Technical Memorandum

September 27, 2021

To	Anna Froehlich, CCOC	**Tel**	613-234-4065 x263
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From	Sahar Soleimani / David Beauseigle	**Ref. No.**	12560245
Subject	Summary of Geotechnical Investigation and Recommendations for Ellwood House Development at 2262 Braeside Avenue, Ottawa, Ontario		

This technical memorandum provides a summary to previous geotechnical investigation carried out for the proposed Ellwood House development at 2262 Braeside Avenue in Ottawa, Ontario. The purpose of this summary memorandum is to review the proposed design and provide any update to the geotechnical design recommendations and guidelines presented previously.

It is noted that this summary should be read in conjunction with the previous geotechnical report prepared for this property in 2018.

1. Background

It is understood that the proposed development consists of construction of a three and a half-storey extension to the existing Ellwood House structure, relocation of several underground services and landscaping. The new structure has a concrete frame and wood frame roof and exterior walls. It is our understanding that the first floor is partially in ground to about 1.5 m in depth.

In 2018, GHD Limited (GHD) completed a previous geotechnical investigation on the property for the development. The results of that investigation were provided in a report titled “Geotechnical Investigation,– 2262 Braeside Avenue, Ottawa, Ontario” dated March 16, 2018 (11155186 | A1 | Report No. 1 |). That investigation included five boreholes advanced to depths varying between 2.2 m and 5.1 m and two monitoring wells within the footprint of the proposed building. The location of boreholes is shown in Figure 1 attached.

Based on the GHD 2018 report, the subsurface conditions consisted of deposits of topsoil or asphalt paved surface which in turn is underlain by fill material with variable thickness over shale bedrock of Billings formation. A thin layer of gravelly sandy silt glacial till overlaid the bedrock only at one borehole location at the north end of the site.

The fill material extends to depths ranging from 1.7 m to 3.5 m (Elevations 97.6 m to 95.6 m). Practical refusal to auger advancement was encountered in all boreholes, at depths ranging from 2.2 to 3.5 m below the existing ground surface. Shale bedrock with limestone lamination was confirmed at three borehole locations at depths ranging from 1.7 to 3.5 m (Elevations 97.6 m to 95.1 m).

The quality of this rock was very poor to poor with RQDs of 15 to 44 within the upper portion of the bedrock. Mud seams were encountered within the bedrock at depths ranging from 2.4 to 3.8 m below ground surface.

Based on the recorded water levels in the monitoring wells the groundwater levels were found at depths of 2.2 m and 3.3 m below the ground surface (Elevations 96.7 m and 96.0 m).

2. Summary of Geotechnical Recommendations

Based on our understanding of the proposed structure, the subsurface conditions encountered in the boreholes, and assuming them to be representative of the subsurface conditions across the Site, the following updated geotechnical recommendations for the most recent design of the proposed buildings are provided. It should be noted that below is a summary of the most significant geotechnical guidelines that should be considered in the design. Since there were no changes in the design since the previous geotechnical report was prepared, all recommendations provided in that report are still valid and should be considered in the design.

2.1 Excavation and Groundwater Control

Based on the available information and the description of the project, it is anticipated that excavations of less than about 2 m in depth will be required. Excavation to this anticipated depth will be through topsoil/pavement, fill material and into weathered shale at some location. Based on the results of the investigation, overburden soil material within excavation would be considered as 'Type 4 Soils', as defined by the OHSA Regulations for Construction. Therefore, overburden excavation with side slopes at 3 horizontal to 1 vertical should be stable in the short term.

Excavation of weathered bedrock may be required for the footing excavations. The excavation of the weathered bedrock may require pneumatic or hydraulic breakers such as hoe rams or heavy excavation equipment equipped for rock excavation. The weathered rock should be planned to be cut back at a 30 degree from vertical.

Excavations below the groundwater level are not expected based on the anticipated excavation depth of 2 m and groundwater levels (i.e., 2.2 m to 3.3 m below the ground surface) observed within the monitoring wells. Some water inflow into the excavation should be expected where the excavation encounters the existing building perimeter drains, any existing site services in a surround of granular material that could be water bearing, or from rainwater surface runoff into the excavation. The limited water inflow could be handled with the use of sumps and well filtered pumps in the floor of the excavation.

Bedrock consists of shale of Billing Formation; this rock is subject to expansion if exposed to air. If bedrock is exposed during excavation, it is required that a lean concrete mud slab be placed on the rock surfaces (horizontal and vertical) and the exposed rock within the excavation/trench side walls be covered by shotcrete or other available material within 24 hrs of excavation.

Temporary support may be required where excavations are proposed adjacent to existing structures / roadways or within influence zones of adjacent foundations such as excavation along the existing Ellwood House structure. The type, design and construction of a temporary shoring system must be carried out by a competent contractor specialized in this field. As this is temporary work, the contractor is responsible for the design of shoring system. As a guideline, the earth pressure coefficients and parameters quoted on Table 2.1 below are suggested for computation of earth pressures against temporary supports. Underpinning of the existing adjacent shallow foundations will be necessary if the excavation expected to be at a deeper level and are within the influence zone of the existing Ellwood House shallow foundation. More specifically, shallow structures adjacent to the excavation will need to be supported/underpinned if they are located above a line rising at a slope of 1V (vertical) to 1 H (horizontal) from a point located 0.60 m below the edge of the base of the excavation within overburden.

Table 2.1 Design Parameters/Temporary Supports

Geotechnical Parameter	Fill Material	Glacial Till
Moist Unit Weight (kN/m^3)	18.0	22.0
Submerged Unit Weight (kN/m^3)	8.2	12.2
Angle of Internal Friction, ϕ	28°	34°
Coeff. of Active Earth Pressure, K_a	0.36	0.29
Coeff. of Passive Earth Pressure, K_p	2.77	3.45
Coeff. of Earth Pressure at Rest, K_o	0.53	0.44

A rock-grout bond strength of 0.5 MPa is recommended for design of rock anchors.

2.2 Existing Fill and Slab-On-Grade

The fill at this site is of variable composition, thickness and density. The composition varied from sandy silt, silty sand, sand and gravel to gravelly silt. In places the fill was noted to contain occasional construction debris and organic inclusions. The thickness of the existing fill varied from approximately 1.7 m to 3.5 m across the site. The density of the fill materials varied from very loose to dense. Loose fill layers may not be suitable to support the slab-on-grade. The exposed surfaces should be examined by geotechnical personnel to assess the competency. Unsuitable fill material must be removed and replaced with Engineered Fill. The Engineered Fill must be placed in maximum loose lift thicknesses of 0.2 m. Each lift of Engineered Fill must be compacted with a heavy roller to 100 percent SPMDD. Engineered Fill must be placed under the continuous supervision of a geotechnical engineer.

Note that the exposed surface at the slab level may be composed of shale bedrock. The exposed shale bedrock may swell and delaminate due to change in moisture conditions or as a result of frost which will ultimately require additional cleaning and prepping of the rock surface. We therefore recommend that the exposed rock surface, if exposed, be protected with a thin layer of lean concrete.

2.3 Frost Protection

All exterior footings associated with the heated building must be provided with at least 1.5 m of soil cover or its equivalent in insulation, in order to provide adequate protection against detrimental frost action. This cover depth requirement must be increased to 1.8 m for footings for unheated or isolated structures such as signs, entrance canopy, or piers.

2.4 Foundations

It is considered that the proposed building could feasibly be supported on or within the weathered shale bedrock or glacial till using conventional spread footing foundations.

Footings placed on weathered shale bedrock or glacial till can be designed using a preliminary serviceability limit state (SLS) bearing capacity value of 350 kPa. A factored ultimate limit states (ULS) bearing resistance of 500 kPa can be used for structural elements resting on weathered bedrock or glacial till.

The surficial fill material and topsoil are not suitable for support of the foundation loads and should be removed from the foundation areas. Where required, Engineered Fill could be placed below a footing to raise grades to the design footing level. The Engineered Fill should consist of Granular B Type II and must be placed in maximum loose lift thicknesses of 0.2 m and compacted with suitable vibratory compaction equipment to 100 percent SPMDD. Engineered Fill for support of foundations should be placed extending downwards and outwards from the edge of footing at 2 horizontal to 1 vertical.

2.5 Seismic Site Classification

In accordance with 2012 National Building Code of Canada, the building and its structural elements must be designed to resist a minimum earthquake force.

Based on the borehole overburden and bedrock results, and in absence of geophysical seismic survey in accordance with Table 4.1.8.4.A of the 2012 National Building Code of Canada, this Site can be classified as Site Class “C”.

We trust that this memorandum contains sufficient information for your present requirements. If you have any questions concerning this memo, please do not hesitate to contact the undersigned.

Regards,

Sahar Soleimani, Ph.D., P.Eng.

David Beauseigle, M.Sc., P.Eng.

SS/DB/ki/1

Encl. Figure 1: Borehole Location Plan
Record of Borehole Logs

Source: Image ©2018 Google, Imagery date: 09/05/2016
Coordinate System: NAD 1983 UTM Zone 18N

OTTAWA COMMUNITY HOUSING
2262 BRAESIDE AVENUE, OTTAWA, ONTARIO
GEOTECHNICAL INVESTIGATION

11155186-A1
Mar 5, 2018

BOREHOLE LOCATION PLAN

FIGURE 1

GIS File: Q:\GIS\PROJECTS\11155000s\11155186\Layouts\001\11155186-A1(001)GIS-OT002.mxd

Notes on Borehole and Test Pit Reports

Soil description :

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey sols is measured by the value of undrained shear strength (Cu).

Classification (Unified system)

Clay	< 0.002 mm		
Silt	0.002 to 0.075 mm		
Sand	0.075 to 4.75 mm	fine	0.075 to 4.25 mm
		medium	0.425 to 2.0 mm
		coarse	2.0 to 4.75 mm
Gravel	4.75 to 75 mm	fine	4.75 to 19 mm
		coarse	19 to 75 mm
Cobbles	75 to 300 mm		
Boulders	>300 mm		

Terminology

"trace"	1-10%
"some"	10-20%
adjective (silty, sandy)	20-35%
"and"	35-50%

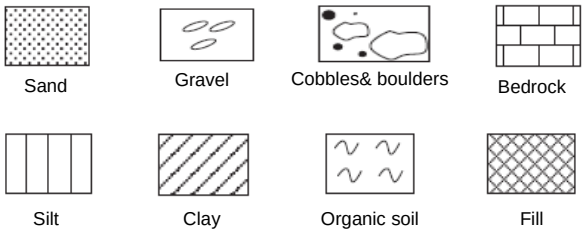
Relative density of granular soils	Standard penetration index "N" value (BLOWS/ft – 300 mm)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Consistency of cohesive soils	Undrained shear strength (Cu) (P.S.F)	(kPa)
Very soft	<250	<12
Soft	250-500	12-25
Firm	500-1000	25-50
Stiff	1000-2000	50-100
Very stiff	2000-4000	100-200
Hard	>4000	>200

Rock quality designation

"RQD" (%) Value	Quality
<25	Very poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

STRATIGRAPHIC LEGEND



Samples:

Type and Number

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon
ST: Shelby tube
AG: Auger
SSE, GSE, AGE: Environmental sampling
PS: Piston sample (Osterberg)
RC: Rock core
GS: Grab sample

Recovery

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

RQD

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

IN-SITU TESTS:

N: Standard penetration index
R: Refusal to penetration
N_c: Dynamic cone penetration index
Cu: Undrained shear strength
Pr: Pressure meter
k: Permeability
ABS: Absorption (Packer test)

LABORATORY TESTS:

I_p: Plasticity index
W_l: Liquid limit
Wp: Plastic limit
H: Hydrometer analysis
GSA: Grain size analysis
A: Atterberg limits
w: Water content
γ: Unit weight
C: Consolidation
CS: Swedish fall cone
CHEM: Chemical analysis
O.V.: Organic vapor

REFERENCE No.: 11155186-A1 ENCLOSURE No.: 1

BOREHOLE No.: BH1-17
ELEVATION: 99.85 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Ottawa Community Housing
PROJECT: Geotechnical Investigation
LOCATION: 2262 Braeside Avenue, Ottawa, Ontario
DESCRIBED BY: S. Wheeler CHECKED BY: R. Vanden Tillaart
DATE (START): December 20, 2017 DATE (FINISH): December 20, 2017

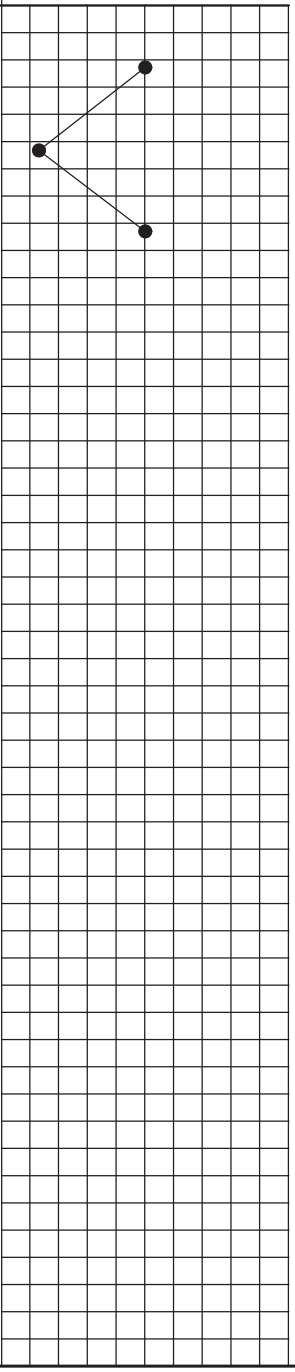
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index
		99.85		GROUND SURFACE			%			N
0	0.08	99.77		ASPHALT - 80mm						
1	0.30	99.55		FILL-SAND AND GRAVEL, grey, damp						
2				FILL-GRAVELLY SANDY SILT, grey to brown, damp, compact		SS1	17	--	50+	50+
3	1.0					SS2	96	--	8-7-6-7	13
4										
5	1.68	98.17				SS3	33	--	25-50+	50+
6	2.0			WEATHERED SHALE BEDROCK, grey, very poor quality				--	--	--
7	2.18	97.67		AUGER REFUSAL						
8				Elevations were surveyed relative to a fire hydrant on site.						
9										
10	3.0									
11										
12										
13	4.0									
14										
15										
16	5.0									
17										
18										
19	6.0									
20										
21										
22										
23	7.0									
24										
25										
26	8.0									
27										
28										
29	9.0									
30										
31										
32										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11155186-SC.GPJ GHD_Geotechnical 2/12/18

REFERENCE No.: 11155186-A1 ENCLOSURE No.: 2

BOREHOLE No.: BH2-17
ELEVATION: 99.10 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Ottawa Community Housing
PROJECT: Geotechnical Investigation
LOCATION: 2262 Braeside Avenue, Ottawa, Ontario
DESCRIBED BY: S. Wheeler CHECKED BY: R. Vanden Tillaart
DATE (START): December 20, 2017 DATE (FINISH): December 20, 2017

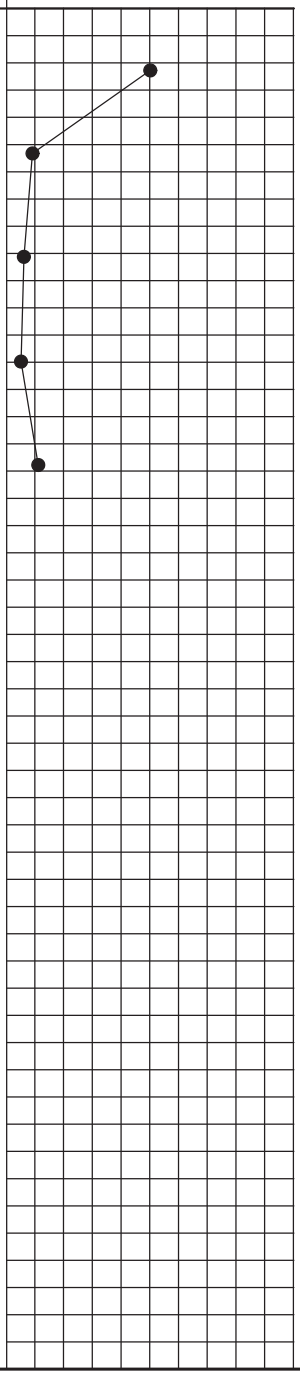
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
0	0.08	99.02		ASPHALT - 80mm						
1	0.30	98.80		FILL-SAND AND GRAVEL, brown, damp, very dense		SS1	2	--	50+	50+
2				FILL-GRAVELLY SANDY SILT, brown, damp, loose, possible cobbles						
3	1.0					SS2	63	--	5-3-6-4	9
4										
5						SS3	13	--	1-3-3-4	6
6	2.0									
7				becoming moist		SS4	58	--	4-2-3-5	5
8										
9	3.0			becoming wet		SS5	33	--	6-5-6-50+	11
10	3.50	95.60		BEDROCK-SHALE with limestone laminations, poor quality based on RQD mud seam encountered at 3.8m BGS		RC1	100	--	26/59	--
11										
12	4.0									
13										
14										
15	5.0									
16	5.10	94.00		End of Borehole						
17										
18										
19	6.0									
20										
21										
22	7.0									
23										
24										
25	8.0									
26										
27										
28	9.0									
29										
30										
31										
32										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11155186-SC.GPJ GHD_Geotechnical 2/12/18

REFERENCE No.: 11155186-A1 ENCLOSURE No.: 3

BOREHOLE No.: BH3-17
ELEVATION: 99.28 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Ottawa Community Housing
PROJECT: Geotechnical Investigation
LOCATION: 2262 Braeside Avenue, Ottawa, Ontario
DESCRIBED BY: S. Wheeler CHECKED BY: R. Vanden Tillaart
DATE (START): December 20, 2017 DATE (FINISH): December 20, 2017

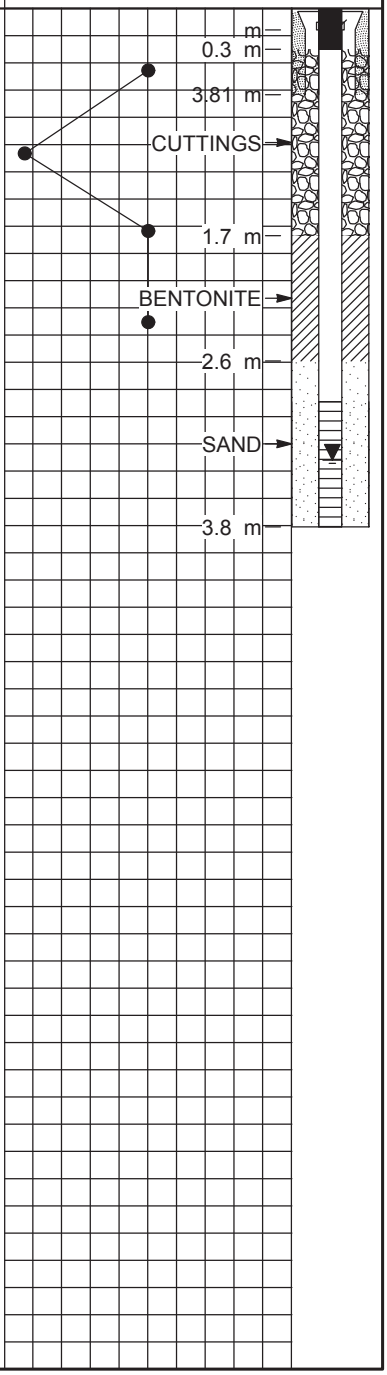
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		99.28		GROUND SURFACE						
0	0.08	99.20		ASPHALT - 80mm						
1	0.30	98.98		FILL-SAND AND GRAVEL, brown, damp, very dense		SS1	33	--	33-50+	50+
2				FILL-SANDY SILT, trace gravel, brown, damp, loose, organics, organic staining						
3	1.0					SS2	92	--	4-4-3-4	7
4										
5	1.68	97.60		WEATHERED SHALE BEDROCK, grey, very poor quality		SS3	21	--	16-50+	50+
6	2.0									
7						SS4	0	--	50+	50+
8	2.44	96.84		SHALE BEDROCK, thinly laminated with limestone, mud seams, very poor quality based on RQD						
9										
10	3.0					RC1	96	--	8/54	--
11										
12										
13	3.81	95.47		End of Borehole Groundwater encountered at 3.32m BGS / 95.96m						
14	4.0									
15										
16										
17	5.0									
18										
19										
20	6.0									
21										
22										
23	7.0									
24										
25										
26	8.0									
27										
28										
29	9.0									
30										
31										
32										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11155186-SC.GPJ GHD_Geotechnical 2/12/18

REFERENCE No.: 11155186-A1 ENCLOSURE No.: 4

BOREHOLE No.: BH4-17
ELEVATION: 98.48 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Ottawa Community Housing
PROJECT: Geotechnical Investigation
LOCATION: 2262 Braeside Avenue, Ottawa, Ontario
DESCRIBED BY: S. Wheeler CHECKED BY: R. Vanden Tillaart
DATE (START): December 20, 2017 DATE (FINISH): December 20, 2017

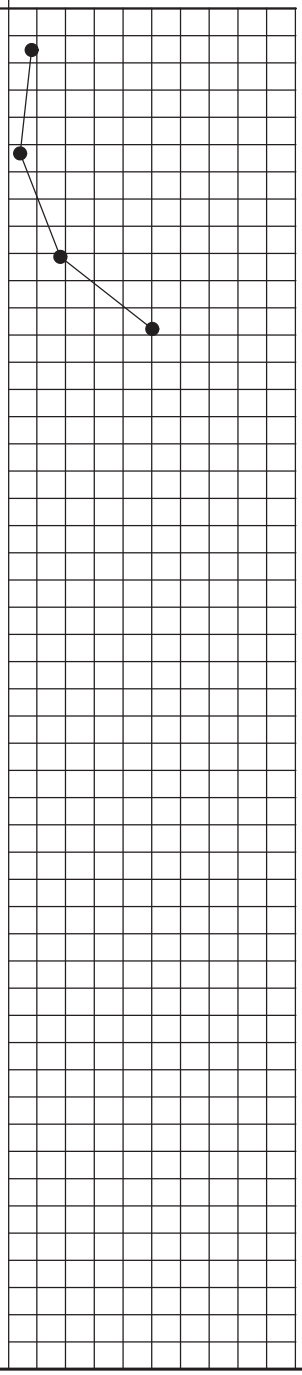
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		98.48		GROUND SURFACE						
	0.08	98.40		TOPSOIL - 80mm						
0-3				FILL-GRAVELLY SILT, some sand, brown, moist, very loose, organics		SS1	33	--	4-3-5-4	8
	1.0					SS2	83	--	2-1-3-2	4
4-6	1.83	96.65		GLACIAL TILL, gravelly sandy silt, brown, moist, very dense		SS3	83	--	4-3-15-3-4	18
	2.0					SS4	21	--	50+	50+
8	2.62	95.86		AUGER REFUSAL						
9-32	3.0 - 9.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11155186-SC.GPJ GHD_Geotechnical 2/12/18

REFERENCE No.: 11155186-A1 ENCLOSURE No.: 5

BOREHOLE No.: BH5-17
ELEVATION: 98.96 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Ottawa Community Housing
PROJECT: Geotechnical Investigation
LOCATION: 2262 Braeside Avenue, Ottawa, Ontario
DESCRIBED BY: S. Wheeler CHECKED BY: R. Vanden Tillaart
DATE (START): December 20, 2017 DATE (FINISH): December 20, 2017

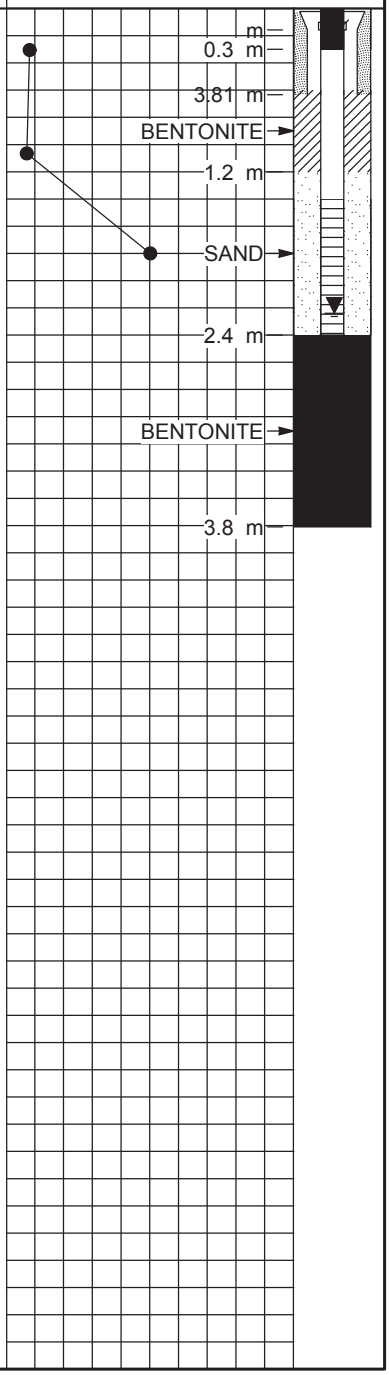
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		98.96		GROUND SURFACE						
0				TOPSOIL - 180mm						
1	0.18	98.78		FILL-GRAVELLY SANDY SILT, brown, loose, moist		SS1	58	--	1-5-3-2	8
2	0.61	98.35		FILL-SILT AND SAND, some gravel, brown, moist, loose						
3	1.0					SS2	92	--	3-4-3-4	7
4										
5						SS3	58	--	12-14-50+	50+
6										
7	2.0 2.08	96.88		WEATHERED SHALE BEDROCK, grey, very poor quality						
8	2.41	96.55		SHALE BEDROCK, thinly laminated, with limestone, poor quality based on RQD, mud seam enountered at 2.41m BGS						
9										
10	3.0					RC1	98	--	18/57	--
11										
12										
13	3.81 4.0	95.15		End of Borehole Groundwater encountered at 2.24m BGS / 96.72m						
14										
15										
16										
17	5.0									
18										
19										
20	6.0									
21										
22										
23	7.0									
24										
25										
26	8.0									
27										
28										
29	9.0									
30										
31										
32										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11155186-SC.GPJ GHD_Geotechnical 2/12/18