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Geotechnical Investigation

Proposed Residential Development
Brazeau Lands
Borrisokane Road - Ottawa

Prepared For

Caivan Brazeau Development Corporation

January 8, 2019

Report: PG4504-1 Revision 2

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Brazeau Development Corporation to conduct a geotechnical investigation for the proposed residential development to be located along Borrisokane Road, in the City of Ottawa (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 boreholes.

❑ provide geotechnical recommendations for the design of the proposed development based on the results of the boreholes 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. The report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

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

2.0 Proposed Development

Specific details of the proposed residential development were not available at the time of writing this report. However, it is expected that the proposed residential development will consist of a single and townhouse style residential dwellings with basement or slab-on-grade construction, attached garages, associated driveways, local roadways and landscaping areas. It is further understood that the proposed development will be serviced by future municipal water, sanitary and storm services and a stormwater management pond within the northwest corner of the site.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation was carried out between November 16 to 20, 2018. At that time, a total of 12 boreholes were advanced to a maximum depth of 5.9 m below existing grade. The boreholes were placed in a manner to provide general coverage of the subject site taking into consideration site features, underground utilities. The location of the test holes are presented on Drawing PG4504-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a track-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The testing procedure consisted of augering to the required depths and at the selected test hole locations sampling and testing the overburden.

Sampling and In Situ Testing

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

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted in cohesive soils using a field vane apparatus.

The thickness of the overburden was evaluated by a dynamic cone penetration testing (DCPT) completed at BH 4. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the 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 at the test hole locations were recorded in detail in the field. Our findings are presented in the Soil Profile and Test Data sheets in Appendix 1.

Groundwater Monitoring

Flexibile PVC standpipes were installed in all borehole locations except for BH 8 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data sheets presented in Appendix 1.

Sample Storage

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

3.2 Field Survey

The borehole locations were selected by Paterson taking into considerations site features. The test hole locations and ground surface elevations at the test hole locations completed during the current investigation were provided by JD Barnes Ltd. It is understood that the ground surface elevations are referenced to a geodetic datum. The test hole locations and ground surface elevations at the test hole locations are presented on Drawing PG4504-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in our laboratory to review the results of the field logging.

4.0 Observations

4.1 Surface Conditions

The subject site was formerly being used as part of a sand extraction operation. Various fill piles, excavated areas, gravel roads, as well as scattered construction debris are located across the site. Also, the ground surface elevation across the majority of the site is well below the ground surface elevation of the east, south and west properties due to the former excavation work.

The site is bordered to the north by the Castello sand pit, to the south by undeveloped land, to the west by Borrisokane Road and to the east by a future residential development.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test hole locations consists of a fill layer overlying a deep deposit of brown silty sand and/or brown sand with varying amounts of gravel, cobbles and boulders. Stiff to very stiff brown to grey silty clay was encountered below the silty sand layer at BH 10, 11 and 12. Also, glacial till was encountered below the silty sand layer at BH 3, 5, and 10 consisting mainly of coarse silty sand with gravel, cobbles and boulders. Practical refusal to DCPT was encountered at 23.5 m below existing ground surface at BH 4.

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

Bedrock

Based on available geological mapping, dolomite of the Oxford formation is present in this area with an overburden drift thickness ranging between 15 to 25 m.

4.3 Groundwater

The groundwater levels in the boreholes from the current geotechnical investigation were measured on November 29, 2018 and are presented in Table 1 below. Long-term groundwater level can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on the above noted observations, the long-term groundwater level was encountered between elevations 95.7 and 98.1 m within the east portion of the site. A perched water level was noted within the west portion of the site at a higher elevation at the borehole locations where a clay deposit was encountered below a sand deposit.

Groundwater levels are subject to seasonal fluctuations and therefore could vary during time of construction.

Table 1 - Summary of Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1	97.42	1.91	95.51	November 29, 2018
BH 2	97.48	1.69	95.70	November 29, 2018
BH 3	97.39	Blocked	n/a	November 29, 2018
BH 4	99.19	2.45	96.74	November 29, 2018
BH 5	97.06	1.00	96.06	November 29, 2018
BH 6	101.00	2.50	98.50	November 29, 2018
BH 7	98.45	Blocked	n/a	November 29, 2018
BH 9	102.14	Blocked	n/a	November 29, 2018
BH 10	101.57	Blocked	n/a	November 29, 2018
BH 11	100.59	Ground Surface	100.59	November 29, 2018
BH 12	104.34	Blocked	n/a	November 29, 2018

5.0 Discussion

5.1 Geotechnical Assessment

It is anticipated that the proposed buildings will be supported by shallow footings placed over an engineered granular fill pad and an approved fill layer (if required to raise subgrade), placed over an undisturbed, compact silty sand, compact to dense glacial till, a stiff to firm silty clay bearing surface.

Due to the relatively shallow groundwater level observed within the future stormwater management pond location and high infiltration rate through the sand layer, it is expected that a significantly high groundwater in-flux will be observed during the initial excavation work for the stormwater management pond.

Excavations below the water level have the potential for basal heave if groundwater is not controlled during excavation work. A series of well points may be required to control groundwater in-flow for service trenches that extend below the water table. It is assumed that the excavations will be carried out within the confines of a fully braced steel trench box or other acceptable shoring systems designed by a qualified engineer to resist the design lateral earth pressures and potential basal heave issues.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials and construction debris, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures. The contractor should take appropriate precautions to avoid disturbing the subgrade and bearing surfaces from construction and worker traffic.

Fill Placement

It is anticipated that the site will require significant grade raises above the existing ground surface within the east portion of the site. Therefore, in-filling operations are anticipated to be completed using approved existing fill and imported fill. The fill should be free of significant amounts of organics, deleterious materials and approved by Paterson at the source location prior to importing to the subject site. Approved fill should be placed in maximum 300 mm loose lifts and compacted by suitably sized compaction equipment making several passes under dry conditions and in above freezing temperatures. Paterson personnel should complete periodic inspections during the placement operations.

Future Building Footprints and Settlement Sensitive Structures

Consideration could be given to placing the proposed footings and floor slabs over the imported fill provided the fill is approved by Paterson at the time of construction. The approved existing fill material should be proof-rolled using suitable compaction equipment under dry conditions, tested and approved by Paterson personnel. A minimum 300 mm thick granular pad, consisting of a Granular A crushed stone, compacted to 98% of its SPMDD is recommended to be placed at footing level over the approved fill subgrade. Where the fill is deemed inadequate below the proposed footings, the fill should be sub-excavated below the design underside of footing and replaced with engineered fill, such as OPSS Granular A or Granular B Type II and compacted to a minimum 98% of the material's SPMDD. The fill should be extended a minimum 300 mm horizontally beyond the footing face in all directions and throughout the lateral support zone of the footing.

As previously discussed, it is understood that consideration is being given to excavating on-site material and placing within areas of the site to be raised to achieve pregrade elevations for the proposed development. The native sand to silty sand anticipated to be encountered is considered suitable for fill purposes across the proposed development.

Future Right-of-Ways and Landscaped Areas

It is recommended that sand fill placement be completed in maximum 300 mm loose lifts, under dry and above freezing temperatures, and proof-rolled by a suitably sized bulldozer making several passes to provide adequate compaction below future right-of-ways and landscaped areas. The geotechnical consultant should periodically inspect the placement activities and confirm that adequate proof-rolling is being completed and fill lift thicknesses are acceptable.

Future Building Footprints and Settlement Sensitive Structures

The fill placement recommendations for the future ROWs could be applied to future building footprints provided that design underside of footing (USF) level is placed over a native sand bearing surface or an approved engineered fill pad. Consideration could be given to placement of sand fill below design USF level of the proposed building footprints. However, several items should be confirmed to allow building foundations to be placed over a sand fill subgrade. It is recommended that compacted sand fill depths below design USF level should be limited to no greater than 1.2 m without area specific review by the geotechnical consultant. It is expected that an engineered fill, such as Granular B Type II, or use of a biaxial geogrid layers will be required to achieve adequate compaction for soils placed at or below the groundwater table or deeper fill depths, where required. A more stringent compaction program should be in place for placement of sand fill below the design USF level. The sand fill should be placed in maximum 300 mm loose lifts and compacted to at least 98% of its SPMDD under dry and above freezing temperatures. Due to the sensitivity of the sand fill to disturbance, a minimum 200 to 300 mm thick granular pad, consisting of a Granular A crushed stone, compacted to 98% of its SPMDD is recommended to be placed at footing level over the sand fill subgrade.

5.3 Foundation Design

Bearing Resistance Values

Footings for the proposed buildings placed over the noted undisturbed, soil bearing surfaces can be designed using the bearing resistance values presented in Table 2.

Table 2 - Bearing Resistance Values

Bearing Surface	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)
Compact to Dense Sand and Gravel	150	225
Stiff Silty Clay	150	225
Compact Silty Sand	100	175
Approved Fill	100	175

Note: Strip footings, up to 2 m wide, and pad footings, up to 4 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 or approved fill 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.

Bearing resistance values for footing design should be determined on a per lot basis at the time of construction. If the subgrade medium is noted to be in a loose state of compactness, it is recommended to proof-roll the bearing medium under dry conditions and above freezing temperature. The subgrade should be inspected by a Paterson 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 the in-situ bearing medium soils 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.

Permissible Grade Raise Restriction

Due to the presence of a silty clay layer, a permissible grade raise recommendation of 103.5 m (geodetic elevation) is required for the west portion of the site. Reference should be made to Drawing PG4504-1 Test Hole Location Plan in Appendix 1 presenting the area containing silty clay which is affected by the permissible grade raise recommendations.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Site Class D** for the shallow foundations considered at this site. Based on the current information, including the level of groundwater table and compactness of the underlying sand layer, the soil underlying the subject site is not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, undisturbed native soil surface or compacted fill approved by Paterson will be considered an acceptable subgrade on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill for the basement slab to consist of 19 mm clear crushed stone. It is recommended that the upper 200 mm of sub-slab fill for slab-ob-grade construction to consist of OPSS Granular A crushed stone.

5.6 Pavement Structure

Car only parking areas, local and collector roadways are anticipated at this site. The proposed pavement structures are shown in Tables 3, 4 and 5.

Table 3 - Recommended Pavement Structure - Driveways

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 approved fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or approved fill **Note:** Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways.	

Table 4 - Recommended Pavement Structure - Local Residential Roadways (no bus traffic)

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either approved fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or approved fill **Note:** Minimum Performance Graded (PG) 58-34 asphalt cement should be used for local roadways.	

Table 5 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness mm	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil
Note: Minimum Performance Graded (PG) 64-34 asphalt cement should be used for roadways with bus traffic.	

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 98% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer or sump pit.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect 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 other exterior unheated footings.

6.3 Excavation Side Slopes

Excavations will be through loose to compact silty sand, glacial till and/or silty clay. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used.

Based on observations at the test hole locations at the time of the field program and review of the recovered soil samples, the subsoil at this site is considered to be mainly a Type 2 or 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. 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.

It is recommended that a dewatering program, such as a series of well points designed and installed by a licensed contractor specializing in dewatering, be completed for service installations completed below the groundwater level.

Excavated soil should not be stockpiled directly at the top of temporary excavations and heavy equipment should be kept away from the excavation sides. A minimum of 4 to 6 m setback should be considered from the excavation face depending on the excavation depth and soil consistency.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

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

Excavation Base Stability

The base of supported excavations can fail by three (3) general modes:

- ❑ Shear failure within the ground caused by inadequate resistance to loads imposed by grade difference inside and outside of the excavation,
- ❑ Piping from water seepage through granular soils, and
- ❑ Heave of layered soils due to water pressures confined by intervening low permeability soils.

Shear failure of excavation bases is typically rare in granular soils if adequate lateral support is provided. Inadequate dewatering can cause instability in excavations made through granular or layered soils. The potential for base heave in cohesive soils should be determined for stability of flexible retaining systems.

The factor of safety with respect to base heave, FS_b, is:

$$FS_b = N_b s_u / \sigma_z$$

where:

N_b - stability factor dependent upon the geometry of the excavation and given in Figure 1 on the following page.
s_u - undrained shear strength of the soil below the base level
σ_z - total overburden and surcharge pressures at the bottom of the excavation

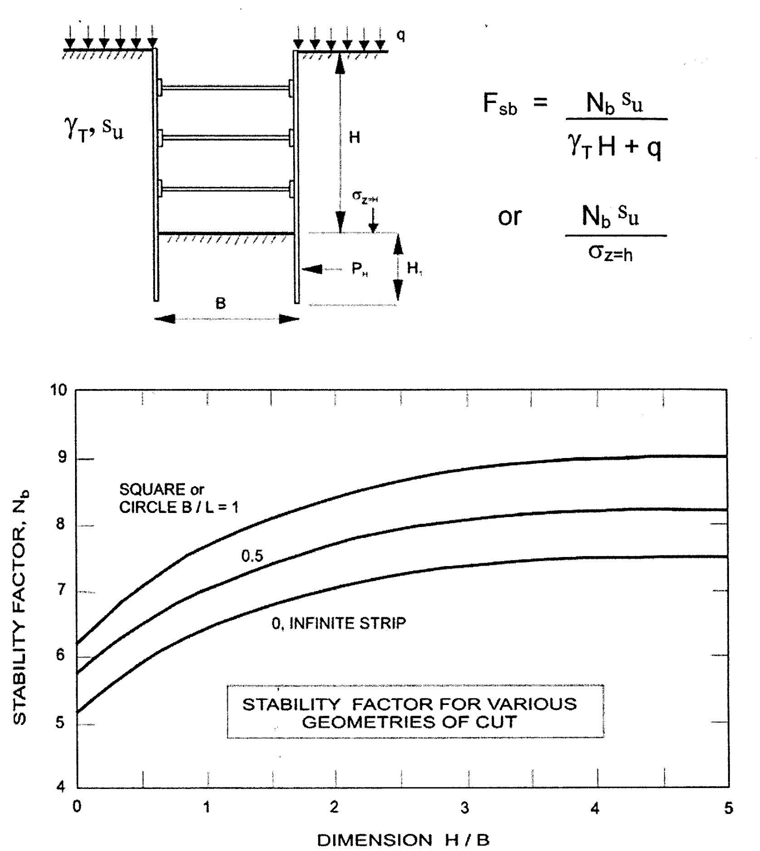

Figure 1 - Stability Factor for Various Geometries of Cut

In the case of soft to firm clays, a factor of safety of 2 is recommended for base stability.

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 City of Ottawa.

It is expected that the invert level of the municipal services will be installed at or below the long term groundwater level within the loose to compact silty sand to sandy silt deposit. As a result, it is recommended that a dewatering program should be implemented prior to construction to temporarily draw down the long term groundwater level during the construction phase. It is recommended that the dewatering program consisting of a series of well points be designed and installed by a licensed contractor specialized in dewatering.

The pipe bedding for sewer and water pipes placed on a relatively dry, undisturbed subgrade surface should consist of at least 150 mm of OPSS Granular A material. If the bedding is located within a layer of 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 lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay and silty sand above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay and silty sand 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.

6.5 Groundwater Control

Due to the permeable silty sand to sandy silt deposit encountered within the shallow groundwater table within the subject site, it is anticipated that conventional pumping with open sumps will be difficult to control the groundwater influx through the sides of the temporary excavation. As a result, it is recommended that a dewatering specialist be consulted to review the most effective dewatering methods.

Permit to Take Water

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, 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.

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.

6.6 Winter Construction

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

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, 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.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping Considerations

East Portion (Silty Sand Area)

No tree planting setback from foundation restrictions are required for the east portion of the subject site due to the absence of a silty clay deposit. There are also no building setback restrictions for swimming pools or exterior structures from a geotechnical perspective.

West Portion (Clay Present in Subsoil Profile)

At the time of writing this report, specific details of the proposed development within the west portion of the site were not available, with the exception of the proposed SWMP location. It is expected that a low to medium sensitivity clay soil will be encountered within the upper 3.5 m below the anticipated finished grade as per City Guidelines. Therefore, the following tree planting setbacks are recommended for the low to medium sensitivity area. Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m). It should be noted that shrubs and other small planting are permitted within the 4.5 m setback area. Areas subjected to the tree planting restrictions within the west portion of the site are presented in Drawing PG4504-1 - Test Hole Location Plan in Appendix 1.

6.8 Stormwater Management Pond

On a conceptual scale, hydrogeological/hydrologic conditions at the subject site suggest that water may infiltrate the open excavation as surface water infiltration during precipitation events and through groundwater flow within the overburden materials. The potential exists for a moderate to high volume of surface water to intercept the excavation footprint. In terms of groundwater flow, the SWMP excavation is expected to intercept the long term groundwater table within the overburden materials. Due to the nature of the upper subsoils profile (silty sand), a high to moderate volume of groundwater inflow into the excavation is anticipated during construction activities.

A temporary MECP Permit to Take Water (PTTW) should be obtained for the project. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations. Based on the above soils information, the proposed SWMP will be located in an area where water infiltration from the silty sand will be important to manage during the construction phase.

Excavation Side Slopes

From a geotechnical perspective, the construction of the proposed SWMP is possible and its long term performance will depend on the stability of its excavation side slopes. From a geotechnical perspective, sidewalls shaped to a 3H:1V slope are considered to be stable in the long term and are adequate for SWMP construction at the subject site. Dewatering of the perched groundwater conditions may lead to temporary rutting and minor sloughing of the side slopes.

Reuse of Excavated Soil from SWMP Excavations

It is understood that consideration is being given to reusing the excavated soil from the SWMP excavations within the proposed development below subgrade level. Based on our review of the soils anticipated to be encountered, it is expected the soils, free of deleterious materials and organics, are considered acceptable for placement within the proposed development below landscaping areas, access lanes and building footprints. It is recommended that the fill material be reviewed and approved by the geotechnical consultant at the time of placement. The excavated clay should be segregated from the sand layers to permit adequate compaction during placement. The material should be placed under dry conditions and in above freezing temperatures for optimal compaction effort. The approved material should be placed in thin lifts and compacted using suitable compaction equipment making several passes. Where the fill is saturated, it is recommended that the material be placed at no greater than 600 mm high and given sufficient time to drain before a compaction effort can be completed.

7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined:

- ❏ Review detailed grading plan(s) from a geotechnical perspective.
- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ 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 placing backfilling materials.
- ❏ Field density tests to ensure that the specified level of compaction has been achieved.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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 to be notified immediately in order to permit reassessment of the recommendations.

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 Caivan Brazeau Development Corporation or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Faisal I. Abou-Seido, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Caivan Brazeau Development Corporation (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Borrisokane Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Ltd.

FILE NO. PG4504

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** November 16, 2018

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.42
Compact, brown **SILTY SAND,** trace gravel	AU	1				
0.76						
Compact, brown **SILTY SAND**	SS	2	75	18	1	96.42
	SS	3	54	13	2	95.42
	SS	4	58	16		
	SS	5	50	17	3	94.42
	SS	6	71	11	4	93.42
- some gravel by 4.9m depth						
- very dense by 5.3m depth	SS	7	71	18	5	92.42
	SS	8	88	57		
5.94						
End of Borehole						
(GWL @ 1.5m depth based on field observations)						
(Piezometer dry and blocked at 1.91m depth - Nov. 29, 2018)						

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Borrisokane Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Ltd.

FILE NO. PG4504

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** November 16, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.48
Brown **SILTY SAND** with organics (0.30)		AU	1				
Compact to loose, brown **SILTY SAND**		SS	2	96	18	1	96.48
		SS	3	83	11	2	95.48
		SS	4	62	12	3	94.48
		SS	5	67	11	4	93.48
		SS	6	62	8	5	92.48
		SS	7	71	17		
(5.94)		SS	8	50	7		

End of Borehole

(GWL @ 1.0m depth based on field observations)

(GWL @ 1.69m - Nov. 29, 2018)

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

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REMARKS

BORINGS BY CME 55 Power Auger

DATE November 20, 2018

FILE NO. PG4504

HOLE NO. BH 3

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.39
Brown **SILTY SAND,** trace gravel, organics (to 0.30)	AU	1				
Compact to dense, brown **SILTY SAND** - silt content increasing with depth	SS	2	67	16	1	96.39
	SS	3	46	11	2	95.39
	SS	4	58	12	3	94.39
	SS	5	50	4		
(to 4.27)	SS	6	83	42	4	93.39
GLACIAL TILL: Dense to compact, brown silty sand with gravel, cobbles and boulders	SS	7	62	30	5	92.39
(to 5.94)	SS	8	54	28		

End of Borehole

(GWL @ 1.2m depth based on field observations)

(Piezometer dry and blocked at 0.56m depth - Nov. 29, 2018)

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

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SOIL PROFILE AND TEST DATA

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REMARKS

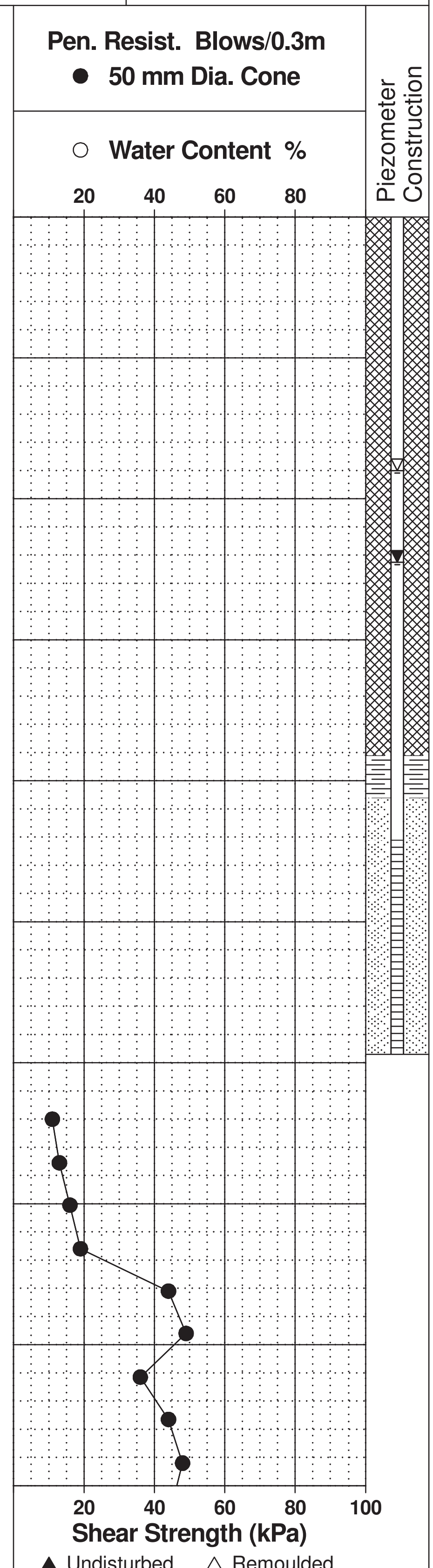
BORINGS BY CME 55 Power Auger

DATE November 19, 2018

FILE NO. PG4504

HOLE NO. BH 4

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.19
Dense to very dense, brown **SILTY SAND** with gravel and cobbles	AU	1				
	SS	2	67	42	1	98.19
	SS	3	38	60	2	97.19
2.29						
Compact, brown **SILTY SAND** - silt content increasing with depth	SS	4	79	14		
2.90					3	96.19
Compact, brown **SILTY SAND**	SS	5	58	28		
	SS	6	58	26	4	95.19
	SS	7	62	29	5	94.19
	SS	8	62	26		
5.94					6	93.19
Dynamic Cone Penetration Test commenced at 5.94m depth.					7	92.19
					8	91.19
					9	90.19



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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DATUM Ground surface elevations provided by J.D. Barnes Ltd.

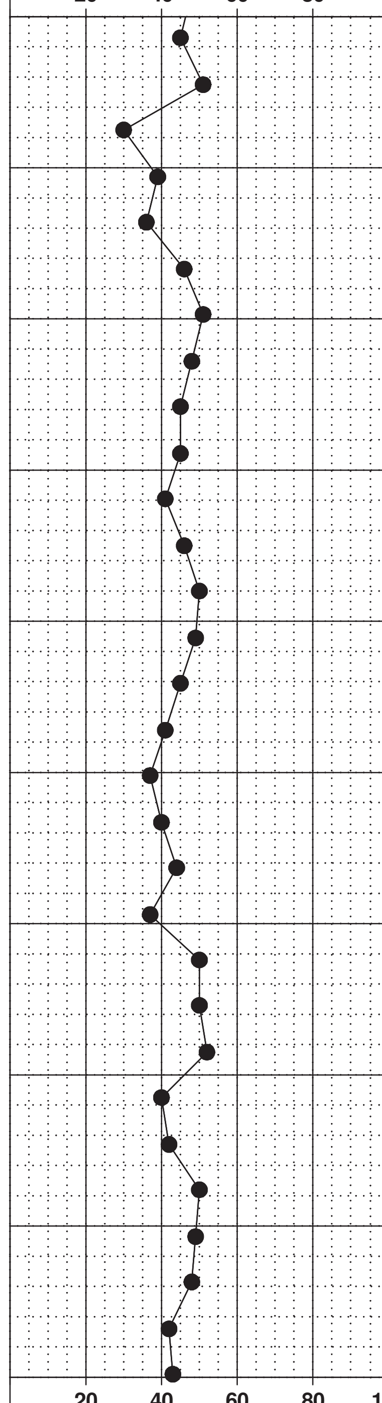
FILE NO. PG4504

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** November 19, 2018

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						9	90.19		
						10	89.19		
						11	88.19		
						12	87.19		
						13	86.19		
						14	85.19		
						15	84.19		
						16	83.19		
						17	82.19		
						18	81.19		



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SOIL PROFILE AND TEST DATA

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REMARKS

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FILE NO. PG4504

HOLE NO. BH 4

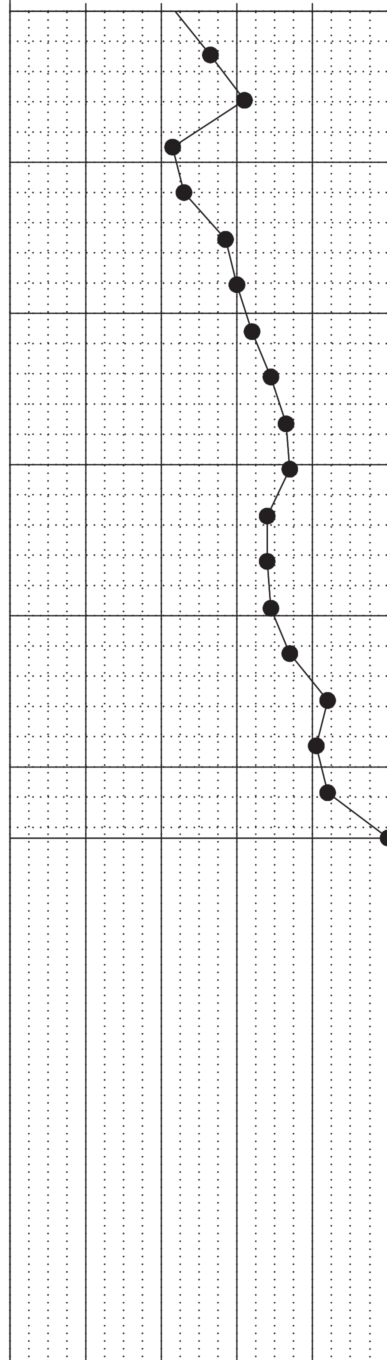
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						18	81.19
						19	80.19
						20	79.19
						21	78.19
						22	77.19
						23	76.19
23.47							
End of Borehole Practical DCPT refusal at 23.47m depth (GWL @ 1.8m depth based on field observations) (GWL @ 2.45m - Nov. 29, 2018)							

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 55 Power Auger

DATE November 16, 2018

FILE NO. PG4504

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.06
Compact, brown **SILTY SAND,** trace gravel and organics		AU	1				
		SS	2	71	18	1	96.06
1.37							
Compact, brown **SILTY SAND**		SS	3	54	9	2	95.06
		SS	4	62	12		
3.05						3	94.06
GLACIAL TILL: Compact, brown silty sand with gravel, cobbles and boulders		SS	5	62	20		
		SS	6	33	15	4	93.06
- silty sand seam at 4.75m depth		SS	7	58	11	5	92.06
		SS	8	42	24		
5.94							

End of Borehole

(GWL @ 1.4m depth based on field observations)

(GWL @ 1.00m - Nov. 29, 2018)

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

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SOIL PROFILE AND TEST DATA

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DATUM Ground surface elevations provided by J.D. Barnes Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 19, 2018

FILE NO. PG4504

HOLE NO. BH 6

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	101.00
Compact, brown **SILTY SAND,** trace gravel	AU	1				
0.84						
Compact, brown **SILTY SAND**	SS	2	75	16	1	100.00
	SS	3	83	24	2	99.00
	SS	4	75	19		
	SS	5	67	15	3	98.00
	SS	6	62	14	4	97.00
	SS	7	71	11	5	96.00
	SS	8	67	14		
5.94						
End of Borehole						

(GWL @ 2.9m depth based on field observations)

(GWL @ 2.50m - Nov. 29, 2018)

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

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REMARKS

BORINGS BY CME 55 Power Auger

DATE November 19, 2018

FILE NO. PG4504

HOLE NO. BH 7

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.45
Brown **SILTY SAND,** trace gravel and organics	0.30	AU	1				
Dense, brown **SILTY SAND,** some gravel		SS	2	67	32	1	97.45
	1.52						
Compact, brown **SILTY SAND**		SS	3	71	30	2	96.45
		SS	4	62	17	3	95.45
		SS	5	96	19	4	94.45
		SS	6	50	6	5	93.45
- grey by 4.6m depth		SS	7	54	13		
	5.94	SS	8	46	7		

End of Borehole

(GWL @ 2.2m depth based on field observations)

(Piezometer dry and blocked at 1.55m depth - Nov. 29, 2018)

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

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FILE NO. PG4504

REMARKS

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger

DATE November 20, 2018

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.91
FILL: Brown silty sand with gravel and organics (to 0.30)	AU	1				
Dense to compact, brown **SAND and GRAVEL,** some cobbles and boulders	SS	2	54	48	1	96.91
	SS	3	62	41	2	95.91
	SS	4	42	21	3	94.91
- grey by 3.8m depth	SS	6	71	26	4	93.91
	SS	7	58	28	5	92.91
(to 5.94)	SS	8	71	25		
End of Borehole						
(GWL @ 1.9m depth based on field observations)						

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

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REMARKS

BORINGS BY CME 55 Power Auger

DATE November 16, 2018

FILE NO. PG4504

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.14
Brown **SILTY SAND** with organics (to 0.30)		AU	1				
Compact, brown **SILTY SAND**		SS	2	79	10	1	101.14
		SS	3	71	15	2	100.14
		SS	4	71	22	3	99.14
		SS	5	67	14		
		SS	6	67	15	4	98.14
						5	97.14
(to 5.94)		SS	7	79	17		
End of Borehole							

(GWL @ 1.5m depth based on field observations)

(Piezometer dry and blocked at 1.79m depth - Nov. 29, 2018)

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Borrisokane Road
Ottawa, Ontario

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FILE NO. PG4504

REMARKS

HOLE NO. BH10

BORINGS BY CME 55 Power Auger **DATE** November 20, 2018

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.57
Brown **SILTY SAND,** trace gravel and organics	0.30	AU	1				
Compact, brown **SILTY SAND**	1.52	SS	2	83	16	1	100.57
Brown **SILTY CLAY,** some sand	2.29	SS	3	79	2	2	99.57
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles, boulders and clay	3.73	SS	4	83	52	3	98.57

End of Borehole

Practical refusal to augering on possible large boulder at 3.73m depth

(GWL @ 1.5m depth based on field observations)

(Piezometer dry and blocked at 1.15m depth - Nov. 29, 2018)

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

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REMARKS

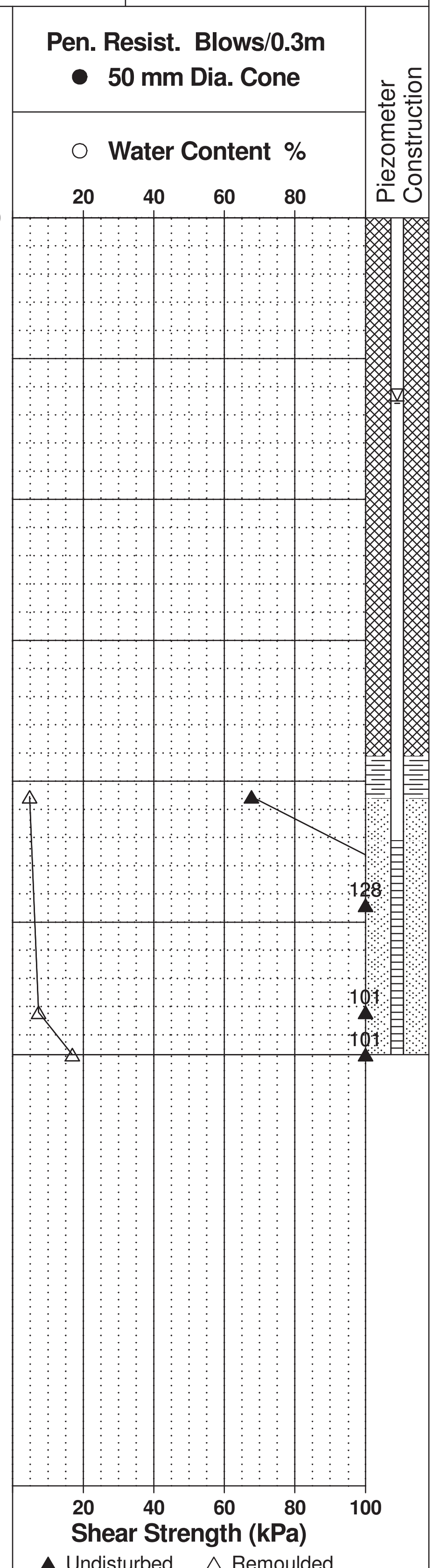
BORINGS BY CME 55 Power Auger

DATE November 16, 2018

FILE NO. PG4504

HOLE NO. BH11

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	100.59
Brown **SILTY SAND** with gravel and organics (0.30)	AU	1				
Compact to loose, brown **SILTY SAND**	SS	2	75	19	1	99.59
	SS	3	96	28	2	98.59
(3.05)	SS	4	50	8	3	97.59
Brown **SILTY CLAY** with sand (3.81)	SS	5	75	2		
Stiff to very stiff, grey **SILTY CLAY**	SS	6	83	P	4	96.59
(5.94)					5	95.59
End of Borehole						
(GWL @ 1.3m depth based on field observations)						



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SOIL PROFILE AND TEST DATA

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FILE NO. PG4504

REMARKS

HOLE NO. BH12

BORINGS BY CME 55 Power Auger

DATE November 16, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	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	104.34		
Brown **SILTY SAND** with gravel 0.30		AU	1						
Compact, brown **SILTY SAND**		SS	2	50	10	1	103.34		
1.52									
Brown **SILTY CLAY,** some sand		SS	3	96	2	2	102.34		
		SS	4	96	P			128 ▲	
3.05						3	101.34		
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders 3.66		SS	5	79	8				
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles and boulders		SS	6	96	40	4	100.34		
		SS	7	83	75	5	99.34		
		SS	8	67	50+				
5.94									

End of Borehole

(GWL @ 1.5m depth based on field observations)

(Piezometer dry and blocked at 4.73m depth - Nov. 29, 2018)

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

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

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 = $(D30)^2 / (D10 \times D60)$
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

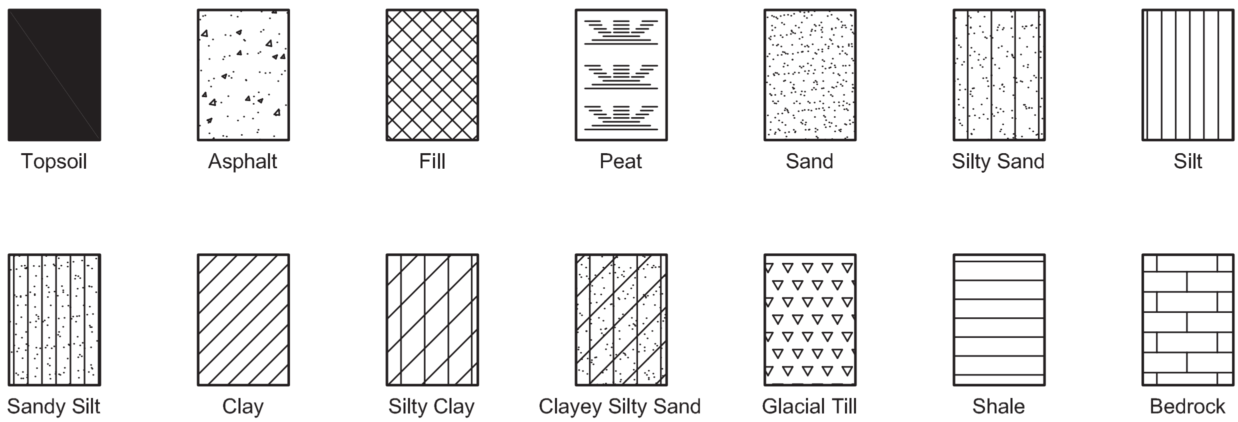
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

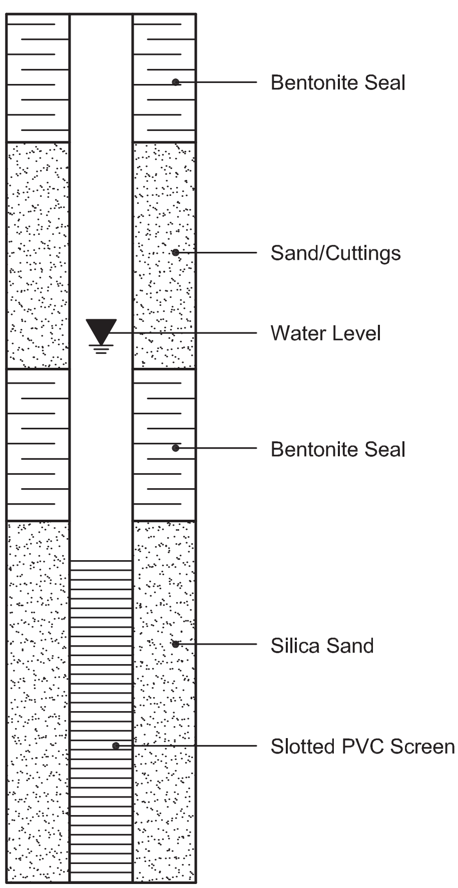
SYMBOLS AND TERMS (continued)

STRATA PLOT

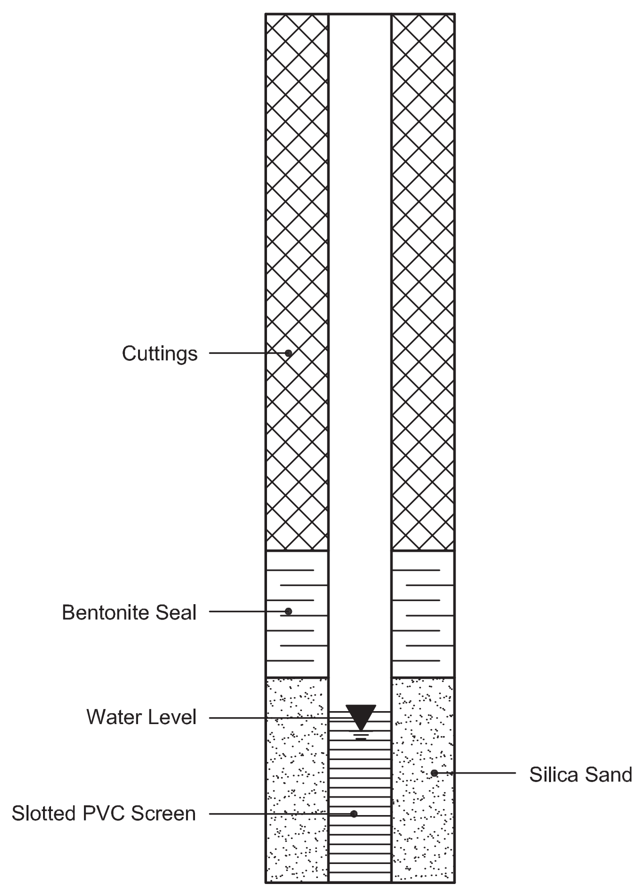


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



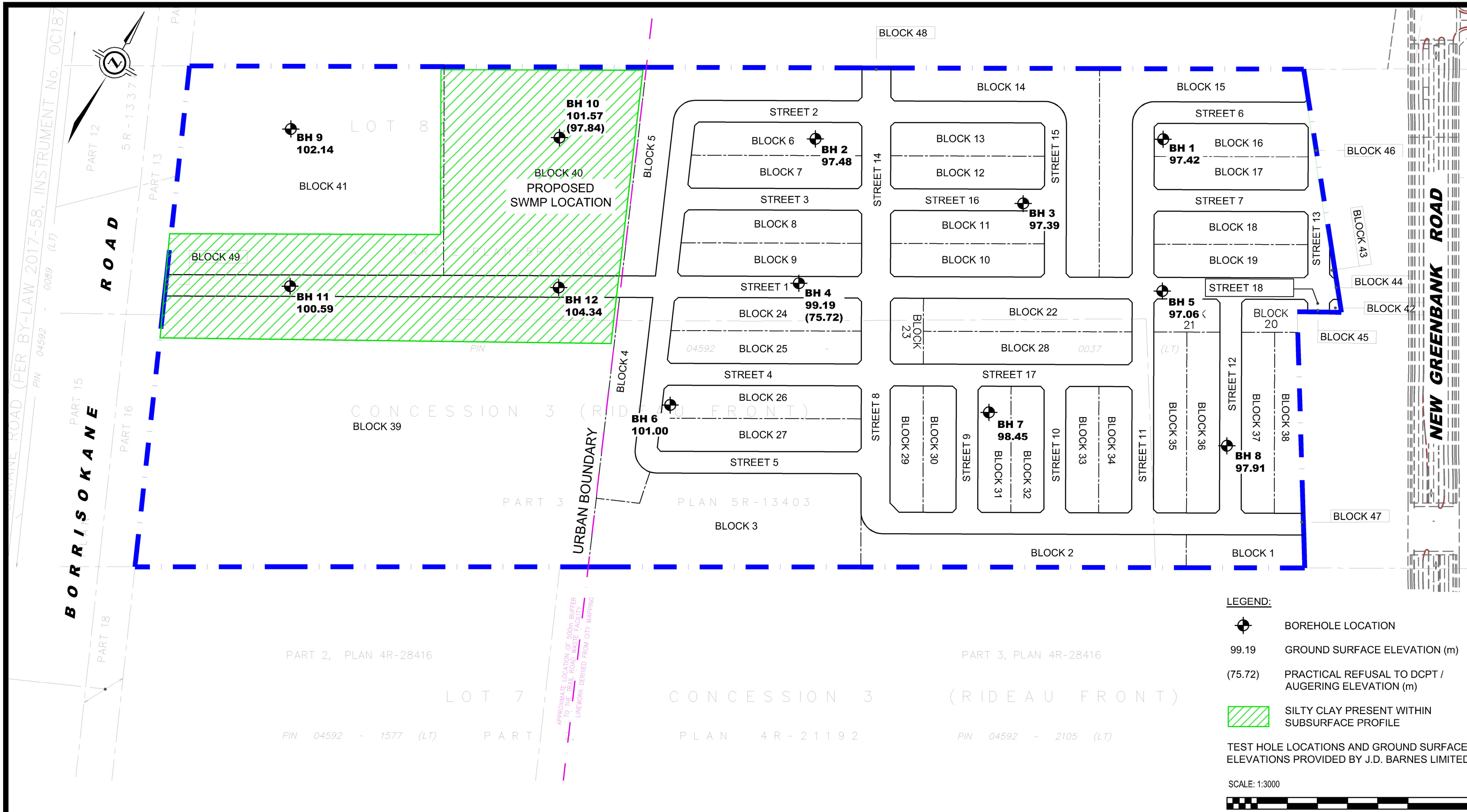
APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG4504-1 - TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO LATEST BASE PLAN	09/01/2019	FA

CAIVAN BRAZEAU DEVELOPMENT CORPORATION
GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - BORRISOKANE ROAD
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:3000	Date: 11/2018
Drawn by: MPG	Report No.: PG4504-1
Checked by: FA	Dwg. No.: PG4504-1
Approved by: FA	Revision No.: 1

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