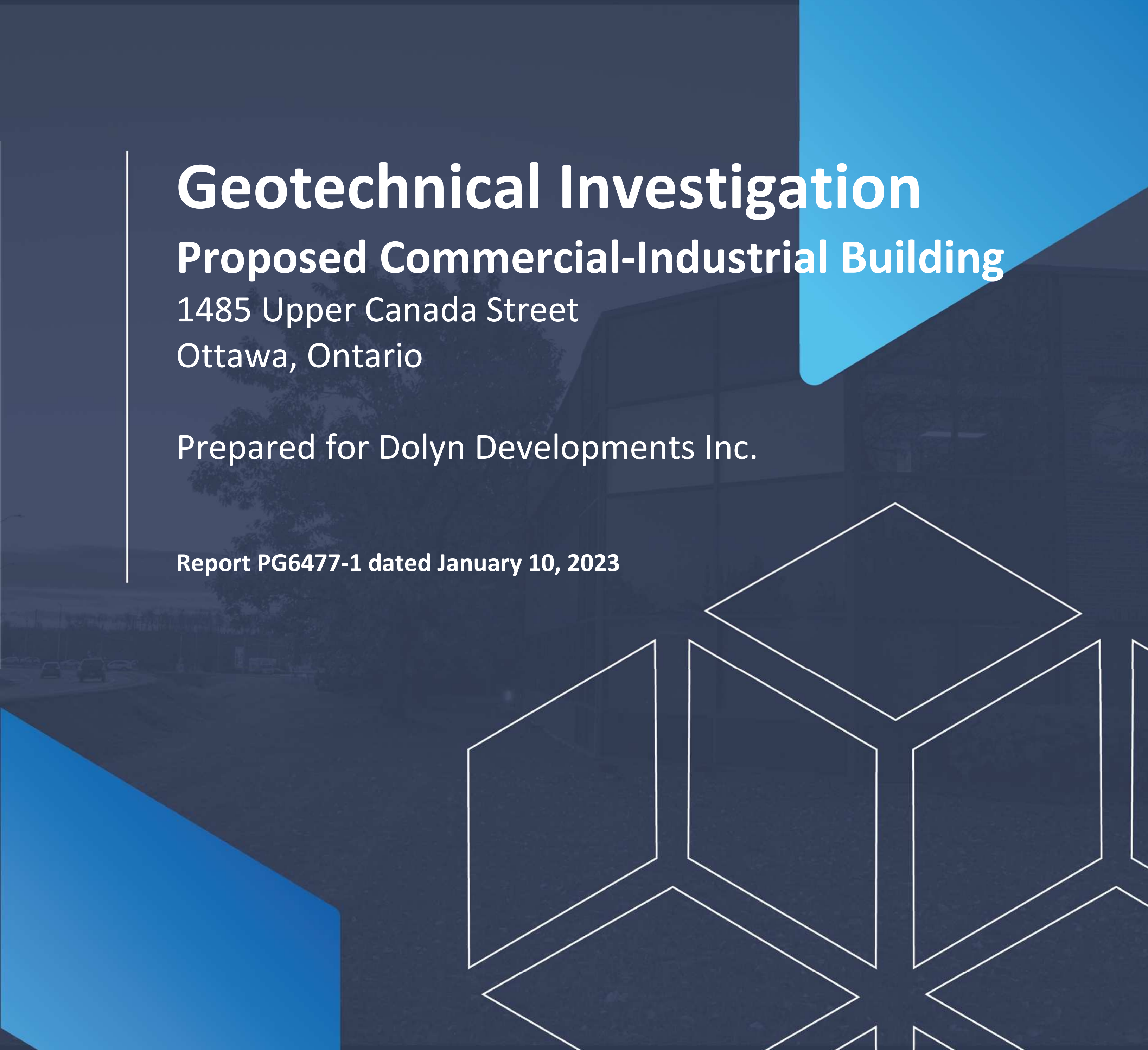

Geotechnical Investigation

Proposed Commercial-Industrial Building

1485 Upper Canada Street
Ottawa, Ontario

Prepared for Dolyn Developments Inc.

Report PG6477-1 dated January 10, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Dolyn Developments Inc. to conduct a geotechnical investigation for the proposed commercial-industrial building to be located at 1485 Upper Canada Street, in the City of Ottawa, Ontario (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 test holes.

☐ 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 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 a low-rise, multi-unit warehouse building of slab-on-grade construction. The building is anticipated to be occupied by commercial and/or industrial used. It is further understood that associated at-grade parking areas, sidewalks and landscaped areas are proposed for the subject development. The proposed development is expected to be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The current field program for the geotechnical investigation was carried out on November 21, 2022 and consisted of advancing a total of 4 boreholes to a maximum depth of 7.0 m below the existing grade. The borehole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground services and available access. The approximate locations of the boreholes are shown on Drawing PG6477-1 – Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a low-clearance 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 and rock coring to the required depths at the selected borehole locations, and sampling and testing the overburden.

Sampling and In Situ Testing

The soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler or from the drill auger and hand auger flights. The samples were initially classified on site, placed in sealed plastic bags, and transported to our laboratory. The depths at which the drill 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 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

Groundwater monitoring wells were installed in boreholes BH 1-22 and BH 2-22 to permit long-term measurement of the groundwater levels. Flexible standpipe piezometers were installed in the remaining boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. The groundwater observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

All monitoring wells should be decommissioned in accordance with Ontario Regulations O.Reg 903 by a qualified licensed well technician and prior to construction.

3.2 Field Survey

The borehole locations were selected by Paterson to provide general coverage of the proposed development taking into consideration the existing site features and underground utilities. The borehole locations, and the ground surface elevation at each borehole location, were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The locations of the boreholes and ground surface elevation at each borehole location are presented on Drawing PG6477-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Review

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 1 month after this report is completed. They will then be discarded unless we are otherwise directed.

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 for sulphate attacks against subsurface concrete structures. The sample was tested to determine the concentration of sulphate and chloride, and the resistivity and the pH of the sample. 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 vacant with fill and partial vegetation present across the surface. The site is bordered by Upper Canada Street to the north and the west, Campeau Drive to the south, and by vacant lots and new commercial-industrial developments to the south and east. The ground surface across the site is relatively level with a gentle down slope from the centre of the site toward the northwest and southeast from approximate geodetic elevations of 106 to 104.5 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the borehole locations consists of a fill, followed by a compact, brown silty sand to sandy silt, transitioning to a loose to dense, grey silty sand to sandy silt.

Glacial till was encountered underlying the grey silty sand to sandy silt and was observed to consist of loose to very loose, grey silty sand with some gravel and some to trace clay and extended to auger refusal.

A thin, stiff to very stiff, brown silty clay veneer was encountered underlying the fill or brown silty sand at boreholes BH 1-22 and BH 2-22 with an approximate thickness of 0.45 m. Practical refusal to augering and DCPT on bedrock was encountered at BH 2-22 and BH 3-22 at depths of 6.32 and 7.03 m below existing grade, respectively.

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, the bedrock consists of interbedded, Paleozoic limestone and shale of the Verulam formation with an approximate drift thickness of 5 to 15 m.

4.3 Groundwater

The groundwater levels were measured in the piezometers installed on November 28, 2022. The observed groundwater levels are summarized in Table 1 below.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-22	105.56	3.10	102.46	Nov. 28, 2022
BH 2-22	104.65	2.19	102.46	Nov. 28, 2022
BH 3-22	104.94	1.99	102.95	Nov. 28, 2022
BH 4-22	105.12	2.70	102.42	Nov. 28, 2022

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

The long-term groundwater level can also be estimated based on the observed colour, moisture content and consistency of the recovered samples. Moisture content testing was completed on representative soil samples obtained from the field investigation. The results are presented in the Soil Profile and Test Data Sheets presented in Appendix 1.

Based on these observations, the long-term groundwater level is expected to range between approximately 2.2 to 3.0 m below ground surface. The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheets presented in Appendix 1.

Groundwater levels are subject to seasonal fluctuations and therefore may vary at the time of construction.

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 warehouse building will be founded on conventional shallow footings placed on an undisturbed, stiff to very stiff brown silty clay or compact to dense, brown silty sand to sandy silt bearing surface.

Due to the presence of a silty clay deposit along the east portion of the subject site, the site will be subjected to a permissible grade raise restriction.

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

Fill Placement

Engineered fill placed for grading beneath the proposed buildings, where required, 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 a composite drainage blanket connected to a perimeter drainage system is provided.

Fill used for grading beneath the base and subbase layers of paved areas should consist, unless otherwise specified, of clean imported granular fill, such as OPSS Granular A, Granular B Type II or select subgrade material. 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 paved areas should be compacted to at least 95% of its SPMDD.

Existing Fill

In areas where existing fill is encountered at design footing level, it is recommended to sub-excavate the fill from within the footing footprint down to the native soil. This process should be reviewed and approved by Paterson at the time of construction. Once the native bearing medium is exposed, if silty and is encountered, a proof rolling operation should be completed using suitable equipment making several passes prior to the commencement of work. If silty clay is encountered, extra precautions should be taken to protect the silty clay from construction traffic. The subgrade can be built up using OPSS Granular A or Granular B Type II compacted to 98% of the material’s SPMDD and approved by Paterson at the time of construction.

If fill is encountered below the finished floor slab, provided that the existing fill is free of deleterious materials and organic matter, it is recommended to sub-excavate a minimum 500 mm of the existing fill and replace it with OPSS Granular A or Granular B Type II compacted to a minimum of 95% of the materials SPMDD and approved by Paterson at the time of construction.

It is highly recommended that a non-woven geotextile liner be placed between the subgrade and the subsequent granular fill to prevent the migration of the subgrade fines into the granular layer over the service life of the building. Soft or poor performing areas within the subgrade should also be sub-excavated and replaced with Granular fill as per the above noted recommendations.

5.3 Foundation Design

Bearing Resistance Values (Shallow Foundations)

Footings placed on an undisturbed, compact to dense silty sand to sandy silt bearing surfaces can be designed using a factored bearing resistance value at SLS of **100 kPa** and a bearing resistance value at ULS of **175 kPa**. A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance values at ULS.

Where the silty sand bearing surface is found to be in a loose state of compactness, the area should be proof-rolled under dry conditions and above freezing temperatures using a vibratory compactor making several passes and approved by the geotechnical consultant prior to placing footings.

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff to very stiff, silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**.

The above-noted bearing resistance values at SLS for soil bearing surfaces will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

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, in the dry, prior to the placement of concrete for footings.

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 silty clay, sandy silt/silty sand, 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.

Modulus of Subgrade Reaction

In order to provide a sufficient slab design, the modulus of subgrade reaction for the undisturbed silty clay or engineering fill placed over the silty clay or silty sand subgrade can be taken as 10 MPa/m for a contact pressure of 180 kPa.

Permissible Grade Raise

Due to the presence of the silty clay deposit, a permissible grade raise restriction of **3.0 m** is recommended. A post-development groundwater lowering of 0.5 m was considered in our permissible grade raise calculations. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C**, 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 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 native soil 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 construction. If existing will is encountered, a minimum sub-excavation of 500 mm will be required followed by proof rolling of the existing fill. Provided that the existing fill is free of deleterious materials and organic matter, reviewed and approved by Paterson, proof rolling operations can be completed. The removed material should be replaced with OPSS Granular A or Granular B Type II and compacted to a minimum 95% of the material’s SPMDD.

It is recommended that the upper 200 mm of sub-floor fill consists of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Design

Car only parking and access lanes are expected at this site. The subgrade material will consist of native soil, free of significant amounts of organics and/or deleterious materials. The proposed pavement structures are presented in Tables 2 and 3.

Table 2 – Recommended Pavement Structure – Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course –** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE –** OPSS Granular A Crushed Stone
300	**SUBBASE –** OPSS Granular B Type II
Subgrade – Either fill, in-situ soil, or OPSS Granular B Type I or II material placed over fill or in-situ soil.	

Table 3 - Recommended Pavement Structure - Access Lanes/Local Roadways, Loading Areas and Heavy Truck Parking

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 placedover fill or 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 I or II material.

Minimum Performance Graded (PG) 58-34 asphalt cement should 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 compaction equipment.

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 buildings. 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 storm sewer or sump pump pit.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials such as clean sand or OPSS Granular B Type I. 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.

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 1.5 m thick soil cover (or insulation equivalent) should be provided for adequate frost protection of heated structures.

Exterior unheated footings, such as those for isolated exterior piers, retaining walls or loading ramps are more prone to deleterious movement associated with frost action. These should be provided with a minimum 2.1 m thick soil cover (or insulation equivalent).

Consideration should be given to providing 2.1 m thick soil cover to interior footings within loading bays where significant exposure to freezing conditions during the winter months may occur. Further consideration may be given to installing heated slabs in these areas.

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 undertake 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 flatter. The flatter 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 & Design 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. Where the pipe bedding is located within the stiff to very stiff silty clay, the thickness of the bedding should be increased to a minimum 300 mm for sewer 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 (concrete or PSM OVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 98% of the material’s standard Proctor maximum dry density.

It should generally be possible to re-use the site-excavated fill, native sand, or dry to moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions.

Any stones greater than 200 mm in their longest dimension should be removed from these materials prior to placement.

The backfill material within the frost zone (2.1 m below finished grade for unheated structures) should match the soils exposed at the trench walls to reduce potential differential frost heaving. The backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

Groundwater Control for Building Construction

Based on our observations, 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.

Permit to Take Water

It is anticipated that groundwater infiltration into the excavation 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 the shallow excavation. 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.

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

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 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.

☐ Review of the geotechnical aspects of the excavation contractor's temporary shoring system design prior to construction, if applicable.

☐ Review of the proposed grading and servicing plans from a geotechnical perspective.

☐ Review of the proposed groundwater infiltration control system and requirements.

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

☐ Sampling and testing of the concrete and fill materials.

☐ 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, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should 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 Dolyn Developments Inc., 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.

Owen R. Canton, EIT

LICENSED PROFESSIONAL ENGINEER
Jan. 10, 2023
F. I. ABOU-SEIDO
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PROVINCE OF ONTARIO

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Report Distribution:

☐ Dolyn Construction Ltd. (email copy)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 1485 Upper Canada St.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

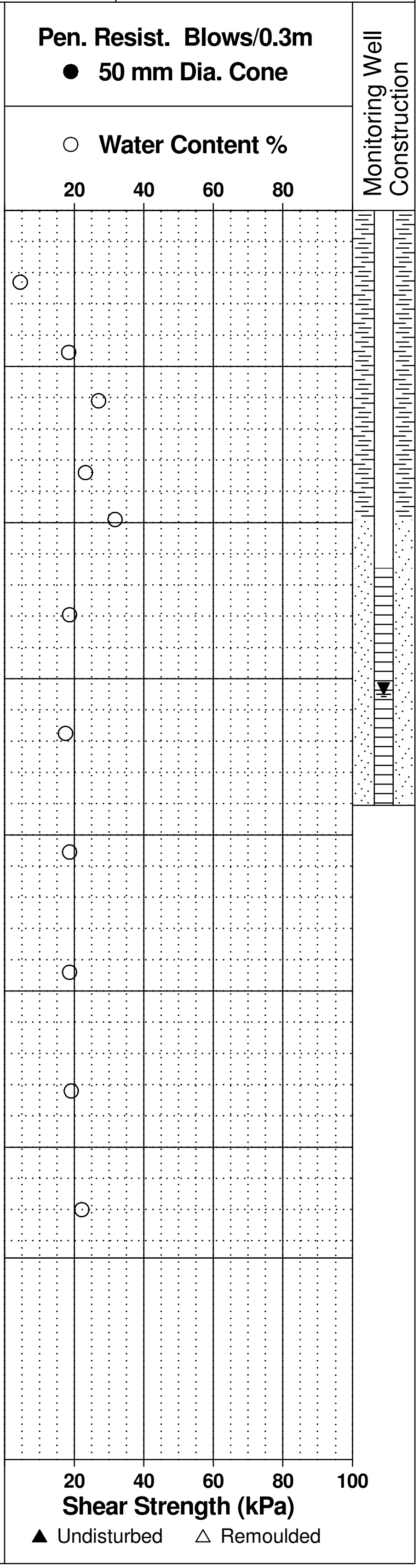
DATE November 21, 2022

FILE NO. PG6477

HOLE NO. BH 1-22

SOIL DESCRIPTION	Strata depth (m)	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with organics, gravel and clay	0.10				
FILL: Brown silty sand with gravel, crushed stone, trace clay	0.94	AU	1		
Compact, brown **SILTY SAND to SANDY SILT,** trace clay	1.75	SS	2	71	15
Stiff, brown **SILTY CLAY,** some sand	2.21	SS	3	96	19
Compact to dense, grey **SILTY SAND to SANDY SILT**		SS	4	50	P
		SS	5	42	18
		SS	6	83	25
		SS	7	58	23
		SS	8	67	30
	6.71	SS	9	50	30
End of Borehole					
(GWL @ 3.10m - Nov. 28, 2022)					

DEPTH (m)	ELEV. (m)
0	105.56
1	104.56
2	103.56
3	102.56
4	101.56
5	100.56
6	99.56



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 1485 Upper Canada St.
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY CME-55 Low Clearance Drill
DATE November 21, 2022
FILE NO. PG6477
HOLE NO. BH 2-22

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
FILL: Brown silty clay with sand and gravel	0.60
Very stiff, brown **SILTY CLAY,** trace sand	1.07
Compact, brown **SILTY SAND to SANDY SILT** - grey by 1.8m depth	5.26
GLACIAL TILL: Loose, grey silty sand, some gravel, trace to some clay	6.32

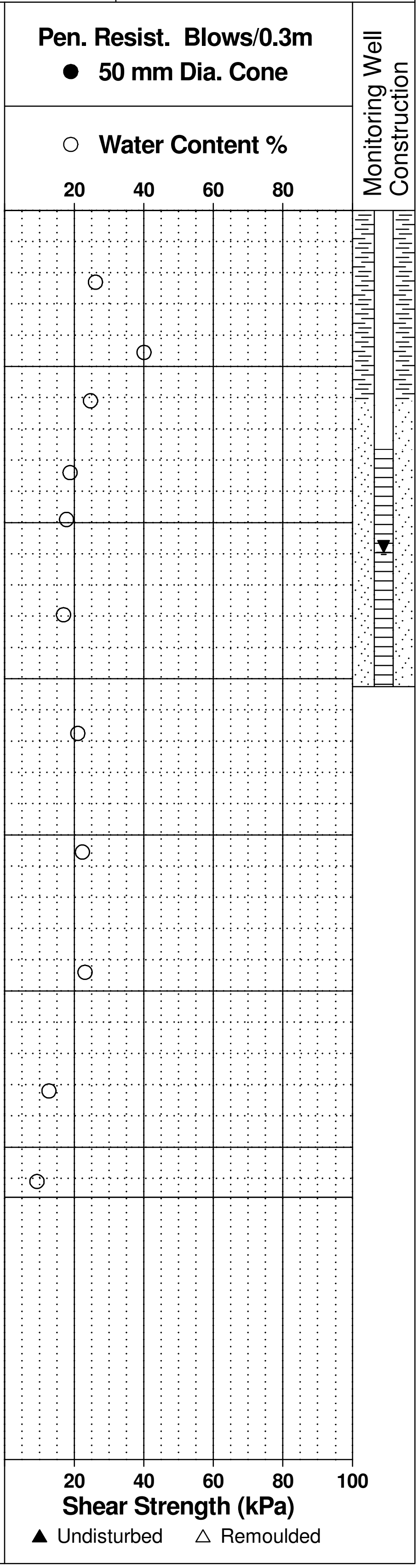
End of Borehole

Practical refusal to augering at 6.32m depth.

(GWL @ 2.19m - Nov. 28, 2022)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	83	12
SS	3	58	16
SS	4	42	12
SS	5	50	11
SS	6	33	6
SS	7	50	16
SS	8	75	8
SS	9	44	50+

DEPTH (m)	ELEV. (m)
0	104.65
1	103.65
2	102.65
3	101.65
4	100.65
5	99.65
6	98.65



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 1485 Upper Canada St.
Ottawa, Ontario

DATUM Geodetic

REMARKS

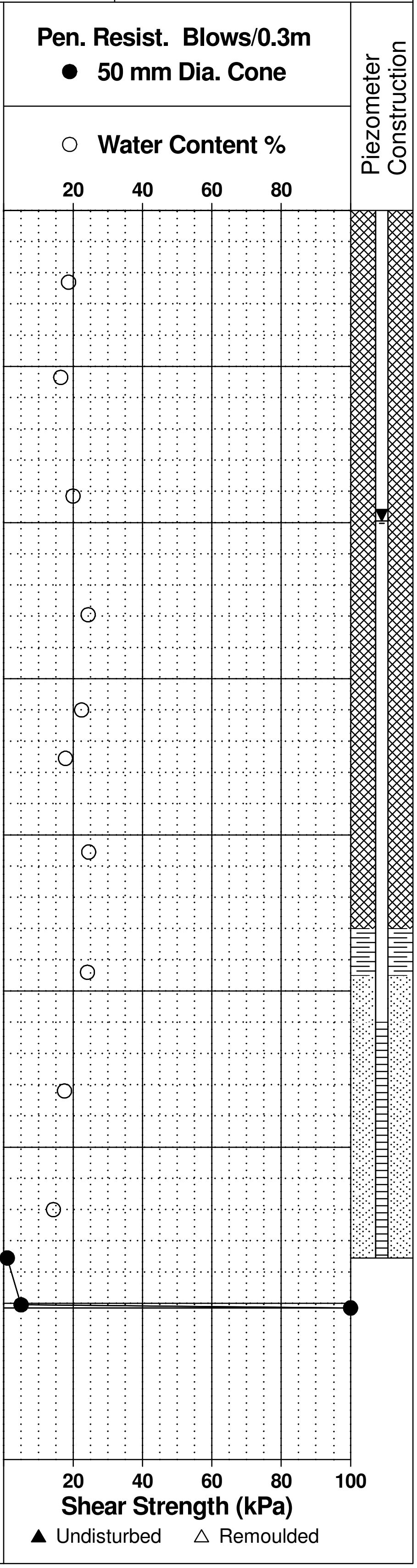
BORINGS BY CME-55 Low Clearance Drill

DATE November 21, 2022

FILE NO. PG6477

HOLE NO. BH 3-22

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.94
FILL: Brown siltysand with topsoil, some gravel						
0.33 Compact, brown **SILTY SAND to SANDY SILT**	AU	1				
	SS	2	58	22	1	103.94
	SS	3	75	20	2	102.94
2.21 Compact to loose, grey **SILTY SAND** - occasional gravel from 3.35 to 3.5m depth	SS	4	58	8		
	SS	5	29	22	3	101.94
	SS	6	50	4	4	100.94
	SS	7	50	5	5	99.94
5.26 **GLACIAL TILL:** Very loose, grey silty sand, some gravel, some to trace clay	SS	8	100	2	6	98.94
	SS		50	3		
6.71 Dynamic Cone Penetration Test commenced at 6.71m depth.					7	97.94
7.03 End of Borehole Practical DCPT refusal at 7.03m depth. (GWL @ 1.99m - Nov. 28, 2022)						



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 1485 Upper Canada St.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

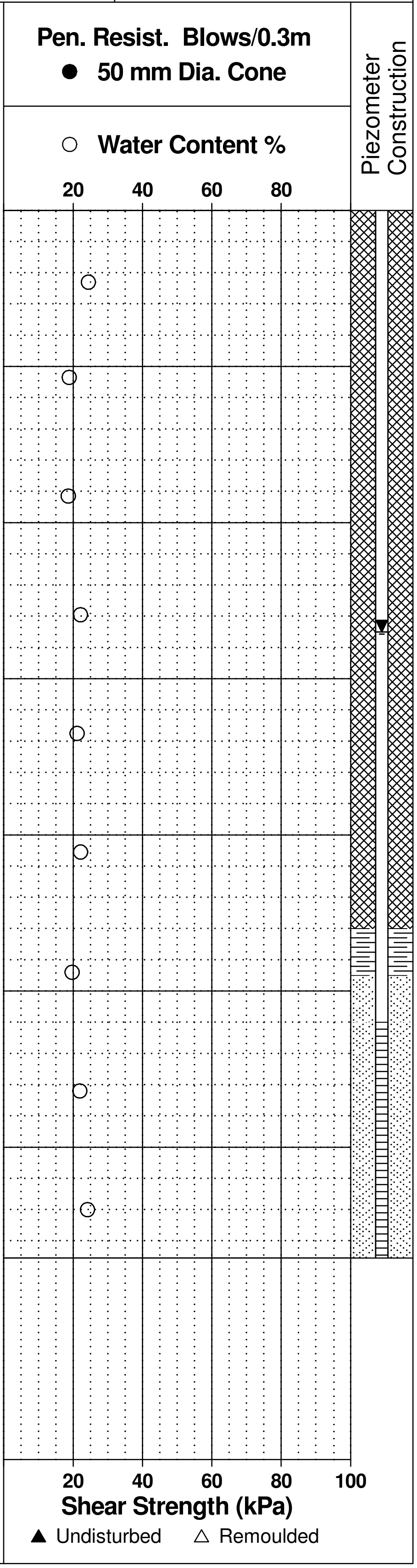
DATE November 21, 2022

FILE NO. PG6477

HOLE NO. BH 4-22

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with topsoil, some gravel, trace clay		AU	1		
0.69					
Compact to loose, brown **SILTY SAND**		SS	2	83	20
		SS	3	83	21
- grey by 2.2m depth		SS	4	75	17
		SS	5	67	14
		SS	6	67	12
		SS	7	42	8
		SS	8	42	4
		SS	9	75	6
6.71					
End of Borehole					
(GWL @ 2.70m - Nov. 28, 2022)					

DEPTH (m)	ELEV. (m)
0	105.12
1	104.12
2	103.12
3	102.12
4	101.12
5	100.12
6	99.12



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))

TW - Thin wall tube or Shelby tube, generally recovered using a piston sampler

G - "Grab" sample from test pit or surface materials

AU - Auger sample or bulk sample

WS - Wash sample

RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic Limit, % (water content above which soil behaves plastically)
PI - Plasticity Index, % (difference between LL and PL)

Dxx - Grain size at which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

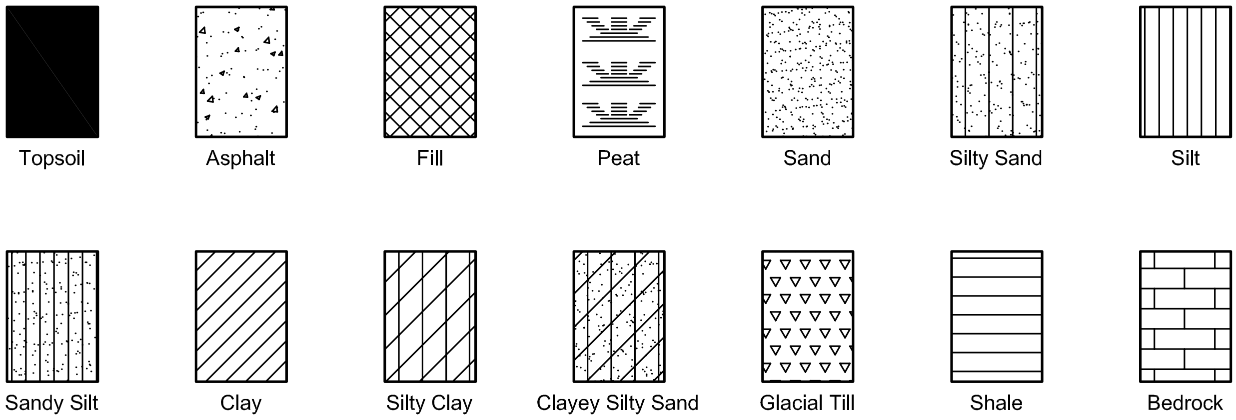
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

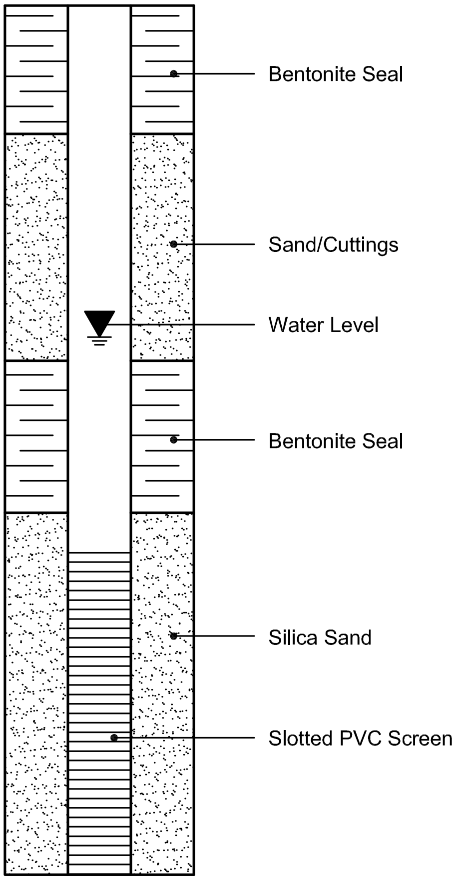
SYMBOLS AND TERMS (continued)

STRATA PLOT

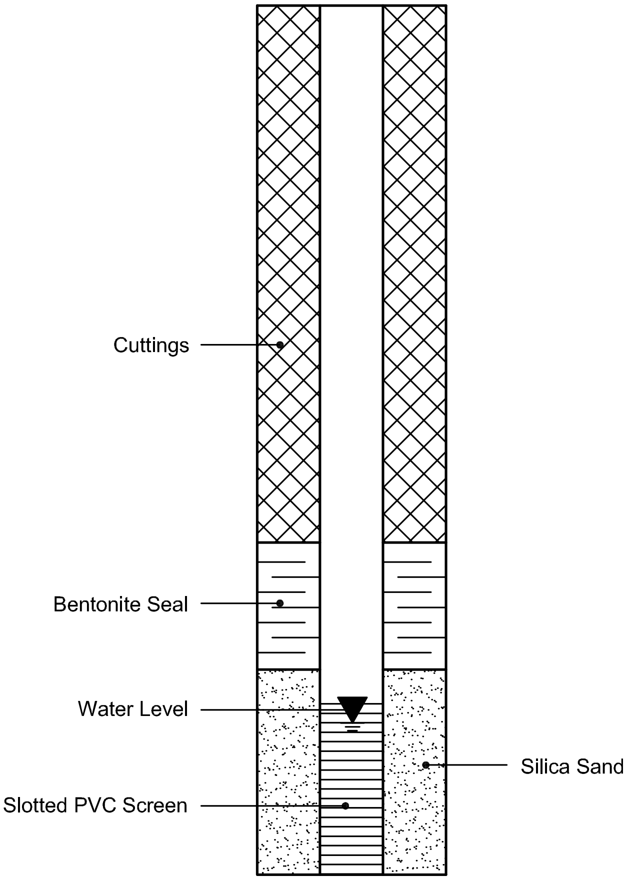


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Client ID:		BH3-22-SS3	-	-	-		
Sample Date:		21-Nov-22 09:00	-	-	-	-	-
Sample ID:		2248162-01	-	-	-		
Matrix:		Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	82.9	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.56	-	-	-	-	-
Resistivity	0.1 Ohm.m	93.5	-	-	-	-	-
Anions							
Chloride	5 ug/g	<5	-	-	-	-	-
Sulphate	5 ug/g	16	-	-	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6477-1 – TEST HOLE LOCATION PLAN

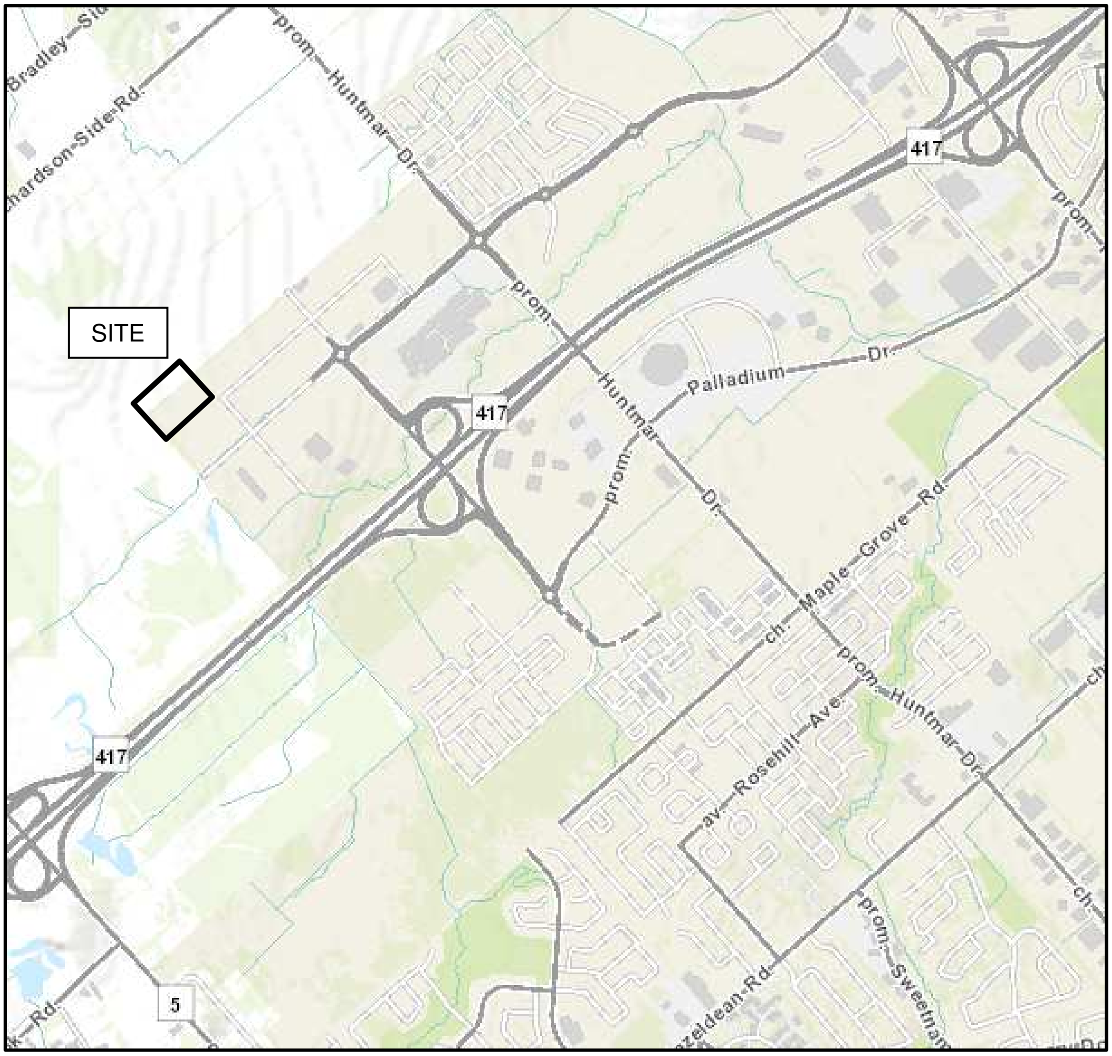
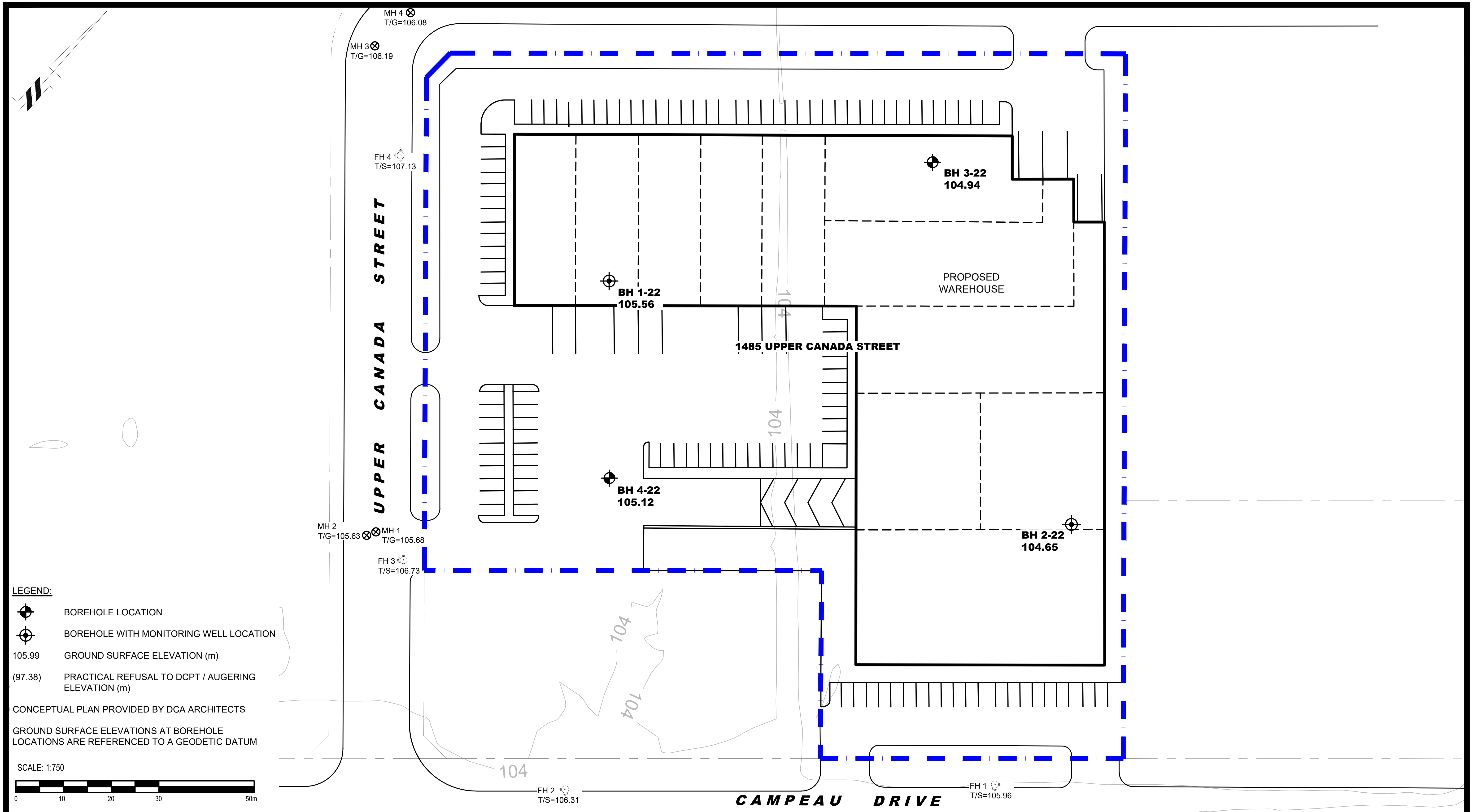


FIGURE 1

KEY PLAN

PATERSON GROUP



LEGEND:

⌖	BOREHOLE LOCATION
⌖	BOREHOLE WITH MONITORING WELL LOCATION
105.99	GROUND SURFACE ELEVATION (m)
(97.38)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY DCA ARCHITECTS

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM

SCALE: 1:750

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

DOLYN CONSTRUCTION LTD.
GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL / INDUSTRIAL BUILDING
1485 UPPER CANADA STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750	Date: 12/2022
Drawn by: JM	Report No.: PG6477-1
Checked by: OC	Dwg. No.: PG6477-1
Approved by: FA	Revision No.:

11x17

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