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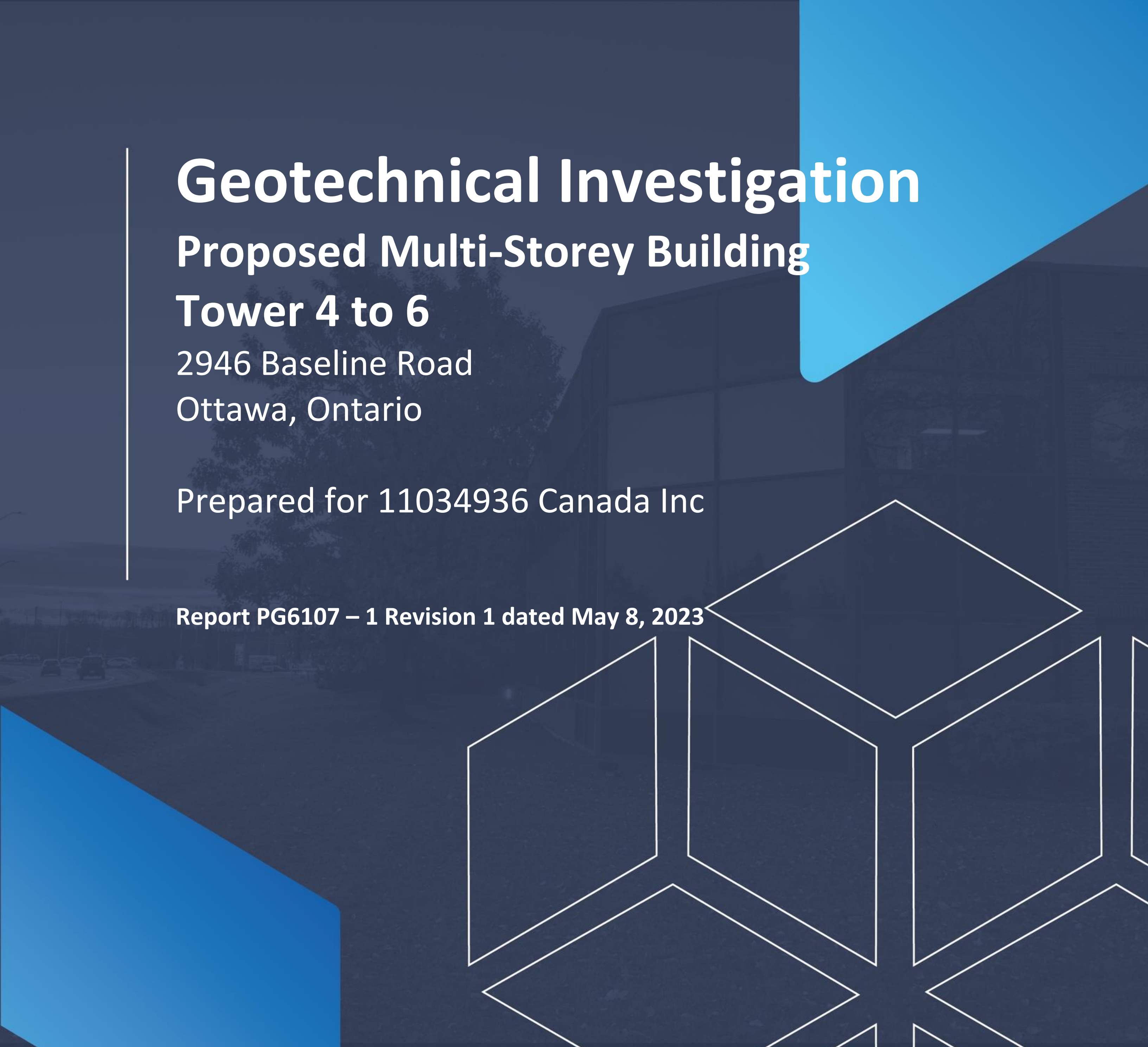

Geotechnical Investigation
Proposed Multi-Storey Building
Tower 4 to 6

2946 Baseline Road
Ottawa, Ontario

Prepared for 11034936 Canada Inc

Report PG6107 – 1 Revision 1 dated May 8, 2023

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by 11034936 Canada Inc. to complete a geotechnical investigation for the subject site located at 2946 Baseline 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 subsurface soil and groundwater conditions by means of boreholes and monitoring well program.

☐ provide preliminary geotechnical recommendations for the foundation design of the proposed buildings and provide geotechnical construction precautions 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 subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the current design information, it is understood that the proposed development will consist of three multi storey residential buildings (Tower 4 to 6). It is understood that the proposed development will consist of 2 to 3 levels of underground parking and storage area. The proposed underground levels are expected to link each residential tower. The current development phase will also include associated at grade asphalt parking areas, access lanes and landscaped areas. It is further anticipated that the site will be fully municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was completed from February 8, 9, 10, 11 and 14, 2022. At that time, 10 boreholes were advanced to a maximum depth of 12.8 m below existing grade. The borehole locations were distributed in a manner to provide general coverage of the proposed development taking into consideration existing site features. The borehole locations are shown on Drawing PG6107-1 - Test Hole Location Plan included in Appendix 2.

A previous field investigation was also completed by others on site. Test hole data and locations were considered as part of this geotechnical report.

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 auguring to the required depths and at the selected locations sampling the overburden.

Sampling and In Situ Testing

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

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm. This testing was done in general accordance with ASTM D1586-11 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

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

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT). 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.

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

Groundwater

PVC groundwater monitoring wells were installed within boreholes BH 1-22, BH 6-22, and BH 10-22 and flexible piezometers were installed in boreholes all other boreholes to permit monitoring of the groundwater level 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 in Appendix 1.

3.2 Field Survey

The ground surface elevations at the test hole locations are referenced to a geodetic datum and measured on field by Paterson's personnel. The locations of the boreholes and the ground surface elevations for each borehole location are presented on Drawing PG6107-1 -Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples were recovered from the subject site and visually examined in Paterson's laboratory to review the field logs. All samples will be stored in the laboratory for a period of one month after issuance of this report. The samples will then be discarded unless otherwise directed.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. If available, the results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently mostly paved areas and occupied by a commercial building. The site is relatively flat with a light slope down towards Baseline Road. The property is surrounded west by Sandcastle Drive, to the south by a residential development, to the north by Baseline Road and to the east by ongoing construction of Towers 1 to 3 of the subject development project.

4.2 Subsurface Profile

Overburden

Generally, the soil profile encountered at the test hole locations consists of a flexible asphalt pavement and granular crushed stones with silty clay or silty sand fill layer overlying a firm to very stiff brown silty clay crust followed by a deep, stiff to very stiff grey silty clay deposit. A layer of glacial till, consisting of sand and gravel within a silty clay soil matrix was encountered at boreholes BH 5-22 and BH 10-22.

A layer of grey silty sand with clay was encountered approximately 12.2 to 12.6 m below existing grade in BH 1-22. The silt and sand content of the silty clay material was also noted to increase with depth.

DCPT was completed at BH 2-22, BH 4-22, BH 6-22 and BH 9-22, practical refusal was encountered at a depth of 12.6, 12.6, 12.8 and 14.0 m respectively. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in the area is part of the Oxford formation, which consists of dolomite. Also, based on available geological mapping, the overburden thickness is expected to range from 10 to 15 m.

4.3 Groundwater

Groundwater level readings were recorded on February 24, 2022, at the piezometer and monitoring well locations. The groundwater level readings are presented in the Soil Profile and Test Data sheets in Appendix 1. Long-term groundwater level can also be estimated based on the observed color, moisture levels and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level is expected between 4 to 5 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations, therefore the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

Foundation Design Considerations

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is expected that the anticipated building loads are too high to found the proposed building over a conventional shallow spread footing foundations. It is expected that the main tower super structures will be founded on piles while the surrounding levels of underground parking will be founded on conventional spread footings placed on an undisturbed stiff silty clay bearing surface.

Due to the presence of the silty clay layer, the subject site will be subjected to a permissible grade restriction. The permissible grade raise recommendations are further discussed in Subsection 5.3.

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

Fill Placement

Fill placed for grading beneath the building area should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill material should be tested and approved prior to delivery to the site. The fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's standard Proctor maximum dry density (SPMDD).

Site-excavated soil, whether native or existing fill, can be placed as general landscaping fill where settlement is a minor concern of the ground surface. 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 placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm thick lifts and to a minimum density of 95% of the respective SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls due to the frost heave potential of the site excavated soils below settlement sensitive areas, such as concrete sidewalks and exterior concrete entrance areas.

5.3 Foundation Design

Conventional shallow Footings

Strip footings, up to 3 m wide, and pad footings, up to 6 m wide, placed over an undisturbed, stiff grey silty clay bearing surface expected at the underground parking elevation can be designed using bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**.

A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance values at ULS.

Footings placed over engineered fill, approved by the geotechnical consultant, can be designed using the above noted bearing resistance values.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

The bearing resistance value given for footings at SLS will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

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. Above the groundwater level, adequate lateral support is provided to a stiff silty clay when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:1V passes only through in situ soil or engineered fill.

Raft Foundation

Consideration could be given to raft foundation, if the buildings loads exceed the bearing resistance values provided for a conventional shallow footings. The following parameters may be used for raft design over a firm to stiff silty clay bearing surface.

For design purposes, it was assumed that the base of the raft foundation will be located at a minimum depth of 6 m below ground surface.

The amount of settlement of the raft slab will be dependent on the sustained raft contact pressure. The bearing resistance value at SLS (contact pressure) of **200 kPa** will be considered acceptable. The loading conditions for the contact pressure are based on sustained loads, that are generally taken to be 100% Dead Load and 50% Live Load. The factored bearing resistance (contact pressure) at ULS can be taken as **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

The modulus of subgrade reaction was calculated to be **4 MPa/m** for a contact pressure of **200 kPa**. The raft foundation design is required to consider the relative stiffness of the reinforced concrete slab and the supporting bearing medium.

The proposed building constructed over the silty clay deposit within the subject site can be designed using the above parameters with a total and differential settlement of 25 and 15 mm, respectively.

Piled Foundation

It is expected that the proposed buildings could be constructed over concrete filled steel pipe piles driven to refusal on the bedrock surface.

For deep foundations, concrete-filled steel pipe piles are generally utilized in the Ottawa area. Applicable pile resistance at SLS values and factored pile resistance at ULS values are given in Table 1. A resistance factor of 0.4 has been incorporated into the factored ULS values. Note that these are all geotechnical axial resistance values.

The geotechnical pile resistance values were estimated using the Hiley dynamic formula, to be confirmed during pile installation with a program of dynamic monitoring. For this project, the dynamic monitoring of 2 to 4 piles is recommended. This is considered to be the minimum monitoring program, as the piles under shear walls may be required to be driven using the maximum recommended driving energy to achieve the greatest factored resistance at ULS values. Re-striking of all piles at least once will also be required after at least 48 hours have elapsed since initial driving.

Table 1 - Pile Foundation Design Data

Pile Outside Diameter (mm)	Pile Wall Thickness (mm)	Geotechnical Axial Resistance		Final Set (blows/ 12 mm)	Transferred Hammer Energy (kJ)
		SLS (kN)	Factored at ULS (kN)		
245	9	925	1110	6	27
245	11	1050	1260	6	31
245	13	1200	1440	6	35

Permissible Grade Raise Recommendations

The grade raise restriction for the subject site was calculated to be **2.0 m** above original ground surface.

To reduce potential long term liabilities, consideration should be given to accounting for larger groundwater lowering and providing means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the settlement sensitive structures, etc.). It should be noted that building over silty clay deposits increases the likelihood of building movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking as compared to unreinforced foundations.

5.4 Design for Earthquakes

The proposed site can be taken as seismic site response Class C as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A) for foundations considered at this site. The soils underlying the site are not susceptible to liquefaction.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill material, the native soil will be considered to be an acceptable subgrade surface on which to commence backfilling for the basement slab. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or 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-floor fill consist of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

A concrete mud slab should be placed to protect the native soil from worker traffic and equipment before pouring the raft slab.

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.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, 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 bulk (drained) unit weight of 20 kN/m^3. The applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Lateral Earth Pressures

The static horizontal earth pressure (p_o) can be calculated using 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
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}). The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = 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. Note that the vertical seismic coefficient is assumed to be zero.

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

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

Table 2 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 3 - Recommended Pavement Structure
Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material 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 98% of the material's SPMDD using suitable vibratory equipment.

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 compaction 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.

Where silty clay is encountered at subgrade level, consideration should be given to installing subdrains during the pavement construction. These drains should be constructed according to City of Ottawa specifications. The drains should be connected to a positive outlet. The subgrade surface should be crowned to promote water flow to the drainage lines. The subdrains will help drain the pavement structure, especially in early Spring when the subgrade is saturated and weaker and, therefore, more susceptible to permanent deformation.

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6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000 installed on the exterior foundation walls and extend down to the footing level. It is further recommended that 100 to 150 mm diameter drainage sleeves at 5 m spacing be cast in the footing or at the foundation wall/footing interface to allow the infiltration of water to flow to the interior underfloor drainage system.

In areas where a perimeter drainage pipe consisting of a 150 mm perforated corrugated plastic pipe, surrounded on all sides by a minimum of 150 mm of 19 mm clear crushed stone is placed at the footing level. The requirement for the drainage sleeves noted above can be reduced to 15 m spacing.

The exterior perimeter and underfloor drainage system should direct water to the sump pit(s) within the lower basement area.

A damp proofing layer such as Bakor 710-11 or equivalent should be applied to the foundation prior to the installation of the composite drainage layer.

Underfloor Drainage

Underfloor drainage will be required to control water infiltration. For preliminary design purposes, we recommend that 100 to 150 mm diameter perforated pipes be placed at 5 m centres. The spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Water Suppression System

A water suppression system will be required for the basement level below a geodetic elevation of 73.20 m to avoid dewatering the surrounding areas adjacent to buildings with shallower founding depths which can cause differential settlement. To manage and control groundwater water infiltration over the long term, the following water suppression system is recommended to be installed for the exterior foundation walls and underfloor drainage (refer to Figure 2 – Water Suppression System in Appendix 2 for an illustration of this system cross-section):

- ❑ A concrete mud slab will be required to create a horizontal hydraulic barrier to lessen the water infiltration at the base of the excavation and will consist of a 300 mm thick layer of 25 MPa compressive strength concrete. The 300 mm minimum thickness is required to enable the support of construction traffic until the footings, pile caps and grade beams are poured and the area is backfilled for the lower floor slab to resist minor buoyancy forces and hydrostatic pressure.

- ☐ A waterproofing membrane will be required to lessen the effect of water infiltration for the underground parking P-3 Levels starting at underside of P-2 Level which is approximately 6-7 m below finished grade. The waterproofing membrane will consist of bentonite panels or approved equivalent fastened to the soldier pile and timber lagging shoring system. The membrane should extend to the bottom of the excavation at the founding level of the proposed footings over the concrete mud slab.

- ☐ A composite drainage layer will be placed from finished grade to the bottom of the foundation wall. It's recommended that the composite drainage system (such as Delta Drain 6000 or equivalent) extend down to the bottom of the foundation wall. It's expected that 150 mm diameter sleeves placed at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area. Water infiltration will result from two sources. The first will be water infiltration from the upper 6-7 m which is above the vertical waterproofed area. The second source will be groundwater breaching the waterproofing membrane.

Membranes and drainage board should be installed as per manufacturer's specification. Paterson should review any proposal by supplier prior to the field work.

Elevator Pit Waterproofing

The elevator shaft exterior foundation walls should be waterproofed to avoid any infiltration into the elevator pit. It is recommended that a waterproofing membrane, such as Colphene Torch'n Stick (or approved other) be applied to the exterior of the elevator shaft foundation wall.

The Colphene Torch'n Stick waterproofing membrane should extend over the vertical portion of the raft slab and down to the top of the footing in accordance with the manufacturer's specifications. A continuous PVC waterstop such as Southern waterstop 14RCB or equivalent should be installed within the interface between the concrete base slab below the elevator shaft foundation walls.

The 150 mm diameter perforated corrugated pipe underfloor drainage should be placed along the perimeter of the exterior sidewalls and provided a gravity connection to the sump pump basin or the elevator sump pit.

The foundation wall of the elevator shaft and buildings sump pit should host a PVC sleeve to allow any water trapped within the interior side of the structures to be discharged to the associated sump pump. A minimum 100 mm diameter perforated, corrugated drainage pipe should extend from the sleeve towards the associated drainage system by gravity drainage and mechanical connection to the associated system. Also, the contractor should ensure that the opening is properly sealed to prevent water from entering the subject structure.

A protection board should be placed over the waterproofing membrane to protect the waterproofing membrane from damage during backfilling operations. The area between the pit structure and bedrock/soil excavation face can be in-filled with lean concrete, OPSS Granular A or Granular B Type II crushed stone.

It should be noted that a waterproofed concrete (with Xypex Additive, or equivalent) is optional for this waterproofing option. Refer to the attached Figure 3- Elevator Waterproofing Detail, for specific details of the waterproofing recommendation.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

Adverse Effects of Dewatering on Adjacent Properties

Based on the expected foundation level of Towers 4 to 6 and the depth of the groundwater level, the proposed building could be founded just below the long term groundwater table and match Towers 1 to 3. Any minor dewatering will be temporary during the construction period and will be considered relatively negligible for the neighbouring buildings. Therefore, adverse effects to the surrounding buildings or properties are not expected due to the proposed development. A water suppression system will be used for the foundation walls extending lower than 73.2 m.

6.2 Protection of Footings Against Frost Action

Perimeter footings, of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 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.

The underground parking area should not require protection against frost action due to the founding depth. Unheated structures, such as the access ramp wall footings, may be required to be insulated against the deleterious effect of frost action. A minimum of 2.1 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

6.3 Excavation Side Slopes

Temporary Side Slopes

The temporary excavation side slopes anticipated should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled.

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. A field review should be completed by Paterson at the time of construction to assess the side slope of excavation deeper than 3 m. 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.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation sides.

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

A trench box is recommended 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.

Temporary Shoring

Temporary shoring may be required for the overburden soil to complete the required excavations where insufficient room is available for open cut methods. The shoring requirements designed by a structural engineer specializing in those works will depend on the depth of the excavation, the proximity of the adjacent structures and the elevation of the adjacent building foundations and underground services. The design and implementation of these temporary systems will be the responsibility of the excavation contractor and their design team. Inspections and approval of the temporary system will also be the responsibility of the designer. Geotechnical information provided below is to assist the designer in completing a suitable and safe shoring system. The designer should take into account the impact of a significant precipitation event and designate design measures to ensure that a precipitation will not negatively impact the shoring system or soils supported by the system. Any changes to the approved shoring design system should be reported immediately to the owner’s structural designer prior to implementation.

The temporary system could consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be included to the earth pressures described below. These systems could be cantilevered, anchored or braced. Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure their stability. The shoring system is recommended to be adequately supported to resist toe failure and inspected to ensure that the sheet piles extend well below the excavation base. It should be noted if consideration is being given to utilizing a raker style support for the shoring system that lateral movements can occur and the structural engineer should ensure that the design selected minimizes these movements to tolerable levels.

The earth pressures acting on the shoring system may be calculated with the following parameters.

Table 4 - Soil Parameters

Parameters	**Values**
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Dry Unit Weight (γ), kN/m^3	20
Effective Unit Weight (γ), kN/m^3	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible. The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be calculated full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

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.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 95% of the material's SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential 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 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 compatible 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 stratigic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Groundwater Control for Building Construction

Due to the relatively impervious nature of the silty clay materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. It is also expected that sandy layers encountered towards the south of the site will allow for more water infiltration in the excavation. The contractor should be prepared to control the water and discharge it away from any bearing surface. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

It is expected that the site will be dewatered using one or multiple dry wells placed at the bottom of the excavation. Pumps should be running within the wells until the foundations is completely backfilled.

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 of 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.

Long-term Groundwater Control

The recommendations for the proposed building long-term groundwater control are presented in Subsection 6.1. Any groundwater encountered along the building perimeter or sub-slab drainage system will be directed to the proposed building cistern/sump pit. Provided the proposed groundwater infiltration control system is properly implemented and approved by the geotechnical consultant at the time of construction, the groundwater flow should be low (i.e.- less than 25,000 L/day) with peak periods noted after rain events. A more accurate estimate can be provided at the time of construction, once groundwater infiltration levels are observed. The groundwater flow should be controllable using conventional open sumps.

6.6 Winter Construction

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

The subsurface conditions 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.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. 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 and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.7 Corrosion Potential and Sulphate

The results of the analytical testing of one (1) soil sample show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate. The results of the chloride content and pH indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site while the resistivity tests yielded results indicative of a non aggressive to slightly aggressive corrosive environment.

7.0 Recommendations

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

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

☐ Sampling and testing of the concrete and fill materials.

☐ Observation of piling activities, if applicable.

☐ Observation of foundation drainage and waterproofing installation, if applicable.

☐ Observation of the placement of the foundation insulation, if applicable.

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

☐ Observation of all subgrades prior to backfilling and follow-up field density tests to determine the level of compaction achieved.

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

☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming 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 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 11034936 Canada Inc 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
May 8, 2023
J. R. VILLENEUVE
100504344
PROVINCE OF ONTARIO

Nicolas Seguin

Nicolas Seguin, EIT

Joey R. Villeneuve, M.A.Sc., P.Eng, ing.

Report Distribution:

- ☐ 6382983 Canada Inc. (Brigil Construction)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

BOREHOLE LOGS BY OTHERS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG6107**

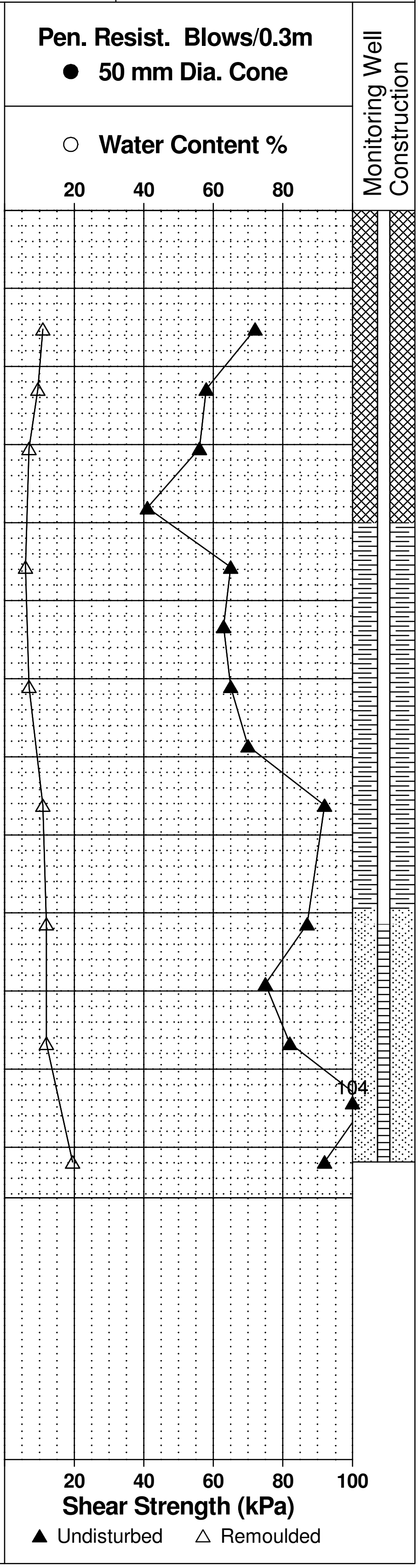
REMARKS

HOLE NO. **BH 1-22**

BORINGS BY CME-55 Low Clearance Drill

DATE 2022 February 8

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	79.58
ASPHALT 0.05	AU	1				
FILL: Granuar Crushed Stone 0.36						
Stiff to very stiff grey **SILTY CLAY**	SS	2	83	6	1	78.58
					2	77.58
					3	76.58
					4	75.58
					5	74.58
					6	73.58
					7	72.58
					8	71.58
	SS	3	100	2		
					9	70.58
					10	69.58
					11	68.58
					12	67.58
12.19						
Grey **SILTY SAND** with clay 12.65						
End of Borehole						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG6107**

REMARKS

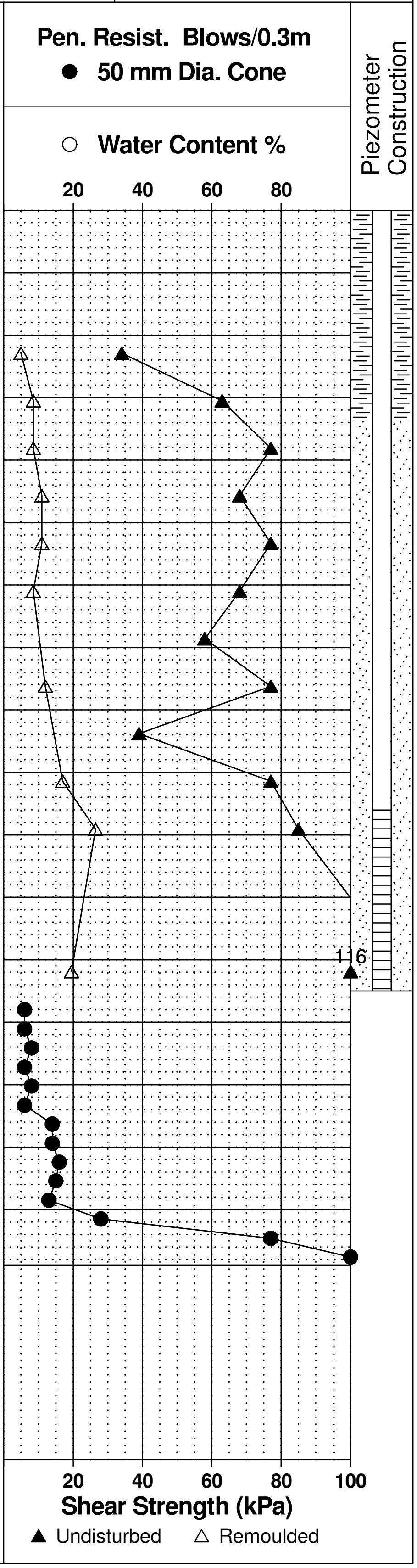
HOLE NO. **BH 2-22**

BORINGS BY CME-55 Low Clearance Drill

DATE 2022 February 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
ASPHALT 0.03		AU	1		
FILL: Granular Crushed stone with brown silty sand 0.30		SS	2	100	8
Firm to stiff brown **SILTY CLAY** - Grey by 2.5 m depth		SS	3	42	2
- Very stiff by 12.0 m depth		SS	4	83	2
12.65		SS	5	100	1
Dynamic Cone Penetration Test commenced at 12.65 m depth. 16.89					

DEPTH (m)	ELEV. (m)
0	80.91
1	79.91
2	78.91
3	77.91
4	76.91
5	75.91
6	74.91
7	73.91
8	72.91
9	71.91
10	70.91
11	69.91
12	68.91
13	67.91
14	66.91
15	65.91
16	64.91



End of Borehole

Practical refusal to DCPT at 16.89 m depth

(Piezometer dry/blocked - Feb 24, 2022)

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. PG6107

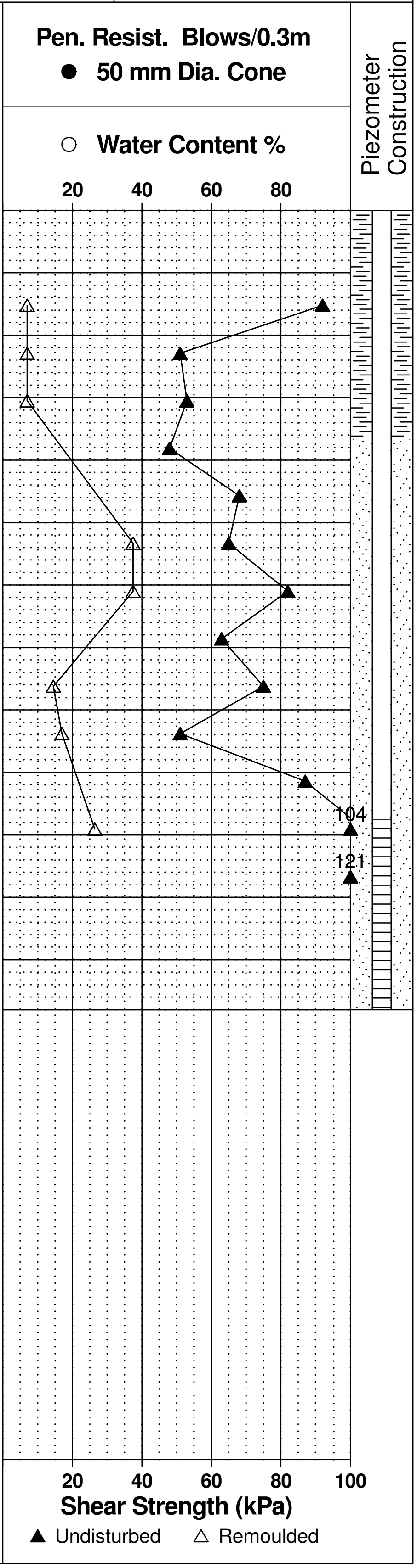
REMARKS

HOLE NO. BH 3-22

BORINGS BY CME-55 Low Clearance Drill

DATE 2022 February 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	80.90
ASPHALT 0.03		AU	1				
FILL: Granular crushed stone with brown silty sand 0.36		SS	2	83	9	1	79.90
Firm to very stiff brown **SILTY CLAY** - Grey by 2.2 m depth						2	78.90
						3	77.90
						4	76.90
						5	75.90
						6	74.90
						7	73.90
						8	72.90
						9	71.90
						10	70.90
						11	69.90
		SS	3	100			
						12	68.90
12.80		SS	4	100	5		
End of Borehole							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

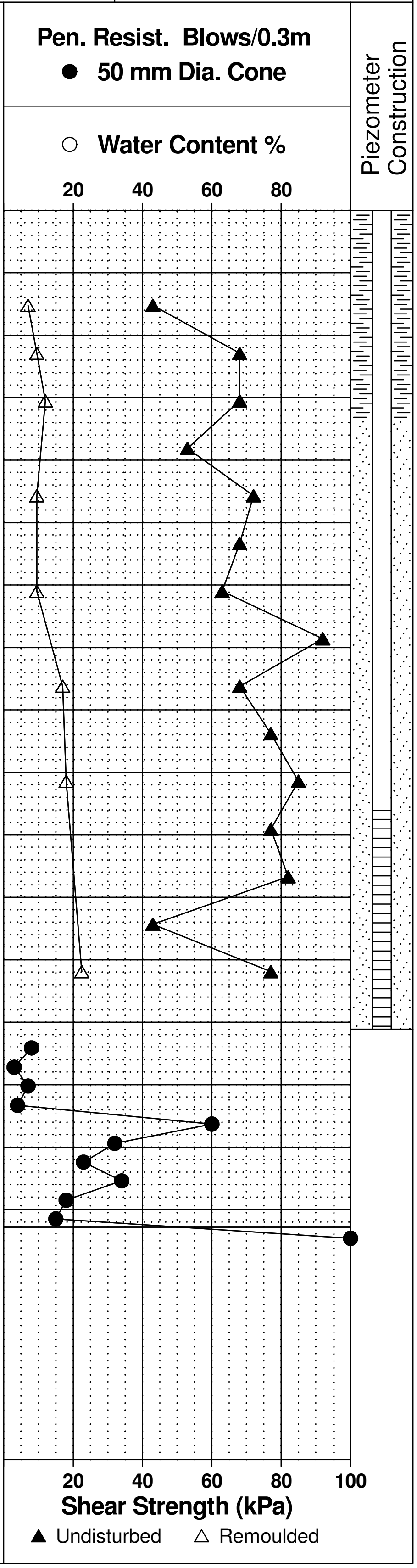
DATE 2022 February 9

FILE NO. PG6107

HOLE NO. BH 4-22

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
ASPHALT	0.03	AU	1		
FILL: Granular crushed stone with silty sand some clay	0.48	SS	2	83	3
Firm to stiff brown **SILTY CLAY** - Grey by 2.5 m depth - Increasing silt and sand content with depth	12.65				
Dynamic Cone Penetration Test commenced at 13.11 m depth.	16.28				
End of Borehole Practical refusal to DCPT at 16.28 m depth					

DEPTH (m)	ELEV. (m)
0	79.19
1	78.19
2	77.19
3	76.19
4	75.19
5	74.19
6	73.19
7	72.19
8	71.19
9	70.19
10	69.19
11	68.19
12	67.19
13	66.19
14	65.19
15	64.19
16	63.19



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

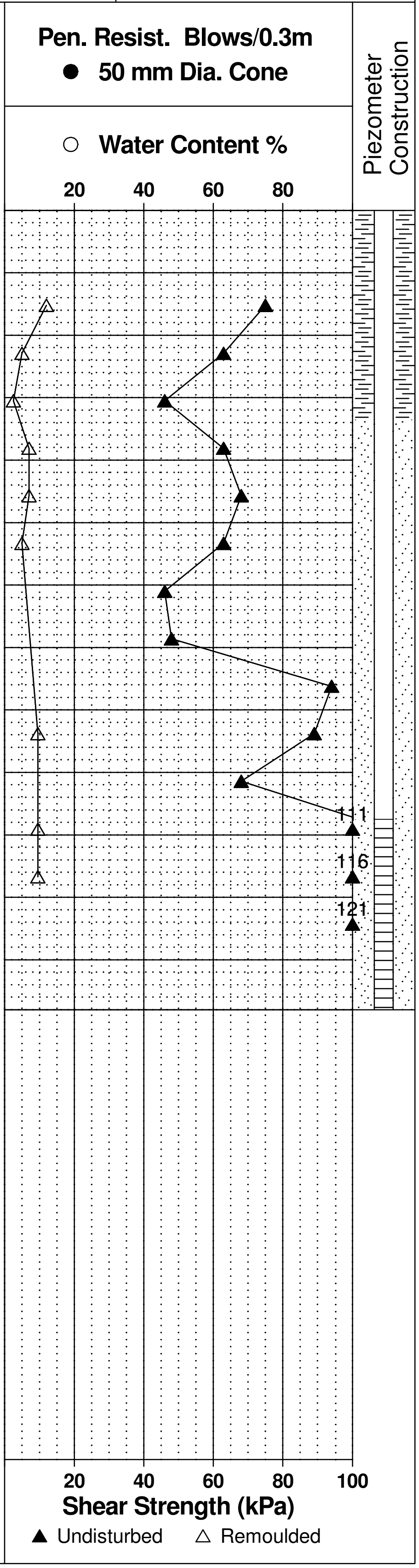
DATE 2022 February 10

FILE NO. PG6107

HOLE NO. BH 5-22

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
ASPHALT	0.08	AU	1		
FILL: Granular crushed stone with sand	0.53	SS	2	100	17
Firm to very stiff brown **SILTY CLAY** - Grey by 2.2 m depth	11.28				
GLACIAL TILL: Grey silty clay with sand, sand, gravel, cobbles and boulders	12.80	SS	3	50	2
End of Borehole (Piezometer dry/blocked - Feb 24, 2022)					

DEPTH (m)	ELEV. (m)
0	78.96
1	77.96
2	76.96
3	75.96
4	74.96
5	73.96
6	72.96
7	71.96
8	70.96
9	69.96
10	68.96
11	67.96
12	66.96



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG6107**

REMARKS

HOLE NO. **BH 6-22**

BORINGS BY CME-55 Low Clearance Drill

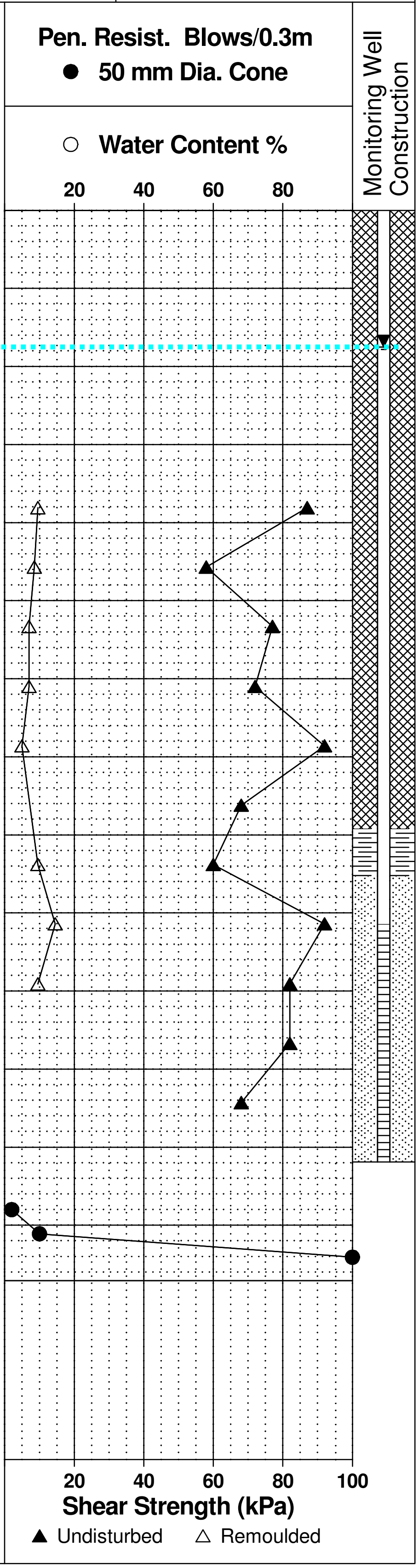
DATE 2022 February 10

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
ASPHALT	0.08	AU	1		
FILL: Granular crushed stone	0.30	AU	2		
FILL: Brown silty sand	0.81	SS	3	100	16
Stiff brown **SILTY CLAY**		SS	4	100	18
		SS	5	100	11
		SS	6	100	4
- Grey by 4.5 m depth					
- Silt content increasing with depth					
	12.80	SS	7	83	3
Dynamic Cone Penetration Test commenced at 12.80 m depth	13.71				
End of Borehole					

Practical refusal to DCPT at 13.71 m depth

(GWL at 1.75 m depth - Feb 24, 2022)

DEPTH (m)	ELEV. (m)
0	78.89
1	77.89
2	76.89
3	75.89
4	74.89
5	73.89
6	72.89
7	71.89
8	70.89
9	69.89
10	68.89
11	67.89
12	66.89
13	65.89



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

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FILE NO. **PG6107**

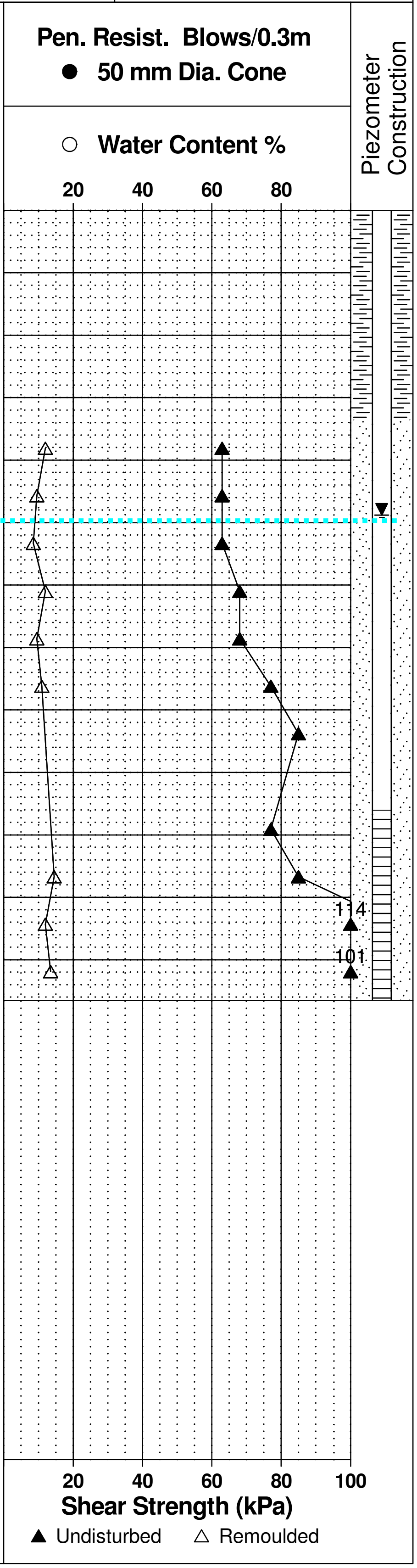
REMARKS

HOLE NO. **BH 7-22**

BORINGS BY CME-55 Low Clearance Drill

DATE 2022 February 11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	78.69
ASPHALT 0.08		AU	1				
FILL: Granular crushed stone 0.53							
FILL: Brown silty sand with gravel 1.47		SS	2	33	50+	1	77.69
Very stiff to stiff brown **SILTY CLAY**		SS	3	75	23	2	76.69
		SS	4	92	13		
		SS	5	83	4	3	75.69
						4	74.69
- Grey by 4.5 m depth						5	73.69
- Increasing silt content with depth						6	72.69
						7	71.69
						8	70.69
		SS	6	100	1	9	69.69
						10	68.69
						11	67.69
						12	66.69
12.65							
End of Borehole							
(GWL at 4.88 m depth - Feb 24, 2022)							



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SOIL PROFILE AND TEST DATA

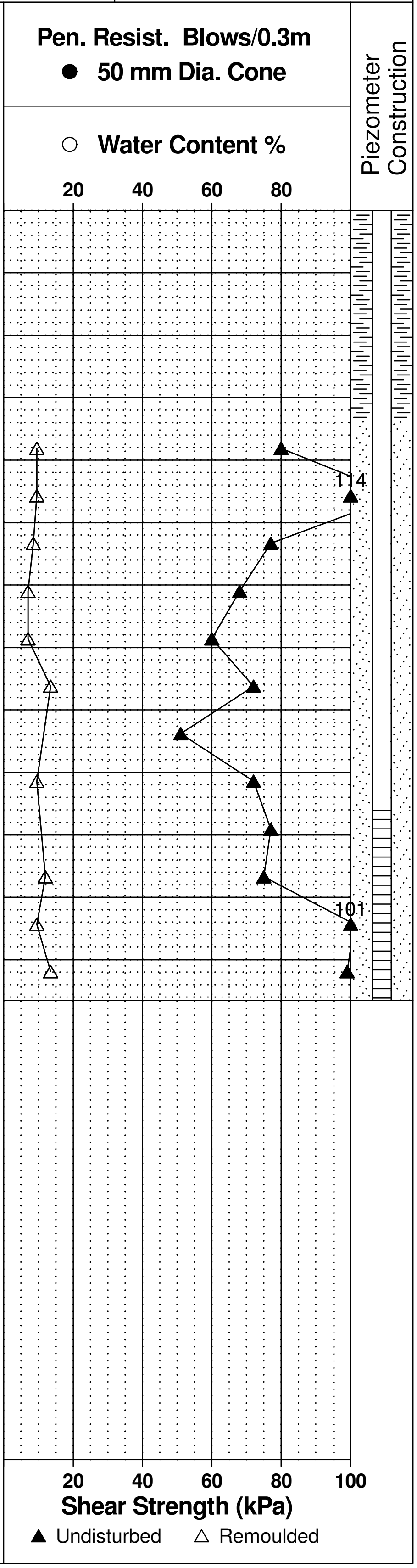
Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY CME-55 Low Clearance Drill
DATE 2022 February 11
FILE NO. PG6107
HOLE NO. BH 8-22

SOIL DESCRIPTION	STRATA PLOT
GROUND SURFACE	
ASPHALT 0.05	☒
FILL: Brown silty sand with gravel and fractured rock 1.45	☒
Very stiff to stiff brown **SILTY CLAY** - Grey by 4.5 m depth 12.65	▨
End of Borehole	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	42	50+
SS	3	100	19
SS	4	100	9
SS	5	100	4

DEPTH (m)	ELEV. (m)
0	78.84
1	77.84
2	76.84
3	75.84
4	74.84
5	73.84
6	72.84
7	71.84
8	70.84
9	69.84
10	68.84
11	67.84
12	66.84



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG6107**

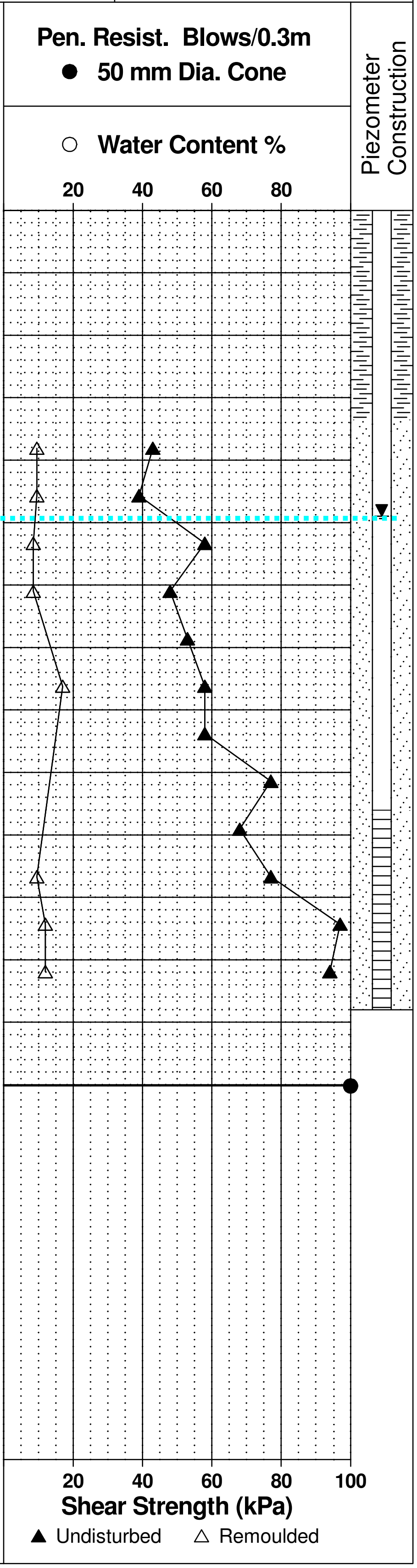
REMARKS

HOLE NO. **BH 9-22**

BORINGS BY CME-55 Low Clearance Drill

DATE 2022 February 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.82
ASPHALT 0.05		AU	1				
FILL: Brown silty sand with garvel 0.51							
Stiff to firm brown **SILTY CLAY**		SS	2	100	20	1	76.82
		SS	3	100	9	2	75.82
		SS	4	100	5	3	74.82
		SS	5	100	4		
						4	73.82
- Grey by 4.5 m depth						5	72.82
						6	71.82
						7	70.82
						8	69.82
						9	68.82
						10	67.82
						11	66.82
						12	65.82
12.80							
Dynamic Cone Penetration Test commenced at 12.80 m depth						13	64.82
14.02						14	63.82
End of Borehole Practical refusal to DCPT at 14.02 m depth (GWL at 4.90 m depth - Feb 24, 2022)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mix-Use, Hi-Rise Development
2940 Baseline Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

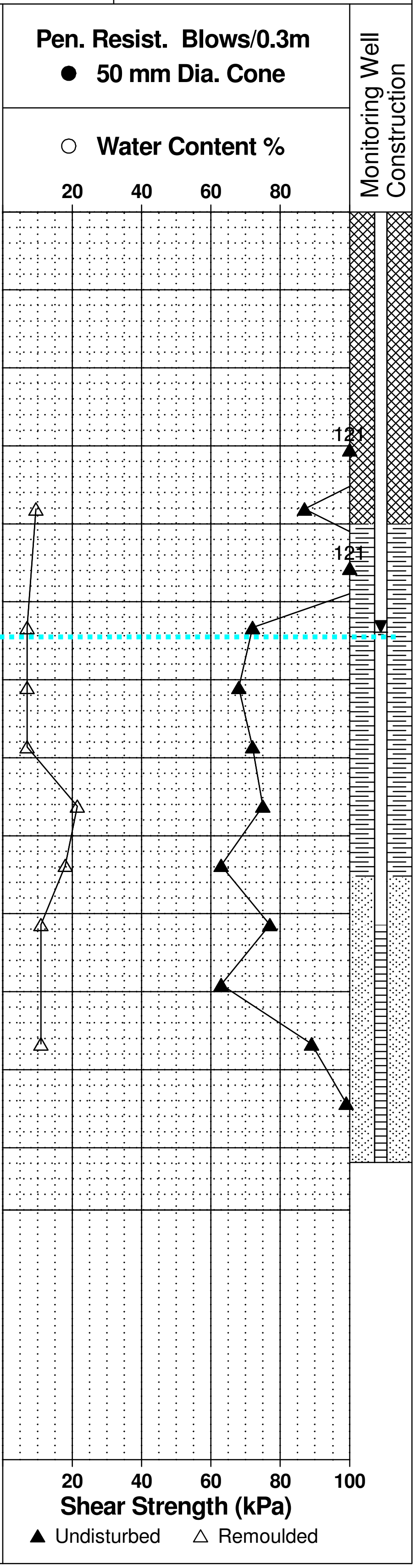
DATE 2022 February 14

FILE NO. PG6107

HOLE NO. BH10-22

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
ASPHALT 0.05	AU	1		
FILL: Brown silty sand with gravel	SS	2	83	28
1.45				
Very stiff to stiff brown **SILTY CLAY**	SS	3	100	12
	SS	4	100	8
- Grey by 4.5 m depth				
12.19				
GLACIAL TILL: Grey silty clay with sand, gravel, trace cobbles and boulders 12.80	SS	5	100	5
End of Borehole				
(GWL at 5.39 m depth - Feb 24, 2022)				

DEPTH (m)	ELEV. (m)
0	78.29
1	77.29
2	76.29
3	75.29
4	74.29
5	73.29
6	72.29
7	71.29
8	70.29
9	69.29
10	68.29
11	67.29
12	66.29



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)

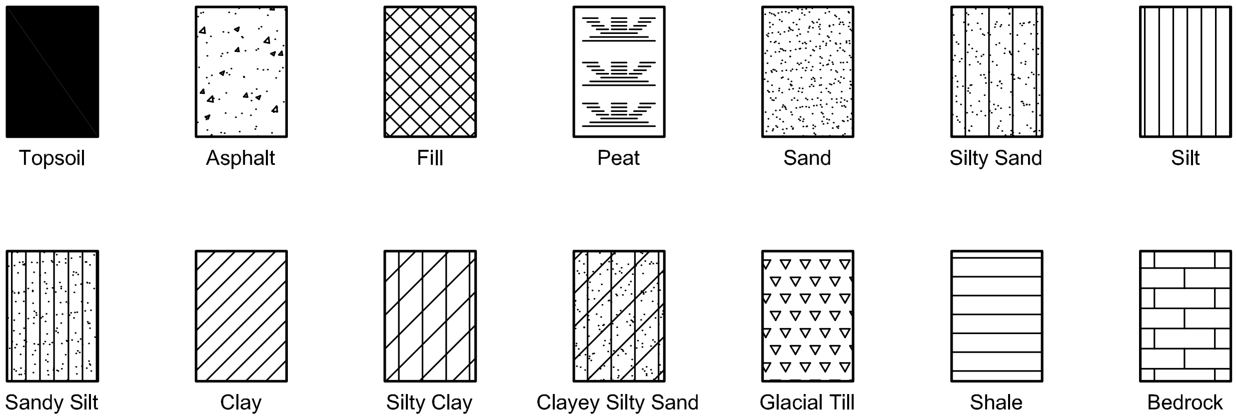
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

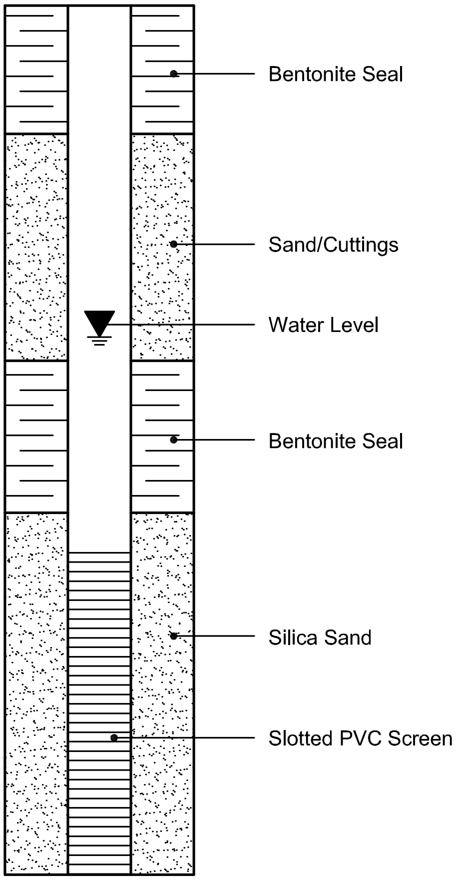
SYMBOLS AND TERMS (continued)

STRATA PLOT

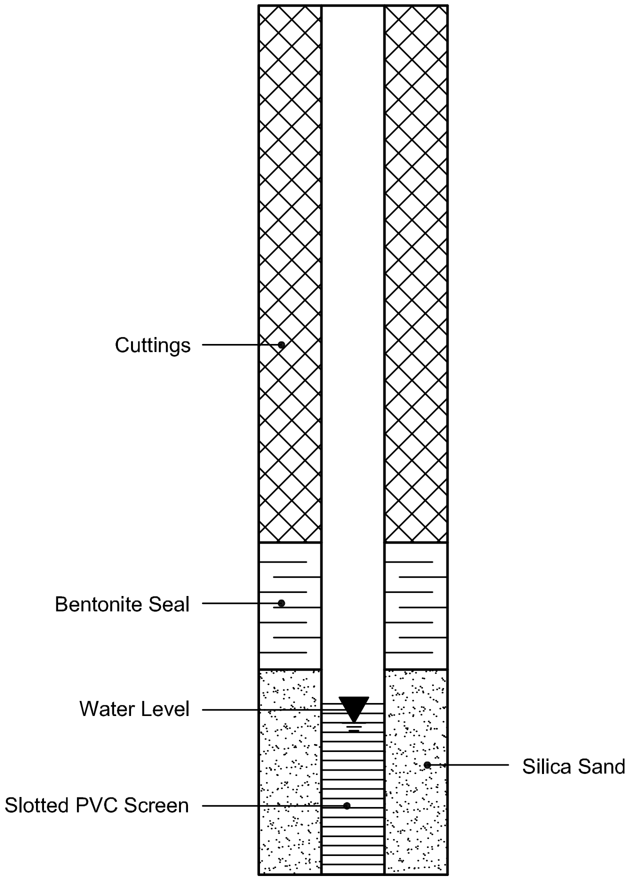


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



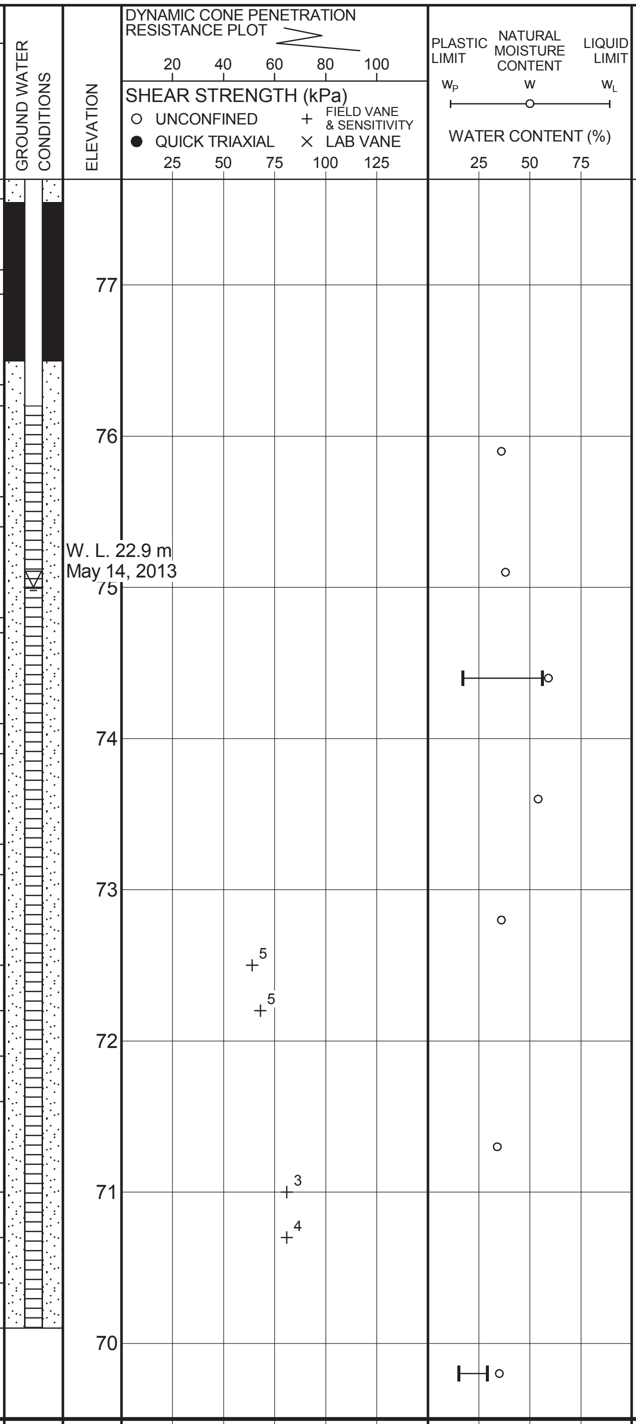
LOG OF BOREHOLE BH13-7

PROJECT: Brigil 2940 Baseline Road
CLIENT: Brigil Platinum
PROJECT LOCATION: 2940-2948 Baseline Road
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 203mm
Date: May/07/2013

REF. NO.: 1599-710
ENCL NO.:

SOIL PROFILE (m) ELEV/DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.7								
77.6 0.0	**Asphalt** 125 mm							
0.1	**Sandy Silt** some clay, brown, damp, loose (Fill)		1	SS	9			
			2	SS	9			
76.2 1.5	**Silty Clay** trace sand, brown, moist, stiff		3	SS	10			
			4	SS	4			
			5	SS	2			
	- grey below 3.7 m		6	SS	1			
	- wet below 4.5 m		7	SS	WH			
				VANE				
				VANE				
			8	SS	WH			
				VANE				
				VANE				
69.5			9	SS	WH			
8.2	**END OF BOREHOLE**							



Notes:

1) 50mm dia. monitoring well installed upon completion
2) Depth of Water

Date	Depth
14/05/2013	2.7 m BSL

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon}$=3% Strain at Failure

SPL Consultants Limited
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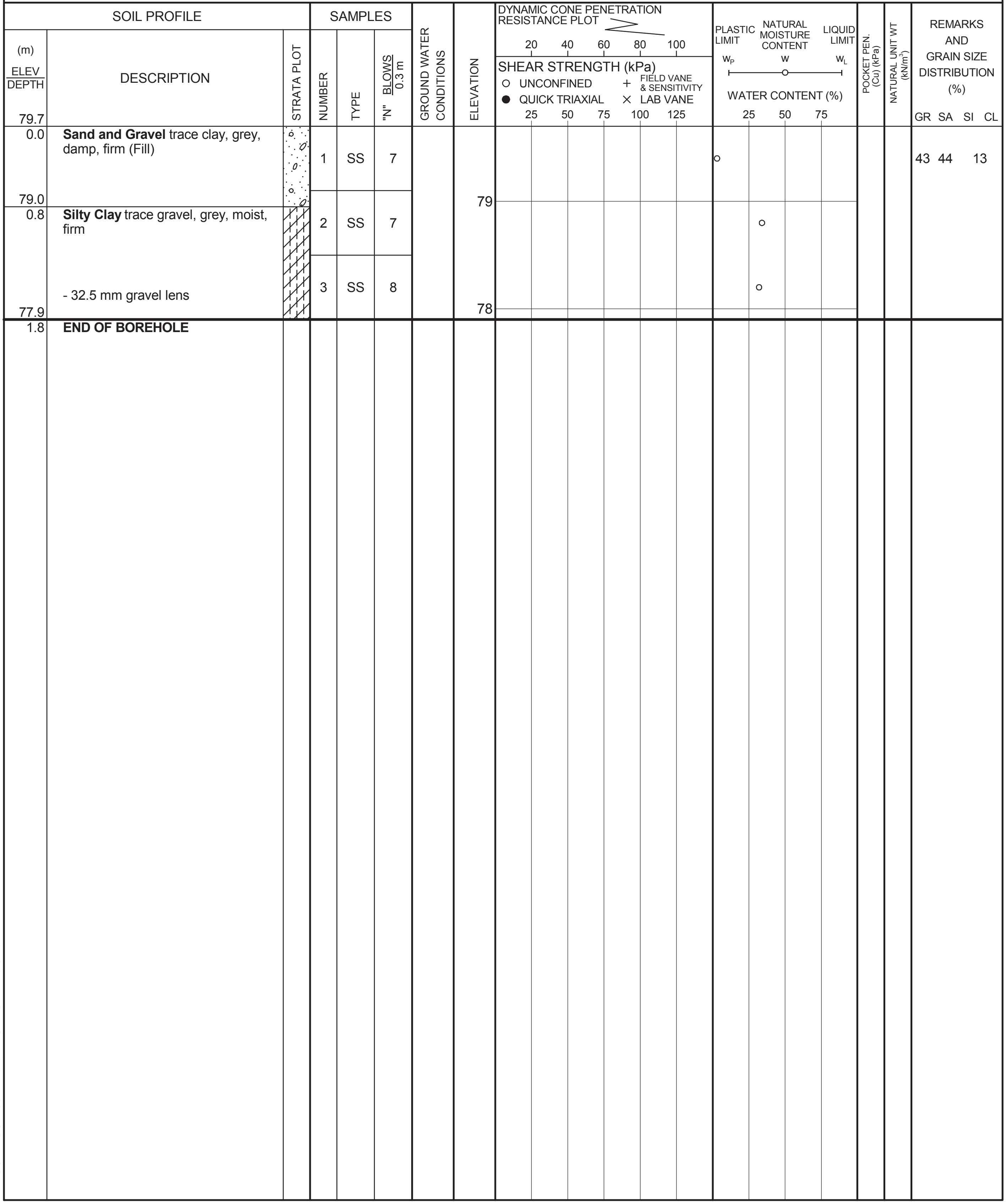
LOG OF BOREHOLE BH13-8

PROJECT: Brigil 2940 Baseline Road
CLIENT: Brigil Platinum
PROJECT LOCATION: 2940-2948 Baseline Road
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 203mm
Date: Feb/05/2013

REF. NO.: 1599-710
ENCL NO.:



SOIL PROFILE			SAMPLES											
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & SENSITIVITY ● QUICK TRIAXIAL × LAB VANE 25 50 75 100 125	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT w LIQUID LIMIT W_L / WATER CONTENT (%) 25 50 75	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR	SA	SI CL
79.7 0.0	**Sand and Gravel** trace clay, grey, damp, firm (Fill)		1	SS	7							43	44	13
79.0 0.8	**Silty Clay** trace gravel, grey, moist, firm		2	SS	7		79							
	- 32.5 mm gravel lens		3	SS	8		78							
77.9 1.8	**END OF BOREHOLE**													

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH13-9

PROJECT: Brigil 2940 Baseline Road	**DRILLING DATA**
CLIENT: Brigil Platinum	Method: Hollow Stem Augers
PROJECT LOCATION: 2940-2948 Baseline Road	Diameter: 203mm
DATUM: Geodetic	Date: May/07/2013
BH LOCATION: See Borehole Location Plan	

REF. NO.: 1599-710

ENCL NO.:

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20, 40, 60, 80, 100

SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & SENSITIVITY; ● QUICK TRIAXIAL; × LAB VANE; 25, 50, 75, 100, 125

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%): 25, 50, 75

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	GR	SA	SI	CL
78.6															
78.6 0.0	**Asphalt** 50 mm	■													
78.5 0.1	**Sand Gravel** some gravel, some organics, brown, damp (FIll)	▨	1	AS			78		○			18	66	16	
77.6 1.1	**Sand and Gravel** brown, damp (Fill)	▨	2	AS					○						
77.1 1.5	**END OF BOREHOLE**														

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPL SOIL LOG 1599-710.GPJ SPL.GDT 23/5/13

SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

LOG OF BOREHOLE BH13-10

PROJECT: Brigil 2940 Baseline Road	**DRILLING DATA**
CLIENT: Brigil Platinum	Method: Hollow Stem Augers
PROJECT LOCATION: 2940-2948 Baseline Road	Diameter: 203mm
DATUM: Geodetic	Date: May/07/2013
BH LOCATION: See Borehole Location Plan	

REF. NO.: 1599-710
ENCL NO.:

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & SENSITIVITY; ● QUICK TRIAXIAL; × LAB VANE; 25 50 75 100 125
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L; WATER CONTENT (%): 25 50 75

SOIL PROFILE			SAMPLES									REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	GR	SA	SI	CL
77.5															
77.4 0.1	**Asphalt** 100 mm	■													
	Gravelly Sand some silt, brown, damp (Fill)	▨					77								
		▨	1	AS	15							30	54		16
76.1 1.4	**END OF BOREHOLE**														

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 33745

Report Date: 22-Feb-2022

Order Date: 15-Feb-2022

Project Description: PG6107

Client ID:		BH8-22 - SS4	-	-	-
Sample Date:		11-Feb-22 09:00	-	-	-
Sample ID:		2208197-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	74.4	-	-	-
General Inorganics					
pH	0.05 pH Units	7.29	-	-	-
Resistivity	0.10 Ohm.m	24.0	-	-	-
Anions					
Chloride	5 ug/g dry	174	-	-	-
Sulphate	5 ug/g dry	93	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURE 2 – WATER SUPPRESSION SYSTEM

FIGURE 3 – ELEVATOR PIT WATERPROOFING

DRAWING PG6107-1 - TEST HOLE LOCATION PLAN

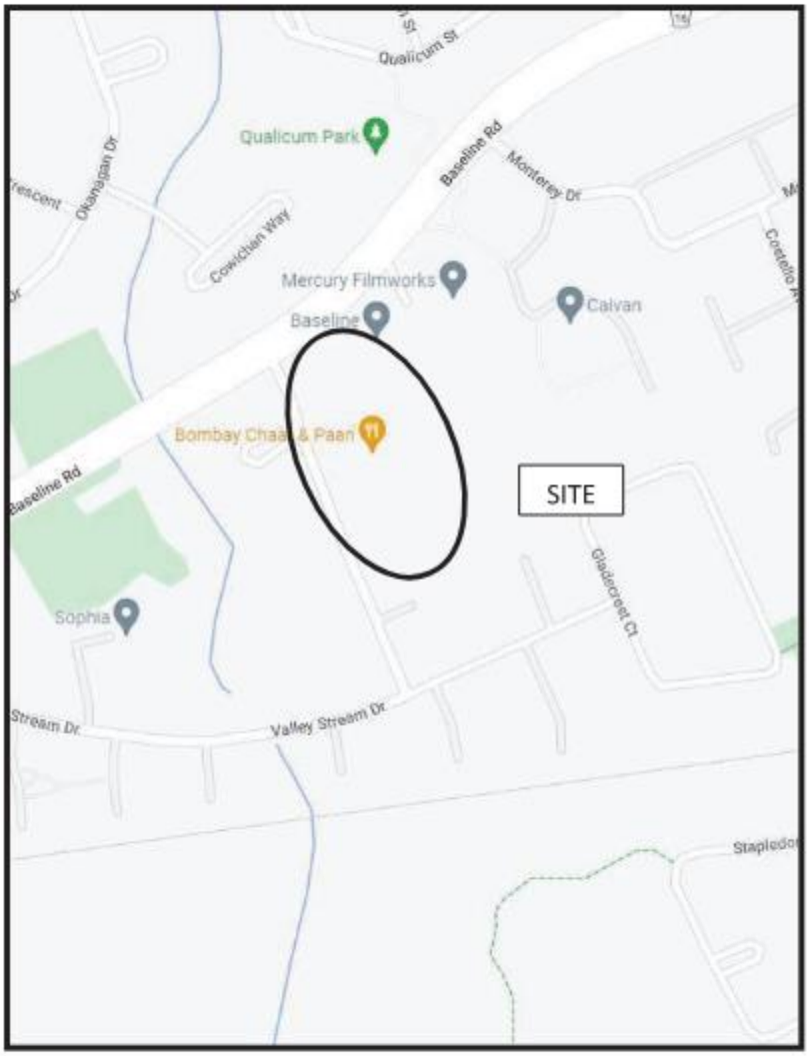
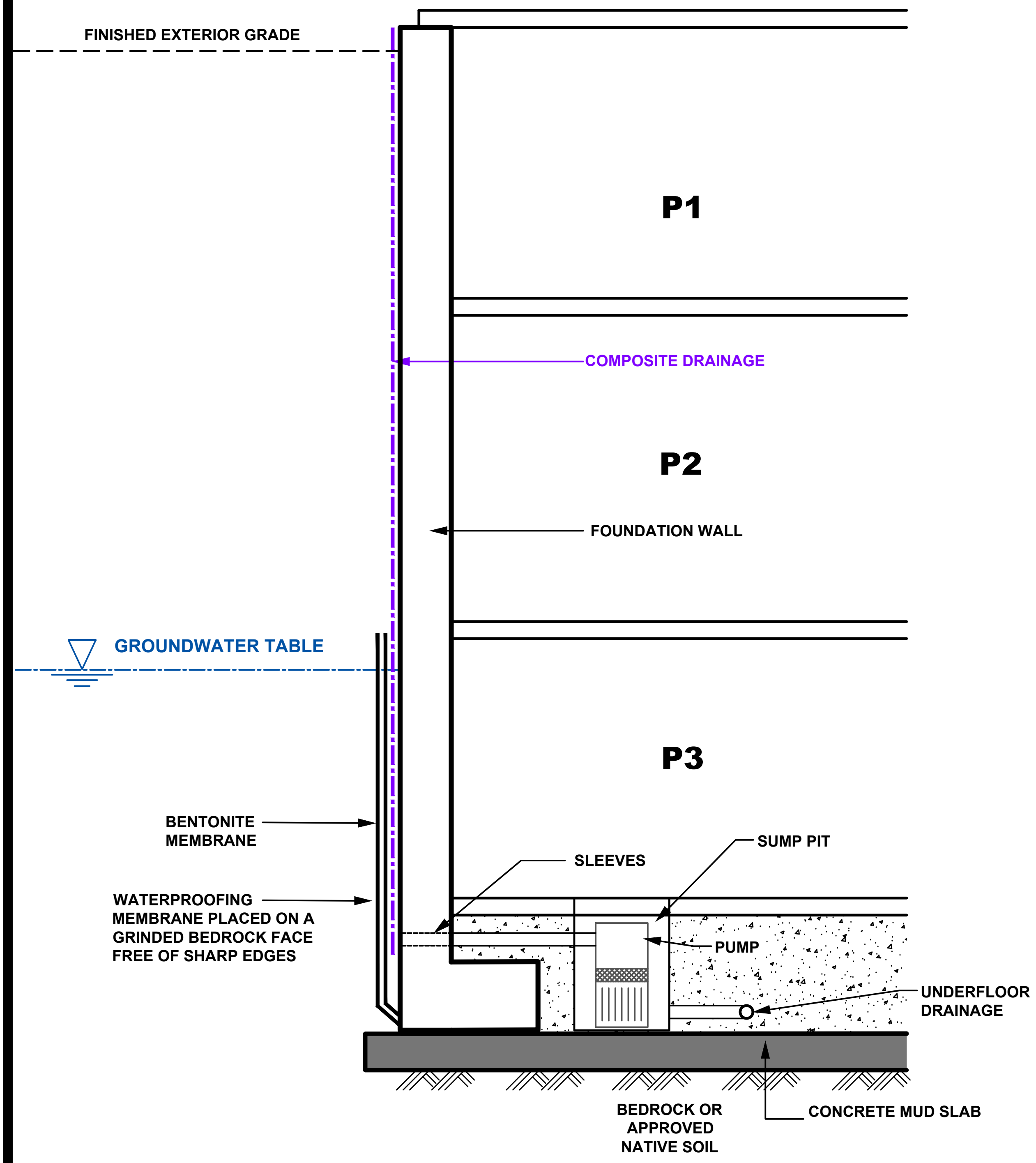


FIGURE 1

KEY PLAN

PATERSON GROUP



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consulting engineers

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www.patersongroup.ca

BRIGIL CONSTRUCTION

GEOTECHNICAL INVESTIGATION
2946 BASELINE ROAD
OTTAWA, ONTARIO

Title:

WATER SUPPRESSION SYSTEM

Date: **03/2023**

Report No.: **PG6107-1**

Scale: **N.T.S.**

Drawing No.: **FIGURE 2**

Drawn by: **NFRV**

Checked by: **BN**

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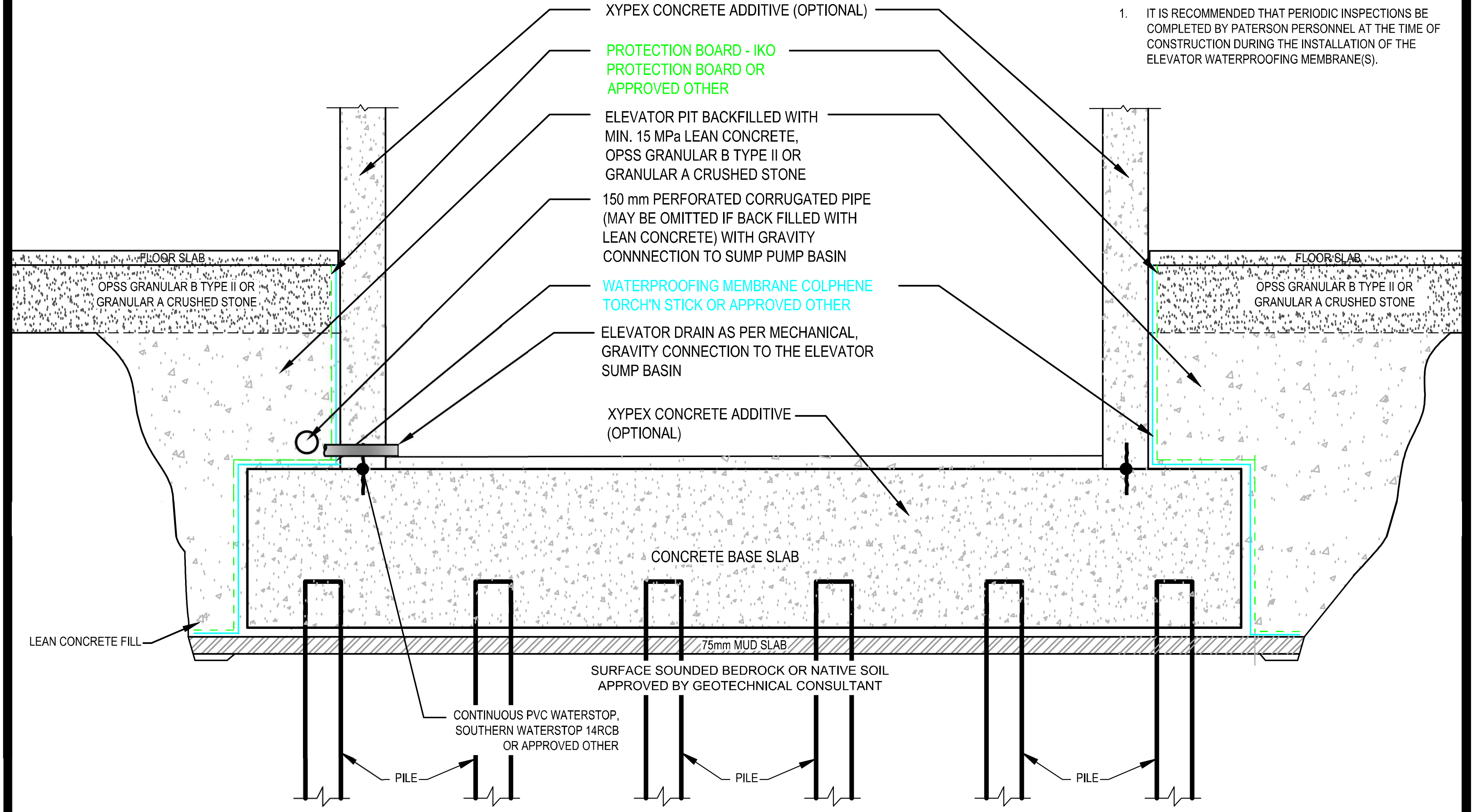
NOTES:

1. IT IS RECOMMENDED THAT PERIODIC INSPECTIONS BE COMPLETED BY PATERSON PERSONNEL AT THE TIME OF CONSTRUCTION DURING THE INSTALLATION OF THE ELEVATOR WATERPROOFING MEMBRANE(S).



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

BIRGIL CONSTRUCTION

PROPOSED MULTI-STOREY BUILDING
2946 BASELINE ROAD

OTTAWA, ONTARIO

Title:

ELEVATOR PIT WATERPROOFING

Scale: N.T.S.
Date: 03/2023
Drawn by: NFRV
Report No.: PG6107
Checked by: JV
Drawing No.: FIGURE 3
Approved by: DJG
Revision No.:

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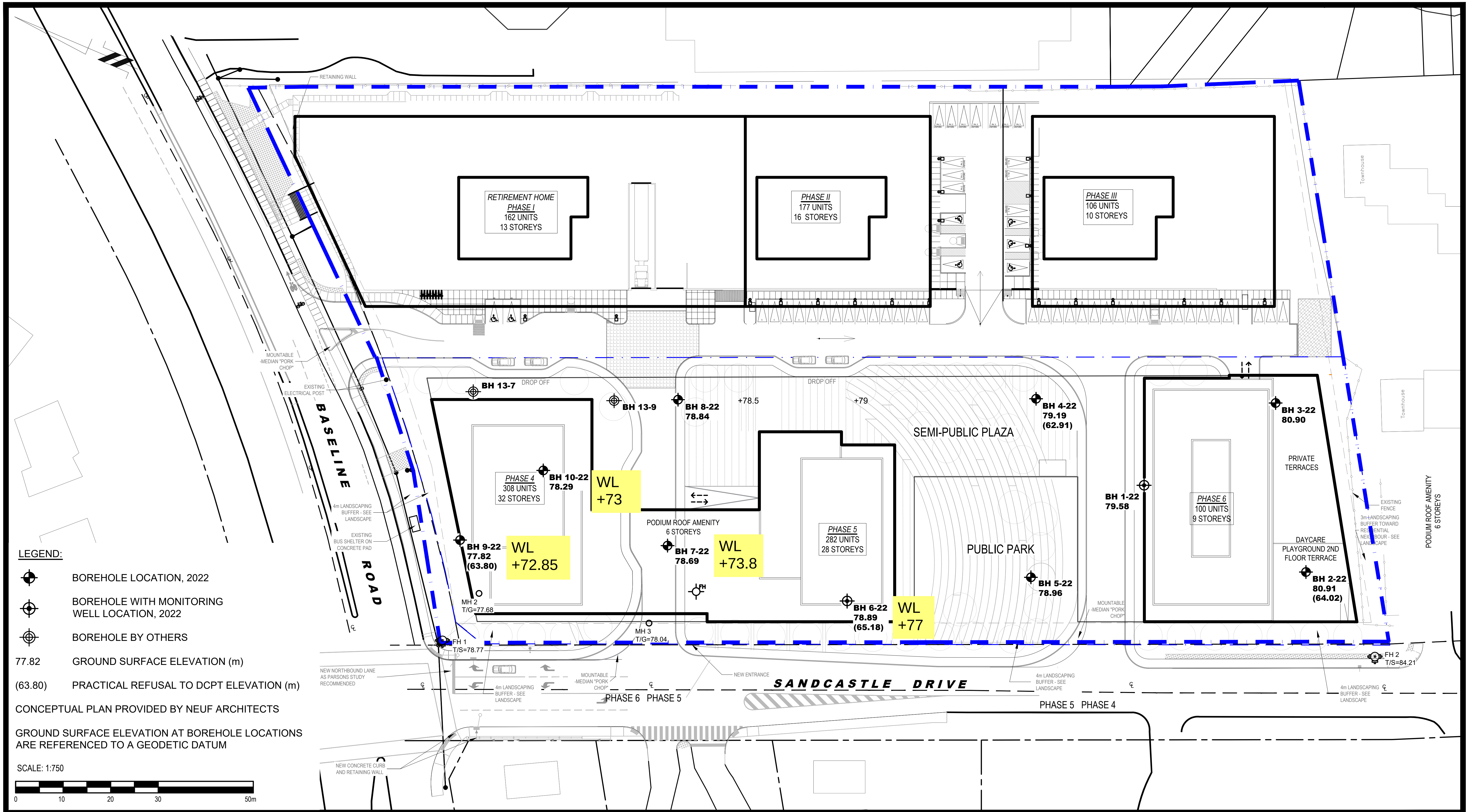

LEGEND:

⌖	BOREHOLE LOCATION, 2022
⌖	BOREHOLE WITH MONITORING WELL LOCATION, 2022
⌖	BOREHOLE BY OTHERS
77.82	GROUND SURFACE ELEVATION (m)
(63.80)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY NEUF ARCHITECTS

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

SCALE: 1:750

PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	03/03/2023	JV

BRIGIL CONSTRUCTION
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL BUILDING
2946 BASELINE ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750
Date: 02/2022
Drawn by: YA
Report No.: PG6107-1
Checked by: BN
Dwg. No.: PG6107-1
Approved by: FA
Revision No.: 1

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APPENDIX 3

TYPICAL FOUNDATION SLEEVE INSTALLATION

Typical 150 mm Diameter Sleeve Installation

Photo 1 – Step 1: It is recommended that the upper 1/3 of the 150 mm drainage sleeve be cut at a 45 degree angle to hydraulically connect the composite foundation drainage board to the interior and underfloor drainage system.

Photo 2 – Step 2: It is recommended that the 150 mm diameter drainage sleeve be installed by carefully cutting an ‘X’ shaped incision through the composite foundation drainage and inserting the 150 mm diameter drainage sleeve inside the ‘X’ by pulling the four (4) triangular flaps towards the installer.

Photo 3 – Step 3: Apply a suitable primer prior to the placement of the adhesive tape such as 3M tape, WP200 BlueSkine or equivalent.

Photo 4 – Step 4: An adhesive such as 3M tape, BlueSkin, or equivalent be utilized to seal the 150 mm drainage sleeve to the composite foundation drainage board to act as a barrier in preventing concrete from blocking connection during the placement of the exterior concrete foundation wall.

Photo 5 – Step 5: As an additional precaution, it is also recommended that an adhesive tape be placed on the interior outlet end of the drainage sleeve between the temporary form work to further prevent concrete from entering the drainage sleeve during the placement of concrete. Once the temporary form work has been removed, the adhesive tape can be cut away to allow groundwater to have a positive gravity connection to the interior perimeter and underfloor drainage system.