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Geotechnical Engineering
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July 5, 2023
Report: PG3545-LET.01 Revision 2

Ottawa South United
1128 Clapp Lane
Ottawa, Ontario
K4M 1A4

Attention: **Mr. Jim Lianos**

Subject: **Geotechnical Investigation**
Proposed Club House and Septic Bed
5650 Mitch Owens Drive - Ottawa

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) completed a geotechnical investigation for the proposed club house and septic bed to be located at the aforementioned site. This report presents our findings and recommendations from a geotechnical perspective for the proposed project.

1.0 Proposed Development

It is our understanding based on available plans that six proposed artificial turf soccer fields will be constructed within the site. It is further understood that a proposed one storey club house building will be constructed within the east portion of the site. Associated asphalt paved parking areas and access lanes, and a septic bed are also anticipated for the proposed development.

2.0 Method of Investigation

Field Program

The field program for the geotechnical investigation was carried out on June 25, 2015. During that time, a total of eleven (11) boreholes were completed to a maximum depth of 6.1 m. The locations of the test holes are shown on Drawing PG3545-1 - Test Hole Location Plan attached to the current letter. The test holes were distributed across the proposed turf field to provide general coverage while considering underground utilities and existing site features.

Based on field observations and moisture content testing, groundwater levels (GWL) were noted to be between 1.5 to 2 m. It should be noted that GWL can vary seasonally and with precipitation events. Therefore, the GWL may vary at the time of construction.

It should be noted that Paterson has reviewed existing soils coverage on surrounding sites in preparation of the current report, the surrounding subsurface conditions were noted to be consistent with the subsurface conditions observed at the subject site. Therefore, the borehole coverage presented in the current investigation is considered sufficient to provide recommendations for the site from a geotechnical perspective.

3.0 Observations

Surface Conditions

The subject area is currently occupied by four full sized soccer fields and four mini soccer fields, which are grass covered. There is an existing asphalt paved parking area and access lane located on the east portion of the site, and a portion of the west and south sides of the site are tree covered. The existing ground surface across the subject site is relatively flat.

Subsurface Profile

Generally, the subsurface profile at all borehole locations consisted of a thin layer of brown silty sand with topsoil followed by a silty sand layer overlying a grey silty clay deposit. All boreholes within the proposed development were terminated in an undisturbed, soft to firm, grey silty clay.

4.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed club house. It is anticipated that any structures will be founded over a silty sand or silty clay bearing surface.

Due to the presence of the sensitive silty clay layer, the subject site will be subjected to a permissible grade raise restriction. If the grade raise restrictions are exceeded, several options are available, such as a preload/surcharge program or the placement of lightweight fill (LWF).

Site Grading and Preparation

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any settlement sensitive structures. As noted previously, the existing fill material, free of organics and deleterious materials, is adequate for reuse to build up the subgrade level under dry conditions. The fill material should be placed in maximum 250 mm loose lifts and compacted by a vibratory roller making several passes and approved by the geotechnical consultant at the time of placement.

Fill Placement

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

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and 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 the SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Proof Rolling

Proof rolling is recommended for the proposed turf field. It is recommended that the ground surface be proof-rolled under dry conditions by an adequately sized roller making several passes and approved by the geotechnical consultant at the time of construction. Any poor performing areas should be removed and replaced with an approved engineered fill.

Foundation Design

Club House

Footings and thickened edge slabs placed on an undisturbed, silty sand/silty clay bearing surface 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 applied to the above noted bearing resistance value at ULS.

It is recommended that the existing silty sand be proof rolled under dry conditions by suitable compaction equipment making several passes. Also, any poor performing areas noted during proof rolling or areas containing significant amounts of organics should be assessed by the geotechnical consultant and removed prior to footing placement and replaced with Granular B Type II compacted to 98% SMPDD.

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 bearing on an undisturbed soil bearing surface and designed using the bearing resistance values provided above 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 silty sand or stiff silty clay above the groundwater table when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil of the same or higher capacity as that of the bearing medium.

Permissible Grade Raise and Settlement

To limit differential settlement, which could occur across the field footprint and at proposed settlement sensitive structures due to additional loading, a permissible grade raise restriction of **1.5 m** is recommended for the subject site.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements. Provided sufficient time is available to induce the required settlements, consideration could be given to surcharging the subject site.

Alternatively, consideration could also be given to undertaking a test fill pile program to assess the suitability to raise the currently recommended permissible grade raise recommendations in conjunction with a supplemental investigation.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed for our calculations.

Light Standards – Club House

For the foundation design, it is recommended that the foundation base of the light standards be extended to at least 2.1 m below the finished grade for frost protection purposes for unheated areas, and to provide additional lateral stability.

From a geotechnical design perspective, end bearing foundations within the silty clay should be designed using a bearing resistance value of **100 kPa (SLS)** and **150 kPA (ULS)**.

The bearing surface and sidewalls should be free of deleterious and loose materials and approved by the geotechnical consultant at the time of construction.

For lateral stability, the static horizontal earth pressure (p_o) could be calculated with 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, 18 kN/m^3
H = depth of embedment (m)

The earth force component (P_o) could be calculated using:

$P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

Uplift Resistance Design

A system, utilizing a concrete grade beam and the weight of a cone of soil over the concrete footing, could be considered to resist the significant lateral loads from the proposed club house. Typically, the horizontal load component is resisted by passive earth pressure (actually the net of passive minus active) and the vertical load component is resisted by the weight that can be mobilized by the anchor.

Geotechnical parameters for typical backfill materials compacted to 98% of standard Proctor maximum dry density (SPMDD) in 300 mm lift thicknesses are provided in Table 1 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 attached for cohesive and cohesionless soils. Also, friction factors between concrete and the various subgrade materials are provided in Table 1.

For soil above the groundwater level, the “drained” unit weight should be used and below groundwater level, the “effective” unit weight should be used. Please note that backfilled excavations in low permeability soils can be expected to fill with water and the use of the effective unit weights would be prudent if drainage of the soils and fill adjacent to the concrete anchor is not provided.

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

Please note that the parameters provided in Table 1 are unfactored and, in the case of passive earth pressure coefficients, are “ultimate” values. As such, the appropriate factor of safety for working stress design, or resistance factor for limit states design (0.4 to 0.8) should be applied.

Table 1 - Geotechnical Parameters for Uplift Resistance Design

Material Description	Unit Weight (kN/m^3)		Friction Angle (°) φ'	Friction Factor, tan δ	Earth Pressure Coefficients		
	Drained γ_{dr}	Effective γ'			Active K_A	At-Rest K_0	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 II Fill (Crushed Stone)	22.5	14	42	0.6	0.2	0.33	5.04
In situ stiff silty clay	17	7.2	33	0.36	0.3	0.46	3.39
Compact silty sand	18	13	36	0.55	0.26	0.41	3.85

Notes:

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

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

Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for foundations bearing over the deep silty clay deposit identified throughout the subject site. The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

Slab on Grade Construction

With the removal of all topsoil and deleterious materials, within the footprint of the proposed structures, the native soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 150 mm of sub-slab fill should consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed structures should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of the SPMDD. 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.

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 beginning of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of 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. The subsurface soil at this site is considered to be mainly a Type 2 or 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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.

Foundation Drainage and Backfill

A perimeter drainage system is considered optional for the proposed structures of slab-on-grade construction. If selected, the system should consist of a 100 to 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

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

Protection of Footings Against Frost Action

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 exterior unheated footings.

Pavement Structure

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

Table 2 – Recommended Pavement Structure – Car Only Parking

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 in-situ soil, or OPSS Granular B Type I or II material over in-situ soil. **Minimum Performance Graded** (PG) 58-34 asphalt cement should be used for this Pavement Structure.	

Table 3 – Recommended Pavement Structure – Access Lanes

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

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and PG 64-34 asphalt cement should be used for roadways with bus traffic.

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

Gravel Covered Areas

If gravel covered access lanes are required, a 300 mm layer of OPSS Granular A crushed stone compacted to 98% of the material's SPMDD using suitable compaction equipment is recommended. It is expected that gravel covered access lanes may require annual maintenance, such as, regrading and padding in poor performing areas.

Ground Water Control

Due to the relatively impervious nature of the silty clay materials, 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 disturbances to the founding medium.

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

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

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.

5.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should 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.

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

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

6.0 Statement of Limitations

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

A soil investigation 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 Ottawa South United (OSU) or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

We trust that this information satisfies your immediate request.

Best Regards,

Paterson Group Inc.

NPatey

LICENSED PROFESSIONAL ENGINEER
July5, 2023
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

Nicole R.L. Patey, B.Eng.

Faisal I. Abou-Seido, P.Eng.

Attachments:

☐ Soil Profile and Test Data Sheets
☐ Symbols and Terms
☐ Figure 1 – Key Plan
☐ Figure 2 - Uplift Cone Angles for Backfill Material
☐ Drawing PG3545-1 - Test Hole Location Plan

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Club House and Septic Bed
5650 Mitch Owens Drive, Ottawa, Ontario

DATUM TBM consists of existing ground surface at eat property boundary. Geodetic elevation = 94.02m.

REMARKS

BORINGS BY Geoprobe

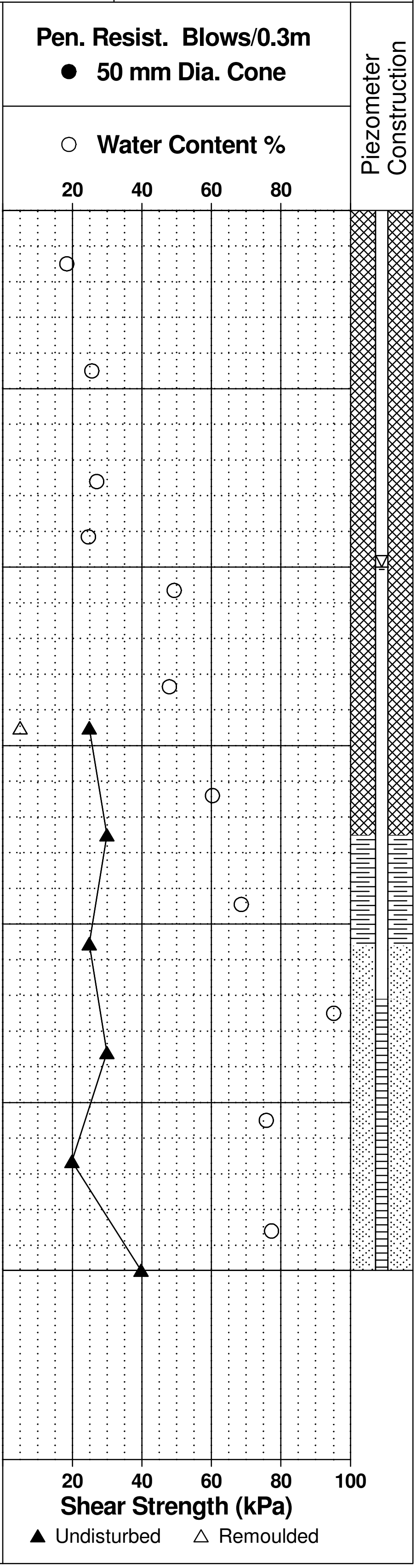
DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 1

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
Ground Surface				
TOPSOIL	SS	1	33	4
0.66				
Loose to very loose, grey **SILTY SAND,** some clay	SS	2	42	5
	SS	3	33	5
1.95				
Soft to firm, grey **SILTY CLAY,** some sand	SS	4	50	W
5.94				
End of Borehole (GWL @ 2.0m depth based on field observations)				

DEPTH (m)	ELEV. (m)
0	93.77
1	92.77
2	91.77
3	90.77
4	89.77
5	88.77



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FILE NO. PG3545

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
Ground Surface						0	93.43		
TOPSOIL 0.10									
Loose to very loose, grey **SILTY SAND,** some clay		SS	1	67	8				
		SS	2	75	4	1	92.43		
1.83		SS	3	100	2				
End of Borehole (BH dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Geoprobe

DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface						0	93.82
TOPSOIL 0.25	■						
FILL: Brown silty sand, some clay 0.60	▨	SS	1	50	3		
Very loose to loose, brown to grey **SILTY SAND,** some clay		SS	2	100	10	1	92.82
1.83		SS	3	100	8		
End of Borehole (BH dry upon completion)							

Pen. Resist. Blows/0.3m

● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

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DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
Ground Surface						0	93.56		
TOPSOIL 0.20									
Loose, grey **SILTY SAND,** some clay		SS	1	75	8				
		SS	2	100	9	1	92.56		
1.57		SS	3	100	1				
Soft, grey **SILTY CLAY,** some sand 1.83									
End of Borehole									
(BH dry upon completion)									

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

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FILE NO. PG3545

HOLE NO. BH 5

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface					0	93.63
TOPSOIL 0.10						
Loose, brown **SILTY SAND,** some clay	SS	1	67	6		
	SS	2	100	6	1	92.63
1.37						
Soft, grey **SILTY CLAY**	SS	3	100	W		
1.83						
End of Borehole (BH dry upon completion)						

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

○ **Water Content %**
20 40 60 80

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

Piezometer Construction

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REMARKS

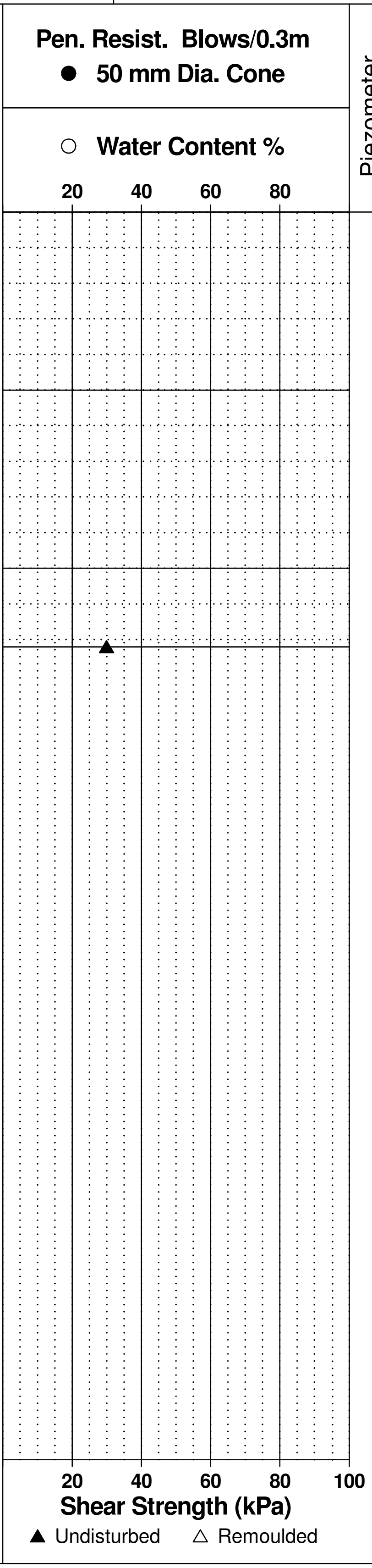
BORINGS BY Geoprobe

DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
Ground Surface						0	93.65	
TOPSOIL 0.10								
Loose, brown **SILTY SAND,** some clay		SS	1	75	10			
		SS	2	58	8	1	92.65	
1.50		SS	3	100	W			
Firm, grey **SILTY CLAY**						2	91.65	
2.44								
End of Borehole (BH dry upon completion)								



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DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
Ground Surface						0	94.02		
TOPSOIL 0.15									
FILL: Brown silty sand, some clay 0.60		SS	1	75	5				
Loose, brown **SILTY SAND**, some clay		SS	2	100	8	1	93.02		
- grey by 1.2m depth 1.83		SS	3	100	6				
End of Borehole (BH dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Geoprobe

DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 8

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface						0	93.73
TOPSOIL	0.20						
FILL: Brown silty sand	0.60	SS	1	67	8		
Loose to very loose, brown **SILTY SAND**		SS	2	100	8	1	92.73
	1.68	SS	3	100	2		
Firm, grey **SILTY CLAY**	1.83						
End of Borehole (BH dry upon completion)							

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

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Club House and Septic Bed
5650 Mitch Owens Drive, Ottawa, Ontario

DATUM TBM consists of existing ground surface at eat property boundary. Geodetic elevation = 94.02m.

REMARKS

BORINGS BY Geoprobe

DATE June 25, 2015

FILE NO. PG3545

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
Ground Surface						0	93.59		
TOPSOIL 0.13									
FILL: Brown silty sand, some clay 0.60		SS	1	62	8				
Loose to very loose, brown **SILTY SAND,** some clay		SS	2	75	7	1	92.59		
1.68		SS	3	100	2				
Firm, grey **SILTY CLAY,** some sand 1.83									
End of Borehole (BH dry upon completion)									

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

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Club House and Septic Bed
5650 Mitch Owens Drive, Ottawa, Ontario

DATUM TBM consists of existing ground surface at eat property boundary. Geodetic elevation = 94.02m.

REMARKS

BORINGS BY Geoprobe

DATE June 25, 2015

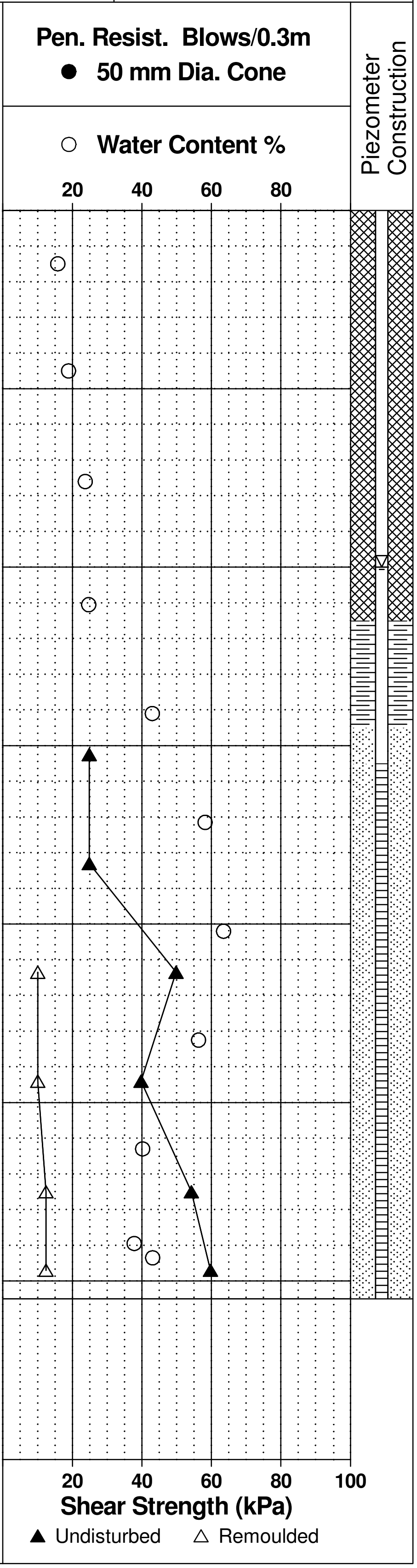
FILE NO. PG3545

HOLE NO. BH10

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface					0	94.02
TOPSOIL 0.10						
FILL: Brown silty sand, some clay 0.60	SS	1	83	7		
Compact to very loose, brown **SILTY SAND,** some clay	SS	2	100	12	1	93.02
1.83	SS	3	100	2		
Loose, grey **SANDY SILT** with clay 2.44					2	92.02
Soft to firm, grey **SILTY CLAY**					3	91.02
					4	90.02
- stiff by 5.0m depth					5	89.02
6.10	SS	4	100	24	6	88.02

End of Borehole

(GWL @ 2.0m depth based on field observations)



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity: $S_t < 2$
Medium Sensitivity: $2 < S_t < 4$
Sensitive: $4 < S_t < 8$
Extra Sensitive: $8 < S_t < 16$
Quick Clay: $S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW - Thin wall tube or Shelby tube, generally recovered using a piston sampler
G - "Grab" sample from test pit or surface materials
AU - Auger sample or bulk sample
WS - Wash sample
RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic Limit, % (water content above which soil behaves plastically)
PI - Plasticity Index, % (difference between LL and PL)

Dxx - Grain size at which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 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)

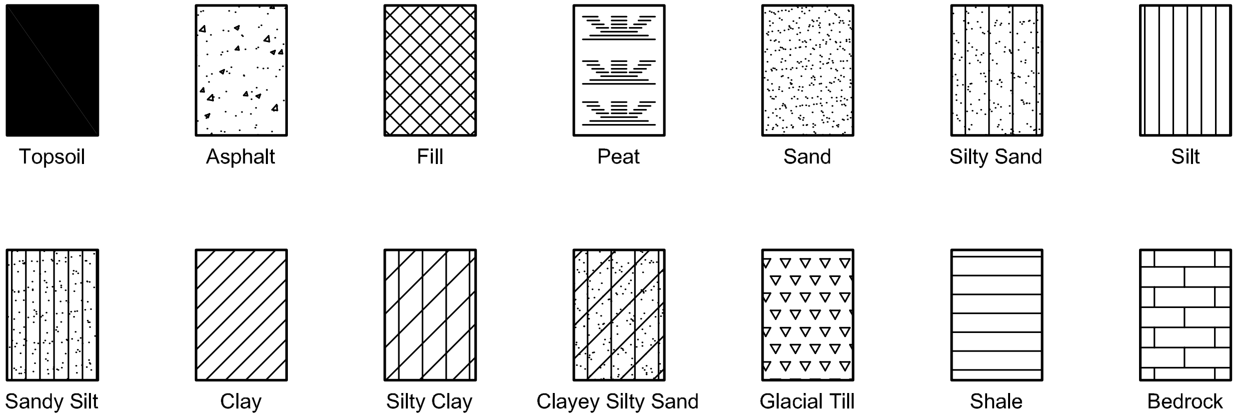
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

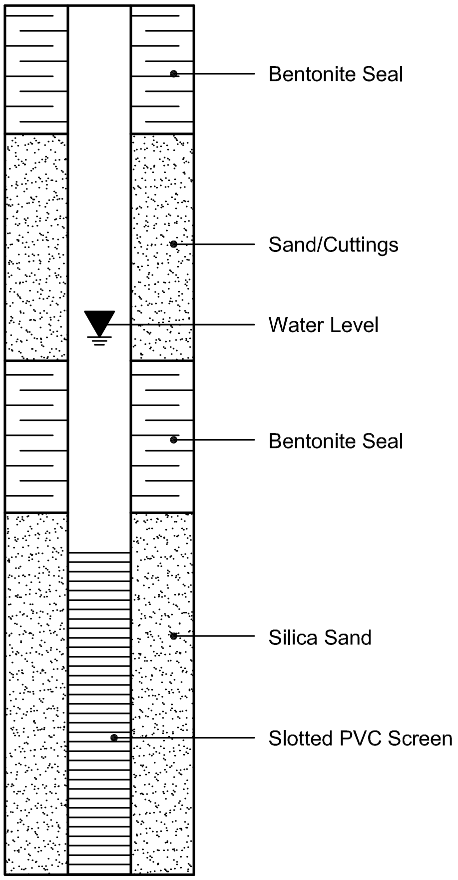
SYMBOLS AND TERMS (continued)

STRATA PLOT

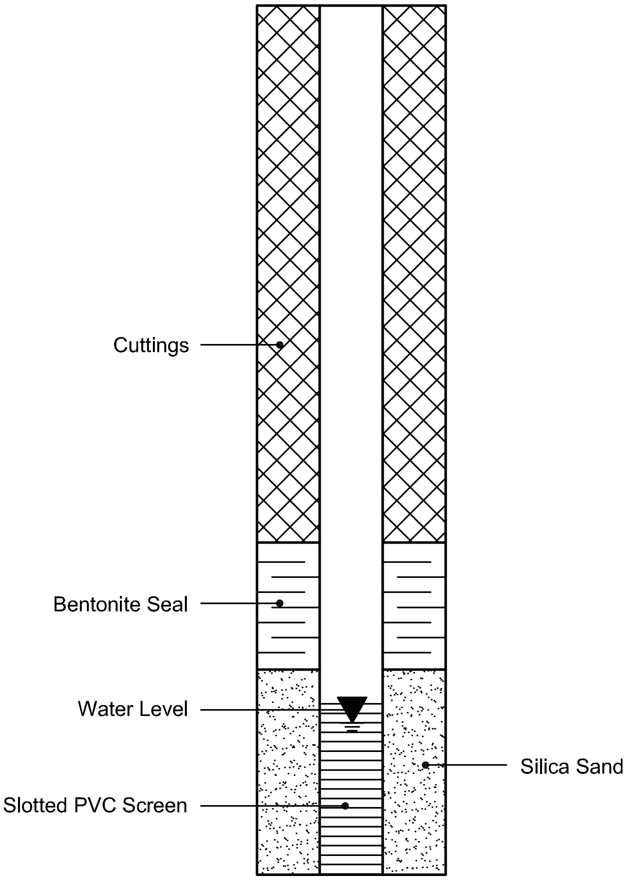


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



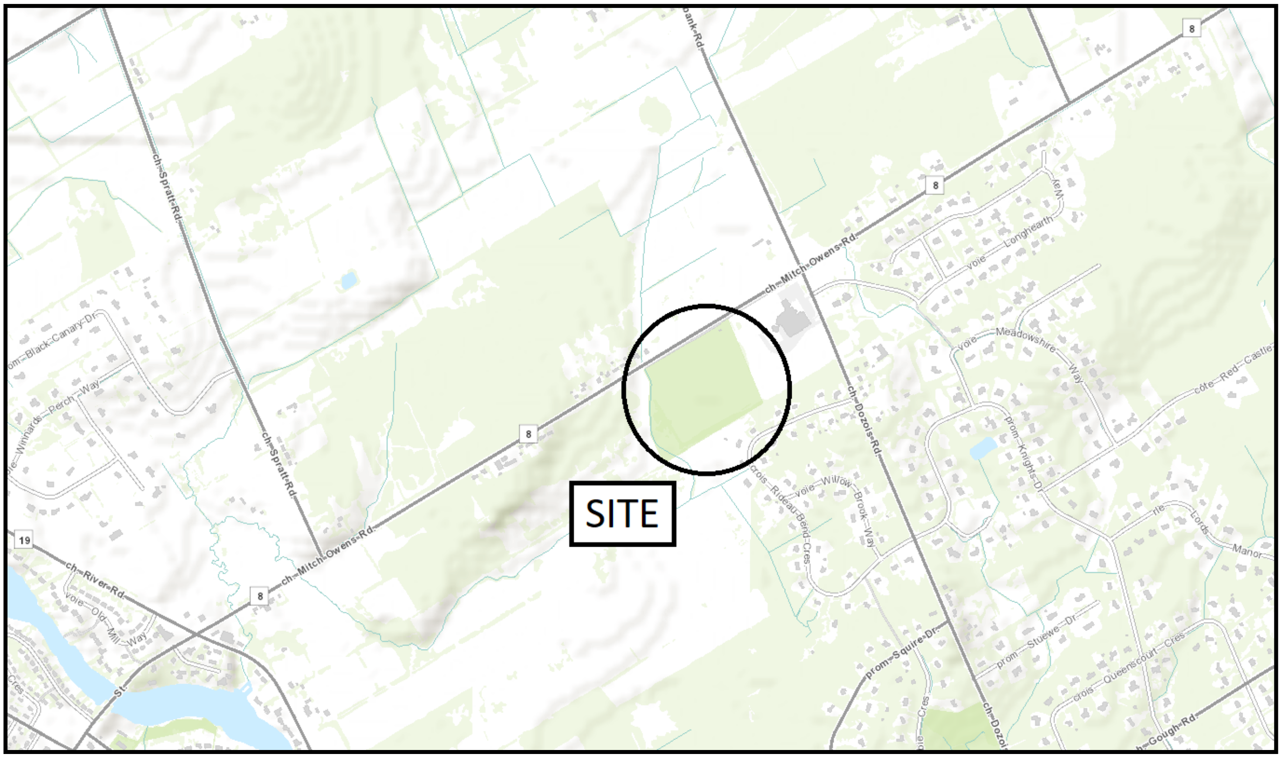
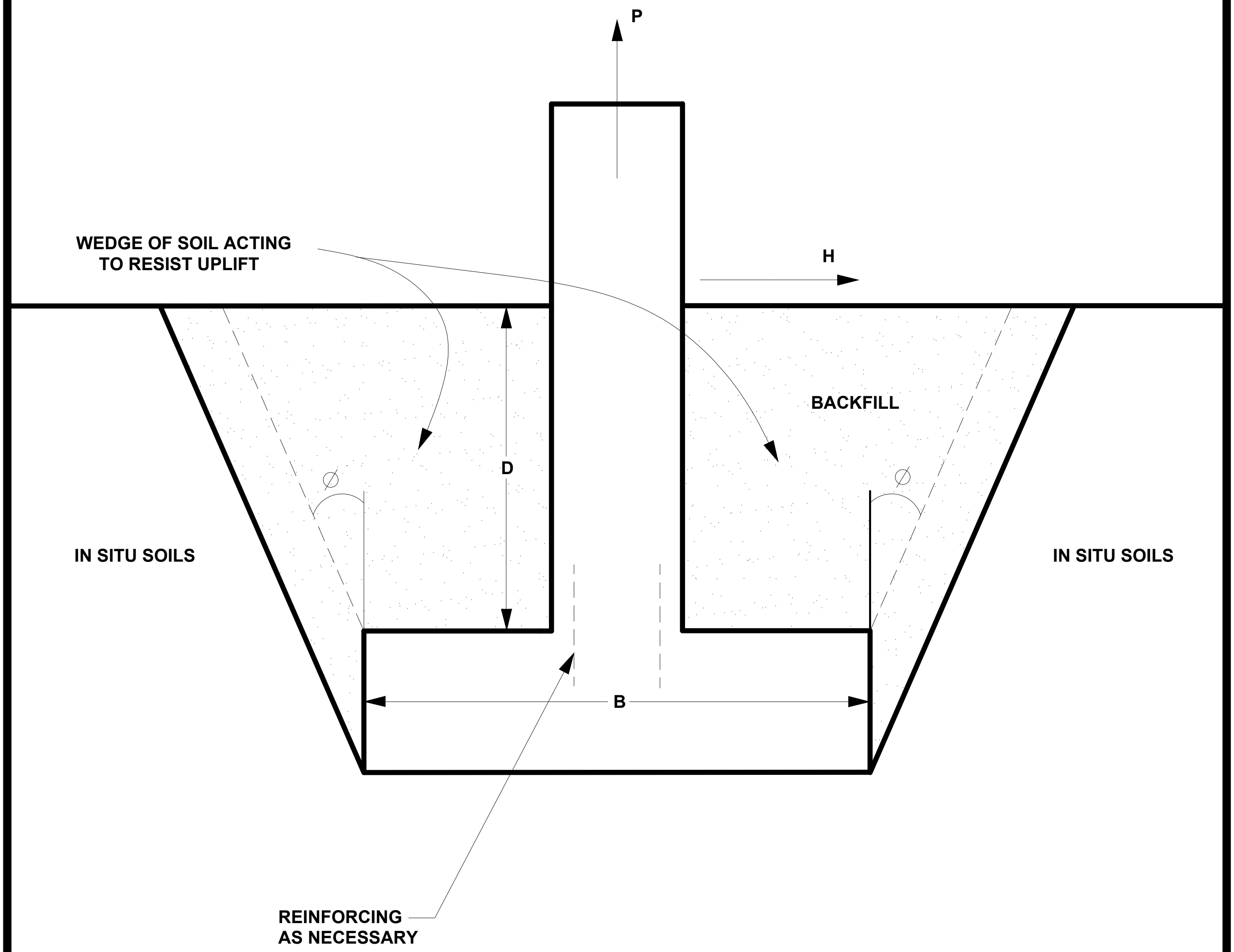


FIGURE 1

KEY PLAN

PATERSON GROUP



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)

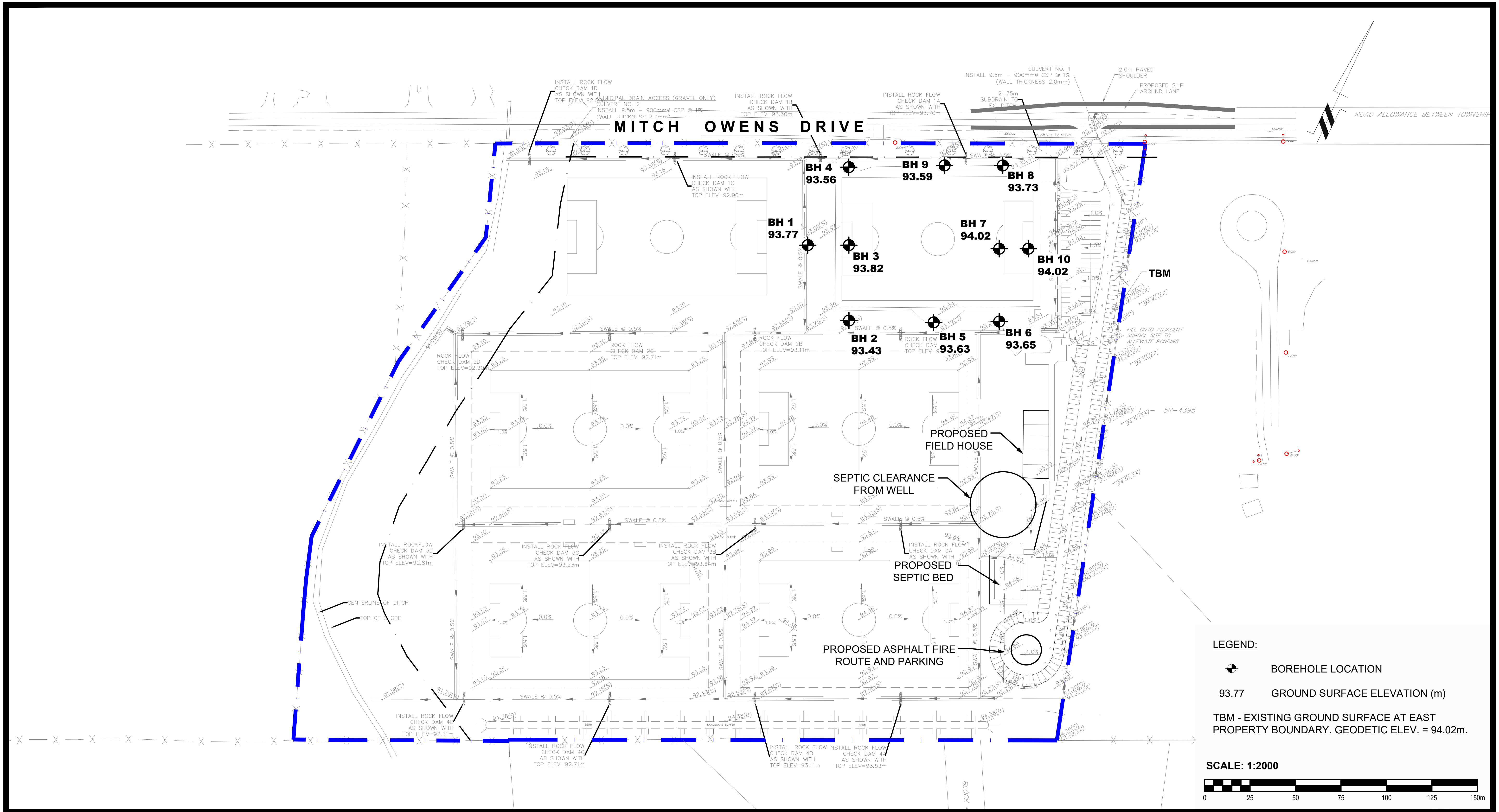
FIGURE 2

UPLIFT CONE ANGLES FOR BACKFILL MATERIAL

PATERSON
GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381

OTTAWA SOUTH UNITED
PROPOSED CLUB HOUSE AND SEPTIC BED
MITCH OWENS DRIVE, OTTAWA, ONTARIO

Report No.: PG3545-1		Scale: N.T.S.
Date: 08/2022	Drawn: MPG	Approved: DG



LEGEND:

⊕	BOREHOLE LOCATION
93.77	GROUND SURFACE ELEVATION (m)

TBM - EXISTING GROUND SURFACE AT EAST PROPERTY BOUNDARY. GEODETIC ELEV. = 94.02m.

SCALE: 1:2000

0 25 50 75 100 125 150m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
1.	UPDATED TO NEW BASE PLAN	28/07/2022	YZ

OTTAWA SOUTH UNITED

GEOTECHNICAL INVESTIGATION
PROPOSED CLUB HOUSE AND SEPTIC BED
5650 MITCH OWENS DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 07/2015
Drawn by: MPG	Report No.: PG3545-1
Checked by: NP	Drawing No.: PG3545-1
Approved by: FA	Revision No.: 1

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