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November 19, 2019
File: PG2934-LET.01 Revision 1

Leitrim Home Hardware
4836 Bank Street
Ottawa, Ontario
K1X 1G6

Attention: **Mr. Omkar Atwal**

Subject: **Geotechnical Investigation**
Proposed Commercial Development
4836 Bank Street - Ottawa

Dear Sir,

Paterson Group (Paterson) was commissioned by Mar Gard Limited (Mar Gard) to conduct a geotechnical investigation for the proposed commercial development to be located at 4836 Bank Street in the City of Ottawa, Ontario. The following letter report presents our findings and recommendations.

Based on the conceptual drawing provided by Mar Gard Limited, it is understood that the proposed commercial development consists of four commercial slab-on-grade buildings with associated asphaltic car parking, access lanes and landscaped areas.

1.0 Field Investigation

The fieldwork for our investigation was conducted on November 5, 2019 and consisted of extending a total of 8 test pits (TP9 to TP16) to a maximum depth of 2.8 m using a backhoe operated by a local contractor. A previous investigation was conducted on October 9, 2013, and consisted of extending a total of 8 test pits to a maximum depth of 4 m using a hydraulic excavator. The testing procedures consisted of excavating to depth at the selected locations and sampling the overburden. Field notes were logged as per ASTM D5434. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

The test hole locations were staked out in the field by personnel from Mar Gard and the approximate locations of the test holes are illustrated on Drawing PG2934-1 - Test Hole Location Plan attached to the present letter.

2.0 Field Observations

The ground surface across the subject site is relatively flat and slopes gradually down towards the east. An existing treed area is located within the west portion of the site and the south portion of the site is mostly grass covered. A commercial slab-on-grade building along with a paved parking area and a garden centre are located to the north of the proposed building locations.

The subsurface profile encountered at the test hole locations consists of a layer of topsoil and/or silty sand with organics overlying a compact to dense glacial till. The glacial till layer consists of a brown to grey silty sand to clayey silt mixed with gravel, cobbles and trace boulders to 4 m depth. Reference should be made to the Soil Profile and Test Data sheets attached to the present letter for specific details of the soil profile encountered at the test pit locations.

Based on available geological mapping, the site is located in an area where the bedrock consists of interbedded quartz sandstone, sandy dolostone and dolostone of the March formation at depths ranging from 3 to 5 m.

All test holes were noted to be dry upon completion, except TP 1 where water infiltration was noted at a 4 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

3.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed commercial development. It is expected that the proposed commercial slab-on-grade structures will be founded on conventional shallow footings placed over a compact glacial till bearing surface.

Site Grading and Preparation

Asphaltic concrete, topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any building and other settlement sensitive structures.

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. 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 the building should be compacted to at least 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with 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 the respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls, unless used in conjunction with a composite drainage system.

Foundation Design

Footings founded on an undisturbed, compact to dense glacial till bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**.

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 provided will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance value at ULS.

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 a soil bearing medium 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 or engineered fill of the same or higher capacity as the soil.

Design for Earthquakes

A seismic site response **Class D** should be used for design of the proposed buildings at the subject site according to the OBC 2012. The soils underlying the site are not susceptible to liquefaction.

Slab on Grade Construction

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, the undisturbed native soil surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of an OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building addition should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

Permissible Grade Raise Recommendations

Based on the results of the geotechnical investigation, a sensitive silty clay deposit was not encountered, therefore, permissible grade raise restrictions are not applicable for the subject site.

Pavement Structure

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

Table 1 - Recommended Pavement Structure - Driveways	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 2 - Recommended Pavement Structure - Local Residential Roadways	
Thickness (mm)	**Material Description**
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either 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 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.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory compacting equipment.

4.0 Design and Construction Precautions

Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed buildings. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 19 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, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

Protection of Footings Against Frost Action

Perimeter footings of heated structures should be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or insulation equivalent) should be provided. A minimum 2.1 m thick soil cover (or insulation equivalent) should be provided for other exterior unheated footings, such as those for isolated exterior piers.

Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes from the start 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 1.5H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly 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.

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

Groundwater Control

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.

The rate of flow of groundwater into the excavation through the overburden should be low for expected founding level. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

Sump Pumps

It is expected that sump pumps will not be required for the slab-on-grade structures proposed as part of the development.

Impacts on Neighbouring Properties and Services

Based on the proximity of neighbouring buildings and soil type, the proposed development will not negatively impact the neighbouring structures. It should be noted that no issues are expected with respect to groundwater lowering that would cause long term adverse effects to adjacent structures surrounding the proposed building.

Landscaping Consideration

Tree Planting Restriction

The subject site is located in an area without sensitive silty clay deposits with regards to tree planting as per the city of Ottawa Tree Planting in Sensitive Marine Clay Soils guidelines of 2007. Therefore, the subject site is not subject to the tree planting restrictions described in the guidelines.

Corrosion Potential and Sulphate

One (1) sample was submitted for testing. The analytical test results of the soil sample indicate that the sulphate content is less than 0.01%. These results along with the chloride and pH value are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the resistivity indicate the presence of a low to moderately aggressive environment for exposed ferrous metals at this site, which is typical of silty clay samples submitted for the subject area. It is anticipated that standard measures for corrosion protection are sufficient for services placed within the silty clay deposit.

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.

Upon request, a report confirming that these works have been conducted in general accordance with our recommendations could be issued 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 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 soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, 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 Leitrim Home Hardware or their agents is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Best Regards,

Paterson Group Inc.

November 19, 2019

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

Richard Groniger, C. Tech.

Attachments

- ❑ Soil Profile and Test Data sheets
- ❑ Analytical Testing Results
- ❑ Figure 1 - Key Plan
- ❑ Drawing PG2934-1 - Test Hole Location Plan

Report Distribution

- ❑ Leitrim Home Hardware
- ❑ Paterson Group

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453934; 5017432

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics		G	1				
0.25							
		G	2			1	
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders						2	
3.80						3	
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	3			4	
4.05							
End of Test Pit							
(Water infiltration at 3.95m depth)							

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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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453918; 5017456

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 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 %	Piezometer Construction
GROUND SURFACE						0			
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders		G	1			1			
						2			
3.65						3			
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	2						
4.00						4			
End of Test Pit									
(TP 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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453865; 5017389

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics, topsoil, trace gravel and cobbles		G	1				
0.75							
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders		G	2			1	
						2	
2.50							
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	3			3	
3.95							
End of Test Pit							
(TP 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

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453857; 5017417

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics, topsoil, trace gravel 0.20		G	1				
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders		G	2			1	
1.85							
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders						2	
						3	
4.00		G	3			4	
End of Test Pit							
(TP 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

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453811; 5017419

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics, topsoil, trace gravel and cobbles		G	1				
0.25							
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders						1	
		G	2			2	
3.20						3	
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	3				
4.00						4	
End of Test Pit							
(TP 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

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453834; 5017419

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 6

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 %	Piezometer Construction
GROUND SURFACE						0			
FILL: Brown silty sand with organics, gravel, cobbles and boulders		G	1			1			
1.70									
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders		G	2			2			
						3			
4.00						4			
End of Test Pit (TP 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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 0453796; 5017456

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics, gravel, cobbles, trace topsoil		G	1				
0.80							
		G	2			1	
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders						2	
3.00						3	
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	3				
4.00						4	
End of Test Pit							
(TP 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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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS GPS 18T 04538017; 5017455

BORINGS BY Backhoe **DATE** October 9, 2013

FILE NO. PG2934

HOLE NO. TP 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with organics, trace topsoil and gravel		G	1				
0.30							
GLACIAL TILL: Compact to dense, brown sandy silt with gravel, cobbles and boulders		G	2			1	
						2	
3.10						3	
GLACIAL TILL: Compact to dense, grey clayey silt with gravel, cobbles and boulders		G	3				
4.00						4	
End of Test Pit							
(TP 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

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

FILE NO. PG2934

HOLE NO. TP 9

BORINGS BY Backhoe **DATE** 2019 November 5

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 %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL		G	1						
0.45									
FILL: Brown silty clay, trace sand, gravel and cobbles		G	2			1			
1.30									
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders		G	3			2			
2.60									
End of Test Pit									
Practical refusal to excavation at 2.60m depth									
(TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

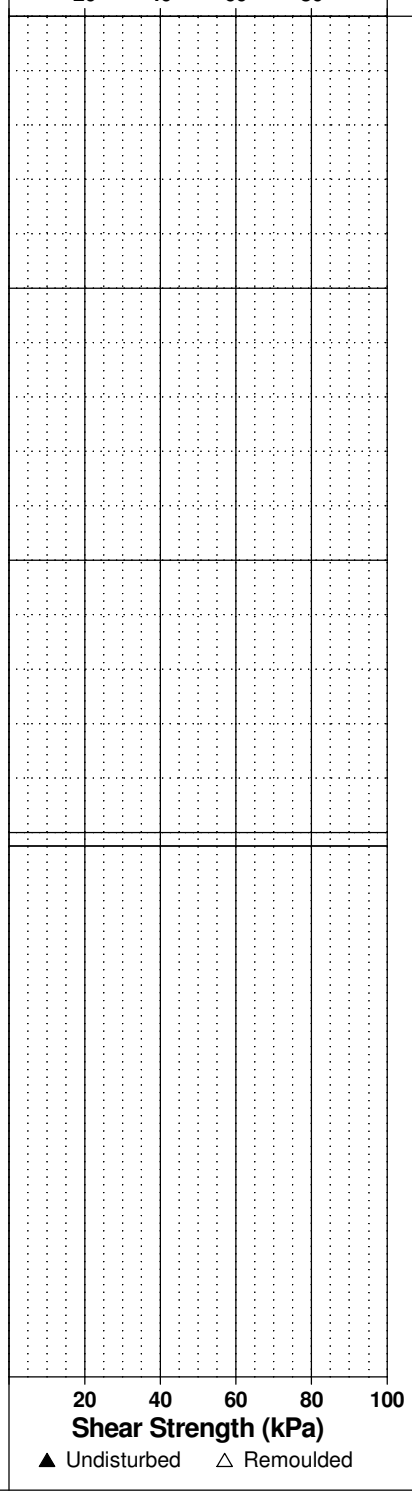
REMARKS

FILE NO. PG2934

HOLE NO. TP10

BORINGS BY Backhoe **DATE** 2019 November 5

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 %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.37		G	1			0			
FILL: Brown silty sand with gravel, trace organics 1.10		G	2			1			
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders		G	3			2			
3.05 End of Test Pit (TP dry upon completion)						3			



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe **DATE** 2019 November 5

FILE NO. PG2934

HOLE NO. TP11

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 %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.30		G	1			0			
FILL: Brown silty sand, trace clay and organics 1.10		G	2			1			
GLACIAL TILL: Loose to dense, brown silty sand with gravel, cobbles and boulders		G	3			2			
3.00 End of Test Pit						3			
(TP 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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

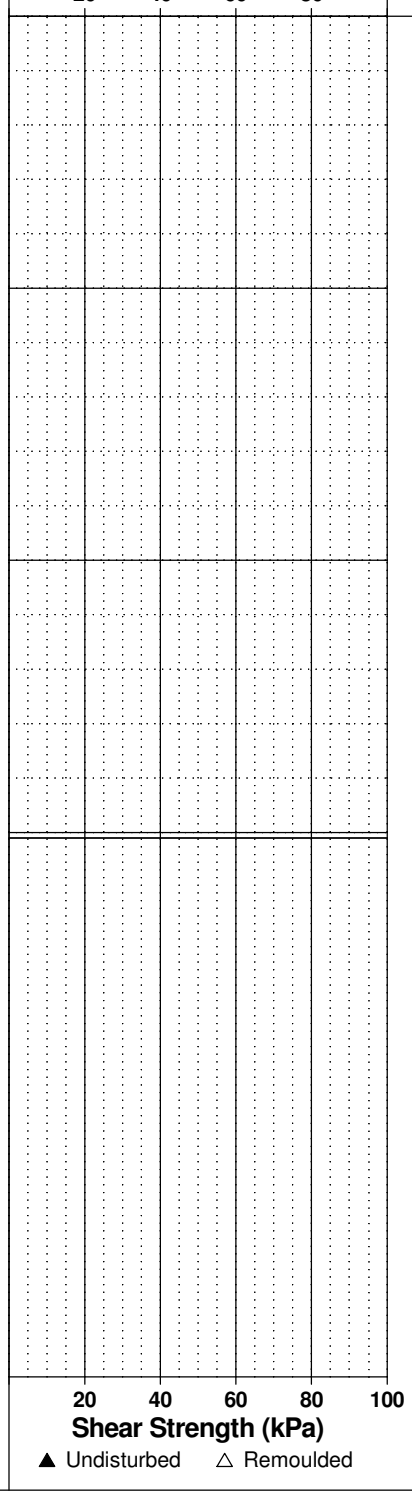
REMARKS

BORINGS BY Backhoe **DATE** 2019 November 5

FILE NO. PG2934

HOLE NO. TP12

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 %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.27		G	1			0			
FILL: Brown silty sand with gravel, trace organics 0.95		G	2			1			
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders		G	3			2			
3.02 End of Test Pit (TP dry upon completion)						3			



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe **DATE** 2019 November 5

FILE NO. PG2934

HOLE NO. TP13

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 %	Piezometer Construction
GROUND SURFACE									
Asphaltic concrete 0.15						0			
FILL: Brown silty sand with gravel, trace organics 0.75		G	1						
GLACIAL TILL: Loose to dense, brown silty sand with gravel, cobbles and boulders		G	2			1			
		G	3			2			
2.50 End of Test Pit (TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

FILE NO. PG2934

HOLE NO. TP14

BORINGS BY Backhoe **DATE** 2019 November 5

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 %	Piezometer Construction
GROUND SURFACE									
Asphaltic concrete 0.10		G	2			0			
FILL: Brown silty sand with gravel, trace organics 0.60		G	1						
GLACIAL TILL: Loose to dense, brown silty sand with gravel, cobbles and boulders		G	3			1			
2.65						2			
End of Test Pit									
(TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe **DATE** 2019 November 5

FILE NO. PG2934

HOLE NO. TP15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Gravel, trace organics		G	1				
0.40							
FILL: Brown silty sand, trace clay and gravel		G	2			1	
1.60							
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders		G	3			2	
2.95							
End of Test Pit							
(TP 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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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 4836 Highway 31
Ottawa, Ontario

DATUM

REMARKS

FILE NO. PG2934

HOLE NO. TP16

BORINGS BY Backhoe **DATE** 2019 November 5

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 %	Piezometer Construction
GROUND SURFACE									
FILL: Gravel, trace sand		G	1			0			
0.25									
FILL: Brown silty sand, trace clay and gravel		G	2			1			
1.80									
GLACIAL TILL: Loose to dense, brown silty sand with gravel, cobbles and boulders		G	3			2			
2.55									
End of Test Pit									

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

Water Content % scale: 20 40 60 80

Shear Strength (kPa) scale: 20 40 60 80 100

▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the 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

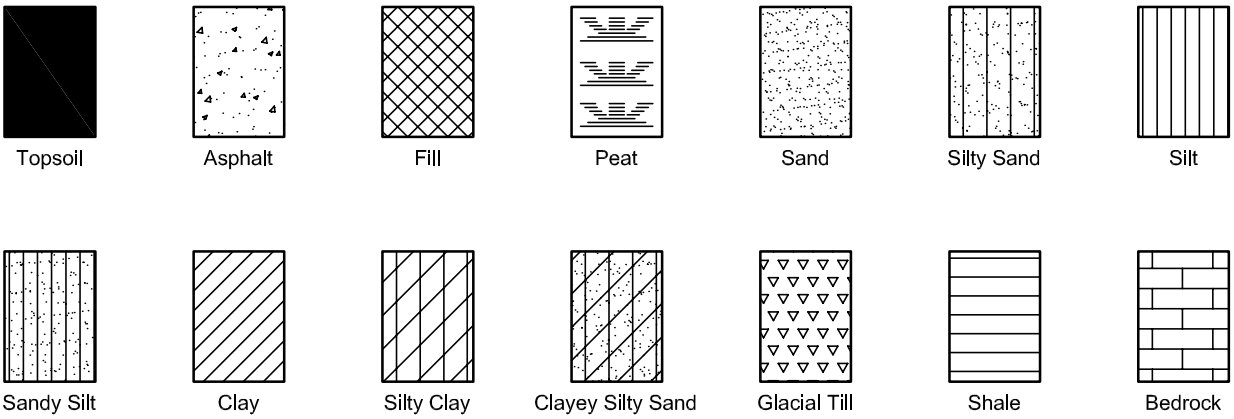
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

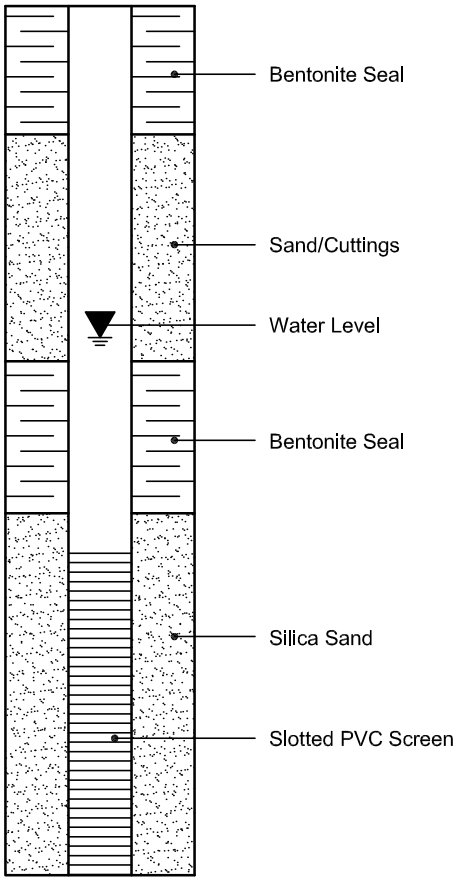
SYMBOLS AND TERMS (continued)

STRATA PLOT

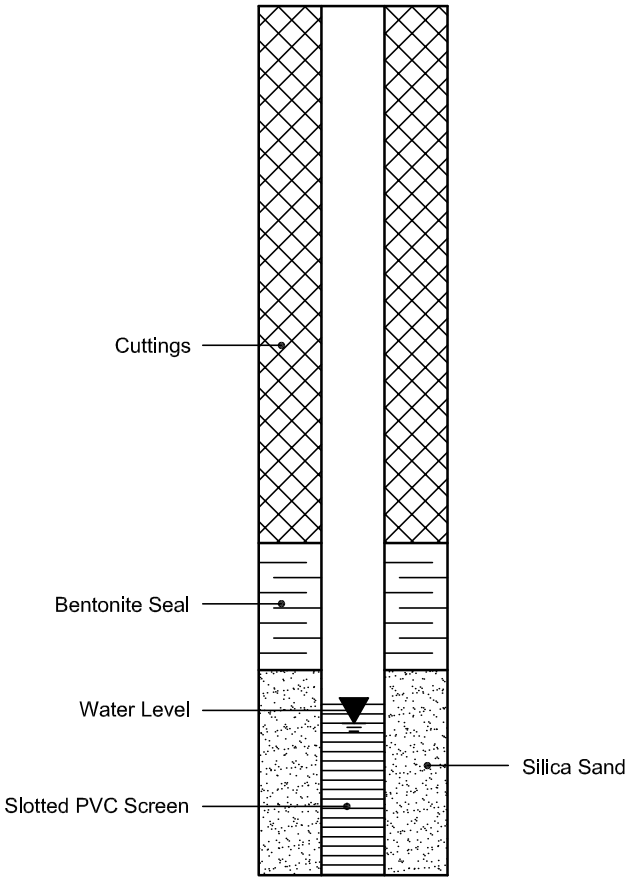


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26475

Report Date: 03-Oct-2019

Order Date: 30-Sep-2019

Project Description: PG2934

	Client ID:	GS1	-	-	-
	Sample Date:	26-Sep-19 09:00	-	-	-
	Sample ID:	1940106-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	89.8	-	-	-
General Inorganics					
pH	0.05 pH Units	6.89	-	-	-
Resistivity	0.10 Ohm.m	102	-	-	-
Anions					
Chloride	5 ug/g dry	6	-	-	-
Sulphate	5 ug/g dry	6	-	-	-

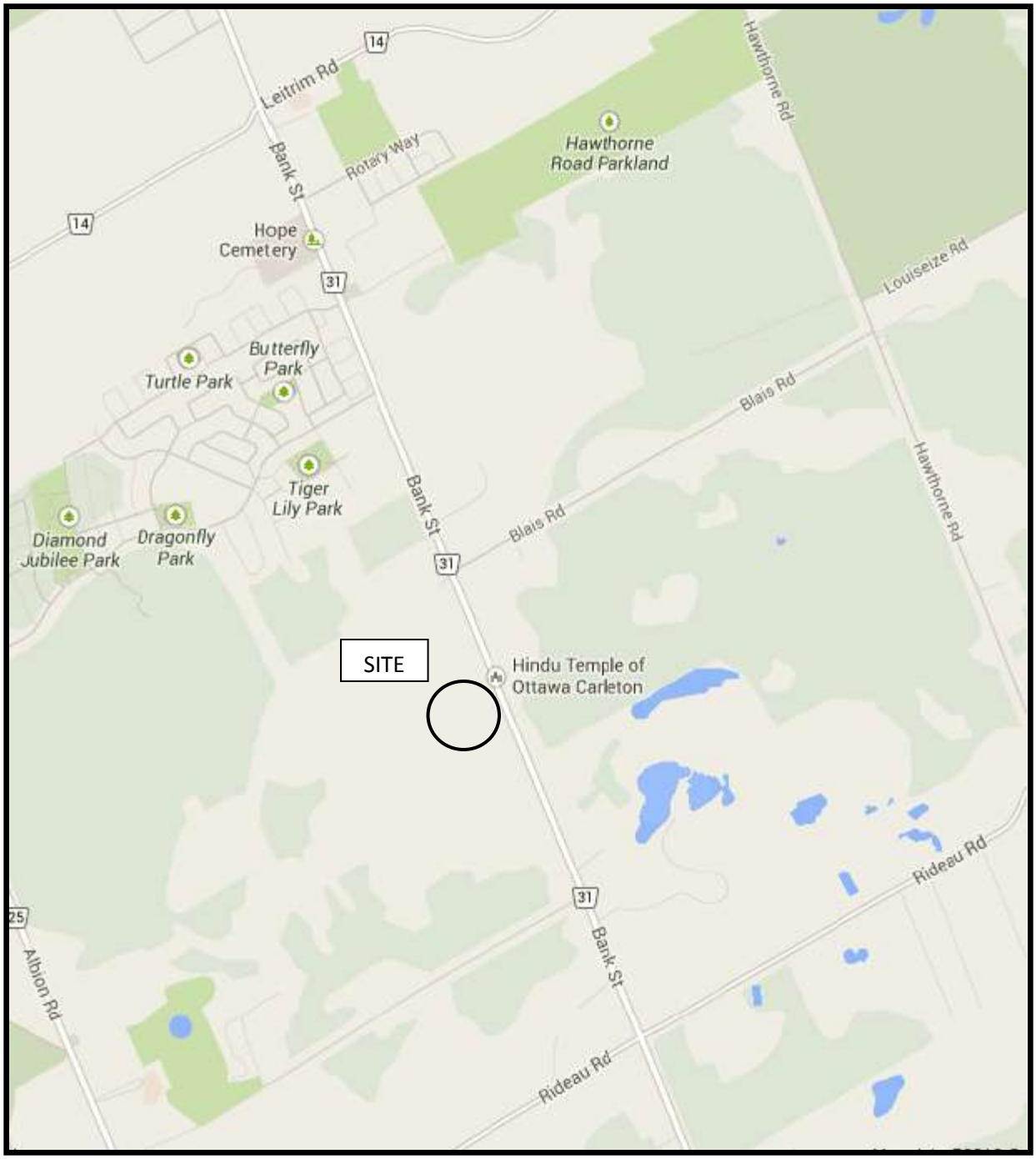
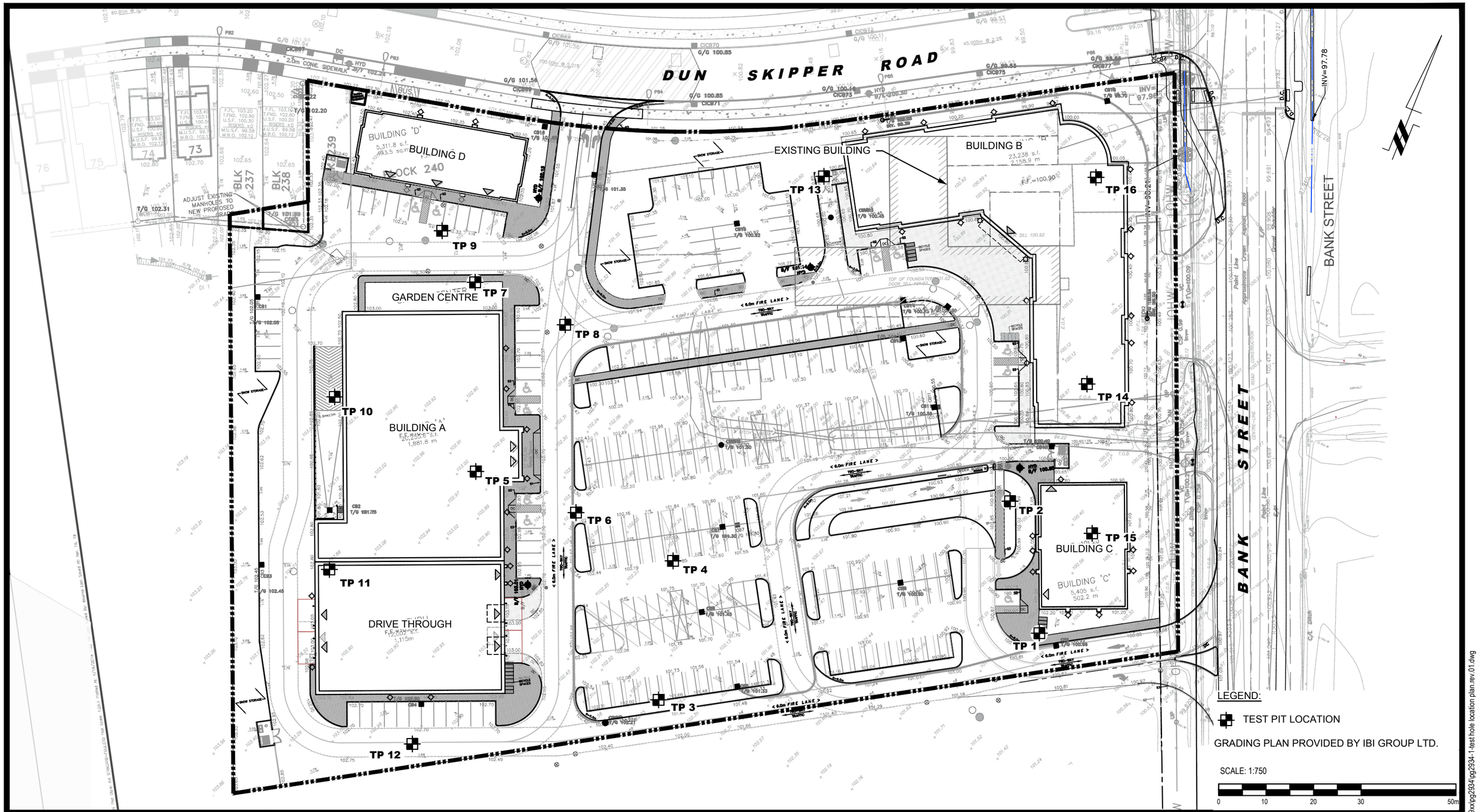


FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL
1	BASE PLAN UPDATED AND NEW TES PITS ADDED	15/11/2019	RG

OTTAWA FEED AND HARDWARE INC. C/O MAR GARD LIMITED

GEOTECHNICAL INVESTIGATION

4836 BANK STREET- PROPOSED COMMERCIAL DEVELOPMENT

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750	Date: 11/2019
Drawn by: YA	Report No.: PG2934-1
Checked by: RG	Dwg. No.: PG2934-1
Approved by: JV	Revision No.: 1

p:\autocad drawings\geotechnical\pg29xx\pg2934\pg2934-1-test hole location plan.rev.01.dwg

11x17