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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Noise and Vibration Studies

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May 25, 2022
PG6256-LET.01

Tanya Farlinger
3150 Woodroffe Avenue
Ottawa, Ontario
K2J 4G4

Attention: **Ms. Serina Ciliberti**

Subject: **Geotechnical Investigation**
Proposed Parking Lot Expansion
3150 Woodroffe Avenue - Ottawa, Ontario

Dear Ms. Farlinger,

Further to your request, Paterson Group (Paterson) completed a geotechnical investigation for the proposed parking lot expansion to be located at the aforementioned site.

The objectives of the assessment were to:

- ❒ Determine the subgrade conditions by means of test pits.
- ❒ Provide pavement design and recommendations for the subject site.

The following report presents a summary of our findings and provides geotechnical recommendations pertaining to the pavement assessment. An evaluation of the existing structure was not part of the scope of the current investigation.

1.0 Field Observations

1.1 Field Program

The field program for the investigation was conducted on May 5, 2022, and consisted of advancing 2 test pits, TP 1-22 and TP 2-22, to a maximum depth of 3.8 m below the existing ground surface. The test pits were reviewed in the field by Paterson personnel under the direction of a senior engineer from the geotechnical division. The test pit procedure consisted of excavating to the required depths at the selected locations and sampling the overburden.

Paterson conducted a geotechnical investigation for the proposed extension of the adjacent municipal sanitary sewer on April 19. 2022, which included one borehole within the subject site. At that time, borehole BH 6-22 was advanced to a depth of 5.94 m below the existing round surface (no borehole log will be provided however, the subsurface profile will be discussed under Subsection 1.3).

The test pits were placed in a manner to provide general coverage of the subject parking lot, taking into consideration existing site features and underground services. The approximate location of the test holes are shown on Drawing PG6256-1 – Test Hole Location Plan attached to the present report.

1.2 Site Conditions

The subject site is currently developed with an existing residential building within the central portion of the site, which is surrounded by treed areas and access lanes with associates landscaped margins. A swimming pool is located along the western edge of the site. The site is bordered by residential dwellings to the south and west, Deerfox Drive to the north and Woodroffe Avenue to the east.

The ground surface across the subject site is relatively flat and at grade with the adjacent roadway at approximate geodetic elevation of 95 m. The subject site is depicted on Drawing PG6256-1 – Test Hole Location Plan attached to the present report.

1.3 Subsurface Conditions

Generally, the soil profile at the test hole locations consists of fill underlain by native topsoil extending to depths ranging from 0.9 to 1.2 m. The fill was generally observed o consist of brown silty sand with trace to some gravel and cobbles.

A layer of hard, brown silty clay with trace sand was encountered underlying the topsoil and fill at TP 1-22 and TP 2-22, followed by a compact to dense glacial till consisting of brown, silty clay to silty sand with gravel. Glacial till was encountered underlying the fill at borehole BH 6-22 and was observed to extend to auger refusal at 5.94 m below the existing ground surface.

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 of the subject site consists of interbedded sandstone and dolomite of the March River formation with an overburden thickness ranging from approximately 5 to 10 m.

Groundwater

Based on the field observations and the recovered soil samples, the long-term groundwater table was not encountered within TP 1-22 and TP 2-22 locations. The groundwater level was measured at a depth of 2.85 m below the existing surface within BH 6-22.

The long-term groundwater levels can also be estimated based on the observed colour, moisture content and consistency of the recovered soil samples. Based on these observations and our knowledge of the geology of the area, the long-term groundwater table can be expected at approximate depths of 3 to 4 m before the existing ground surface.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level may vary at the time of construction.

Analytical Testing Results

The results of the 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 of 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.

2.0 Assessment

2.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered to be suitable for the proposed parking lot expansion. It is anticipated the subgrade below the proposed subbase of the proposed parking lot will consist of a combination of compact silt sand, hard brown silty clay and compact to dense glacial till.

2.2 Site Grading and Preparation

Topsoil and fill, such as those containing organic or deleterious material, should be stripped from under the proposed parking lot and any other settlement sensitive structures. Due to the presence of topsoil underlying the existing fill material within a greater portion of the site, it is recommended that the existing fill is removed.

Fill containing acceptable amount of deleterious fill, to be verified upon exposure by Paterson personnel, can be left in place at a depth of 1 m below proposed finished grade.

2.3 Site Grading and Preparation

Engineered fill placed for grading beneath access lanes and heavy truck parking areas should consist of clean, imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with the site excavated material, free of significant amount of organic material, can be used as general landscaping fill and beneath car only parking areas. This material should be spread in thin lifts with a maximum thickness of 300 mm and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

3.0 Parking Lot Design and Construction

3.1 Parking Lot Design

Light vehicle only and heavy vehicle parking areas as well as access lanes and loading areas are anticipated as part of the proposed parking lot addition. The recommended pavement structures are presented in Tables 1 and 2.

Table 1 - Recommended Pavement Structure – Light Vehicle Only Parking Areas & Access Lanes

Thickness (mm)	Material Description
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
Separation Layer	**Woven Geotextile** - Terrafix 200W, or equivalent
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil.	

Table 2 - Recommended Pavement Structure - Heavy Vehicle Parking Areas & Loading Areas	
Thickness (mm)	**Material Description**
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
Separation Layer	**Woven Geotextile** - Terrafix 200W, or equivalent
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil.	

Consideration should be given to re-grading of the parking lot and adjusting the existing catch basins as needed to promote adequate surface drainage.

3.2 Construction Considerations

Performance graded (PG) 58-34 asphaltic concrete is recommended for use on this project. The proposed pavement structure, where it abuts the existing pavement, should match the existing pavement layers.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be sub-excavated and replaced with OPSS Granular A or Granular B Type II Material.

The pavement granular materials should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's standard Proctor maximum dry density (SPMDD).

It should be noted that periodic maintenance, such as sealing of cracking due to seasonal temperature fluctuations will be required to ensure the full service life of the pavement is achieved.

3.3 Existing and Proposed Pavement Joint/Tie-In

It is recommended that a milled step joint should be provided in the existing asphalt to provide a proper tie-in where the new and existing pavement abuts. The step joint should be 300 mm wide and 50 mm deep and provided with a light tack coat consisting of SS-1 emulsified asphalt to ensure proper bonding of the new and existing asphalt pavement and to provide more resistance to cracking at the joint. The pavement joint/tie-in should be reviewed and approved by Paterson Group at the time of construction.

3.4 Field Inspections During Construction

It is recommended that Paterson personnel complete periodic inspections during construction. The inspections would include, at minimum, review of the subgrade material, compaction testing, sampling and testing of the granular fill and asphaltic layers and drainage inspections, where required.

4.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test hole locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for the purposes other than those described herein or by person(s) other than Tanya Farlinger, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

Owen Canton, EIT

Faisal I. Abou-Seido, P.Eng.

Attachments

- ❑ Soil Profile and Test Data Sheets
- ❑ Symbols and Terms
- ❑ Analytical Testing Results
- ❑ Figure 1 - Key Plan
- ❑ Drawing PG6256-1 - Test Hole Location Plan

Report Distribution

- ❑ Tanya Farlinger
- ❑ Paterson Group

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Parking Lot Addition - 3150 Woodroffe Avenue
Ottawa, Ontario

DATUM Geodetic

REMARKS

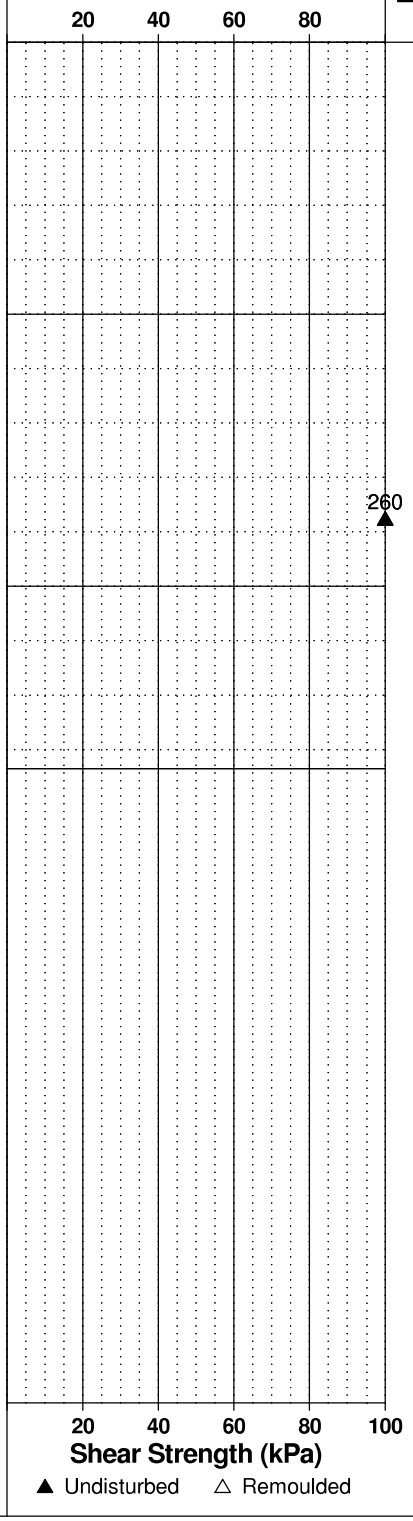
BORINGS BY Excavator **DATE** May 5, 2022

FILE NO. PG6256

HOLE NO. TP 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	95.28
FILL: Brown silty sand with gravel, trace topsoil		G	1				
- occasional cobbles by 0.5m depth		G	2				
0.84		G	3				
TOPSOIL 0.99						1	94.28
Hard, brown **SILTY CLAY,** some sand, trace gravel 1.11		G	4				
Hard, brown **SILTY CLAY**		G	5				
1.97		G	6			2	93.28
GLACIAL TILL: Very dense, brown silty sand to sandy silt wiht gravel, cobbles and boulders							
2.67							
End of Test Pit							
(TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Parking Lot Addition - 3150 Woodroffe Avenue
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator **DATE** May 5, 2022

FILE NO. PG6256

HOLE NO. TP 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	94.77
TOPSOIL 0.20		G	1				
FILL: Brown silty sand with gravel, occasional cobbles and boulders		G	2			1	93.77
1.03							
TOPSOIL 1.27		G	3				
Compact, reddish brown **SILTY SAND,** trace gravel 1.75		G	4				
		G	5			2	92.77
Hard, brown **SILTY CLAY**		G	6				
		G	7			3	91.77
3.48		G	8				
GLACIAL TILL: Very dense, brown silty sand to sand to sand with gravel, cobbles and boulders 3.79							
End of Test Pit							
(TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

260
260
260

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

Piezometer Construction

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 = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

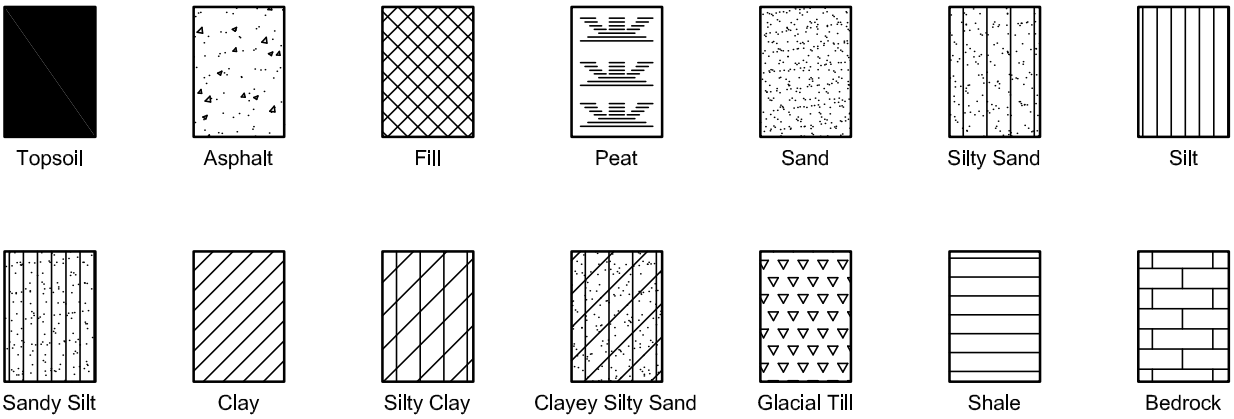
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

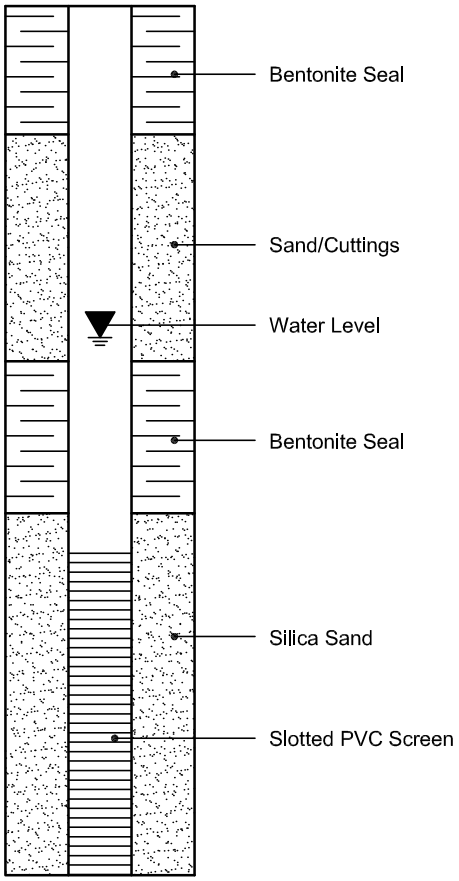
SYMBOLS AND TERMS (continued)

STRATA PLOT

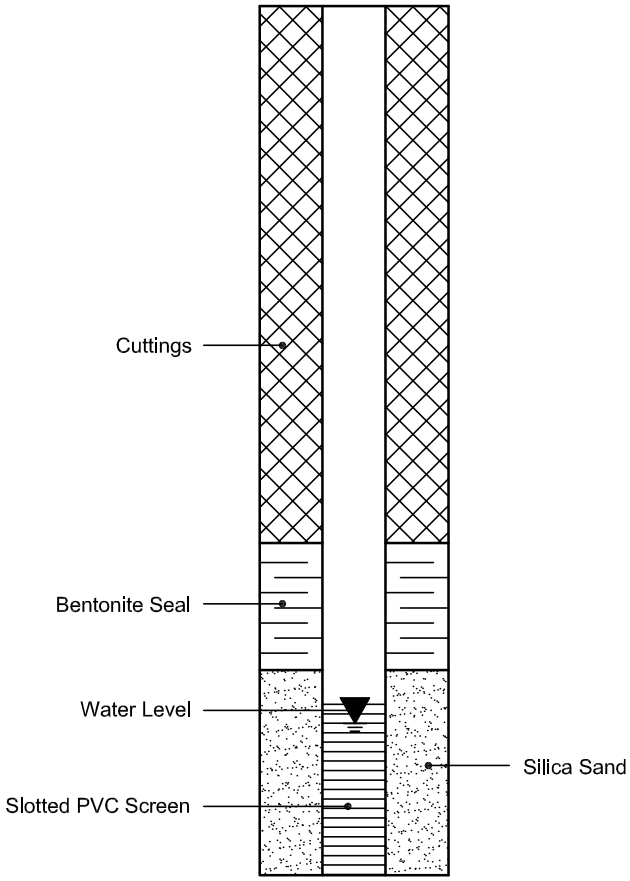


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 13-May-2022

Client: **Paterson Group Consulting Engineers**

Order Date: 6-May-2022

Client PO: **54532**

Project Description: PG6256

	Client ID:	TP1-22-G4	-	-	-
	Sample Date:	05-May-22 09:00	-	-	-
	Sample ID:	2219651-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	78.0	-	-	-
General Inorganics					
pH	0.05 pH Units	6.60	-	-	-
Resistivity	0.10 Ohm.m	82.6	-	-	-
Anions					
Chloride	5 ug/g dry	17	-	-	-
Sulphate	5 ug/g dry	18	-	-	-

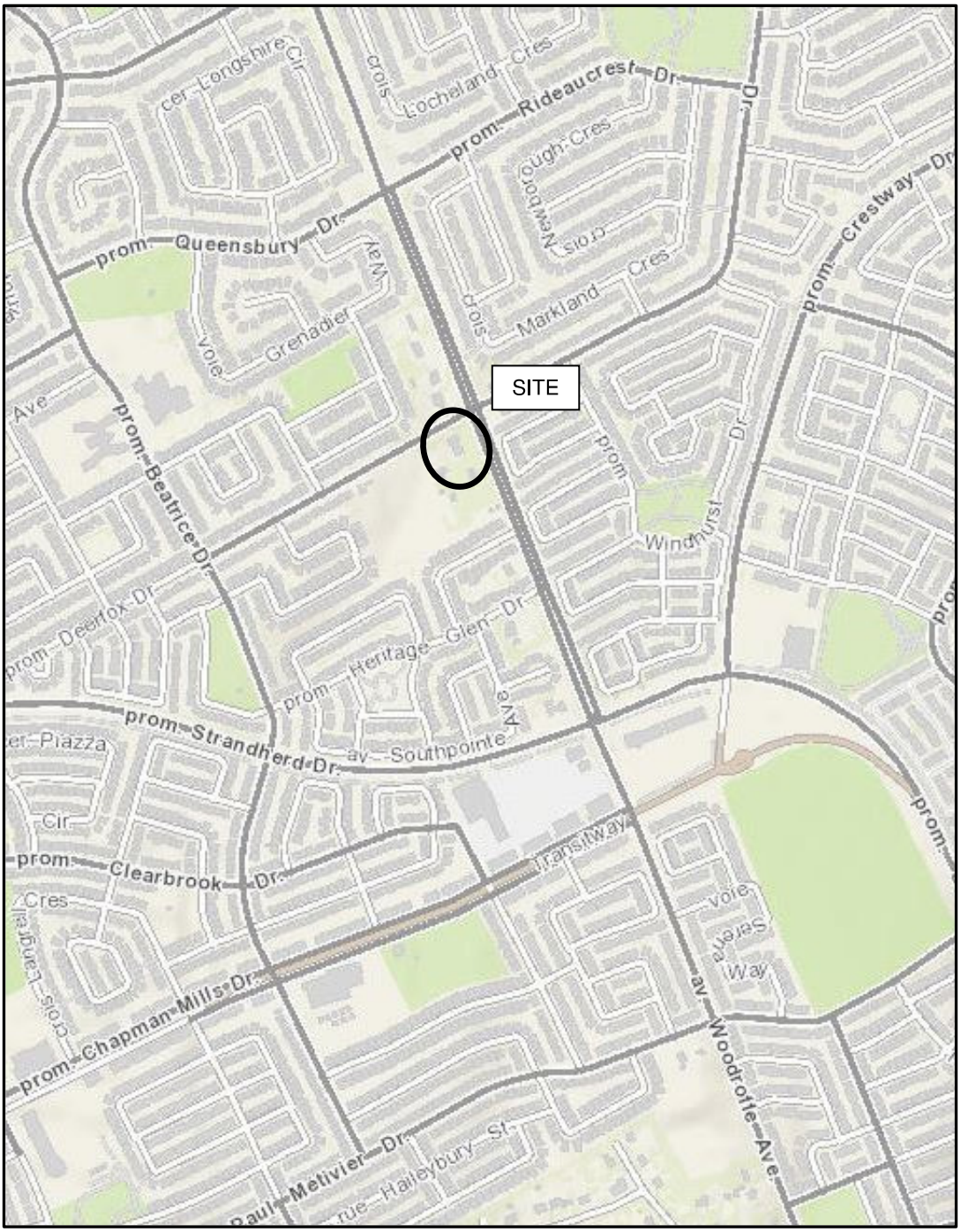
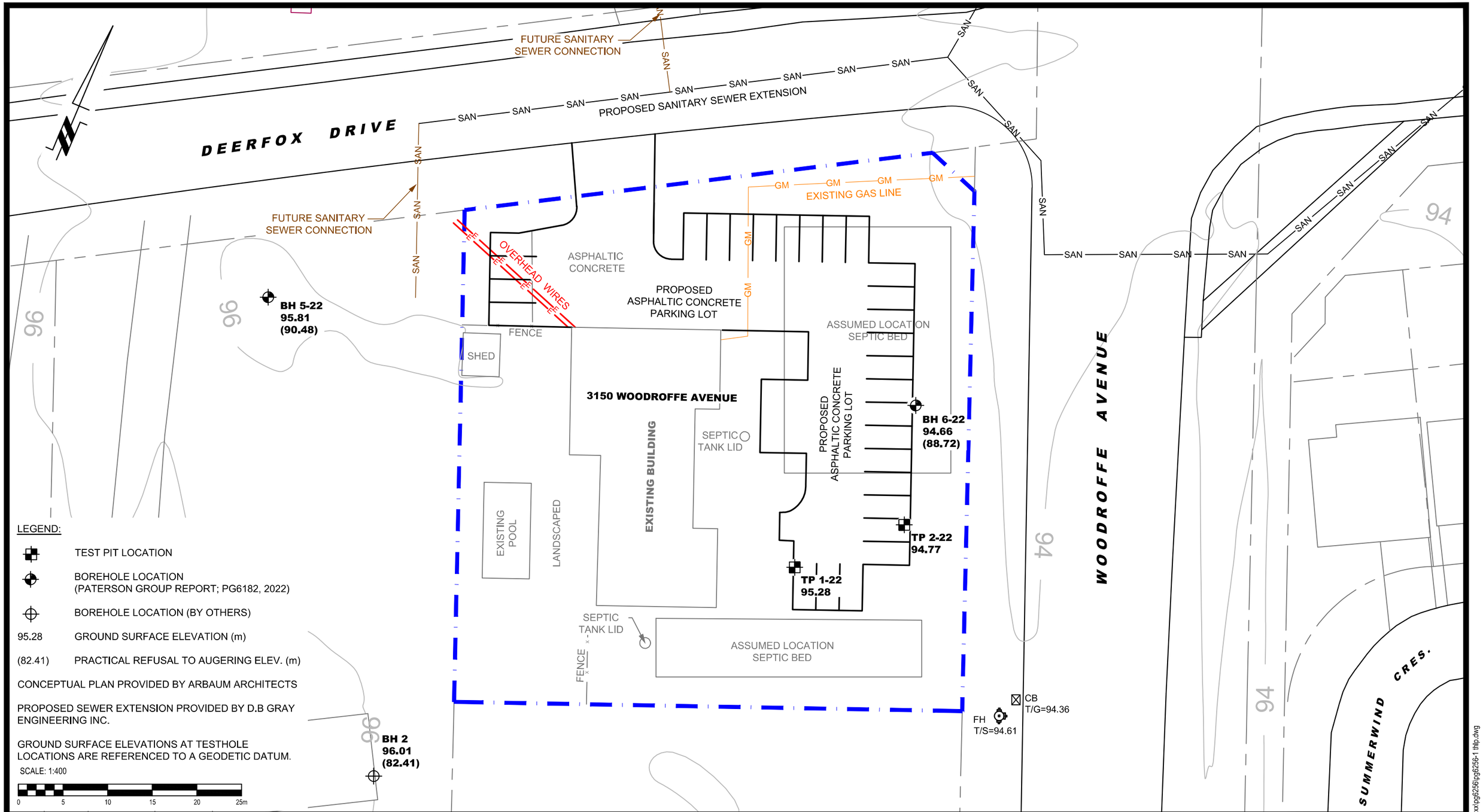


FIGURE 1

KEY PLAN



LEGEND:

- TEST PIT LOCATION
- BOREHOLE LOCATION (PATERSON GROUP REPORT; PG6182, 2022)
- BOREHOLE LOCATION (BY OTHERS)
- 95.28 GROUND SURFACE ELEVATION (m)
- (82.41) PRACTICAL REFUSAL TO AUGERING ELEV. (m)

CONCEPTUAL PLAN PROVIDED BY ARBAUM ARCHITECTS

PROPOSED SEWER EXTENSION PROVIDED BY D.B GRAY ENGINEERING INC.

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

SCALE: 1:400

0 5 10 15 20 25m

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NO.	REVISIONS	DATE	INITIAL

MS. TANYA FARLINGER

GEOTECHNICAL INVESTIGATION
PROPOSED PARKING LOT ADDITION
3150 WOODROFFE AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:400	Date: 05/2022
Drawn by: GK	Report No.: PG6256-1
Checked by: OC	Dwg. No.: PG6256-1
Approved by: DJG	Revision No.:

11x17

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