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Geotechnical Engineering

Environmental Engineering

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Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development Richmond Subdivision Ottawa Street, Richmond, Ontario

Prepared For

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Table of Contents

Page

1.0	Introduction 1	
2.0	Proposed Development1	
3.0	Method of Investigation3.1Field Investigation3.2Field Survey3.3Laboratory Testing	
4.0	Observations4.1Surface Conditions44.2Subsurface Profile44.3Groundwater5	
5.0	Discussion5.1Geotechnical Assessment.65.2Site Preparation.65.3Foundation Design85.4Design for Earthquakes.115.5Basement Slab125.6Pavement Structure.12	
6.0	Design and Construction Precautions6.1Foundation Drainage and Backfill146.2Protection of Footings Against Frost Action146.3Excavation Side Slopes146.4Pipe Bedding and Backfill166.5Groundwater Control176.6Winter Construction186.7Landscaping Considerations186.8Slope Stability Analysis20	
7.0	Recommendations 22	•
8.0	Statement of Limitations	;

Appendices

Appendix 1Soil Profile and Test Data Sheets
Boreholes by Others
Symbols and Terms
Atterberg Limits Testing Results
Grain Size Distribution and Hydrometer Testing Results

Appendix 2 Figure 1 - Key Plan Figure 2A to 4B - Slope Stability Analysis Sections Drawing PG4683-1 - Test Hole Location Plan Drawing PG4683-2 - Permissible Grade Raise Plan Drawing PG4683-3 - Tree Planting Setback Recommendations

1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes (Mattamy) to complete a geotechnical investigation for the proposed residential development - Richmond Subdivision to be located along Ottawa Street, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the study is:

- to determine the subsurface soil and groundwater conditions based on available subsoil information and supplemental borehole investigation.
- to provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. Investigating the presence or potential presence of contamination on the proposed development was not part of the scope of work. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on current plans, it is understood that the proposed development will consist of a series of residential dwellings with the associated driveways, local roadways, landscaped areas and parking areas. A community park and a school building are also proposed as part of the subject development. The proposed development is also understood to be municipally serviced.



2.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation was conducted on October 31, 2018. At that time, a total of 8 test pits were advanced to a maximum depth of 3 m or excavation refusal. Previous geotechnical field investigations were completed by others in 2007. During that time, a total of 39 test holes consisting of a combination of test pits and borehole were extended to a maximum depth of 4.5 m. The results of the previous investigations completed by others are discussed in the present report. The locations of the test holes are shown on Drawing PG4683-1 - Test Hole Location Plan included in Appendix 2.

The test pits were completed using a rubber-tired backhoe. All fieldwork was conducted under the full-time supervision of personnel from our geotechnical division under the direction of a senior engineer. The testing procedure consisted of augering to the required depths and at the selected locations sampling the overburden.

Sampling and In Situ Testing

Soil samples from the test pit locations were recovered from the test pit sidewalls at selected intervals. All soil samples were initially classified on site and placed in sealed plastic bags and transported to our laboratory. The depths at which the grab samples were recovered from the test pits are shown as, G on the Soil Profile and Test Data sheets presented in Appendix 1.

Undrained shear strength testing in test pits was completed using a handheld, portable vane apparatus (field inspection vane tester Roctest Model H-60).

All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for visual inspection.

The subsurface conditions observed at the test pits were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets and Borehole/test pit Logs by Others in Appendix 1.

3.2 Field Survey

The borehole locations were determined by Paterson personnel taking into consideration the presence of underground and aboveground services. The location and ground surface elevation at each borehole location were provided by Annis O'Sullivan Vollebekk (AOV). It is understood that the elevations were referenced to a geodetic datum. The test hole locations and ground surface elevations at the test hole locations are presented on Drawing PG4683-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging.

A total of 5 atterberg limit tests were completed on selected soil samples. The results are presented under Subsection 4.2. In addition, 3 soil samples were submitted for grain size distribution analysis. The results of our testing are presented in Subsection 4.2 and on Grain Size Distribution sheets in Appendix 1.

It should be noted that a cone penetration testing (CPT) and grain size distribution and hydrometer analysis completed by others are also attached in Appendix 1.

4.0 Observations

4.1 Surface Conditions

Generally, the subject site consists of agricultural lands and lands formerly used for agricultural purposes. The ground surface across the subject site slopes down towards the north with a difference in elevation up to 8 m. Ottawa Street cuts the site within the central portion while Jock River borders the site along the south property line with an average slope of 8H:1V. Tree lines were observed around the perimeter of the site.

The site is bordered to the east by a residential development, to the south by the Jock River, to the north and west by agricultural lands.

4.2 Subsurface Profile

Overburden Profile

South and Central Portion

Generally, the subsurface profile encountered at the test hole locations within the south and central portions of the site mainly consists of topsoil overlying a compact to dense sandy silt deposit. Glacial till was encountered below the above noted layers consisting of sandy silt with gravel and varying amounts of cobbles and boulders. Shallow bedrock was encountered in the majority of the test pits within the south portion below a cultivated organic zone/topsoil and/or sandy silt deposit.

North Portion

Generally, the subsurface profile at the test hole locations within the north portion of the site consists of topsoil overlying a stiff brown silty clay to clayey silt deposit. The silty clay layer is underlain by a layer of compact to dense sandy silt. Glacial till was encountered below the above noted layers consisting of compact to dense brown sandy silt mixed with varying amounts of gravel, cobbles and boulders. Bedrock was encountered below a number of the test pit locations within the north portion of the site.

Atterberg Limit Tests

Atterberg limit testing of 5 samples was completed. The Plasticity Index of the underlying silty clay was measured to range from 8 to 31. The results of the atterberg limit testing on select silty clay samples are presented in Appendix 1.

Grain Size Distribution Tests

Three (3) sieve analyses were completed for the current investigation by this firm and 5 in the previous investigation by others to classify selected soil samples according to the Unified Soil Classification System (USCS). The results are presented in Appendix 1.

Bedrock

Based on available geological mapping, the bedrock in this area mostly consists of Dolomite of the Oxford formation with an overburden drift thickness of 1 to 10 m depth.

4.3 Groundwater

Based on the groundwater observations within the open holes and groundwater measurements completed by others, groundwater was encountered between 2 to 3 m below existing grade. Long-term groundwater conditions can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, it is estimated that long-term groundwater level can be expected between 3 to 4 m depth. Groundwater levels are subject to seasonal fluctuations and therefore could vary during time of construction. The groundwater conditions observed at the test pits were recorded in detail in the field. Our groundwater observations are presented in the Soil Profile and Test Data sheets in Appendix 1.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed development. Bedrock removal may require line drilling and blasting or hoe ramming depending on the depth of bedrock removal required. Due to the presence of the silty clay layer within the north portion of the site, residential buildings should be designed in accordance with Part 4 of the current Ontario Building Code (OBC). Also, due to the silty clay deposit within the north portion of the site, the proposed development will be subjected to grade raise restrictions.

Permissible grade raise recommendations have been designed for the north portion of the subject site. The recommended permissible grade raise areas are presented in Drawing PG4683-2 - Permissible Grade Raise Plan in Appendix 2. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

Due to the presence of the Jock River bordering the south portion of the site, a slope stability analysis has been completed to identify the appropriate limit of hazard lands setback as per the Ottawa Guidelines .

Municipal services are anticipated within the subject site and will generally be completed through OHSA Type 2 and 3 soils.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Due to the relatively shallow depth of the bedrock surface within the south portion of the site and the anticipated founding level for the proposed buildings, bedrock removal may be required.



Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming.

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

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

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

Excavation side slopes in sound bedrock can be excavated almost vertical side walls. A minimum 1 m horizontal ledge, should remain between the overburden excavation and the bedrock surface. The ledge will provide an area to allow for potential sloughing or a stable base for the overburden shoring system.

Vibration Considerations

Construction operations are 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: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to 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). The guidelines are for current construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II material. 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 buildings 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. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If excavated stiff brown silty clay, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the silty clay, under dry conditions, 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 Foundation Design

Bearing Resistance Values

Conventional style shallow footings for buildings can be designed using the bearing resistance values presented in Table 1. A geotechnical resistance factor of 0.5 was applied to the bearing resistance values at ULS.

Table 1 - Bearing Resistance Values											
Bearing Surface	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)									
Undisturbed, Compact Sandy Silt	80	150									
Undisturbed, Stiff Silty Clay/Clayey Silt	125	180									
Undisturbed, Compact Glacial Till	150	250									
Clean, Surface Sounded Bedrock - 500											
Note: Pad footings, up to 3 m wide, and strip footings, up to 2 m wide, can be designed using the											

Note: Pad footings, up to 3 m wide, and strip footings, up to 2 m wide, can be designed using the above noted bearing resistance values placed over an undisturbed, silty clay bearing surface.

The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one 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 bearing resistance values at SLS for shallow footing bearing on the abovenoted soils will be subjected to potential post-construction total and differential settlements of 25 and 15 mm, respectively.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer. Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also, at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the subexcavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.



Settlement/Grade Raise

Based on the undrained shear strength testing results, consolidation testing and experience with the local silty clay deposit. The recommended permissible grade raise areas for buildings within the north portion of the site is 2 m above existing grade and are defined in Drawing PG4683-2 - Permissible Grade Raise Plan in Appendix 2.

Where proposed grade raises exceed our permissible grade raise recommendations, several options could be considered for the foundation support of the proposed buildings:

Scenario A

Where the grade raise is close to, but below, the maximum permissible grade raise, consideration should be given to using more reinforcement in the design of the foundation (footings and walls) to reduce the risks of cracking in the concrete foundation. The use of control joints within the brick work between the garage and basement area should also be considered.

Scenario B

Where the grade raise cannot be accommodated with soil fill, the following options could be used alone or in combination.

Option 1 - Use of Lightweight Fill

Lightweight fill (LWF) can be used, consisting of EPS (expanded polystyrene) Type 19 or 22 blocks or other light weight materials which allow for raising the grade without adding a significant load to the underlying soils. However, these materials are expensive and, in the case of the EPS, are more difficult to use under the groundwater level, as they are buoyant, and must be protected against potential hydrocarbon spills. Use lightweight fill within the interior of the garage and porch areas to reduce the fill-related loads.



Option 2 - Preloading or Surcharging

It is possible to preload or surcharge the proposed site in localized areas provided sufficient time is available to achieve the desired settlements based on theoretical values from the settlement analysis. If this option is considered, a monitoring program using settlement plates will have to be implemented. This program will determine the amount of settlement in the preloaded or surcharged areas. Obviously, preloading to proposed finished grades will allow for consolidation of the underlying clays over a longer time period. Surcharging the site with additional fill above the proposed finished grade will add additional load to the underlying clays accelerating the consolidation process and allowing for accelerated settlements. Once the desired settlements are achieved, the site can be unloaded and the fill can be used elsewhere on site.

Once the required grade raises are established, the above options could be further discussed along with further recommendations on specific requirements.

5.4 Design for Earthquakes

For the south portion, the site class for seismic site response can be taken as **Class C** for the foundations bearing on a compact to dense glacial till and/or bedrock within the north portion of the subject site. A higher site class, such as Class A or B, is applicable for footings bearing on the bedrock surface. However, a site specific seismic shear wave test will be required to confirm the Class A or B seismic site classification.

For the north portion of the site, the bedrock depths do not exceed 5 m below existing grade. Assuming a conservative shear wave velocity of 200 m/s for all overburden, and a conservative shear wave velocity of 1,500 m/s for the bedrock, the average shear wave velocity pf the upper 30 m profile , Vs30, is estimated to be well above **360 m/s** throughout the north portion of the site. Therefore, the site class for seismic site response can be taken as **Class C** for the foundations within the north portion of the site.

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 fill, containing deleterious or organic materials, the native soil will be considered to be an acceptable subgrade surface on which to commence backfilling for basement floor slab or slab on grade construction. 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.

It is recommended that the upper 200 mm of sub-floor fill for basement slab construction consist of 19 mm clear crushed stone. All backfill materials 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

For design purposes, the pavement structure presented in the following tables is recommended for the design of the proposed pavement structures.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas/Driveways											
Thickness (mm)	Material Description										
50	Wear Course - HL-3 or Superpave 12.5 Asphaltic Concrete										
150	BASE - OPSS Granular A Crushed Stone										
300	SUBBASE - OPSS Granular B Type II										
- SUBGRADE - Either i - Minimum Performanc	- SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil										

Table 3 - Recommended Pavement Structure - Local Roadways										
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	400 SUBBASE - OPSS Granular B Type II									
- SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil										

Table 4 - Recommended Pavement Structure - Arterial Roadways with Bus Traffic										
Thickness (mm)	Material Description									
40	Wear Course - HL-3 or Superpave 12.5 Asphaltic Concrete									
50	Upper Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete									
50	Lower Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete									
150	BASE - OPSS Granular A Crushed Stone									
550	SUBBASE - OPSS Granular B Type II									
- SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil - Minimum Performance Graded (PG) 64-34 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 I or II material.

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.

Pavement Structure Drainage (North Portion)

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

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 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

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

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 equivalent) 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 a combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be 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 excavations 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 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.

Excavation Base Stability

The base of supported excavations can fail by three (3) general modes:

- Shear failure within the ground caused by inadequate resistance to loads imposed by grade difference inside and outside of the excavation,
- D Piping from water seepage through granular soils, and
- □ Heave of layered soils due to water pressures confined by intervening low permeability soils.

Shear failure of excavation bases is typically rare in granular soils if adequate lateral support is provided. Inadequate dewatering can cause instability in excavations made through granular or layered soils. The potential for base heave in cohesive soils should be determined for stability of flexible retaining systems.

The factor of safety with respect to base heave, FS_b, is:

$$FS_b = N_b s_u / \sigma_z$$

where:

 $N_{\rm b}$ - stability factor dependent upon the geometry of the excavation and given in Figure 1 on the following page.

s_u - undrained shear strength of the soil below the base level

 $\sigma_{\!z}$ - total overburden and surcharge pressures at the bottom of the excavation





Figure 1 - Stability Factor for Various Geometries of Cut

In the case of soft to firm clays, a factor of safety of 2 is recommended for base stability.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water 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 SPMDD.

Generally, it should be possible to re-use the moist, not wet, silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used.

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.

To reduce long-term lowering of the groundwater level at the north side of site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Although, permeable sandy silt deposit covers the majority of the site, the groundwater level was estimated between 3 to 4 m depth. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium...

Permit to Take Water

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

For typical ground or surface water volumes, being pumped during the construction phase, 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.

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.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

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

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

6.7 Landscaping Considerations

Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations within the north portion of the subject site. Sieve analysis testing was also completed on selected soil samples. The abovenoted soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Appendix 1.

Based on the results of our review, the two tree planting setback areas are present within the proposed development. The two areas are detailed below and have been outlined in Drawing PG4683-3 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - Silty Sand to Sandy Silt Areas

No tree planting setback from foundation restrictions are required for the subject site due to the absence of a silty clay deposit within the future location of the proposed residential development (west portion of site).

Area 2 - Low to Medium Sensitivity Area

A low to medium sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below preliminary finished grade as per City Guidelines at the areas outlined in Drawing PG4683-3 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the modified plasticity limit does not exceed 40% in these areas. The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met.

Aboveground Swimming Pools, Hot Tubs, Decks and Additions

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations within the north portion of the site. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer's requirements.

Additional grading around the hot tub should not exceed permissible grade raises within the north portion of the site. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications.

Additional grading around proposed deck or addition should not exceed permissible grade raises along the north portion of the site. Otherwise, standard construction practices are considered acceptable.

6.8 Slope Stability Analysis

Slope Conditions

Based on our field observations and available topographic mapping, the subject slopes in the vicinity of the watercourse at the southeast end of the site are stable with no signs of active erosion and are sloped at 8H:1V slope or less. Test pits in close proximity to the existing slopes were analyzed to determine the subsurface soil conditions for our analysis.

Slope Stability Analysis

The slope stability analysis was modeled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop's method, which is a widely accepted slope analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the slope failure would comprise permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

Three (3) slope cross-sections (Sections A, B, C) were studied as the worst case scenarios. The cross section locations are presented on Drawing PG4683-1 - Test Hole Location Plan in Appendix 2. It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 2A through 4B in Appendix 2 from the topographic data identified on Drawing PG4683-1 - Test Hole Location Plan in Appendix 2.

Stable Slope Allowance

The static analysis results for slope sections A, B, and are presented in Figures 2A, 3A, and 4A, respectively, provided in Appendix 2. The factor of safety for the slopes was greater than 1.5 for the slope sections analysed.

The results of the analyses with seismic loading are shown in Figures 2B, 3B, and 4B presented in Appendix 2. The results indicate that the factor of safety for the sections are greater than 1.1. Based on these results, the slopes are considered to be stable under seismic loading.

As the slopes were determined to be stable under static and seismic conditions for the sections analyzed, a stable slope allowance is not required.

Toe Erosion and Erosion Access Allowance

The slopes were generally observed to be vegetated with trees and brush. Further, flow from the creek in the watercourse at the base of the slopes was observed to be minimal, with no signs of significant active erosion observed at the toe of the slopes. Nonetheless, a conservative toe erosion allowance of 5 m was utilized.

A 6 m erosion access allowance is recommended to be applied from the top of stable slope for the slopes to allow for future maintenance of the slope.

Limit of Hazard Lands

Limit of hazard lands are not required for this site as the combined setback of the toe erosion and erosion access allowances do not extend beyond the limits of the flood zone. Therefore, the proposed limit of development is not limited by the slope stability.

It is recommended that the existing vegetation and mature trees not be removed from the slope faces as the presence of the vegetation reduces surficial erosion activities. If the existing vegetation needs to be removed along the slope faces, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed or an erosional control blanket be placed across the exposed slope face.

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

- Grading plan review for the north portion of the site from a geotechnical perspective, once the final grading plan is available.
- 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.
- **G** 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 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 Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's 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. 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, Paterson requests to be notified immediately in order to permit reassessment of the 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 Mattamy Homes 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.

Faisal I. Abou-Seido, P.Eng

Report Distribution:

- Mattamy Homes (3 copies)
- Paterson Group (1 copy)



David J. Gilbert, P.Eng.

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

BOREHOLES BY OTHERS

ATTERBERG LIMITS' TESTING RESULTS

GRAIN SIZE DISTRIBUTION TESTING RESULTS

GRAIN SIZE DISTRIBUTION TESTING AND HYDROMETER TESTING RESULTS - BY OTHERS

CPT TESTING RESULTS BY OTHERS

natoreonar		ır	SOIL PROFILE AND TEST DATA Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario									
154 Colonnade Road South, Ottawa, Ont	ario k	(2E 7J										
DATUM Ground surface elevations	FILE NO.	PG4683										
REMARKS									HOLE NO).		
BORINGS BY Backhoe				DA	TE (31 Octobe	er 2018			IP 1-18		
SOIL DESCRIPTION	PLOT		SAN	NPLE 것	E .	DEPTH (m)	ELEV. (m)	Pen. R • 5	esist. Bl 0 mm Dia	ows/0.3m a. Cone	ter tion	
GBOUND SUBFACE	STRATZ	STRATA TYPE NUMBER % RECOVER						0 V 20	Water Content % 20 40 60 80			
TOPSOIL with organics, some silty		G	1			- 0-	-94.76					
clay0.30		_										
Brown SILTY CLAY to CLAYEY SILT, some sand		G	2					ο				
0.70		G	3					p				
		_ G	4			1-	-93.76	0				
		G	5					φ				
Compact, brown SANDY SILT			_ G	6					O			
						2-	-92.76					
<u>2.80</u>												
GLACIAL TILL: Compact to dense, brown sandy silt, trace gravel, coccasional cobbles, boulders 3.00 End of Test Pit		G	7			3-	-91.76	ο				
(TP dry upon completion)												
								20 Shea ▲ Undist	40 (ar Streng	50 80 10 th (kPa) Remoulded	⊣ 00	

natorsonar		Ir	Con	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario								
154 Colonnade Road South, Ottawa, On	tario I	K2E 7J	Eng									
DATUM Ground surface elevations	s prov	rided b	oy Anr	nis, O'S	Sulliv	an, Vollet	oekk Ltd.		FILE NO	PG4683		
REMARKS									HOLE NO	D		
BORINGS BY Backhoe				DA	ΔTE	31 Octob	er 2018	1		TP 2-18		
SOIL DESCRIPTION	PLOT		SAN	/IPLE		DEPTH (m)	ELEV. (m)	Pen. Re • 5	esist. Bl 0 mm Dia	ows/0.3m a. Cone	er tion	
	STRATA	ТҮРЕ	NUMBER	% RECOVER	N VALUE of RQD		0 W	/ater Co	ntent %	Piezome Construc		
TOPSOIL with organics, some silty		G	1	н 		- 0-	-94.53		40 (
0.20												
Very stiff, brown SILTY CLAY		G	2						0			
Very stiff, light brown CLAYEY SILT to SANDY SILT 1.00		G	3				02.52	O				
		G	4				-93.33	0				
Compact, brown SANDY SILT		G	5					O				
- trace gravel to 1.5m depth		G	6					C				
		G	7			2-	-92.53	O				
2.50		G	8					0				
(TP dry upon completion)												
								20 Shea ▲ Undist	40 0 ar Streng urbed ∠	60 80 1 1th (kPa) ∆ Remoulded	00	

natoreonar	'NI	Ir	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario									
154 Colonnade Road South, Ottawa, C	Intario	K2E 7J										
DATUM Ground surface elevation	ns prov	vided k	oy Ann	iis, O'S	ulliva	an, Vollet	oekk Ltd.		FILI	E NO.	PG4683	
REMARKS									но			
BORINGS BY Backhoe				DA	TE (31 Octob	er 2018			I	P 3-18	
SOIL DESCRIPTION	PLOT		SAM	IPLE 거		DEPTH (m)	ELEV. (m)	Pen. F ● {	lesist 50 mn	. Blows n Dia. C	s/0.3m one	ter tion
	STRATA	ТҮРЕ	NUMBER	% RECOVER	N VALUI or RQD			0 N	Nater	Conter	it %	Piezome
TOPSOIL with organics, some silty		G	1			0-	-94.22		40	00		
0.2	20											-
		G	2						0			-
Very stiff, brown SILTY CLAY												-
		G	3						O			
						1-	-93.22					
1.2	20	G	4						0			
		:										
		G	5						0			
		G	6					0				
Compact, brown SANDY SILT						2-	-92 22					
		: G	7			_	02.22	0				
		•										
27	70	G	8					•				
End of Test Pit		·										
(TP dry upon completion)												
								She	ar Sti	rength (kPa)	00
									lurbed		noulded	

natoreonar		ıır	Cons	sulting	SOIL PROFILE AND TEST DATA								
154 Colonnade Road South, Ottawa, O	ntario	K2E 7J	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario										
DATUM Ground surface elevation	ns prov	vided k	oy Anni	is, 0'8	Sulliv	an, Vollet	oekk Ltd.	FILE NO.	PG4683				
REMARKS								HOLE NO					
BORINGS BY Backhoe				D	ATE	31 Octob	er 2018		IP 4-18				
SOIL DESCRIPTION	PLOT		SAM	PLE		DEPTH (m)	ELEV. (m)	Pen. Resist. Blo ● 50 mm Dia	ws/0.3m . Cone	ter tion			
GROUND SURFACE	STRATA	ТҮРЕ	NUMBER	% RECOVER	N VALU or RQD			 Water Con 20 40 6 	tent %	Piezome			
TOPSOIL with organics some silty		G	1			- 0-	-95.01						
clay	80	_											
0.0													
		G	2					φ					
Compact, brown SANDY SILT, trace clay													
- trace gravel to 0.8m depth		G	3			1-	-94 01	<u>о</u>					
		G	4				0 1.0 1	0					
1 /													
		G	5					φ					
Compact, brown SILTY SAND	70	G	6					O					
End of Test Pit													
Practical refusal to excavation on inferred bedrock surface at 1.70m depth													
(TP dry upon completion)													
								20 40 60 Shear Strengt	D 80 10 h (kPa)	00			
								▲ Undisturbed △	Remoulded				

natoreonar	Con	SOIL PROFILE AND TEST DATA									
154 Colonnade Road South, Ottawa, On	tario ł	(2E 7J	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa. Ontario								
DATUM Ground surface elevations	prov	ided b	y Ann	nis, O'S	ulliva	n, Vollet	oekk Ltd.	FILE NO.			
REMARKS										PG4683	
BORINGS BY Backhoe	1	1		DA	те 3	1 Octobe	er 2018		HOLE NO.	TP 5-18	
SOIL DESCRIPTION	PLOT		SAM	IPLE		DEPTH	ELEV.	Pen. Re ● 50	esist. Blo 0 mm Dia.	ws/0.3m Cone	er on
	STRATA	ТҮРЕ	NUMBER	% RECOVERY	N VALUE or RQD	N VALUE OF ROD		0 W	ater Cont	ent %	Piezomete Constructi
TOPSOIL with organics, trace silty		G	1	н 		0-	-94.70				шU
clay 0.25		_ •									
Compact, brown SANDY SILT to CLAYEY SILT		G	2					0			
		G	3			4	00.70	0			
Compact, brown SANDY SILT		_ G	4			1-	-93.70	0			
- trace gravel from 1.3 to 1.6m depth		G	5					O			
		_ G	6			2-	-92.70	0 			-
2.30 End of Test Pit		G	7					Φ			
(TP dry upon completion)											
								20 Shea ▲ Undistu	40 60 ar Strengtl urbed △	80 1 h (kPa) Remoulded	00

natoreonar		ır	Con	sulting	SOIL PROFILE AND TEST DATA								
154 Colonnade Road South, Ottawa, Ont	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario												
DATUM Ground surface elevations	an, Vollet	oekk Ltd.		FILE N	0. PC/69	22							
REMARKS									HOLE	FG400	<u></u>		
BORINGS BY Backhoe		1		DA	TE	31 Octob	er 2018	1		TP 6-1	B		
SOIL DESCRIPTION	PLOT		SAN			DEPTH	ELEV.	Pen. R	lesist. E 50 mm C	Blows/0.3m Dia. Cone	P D		
	STRATA	ТҮРЕ	NUMBER	* ECOVERY	VALUE	()	• V	Vater Co	ontent %	ezomete onstructi			
GROUND SURFACE			-	RI	zv	- 0-	-94.58	20	40	60 80	Ū Ē		
TOPSOIL with organics, trace silty clay		G	1										
Very stiff, brown SILTY CLAY, trace sand		G	2					0					
0.90		G	3			-	00 50		Ö				
		_ G	4			1-	-93.36	φ					
Compact, brown SANDY SILT		_ G	5					O					
2.00		G	6			2-	-02 59	0					
End of Test Pit						2	92.50						
(TP dry upon completion)													
								20 Shea ▲ Undis	40 ar Stren turbed	60 80 60 kPa) △ Remoulded	100		

natorsonar		ır	Con	sulting	SOIL PROFILE AND TEST DATA								
154 Colonnade Road South, Ottawa, Ont	ario k	(2E 7J	Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario										
DATUM Ground surface elevations	prov	ided b	y Anr	Sulliv	an, Vollek	oekk Ltd.	FILE NO.						
REMARKS													
BORINGS BY Backhoe				D	ATE	31 Octob	er 2018	TP 7-18					
SOIL DESCRIPTION	PLOT		SAN			DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone					
	STRATA	TYPE	NUMBER	% ECOVER1	N VALUE or RQD	N VALUE OF ROD		• Water Content %					
GROUND SURFACE				<u></u>	4	0-	-95.17						
clay		G	1										
Compact, brown SANDY SILT, trace clay		G	2					0					
_ clay content decreasing with depth _{0.60}		-											
		G	3					O					
		G	4			1-	-94.17	O					
Compact, brown SANDY SILT		_ G	5					O					
0.00		_ G	6										
End of Test Pit		_				2-	-93.17						
(TP dry upon completion)													
								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded					

natorsonarounConsulting						SOIL PROFILE AND TEST DATA Geotechnical Investigation Prop. Residential Development - Ottawa Street Ottawa, Ontario				
154 Colonnade Road South, Ottawa, Ontario K2E 7J5				G Pr O						
DATUM Ground surface elevations	prov	ided k	oy Ann	iis, O'S	Sulliv	an, Vollet	oekk Ltd.	FIL	E NO. PG4683	
REMARKS								но	LE NO	
BORINGS BY Backhoe		1		D	ATE	31 Octob	er 2018		TP 8-18	
SOIL DESCRIPTION	РГОТ		SAMPLE			DEPTH (m)	ELEV.	Pen. Resis • 50 mr	en. Resist. Blows/0.3m ● 50 mm Dia. Cone ভু <u>ই</u>	
	STRATA	TYPE	NUMBER	* ECOVER	N VALUE or RQD			• Water	Vater Content %	
GROUND SURFACE				Я	4	0-	94.80	20 40		
TOPSOIL with organics, trace silty sand		G	1							
Compact, brown SANDY SILT, trace clay										-
- clay content decreasing with depth)		G	2					0		-
		G	3			1-	-03 80	0		
		G	4				93.00	0		
Compact, brown SANDY SILT		G	5					ο		
		G	6					φ		
<u>2.00</u>		G	7			2-	-92.80	0		-
(TP dry upon completion)										
								20 40 Shear St ▲ Undisturbed	60 80 1 rength (kPa) d	[⊣] 00

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
SYMBOLS AND TERMS (continued)

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											
Сс	-	Concavity coefficient = $(D30)^2 / (D10 \times D60)$											
Cu	-	Uniformity coefficient = D60 / D10											
Cc and	Cu are	used to assess the grading of sands and gravels:											

Well-graded gravels have: 1 < Cc < 3 and Cu > 4Well-graded sands have: 1 < Cc < 3 and Cu > 4Well-graded sands have: 1 < Cc < 3 and Cu > 6Sands 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)
Сс	-	Compression index (in effect at pressures above p'c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio	D	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 Peat Sand Silty Sand Fill Δ Sandy Silt Clay Silty Clay Clayey Silty Sand Glacial Till Shale Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION









W Jacques W Whitford

TP07-33

1 of 1

attamy Homes ٦.

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		Dense, brown SANDY SILT							ľ					li				1											-
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-		Refusal on Inferred Bedrock	ĺ						1		1							!			Ì.		II.	밁		H		H	ŀ
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	1	¥ Inferred Groundwater Level									F	ler	no	uld	led	Va	me	Τe	est,	kP	a		Ap	p'd					
		Groundwater Level Measured in S	tand	pipe	;					Δ	P	° oc	ke	t P	ene	etro	me	eter	гT	est,	kP	a	Da	te	_				

	Whi	iques tford	T	E:	ST I	PIT	RE	COR	D TP07-34
c	LIENT	Mattamy Homes							BOREHOLE No TP07-34
	OCATION ATES: BC	Proposed Subdivision, Richmon	nd, (TER I	<u>)n</u> Lev	 EL		<u> </u>		PROJECT No 1026929
	Ê					SA	MPLES		UNDRAINED SHEAR STRENGTH - KPa
(m) H) NOI		V PLO	LEVE		2	RY	<u>۳</u> 0	50 100 150 200
DEPT	EVAT	SOIL DESCRIPTION	IRAT/	ATER	ТҮРЕ	UMBE	COVE (mm)	VALL R RQI	WP W WL
	Ē		s.	5		z	RE	żO	DYNAMIC PENETRATION TEST, BLOWS/0.3m * STANDARD PENETRATION TEST, BLOWS/0.3m
- 0 -	<u>99.56</u>	250 mm TOPSOII	.14						10 20 30 40 50 60 70 80 90
-	99.3		1 1		BS	1			
		Stiff, brown lean CLAY (CL)							
-	·				BS	2			
- 1									
				¥					
_					BS	3			
-									
-	97.6								
- 2 -		Dense, brown to grey SANDY							
		SILT (ML)			BS	4			
-					BS	5			
- 3 -]									
-	96.3				BS	6			
- 4	96.0	Dense, grey sandy silt, trace gravel, occasional cobbles: TILL		4	BS	7			
1		(ML) End of Borehole							
- 4 -									
1		Refusal on Inferred Bedrock							
-									
1									
- 5 -	Ì								
- 6 -									
	-	☑ Inferred Groundwater Level							 Field Vane Test, kPa Remoulded Vane Test, kPa App'd
		Groundwater Level Measured in S	tandp	ipe					△ Pocket Penetrometer Test, kPa Date

Jacques Whitford

TEST PIT RECORD

TP07-36

BOREHOLE No. TP07-36

PROJECT No. 1026929

1 of 1

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

D	ATES: BO	RING June 15, 2007 WAT	FER I	LEV	EL				DATU	М		Local	
	Ē.					SA	MPLES		UNDRAINED SH	EAR STRENG	STH - kP	'a	
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H H	VTIC	SOIL DESCRIPTION	1 1	ERL	щ	BER	n) VER	SDE LE	· · ·	I	'Wp-	w	wL
BE	EV/		IR	VAT	Σ	N N	ŊĒ	-VA R R	WATER CONTENT & ATTERBE	RGLIMITS	F		-1
	E		S	5		Z	R	zo	DYNAMIC PENETRATION TES	F, BLOWS/0.3m))	Â	
	100 16	· · · · · · · · · · · · · · · · · · ·							10 20 30 40	50 60	รสา โ) 70	1 80	. 00
- 0 -	100.10	200 mm TOPSOIL	<u></u>		DC	1							ΠĨ
-	100.0	Stiff brown loop CLAV (CL)			Do								i i i F
		Suil, brown lean CLAT (CL)											
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-													
- 1 -	99.1												
-		Dense, brown SANDY SILT		Ā									
-		(ML)			BS	3							
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_													
- 2 -					BS	4		,				<u>titi</u> i	riit-
-													iiiiE
-													
					BS	5							
-	97.3	End of Borehole			0.5				·····			++++++	
- 3 -		Life of Borenoic							╷╷╷╷╷╷╷╷╷╷╷╷╷╷╷╷╷╷╷		 		//////////////////////////////////////
-		Refusal on Inferred Bedrock											
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									□ Field Vane Test, kPa				
		 Interred Groundwater Level Groundwater Level Management in State 	tond	nin					Remoulded Vane Tes	t, kPa	App'd		
L		- Groundwater Level Measured in S	เลทป	hibe	;				△ Pocket Penetrometer	i est, kPa	Date		

LIENT	Mattamy Homes			<u> </u>				BOREHOLE No. MW07-37
DCATION	Proposed Subdivision, Richmon	<u>d, (</u>	DN					PROJECT No1026929
ATES: BC	DRINGWAT	TER	LEV	'EL		Jun	e 20, 2	DATUM Local
(E)		Б	/EL		SA T			UNDRAINED SHEAR STRENGTH - KPa
Ê	SOIL DESCRIPTION	APL	R LEV		н	ERY	50	
EVA		RAT	ATE	TΥΡΕ	UMB	Q U C C C	VALI R RQ	WATER CONTENT & ATTERBERG LIMITS
Ξ		S	3		z	R	źŌ	DYNAMIC PENETRATION TEST, BLOWS/0.3m *
99.62						<u> </u>		10 20 30 40 50 60 70 80 €
99.5	75 mm TOPSOIL	1						
	Firm, greyish brown lean CLAY			SS		150	6	
			Ŧ		<u> </u>			
98.4				SS	2	300	6	<u>↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓</u>
	Compact to dense, greyish brown							
	SANDI SILI (ML)	•	Σ	22	2	350	27	
				55			57	
				SS	4	320	27	
96.4								
96.2	Compact to dense, grey SANDY			SS	5	280	50/	
	SILT (ML)						75 mm	
	End of Borenole							
	Auger Refusal on Inferred							
	Bedrock		·					
	Monitoring Well Installed							
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7	Informed Groundwater T1						ľ	Field Vane Test, kPa
-	- monou onounawater Level							Remonded Vane Test kPa Appld
	99.62 99.62 99.5 98.4 96.2	DCATION Proposed Subdivision, Richmon NTES: BORING June 14, 2007 WAT WAT SOIL DESCRIPTION SOIL DESCRIPTION 99.62 99.5 75 mm TOPSOIL // 99.62 99.5 75 mm TOPSOIL // 99.62 99.5 75 mm TOPSOIL // 99.62 Compact to dense, greyish brown lean CLAY (CL) 98.4 Compact to dense, grey shown SANDY SILT (ML) SILT (ML) 96.4 96.2 Compact to dense, grey SANDY SILT (ML) End of Borehole Auger Refusal on Inferred Bedrock Monitoring Well Installed Monitoring Well Installed	QCATION Proposed Subdivision, Richmond, C ATTES: BORING June 14, 2007 WATER Image: Solid DESCRIPTION Image: Solid DESCRIPTION Image: Solid DESCRIPTION Image: Solid DESCRIPTION 99.62 SOLIDESCRIPTION Image: Solid DESCRIP	DCATION Proposed Subdivision, Richmond, ON NTES: BORING June 14, 2007 WATER LEV W SOIL DESCRIPTION U U 99.62 SOIL DESCRIPTION U U 99.62 Firm, greyish brown lean CLAY U V 98.4 Compact to dense, greyish brown U V 96.4 96.4 U V V 96.4 SILT (ML) U V V 96.4 SILT (ML) U V V 96.4 SULT (ML) U V V 96.4 Super Refusal on Inferred Hedrock U V 96.4 Monitoring Well Installed U U V	DCATION Proposed Subdivision, Richmond, ON NTES: BORINGJune 14, 2007WATER LEVEL Image: Compact I of the set	DCATION Proposed Subdivision, Richmond, ON NTES: BORING June 14, 2007 WATER LEVEL Image: Solid DESCRIPTION Image: Solid DESCRIPTION Image: Solid DESCRIPTION Image: Solid DESCRIPTION 99.62 SOIL DESCRIPTION Image: Solid	Victorial Proposed Subdivision, Richmond, ON VITES: BORING_June 14, 2007 WATER LEVEL June WATER LEVEL June SOIL DESCRIPTION VIEW VIEW 99.62 SOIL DESCRIPTION VIEW VIEW 99.62 SOIL DESCRIPTION VIEW VIEW VIEW 99.62 SOIL DESCRIPTION VIEW VIEW VIEW VIEW 99.62 Compact to dense, greyish brown lean CLAY (CL) VIEW SS 1 150 98.4 Compact to dense, greyish brown SANDY SILT (ML) VIEW SS 4 320 96.4 SS SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS 5 280 SILT (ML) SS S S SILT (ML) SS<	VECATION Proposed Subdivision, Richmond, ON VITES: BORING June 14, 2007 WATER LEVEL June 20, 2 SOIL DESCRIPTION Image: Additional system of the syste

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C	LIENT	Mattamy Homes)NI					BOREHOLE No 102(2020
D D	ATES: BO	1100000000000000000000000000000000000	TER	LEV	EI.				PROJECT No. 1026929
	2		<u> </u>			SA	MPLES		UNDRAINED SHEAR STRENGTH - KPa
(E	L) N		LO1	EVEL			7		50 100 150 200
РТН	ATIC	SOIL DESCRIPTION	VTA F	ER L	ĿΕ	ABER	DVER m)	VLUE RQD	
DE	ELEV		STR/	WAT	Ϋ́	ΝΩ	Ū.	N-V≜ OR F	DYNAMIC PENETRATION TEST, BLOWS/0.3m
			-			-			STANDARD PENETRATION TEST, BLOWS/0.3m
- 0 -	<u>99.75</u>	200 mm TOPSOU	114					· · · · · · · · · · · · · · · · · · ·	
-	99.6	Stiff brown loop CLAY (CL)	1		BS	1			
-		Sull, brown lean CLAY (CL)							
					BS	2	-		
-									
- 1 -									
-									
-					BS	3			
	98.2	Danage Language CANDY OIL T							
-		(ML)							
- 2 -					BS	4	-		
-									
-									
					BS	5			
-									
- 3 -									
					BS	6			
-	96.4	D							
		gravel, occasional cobbles: TILL			BS	7			
-		(ML)	N E						
- 4 -	95.8	T 1 (D 1 1	11						
-		End of Borenole							
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~		V Informed Groundwater I and							□ Field Vane Test, kPa
		Groundwater Level Measured in S	Stand	pipe	,				△ Pocket Penetrometer Test, kPa Date

J	Jac Whi	ques tford	T	'E	ST I	PIT	RE	COR	D TP07-39
C	LIENT	Mattamy Homes							BOREHOLE No TP07-39
L	OCATION	Proposed Subdivision, Richmo	nd, C)N					PROJECT No. 1026929
D.	ATES: BC	DRING June 15, 2007 WA		DATUM Local					
-	Ê		5	Ē		SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa
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DEPT	EVAT		RAT	ATEF	ТҮРЕ	UMB	С С С С С С	RRC	WATER CONTENT & ATTERBERG LIMITS
	Е		ST	R		Ī	RE	żÖ	DYNAMIC PENETRATION TEST, BLOWS/0.3m *
	99.83								10 20 30 40 50 60 70 80 90
	99.6	220 mm TOPSOIL			BS	1			
-		Stiff, brown lean CLAY (CL)							
					DC	-			
-					B2	2			
					BS	3			
				₽					
	98.1	Dense, brown SANDY SILT							
		(ML)			BS	4			
-					BS	5			
				1					
					DC	6			
- 3 -	<u>96.9</u>	End of Borehole			DO	0			
-		Refusal on Inferred Bedrock							
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- 4 -									
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F 6 -			d	•		•	- 1	•	Field Vane Test, kPa
1		 ✓ Inferred Groundwater Level ▼ Groundwater Level 	Stor .		2				Remoulded Vane Test, kPa App'd Remoulded Vane Test, kPa
1	1	+ Groundwater Level Measured in	Stanc	ıpıp	6				△ rocket Penetrometer Test, kPa Date

_/₩	Jacques Whitford
V	WINCIUS

App'd

Field Vane Test, kPa

Remoulded Vane Test, kPa

V	W Whi	tford MON	TI	O]	RIN	١G	WE]	LL R	RECORD MW07-40
C	LIENT	Mattamy Homes	_					·	BOREHOLE No. MW07-40
L	OCATION	Proposed Subdivision, Richmon	<u>d, C</u>	<u>)</u> N					PROJECT No1026929
Ľ	ATES: BC	DRING June 15, 2007 WAT	ER	LEV	'EL				DATUM Local
	m)					SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa
<u>ا</u>) NC		PLO	EVE.		~	≿		50 100 150 200
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ä	ELEV		STR	WA	≿	S N	ЦЩ Щ	N-V-N	DYNAMIC PENETRATION TEST. BLOWS/0.3m *
							Ľ		STANDARD PENETRATION TEST, BLOWS/0.3m
- 0 -	100.26			L					10 20 30 40 50 60 70 80 90
	<u> 100.1</u>	-150 mm TOPSOIL	ÌŤ		SS	1	320	7	
		SANDY SILT (ML)							
- 1 -				- -	SS	2	420	17	
	98.3				SS	3	300	50/	
- 2 -		End of Borehole						50 mm	
		Auger Refusal on Inferred							
		Bedrock							
- 3 -									
		Monitoring Well Installed							
- 4 -									
- 5 -									
- 6 -									
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 $\[equiv]$ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

	W Jac	cques itford	T	Έ.	ST 1	PIT	RE	COR	D TP07-41
C	LIENT	Mattamy Homes							
L	OCATION	Proposed Subdivision, Richmon	nd, C	DN					PROJECT №1026929
	ATES: BO	DRINGJune 15, 2007 WA	TER	LEV	EL				DATUM Local
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	Е		SI	3		z	RE	20	DYNAMIC PENETRATION TEST, BLOWS/0.3m
- 0 -	99.77								10 20 30 40 50 60 70 80 90
	99.6	200 mm TOPSOIL	<u>\</u>						
-		Compact to dense, grey and brown SANDY SILT (ML)							
		orown SANDI SILI (ML)			BS	1			
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-	98.0				BS	3			
- 2 -		Dense, grey sandy silt, trace gravel, occasional cobbles: TILL							
-	97.6	_(ML)			BS	4			
-		End of Borehole							
		Refusal on Inferred Bedrock							
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		☑ Inferred Groundwater Level							 Field Vane Test, kPa Remoulded Vane Test, kPa App'd
		✓ Groundwater Level Measured in S	tandr	oipe					△ Pocket Penetrometer Test, kPa Date

Jacques Whitford	
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TP07-42

TP07-42 1026929 Local

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1 of 1

CLIENT Mattamy Homes

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L	OCATION	Proposed Subdivision, Richmon	<u>d, C</u>)N						- PROJEC	T No	102
D	ATES: BC	DRING June 14, 2007 WAT	TER	LEV	EL					- DATUM	[L
	Ê					SA	MPLES		UND	RAINED SHE	AR STREN	GTH - kPa
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υ.	99.8	200 mm TOPSOIL										
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		SANDY SILT (ML)			BS	1						
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Ŭ -	99.8	200 mm TOPSOIL	<u></u>						l		ļ			1		Π		1	11	1			111	1		I	Π	Ţ
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2	90.0	Dense, grey sandy silt, trace			BS	2			H			ΤŤ	П			t	$\frac{1}{11}$		$\frac{1}{1}$		Ť	i li		$\frac{1}{1}$		ήŀ		ťť
-		gravel, occasional cobbles: TILL			60																						} 	¦F
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1	90.7	End of Borehole		$\left \right $				• • •	ŀ		+	ii-		11		+÷	i i i		H	ili	++-	i hi	++	i		╢	H	╬
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-		Refusal on Inferred Bedrock									!				$\frac{1}{1}$	11										H.		1
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W Whitford

TEST PIT RECORD

TP07-44

BOREHOLE No. TP07-44

PROJECT No. 1026929

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING	June 15, 2007	WATER LEVEL

D	ATES: BC	DRING June 15, 2007 WA	FER I	LEV	'E L		_							_	DA	TU	Μ.					L)ca	1	
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	<u>7</u>	Z Inferred Groundwater Level							□ Field Vane Test, kPa
		Groundwater Level Measured in Sta	ndpi	pe					△ Pocket Penetrometer Test, kPa Date

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W Whitford

TEST PIT RECORD

TP07-46

BOREHOLE No. TP07-46

PROJECT No. _____1026929

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

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DATES: BORING June 14, 2007 WATER LEVEL														_	DA	١TU	м.					L	oca	<u> </u>		-
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c	LIENT	Mattamy Homes							BOREHOLE No. TP07-47
L	OCATION	Proposed Subdivision, Richmor	n d, (<u>)N</u>					PROJECT No1026929
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		- Groundwater Level Measured in St		△ Pocket Penetrometer Test, kPa Date					

Whitford

TEST PIT RECORD

TP07-48

BOREHOLE No. _____ TP07-48

PROJECT No. 1026929

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

Tupe 15 2007

D.	DATES: BORING June 15, 2007 WATER LEVEL															-	D/	٩T	UN	1 _					_I	200	al			-
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	Jacques WhitfordTEST PIT RECORD1 of 1 TP07-49													
C	LIENT	Mattamy Homes	1.0						BOREHOLE No					
	ATES: BO	1100000000000000000000000000000000000	<u>ona, (</u> Ated		/61		<u> </u>		PROJECT No1026929					
	2						MPI FS		UNDRAINED SHEAR STRENGTH - KP2					
Ê	u) N		LOT	EVEL		<i>"</i>		<u> </u>	50 100 150 200					
EPTH	'ATIC	SOIL DESCRIPTION	VTA F	ER L	E E	ABER	n) VER	SDE	Wp W WL					
ā	ELEV		STR/	WAT	∣≿	NC N	Ű.	N-VA OR F	WATER CONTENT & ATTERBERG LIMITS					
	100 (7			-	<u> </u>				STANDARD PENETRATION TEST, BLOWS/0.3m					
- 0 -	100.67	230 mm TOPSOIL	177											
-	100.4	Compact to dense brown and	<u>, ,</u> 											
		grey SANDY SILT (ML)			BS	1								
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- 1 -					BS	2								
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-		Refusal on Inferred Bedrock												
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		∑ Inferred Groundwater Level												
	Groundwater Level Measured in Standpipe								△ Pocket Penetrometer Test, kPa Date					

V	Whi	ques tford	Т	'ES	COR	ORD TP07-50						
C	LIENT	Mattamy Homes		-					BOREHOLE No. TP07-50			
L	OCATION	Proposed Subdivision, Richmon	<u>d, O</u>	<u>N</u>					PROJECT No1026929			
D.	ATES: BO	RINGJune 14, 2007 WAT	TER J	LEV	EL				DATUM Local			
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TH (n	TION	SOIL DESCRIPTION	LA PL	R LE	ш	BER	VERY	З С Г	/ /			
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	ш		l s				~	20	STANDARD PENETRATION TEST, BLOWS/0.3m			
- 0 -	100.42								10 20 30 40 50 60 70 80 90			
-	100.1	300 mm TOPSOIL	<u></u>		BS	1						
-	_100.1	Compact to dense, brown and	ÎП		BS	2						
		grey SANDY SILT (ML)		¥								
-					BS	3						
- 1 -												
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- 3 -					BS	7						
-												
	96.9											
-	06.6	Dense, grey sandy silt, trace gravel, occasional cobbles: TILL			BS	8						
-	90.0											
- 4 -		End of Borehole							<u>+++++</u>			
-		Refusal on Inferred Bedrock			:							
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		 ✓ Inferred Groundwater Level ✓ Groundwater Level Measured in S 	stand	pine		Remoulded Vane Test, kPa App'd A Pocket Penetrometer Test, kPa Date						
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	Jac Whi	ques tford	T	E,	ST I	PIT	RE	COR	E)	_									Т	'P0	7-	51	1	of 1
C	LIENT	Mattamy Homes													_	во	RE	ноі	LE I	No.		Т	P07	-51	
L	OCATION	Proposed Subdivision, Richmon	nd, C	<u>N</u>											_	PRO	OJE	ЕСТ	No.			_1()269	29	
D	ATES: BC	RING June 14, 2007 WA	TER	LEV	EL				T						_	DA	TU	М		_]	Loca	al	<u> </u>
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		grey SANDY SILT (ML)		¥							li						ili		li						Ϊŀ
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-					BS	4																			
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		Dense, grey SANDY SILT			BS	5																	 		
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		✓ Inferred Groundwater Level								כ	Re	mo	uld	led	Va	ne	Tes	t, kl	Pa		App	o'd .		-	_
		Groundwater Level Measured in Standpipe								4	Po	cke	et P	ene	tro	met	ter '	Test	t, kI	Pa	Dat	е.			_

Whitford

TEST PIT RECORD

TP07-52

BOREHOLE No. TP07-52

1 of 1

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

L	OCATION	Proposed Subdivision, Richmon	ld, C	<u>)N</u>		PROJECT No102692	<u> 29 </u>												
D	ATES: BO	VRING June 14, 2007 WA7	TER I		EL				DATUM Loca										
~	(E)					SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa	00									
DEPTH (m	ELEVATION	SOIL DESCRIPTION	STRATA PLC	WATER LEV	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD	SU 100 150 2 WP W WATER CONTENT & ATTERBERG LIMITS H DYNAMIC PENETRATION TEST, BLOWS/0.3m *	00 									
			┢	┼┤					STANDARD PENETRATION TEST, BLOWS/0.3m	,									
- 0 -	100.59		1577	\square						90									
-	100.3	280 mm TOPSOIL	<u> </u>		BS	1													
-	100.5	Compact to dense, brown and	m	1	BS	2													
		grey SANDY SILT (ML)		ΓŢ															
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- 1 -		l																	
					BS	3													
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	98.1	L																	
-		Dense, grey SANDY SILT			BS	5													
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- 3 -										1111F ++++									
-	97.4	Dange grou gondy silt trage																	
-		gravel, occasional cobbles: TILL	11		BS	6													
		(ML)																	
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- 4 -																			
-					BS	7													
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		Σ Inferred Groundwater Level							 Field Vane Lest, KPa Remoulded Vane Test kPa App'd 										
		 Interfed Oroundwater Level Groundwater Level Measured in Standpipe 							\triangle Pocket Penetrometer Test, kPa Date										

Whitford

TP07-53

1 of 1

CLIENT <u>Mattamy Homes</u>

 BOREHOLE No.	TP07-53

LOCATION Proposed Subdivision Richmond ON

Bit Date		ATES BO	June 15 2007	<u>na, c</u>	<u>ЛN</u>		PROJECT No102692						
Solic DESCRIPTION Solic DESCRIPION Solic DESCRIPTION Sol			WA	TER	LEV				DATUM	<u>L</u>	ocal		
100 301 DESORIPTION 101	Ê	(ш) ₇		5	ΈĽ	_	SA	MPLES		UND	RAINED SHEAR STRE	NGTH - kPa	
Sold Deckor non Yes	Ξ.	NOI 1		A PLO	LEV		L K	[₹	<u>۳</u> 0				200
□ □ □ □ 2 2 2 2 2 0	EP	LAV	SOL DESCRIPTION	SAT/	VTER	ΥΡΕ	MBI		RQI RQI	WATER CONTENT	& ATTERBERG LIMITS	Wp L	w ₩ _L
0 100.94 0 </td <td></td> <td>ELE</td> <td></td> <td>STF</td> <td>W/</td> <td>-</td> <td>Z</td> <td>L C L</td> <td>2 g</td> <td>DYNAMIC PENETR</td> <td>ATION TEST, BLOWS/0</td> <td>3m</td> <td>*</td>		ELE		STF	W/	-	Z	L C L	2 g	DYNAMIC PENETR	ATION TEST, BLOWS/0	3m	*
100.94 200 mm TOPSOIL 10.0 20.0 40.50 60.70 80.50 90.70 80.50 90.70 80.50 90.70 80.50 90.70 80.50 90.70 80.50	<u> </u>				-					STANDARD PENET	RATION TEST, BLOWS	0.3m	•
100.77 Firm, brown lean CLAY (CL) Its	- 0 ·	100.94	200 mm TODSOIL	1577			<u> </u>			10 20	30 40 50	60 70	80 90
Parm, brown lean CLAY (CL) BS 2 Image: Compact to dense, brown and grey SANDY SILT (ML) 99.4 Compact to dense, brown and grey SANDY SILT (ML) BS 3 98.5 Dense, grey sandy silt, trace gravel, occasional cobbles and boulders: TILL (ML) BS 5 97.4 End of Borehole BS 6 97.4 End of Borehole Image: Compact Level Y Inferred Groundwater Level Image: Compact Co		100.7		<u> </u>		BS	1						
-1 99.4 Compact to dense, brown and grey SANDY SILT (ML) BS 3 0 <td></td> <td></td> <td>Firm, brown lean CLAY (CL)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>			Firm, brown lean CLAY (CL)										
-1 99.4 Compact to dense, brown and grey SANDY SILT (ML) 2 BS 3 0 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>													
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99.4 99.4 Compact to dense, brown and grey SANDY SLT (ML) 98.5 Dense, grey sandy silt, trace gravel, occasional cobiles and boulders: TILL (ML) BS 6 97.4 P7.4 P7.4 End of Borehole Refusal on Inferred Boulders 4 P7.4 P7.4 P7.4 P7.4 End of Borehole Refusal on Inferred Boulders P7.4						PS	2						
- -99.4 Compact to dense, brown and grey SANDY SILT (ML) BS 3 98.5 BS Dense, grey sandy silt, trace gravel, occasional cobbles and boulders: TILL (ML) BS 5 97.4 End of Borehole Refusal on Inferred Boulders BS 5 Inferred Groundwater Level Groundwater Level Groundwater Level Oreke Penetrometre Test, kPa Pocket Penetrometre Test, kPa Dense, Appid	- 1 -					DS	<u></u>						
99.4 Compact to dense, brown and grey SANDY SILT (ML) 98.5 BS 4 98.5 BS 5 98.5 BS 5 97.4 BS 6 97.4 BS	-												
-2 BS 3 -2 BS 4 -3 BS 5 -3 BS 6 -3 BS 6 -7 BS 6 -97.4 BS 6 -3 BS 6 -97.4 BS 6 -3 BS 6 -97.4 BS 6 -3 BS 6 -97.4 BS 6 -3 BS 6 -97.4 BS 6 -3 BS 6 -3 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -97.4 BS 6 -10 BS 6 -10 BS 7 -10 BS 8 -10 BS 9 -10 <td< td=""><td> -</td><td>00.4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	-	00.4											
- 2 grey SANDY SILT (ML) BS 3 IIII IIII IIII IIIII IIIII IIIIIIIIII		99.4	Compact to dense, brown and		₽	DC	-						
-2 98.5 Dense, grey sandy silt, trace gravel, occasional cobbles and boulders: TILL (ML) -3 97.4 BS 6 97.4 End of Borehole Refusal on Inferred Boulders BS 6 5 Inferred Groundwater Level ✓ Inferred Groundwater Level © Field Vanc Test, kPa Coroundwater Level © Field Vanc Test, kPa Coroundwater Level © Percent Test, kPa Procest Coroundwater Level © Percent Test, kPa Procest Coroundwater Level © Percent Test, kPa Procest Coroundwater Level © Percent Test, kPa Procest Coroundwater Level © Percent Test, kPa Procest Percent Test, kPa © Removed Test, kPa	-		grey SANDY SILT (ML)			82	3						
-2 98.5 -3 -3 -3 -3 -97.4 -4 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -4 -3 -5 -3 -6 -3 -7 -3 -7 -3 -3 -3 -3 -3 -3 -3 -4 -3 -4 -3 -5 -3 -6 -3 -7 -3 -4 -3 -5 -3 -6 -3 -7 -3 -6 -3 -7 -3 -6 -3 -7 -3													
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-3 -3 -3 -3 -97.4 -4 -97.4 -97.4 -97.4	-					00	-						
-3 BS 5 97.4 BS 6 97.4 End of Borehole Refusal on Inferred Boulders Image: Constrained C	-	98.5	Dense grou condu gilt to a		- 1			Í					
- 3 97.4 97.4 End of Borehole Refusal on Inferred Boulders 5 6 ✓ Inferred Groundwater Level ✓ Groundwater Level ✓ Groundwater Level Measured in Standpipe			gravel, occasional cobbles and			BS	5						
- 3 97.4 97.4 End of Borehole Refusal on Inferred Boulders 5 6 ¥ Inferred Groundwater Level ¥ Groundwater Level Standpipe			boulders: TILL (ML)										
97.4 BS 6 97.4 End of Borehole Refusal on Inferred Boulders Inferred Boulders 5 Inferred Groundwater Level ✓ Inferred Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level	- 2 -												
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97.4 End of Borehole Refusal on Inferred Boulders Image: Construction of the second of t	-					BS	6						
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 4 5 6 ✓ Inferred Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Groundwater Level ✓ Proket Penetrometer Test, kPa App'd 			Refusal on Inferred Boulders										
6 ✓ Inferred Groundwater Level ✓ Groundwater Level □ Field Vane Test, kPa ▲ Pocket Penetrometer Test kPa	- 4 -		Torada on monor bounders										1
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		-	✓ Inferred Groundwater Level							□ Field Vane To	est, kPa		
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V	Jac White	ques tford	D TP07-54	f 1						
C	LIENT	Mattamy Homes	BOREHOLE No. TP07-54	_						
LC	OCATION	Proposed Subdivision, Richmond	PROJECT No1026929	-						
D	ATES: BO	RING June 15, 2007 WAT	ER I	LEV	EL				DATUM Local	_
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u) H]		SOIL DESCRIPTION	A PL	R LEV	ш	BER	/ERY)	ы Ч		
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	Ш		S	5		Z	RI	zo	DYNAMIC PENETRATION TEST, BLOWS/0.3m	
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U	101.2	200 mm TOPSOIL	<u></u>		BS	1				
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		gicy SAIVD I SILI (ML)			BS	2				
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		$\overline{\Sigma}$ Inferred Groundwater Level							Remoulded Vane Test, kPa App'd	
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	Jac	Aques Itford	RD	.55	1 of 1													
c	LIENT	Mattamy Homes			BOREHOLE No	Т	'P07-'	55										
L	OCATION	Proposed Subdivision, Richmon	<u>d, (</u>)N						PROJECT No.	1(02692	29					
D	ATES: BC	DRING June 14, 2007 WAT	ER	LEV	'EL					DATUM Local								
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E T	NO		PLC	LEVI		R	RY	шо	50	100	150	20	00 					
EPTI	VATI	SOIL DESCRIPTION	ATA	TER	ΥPE	MBE	Э М Е	RQE	WATER CONTENT &	ATTERBERG LIMITS	WP F		w∟ —∔					
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- 0 -	101.07	180 mm TOPSOIL	<u>\.</u>		BS	1												
		Compact to dense, brown and																
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			.]															
	98.3	Dense grev sandy silt trace											⁻ -					
- 3 -		gravel, occasional cobbles: TILL			B2	0					<u> </u> 	 	 					
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		Refusal on Inferred Bedrock																
													 					
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		 Interfed Groundwater Level Groundwater Level Measured in St 	and	pipe	:				$ \square \text{Kemoulded V} \\ \triangle \text{Pocket Penet} $	ane Test, kPa rometer Test, kPa	App'd . Date							

W Jacques W Whitford

TEST PIT RECORD

TP07-56

– BOREHOLE No. TP07-56

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 14, 2007 WATER LEVEL

 PROJECT N₀.
 1026929

 DATUM
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	2			Ι.		SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa
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H	2	SOIL DESCRIPTION	Ν	RLI	ш	BER	/ER	ЗО.	
DEP	EV.		R	ATE	LγP	Wn	0 E	V AL R R(WATER CONTENT & ATTERBERG LIMITS
	Ē		ST	≥		ž	RE	żō	DYNAMIC PENETRATION TEST, BLOWS/0.3m
				┢	<u> </u>		-		STANDARD PENETRATION TEST, BLOWS/0.3m
- 0 -	<u>101.21</u>		N.	ļ					
	101.0	200 mm TOPSOIL			BS	1			
-		Compact to dense, brown and			BS	2			
L _		grey SANDY SILT (ML)		Ť					
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- 1 -									
-				1	BS	3			
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- 2 -	99.2			1					
-		Dense, grey SANDY SILI (ML)	[]]]	1					
-			ŀ						
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- 3 -			ŀ						
-	98.0]		BS	5			
-		Dense, grey sandy silt, trace			<u> </u>			·	
	97.6	gravel, occasional cobbles: TILL			BS	6			
-		-(IML) End of Borehole	Γ						
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		¥ Groundwater Level Measured in S	tand	lpip	e				△ Pocket Penetrometer Test, kPa Date
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TP07-57

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Mattamy Homes CLIENT

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LOCATION Proposed Subdivision, Richmond, ON PROJECT No. _____ 1026929_____

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	ATES: BO	DRINGUne 15, 2007 WA	TER		DATUM Local											
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F 0 -	102.7	200 mm TOPSOIL	<u>\.</u>	; 	BS	<u> </u>	+	 								
-	102.7	End of Borehole	<u> </u>	\vdash		+	<u> </u> '									
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-		Refusal on Inferred Bedrock		!			1									
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		$\stackrel{\checkmark}{=}$ Inferred Groundwater Level				Remoulded Vane Test, kPa App'd										
		Groundwater Level Measured in St	andp	vipe				1	△ Pocket Penetrometer Test, kPa Date							

TP07-58

1 of 1

C	LIENT	Mattamy Homes							BOREHOLE No.	TP07-58
L	OCATION	Proposed Subdivision, Richmon	<u>id, C</u>)N					PROJECT No.	1026929
D	ATES: BC	DRINGJune 15, 2007 WA	TER	R LEVEL					DATUM	Local
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EPTI	VAT	SOIL DESCRIPTION	MTA	TER	ΥPE	MBE		'ALU RQI	WATER CONTENT & ATTERBERG LIMITS	₩ _₽ ₩ ₩ _L 01
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	101 20		$\left \right $						STANDARD PENETRATION TEST, BLOWS/0.3m	•
- 0 -	101.39	200 mm TOPSOIL	1	-	BS	1				
-	101.2	Compact to dense, brown and	<u>h</u>		00					
_	100.9	grey SILTY SAND (SM)			BS	2				
-		Dense, grey sandy silt, trace								
-	100.5	gravel: TILL (ML)			BS	3				
- 1 -		End of Borehole								
-		Refusal on Inferred Bedrock								
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Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

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Date

 $\overline{\nabla}$ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

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C	LIENT	Mattamy Homes							$\mathbf{E} = \mathbf{E} \mathbf{E} \mathbf{E} \mathbf{E} \mathbf{E} \mathbf{E} \mathbf{E} \mathbf{E}$
L	OCATION	Proposed Subdivision, Richmo	nd <u>, (</u>	DN					PROJECT No1026929
D	ATES: BC	DRING June 14, 2007 WA	TER	LEV	EL				DATUM Local
	E)		1 E	E		SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa
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EPT	EVAT	SUIL DESCRIPTION	RAT/	ATER	ΥPE	MBE	NO (m	/ALL	للله المحتوي الم واحت المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي المحتوي محتوي المحت المحتوي المحتو واحت المحت المحتوي المحتوي المحتوي المحتوي المحتوي ا
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	101.13		+						STANDARD PENETRATION TEST, BLOWS/0.3m
- 0 -	100.9	200 mm TOPSOIL	<u>\.</u>		BS	1			
	100,9	Compact to dense, brown	111						
	100.6	SANDY SILT (ML)			BS	2			
		End of Borehole							
-		Refusal on Inferred Bedrock							
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								Field Vane Test, kPa	
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		- Oroundwater Level Measured in S	standį	orpe					△ Pocket Penetrometer Test, kPa Date

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C	CLIENT Mattamy Homes														В	SOF	REH	OLI	E No	•	TP07-60				
L	LOCATION Proposed Subdivision, Richmond, ON												PROJ								1				
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											NDAF		PEN	IETF	RATI		TES	T, BL	LOWS	.5m /0.3m	ı		•		
- 0 -	101.36		NI.							1	0	20	0	3	0	4	10	5	0	60		70	80)	90
-	101.2	200 mm TOPSOIL			BS	1																			
-		grey SANDY SILT (ML)												11											
					BS	2																			
-	100.5																								
- 1 -		Dense, grey sandy silt, trace			BS	3			$\frac{11}{11}$	 	<u>; ; ;</u>	1		<u> </u> 		H									
-		(ML) gravel, occasional cobbles: TILL										i				ii H									
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-	99.5				BS	5																			
- 2 -		End of Borehole																							
-		Refusal on Inferred Bedrock																							
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TP07-61

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CLIENT <u>Mattamy Homes</u>

 BOREHOLE No
 PROJECT No.

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	OCATION	Proposed Subdivision, Richmon	<u>id, (</u>	<u>)N</u>						PROJ	ECT No.		10
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DEPTH	ELEVATIC	SOIL DESCRIPTION	STRATA F	WATER L	ТҮРЕ	NUMBER	RECOVER (mm)	N-VALUE OR RQD	WATER CONTENT	ATTERBE	ERG LIMITS).3m	Wp
- 0 -	102.15								10 20	RATION TE 30 40	ST, BLOWS 50	3/0.3m 60	70
-	101.9	230 mm TOPSOIL	<u></u>		BS	1							
-	101.8	Compact to dense, brown SILTY SAND (SM)			BS	2							
_	101.5	-Fractured Bedrock	╞╧┓			_							
-		End of Borehole											
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0 102.15 230 mm TOPSOIL 10.1<		100.15								-	ST/	ANI	DAR	D F	PEN	ΙEΤΙ	RAT	ION	N TE	ST	, Bt	.ow	/S/0.	.3m				•		
101.9 250 min 107S 0L SAND (SM) 105 105 101.9 101	- 0 -	102.15	220 - TOPSOU	NT.								10		20)	2	80		40		5	0	6	0	1	70		80		90
101.8 Compact to dease, brown SILTY B8 2 101.5 Fractured Bedrock 101.5 Fractured Bedrock End of Borehole 101.6	-	101.9	230 HIM TOPSOIL	1. N		BS	1										H													!}-
SAND (SM) Fractured Bedrock Refusal on Inferred Bedrock 2	-	101.8	Compact to dense, brown SILTY			BS	2			11		Ľ	11	Ì	Ĥ	ÌÌ.	Įį.			ij	i	ij.	ii.	lii	ij	lii	ii	1i		ļĒ
Practured Bedrock End of Borehole T Refusal on Inferred Bedrock Refusal on Inferred Bedrock Refusal on Inferre	⊢ -	101.5	SAND (SM)			20	<u> </u>			-11		li		i			li:												, ; ;] }]]]	ίĿ
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6 ✓ Inferred Groundwater Level ✓ Groundwater Level □ Field Vane Test, kPa ✓ Groundwater Level Measured in Standpipe	1						1							Ľ		!		H				ÌÌ	j		i	11	<u>i</u> l	ij	i i I	ŀ
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Jacques Whitford

TEST PIT RECORD

TP07-62

BOREHOLE No. ___

TP07-62

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

L	OCATION	Proposed Subdivision, Richmon	<u>d, C</u>	<u>N</u>					PROJECT No 1026929	_
D.	ATES: BC	DRINGJune 15, 2007 WAT	ER I		EL				DATUM Local	_
	(Ê		F			SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa	
DEPTH (m)	ELEVATION (SOIL DESCRIPTION	STRATA PLO	WATER LEVE	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD	50 100 150 200 Wp W WL WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m *	
	101 68	· · · · · · · · · · · · · · · · · · ·							□ STANDARD PENETRATION TEST, BLOWS/0.3m ■ 10 20 30 40 50 60 70 80 9	ก
-0-	101.4	200 mm TOPSOIL	<u>, 15,</u> 4, 1,		BS	1				Ē
- 1	101.2	Compact to dense, brown and grey SANDY SILT (ML)			BS	2				-
-	101.0	Dense, brown sandy silt, trace gravel, occasional cobbles: TILL			BS	3				╞
- 1 -		(ML)								F
1 - - -		End of Borehole Refusal on Inferred Bedrock			:					
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~ 6 -			L	L			I		Field Vane Test kPa	
									 Remoulded Vane Test, kPa App'd 	
		▼ Groundwater Level Measured in S	tand	pipe					△ Pocket Penetrometer Test, kPa Date	
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	Withford TEST PIT RECORD														_						— T1	 P0		-6'		1	of	1	
	LIENT	Mattamy Homes														,	~~						. 0	́т	ישט. מתי	, ,	\sim		
	OCATION	Proposed Subdivision, Richmon	nd, C	DN												I I		NE OU	HC FC1	JLI TN	5 No Io	э		 _1(<u>PU</u> 021	<u>/-(</u> ;0'	<u>33</u> 70		-
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	101 44	· · · · · · · · · · · · · · · · · · ·	+	-				· · · · · · · · · · · · · · · · · · ·	STANDARD PENETRATION TEST, BLOWS/0.3m										,										
- 0	101.44	200 mm TOPSOIL	<u></u>		DC				╀		10	11	20		3	0		40		50) ; ; ; ;	60 1 T	; ; ; ; ; ;	70) 	80	<u>)</u>	90	2
	101.2	Compact to dense, brown	Î		BS	1			ľ																		111		
	101.0	SANDY SILT (ML)	ļilt		BS	2			ļ				1		Ц			ļ	<u>11</u>	1		4		4		4			<u> </u>
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		Refusal on Inferred Bedrock											1						 										
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		✓ Inferred Groundwater Level								F	Ren	nou	ıld	ed	Va	ine	T	est,	, kł	Pa		A	pp' d	! _			<u> </u>		
	Groundwater Level Measured in Standpipe								Δ	F	Poc	ket	: Pe	ene	etro	m	ete	r T	est	, k	Pa	D	ate	_					

Whitford

TP07-64

BOREHOLE No. TP07-64

1 of 1

CLIENT Mattamy Homes

LOCATION	Proposed	Subdivision	Richmond
LOCATION	FIODOSCU	Suburyision,	Nichmond.

		Proposed Subdivision Richmon			BOREHOLE No 102(020							
L	OCATION	DDIG June 14 2007	<u>u, c</u>						PROJECT No. 1020929			
D	TES: BU	RING Jule 14, 2007 WAT				···· .			DATUM LOCAL			
H (m)	(m) NO		PLOT	LEVEL		SA ≃	MPLES ∑	ш.	UNDRAINED SHEAR STRENGTH - kPa 50 100 150 200			
DEPTH	ELEVATI	SOIL DESCRIPTION	STRATA	WATER	TYPE	NUMBE	RECOVE (mm)	N-VALU OR RQE	WP W WL WATER CONTENT & ATTERBERG LIMITS H OF THE DYNAMIC PENETRATION TEST, BLOWS/0.3m *			
									STANDARD PENETRATION TEST, BLOWS/0.3m			
_ 0 _	101.32								10 20 30 40 50 60 70 80 90			
	101.1	230 mm TOPSOIL	<u>\' //</u> //. \		BS	1						
		Compact to dense, brown SILTY										
	-	SAND (SM)			BS	2						
•												
- 1 -	100.2											
•		Dense, grey SILTY SAND (SM)		₽	BS	3						
	-					-						
- 2 -					BS	4						
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	98.9	D										
		gravel, occasional cobbles: TILL			BS	5						
		(SM)										
- 3 -												
					BS	6						
	97.8	End of Borehole										
- 4 -		Refusal on Inferred Bedrock										
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		Inferred Groundwater Level							□ Field Vane Test, kPa □ Removalded Vane Test, kPa			
		✓ Groundwater Level Measured in S	tand	lpipe	•				\triangle Pocket Penetrometer Test, kPa Date			
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	Jac	ques tford	RD TP07-65 ^{1 of}															
	LIENT	Mattamy Homes							BOREHOLE No TP07-65									
L	OCATION	Proposed Subdivision, Richmon	<u>d, C</u>	<u>)N</u>					PROJECT № 1026929									
D	ATES: BO	DRING June 15, 2007 WAT	ER :	LEV	EL				DATUM Local									
	E)					SA	MPLES		UNDRAINED SHEAR STRENGTH - KPa									
E H	NO		V PLO	LEV		l K	ΞRΥ	щD										
DEPT	EVAT	SOIL DESCRIPTION	RAT/	ATER	ΓΥΡΕ	MBI		VALL RQ	WP W WL									
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	100.15								STANDARD PENETRATION TEST, BLOWS/0.3m 10 20 30 40 50 60 70 80 90									
- 0 -		250 mm TOPSOIL	<u>/</u>	-	BS	1												
-	99.9	Compact to dense, brown SILTY																
		SAND (SM)																
-	993				BS	2												
		Dense, grey sandy silt, trace																
- 1 -		gravel, occasional cobbles: TILL (SM)		¥	BS	3												
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- 3 -		End of Borehole																
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		$\overline{\underline{\nabla}}$ Inferred Groundwater Level							Remoulded Vane Test, kPa App'd									
		▼ Groundwater Level Measured in S	tand	pipe	;				 □ Removided vane lest, KPa App'd △ Pocket Penetrometer Test, kPa Date 									
CLIENT Mattamy Homes BOREHOLE No. TP4 LOCATION Proposed Subdivision, Richmond, ON PROJECT No. 102 DATES: BORING_June 14, 2007 WATER LEVEL June 20, 2007 DATUM LocATION DSEAR STRENGTH - FRA Image: Colspan="2">Image: Colspan="2">OATUM LocAtion 14, 2007 WATER LEVEL June 20, 2007 DATUM LocAtion 16, 00 Image: Colspan="2">Image: Colspan="2">OATUM June 20, 2007 DATUM LocAtion 16, 00 Image: Colspan="2">Image: Colspan="2">OATUM Soll DESCRIPTION Image: Colspan="2">Soll DESCRIPTION Soll DESCRIPTION Soll DESCRIPTION Soll DESCRIPTION Image: Colspan="2">OUTUR WATER LEVEL June 20, 2007 DATUM WATER CONTENT & ATERBERG LIMITS Image: Colspan="2">OUTUR WATER CONTENT & ATERBERG LIMITS WP Image: Colspan="2">OUTUR WATER CONTENT & ATERBERG LIMITS Image: Colspan="2">Colspan= Colspan="2">OUTUR WE Image: Colspan="2">OUTUR OUTUR WE Image: Colspan="2">OUTUR OUTUR WE	1 of 1																	
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DOCATION Proposed Subdivision, Richmond, ON PROJECT No. 102 DATES: BORING June 14, 2007 WATER LEVEL June 20, 2007 DATUM L Image: Colspan="2">Image: Colspan="2">O ATUM Image: Colspan="2">Image: Colspan="2">Image: Colspan="2" Image: Colspan="2">Image: Colspan="2" Image: Colspan="2">O Image: Colspan="2" Image: Colspan="2">O Image: Colspan="2" Image: Colspan="2">Image: Colspan="2" Image: Colspan="2">Image: Colspan="2" Image: Colspan="2">O Image: Colspan="2" Image: Colspan="2">Image: Colspan="2" Image: Colspan="2">O Image: Colspan="2" Image: Colspan="2" Image: Colspan="2" Image: Colspan="2">O Image: Colspan="2" Image: Colspan="2">Image: Colspan="2" Image: Cols	-66																	
DATES: BORING JUNE 14, 200/ WATER LEVEL June 20, 200/ DATUM L Image: Comparison of the c	929																	
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- 1 Compact to dense, brown to grey SILTY SAND (SM) - 1 BS 2 - 3 Dense, grey sandy silt, trace gravel, occasional cobbles: TILL (SM) - 3 BS 5 - 3 97.0 - 4 BS 6	80 90																	
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98.9 Dense, grey sandy silt, trace BS 4 1100 1110 1111																		
- 2 gravel, occasional cobbles: TILL - 3 - 3 - 3 97.0 End of Borehole Refusal on Inferred Boulders - 4																		
- 2 - (SM) BS 5																		
BS 5 BS 5 BS 6																		
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Refusal on Inferred Boulders	<u> </u> 																	
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☐ Field Vane Test, kPa ☐ Removalded Vane Test kPa																		
▼ Groundwater Level Measured in Standpipe △ Pocket Penetrometer Test, kPa App'd																		

	Jacques TEST PIT RECORD TP07-67													
	LIENT OCATION	Mattamy Homes Proposed Subdivision, Richmon DRING June 14, 2007 WA	i <u>d, C</u> FFR)N LEV	·				BOREHOLE №. TP07-67 PROJECT №. 1026929 DATIM Local					
	2					SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa					
DEPTH (m)	ELEVATION (n	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	50 100 150 200 Water content & atterberg limits Wp W WL DYNAMIC PENETRATION TEST, BLOWS/0.3m *									
	101.50								10 20 30 40 50 60 70 80 90					
	101.3	200 mm TOPSOIL	<u>\.</u>		BS	1								
-		Compact, brown SILTY SAND (SM)		₽										
-					BS	2								
- 1 -					BS	3								
	100.2	Dense, grey sandy silt, trace												
	99.9	gravel, occasional cobbles: TILL (SM)			BS	4		Va a s						
- 2 -		End of Borenole Refusal on Inferred Bedrock												
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		▼ Groundwater Level Measured in S		△ Pocket Penetrometer Test, kPa Date										

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С	LIENT	Mattamy Homes								BOREHOLE N) .	TP07	7-68	
L	OCATION	Proposed Subdivision, Richmon	nd, C)N_	_					PROJECT No		1026	929	
D	ATES: BO	DRING June 20, 2007 WA	TER	LEV	EL				·	DATUM		Lo	cal	
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DEPTH	ELEVATIC	SOIL DESCRIPTION	STRATA	WATER I	ТҮРЕ	NUMBER	(mm)	N-VALUE OR RQD	WATER CONTENT & A	' TTERBERG LIMITS ON TEST, BI OWS/0	,) 3m	₩ _P w I€	, 'w ,1 , ★	L
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U .		130 mm TOPSOIL			BS	1					1 111	1 1 1 1		
		Compact, brown SILTY SAND (SM)			BS	2								
-		Compact to dense, brown and grey SANDY SILT (ML)			BS	3								
- 1 -	·				BS	4								
-		End of Hand Auger Hole										1111		
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□ Remoulded Vane Test, kPa

App'd \triangle Pocket Penetrometer Test, kPa Date

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	Jacques WhitfordTEST PIT RECORD1 of 1 TP07-69											
C	LIENT	Mattamy Homes							BOREHOLE No TP07-69			
L	OCATION	Proposed Subdivision, Richmon	<u>d, C</u>	<u>)N</u>					PROJECT No1026929			
D.	ATES: BO	DRINGJune 20, 2007 WAT	TER	LEV	EL.				DATUM Local			
(ш	(m) N		LOT	EVEL		SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa 50 100 150 200			
DEPTH	ELEVATIC	SOIL DESCRIPTION	STRATA F	WATER L	TYPE	NUMBER	RECOVER (mm)	N-VALUE OR RQD	WP W WL WATER CONTENT & ATTERBERG LIMITS WO DYNAMIC PENETRATION TEST, BLOWS/0.3m *			
									10 20 30 40 50 60 70 80 90			
		150 mm TOPSOIL	<u></u>		BS	1						
		Compact, brown silty sand, trace gravel, occasional cobbles: TILL			BS	2						
-												
-		End of Hand Auger Hole										
-1-		Hand Auger Refusal										
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		V Informal Converting 1							□ Field Vane Test, kPa			
	 Interred Groundwater Level Groundwater Level Measured in Standpipe 							□ Remoulded Vane Test, kPa App'd △ Pocket Penetrometer Test, kPa Date				

TEST PIT RECORD

TP07-70

BOREHOLE No. TP07-70

PROJECT No. 1026929

1 of 1

CLIENT <u>Mattamy Homes</u>

LOCATION Proposed Subdivision, Richmond, ON

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DATES: BORING June 20, 2007 WATER LEVEL										— DATUM]	Local			
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	EL		S	3		Ż	RE	żΟ	DYNAMIC PENET	RATION TEST, BLOWS/0	.3m	*			
				-					STANDARD PEN	ETRATION TEST, BLOWS	/0.3m	•			
- 0 -									10 20	30 40 50	60 70	80 90			
-		Compact brown SH TY SAND													
-		(SM)													
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-															
-		End of Hand Auger Hole	11.		+				╋╋┿┥┥	╶┼╽╷╷╷╷╷╸╸╸╸╸	┊╏┊┊┊┊ ╋				
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		∑ Inferred Groundwater Level							□ Field Vane	Test, kPa	A				
		✓ Groundwater Level Measured in S	tandı	oine						etrometer Test LD-	App'd _				
										en onneter Test, KPa	Date -				

	Jacques TEST PIT RECORD TP07-71												
	CLIENT	Mattamy Homes											
	LOCATION	Proposed Subdivision, Richm	<u>ond, C</u>	<u>)N</u>					PROJECT No1026929				
	DATES: BO	DRING June 14, 2007 W	ATER		EL				DATUM Local				
2	(E)		5	H		SA	MPLES		UNDRAINED SHEAR STRENGTH - kPa				
E	I OF	SOIL DESCRIPTION	A PL(S LEV		L H	ERY	щD					
DEP	EVA		RAT	ATER	ΓΥΡΕ	JMBI		VALL RQ	WP W WL WATER CONTENT & ATTERBERG LIMITS				
			ST	3		ž	REC	żŐ	DYNAMIC PENETRATION TEST, BLOWS/0.3m				
	102.71								STANDARD PENETRATION TEST, BLOWS/0.3m				
	102.5	230 mm TOPSOIL	<u></u>		BS	1							
	102.5	Fractured Bedrock	- [* ``										
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L 1 .		Refusal on Inferred Bedrock											
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C	LIENT	Mattamy Homes												_	_	B	OR.	EH	OL	E N	0		Т	P07	-7	2	
L	OCATION	Proposed Subdivision, Richmon	nd, C	DN											_	PF	loi	IEC	TN	No.			_1()26	92	9	_
D	ATES: BO	DRINGJune 14, 2007 WA	TER	LEV	EL		Jun	e 20, 2	2 <u>00</u> T	7					-	D/	AT	UM	[Loc	al		
(u	(m)		Б	/EL		SA	MPLES	.					ل 50	JND	RA	INE	D S	SHE.	AR	STR	ENC	STH	- kP	а	20	0	1
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	▼ Groundwater Level Measured in Standpipe									△ Pocket Penetrometer Test, kPa Date																	







HYDROMETER	HYDROMETER U.S. SIEVE NUMBERS U.S. SIEVE OPENING IN INCHES 200 100 50 30 16 8 4 2/8 1/2 2/4 1 1.5 2 4 6																	
100			•			•	1				3/4	• [']	.5) 	1		
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0.001 0.01	0.	1 GR	AIN SI	ZE IN	1 MIL	LIMETI	ERS	<u> </u>		10					10	0		
SILT OR CLAY				SAN	D			GRAVEL						COBBL			BLE	s
Chaoiman Identification		fine	ficati	m	edi	um o	coars	e	fi	ne		C02	arse	e	י ור			
● TP 8-18 G 3	/IL - Ino	organic	c silt,	trace	e cla	ay			23		L		_	ſ	-1	3.3	6 84	14.8
Specimen Identification D100	D	060	[D30		D1	0	%	Gra	avel	%	San	d	(%S	ilt	%	Clay
• TP 8-18 G 3 0.25	0	.05	0	.023		0.00)32		0.0)		1.7				98	.3	
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CLIENT Mattamy Homes									FI	LE N	10.	_		P	G46	683		_
PROJECT Geotechnical Investi	gation ·	- Prop	. Res	ident	tial				D	ATE		_		31	Oc	t 18		-
Development - Ottaw	a Stree	et				nc							. •	~		7-		
patersong	ľU	uľ	J	Engir	nee	rs			F	G	К/			5				
154 Colonnade Road South, Ottaw	<i>r</i> a, Onta	ario K2	2E 7J	5					D	15		K	В	U		I O	Ν	



2781 Lancaster Rd. Tel: 613 738-0708

N

Hydrometer Analysis

N	2781 Lancaster Rd. Ottawa ON, K1B 1A7	Wash S	Sieve Analysis
Client :	Mattamy Homes	Project No.	1026929
Project :	Mattamy Homes, Richmond	Test Method :	LS 602 (ASTM C136)
Material Type :	Soils / Aggregate:		
Proposed Use :	Fill / Granulars:	Sample No. :	N/A
Supplier :	N/A		
Source :	TP-66		
Sampled From :	SS-4		
Sampled By :	Jeff Forrester	Date Sampled :	14-Jun-07
Tested By :	Eric Naylor	Date Tested :	20-Jun-07

Santa Ma				Nash	Test Data	a	南京國家的	A STANDARD
Sar	mple Weight E	Before Sieve :		S	ample Weigh	nt Before Wash :	2163.8	
Sa	ample Weight	Aftter Sieve :	Martin and Art		Sample Wei	ight After Wash :	1424.5	Corrected
	% L	oss In Sieve :			%	Passing No.200	34.2	N/A
臺城市			ALL Analysis	S AND AND AND AND AND AND AND AND AND AND		他感到起意		
Sieve	Size of	Opening	Wt. Retained	Cum W	/t. Retained	% Passing	Specif	ications
No.	Inches	mm	grams	9	rams		Min	Max
	3	76.2						
	2	53.0						
	1	26.5		1				
	3/4	19.0						
	5/8	16.0						
	1/2	13.2						
	3/8	9.5						
+4	0.187	4.75		3	392.4	81.9		
		- 4.75		1	424.3			
8	0.0937	2.36						
16	0.0469	1.18						
30	0.234	0.600				1		
50	0.0117	0.300						
100	0.0059	0.150						
200	0.0029	0.075						
		Pan						
Cla	ssification of s	sample :	% Gravel :	18.1	% Sand :	47.7	% Silt and Clay :	34.2
10	0							
90	0							
2 ⁰ 80	o							
15 70	0				1111			
<u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u>	0							
10 40	0							
0 30	0				++++			
10	0							
	0							
	0.01		0.1		1		10	100
				Grain S	Size in Millime	eters		

Remarks :

Laboratory Supervisor : R. . Com Record P:12007/1026929\Lab Testing\Wash Sieve, TP66, SS-4,xls

Date: 1112212007

	W	2781 Lancaster Ottawa ON, K1	Rd. B 1A7				Wash \$	Sieve Analysis
Client :	httord	Mattamy Ho	mes				Project No.	1026929
Project :		Mattamy Ho	nes, Richmond				lest Method :	LS 602 (ASTM C136
Material 7	Гуре :	Soils / Aggre	egate:					N 1/A
Proposed	Use :	Fill / Granula	irs:				Sample No. :	N/A
Supplier :		N/A						
Source :	Francis	1P-48						
Sampled	From :	BS-3					Date Sampled	14-Jun-0)
Sampleu Tested B	by: v·	Eric Navlor	F1				Date Tested	21-Jun-0
					-		A CALL IN TAXA	10 10 10 10 L
the states			INT. SIZE TO	vasn	lest Dat	a		
San	nple Weight	Before Sieve :	ACON MARSHIE	S	ample Weig	nt Before Wash :	254.2	Corrected
Sa	mple Weigh	t Aftter Sieve :	and the second s		Sample vve	Ight After Wash :	8.3	Corrected
	% L	loss in Sieve :	5-1)- //E	-	%	Passing No.200	90./	N/A
食汤服	Non Other Ha			Sieve	Analysis		大学 全部的 利利	为这些中国的
Sieve	Size of	Opening	Wt. Retained	Cum Wt. Retained % Passing		Specific	cations	
No.	Inches	mm	grams	g	rams		Min	Max
	3	76.2						
	2	53.0						
	1	26.5						
	3/4	19.0						
	5/8	16.0						
	1/2	13.2						
	3/8	9.5			4.6	00.4		
+4	0.187	4.75			6.7	33.4		
-	0.0027	- 4./5			0.7			-
8	0.0937	2.30						
10	0.0409	0.600						
50	0.234	0.000		-				
100	0.0059	0.150						
200	0.0029	0.075						
		Pan						
Cla	ssification of	sample :	% Gravel ;	0.6	% Sand :	2.6	% Silt and Clay :	96.7
Percent Passing 5 5 4 5 9 4.86								

1

Grain Size in Millimeters

Remarks:

0.01

Laboratory Supervisor : B. Con Record P:\2007\1026929\Lab Testing\Wash Sieve, TP48, SS-3.xls

0.1

Date: June 22/2007

100

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N	2781 Lancaster Rd. Ottawa ON, K1B 1A7	Wash Sieve Analysi				
Client :	Mattamy Homes	Project No.	1026929			
Project :	Mattamy Homes, Richmond	Test Method :	LS 602 (ASTM C136)			
Material Type :	Soils / Aggregate:					
Proposed Use :	Fill / Granulars:	Sample No. :	N/A			
Supplier :	N/A					
Source :	TP-48					
Sampled From :	BS-7					
Sampled By :	Jeff Forrester	Date Sampled :	14-Jun-07			
Tested By :	Eric Naylor	Date Tested :	20-Jun-07			
	Wash Test Da	ta	THE PARK			

Sample Weight Before Sieve :		Sample Weight Before Wash				385		
Sa	ample Weight	Aftter Sieve :	ANTES IN STREET	l	Sample Wei	ght After Wash :	232	Corrected
	% L	oss In Sieve :			%	Passing No.200	39.7	N/A
A STREET				Sieve	Analysis			
Sieve	Size of	Opening	Wt. Retained	Cum W	/t. Retained	% Passing	Speci	fications
No.	Inches	mm	grams	g	rams		Min	Max
	3	76.2						
	2	53.0						
	1	26.5						
ļ	3/4	19.0						
	5/8	16.0						
	1/2	13.2						
	3/8	9.5						
+4	0.187	4.75			44.7	88.4		
		- 4.75		1 7	231.9			
8	0.0937	2.36						
16	0.0469	1.18						
30	0.234	0.600						
50	0.0117	0.300						
100	0.0059	0.150						
200	0.0029	0.075						
		Pan						
Cla	ssification of a	sample :	% Gravel	11.6	% Sand :	48.6	% Silt and Clay :	39.7
10()							
90	5 _							
P 80	D				++++			
is 70	2							
6 50								
tia 40	0				++++			
2 3(D							
6 20								
	ō							
	0.01		0.1		1		10	100
				Grain S	Size in Millime	eters		

Remarks :

Laboratory Supervisor : Brian Perest

Date: June 21/2007

P:\2007\1026929\Lab Testing\Wash Sieve, TP48, SS-7,xls

N	2781 Lancaster Rd. Ottawa ON, K1B 1A7	Wash Sieve Analysis			
Client :	Mattamy Homes	Project No. :	1026929		
Project :	Mattamy Homes, Richmond	Test Method :	LS 602 (ASTM C136)		
Material Type :	Soils / Aggregate:				
Proposed Use :	Fill / Granulars:	Sample No. :	N/A		
Supplier :	N/A				
Source :	TP-54				
Sampled From :	BS-3				
Sampled By :	Jeff Forrester	Date Sampled :	14-Jun-07		
Tested By :	Eric Naylor	Date Tested :	21-Jun-07		

	的原题则可以		Real Street	Nash	Test Data		·····································	and the second	
Sar	nple Weight E	Before Sieve :	Bundara A Real	S	ample Weigh	nt Before Wash :	259.3		
Sa	ample Weight	Aftter Sieve :	and the local	1 V	Sample Wei	ght After Wash :	9.5	Corrected	
	% L	oss In Sieve :			%	Passing No.200	96.3	N/A	
AND TH				Sieve	Analysis				
Sieve	Size of	Opening	Wt. Retained	Cum W	t. Retained	% Passing	Specif	ications	
No.	Inches	mm	grams	9	rams		Min	Max	
	3	76.2							
	2	53.0							
	1	26.5							
	3/4	19.0							
	5/8	16.0							
	1/2	13.2							
	3/8	9.5							
+4	0.187	4.75			0.0	100.0			
		- 4.75							
8	0.0937	2.36	1						
16	0.0469	1.18							
30	0.234	0.600							
50	0.0117	0.300							
100	0.0059	0.150							
200	0.0029	0.075							
		Pan							
Cla	ssification of s	sample :	% Gravel ;	0.0	% Sand :	3.7	% Silt and Clay :	96.3	
10	0							<u>, , , , , , , , , , , , , , , , , , , </u>	
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<u>6</u> 5	0			_	++++				
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	·			Grain S	Size in Millime	eters			

Remarks :

Laboratory Supervisor : B. Con Russ

Date: June 22/2007

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APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2A TO 4B - SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG4683-1 - TEST HOLE LOCATION PLAN

DRAWING PG4683-2 - PERMISSIBLE GRADE RAISE PLAN

DRAWING PG4683-3 - TREE PLANTING SETBACK RECOMMENDATIONS

KEY PLAN

FIGURE 1

















ELEVATIONS FOR THE TEMPORARY BENCHMARK. ASSUMING THAT THE GROUND SURFACE HAS NOT BEEN MODIFIED SINCE THE TEST PITS WERE COMPLETED, PATERSON INTERPOLATED THE GROUND SURFACE ELEVATIONS AT THESE TEST PITS BASED ON THE MOST RECENT TOPOGRAPHIC SURVEY PROVIDED BY MATTAMY HOMES COMPLETED BY LATE 2018.

natorcongroup					MATTAMY HOMES
patersongroup					GEOTECHNICAL INVESTIGATION
consulting engineers					PROPOSED RESIDENTIAL DEVELOPMENT - OTTAWA STREET - RICH
					OTTAWA,
154 Colonnade Road South					Title:
Ottawa, Ontario K2E 7J5	0				TEST HOLE LOCATION PLAN
Tel. (615) 226-7361 Fax. (615) 226-6344		REVISIONS	DATE	INITIAL	

SCALE: 1:5000

			5					
	0	50	100	150	200	2	50	300m
	Scale:			Date:				
		1:5000		11/2018				
	Drawn by:			Report No.:				
IMOND		RCG			F	'G468	3-1	
ONTARIO	Checked by:			Dwg. Ne	o.:			
		RG			DC	165	22	.1
	Approved by:				F G	101	53	•
		DJG		Revisio	n No.:	0		



	0	50	100	150	200	250	300m		
	Scale:			Date:					
		1:5000			11	/2018			
	Drawn by:			Report No.:					
IMOND		RCG			PG	64683-1			
ONTARIO	Checked by:			Dwg. No.:					
		RG		D	21	603	2		
	Approved by:			F V	34	003	-2		
		DJG		Revision No	.:	0			



			400	150		050			
	U	50	100	150	200	250	300m		
	Scale:			Date:					
		1:5000			11	/2018			
	Drawn by:			Report No.:					
IMOND		RCG			PG	64683-1			
ONTARIO	Checked by:			Dwg. No.:					
		RG		D	21	603	2		
	Approved by:			- FG4003-3					
		DJG		Revision No.	:	0			