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Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Materials Testing

Building Science

Noise and Vibration Studies

Geotechnical Investigation

Proposed Building Addition
158 Cardevco Road
Carp, Ontario

Prepared For

Whelan Truck Repair

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Report: PG6233-1

Revision 4

FILE# D07-12-23-0002 SITE PLAN# 19363

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Whelan Truck Repair to conduct a geotechnical investigation for the proposed building addition to be located at 158 Cardevco Road in Carp, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

- ☐ Determine the existing 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 proposed development as they are understood at the time of this report.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed building addition will be located to the south of the existing structure and will consist of a single-storey industrial building of slab-on-grade construction. The proposed building addition will be linked to the existing building via a breezeway.

Associated gravel access lanes and at-grade parking areas will be located around the existing building and proposed building addition. Stormwater infiltration galleries will also be located to the east and west of the proposed building addition, below finished grades. It is further anticipated that the building addition will be serviced with the existing private well and septic system.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on March 24, 2023, consisting of 6 boreholes which were advanced to a maximum depth of 4.7 m below the existing ground surface. In addition, a previous geotechnical investigation was carried out on May 20, 2022. At that time, 3 test pits which were advanced to a maximum depth of 3.1 m below the existing ground surface.

The test hole locations were determined by Paterson and were distributed in a matter to provide general coverage of the proposed building addition. The approximate locations of the test holes are presented on Drawing PG6233-1 – Test Hole Location Plan, which is appended to this document.

The boreholes were advanced with a track-mounted drill rig operated by a two-person crew. The test pits were advanced using a hydraulic excavator. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The drilling and test pitting procedures consisted of augering and excavating to the required depth, respectively, at the selected locations, and sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were recovered using a 50 mm diameter split-spoon sampler or from the auger flights. The split spoon and auger samples were classified on site and placed in sealed plastic bags. All soil samples were transported to our laboratory. The depths at which the auger and split spoon samples were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

In conjunction with the recovery of the split spoon samples, the Standard Penetration Tests (SPT) were conducted. 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.

Soil samples from test pits were recovered from the sidewalls of the open excavation. Grab samples were collected from the test pits at selected intervals. The samples were initially classified on site, placed in sealed plastic bags and transported to our laboratory. The depths at which the grab samples were recovered from the test pits and boreholes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Subsurface conditions observed in the test holes were recorded in detail in the field. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Three (3) boreholes were instrumented with monitoring wells to allow groundwater level monitoring. The groundwater level readings were obtained after a suitable stabilization period subsequent to the completion of the field investigation.

In addition, open hole groundwater levels were recorded at the time of excavation of the test pits. Groundwater level measurements and observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the subject site. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a high precision, handheld GPS and referenced to a geodetic datum. The location of the boreholes is presented on Drawing PG6233- 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. Soil samples will be stored for a period of one month after this report is completed, unless 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 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 sample. The results are presented in Appendix 1 and are discussed further in Section 6.7.

3.5 Permeameter Testing

Groundwater infiltration testing was conducted by others on June 29, 2023 using a Guelph Permeameter. This testing was completed at a total of 5 locations across the site, in order to provide general coverage of the site conditions.

For each test, the permeameter reservoir was filled with water and inverted into the hole, ensuring that it was relatively vertical and rested on the bottom of the hole. As the water infiltrated into the soil, the water level of the reservoir was monitored at various time intervals until the rate of fall reached equilibrium. The results of testing are further discussed in Section 4.3.

4.0 Observations

4.1 Surface Conditions

The subject site is occupied by an existing single-storey industrial building, which is immediately surrounded by gravel access lanes and parking areas. The site also has a landscaped area located at the north-west portion of the property, as well as swales on the side of Cardevco Road.

The subject site is bordered to the north and west by Cardevco Road and to the south and east by commercial properties. The ground surface across the site is relatively level at approximate geodetic elevation 117 m.

4.2 Subsurface Profile

Overburden

Generally, the soil profile at the test pit locations consists of an approximate 2 to 3.2 m thick fill layer underlain by a native silty sand deposit. The fill material was generally observed to consist of compact to very dense, brown silty sand with gravel, crushed stone, brick fragments, asphalt and concrete. A compact, brown native silty sand, with gravel and traces of cobbles, was encountered underlying the fill.

However, practical refusal to augering/excavation was encountered in test holes BH 1-23, BH 2-23, BH 3-23, TP 1A-22, TP 2-22, and TP 3-22, at approximate depths ranging from 2.1 to 4.3 m below the existing ground surface.

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

Bedrock

The bedrock was cored at borehole BH 1-23 to confirm the bedrock depth, determine the nature of the bedrock, and to assess its quality. The bedrock was encountered at a depth of about 4.3 m below the existing ground surface, and was cored to a depth of 4.7 m. The bedrock was observed to consist of limestone, and based on the RQDs of the recovered rock core, the bedrock can be classified as excellent in quality.

4.3 Groundwater

Permeameter Testing Results

A total of 10 permeameter tests were conducted at 5 locations to provide general coverage of the subject site. The testing results are provided in the Stormwater Management Report, Revision 1 dated August 2023 and prepared by Shade Group Inc.

In summary, the permeameter testing results yielded field saturated hydraulic conductivity values between 2.6×10^{-4} to 6.4×10^{-4} cm/s, with unfactored infiltration rates ranging between approximately 17.4 to 34.1 mm/hr. With a conservative factor of safety of 3.5 applied to the fill infiltration rates, a design infiltration rate of **5 mm/hr** is recommended.

Groundwater Level Readings

Groundwater infiltration into the test pits was encountered at the time of the field program at depths of approximately 1.6 to 1.8 m in May 2022. In addition, groundwater levels were measured in the monitoring wells on March 30, 2023. The measured groundwater levels are presented in Table 1.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-23	117.83	1.80	116.03	March 30, 2023
BH 2-23	117.47	1.38	116.09	March 30, 2023
BH 3-23	117.30	1.09	116.21	March 30, 2023

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

The monitoring well installed at BH 2-23 was equipped with a data logger to accurately monitor seasonal fluctuations in the groundwater levels. The groundwater readings measured within the monitoring well between November 2023 and June 2024 varied from an elevation of 114.88 m to 115.94 m, with a difference in elevation between high and low readings of 1.06 m. Refer to Paterson Group Memo PH4559-MEMO.02 dated November 20, 2024 for additional details.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed building addition. It is recommended that foundation support for the proposed building addition consist of conventional spread footings bearing on the undisturbed, native silty sand or clean, surface sounded bedrock.

Based on the results from boreholes and test pits, fill is anticipated at the proposed underside of footing elevation. Where this occurs, the fill should be sub-excavated to the surface of the undisturbed, native silty sand or clean, surface sounded bedrock and replaced with engineered fill or lean concrete to the proposed underside of footing elevation. The lateral limits of the engineered fill or lean concrete placement should be in accordance with our lateral support recommendations provided herein.

Where fill is sub-excavated in the vicinity of the existing building footing, the fill should be sub-excavated in stages no wider than 1.5 m at a time, so as to maintain support for the existing footing. This is discussed further in Section 6.3.

From the results of the groundwater infiltration testing, the subsurface soils at the site are suitable for the proposed stormwater infiltration galleries. However, given the relatively shallow depth of the groundwater, the stormwater infiltration galleries will themselves need to be very shallow in order to stay 1 m above the seasonally high groundwater table depth, as required in the MECP Stormwater Management and Planning Design Manual.

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 and other settlement sensitive structures. It is anticipated that the existing fill within the proposed building addition footprint, free of deleterious material and significant amounts of organics, can be left in place below the proposed building addition footprint outside of lateral support zones for the footings.

However, it is recommended that the existing fill layer be proof-rolled with several passes of a vibratory drum roller, under dry conditions and above freezing temperatures, and approved by Paterson personnel at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved engineered fill material.

Existing foundation walls and other demolished debris should be completely removed from the proposed building perimeter and within the lateral support zones of the foundation. Under paved area, existing construction remnants, such as foundation walls should be excavated to a minimum of 1 m below final grade.

Fill Placement

Fill used for grading beneath the proposed building addition 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.

Alternatively, 19 mm clear crushed stone can be used as a suitable material to build up the subgrade for paved areas. Where utilized, the 19 mm clear crushed stone should be compacted with several passes of a vibratory drum roller or plate compactor.

Further, where 19 mm clear crushed stone is used, a geotextile should be placed over the top prior to placing additional material, in order to prevent fines from migrating into the voids of the 19 mm clear crushed stone.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane.

Lean Concrete Filled Trenches

As an alternative to placing engineered fill, where required, consideration should be given to excavating vertical trenches to the undisturbed, native silty sand or clean, surface sounded bedrock, and backfilling with lean concrete to the founding elevation (minimum 17 MPa 28-day compressive strength). Typically, the excavation side walls will be used as the form to support the concrete. The trench excavation should be at least 150 mm wider than all sides of the footing (strip and pad footings) at the base of the excavation. The additional width of the concrete poured against an undisturbed trench sidewall will suffice in providing a direct transfer of the footing load to the underlying, native silty sand or clean, surface sounded bedrock. Once the trench excavation is approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation

5.3 Foundation Design

Conventional Shallow Footings

Footings placed on an undisturbed, native silty sand bearing surface, or on engineered fill or lean concrete which is placed directly over the undisturbed, native silty sand, can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**. A geotechnical factor of 0.5 was incorporated to the bearing resistance value at ULS. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed, in the dry, prior to the placement of concrete footings.

Footings places on an undisturbed, native silty sand bearing surface and designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and different settlements of 25 to 20 mm, respectively.

Footings placed on clean, surface sounded bedrock, or on lean concrete placed directly over clean, surface sounded bedrock, can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **1,000 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance at ULS.

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

Lateral Support

As a general procedure, it is recommended that footings for the proposed building addition that are located adjacent to the existing structure be founded at the same level as the existing footings, so that minimal stress is added to the existing structure from the new structure.

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

5.4 Design for Earthquakes

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

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

5.5 Slab on Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the existing fill 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. A vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as OPSS Granular B Type II.

It is recommended that the upper 150 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill materials required to raise grade 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 Gravel Access Lane and Parking Area Design

The existing fill material at the subject site generally consists of a silty sand with gravel and crushed stone, and is considered to be a suitable structure for existing gravel access lanes and parking areas, as well as for any proposed gravel access lanes and parking areas.

However, should imported fill be needed for new gravel access lanes and/or parking areas, the recommended gravel structures presented in Tables 2 and 3, below, should be used.

Table 2 - Recommended Gravel Structure - Car Only Parking Areas

Thickness (mm)	Material Description
200	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Existing imported fill, or OPSS Granular B Type I or II material placed over in situ soil.	

Table 3 - Recommended Gravel Structure - Access Lanes

Thickness (mm)	Material Description
250	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Existing imported fill, or OPSS Granular B Type I or II material placed over in situ soil.	

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

The existing fill and gravel structures, provided in Table 3, above, are also considered suitable for the fire lane, from a geotechnical perspective.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. The excavated on-site soils may be used for backfill around the exterior sides of the foundation walls, provided they are in an unfrozen state and at a suitable moisture content for compaction. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

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

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

6.3 Excavation Side Slopes

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

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or 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 is used to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

Footing Excavations in the vicinity of the Existing Building

As noted above in Section 5.1, where fill is sub-excavated within the lateral support zone of the existing building footing, the fill should be sub-excavated in stages no wider than 1.5 m at a time, so as to maintain support for the existing footing. Multiple sections which are 1.5 m wide can be excavated at a given time, provided they are separated by at least a 3 m width which is unexcavated. This is typically referred to as the “piano key” method. Further details can be provided upon request.

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.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe.

Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 300 mm thick lifts and compacted to 98% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the material’s SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

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

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

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

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

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

6.7 Corrosion Potential and Sulphate

The results of analytical testing 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.

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

☐ Sampling and testing of the concrete and fill materials.

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

☐ Observation of all subgrades prior to backfilling.

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

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

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

8.0 Statement of Limitations

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

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

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Whelan Truck Repair 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.

Deepak K Rajendran, E.I.T.

LICENSED PROFESSIONAL ENGINEER
Nov. 22, 2024
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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

Phase II - Environmental Site Assessment
158 Cardevco Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

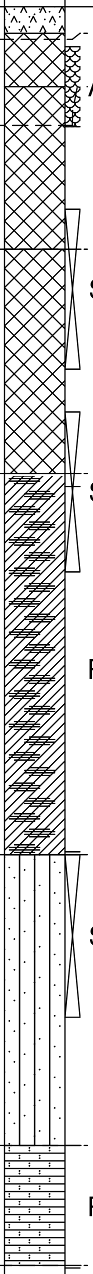
BORINGS BY CME 55 Power Auger

DATE March 24, 2023

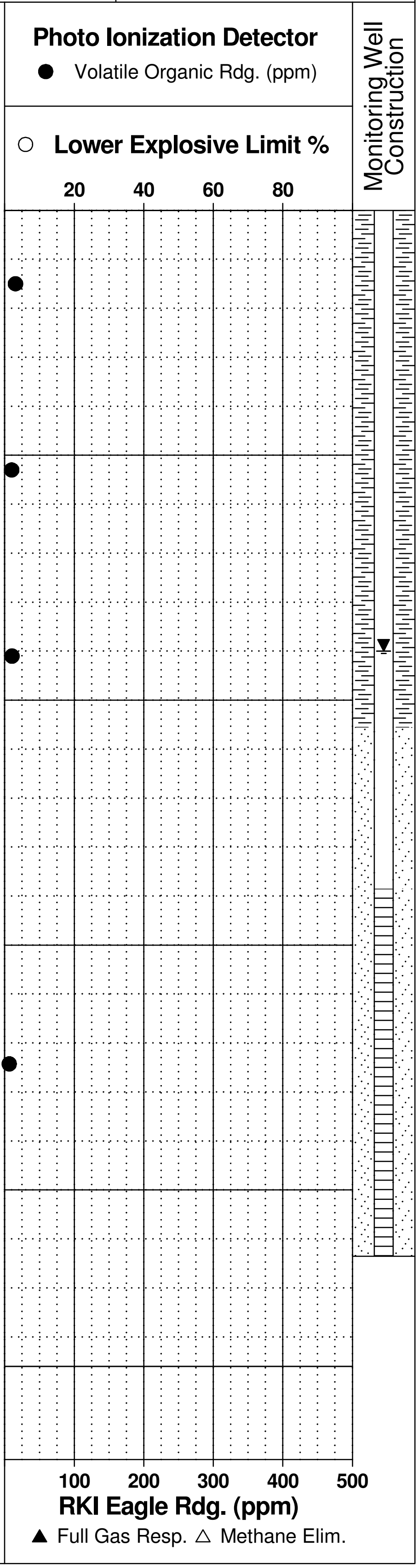
FILE NO. PG5996

HOLE NO. BH 1-23

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic Concrete	0.10				
FILL: Compacted granular base , brown silty sand with crushed stone and gravel	0.30	AU	1		
FILL: Compact to dense brown silty sand with some gravel, crushed stone, trace clay	0.91				
FILL: Dense to very dense brown silty sand with some gravel , trace clay	1.75	SS	2	66	37
Auger Refusal on Limestone cobbles,boulders Limestone Boulders Some cobbles and boulders by 1.80 Limestone Boulders Some cobbles and boulders by 1.80	3.18	SS RC	3 1	42 100	50+ 100
Compact, brown **SILTY SAND** with some gravel	4.27	SS	4		24
Excellent quality **LIMESTONE BEDROCK**	4.72	RC	2	100	100
End of Borehole (GWL @ 1.80m depth on March 30, 2023)					



DEPTH (m)	ELEV. (m)
0	117.83
1	116.83
2	115.83
3	114.83
4	113.83



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

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
158 Cardevco Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 24, 2023

FILE NO. **PG5996**

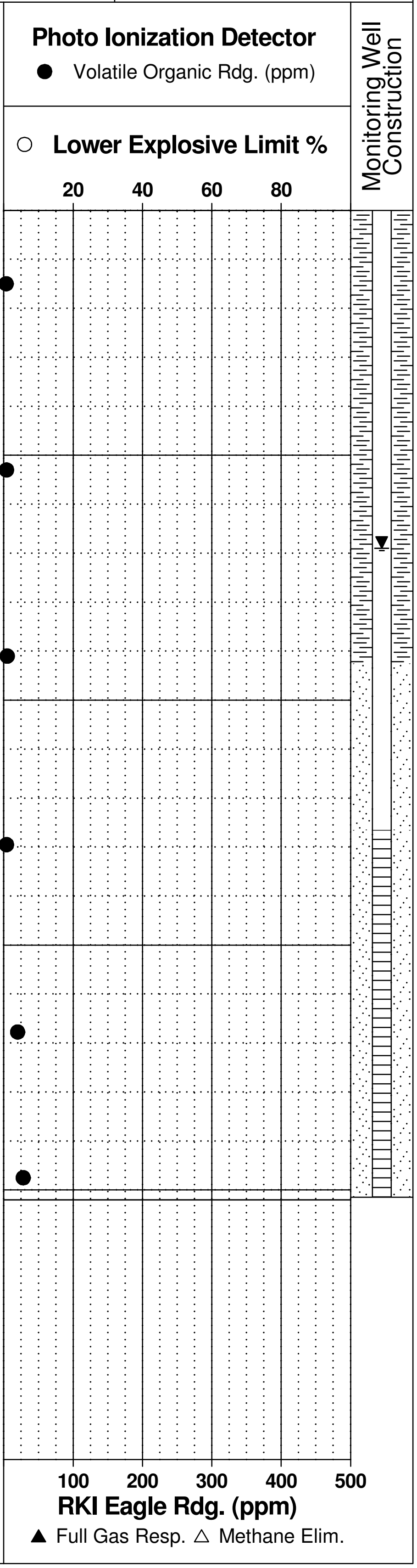
HOLE NO. **BH 2-23**

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Compact to dense gravel surface, with brown silty sand, with some crushed stone, trace clay — 0.91	AU	1		
FILL: Compact brown silty sand with gravel, with gravel, crushed stone, trace plastic — 1.45	SS	2	67	22
FILL: Compact brown silty sand, some gravel and clay, trace concrete — 2.21	SS	3	58	30
FILL: Compact silty sand trace asphaltic concrete — 3.20	SS	4	50	
Compact, brown **SILTY SAND**, some gravel — 3.73	SS	5	67	31
Compact, brown **SILTY SAND** — 4.04	SS	6	50	50+
LIMESTONE BEDROCK — 4.09				

End of Borehole

(GWL @ 1.38m depth on March 30, 2023)

DEPTH (m)	ELEV. (m)
0	117.47
1	116.47
2	115.47
3	114.47
4	113.47



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158 Cardevco Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

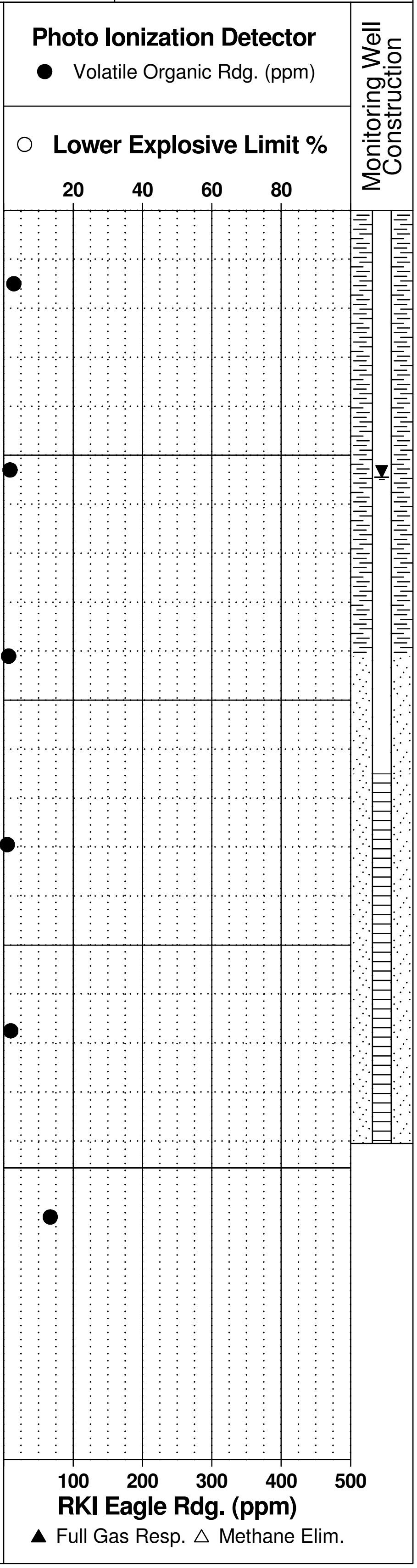
BORINGS BY CME 55 Power Auger

DATE March 24, 2023

FILE NO. PG5996

HOLE NO. BH 3-23

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	117.30
FILL: Compact to dense brown silty sand with gravel, crushed stone, sand and clay 0.30	AU	1				
FILL: Compact, redish brown silty sand, some gravel, occasional cobbles and boulders,	SS	2	75	21	1	116.30
Some concrete fragments by 1.52m depth	SS	3	42	29	2	115.30
2.29						
Dense, brown **SAND** with gravel	SS	4				
	SS	5	38		3	114.30
3.73						
Compact, brown **SILTY SAND** 3.91						
End of Borehole (GWL @ 1.09m depth on March 30, 2023)	SS	6	50			



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
158 Cardevco Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

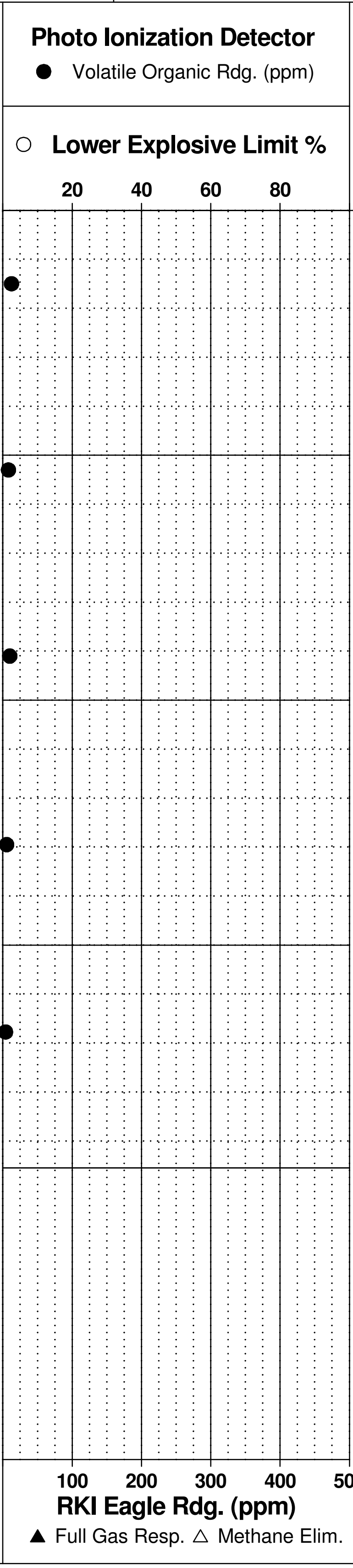
BORINGS BY CME 55 Power Auger

DATE March 24, 2023

FILE NO. PG5996

HOLE NO. BH 4-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Monitoring Well Construction
GROUND SURFACE						0	117.76	
FILL: Compact, brown silty sand with gravel, crushed stone, trace clay 0.30		AU	1					
FILL: Compact, brown silty sand with gravel, trace clay		SS	2	42	29	1	116.76	
		SS	3	42	24	2	115.76	
		SS	4	46	22	3	114.76	
3.20								
Dense to very dense, brown **SILTY SAND**, some gravel, occasional cobbles		SS	5	63	40			
3.66								
End of borehole								



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
158 Cardevco Road
Ottawa, Ontario

DATUM Elevations are referenced to a geodetic datum

REMARKS

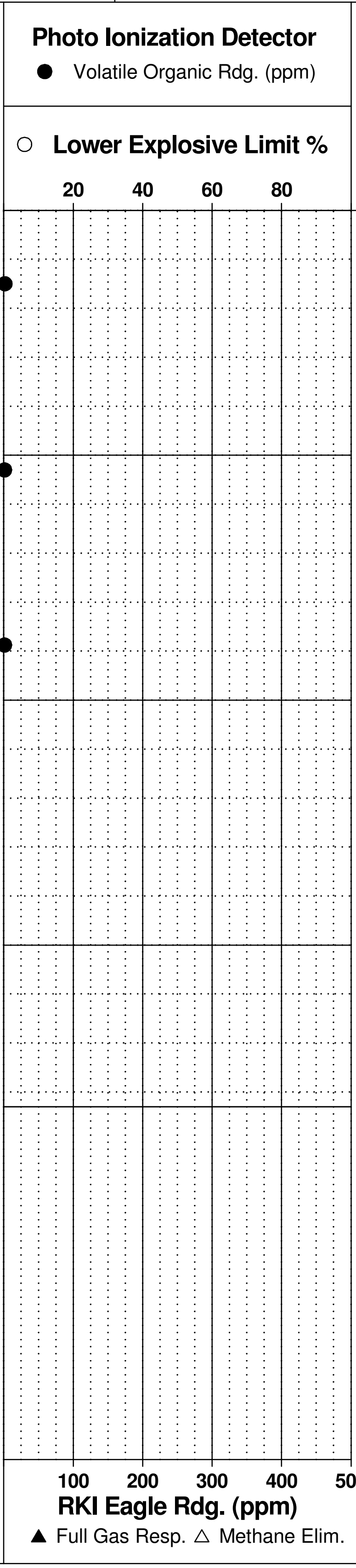
BORINGS BY CME 55 Power Auger

DATE March 24, 2023

FILE NO. PG5996

HOLE NO. BH 5-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Monitoring Well Construction
GROUND SURFACE						0	117.62	
FILL: Compact to dense brown silty sand with gravel, crushed stone, some clay, occasional brick fragments 0.30	▨	AU	1					
FILL: Compact to dense, brown silty sand some gravel and clay	▨	SS	2	42	7	1	116.62	
	▨	SS	3	4	50+			
2.03						2	115.62	
End of borehole								
						3	114.62	



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
158 Cardevco Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE May 20, 2022

FILE NO. PG6233

HOLE NO. TP 1-22

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	Piezometer Construction
GROUND SURFACE						0	117.44		
FILL: Dense to very dense brown silty sand with gravel and crushed stone	▨	G	1						
0.52	▨								
FILL: Dense brown silty sand with gravel, crushed stone, asphalt and concrete	▨					1	116.44		
	▨	G	2						
1.71	▨	G	3						
End of Test Pit Refusal to excavation in dense fill at 1.71 m depth (Open hole GWL 1.6 m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
158 Cardevco Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2022 May 20

FILE NO. PG6233

HOLE NO. TP 1A-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	117.44
FILL: Dense to very dense brown silty sand with gravel and crushed stone	☒						
0.52							
FILL: Dense brown silty sand with gravel, crushed stone, asphalt and concrete	☒					1	116.44
2.02						2	115.44
Compact brown **SILTY SAND** with gravel, trace cobbles							
2.31		G	1				
End of Test Pit Refusal to excavation on bedrock surface at 2.31 m depth (Open hole GWL 1.6 m depth)							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
158 Cardevco Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2022 May 20

FILE NO. PG6233

HOLE NO. TP 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	117.58		
FILL: Dense brown silty sand with gravel and crushed stone		G	1						
0.55									
FILL: Compact brown silty sand with gravel, crushed stone and brick fragments						1	116.58		
		G	2						
						2	115.58		
2.20									
Compact brown **SILTY SAND** with gravel, trace cobbles		G	3						
						3	114.58		
3.12									
End of Test Pit Refusal to excavation on bedrock surface at 3.12 m depth (Open hole GWL at 1.8 m depth)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
158 Cardevco Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2022 May 20

FILE NO. **PG6233**

HOLE NO. **TP 3-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	117.34
FILL: Dense to very dense granular crushed stone, some sand		G	1				
0.28							
FILL: Dense brown silty sand with gravel, asphalt and concrete		G	2				
						1	116.34
2.00							
Compact brown **SILTY SAND** with gravel, trace cobbles		G	3				
2.06							

End of Test Pit

Refusal to excavation on inferred bedrock at 2.06 m depth

(Open hole GWL at 1.82 m depth)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

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)

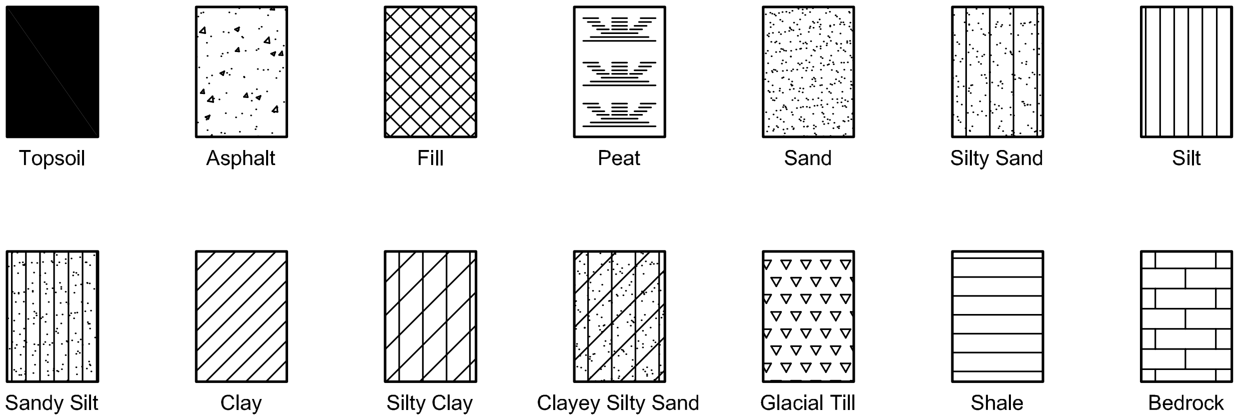
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

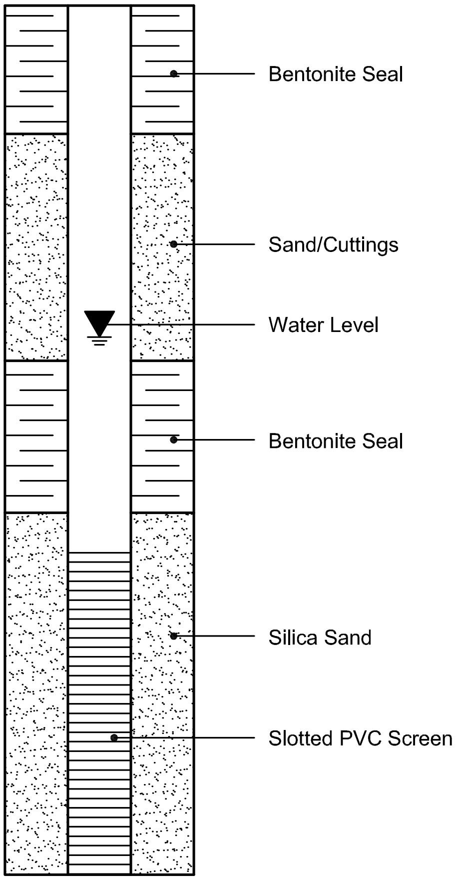
SYMBOLS AND TERMS (continued)

STRATA PLOT

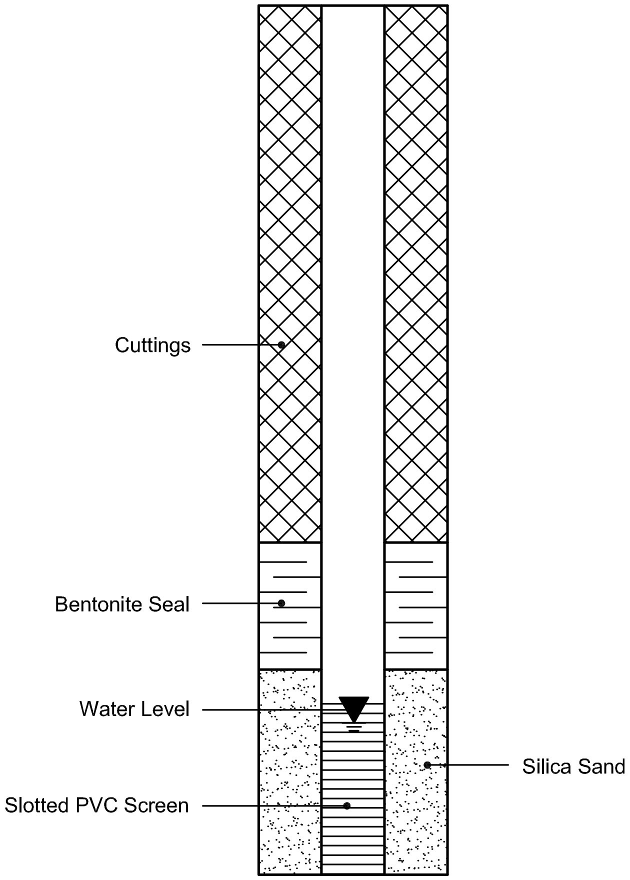


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 54746

Report Date: 02-Jun-2022

Order Date: 26-May-2022

Project Description: PG6233

Client ID:		TP2-G3	-	-	-
Sample Date:		20-May-22 09:00	-	-	-
Sample ID:		2222269-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	86.7	-	-	-
General Inorganics					
pH	0.05 pH Units	7.45	-	-	-
Resistivity	0.10 Ohm.m	70.3	-	-	-
Anions					
Chloride	5 ug/g dry	42	-	-	-
Sulphate	5 ug/g dry	33	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6233-1 - TEST HOLE LOCATION PLAN

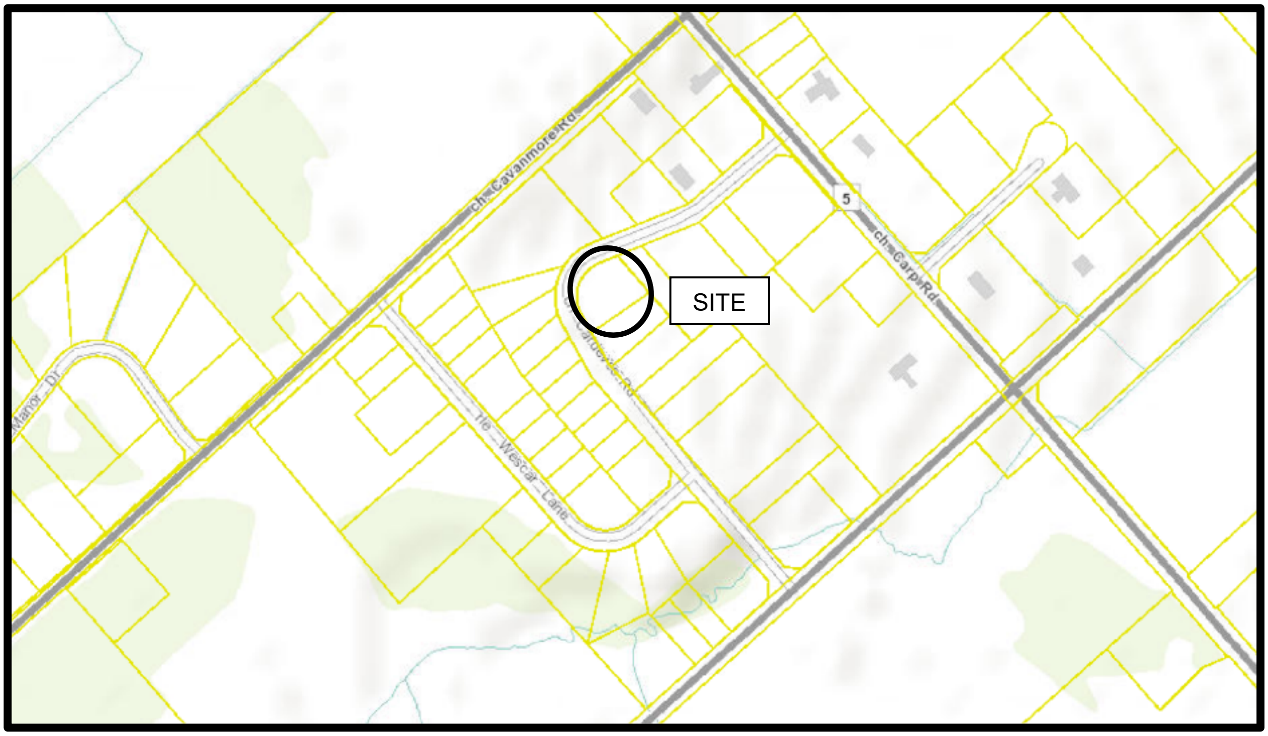
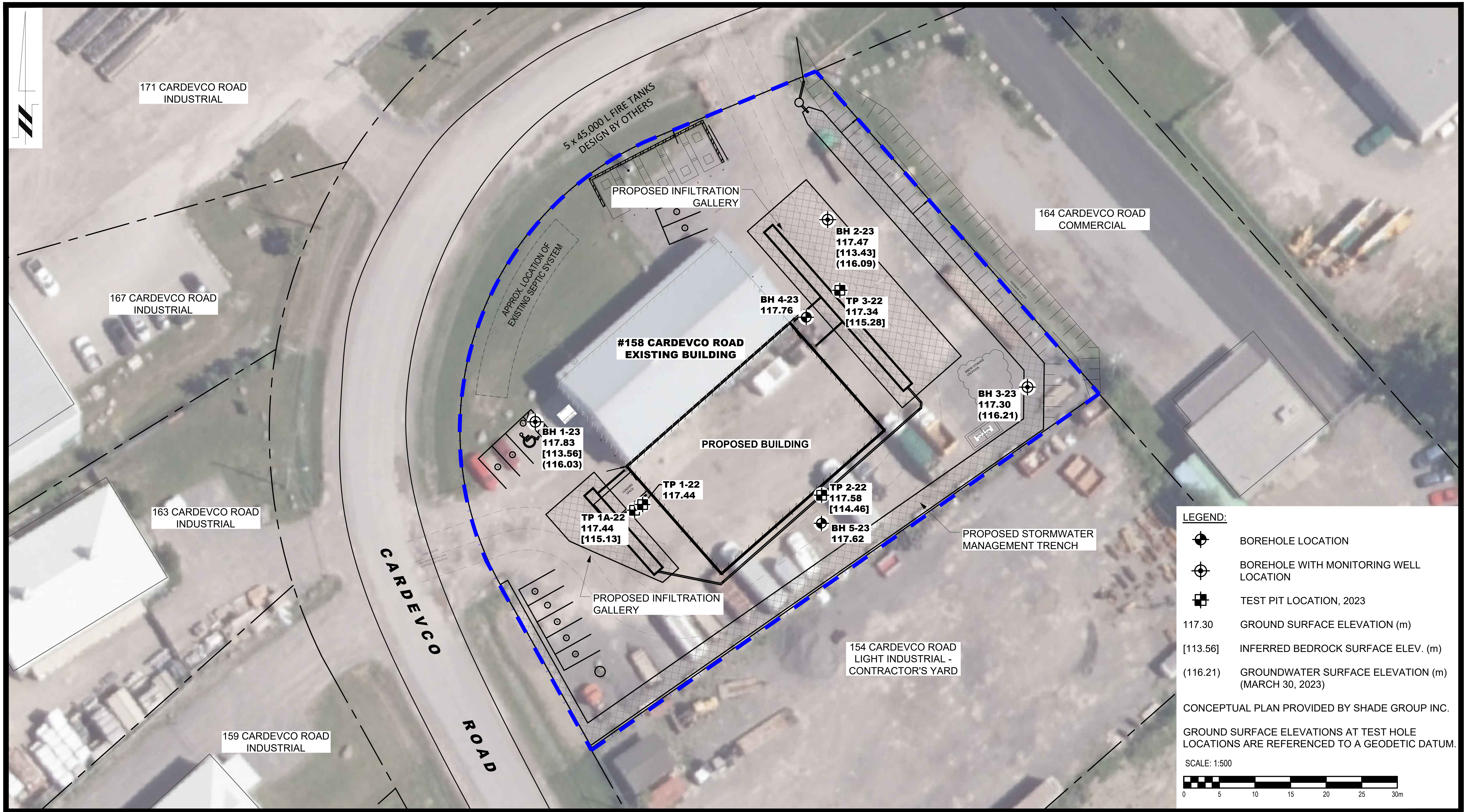


FIGURE 1

KEY PLAN



LEGEND:

⊕	BOREHOLE LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
▚	TEST PIT LOCATION, 2023
117.30	GROUND SURFACE ELEVATION (m)
[113.56]	INFERRED BEDROCK SURFACE ELEV. (m)
(116.21)	GROUNDWATER SURFACE ELEVATION (m) (MARCH 30, 2023)

CONCEPTUAL PLAN PROVIDED BY SHADE GROUP INC.

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

SCALE: 1:500

PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL
1	REVISE TO UPDATE SITE PLAN	11/11/2024	NZ

WHELAN TRUCK REPAIR

GEOTECHNICAL INVESTIGATION
PROPOSED BUILDING ADDITION
158 CARDEVCO ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 12/2023
Drawn by: NFRV	Report No.: PG6233-1
Checked by: BN	Dwg. No.: PG6233-1
Approved by: SD	Revision No.: 1

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11x17

FILE# D07-12-23-0002 SITE PLAN# 19363