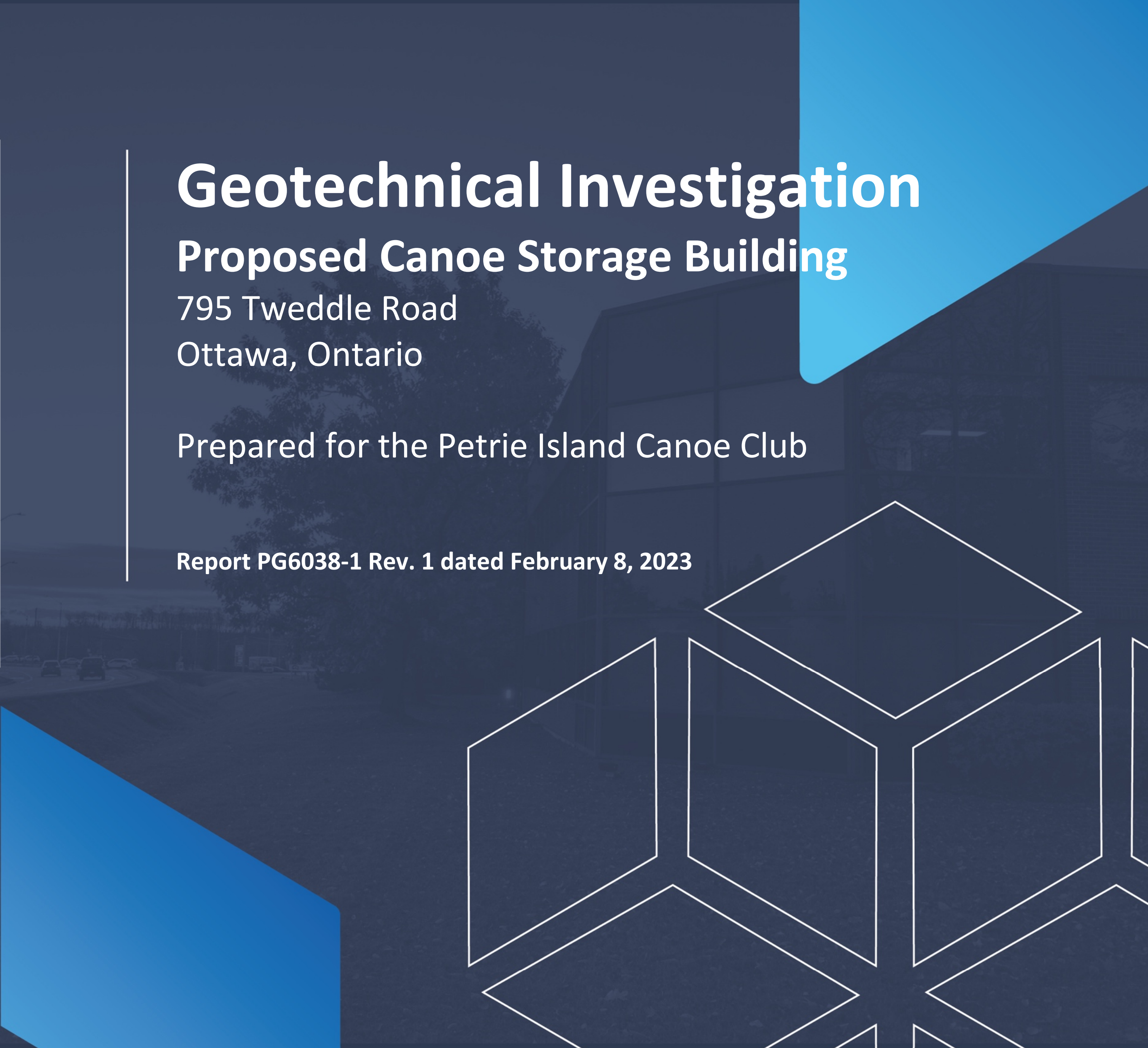

Geotechnical Investigation

Proposed Canoe Storage Building

795 Tweddle Road
Ottawa, Ontario

Prepared for the Petrie Island Canoe Club

Report PG6038-1 Rev. 1 dated February 8, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by the Petrie Island Canoe Club to conduct a geotechnical investigation for the proposed canoe storage building to be located at 795 Tweddle Road on Petrie Island in the City of Ottawa, Ontario.

The objectives of the geotechnical investigation were to:

❑ Determine the subsoil and groundwater conditions at this site by means of a borehole.

❑ Provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect it’s design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

Based on the available drawings, the proposed development at the aforementioned site will consist of a slab-on-grade structure with an approximate footprint of 270 m^2. A perimeter deck is also proposed to be supported on concrete piers. This building will be located approximately 70 m west of the Ottawa River shoreline.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was conducted on October 13, 2021 and consisted of 1 borehole which was advanced to a depth of 7.5 m below the existing ground surface. The borehole was located taking into consideration the existing site features and underground utilities. The borehole location is shown on Drawing PG6038-1 - Test Hole Location Plan included in Appendix 2.

The borehole was advanced using a truck-mounted 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. The test hole procedures consisted of advancing the borehole to the required depth at the selected location and sampling the overburden.

Sampling and In Situ Testing

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

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.

The subsurface conditions observed in the borehole were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1 of this report.

3.2 Field Survey

The borehole location and ground surface elevation at the borehole location were surveyed by Paterson using a handheld GPS unit, and referenced to a geodetic datum. The borehole location and ground surface elevation at the borehole location are presented on Drawing PG6038-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the borehole and visually examined in our laboratory to review the field logs.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site is located approximately 70 m west of the Ottawa River shoreline, and at the western edge of the sand beach. The site is bounded by a gravel parking lot to the south, sand beach to the east, and grassed areas to the north and west. The existing ground surface slopes downward gradually towards the Ottawa River to the east.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the borehole location consists of fill to an approximate depth of 4.3 m, consisting of a silty sand, with trace to some wood, peat, and organics, underlain by a 0.6 m thick layer of clayey silt, then a native silty sand to the bottom depth of the borehole at a 7.5 m depth.

Practical refusal to the DCPT was not encountered at an approximate depth of 30.2 m below the existing ground surface.

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, the bedrock in the subject area consists of dolomite of the Oxford formation and is presents at depths ranging from 25 to 50 m.

4.3 Groundwater

The groundwater level was observed in the completed borehole at an approximate depth of 2.4 m. However, it should be noted that the groundwater level is subject to seasonal fluctuations and fluctuations from the adjacent river level, therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed building. It is recommended that foundation support for the proposed building consist of conventional spread footings bearing on the existing fill, which is prepared in accordance with the recommendations provided herein.

Due to the proximity of the proposed building to the Ottawa River, it is understood that the building will be subject to scour and flood loads. For scour protection, a geotextile-lined, rip-rap filled trench is recommended surrounding the building foundations. For flood loads, it is recommended that the foundations be designed to act as deadman anchors.

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

5.2 Site Grading and Preparation

Stripping Depth

Deleterious fill, such as fill consisting predominantly of organic and/or disturbed materials, should be stripped from under any buildings and other settlement sensitive structures. However, it is anticipated that the existing fill within the footprint of the proposed structure, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprint. For the slab-on-grade, it is recommended that the existing fill layer be proof-rolled several times **under dry conditions and above freezing temperatures** and approved by Paterson personnel at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

Fill Placement

Fill used for grading beneath the proposed building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery to the site. It should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building area should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Site excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Site excavated soils are not suitable for use 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.

Scour Protection

In order to provide scour protection for the proposed building, it is recommended that a 1 m wide trench be excavated at a distance 2 m beyond the outermost foundations (whether that be the perimeter footings or concrete piers) on all sides of the building. The trench should extend 300 mm below the foundation depth, and should be lined with a non-woven geotextile liner, such as Terrafix 270R or equivalent, and backfilled with a 100 to 200 mm diameter rip-rap. The geotextile liner should wrap over the trench sidewalls, base and top to completely encase the rip-rap layer. A thin layer of topsoil, or sand, can then be placed overtop of the geotextile liner at the ground surface.

Subgrade Improvement Program for Foundations

The following subgrade improvement program is recommended for all footings, which will be located on the existing fill:

☐ The bearing surface at design underside of footing level should be sub-excavated at least 150 mm below footing level.

☐ The subgrade should then be covered with a woven geotextile liner, such as Terrafix 270R or equivalent, followed by a biaxial geogrid, such as Geosynthetics Systems TBX 2200 or equivalent.

☐ The sub-excavated area should then be in-filled with engineered fill, such as OPSS Granular B Type II, placed in one 150 mm loose lift up to the underside of footing elevation, and compacted to 98% of its SPMDD.

5.3 Foundation Design

Bearing Resistance Values

Conventional spread footings, and concrete piers for the proposed perimeter deck, bearing on the undisturbed existing fill, which is prepared in accordance with our recommendations above, can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**. A geotechnical resistance factor of 0.5 was incorporated to the bearing resistance value at ULS.

An undisturbed soil bearing surface consists of a surface 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.

Footings designed using the bearing resistance value 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. Adequate lateral support is provided to the existing fill 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.

5.4 Flood Load Resistance

Lateral and uplift forces on the proposed foundations can be resisted by designing the concrete footings to act as deadman anchors.

Geotechnical parameters for typical backfill materials compacted to 98% of SPMDD in 300 mm lift thicknesses are provided in Table 1 below, along with the associated earth pressure coefficients for horizontal resistance calculations for deadman anchors. General uplift cone or prism angles are provided in Figure 2 - Uplift Cone Angles for Backfill Material in Appendix 2 for cohesionless soils. Also, friction factors between concrete and the various subgrade materials are provided in Table 1.

Given the soil at this site will likely be subjected to submerged conditions during the design life of the proposed building, calculate using the “effective” unit weight.

A sieve analysis and standard Proctor test should be completed on each of the fill materials proposed to obtain an accurate soil density to be expected, so the applicable unit weights can be estimated.

Table 1 - Geotechnical Parameters for Uplift and Lateral Resistance Design

Material Description	Unit Weight (kN/m^3)		Internal Friction Angle (°) φ'	Friction Factor, tan δ	Earth Pressure Coefficients		
	Drained γ_{dr}	Effective γ'			Active K_A	At-Rest K_O	Passive K_P
OPSS Granular A Fill (Crushed Stone)	22	13.5	40	0.6	0.22	0.36	4.58
OPSS Granular B Type I Fill (Well-Graded Sand-Gravel)	21.5	13.5	36	0.55	0.26	0.41	3.85
OPSS Granular B Type II Fill (Crushed Stone)	22.5	14	40	0.6	0.2	0.33	5.04
Existing Fill	18	9.5	33	0.45	0.3	0.46	3.39

Notes:

❑ Properties for fill materials are for condition of 98% of standard Proctor maximum dry density.

❑ The earth pressure coefficients provided are for horizontal backfill profile.

5.5 Design for Earthquakes

The site class for seismic site response can be taken as **Class E**. Soils underlying the subject site are not considered to be susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code 2012 for a full discussion of the earthquake design requirements.

5.6 Slab on Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the existing fill subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for slab-on-grade construction.

A vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as Granular B Type II.

It is recommended that the upper 200 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill materials required to raise grade within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.7 Pavement Design

Should paving be a part of the proposed development, the pavement structures for car only parking areas, access lanes and heavy truck parking areas are shown in Tables 2 and 3 below.

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 99% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The existing fill should be deemed suitable for backfill by a Paterson Personnel at the time of backfill. If good quality, non frost susceptible fill is not available on-site, imported granular materials, such as clean sand or OPSS Granular B Type II granular material, can also be used for this purpose.

6.2 Protection of Footings Against Frost Action

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

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

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. Excavations below the groundwater level should be cut back at a maximum slope of 1.5H:1V. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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

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

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

6.4 Pipe Bedding and Backfill

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

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% 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 98% of its 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 minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the material’s SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

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

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

If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

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

The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur. In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

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

6.7 Corrosion Potential and Sulphate

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

7.0 Recommendations

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

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

☐ Sampling and testing of the concrete and fill materials used.

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

☐ Observation of all subgrades prior to backfilling.

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

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

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

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and 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 of this nature is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request that we be notified 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 Petrie Island Canoe Club, 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.

KBell

Killian Bell, B.Eng.

LICENSED PROFESSIONAL ENGINEER
Feb. 8, 2023
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Storage Structure - Petrie Island
795 Trim Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 13, 2021

FILE NO. PG6038

HOLE NO. BH 1-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	43.01
FILL: Brown silty sand	▨	AU	1				
- some gravel and organics from 1.5 to 2.1m depth	▨	SS	2	100	50+	1	42.01
- running sand encountered in augers below 2.4m depth	▨	SS	3	83	37	2	41.01
- trace wood by 3.0m depth	▨	SS	4	83	9		
- some peat and organics by 3.8m depth	▨	SS	5	33	6	3	40.01
4.27	▨	SS	6	75	9	4	39.01
Brown **CLAYEY SILT,** trace organics 4.88	▨	SS	7	42	3	5	38.01
Loose to very loose, brown **SILTY SAND**	▥	SS	8	42	W		
	▥	SS	9	33	6	6	37.01
7.47	▥	SS	10	33	2	7	36.01
End of Borehole							
(GWL @ 2.4m 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

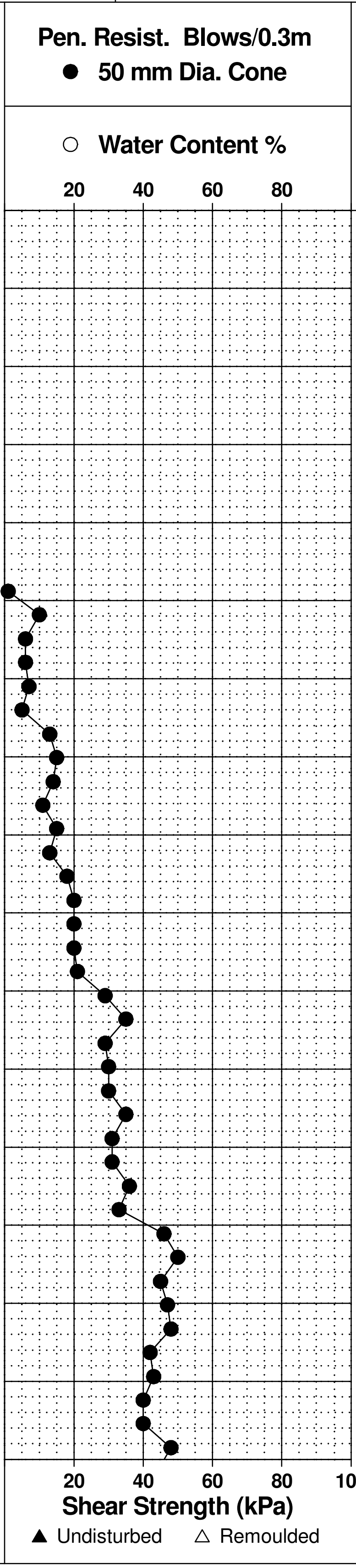
patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Storage Structure - Petrie Island
795 Trim Road, Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY CME-55 Low Clearance Drill
DATE October 13, 2021
FILE NO. PG6038
HOLE NO. BH 1A-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	43.08
						1	42.08
OVERBURDEN - augered to 4.6m depth						2	41.08
						3	40.08
4.60						4	39.08
Dynamic Cone Penetration Test commenced at 4.9m depth.						5	38.08
						6	37.08
						7	36.08
						8	35.08
						9	34.08
						10	33.08
						11	32.08
						12	31.08
						13	30.08
						14	29.08
						15	28.08
						16	27.08



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Storage Structure - Petrie Island
795 Trim Road, Ottawa, Ontario

DATUM Geodetic

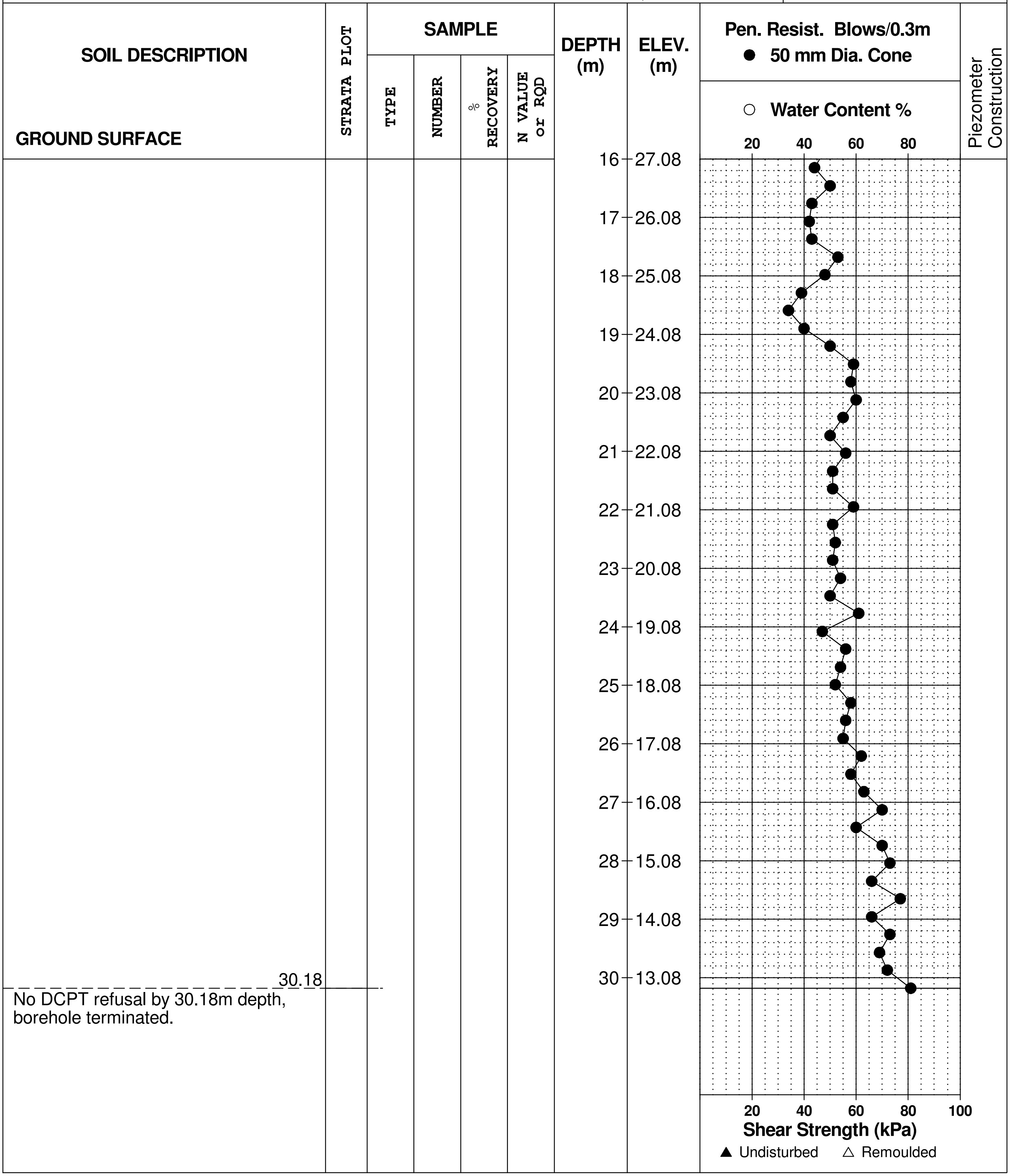
REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 13, 2021

FILE NO. PG6038

HOLE NO. BH 1A-21



No DCPT refusal by 30.18m depth, borehole terminated.

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 x D60)
Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

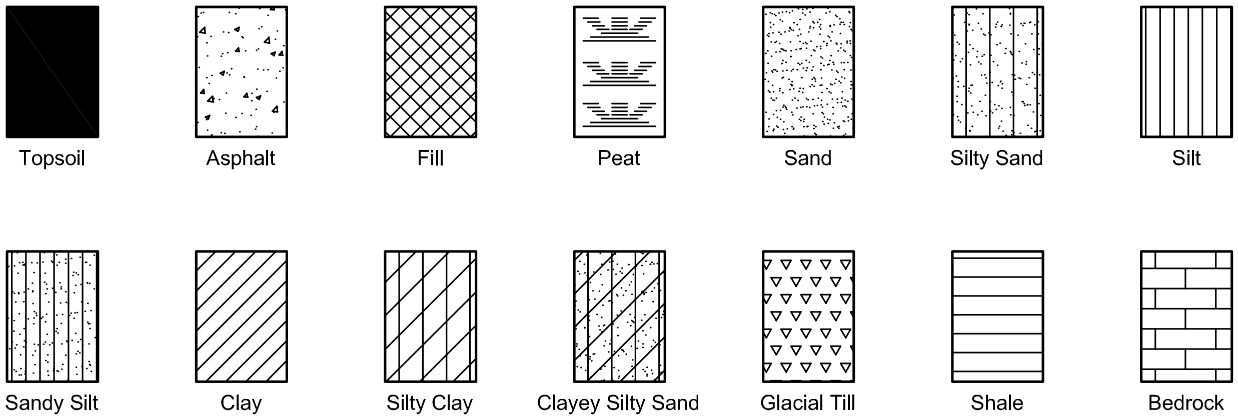
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

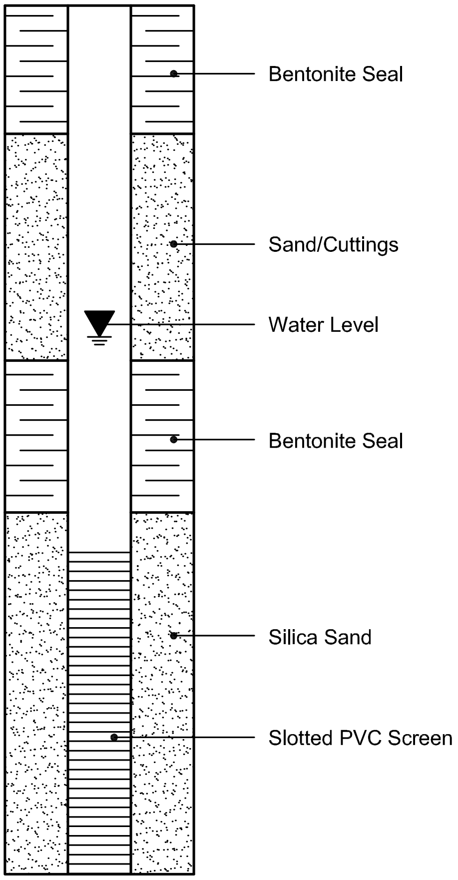
SYMBOLS AND TERMS (continued)

STRATA PLOT

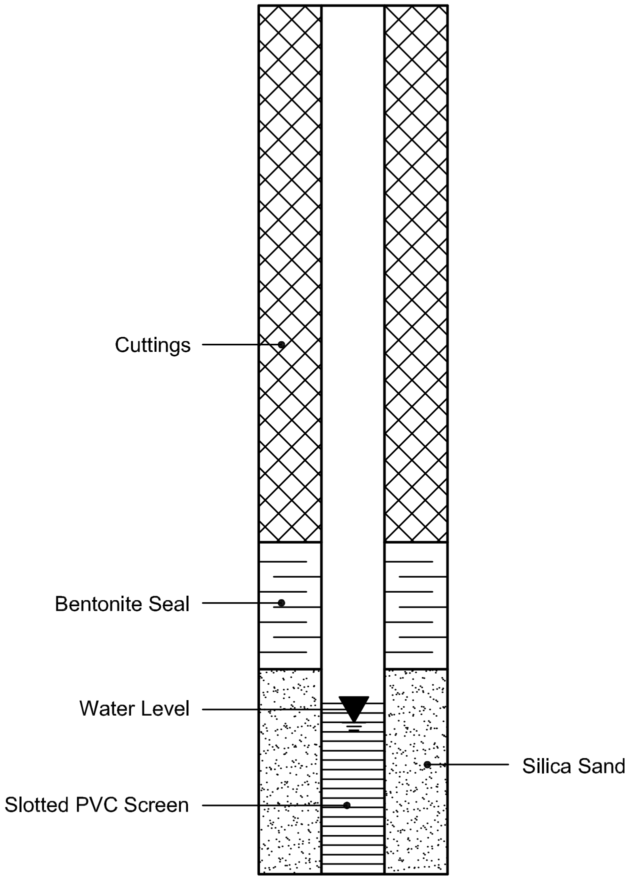


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24536

Report Date: 20-Oct-2021

Order Date: 15-Oct-2021

Project Description: PG4136

	Client ID:	BH1-21 / SS2	-	-	-
	Sample Date:	13-Oct-21 09:00	-	-	-
	Sample ID:	2142525-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	88.4	-	-	-
General Inorganics					
pH	0.05 pH Units	6.02	-	-	-
Resistivity	0.10 Ohm.m	117	-	-	-
Anions					
Chloride	5 ug/g dry	<5	-	-	-
Sulphate	5 ug/g dry	43	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 – UPLIFT CONE ANGLES FOR BACKFILL MATERIAL

DRAWING PG6038-1 – TEST HOLE LOCATION PLAN

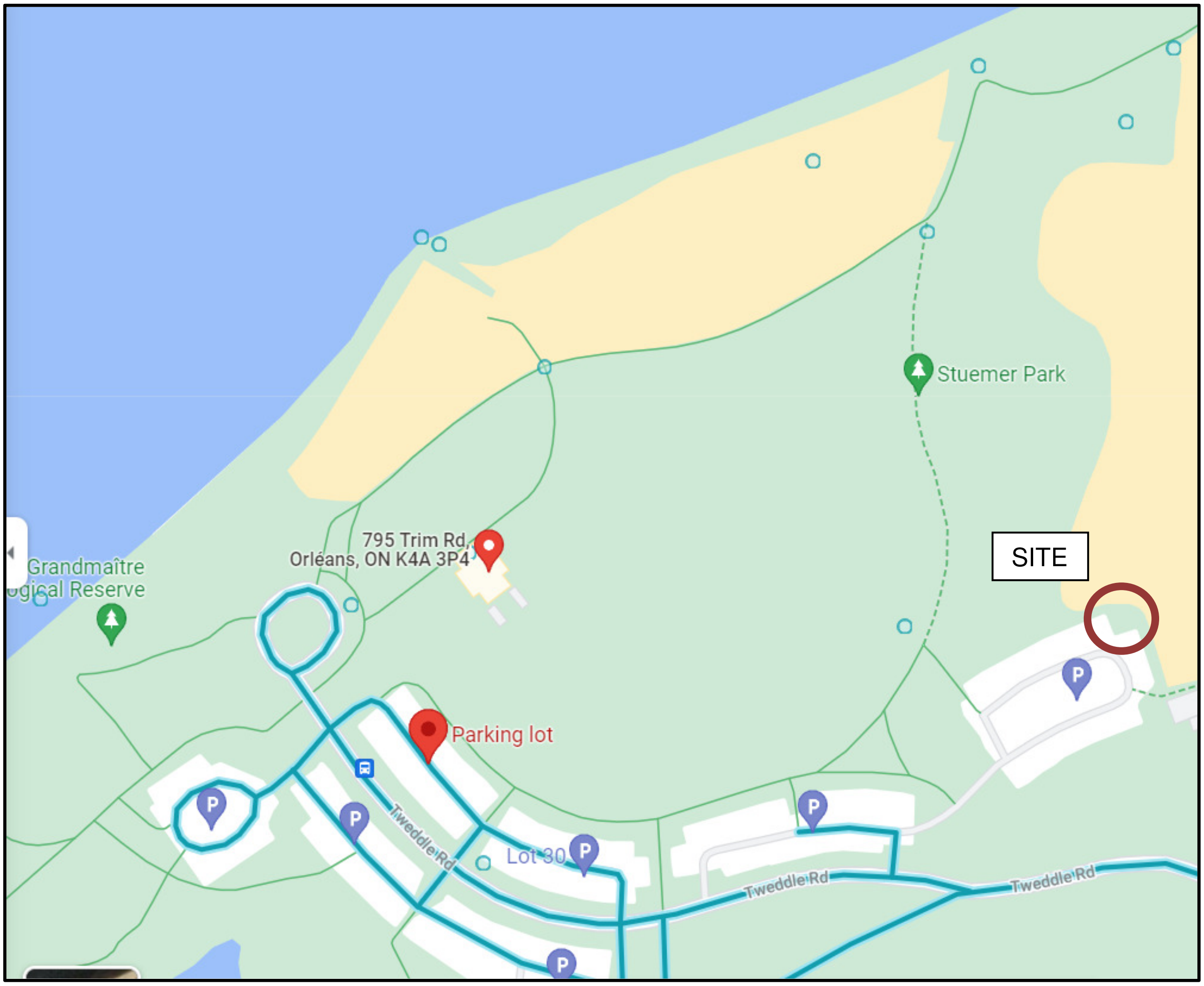
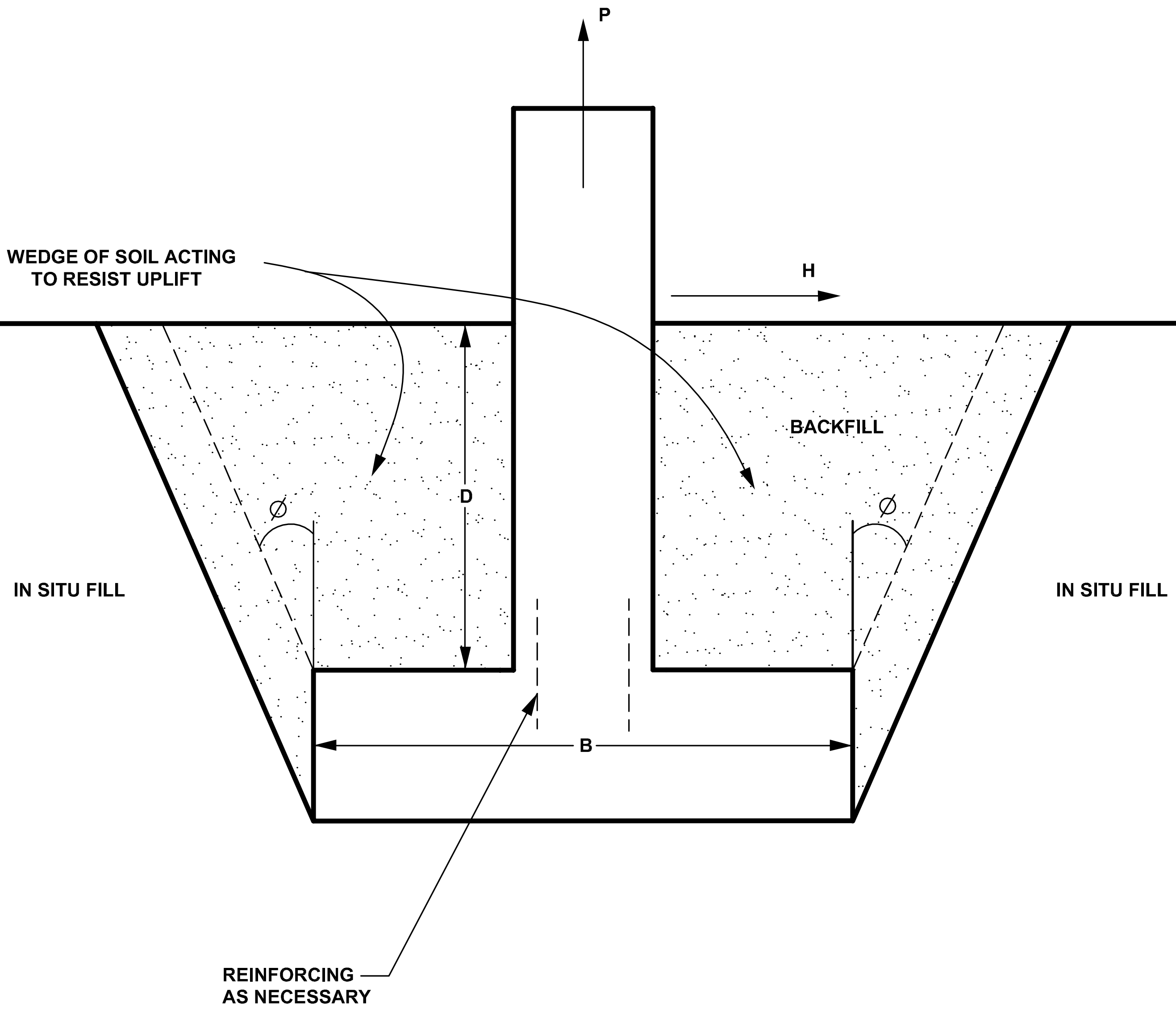


FIGURE 1

KEY PLAN



WHERE
P = UPLIFT LOAD
H = HORIZONTAL LOAD
B = WIDTH OF FOOTING

∅ - USE 20° FOR COHESIONLESS SOIL (ie.- GRANULAR BACKFILL COMPACTED TO 98% SPMDD)
- USE 30° FOR COHESIVE SOIL (ie.- SILTY CLAY COMPACTED WITH A SHEEPSFOOT ROLLER)

FIGURE 2

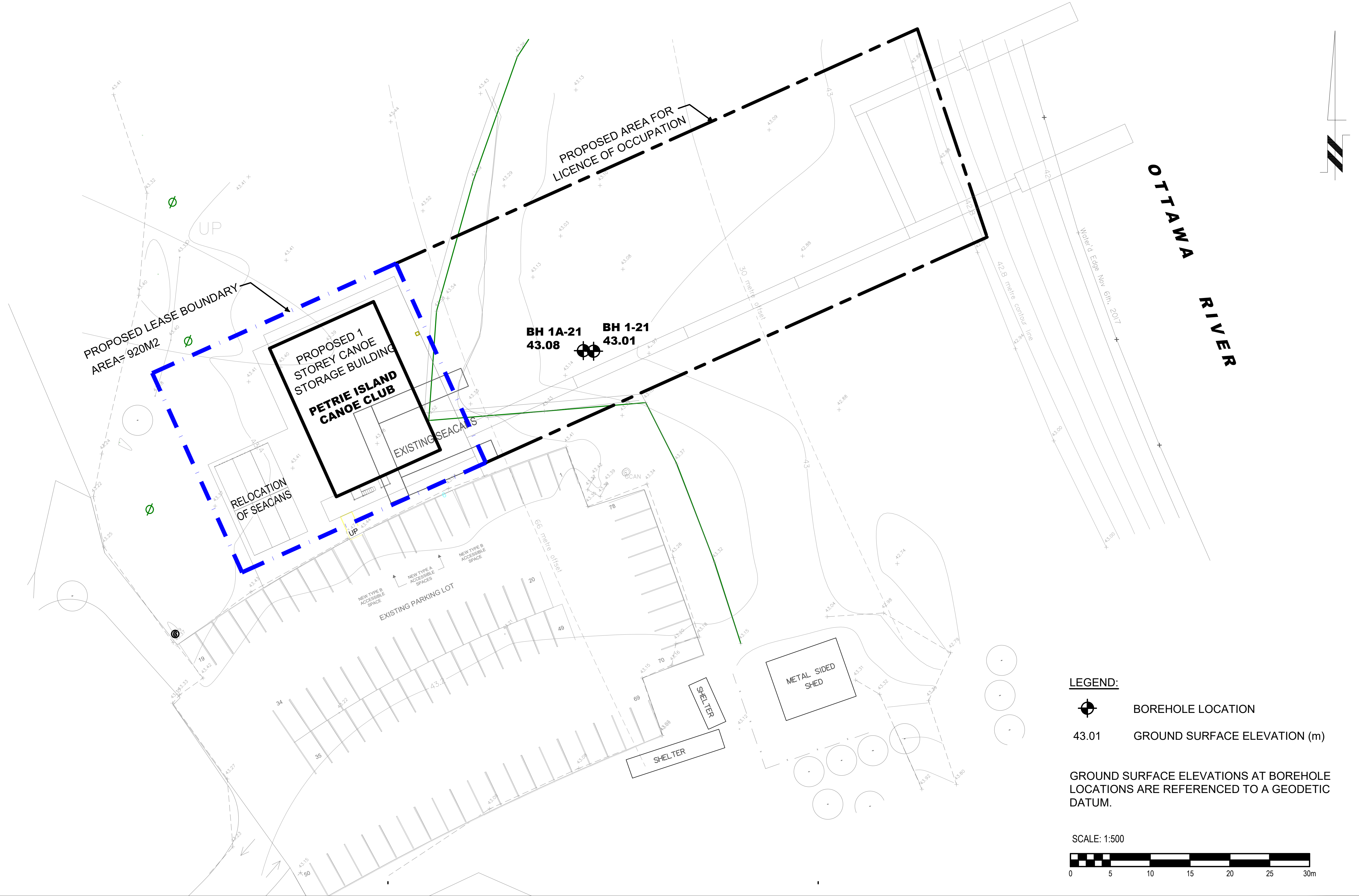
UPLIFT CONE ANGLES FOR BACKFILL MATERIAL

patersongroup
consulting engineers
154 Colonnade Road, Ottawa, Ontario K2E 7J5

J.L. RICHARDS & ASSOC. LTD.

PETRIE ISLAND CANOE CLUB - COMMUNITY ARENA
PETRIE ISLAND - OTTAWA, ONTARIO

Report No.:		Scale:
PG6038-1		N.T.S.
Date:	Drawn:	Approved:
10/2021	MPG	SD



LEGEND:

⌖ BOREHOLE LOCATION

43.01 GROUND SURFACE ELEVATION (m)

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

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

NO.	REVISIONS	DATE	INITIAL
1.	UPDATED CONCEPTUAL PLAN	02/03/2023	SD

J.L. RICHARDS & ASSOCIATES LTD.
GEOTECHNICAL INVESTIGATION
PROP. STORAGE STRUCTURE - PETRIE ISLAND - 795 TWEDDLE ROAD
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:500
Date: 10/2021
Drawn by: MPG
Report No.: PG6038-1
Checked by: SD
Dwg. No.: PG6038-1
Approved by: SD
Revision No.: 1

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