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**G5329**

**DECEMBER 2019**

PRELIMINARY  
GEOTECHNICAL REPORT  
PROPOSED MIXED USE  
DEVELOPMENT  
BARRIE WATERFRONT  
51, 53, 55 & 75 BEDFORD STREET  
& 20 CHECKLEY STREET  
BARRIE, ONTARIO

DISTRIBUTION

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1 COPY (electronic)	BARRIE LAKESHORE DEVELOPMENTS
1 COPY	McCLYMONT & RAK ENGINEERS, INC.

**PREPARED FOR:**

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BARRIE LAKESHORE DEVELOPMENTS

3200 Highway 7  
Vaughan, Ontario  
L4K 5Z5





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## 1.0 INTRODUCTION

Barrie Lakeshore Developments (the Client) retained McClymont & Rak Engineers Inc. (MCR) to prepare a Geotechnical report for the proposed Barrie Waterfront Development located at 51, 53, 55 and 75 Bedford Street and 20 Checkley Street, in the City of Barrie. The development consists of four residential/commercial towers, varying from 22 to 42 floors in height, with no basements or underground parking, hereafter referred to as 'the Site'.

The objective of the report was to discuss design alternatives required for foundations, site preparation, underground utilities and road construction. The above design and construction issues are addressed in the following report.

## 2.0 SITE DESCRIPTION

The Site is designated for a mixed use development including retail, commercial and residential. The Site is currently occupied by a vacant commercial building, associated paved areas and natively vegetated land.

U-Haul Storage enterprise and a commercial property and two condominium buildings with associated parking lot bound the Site to the north, condominium buildings and Lakeshore Drive to the east and Kempenfelt Bay (Lake Simcoe) is located further east.

Overall, the Site topography is relatively flat at an approximate elevation of 221.00 m. The topography slopes slightly to the east towards Kempenfelt Bay, which is located less than 100.00 m to the east of the Site.

## 3.0 SITE INVESTIGATIONS

MCR reviewed the previous investigations, a total of forty boreholes were drilled, by others, in December 2007, January/May and June 2008 (by Peto MacCallum/Terraprobe) and August 2013 (Brown Associates Limited) and GHD (September 2019) at the locations shown on Borehole Location Plan, attached to this report.

The boreholes were advanced to depths ranging from 5.10 to 52.30 m. The Borehole records are attached in Appendix A.

Fifteen boreholes were equipped with monitoring wells for long-term groundwater monitoring.

Borehole elevations by Peto MacCallum/Terraprobe, referred to in this report are metric and geodetic. However, boreholes by Brown Associates Limited and GHD did not provide Geodetic elevations.

In addition, moisture content of all of soil samples and grain size analyses (soil gradation) for selected soil samples from the Peto MacCallum boreholes were determined. The test results are presented in Appendix A.

#### **4.0 SOIL AND GROUNDWATER CONDITIONS**

The flat site, at Elev. 221.00 m, has been investigated by others and the consensus describes the subsurface conditions as deep lacustrine (sedimentary) deposits comprising water borne clays, silts and sands. It is important to note that although southern Ontario has been subject to 4 glacial periods there is only limited indication of till-like deposits (Terraprobe/2008).

In general, based on GHD Boreholes, the Site is underlain by a thin layer of organic material/topsoil (less than 100 mm thick) and fill comprised of silt, silty sand, sand and sand and gravel, which is typically loose, moist and contains trace organics. The fill material extends to depths varying from near ground surface to about 6.00 m below ground surface.

The fill is locally underlain by a peat layer, which was observed at two of the boreholes MW1-19 and MW2-19. The peat is in a wet condition and contains traces of gravel, sand, silt, marl and organics and varies in thickness from less than 1.00 m to approximately 3.50 m.

The fill and peat is underlain by a deposit comprised of sand, silt, and silty sand that is light brown to grey and is generally loose and wet.

The loose to compact deposit typically has N values/low blow counts from 4 to 25 blows per 0.3 m.

This deposit was encountered down to approximate depth of 28.00 m below ground surface. At MW3-19, the SPT 'N' values below a depth of 20 m increased to greater than 50 blows per 0.3 m, indicating a dense condition within the silty sand and silt deposit at this depth.

The grey deposit is in a wet state and contains a stiff clayey silt to silty clay layer, with thickness up to approximately 4.00 m.. The stiff silty clay layer was encountered in MW4-19, MW5-19 and MW6-19 at depths between approximately 13.00 to 17.00 m below ground surface, with low blow counts varying from 3 to 15 blows per 0.3 m, indicating a stiff condition.

## **Fill**

The remaining boreholes contained fill layer covering the entire site and reaching to a depth of some 4 m below grade, Elev. 216.00m. The fill presents, due to a long list of large debris/concrete foundations, etc., a real concern for the cost of trenching, bedding, shoring, excavations and caisson drilling.

Contractors must be aware that the fill, although contaminated, will remain on site and building permits will be obtained using the Risk Assessment approach.

## **Peat**

The peat, exceeding to a depth of 7 m below grade (Peto BH2) or Elev. 213.00m, is described as fibrous, i.e. not decomposed. However, peat samples could not be recovered (Brown BH502 and 503), presumably due to high degree of decomposition/moisture content.

The above listed cost concerns (excavation/bedding and drilling) apply to construction in these decomposed peat deposits.

GHD extracted peat samples using Shelby tubes and we are assessing the viability of pre-treating the peat deposit, in situ, using wet soil mixing using grout slurry. For soil profiles, borehole logs and laboratory test results see Appendix A.

Two samples from the peat samples were examined in the laboratories. The peat laboratory test results are presented in Appendix G.

### **Upper bearing deposit at 20 m**

There is some consistency, except for firm clay in Peto BH2, in the presence of compact/dense silts and sands at about 20 m depth or Elev. 200.00 m.

The deposit, subject to PMT testing, represents the Upper Aquifer and is targeted for a low capacity friction/end bearing caissons supporting the proposed podiums.

### **Lower bearing deposit at 45 m**

The boreholes and shear wave tests indicate consistent presence of very dense silty sands at/above Elev. 185.00m.

The Lower Aquifer deposit, subject to PMT testing extending to a depth of 50m below grade, Elev. 170.00m, is targeted for a high capacity slurry drilled caissons to support the proposed residential towers.

### **Groundwater**

Water level in Lake Simcoe is at Elev. 219.50 m, and for discussion/construction purposes we assumed GW level at Elev. 219.50 m.

There are, reportedly, two aquifers with the upper (UA) reaching down to 20 m, Elevation 200.00m below grade. The UA, as shown on soil profiles by Brown and GHD, enclosed as Appendix A, consists of native organics/peat, silt, silty sands and clay/clayey silts.

The lower aquifer (LA) represents a deep and relatively consistent deposit of sands, of various grain size composition, and extends to the depth explored of some 50 m below grade Elevation 170.00 m. The deposit is dense to very dense and although described as 'wet' the reported densities indicate it is moist rather than wet.

Based on the Geohydrological Assessment report, by GHD, it is understood that the Site is located within the Lake Simcoe and Couchiching Black River Source Water Protection area and is situated within the City of Barrie Wellhead Protection Area.

## 5.0 SITE PREPARATION

We reviewed the site grading plan, attached in Appendix D, and it is our opinion that slope stability study is not required at the current stage of the development.

However, the presence of deep fill, placed over peat, will require an extensive site preparation to allow for movement of heavy caisson drilling rigs, especially for slurry drilled caisson.

The cut/fill plan must make a provision for importing large quantities of soil/shale/crushed/recycled aggregates for working platforms. For the type of equipment required, we recommend the following:

- The exposed subgrade should be proof rolled with a loaded truck. Any soft areas shall be sub-excavated and replaced with dry suitable material.
- All imported soil/shale/crushed/recycled should be approved by the project's environmental engineer.
- The backfill material must be placed in 200 mm layers and compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD) under full supervision of our office.

- The final subgrade should be proof-rolled again with a loaded truck prior to installing the granular base materials.
- The approved subgrade must be covered with minimum 500 mm of approved crusher run limestone/recycled crushed concrete approved by the project's environmental engineer (subject to the proof rolling results). This layer should be compacted to 100% SPMDD.
- The final exposed grade must be proof-rolled with a loaded truck. Any deficiencies must be addressed under monitoring by our personnel.
- A system of weeping tiles should be installed in the subgrade to collect runoff and keep the integrity of the base (firm and stable).

A subgrade certification letter will be issued by our office (MCR) upon completion of the work.

## 6.0 UNDERGROUND UTILITIES

Within the building footprint, underground utilities will be suspended from ground level structural floor slabs.

Outside of building envelopes, the provided sanitary servicing drawing, attached in Appendix D, illustrate relatively high invert elevations of the existing utilities and relatively short connections to the proposed buildings

Invert level/bedding preparation will require removal, and off-site disposal, of unsuitable organic soils/peat. Typical Class B bedding will have limited use and compaction to 98% of SPMDD will prove unattainable.

It should also be noted that the subsurface conditions are not suitable for conventional shoring or the use of trench boxes. Where feasible, a block of the weak soils, along the horizontal/vertical alignment of the proposed services should be stabilized by wet soil mixing. A ditch which could be used, with the stabilized block, to open a 'narrow' trench allowing pipe placement.

Should the groundwater influx persist, the stabilized soil block could be lined on one or both sides by a string of well points. A test section will be required to perfect the application, for details see Appendix B.

## 7.0 ROADS

Phasing of construction might provide an opportunity to stockpile/surcharge the ROW by imported granular/recycled materials.

**In case of no public roads on the subject site** then all roads will be constructed to 'urban section' with curbs and gutters.

As a result, the wearing course HL3 elevation will control the thickness of underlying pavement structure. Placement of HL3 should be deferred to the latest possible date.

The long-term performance of a pavement structure will reflect the quality of subgrade preparation.

It is expected that approximately 50% of exposed subgrade in the loose fill (with debris) will require sub-excavation and replacement with Granular C, B, recycled, etc. Anticipate that 30% of the subgrade area will require GEOGRID to aid compaction of granular subbase.

Assume minimum average thickness of subbase course as 600mm. Base course should be placed only after the subbase course been rectified/graded and recompacted. Asphalt base course HL8 should allow construction traffic to target repair/improved drainage areas.

### **For public roads:**

Pavement design, as per the Town of Barrie Standard Requirements, attached in Appendix F, is adequate for this project.

**For private roads and fire routes:**

A typical **Heavy-Duty pavement** design is as follows:

	<b>Heavy Duty</b>
<b>Asphaltic Concrete</b>	40 mm HL3 65 mm HL8
<b>19 mm Crushed Limestone</b>	150 mm
<b>Granular B Sub-base</b> or 50 mm Crushed Limestone	300 mm

## 8.0 COMMERCIAL PODIUMS

We evaluated CFAs/Rigid Inclusions/Wet Soil Mixing (Appendix B). Due to the presence of peat/organics caissons, drilled with protective temporary liners, are suggested. It is assumed, that some 10% of the caissons will need to be tremied.

For podium foundations JAP has a 10x10 m grid with 914 mm diameter caissons, with max 5,350 kN working load, drilled from the cut off elevation – see Appendix C.

In order to minimize excavation depth, required by grade beams, a flat structural slab is proposed.

The working load of proposed caissons, 20 m deep founded at Elev. 200.00 m will be verified by O-Cell test carried out to 10,700 kN.

Preliminary calculations indicate that at the working load of 5,350 kN at 50 kPa the shaft resistance would be 2890kPa and 2,460kN taken by end bearing. These values are, given the weak soils, to be verified by the initial O-Cell test.

Upon completion of final foundation drawings, Geo-structural FE analyses will be carried out to optimize caisson length/spacing/group effect.

To assure integrity of caisson installation, full time supervision/exact record keeping, with separate data sheets for each caisson, must be carried out by our office.

## 9.0 RESIDENTIAL TOWERS

For low and midrise buildings, CFAs/Rigid Inclusions/Wet Soil Mixing methods were considered. However, we understand that the Town of Barrie previously approved high rise buildings to be constructed at the subject Site.

Therefore, given the anticipated building loads, slurry drilled and tremied caissons are the optimal foundation system for the encountered foundation conditions.

The towers, designed for 6x6 m grid, will be supported by 1676mm diameter and 45 m long caissons founded at Elevation 185.00 m. The caissons drilled from grade, with working load of up to 20 MN are anticipated – see Appendix C.

The same shaft resistance and end bearing parameters, listed for conventional caissons, are assumed for slurry caissons.

The load bearing capacity will again be subject to electronic (shaft configuration) and sonic (shaft integrity/depth) profiling and O-Cell results. The industry test standards are prescribed (ASTM and AASHTO 2012) and MCR will not object to caisson contractor's selection of the O-Cell/shaft profile testing company.

The high cost of slurry caissons dictates Geo-structural FE analyses be carried out to optimize spacing/group effect and length of each caisson.

The slurry caissons will be drilled into the Lower Aquifer (LA) and will require a customized slurry composition to assure: (1) sufficient density to balance any 'artesian' groundwater pressure from the LA (there is no evidence), (2) low mobility not to permeate into groundwater regime and (3) chemical composition not to contaminate drinking water. Specialty caisson contractors must provide slurry design/lab certificates to qualify.

Detailed/extensive installation records, for each slurry caisson, must be provided by MCR.

## **10.0 EARTHQUAKE CONSIDERATIONS**

Based on the provided Shear Wave Velocity Test results, attached in Appendix E, the subject site could be classified as Class D; the applicable values of  $F_a$  and  $F_v$  are 1.3 and 1.4 respectively. A structural consultant should review all factors.

## **11.0 FLOOR SLAB CONSTRUCTION**

Given the encountered subsurface soil and foundation conditions, the ground floor slab will be constructed as structural slabs.

In the area of the proposed structural slab, all underground services should be suspended from the structural floor slab and should not rely on the existing soils for support.

## **12.0 GENERAL COMMENTS**

The comments given in this report are based on the provided project's information and intended only as guidance for design engineers, and are subject to field verification by further investigations.

We trust this report contains information requested at this time. However, if any clarification is required or if we can be of further assistance, please call us.

Respectfully,  
McCLYMONT & RAK ENGINEERS INC.



L.S. Mousa, P.Eng.

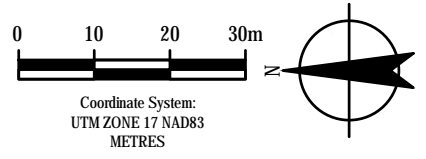
L.J. Rak, M.Eng., P.Eng.

# FIGURES



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LEGEND	
---	APPROXIMATE PROPERTY BOUNDARY
MW 5-19 ●	MONITORING WELL (GHD)
BH 204 ⊕	BOREHOLE/MONITORING WELL (TERRAPROBE)
MW 4-09 ●	MONITORING WELL (OTHER)
TBH 120 ⊕	BOREHOLE/MONITORING WELL (PETO MACCALLUM)
TP27-09 □	TEST PIT LOCATION



PROPOSED RESIDENTIAL DEVELOPMENT  
51-75 BRADFORD STREET, BARRIE, ONTARIO  
HYDROGEOLOGIC ASSESSMENT

INVESTIGATIVE LOCATIONS

Project No. 11201680  
Date November 2019

FIGURE 3.1

# **APPENDIX A**



# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW1-19  
 DATE COMPLETED: 20 September 2019  
 DRILLING METHOD: HSA and Mud Rotary  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE					
				NUMBER	INTERVAL	REC (%)	'N Value	PID (ppm)	
0.15	TOPSOIL(FILL), sandy, brown, moist, rootlets	0.15	CONCRETE						
0.5	SILT (FILL), trace sand, trace clay, trace gravel, light brown, moist			SS1	X	46	32	0	
0.76	SILTY SAND (FILL), gravelly, very dense, grey, limestone fragments, moist	0.76		SS2	X	21	55	0	
1.5	- trace clay, trace peat, loose, fine to medium grained, brown, wet, organics at 1.52m BGS			SS3	X	25	9	0	
2.0				SS4	X	29	9	0	
2.82	PEAT, organic, with gravel, with sand, trace silt, dark brown, wet, rootlets	2.82		SS7	X	46	2	29	
3.0	- trace gravel, trace sand, with petroleum hydrocarbon odour at 3.05m BGS			SS6	X	17	3	1	
3.5	- wood fibers, no odour at 3.81m BGS			SS7	X	0	4		
4.0				SS8	X	33	4	2	
4.5				SS9	X	75	16	1	
5.0				SS10	X	71	17	1	
5.5	- wet at 5.33m BGS			SS11	X	71	17	1	
6.0	- dark brown, wet at 6.10m BGS		BENTONITE	SS12	X	75	18	1	
6.30	SAND and SILT, medium dense, fine grained, grey, wet	6.30		SS13	X	67	19	1	
6.5									
6.86	SILT, trace sand, grey, wet	6.86							
7.0									
7.5									
8.0									
8.5									
9.0	- trace clay at 9.14m BGS								
9.5									

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS  

OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19





# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW2-19  
 DATE COMPLETED: 17 September 2019  
 DRILLING METHOD: HSA  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE				
				NUMBER	INTERVAL	REC (%)	'N' Value	PID (ppm)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5	SAND (FILL), silty, trace gravel, medium dense, light brown, moist  - with gravel, brown, moist to wet, asphalt at 0.76m BGS  TIMBER (FILL), dark brown, wet  PEAT, organic, trace sand, trace gravel, trace silt, dark brown, wet  SILTY SAND, medium dense, brown, fine grained, wet  - trace gravel, trace organics, loose, grey at 4.57m BGS  END OF BOREHOLE @ 5.18m BGS	1.52 2.29 3.15 5.18	<p style="margin-left: 20px;">CONCRETE</p> <p style="margin-left: 20px;">BENTONITE</p> <p style="margin-left: 20px;">20/40 SAND</p> <p><b>WELL DETAILS</b>        Screened interval: 3.05 to 4.57m BGS        Length: 1.52m        Diameter: 51mm        Slot Size: 10        Material: PVC        Seal:          0.30 to 2.74m BGS          Material: BENTONITE        Sand Pack:          2.74 to 4.57m BGS          Material: SILICA SAND #2</p>	SS1 SS2 SS3 SS4 SS5 SS6	X X X X X X	50 63 4 17 58 71	17 12 3 4 11 6	0 0 0 0 0 0

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS  

OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19





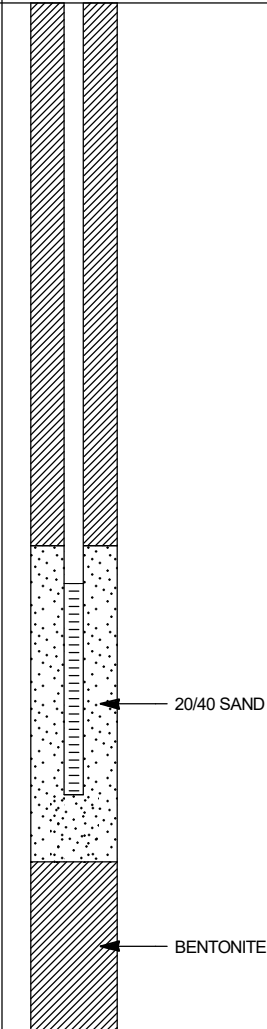


# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW3-19  
 DATE COMPLETED: 18 September 2019  
 DRILLING METHOD: HSA  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE				
				NUMBER	INTERVAL	REC (%)	'N' Value	PID (ppm)
20.5				SS16	X	63	40	1
21.0								
21.5	SILTY SAND, trace clay, very dense, fine grained, grey, wet	21.34		SS17	X	71	52	1
22.0								
22.5								
23.0	- with bands of ~0.5cm thick clay, dense at 22.86m BGS			SS18	X	58	46	1
23.5								
24.0								
24.5	- trace clay, trace gravel, very dense at 24.38m BGS			SS19	X	71	77	1
25.0								
25.5								
26.0	SILT, trace clay, grey, wet	25.91		SS20	X	54	35	0
26.5								
27.0								
27.5								
28.0	END OF BOREHOLE @ 28.04m BGS	28.04		SS21	X	67	75	0
28.5								
29.0								
29.5								



**WELL DETAILS**  
 Screened interval:  
 24.20 to 25.73m BGS  
 Length: 1.52m  
 Diameter: 51mm  
 Slot Size: 10  
 Material: PVC  
 Seal:  
 0.30 to 23.93m BGS  
 Material: BENTONITE  
 Sand Pack:  
 23.93 to 26.21m BGS  
 Material: SILICA SAND #2

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS



OVERBURDEN LOG 11201680-30.GPJ GHD Corp 12/11/19



# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW4-19  
 DATE COMPLETED: 30 September 2019  
 DRILLING METHOD: HSA and Mud Rotary  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE				
				NUMBER	INTERVAL	REC (%)	'N Value	PID (ppm)
0.05	TOPSOIL (FILL), sandy, brown, moist, rootlets	0.05	<p style="text-align: center;">CONCRETE</p> <p style="text-align: center;">BENTONITE</p>	SS1	X	50	12	0
0.5	SAND (FILL), with gravel, with silt, trace clay, compact, fine grained, dark brown, moist, faint sweet odour (asphalt)			SS2	X	79	8	0
1.0	- silty, loose, with wood fragments, brick, purple discolouration, faint sweet odour at 0.76m BGS			SS3	X	50	2	1
1.5	SAND, silty, trace clay, trace organics, very loose, fine grained, brown, moist to wet, no odour	1.52		SS4	X	63	7	0
2.0	- loose, wet at 2.29m BGS			SS5	X	58	3	0
2.5				SS6	X	71	9	0
3.0	- very loose, grey and brown at 3.05m BGS			SS7	X	67	17	1
3.5				SS8	X	67	17	1
4.0	- trace silt, loose, brown at 3.81m BGS			SS9	X	58	18	1
4.5	- silty, medium dense, brown with minor grey, deformed bands at 4.57m BGS			SS10	X	50	7	0
5.0	- brown at 5.33m BGS			SS11	X	71	7	0
6.0	SANDY SILT, brown, wet	6.10		SS12	X	75	9	0
6.5	- grey at 6.61m BGS			SS13	X	92	3	0
7.0	- trace sand at 6.86m BGS			X				
7.5				X				
8.0				X				
8.5	- clayey at 8.38m BGS			X				
9.0				X				
9.5				X				

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS  

OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19



# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW4-19  
 DATE COMPLETED: 30 September 2019  
 DRILLING METHOD: HSA and Mud Rotary  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE				
				NUMBER	INTERVAL	REC (%)	'N Value	PID (ppm)
10.5				SS14	X	104	2	0
11.0				SS15	X	108	2	1
11.5				SS16	X	104	6	0
12.0				SS17	X	75	12	1
12.5				SS18	X	71	16	1
13.0	- with sand at 12.95m BGS			SS19	X	75	16	1
13.5	- trace sand at 13.72m BGS		← 20/40 SAND	SS20	X	104	2	0
14.0				SS21	X	104	9	0
14.5	SILTY CLAY, soft, grey, wet	14.48		SS22	X	0	47	
15.0	- with silt, stiff at 15.24m BGS		← BENTONITE					
16.5	END OF BOREHOLE @ 16.61m BGS	16.61						

**WELL DETAILS**  
 Screened interval:  
 12.26 to 13.78m BGS  
 Length: 1.52m  
 Diameter: 51mm  
 Slot Size: 10  
 Material: PVC  
 Seal:  
 0.30 to 11.89m BGS  
 Material: BENTONITE  
 Sand Pack:  
 11.89 to 14.94m BGS  
 Material: SILICA SAND #2

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS



OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19



# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW5-19  
 DATE COMPLETED: 26 September 2019  
 DRILLING METHOD: HSA and Mud Rotary  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE					
				NUMBER	INTERVAL	REC (%)	'N Value	PID (ppm)	
0.5	TOPSOIL (FILL), sandy, brown, moist, rootlets SAND AND GRAVEL (FILL), trace silt, medium dense, grey, moist	0.02	CONCRETE	SS1	X	50	22	0	
1.0	SAND (FILL), with gravel, trace silt, loose, brown and grey, moist, with asphalt fragments	0.76		SS2	X	38	9	3	
1.5	- with silt, compact, fine grained at 1.52m BGS			SS3	X	46	13	0	
2.0				SS4	X	33	16	0	
3.0	SILTY SAND, very loose, fine grained, black-brown, wet	3.05		SS5	X	75	3	1	
4.0	- trace gravel, dark grey at 3.81m BGS			SS6	X	58	3	0	
5.0				SS7	X	21	9	0	
5.5	- medium dense at 5.33m BGS		BENTONITE	SS8	X	79	14	0	
6.0	- trace gravel at 6.10m BGS			SS9	X	63	19	0	
7.0	- trace silt at 6.86m BGS			SS10	X	75	22	0	
7.5	- medium dense, fine grained, grey, wet at 7.62m BGS			SS11	X	58	26	0	
8.5				SS12	X	58	16	0	
9.0				SS13	X	54	10	0	
9.5	SANDY SILT, trace clay, stiff, fine grained, grey, wet	9.14							
	- trace sand, trace gravel at 9.91m BGS								

**NOTES:** MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19





# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: 57-75 Bradford Street Property  
 PROJECT NUMBER: 11201680  
 CLIENT: Greenwin Barrie Inc. and 2714708 Ontario Ltd.  
 LOCATION: 51-75 Bradford Street, Barrie, Ontario

HOLE DESIGNATION: MW6-19  
 DATE COMPLETED: 25 September 2019  
 DRILLING METHOD: HSA and Mud Rotary  
 FIELD PERSONNEL: S. Howell

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Monitoring Well	SAMPLE				
				NUMBER	INTERVAL	REC (%)	'N Value	PID (ppm)
0.18	SAND (TOPSOIL), silty, trace gravel, brown, moist	0.18	CONCRETE	SS1	X	67	18	0
0.5	SILT (FILL), sandy, trace gravel, compact, light brown, moist - trace clay at 0.76m BGS			SS2	X	71	16	1
1.0				SS3	X	63	13	1
1.5	- trace asphalt at 1.52m BGS			SS4	X	46	15	1
2.0				SS5	X	29	12	1
2.5	- brick at 2.29m BGS			SS6	X	29	4	1
3.0				SS7	X	29	3	1
3.5	- brick, wood fragments at 3.05m BGS			SS8	X	46	4	1
4.0				SS9	X	71	2	1
4.5	- very loose, moist to wet at 3.81m BGS			SS10	X	83	5	1
5.0				SS11	X	58	11	0
5.5	- dark brown, wet at 4.57m BGS			SS12	X	58	6	1
6.0				SS13	X	58	6	1
6.0	SAND, very loose, fine grained, brown, wet, with brick fragments	5.94						
6.5	- grey, without brick fragments at 6.50m BGS							
7.0								
7.5	- sand, with silt, compact, grey at 7.62m BGS							
8.0								
8.5	- loose at 8.38m BGS							
9.0								
9.0	CLAYEY SILT, with clay, trace sand, medium stiff, grey, wet	8.92	BENTONITE					
9.5	- soft at 9.14m BGS							
	- very soft at 9.91m BGS							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS  

OVERBURDEN LOG 11201680-30.GPJ GHD\_Corp 12/11/19

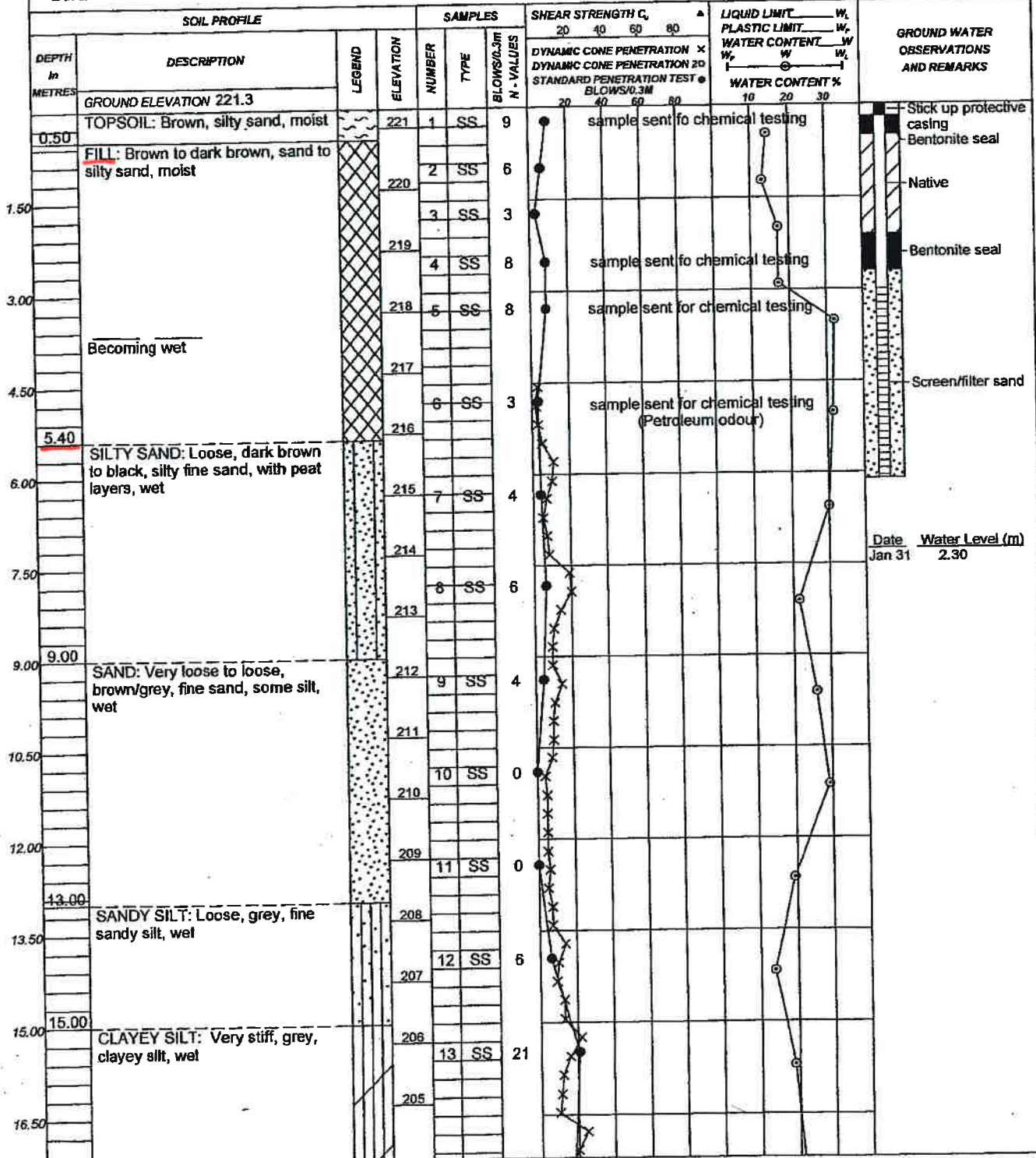


### LOG OF BOREHOLE NO. 1/MW3

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**BORING DATE** January 25, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH, AD



Date Jan 31 Water Level (m) 2.30

**NOTES**  
 x-x Dynamic Cone Penetration Test from 4.6 to 20.4 m

CHECKED BY 

**LOG OF BOREHOLE NO. 1/MW3**

PROJECT PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

OUR PROJECT NO. 07BF057

LOCATION Lakeshore Drive, Barrie, Ontario

BORING DATE January 25, 2008

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers/Casing and Wash Boring

TECHNICIAN JH, AD

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $w_L$			GROUND WATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	20 40 60 80				PLASTIC LIMIT $w_p$				
							DYNAMIC CONE PENETRATION $\times$				WATER CONTENT $w$				
CONTINUED FROM PREVIOUS PAGE							DYNAMIC CONE PENETRATION $20^\circ$				WATER CONTENT $w$				
							STANDARD PENETRATION TEST $\bullet$				WATER CONTENT %				
							BLOWS/0.3M								
18.00	CLAYEY SILT: Very stiff, grey, clayey silt, wet		203	14	SS	16									
19.50			202												
20.00	SILT: Dense, grey, silt, trace fine sand, with occasional silty sand seams, wet		201				137X								
21.00			200	15	SS	39	151X								
22.50			199					142X							
23.00	SILTY SAND: Dense to very dense, grey, silty sand, occasional sandy silt seams, wet		198												
24.00			197												
25.50			196	16	SS	34									
27.00			195												
28.50			194												
30.00			193	17	SS	45									
31.50			192												
33.00	191														
	fine sand		190	18	SS	64									
			189												
			188												
			187	19	SS	64									

**NOTES**

x-x Dynamic Cone Penetration Test from 4.6 to 20.4 m

CHECKED BY 

**LOG OF BOREHOLE NO. 1/MW3**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 25, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH, AD

SOIL PROFILE		SAMPLES			SHEAR STRENGTH C, ▲				LIQUID LIMIT — W <sub>L</sub>			GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	20 40 60 80				PLASTIC LIMIT — W <sub>p</sub>			
							DYNAMIC CONE PENETRATION ×				WATER CONTENT — W <sub>p</sub>			
							DYNAMIC CONE PENETRATION 20				W			
							STANDARD PENETRATION TEST ●				WATER CONTENT %			
							BLOWS/0.3M				10 20 30			
CONTINUED FROM PREVIOUS PAGE														
34.50	SILTY SAND: Dense to very dense, grey, silty sand, occasional sandy silt seams, wet		186										*Suspect sample hydraulically disturbed	
36.00			185											
37.50			184	20	SS	9*								
38.00			183											
39.00	SAND: Dense to very dense, grey and brown, fine to medium sand, trace gravel, wet		182											
40.50			181	21	SS	41								
42.00			180											
43.50			179	22	SS	100/25 mm								
45.00	Becoming gravelly		178											
45.80	END		176	23	SS	74/100 mm						Upon completion of augering Wet cave at 2.4 m		

NOTES

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## LOG OF BOREHOLE NO. 2

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

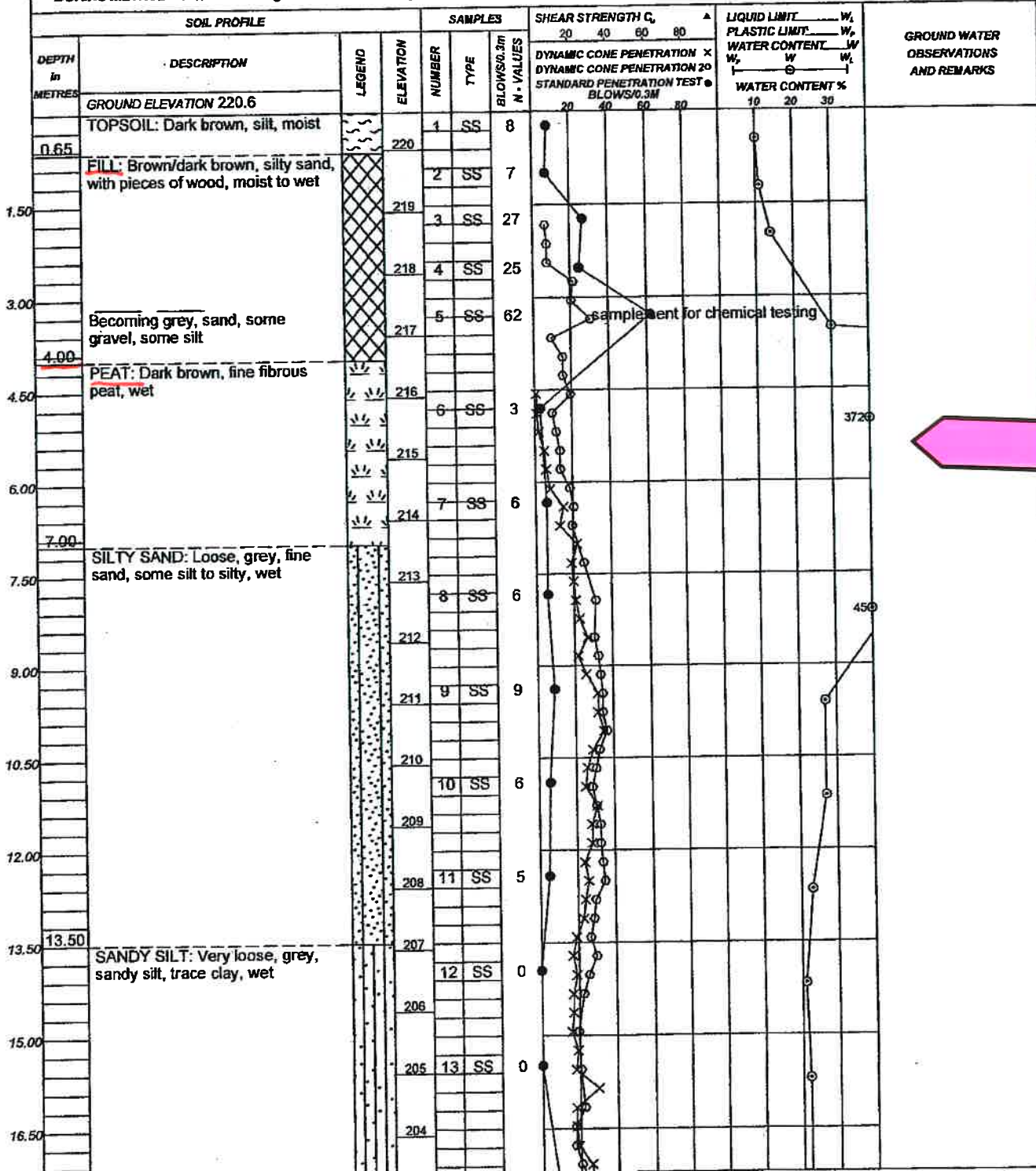
**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 16, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers

**TECHNICIAN** JH



**NOTES**

x-x Dynamic Cone Penetration Test from 4.6 to 23.8 m  
o-o Dynamic Cone Penetration Test from 1.8 to 32.6 m

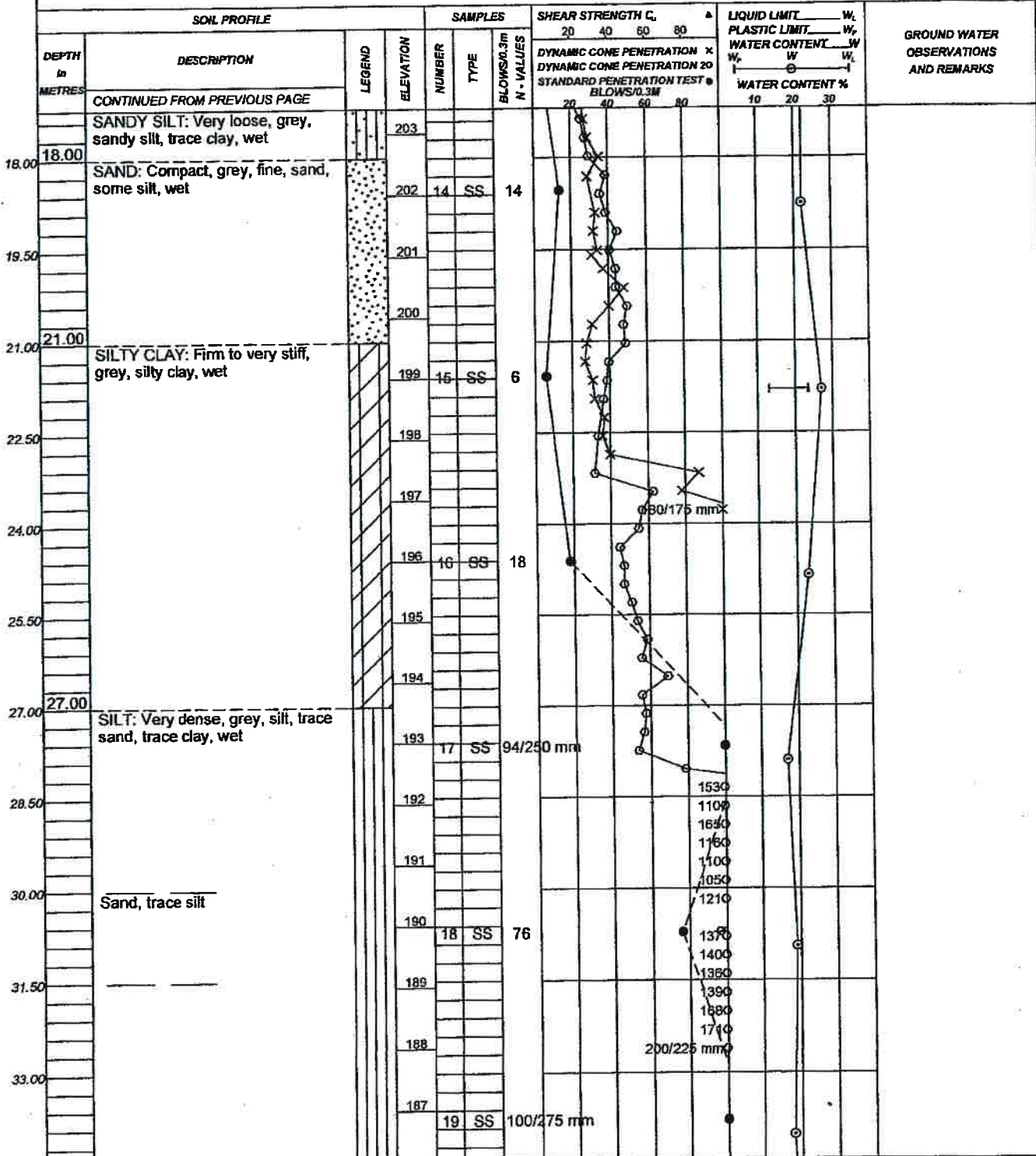
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### LOG OF BOREHOLE NO. 2

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 16, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH



**NOTES**  
 x-x Dynamic Cone Penetration Test from 4.6 to 23.8 m  
 o-o Dynamic Cone Penetration Test from 1.8 to 32.6 m

CHECKED BY

**LOG OF BOREHOLE NO. 2**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 16, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH

SDIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	20	40	60	80	PLASTIC LIMIT $W_p$		WATER CONTENT $W$
							DYNAMIC CONE PENETRATION $\times$				DYNAMIC CONE PENETRATION $20$		
STANDARD PENETRATION TEST $\bullet$							BLOWS/0.3M				WATER CONTENT %		
							20	40	60	80	10	20	30
34.50	CONTINUED FROM PREVIOUS PAGE		185										
	SILT: Very dense, grey, silt, trace sand, trace clay, wet		185										
36.00			184	20	SS	81							
			183										
37.50			182										
			181										
39.00				181	21	SS	94/225 mm						
40.00	END												

Upon completion of augering  
Wet cave at 3.6 m

NOTES

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### LOG OF BOREHOLE NO. 3

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

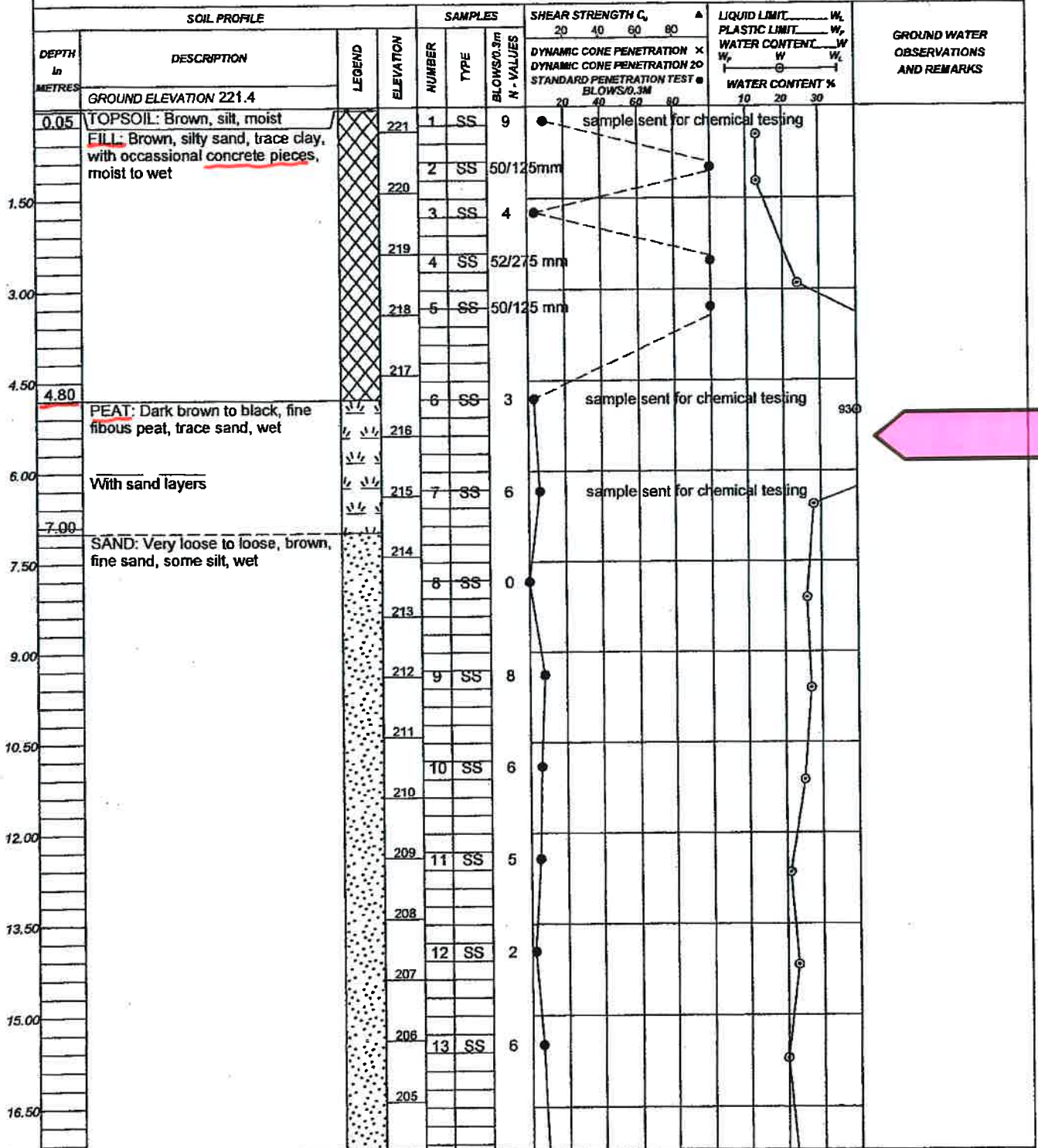
**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 14, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH



NOTES

*GW*

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**LOG OF BOREHOLE NO. 4**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 11, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C, $\Delta$			LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	20 40 60 80			PLASTIC LIMIT $W_P$			
							DYNAMIC CONE PENETRATION $\times$			WATER CONTENT $W$			
							DYNAMIC CONE PENETRATION $20$			WATER CONTENT $W$			
							STANDARD PENETRATION TEST $\bullet$			WATER CONTENT $W$			
							BLOWS/0.3M			10 20 30			
	GROUND ELEVATION 222.0												
	<b>FILL:</b> Brown to dark brown, silty sand to sandy silt, trace gravel, pieces of brick, moist to wet		221	1	SS	16							
1.50			220	2	SS	13							
			219	3	SS	9							
3.00			218	4	SS	6							
3.20	<b>PEAT:</b> Dark brown/black, fine fibrous peat, wet		218	5	SS	3						sample sent for chemical testing	
4.50	<b>SILTY FINE SAND:</b> Very loose to loose, brown, some silt to silty, trace silt, occasional peat layers, wet		217	6	SS	2						sample sent for chemical testing	
6.00			216	7	SS	2						sample sent for chemical testing	
7.50			215	8	SS	12							
9.00			214	9	SS	8							
10.50	<b>SILT:</b> Very loose, grey, silt, trace sand, trace clay, wet		213	10	SS	0							
12.00	<b>CLAYEY SILT:</b> Very soft to firm, grey, clayey silt, wet		210	11	SS	0							
13.50			209	12	SS	2							
15.00			208	13	SS	7							
16.50			207										
			206										
			205										

NOTES

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**LOG OF BOREHOLE NO. 4**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 11, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH

SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$			LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	20 40 60 80			W <sub>L</sub> PLASTIC LIMIT W <sub>P</sub> WATER CONTENT % W <sub>L</sub> W <sub>P</sub> WATER CONTENT %			
							DYNAMIC CONE PENETRATION X DYNAMIC CONE PENETRATION 20 STANDARD PENETRATION TEST ● BLOWS/0.3M			10 20 30			
	CONTINUED FROM PREVIOUS PAGE												
18.00	CLAYEY SILT: Very soft to firm, grey, clayey silt, wet		204										
	SILT: Dense to compact, grey, silt, trace sand, trace clay, wet		203	14	SS	40							
19.50			202										
21.00			201										
			200	15	SS	34							
22.50			199										
24.00			198										
			197	16	SS	26							
25.50			196										
27.00	SILTY CLAY: Firm to stiff, grey, silty clay, wet, low plastic		195										
			194	17	SS	7							
28.50			193										
30.00			192										
			191	18	SS	14							
31.50			190										
33.00	SILT: Very dense, grey, silt, trace sand, trace clay, wet		189										
			188	19	SS	99/250 mm							

NOTES

CHECKED BY *[Signature]*

**LOG OF BOREHOLE NO. 4**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 11, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH

SOIL PROFILE		SAMPLES		SHEAR STRENGTH C, ▲			LIQUID LIMIT W <sub>L</sub>			GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	DYNAMIC CONE PENETRATION x				
							STANDARD PENETRATION TEST ●				
							20	40	60		80
							20	40	60	80	
CONTINUED FROM PREVIOUS PAGE											
34.50	SILT: Very dense, grey, silt, trace sand, trace clay, wet		187								
36.00	Becoming compact, sandy silt		186								
37.50			185	20	SS	15					
39.00			184								
39.00	SAND: Dense to very dense, grey, sand, some gravel to gravelly, trace silt, wet		183								
40.50			182	21	SS	43					
42.00			181								
43.50			180								
45.00			179	22	SS	83					
46.30			178								
46.50	DYNAMIC CONE PENETRATION TEST		177	23	SS	81					
47.20	END		176	24	SS	88/275 mm					
			175								

**NOTES**  
x-x Dynamic Cone Penetration Test from 46.3 to 47.2 m

Upon completion of augering Wet cave at 3.0 m

Checked by *JH*

**LOG OF BOREHOLE NO. 5**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

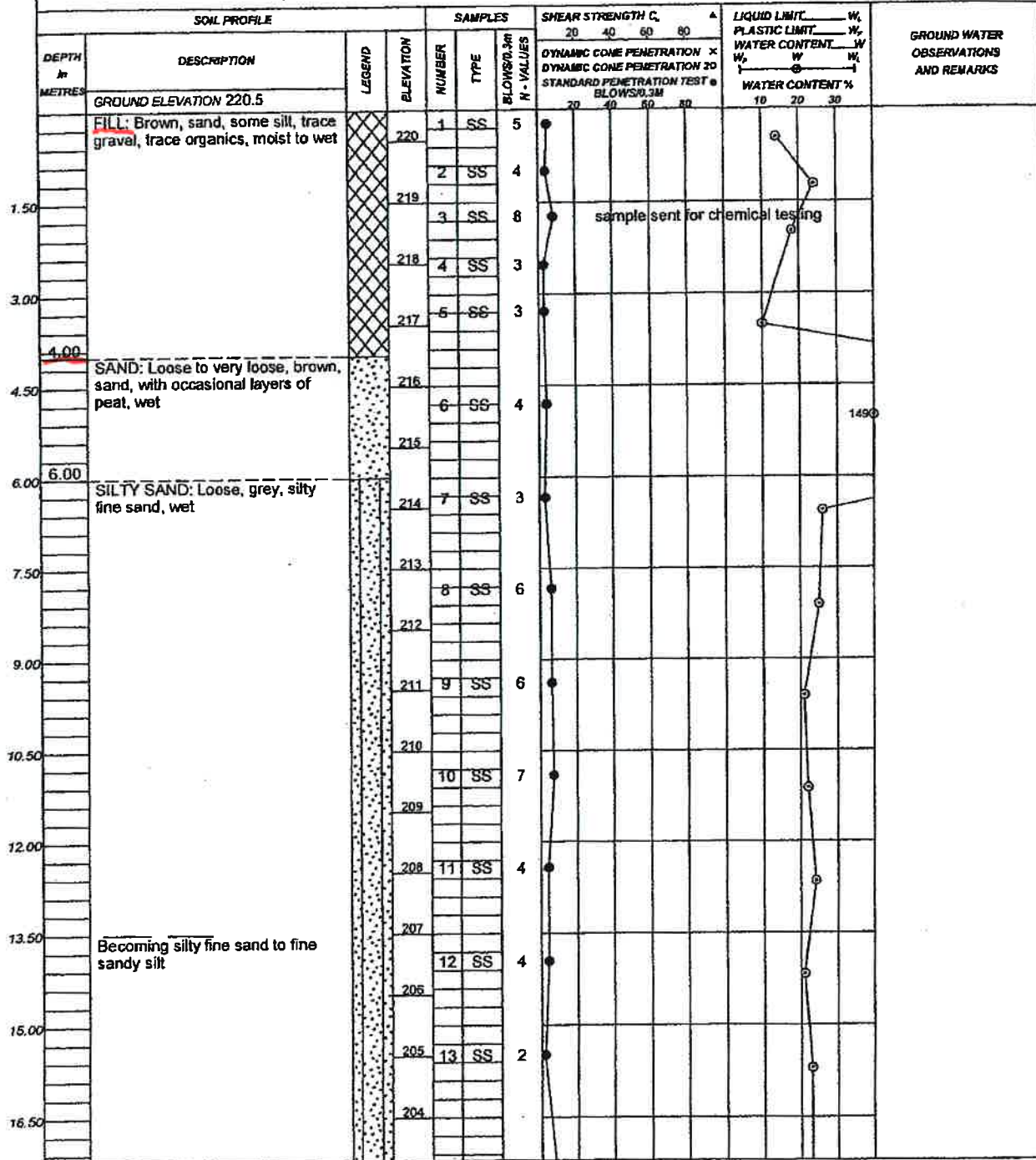
**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 18, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers

**TECHNICIAN** JH



NOTES

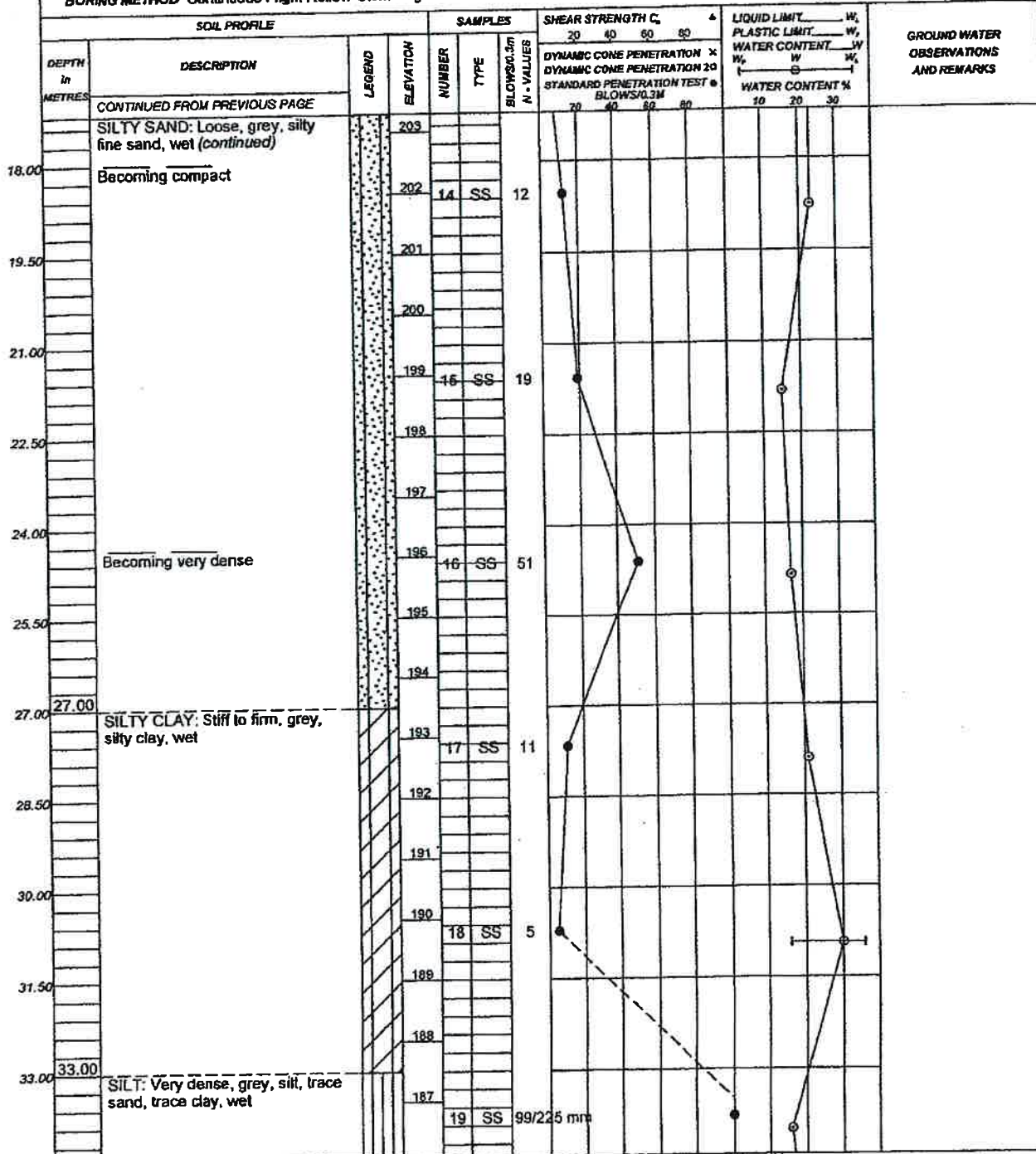
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**LOG OF BOREHOLE NO. 5**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 18, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH



NOTES

CHECKED BY *MM*

**LOG OF BOREHOLE NO. 5**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 18, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH

DEPTH in METRES	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES		SHEAR STRENGTH C				LIQUID LIMIT			GROUND WATER OBSERVATIONS AND REMARKS
				NUMBER	TYPE	20	40	60	80	W <sub>L</sub>	W <sub>P</sub>	W	
34.50	CONTINUED FROM PREVIOUS PAGE												
	SILT: Very dense, grey, silty, trace sand, trace clay, wet (continued)												
36.00			185										
			184	20	SS	50/100 mm							
37.50			183										
			182										
39.00			181										
40.00	END			21	SS	97/275 mm							Upon completion of augering: Wet cave at 1.4 m

NOTES

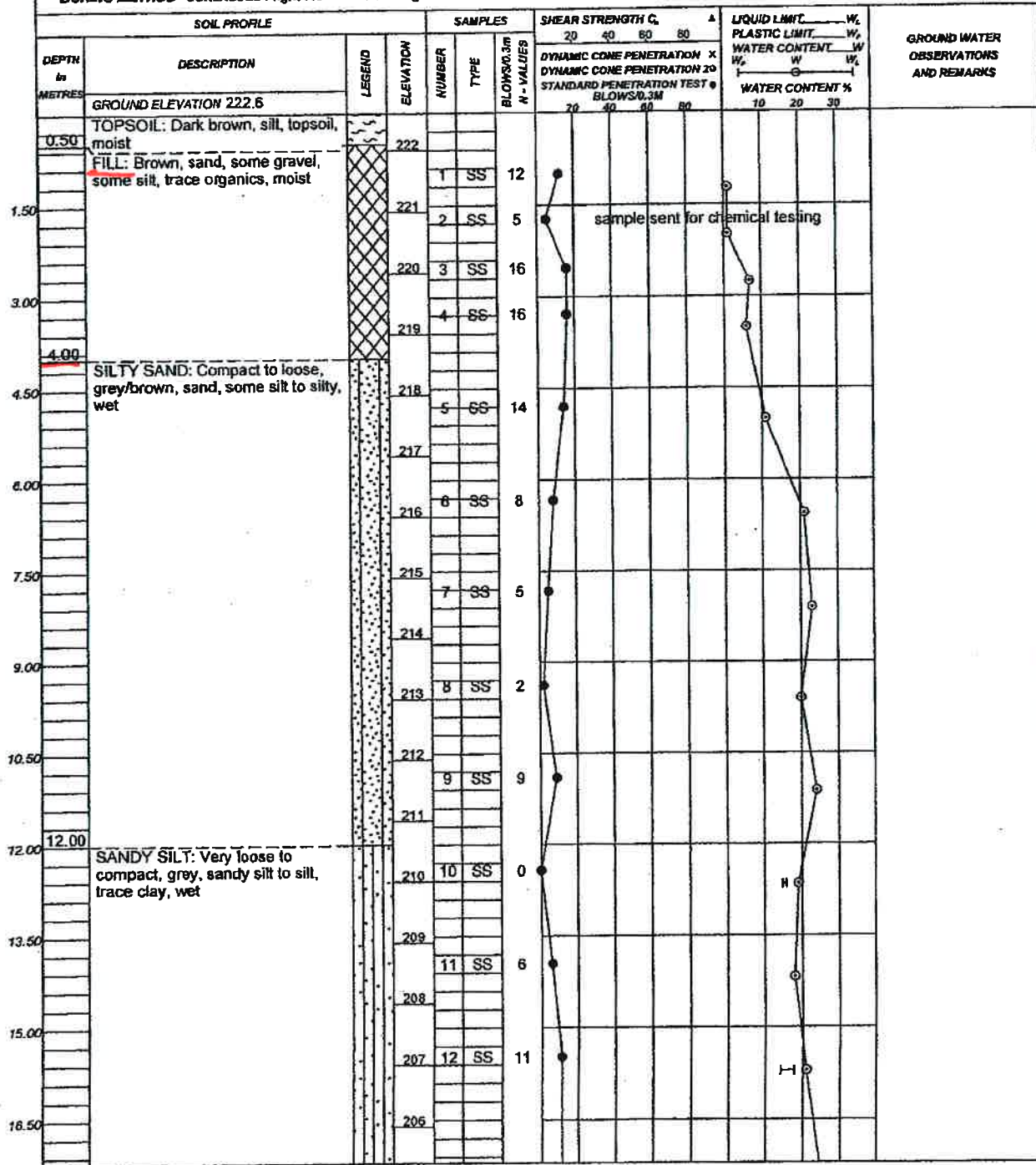
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**LOG OF BOREHOLE NO. 6**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** December 20, 2007

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** NLB



NOTES

CHECKED BY *MJ*

**LOG OF BOREHOLE NO. 6**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** December 20, 2007

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** NLB

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C, ▲				LIQUID LIMIT — W, PLASTIC LIMIT — W, WATER CONTENT — W, %			GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	DYNAMIC CONE PENETRATION ×				WATER CONTENT %				
							STANDARD PENETRATION TEST @ BLOWS/0.3M				WATER CONTENT %				
							20	40	60	80	10	20	30		
	CONTINUED FROM PREVIOUS PAGE														
18.00	CLAYEY SILT: Stiff, grey, clayey silt, wet	[Pattern]	205												
			204	13	SS	11									
19.50			203												
			202												
21.00	SILT: Compact, grey, silt, trace clay, wet	[Pattern]	201	14	SS	12									
			200												
22.50			199												
			198	15	SS	13									
24.00			197												
25.50			196												
27.00			195	16	SS	11									
28.50			194												
30.00	SAND: Compact, grey, sand, trace silt, wet	[Pattern]	193												
			192	17	SS	14									
31.50			191												
32.00	SILT: Very dense, grey, silt, trace sand, trace clay, wet	[Pattern]	190												
			189	18	SS	106/225 mm									
33.00															

NOTES

CHECKED BY *[Signature]*

**LOG OF BOREHOLE NO. 6**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** December 20, 2007

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers

**TECHNICIAN** NLB

SOIL PROFILE			SAMPLES				SHEAR STRENGTH C, $\Delta$				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/30cm N - VALUES	20 40 60 80				PLASTIC LIMIT $W_P$			
							DYNAMIC CONE PENETRATION X DYNAMIC CONE PENETRATION 20 STANDARD PENETRATION TEST $\Phi$ BLOWS/30cm				WATER CONTENT $W$			
CONTINUED FROM PREVIOUS PAGE							20 40 60 80				10 20 30			
34.50	SILT: Very dense, grey, silt, trace sand, trace clay, wet (continued)		188											
			187											
36.00			185											
37.00	END			19	SS	99								Upon completion of augering Wet cave at 3.4 m

NOTES

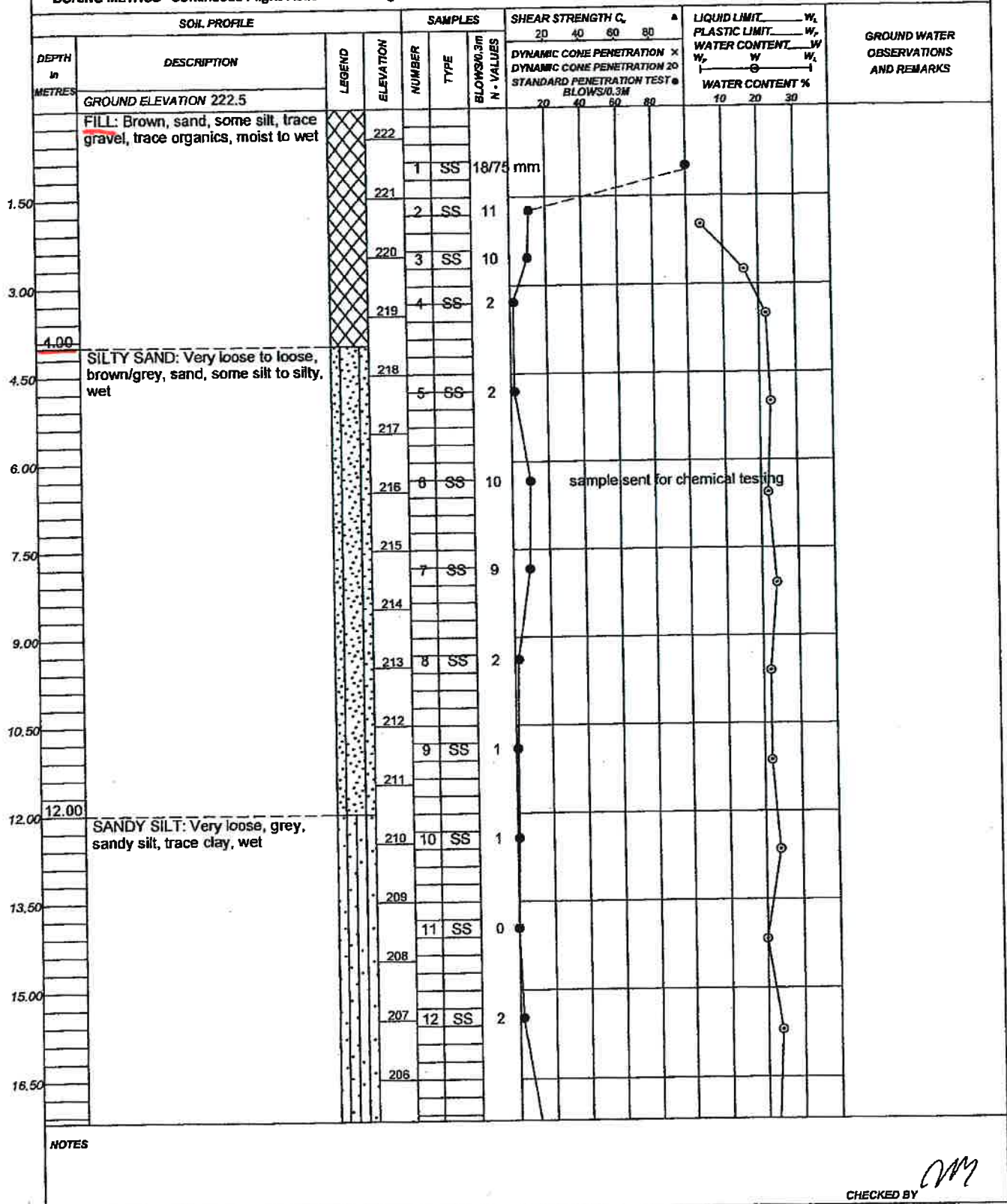
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### LOG OF BOREHOLE NO. 7

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** December 19, 2007

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** NLB



NOTES

CHECKED BY *GW*

**LOG OF BOREHOLE NO. 7**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** December 19, 2007

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers

**TECHNICIAN** NLB

SOIL PROFILE				SAMPLES			SHEAR STRENGTH $C_u$ ▲				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	DYNAMIC CONE PENETRATION X				PLASTIC LIMIT $W_p$			
							DYNAMIC CONE PENETRATION 20				WATER CONTENT $W_w$			
							STANDARD PENETRATION TEST ●				WATER CONTENT %			
							BLOWS/0.3M				10 20 30			
	CONTINUED FROM PREVIOUS PAGE													
18.00	SANDY SILT: Very loose, grey, sandy silt, trace clay, wet		205											
18.50	SAND: Compact to dense, sand, trace silt, wet	[Pattern]	204	14	SS	18								
19.50			203											
21.00			202											
22.50			201	15	SS	32								
24.00	SILT: Very dense to compact, grey, silt, some sand, trace gravel, trace clay, wet	[Pattern]	200											
24.00			199											
25.50			198	16	SS	63								
27.00			197											
28.50	SAND: Brown/grey, sand, trace silt, wet	[Pattern]	196											
30.00			195	17	SS	26								
31.50			194											
33.00			193											
			192	18	SS	35								
			191											
			190											
			189	19	SS	*0*							*Suspect sample disturbance	

NOTES


CHECKED BY *MM*

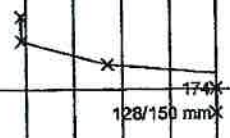
**LOG OF BOREHOLE NO. 7**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** December 19, 2007

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** NLB

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C, $\Delta$				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	20 40 60 80				PLASTIC LIMIT $W_P$	WATER CONTENT $W_w$		
							DYNAMIC CONE PENETRATION $\times$				W <sub>L</sub>	W <sub>p</sub>	W <sub>L</sub>	
							DYNAMIC CONE PENETRATION 20				WATER CONTENT %			
							STANDARD PENETRATION TEST $\bullet$				10	20	30	
							BLOWS/0.3M							
34.50	CONTINUED FROM PREVIOUS PAGE													
	SAND: Brown/grey, sand, trace silt, wet		187											
35.60														
36.00	DYNAMIC CONE PENETRATION TEST		185											
37.50				185										
38.00	END													



Upon completion of augering  
Wet cave at 3.2 m

**NOTES**  
*x-x Dynamic Cone Penetration Test from 36.6 to 38.0 m*

CHECKED BY 

### LOG OF BOREHOLE NO. 8/MW2

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

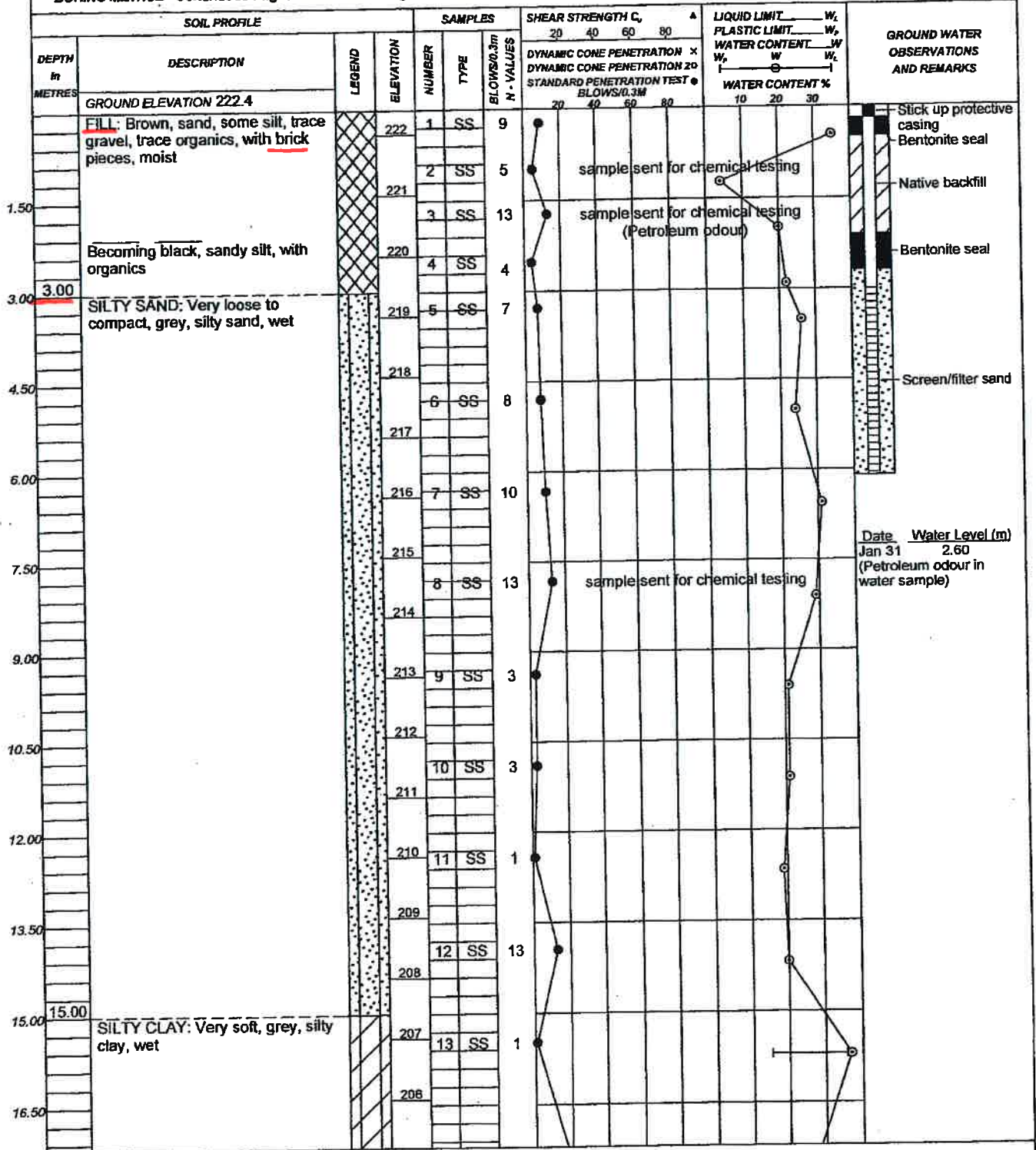
**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 22, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH



NOTES

*M*

CHECKED BY

**LOG OF BOREHOLE NO. 8/MW2**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

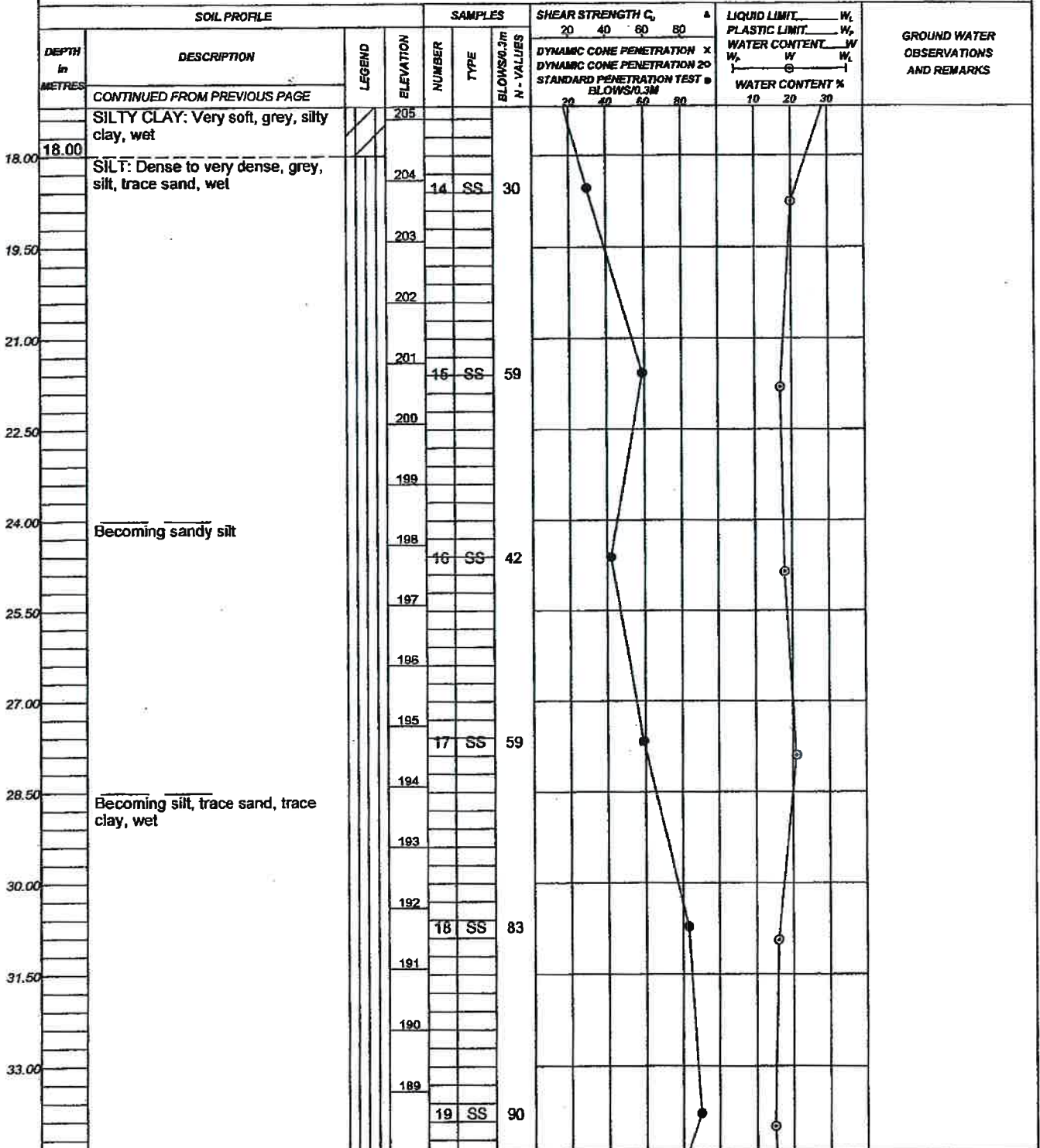
**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 22, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH



NOTES

*[Handwritten Signature]*

CHECKED BY

**LOG OF BOREHOLE NO. 8/MW2**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 22, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH

SOIL PROFILE			SAMPLES				SHEAR STRENGTH C <sub>v</sub> ▲		LIQUID LIMIT W <sub>L</sub>		GROUND WATER OBSERVATIONS AND REMARKS
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/30cm N - VALUES	20 40 60 80		PLASTIC LIMIT W <sub>p</sub>		
							DYNAMIC CONE PENETRATION ×		WATER CONTENT W <sub>w</sub>		
							DYNAMIC CONE PENETRATION 20		W <sub>p</sub>		
							STANDARD PENETRATION TEST ●		WATER CONTENT %		
							20 40 60 80		10 20 30		
34.50	CONTINUED FROM PREVIOUS PAGE		187								
	SILT: Dense to very dense, grey, silt, trace sand, wet										
36.00	SAND: Compact to dense, grey, sand, trace to some silt, wet		186	20	SS	6*				*Suspect sample disturbance	
			185								
37.50			184								
			183	21	SS	21					
39.00			182								
			181								
42.00			180	22	SS	35					
			179								
43.50			178								
	Becoming gravelly sand, trace silt		177	23	SS	28					
45.00			176								
46.50			175								
	Becoming very dense		174	24	SS	139					
48.00			173								
49.50			172								
51.00			171								

NOTES

CHECKED BY *M*

## LOG OF BOREHOLE NO. 8/MW2

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057


**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 22, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers/Casing and Wash Boring

**TECHNICIAN** JH

SOIL PROFILE			SAMPLES				SHEAR STRENGTH C, ▲				LIQUID LIMIT — W <sub>L</sub>			GROUND WATER OBSERVATIONS AND REMARKS
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	20 40 60 80				PLASTIC LIMIT — W <sub>p</sub>			
							DYNAMIC CONE PENETRATION ×				WATER CONTENT — W <sub>c</sub>			
							DYNAMIC CONE PENETRATION 20				W <sub>c</sub> — W <sub>c</sub>			
							STANDARD PENETRATION TEST ●				WATER CONTENT %			
							20 40 60 80				10 20 30			
	CONTINUED FROM PREVIOUS PAGE													
52.30	SAND: Compact to dense, grey, sand, trace to some silt, wet		170	25	SS	100/25 mm								Upon completion of augering Wet cave at 3.2 m
	END													

NOTES

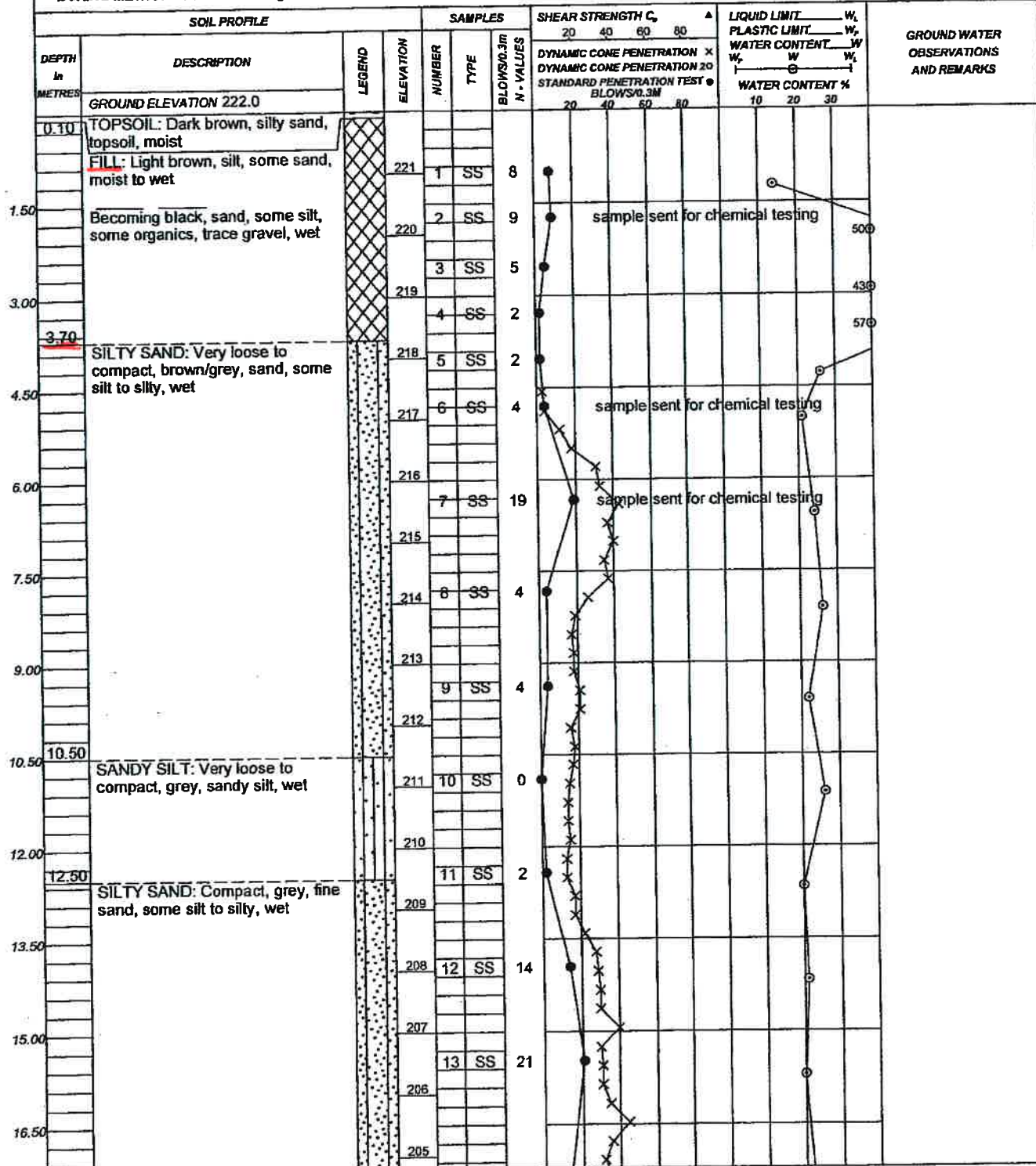
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### LOG OF BOREHOLE NO. 9

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 8, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** MN



**NOTES**  
 x-x Dynamic Cone Penetration Test from 4.6 to 26.8 m

CHECKED BY 

### LOG OF BOREHOLE NO. 9

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 8, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** MN

SOIL PROFILE			SAMPLES		SHEAR STRENGTH C, ▲		LIQUID LIMIT — W <sub>L</sub>		GROUND WATER OBSERVATIONS AND REMARKS				
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	DYNAMIC CONE PENETRATION ×			WATER CONTENT W			
							STANDARD PENETRATION TEST ●			WATER CONTENT %			
							20	40	60	80	10	20	30
	CONTINUED FROM PREVIOUS PAGE												
18.00	SILTY SAND: Compact, grey, fine sand, some silt to silty, wet	[Symbol]	204										
18.00	CLAYEY SILT: Stiff to very stiff, grey, clayey silt, wet	[Symbol]	203	14	SS	9							
19.50			202										
21.00			201										
21.50	SILT: Dense to compact, grey, silt, trace sand, trace clay, wet	[Symbol]	200	15	SS	47							
22.50			199										
24.00			198										
25.50			197	16	SS	41							
25.50			196				160	110	104	135	185		
27.00			195										
28.50			194	17	SS	23							
30.00			193										
31.50			192										
31.50			191	18	SS	31							
33.00	SAND: Dense to compact, grey, fine/fine to medium sand, some silt, wet	[Symbol]	189										
33.00			188	19	SS	40							

**NOTES**

x-x Dynamic Cone Penetration Test from 4.6 to 26.8 m

*AM*

CHECKED BY

**LOG OF BOREHOLE NO. 9**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 8, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** MN

SOIL PROFILE			SAMPLES			SHEAR STRENGTH $C_u$ $\Delta$				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS			
DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	DYNAMIC CONE PENETRATION $\times$				WATER CONTENT $W_w$					
							DYNAMIC CONE PENETRATION $\times$				WATER CONTENT $W_w$					
							STANDARD PENETRATION TEST $\bullet$				WATER CONTENT $W_w$					
							BLOWS/0.3M				10 20 30					
CONTINUED FROM PREVIOUS PAGE																
34.50	SAND: Dense to compact, grey, fine/fine to medium sand, some silt, wet  Becoming gravelly sand		187													
36.00			186													
37.50			185	20	SS	24										
39.00			184													
40.50			183													
42.00			182	21	SS	40										
43.30			181													
43.50			DYNAMIC CONE PENETRATION TEST		180											
45.00					179	22	SS	21								
46.50					178											
	177															
46.90	176															
	END															

Upon completion of augering  
Wet cave at 2.5 m

**NOTES**  
o-o Dynamic Cone Penetration Test from 43.6 to 46.9 m

CHECKED BY

**LOG OF BOREHOLE NO. 10**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT  
**LOCATION** Lakeshore Drive, Barrie, Ontario  
**BORING METHOD** Continuous Flight Hollow Stem Augers

**BORING DATE** January 30, 2008

**OUR PROJECT NO.** 07BF057  
**ENGINEER** GW  
**TECHNICIAN** JH

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C (kPa) ▲				LIQUID LIMIT $W_L$			GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/3m N - VALUES	20 40 60 80				PLASTIC LIMIT $W_p$			
							DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST #				WATER CONTENT $W_w$			
							BLOWS/3m				WATER CONTENT %			
				20 40 60 80				10 20 30						
	GROUND ELEVATION 222.3													
	FILL: Brown, silty sand to sandy silt, trace organics, with wood pieces, moist	[Cross-hatched pattern]	222	1	SS	10								
1.50			221	2	SS	12								
			220	3	SS	5								sample sent for chemical testing
2.70			219	4	SS	4								sample sent for chemical testing
3.00	SAND: Loose to compact, brown, medium sand, trace silt, wet	[Dotted pattern]	219	5	SS	9								
			218											
4.50			217	6	SS	13								
6.00			216	7	SS	13								
6.70	BOREHOLE TERMINATED AT 6.70 m												Upon completion of augering Wet cave at 2.4 m	

NOTES

CHECKED BY 

**LOG OF BOREHOLE NO. MW1**

**PROJECT** PROPOSED BLUE SAILS CONDOMINIUM DEVELOPMENT

**OUR PROJECT NO.** 07BF057

**LOCATION** Lakeshore Drive, Barrie, Ontario

**BORING DATE** January 30, 2008

**ENGINEER** GW

**BORING METHOD** Continuous Flight Hollow Stem Augers

**TECHNICIAN** JH

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C <sub>v</sub> (kPa)				LIQUID LIMIT W <sub>L</sub>			GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH to METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N - VALUES	20	40	60	80	PLASTIC LIMIT W <sub>P</sub>	WATER CONTENT W <sub>w</sub>		
							DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST				W <sub>1</sub>	W		W <sub>2</sub>
							BLOWS/0.3M				WATER CONTENT %			
				20	40	60	80	10	20	30				
	GROUND ELEVATION 222.9													
1.50	Topsoil over Sand Fill	[Cross-hatch pattern]	222											
3.00		[Cross-hatch pattern]	221											
3.50		[Cross-hatch pattern]	220											
4.50	SAND: Compact to loose, brown, sand, some silt, wet	[Dotted pattern]	219											
		[Dotted pattern]	218	1	SS	17								
6.00		[Dotted pattern]	217											
6.10	BOREHOLE TERMINATED AT 6.10 m			2	SS	7								Upon completion of augering Wet cave at 4.3 m Date <u>Jan 31</u> Water Level (m) <u>3.00</u>

NOTES

CHECKED BY



# Terraprobe

# LOG OF BOREHOLE 100

PROJECT: Blue Sails Site Development

DATE: June 6, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT WATER CONTENT (%) w <sub>p</sub> w w <sub>L</sub> 10 20 30	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
220.6 0.0	<b>FILL</b> - Sandy Silt to Sand, some gravel, trace wood, brick debris, surficially intermixed with topsoil, loose to compact, brown, moist to wet  very loose		1	SS	15	220				▽
			2	SS	5	219				
			3	SS	11	218				
			4	SS	7	217				
			5	SS	2	216				
216.6 4.0	<b>PEAT</b>		6	SS	10	216				
215.4 5.2	<b>SILTY TO FINE SAND</b> trace gravel, very loose, grey, wet  loose below		7	SS	1	215				
			8	SS	9	214				
			9	SS	5	213				
			10	SS	7	212				
210.6 10.0	<b>SILT AND SAND</b> trace clay, trace gravel, loose to very loose, grey, wet		11	SS	1	211				
			12	SS	2	210				
			VANE			209				
			13 SHELBY			208				
			VANE							
203.9 16.7	<b>CLAYEY SILT TO SILTY CLAY</b> trace sand, trace gravel, firm, grey, moist		14	SS	5	207				
						206				
200.6 20.0						205				
						204				
						203				
						202				
						201				
						200				

**NOTES:**

Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 119.1m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 100

PROJECT: Blue Sails Site Development

DATE: June 6, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES		ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								"N" VALUES
188.6	SILTY TO FINE SAND trace gravel, dense to very dense, grey, wet		15	SS	50/15cm	199						
			16	SS	53	196						
			17	SS	46	193						
			18	SS	68	190						
182.0	SANDY SILT trace clay, trace gravel, dense to very dense, grey, moist		19	SS	46	187						
			20	SS	90/28cm	184						
182.5	COARSE SAND some gravel, trace silt, very dense, grey, moist to wet					183						
			21	SS	77	181						
180.5	End of Borehole											

NOTES:  
Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 119.1m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 101

PROJECT: Blue Sails Site Development

DATE: 5-6 June, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS	
			NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa							
						20	40	60	80	100	10	20	30	
			15	SS	79									
195.8			16	SS	86									
26.0	SILTY TO FINE SAND trace gravel, very dense, grey, wet		17	SS	53									
			18	SS	50/15cm									
			19	SS	50/13cm									
188.8			20	SS	50/13cm									
35.0	FINE TO COARSE SAND trace to some silt, trace gravel, very dense, grey, wet		21	SS	50/14cm									
181.9														
39.9	End of Borehole													

NOTES:  
Borehole was caving at 3.7m and unstabilized water level at 2.1m (Elev. 219.7m) upon completion of drilling.





# Terraprobe

# LOG OF BOREHOLE 103

PROJECT: Blue Sails Site Development

DATE: 3-4 June, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		SAMPLES			PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	WATER CONTENT (%) WP W WL	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE					
221.5 0.0	very loose  FILL - Sandy Silt to Sand, some gravel, concrete rubble, brick debris, topsoil presence, embedded rootlets, loose to compact, brown/dark gray, moist	[Pattern]	1	SS	12	221 220 219 218 217 216 215 214 213 212 211 210 209 208 207 206 205 204 203 202 201	○ UNCONFINED + FIELD VANE ● POCKET PEN. X LAB VANE		
			2	SS	4				
			3	SS	3				
			4	SS	17				
			5	SS	4				
216.8 4.6	<b>PEAT</b>	[Pattern]	6	SS	4				
216.7 5.4	SILTY TO FINE SAND trace gravel, loose, brown, wet  compact below  grey	[Pattern]	7	SS	6				
			8	SS	13				
			9	SS	12				
211.5 10.0			SILT AND SAND trace clay, trace gravel, compact, grey, wet  very loose	[Pattern]	10	SS	12		
	11	SS			2				
	12	SS			2				
	13	SS			14				
201.5 20.0		[Pattern]	14	SS	22				

**NOTES:**

Borehole was caving at 3.6m and unstabilized water level at 2.7m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 103

PROJECT: Blue Sails Site Development

DATE: 3-4 June, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	SHEAR STRENGTH kPa	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES								
186.5	CLAYEY SILT TO SILTY CLAY trace to some sand, trace gravel, embedded sand layers, very stiff to hard, grey, moist		15	SS	34	200							
			16	SS	62	197							
			17	SS	46	194							
			18	SS	21	191							
			19	SS	36	188							
181.4	SANDY SILT TO SILTY SAND trace clay, trace gravel, very dense, grey, moist to wet		20	SS	95/27cm	185							
40.1			21	SS	62	182							
	End of Borehole												

**NOTES:**

Borehole was caving at 3.6m and unstabilized water level at 2.7m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 104

PROJECT: Blue Salls Site Development

DATE: June 11, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Dynamic Cone Penetration Test

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
220.5 0.0						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE	w <sub>p</sub> w      w <sub>L</sub> WATER CONTENT (%)				

NOTES:



# Terraprobe

# LOG OF BOREHOLE 105

PROJECT: Blue Sails Site Development

DATE: 26-27 May, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES								
222.3													
0.0	<b>FILL - Silty Fine Sand, trace gravel, trace wood, trace brick, dense, brown, damp to moist</b>		1	SS	44	222							
			2	SS	7	221							
	loose, grey		3	SS	37	220							
220.2													
2.1	<b>coarse sand and cinders</b>		4	SS	6	219							
219.6													
2.8	<b>ORGANIC MATTER</b> decayed vegetation, trace cinders, trace wood, loose, firm, brownish black, moist		5	SS	4	218							
	<b>SILTY TO FINE SAND</b> trace gravel, loose to compact, brown, wet		6	SS	10	217							
	grey		7	SS	21	216							
			8	SS	12	215							
			9	SS	4	214							
212.4													
9.9	<b>SILT AND SAND</b> trace gravel, very loose to loose, grey, very moist to wet		10	SS	4	213							
			11	SS	1	212							
			12	SS	6	211							
			13	SS	17	210							
	becoming compact		14	SS	12	209							
204.8													
17.5	<b>CLAYEY SILT TO SILTY CLAY</b> trace sand, trace gravel, stiff, grey, moist		15	SS	8	208							
			16	SS	12	207							
201.7													
20.6													

**NOTES:**

Borehole was caving at 3.7m and unstabilized water level at 3.0m (Elev. 219.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 105

PROJECT: Blue Sails Site Development

DATE: 26-27 May, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	SHEAR STRENGTH kPa	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
192.6	SANDY SILT trace gravel, trace clay, very dense, grey, very moist  dense		17	SS	50/13cm	201		○ UNCONFINED + FIELD VANE ● POCKET PEN. x LAB VANE	w <sub>p</sub> w      w <sub>L</sub> WATER CONTENT (%) 10    20    30				
192.7			18	SS	50/10cm	200							
			19	SS	54	199							
			20	SS	63	198							
			21	SS	92	197							
			22	SS	48	196							
183.8	FINE TO COARSE SAND some silt, trace gravel, very dense, grey, very moist to wet  dense  sandy silt, some clay		23	SS	67	195							
38.5			24	SS	36	194							
			25	SS	50/15cm	193							
	26	SS	94/25cm	192	191	190	189	188	187	186	185	184	End of Borehole

NOTES:  
Borehole was caving at 3.7m and unstabilized water level at 3.0m (Elev. 219.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 108

PROJECT: Blue Sails Site Development

DATE: 26-27 May, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	SHEAR STRENGTH kPa	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
199.6	hard	[Hatched pattern]	15	SS	52	201							
22.8	SANDY SILT trace clay, trace gravel, dense, grey, very moist	[Dotted pattern]	16	SS	40	198							
	very dense below	[Dotted pattern]	17	SS	78	185							
		[Dotted pattern]	18	SS	97	182							
	silty sand	[Dotted pattern]	19	SS	50/13cm	189							
		[Dotted pattern]	20	SS	50/10cm	188							
184.1	End of Borehole	[Dotted pattern]	21	SS	50/13cm	185							
38.2													

**NOTES:**

Borehole was caving at 3.0m and unstabilized water level at 2.1m (Elev. 220.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 109

PROJECT: Blue Sails Site Development

DATE: 2-3 June, 2008

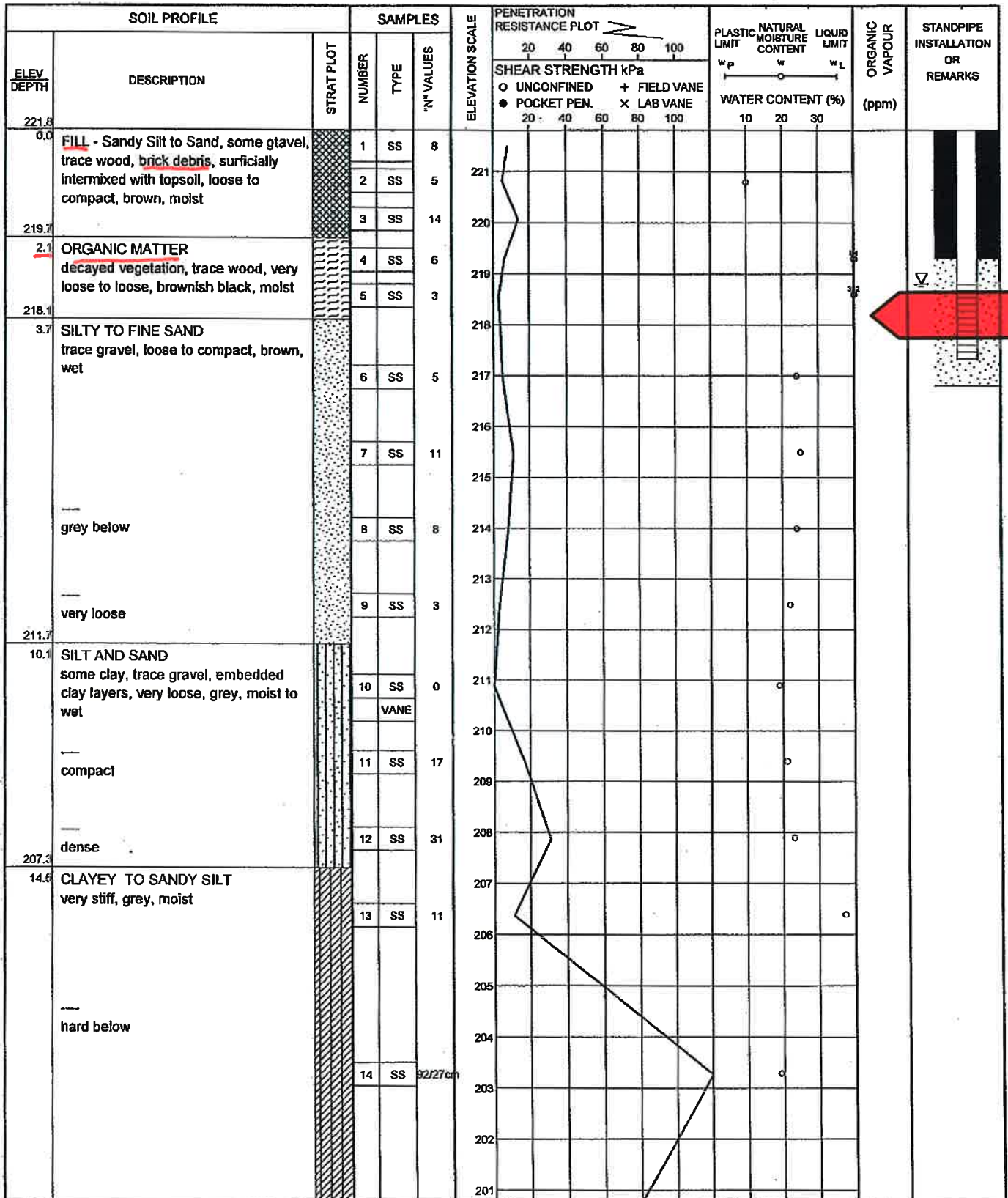
LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039



**NOTES:**

Borehole was caving at 3.3m and unstabilized water level at 3.0m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 109

PROJECT: Blue Sails Site Development

DATE: 2-3 June, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
			15	SS	72						
			16	SS	33						
	silty sand, dense, wet		17	SS	44						
			18	SS	65						
			19	SS	50/13cm						
186.8											
35.0	MEDIUM SAND trace gravel, trace silt, very dense, grey, wet										
184.8			20	SS	63						
37.0	End of Borehole										

**NOTES:**

Borehole was caving at 3.3m and unstabilized water level at 3.0m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 110

PROJECT: Blue Sails Site Development

DATE: May 23, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Dynamic Cone Penetration Test

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	WATER CONTENT (%)	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE					
221.1 0.0									
					SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE				
					20 40 60 80 100 20 40 60 80 100 10 20 30				
					221 220 219 218 217 216 215 214 213 212 211 210 209 208 207 206 205 204 203 202				

NOTES:



# Terraprobe

# LOG OF BOREHOLE 111

PROJECT: Blue Sails Site Development

DATE: 29-30 May, 2008

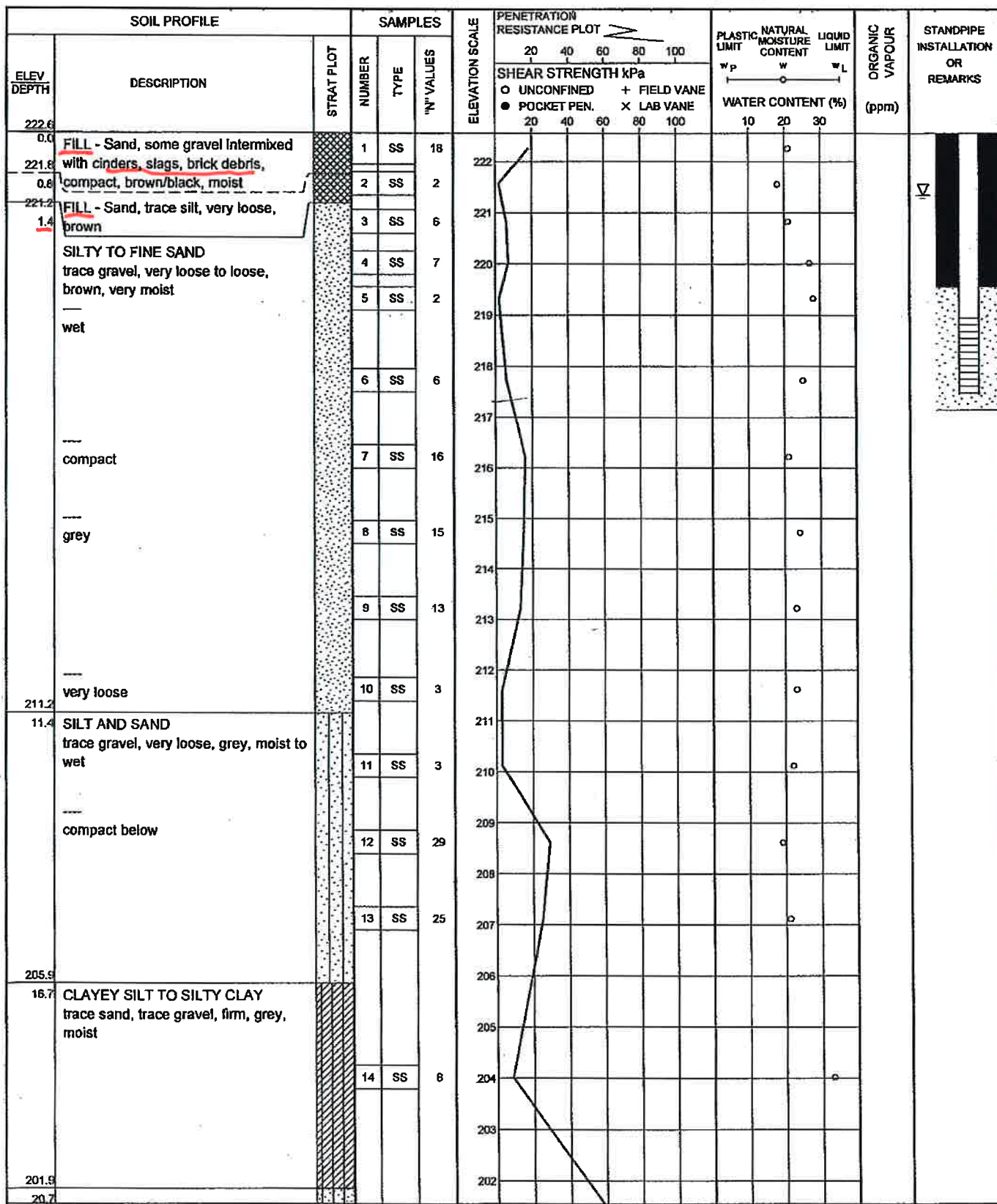
LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039



**NOTES:**

Borehole was caving at 3.0m and unstabilized water level at 1.22m (Elev. 221.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 111

PROJECT: Blue Sails Site Development

DATE: 29-30 May, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT:

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								"N" VALUES
						○ UNCONFINED ● POCKET PEN.						
						+ FIELD VANE × LAB VANE	WATER CONTENT (%)					
	SANDY SILT TO SILTY SAND trace gravel, trace clay, very dense, grey, very moist to wet		15	SS	69	201						
							200					
							199					
					16	SS	59	198				
								197				
								196				
			17	SS	60	195						
						194						
						193						
			18	SS	75	192						
						191						
						190						
			19	SS	62	189						
						188						
						187						
						186						
185.4	fine to coarse sand		20	SS	52							
37.2	End of Borehole											

**NOTES:**

Borehole was caving at 3.0m and unstabilized water level at 1.22m (Elev. 221.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 112

PROJECT: Blue Sails Site Development

DATE: May 23, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa							
						○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE								
220.9	50mm ASPHALT													
220.8	700mm GRANULAR BASE													
220.1	FILL - Sand, trace silt, trace gravel, brick debris, concrete debris, cinders, brown, compact, moist		1	SS	18									
219.5			2	SS	4									
218.8	ORGANIC MATTER		3	SS	2									
218.1	decayed vegetation, trace wood, trace cinders, very soft, black, wet		4	SS	2									
214.4	PEAT, trace marl fragments													
	SILTY TO FINE SAND													
	trace gravel, very loose to loose, brown, wet		5	SS	8									
			6	SS	9									
214.4	End of Borehole													

**NOTES:**

Borehole was caving at 4.2m and unstabilized water level at 2.1m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 113

PROJECT: Blue Sails Site Development

DATE: May 22, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANOPIPE INSTALLATION OR REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							20 40 60 80 100
220.6	FILL - Sand, some gravel, trace silt, topsoil inclusions, <u>concrete debris</u> , trace cinders, loose to compact, dark brown, moist  <u>ORGANIC MATTER</u> decayed vegetation, trace wood, soft, brownish black, wet  SILTY TO FINE SAND trace gravel, loose to compact, greyish brown, wet		1	SS	24	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 10 20 30	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○		
0.0			2	SS	8							220
219.2			3	SS	3							219
1.4			4	SS	7							218
218.5			5	SS	6							217
2.1			6	SS	11							216
214.1			7	SS	8							215
6.6	End of Borehole											

**NOTES:**

Borehole was caving at 5.0m and unstabilized water level at 1.8m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 114

PROJECT: Blue Sails Site Development

DATE: May 23, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. x LAB VANE	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES								
220.1	<b>FILL - Sand, trace silt, trace gravel, topsoil inclusions, embedded rootlets, loose to compact, dark brown, moist</b> --- cinders with some coarse sand  <b>ORGANIC MATTER</b> decayed vegetation, some gravel, compact, black, moist  <b>PEAT</b>  <b>SILTY TO FINE SAND</b> trace gravel, trace decayed vegetation, loose to compact, dark brown, moist --- grey, wet below		1	SS	4	220							
0.0			2	SS	16	219							
218.6			3	SS	11	218							
1.5			4	SS	2	217							
217.9			5	SS	12	216							
2.2			6	SS	9	215							
217.3			7	SS	9	214							
213.6	End of Borehole												

**NOTES:**

Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 218.6m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 115

PROJECT: Blue Sails Site Development

DATE: May 22, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa						
						20 40 60 80 100	20 40 60 80 100						
219.9													
0.0	<b>FILL - Silty Sand, trace gravel, topsoil inclusions with rootlets, brick debris, trace cinders, loose, brown, moist</b>  <b>FILL - Gravelly Sandy Silt, brick debris, concrete rubble, loose to compact, grey, moist</b>  very loose, wet  <b>ORGANIC MATTER</b> decayed vegetation, peat inclusions, trace rootlets, very soft, brownish black, moist  <b>COARSE SAND</b> trace gravel, compact, brown, moist  End of Borehole		1	SS	7								
219.2			2	SS	8	219							
0.7			3	SS	14	218							
			4	SS	3	217							
216.9			5	SS	1	216							
3.0			6	SS	26	215							

**NOTES:**

Borehole was caving at 2.6m and unstabilized water level at 2.3m (Elev. 217.6m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 116

PROJECT: Blue Sails Site Development

DATE: May 22, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
220.1	FILL - Silty Sand, some gravel, <u>concrete rubble</u> , compact, grey/brown, moist		1	SS	23	220						
218.7			2	SS	30	219						
1.4	dense, grey  very loose, brown		3	SS	31	218						
			4	SS	3	217						
			5	SS	14	216						
215.0	FINE TO MEDIUM SAND some silt, trace gravel, loose to compact, greyish brown, very moist		6	SS	7	215						
5.1			End of Borehole									

**NOTES:**

Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 218.6m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 117

PROJECT: Blue Sails Site Development

DATE: May 23, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES							
220.6	FILL - Sand, some silt to silty, some gravel, loose to compact, brown, damp to moist  brick debris, concrete rubble, very moist  trace wood, organic matter, black		1	SS	24							
0.0			2	SS	10							
			3	SS	6							
			4	SS	26							
			5	SS	15							
216.8			6	SS	27							
3.8	FINE TO MEDIUM SAND											
215.5	trace gravel, compact, grey, wet											
5.1	End of Borehole											

**NOTES:**

Borehole was caving at 2.0m and unstabilized water level at 1.8m (Elev. 218.8m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 118

PROJECT: Blue Salls Site Development

DATE: May 23, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Dynamic Cone Penetration Test

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
220.4 0.0						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. X LAB VANE	W <sub>P</sub> W      W <sub>L</sub>  ----- -----  10      20      30				

NOTES:



# Terraprobe

# LOG OF BOREHOLE 119

PROJECT: Blue Sails Site Development

DATE: June 10, 2008

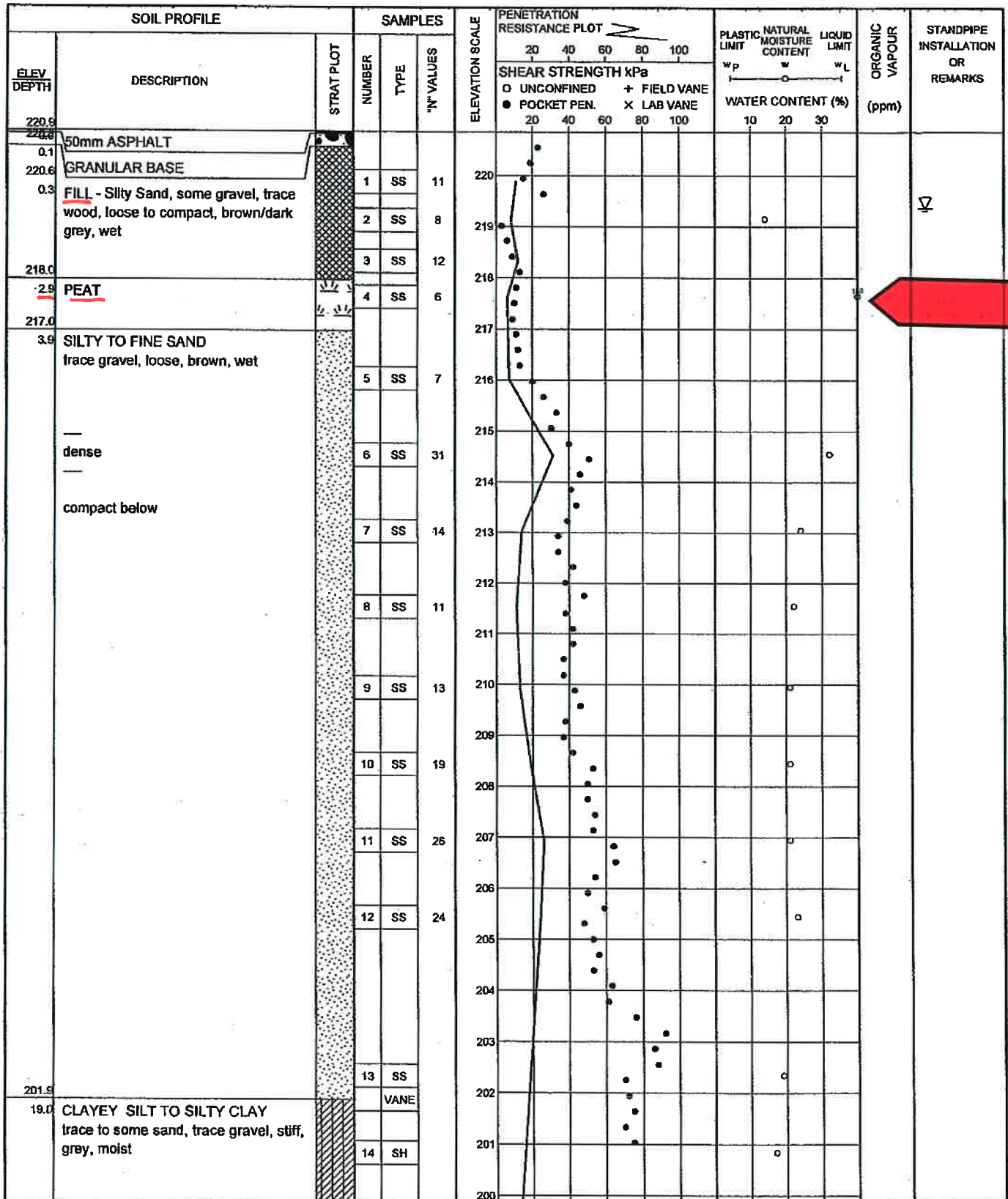
LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039



**NOTES:**

Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 218.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 119

PROJECT: Blue Sails Site Development

DATE: June 10, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Hollow Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
195.4	CLAYEY SILT TO SILTY CLAY trace to some sand, trace gravel, stiff, grey, moist	[Hatched pattern]	15	SS	11						
25.6	SANDY SILT trace gravel, trace clay, very dense, grey, moist	[Dotted pattern]	16	SS	53						
190.9	SILTY SAND trace clay, trace gravel, very dense, grey, moist to wet	[Dotted pattern]	17	SS	50						
30.0			18	SS	71						
186.2	End of Borehole		19	SS	50/13cm						

**NOTES:**

Borehole was caving at 1.5m and unstabilized water level at 1.5m (Elev. 218.3m) upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE 120

PROJECT: Blue Sails Site Development

DATE: May 22, 2008

LOCATION: Bradford Street to Lakeshore Drive

EQUIPMENT: Bombardier/Solid Stem Augers

CLIENT: \_\_\_\_\_

ELEVATION DATUM: Geodetic

FILE: 3-08-4039

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
220.3	FILL - Silty Sand, some gravel, brick debris, trace cinders, topsoil inclusions, embedded rootlets, trace wood, compact, dark brown, moist --- concrete rubble, petroleum odour, grey --- decayed vegetation, grey to black, wet 3.5 ORGANIC MATTER 216.4 decayed vegetation, some gravel, firm, black, moist 4.0 Peat 215.2 5.1 End of Borehole		1	SS	12	220	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. X LAB VANE 20 40 60 80 100 WATER CONTENT (%) w <sub>p</sub> — w — w <sub>L</sub> 10 20 30			
0.0			2	SS	27	219				
			3	SS	13	218				
			4	SS	14	217				
216.9			5	SS	10	216				
215.2			6	SS	6					

**NOTES:**

Borehole was caving at 3.3m and unstabilized water level at 1.2m (Elev. 219.1m) upon completion of drilling.



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 109 Woodbine Avenue, Suite 2  
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 Tel: (416) 474-3353 Fax: (416) 424-3720  
 Email: brown@brownassoc.com

**Project:** S1 75 Dracoid Simat (Harmony Village) City of  
**Location:** Barrie, Ontario  
**Client:** Harmony Village Lake Simcoe Inc.  
 2250 Dovers Rd Drive, Suite 114  
 Brampton, ON L6H 0W3

**Project Number:** 12\*3781  
**Technologist:** C.W. O'Connell A.S.C.T

**BHAMW Location:** See site drawing  
**Bench Mark:**

**TOR Elevation:**

**BOREHOLE LOG No:** BH-501-13 **Page:** 1 of 3

**Date of Borehole:** 09 Aug 13

Bench Mark	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Test				Lab Sample No.	PID READING	Sample	% Recovery	Standard Penetration (Blows per 0.30m)	Moisture Content (%)
						Moisture Content									
						Dynamic Penetration Test									
00	40	80	90												
0.1			SS-1	0.6m to 0.6m FLL - 75mm MIXTURE of TOPSOIL and GRAVEL, some WOOD CHIPS, brown slightly moist, non plastic, non cohesive, very loose, irregular (broken sand stre)	0				SOIL-3781-130409-501-002			75	4		
0.6			SS-2	0.6m to 1.4m FLL - FINE to MEDIUM SAND, dark brown to brown, wet, non plastic, non cohesive, loose, organic staining	0							50	8		
1.4			SS-3		0							<50	<3		
2.1			SS-4	1.4m to 3.7m NATIVE - SM - SAND, brown to gray, by 2.3m wet, non plastic, non cohesive, very loose, roots present	0							60	<2		
3.7			SS-5		0							75	<1.5		
4.2			SS-6		0							<25	?		
5.3			SS-7		0							<25	?		
6.7			SS-8	3.7m to 12.6m NATIVE - SM - SAND, gray, wet, non plastic, non cohesive, very loose to loose	0							<25	4		
12.6			SS-9		0							<50	6		





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 Email: baa@aronow.com

**Project:** 51 / 5 Dradford Street (Harmony Village) City of  
**Location:** Dumb On/ano  
**Client:** Harmony Village Lake Simcoe Inc  
 2250 Bala Drive, Suite 114  
 Brampton, ON L6R 6W3

**Project Number:** 12/0781  
**Technologist:** C.W. Colbourne, A.Sc.T

**BHAW Location:** See P&I drawing

**Bench Mark:**

**TON Elevation:**

**BOREHOLE LOG No.:** BH-5D1-13 Page 3 of 3

**Date of Borehole:** 09 Aug 13

**Stratigraphy**

Depth in Metres	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Tests				Lab Sample No.	PID READING	% Recovery	Standard Penetration Test (Blows per 0.30m)	Moisture Content %
						Moisture Content Dynamic Penetration Test								
20.1			SS-16											
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15.7m to 23.0m  
 NATIVE - SM - SILTY SAND grey, moist non plastic, non cohesive, compact to 20.3m; loose to 21.6m changing to recompact

Borehole terminated at 23.3m from existing grade. Borehole did advance through the groundwater table but due to disturbance and collapse of the borehole the groundwater level is approximated. No monitoring well was installed.



**BRUCE A. BROWN ASSOCIATES LIMITED**  
 Consultants in the Environmental and Applied Earth Sciences  
 169 West Beaver Avenue, Suite 2  
 Toronto, Ontario, Canada M2B 2L7  
 Tel: (416) 476-3355 Fax: (416) 476-1750  
 Email: info@brucebrown.com

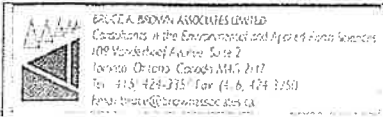
**Project Location:** 51, 75 Bradford Street (Harmony Village) City of  
 Bantia, Ontario  
**Client:** Harmony Village Lake Simcoe Inc  
 2250 Bayview Drive, Suite 114  
 Brampton, ON L6H 0V3

**Project Number:** 12/03/01 **Technologist:** G.W. Coburn, A.Sc.T

**BEMW Lesson:** See site drawing **Bench Mark:** Temp Bench Mark **TON Elevation:**

**BOREHOLE LOG No.:** BH-502-13 **Page 1 of 3** **Date of Borehole:** 12-Aug-13

Depth in Meters	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Tests				Lab Sample No.	PID READING	Samples		
						Moisture Content						% Recovery	Standard Penetration Test (Blows per 0.30m)	Molature Content %
						20	40	60	80					
0.0			SS-1	Grade to 0.6m FILL - SCUM of Topsoil underlain by SAND and GRAVEL brown, slightly moist, non plastic, non cohesive, compact								75	17	
0.6			SS-2	0.6m to 2.1m FILL - SAND and GRAVEL, gray/brown moist, non plastic, non cohesive, loose, 0.1m <75mm thick PHC impacted zone at 1.3m to 1.4m from grade, beyond 1.4m no PHC impacts observed, organic staining present						SOIL-3781-130809-502-001		50	6	
2.1			SS-3									<25	9	
2.1			SS-4	2.1m to 2.6m FILL - MIXTURE of SAND, GRAVEL, TOPSOIL, FRAGMENTS OF DIMENSIONAL TIMBER, gray/brown, moist, non plastic, non cohesive, very loose								<50	<1	
2.6			SS-5									0	5	
2.6			SS-6	From 2.6m to 5.0m NO RECOVERABLE SOIL SAMPLE								0	<1	
5.0			SS-7	From 5.0m to 8.1m NATIVE SM - MEDIUM to FINE SAND, grey, well non plastic, non cohesive, loose								75	7	
8.1			SS-8									50	4	
8.1			SS-9	8.1m to 21.5m SM - SILTY SAND, grey, well non plastic, non cohesive, very loose to loose, trace clay by 21.3m								<50	5	



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 109 Woodbine Avenue, Suite 2  
 Toronto, Ontario, Canada M4G 1H7  
 Tel: 416-424-2151 Fax: 416-424-2350  
 Email: brownb@brownassociates.ca

**Project Location:** 51 75 Braddon Street (Hammary Village) City of Toronto, Ontario  
**Project Number:** 12-3781  
**Technologist:** C.W. Colbourne A.Sc.T  
**Client:** Hammary Village Lake Simcoe Inc  
 2250 Bowlin Drive, Suite 111  
 Brampton, ON L6R 0W3

**BHAMW Location:** See site drawing  
**Bench Mark:** Terra Bench Mark  
**TOR Elevation:**

**BORING LOG No.:** BH-502-13 Page 2 of 3  
**Date of Borehole:** 09-Aug-13 & 12-Aug-13

Depth in Metres	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Tests				Lab Sample No.	PID READING	Samples							
						Moisture Content						% Recovery	Standard Penetration Test (N <sub>60</sub> Blows per 0.30m)	Moisture Content %					
						20	40	60	80										
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12.6			SS-10														<50		3
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8 m to 21.5 m  
 SM - SILTY SAND gray, wat. non-plastic, non-cohesive vary loose to loose fine clay by 21.5m

SS-10

SS-11

SS-12



BRUCEAL BROWN ASSOCIATES LIMITED  
 Consultants in the Environmental and Applied Earth Sciences  
 103 Woodbine Avenue, Suite 2  
 Toronto, Ontario, Canada M4G 2H2  
 Tel: 416-424-3255 Fax: (416)-724-3150  
 Email: bruceal@brucealbrown.com

Project Location: 51 75 Blandford Street (Hastings Village) City of Barrie, Ontario  
 Client: Hastings Village Lake Success Inc.  
 2250 Blandford Street Suite 118  
 Strumpston, ON, L6H 0Y9

Project Number: 1713781  
 Technologist: C.W. Colbourne A.Sc.T

BHGMW Location: See this drawing  
 Bench Mark: Trump Bench Mark  
 TOR Elevation:

BOREHOLE LOG No. BH-502-13 Page 3 of 3  
 Date of Borehole: 09 Aug 13 & 12 Aug 13

Depth in Meters	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Tests			Lab Sample No.	PID READING	Samples		
						Moisture Content					% Recovery	Standard Penetration (N-Blows per 0.30m)	Moisture Content %
						20	40	60					
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6.4m to 21.9m  
 SM SILTY SAND grey wet, non-plastic, non-cohesive, very loose to loose limco clay by 21.3m

21.9m to 23.3m  
 CL SILTY CLAY grey moist high-plasticity cohesive very stiff

Dominate terminated at 23.3m from existing grout. Borehole did advance through the groundwater table but due to disturbance and collapse of the borehole the groundwater level is unobtainable. No monitoring well was installed.

SP-3

SP-4













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 Consulting and Environmental and Project Earth Services  
 109 Woodbine Avenue, Suite 2  
 Toronto, Ontario, Canada M4G 2H7  
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 Email: info@brucebrown.com.ca

Project Location: 51 75 Bradford Street (Hamrozy Village), City of  
 Brampton, Ontario

Project Number: 12/3785 Technologist: C.W. Cobourn A.Sc.T

Client: Hamrozy Village Lako Simoes Inc  
 2250 Bovaird Drive, Suite 114  
 Brampton, ON, L6H 6W4

BH17MW Location: See Site drawing Bench Mark: Top of Bench Mark TOR Elevation:

BOREHOLE LOG No. BH-504-13 Page 3 of 3 Date of Borehole: 13 Aug 13

Stratigraphy

Depth in Meters	Monitoring Well Diagram	Symbol	Sample Interval	Description	Elevation	Tests				Lab Sample No.	PID READING	Samples		
						Moisture Content						% Recovery	Standard Penetration	Moisture Content %
						0	20	40	60					
20.0														
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4.0m to 23.0m  
 NATIVE - SM - SILTY SAND, grey wet to moist by 10.0m, non plastic, non cohesive very loose to 1.0 cm changing to compact to loose by 31.0m to denser by 32.0m

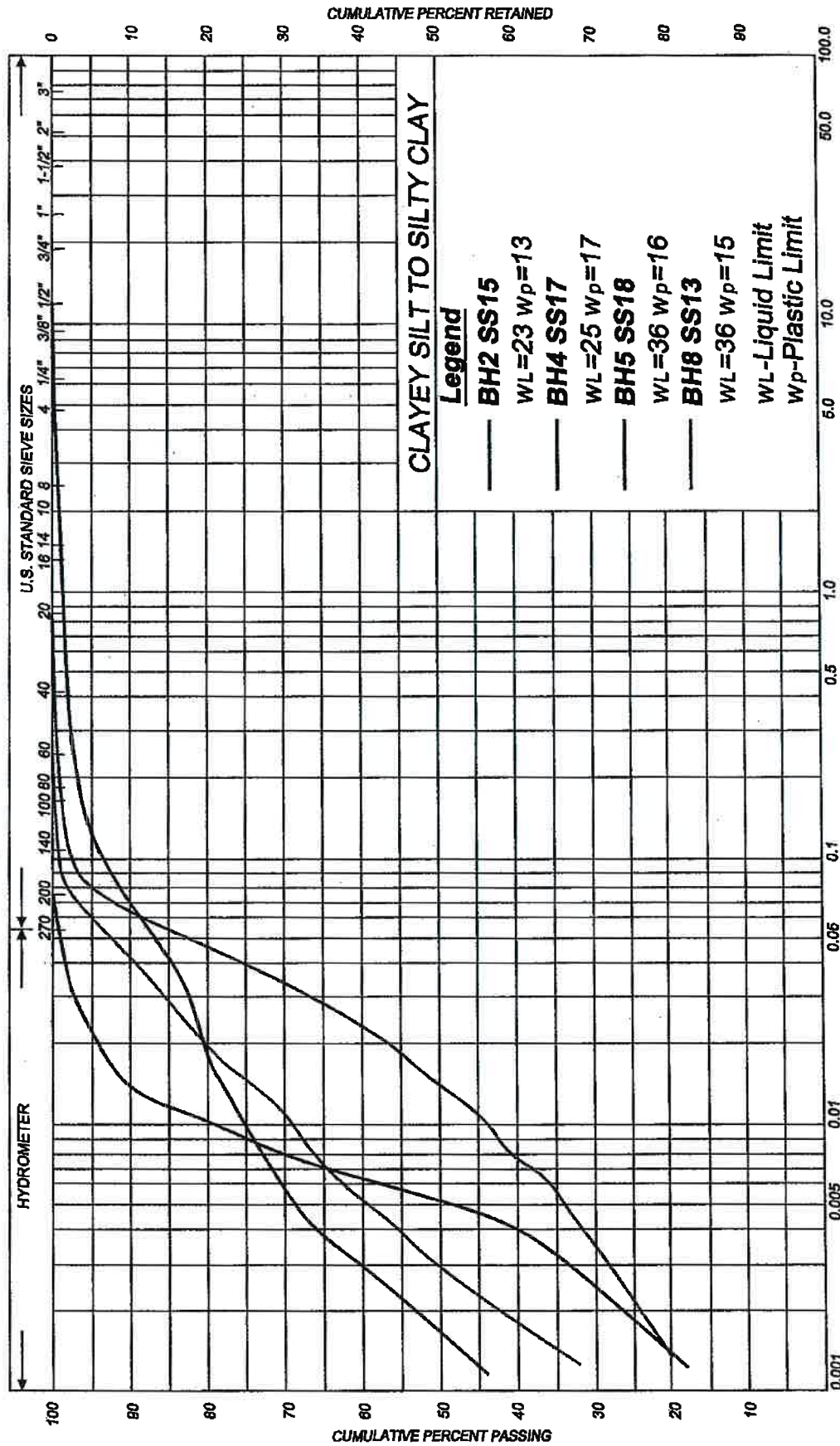
Downhole terminated at 23.0m from casing grade. Borehole did advance through the groundwater table but due to a disturbance and collapse of the borehole the groundwater level is approximated. No monitoring well was installed.





**PARTICLE SIZE DISTRIBUTION CHART**

PML Ref.: 07BF057  
Figure No.: 3

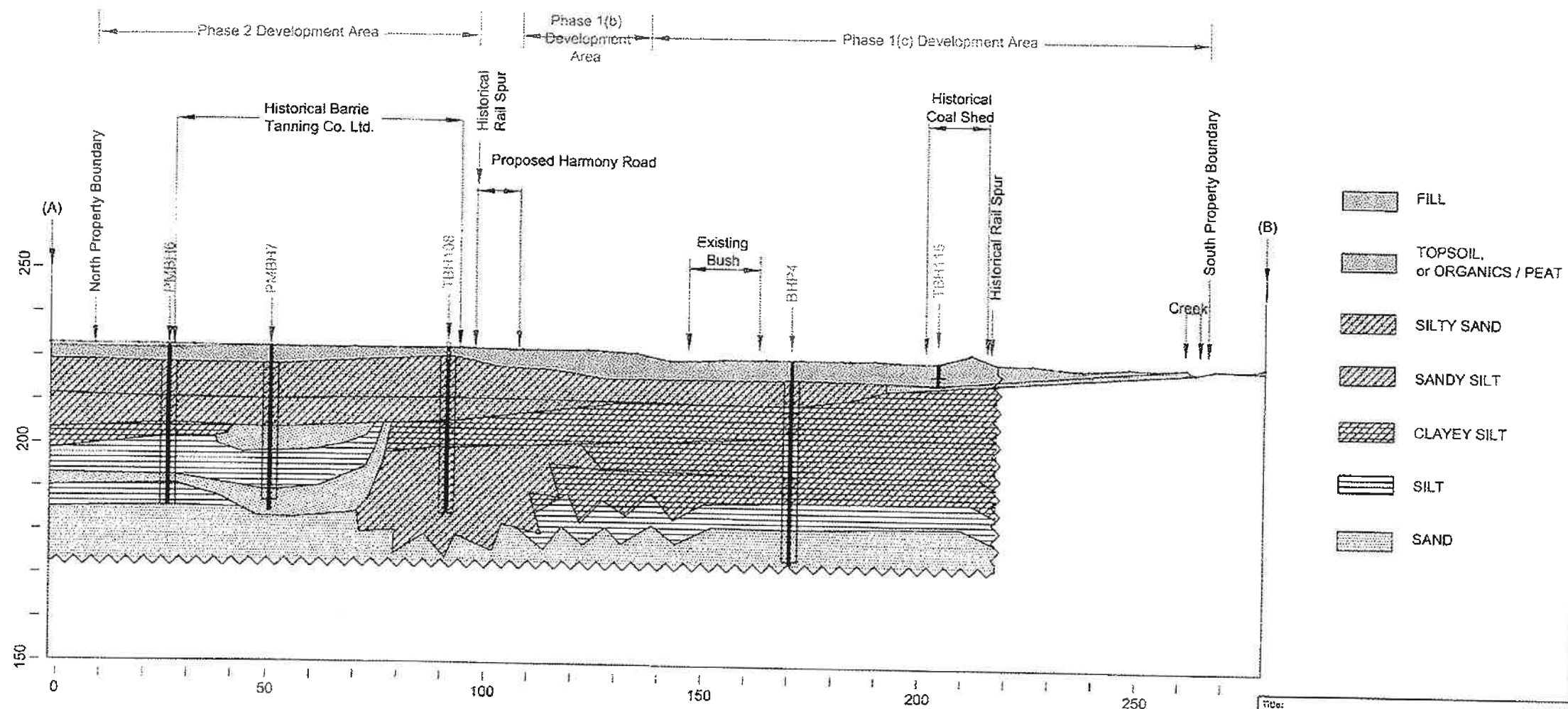


HYDROMETER		U.S. STANDARD SIEVE SIZES		GRAIN SIZE IN MILLIMETERS		SOIL CLASSIFICATION	
270	200	4	1/4"	0.075	0.075	CLAY	CLAY
140	100	20	3/8"	0.075 - 0.425	0.075 - 0.425	CLAY	CLAY
80	60	40	1/2"	0.425 - 0.850	0.425 - 0.850	CLAY	CLAY
40	40	60	3/4"	0.850 - 2.000	0.850 - 2.000	CLAY	CLAY
20	20	100	1"	2.000 - 4.750	2.000 - 4.750	CLAY	CLAY
10	10	20	1 1/2"	4.750 - 12.500	4.750 - 12.500	CLAY	CLAY
5	5	40	2"	12.500 - 25.000	12.500 - 25.000	CLAY	CLAY
2	2	60	3"	25.000 - 75.000	25.000 - 75.000	CLAY	CLAY
1	1	100		75.000 - 100.000	75.000 - 100.000	CLAY	CLAY



**TABLE III**  
**SUMMARY OF GROUND WATER DATA**

Location	Elevation of Ground Surface (m)	Approx. Depth of Monitoring Well (m)	Screened Interval Elevations (m)	Depth to Ground Water (metres below ground surface)		Ground water Elevation (m)
				January 31, 2008		
MW1	222.9	6.1	220.1 to 216.8	3.0		219.9
MW2 (BH8)	222.4	6.1	219.6 to 216.3	2.0		219.8
MW3 (BH1)	221.3	6.1	218.5 to 215.2	2.3		219.0

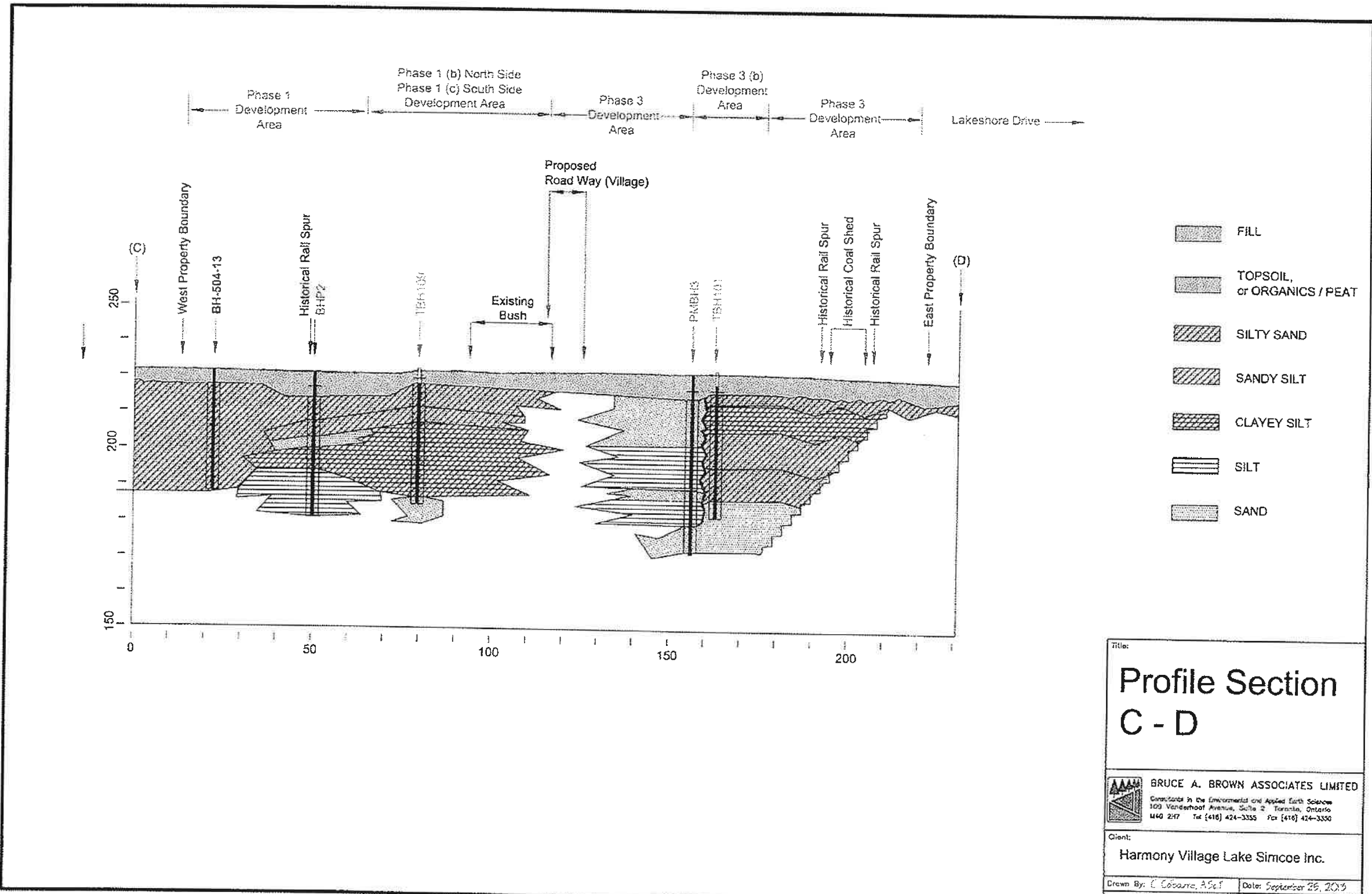


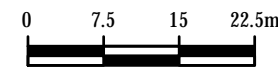
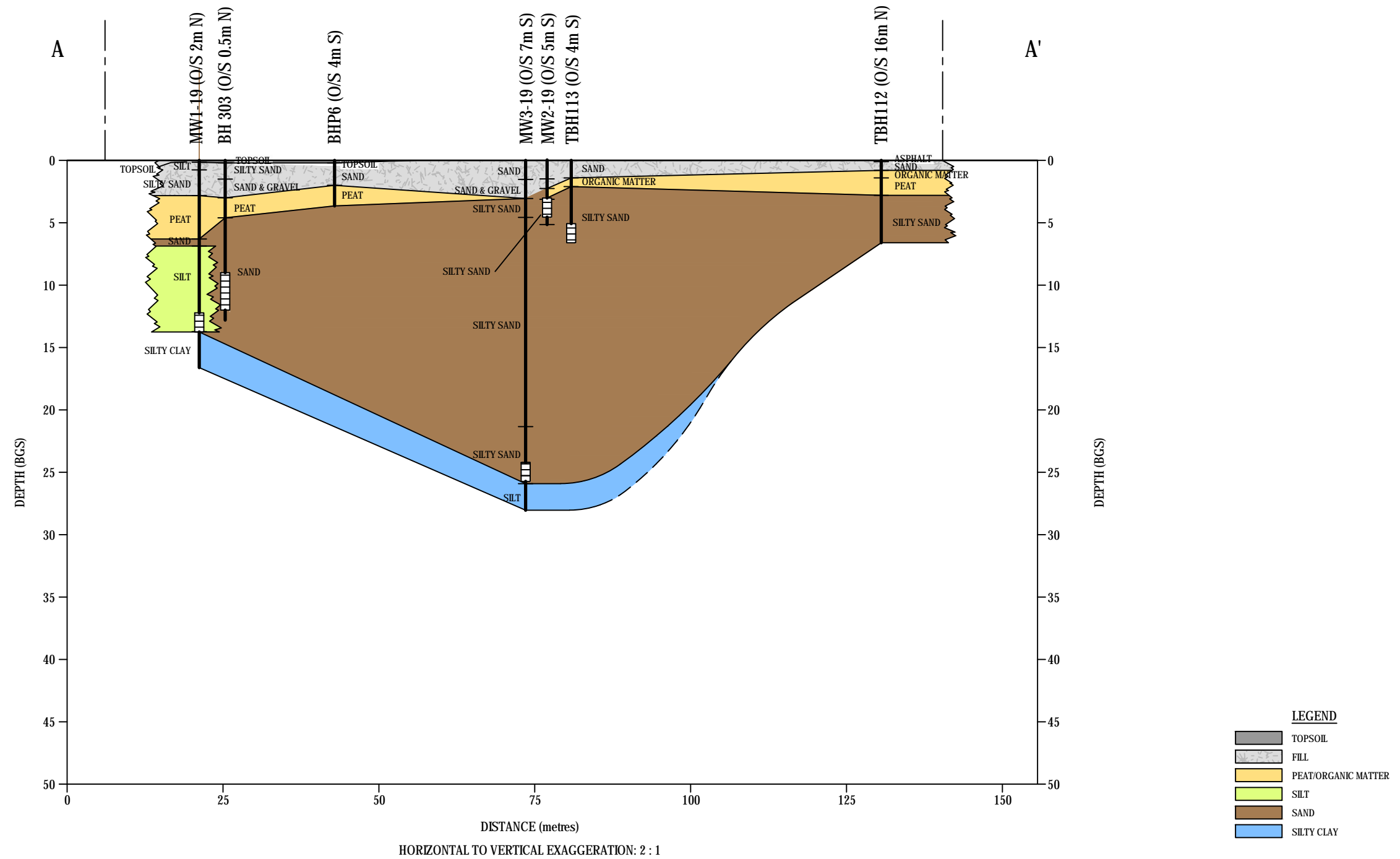
Profile Section  
A - B

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 M4G 2H7 Tel: (416) 424-3355 Fax: (416) 424-3350

Client:  
 Harmony Village Lake Simcoe Inc.

Drawn By: C. Cosimo, A.S.C. Date: September 25, 2009  
 Project No.: 12-378 Drawing No.: 5161072507



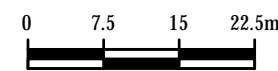
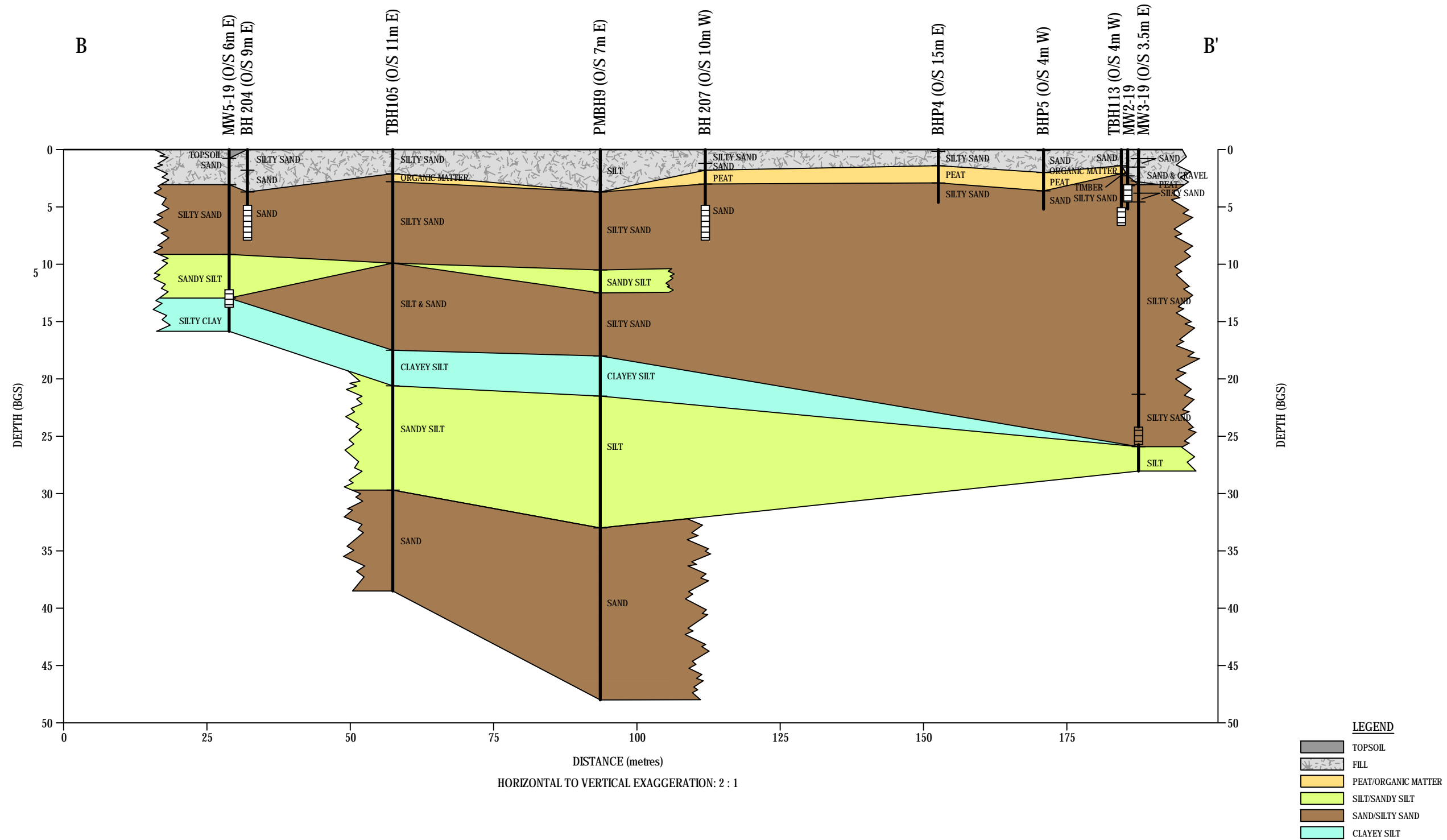


PROPOSED RESIDENTIAL DEVELOPMENT  
51-75 BRADFORD STREET, BARRIE, ONTARIO  
HYDROGEOLOGIC ASSESSMENT

Project No. 11201680  
Date November 2019

CROSS-SECTION A-A'

FIGURE 4.1



PROPOSED RESIDENTIAL DEVELOPMENT  
51-75 BRADFORD STREET, BARRIE, ONTARIO  
HYDROGEOLOGIC ASSESSMENT

Project No. 11201680  
Date November 2019

CROSS-SECTION B-B'

FIGURE 4.2

# **APPENDIX B**

# WET SOIL MIXING

Wet soil mixing offers a cost-effective and efficient means to overcome a variety of soil problems.



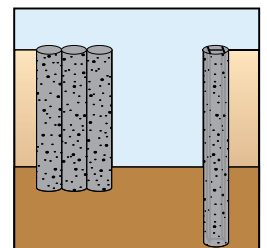
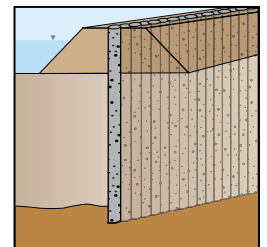
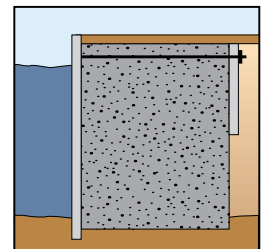
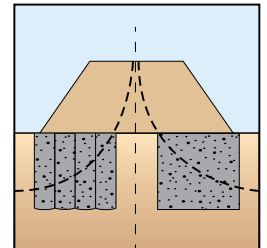
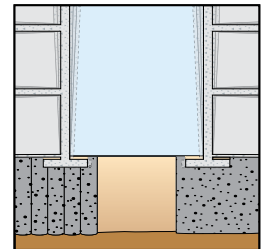
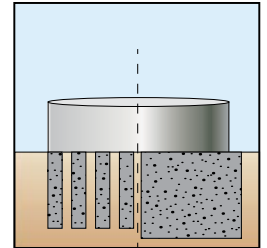
Above: Soil mix columns constructed along the alignment of an existing waterline provided a containment system to protect the critical utility in Maryland.

Center: Soil mixing for foundation support and liquefaction mitigation at a planned hospital site in California.



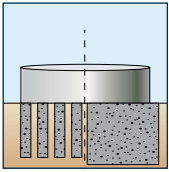
Wet soil mixing is the controlled mechanical mixing of the in situ soil with grout slurry using a rotary mixing tool. The wet method relies on the introduction of an engineered grout slurry to create soil-cement (soilcrete) elements for soil stabilization, or to support earth or building loads. The intent of the soil mixing program is to achieve improved engineering properties of the in situ treated soil, generally a design compressive strength, shear strength and/or permeability. Soil mixing can also be used to immobilize and/or stabilize contaminants, or as a chemical treatment system.

Hayward Baker (HB) has designed and constructed soil mixing programs for over 20 years and has successfully completed over 150 projects. Experienced employees working with self-developed specialty mixing tools and proprietary data acquisition (DAQ) equipment and software enable HB to perform the highest quality soil mixing to meet each project's requirements. For a variety of subsurface and project conditions, HB's wet soil mixing may be the answer.



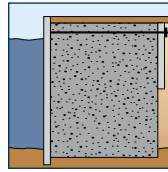
# Technology & Applications . . .

**W**et soil mixing is applicable to a wide range of soils. For soils with high moisture content, dry soil mixing may also be considered. Soil mixing has been performed to depths up to 100 feet (30 meters). Soils vary widely in their ability to be mixed, depending on the soil type, strength, water content, plasticity, stratigraphy, and texture. Almost any soil type, including organics, can be treated, although they may require high binder contents and/or pretreatment to achieve required results. In cases when the target soil is very soft, including some very weak clays and peats, 100% of the soil may require treatment. This complete coverage of soil mixing is referred to as mass mixing, and treatment to depths of approximately 20 feet (6 meters) has been performed with the horizontal axis mass mixing tool. Deeper mass mixing depths can be accomplished by overlapping columns. Experienced HB representatives are available to discuss treatment in challenging soils.



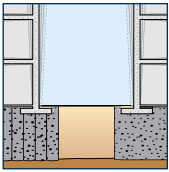
## Foundation Support

Structures such as tanks, buildings, and others with heavily loaded foundations can be supported by soil mix columns or mass mixing.



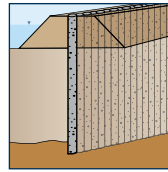
## Port Development

The soft soils often found at port facilities can be treated with soil mixing. Stabilization can provide structural support, and/or it can greatly reduce lateral loads on bulkhead walls.



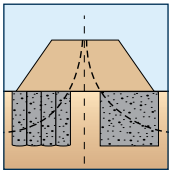
## Liquefaction Mitigation

Liquefaction problems in seismic areas can be remedied by using soil mixing to support the structure and to resist lateral spreading.



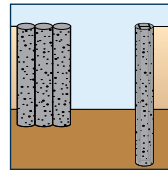
## Water Cutoff

Secant soil mix columns can be constructed beneath undeveloped sites or existing levees to produce a water cutoff wall.



## Slope Stabilization

Soil mixing can provide substantial shearing resistance to stabilize slopes, excavations, or embankments. Shear walls can be constructed by interlocking columns or with the mass mixing tool.



## Excavation Support

Soil mix columns can be used to construct in situ retaining structures. Structural steel elements are often installed into the uncured soil mix columns to add strength and provide load distribution should anchoring be necessary.



①



③



④



②



⑤

① Settlement control for tank foundations in Alberta, Canada provided by soil mix columns.

② Mass soil mixing to solidify and stabilize soils underlying a planned building in New York.

③ A new high-rise building in Florida requiring soil mix columns to provide earth retention and bottom seal for a dry excavation near the ocean.

④ Deep soil mix columns (shown) and mass soil mix cap constructed for settlement control of new tanks in Louisiana.

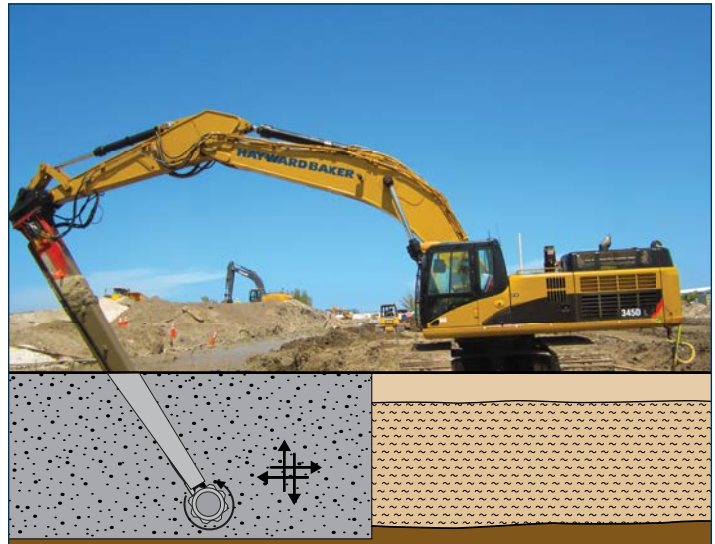
⑤ Mass soil mixing to create vertical panels for water cutoff in restricted access and low headroom in Washington.

# Procedures & Design Considerations . . .

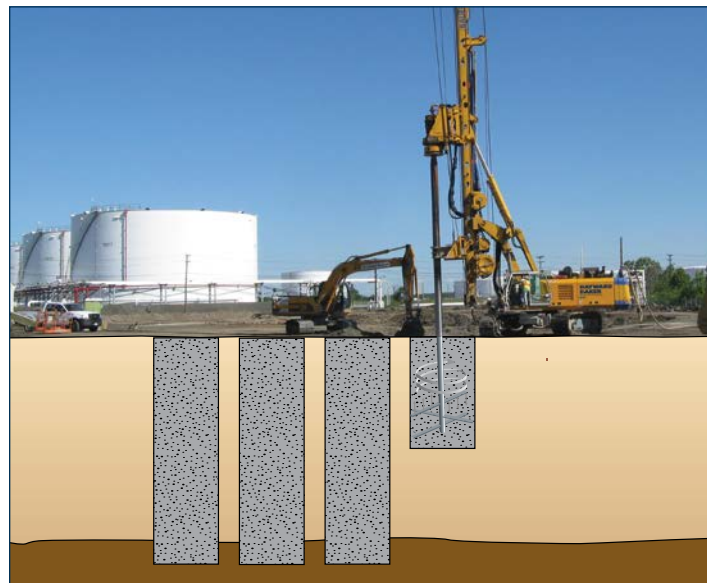
## Wet Mixing Procedures

A range of mixing tool configurations can be designed to construct varied geometries in diverse soils. As the soil mixing tool penetrates the ground during column construction, grout slurry is pumped through the hollow stem of the shaft and injected into the soil through nozzles located on the rotating mixing blades. The mixing blades on the tool shear and mix the soil with the grout slurry. Injection and soil mixing continue to design depth. When design depth is reached, tool rotation and grout injection continue as the tool is withdrawn, leaving behind stabilized soilcrete columns. The columns may be designed as individual foundation elements or clustered to construct larger geometries over a wider area.

When mass mixing, initial conditioning of the soil may be performed with separate equipment. The binder agents are injected as the horizontal axis mixing tool passes throughout the soil mass being treated.



*During mass mixing, the track hoe arm raises, lowers, and sweeps the horizontal axis mixing tool through the treatment zone, mixing the soil with the slurry, which is injected through a port near the mixing tool.*



*During column mixing, the mixing tool mixes the soil as it advances to the maximum treatment depth and continues mixing during withdrawal.*

Depending on the soil type and required binder content, excess soilcrete generated may range from 20 to 50% of the treated volume.

## Design Considerations

Soil mixing can treat a wide range of soil types. Soft cohesive soils are usually targeted as other soil types can often be treated more economically with other techniques. Variabil-

ity of the product is largely a function of the variability of the soil. It is crucial to understand site geology and history, soil gradation, pH, and the in situ moisture content of each treatment stratum. The sulfate and organic content of each stratum should also be determined.

Soil mixing creates a soilcrete product that is stiff and strong, although final mix strength depends on many factors, some of which include soil type, water content, pH, organic content, grout quantity, and mixing energy. Therefore, it is recommended that laboratory bench scale testing using site soils and methods to simulate mixing procedures be conducted. The strength of field-mixed samples may vary from that of lab-prepared samples. Selecting a strength value for design should involve, among other things, considering the variations in strength that are inherent to this process. Additional recommendations for design can be found in the soil mixing chapter of *Ground Improvement*, by Dr. M. Topolnicki, Third Edition, Spon Press. ISBN 9780415599214.

It is challenging to mix low-plasticity clays with shear strength greater than 1,500 psf, high-plasticity clays with shear strength greater than 1,000 psf, and cohesive soils with moisture contents much lower than the liquid limits. However, with appropriate pretreatment even these difficult soils can be treated successfully. Obstructions need to be identified prior to implementation. Stiff soils and obstructions may require predrilling ahead of the soil mixing process.

# Equipment & Materials . . .

*No single tool will be the best for all soil types, and field adjustments are sometimes performed.*

## Wet Mixing Rig

The base mixing rig is used to provide stability, depth capability, and power to the mixing tool. Drill heads vary from conventional hydraulic drill heads to dual-motor, crane-mounted turntables. Torque units range from 30,000 to 300,000 ft-lbs (40.7 kN-m to 406.7 kN-m).

The mixing tool can be a combination of partial flighting, mix blades, injection ports and nozzles, and shear blades. No single tool will be the best for all soil types, and field adjustments are sometimes performed. Column size ranges from 1 to 12 feet (0.3 to 3.6 meters) in diameter.



*Dual axis wet soil mixing rig used to construct a perimeter retaining wall prior to excavation for a planned high-rise in Florida.*



*Soil mix columns constructed for foundation support and liquefaction mitigation for the expansion of a nuclear plant in North Carolina.*

When performing mass mixing, a horizontal axis mixing tool is connected to the arm of a modified track hoe. The mixing tool is moved throughout the soil being treated as binder is injected through a port located at the rotating tool.

## Grout Slurry Delivery

Depending on the in situ soil and required properties of the soilcrete, the volume of grout slurry necessary ranges from 20 to 50% by volume of soil treated, known as volume ratio.

Pre-production laboratory testing is used to prescribe the grout slurry design and volume ratio. Grout slurry is typically deliv-

ered on penetration as well as withdrawal. The grout slurry batching system can be a computer-controlled colloidal shear mixer, or a continuous jet mixing system. Grout slurry is continually agitated while it is held in storage. The grout slurry is pumped to the mixing rig from the storage unit at a delivery rate necessary to produce the designed volume ratio.

The grout slurry flow per cubic yard of soil being mixed is adjusted to the requirements of the design mix and the results of testing. Flow monitoring devices are installed in the grout slurry delivery line to monitor flow, density, total injected grout, and pressure.

## Grout Slurry

The grout slurry consists of water and cementitious binders and may contain swelling clays. Cementitious binder is typically Portland cement, but fly ash, lime, and ground granulated blast furnace slag (GGBFS) may also be used.



*A soil mixing grout slurry batch plant. Real-time monitoring of all mixing parameters allows for control of batching and pumping operations.*

*HB has developed proprietary data acquisition (DAQ) equipment and software for real-time monitoring of all parameters during the wet soil mixing process.*

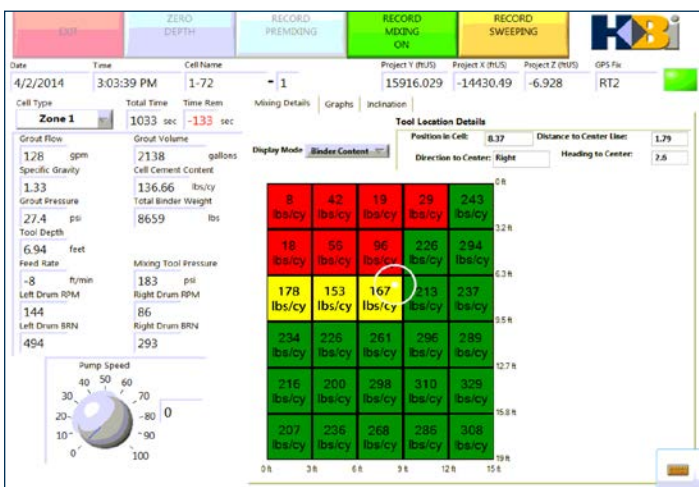
# Quality Control . . .

## Pre-Construction

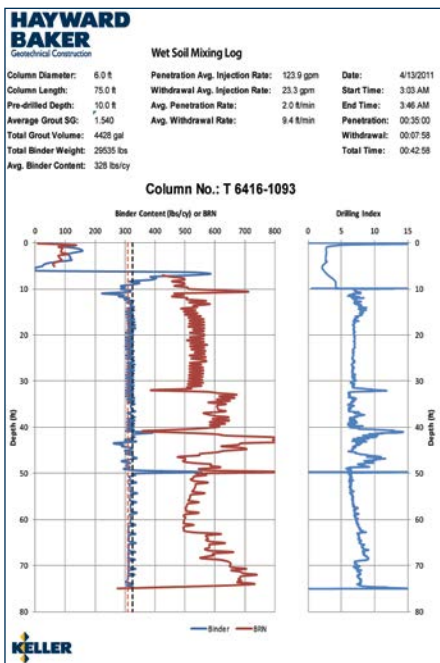
Prior to soil mixing, samples of the soil to be treated are retrieved for laboratory bench scale testing. The samples are mixed in a laboratory with varying slurry types and volume ratios to help identify the mix design that will achieve the required performance.

## During Construction

To assist in monitoring and controlling the construction process, HB has developed proprietary data acquisition (DAQ) equipment



Mass soil mixing DAQ system rig operator interface.



Example of DAQ system full data report for wet soil mixing.

and software for real-time monitoring of all parameters. Soil mixing rigs are fully instrumented with an on-board computer system to monitor the slurry dosage and mixing energy. During column mixing, the system also regulates the penetration and lift rates to keep the dosage within the specified range. Data are recorded and displayed on an in-cab monitor.

It is also possible to remotely monitor the feedback. All data are transmitted in near real-time to an online central database via cell modem.

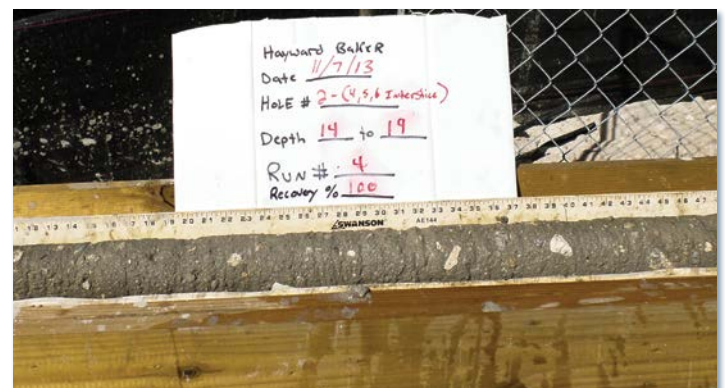
The following information is documented prior to and during construction:

- ◆ Column or cell identification
- ◆ Working grade
- ◆ Column diameter or cell volume
- ◆ Slurry type
- ◆ Mixing time
- ◆ Slurry dosage rate and pressure
- ◆ Tool rpm
- ◆ Total quantity of slurry added during mixing
- ◆ Mixing depth
- ◆ Lab tests on soilcrete samples

Fresh soilcrete is sampled immediately after mixing for casting into cylinder molds for later laboratory strength and permeability testing.

## Post-Construction

Core sampling is common but challenging in the relatively low-strength soilcrete. Coring crews experienced with coring lower strength materials with appropriate equipment are required to



Soilcrete core sample ready for curing and subsequent strength testing.

retrieve quality samples. Soil inclusions are common, but should not exceed a size that will adversely affect the required performance of the soilcrete system. Rock fragments in soilcrete may break free during coring and grind up the core sample, resulting in low recovery from high-quality soilcrete.

# Advantages of Hayward Baker Wet Soil Mixing

Wet soil mixing offers a cost-effective and efficient means to overcome soft soil problems for a variety of soil types, loadings, and project requirements. Possible benefits include:

- ◆ *Development of otherwise unusable (cost/time-prohibitive) sites*
- ◆ *Accelerate construction schedule*
- ◆ *Possible elimination of site dewatering*
- ◆ *Often economical compared to remove-and-replace options*
- ◆ *Low vibration and noise*
- ◆ *Rapid mobilization*
- ◆ *Excess soilcrete can often be used as a fill material*
- ◆ *Often combined with other ground improvement systems to increase savings*
- ◆ *Contaminant solidification/stabilization*



*Soil mixing performed to increase bearing capacity and reduce settlement for planned tanks in Texas.*

## You have a strong partner with Hayward Baker

Hayward Baker Inc. (HB) is North America's leader in geotechnical construction, offering the full range of pre- and post-construction services for foundation rehabilitation, settlement control, liquefaction mitigation, soil stabilization, groundwater control, slope stability, excavation support, underpinning, and environmental remediation. HB is annually ranked #1 in the profession by Engineering News-Record (ENR).

Headquartered in Hanover, Maryland, HB has over 25 offices servicing North and Central

America. Since its inception, HB has established itself in the forefront of geotechnical specialty contracting, evolving and expanding to meet the increasingly complex needs of the construction community. HB is capable of offering full design-build services for any geotechnical construction application.

HB has the experience and innovation to assist engineers, contractors, and owners with identifying and constructing the most economical solution that satisfies the technical requirements of each project, typical or unique.

## HAYWARD BAKER

Geotechnical Construction

KELLER

Design-Build Services for the Complete Range of Geotechnical Technologies

### Grouting

Cement Grouting (High Mobility Grouting)  
Chemical Grouting  
Compaction Grouting (Low Mobility Grouting)  
Fracture Grouting  
Jet Grouting  
Polyurethane Grouting

### Ground Improvement

Dry Soil Mixing  
Dynamic Compaction  
Injection Systems for Expansive Soils  
Rapid Impact Compaction  
Rigid Inclusions (Controlled Stiffness Columns)  
Vibro Compaction  
Vibro Concrete Columns  
Vibro Piers™ (Aggregate Piers)  
Vibro Replacement (Stone Columns)  
Wet Soil Mixing

### Structural Support

Augercast Piles  
Drilled Shafts  
Driven Piles  
Franki Piles (PIFs)  
Helical Piles  
Jacked Piers  
Macropiles™  
Micropiles  
Pit Underpinning

### Earth Retention

Anchors  
Anchor Block Slope Stabilization  
Gabion Systems  
Micropile Slide Stabilization System (MS<sup>3</sup>)  
Secant or Tangent Piles  
Sheet Piles  
Soil Nailing  
Soldier Piles & Lagging

### Additional Services

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Sculpted Shotcrete  
Slab Jacking  
Slurry Walls  
TRD Soil Mix Walls  
Wick Drains

**Website** [www.HaywardBaker.com](http://www.HaywardBaker.com)  
**Email** [info@HaywardBaker.com](mailto:info@HaywardBaker.com)

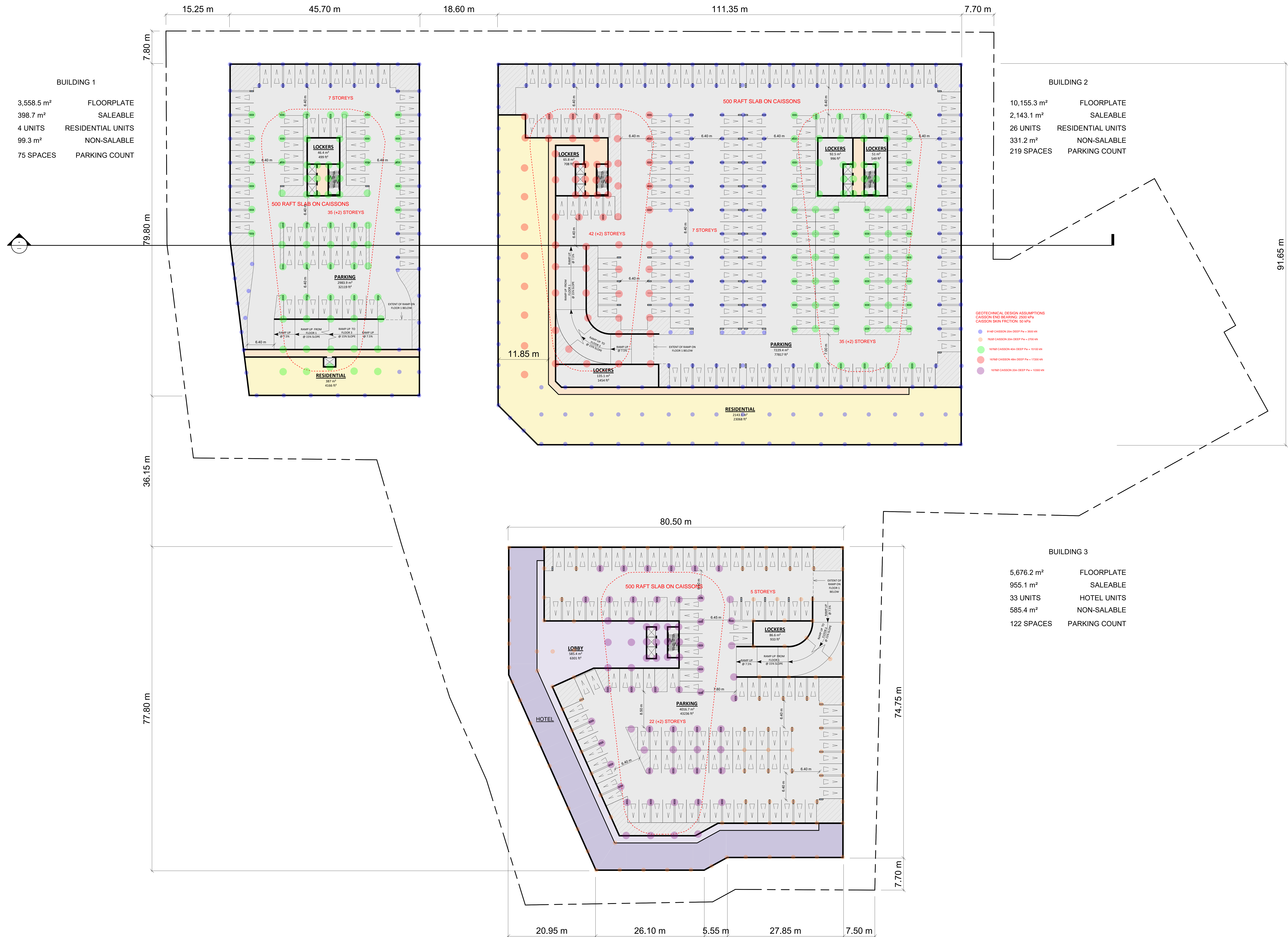
### Hayward Baker Inc.

A member of the Keller worldwide group of companies

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H1-MAR-20005-JW Aug 2014

For a complete list of our offices, visit:  
[www.HaywardBaker.com](http://www.HaywardBaker.com)

# **APPENDIX C**



#	DATE	DESCRIPTION	BY

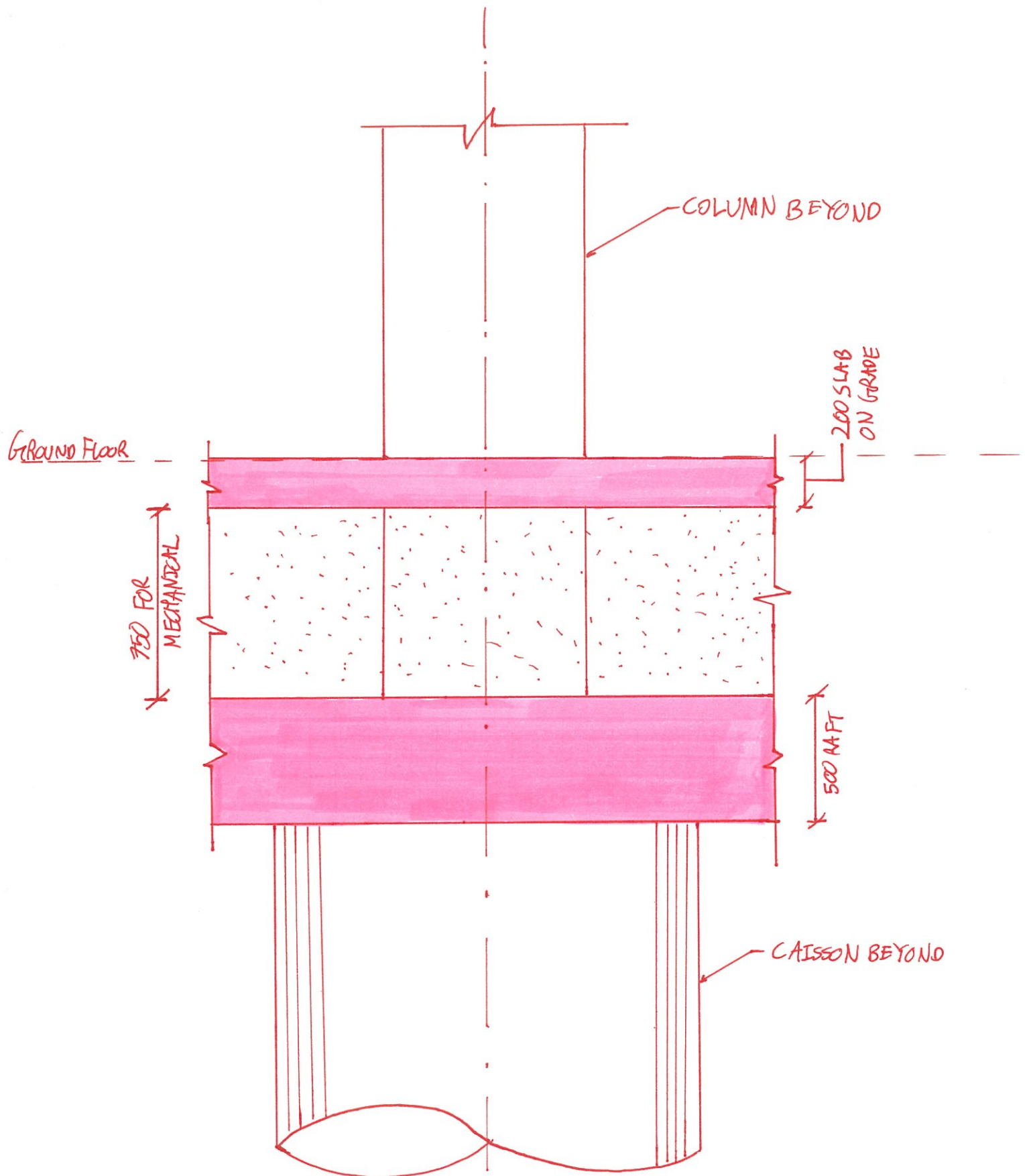
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BARRIE, ON

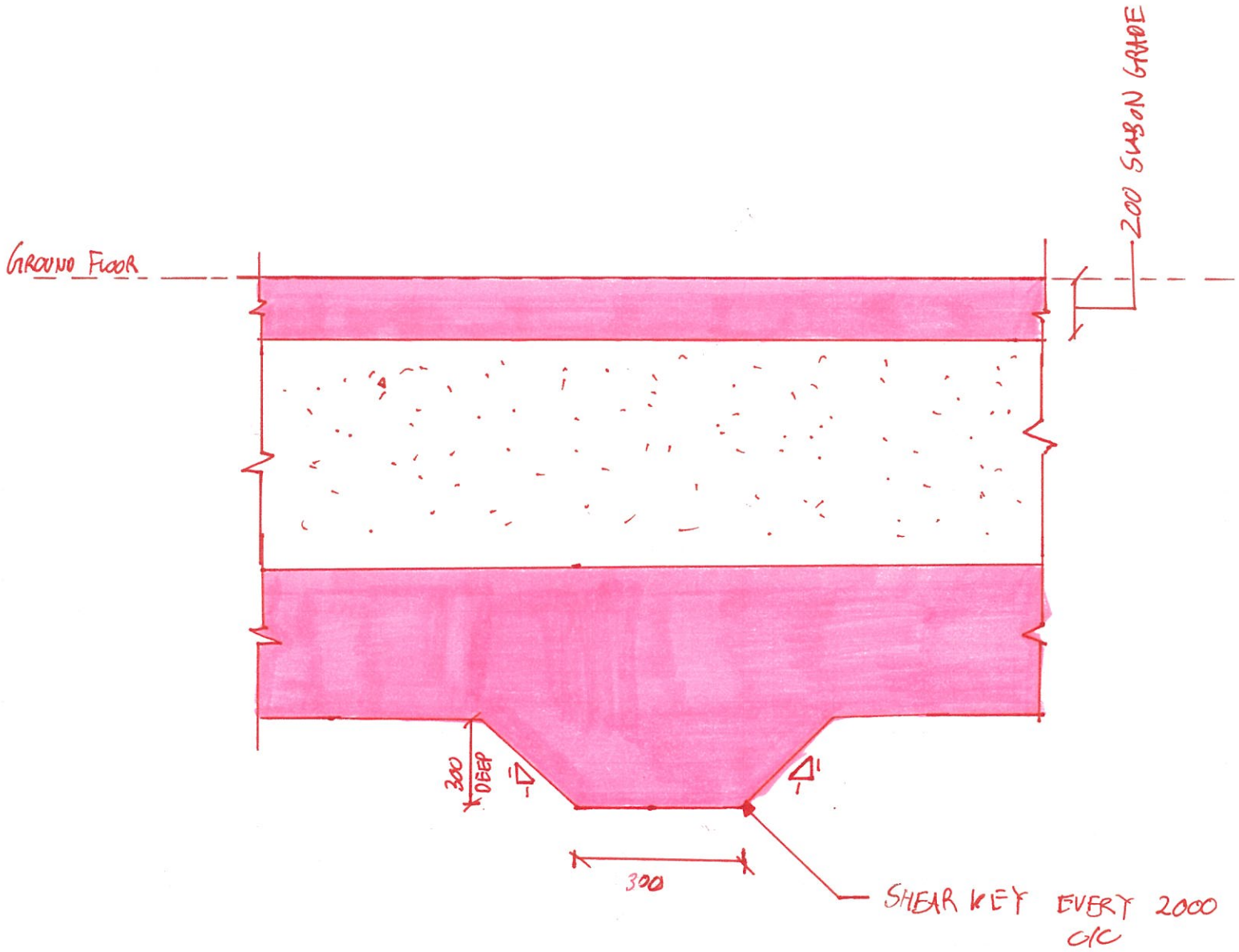
DRAWING: **TYPICAL PODIUM PLAN**

PROJECT NO:	19-1055D
PROJECT DATE:	2019-09-09
DRAWN BY:	Author
CHECKED BY:	Checker
SCALE:	1:300

DRAWING NO: **A101**

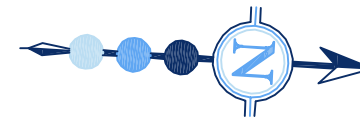


TYPICAL SECTION AT RAFT & CAISSON


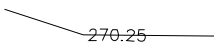
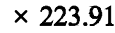
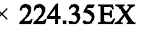
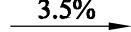


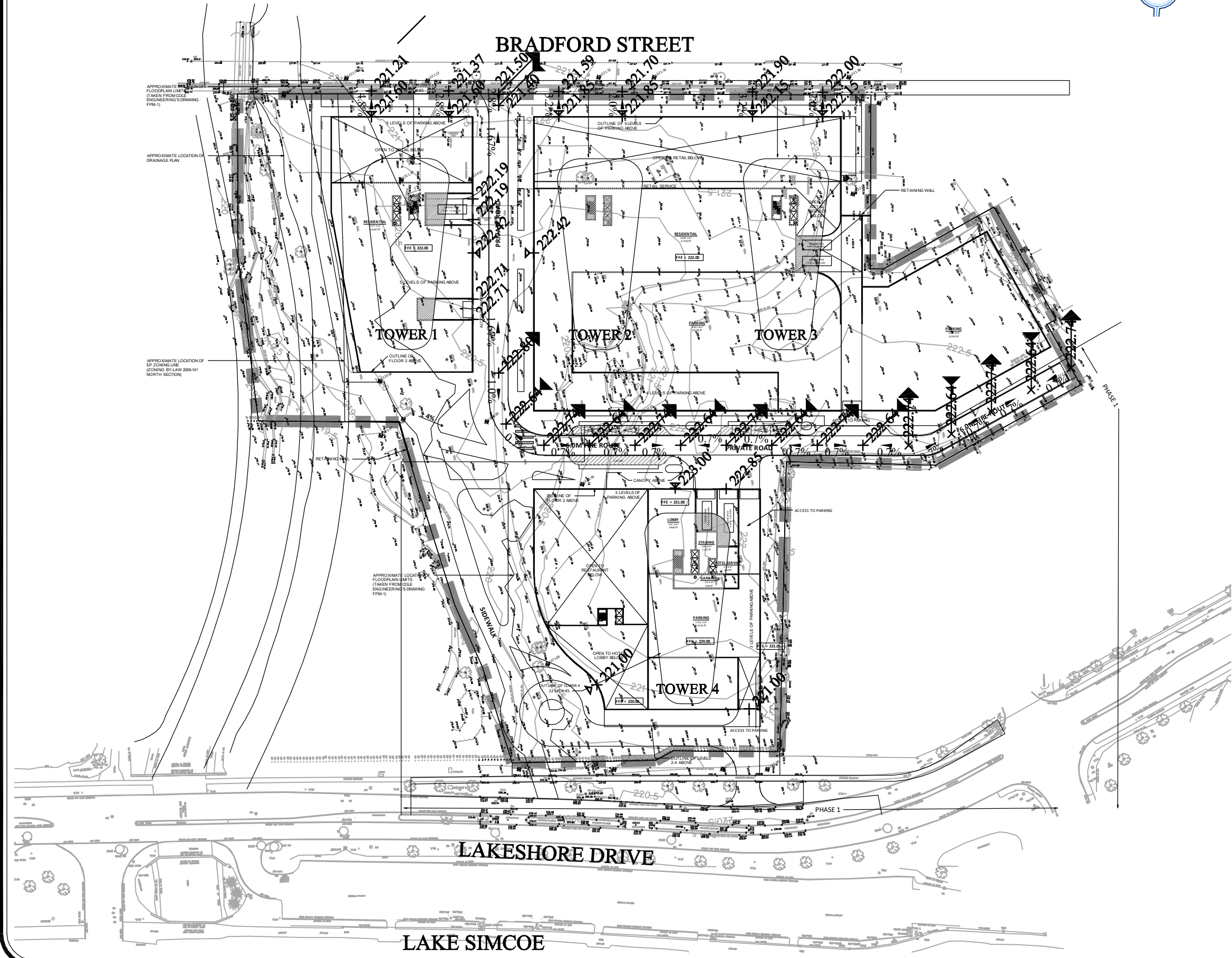
TYPICAL SECTION AT SHEAR KEY

# **APPENDIX D**



**LEGEND:**

-  PROPERTY BOUNDARY
-  EXISTING CONTOUR AND ELEVATION
-  PROPOSED ELEVATION
-  EXISTING ELEVATION
-  PROPOSED ROAD GRADE



\*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

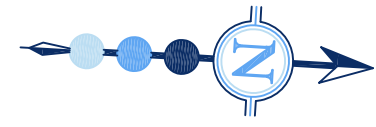
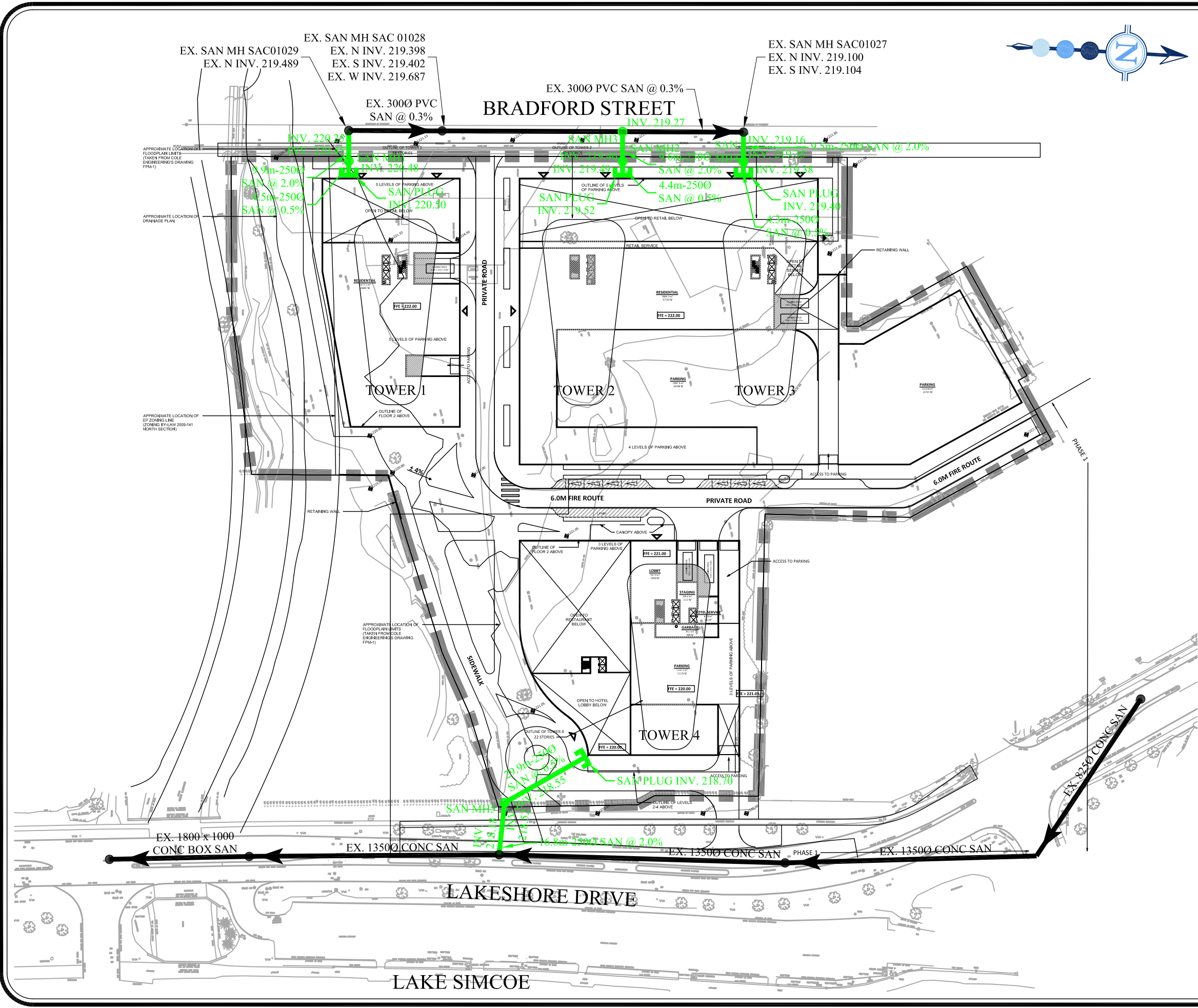
 30 CENTURIAN DRIVE, SUITE 100  
 MARKHAM, ONTARIO L3R 8B8  
 TEL: (905) 475-1900  
 FAX: (905) 475-8335

**2714708 ONTARIO INC. AND  
 GREENWIN BARRIE INC.**

**51-75 BRADFORD STREET -  
 BARRIE**

**PRELIMINARY  
 GRADING FIGURE**

DESIGNED BY: V.A.S.	CHECKED BY: P.G.
SCALE: 1:1250	DATE: NOVEMBER 2019
PROJECT No: <b>2196</b>	FIGURE No: <b>X.X</b>



**LEGEND:**

- PROPERTY BOUNDARY
- PROPOSED SANITARY SEWER AND MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE

\*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

30 CENTURIAN DRIVE, SUITE 100  
 MARKHAM, ONTARIO L3R 8B8  
 TEL: (905) 475-1900  
 FAX: (905) 475-8335

**2714708 ONTARIO INC. AND  
 GREENWIN BARRIE INC.**

**51-75 BRADFORD STREET -  
 BARRIE**

**SANITARY  
 SERVICING FIGURE**

DESIGNED BY: V.A.S.	CHECKED BY: P.G.
SCALE: 1:1250	DATE: NOVEMBER 2019
PROJECT No: <b>2196</b>	FIGURE No: <b>X.X</b>

# **APPENDIX E**



**GEOPHYSICS GPR INTERNATIONAL INC.**

6741 Columbus Road  
Unit 103  
Mississauga, Ontario  
Canada L5T 2G9

Tel.: (905) 696-0656  
Fax: (905) 696-0570  
gprtor@on.aibn.com  
www.geophysicsgpr.com

June 17, 2008

GPR file: T08040F

Tim Orpwood  
**Terraprobe Ltd.**  
10 Bram Court,  
Brampton, Ontario  
L6W 3R6

RECEIVED  
JUN 23 2008

**RE: Shear-wave velocity soundings at Blue Sails Condominium Site on Lakeshore Drive, Barrie, Ontario.**

Dear Mr. Orpwood,

Geophysics GPR International Inc. has been requested by Terraprobe Ltd. to carry out two shear-wave velocity soundings at Blue Sails Condominium Site, Barrie, Ontario. This investigation utilised the multi-channel analysis of surface waves (MASW) and the micro-tremor array measurements (MAM) methods to generate vertical shear-wave velocity profiles.

The survey was performed on June 3<sup>rd</sup>, 2008. Figure 1 indicates the approximate location of the seismic soundings.

The following paragraphs describe the survey design, the principles of the test method, the methodology for interpreting the data and finally a culmination of the results in table format.

### **MASW and MAM Surveys**

#### ***Basic Theory***

The Multi-channel Analysis of Surface Waves (MASW) and the Micro-tremor Array Measurements (MAM) are seismic methods used to evaluate the shear-wave velocities of subsurface materials through the analysis of the dispersion properties of Rayleigh surface waves ("ground roll"). The dispersion properties are measured as a change in phase velocity with frequency. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. Inversion of the Rayleigh wave dispersion curve yields a shear-wave ( $V_s$ ) velocity depth profile (sounding). Figure 2 outlines the basic operating procedure for the MASW method. Figure 3 is an example image of a typical MASW record and resulting 1D  $V_s$  model. A more detailed description of the method can be found in the paper *Multi-channel Analysis of Surface Waves*, Park, C.B., Miller, R.D. and Xia, J. Geophysics, Vol. 64, No. 3 (May-June 1999); P. 800-808.



### ***Survey Design***

The MASW survey utilized a similar set-up to a seismic refraction investigation (i.e. 24 geophones in a linear array). The principle consists of intentionally generating an acoustic wave at the surface and digitally recording the surface waves from the moment of source impact with a linear series of geophones on the surface. This is referred to as an "active source" method. A sledgehammer was used as the primary energy source with traces being recorded off both ends of the seismic spread. The spacing between geophones was 3 meters. Unlike the refraction method, which produces a data point beneath each geophone, the shear-wave depth profile is the average of the bulk area within the geophone spread.

The MAM survey was performed utilizing both the same geophone array as the MASW investigation and using a 9-geophone circular array. The MAM method is considered a "passive source" method in that there is no time break and the motions recorded are from ambient energy generated by cultural noise such as traffic, wind, wave motion, etc. Data collection for the passive method involves recording approximately 10 minutes of background "noise". The records generated by the MAM method contain lower frequency data thus increasing the depth of investigation. Typically the MAM results aid in clarifying the MASW results for depths greater than 20m; however, the direction of noise propagation relative to the spread orientation can skew the results.

### ***Interpretation Method***

The main processing sequence involved plotting, picking and 1D inversion of the MASW/MAM shot records using the SeisimagerSW™ software package. In theory, all the MASW shot records for a given spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation and localized surface variations.

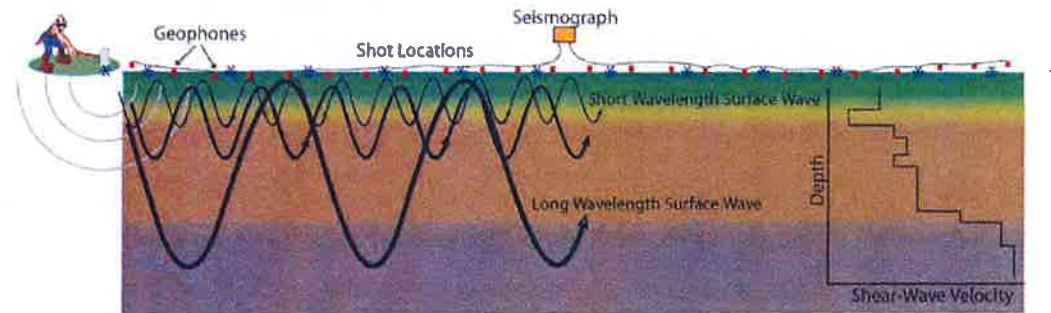
The results of the MASW/MAM tests are presented in chart format as Figures 4 and 5. The charts present the 1-D shear wave velocity values from the inversion models of the passive and active seismic records.



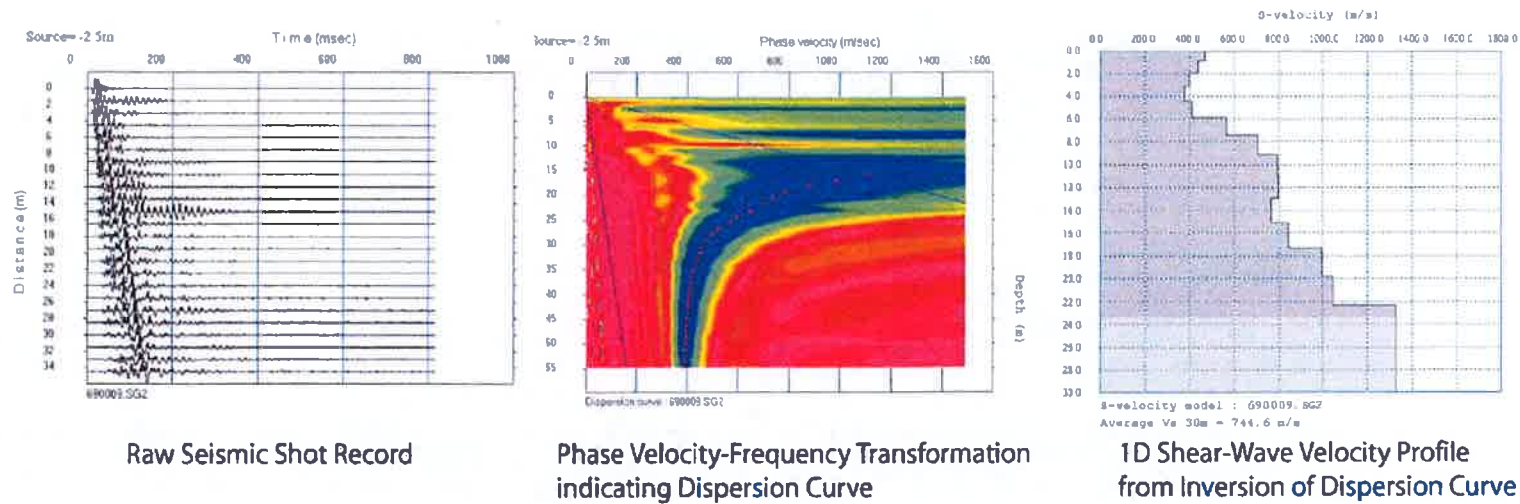


Figure 1: Approximate location of the shear-wave velocity soundings



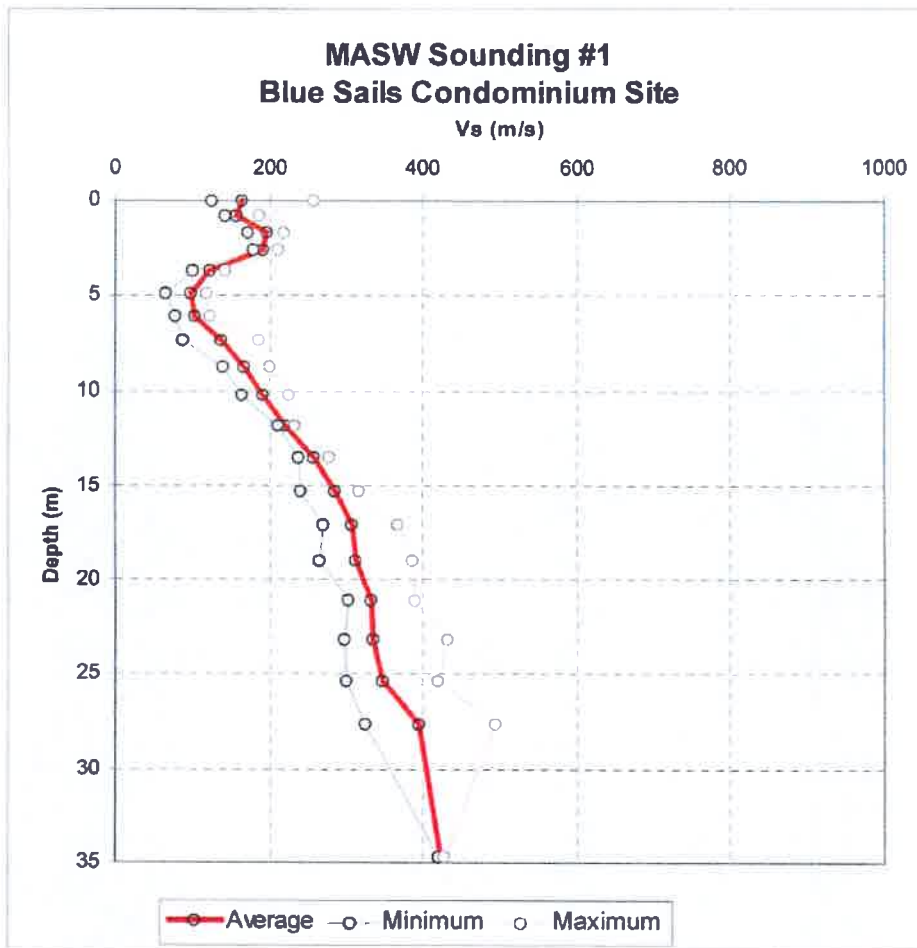


**Figure 2: MASW Operating Principle**



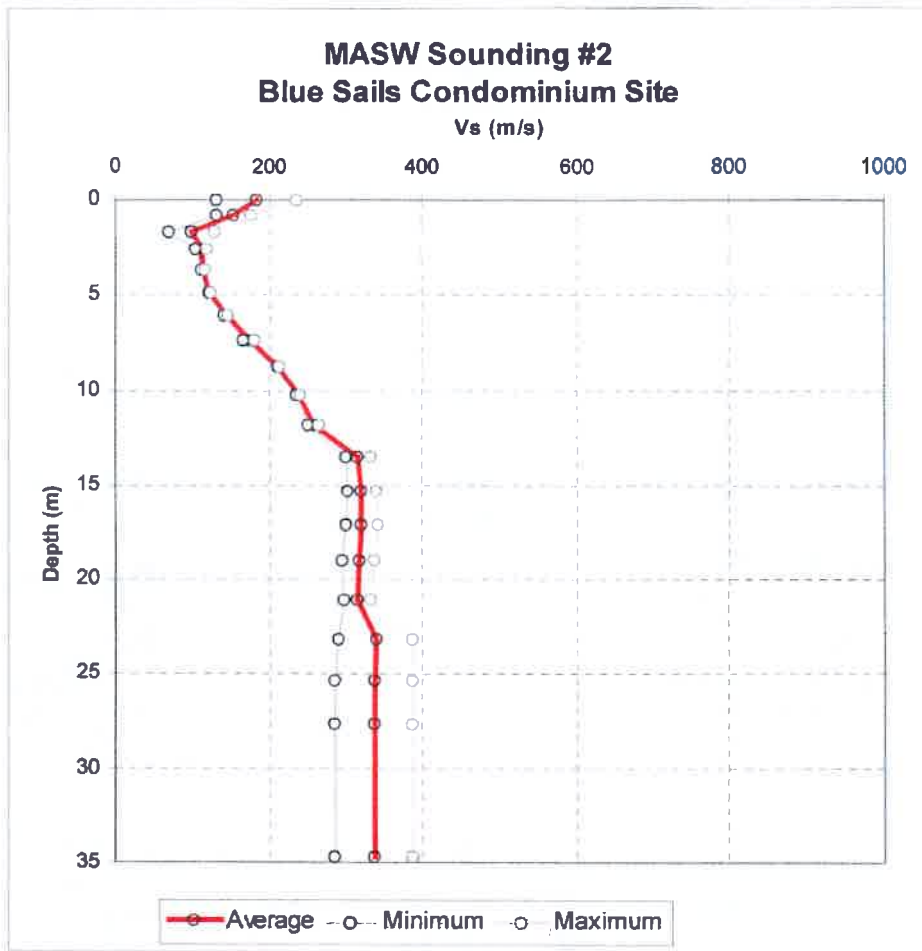
**Figure 3: Example of a typical MASW shot record, phase velocity/frequency curve and resulting 1D shear-wave velocity model.**





**Figure 4: MASW/MAM Shear-wave Velocity Sounding#1: Southwest-Northeast**





**Figure 5: MASW/MAM Shear-wave Velocity Sounding#2: Southeast-Northwest**



## CONCLUSIONS

The approximate locations of the seismic soundings are presented in Figure 1. The locations of the profiles were based on the available space. The profiles were located approximately in the centre of the site.

The results of the MASW/MAM sounding are presented in Figure 4 and Figure 5. The background seismic noise levels were very high at this particular site (due largely to off-site construction and drilling). The seismic signal strength was not strong enough to generate clear dispersion curves for the far-offset shots typically performed. Accordingly, only the near-offset ( $\pm 6$ m offset) shots were used.

The  $V_{s30}$  values for the soundings are presented in Table 2. The  $V_{s30}$  values are based on the harmonic mean of the shear wave velocities over the upper 30 m. The  $V_{s30}$  value is calculated by dividing the total depth of interest (e.g. 30m) by the sum of the time spent in each velocity layer up to that depth. This harmonic mean value reflects the equivalent single layer response.

**Table 1: Calculated  $V_{s30}$  values (m/s) (0 to 30m)**

Sounding	$V_s$ 30 (minimum)	$V_s$ 30 (average)	$V_s$ 30 (maximum)
1 (Active&Passive)	170	210	250
2 (Active Only)	198	218	235
Circular Passive		202	

The calculated average  $V_{s30}$  values from the 1D MASW/MAM soundings were 210 m/s and 218 m/s ( $\pm 15\%$ ) for Profiles 1 and 2 respectively.

At the request of the client the harmonic mean value velocities were also calculated over the depth interval of 2 to 32m. The calculated average  $V_{s30}$  values over the interval of 2 to 32m from the 1D MASW/MAM soundings were 221m/s and 230m/s ( $\pm 15\%$ ) for Profiles 1 and 2 respectively.

Based on the  $V_{s30}$  values (as determined through the MASW method) and The National Building Code of Canada, 2005 Edition, the soil type for the investigation area would be classified as category D ( $180 < V_s < 360$ ).

This report has been written by Ben McClement, P.Eng.

  
Ben McClement, P.Eng.



## **APPENDIX F**



# **APPENDIX G**



Report # 558112

MCCLYMONT & RAK ENGINEER - Juan Chahine - 5329 OM

Page 1 of 1

Sample ID:	Lab #	pH	BpH	Total Salts (mmhos/cm)	Organic Matter (%)	Nitrogen NO3-N (ppm)	Phosphorus - P (ppm)		Potassium K (ppm)	Magnesium Mg (ppm)	Calcium Ca (ppm)
ST-1 - 5329 ST-2	31913018 31913019				75.3 77.4						

Sample ID:	Zinc Zn (ppm)	Zn Index	Manganese Mn (ppm)	Mn Index	Copper Cu (ppm)	Iron Fe (ppm)	Boron B (ppm)	Texture	Cation Exchange MEQ/100g	Base Saturation			
										K%	Mg%	Ca%	H%
ST-1 ST-2													

Sample ID:	Sodium Na (ppm)	Sulphate Sulphur SO4-S (ppm)	Chloride Cl (ppm)	Aluminum Al (ppm)	K/Mg Ratio	Exchangeable Acidity						
ST-1 ST-2												

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These results pertain solely to the sample(s) received by the laboratory.*

Authorized By: Jack Legg - CCA-ON, 4R NMS

MCCLYMONT & RAK ENGINEER - Juan Chahine - 5329 OM  
111 Zenway Blvd, Unit 4  
Vaughan, ON L4H 3H9

Email

Date Received: Oct-31-2019

Date Reported: Nov-12-2019

Fax: 905-851-1722

Email: jchahine@mccrak.com

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**McCLYMONT AND RAK ENGINEERS INC.**  
**GEO-ENVIRONMENTAL CONSULTANTS**

111 Zenway Blvd, Unit 4, Vaughan, Ontario L3R 4B5  
 TEL: 905-470-0160 FAX: 905-475-6371

**Bulk Density & Specific Gravity**

Job No: **5329** (51-74 bradford St., Barrie, Ontario)  
 11201680 Smart Centres (S. Howell GHD)  
 Sample Type: Shelby Tube Undisturbed **Peat**  
 Date Sampled: **Oct. 01st., 2019**

Sample No.: **ST-2** (near to BH#210)  
 Depth: **15' feet - 17' Feet**  
 Date Tested: 30/10/2019

**Bulk Density**

Trial Number		1	2	3
Inner Diameter of the Shelby Tube	cm.	7.0	7.0	7.0
Inner Area of the Shelby Tube	cm <sup>2</sup>	38.5	38.5	38.5
Length of the Undisturbed Core	cm.	3.30	3.65	3.80
Weight of the Undisturbed Core	g.	132.0	144.5	151.5
Bulk Density of the Sample	g/cm <sup>3</sup> (t/m <sup>3</sup> )	1.039	1.028	1.036
Average Bulk Density	g/cm <sup>3</sup> (t/m <sup>3</sup> )	1.034		

**Specific Gravity**

Trial Number		1
Weight of Wet Sample	g.	317.40
Calculated Weight of Dry Sample	g.	69.97
Weight of Container+Sample+Water to Calibration Mark	g.	1551.70
Weight of Container+Water to Calibration Mark	g.	1532.2
Specific Gravity		1.386
Average Specific Gravity		1.386

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**Bulk Density & Specific Gravity**

Job No: **5329** (51-74 bradford St., Barrie, Ontario)  
 11201680 Smart Centres (S. Howell GHD)  
 Sample Type: Shelby Tube Undisturbed **Peat**  
 Date Sampled: **Sept. 30th., 2019**

Sample No.: **ST-1** (near to MW1-19)  
 Depth: **10.5' feet - 13' Feet**  
 Date Tested: 30/10/2019

**Bulk Density**

Trial Number		1	2	3
Inner Diameter of the Shelby Tube	cm.	7.0	7.0	7.0
Inner Area of the Shelby Tube	cm <sup>2</sup>	38.5	38.5	38.5
Length of the Undisturbed Core	cm.	3.00	3.40	2.70
Weight of the Undisturbed Core	g.	118.7	134.7	106.5
Bulk Density of the Sample	g/cm <sup>3</sup> (t/m <sup>3</sup> )	1.028	1.029	1.025
Average Bulk Density	g/cm <sup>3</sup> (t/m <sup>3</sup> )	1.027		

**Specific Gravity**

Trial Number		1
Weight of Wet Sample	g.	255.70
Calculated Weight of Dry Sample	g.	51.82
Weight of Container+Sample+Water to Calibration Mark	g.	1485.80
Weight of Container+Water to Calibration Mark	g.	1471.6
Specific Gravity		1.377
Average Specific Gravity		1.377

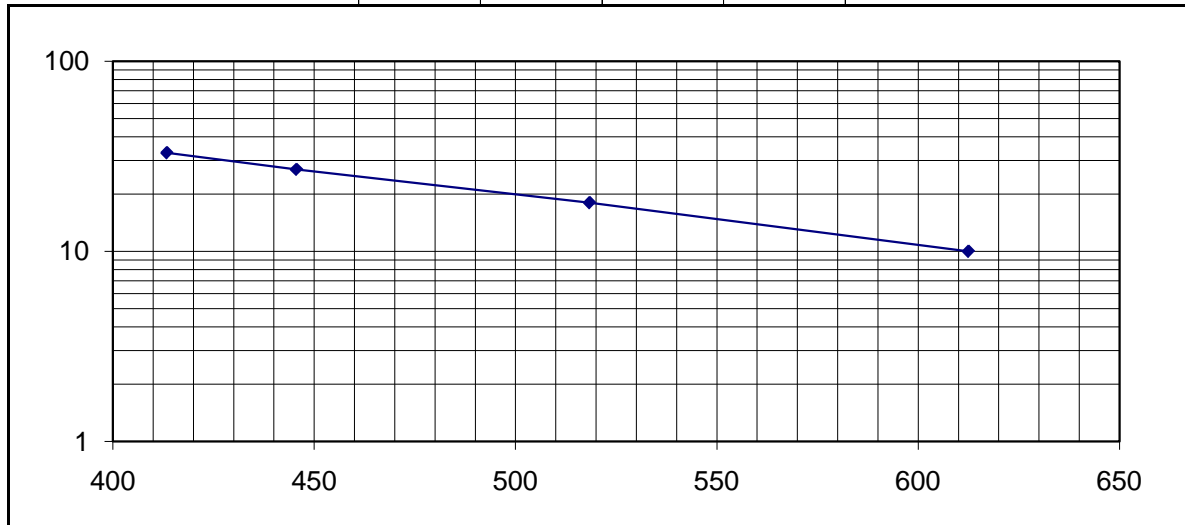
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**Liquid Limit, Plastic Limit, and Plasticity Index ASTM D 4318**

Job No: **5329** (51-74 bradford St., Barrie, Ontario)  
 11201680 Smart Centres (S. Howell GHD) Sample No.: **ST-2** (near to BH#210)  
 Sample Type: Shelby Tube Undisturbed **Peat** Depth: **15' feet - 17' Feet**  
 Date Sampled: **Oct. 01st., 2019** Date Tested: 30/10/2019

TYPE OF TEST	LIQUID LIMIT				PLASTIC LIMIT		
	1	2	3	4	1	2	3
TRIAL NO.	1	2	3	4			
NO. OF BLOWS	33	27	18	10			
CONTAINER NO.	12	9	17	13			
SAMPLE WET +TARE gm	53.1	33.9	57.1	26.1			
SAMPLE DRY +TARE gm	13.0	8.5	12.0	6.5			
WT. OF WATER gm	40.1	25.4	45.1	19.6			
WT.OF CONTAINER gm	3.3	2.8	3.3	3.3			
WT. OF DRY SAMPLE gm	9.7	5.7	8.7	3.2			
WATER CONTENT %	413.40	445.61	518.39	612.50			



LIQUID LIMIT      L.L.      460

PLASTIC LIMIT      P.L.      not determined

Plasticity Index      P.I.      N.A.

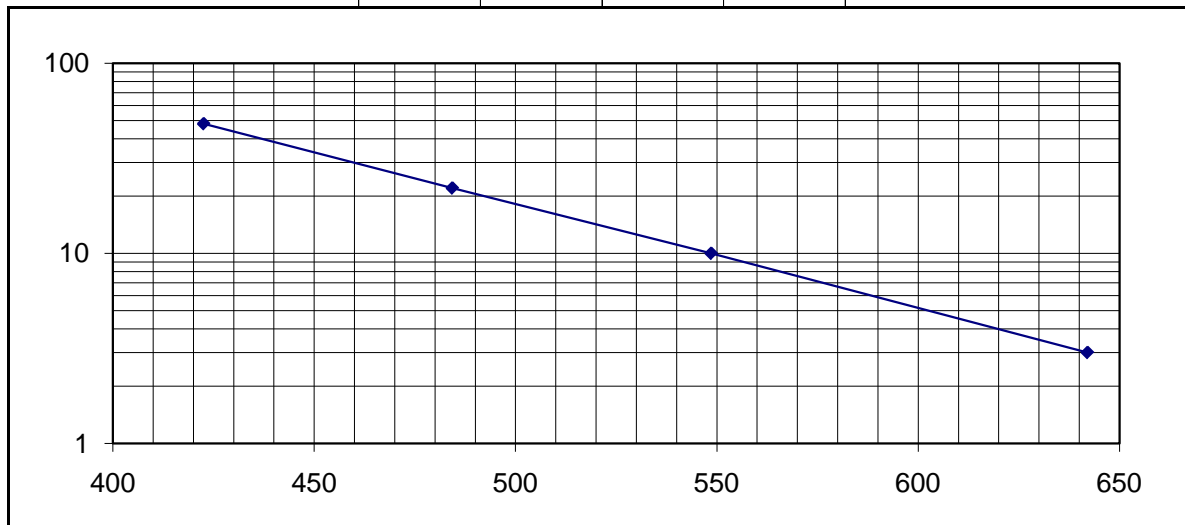
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**Liquid Limit, Plastic Limit, and Plasticity Index ASTM D 4318**

Job No: **5329** (51-74 bradford St., Barrie, Ontario)  
 11201680 Smart Centres (S. Howell GHD) Sample No.: **ST-1** (near to MW1-19)  
 Sample Type: Shelby Tube Undisturbed **Peat** Depth: **10.5' feet - 13' Feet**  
 Date Sampled: **Sept. 30th., 2019** Date Tested: 30/10/2019

TYPE OF TEST	LIQUID LIMIT				PLASTIC LIMIT		
	1	2	3	4	1	2	3
TRIAL NO.	1	2	3	4			
NO. OF BLOWS	48	22	10	3			
CONTAINER NO.	14	2	24	15			
SAMPLE WET +TARE gm	68.1	51.3	27.3	17.4			
SAMPLE DRY +TARE gm	15.7	11.1	7.0	5.2			
WT. OF WATER gm	52.4	40.2	20.3	12.2			
WT.OF CONTAINER gm	3.3	2.8	3.3	3.3			
WT. OF DRY SAMPLE gm	12.4	8.3	3.7	1.9			
WATER CONTENT %	422.58	484.34	548.65	642.11			



LIQUID LIMIT      L.L.      470

PLASTIC LIMIT      P.L.      not determined

Plasticity Index      P.I.      N.A.

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## GRAIN SIZE ANALYSIS

### Moisture & Fibre Contents

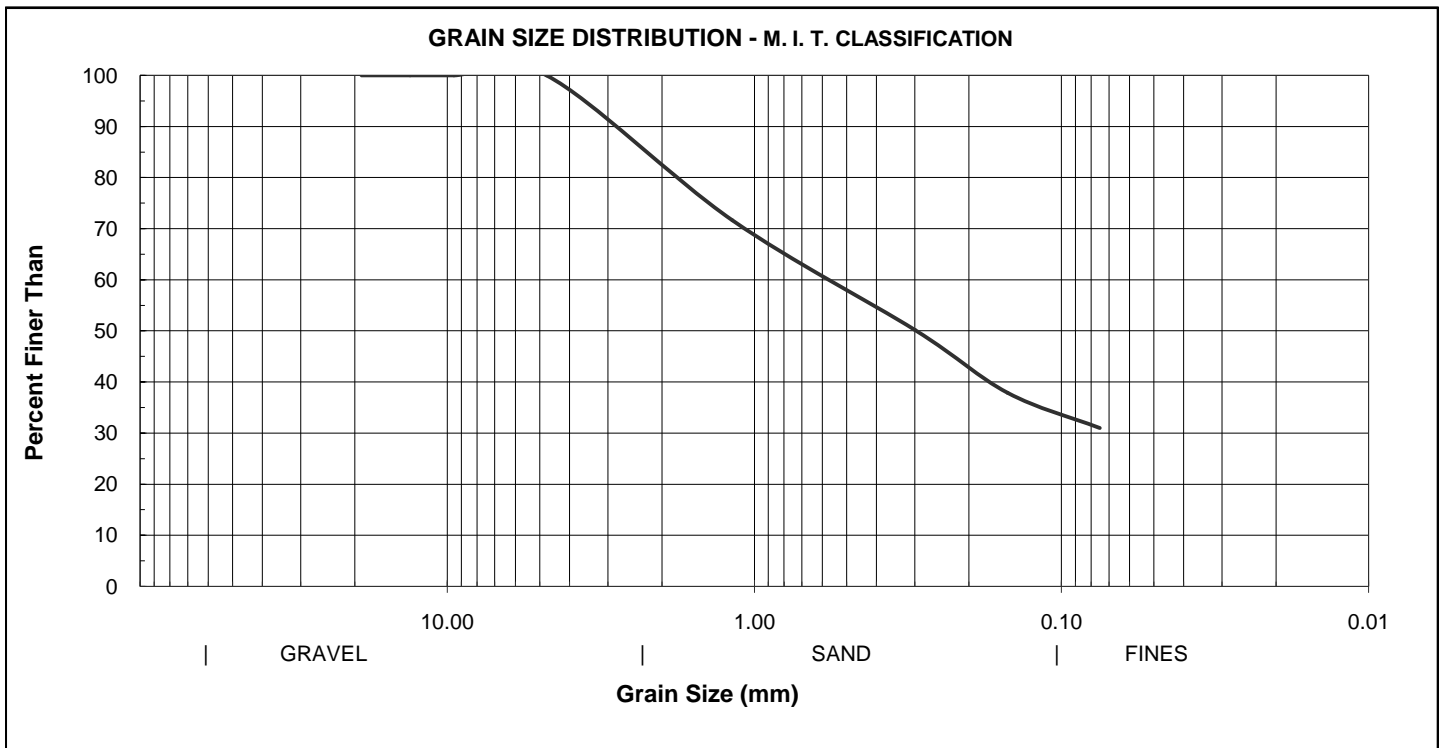
Job No: <b>5329</b>	(51-74 Bradford St., Barrie, Ontario)	Sample No.: <b>ST-1</b> (near to MW 1-19)
11201680 Smart Centres (S. Howell GHD)		Depth: <b>10.5' feet - 13' Feet</b>
Sample Type: Shelby Tube Undisturbed <b>Peat</b>		Date Tested: 30/10/2019
Date Sampled: <b>Sept. 30th., 2019</b>		

Total weight of wet sample+container (g)	378.8	Weight of wet sample+container(g)	62.8
Weight of container(g)	250.1	Weight of dry sample+container(g)	15.2
Weight of wet sample(g)	128.7	Weight of container(g)	3.1
Weight of dry sample (g)	26.1	Weight of dry sample(g)	12.1
Moisture content %	393.4	Weight of water(g)	47.6

<b>Moisture content %</b>	<b>393.4</b>
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### EXTRACTION/GRADATION TEST RESULTS

SIEVE NO.	SIEVE SIZE	WT. RETAINED	RETAINED	PASSING	SPECIFICATION
#	mm	g	%	%	%
3/4	19.0	0.0	0.0	100.0	
0.53	13.2	0.0	0.0	100.0	
3/8	9.5	0.0	0.0	100.0	
4	4.75	0.0	0.0	100.0	
16	1.18	7.4	<b>28.4</b>	71.6	<b>Fibre Content</b>
50	0.300	13.0	49.8	50.2	
100	0.150	16.2	62.1	37.9	
200	0.075	18.0	69.0	31.0	



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## GRAIN SIZE ANALYSIS

### Moisture & Fibre Contents

Job No: <b>5329</b>	(51-74 Bradford St., Barrie, Ontario)	Sample No.: <b>ST-2</b> (near to BH#210)
11201680 Smart Centres (S. Howell GHD)		Depth: <b>15' feet - 17' Feet</b>
Sample Type: Shelby Tube Undisturbed <b>Peat</b>		Date Tested: 30/10/2019
Date Sampled: <b>Oct. 01st., 2019</b>		

Total weight of wet sample+container (g)	361.3	Weight of wet sample+container(g)	47.1
Weight of container(g)	252.5	Weight of dry sample+container(g)	12.8
Weight of wet sample(g)	108.8	Weight of container(g)	3.1
Weight of dry sample (g)	24.0	Weight of dry sample(g)	9.7
Moisture content %	353.6	Weight of water(g)	34.3

<b>Moisture content %</b>	<b>353.6</b>
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### EXTRACTION/GRADATION TEST RESULTS

SIEVE NO.	SIEVE SIZE	WT. RETAINED	RETAINED	PASSING	SPECIFICATION
#	mm	g	%	%	%
3/4	19.0	0.0	0.0	100.0	
0.53	13.2	0.0	0.0	100.0	
3/8	9.5	0.0	0.0	100.0	
4	4.75	0.0	0.0	100.0	
16	1.18	5.1	<b>21.3</b>	78.7	<b>Fibre Content</b>
50	0.300	14.0	58.4	41.6	
100	0.150	16.2	67.5	32.5	
200	0.075	17.3	72.1	27.9	

