225

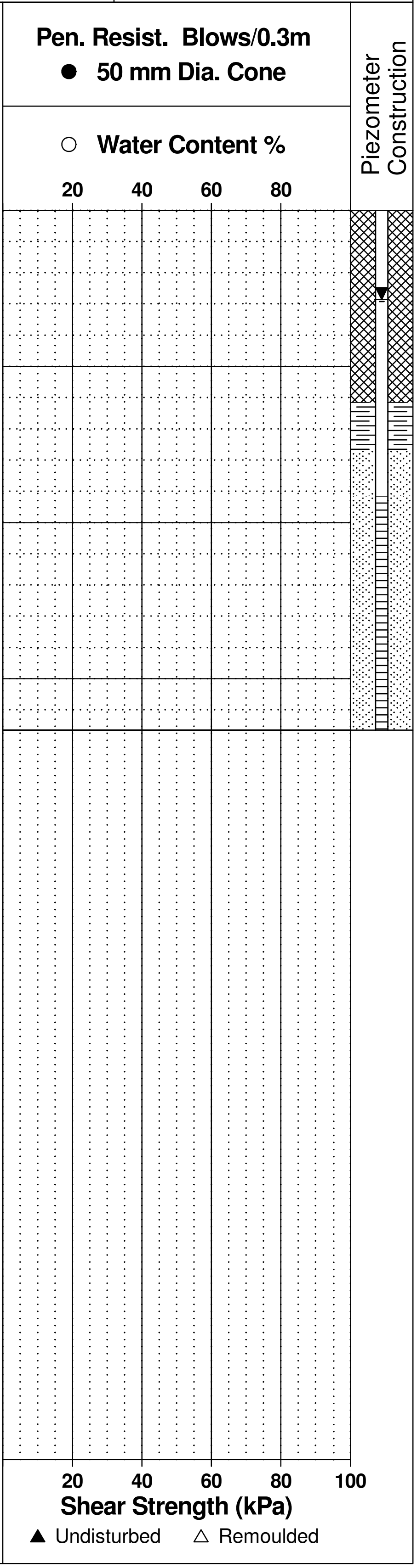
HOLE NO. BH 1-22

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	100.86
TOPSOIL 0.36						
	AU	1				
	SS	2	58	30	1	99.86
GLACIAL TILL: Compact to dense, brown silty sand to sandy silt with gravel, cobbles and boulders, some to trace clay to 0.8m depth	SS	3	75	50+		
					2	98.86
	SS	4	50	31		
- grey by 2.9m depth					3	97.86
3.33	SS	5	44	50+		

End of Borehole

Practical refusal to augering at 3.33m depth.

(GWL @ 0.57m - May 19, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 16, 2022

FILE NO. PG6225

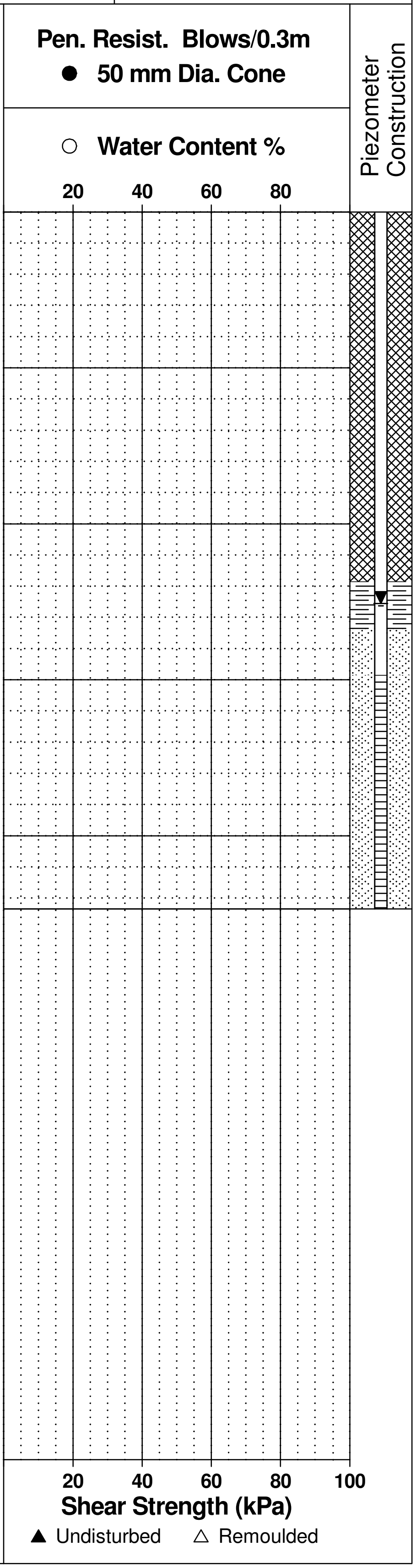
HOLE NO. BH 2-22

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	102.07
TOPSOIL 0.33						
Compact to dense, brown **SILTY SAND to SANDY SILT,** trace gravel - trace clay from 0.3 to 0.8m depth	AU	1				
	SS	2	75	25	1	101.07
1.68						
GLACIAL TILL: Compact to dense, grey silty sand to sandy silt with gravel, cobbles and boulders, trace clay	SS	3	33	50+	2	100.07
	SS	4	33	38		
	SS	5	44	50+	3	99.07
	SS	6	56	50+	4	98.07
4.47						

End of Borehole

Practical refusal to augering at 4.47m depth.

(GWL @ 2.51m - May 19, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

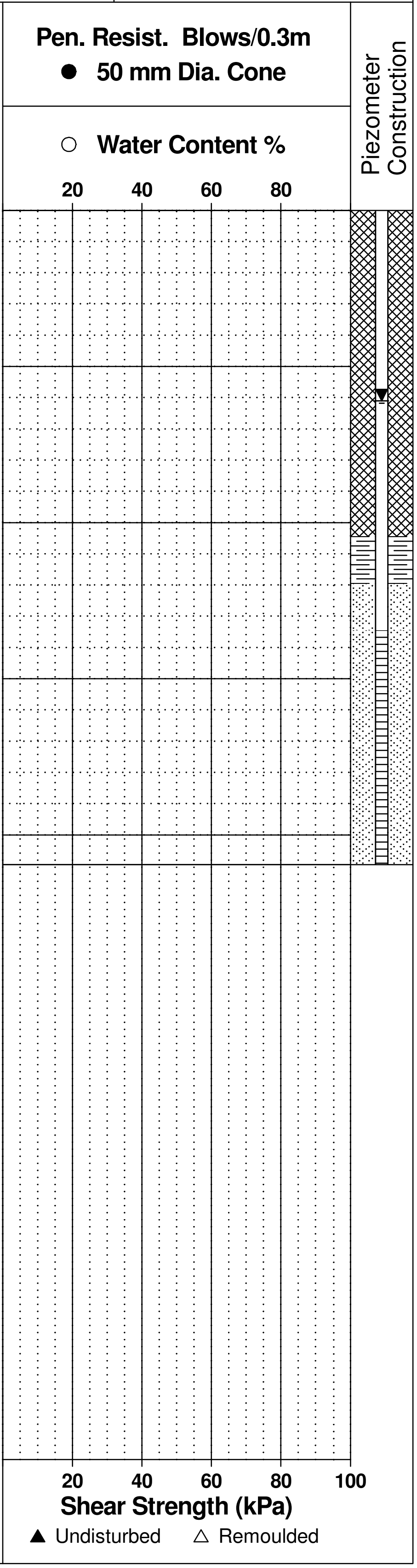
DATUM Geodetic
REMARKS
BORINGS BY Track-Mount Power Auger
DATE May 16, 2022
FILE NO. **PG6225**
HOLE NO. **BH 3-22**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	101.34
TOPSOIL 0.38						
Very stiff to stiff, brown **SILTY CLAY to CLAYEY SILT,** trace gravel 0.69	AU	1				
	SS	2	58	39	1	100.34
GLACIAL TILL: Very dense, brown silty sand to sandy silt with gravel, cobbles and boulders	SS	3	55	50+	2	99.34
	SS	4	100	50+	3	98.34
- grey by 3.1m depth	SS	5	50	50+		
4.19	SS	6	67	50+	4	97.34

End of Borehole

Practical refusal to augering at 4.19m depth.

(GWL @ 1.22m - May 19, 2022)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 16, 2022

FILE NO. PG6225

HOLE NO. BH 4-22

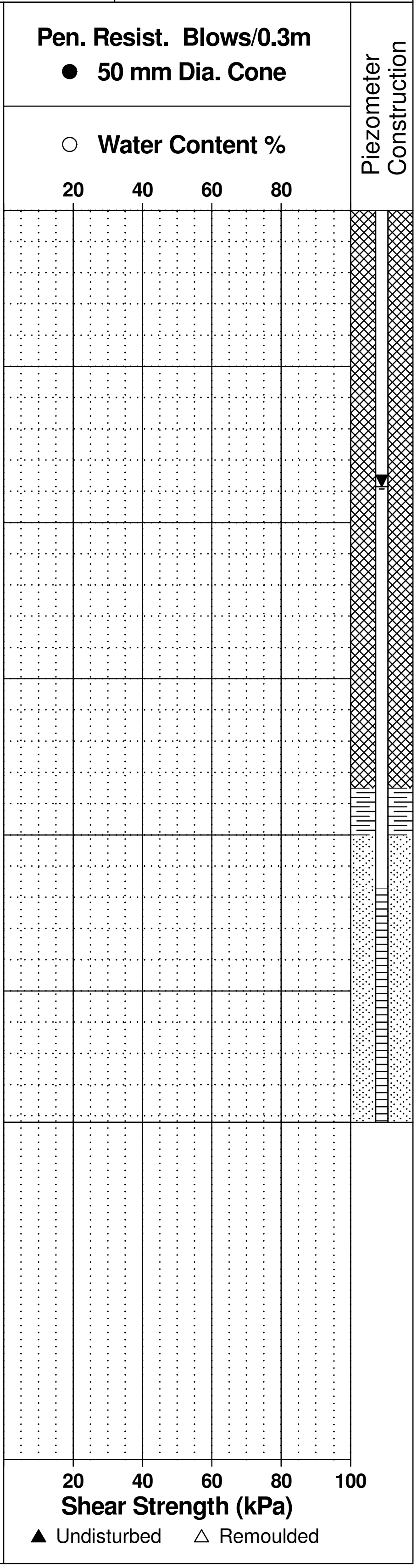
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.33				
Very stiff to stiff, brown **SILTY CLAY to CLAYEY SILT,** some sand, trace gravel 0.60	AU	1		
Compact, brown **SILTY SAND to SANDY SILT** with gravel, occasional cobbles, trace clay 1.45	SS	2	33	25
Compact to dense, brown **SILTY SAND,** trace gravel	SS	3	58	36
2.49	SS	4	63	50+
GLACIAL TILL: Compact to dense, grey silty sand to sandy silt with gravel, cobbles and boulders, trace clay	SS	5	55	50+
	SS	6	25	50+
	SS	7	83	50+
	SS	8	80	50+
5.84				

DEPTH (m)	ELEV. (m)
0	102.49
1	101.49
2	100.49
3	99.49
4	98.49
5	97.49

End of Borehole

Practical refusal to augering at 5.84m depth.

(GWL @ 1.77m - May 19, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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BORINGS BY Track-Mount Power Auger

DATE May 17, 2022

FILE NO. PG6225

HOLE NO. BH 5-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.83
TOPSOIL 0.46		AU	1				
FILL: Brown silty sand to sandy silt , trace gravel and topsoil		SS	2	12	4	1	101.83
- trace wood by 1.5m depth 1.83		SS	3	4	6		
						2	100.83
GLACIAL TILL: Compact to dense, grey silty sand to sandy silt with gravel, cobbles and boulders		SS	4	22	42		
						3	99.83
3.30		SS	5	40	50+		
End of Borehole Practical refusal to augering at 3.30m depth.							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 17, 2022

FILE NO. PG6225

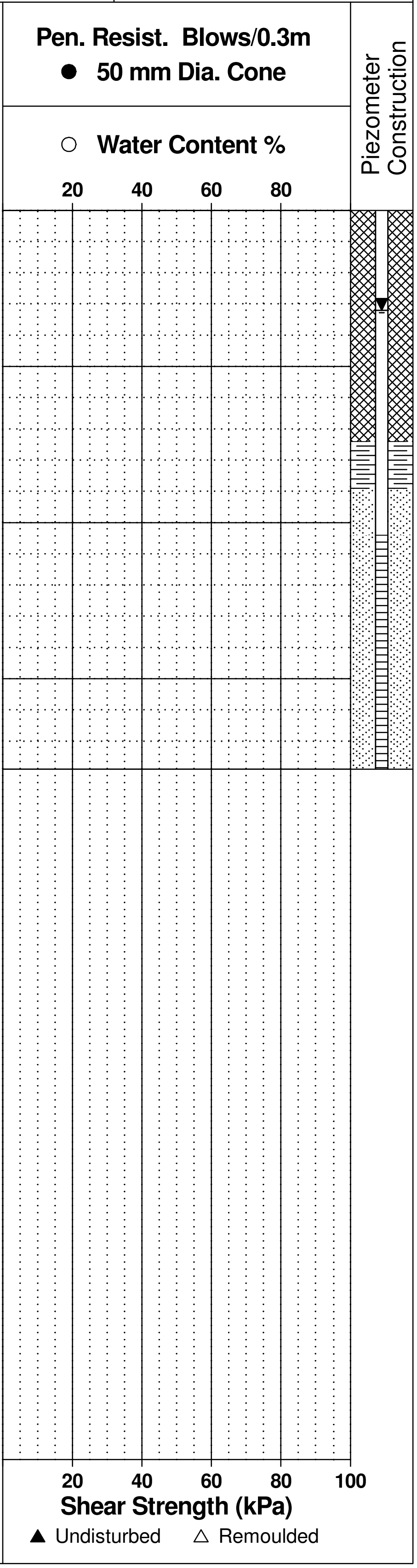
HOLE NO. BH 5A-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	102.83
						1	101.83
OVERBURDEN						2	100.83
						3	99.83
3.58							

End of Borehole

Practical refusal to augering at 3.58m depth.

(GWL @ 0.64m - May 19, 2022)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 17, 2022

FILE NO. **PG6225**

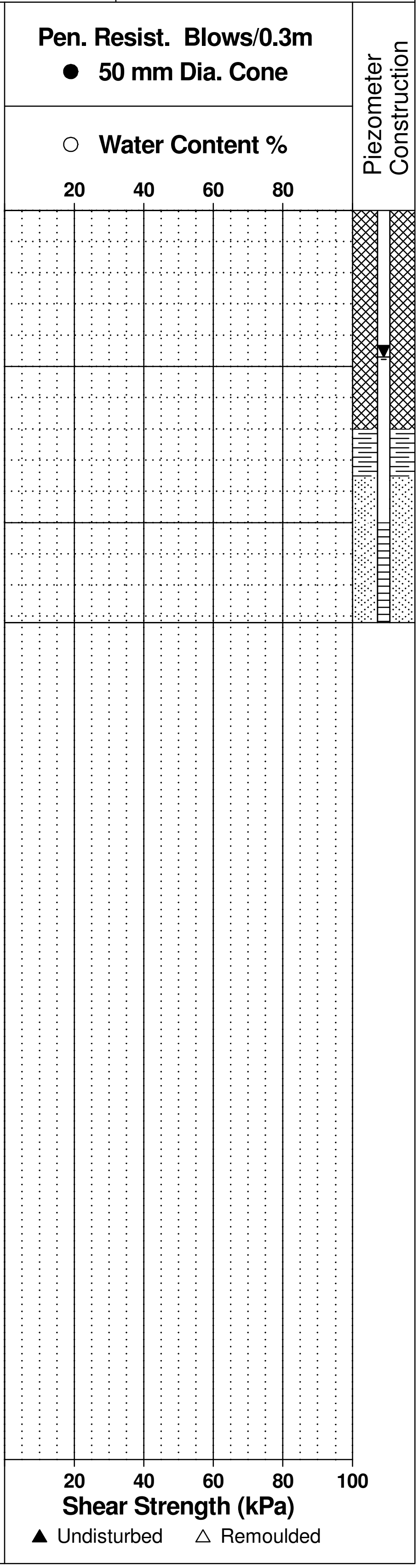
HOLE NO. **BH 6-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.14
TOPSOIL 0.48		AU	1				
Loose to compact, brown **SILTY SAND,** some clay and gravel 1.68		SS	2	50	7	1	102.14
GLACIAL TILL: Dense to very dense, brown silty sand to sandy silt with gravel, cobbles and boulders		SS	3	75	50+	2	101.14
- grey by 2.3m depth 2.64		SS	4	25	50+		

End of Borehole

Practical refusal to augering at 2.64m depth.

(GWL @ 0.94m - May 19, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 17, 2022

FILE NO. PG6225

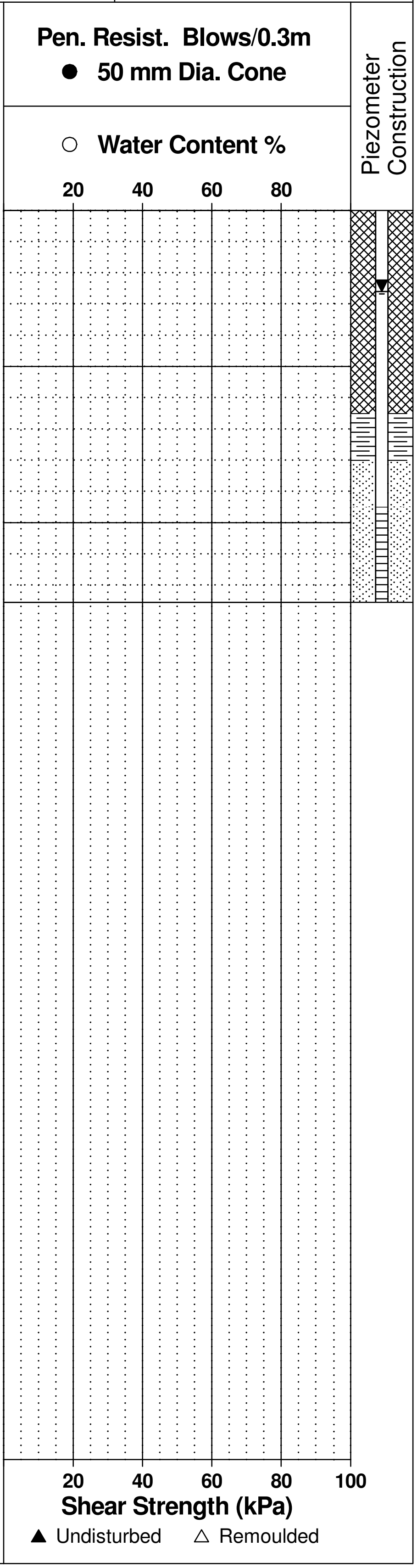
HOLE NO. BH 7-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.60
TOPSOIL 0.33							
Very stiff, brown **SILTY CLAY,** some sand 0.69		AU	1				
GLACIAL TILL: Dense to very dense, brown silty sand to sandy silt with gravel, cobbles and boulders		SS	2	58	45	1	102.60
		SS	3	59	50+		
- grey by 2.2m depth						2	101.60
2.51		SS	4	75	50+		

End of Borehole

Practical refusal to augering at 2.51m depth.

(GWL @ 0.52m - May 19, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - 4840 Bank Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 17, 2022

FILE NO. PG6225

HOLE NO. BH 8-22

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.30
Very stiff, brown **SILTY CLAY** with sand, trace gravel	0.76
GLACIAL TILL: Dense to very dense, brown silty sand wiwth gravel, cobbles and boulders	2.59
GLACIAL TILL: Dense to very dense, grey silty sand to sandy silt with gravel, cobbles and boulders, trace clay	6.58

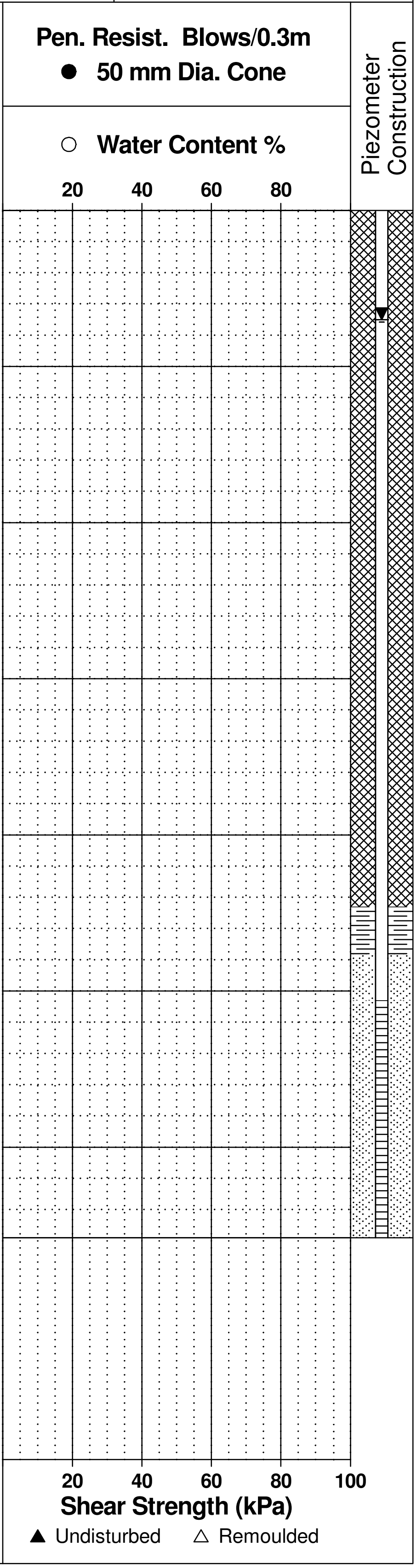
End of Borehole

Practical refusal to augering at 6.58m depth.

(GWL @ 0.70m - May 19, 2022)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	42	47
SS	3	18	50+
SS	4	62	50+
SS	5	33	32
SS	6	75	36
SS	7	83	50+
SS	8	63	50+
SS	9	73	50+

DEPTH (m)	ELEV. (m)
0	103.69
1	102.69
2	101.69
3	100.69
4	99.69
5	98.69
6	97.69



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 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)

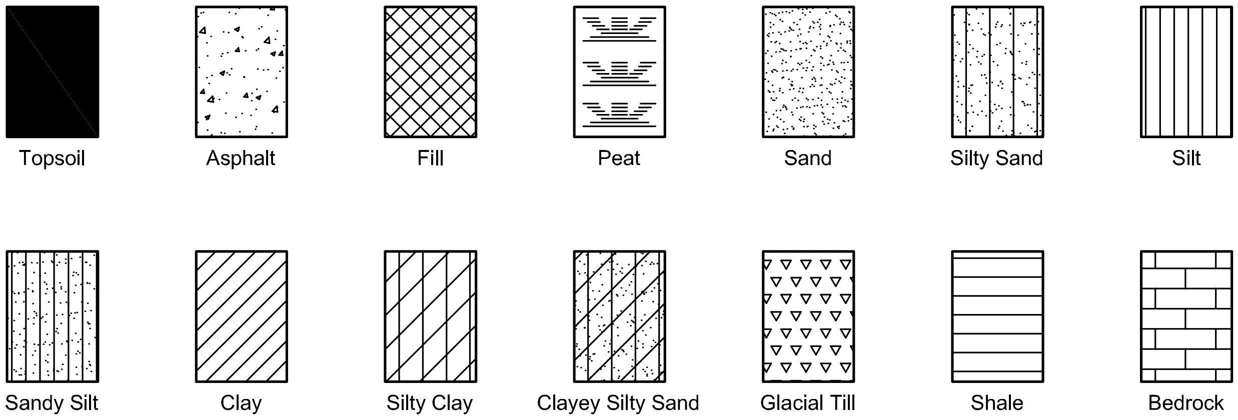
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

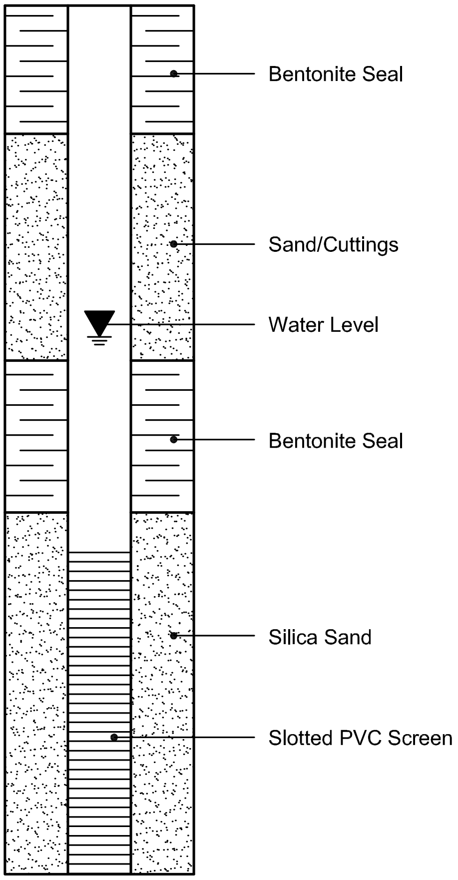
SYMBOLS AND TERMS (continued)

STRATA PLOT



MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION

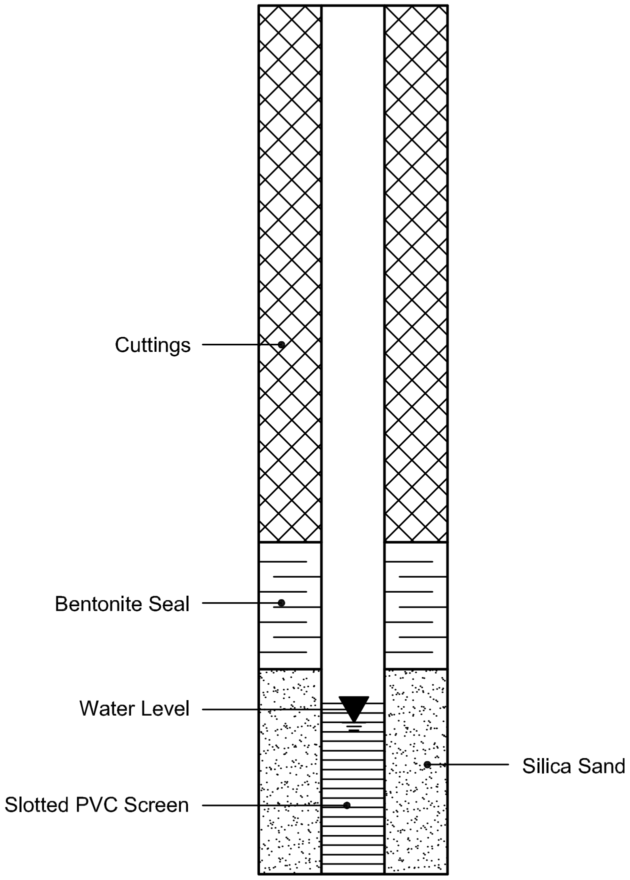


TABLE 1

RECORD OF TEST PITS

Test Pit Number	Depth (metres)	Description
TP 08-1 (Elev. 102.51m)	0.00 – 0.50	TOPSOIL
	0.50 – 0.80	Grey brown sandy silt, some clay, trace gravel (FILL)
	0.80 – 2.50	Brown SILTY SAND, some gravel, trace clay, with cobbles and boulders
	2.50 – 3.66	Grey SILTY SAND, some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)
	3.66	Excavator Refusal on Bedrock
		Note 1: Water seepage at depths of 0.5, 0.8 and 1.2 metres below existing ground surface.
		Note 2: Water level in test pit at 0.2 metres below ground surface upon completion of the excavation.
		Sample Depth (m) 1 0.50 – 0.80 2 1.00 – 1.70 3 2.70 – 3.10
TP 08-2 (Elev. 104.69m)	0.00 – 0.25	TOPSOIL
	0.25 – 1.55	Grey SILTY SAND, some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)
	1.55	Excavator Refusal on Bedrock
		Note: Water seepage at a depth of 0.8 metres below existing ground surface.
		Sample Depth (m) 1 0.30 – 0.60

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 54674

Report Date: 19-May-2022

Order Date: 17-May-2022

Project Description: PG6225

Client ID:		BH2-22-SS3	-	-	-
Sample Date:		16-May-22 09:00	-	-	-
Sample ID:		2221262-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	91.0	-	-	-
General Inorganics					
pH	0.05 pH Units	7.96	-	-	-
Resistivity	0.10 Ohm.m	91.9	-	-	-
Anions					
Chloride	5 ug/g dry	7	-	-	-
Sulphate	5 ug/g dry	9	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6225-1 - TEST HOLE LOCATION PLAN

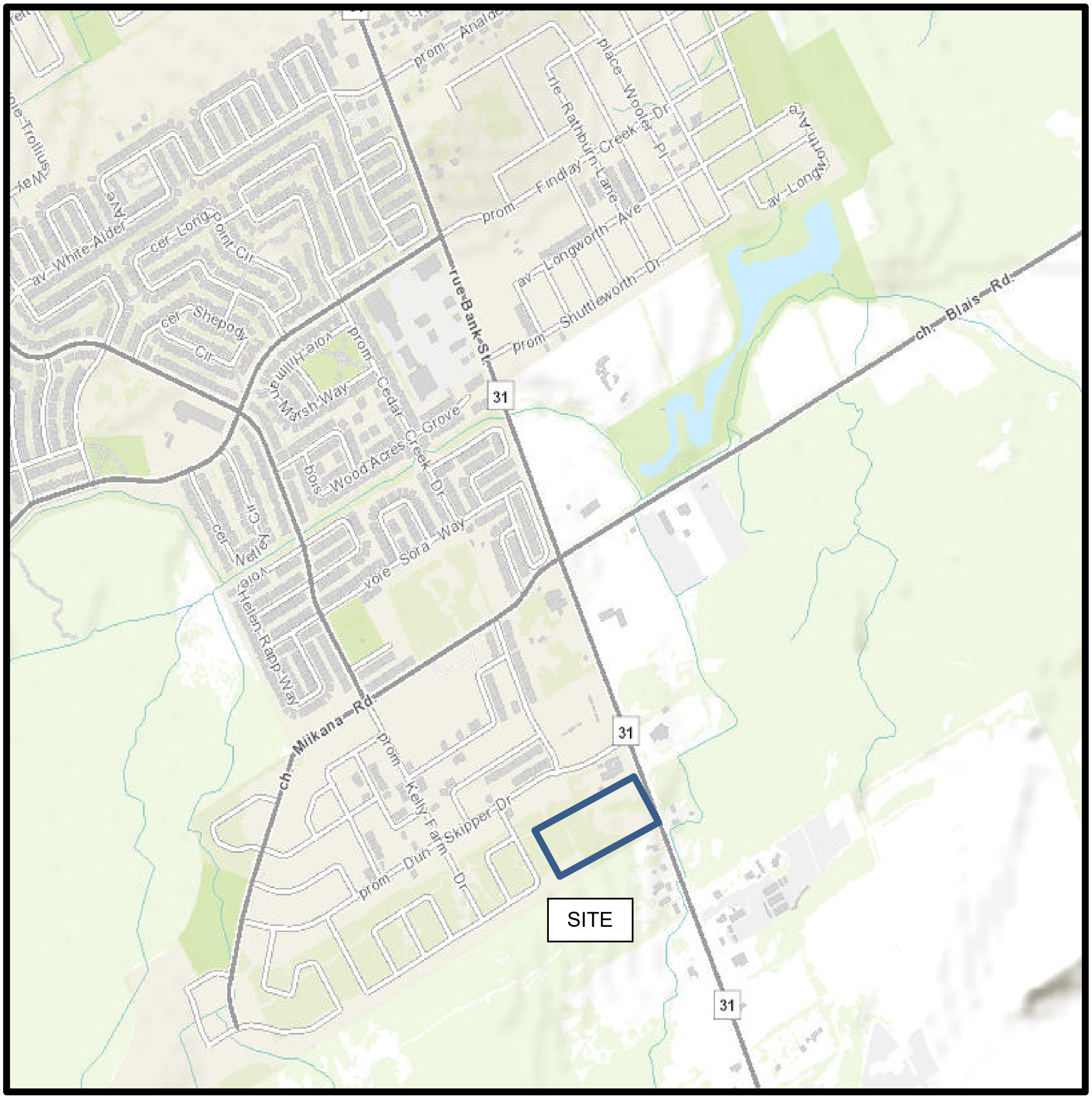
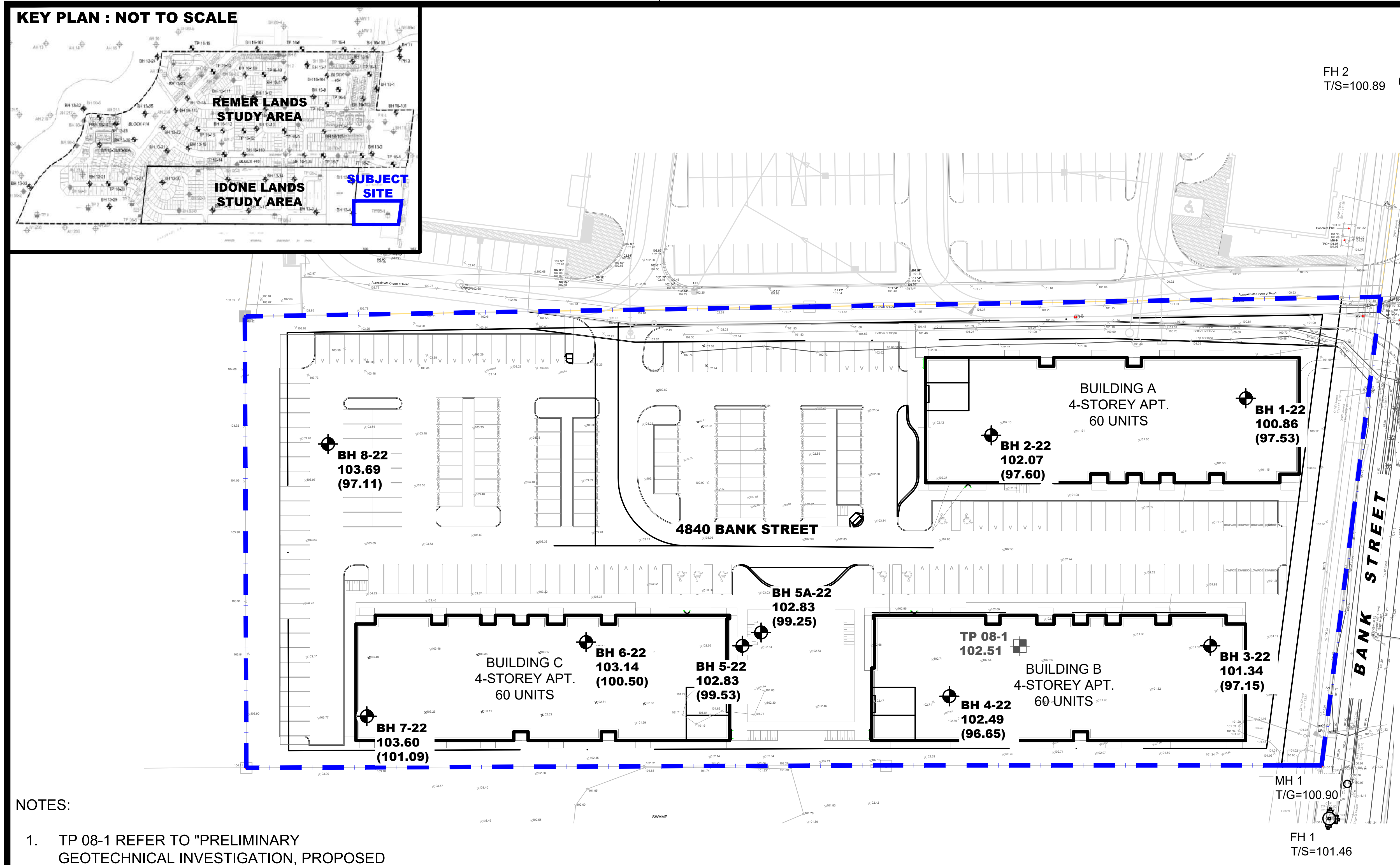


FIGURE 1

KEY PLAN



NOTES:

1. TP 08-1 REFER TO "PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, IDONE PROPERTY, 4840 BANK STREET, OTTAWA, ONTARIO - GOLDER ASSOCIATES REPORT NO. 08-1121-0044

LEGEND:

⌖	BOREHOLE LOCATION
▨	TEST PIT LOCATION BY OTHERS (GOLDER ASSOCIATES LTD., 2008)
101.34	GROUND SURFACE ELEVATION (m)
(97.15)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY CHAMBERLAIN ARCHITECTS SERVICES LTD.

ALL GROUND SURFACE LOCATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1000

0 10 20 30 40 50m 75m

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NO.	REVISIONS	DATE	INITIAL

REGIONAL GROUP

GEOTECHNICAL INVESTIGATION

PROPOSED MULTI-STOREY BUILDINGS - IDONE SOUTH APARTMENTS BLOCK

4840 BANK STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 05/2022
Drawn by: JM	Report No.: PG6225-1
Checked by: SK	Dwg. No.: PG6225-1
Approved by: SD	Revision No.:

p:\autocad drawings\geotechnical\pg62xx\pg6225\pg6225-1-test hole location plan (rev.01).dwg

11x17