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Consolidated Geotechnical Investigation

Proposed Residential Development
Kanata North Development
March Road - Ottawa, Ontario

Prepared For

Novatech Engineering Consultants Ltd.

May 17, 2019

Report PG4258-2

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Novatech Engineering Consultants to prepare a geotechnical report outlining the geotechnical constraints for the Kanata North Urban Expansion Area Community Design Plan (CDP) along March Road in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The current report consolidates the existing geotechnical studies completed for the individual properties. The relevant geotechnical studies are listed below:

- ❏ Paterson Report PG4258-1 dated June 14, 2018 entitled "Geotechnical and Hydrological Investigation, Proposed Storm Water Management Facility, Kanata North Development, March Road - Ottawa, Ontario"
- ❏ Paterson Report PG2878-3 dated April 8, 2013 entitled "Preliminary Geotechnical Investigation, 1075 March Road, Ottawa, Ontario"
- ❏ Paterson Letter Report PG1823-LET.01 dated March 18, 2009 entitled "Preliminary Geotechnical Investigation, Proposed Residential Development, Burke and Maxwell Properties, March Road, Ottawa.
- ❏ Paterson Letter Report PG1716-LET.01 dated August 25, 2009 entitled "Preliminary Geotechnical Investigation Proposed Residential Development, Foley Lands, March Road, Ottawa."

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

2.0 Proposed Development

It is understood that the proposed development will consist of low rise residential and commercial buildings. It is further anticipated that the development will be municipally serviced and include local, car parking and landscaped areas.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

Test pits excavated by a hydraulic shovel or rubber tired backhoe were completed throughout the subject properties. The test holes were distributed in a manner to provide general coverage of the subject sites. Approximate locations of the test holes are shown in Drawing PG2878-1 - Test Hole Location Plan included in Appendix 2.

Sampling and In Situ Testing

Soil samples from the test pits were recovered from the side walls of the open excavation and all soil samples were initially classified on site. All samples were transported to our laboratory for further examination and classification. The depths at which the grab samples were recovered from the test holes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Undrained shear strength testing, using a hand held vane apparatus, was carried out at regular intervals of depth in cohesive soils.

Soil samples collected from the boreholes were either recovered directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. Soil samples from the test pits were recovered from the side walls of the open excavation. All soil samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the auger, split spoon and grab samples were recovered from the boreholes are shown as AU, SS and G, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

In conjunction with the recovery of the split spoon samples, the Standard Penetration Test (SPT) was conducted. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented on the borehole logs. The recovery value is the length of the bedrock sample recovered over the length of the drilled section. The RQD value is the total length of intact rock pieces longer than 100 mm over the length of the core run. The values indicate the bedrock quality.

Subsurface conditions observed in the test holes were recorded in detail in the field. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Open hole groundwater infiltration levels were observed at the time of excavation at each test pit location.

Monitoring wells were installed in the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. Our observations are presented in the Soil Profile and Test Data sheets in Appendix 1.

Hydraulic Conductivity Testing

Hydraulic conductivity testing was completed in the three monitoring wells. Falling head and rising head tests ("slug tests") were completed in accordance with ASTM Standard Test Method D4404 - Field Procedure for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers.

Slug testing was completed on November 14, 2017 by Paterson personnel. The general test method consisted of the measurement of the static water level in the well, followed by inducing a near-instantaneous change of head in the monitoring well and subsequent monitoring of water level recovery with an electronic water level tape and a Mini Diver water level logger. The change in head was induced by the introduction of an aluminum slug, 1 m in length and 40 mm in diameter. The slug was introduced to raise the groundwater level in the monitoring well, following which the decrease in water level over time was monitored (falling head test). Once the water level had stabilized (or nearly stabilized), the slug was then removed to lower the groundwater level, following which the increase in water level over time was monitored (rising head test).

3.2 Field Survey

The location and ground surface elevations at the borehole locations are presented on Drawing PG4258-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. Soil samples will be stored for a period of one month after this report is completed, unless otherwise directed.

3.4 Analytical Testing

Three soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was analysed to determine the concentrations of sulphate and chloride, the resistivity and the pH of the sample. The analytical test results are presented in Appendix 1 and discussed in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site covers an area of approximatly 49.5 hectares. The majority is currently undeveloped and used as agricultural land. The ground surface is generally flat and gently slopes down from west to east towards March Road. An existing creek flows from west to east across the subject site.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test hole locations consists of a native, stiff to hard silty clay deposit followed by a layer of glacial till which in turn is overlying bedrock. The glacial till consisted of a silty clay fine soil matrix with trace to some sand and gravel, and trace cobbles and boulders. Grey limestone bedrock was encountered underneath the glacial till at approximately 2.1 to 3.5 m depth. Generally, the bedrock quality is fair to good within the upper 0.5 to 1 m and good to excellent quality at depth based on the RQD values. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on geological mapping, the local bedrock consists of sandstone and dolomite of the March Formation. The overburden thickness is expected to range from approximately 2 to 3 m.

4.3 Groundwater

The groundwater level (GWL) readings were recorded at the borehole locations on November 14, 2017 and in the test pits upon completion of the field program. The results are presented in Table 1 below and in the Soil Profile and Test Data sheets. It is important to note that based on observations of the soil samples recovered from the borehole locations, such as colouring, moisture levels and consistency, the long-term groundwater level is not expected within the overburden soils. The groundwater level readings within the monitoring wells indicate that an artesian pressure is present below the bedrock surface. It should be noted that groundwater levels are subject to seasonal fluctuations and therefore groundwater levels could differ at the time of construction.

Table 1 - Summary of Groundwater Level Readings				
Borehole Number	**Ground Elevation, m**	**Groundwater Levels, m**		**Recording Date**
		Depth	**Elevation**	
PG4258-1				
BH 1	83.20	0.04	83.16	November 14, 2017
BH 2	82.43	0.50	81.93	November 14, 2017
BH 3	81.77	-0.04	81.81	November 14, 2017
PG2878-3				
TP25	89.66	dry	-	March 21, 2013
TP26	89.74	dry	-	March 21, 2013
TP27	88.96	dry	-	March 21, 2013
TP28	86.85	dry	-	March 21, 2013
TP29	86.13	dry	-	March 21, 2013
TP30	86.42	dry	-	March 21, 2013
TP31	88.37	dry	-	March 21, 2013
TP32	86.81	dry	-	March 21, 2013
TP33	84.00	dry	-	March 21, 2013
TP34	84.02	dry	-	March 21, 2013
TP35	82.99	2.70	80.29	March 21, 2013
TP36	84.76	2.60	82.16	March 21, 2013
PG1823-LET.01				
TP1	88.10	dry	-	February 9,2009
TP2	88.57	1.40	87.17	February 9,2009
TP3	85.48	dry	-	February 9,2009
TP4	88.13	dry	-	February 9,2009
TP5	88.50	dry	-	February 9,2009
TP6	89.10	dry	-	February 9,2009
TP7	88.06	1.80	86.26	February 9,2009
TP8	89.86	1.10	88.76	February 9,2009
TP9	91.42	1.90	89.52	February 9,2009
TP10	90.76	2.50	88.26	February 9,2009
TP11	90.22	1.00	89.22	February 9,2009
TP12	89.26	dry	-	February 9,2009

PG1716-LET.01				
TP 1	81.70	1.75	79.95	July 9, 2008
TP 2	83.10	dry	--	July 9, 2008
TP 3	83.80	1.75	82.05	July 9, 2008
TP 4	86.20	1.20	85.00	July 9, 2008
TP 5	86.80	1.10	85.70	July 9, 2008
TP 6	90.70	dry	--	July 9, 2008
TP 7	89.40	dry	--	July 9, 2008
TP 8	88.80	dry	--	July 9, 2008
TP 9	81.90	1.50	80.40	July 9, 2008
TP 10	88.40	2.65	85.75	July 9, 2008
TP 11	89.50	dry	--	July 9, 2008

Notes:
- The test hole locations were located in the field and surveyed by Novatech Engineering Consultants Ltd. The ground surface elevations are referenced to a geodetic datum.
- The negative depth at BH 3 denotes water level recorded in the monitoring well above ground surface.

Hydraulic Conductivity

Following the completion of the slug testing, the test data was analyzed as per the method set out by Hvorslev (1951). Assumptions inherent in the Hvorslev method include a homogeneous and isotropic aquifer of infinite extent, zero-storage assumption, and a screen length significantly greater than the monitoring well diameter. The assumption regarding aquifer storage is considered to be appropriate for groundwater flow through the overburden aquifer. The assumption regarding screen length and well diameter is considered to be met based on a typical screen length of 1.52 m and a diameter of 0.05 m.

While the idealized assumptions regarding aquifer extent, homogeneity, and isotropy are not strictly met in this case (or in any real-world situation), it has been our experience that the Hvorslev method produces effective point estimates of hydraulic conductivity in conditions similar to those encountered at the subject site.

Hvorslev analysis is based on the line of best fit through the field data (hydraulic head recovery vs. time), plotted on a semi-logarithmic scale. In cases where the initial hydraulic head displacement is known with relative certainty, such as in this case where a physical slug has been introduced, the line of best fit is considered to pass through the origin. In cases where the initial hydraulic head displacement is known with less certainty (e.g. a bail test, where water is pumped rapidly from the well), the best-fit line is drawn regardless of the origin.

Based on the above test methods, the monitoring wells from the current investigation displayed hydraulic conductivity values ranging from 1.1 x 10^{-5} to 5.8 x 10^{-5} m/sec, with a geometric mean of 3.3 x 10^{-5} m/sec. The results of the hydraulic conductivity testing are presented in Appendix 1.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed development. It is expected that low rise wood framed buildings could be founded on conventional shallow footings placed on an undisturbed, stiff silty clay, compact glacial till or surface-sounded bedrock bearing surface.

A permissible grade raise restriction is required for the proposed residential development where the silty clay layer is present below the proposed buildings.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Preparation

Stripping Depth

Topsoil and deleterious materials, such as those containing significant amounts of organics, should be removed from within any settlement sensitive structure.

Bedrock Removal

Based on the bedrock encountered in the area, it is expected that hoe-ramming or controlled blasting will be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the effects for any nearby existing buildings or structures should be addressed. A pre-blast or construction survey located in proximity of the blasting operations should be conducted prior to commencing construction. The extent of the survey should be determined by the blasting consultant and sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocity (measured at the property line) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing nearby buildings.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is an experienced blasting consultant.

Any bedrock removed via hoe-ramming or blasting methods may be stockpiled at the site and reviewed by the geotechnical consultant for use as backfill below building footprints and as general landscaping fill.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipments could be the source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system using soldier piles or sheet piling will require the use of these equipments. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). It should be noted that these guidelines are for today's construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill used for grading beneath any settlement sensitive structures should consist, unless otherwise specified, 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 the proposed building areas should be compacted to at least 98% of its 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. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. 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.

5.3 Bearing Resistance Values

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit state (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit state (ULS) of **225 kPa**. Footings placed on an undisturbed, compact glacial till bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**. Footings placed on a clean, weathered bedrock can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **750 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.

The above noted allowable bearing capacities are provided for design purposes and should be confirmed in the field prior to placement of concrete for structures.

Permissible Grade Raise

A **permissible grade raise restriction of 2 m** is recommended for areas where building foundations are founded over a silty clay deposit. Areas effected by a permissible grade raise restriction due to the presence of a silty clay deposit are indicated in Drawing PG4258-2 - Permissible Grade Raise Plan in Appendix 2. Footings bearing on a dense glacial till or bedrock surface are not subjected to permissible grade raise restrictions.

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 engineered fill or native soil above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or flatter).

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered within the west and central portion of the subject site. A higher site class, such as site Class A or B may be applicable for the subject site, but would need to be confirmed with site specific shear wave velocity testing.

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.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, such as those containing organic materials, from within the footprint of the proposed buildings, the native soil surface or approved engineered fill 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 prior to placing any fill. 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-floor fill consist of 19 mm clear crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

Access roads, paved walkways and car parking areas are anticipated for the proposed development. The proposed pavement structures are presented in Tables 2 and 3.

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
450	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Pavement Structure - Paved Walkway and Car Only Parking Areas

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

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

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, such as Terratrack 200 or equivalent, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

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.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system 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 site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls unless placed in conjunction with a composite drainage system, such as Delta Drain 6000 or equivalent. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose.

Clay seal recommendations at the creek crossings have been provided in memorandum PG4258-MEMO.01 dated June 13, 2018 presented in Appendix 1.

6.2 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 an equivalent combination of soil cover and foundation insulation should be provided in this regard.

Exterior unheated footings, such as those for 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 an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should be either cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is 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 subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept at least 3 m away from the excavation sides.

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

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

6.4 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for bedding for sewer pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's standard Proctor maximum dry density (SPMDD).

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty sand above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty sand materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 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. It is anticipated that groundwater infiltration into the excavations should be moderate, if encountered, and controllable using open sumps.

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 of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

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

6.6 Winter Construction

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

The subsoil conditions for the silty-clay area of the site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

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

6.7 Corrosion Potential and Sulphate

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

6.8 Tree Planting Restrictions

Based on the subsurface conditions encountered in the boreholes, the hard to stiff silty clay crust extends to a glacial till layer of bedrock. As such, the silty clay should be considered low to medium sensitivity clay and should not be considered a sensitive marine clay.

Based on the above discussion, it is recommended that trees placed within 4.5 m of the foundation wall consist of street trees with shallow root systems that extend less than 1.5 m below ground surface. Trees placed greater than 4.5 m from the foundation wall may consist of moderate water demanding trees with roots extending to a maximum 2 m depth. It should be noted that shrubs and other small plantings are permitted within the 4.5 m setback area.

It is documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils which shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and should not be considered in the landscaping design.

7.0 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 of the finalized pond design drawings from a geotechnical perspective, once available.
- ❏ Periodic site visits during controlled blasting operations and to monitoring the groundwater influx during construction.
- ❏ Observation of all bearing surfaces prior to the placement of concrete and/or precast structures.
- ❏ 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 and bearing surfaces prior to backfilling.
- ❏ Field density tests to determine the level of compaction achieved.

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.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request permission to review the grading plan once available. Also, our recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation 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 Novatech Engineering Consultants Ltd. 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.

Paterson Group Inc.

Joey R Villeneuve, M.A.Sc, EIT

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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** October 20, 2017

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	83.20
TOPSOIL (to 0.40)						
Very stiff to stiff, brown **SILTY CLAY,** trace sand (0.40 – 1.68)	SS	1	92	10	1	82.20
GLACIAL TILL: Dense, brown silty clay with sand, gravel, cobbles, some boulders (1.68 – 2.13)	SS	2	96	30	2	81.20
BEDROCK: Grey limestone (2.13 – 4.98)	RC	1	96	76	3	80.20
	RC	2	98	87	4	79.20
End of Borehole (4.98)						

(GWL @ 0.04m depth - Nov 14/17)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Monitoring Well Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger

DATE October 20, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.43
TOPSOIL (to 0.40)							
Stiff to hard, brown **SILTY CLAY,** trace sand (0.40 to 2.72)		SS	1	100	11	1	81.43
		SS	2	100	10	2	80.43
		SS	3	100	50+		
GLACIAL TILL: Very dense, brown silty clay with sand, gravel, cobbles, trace boulders (2.72 to 3.48)		SS	4	71	50+	3	79.43
BEDROCK: Grey limestone (3.48 to 6.20)		RC	1	100	67	4	78.43
		RC	2	100	69	5	77.43
						6	76.43
End of Borehole							
(GWL @ 0.5 m depth - Nov 14/17)							

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger

DATE October 20, 2017

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.77
TOPSOIL	0.35	AU	1				
Very stiff to stiff, brown **SILTY CLAY,** trace sand		SS	2	92	10	1	80.77
		SS	3	100	8	2	79.77
	2.59	SS	4	75	13		
GLACIAL TILL: Compact to very dense, brown silty clay with sand, gravel, cobbles, trace boulders		SS	5	50	50+	3	78.77
	3.45	RC	1	100	0		
BEDROCK: Grey limestone		RC	2	100	91	4	77.77
		RC	3	92	79	5	76.77
	5.54						

End of Borehole

(GWL @ 0.04 m above ground surface - Nov 14/17)

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

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

REMARKS Northing 5025146.3; Easting 348117.8

BORINGS BY CME 55 Power Auger

DATE November 16, 2017

FILE NO. PG3975

HOLE NO. BH 2A-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.95
OVERBURDEN						1	81.95
2.51						2	80.95
BEDROCK: Poor to fair quality, grey limestone, some shale partings		RC	1	100	47	3	79.95
		RC	2	100	80	4	78.95
						5	77.95
		RC	3	100	69		
6.07						6	76.95
End of Borehole							
(GWL @ 0.98m-Dec. 20, 2016)							

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

REMARKS Northing 5025146.3; Easting 348117.8

BORINGS BY CME 55 Power Auger

DATE November 16, 2017

FILE NO. PG3975

HOLE NO. BH 2B-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.95
						1	81.95
OVERBURDEN						2	80.95
3.02		RC	1	100		3	79.95
		RC	2	100	67	4	78.95
		RC	3	100	66	5	77.95
						6	76.95
BEDROCK: Fair to excellent quality, grey limestone, some shale partings		RC	4	100	61	7	75.95
		RC	5	100	93	8	74.95
						9	73.95
		RC	6	100	95	10	72.95
		RC	7	100	90	11	71.95
12.17						12	70.95
End of Borehole							
(GWL @ 1.12m-Dec. 20, 2016)							

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

REMARKS Northing 5025257.5; Easting 347719.2

BORINGS BY CME 55 Power Auger

DATE November 18, 2017

FILE NO. PG3975

HOLE NO. BH 3A-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.84
OVERBURDEN						1	87.84
1.73							
BEDROCK: Fair to good qualtiy, grey limestone, some shale partings						2	86.84
		RC	1	100	67		
						3	85.84
		RC	2	100	86		
						4	84.84
						5	83.84
		RC	3	100	68		
6.02						6	82.84
End of Borehole							
(GWL @ 3.27m-Dec. 20, 2016)							

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

○ Water Content %
20 40 60 80

Monitoring Well Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

REMARKS Northing 5025257.5; Easting 347719.2

BORINGS BY CME 55 Power Auger

DATE November 18, 2017

FILE NO. PG3975

HOLE NO. BH 3B-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.84
OVERBURDEN						1	87.84
1.73							
BEDROCK: Good to fair quality, grey limestone, some shale partings		RC	1	100	81	2	86.84
		RC	2	95	41	3	85.84
						4	84.84
		RC	3	100	58	5	83.84
		RC	4	100	58	6	82.84
- excellent to good quality by 7.5m depth						7	81.84
		RC	5	100	100	8	80.84
		RC	6	100	93	9	79.84
						10	78.84
		RC	7	100	81	11	77.84
12.02						12	76.84
End of Borehole							
(GWL @ 4.01m-Dec. 20, 2016)							

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

REMARKS Northing 5024849.7; Easting 347680.5

BORINGS BY CME 55 Power Auger

DATE November 18, 2017

FILE NO. PG3975

HOLE NO. BH 4A-16

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.34
OVERBURDEN					1	88.34
2.03					2	87.34
BEDROCK: Good to excellent qualtiy, grey limestone, some shale partings	RC	1	100	88	3	86.34
	RC	2	100	97	4	85.34
	RC	3	95	90	5	84.34
6.07					6	83.34

End of Borehole

(GWL @ 0.49m-Dec. 20, 2016)

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

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

Sentinel Monitoring Wells
Kanata North Community Design Plan
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Consulting Engineering Ltd.

FILE NO. PG3975

REMARKS Northing 5024849.7; Easting 347680.5

HOLE NO. BH 4B-16

BORINGS BY CME 55 Power Auger **DATE** November 16, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.34
OVERBURDEN						1	88.34
2.26						2	87.34
		RC	1	100	91	3	86.34
		RC	2	100	97	4	85.34
		RC	3	100	98	5	84.34
						6	83.34
BEDROCK: Excellent qualtiy, grey limestone, some shale partings		RC	4	100	100	7	82.34
		RC	5	100	81	8	81.34
						9	80.34
		RC	6	100	88	10	79.34
		RC	7	100	93	11	78.34
12.19						12	77.34
End of Borehole (MW blocked at 0.35m depth - Dec. 20, 2016)							

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

○ Water Content %

20 40 60 80

Monitoring Well Construction

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe **DATE** October 19, 2017

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	85.22		
TOPSOIL 0.40									
Stiff, brown **SILTY CLAY,** trace sand 0.56									
BEDROCK: Grey limestone 0.66									
End of Test Pit (TP dry upon completion)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. TP 2

BORINGS BY Backhoe

DATE October 19, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE: TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.12
TOPSOIL (to 0.30)							
Very stiff to stiff, brown **SILTY CLAY,** trace sand (0.30 to 1.65)						1	87.12
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, trace boulders (1.65 to 2.16)						2	86.12
End of Test Pit (2.16)							

End of Test Pit

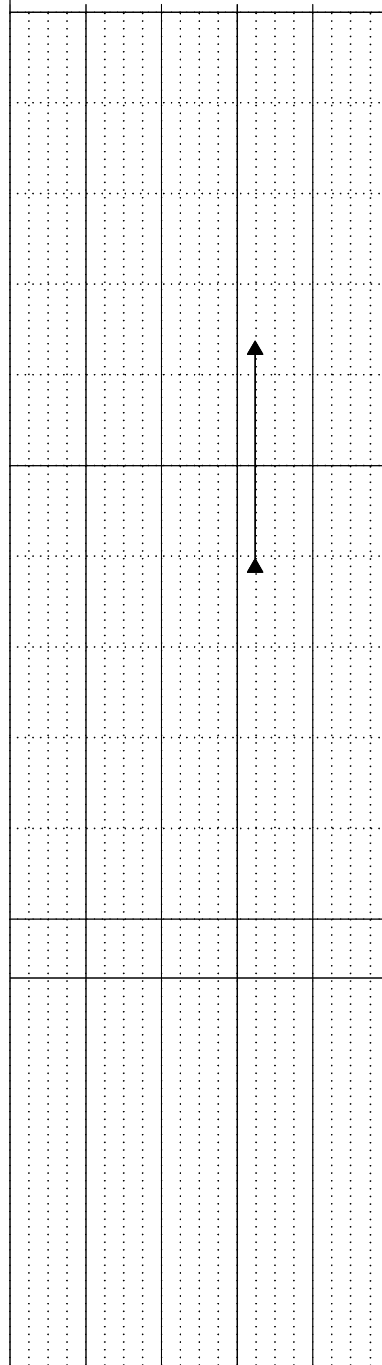
TP terminated on bedrock surface at 2.16m depth

(GWL @ 1.5m depth based on field observations)

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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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical investigation
Proposed Stormwater Management Facility
1053 March Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG4258

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe

DATE October 19, 2017

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	89.87		
TOPSOIL (to 0.30)									
Very stiff to stiff, brown **SILTY CLAY,** trace sand (0.30 to 1.42)						1	88.87		∇ (1.4)
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, trace boulders (1.42 to 2.13)						2	87.87		
End of Test Pit (2.13)									

End of Test Pit

TP terminated on bedrock surface at 2.13m depth

(GWL @ 1.4m depth based on field observations)

Water Content % scale: 20, 40, 60, 80

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG2878

REMARKS 18T 0425287; 5023780

HOLE NO. TP25

BORINGS BY Hydraulic Excavator **DATE** March 21, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.66		
TOPSOIL 0.30									
Very stiff to stiff, brown **SILTY CLAY** 0.61		G	1					○	
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 0.61m depth (TP dry upon completion)									

Water Content % axis: 20, 40, 60, 80

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425362; 5023727

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP26

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	89.74		
TOPSOL 0.60									
Very stiff to stiff, brown **SILTY CLAY** 1.22						1	88.74		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 1.52		G	1					○	
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 1.52m depth (TP dry upon completion)									

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

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG2878

REMARKS 18T 0425446; 5023599

HOLE NO. TP27

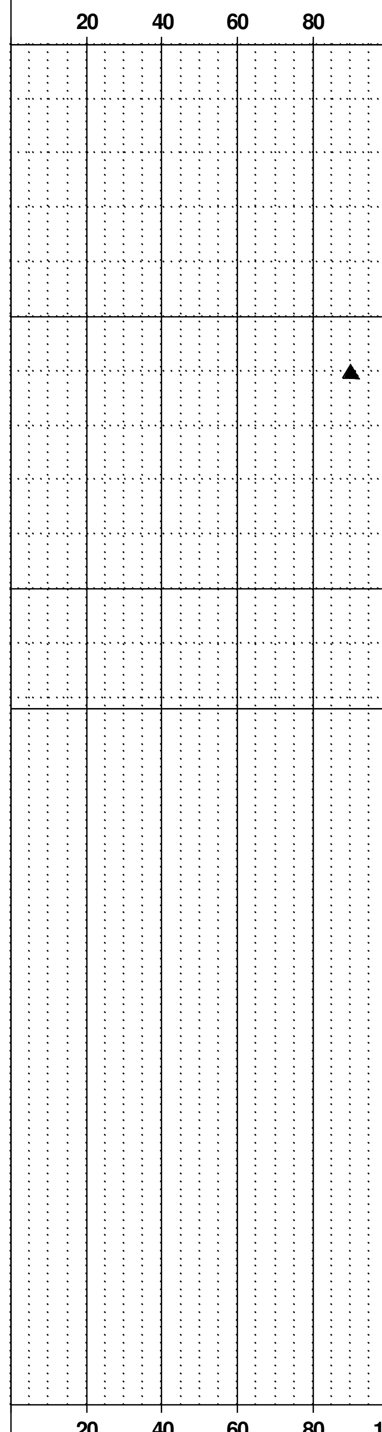
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.96
TOPSOIL (to 0.60)							
						1	87.96
Very stiff to stiff, brown **SILTY CLAY,** trace sand (0.60 to 2.44)							
						2	86.96
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 2.44m depth (TP dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425582; 5023702

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP28

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.85		
TOPSOIL (to 0.41)									
Very stiff to stiff, brown **SILTY CLAY** (0.41 to 1.52)						1	85.85		
		G	1						
End of Test Pit									
Practical refusal to excavation on inferred bedrock surface at 1.52m depth									
(TP dry upon completion)									

Pen. Resist. / Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425480; 5023826

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP29

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	86.13		
TOPSOIL (to 0.41)									
Firm to stiff, brown **SILTY CLAY** (0.41 to 1.07)						1	85.13		∇ (GWL)
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders (1.07 to 1.52)		G	1					○ ~20	
End of Test Pit (1.52)									

Practical refusal to excavation on inferred bedrock surface at 1.52m depth

(GWL @ 0.7m depth based on field observations)

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425420; 5023875

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

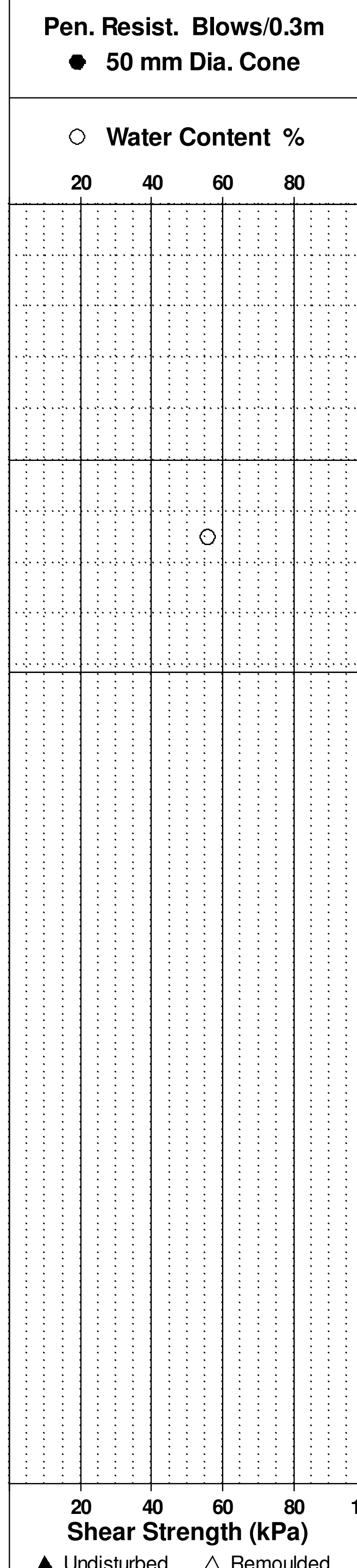
FILE NO. PG2878

HOLE NO. TP30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.42
TOPSOIL (to 0.38)							
Very stiff to stiff, brown **SILTY CLAY,** trace sand (0.38 to 1.83)						1	85.42
		G	1				
End of Test Pit (1.83)							

Practical refusal to excavation on inferred bedrock surface at 1.83m depth

(TP dry upon completion)



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425562; 5023981

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP31

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.37		
TOPSOIL 0.41									
Stiff, brown **SILTY CLAY,** some sand, trace gravel 0.81									
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 0.81m depth (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM	Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.
REMARKS	18T 0425629; 5023917
BORINGS BY	Hydraulic Excavator
DATE	March 21, 2013
FILE NO.	PG2878
HOLE NO.	TP32

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	86.81		
TOPSOIL 0.66									
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 0.66m depth (TP dry upon completion)									

Water Content % axis: 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

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425702; 5023822

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP33

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	84.00		
TOPSOIL (0.61)									
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 0.61m depth (TP dry upon completion)									

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425799; 5023895

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP34

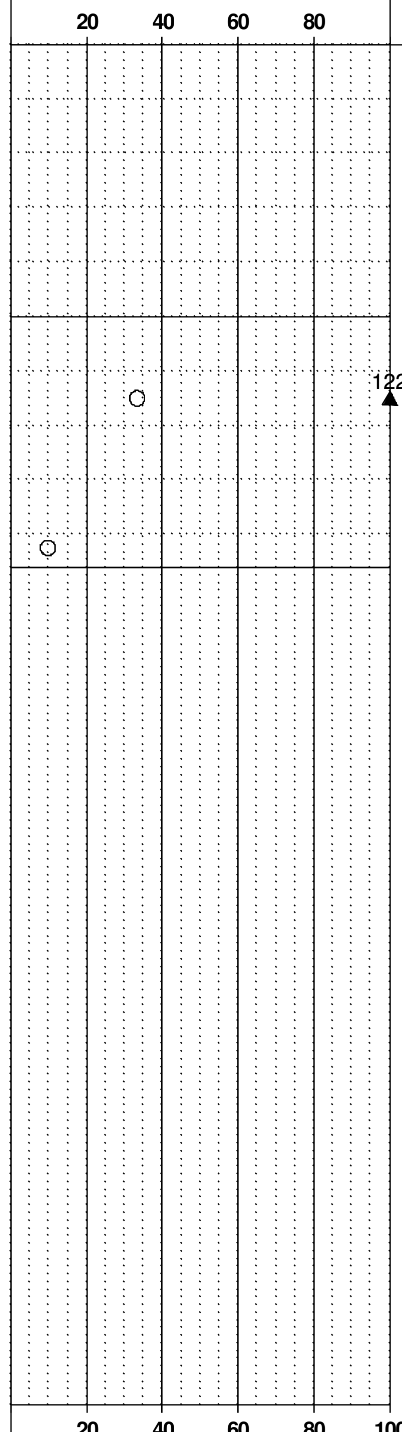
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.02
TOPSOIL (to 0.41)							
Hard to very stiff, brown **SILTY CLAY** (to 1.52)						1	83.02
		G	1				
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulder, (to 1.92)		G	2				
End of Test Pit							

Practical refusal to excavation on inferred bedrock surface at 1.92m depth

(TP dry upon completion)

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425826; 5024040

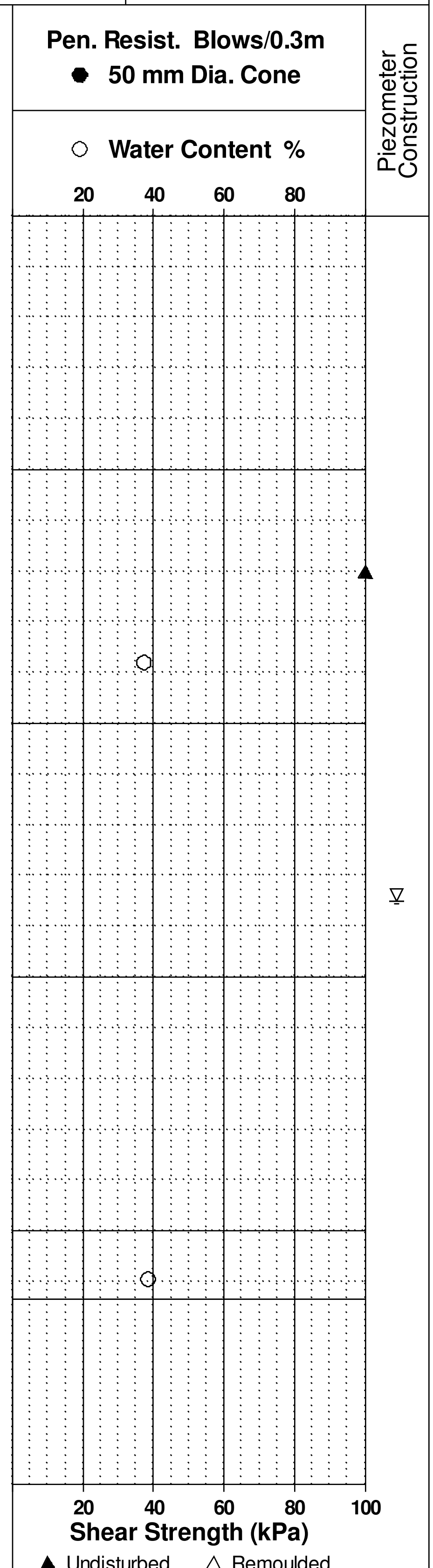
BORINGS BY Hydraulic Excavator

DATE March 21, 2013

FILE NO. PG2878

HOLE NO. TP35

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.99
TOPSOIL							
0.46							
Hard to very stiff, brown **SILTY CLAY**						1	81.99
		G	1				
						2	80.99
						3	79.99
						4	78.99
4.27		G	2				
End of Test Pit Practical refusal to excavation on inferred bedrock surface at 4.27m depth (GWL @ 2.7m depth based on field observations)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Future Development Lands - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS 18T 0425699; 5024001

BORINGS BY Hydraulic Excavator

DATE March 21, 2013

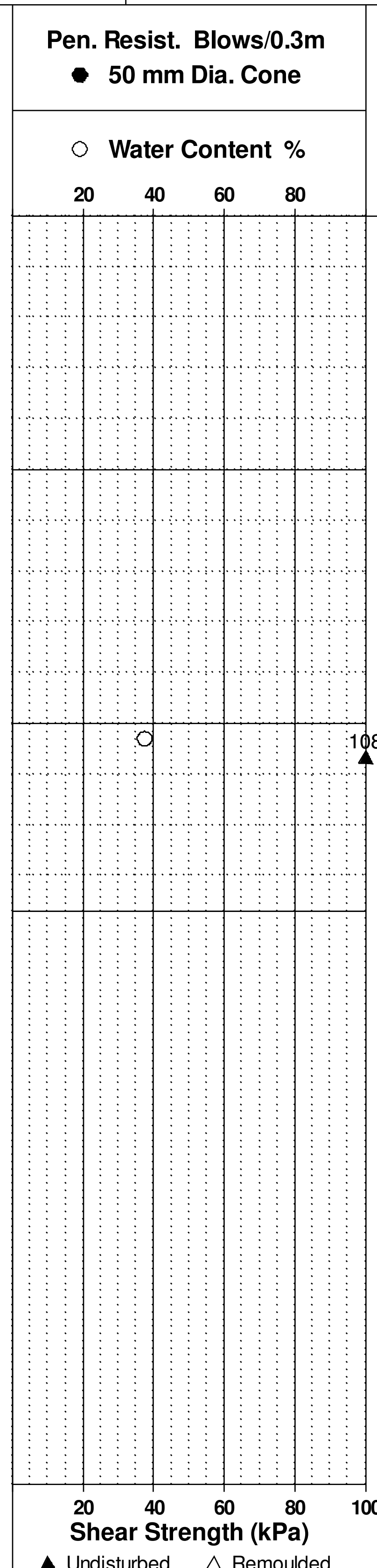
FILE NO. PG2878

HOLE NO. TP36

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.76
TOPSOIL (to 0.41)							
Hard to very stiff, brown **SILTY CLAY** (0.41 to 2.74)						1	83.76
		G	1			2	82.76
End of Test Pit (2.74)							

Practical refusal to excavation on inferred bedrock surface at 2.74m depth

(GWL @ 2.6m depth based on field observations)



Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 1

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.10		
TOPSOIL 0.18									
Brown **SILTY SAND**, trace organic matter 0.55		G	1						
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 0.70									
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 0.70m depth (TP dry upon completion)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 9 Feb 09

FILE NO. PG1823

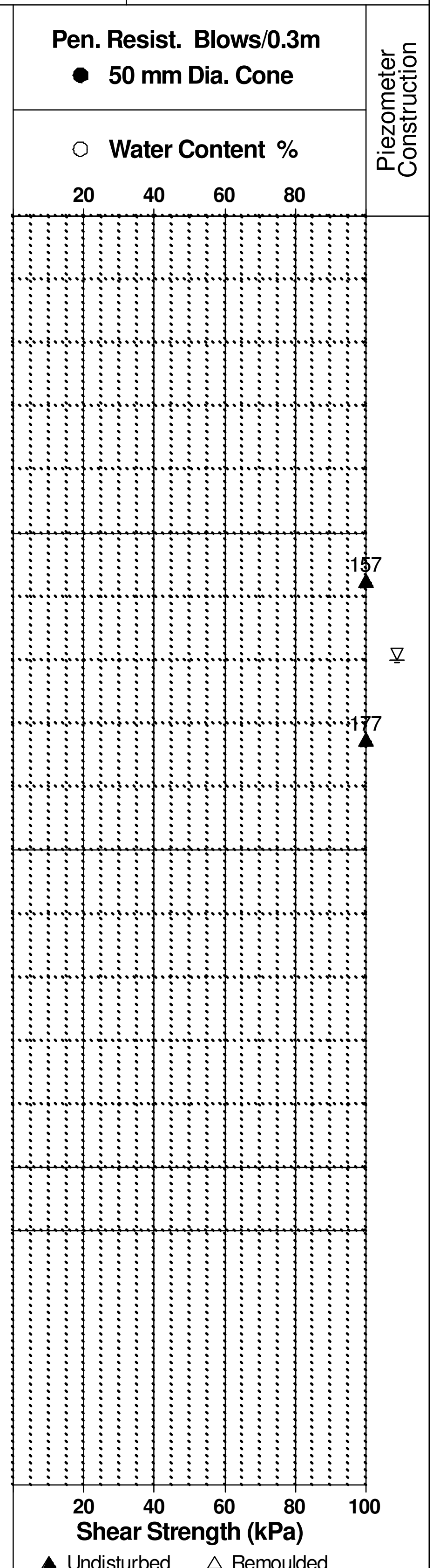
HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.57
TOPSOIL (to 0.25)							
Very stiff, brown **SILTY CLAY** - grey by 0.75m depth		G	1				
		G	2				
						1	87.57
						2	86.57
(to 2.90)							
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders (to 3.20)						3	85.57
End of Test Pit							

End of Test Pit

Practical refusal to excavation on inferred bedrock surface @ 3.20m depth

(Open hole GWL @ 1.4m depth)



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 3

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	85.48		
TOPSOIL (to 0.18)									
Brown SILTY CLAY (0.18 to 0.47)		G	1						
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders (0.47 to 1.90)		G	2			1	84.48		
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.90m depth (TP dry upon completion)									

Water Content % axis: 20, 40, 60, 80

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 4

BORINGS BY Hydraulic Shovel

DATE 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	88.13		
TOPSOIL — 0.20									
Brown **SILTY SAND** — 0.50		G	1						
GLACIAL TILL: Grey clayey silt, some gravel, trace sand, cobbles and boulders — 1.40		G	2			1	87.13		
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.40m depth (TP dry upon completion)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 5

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.50		
TOPSOIL 0.26									
Brown **SANDY SILT**, trace gravel 0.80		G	1						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders 1.15		G	2			1	87.50		
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.15m depth (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 6

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.10		
TOPSOIL (0.25)									
Brown **SILTY CLAY** (0.85)		G	1						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders (2.20)		G	2			1	88.10		
						2	87.10		
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 2.20m depth (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

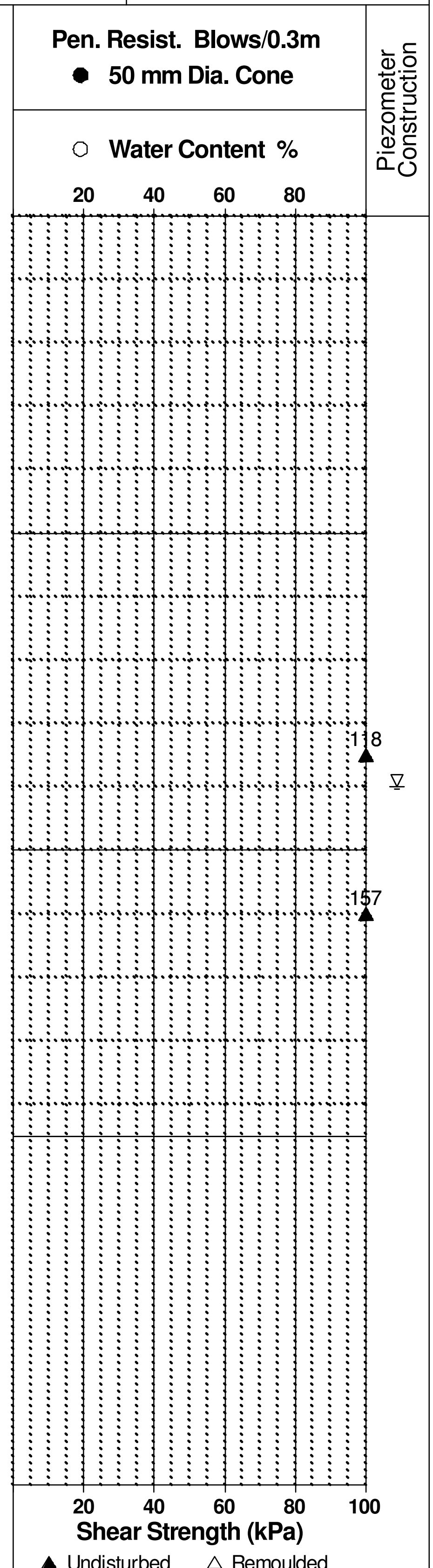
FILE NO. PG1823

REMARKS

HOLE NO. TP 7

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.06
TOPSOIL 0.20							
		G	1				
						1	87.06
Very stiff, brown **SILTY CLAY** - grey-brown by 1.4m depth		G	2				
						2	86.06
2.60							
GLACIAL TILL: Grey-brown silty sand with clay, gravel, cobbles and boulders		G	3				
2.90							
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 2.90m depth (Open hole GWL @ 1.8m depth)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP 8

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.86		
TOPSOIL (to 0.25)									
Brown **SANDY SILT**, trace organic matter (to 0.60)		G	1						
Brown **SILTY CLAY** (to 1.40)		G	2			1	88.86		∇
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.40m depth (Open hole GWL @ 1.1m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 9 Feb 09

FILE NO. PG1823

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.42
TOPSOIL (0.20)							
Brown **SILTY CLAY** (1.30)		G	1			1	90.42
GLACIAL TILL: Grey-brown clayey silt with gravel, cobbles and boulders, trace sand (2.30)		G	2			2	89.42
End of Test Pit							

Practical refusal to excavation on inferred bedrock surface @ 2.30m depth

(Open hole GWL @ 1.9m 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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP10

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.76
TOPSOIL	0.20						
Brown **SANDY SILT**, some organic matter	0.70	G	1				
GLACAIL TILL: Grey silty sand with gravel, cobbles and boulders	2.90	G	2			1	89.76
		G	3			2	88.76
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 2.90m depth (Open hole GWL @ 2.5m depth)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP11

BORINGS BY Hydraulic Shovel **DATE** 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	90.22		
TOPSOIL 0.25									
Brown SILTY SAND, some organic matter 0.90		G	1						
GLACIAL TILL: Grey-brown silty sand with clay and gravel 1.20		G	2			1	89.22		∇
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.20m depth (Open hole GWL @ 1.0m depth)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG1823

REMARKS

HOLE NO. TP12

BORINGS BY Hydraulic Shovel

DATE 9 Feb 09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	89.26		
TOPSOIL — 0.20									
Brown **SILTY SAND** — 1.00						1	88.26		
GLACIAL TILL: Grey silty sand with clay and gravel — 1.60									
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.60m depth (TP dry upon completion)									

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Hydraulic Shovel

DATE July 9, 2008

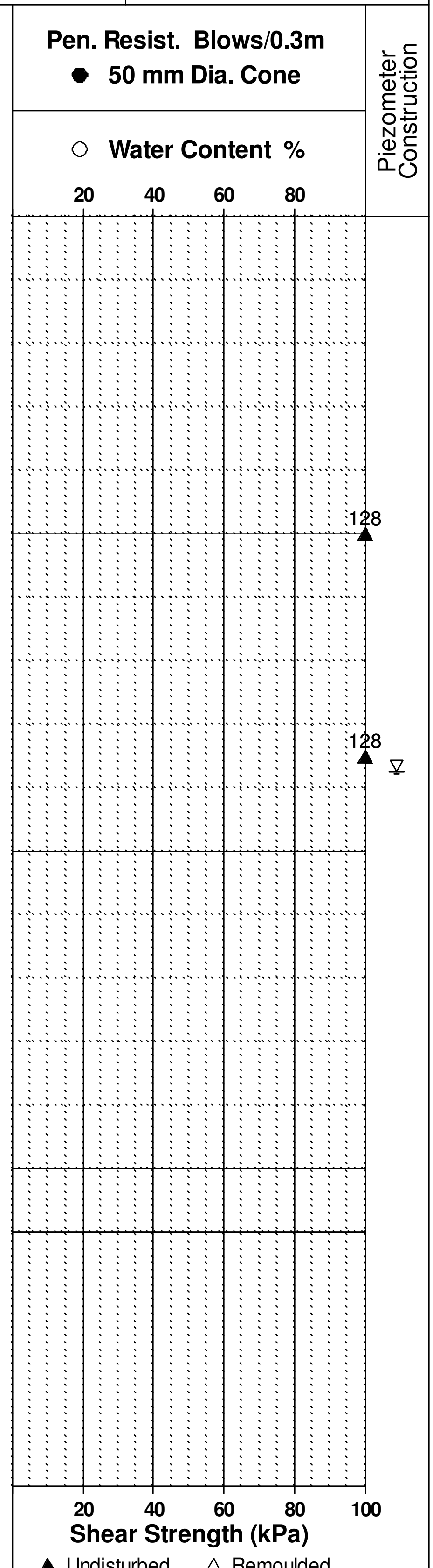
FILE NO. PG1716

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.70
TOPSOIL (to 0.25)							
Very stiff, brown **SILTY CLAY** - grey by 0.5m depth (0.25 to 2.10)						1	80.70
						2	79.70
GLACIAL TILL: Compact to dense grey silty clay, trace sand and gravel (2.10 to 3.20)		G	1			3	78.70
End of Test Pit (3.20)							

Practical refusal to excavation @ 3.20m depth

(Open hole WL @ 1.75m depth)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	83.10		
TOPSOIL (to 0.40)	■	G	1						
End of Test Pit Practical refusal to excavation @ 0.40m depth									

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
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	83.80		
TOPSOIL 0.25									
Hard, brown **SILTY CLAY** 1.10		G	1			1	82.80	▲ 128	
GLACIAL TILL: Dense brown silty clay, trace gravel and cobbles 1.80		G	2						▽
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.80m depth (Open hole WL @ 1.75m depth)									

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
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

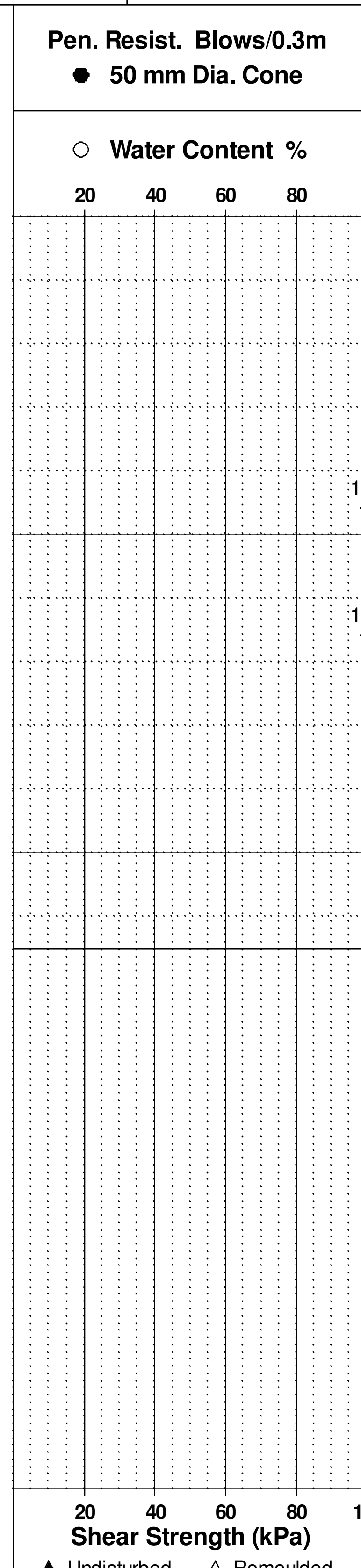
BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.20
TOPSOIL (to 0.30)							
Hard, brown **SILTY CLAY** (0.30 to 1.55)						1	85.20
GLACIAL TILL: Brown-grey silty clay, some sand and cobbles (1.55 to 2.30)		G	1			2	84.20
End of Test Pit Practical refusal to excavation @ 2.30m depth (Open hole WL @ 1.2m depth)							



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.80
TOPSOIL 0.23							
Very stiff, brown **SILTY CLAY** 1.60		G	1			1	85.80
GLACIAL TILL: Compact to dense grey-brown silty clay, some gravel and cobbles 2.50		G	2			2	84.80

End of Test Pit

Practical refusal to excavation @ 2.50m depth

(Open hole WL @ 1.1m 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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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

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 % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	90.70		
TOPSOIL 0.30									
End of Test Pit Practical refusal to excavation on bedrock surface @ 0.30m depth									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

FILE NO. PG1716

HOLE NO. TP 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	89.40		
TOPSOIL 0.15									
GLACIAL TILL: Silty sand with gravel, cobbles and boulders 0.54									
BEDROCK: Weathered limestone 1.35						1	88.40		
End of Test Pit (TP dry upon completion)									

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

FILE NO. PG1716

HOLE NO. TP 8

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									
Bedrock at surface						0	88.80		

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Hydraulic Shovel

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) / Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	81.90		
TOPSOIL (to 0.30)									
Very stiff, grey-brown **SILTY CLAY** (0.30 to 1.60)		G	1			1	80.90	128 ▲ (Undisturbed)	
								128 ▲ (Undisturbed)	▽
GLACIAL TILL: Compact to dense brown-grey silty clay, trace gravel, cobbles and boulders (1.60 to 2.60)						2	79.90		
End of Test Pit (2.60)		G	2						

End of Test Pit

Practical refusal to excavation @ 2.60m depth

(Open hole WL @ 1.5m depth)

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %; Scale: 20, 40, 60, 80, 100

Shear Strength (kPa): ▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

HOLE NO. TP10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	88.40		
TOPSOIL — 0.35									
Very stiff, brown **SILTY CLAY** — 1.60						1	87.40	▲ 128; ▲ 128	
GLACIAL TILL: Brown-grey silty clay, some gravel and cobbles — 2.70						2	86.40		∇
End of Test Pit									
Practical refusal to excavation @ 2.70m depth									
(Open hole WL @ 2.65m depth)									

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

REMARKS

BORINGS BY Rubber Tired Backhoe

DATE July 9, 2008

FILE NO. PG1716

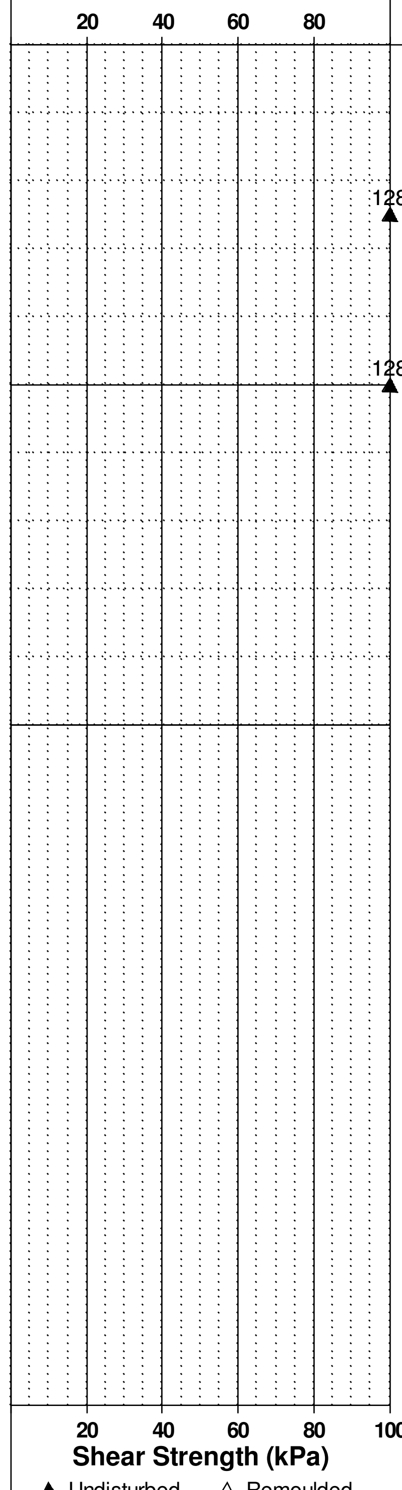
HOLE NO. TP11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.50
TOPSOIL 0.25							
Very stiff, brown **SILTY CLAY** 1.20						1	88.50
GLACIAL TILL: Dense brown-grey silty clay, trace gravel and cobbles - boulders at 1.7m 2.00						2	87.50
End of Test Pit Practical refusal to excavation @ 2.00m depth (TP dry upon completion)							

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

○ Water Content %

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 strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

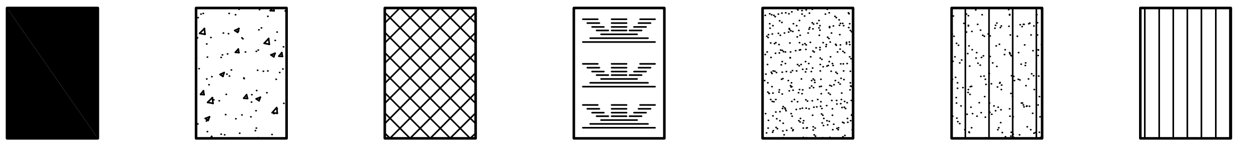
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

PERMEABILITY TEST

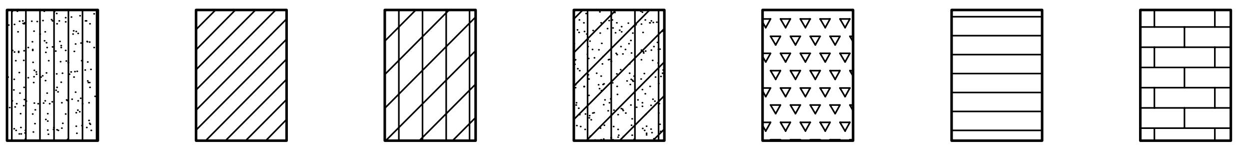
k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during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

SYMBOLS AND TERMS (continued)

STRATA PLOT



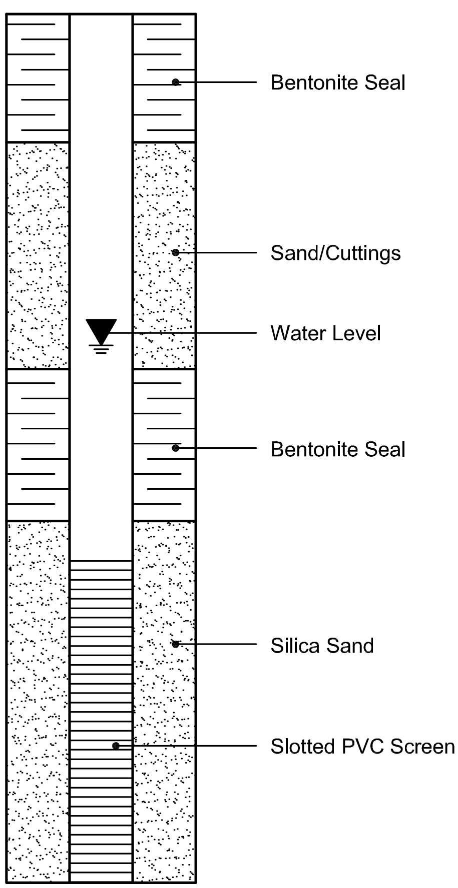
Topsoil | Asphalt | Fill | Peat | Sand | Silty Sand | Silt



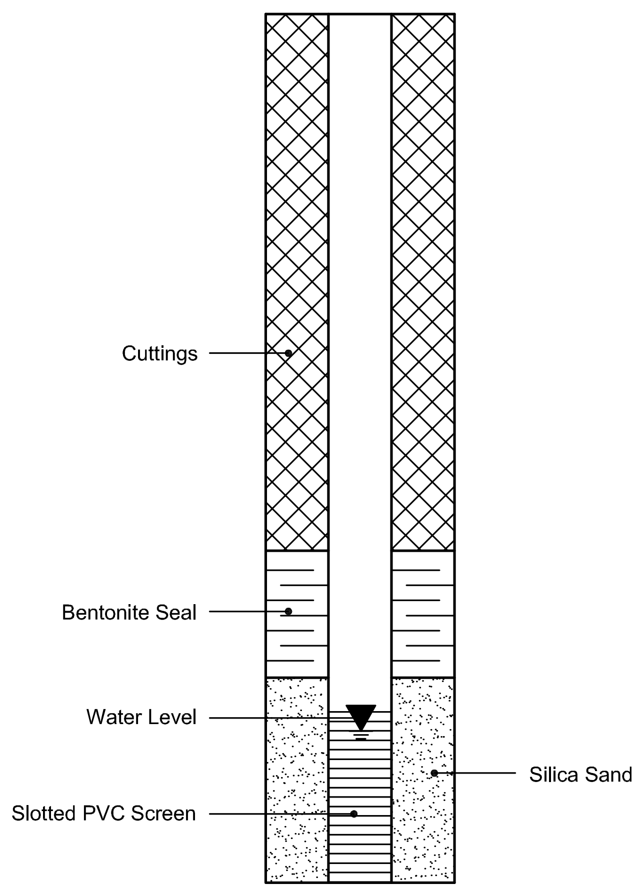
Sandy Silt | Clay | Silty Clay | Clayey Silty Sand | Glacial Till | Shale | Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 22658

Report Date: 01-Nov-2017

Order Date: 26-Oct-2017

Project Description: PG4258

	Client ID:	BH2-SS4	-	-	-
	Sample Date:	20-Oct-17	-	-	-
	Sample ID:	1743469-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	86.5	-	-	-
General Inorganics					
pH	0.05 pH Units	7.90	-	-	-
Resistivity	0.10 Ohm.m	67.8	-	-	-
Anions					
Chloride	5 ug/g dry	9	-	-	-
Sulphate	5 ug/g dry	16	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG4258-1 - TEST HOLE LOCATION PLAN

DRAWING PG4258-2 - PERMISSIBLE GRADE RAISE PLAN

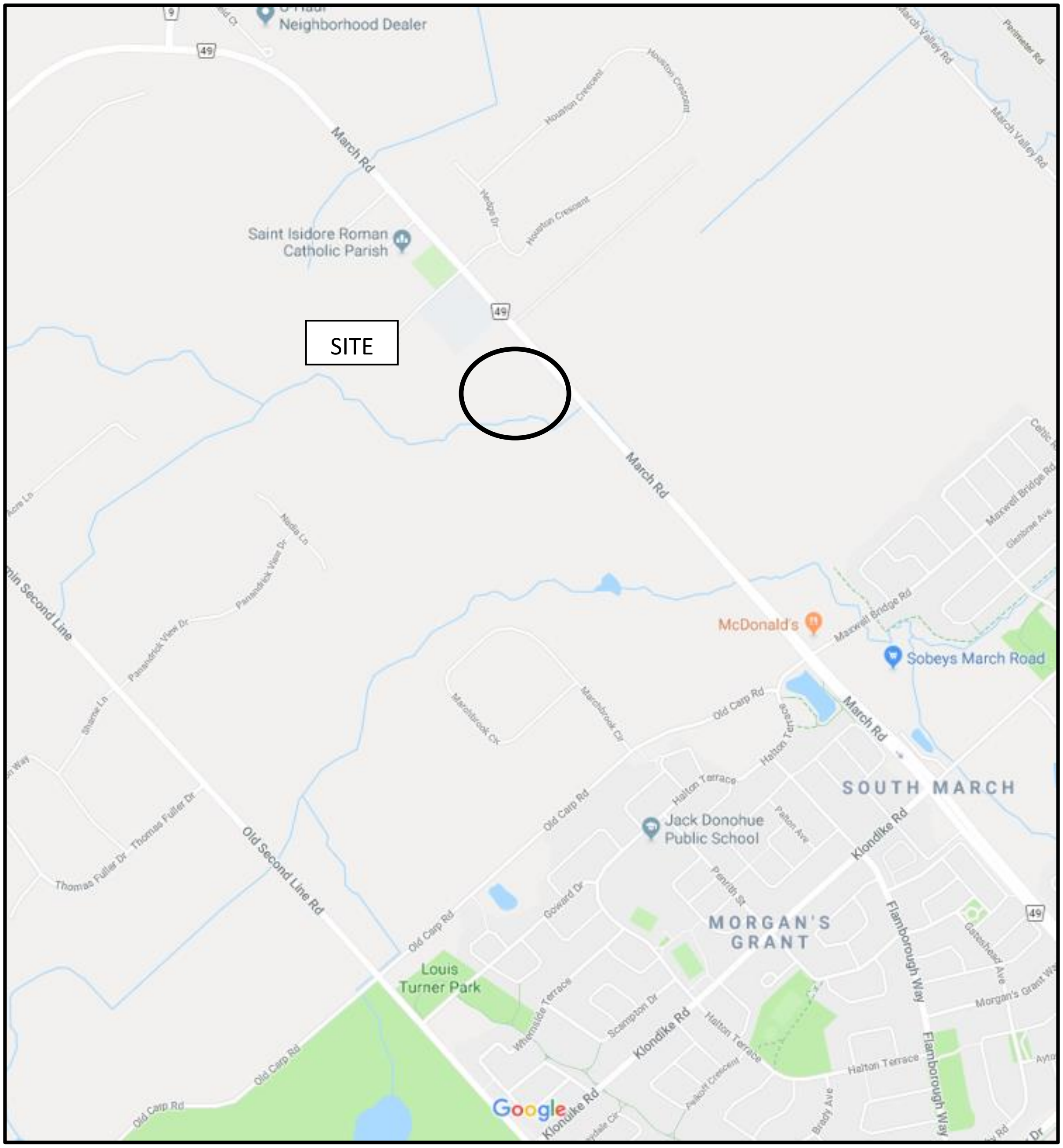
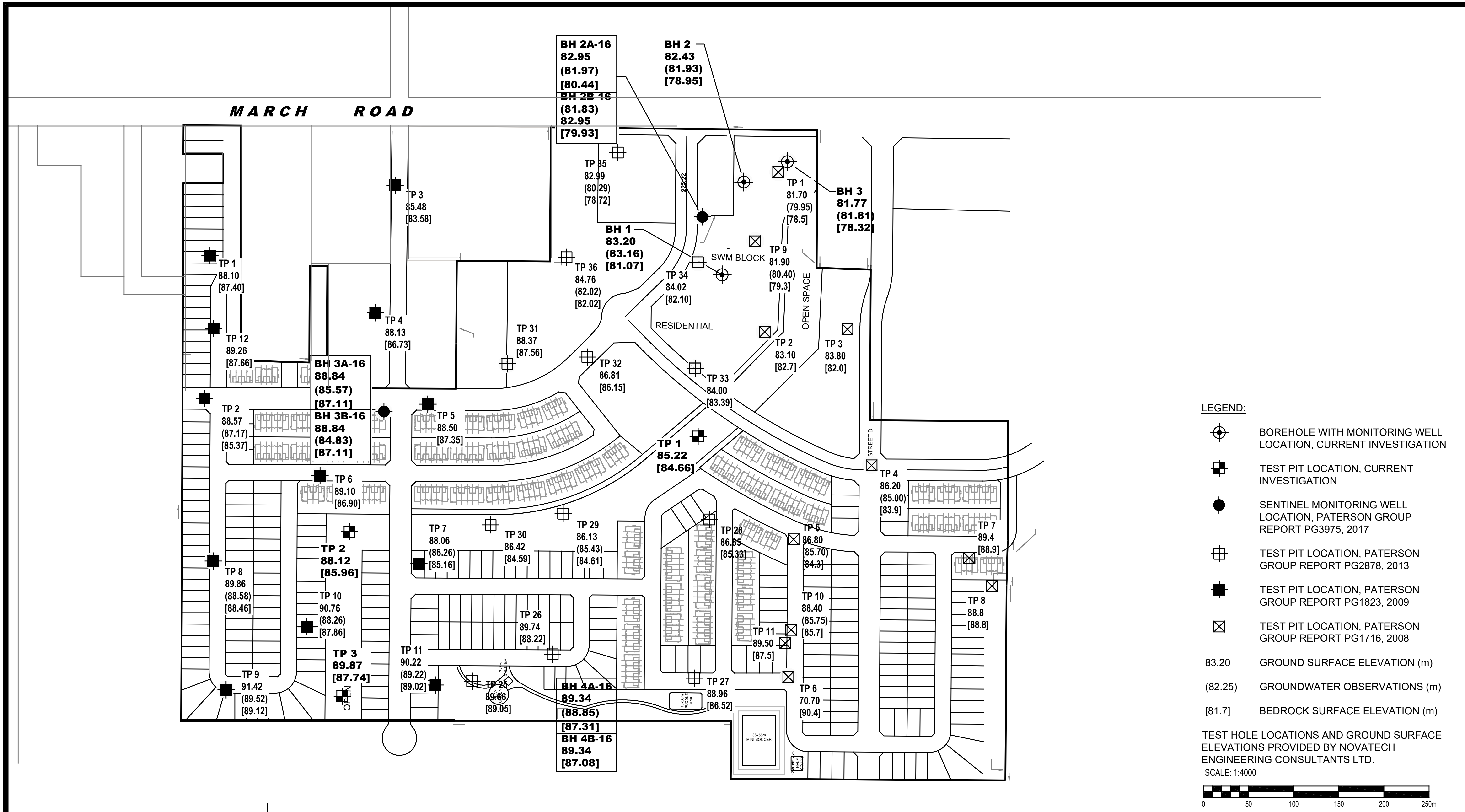


FIGURE 1

KEY PLAN

patersongroup



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL
3	UPDATED BASE PLAN	2/05/2019	JV
2	SENTINEL MONITORING WELLS ADDED	23/05/2018	RG
1	TEST PITS FROM PREVIOUS INVESTIGATIONS ADDED	19/02/2018	RG

NOVATECH ENGINEERING CONSULTANTS LIMITED
GEOTECHNICAL INVESTIGATION
PROP. STORMWATER MANAGEMENT FACILITY - MARCH ROAD
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:4000	Date: 11/2017
Drawn by: MPG	Report No.: PG4258-1
Checked by: NZ	Dwg. No.: PG4258-1
Approved by: DJG	Revision No.: 2

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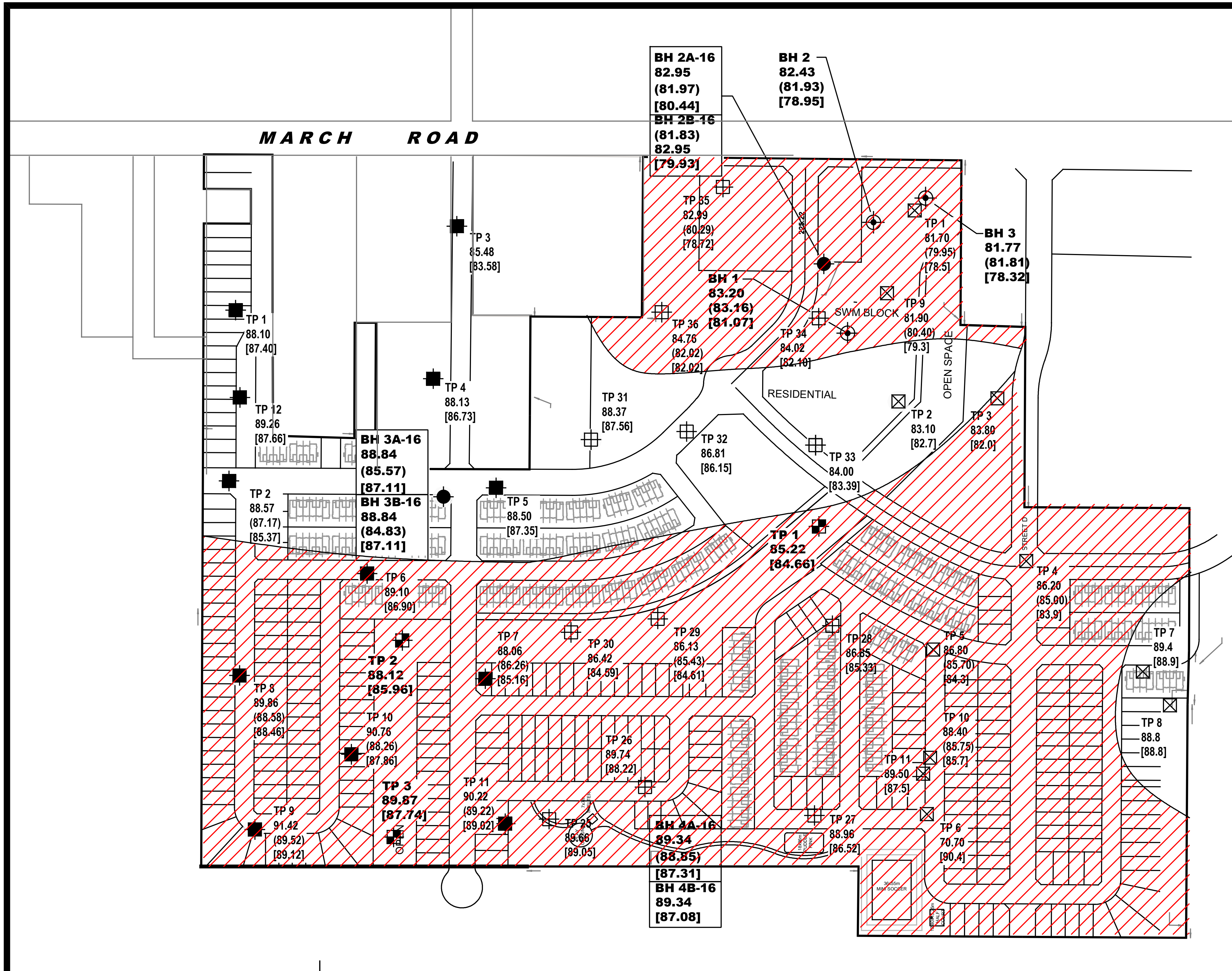

PERMISSIBLE GRADE RAISE:

UP TO 2.0m

LEGEND:

- BOREHOLE WITH MONITORING WELL LOCATION, CURRENT INVESTIGATION
- TEST PIT LOCATION, CURRENT INVESTIGATION
- SENTINEL MONITORING WELL LOCATION, PATERSON GROUP REPORT PG3975, 2017
- TEST PIT LOCATION, PATERSON GROUP REPORT PG2878, 2013
- TEST PIT LOCATION, PATERSON GROUP REPORT PG1823, 2009
- TEST PIT LOCATION, PATERSON GROUP REPORT PG1716, 2008

83.20 GROUND SURFACE ELEVATION (m)

(82.25) GROUNDWATER OBSERVATIONS (m)

[81.7] BEDROCK SURFACE ELEVATION (m)

TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY NOVATECH ENGINEERING CONSULTANTS LTD.

SCALE: 1:4000

0 50 100 150 200 250m

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154 Colonnade Road South
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NO.	REVISIONS	DATE	INITIAL

NOVATECH ENGINEERING CONSULTANTS LIMITED

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - MARCH ROAD

OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE

Scale: 1:4000	Date: 05/2019
Drawn by: JV	Report No.: PG4258-2
Checked by: DJG	Dwg. No.: PG4258-2
Approved by: DJG	Revision No.: 2