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# Geotechnical Investigation

Proposed Commercial Development
4149 Strandherd Drive
Ottawa, Ontario

Prepared For

Myers Automotive Group

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Report: PG5045-1 Revision 3

**Paterson Group Inc.**
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

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# 1.0 Introduction

Paterson Group (Paterson) was commissioned by Myers Automotive Group to conduct a geotechnical investigation for the proposed commercial development to be located at 4149 Strandherd Drive, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

☐ determine the subsoil and groundwater conditions at this site by means of test holes and available soils information.

☐ provide geotechnical recommendations for the design of the proposed development based on the results of the test holes and other soil information available.

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.

# 2.0 Proposed Development

Based on available plans, the proposed development will consist of three automobile dealership buildings. It shall be noted that building A, located within the south east protion of the site has already been constructed. However, Building B to the south west, and Building C to the north.

It is further understood that the remainder of the site will consist of at-grade parking areas, access lanes and landscaped areas, and that the subject site will be municipally serviced.

# 3.0 Method of Investigation

## 3.1 Field Investigation

### Field Program

The field program for the geotechnical investigation was carried out on September 11 and 12, 2019. At that time, nine (9) boreholes (BH 1 to BH 9) were advanced to a maximum depth of 10.5 m below existing ground surface. The test holes were located in the field by Paterson in a manner to provide general coverage of the subject site. The borehole locations are shown on Drawing PG5045-1 - Test Hole Location Plan in Appendix 2.

The boreholes were drilled with a track-mounted drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The drilling procedures consisted of advancing each test hole to the required depths at the selected locations and sampling and testing the overburden.

### Sampling and In Situ Testing

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

Standard Penetration Testing (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.

Undrained shear strength testing, using a vane apparatus, was carried out at regular intervals of depth in cohesive soils.

The overburden thickness was also evaluated during the course of the investigation by dynamic cone penetration testing (DCPT) at two borehole locations. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

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.

**Groundwater**

Flexible polyethylene standpipes were installed within all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

**Sample Storage**

All soil samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

## 3.2 Field Survey

The test hole locations were selected in the field by Paterson personnel in a manner to provide general coverage of the subject site taking into consideration existing site features. Ground surface elevations were referenced to a temporary benchmark (TBM), consisting of the top spindle of a fire hydrant located on the south side of Dealership Drive approximately 50 m west of Strandherd Drive. A geodetic elevation of 96.22 m was provided for the TBM by Stantec Geomatics Ltd. The location of the test holes and TBM are presented on Drawing PG5045-1 - 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 soil sample was submitted from an adjacent site as part of a previous investigation 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 sulphate and chloride concentration, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

# 4.0 Observations

## 4.1 Surface Conditions

Currently, the south east portion of the site is occupied by Building A - Mayers Barrhaven VW Automobile Dealership. However, at the time of the investigation, the subject site consisted of a vacant land. The site was grass covered with occasional bushes and small trees, and was generally flat and at grade with the surrounding properties. The site is bordered to the north and west by vacant lands, to the south by Dealership Drive and to the east by Strandherd Drive.

A drainage ditch was noted west of the subject site approximately parallel to the west property line. A stormwater management pond was also noted, located north of the subject site, approximately 105 m long by 12 m wide. A fill pile was also observed in the northwest corner of the subject site.

An approximately 2 m deep depression was observed in the southwest corner of the site. As currently proposed, the majority of the proposed Building B footprint would be within this area.

## 4.2 Subsurface Profile

### Overburden

Generally, the subsurface profile encountered at the borehole locations consists of a topsoil layer overlying a brown stiff silty clay deposit. A firm to stiff grey silty clay deposit was encountered below the brown silty clay layer. It is noted that the thickness of silty clay layer varies from 0.5 m to 1.1 m at the northern portion of the site, to 3.2 m to 5.7 m at the southern portion of the site. A loose to dense glacial till deposit was encountered below the silty clay deposit. The fine matrix of the glacial till was observed to consist of sandy silt with gravel, cobbles, boulders and trace to some clay, or silty clay with sand, gravel, cobbles and boulders. Practical refusal to augering was encountered at depths ranging from 5.5 to 7.6 m below ground surface. Practical refusal to DCPT was encountered at 16.8 m depth at BH 1. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for details of the soil profiles encountered at each test hole location.

### Bedrock

Based on available geological mapping, the local bedrock consists of interbedded limestone and dolomite of the Gull River formation with an anticipated overburden thickness of 10 to 25 m.

## 4.3 Groundwater

Groundwater levels were measured in the open boreholes at the time of the investigation. The groundwater level observations are presented on the Soil Profile and Test Data sheets in Appendix 1.

It should be noted that groundwater level readings can be influenced by surface water infiltrating the backfilled boreholes. Long-term groundwater levels can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples. Based on these observations, it is estimated that the long-term groundwater table can be expected at approximately 2 to 3 m below ground surface. It should also be noted that groundwater levels are subject to seasonal fluctuations, and therefore the groundwater level could vary at the time of construction.

# 5.0 Discussion

## 5.1 Geotechnical Assessment

The subject site is considered satisfactory for the proposed development, from a geotechnical perspective. It is anticipated that Building C will be founded on conventional shallow footings bearing on the undisturbed, compact glacial till, while Building A and B will be constructed with conventional shallow footings bearing on undisturbed, firm to stiff silty clay.

Due to the presence of a silty clay deposit, a permissible grade raise restriction will be required for the subject site.

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

## 5.2 Site Grading and Preparation

### Stripping Depth

Topsoil and fill, containing deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. Care should be taken not to disturb adequate bearing soils below the subgrade level during site preparation activities.

A minimum 75 mm thick lean concrete mud slab is recommended to be placed over the approved subgrade to protect the bearing surfaces of the proposed buildings from construction and worker traffic.

### Fill Placement

Fill used 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. 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 building should be compacted to at least 98% of its 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. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

## 5.3 Foundation Design

### Bearing Resistance Values

Using continuously applied loads, footings for the proposed buildings can be designed using the bearing resistance values presented in Table 1.

**Table 2 - Bearing Resistance Values**

| Bearing Surface | Bearing Resistance Value at SLS (kPa) | Factored Bearing Resistance Value at ULS (kPa) |
|---|---|---|
| Compact Glacial Till | 150 | 225 |
| Very stiff to stiff brown silty clay | 150 | 225 |
| Firm grey silty clay | 75 | 160 |

**Note:** Strip footings, up to 3 m wide, and pad footings, up to 6 m wide, placed over a silty clay bearing surface can be designed using the above noted bearing resistance values.

The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively. Bearing resistance values for footing design should be determined on a per lot basis at the time of construction.

### 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 silty clay, glacial till or engineered fill above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

### Permissible Grade Raise

**A permissible grade raise restriction of 1.0 m** is recommended for areas where building foundations are founded over a silty clay deposit. A post-development groundwater lowering of 0.5 m was considered in our permissible grade raise calculations If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

## 5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered at this site. The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

## 5.5 Floor Slab Construction

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprint of the proposed building, the native soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction.

It is recommended that a minimum 75 mm thick lean concrete (15 MPa strength) mud slab be placed to protect the silty clay bearing surface from disturbance due to construction and worker traffic. The bearing surface should be inspected and approved by Paterson personnel prior to placement of the mud slab.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II is recommended for backfilling below the floor slab. All backfill materials within the footprint of the proposed building should be placed in maximum 300 mm loose lifts and compact to at least 98% of the material's SPMDD. The upper 200 mm of sub-slab fill below the slab-on-grade should consist of OPSS Granular A crushed stone.

If a basement level is considered, it is expected that the basement area for the proposed multi-storey building will be mostly parking and the recommended pavement structure noted in Subsection 5.7 will be applicable. However, if storage or other uses of the lower level are proposed where a concrete floor slab will be used, it is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

## 5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for basement walls, if included in the design of the proposed buildings. However, in our opinion, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m$^3$. The applicable effective unit weight of the retained soil can be estimated as 13 kN/m$^3$, where applicable. A hydrostatic pressure should be added to the total static earth pressure when calculating the effective unit weight.

The total earth pressure ($P_{AE}$) includes both the static earth pressure component ($P_o$) and the seismic component ($\Delta P_{AE}$).

### Static Earth Pressures

The static horizontal earth pressure ($P_o$) can be calculated by a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

$K_o$ = at-rest earth pressure coefficient of the applicable retained soil, 0.5
$\gamma$ = unit weight of fill of the applicable retained soil (kN/m$^3$)
$H$ = height of the wall (m)

### Seismic Earth Pressures

The seismic earth pressure ($\Delta P_{AE}$) can be calculated using the earth pressure distribution equal to $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

$a_c$ = $(1.45\text{-}a_{max}/g)a_{max}$
$\gamma$ = unit weight of fill of the applicable retained soil (kN/$m^3$)
H = height of the wall (m)
g = gravity, 9.81 m/$s^2$

The peak ground acceleration, ($a_{max}$), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero.

The earth force component ($P_o$) under seismic conditions could be calculated using $P_o = 0.5\ K_o\gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force ($P_{AE}$) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o\cdot(H/3)+\Delta P_{AE}\cdot(0.6\cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

## 5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and access lanes.

**Table 2 - Recommended Pavement Structure - Car Only Parking Areas**

| Thickness (mm) | Material Description |
|---|---|
| 50 | **Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete |
| 150 | **BASE** - OPSS Granular A Crushed Stone |
| 300 | **SUBBASE** - OPSS Granular B Type II |
| **SUBGRADE** - Either fill, in situ silty clay 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 |
| 450 | **SUBBASE** - OPSS Granular B Type II |
| **SUBGRADE** - Either fill, in situ silty clay 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.

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

### Pavement Structure Drainage

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

Due to the impervious nature of the subgrade materials consideration should be given to installing subdrains during the pavement construction. These drains should extend in four orthogonal directions or longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines or the pipe, should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be shaped to promote water flow to the drainage lines.

# 6.0 Design and Construction Precautions

## 6.1 Foundation Drainage and Backfill

### Perimeter Drainage System

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

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 where frost heave sensitive structures, such as sidewalks, will be placed. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material may be used for this purpose. A composite drainage system, such as Delta Drain 6000 or equivalent should be placed against the foundation wall to promote drainage toward the perimeter drainage pipe.

### Underfloor Drainage

It is anticipated that underfloor drainage will be required to control water infiltration below any underground parking structures. The spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

### Foundation Backfill

Where space is available, 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 composite drainage system, such as Delta Drain 6000 or an approved equivalent. 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 required to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for exterior unheated footings, not thermally connected to a heated space, such as exterior columns and/or wing walls.

It has been our experience that insufficient soil cover is typically provided to footings located in areas where minimal soil cover is available, such as entrance ramps to underground parking garages. Paterson requests permission to review design drawings prior to construction to ensure proper frost protection is provided.

## 6.3 Excavation

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.

### Unsupported Excavation

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 subsurface soil is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. 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.

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

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

## 6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of its SPMDD.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

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) 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 95% of the material’s SPMDD.

To reduce long term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material’s SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

## 6.5 Groundwater Control

### Groundwater Control for Building Construction

It is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of the excavation, provided that a series of drainage lines are placed at subgrade level to direct water flow toward the sump pumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

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

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

### Long-term Groundwater Control

Our recommendations for the proposed buildings' long-term groundwater control are presented in Subsection 6.1. Any groundwater which encounters the buildings' perimeter groundwater infiltration control system will be directed to the storm sewer or the proposed building sump pit. It is expected that groundwater flow will be low (i.e. less than 25,000 L/day with peak periods noted after rain events. It is anticipated that the groundwater flow will be controllable using conventional open sumps.

### Impacts on Neighbouring Structures

It is understood that one or two levels of underground parking are planned for one of the proposed buildings. Based on the long-term groundwater level and low permeability of the soils, the extent of any significant groundwater lowering will take place within a limited range of the proposed building. Based on the proximity of neighbouring buildings and minimal zone impacted by the groundwater lowering, the proposed development will not negatively impact the neighbouring structures.

It should be noted that no issues are expected with respect to groundwater lowering that would cause long term damage to adjacent structures surrounding the proposed buildings.

## 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 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.

## 6.7 Corrosion Potential and Sulphate

The analytical testing results 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 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 moderately aggressive corrosive environment.

# 7.0 Recommendations

For the foundation design data provided herein to be applicable, a materials testing and observation services program is required to be completed. The following aspects should be performed by the geotechnical consultant:

- ☐ A review of the site grading plan(s) from a geotechnical perspective, once available.
- ☐ A review of architectural and structural drawings to ensure adequate frost protection is provided to the subsoil.
- ☐ Observation of all bearing surfaces prior to the placement of concrete.
- ☐ Sampling and testing of the concrete and fill materials used.
- ☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ☐ Observation of all subgrades prior to backfilling.
- ☐ Field density tests to determine the level of compaction achieved.
- ☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming the construction has been conducted in general accordance with the recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

# 8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available and our recommendations when the drawings and specifications are complete.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The recommendations provided in this report are intended for the use of design professionals associated with this project. Contractors bidding on or undertaking the work should examine the factual information contained in this report and the site conditions, satisfy themselves as to the adequacy of the information provided for construction purposes, supplement the factual information if required, and develop their own interpretation of the factual information based on both their and their subcontractors construction methods, equipment capabilities and schedules.

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 Myers Automotive Group or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

**Paterson Group Inc.**

LICENSED PROFESSIONAL ENGINEER
December 23, 2021
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Maha Saleh, M.A.Sc., PEng. (Prov.)

David J. Gilbert, P.Eng.

**Report Distribution:**

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# APPENDIX 1

## SOIL PROFILE AND TEST DATA SHEETS

## SYMBOLS AND TERMS

## ANALYTICAL TESTING RESULTS

**patersongroup** Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

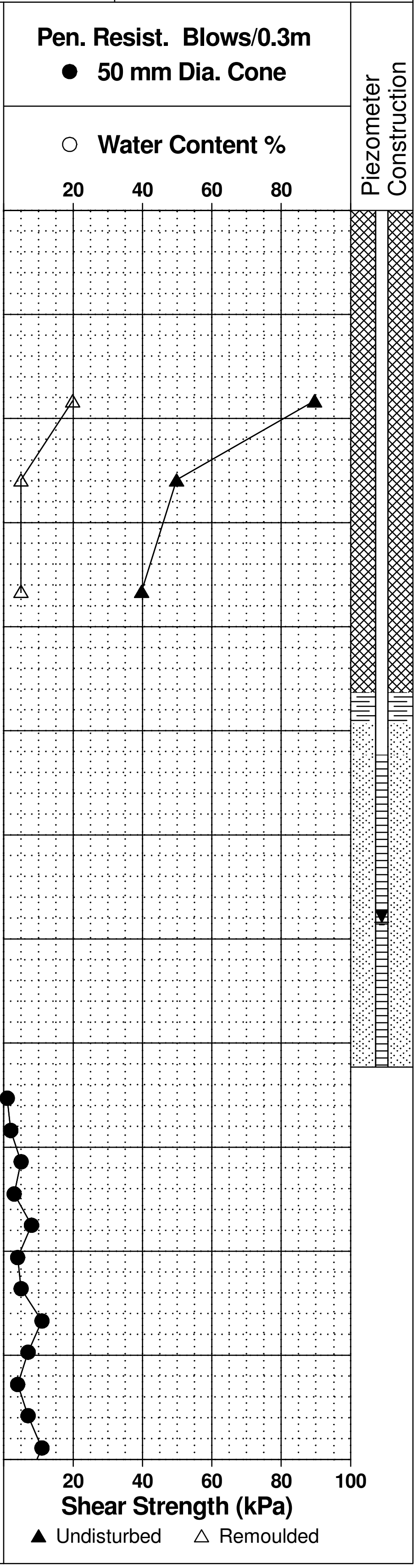
# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

**DATUM** TBM - Top spindle of fire hydrant located across from subject site, along Dealership Drive. Geodetic elevation = 96.22m, provided by Stantec Geomatics Ltd.
**REMARKS**
**BORINGS BY** CME 55 Power Auger
**DATE** 2019 September 11
**FILE NO.** PG5045
**HOLE NO.** BH 1

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | % RECOVERY | N VALUE or RQD |
|---|---|---|---|---|---|
| GROUND SURFACE | | | | | |
| **TOPSOIL** 0.15 | | AU | 1 | | |
| Stiff to firm, brown **SILTY CLAY**<br>- grey by 2.3m depth<br>3.81 | | SS | 2 | 100 | 5 |
| **GLACIAL TILL:** Grey silty clay, some sand and gravel<br>5.40 | | SS<br>SS | 3<br>4 | 46<br>46 | 6<br>3 |
| **GLACIAL TILL:** Grey sandy silt with gravel, some clay<br>6.90 | | SS<br>SS | 5<br>6 | 58<br>58 | 22<br>8 |
| **GLACIAL TILL:** Grey silty clay, some sand and gravel<br>8.23 | | SS<br>SS | 7<br>8 | 58<br>67 | 16<br>7 |
| Dynamic Cone Penetration Test commenced at 8.23m depth.<br>Inferred **GLACIAL TILL** | | | | | |

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 94.45 |
| 1 | 93.45 |
| 2 | 92.45 |
| 3 | 91.45 |
| 4 | 90.45 |
| 5 | 89.45 |
| 6 | 88.45 |
| 7 | 87.45 |
| 8 | 86.45 |
| 9 | 85.45 |
| 10 | 84.45 |
| 11 | 83.45 |
| 12 | 82.45 |



# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

**DATUM** TBM - Top spindle of fire hydrant located across from subject site, along Dealership Drive. Geodetic elevation = 96.22m, provided by Stantec Geomatics Ltd.

**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 11

**FILE NO.** PG5045

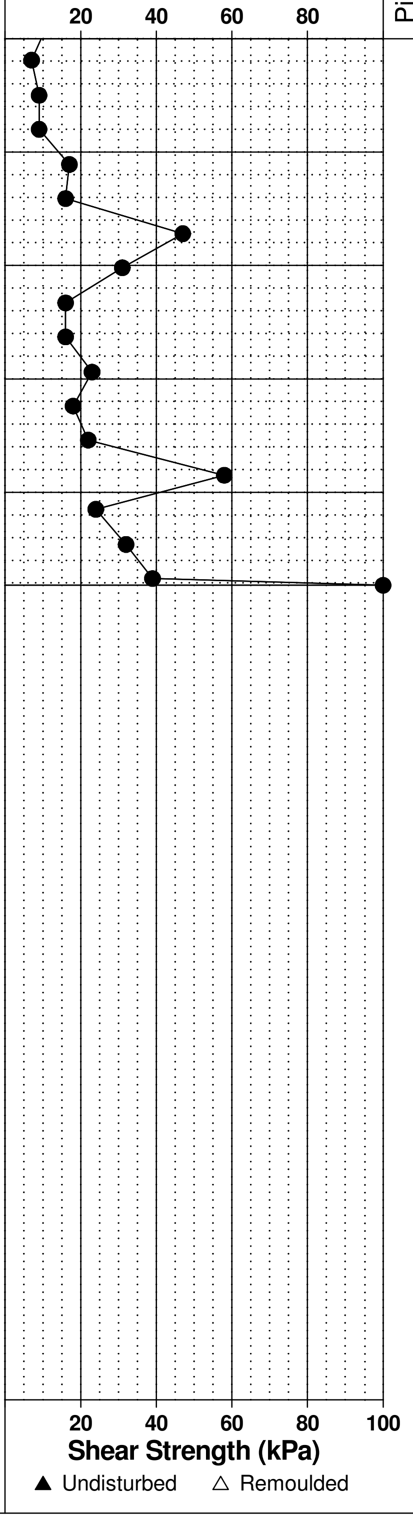
**HOLE NO.** BH 1

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| GROUND SURFACE | | | | | | | |
| | | | | | | 12 | 82.45 |
| | | | | | | 13 | 81.45 |
| Inferred **GLACIAL TILL** | | | | | | 14 | 80.45 |
| | | | | | | 15 | 79.45 |
| | | | | | | 16 | 78.45 |
| 16.82 | | | | | | | |
| End of Borehole<br>Practical DCPT refusal at 16.82m depth<br>(GWL @ 6.84m - Sept. 23, 2019) | | | | | | | |

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

○ Water Content %

Piezometer Construction



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# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

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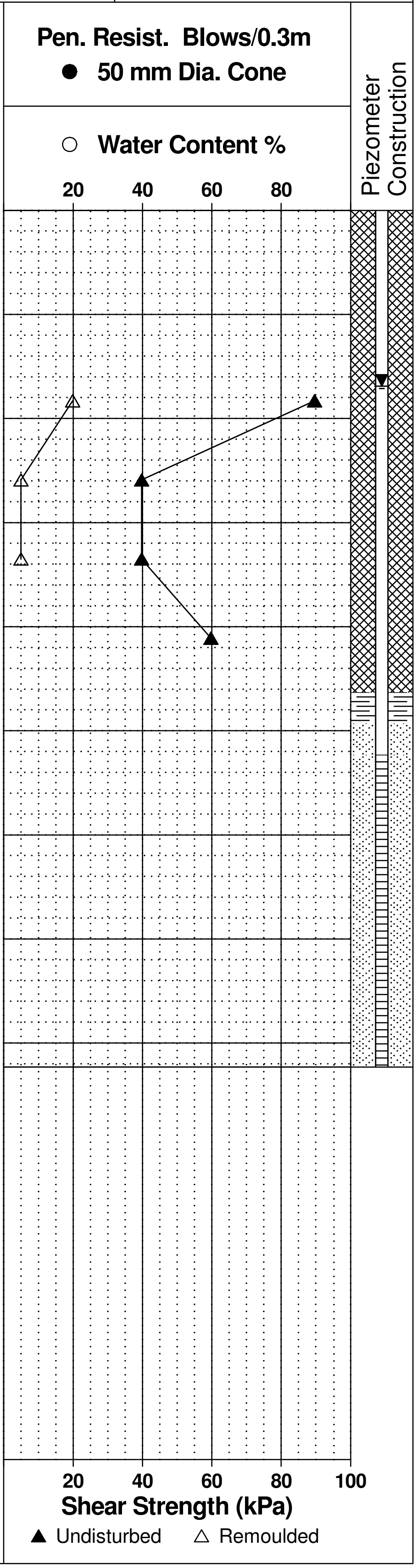
**REMARKS**
**BORINGS BY** CME 55 Power Auger
**DATE** 2019 September 11
**FILE NO.** PG5045
**HOLE NO.** BH 2

| SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | % RECOVERY | N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | 0 | 94.54 |
| **TOPSOIL** 0.18 | AU | 1 | | | | |
| Stiff, brown **SILTY CLAY** | SS | 2 | 79 | 6 | 1 | 93.54 |
| - firm to stiff and grey by 2.3m depth | | | | | 2 | 92.54 |
| | | | | | 3 | 91.54 |
| | | | | | 4 | 90.54 |
| 5.33 | | | | | 5 | 89.54 |
| **GLACIAL TILL:** Grey sandy silt with gravel, some clay | SS | 4 | 83 | 6 | 6 | 88.54 |
| | SS | 5 | 50 | 8 | | |
| | SS | 6 | 50 | 7 | 7 | 87.54 |
| 8.23 | SS | 7 | 54 | 17 | 8 | 86.54 |
| End of Borehole<br>(GWL @ 1.69m - Sept. 23, 2019) | | | | | | |



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# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

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**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 11

**FILE NO.** PG5045

**HOLE NO.** BH 3

| SOIL DESCRIPTION | Bottom depth (m) |
|---|---|
| GROUND SURFACE | |
| **TOPSOIL** | 0.08 |
| Stiff to firm, brown **SILTY CLAY**<br>- stiff and grey by 3.0m depth | 5.33 |
| **GLACIAL TILL:** Grey sandy silt with gravel, some clay, trace cobbles and boulders | 7.62 |

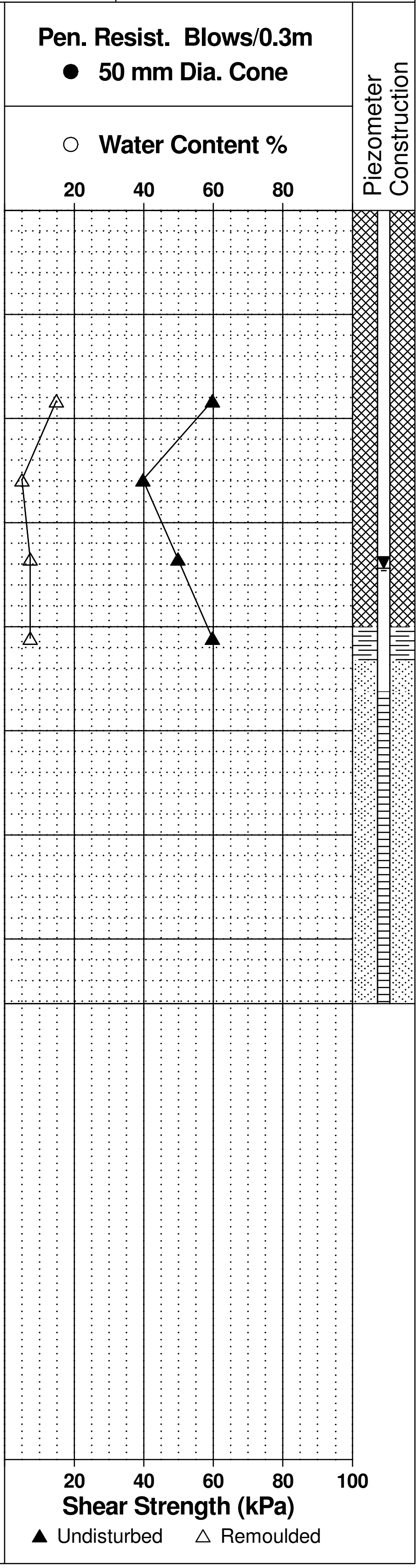
End of Borehole

Practical refusal to augering at 7.62m depth

(GWL @ 3.44m - Sept. 23, 2019)

| SAMPLE TYPE | NUMBER | % RECOVERY | N VALUE or RQD |
|---|---|---|---|
| AU | 1 | | |
| SS | 2 | 100 | 3 |
| SS | 3 | 12 | 4 |
| SS | 4 | 46 | 53 |
| SS | 5 | 50 | 10 |
| SS | 6 | 38 | 31 |

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 94.23 |
| 1 | 93.23 |
| 2 | 92.23 |
| 3 | 91.23 |
| 4 | 90.23 |
| 5 | 89.23 |
| 6 | 88.23 |
| 7 | 87.23 |



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# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

**DATUM** TBM - Top spindle of fire hydrant located across from subject site, along Dealership Drive. Geodetic elevation = 96.22m, provided by Stantec Geomatics Ltd.

**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 11

**FILE NO.** PG5045

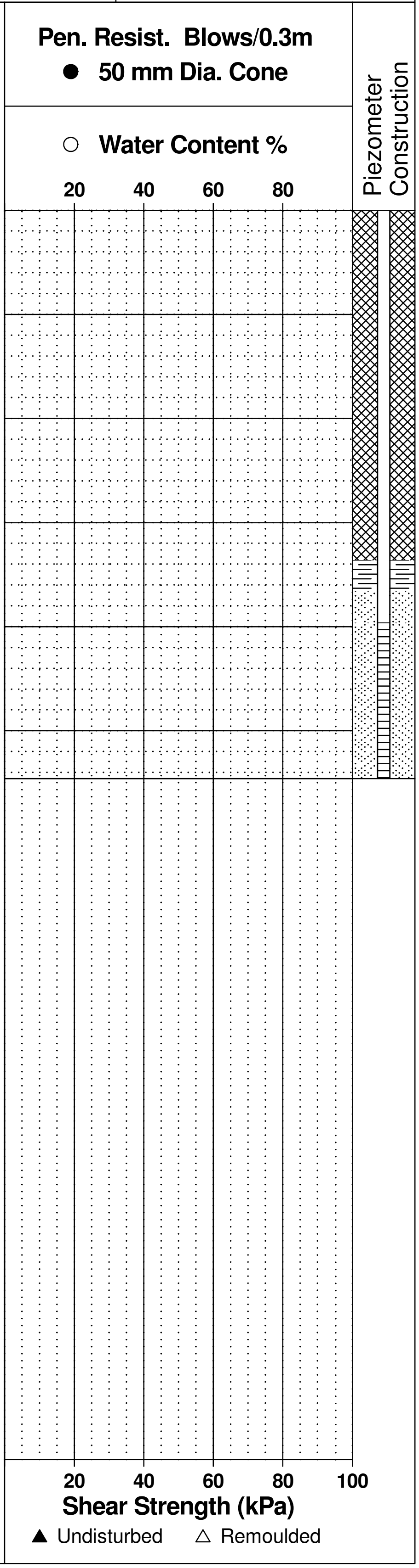
**HOLE NO.** BH 4

| SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | 0 | 94.94 |
| **TOPSOIL** 0.08 | AU | 1 | | | | |
| Stiff, brown **SILTY CLAY** 1.17 | SS | 2 | 83 | 6 | 1 | 93.94 |
| **GLACIAL TILL:** Brown silty sand to sandy silt with gravel and clay<br>- grey by 2.3m depth | | | | | 2 | 92.94 |
| | SS | 4 | 33 | 9 | | |
| | | | | | 3 | 91.94 |
| | SS | 5 | 42 | 6 | | |
| | | | | | 4 | 90.94 |
| | SS | 6 | 12 | 9 | | |
| | SS | 7 | 71 | 9 | | |
| | | | | | 5 | 89.94 |
| 5.46 | SS | 8 | 100 | 50+ | | |

End of Borehole

Practical refusal to augering at 5.46m depth

(Piezometer blocked and dry at 5.52m depth - Sept. 23, 2019)



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# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

**DATUM** TBM - Top spindle of fire hydrant located across from subject site, along Dealership Drive. Geodetic elevation = 96.22m, provided by Stantec Geomatics Ltd.

**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 11

**FILE NO.** PG5045

**HOLE NO.** BH 5

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | 95.47 |
| **TOPSOIL** 0.10 | | AU | 1 | | | | |
| Stiff, brown **SILTY CLAY**<br>- with sand by 0.9m depth 1.17 | | SS | 2 | 92 | 7 | 1 | 94.47 |
| **GLACIAL TILL:** Brown silty sand to sandy silt with gravel, trace clay | | SS | 3 | 58 | 30 | 2 | 93.47 |
| | | SS | 4 | 33 | 9 | 3 | 92.47 |
| - grey by 3.2m depth | | SS | 5 | 62 | 9 | | |
| | | SS | 6 | 75 | 13 | 4 | 91.47 |
| | | SS | 7 | 71 | 12 | 5 | 90.47 |
| 6.04 | | SS | 8 | 67 | 19 | 6 | 89.47 |

End of Borehole

Practical refusal to augering at 6.04m depth

(GWL @ 4.68m - Sept. 23, 2019)

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

○ **Water Content %**

20 40 60 80

Piezometer Construction

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

# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

**DATUM** TBM - Top spindle of fire hydrant located across from subject site, along Dealership Drive. Geodetic elevation = 96.22m, provided by Stantec Geomatics Ltd.

**REMARKS**

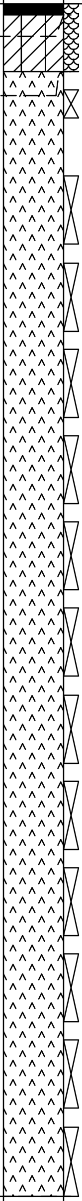
**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 12

**FILE NO.** PG5045

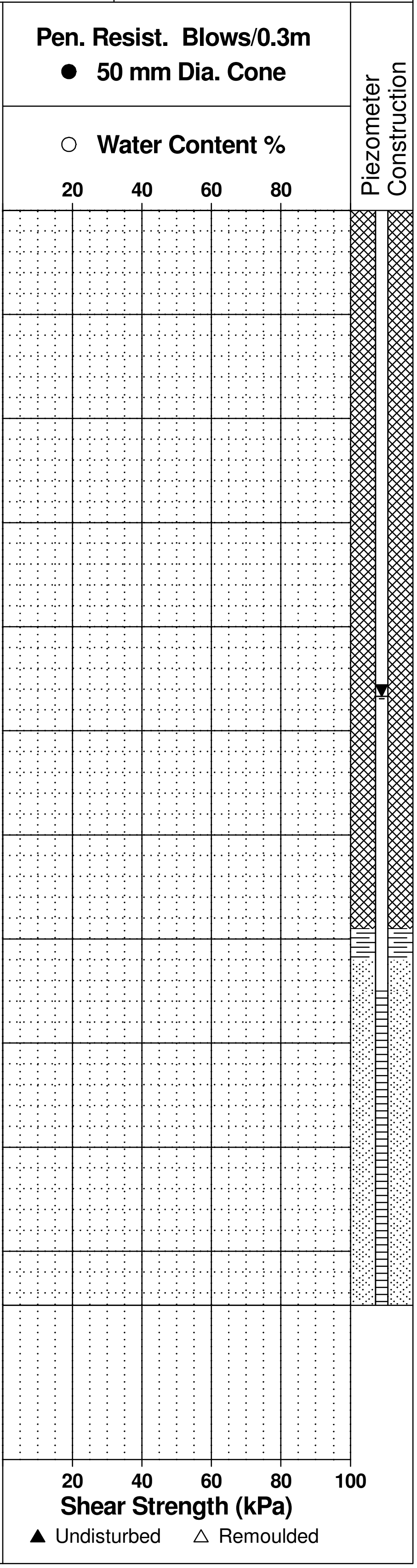
**HOLE NO.** BH 6

| SOIL DESCRIPTION | Depth (m) |
|---|---|
| **GROUND SURFACE** | |
| **TOPSOIL** | 0.10 |
| Stiff, brown **SILTY CLAY,** some sand | 0.60 |
| **GLACIAL TILL:** Brown silty sand to sandy silt, some gravel, trace to some clay<br>- grey by 2.8m depth | 10.52 |
| End of Borehole<br>(GWL @ 4.67m - Sept. 23, 2019) | |



| TYPE | NUMBER | % RECOVERY | N VALUE or RQD |
|---|---|---|---|
| AU | 1 | | |
| SS | 2 | 70 | 50+ |
| SS | 3 | 58 | 21 |
| SS | 4 | 62 | 11 |
| SS | 5 | 79 | 12 |
| SS | 6 | 54 | 28 |
| SS | 7 | 71 | 16 |
| SS | 8 | 100 | 10 |
| SS | 9 | 21 | 49 |
| SS | 10 | 42 | 7 |
| SS | 11 | 33 | 7 |
| SS | 12 | 25 | 3 |
| SS | 13 | 25 | 3 |
| SS | 14 | 58 | 17 |

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 95.42 |
| 1 | 94.42 |
| 2 | 93.42 |
| 3 | 92.42 |
| 4 | 91.42 |
| 5 | 90.42 |
| 6 | 89.42 |
| 7 | 88.42 |
| 8 | 87.42 |
| 9 | 86.42 |
| 10 | 85.42 |



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# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
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**REMARKS**

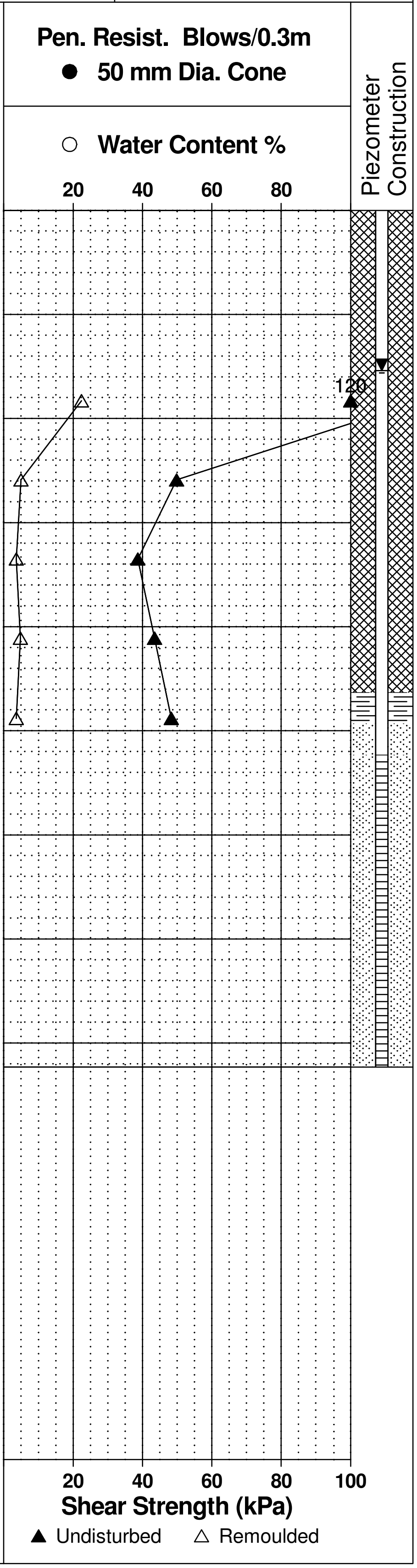
**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 12

**FILE NO.** PG5045

**HOLE NO.** BH 7

| SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | 0 | 94.58 |
| **TOPSOIL** 0.08 | AU | 1 | | | | |
| Very stiff to stiff, brown **SILTY CLAY,** trace sand and gravel | SS | 2 | 100 | 6 | 1 | 93.58 |
| | | | | | 2 | 92.58 |
| 3.35 | | | | | 3 | 91.58 |
| Firm, grey **SILTY CLAY** | | | | | 4 | 90.58 |
| 5.33 | | | | | 5 | 89.58 |
| **GLACIAL TILL:** Grey sandy silt with gravel, trace clay | SS | 4 | 54 | 10 | 6 | 88.58 |
| | SS | 5 | 50 | 21 | 7 | 87.58 |
| | SS | 6 | 33 | 11 | | |
| 8.23 | SS | 7 | 42 | 18 | 8 | 86.58 |
| End of Borehole<br>(GWL @ 1.54m - Sept. 23, 2019) | | | | | | |



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# SOIL PROFILE AND TEST DATA

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**Prop. Commercial Development - 4149 Strandherd Drive**
**Ottawa, Ontario**

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**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 12

**FILE NO.** PG5045

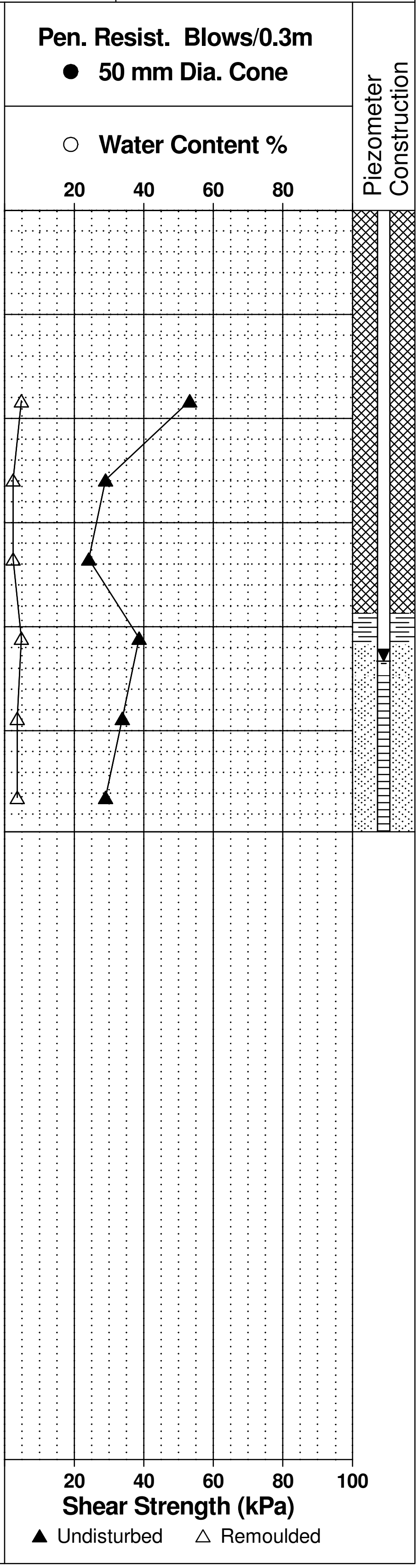
**HOLE NO.** BH 8

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | 93.63 |
| **TOPSOIL** 0.05 | | AU | 1 | | | | |
| | | SS | 2 | 100 | 2 | 1 | 92.63 |
| Stiff to firm, brown **SILTY CLAY**<br>- grey by 2.3m depth | | | | | | 2 | 91.63 |
| | | | | | | 3 | 90.63 |
| | | | | | | 4 | 89.63 |
| | | | | | | 5 | 88.63 |
| 5.64 **GLACIAL TILL;** Grey sandy silt with gravel, some clay, trace cobbles and boulders 5.97 | | SS | 4 | 71 | 5 | | |

End of Borehole

Practical refusal to augering at 5.97m depth

(GWL @ 4.33m - Sept. 23, 2019)



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**REMARKS**

**BORINGS BY** CME 55 Power Auger

**DATE** 2019 September 12

**FILE NO.** PG5045

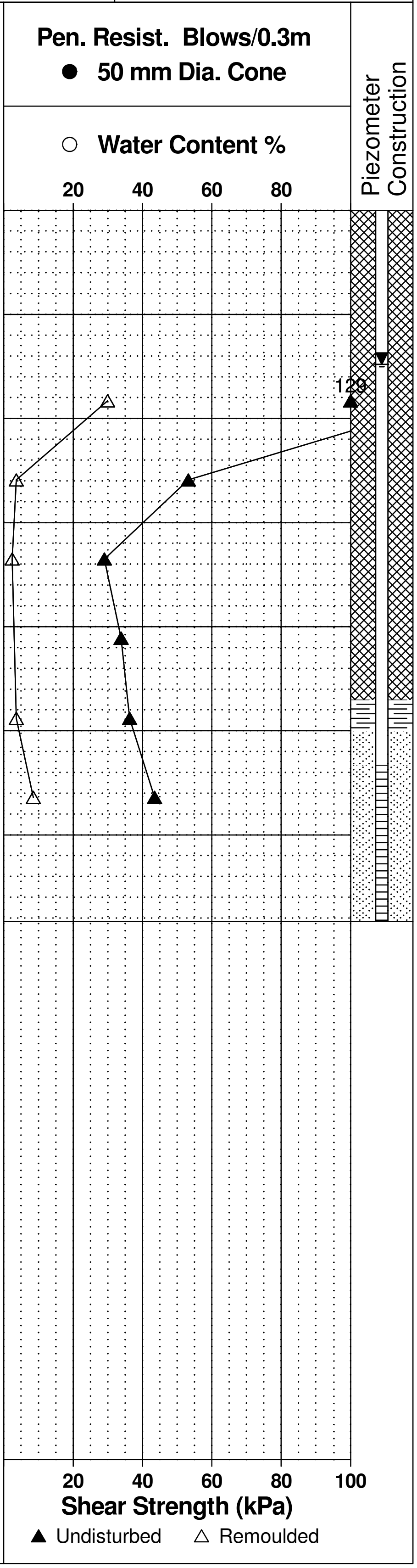
**HOLE NO.** BH 9

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | 94.55 |
| **TOPSOIL** 0.05 | | AU | 1 | | | | |
| | | SS | 2 | | 7 | 1 | 93.55 |
| Very stiff to stiff, brown **SILTY CLAY** | | | | | | 2 | 92.55 |
| - firm and grey by 3.0m depth | | | | | | 3 | 91.55 |
| | | | | | | 4 | 90.55 |
| | | | | | | 5 | 89.55 |
| 5.79 | | SS | 4 | 100 | 4 | | |
| **GLACIAL TILL:** Grey sandy silt with gravel, cobbles and boulders, trace clay | | | | | | 6 | 88.55 |
| | | SS | 5 | 38 | 16 | | |
| 6.83 | | | | | | | |

End of Borehole

Practical refusal to augering at 6.83m depth

(GWL @ 1.48m - Sept. 23, 2019)



# 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 $p'_c$)

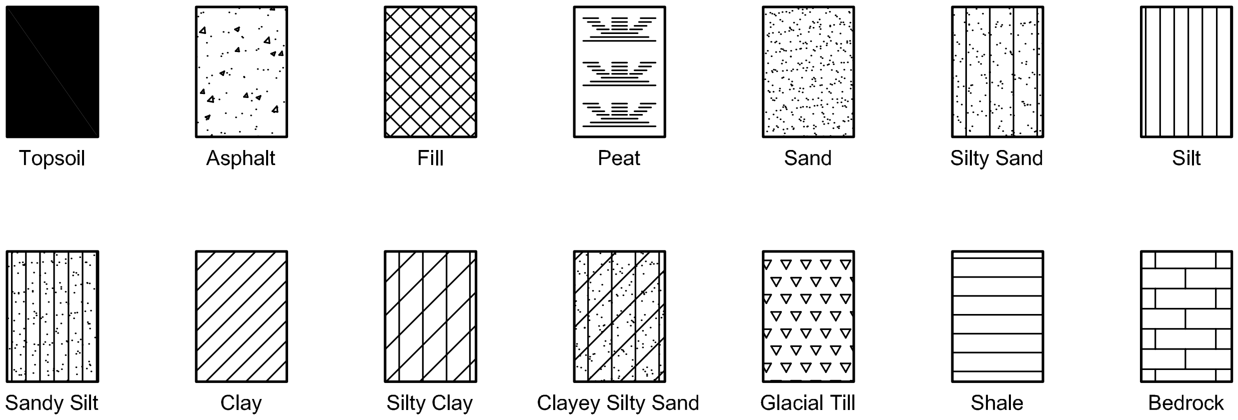
OC Ratio Overconsolidaton ratio = $p'_c$ / $p'_o$
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

## 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.

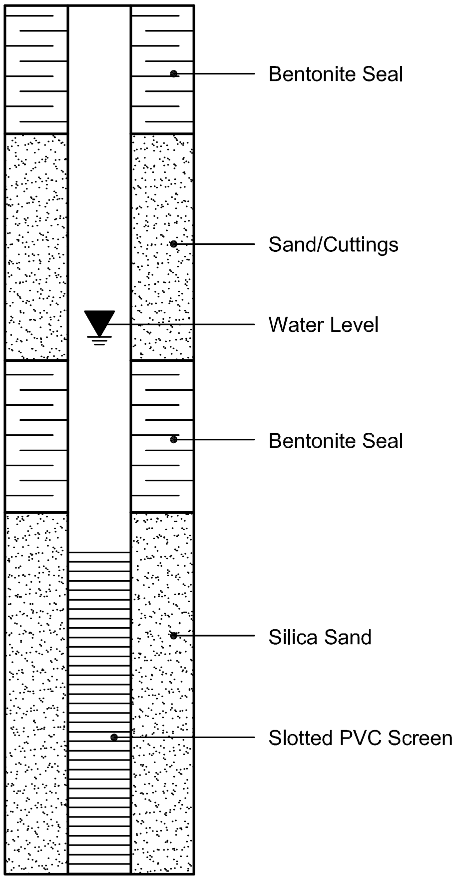
# SYMBOLS AND TERMS (continued)

## STRATA PLOT

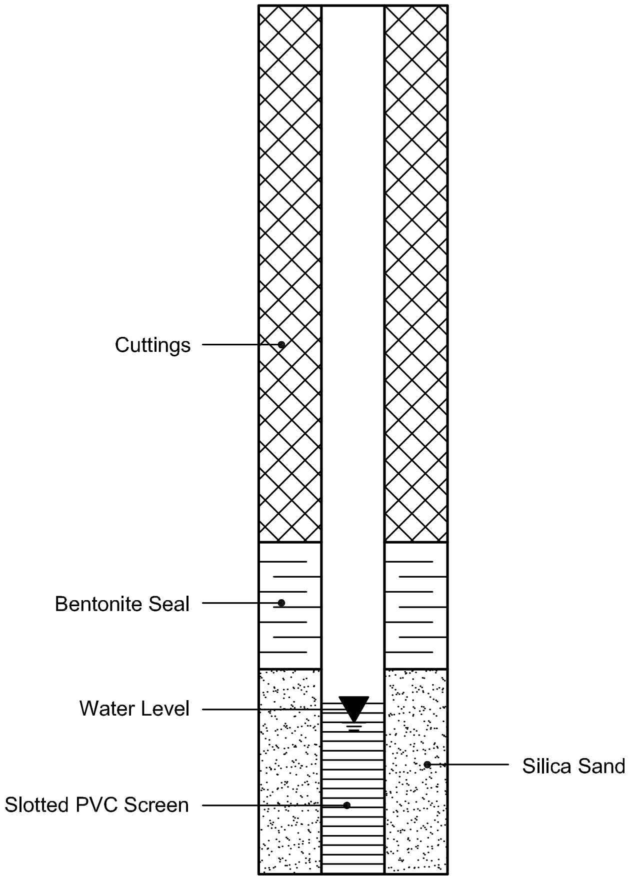


## MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



## *Certificate of Analysis*

Report Date: 08-Dec-2014
Order Date:28-Nov-2014

Client: **Paterson Group Consulting Engineers**
Client PO: 17344
Project Description: PG3380

| | | | | | |
|---|---|---|---|---|---|
| | **Client ID:** | BH3 SS3 | - | - | - |
| | **Sample Date:** | 27-Nov-14 | - | - | - |
| | **Sample ID:** | 1448345-01 | - | - | - |
| | **MDL/Units** | Soil | - | - | - |
| **Physical Characteristics** | | | | | |
| % Solids | 0.1 % by Wt. | 73.5 | - | - | - |
| **General Inorganics** | | | | | |
| pH | 0.05 pH Units | 7.37 | - | - | - |
| Resistivity | 0.10 Ohm.m | 46.2 | - | - | - |
| **Anions** | | | | | |
| Chloride | 5 ug/g dry | 8 | - | - | - |
| Sulphate | 5 ug/g dry | 7 | - | - | - |

P: 1-800-749-1947
E: PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

OTTAWA-EAST
300-2319 St. Laurent Blvd.
Ottawa, ON K1G 4J8

OTTAWA-WEST
104-195 Stafford Rd. W.
Nepean, ON K2H 9C1

MISSISSAUGA
6645 Kitimat Rd. Unit #27
Mississauga, ON L5N 6J3

SARNIA
218-704 Mara St.
Point Edward, ON N7V 1X4

NIAGARA
360 York Rd. Unit 16B
Niagara-on-the-Lake, ON L0S 1JC

KINGSTON
1058 Gardiners Rd.
Kingston, ON K7P 1R7

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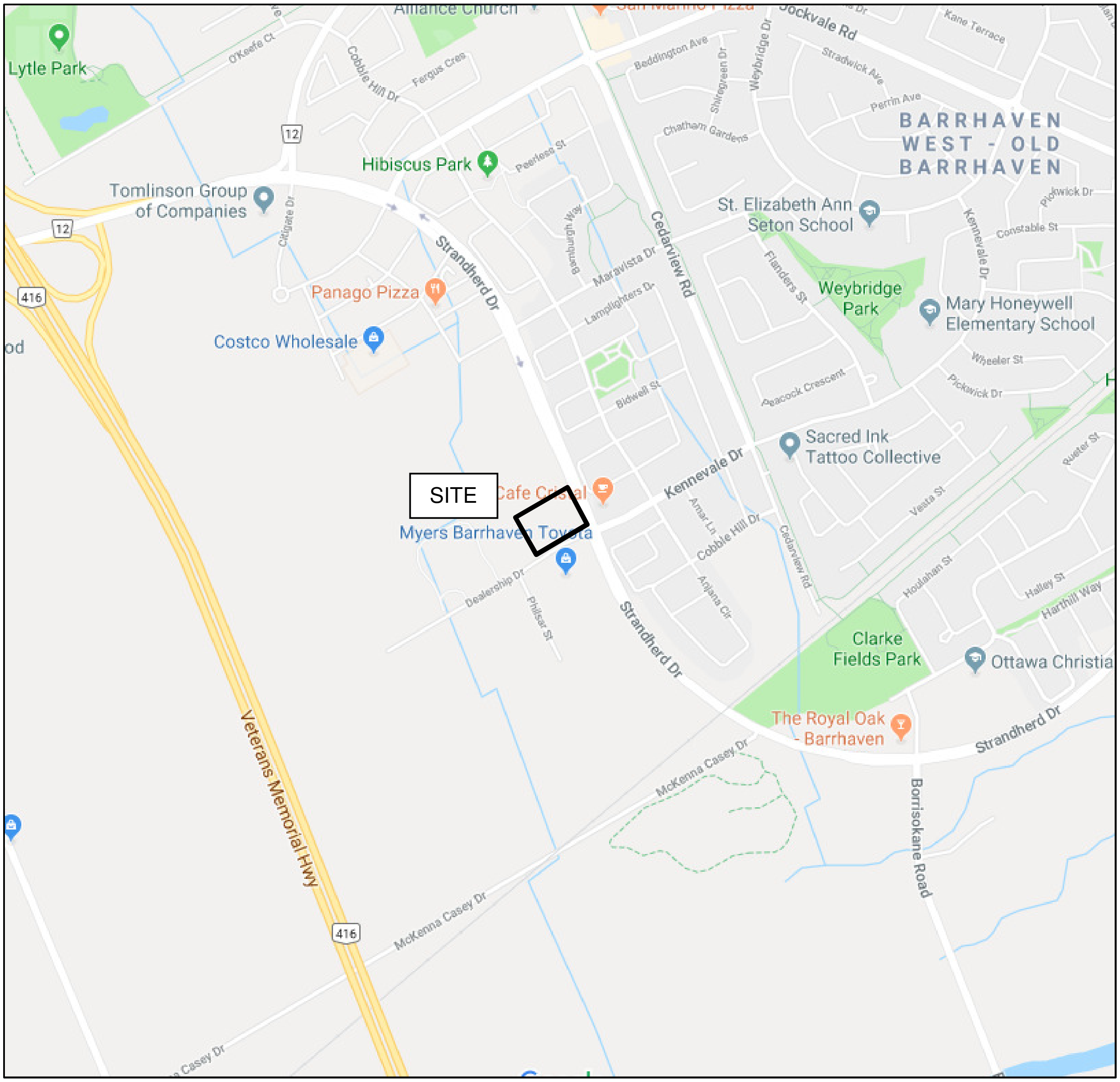
# APPENDIX 2

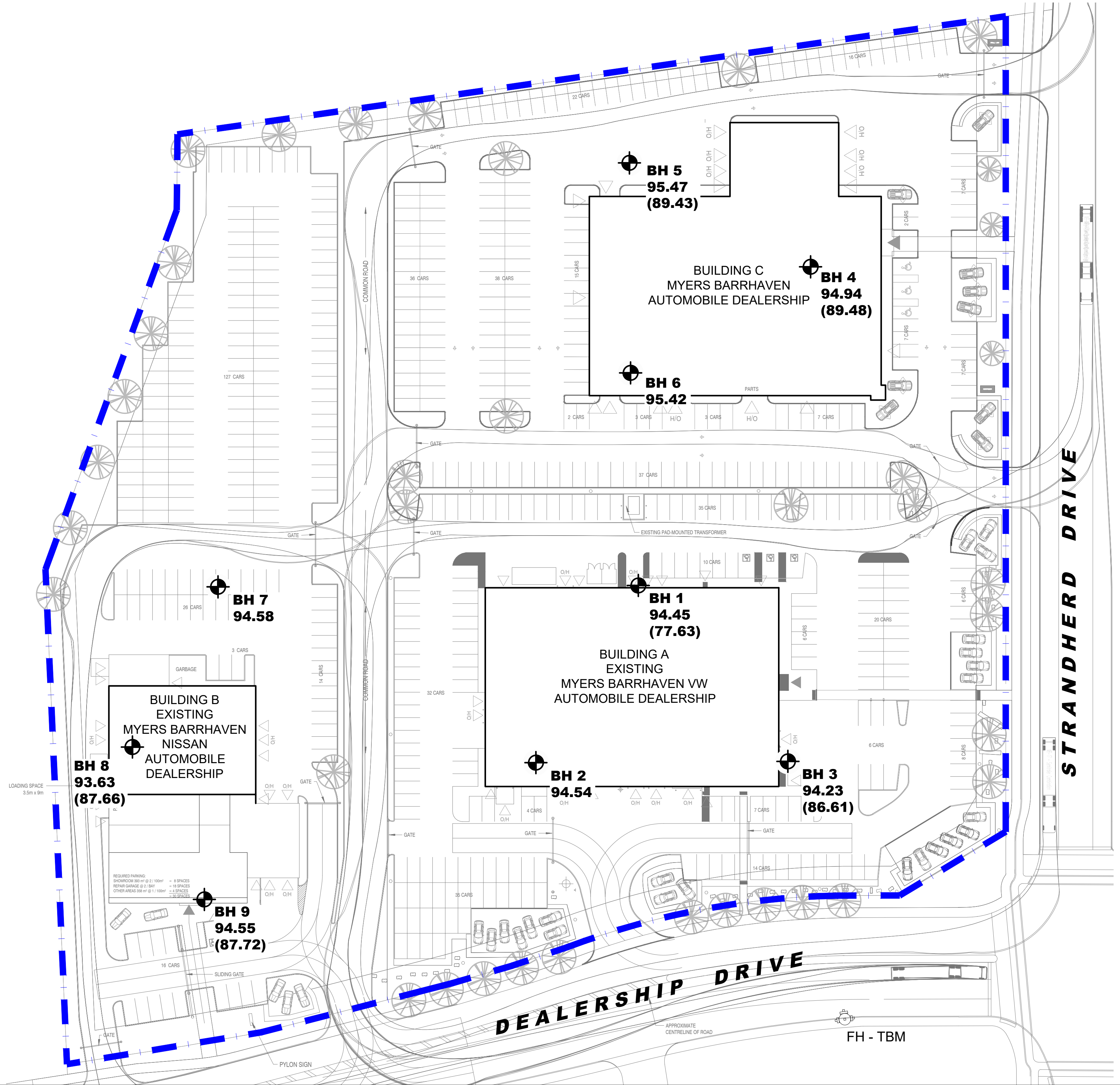
FIGURE 1 - KEY PLAN

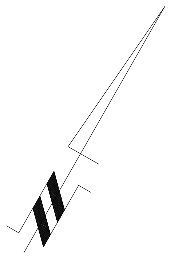
DRAWING PG5045-1 - TEST HOLE LOCATION PLAN



# FIGURE 1

## KEY PLAN





LEGEND:

| | |
|---|---|
| ⊕ | BOREHOLE LOCATION |
| 94.45 | GROUND SURFACE ELEVATION (m) |
| (77.63) | PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m) |

CONCEPTUAL PLAN PROVIDED BY KWC ARCHITECTS INC.

TBM - TOP SPINDLE OF FIRE HYDRANT. GEODETIC ELEVATION = 96.22m, PROVIDED BY STANTEC GEOMATICS LIMITED.

SCALE: 1:1000

0 10 20 30 40 50m 75m

**patersongroup**
**consulting engineers**

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

| NO. | REVISIONS | DATE | INITIAL |
|---|---|---|---|
| 1 | UPDATED TO NEW CONCEPTUAL PLAN | 20/12/2021 | MS |

MYERS AUTOMOTIVE GROUP

GEOTECHNICAL INVESTIGATION
PROP. COMMERCIAL DEVELOPMENT - 4149 STRANDHERD DRIVE
OTTAWA, ONTARIO

Title:
# TEST HOLE LOCATION PLAN

Scale: 1:1000
Date: 09/2019
Drawn by: MPG
Report No.: PG5045-1
Checked by: MS
Dwg. No.: PG5045-1
Approved by: DJG
Revision No.:

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