

December 14, 2015
PG3700-LET.01

1828486 Ontario Limited
277 Kirchoffer Avenue
Ottawa, ON
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Attention: **Mr. Rolf Bauman**

Subject: **Geotechnical Investigation
Proposed Residential Buildings
890 Greenbriar Avenue - Ottawa**

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
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Dear Sir,

Paterson Group (Paterson) was commissioned by 1828486 Ontario Limited to conduct a geotechnical investigation for the proposed residential buildings to be constructed at 890 Greenbriar Avenue, in the City of Ottawa, Ontario.

It is understood that two residential buildings (two storey) with a basement level are to be constructed at the subject site. Associated access lanes and landscaped areas are anticipated.

1.0 Field Investigation

The fieldwork for the investigation was conducted on December 8, 2015, and consisted of three test pits within the proposed building footprints. The test pits were advanced to a maximum of 3.6 m depth. The test pits were excavated under the full time supervision of Paterson personnel, under the direction of a senior engineer from the geotechnical division. The field procedure consisted of reviewing the excavation, sampling and testing the overburden at selected locations.

The test hole locations are presented in Drawing PG3700-1 - Test Hole Location Plan attached to the present letter report.

2.0 Field Observations

The subject site is currently occupied by a 2-storey residential dwelling with an attached garage, access lane, landscaped areas, and several mature trees. The property is slightly above grade of Greenbriar Avenue (north) and at grade or slightly below grade of the neighbouring properties to the rear.

Generally, the subsurface profile encountered at the test pit locations consists of a thin topsoil layer over a stiff to very stiff silty clay deposit. Refer to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test hole locations.

Based on available geological mapping and historical borehole information in the area, a deep silty clay deposit is expected in this area. Also, bedrock in this area consists of limestone from the Gull River formation. Bedrock is expected to range between 20 and 30 m depth.

Based on the field observations, such as moisture levels, colouring and consistency of the recovered soil samples, the long-term groundwater level is expected between 4 to 5 m depth. Groundwater levels are subject to seasonal fluctuations and therefore, the groundwater levels could vary at the time of construction.

3.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is satisfactory for the proposed residential buildings. The proposed low-rise residential buildings are expected to be constructed over conventional shallow foundations placed over a stiff to very stiff silty clay or an engineered fill layer over a stiff to very stiff silty clay bearing surface.

Due to the presence of the silty clay layer, the proposed development will be subjected to a permissible grade raise restriction. It is recommended to keep the proposed grades within 1 m of the existing grade to limit settlement to tolerable levels. If the grade raise restriction is exceeded, several options are available, such as a preload/surcharge program or the placement of lightweight fill below the proposed buildings.

Site Grading and Preparation

Topsoil, asphalt, and fill, containing deleterious or organic materials, should be stripped from under any building, paved areas, pipe bedding and other settlement sensitive structures. Care should be provided not to disturb adequate bearing soils at subgrade level during site preparation activities.

Fill placed 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 maximum lift thickness of 300 mm and compacted with suitable compaction equipment. Fill placed beneath the buildings 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 surface settlement is of minor concern. The existing materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If the existing materials are to be placed to increase the subgrade level for areas to be paved, the non-specified existing fill should be compacted in 300 mm lifts and compacted to a minimum density of 95% of the respective SPMDD.

Foundation Design

Pad footings, up to 5 m wide, and strip footings, up to 3 m wide, placed on an undisturbed, stiff silty clay bearing surface or approved engineered fill placed over a stiff, silty clay bearing surface can be designed using a bearing resistance value at SLS of **100 kPa** and a factored bearing resistance value at ULS of **180 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance values at ULS.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings. The bearing resistance value at SLS given for footings 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 a soil bearing medium when a plane extending horizontally and vertically from the footing perimeter at a minimum of 1.5H:1V, passing through in situ soil or engineered fill of equal or higher capacity as the soil.

Permissible Grade Raise Recommendations

A permissible grade raise restriction of 1 m is recommended for the subject site. A post-development groundwater lowering of 0.5 m was considered in the permissible grade raise restriction calculations.

Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for foundations constructed at the subject site. Refer to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements. The soils underlying the subject site are not susceptible to liquefaction.

Basement Slab

With the removal of all topsoil and deleterious materials, within the proposed building footprint, the native soil, free of organic and deleterious materials, and approved by the geotechnical consultant at the time of construction is considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 150 to 200 mm of sub-slab fill should consist of a 19 mm clear crushed stone. All backfill material within the proposed building footprints should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

Pavement Structure

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

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

Table 2 - Recommended Pavement Structure - Access Lanes and Heavy Truck Parking Areas	
Thickness (mm)	Material Description
40	Wear Course - HL-3 or Superpave 12.5 Asphaltic Concrete
50	Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
400	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soils or OPSS Granular B Type I or II material placed over in situ soil or fill	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

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

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the SPMDD.

4.0 Design and Construction Precautions

Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended to be provided for the proposed structures. 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 are not recommended for placement as backfill against the foundation walls, unless placed in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000. The drainage geocomposite should be connected to the perimeter foundation drainage system. Otherwise, imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be placed for foundation backfill.

Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided.

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

Excavation Side Slopes

The excavation side slopes in overburden materials should either be excavated to acceptable slopes or be retained by shoring systems from the beginning of the excavation until the structure is backfilled. Sufficient room should be available for the greater part of the excavation to be construction by open-cut methods (i.e. unsupported excavations). If sufficient room is unavailable due to existing structures or property boundaries, a shoring system may be required.

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower 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 maintain safe working distance from the excavation sides.

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

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.

A temporary MOECC permit to take water (PTTW) may be required for this project if more than 50,000 L/day are to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOECC.

The groundwater flow rate into the excavation through the overburden should be low to moderate for expected founding levels of the proposed building.

Winter Construction

If winter construction is considered for this project, precautions should be provided for frost protection. The subsurface soil conditions mainly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The excavation base should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level. The trench excavations should be completed in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. Where excavations are constructed in proximity of existing structures precaution to adversely affecting the existing structure due to the freezing conditions should be provided.

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:

- Review detailed grading plan(s) from a geotechnical perspective.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials used.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that the construction have been conducted in general accordance with Paterson's recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

6.0 Statement of Limitations

The recommendations provided in the report are in accordance with Paterson's present understanding of the project. Paterson request 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 the test locations, Paterson requests immediate notification to permit reassessment of the recommendations.

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

The present report applies only to the project described in the report. The use of the report for purposes other than those described above or by person(s) other than 1828486 Ontario Limited or their agents is not authorized without review by Paterson.

Best Regards,

Paterson Group Inc.

Michael Beaudoin, B.Eng.



David J. Gilbert, P.Eng.

Attachments

- Soil Profile and Test Data sheets
- Figure 1 - Key Plan
- Drawing PG3700-1 - Test Hole Location Plan

Report Distribution

- 1828486 Ontario Limited (3 copies)
- Paterson Group (1 copy)

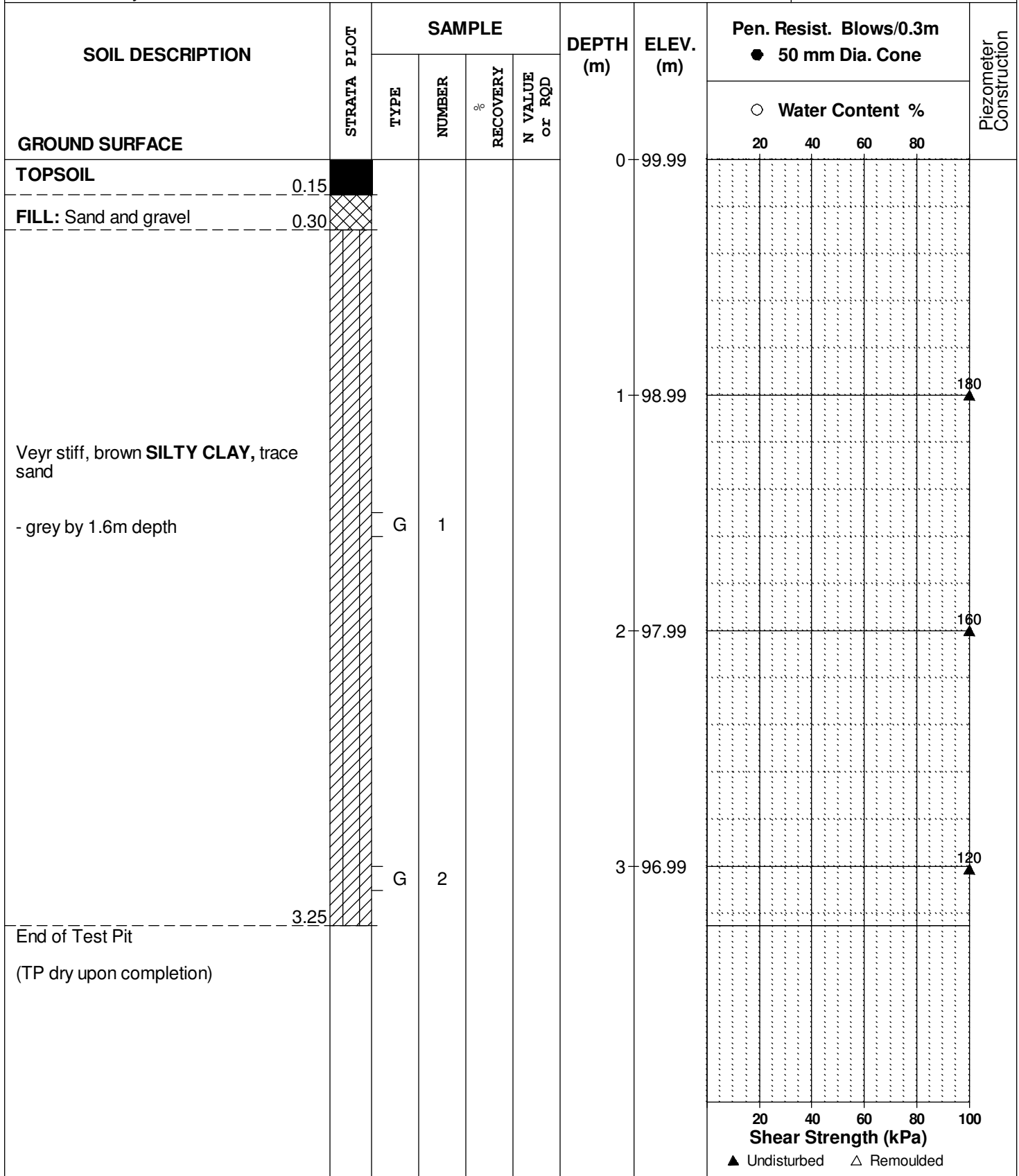
DATUM TBM - Top spindle of fire hydrant located on the northside of Greenbriar Drive, opposite northwest corner of subject site. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO.
PG3700

HOLE NO.
TP 1

BORINGS BY Hydraulic Shovel

DATE 8 December 2015



DATUM TBM - Top spindle of fire hydrant located on the northside of Greenbriar Drive, opposite northwest corner of subject site. An arbitrary elevation of 100.00m was assigned to the TBM.

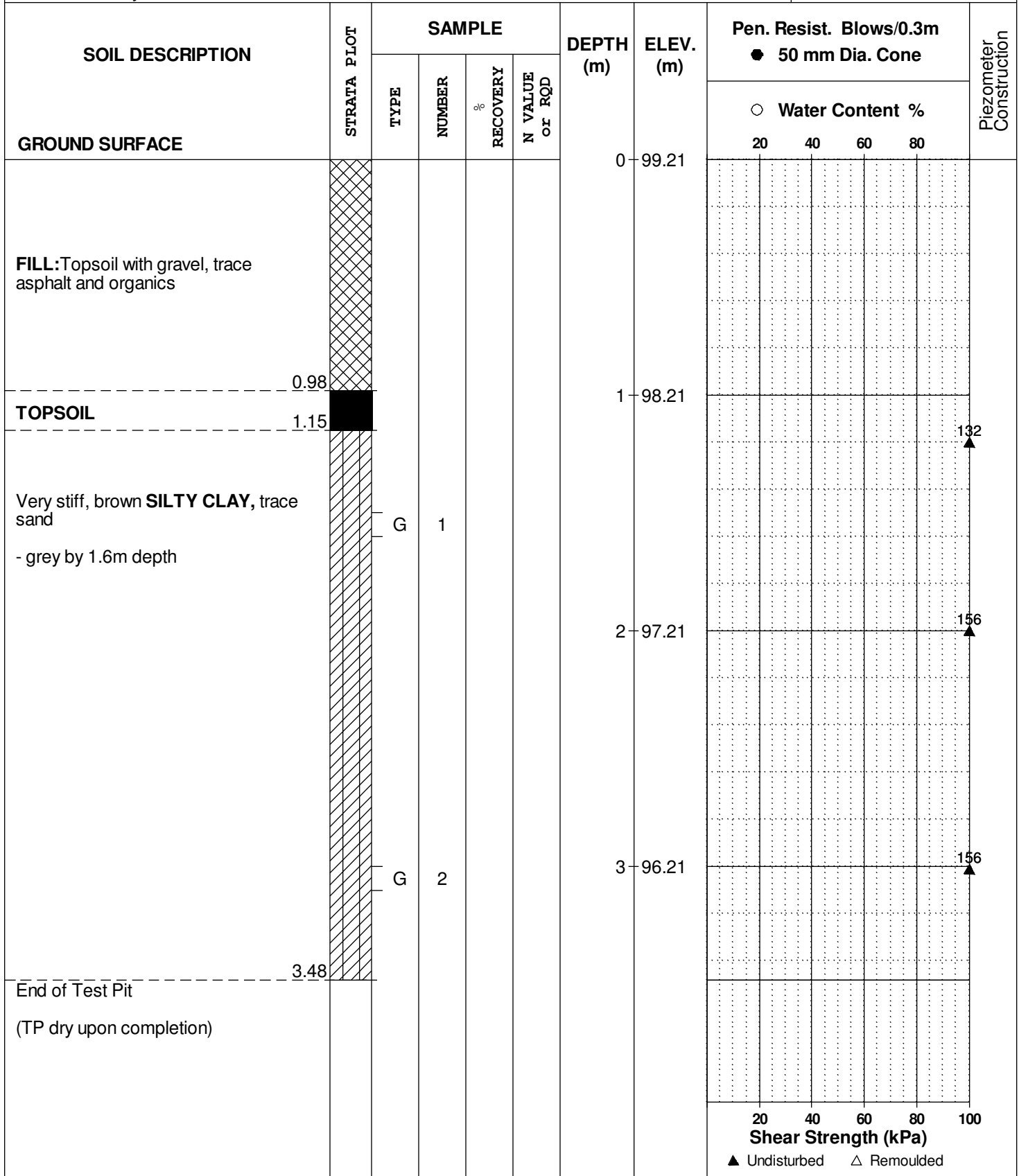
REMARKS

FILE NO.
PG3700

HOLE NO.
TP 2

BORINGS BY Hydraulic Shovel

DATE 8 December 2015



DATUM TBM - Top spindle of fire hydrant located on the northside of Greenbriar Drive, opposite northwest corner of subject site. An arbitrary elevation of 100.00m was assigned to the TBM.

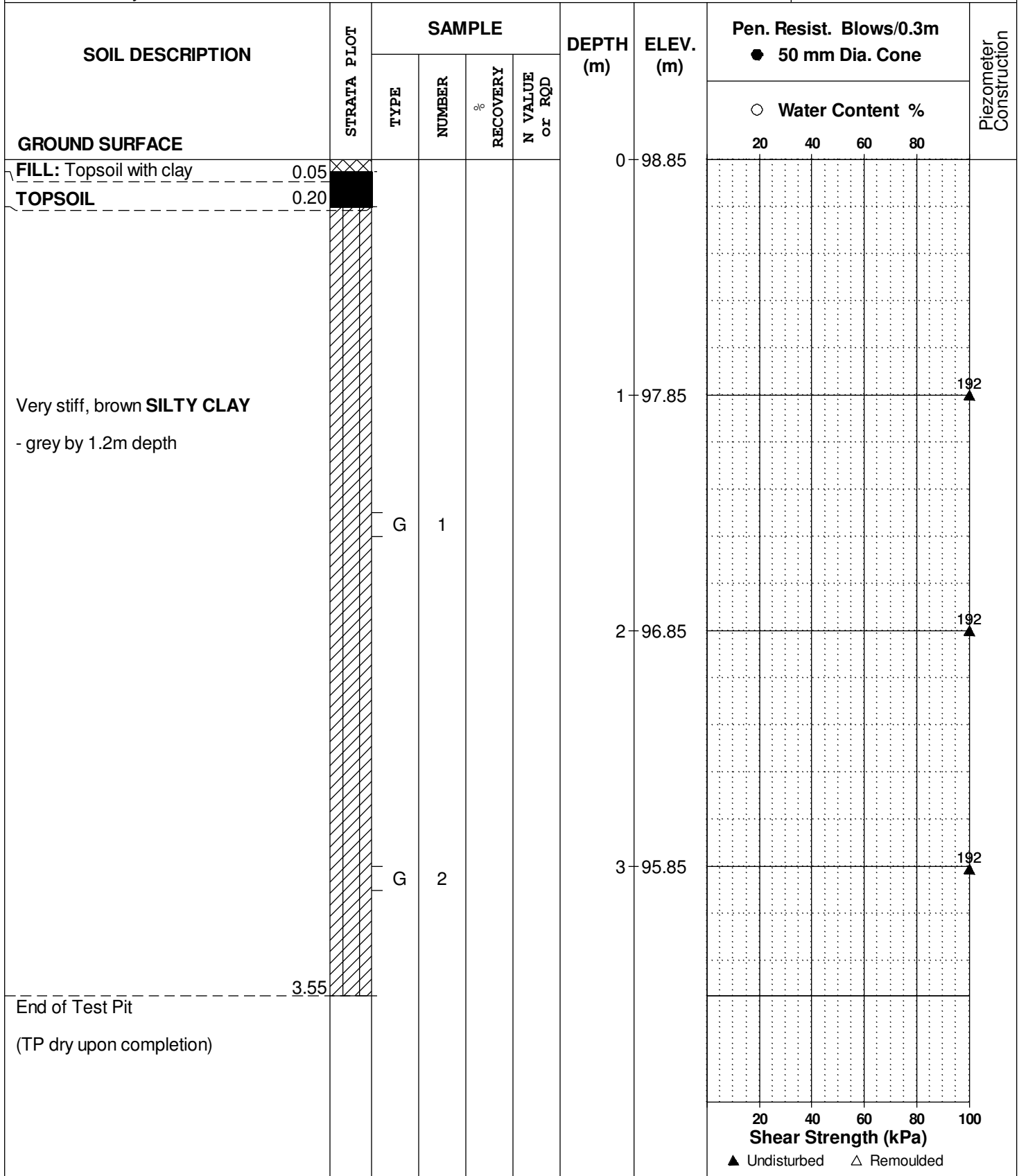
REMARKS

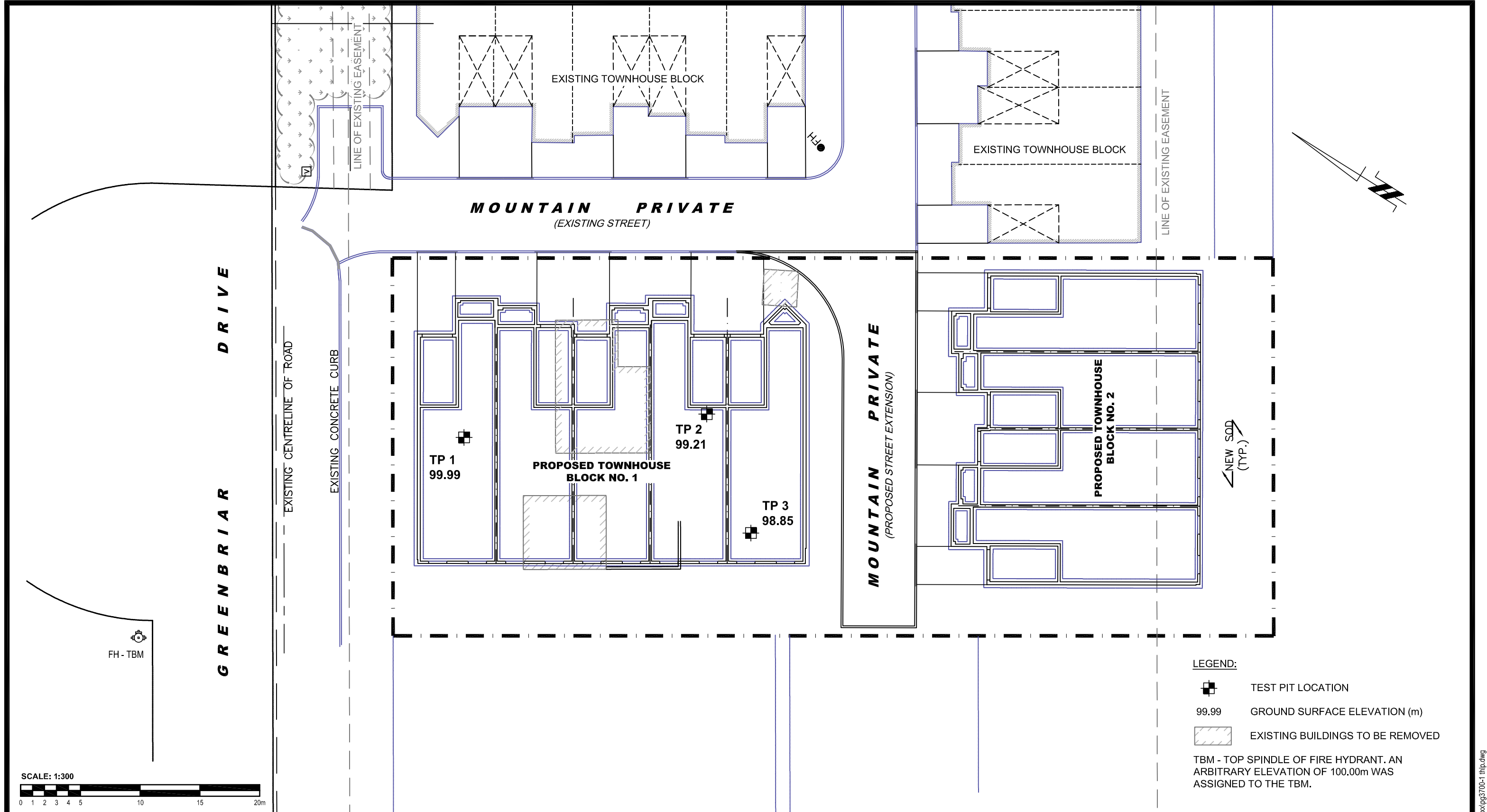
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PG3700

HOLE NO.
TP 3

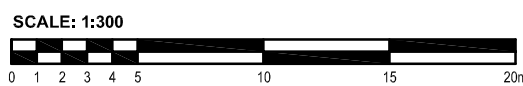
BORINGS BY Hydraulic Shovel



DATE 8 December 2015





FH - TBM



- LEGEND:**
-  TEST PIT LOCATION
 - 99.99 GROUND SURFACE ELEVATION (m)
 -  EXISTING BUILDINGS TO BE REMOVED
- TBM - TOP SPINDLE OF FIRE HYDRANT. AN ARBITRARY ELEVATION OF 100.00m WAS ASSIGNED TO THE TBM.

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consulting engineers

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NO.	REVISIONS	DATE	INITIAL
0			

1828486 Ontario Limited
GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - 890 GREENBRIAR AVENUE
OTTAWA, ONTARIO
Title: **TEST HOLE LOCATION PLAN**

Scale: 1:300
Drawn by: MPG
Checked by: MB
Approved by: CDS

Date: 12/2015
Report No.: PG3700-1
Dwg. No.: **PG3700-1**
Revision No.:

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