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Geotechnical Investigation

Proposed Commercial Development Earl Armstrong Road at Limebank Road Ottawa, Ontario

Prepared For

Morguard Investments

January 28, 2013

Report: PG2744-1

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Studies

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1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by Morguard Investments to conduct a geotechnical investigation for the proposed commercial development to be located at the southeast corner of the intersection of Earl Armstrong Road and Limebank Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were:

- to determine the subsurface soil and groundwater conditions by means of boreholes,
- to provide geotechnical recommendations pertaining to 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. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 PROPOSED PROJECT

It is understood that the proposed commercial development will consist of several small to medium sized slab-on-grade buildings and a large anchor store of slab-on-grade construction. It is further understood that associated access lanes, parking and landscaped areas will occupy the remainder of the site.

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3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

Field Program

The field program for the investigation was conducted on December 13, 14, 17, 18 and 19, 2012. At that time, twenty-eight (28) boreholes were completed by Paterson to provide general coverage of the subject site. The locations of the test holes are shown on Drawing PG2744-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples were recovered from the auger flights or a 50 mm diameter split-spoon sampler. The soil from the auger flights and split-spoon samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. The depths at which the auger flight and split-spoon samples were recovered from the boreholes are depicted as AU and SS, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

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

Undrained shear strength testing, using a vane apparatus, was conducted at regular intervals of depth in cohesive soils.

The thickness of the overburden was evaluated by dynamic cone penetration testing (DCPT) at BH 2, BH 9 and BH 15. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Flexible PVC standpipes were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test hole locations were selected by Paterson and surveyed by Annis, O'Sullivan, Vollebekk. The ground surface elevations at the test hole locations are referenced to a geodetic datum. The locations and ground surface elevations of the test holes are presented on Drawing PG2744-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

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

3.4 Analytical Testing

One (1) soil sample from the subject site was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the soil. The analytical test results are presented in Appendix 1 and discussed in Subsection 6.7. Ottawa

4.0 OBSERVATIONS

4.1 Surface Conditions

The subject site is relatively flat, grass covered and recently used for agricultural purposes. The site is bordered to the north and west by Earl Armstrong Road and Limebank Road, respectively, to the south by agricultural land and to the east by a drainage ditch followed by agricultural land. Standing water was noted within the southeast portion of the site at the time of our investigation. The subject site is slightly below grade of adjacent roadways.

4.2 Subsurface Profile

Generally, the subsurface conditions encountered at the test hole locations consist of a thin layer of topsoil/agricultural disturbed zone overlying a brown silty clay crust layer followed by a grey silty clay deposit. Practical refusal to DCPT was encountered between 15.6 to 16.4 m depth at BH 2, BH 9 and BH 15.

Silty Clay

Based on our findings, a 13 to 14 m thick silty clay deposit is present which consists of an upper weathered, brown silty clay crust extending to depths varying between 3.1 to 4.3 m below existing ground surface. A total of sixteen (16) representative soil samples of the weathered brown silty clay were submitted for moisture contents with results varying between 25 to 32%. The results of the undrained shear testing within the weathered brown silty clay crust varied between 60 to 250 kPa, which are indicative of a hard to stiff deposit.

The undrained shear strength testing completed within the underlying grey silty clay varied between 25 to 90 kPa which are indicative of a firm to stiff consistency.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the interbedded quartz sandstone, sandy dolostone and dolostone of the March Formation is expected to be encountered at depths ranging from 15 to 25 m.

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4.3 <u>Groundwater</u>

Groundwater levels were measured in the standpipes on January 2, 2013 and are presented on the Soil Profile and Test Data sheets in Appendix 1. It should be noted that perched water can become trapped within the backfilled borehole, which can lead to higher than normal groundwater readings. The long term groundwater level can also be estimated based on the recovered soil sample's moisture level and consistency. Based on these observations, the long term groundwater table is anticipated to be at a 2 to 3 m depth. It should be further noted that the groundwater level could vary at the time of construction.

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5.0 DISCUSSION

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed development. It is expected that the proposed commercial buildings will be founded by conventional shallow footings placed on an undisturbed, stiff silty clay bearing surface.

Due to the presence of the underlying sensitive silty clay, the subject site will be subjected to permissible grade raise restrictions. If the grade raise restrictions are exceeded, several options are available, such as a preload/surcharge program or the placement of lightweight fill below the proposed buildings.

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.

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

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, the material should be compacted in thin lifts to a minimum density of 95% of the respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Based on the results of the geotechnical investigation, lightly loaded structures, such as the buildings anticipated, could be founded on shallow footings bearing on a stiff brown silty clay crust.

Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**. A geotechnical resistance factor of 0.5 was applied to the above-noted bearing resistance value at ULS.

Footings designed using the above-noted bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

Based on the silty clay layer depth and stiffness of the deposit, the following permissible grade raises are recommended for the subject site:

□ A permissible grade raise restriction of 1.2 m is recommended for the proposed buildings across the subject site.

A permissible grade raise restriction of 2 m is recommended for parking areas and access roadways.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics have been conservatively estimated based on the shear strength of the clay and the subsoil conditions observed at the borehole locations.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for the foundations considered at this site. The soils underlying the proposed shallow foundations are not susceptible to liquefaction for the local seismicity. Reference should be made to the latest revision of the 2006 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab on Grade Construction

With the removal of the topsoil layer 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 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 consists of OPSS Granular A 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 the SPMDD.

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5.6 **Pavement Structure**

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

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

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

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

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type 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 98% of the SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

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 the load bearing capacity.

Due to the impervious nature 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 shaped to promote water flow to the drainage lines.

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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. It is understood that the proposed buildings will be of slab-ongrade construction, however, it should be noted that the perimeter foundation drainage system provides an outlet for perched water below the proposed sidewalks anticipated to be surrounding the subject buildings. Due to the native soils consisting of a low permeability silty clay, a bath tub effect can occur around the proposed buildings, where surface water infiltrating below the proposed sidewalks can become trapped within the foundation backfill soils. Perched water around the proposed buildings can lead to heaved sidewalks during freeze/thaw cycles. If a perimeter drainage system is to be used, the system should consist of a 100 to 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 structures. 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. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose. 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 blanket, such as Miradrain G100N or Delta Drain 6000.

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.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 <u>Excavation Side Slopes</u>

The side slopes of excavations in the soil and fill overburden materials should be either cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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

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

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

6.4 Pipe Bedding and Backfill

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A crushed stone. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

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

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

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

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long (in the trench direction) 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 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 <u>Groundwater Control</u>

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

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

6.6 <u>Winter Construction</u>

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.

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Corrosion Potential and Sulphate 6.7

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

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.

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

A report confirming that 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.

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8.0 STATEMENT OF LIMITATIONS

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

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

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

Paterson Group Inc.

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng.

Report Distribution:

- □ Morguard Investments (3 copies)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

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Practical DCPT refusal at 16.41m												
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TOPSOIL	_	₿AU	1			- 0-	-92.16						
Hard to very stiff, brown SILTY CLAY	6	ss	2	100	8	1-	-91.16	0					
- stiff by 2.6m depth						2-	-90.16			2			
3.09	5					3-	-89.16						
Firm to stiff, grey SILTY CLAY						4-	-88.16						
						6-	-86.16						
End of Borehole		+											
(GWL @ 3.10m-Jan. 2, 2013)								20 Sheai ▲ Undistu	40 0 r Streng rbed △	50 80 1 th (kPa)	100		

natersonard		In	Con	sulting		SOI	l pro	FILE AND TEST DATA				
154 Colonnade Road South, Ottawa, Or	ntario	Р К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa. Ontario							
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	/an,	Vollebekk	Limited.	FILE NO. DC0744				
REMARKS E 370363; N 5016035												
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 13, 201	2 BH 4				
	БОЛ	SAMPLE				DEPTH	ELEV.	Pen. Resist. Blows/0.3m				
SOIL DESCRIPTION	A PI		Ř	IRY	Ë Q	(m)	(m)		tructi			
	TRAT	ТХРЕ	UMBE	COVE	VALI R			• Water Content %	Cons			
GROUND SURFACE	ũ	_	Z	RE	zŐ	0	-01 00	20 40 60 80				
TOPSOIL	8	S AU	1				91.99					
			0	100	F	1-	-90.99					
		80	2	100	5		00.00					
Hard to very stiff, brown SILTY												
CLAY						2-	- 89 99	24				
							00.00		F			
								15				
- stiff by 2.9m depth						3-	- 88 99					
							00.99					
3.70								4				
						1-	97.00					
						4	07.99					
							00.00					
Firm to stiff, grey SILTY CLAY						5-	- 66.99	$\begin{array}{c} \bullet \\ \bullet $				
							05.00					
						6-	-85.99					
6.55	;fXZ	-										
(GWL @ 2.18m-Jan. 2, 2013)												
								20 40 60 80 100				
								Snear Strength (kPa) ▲ Undisturbed △ Remoulded				

natoreonar		In	Con	sulting		SOIL PROFILE AND TEST DATA						
154 Colonnade Road South, Ottawa, O	Intario	Р К2Е 7	Eng 'J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario							
DATUM Ground surface elevations	provid	ed by	Annis,	O'Sulliv	/an, V	/ollebekk	Limited.		FILE NO.	DC0744	1	
REMARKS E 370377; N 5015993										PG2/44	•	
BORINGS BY CME 55 Power Auger				DA	TE [Decembe	r 13, 201	2	HOLE NO.	BH 5		
	Б	SAMPLE				NEDTH	FLEV	Pen. R	esist. Blov	n n		
SOIL DESCRIPTION	A PL		ĸ	RY	۲ ۲	(m)	(m)	50 mm Dia. Cone			mete	
	RAT	TRAT TYPE			/ALU RQI			• Water Content %			^o iezo	
GROUND SURFACE	5		N	REC	z Ö			20	40 60	80		
TOPSOIL 0.3	0					0-	-92.12					
Hard to very stiff, brown SILTY						1 -	-91.12					
CLAY						2-	-90.12					
<u>3.2</u>	0					3-	-89.12		*			
Firm to stiff, grey SILTY CLAY						5-	-87.12	A 				
6.5	5					6-	-86.12					
GWL @ 4.62m-Jan. 2, 2013)												
								20 Shea ▲ Undist	40 60 ar Strength urbed △ F	80 I (kPa) Remoulded	100	

natoreonard	In	Con	sulting		SOI	ST DATA						
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Engi 7J5	ineers	Geo Pro Otta	otechnic p. Comi awa. Or	cal Inves mercial I ntario	tigation Developme	ent-Earl A	Armstrong R	ld.	
DATUM Ground surface elevations p	provid	ed by	Annis,	O'Sulliv	van, V	ollebekk	Limited.		FILE NO.	PC 2744		
REMARKS E 370315; N 5015956										FG2744	•	
BORINGS BY CME 55 Power Auger				DA	TE D	ecembe	r 17, 201	2		[°] BH 6	- 1	
	E01		SAM	PLE		DEPTH ELE	ELEV.	ELEV. Pen. Re		esist. Blows/0.3m		
SOIL DESCRIPTION	A PJ		R	RY	ËQ	(m)	(m)	• 5		a. Cone	pmet	
	FRAT	LYPE	JMBE	~ E	r RQ			• Water Content %			ons;	
GROUND SURFACE	ν.		N	RE(z ^ö	0	00.00	20	40 6	0 80		
TOPSOIL0.30		8 AU	1			0-	-92.36					
		17										
		ss	2	100	7	1-	-91.36	Ċ	> 			
		1										
Very stiff to stiff, brown SILTY CLAY		1										
						2-	-90.36					
]										
						3-	-89.36					
						-						
3 70								4				
		1				4-	-88.36					
									.			
Firm to stiff, grey SILTY CLAY		1				5-	87.36	4				
						6-	-86.36					
		1										
6.55	5 <i>711</i> 2	1										
(GWL @ 2.56m-Jan. 2, 2013)												
											_	
								20 Shea	40 6 ar Strena	80 80 ⁻ th (kPa)	100	
								▲ Undist	urbed ∆	Remoulded		

natersonard		In	Con	sulting		SOIL PROFILE AND TEST DATA						
154 Colonnade Road South, Ottawa, Or	ntario	K2E 7	Eng J5	ineers	G Pi	eotechnic rop. Com ttawa Or	cal Invest mercial E stario	tigation Development-Earl Armstrong Rd.				
DATUM Ground surface elevations p	orovide	ed by /	Annis,	O'Sulliv	van, '	Vollebekk	Limited.	FILE NO.				
REMARKS E 370331; N 5015918												
BORINGS BY CME 55 Power Auger	1			DA	TE	Decembe	r 17, 201	2 BH 7				
SOIL DESCRIPTION	PLOT		SAM	IPLE			ELEV.	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				
	STRATA	ТҮРЕ	NUMBER	% ECOVERY	N VALUE or RQD	N VALUE OF ROD		Water Content % Unit of the second				
GROUND SURFACE				<u></u>	-	- 0-	92.05	20 40 60 80				
Very stiff to stiff brown SILTY CLAY		ss	1	100	7	1-	-91.05	оо. о. о.				
Very sun to sun, brown SILTY CLAY						2-	-90.05					
<u>3.70</u>						3-	-89.05					
						4-	-88.05					
Firm, grey SILTY CLAY						5-	-87.05					
<u>6.5</u> 5						6-	-86.05					
(GWL @ 1.90m-Jan. 2, 2013)								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded				

natoreonard		In	Con	sulting		SOI	l pro	FILE AND TEST DATA
154 Colonnade Road South, Ottawa, O	ntario	К2Е 7	Eng J5	ineers	Ge Pr	eotechnic op. Comi	cal Invest mercial C	tigation Development-Earl Armstrong Rd.
DATUM Ground surface elevations p	orovid	ed by <i>i</i>	Annis,	O'Sulliv	ran, N	Vollebekk	Limited.	FILE NO. DC0744
REMARKS E 370398; N 5015959								
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 14, 201	2 BH 8
	LO		SAM	IPLE		DEPTH	ELEV.	Pen. Resist. Blows/0.3m
SOIL DESCRIPTION	A PI		R	RY	Be.	(m)	(m)	• 50 mm Dia. Cone
	TRAT	TYPE		COVE	VALI RQ			• Water Content %
GROUND SURFACE	ũ	_	N.	RE	zö	0-	02.20	20 40 60 80
TOPSOIL0.28	3	_] 0-	-92.20	
Hard to stiff, brown SILTY CLAY		ss	1	100	8	1-	-91.28	
						2-	-90.28	
3.20)					3-	-89.28	
Firm to stiff, grey SILTY CLAY						4-	-88.28	
						5-	-87.28	
6.55	5					6-	-86.28	
End of Borehole								
(GWL @ 1.70m-Jan. 2, 2013)								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

Patci Soligioup Engineers Geotechnical Investigation	
154 Colonnade Road South, Ottawa, Ontario K2E 7J5 Colonnade Road South, Ottawa, Ontario K2E 7J5	d.
DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Limited. FILE NO.	
PG2744	
BORINGS BY CME 55 Power Auger DATE December 14, 2012 HOLE NO. BH 9	
당 SAMPLE Pen. Resist. Blows/0.3m	. c
SOIL DESCRIPTION 법 DEPTH ELEV. ● 50 mm Dia. Cone	meter
LE BURNER Content %	Diezo
GROUND SURFACE	
TOPSOIL 0-91.88 0.33 AU 1	
SS 2 100 4 1 90.88	1
Very stiff to stiff brown SILTY CLAY	
2-89.88	***
	ततित तत्तत
3.05	
4+87.88	
Firm to stiff, grey SILTY CLAY	
5-86.88	
6-85.88	
commenced at 6.55m depth. Cone	-
pushed to 14.0m depth.	-
	-
8 83.88	-
	-
20 40 60 80 Shear Strength (kBa)	00
▲ Undisturbed △ Remoulded	

natersonard		Consultin			SOIL PROFILE AND TEST DATA						
154 Colonnade Road South, Ottawa, Or	ntario	ГР К2Е 7	Eng J5	jineers	Geo	otechnic op. Comi	cal Inves mercial [tigation Developm	ent-Earl	Armstrong Re	d.
DATUM Ground surface elevations p	orovido	ed by .	Annis,	, O'Sulliv	Οπ /an, V	ollebekk	Limited.		FILE NO	D 00744	
REMARKS E 370383; N 5015914										PG2744	
BORINGS BY CME 55 Power Auger				DA	TE D	ecembe	r 14, 201	2		^{D.} BH 9	
	Ę		SAN	IPLE				Pen. R	esist. Bl	ows/0.3m	
SOIL DESCRIPTION	A PLC		r.	ЗХ	۳o	DEPTH (m)	ELEV. (m)	• 5	i0 mm Di	a. Cone	meter
	TRAT	ТҮРЕ	UMBEI	COVEI	VALU r roi			• v	Vater Co	ntent %	Piezo Consti
GROUND SURFACE	ō	_	z	RE	zö	۹-	- 82 88	20	40	60 80	
						9	02.00				
						10					
						10-	-81.88				
						11-	-80.88				
											•
						12-	-79.88				
						13-	-78.88				
						-					
						14	77.00				
						14-	- / / .00				
											-
								I			
						15-	-76.88				
15.72		+									•
Practical DCPT refusal at 15.72m											
depth											
(GWL @ 1.65m-Jan. 2, 2013)											
								20 Shea	40 ar Stren <u>c</u>	60 80 1 jth (kPa)	00
								▲ Undist	turbed 2	Remoulded	

natersonard		n	Con	sulting	J	SOI	L PRO	FILE AI	ND TES	T DATA	
154 Colonnade Road South, Ottawa, Or	ntario	Р К2Е 7	Eng J5	ineers	P	eotechnic rop. Com	cal Inves mercial [ptario	tigation Developm	ent-Earl A	rmstrong Re	d.
DATUM Ground surface elevations p	provide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS E 370375; N 5015866										PG2/44	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 19, 201	2	HOLE NO.	BH10	
	E		SAN	IPLE		DEDTU	/	Pen. R	esist. Blo	ws/0.3m	<u> </u>
SOIL DESCRIPTION	PLC			ĸ	M -	_ DEPTH (m)	ELEV. (m)	• 5	50 mm Dia	Cone	mete
	RATA	ΥРЕ	MBER	OVER	ROD	a		• •	Vater Con	tent %	iezoi
GROUND SUBFACE	ST	H	Ю N	REC	N O			20	40 60) 80	۵Ğ
	5					- 0-	-92.38				
Very stiff to stiff, brown SILTY CLAY		ss	1	100	5	1-	-91.38	0			Ţ
						2-	-90.38				
<u>3.2</u> 0		-				3-	-89.38	A.			
Firm to stiff, grey SILTY CLAY						4-	-88.38	4			
						5-	-87.38	4		· · · · · · · · · · · · · · · · · · ·	
						6-	-86.38		A		
End of Borehole		-									
(GWL @ 0.74m-Jan. 2, 2013)								20 Shea ▲ Undisi	40 60 ar Strengt turbed △) 80 1 h (kPa) Remoulded	00

naterconard	ור	In	Con	sulting	1	SOI	l pro	FILE AI	ND TEST	DATA	
154 Colonnade Road South, Ottawa, Or	ineers	G Pi	eotechnic rop. Com	cal Inves mercial [ptario	tigation Developm	ent-Earl Ar	mstrong Re	d.			
DATUM Ground surface elevations p	provid	ed by a	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS E 370433; N 5015901										FG2744	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 14, 201	2	HOLE NO.	BH11	
	텅		SAN	IPLE		ПЕРТЦ		Pen. R	Resist. Blov	vs/0.3m	- u
SOIL DESCRIPTION	A PL		~	Х	ы о	(m)	(m)	• 5	50 mm Dia.	Cone	mete
	RAT	ТРE	MBEI		VALU RQI			0	Nater Conte	ent %	iezo onsti
GROUND SURFACE	LS LS	E F	NN	REC	N OL			20	40 60	80	шÖ
TOPSOIL 0.28	8	§ AU	1			- 0-	-92.32				
[
		17									₩₹
		ss	2	100	7	1-	-91.32				
		11									
Vory stiff to stiff brown SILTY CLAY		∦ ss	3	100	4						
		1			•	2-	90.32				
								4			
						3-	89.32				
<u>3.7</u> 0								4			
						4-	88.32				
Firm, grey SILTY CLAY						5-	87.32				
							07.02				
						6	06.22		4		
						0-	-00.32				
6.55											
(GWL @ 0.76m-Jan. 2, 2013)											
								20	40 60	80 1	 00
								She	ar Strength	(kPa)	
	1							🔺 Undis	turbed \triangle F	Remoulded	

naterconard	וור	In	Con	sulting		SOI	l pro	FILE AI	ND TEST	DATA	
154 Colonnade Road South, Ottawa, Ot	ntario	К2Е 7	Eng J5	ineers	Ge Pr	eotechnic rop. Com	cal Inves mercial [tigation Developm	ent-Earl Ar	mstrong R	d.
DATUM Ground surface elevations p	orovide	ed by	Annis,	O'Sulliv	/an, \	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS E 370343; N 5015841										PG2/44	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 14, 201	2	HOLE NO.	BH12	
	텅		SAN	IPLE		ПЕРТН		Pen. R	esist. Blov	vs/0.3m	r n
SOIL DESCRIPTION	A PL		~	Х	ы о	(m)	(m)	• 5	50 mm Dia.	Cone	mete 'uctic
	RAT	ЪE	MBEI		VALU			0	Vater Conte	ent %	onsti
GROUND SURFACE	ST	H	NN NN	REC	N O			20	40 60	80	щО
TOPSOIL 0.30)	🕈 AU	1			- 0-	-92.56				
		17									₩₩
		ss	2	100	7	1-	-91.56				
Very stiff to stiff, brown SILTY CLAY											
										· · · · · · · · · · · · · · · · · · ·	
						2-	-90.56				1
								//			
						3-	-89.56				
<u>3.40</u>											
								4	×.		
						4-	- 88 56				
							00.00				
Firm, grey SILTY CLAY						_	07 50				
						5-	-87.56	4	f		
						6-	-86.56				
6.55											
End of Borehole											
(GWL @ 0.82m-Jan. 2, 2013)											
								20 She	40 60 ar Strength	80 1 (kPa)	00
								▲ Undis	turbed \triangle F	Remoulded	

naterconard		In	Con	sulting	1	SOI	l pro	FILE AI	ND TEST	DATA	
154 Colonnade Road South, Ottawa, O	ntario	Р к2е 7	Eng J5	ineers	F	Geotechnic Prop. Com	cal Inves mercial E stario	tigation Developm	ent-Earl Ar	mstrong R	d.
DATUM Ground surface elevations p	provide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS E 370478; N 5015840										PG2/44	
BORINGS BY CME 55 Power Auger	1	1		DA	ΑTE	Decembe	r 14, 201	2		BH13	
	Б		SAN	IPLE		DEPTH	FLEV	Pen. R	esist. Blov	vs/0.3m	re no
SOIL DESCRIPTION	A PL		ĸ	RY	빋	(m)	(m)	• 5	i0 mm Dia.	Cone	mete
	TRAT.	LYPE	JMBE	SOVE:	VALU			• v	Vater Conte	ent %	^o iezc
GROUND SURFACE	2		N	REC	z č	5	00 55	20	40 60	80	шО
TOPSOIL 0.33	8					0-	92.55				
		17				1_	01 55				
		ss	1	100	6		91.55				
Very stiff to stiff, brown SILTY CLAY											
						2-	-00 55			1	
							30.33	<i> </i>			
						3-	- 89 55	<u> </u>			
<u>3.2</u> 0						5-	-09.00				
								4	F		
						1-	00 55				
						4-	66.55				
Firm, grey SILTY CLAY						-	07 55				
						5-	-87.55				
							00 55				
						6-	-86.55				
6.55	;///	1									
(GWL @ 0.87m-Jan. 2, 2013)											
								20	40 60	80 1	- 00
								Snea ▲ Undisi	turbed \triangle F	r (kra) Remoulded	

natoreonard		In	Con	sulting	1	SOI	L PRO	FILE AI	ND TEST	DATA						
154 Colonnade Road South, Ottawa, Or	154 Colonnade Road South, Ottawa, Ontario K2E 7J5									 Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa Ontario 						
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744						
REMARKS E 370348; N 5015784										PG2/44						
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 18, 201	2	HOLE NO.	BH14						
	턴		SAM	IPLE		DEDTU		Pen. R	esist. Blov	vs/0.3m	- <u>-</u> <u>-</u>					
SOIL DESCRIPTION	PL(~	ĸ	ы .	(m)	(m)	• 5	i0 mm Dia.	Cone	nete uctio					
	RATA	YPE	MBER	OVER	ROD	i		• V	Vater Cont	ent %	iezol					
GROUND SURFACE	LS	H	ŊŊ	REC	N OF			20	40 60	80	۳Ğ					
TOPSOIL						- 0-	-92.56									
Very stiff to stiff, brown SILTY CLAY		ss	1	100	7	1-	-91.56		0		Ŧ					
						2-	-90.56	<u> </u>		1.						
<u>3.05</u>						3-	-89.56	A	•							
						4-	-88.56		••••••••••••••••••••••••••••••••••••••							
Firm, grey SILTY CLAY						5-	-87.56	<u> </u>								
						6-	-86.56									
End of Borehole	raze	-														
(GWL @ 0.92m-Jan. 2, 2013)								20 Shea ▲ Undist	40 60 ar Strength turbed △ F	80 1 1 (kPa) Remoulded	00					

natersonard		In	Con	sulting	1	SOI	l pro	FILE AN	ND TES	T DATA	
154 Colonnade Road South, Ottawa, Or	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.									
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	D00744	
REMARKS E 370320; N 5015745										PG2/44	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 18, 201	2	HOLE NO.	BH15	
	텅		SAN	IPLE		DEDTU		Pen. R	esist. Blo	ws/0.3m	<u>۔ د</u>
SOIL DESCRIPTION	PL(~	۲X	ы . ы .	(m)	(m)	• 5	0 mm Dia.	Cone	mete uctic
	RATZ	ЧPE	MBEF	OVEF	VALU			• v	Vater Cont	tent %	iezo onstr
GROUND SURFACE	ST	E E	DN N	REC	N OL			20	40 60	80	шО
TOPSOIL						- 0-	-92.49			·····	
Very stiff to stiff, brown SILTY CLAY		ss	1	100	5	1-	-91.49	ç	>		Ţ
						2-	-90.49			1	
<u>3.0</u> 5						3-	-89.49				
Firm to stiff, grey SILTY CLAY						4-	-88.49				
						5-	-87.49				
6.55 Dynamic Cone Penetration Test						6-	-86.49				
commenced at 6.55m depth. Cone pushed to 12.9m depth.						7-	-85.49				
						8-	-84.49				
						9-	-83.49	20 Shea ▲ Undist	40 60 ar Strengti urbed △) 80 1 h (kPa) Remoulded	00

nat	oreonard					SOIL PROFILE AND TEST DATA						
154 Coloni	nade Road South, Ottawa, On	Itario	K2E 7	Eng J5	ineers	G Pi	eotechnic rop. Comi ttawa Or	cal Inves mercial [ptario	tigation Developme	ent-Earl Ar	mstrong Ro	d.
DATUM	Ground surface elevations p	rovide	ed by .	Annis,	O'Sulliv	/an, `	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS	E 370320; N 5015745										PG2/44	
BORINGS BY	CME 55 Power Auger		1		DA	TE	Decembe	r 18, 201	2		BH15	
		텅		SAN	IPLE		ПЕРТН	FLEV	Pen. Re	esist. Blo	ws/0.3m	25
S	OIL DESCRIPTION	A PL		ĸ	RY	E۵	(m)	(m)	• 5	0 mm Dia.	Cone	mete
		[RAT]	ΓΥΡΕ	JMBEJ	SOVE] №	VALU 2 RQI			• •	later Cont	ent %	^o iezo
GROUND	SURFACE	เง		N	REC	zö		02 10	20	40 60	80	<u> </u>
							9-	-03.49				
												-
							10-	-82.49		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	-
												-
							11-	-81.49				
												-
												-
							12-	80.49				
							13-	-79.49			· · · · · · · · · · · · · · · · · · ·	-
							14-	- 78 49				
								/ 0.10				
							15-	77.49				
												-
End of Bor	<u>15.60</u> ehole		ł									•
Practical D	CPT refusal at 15.60m											
	10.00 (0.0010)											
(GWL@I	. 16m-Jan. 2, 2013)											
									20 Shea	40 60 ar Strengt) 80 10 h (kPa)	00
										urbed Δ	Remoulded	

natersonard		in	Con	sulting		SOI	l pro	FILE AND TEST DATA			
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario						
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.	FILE NO. DC0744			
REMARKS E 370273; N 5015739											
BORINGS BY CME 55 Power Auger	1	1		DA	TE	Decembe	r 19, 201	2 BH16			
	5		SAM	IPLE		DEPTH	ELEV.	Pen. Resist. Blows/0.3m			
SOIL DESCRIPTION	A PI		R	RY	۲e	(m)	(m)	● 50 mm Dia. Cone 50 mm Dia. Cone			
	TRAT	ТУРЕ	UMBE	COVE ∾	VALI RQ			• Water Content %			
GROUND SURFACE	Ω.		ŭ	REC	z ö	0	-02 51	20 40 60 80			
TOPSOIL		_				0-	92.01				
Very stiff to stiff, brown SILTY CLAY		ss	1	100	5	1-	-91.51				
						2-	-90.51	1			
<u>3.05</u>						3-	-89.51				
						4-	-88.51				
Firm to stiff, grey SILTY CLAY						5-	-87.51				
<u>6.5</u> 5						6-	-86.51				
End of Borehole											
(GWL @ 1.54m-Jan. 2, 2013)								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded			

natersonard		In	Con	sulting		SO	L PRO	FILE AI	ND TEST	DATA	
154 Colonnade Road South, Ottawa. Or	ntario	• Р к2е 7	Eng J5	ineers	G P	eotechnic rop. Com	al Inves mercial [tigation Developm	ent-Earl Arn	nstrong Ro	d.
DATUM Ground surface elevations p	provide	ed by <i>i</i>	Annis,	O'Sulliv	∣ 0 ∕an,	Vollebekk	Limited.		FILE NO.	DOOT / /	
REMARKS E 370245; N 5015843		-								PG2744	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 19, 201	2	HOLE NO.	BH17	
	Ĕ		SAM	IPLE				Pen. R	Resist. Blow	s/0.3m	. с
SOIL DESCRIPTION	PLC			ĸ	M -	DEPTH (m)	ELEV. (m)	• 5	50 mm Dia. C	Cone	netei uctio
	RATA	ХРЕ	MBER	over	ROD			0	Nater Conte	nt %	iezor onstr
GROUND SURFACE	ST	H	- NN	REC	и о И			20	40 60	80	٩Ğ
TOPSOIL 0.30		🛱 AU	1			- 0-	-92.14				
0											
		1									
		ss	2	100	5	1-	-91.14		0		
Very stiff to stiff brown SILTY CLAY		14									፼≠፼
									· · · · · · · · · · · · · · · · · · ·		
						2-	-90.14				
										1	
3 20						3-	-89.14				
<u>3.20</u>											
									F		
						4-	-88.14				
Firm to still, grey SILTY CLAY						5-	0711				
							07.14		••••••••••••••••••••••••••••••••••••••		
						6-	-86.14				
6.55											
End of Borehole											
(GWL @ 1.40m-Jan. 2, 2013)											
								<u> </u>	40 60	20 4	
								She	ar Strength	(kPa)	
								▲ Undis	turbed \triangle Re	emoulded	

natersonard		In	Con	sulting	,	SOI	l pro	FILE AND TEST DATA			
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa. Ontario						
DATUM Ground surface elevations p	orovido	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.	FILE NO.			
REMARKS E 370215; N 5015879								FG2744			
BORINGS BY CME 55 Power Auger	1	1		DA	TE	Decembe	r 19, 201	2 BH18			
SOIL DESCRIPTION	LOT		SAN	IPLE		DEPTH	ELEV.	Pen. Resist. Blows/0.3m ● 50 mm Dia, Cone			
	ATA F	田田	BER	VERY	ALUE	(m)	(m)				
GROUND SUBFACE	STR	ТY	MUN	RECO	N VI			20 40 60 80			
TOPSOIL						- 0-	92.36				
Very stiff to stiff, brown SILTY CLAY		ss	1	100	5	1-	-91.36	0			
						2-	-90.36				
<u>3.05</u>						3-	-89.36				
Firm to stiff, grey SILTY CLAY						4-	-88.36				
						5-	-87.36				
6.55						6-	-86.36				
End of Borehole											
(GWL @ 1.31m-Jan. 2, 2013)								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded			

natersonard		in	Con	sulting		SOI	l pro	FILE AN	ND TES	T DATA		
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa Ontario							
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744		
REMARKS E 370242; N 5015870										FG2/44		
BORINGS BY CME 55 Power Auger	1	1		DA	TE	Decembe	r 19, 201	2	HOLE NO.	BH19		
	LOT		SAM	IPLE		DEPTH	ELEV.	Pen. R	esist. Blo	ws/0.3m	er	
SOIL DESCRIPTION	[A P]	ы	IR	ERY	ВQ	(m)	(m)	• 5	u mm Dia.	Cone	omet	
	TRA	ІДХТ	TYP:		ЧAL УAL			• v	Vater Cont	ent %	Piez Cons	
GROUND SURFACE	01		4	RE	z	- 0-	-92.39	20	40 60	80	×× ×	
<u>0.28</u>	VVX	1										
		$\overline{\mathbb{N}}$				1_	01 20					
		ss	1	100	6		91.39	0	· · · · · · · · · · · · · · · · · · ·	•	₩₽₩	
Very stiff to stiff, brown SILTY CLAY												
						2-	-90.39	1				
										· · · · · · · · · · · · · · · · · · ·		
						3-	89.39					
<u>3.70</u>								4				
						4-	- 88 39					
							00.00					
									N.			
Firm to stiff grey SILTY CLAY						_			$\sim 10^{-10}$			
						5-	-87.39					
						6-	-86.39					
6 55										\mathbf{X}		
End of Borehole		+										
(GWL @ 1.24m-Jan. 2, 2013)												
								20 <u>20</u>	<u> </u>	<u> </u>	1 00	
								Shea	ar Strengt	h (kPa)		
								🔺 Undist	urbed $ riangle$	Remoulded		

natoreonar		In	Con	sulting	SOIL PROFILE AND TEST DATA							
154 Colonnade Road South, Ottawa. Or	ntario	Р к2е 7	Eng J5	lineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.							
DATUM Ground surface elevations p	orovide	ed by a	Annis,	, O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	500544		
REMARKS E 370269; N 5015790		-								PG2744		
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 19, 201	2	HOLE NO	BH20		
	Ę		SAN	IPLE				Pen. R	esist. Blo	ows/0.3m		
SOIL DESCRIPTION	A PLO		~	ХХ	ĔО	DEPTH (m)	ELEV. (m)	• 5	0 mm Dia	. Cone	meter	
	FRAT	LYPE	UMBEI	COVEI	VALU r RQI			• v	Vater Con	tent %	Diezo	
GROUND SURFACE	N.		E	REC	z ö	0	02.46	20	40 6	0 80		
TOPSOIL0.28						- 0-	-92.46					
		$\overline{\mathbf{N}}$					01.40					
		ss	1	100	6	1-	-91.46	0		······································	Ī▓₽	
								• • • • • • • • • • • • •				
Very stiff to stiff, brown SILTY CLAY												
						2-	90.46	+				
2.20						3-	89.46					
<u>3.20</u>		1										
								≰ : .				
						1-	- 88 /6			· · · · · · · · · · · · · · · · · · ·		
4.27	Γ <i>Ι</i> Χ						00.40		····	······································		
End of Borehole												
(GWL @ 1.20m-Jan. 2, 2013)												
								20	40 6	<u> </u>	⊣ I 00	
								Shea	ar Streng	th (kPa)		
								↓ ▲ Undist	urbed \triangle	Remoulded		

natoreonard		In	Con	sulting	g SOIL PROFILE AND TEST DATA							
154 Colonnade Road South, Ottawa, Or	ntario	Р к2е 7	Eng J5	lineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.							
DATUM Ground surface elevations p	orovide	ed by a	Annis,	, O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	00074/	•	
REMARKS E 370323; N 5015843										PG2/44	+	
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	<u>r 18, 201</u>	2	HULE NO.	BH21		
	TO		SAN	IPLE		DEPTH	ELEV.	Pen. R	esist. Blo	ws/0.3m	er	
SOIL DESCRIPTION	I PI		ĸ	ïRΥ	ËQ	(m)	(m)	• 5	o mm Dia	. Cone	omet	
	TRAT	ТУРЕ	UMBE	COVE	VALI F RO			• v	Vater Con	tent %	Piez	
GROUND SURFACE	Ω Ω	~~	Z	RE	z ^o	0-	-92 34	20	40 60	0 80		
TOPSOIL		8≩ AU	1				02.01					
		∇			_	1-	-01 3/					
		ss	2	100	5		91.34	C)		🗱 👹	
Very stiff to stiff, brown SILTY CLAY												
						2-	-90.34			······································		
											120 	
<u>3.05</u>		-				3-	-89.34					
Firm, grey SILTY CLAY									Ţ			
						4-	88.34					
4.27	'YXX	-										
(GWI @ 0.97m-lan 2.2013)												
								20 Shee	40 60 ar Strengt) <u>80</u> h (kPa)	100	
								▲ Undist	turbed \triangle	Remoulded		

naterconard		In	Con	sulting	SOIL PROFILE AND TEST DATA						
154 Colonnade Road South, Ottawa, Or	ntario	K2E 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa. Ontario						
DATUM Ground surface elevations p	provide	ed by	Annis,	O'Sulliv	/an, \	/ollebekk	Limited.	FILE NO.			
REMARKS E 370374; N 5015831											
BORINGS BY CME 55 Power Auger				DA	TE [Decembe	r 18, 201	2 BH22			
	Ę		SAN	IPLE		DEPTH	ELEV.	Pen. Resist. Blows/0.3m	re no		
SOIL DESCRIPTION	A PI		ж	RY	ЩО	(m)	(m)	• 50 mm Dia. Cone	mete		
	[RAT	LYPE	JMBE	COVE	VALU			• Water Content %	Diezo		
GROUND SURFACE	ν.	L.	N	REC	n <u>o</u>	0.	02.56	20 40 60 80	-0		
TOPSOIL		§ AU	1				-92.30				
		1			_	1-	-01 56				
		ss	2	100	7		31.50		8		
Very stiff to stiff, brown SILTY CLAY											
						2-	- 90 56				
							30.50				
2 10						3-	- 90 56				
3.10						5	-09.50				
						4-	00 50				
4.27						4	00.00				
End of Borehole											
(GWL @ 0.70m-Jan. 2, 2013)											
								20 40 60 80 100)		
								Shear Strength (kPa) ▲ Undisturbed △ Remoulded			

natersonard		In	Con	sulting		SOI	l pro	FILE AN	ID TEST	DATA		
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario							
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744		
REMARKS E 370402; N 5015813								-		PG2/44		
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 14, 201	2	HOLE NO.	BH23		
	Б		SAN	IPLE		ПЕРТН		Pen. Re	esist. Blov	vs/0.3m	25	
SOIL DESCRIPTION	A PL		æ	RY	Ĕ٥	(m)	(m)	• 50) mm Dia.	Cone	ructio	
	TRAT	IVPE	JMBE 1	SOVE] ∾°	VALU RQI			• w	ater Conte	ent %	^o iezo	
GROUND SURFACE	เง		M	REC	z ^ö		00 50	20	40 60	80	шО	
TOPSOIL 0.33						_ 0-	-92.59					
		0	1	100	7	1-	-91.59					
				100	1							
Very stiff to stiff, brown SILTY CLAY												
						2-	-90.59	A		12	9	
] ¥	
						3-	-89.59					
<u>3.2</u> 0												
								4				
						4-	88.59		\			
						5-	87 59					
							07.00		T.			
						6-	- 86 59		4			
							00.00					
6.55	Γ <i>ΙΧ</i>											
(C)ML @ 2.5m donth based on field												
observations)												
								20	40 60	80 10	1 00	
								Shea	r Strength µrbed △ F	i (KPa) Remoulded		

natoreonard		In	Con	sulting	SOIL PROFILE AND TEST DATA							
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	lineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.							
DATUM Ground surface elevations p	orovide	ed by <i>i</i>	Annis,	, O'Sulliv	/an, `	Vollebekk	Limited.		FILE NO.	D00744		
REMARKS E 370427; N 5015863										PG2744		
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 14, 201	2	BH24			
	Ĕ		SAN	IPLE		DEDTU		Pen. Re	esist. Blo	ows/0.3m		
SOIL DESCRIPTION	PLC			ĸ	F-1 -	DEPTH (m)	ELEV. (m)	➡ 50	0 mm Dia	. Cone	netel uctio	
	RATA	ХРЕ	MBER	OVER	ROD			• w	ater Con	tent %	iezor	
GROUND SURFACE	L.S.	H	D N	REC	N O			20	40 6	0 80	ΓĞ	
TOPSOIL 0.33		🖉 AU	1			- 0-	-92.56					
									· · · · · · · · · · · · · · · · · · ·			
		$\overline{\Lambda}$				-	01 50					
		ss	2	100	6	1-	-91.30					
									· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		
Very stiff to stiff, brown SILTY CLAY						2-	- 00 56			1		
						2	90.00					
										· · · · · · · · · · · · · · · · · · ·	10	
						3-	- 89 56	4				
							00.00					
3.70								4				
Firm. arev SILTY CLAY						4-	-88.56					
4.27		1										
(GWI @ 0.72m-lan 2.2013)												
								20	<u> </u>	<u> </u>	_ 100	
								Shea	r Strengt	th (kPa)		
	1	1								i cinouldeu		

natoreonar	ור	In	Cor	nsulting	ng SOIL PROFILE AND TEST DATA							
154 Colonnade Road South, Ottawa, Or	ntario	Р к2е 7	Eng J5	jineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.							
DATUM Ground surface elevations p	provid	ed by	Annis,	, O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744		
REMARKS E 370294; N 5015892										FG2/44		
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 18, 201	2	BH25			
	5		SAN	IPLE			ELEV	Pen. R	esist. Blo	ws/0.3m	25	
SOIL DESCRIPTION	PL(~	۲X	E o	(m)	(m)	• 5	0 mm Dia.	Cone	mete	
	RATZ	ХРЕ	MBEF	OVEF	ROL			• V	Vater Cont	ent %	iezo	
GROUND SURFACE	LS I	H	DN I	REC	N N OF			20	40 60	80	ЪG	
TOPSOIL 0.30						- 0-	-92.36					
0												
		ss	1	100	7	1-	91.36	0			╶▓₌▓	
		14										
Very stiff to stiff, brown SILTY CLAY												
						2-	90.36			1 		
										1	0 5	
						3-	- 89 36					
3.35							00.00					
								<u> </u>				
Firm, grey SILTY CLAY												
4.27						4-	88.36					
End of Borehole		T										
(GWL @ 1.13m-Jan. 2, 2013)												
								20 Shea	40 60 ar Strengtl	80 1 ו (kPa)	100	
								▲ Undist	urbed Δ	Remoulded		

Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario I54 Colonnade Road South, Ottawa, Ontario K2E 7J5 Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Limited. FILE NO. PG2744 Remarks E 370275; N 5015923 BORINGS BY CME 55 Power Auger DATE December 18, 2012 Soil DESCRIPTION To SaMPLE DEPTH Pen. Resist. Blows/0.3m Sond DESCRIPTION Sample DEPTH Curl Sign Colspan="2">Output suffer Colspan="2">Output suffer Colspan="2">Output suffer Colspan="2">Output suffer Colspan="2">Output suffer Colspan="2">Output suffer Colspan="2">Soil DESCRIPTION Sign Colspan="2">Soil Sign Colspan= 20 Output suffer Colspan="2">Output	torennari	nir	Со	nsulting		SOI	l pro	FILE AND T	EST DATA			
Other is deviced by Annis, O'Sullivan, Vollebekk Limited. FILE NO. PG27744 Marks E 370275; N 5015923 BORINGS BY CME 55 Power Auger DATE December 18, 2012 SOIL DESCRIPTION Image: Sample for the stiff, brown SILTY CLAY Soil Sample for the stiff, brown SILTY CLAY	Donnade Road South, Ottawa, Or	ntario K2E	En En	gineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.							
REMARKS E 370275; N 5015923 BORINGS BY CME 55 Power Auger SOIL DESCRIPTION BATE December 18, 2012 SOIL DESCRIPTION BATE December 18, 2012 SAMPLE BERV (m) BH26 Pen. Resist. Blows/0.3m 50 mm Dia. Cone Cone Somm Dia. Cone Somm Dia. Cone Somm Dia. Cone Somm Dia. Cone SS 1 100 5 1 - 91.27 Very stiff to stiff, brown SILTY CLAY	Ground surface elevations p	provided b	by Annis	s, O'Sulliv	/an, V	ollebekk	Limited.	FILE	NO. DO0744			
BORINGS BY CME 55 Power Auger DATE December 18, 2012 Pen. Resist. Blows/0.3m BH26 SOIL DESCRIPTION Image: Solid bit in the start of the start	s E 370275; N 5015923								PG2744	•		
SOIL DESCRIPTION SAMPLE DEPTH ELEV. (m) Pen. Resist. Blows/0.3m Bows/0.3m GROUND SURFACE 0.30 8 8 92.27 0 92.27 0 92.27 0 92.27 0 92.27 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 92.27 0 0 0 92.27 0 0 0 92.27 0 <	BY CME 55 Power Auger			DA	TE D	Decembe	r 18, 201	2	^{- NO.} BH26			
SOIL DESCRIPTION OIL EVALUATION Depth fill ELEV. (m) • 50 mm Dia. Cone Disputsed GROUND SURFACE 0.30 0.00 0.00 0 92.27 0 40 60 80 Very stiff to stiff, brown SILTY CLAY SS 1 100 5 1 91.27 0 40 60 80	¥	н	SA	MPLE				Pen. Resist.	Blows/0.3m			
SROUND SURFACE SS 1 100 5 1 92.27 • Water Content % 92.27 20 40 60 80 1 100 5 1 91.27 0 1	SOIL DESCRIPTION	A PLO	ď	RY	브ㅇ	DEPTH (m)	ELEV. (m)	● 50 mm	Dia. Cone	meter		
GROUND SURFACE 0 2 2 0 92.27 TOPSOIL 0.30 0 0 92.27 0 0 Very stiff to stiff, brown SILTY CLAY SS 1 100 5 1 91.27		TYPE			VALU F RQ			• Water	Content %	Piezo		
TOPSOIL 0.30 SS 1 Very stiff to stiff, brown SILTY CLAY) SURFACE	03	2	RE	z	0-	- 92 27	20 40	60 80			
Very stiff to stiff, brown SILTY CLAY	IL0.30)				0	52.27					
Very stiff to stiff, brown SILTY CLAY												
Very stiff to stiff, brown SILTY CLAY										. 👹 👹		
Very stiff to stiff, brown SILTY CLAY		S	S 1	100	5	1-	-91.27	Ó	······································			
Very stiff to stiff, brown SILTY CLAY										. 🗱 ី		
	i to stiff, brown SILTY CLAY											
						2-	90.27	<u> </u>	<u>.</u>			
									· · · · · · · · · · · · · · · · · · ·	115		
							00.07					
3-89.27	<u>3.20</u>					3-	-89.27					
Firm, grey SILTY CLAY	ev SILTY CLAY							T				
4 88.27						4-	88.27					
	4.27	'FRA							<u></u>			
	1.00m lan 0.0010)											
(GWL @ 1.20m-Jan. 2, 2013)	(1.20m-Jan. 2, 2013)											
								20 40	60 80 1	100		
Snear Strengtn (kPa) ▲ Undisturbed △ Remoulded								Snear Stre	A Remoulded			

natersonard		in	Con	sulting	g SOIL PROFILE AND TEST DATA							
154 Colonnade Road South, Ottawa, Or	ntario	К2Е 7	Eng J5	ineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd. Ottawa, Ontario							
DATUM Ground surface elevations p	provide	ed by <i>i</i>	Annis,	, O'Sulliv	van, V	ollebekk	Limited.		FILE NO.	D00744		
REMARKS E 370255; N 5015967										PG2/44		
BORINGS BY CME 55 Power Auger				DA	TE D	Decembe	r 18, 201	2	BH27			
	E		SAN	IPLE				Pen. Re	esist. Blo	ws/0.3m	, c	
SOIL DESCRIPTION	PLC			к		DEPTH (m)	ELEV. (m)	● 50	0 mm Dia	. Cone	neter	
	LATA	(PE	IBER	NER %	ALUE			0 M	later Con	tont %	ezor	
	STE	T	Î	RECO	N OF V			20	40 6) 80	ĒS	
TOPSOIL						0-	-92.29					
0.30												
		ss	1	100		1-	-91.29	0				
		14										
Very stiff to stiff, brown SILTY CLAY												
						2-	-90.29			1		
										1	20	
						3-	-89.29					
<u>3.7</u> 0								<u>k</u>				
Firm. grev SILTY CLAY						4-	-88.29					
4.27	'f <i>lX</i>	1					00.20					
(GWL @ 2.04m-Jan. 2, 2013)												
											4	
								20 Shea	40 60 Ir Strengt) 80 1 h(kPa)	00	
								▲ Undist	urbed △	Remoulded		

natoreonar		In	Con	sulting		SOI	l pro	FILE AN	ND TES	T DATA	
154 Colonnade Road South, Ottawa, O	lineers	Geotechnical Investigation Prop. Commercial Development-Earl Armstrong Rd.									
DATUM Ground surface elevations	orovid	ed by a	Annis,	, O'Sulliv	van,	Vollebekk	Limited.		FILE NO.	DC0744	
REMARKS E 370327; N 5015999										PG2/44	·
BORINGS BY CME 55 Power Auger				DA	TE	Decembe	r 17, 201	2	HOLE NO.	BH28	
	5		SAN	IPLE			ELEV	Pen. R	esist. Blo	ows/0.3m	- 5
SOIL DESCRIPTION	A PL		~	Х	ы о	(m)	(m)	• 5	0 mm Dia	. Cone	mete 'uctic
	RAT	ΖЬΕ	MBEI	OVEF	VALU RQI			• v	later Con	tent %	iezo onstr
GROUND SURFACE	ST	F	DN	REC	N O N			20	40 60	0 80	шÖ
TOPSOIL 0.30)	🖉 AU	1			- 0-	-91.97		· · · · · · · · · · · · · · · · · · ·		
		17									
		ss	2	100	6	1-	-90.97				
		1									
Hard to stiff, brown SILTY CLAY						2-	- 89.97			······································	
						3-	88.97				
										· · · · · · · · · · · · · · · · · · ·	
						4-	87 97				
4.27	'f X	4					07.07				
End of Borenole											
(GWL @ 2.04m-Jan. 2, 2013)											
								20	40 6	0 80 1	100
								Snea ▲ Undist	urbed \triangle	n (KPa) Remoulded	

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the 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 i	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 ∇ Sandy Silt Clay Silty Clay Clayey Silty Sand Glacial Till Shale Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION



PIEZOMETER CONSTRUCTION





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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South Nepean, ON K2E 7J5 Attn: Richard Groniger

Phone: (613) 226-7381 Fax: (613) 226-6344

Client PO: 12745	Report Date: 11-Jan-2013
Project: PG2744	Order Date: 7-Jan-2013
Custody: 5707	Order #: 1302042

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID **Client ID** 1302042-01 BH#7 SS1

Dale Robertson, BSc Laboratory Director

Approved By:

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work



Client: Paterson Group Consulting Engineers Client PO: 12745

Project Description: PG2744

Order #: 1302042

Report Date: 11-Jan-2013 Order Date:7-Jan-2013

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date Analysis Date			
Anions	EPA 300.1 - IC, water extraction	9-Jan-13	9-Jan-13		
рН	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	8-Jan-13	8-Jan-13		
Resistivity	EPA 120.1 - probe, water extraction	10-Jan-13	10-Jan-13		
Solids, %	Gravimetric, calculation	9-Jan-13	9-Jan-13		

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Client: Paterson Group Consulting Engineers

Report Date: 11-Jan-2013 Order Date:7-Jan-2013

Client PO: 12745		Project Description	: PG2744		
	Client ID:	BH#7 SS1	-	-	-
	Sample Date:	17-Dec-12	-	-	-
	Sample ID:	1302042-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	69.5	-	-	-
General Inorganics					
рН	0.05 pH Units	7.40	-	-	-
Resistivity	0.10 Ohm.m	25.2	-	-	-
Anions					
Chloride	5 ug/g dry	9	-	-	-
Sulphate	5 ug/g dry	270	-	-	-

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Client: Paterson Group Consulting Engineers

Client PO: 12745

Project Description: PG2744

ug/g ug/g

Ohm.m

Order #: 1302042

RPD

Limit

RPD

Report Date: 11-Jan-2013 Order Date:7-Jan-2013

Notes

Analyta		Reporting		Source		%REC
Analyte	Result	Limit	Units	Result	%REC	Limit

Chloride	ND	5
Sulphate	ND	5
General Inorganics		
Resistivity	ND	0.10

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Client: Paterson Group Consulting Engineers

Client PO: 12745

Project Description: PG2744

Report Date: 11-Jan-2013

Order #: 1302042

Order Date:7-Jan-2013

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	12.7	5	ug/g dry	12.2			4.3	20	
Sulphate	39.6	5	ug/g dry	37.6			5.1	20	
General Inorganics									
рН	7.13	0.05	pH Units	6.88			3.6	10	
Resistivity	77.9	0.10	Ohm.m	80.7			3.5	20	
Physical Characteristics									
% Solids	81.0	0.1	% by Wt.	72.8			10.7	25	

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Client PO: 12745

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Project Description: PG2744

Order #: 1302042

Report Date: 11-Jan-2013 Order Date:7-Jan-2013

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions Chloride Sulphate	10.7 13.3		mg/L mg/L	1.2 3.76	94.4 95.8	78-113 78-111			

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Client: Paterson Group Consulting Engineers

Client PO: 12745

Project Description: PG2744

Report Date: 11-Jan-2013

Order #: 1302042

Order Date:7-Jan-2013

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable ND: Not Detected MDL: Method Detection Limit Source Result: Data used as source for matrix and duplicate samples %REC: Percent recovery. RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'. Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

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Page 7 of 7

Contact Name: Contact Name: Address: 154 Criteria: 10. Reg. 153/04 Table [10. Reg. 153/11 (Cu	TR RE ISSAUGA	USTE SPOI LIAB SAR	ED . NSIV LE . NIA Project # Email / Filing	E. Reference:	6 274 1274: 2 Paters 11PWQ011	He 30 Ot p: e: ww H4	ead Offic 0-2319 : tawa, Oi 1-800-7 paracel ww.paracel ww.paracel vw.paracel 1-800-7 paracel vw.par	ce St. Laur ntario K 49-1947 @paraci cellabs.c	ent Blvd. 1G 4J8 , ellabs.com com	TAT: 1 Date Re itary) Munic	Ch N? Pa WRegula [] 2 Day quired: ipality:	iain of (Lab Us . 5	Custo e Only) 707 (of	dy	
Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Wat	er) SS (Storm/S	anitary Se	wer) P (l	Paint) A (Air) O (C	Other)				Re	quired Ar	alyses				
Paracel Order Number: $\begin{vmatrix} 302042 \\ Sample ID/Location Name \\ 1 \\ BH = 7 \\ 5 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 $	Matrix	Air Volume	- # of Containers	Sample Date Dec 17, 17	Time	× 61	X Chlordes	> Reschick	× Sc/Males		ml				
Comments:		/ [210	17.81	A 100				12	14 3 1		Method	of Delive	ry:	
Relinquished By (Print & Sign): Date/Time:	Receive Date/Tiu Tempera	d by Driv ne: 0 nture:	/er/Depo	JEOUSE 13 4:2	Receive N Z 7 Date/Tin Temper	d at Lab: me: Ta ature: 2	14 F	1131	20-4 5:00	Verified Date/Ti pH Ver	I By: M/ C me: J	lan7 By:	113 N	·/	7

Chain of Custody (Blank) - Rev 0.0 December 2011

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2744-1 - TEST HOLE LOCATION PLAN

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FIGURE 1 KEY PLAN





	91.88	GROUND SUR	FACE ELEVATIO	ON (m)				
	(76.16)	PRACTICAL D	CPT REFUSAL E	ELEVATION (m)				
	BASE PLAN SURFACE E PROVIDED	I, TEST HOLE L ELEVATIONS AT BY ANNIS, O'SU	OCATIONS AND TEST HOLE LO ILLIVAN, VOLLEI	GROUND CATIONS BEKK LIMITED.				
	SCALE - 1:150	0 25 50	0 75	100m				
		Dwg. No. PG2744-1						
LUCATION PLAN			Report No.:	PG2744-1				
		Date:	01/2013					

BOREHOLE LOCATION



LEGEND: