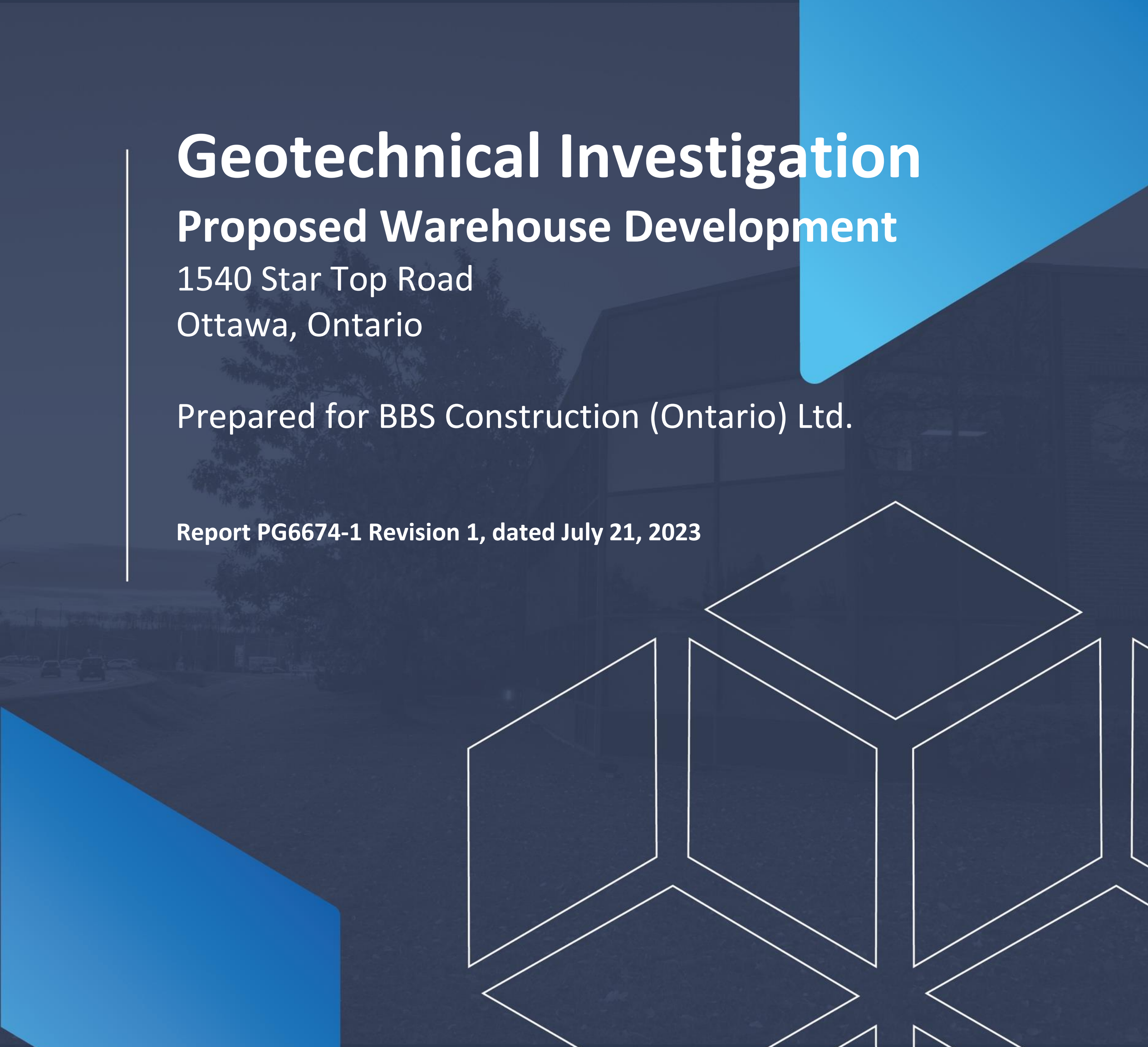


Geotechnical Investigation

Proposed Warehouse Development

1540 Star Top Road
Ottawa, Ontario

Prepared for BBS Construction (Ontario) Ltd.

Report PG6674-1 Revision 1, dated July 21, 2023

Table of Contents

Appendices

Appendix 1	Soil Profile and Test Data Sheets Symbols and Terms Analytical Test Results
Appendix 2	Figure 1 - Key Plan Drawing PG6674-1 - Test Hole Location Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by BBS Construction (Ontario) Ltd. to conduct a geotechnical investigation for the proposed warehouse development to be located at 1540 Star Top Road in the City of Ottawa (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report).

The objective of the geotechnical investigation was to:

- Determine the subsoil and groundwater conditions at this site by means of a test hole program.

- 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 site 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

It is understood that the proposed warehouse development will consist of a one-storey slab-on-grade structure and will be located throughout the southwestern portion of the subject site. It is expected the proposed building will be surrounded with associated parking areas, access lanes and hardscaping.

It is expected that the proposed warehouse development will be municipally serviced, and the existing structures located along the eastern portion of the subject site will remain as part of the proposed development. The existing structures located within the proposed building footprint will be demolished as part of the proposed development.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on May 9 and May 10, 2023, and consisted of advancing a total of eleven (11) boreholes to a maximum depth of 6.7 m below the existing ground surface.

The test holes were completed using a low clearance drill rig operated by a two-person crew. The drilling procedure consisted of drilling to the required depths at the selected locations, and sampling and testing the overburden. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer.

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. Rock cores (RC) were obtained using 47.6 mm inside diameter coring equipment.

All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags, and rock cores were placed in cardboard boxes. All samples were transported to our laboratory for further examination and classification. The depths at which the auger, split spoon and rock core samples were recovered from the boreholes are shown as AU, SS and RC, 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.

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

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

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 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

BH 1-23, BH 2-23, BH 3-23 and BH 7-23 were fitted with monitoring wells to allow groundwater level monitoring. The remaining boreholes were not instrumented with a groundwater monitoring device and were backfilled upon completion of sampling. Typical monitoring well construction details are described below:

- Slotted 32 mm diameter PVC screen at the base of each borehole.
- 32 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- No.3 silica sand backfill within annular space around screen.
- Bentonite above sand pack to just below ground surface.
- Clean backfill from top of bentonite plug to the ground surface.

The groundwater level measurements are shown on the Soil Profile and Test Data sheets and are tabulated in Subsection 4.3.

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the development, taking into consideration the existing site features and underground utilities.

The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum. The location of the test holes and ground surface elevation at each test hole location are presented on Drawing PG6674-1 - 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.

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 two one- to two-storey slab-on-grade commercial structures along the eastern portion of the subject site. The remainder western and central portions of the subject site were observed to consist of equipment and material storage areas. Based on our review of historical aerial photographs, it is understood the subject site had been occupied by a ready-mix concrete facility between approximately the 1970's and the early-2000's.

The ground surface across the subject site is relatively flat and approximately level with the surrounding roadways. The subject site is bordered by commercial buildings to the north, east and west, further by Star Top Road to the east, and a 4-storey federal campus and associated parking areas to the south.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile was observed to consist of fill underlain by the bedrock formation. The fill layer was observed to be underlain by a layer of silty clay and/or silty sand at BH 3-23, BH 4-23 and BH 8-23.

The ground surface at BH 1-23, BH2-23, BH 3-23, BH 7-23 and BH 10-23 were observed to consist of an approximately 100 to 150 mm thick layer of concrete. The remaining borehole surfaces consisted of a layer of fill. Each test hole consists of fill which extends to an approximate depth of 0.7 to 3.7 m below existing ground surface. The upper portion of fill was observed to consist of brown silty sand with crushed stone and gravel and the lower portion was observed to consist of brown sandy silt to silty sand with traces to some clay. The lower portion of fill for BH 8-23 to BH10-23 was observed to consist of brown to grey silty clay fill with traces of sand and gravel.

The fill is underlain by a 490 mm thick layer of silty clay with traces of sand at BH 3-23. Further, a 1.5 m thick layer of brown to grey silty fine to medium sand with clay and gravel was encountered below the fill layer at the location of BH 4-23. A 700 mm thick layer of glacial till was encountered below the fill layer at the location of BH 2-23. The glacial till was observed to consist of brown silty sand with clay and traces of gravel.

Refusal to augering was encountered in all the boreholes at a depth of 1.8 to 3.7 m below existing ground surface.

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

Bedrock

Shale bedrock was encountered in the current boreholes at depths ranging from 1.8 to 3.7 m below ground surface. The recovery values and RQD values for the bedrock cores were calculated and varied between 64 and 100%, while the RQD values ranged between 0 and 71%. The quality of bedrock is therefore considered to range from very poor to fair.

Based on available geological mapping, the bedrock in the subject area consists of Paleozoic shale from the Carlsbad formation, with an overburden drift thickness of 1 to 5 m depth.

4.3 Groundwater

Groundwater levels were measured during the current investigation on May 19, 2023, within the installed wells. The groundwater level measurements are presented in Table 1 below.

Table 1 – Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Measured Groundwater Level / Groundwater Infiltration for Boreholes		Dated Recorded
		Depth (m)	Elevation (m)	
BH 1-23	66.01	2.95	63.06	May 19, 2023
BH 2-23	65.92	1.87	64.05	
BH 3-23	67.44	1.89	65.55	
BH 7-23	66.83	2.19	64.64	

Note: The ground surface elevation at each borehole location for the current investigation was surveyed using a handheld GPS referenced to a geodetic datum.

The remainder of the boreholes appeared to be dry upon completion of sampling and were subsequently backfilled. Long-term groundwater levels can also be estimated based on recovered soils samples moisture levels, soil sample coloring and consistency. Based on this methodology, the long-term groundwater level is estimated to be located below the bedrock surface.

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 anticipated that the proposed warehouse may be supported upon conventional spread footings placed over an undisturbed, compact silty sand, glacial till or a layer of engineered fill wrapped in bi-axial geogrid and woven-geotextile underlain by the aforementioned bearing surfaces or existing fill.

It is expected some bedrock removal will be required for site servicing works. Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming. The blasting operations should be planned and conducted under the guidance of a professional engineer with experience in blasting operations.

If encountered and as advised by Paterson personnel at the time of construction, precautions should be taken during construction to reduce the risks associated with heaving of potentially expansive shale bedrock. The bedrock surface should be protected from excessive dewatering and exposure to ambient air. Therefore, a 50 mm thick concrete mud slab consisting of a minimum of 15 MPa lean concrete, should be placed on the exposed bedrock surface within 48-hour period of being exposed. The excavated side slopes of the bedrock surface should be sprayed with bituminous emulsion to seal bedrock from exposure to air and dewatering.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing significant amounts of organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Existing foundation walls, and other construction debris should be entirely removed from within proposed building perimeters. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 m below final grade.

It is important to note that due to the presence of a 0.7 to 3.7 m thick layer of fill overlying the native soils and bedrock formation, sub-excavation of the existing fill will be required within the footprint of the proposed building. Where the fill is free of organic matter, the fill may be left in place provided proof-rolling of the fill is reviewed and approved by Paterson at the time of construction. This is discussed further in Subsection 5.3 and Subsection 5.4 of this report.

In general, it is recommended that a minimum 1.0 m or 500 mm deep sub-excavation of the existing fill will be required to be completed below the proposed footings and slab-on-grade footprint, respectively, and extend a minimum of 500 mm beyond the face of the overlying footing footprints. Any fill left in place will be required to be proof-rolled using suitably sized compaction equipment in dry conditions and above freezing temperatures prior to placement of engineered fill. The proof-rolling and compaction efforts should be reviewed and approved by Paterson personnel at the time of construction.

Fill Placement

Fill placed for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II.

The imported fill material should be tested and approved prior to delivery. The fill should be placed in maximum 300 mm thick loose lifts and compacted by suitable compaction equipment. Fill placed beneath the building should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids.

If site-excavated material, reviewed and approved by Paterson, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved and between footings, it is recommended that the material be placed under dry conditions and in above freezing temperatures. The reviewed and approved fill should be compacted in thin lifts using suitable compaction equipment for the lift thickness by making several passes and approved by Paterson personnel.

Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite drainage membrane, such as Miradrain G100N or Delta Drain 6000.

Bedrock Removal

Bedrock removal could be carried out by hoe-ramming where only small quantities of bedrock need to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be completed prior to commencing site activities.

The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations. As a general guideline, peak particle velocities of 25 mm/sec (measured at the structures) should not be exceeded during the blasting program to reduce the risks of damage to the existing structures.

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

Vibration Considerations

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

The following construction equipment could cause vibrations: piling equipment, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of a shoring system with soldier piles or sheet piling will require these pieces of equipment. Vibrations, caused by blasting or construction operations could cause detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters determine the recommended vibration limit, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards.

Considering there are several sensitive buildings in close proximity to the subject site, consideration to lowering these guidelines is recommended. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed building.

Protection of Expansive Shale

Due to the potentially expansive nature of the shale bedrock encountered at the subject site, precautions should be taken during construction to reduce the risks associated with heaving of the shale bedrock.

Where exposed, the bedrock surface should be protected from excessive dewatering and exposure to ambient air. Therefore, a 50 mm thick concrete mud slab consisting of a minimum of 15 MPa lean concrete, should be placed on the exposed bedrock surface within 48-hour period of being exposed. The excavated side slopes of the bedrock surface should be sprayed with bituminous emulsion to seal bedrock from exposure to air and dewatering. It is recommended that Paterson field personnel complete reviews of these applications at the time of construction.

5.3 Foundation Design

Bearing Resistance Values

Native Overburden Bearing Surface

Footings placed on an undisturbed, compact silty sand and/or glacial till 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 **225 kPa**, incorporating a geotechnical resistance factor of 0.5.

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 the concrete for the footings.

Engineered Fill Bearing Surface

Where fill is encountered at the design founding elevation, it is recommended to sub-excavate a minimum of 1.0 m below the proposed founding depth for the overlying footing structure and be re-instated with engineered fill.

If native subgrade is encountered within the sub-excavation, the depth of the sub-excavation may be limited to the native subgrade surface. The sub-excavation is recommended to extend a minimum of 500 mm horizontally beyond the overlying footing faces.

Once the sub-excavation has been complete, it is recommended to proof-roll the in-situ fill subgrade and that the proof-rolling be reviewed and approved by Paterson personnel. If the fill is deemed unsuitable for the placement of engineered fill, additional sub-excavations may be required and as determined at the time of construction.

Once approved by Paterson personnel, the sub-excavation may be in-filled up to the design founding elevation using engineered fill, such as OPSS Granular A or OPSS Granular B Type II crushed stone placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the materials SPMDD.

Where implemented, the engineered fill layer is recommended to be wrapped by a layer of bi-axial geogrid, such as Terrafix TBX2000, and then further by a layer of woven geotextile, such as Terrafix 200W. it is recommended that each layer overlaps beyond the footing footprint by a minimum of 500 mm beyond the edge of the overlying footing face. All abutting layers of geogrid and geotextile should be fastened/secured and overlapped as per the manufacturer’s recommendations. The installation of these layers should be reviewed by Paterson personnel at the time of construction.

Footings placed on a layer of engineered fill prepared as described herein and approved by Paterson personnel 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 **225 kPa**, incorporating a geotechnical resistance factor of 0.5.

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 overburden above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Settlement

For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

Permissible Grade Raise

Due to the presence of a silty clay layer encountered at BH 3-23, the area within 15 m of this test hole is subjected to a permissible grade restriction. Based on our review of the subsoil profile, a permissible grade raise restriction of **2.0 m** above existing ground surface will be assigned where the settlement-sensitive structures/infrastructure would be founded upon or above the silty clay deposit.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for foundations constructed at the subject site as deduced from Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC 2012). If a higher seismic site class is required (Class A, Class B or Class C, dependent on founding conditions), a site-specific shear wave velocity test may be completed to accurately determine the applicable seismic site classification for foundation design of the proposed buildings.

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

5.5 Slab-on-Grade Construction

With the removal of all topsoil, deleterious fill/material within the footprint of the proposed warehouse footprint, the existing fill approved by Paterson field personnel at the time of construction will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

It is recommended that where fill is encountered at the subgrade level below the slab-on-grade, that the existing fill be sub-excavated a minimum depth of 500 mm below the underside of the slab-on-grade surface. Where fill is encountered at the depth of this sub-excavation, the ground surface should be proof-rolled by a suitably sized vibratory-roller and that proof-rolling be reviewed and approved by Paterson field personnel.

Proof-rolling is recommended to be undertaken in the dry and in above-freezing conditions. Any soft areas should be removed and backfilled with appropriate granular material. If the existing fill layer is considered acceptable, it may be left in place for support of the slab-on-grade sub-slab fill layer.

It is recommended that the upper 200 mm of sub-slab fill consist of OPSS Granular A crushed stone compacted to a minimum of 98% of the materials SPMDD. All backfill material within the footprint of the building footprint should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

5.6 Pavement Design

Car only parking areas, driveways and access lanes are anticipated at this site. The proposed pavement structures are shown in Tables 2 and 3.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas and Fire-Truck Routes

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 Pavement Structure - Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or 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. 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 as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

Since the building will consist of a slab-on-grade perimeter foundation drainage system is considered optional throughout the landscaped portions of the proposed building footprint. In areas where hard-scaping or pavement structures will abut the building footprint, it is recommended to implement a foundation drainage system.

The system should consist of a 150 mm diameter perforated corrugated plastic pipe wrapped in a geosock and surrounded on all sides by 150 mm of 10 mm clear crushed stone. The pipe should be placed at the footing level around the exterior perimeter of the structure. The clear stone should be wrapped in a non-woven geotextile. 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 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.

Concrete Sidewalks Adjacent to Buildings

To avoid differential settlements within the proposed sidewalks adjacent to the proposed building, it is recommended that the upper 600 mm of backfill placed below the concrete sidewalks adjacent to the building footprints to consist of non-frost susceptible material such as OPSS Granular A or Granular B Type II. The granular material should be placed in maximum 300 mm loose lifts and compacted to a minimum of 98% of the material’s SPMDD using suitable compaction equipment. The subgrade material should be shaped to promote positive drainage towards the building’s perimeter drainage system. Consideration should be given to placing a layer of rigid insulation below the granular fill layer, however, should be detailed by Paterson once design drawings are being complete by others.

Further, consideration can be given to installing a 150 mm diameter perforated, corrugated plastic pipe surrounded on all sides by 150 mm of 19 mm clear crushed stone at the interface of the soil subgrade and the granular sidewalk base. If a drainage pipe is provided at the top of the soil subgrade layer, the granular backfill thickness below the sidewalk may be reduced to 300 mm.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

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

6.3 Excavation Side Slopes

The side slopes of 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 assumed that sufficient room will be available in selected areas 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. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides. Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

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

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and 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 layer should be increased to 300 mm where the subgrade consists of bedrock. 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. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 99% of the material's standard Proctor maximum dry density.

It should generally be possible to re-use the upper portion of the dry to moist (not wet) 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 site-generated materials prior to placement.

Well fractured bedrock should be acceptable as backfill for the lower portion of the trenches when the excavation is within bedrock provided the rock fill is placed only from at least 300 mm above the top of the service pipe and that all stones are 150 mm or smaller in their longest dimension.

The backfill material within the frost zone (about 1.8 m below finished grade) 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

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.

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

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

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project.

The subsoil conditions at this site 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 an aggressively severe corrosive environment.

6.8 Landscaping Considerations

Tree Planting Considerations

Given the discontinuity and relatively thin layer thickness in the clay deposit encountered at the subject site (i.e., only at BH 3-23), it is expected that there is insufficient presence of clay for the support of the foundations to influenced by the potential moisture depletion caused by trees, if considered throughout the subject site. Since the structure is anticipated to be founded upon engineered fill or non-cohesive in-situ soil and not upon silty clay soils, City approved trees within the subject site will not be subject to planting restrictions as based on the *City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines*) from a geotechnical perspective.

7.0 Recommendations

It is recommended that the following be carried out by Paterson once preliminary and future details of the proposed development have been prepared:

- Review preliminary and detailed grading, servicing and structural plan(s) from a geotechnical perspective.

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

- Review and inspection of the installation of the foundation drainage systems.
- 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 and follow-up field density tests to determine the level of compaction achieved.
- 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 soil 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 BBS Construction (Ontario) Ltd. or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
July 21, 2023
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Drew Petahtegoose, B.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ☐ BBS Construction (Ontario) Ltd. (1 email copy)
- ☐ Paterson Group (1 copy)

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 Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

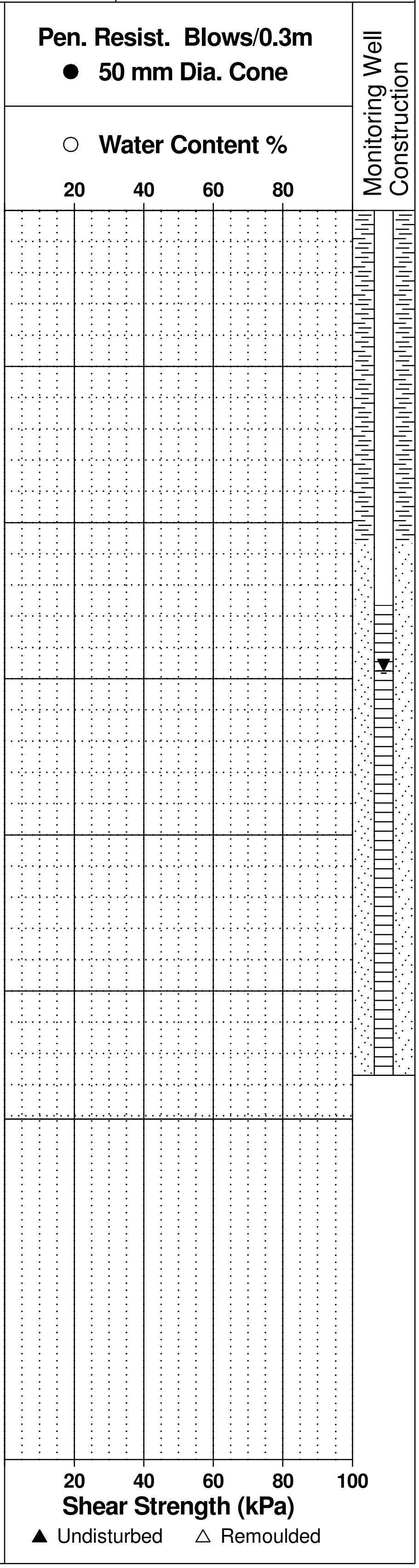
BORINGS BY CME-55 Low Clearance Drill

DATE May 10, 2023

FILE NO. PG6674

HOLE NO. BH 1-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	66.01
Concrete Slab — 0.10							
FILL: Loose to compact, brown silty sand, trace to some crushed stone and gravel — 0.91		AU	1				
FILL: Brown sandy silt to silty sand, trace to some clay		SS	2	42	10	1	65.01
— 1.91		SS	3	8	50+		
BEDROCK: Poor to fair quality, black shale						2	64.01
		RC	1	98	46		
						3	63.01
						4	62.01
		RC	2	100	54		
						5	61.01
— 5.82		RC	3	65	32		
End of Borehole							
(GWL @ 2.95m - May 19, 2023)							



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

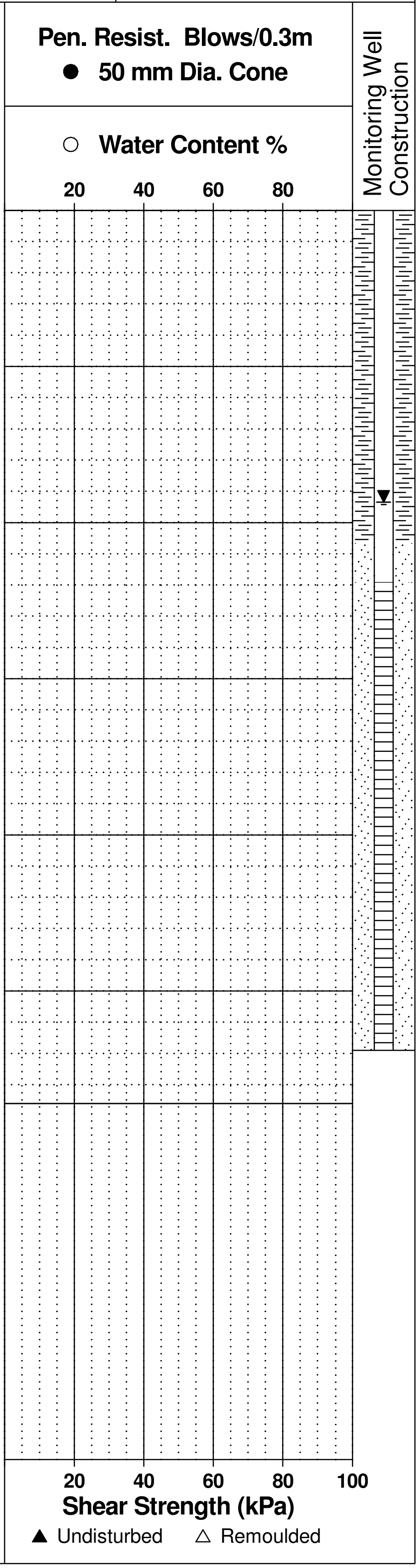
BORINGS BY CME-55 Low Clearance Drill

DATE May 10, 2023

FILE NO. PG6674

HOLE NO. BH 2-23

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	65.92
Concrete Slab 0.10						
	AU	1				
					1	64.92
FILL: Compact to loose, brown silty sand, some crushed stone, trace gravel	SS	2	50	12		
	SS	3	83	4		
2.21					2	63.92
GLACIAL TILL: Compact to loose, brown silty sand, with clay, trace gravel, occasional cobbles and boulders	SS	4	17	50+		
2.92						
	RC	1	85	0	3	62.92
BEDROCK: Very poor to fair quality, black shale	RC	2	97	63	4	61.92
					5	60.92
	RC	3	71	71		
5.72						
End of Borehole						
(GWL @ 1.87m - May 19, 2023)						



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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 10, 2023

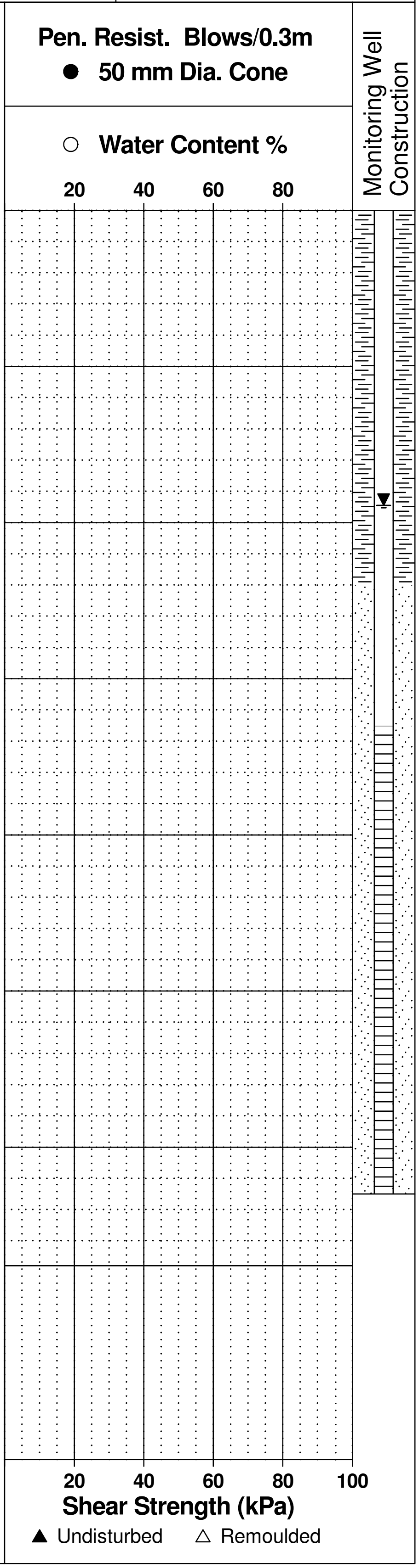
FILE NO. PG6674

HOLE NO. BH 3-23

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
Concrete Slab	0.10
FILL: Dense to loose. brown silty sand, some crushed stone, trace gravel and asphalt	1.83
TOPSOIL	2.13
Stiff, grey **SILTY CLAY,** trace sand	2.62
BEDROCK: Poor to excellent quality, black shale	6.76
End of Borehole (GWL @ 1.89m - May 19, 2023)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	66	50+
SS	3	8	5
SS	4	25	50+
RC	1	100	30
RC	2	69	46
RC	3	100	96

DEPTH (m)	ELEV. (m)
0	67.44
1	66.44
2	65.44
3	64.44
4	63.44
5	62.44
6	61.44



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 4-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	66.56
FILL: Brown silty sand with gravel and crushed stone 0.33		AU	1				
FILL: Brown silty sand 0.69		AU	2				
Compact, brown **SILTY SAND,** trace gravel 1.52		SS	3	25	25	1	65.56
Loose, grey **SILTY SAND** with some clay 2.21		SS	4	42	7	2	64.56
End of Borehole Practical refusal to augering at 2.21m 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

Monitoring Well Construction

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 5-23

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 % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE						0	67.04		
FILL: Compact. brown silty sand with gravel and crushed stone	▨	AU	1						
	▨	SS	2	42	20	1	66.04		
1.52									∇
FILL: Compact gravel with some sand	▨	SS	3	25	14	2	65.04		
	▨	SS	4	33	15	3	64.04		
	▨	SS	5	42	17				
3.71									

End of Borehole

Practical refusal to augering at 3.71m depth

(Open hole GWL @ 1.5m depth)

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 5A-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Monitoring Well Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	67.04		
						1	66.04		
OVERBURDEN									
						2	65.04		
						3	64.04		
3.71									
End of Borehole Practical refusal to augering at 3.71m depth.									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 6-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE						0	66.83		
FILL: Compact to loose brown silty sand with gravel and crushed stone		AU	1						
0.68									
FILL: Light brown to white silty sand with some gravel		SS	2	100	26	1	65.83		
		SS	3	25	50+				
1.80									
End of Borehole Practical refusal to augering at 1.80m depth									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 7-23

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	66.83
Concrete Slab	0.15						
FILL: Compact, brown silty sand with gravel and crushed stone	0.69	AU	1				
FILL: Compact, brown silty sand, trace gravel	1.68	SS	2	50	50+	1	65.83
FILL: Very dense, black silty sand with crushed stone	2.21	SS	3	54	79	2	64.83
BEDROCK: Very poor to good quality, black shale	5.13	RC	1	64	0	3	63.83
		RC	2	98	49	4	62.83
		RC	3	100	50	5	61.83
End of Borehole							

(GWL @ 2.19m - May 19, 2023)

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

Monitoring Well Construction

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 8-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.32
FILL: Compact, brown silty sand with gravel and crushed stone (to 0.69)	⊠	AU	1				
FILL: Very dense to compact, brown silty sand with gravel (0.69 to 1.83)	⊠	SS	2	50	50+	1	66.32
		SS	3	50	21		
FILL: Grey-brown silty clay, trace sand and gravel (1.83 to 2.44)	⊠					2	65.32
End of Borehole (2.44)		SS	4	0	50+		

Practical refusal to augering at 2.44m 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

Monitoring Well Construction

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

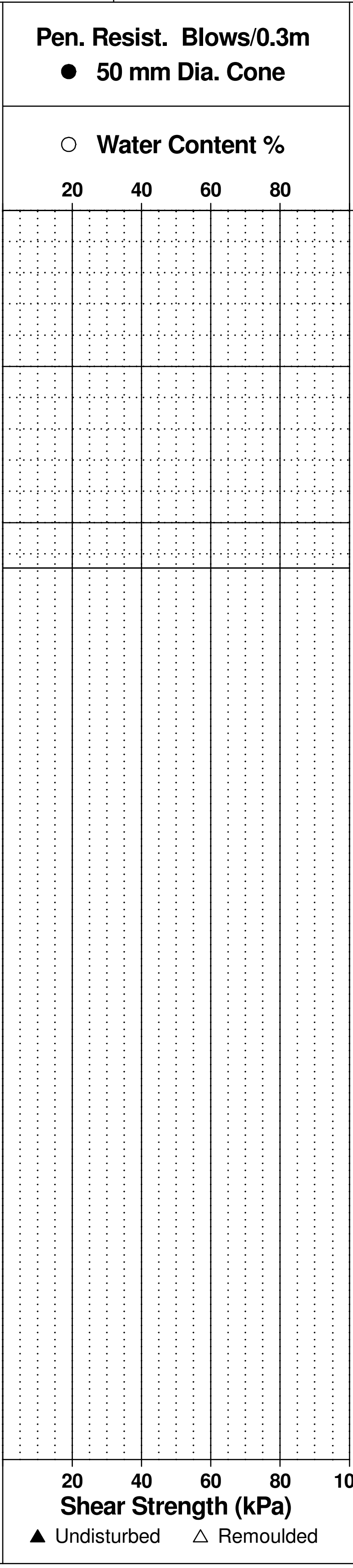
BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH 9-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.89
FILL: Very loose, brown silty sand with gravel and crushed stone 0.61		AU	1				
FILL: Very loose, brown silty sand with clay, trace gravel 0.91		SS	2	100	3	1	66.89
FILL: Very loose to compact, light brown silty clay, trace sand and gravel 2.29		SS	3	33	5	2	65.89
End of Borehole Practical refusal to augering at 2.29m depth							



Monitoring Well Construction

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1540 Star Top Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 11, 2023

FILE NO. PG6674

HOLE NO. BH10-23

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 % 20 40 60 80	Monitoring Well Construction
GROUND SURFACE									
Concrete Slab 0.13		AU	1			0	66.16		
FILL: Very dense, brown silty sand trace gravel 1.52		SS	2	8	50+	1	65.16		
FILL: Firm, grey to black silty clay trace sand and gravel 1.93		SS	3	42	50+				
End of Borehole Practical refusal to augering at 1.93m depth									

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

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %

LL - Liquid Limit, % (water content above which soil behaves as a liquid)

PL - Plastic limit, % (water content above which soil behaves plastically)

PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size

D10 - Grain size at which 10% of the soil is finer (effective grain size)

D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)

Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth

p'_c - Preconsolidation pressure of (maximum past pressure on) sample

Ccr - Recompression index (in effect at pressures below p'_c)

Cc - Compression index (in effect at pressures above p'_c)

OC Ratio Overconsolidaton ratio = p'_c / p'_o

Void Ratio Initial sample void ratio = volume of voids / volume of solids

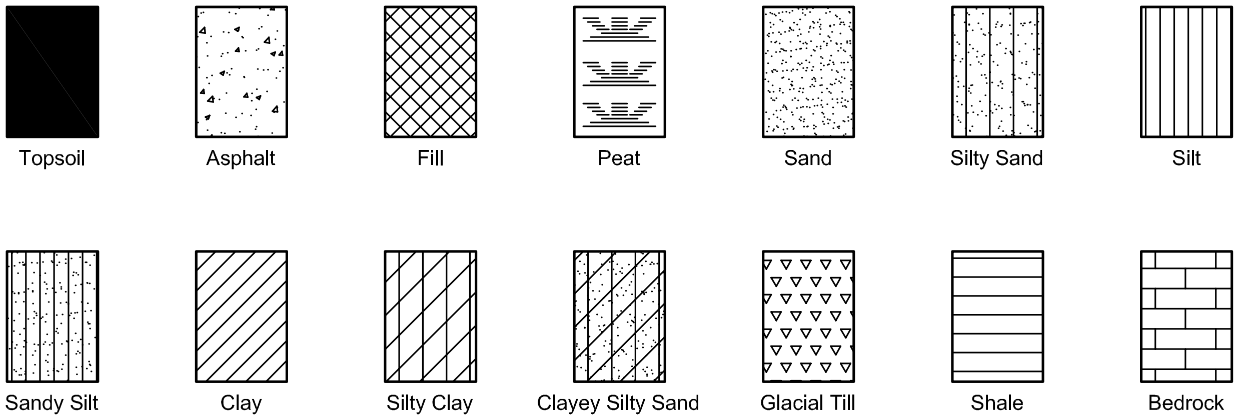
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

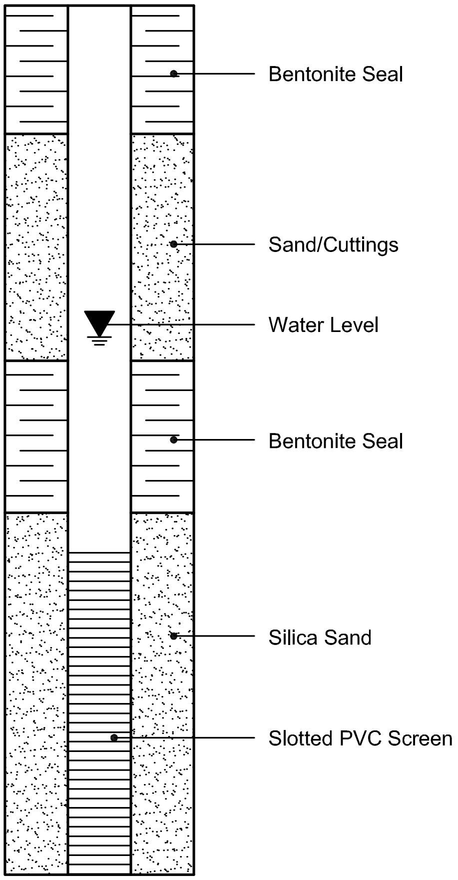
SYMBOLS AND TERMS (continued)

STRATA PLOT

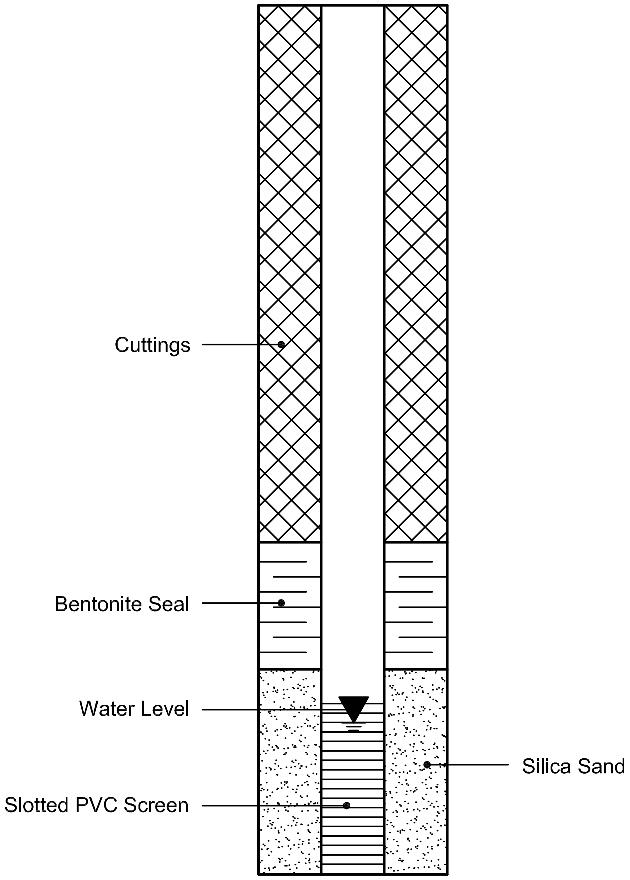


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



	Client ID:	BH4-23 SS3	-	-	-
	Sample Date:	26-May-23 00:00	-	-	-
	Sample ID:	2321434-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	79.3	-	-	-
General Inorganics					
pH	0.05 pH Units	7.28	-	-	-
Resistivity	0.1 Ohm.m	12.3	-	-	-
Anions					
Chloride	10 ug/g dry	263	-	-	-
Sulphate	10 ug/g dry	535	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

DRAWING PG6674-1 – TEST HOLE LOCATION PLAN

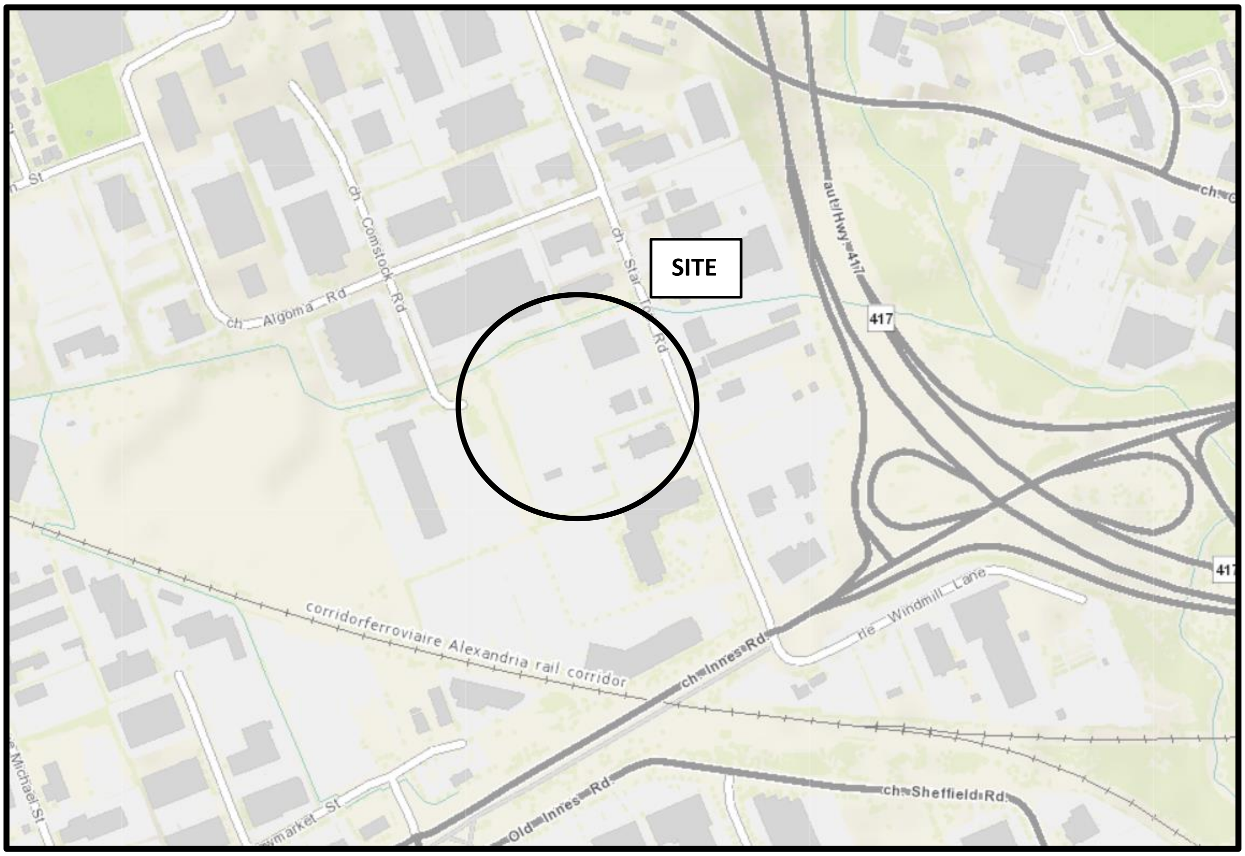
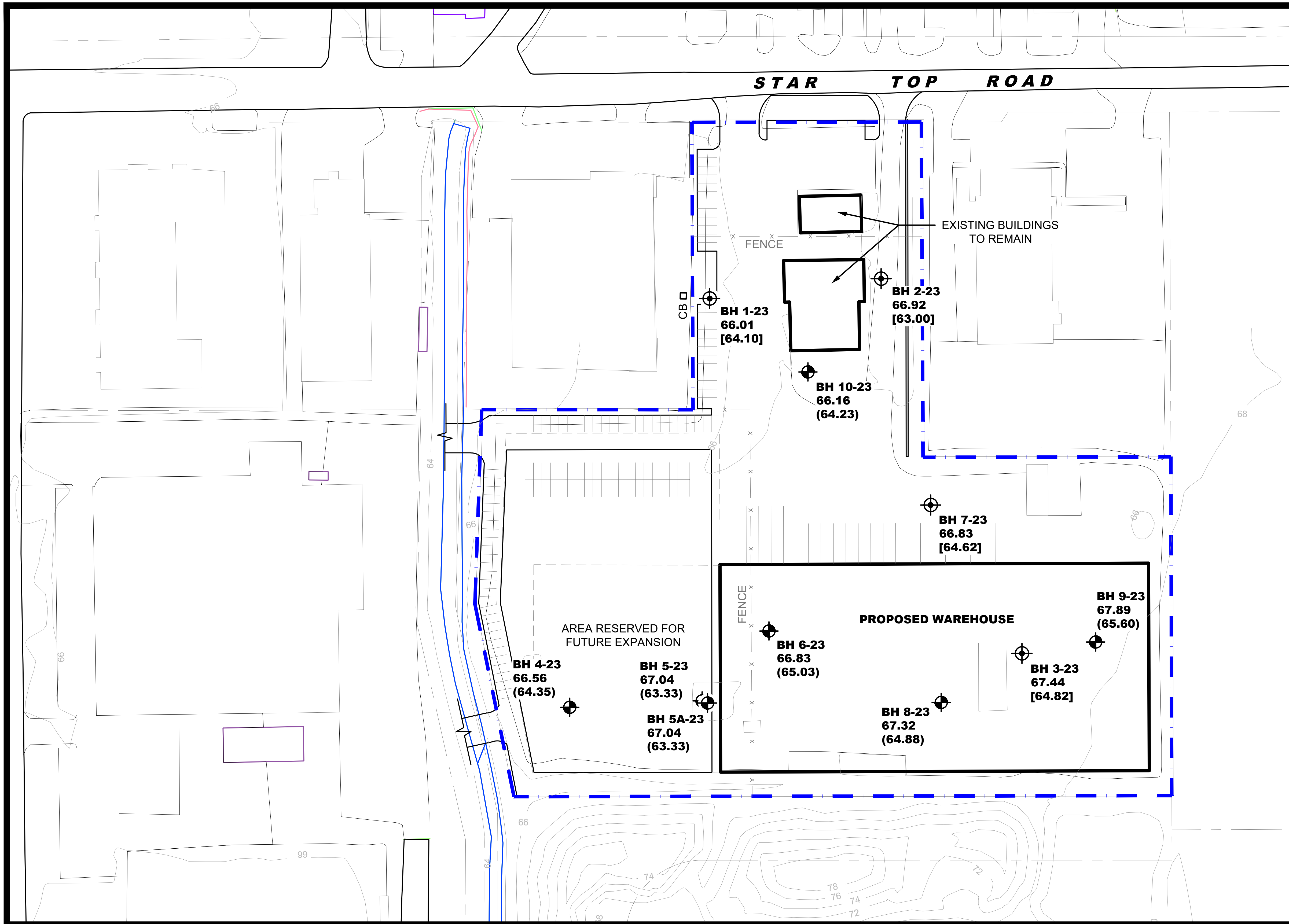


FIGURE 1

KEY PLAN



LEGEND:

⌖	BOREHOLE LOCATION
⌖	BOREHOLE WITH MONITORING WELL LOCATION
67.31	GROUND SURFACE ELEVATION (m)
(64.87)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
[64.82]	BEDROCK SURFACE ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY BBS CONSTRUCTION (ONTARIO) LTD.

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

SCALE: 1:1250

0 5 10 15 20 25 50 75m

PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL

BBS CONSTRUCTION (ONTARIO) LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
1540 STAR TOP ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250

Date: 05/2023

Drawn by: GK

Report No.: PG6674-1

Checked by: DP

Dwg. No.: PG6674-1

Approved by: DJG

Revision No.:

p:\autocad drawings\geotechnical\pg66xx\pg6674\pg6674-1 test hole location plan.dwg

11x17