

BRADFORD HIGHLANDS JOINT VENTURE

PRELIMINARY GEOTECHNICAL INVESTIGATION- BRADFORD HIGHLANDS GOLF COURSE REDEVELOPMENT, BRADFORD, ONTARIO

AUGUST 02, 2023

FINAL





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GEOTECHNICAL
INVESTIGATION-
BRADFORD HIGHLANDS
GOLF COURSE
REDEVELOPMENT,
BRADFORD, ONTARIO

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August 02, 2023

BRADFORD HIGHLANDS JOINT VENTURE
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Attention: Mr. Neil Palmer

Subject: Preliminary Geotechnical Investigation - Bradford Highlands Golf Course Redevelopment, Bradford, Ontario

Dear Sir:

WSP Canada Inc. (WSP) is pleased to provide our Geotechnical Investigation Report for the proposed residential development at the above noted site. The purpose of the geotechnical investigation is to identify the subsurface conditions at select borehole locations and to provide design recommendations in support of the proposed development, consisting of a total of 946 residential units and two Storm Water Management (SWM) ponds along with associated roadways and municipal servicing, as well as identify any potential constraints which may be encountered during construction.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office

Kind regards,

A handwritten signature in black ink, appearing to read 'NLP'.

Nick La Posta, P.Eng.
Team Lead, Ground Engineering East

FJ/kj
Report ref.: 22517668

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May 16, 2022	DRAFT		
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August 2, 2023

Nick La Posta, P.Eng.
Team Lead - Ground Engineering East

Date

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TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	SITE AND PROJECT DESCRIPTION.....	2
3	METHOD OF INVESTIGATION.....	3
3.1	AVAILABLE GEOTECHNICAL INFORMATION.....	3
3.2	CURRENT GEOTECHNICAL INVESTIGATION.....	3
3.3	GEOTECHNICAL LABORATORY TESTING.....	4
4	SUBSURFACE CONDITIONS.....	5
4.1	TOPSOIL.....	5
4.2	COHESIVE DEPOSITS - SILTY CLAY TO CLAY AND SILT.....	5
4.3	GLACIAL TILL.....	6
4.4	NON-COHESIVE DEPOSITS – SILTY SAND TO SAND.....	7
4.5	GROUNDWATER.....	8
5	PRELIMINARY GEOTECHNICAL RECOMMENDATIONS.....	9
5.1	SITE BACKGROUND.....	9
5.2	OVERVIEW OF SUBSURFACE CONDITIONS.....	9
5.3	SITE PREPARATION AND GRADING.....	9
5.4	PRELIMINARY FOUNDATION RECOMMENDATIONS.....	10
5.4.1	GENERAL FOUNDATION COMMENTS.....	11
5.5	FLOOR SLAB CONSTRUCTION AND DRAINAGE.....	11
5.6	LATERAL EARTH PRESSURES PARAMETERS.....	11
5.7	TEMPORARY EXCAVATIONS.....	12
5.8	GROUNDWATER CONTROL.....	13
5.9	PIPE BEDDING AND COVER.....	13
5.10	TRENCH BACKFILL.....	14
5.11	STORMWATER MANAGEMENT (SWM) POND.....	14
5.12	PRELIMINARY PAVEMENT DESIGN.....	15
5.13	DESIGN REVIEW, TESTING AND INSPECTIONS.....	16
6	LIMITATIONS OF REPORT.....	17

TABLES

TABLE 3.1	BOREHOLE ELEVATION, DEPTH, AND MONITORING WELL INSTALLATION	3
TABLE 4.1	TOPSOIL THICKNESS	5
TABLE 4.2	GRAIN SIZE DISTRIBUTION FOR COHESIVE DEPOSITS.....	6
TABLE 4.3	ATTERBERG LIMITS FOR COHESIVE DEPOSITS	6
TABLE 4.4	GRAIN SIZE DISTRIBUTION FOR GLACIAL TILL	7
TABLE 4.5	ATTERBERG LIMITS FOR GLACIAL TILL	7
TABLE 4.6	GRAIN SIZE DISTRIBUTION FOR NON-COHESIVE DEPOSITS	8
TABLE 4.7	GROUNDWATER AND CAVING OBSERVATION.....	8
TABLE 5.1	RECOMMENDED UNFACTORED SOIL PARAMETERS.....	12

FIGURES

FIGURE 1	CONCEPTUAL SITE PLAN
FIGURE 2	BOREHOLE LOCATION PLAN

APPENDICES

A	EXPLANATION OF TERMS USED IN THE RECORD OF BOREHOLE AND BOREHOLE LOGS
B	GEOTECHNICAL LABORATORY TEST RESULTS
C	ENGINEERED FILL

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by the Bradford Highlands Joint Venture (Client) to undertake a geotechnical investigation to determine the existing subsurface conditions at the site and provide geotechnical recommendations in support of the preliminary design of the proposed development, which currently consists of a total of 946 residential units, two Storm Water Management (SWM) ponds, along with associated roadways and municipal servicing, in the Bradford Highlands Golf Course, Bradford, Ontario (Site).

A previous geotechnical and hydrogeological investigation has been completed by Golder for the Site in March 2016. Details regarding the previous investigation reports are provided below.

- Golder Associates Ltd. 2017. Draft Report: Preliminary Geotechnical Investigations – Bradford Highlands Golf Course Redevelopment, Bradford, Ontario. February 2017
- Golder Associates Ltd. 2018. Hydrogeological Investigations – Bradford Highlands Golf Course Redevelopment, Bradford, Ontario. March 2018

Based on the conceptual plan (dated December 16, 2021) provided to our office, the proposed development will consist of a total of 946 residential units and two SWM ponds along with associated roadways and municipal servicing. It should be noted that, Golder advanced a total of nineteen (19) boreholes across the site in 2016 and at that time, the spacing of the boreholes was restricted by the active golf course.

The purpose of the current geotechnical investigation was to supplement the existing borehole information by advancing a total of eighteen (18) additional boreholes to provide sufficient borehole coverage across the site. Four additional monitoring wells were installed for long term groundwater monitoring at these specific locations.

The objective of this report is to characterize the subsurface conditions through the advancement of the eighteen (18) boreholes at the Site and to provide geotechnical recommendations for the design and construction of the proposed residential development. The hydrogeological aspects of the project will be addressed under a separate cover.

This report is provided on the basis of the terms of reference for WSP's mandate, and on the assumption that the design will be in accordance with all applicable codes, guidelines, and standards. If there are any changes in the design features relevant to the geotechnical analyses or recommendations, or if any questions arise concerning the geotechnical aspects of the codes and standards, WSP must be contacted immediately to review the design where deemed required. In some circumstances, it may be necessary to carry out additional investigations, analysis and reporting before the recommendations of this report can be relied upon.

The site investigation and recommendations of this report follow generally accepted practice for geotechnical consultants in Ontario. Laboratory testing for the most part generally follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for the Bradford Highlands Joint Venture and its architect and designers. Use of this report by a third party without WSP Canada Inc. written consent is strictly prohibited. The limitation conditions presented in this report form an integral part of the report. Therefore, the recommendations provided in the report must be considered in conjunction with these limitations.

2 SITE AND PROJECT DESCRIPTION

The project site extends from Line 6 in the north to 5th Line / Canal Road (and the associated canal) in the south, and from Brownlee Drive in the west to Inverness Way in the east, in Bradford, Ontario.

The site generally slopes from north (approximate Elevation 250 m) to south (approximate Elevation 220 m) and slopes from west (approximate Elevation 245 m – approximate Elevation 230 m) to east (approximate Elevation 235 m – approximate Elevation 220 m).

Based on information provided to our office, it is understood that the development comprises the design and construction of a total of 946 residential units and includes two SWM ponds along with associated roadways and municipal servicing. At the time of this report, the proposed design grades (i.e. finished floor elevations, pavement subgrade and utility inverts, etc.) were not available. As such, the engineering recommendation provided herein regarding geotechnical design aspects of the project should be considered preliminary in nature only.

A preliminary concept plan is attached to this report in the **Figure 1-Preliminary Concept Plan, dated December 2021**.

3 METHOD OF INVESTIGATION

3.1 AVAILABLE GEOTECHNICAL INFORMATION

In 2016, a geotechnical investigation work was completed by Golder Associated Ltd. (Golder); the investigation included advancing a total of nineteen boreholes, with ten boreholes being outfitted with monitoring wells. These boreholes were drilled to 3.5 m below existing ground surface (mbgs) to 7.3 mbgs. The approximate locations of these previous boreholes, as well as the borehole logs are provided in *Appendix A*. The subsurface soils in those previous boreholes generally consisted of topsoil and/or fill materials overlying firm to hard clayey silt to silty clay and stiff to hard glacial till. A hard sandy silt deposit was encountered in one of the borehole locations underlying the cohesive deposit.

3.2 CURRENT GEOTECHNICAL INVESTIGATION

The current borehole investigation was conducted at the site between March 23 to 29, 2022. A total of eighteen boreholes (designated as BH22-01 to BH22-18) were advanced at the site. The boreholes were advanced to depths ranging between 6.2 mbgs and about 11.0 mbgs. Boreholes BH22-03, BH22-05, BH22-06, and BH22-09 were advanced within, or in proximity to, the proposed SWM ponds. The remainder of the boreholes were advanced in proximity/within the footprint of the proposed building structures. The borehole locations should be considered approximate. The borehole locations are shown on the attached *Borehole Location Plan - Figure 2*. Previously drilled borehole and monitoring well locations, are also indicated on the Borehole Location Plan (grey borehole symbols).

Drilling equipment was supplied and operated by a drilling sub-contractor under the direction and supervision of Golder's technical staff. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler a 0.3 m depth into the undisturbed soil (SPT 'N' values) gives an indication of the relative density condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the attached *Borehole Log - Appendix A*.

Soil samples were visually classified in the field and re-evaluated by engineering personnel in our laboratory. All soil samples were tested for moisture contents. Laboratory Grain Size Analyses were carried out on representative samples and the results are provided in *Geotechnical Laboratory Test Result - Appendix B*.

A summary of the boreholes and monitoring wells information is presented in **Table 3.1** below.

Table 3.1 Borehole Elevation, Depth, and Monitoring Well Installation

BOREHOLE NO.	APPROX. GROUND SURFACE ELEV. (m)	BOREHOLE COORDINATES		BOREHOLE DEPTH (m)	MONITORING WELL INSTALLATION
		Northing	Easting		
BH22-01	237.1	4883640	613921	8.1	-
BH22-02	234.5	4883457	613966	6.2	-
BH22-03	231.5	4883181	613955	11.0	50 mm dia. monitoring well
BH22-04	229.9	4883052	614065	11.0	-
BH22-05	224.0	4882763	614075	11.0	50 mm dia. monitoring well
BH22-06	220.7	4882644	614056	11.0	50 mm dia. monitoring well
BH22-07	229.1	4882740	613889	8.0	-
BH22-08	228.1	4882862	613947	8.0	-
BH22-09	231.6	4883030	613927	11.0	50 mm dia. monitoring well
BH22-10	238.3	4883347	613849	8.0	-
BH22-11	241.9	4883581	613829	8.0	-

BOREHOLE NO.	APPROX. GROUND SURFACE ELEV. (m)	BOREHOLE COORDINATES		BOREHOLE DEPTH (m)	MONITORING WELL INSTALLATION
		Northing	Easting		
BH22-12	213.2	4883516	613608	8.0	-
BH22-13	241.6	4883307	613701	8.0	-
BH22-14	242.8	4883207	613647	8.0	-
BH22-15	235.6	4883102	613793	8.0	-
BH22-16	238.9	4882952	613636	8.0	-
BH22-17	219.9	4882531	613929	8.0	-
BH22-18	232.4	4882455	613650	8.0	-

Water level observations were made during the drilling and in the open boreholes upon the completion of drilling operations. Monitoring wells were installed at four borehole locations, WSP Golder’s technical staff returned to the site subsequent to the drilling operations to obtain groundwater levels at the site. The groundwater levels in the monitoring wells were measured on April 26, 2022. These data are summarized at the bottom of the borehole log sheets and also in **Table 4.7**.

The boreholes were staked in the field by WSP Golder’s technical staff and the ground surface elevations and coordinates at the borehole locations were surveyed using a Trimble GPS; as such these elevations and coordinates are for the purpose of engineering analysis herein only and should be considered approximate. Contractors performing any work referenced to the borehole elevations should confirm the borehole elevations for their work.

3.3 GEOTECHNICAL LABORATORY TESTING

Representative samples were selected for geotechnical index testing. The testing program consisted of the measurement of the natural moisture content of all available soil samples, grain size analyses on eleven (11) selected samples, consistency (Atterberg) limits for nine (9) soil samples. Test results are shown on the individual borehole logs presented in **Borehole Log - Appendix A**. The grain size analysis curves and results of the consistency (Atterberg) limit tests are attached to this report in **Geotechnical Laboratory Test Result - Appendix B**.

4 SUBSURFACE CONDITIONS

Based on the OGS Earth Quaternary Geology GIS map of Ontario issued by Ministry of Northern Development and Mines, the Site is situated within coarse-textured glaciolacustrine deposits consisting of sand, gravel including minor silt and clay, foreshore and basinal deposits; and till consisting of sandy silt to silty sand textured till on paleozoic terrain.

Based on the results of the field investigation, the subsurface conditions at the borehole locations generally comprised a topsoil overlying cohesive deposit (silty clay to clay and silt) and the cohesive deposit is underlain by a glacial till (clayey sandy silt to clayey silty sand and sand and silt) and non-cohesive deposit (silty sand to sand).

For details of the subsurface conditions encountered at the borehole locations, reference should be made to the individual borehole log sheets presented in **Borehole Log - Appendix A** and the associated laboratory test results in **Appendix B**. The properties of the soil types encountered at the boreholes are described briefly in the following sections.

4.1 TOPSOIL

Topsoil was encountered in each of the boreholes advanced within the property boundary. The recorded approximate topsoil thicknesses at the borehole locations are summarized in **Table 4.1** below.

Table 4.1 Topsoil Thickness

BOREHOLE NO	APPROX. TOPSOIL THICKNESS (mm)	BOREHOLE NO	APPROX. TOPSOIL THICKNESS (mm)
BH22-01	500	BH22-10	400
BH22-02	400	BH22-11	450
BH22-03	500	BH22-12	600
BH22-04	300	BH22-13	510
BH22-05	450	BH22-14	510
BH22-06	450	BH22-15	410
BH22-07	250	BH22-16	200
BH22-08	300	BH22-17	300
BH22-09	450	BH22-18	610

It should be noted that topsoil quantities should not be calculated from the borehole information, as large variations in depth may exist between boreholes. A detailed topsoil layer thickness survey is required to determine an accurate evaluation of quantity.

4.2 COHESIVE DEPOSITS - SILTY CLAY TO CLAY AND SILT

Native cohesive deposits were encountered in all of the boreholes beneath the topsoil except boreholes BH22-05 and BH22-16. These cohesive deposits ranged between brown to grey silty clay to clay and silt with trace to some sand and trace gravel. The in-situ water contents of this deposit were variable and ranged between drier than the plastic limit to wetter than the plastic limit. The cohesive deposit extended to depths ranging between 2.1 mbgs and 5.5 mbgs. The native cohesive deposits were generally interlayered with the glacial till encountered at the site.

The measured SPT 'N' values in the cohesive deposits ranged between 4 blows to greater than 50 blows per 0.3 m of penetration, suggestive of a soft to hard consistency. The natural moisture contents, as determined by laboratory tests, ranged approximately from 10% to 13%.

Three (3) laboratory particle size distribution analyses were conducted on selected samples obtained from the cohesive deposits. Test results are provided in **Table 4.2**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in **Appendix A**. The particle size distribution curves are provided in **Appendix B**.

Table 4.2 Grain Size Distribution for cohesive deposits

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-4	SS6	4.6-5.1	Sandy silt and clay, trace gravel	7.9	25.9	66.2	
BH22-08	SS4	2.3-2.8	Clay and silt, some sand, trace gravel	1.6	11	37.9	49.5
BH22-13	SS3	1.5-1.9	Sandy clayey Silt, trace gravel	3.5	27.5	38.1	30.9
BH22-17	SS3	1.5-1.9	Silty clay, trace sand	0.0	0.8	32.5	66.7

Three Atterberg Limit tests were carried out on the above-noted samples from borehole BH22-08, BH22-13, and BH22-17. The results are summarized in **Table 4.3** and are shown on the borehole logs in **Appendix A**. A plasticity chart with the test results is provided in **Appendix B**.

Table 4.3 Atterberg Limits for cohesive deposits

BOREHOLE NO.	SAMPLE NO	DEPTH (mbgs)	SOIL DESCRIPTION	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
BH22-08	SS4	2.3-2.8	Clay and silt, some sand, trace gravel	26	16	10
BH22-13	SS3	1.5-1.9	Sandy clayey Silt, trace gravel	20	13	7
BH22-17	SS3	1.5-1.9	Silty clay, trace sand	30	18	12

4.3 GLACIAL TILL

A variable glacial till was encountered in all boreholes except BH22-07 and BH22-08. The till was generally interlayered with the non-cohesive and cohesive deposits. The till ranged between brown to grey non-cohesive till (sand and silt to sandy silt with some clay and trace gravel) to cohesive till (clayey sandy silt to clayey silty sand with some sand and trace gravel). The water contents of this layer were variable from drier than the plastic limit to wetter than plastic limits. This deposit was encountered at a depth ranging between 2.8 mbgs and 5.5 mbgs and extended to depths ranging between 5.5 mbgs to 11.1 mbgs (termination depth in boreholes BH22-02, BH22-04, BH22-05, BH22-06, BH22-09, BH22-12, BH22-13, BH22-14, BH22-16, and BH22-17).

The measured SPT 'N' values in the non-cohesive till deposits ranged between 23 blows to greater than 50 blows per 0.3 m of penetration, indicating that the non-cohesive till deposits were generally compact to very dense.

The measured SPT 'N' values in the cohesive till deposits ranged between 15 blows to greater than 50 blows per 0.3 m of penetration, indicating of a very stiff to hard consistency.

The natural moisture contents, as determined by laboratory tests, ranged approximately from 7% to 22%.

Laboratory particle size distribution analyses were conducted on six selected samples obtained from the glacial till. Test results are provided in **Table 4.4**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in **Appendix A**. The particle size distribution curves are provided in **Appendix B**.

Table 4.4 Grain Size Distribution for Glacial Till

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-2	SS4	2.3-2.8	Clayey sandy silt, trace gravel	1.6	25.9	38.3	34.2
BH22-3	SS8	7.6-8.0	Sandy silt and clay till, trace gravel	3.8	27	34.5	34.7
BH22-5	SS5	3.1-3.4	Silty clay, trace sand, trace gravel	2.4	5	34.6	58
BH22-6	SS8	7.6-8.0	Clayey silt, some sand, trace gravel	1.8	17.2	48.1	32.9
BH22-12	SS4	2.9-2.8	Sand and silt, some clay, trace gravel	1.8	48.1	35.6	14.5
BH22-18	SS5	3.1-3.5	Clayey silty sand, trace gravel	2.9	42.1	34.9	20.1

Atterberg Limit testing was carried out on the above-noted samples from boreholes BH22-2, BH22-3, BH22-5, BH22-6, BH22-12 and BH22-18. The results are summarized in **Table 4.5** and are shown on the borehole logs in **Appendix A**. The results indicated that the sand and silt from BH22-12 was non-plastic, in accordance with the Canadian Foundation Engineering Manual (2006). A plasticity chart with the test results is provided in **Appendix B**.

Table 4.5 Atterberg Limits for Glacial Till

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
BH22-2	SS4	2.3-2.8	Clayey sandy silt, trace gravel	20	12	8
BH22-3	SS8	7.6-8.0	Sandy Silt and Clay till, , trace gravel	18	11	7
BH22-5	SS5	3.1-3.4	Silty clay, trace sand, trace gravel	26	16	10
BH22-6	SS8	7.6-8.0	Clayey silt, some sand, trace gravel	19	12	7
BH22-12	SS4	2.9-2.8	Sand and silt, some clay, trace gravel	NP	NP	NP
BH22-18	SS5	3.1-3.5	Clayey silty sand, trace gravel	16	12	4

4.4 NON-COHESIVE DEPOSITS – SILTY SAND TO SAND

A brown to grey native non-cohesive deposits were encountered below the topsoil, glacial till and silty clay in boreholes BH22-01, BH22-03, BH22-05, BH22-07, BH22-08, BH22-10, BH22-11, BH22-15, BH22-16 and BH22-18 respectively. This soil layer ranged between sandy silt and clay to sand material and generally moist to wet at the time of investigation. This soil layer was encountered at a depth ranging between 0.2 mbgs and 10.7 mbgs and extended to the depth ranging between 0.6 mbgs and termination depth in boreholes BH22-01, BH22-03, BH22-07, BH22-08, BH22-10, BH22-15, and BH22-18 respectively.

The measured SPT ‘N’ values in the non-cohesive deposits ranged from 8 blows to greater than 50 blows per 0.3 m of penetration, indicating that the non-cohesive deposits were generally loose to very dense. Based on the laboratory test, the natural moisture content of this non-cohesive deposits ranged between 7.0% and 24%.

Two (2) laboratory particle size distribution analyses were conducted on selected sample obtained from non-cohesive deposits. Test results are provided in **Table 4.6**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in **Appendix A**. The particle size distribution curves are provided in **Appendix B**.

Table 4.6 Grain Size Distribution for non-cohesive deposits

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-5	SS3	1.5-1.9	Sand, some silt and clay, trace gravel	6.3	73.9	19.8	

4.5 GROUNDWATER

Groundwater (free water) and caving were noted in some boreholes advanced at the site during the investigation immediately upon completion of drilling. Monitoring wells were installed in four boreholes. The groundwater levels in monitoring wells were recorded on April 26, 2022.

A summary of the groundwater levels measured in the monitoring wells installed at the site is provided below in **Table 4.7**; Minimum and maximum groundwater levels recorded in the monitoring wells, are indicated in **red** in the table below.

Table 4.7 Groundwater and Caving Observation

BOREHOLE	DATE	BH ELEVATION (masl)	GROUNDWATER DEPTH (mbgs)	GROUNDWATER ELEVATION (masl)	MEASUREMENT SOURCE
BH22-03	April 26, 2022	231.5	-	-	**Monitoring Well
BH22-05	April 26, 2022	224.0	0.2	223.8	Monitoring Well
BH22-06	April 26, 2022	220.7	0.3	220.4	Monitoring Well
BH22-09	April 26, 2022	231.6	0.9	230.7	Monitoring Well
*BH2	Dec 8, 2016	242.46	3.4	242.3	Monitoring Well
*BH3	Dec 8, 2016	242.56	3.4	241.9	Monitoring Well
*BH5	Dec 8, 2016	244.76	3.2	244.9	Monitoring Well
*BH8	Sep 23, 2016	234.42	1.5	235.1	Monitoring Well
*BH11	Dec 8, 2016	226.23	4.4	229.2	Monitoring Well
*BH14	Dec 8, 2016	218.88	0.2	220.2	Monitoring Well
*BH16	Dec 8, 2016	230.16	4.0	227.6	Monitoring Well
*BH18	Dec 8, 2016	236.05	1.3	235.7	Monitoring Well

* Groundwater level data from previous field investigation conducted in 2016.

** Water was at the top of casing and unable to read water level from monitoring well on April 26, 2022.

It should be noted that the groundwater levels can vary between borehole locations and are subject to seasonal fluctuations in response to major weather events.

5 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following sections provide geotechnical design recommendations for the proposed residential development at the aforementioned site based on the information obtained from the borehole investigation and laboratory testing, which we believe fairly represents the subsurface conditions of the Site. These recommendations are intended for the guidance of the design engineer to establish constructability and should not be construed as instructions to contractors. If significant differences in the subsurface conditions described above are found, we request to be contacted immediately to review and revise our findings and recommendations, if necessary.

The construction methods described in this report must not be considered as being specifications or recommendations to the prospective contractors, or as being the only suitable methods. Prospective contractors should evaluate all of the factual information, obtain additional subsurface information as they might deem necessary and should select their construction methods, sequencing and equipment based on their own experience in similar ground conditions. The readers of this report are also reminded that the conditions are known only at the borehole locations and in view of the spacing of the boreholes, conditions may vary significantly between boreholes.

5.1 SITE BACKGROUND

Based on the concept plan provided to our office the proposed development is comprised of:

- 946 units of single detached, semi detached and townhouses, each two to three storeys in height;
- Two Storm Water Management (SWM) Ponds in the southeast portion of the site; and,
- Associated driveway/parking areas and municipal servicing.

Design details for the proposed building structures, such as underside of footing elevations, were not available at the time when this report was prepared. Based on discussions with the client, it is understood that one level of basement is to be constructed for the majority of the buildings at the Site. A preliminary concept plan is attached to this report in the Figures section (**Preliminary Concept Plan, dated December 16, 2021**).

5.2 OVERVIEW OF SUBSURFACE CONDITIONS

Based on the results of the field investigation, the subsurface conditions consist of topsoil overlying soft to hard cohesive deposits (silty clay to clay and silt); the cohesive deposits are underlain by compact to very dense and very stiff to hard glacial till (clayey sandy silt to clayey silty sand and sand and silt) and loose to very dense non-cohesive deposits (silty sand to sand).

Based on the groundwater levels recorded in the monitoring wells, groundwater was observed at depths ranging between 0.2 m and 4.4 mbgs (between approximately Elevation 223.8 m and 229.2 m) and it should be noted that, groundwater was observed at the surface of the borehole BH22-03 close to the ground surface elevation.

5.3 SITE PREPARATION AND GRADING

The details of site grading were not yet available at the time of this report writing. However, it is anticipated that the site will require some regrading as part of the redevelopment of the site. As indicated above, the surface of the majority of the boreholes encountered topsoil.

Removal of all topsoil /reworked soils will be required to facilitate the proposed development on the site. It is recommended that a topsoil test pit program be completed at the site by WSP prior to construction to refine the topsoil thicknesses across the site. Regarding the reuse of the site topsoil, the topsoil may be reused in landscaping applications or other non-structural fill applications. WSP should be contacted to review all proposed topsoil reuse on site.

Subsequent to the completion of the required stripping and removal of unsuitable materials, the sub-grade should be proof-rolled and inspected by experienced WSP geotechnical engineering personnel. The proof-rolling and compaction of the exposed sub-grade is recommended to be conducted using a vibratory compactor with a minimum static weight of ten (10) tonnes. The proof-rolling program should consist of a minimum of six (6) passes per unit area and be tested to assure that the sub-grade is compacted to a minimum of 100% of the exposed material's Standard Proctor Maximum Dry Density (SPMDD). Any loose/soft or wet areas identified at the time of proof-rolling that cannot be uniformly compacted are recommended to be sub-excavated and backfilled with approved engineered fill consistent with the recommendations provided in *Engineered Fill - Appendix C*.

Based on the measured natural water contents, the majority of the native tills deposits are generally expected to have moisture contents within an acceptable range of the estimated optimum water contents for compaction. The non-cohesive subsoils are generally wetter than their estimated optimum water contents for compaction; in addition, the near-surface loose/soft silty/clayey soils (i.e. silty clay to silty sand and sand) are expected to be generally wetter than their estimated optimum water contents for compaction; these soils will require some drying prior to being reused as engineered fill. The clayey soils may be difficult to be adequately dried by aeration and should, therefore be considered for reuse as non-structural fill (i.e. in landscaping areas). Experience also indicates that clay fills, even when adequately compacted have a tendency to settle over a long period of time. It should also be noted that due to the fine-grained nature of the soils encountered at the site, their workability is sensitive to moisture conditions and some difficulty would be expected in achieving adequate compaction during wet weather. In this regard, imported materials may have to be used for engineered fill subject to the approval of WSP at the source(s), prior to hauling them to the site.

Where engineered fill is required to develop the design grades and elevations or for use in backfilling excavations created through the removal of unsuitable materials or soils as described above, the excavated on-site materials may be re-used, subject that these are free of organic and other unsuitable materials and have appropriate moisture content. Boulders or cobbles greater than 200 mm in size should be removed from the fill.

Alternatively, Ontario Provincial Standard Specification (OPSS) Granular B – Type I, OPSS Select Subgrade Material (SSM) or approved equal may be used.

All fill materials imported to the site must meet all applicable municipal, provincial and federal guidelines and requirements associated with environmental characterization of the materials.

Engineered fill is to be placed in maximum 200 mm thick loose lifts under full time supervision of qualified geotechnical personnel. Each lift is to be uniformly compacted to achieve a minimum of 100% of the material's SPMDD. Additional information related to the placement and compaction of engineered fill can be found in *Engineered Fill - Appendix C*.

In any areas where fill depths of greater than 1 m will be placed, WSP should review these areas to determine the potential for long-term consolidation settlement in areas where soft / firm cohesive soils are located. As such it is recommended that WSP complete an overall review of the proposed grading once the site grading plans are available.

5.4 PRELIMINARY FOUNDATION RECOMMENDATIONS

Details of the proposed residential development such as underside of footing elevations were not available at the time when this report was prepared. When this information is available, the recommendations provided below should be reviewed by WSP to confirm that the recommendations are still valid based on the design information.

Based on discussions with the client, it is understood that one level of basement will be constructed for the residential structures at the Site and the finished basement floor will be at about 3.0 m below final site grades.

Based on the soil conditions encountered in the boreholes and provided that the site is prepared in accordance with the recommendations presented in this report, the proposed buildings may be supported with conventional spread and strip footings that are founded directly on the competent, native and undisturbed deposits. These footings may be designed based on a preliminary factored ultimate geotechnical resistance at Ultimate Limit States (ULS) of 200 kPa. A preliminary serviceability geotechnical resistance at Serviceability Limit States (SLS) of 130 kPa may be used in the design of the foundations.

When the engineered fill is completed in accordance with the requirements provided in *Appendix C*, footings may be designed based on a preliminary factored ultimate geotechnical resistance at Ultimate Limit States (ULS) of

150 kPa. A preliminary serviceability geotechnical resistance at Serviceability Limit States (SLS) of 100 kPa may be used in the design of the foundations.

We note that in some areas of the site, relatively shallow, soft to firm cohesive soils were encountered which are unsuitable for structural support. These areas will require subexcavation and replacement with engineered fill or granular materials.

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

5.4.1 GENERAL FOUNDATION COMMENTS

All footings exposed to seasonal freezing conditions should be provided with at least 1.5 m of earth cover or equivalent thermal insulation against frost. It is recommended to keep footings as high as possible to avoid or minimize penetration below groundwater levels while considering the minimum frost cover requirement.

Variations in the soil conditions are expected in between the borehole locations, and during construction, the geotechnical resistances should be confirmed by experienced WSP site personnel.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper foundations.

The non-cohesive soils at the base of footings can be easily disturbed by construction machinery and foot traffic or lose their strength in contact with surface water. We recommend that an allowance be made for placing a 50 mm thick skim coat of low-strength concrete on the founding subgrade immediately after its approval, to prevent its disturbance by construction activities and from ground or surface water, where necessary.

During winter construction, foundations and slab on grades must not be poured on frozen soil. Foundations must be adequately protected at all times from cold weather and freezing conditions.

In the vicinity of the existing buried utilities, all footings must be lowered to undisturbed native soils, or alternatively the services must be structurally bridged.

It should be noted that the recommended geotechnical resistances have been calculated by WSP from the borehole information for the preliminary design stage only. Additional input may be required as new design information becomes available and is refined. For example, more specific information is available with respect to conditions between boreholes when construction is underway. In this regard, the interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by WSP to validate the information for use during the construction stage.

5.5 FLOOR SLAB CONSTRUCTION AND DRAINAGE

The floor slabs can be a slab-on-grade supported on either competent native soils or engineered fill, provided disturbed, softened or loose native soils are removed and the base thoroughly inspected by a WSP geotechnical engineer and proof-rolled before placing granular base materials. Any fill required to raise the grade below the floor slab can consist of inorganic soil, placed in shallow lifts and compacted to 98 percent of its Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab.

A review of the slab elevations should be completed once site grading information is available to determine the potential need for a perimeter and/or underfloor drainage system.

5.6 LATERAL EARTH PRESSURES PARAMETERS

The lateral earth pressure for the design of retaining walls, foundation walls, shoring, or trench boxes can be estimated from the following expressions:

Above groundwater table: $p = K (\gamma z + q)$

Below groundwater table: $p = K \{ \gamma h_1 + \gamma_1(z - h_1) + q \} + p_w$

Where:

- p = Lateral earth and water pressure in kPa acting at depth z ;
- z = Depth below ground surface, in meters;
- K = Active earth pressure coefficient, (K_a);
- γ = Unit weight of soil above groundwater table, in kN/m^3 ;
- γ_1 = Submerged unit weight of soil below water table;
- h = Thickness of soil above groundwater table, in meters;
- q = Value of Surcharge (kPa);
- p_w = Hydrostatic water pressure

The suggested soil parameters (unfactored) for the retaining wall design and/or ground support systems are summarized in **Table 5.1**. The suggested soil parameters are based on SPT N-values, soil laboratory test results and supplemented by the judgement based on local and regional experience with these soil types.

Table 5.1 Recommended Unfactored Soil Parameters

SOIL TYPE	NEW GRANULAR FILL		NON-COHESIVE NATIVE SOILS (INCLUDING NON-COHESIVE TILL)				COHESIVE NATIVE SOILS (INCLUDING COHESIVE TILL)					
	'A'	'B'	15-29	30-39	40-50	>50	3-9	10-14	15-29	30-50	>50	
SPT 'N'												
Unit weight (kN/m^3)	22	21	21	21	22	22	18	20	21	21	22	
Effective angle of internal friction ($^\circ$), ϕ'	35	32	30	32	34	35	26	28	30	32	34	
Effective cohesion, c' (kPa)	-	-	-	-	-	-	0	2	5	10	10	
Undrained shear strength (kPa) (**)	-	-	-	-	-	-	40	75	100	200	250	
Coefficient of lateral earth pressure												
Active, K_a	0.27	0.31	0.33	0.31	0.28	0.27	0.39	0.36	0.33	0.31	0.28	
At rest, K_o	0.43	0.47	0.50	0.47	0.44	0.43	0.56	0.53	0.50	0.47	0.44	
Passive, K_p	3.69	3.25	3.00	3.25	3.54	3.69	2.56	2.77	3.00	3.25	3.54	

Backfilling of the footing wall excavations is recommended to be placed in 200 mm thick lifts, uniformly compacted to 100% SPMDD to proposed sub-grade elevations.

5.7 TEMPORARY EXCAVATIONS

The details for the proposed services installations are not available at the time of preparing this report. The recommendations provided below assume that conventional depths for services will be carried out (approximately 3 mbgs to 5 mbgs).

Based upon the subsurface conditions at the borehole locations, excavations can be carried out with heavy hydraulic back-hoes. It is recommended that provision be carried in the contract for the excavation and disposal of obstructions on site, including cobbles and boulders within the till deposits.

All temporary excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). The firm to hard cohesive and compact to very dense native non-cohesive deposits can be classified as Type 3 soils above the groundwater table and Type 4 below the groundwater table. Soft / loose soils can be classified as Type 4 soils. For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number Type designation.

Temporary excavation walls should not exceed 3.0 horizontal to 1.0 vertical (3H:1V) and 1.0 horizontal to 1.0 vertical (1H:1V) in Type 4 and 3 soils, respectively. All excavated spoil should be placed at least the depth of the trench away from the edge of the trench for safety reasons.

5.8 GROUNDWATER CONTROL

Groundwater was encountered in most of the boreholes after the completion of drilling and varied in depth as measured in the monitoring wells (April 26, 2022). Based on these observations and the previous field investigation conducted by Golder (2016), groundwater in the project area is anticipated to be generally between 0.2 m and 4.4 m below ground surface (mbgs). The ground water levels, and caving depths are provided in Table 4.7. As noted above, groundwater levels can vary between borehole / monitoring well locations and are subject to seasonal fluctuations in response to major weather events.

Where excavations are completed for the proposed work, it is assumed that excavations will need to be extended below the groundwater table in many areas of the site. As such, it is likely that dewatering will be required at the site and an Environmental Activity and Sector Registry (EASR) or a Permit to Take Water (PTTW) will be required for the excavations along specific areas of the proposed roadway alignment. Daily water takings of 50 m³/day require registration of the MECP EASR database, and daily water takings of 400 m³/day require a PTTW. Both the EASR and the PTTW require a hydrogeological assessment report to support the specific application. In addition, a permit to discharge the collected water to the sewer system/water body will be required from the applicable agency. A PTTW application requires a minimum of 90 days for the MOECC to process; in this regard, appropriate lead time should be factored into the overall project schedule to accommodate the PTTW process, if required. Additional detailed information will be provided within our hydrogeological report, which will be provided under a separate cover.

In any areas requiring dewatering, the groundwater table must be lowered a minimum of one (1) meter below the lowest excavation level. A specialized dewatering contractor should be retained to design and install the dewatering system.

In order to minimize predictable water issues and costs, it is recommended that excavation and in-ground construction be performed in drier seasons.

5.9 PIPE BEDDING AND COVER

The native subsoils are considered to be suitable for supporting the pipes, provided the integrity of the base can be maintained during construction. It should be noted that some difficulty may be encountered in excavating very dense/hard glacial till at some locations. In addition, the tills are glacially derived and as such, should be expected to contain cobbles and/or boulders.

The soils above the groundwater level, or properly dewatered if encountered below the groundwater level, will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, must be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt.

The bedding material should consist of well graded granular material such as Granular 'A' or equivalent. The bedding material should be compacted to at least 98 percent of its SPMDD. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as

set out by the local authority or municipality, should be placed. It is recommended that WSP be on site during excavations to assess the suitability of the subgrade materials to support the pipes.

If localized wet trench conditions are encountered, a uniformly graded clear stone may be used provided a suitable, approved filter fabric (geotextile) is placed in conjunction with the clear stone. The geotextile must extend underneath the clear stone, along the sides of the trench, and wrapped on top of the clear stone such that the clear stone is fully wrapped by the geotextile. A minimum geotextile overlap of 1 m is required; alternatively stitching of the geotextile could be considered. WSP should be on site on a full-time basis if this method is being considered.

Localized, wet and unstable soils encountered within generally stable soil zones can be generally stabilized by ‘punching’ a 50 mm well graded crusher run limestone pad into the soft subgrade prior to bedding placement. The thickness of the ‘pad’ will depend on field conditions and should be examined by WSP personnel during the construction operations.

5.10 TRENCH BACKFILL

The excavated native soils can be used as construction backfill provided their moisture content at the time of placement is within 2% of the optimum moisture content. Boulders or cobbles greater than 200 mm in size should be removed from the trench backfill.

For the non-cohesive soils, smooth drum type vibratory rollers are recommended. Cohesive soils should be compacted with sheepsfoot type vibratory compactors. The trench backfill should be placed in maximum 0.3 m lift thickness and compacted to at least 98 percent of its SPMDD. Trench backfilling operations should be avoided during freezing weather.

It is preferable that the native soils be re-used from approximately the position at which they are excavated so that frost response characteristics of the soils after construction remain essentially similar. If required, consideration may also be given to backfilling trenches with a well graded, compacted granular soil such as Granular ‘B’ material.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for the compaction requirements noted above. Stockpiles should therefore be covered with tarpaulins to help minimize moisture increases.

5.11 STORMWATER MANAGEMENT (SWM) POND

Based on the concept plan provided to our office, two SWM Ponds (**Pond#1 near Block 639** and **Pond#2 near Block 638**) are proposed as part of this development at the southeast portion of the site. At the time of this report, design details were not available for the SWM Pond (i.e. design grades, normal water level, side slopes, etc.). In this regard the recommendations below should be considered preliminary in nature.

The proposed pond elevations and the approximate existing ground surface elevations at the locations of the boreholes are summarized in the following table:

SWM POND NO.	BH NO.	EXISTING GROUND SURFACE ELEVATIONS AT BH LOCATION (m)	GROUNDWATER ELEVATION (MASL) (APRIL 26, 2022)
Pond #1	BH22-03	231.5	231.4*
	BH22-09	231.6	230.7
Pond #2	BH22-05	224.0	223.8
	BH22-06	220.7	220.4

* Groundwater observed in monitoring well to be at the top of the casing (relatively level with the existing grade)

Boreholes BH22-03 and BH22-09 were advanced in proximity to/within the footprint of the proposed SWM Pond 1. The subsurface conditions at these two boreholes comprise surficial topsoil overlying silty clay to a depth ranging between 3.1 mbgs and 6.1 mbgs respectively; the silty clay was underlain by clayey silt till and silty sand to the termination depth of about 11.0 mbgs. Groundwater levels are indicated in the table above.

Boreholes BH22-05 and BH22-06 were advanced in proximity to/within the footprint of the proposed SWM Pond 2. The subsurface conditions at these boreholes comprise surficial topsoil overlying non-cohesive deposits (silty sand to sand) and cohesive deposits (silty clay) to a depth ranging between 2.7 mbgs and 6.1 mbgs; the non-cohesive and cohesive deposits were underlain by glacial till (clayey silt to sandy clayey silt) to the termination depth of about 11.0 mbgs. Groundwater levels are indicated in the table above.

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

Based on the subsurface conditions encountered in the boreholes within the proposed ponds footprint, excavation depths for the proposed ponds are expected within the glacial tills. In one borehole (Borehole BH22-05), non-cohesive sands were encountered underlying the topsoil and extended to a depth of 2.7 mbgs. As relatively high groundwater was measured in the monitoring wells with the SWM Ponds, groundwater control will likely be required during the pond excavation.

A preliminary review of the encountered cohesive soils, (cohesive deposits and cohesive till deposits) including the laboratory results, indicate that these materials have relatively low permeabilities and as such, a SWM Pond liner may not be required to be constructed at the SWM Pond locations. As noted above, a sand deposit was encountered at a relatively shallow depth in Borehole BH22-05; in this regard, some areas of the SWM Ponds may require for a hydraulic barrier to be constructed in select areas of the SWM Pond footprints.

It is noted that design drawings are not available for the SWM Ponds at this time. It is strongly recommended that when these drawings become available, that a complete review of the SWM pond design from a geotechnical perspective be completed. In particular, it is noted that the groundwater level in Borehole BH22-03 was noted to be at grade (and possibly above grade) during the April 26, 2022, visit; it will be critical to review the SWM Pond depth(s) as input toward potential basal instability / aquifer depressurization both during construction, and during long-term maintenance activities.

5.12 PRELIMINARY PAVEMENT DESIGN

Based on the borehole results, the subgrade for the pavement structure will generally comprise competent highly frost susceptible variable glacial till and both cohesive and non-cohesive deposits- and potentially engineered fill (depending on site grading). Prior to placing any granular material, the exposed subgrade should be prepared and heavily proof-rolled under the supervision of the geotechnical engineer. Remedial work should be carried out on any disturbed, softened or poorly performing zones, as directed by the geotechnical engineer. The recommended preliminary pavement design for this proposed redevelopment is outlined below and is consistent with Town of Bradford Standards.

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Local Road	Arterial Road
Asphaltic Material (OPSS 1150)	HL3 Surface	40	40
	HL8 8 Binder	50	100
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Subbase	375	450
Total Pavement Thickness (mm)		615	740
Over Prepared and Approved Subgrade			

Granular materials should be uniformly compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD). The asphalt materials should be compacted to between 92.0 and 96.5 percent of their Marshall Maximum Relative Densities (MRDs), as measured in the field using a nuclear density gauge.

It should be noted that the pavement structure provided above is not intended to support heavy construction traffic. In this regard, heavy construction traffic, including triaxials, graders, etc., should be limited to areas of the site where suitable temporary access roads have been constructed so that disturbance to the native soils will be

minimized. The contractor should be responsible for determining the locations of, and constructing, these temporary access roads.

WSP should provide additional design recommendations regarding the pavement design once final grades have been determined and traffic data is provided.

5.13 DESIGN REVIEW, TESTING AND INSPECTIONS

WSP requests to be afforded the opportunity to complete a final review of the proposed development discussed in this report to verify that geotechnical recommendations are appropriate. If not given this opportunity, we cannot assume liability for omissions, misinterpretations or deficiencies in our recommendations.

WSP should be contacted to provide geotechnical testing and inspections during construction operations. Exposed subgrade soils for all structures are to be inspected to confirm the material is stable and competent. Inspections of seepage and groundwater conditions during construction are also required, as discussed in this report. Testing and inspections for general QA/QC are to include sampling and laboratory testing of fill materials and asphalt, compaction testing for the placement of fill materials and asphalt, and field and laboratory testing of concrete (including mix design reviews).

6 LIMITATIONS OF REPORT

This report is intended solely for the Bradford Highlands Joint Venture. The material in it reflects our best judgment in light of the information available to WSP at the time of preparation. Unless otherwise agreed in writing by WSP, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

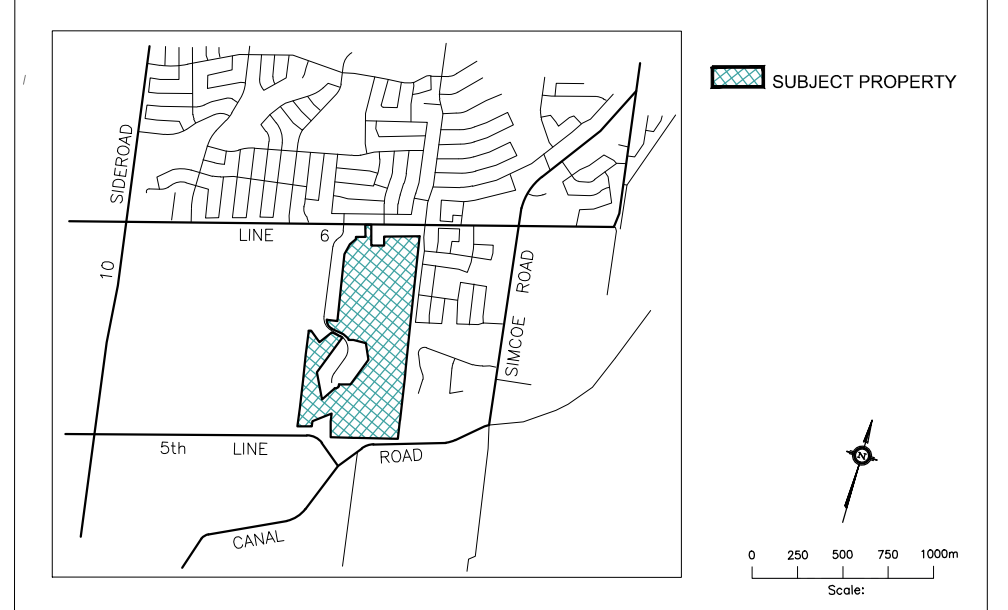
Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

FIGURES

CONCEPTUAL DEVELOPMENT PLAN - OPTION 1

Part of Block 36, Plan 51M-221 and
Part of Lot 13,
Concession 5
(Geographic Township of West Gwillimbury)
Town of Bradford-West Gwillimbury
County of Simcoe

KEY PLAN



SCHEDULE OF LAND USE

Lot/Block	Land Use	Units	Area (ha)
	Single Detached min. 11.6m (38ft)	454	26.38
	Semi Detached min. 7.6m (25ft)	178	6.31
	Street Townhouses min. 6.1m (20ft)	266	3.15
	Back to Back Townhouses min. 6.4m (21ft)	48	0.90
	Park		4.03
	Stormwater Management Ponds		5.38
	Environmental Protection		0.52
	Future Development		
Public Roads	Street 'A' 26.0m ROW	1,555m	
	Streets 'B'-'C' 20.0m ROW	767m	
	Streets 'D'-'N' 18.0m ROW	4,108m	
Total		6,430m	946

OWNER'S AUTHORIZATION

We, Bradford Highlands Joint Venture, hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

Bradford Highlands Joint Venture _____ Date _____

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

Date _____

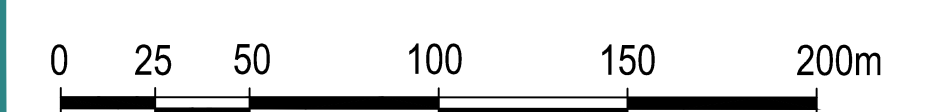
ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 5(17) OF THE PLANNING ACT, CHAPTER P.13 (R.S.O. 1990).

- (a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
- (b),(c) - As shown on the Draft and Key Plan.
- (d) - Land to be used in accordance with the Schedule of Land Use.
- (i) - Soil is sands, silts, clay and tills.
- (h),(k) - Full municipal services to be provided.

NOTE: Contours relate to Canadian Geodetic Datum.
Contour interval is 1m with .25m interpolated.

Scale: 1:2000

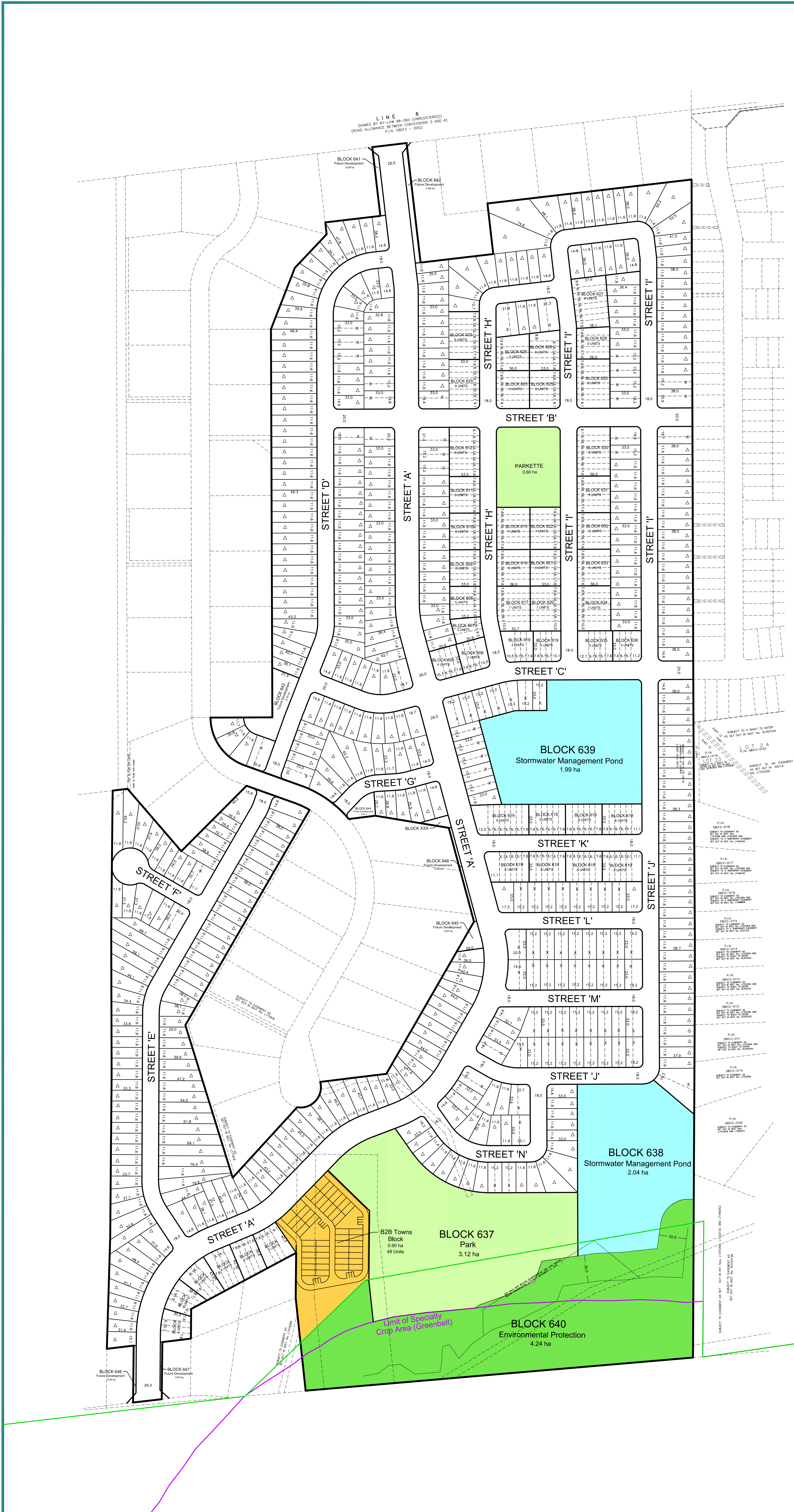


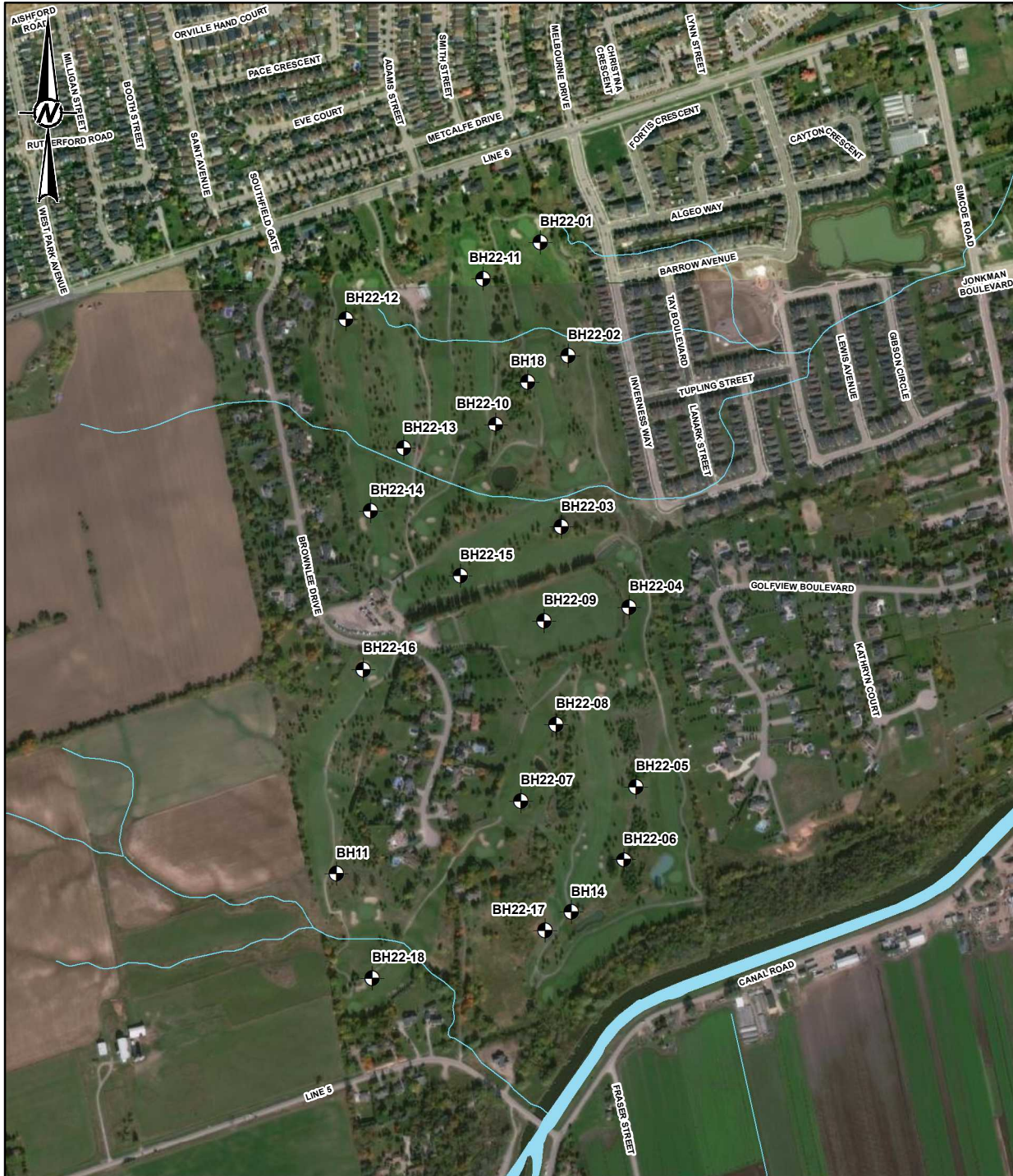
Date	Revision	By
02/11/20		GP
13/02/21		GP
24/11/21		GP
01/12/21		GP
16/12/21		GP

Prepared For:






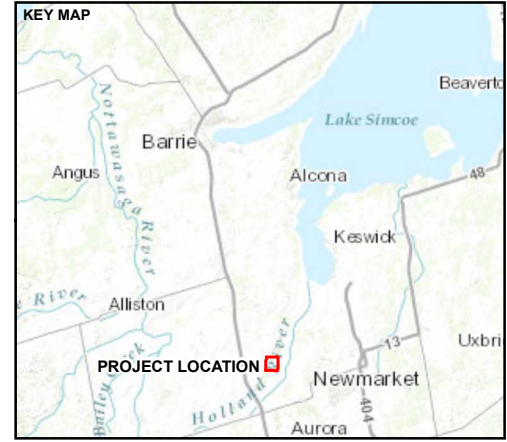
MGP File: 15-2422





LEGEND

-  BOREHOLE
-  WATERCOURSE
-  WATERBODY



FINAL



REFERENCE(S)

1. BASEDATA OBTAINED FROM MRNF LIO 2020
2. BASE IMAGERY: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. PRO JECTION: TRANSVERSE MERCATOR DATUM : NAD 83 COORDINATE SYSTEM : UTM ZONE 17N

CLIENT
BRADFORD HIGHLANDS

PROJECT
**BRADFORD HIGHLANDS GOLF COURSE
23 BROWNLEE DRIVE, BRADFORD, ONTARIO**

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2022-03-08
	DESIGNED	SO
	PREPARED	SO/DB
	REVIEWED	FJ
	APPROVED	

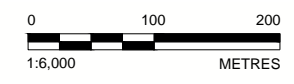
PROJECT NO. 22517668	CONTROL 0001	REV. 0.0	FIGURE 1
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ANSIA



LEGEND

- BOREHOLE LOCATION
- APPROXIMATE PHASE TWO BOUNDARY
- APPROXIMATE MNR NATURAL HERITAGE BOUNDARY



REFERENCE(S)
 BASE DATA - MNR LIO, OBTAINED 2015
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2017
 BOREHOLE LOCATION SURVEY: RADY-PENTEK & EDWARD SURVEYING LTD., JULY 28, 2016
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N
 BASE IMAGERY SOURCE: GOOGLE EARTH, 2015

CLIENT
 BRADFORD HIGHLANDS JOINT VENTURE

PROJECT
 PRELIMINARY GEOTECHNICAL INVESTIGATION
 BRADFORD HIGHLANDS GOLF COURSE

TITLE
 BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2017-02-13
	PREPARED	SB
	DESIGN	
	REVIEW	NL
	APPROVED	

Path: \\golder-gba\gis\mexico\GIS\Projects\BradfordHighlands_GolfCourse_Bradford099_PROJ1543120_General\Drawings\Borehole_Location_Plan_Preliminary_Geotechnical.dwg | File Name: 1543120-0002-BG-0002.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX

A

EXPLANATION OF TERMS
USED IN THE RECORD OF
BOREHOLE AND
BOREHOLE LOGS

Enclosure 1-A: Notes on Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by WSP also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.
2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.
3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.



LOG OF BOREHOLE BH22-01

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883640 E 613921

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-29-2022 to Mar-29-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80						
237.10	Ground Surface																
0.00	TOPSOIL: (500 mm)		1	SS	18												
236.60	SILTY CLAY: Brown to grey, trace gravel, cobble fragment, cohesive w<PL, stiff to hard. wet spon		2	SS	11												
1			3	SS	10												
2			4	SS	18												
3			5	SS	34												
233.10			6	SS	27												
4.00	SANDY CLAYEY SILT TILL: Grey, trace gravel, cohesive w>PL, very stiff to hard.		7	SS50/127mm													
230.10	SILTY SAND: Grey, some plastic fines, wet, very dense.		8	SS	61												
7.00																	

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity
 ○ = 3% Strain at Failure

WSP 2022-03-29 09:30:17: 22517668 - BH22-01 - LOG OF BOREHOLE BH22-01 - 1 of 2



LOG OF BOREHOLE BH22-01

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-29-2022 to Mar-29-2022
BH LOCATION: N 4883640 E 613921	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80							100
Continued																		
229.00	END OF BOREHOLE						229											
8.10	Notes: 1). Upon completion of drilling, borehole had caved at 6.1 meter below ground surface (mbgs).																	

WSP SOIL RECORDING SYSTEM INC. 6525 CHURCHILL BLVD. UNIT 101, MISSISSAUGA, ONTARIO L4V 1V3
 TEL: 905.276.1400 FAX: 905.276.1401 WWW.WSP-ENGINEERING.COM

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-02

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883457 E 613966

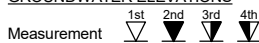
Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-29-2022 to Mar-29-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY: PM
 COMPILED BY: FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
234.50	Ground Surface															
0.00	TOPSOIL: (400 mm)		1	SS	7											
234.10	SILTY CLAY: Brown, trace gravel, cohesive w<PL, soft to very stiff.															
0.40			2	SS	3											
1			3	SS	17											
2			4	SS	31											
3			5	SS	46											
4			6	SS	46											
231.60	CLAYEY SANDY SILT TILL: Brown to grey, trace sand, trace gravel, cohesive w<PL, hard. grey															
2.90			7	SS	100mm											
6.20	END OF BOREHOLE															

Notes:
 1). Borehole was terminated due to auger refusal.
 2). Upon completion of drilling, borehole had caved at 5.5 meters below ground surface (mbgs) and groundwater level was at approximately at 0.7 meters below ground surface (mbgs).

GROUNDWATER ELEVATIONS



GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity
 ○ ● =3% Strain at Failure

WSP 2022-03-29 10:30 AM 2022-03-29 10:30 AM 2022-03-29 10:30 AM 2022-03-29 10:30 AM



LOG OF BOREHOLE BH22-03

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883181 E 613955

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-24-2022 to Mar-24-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L
Continued																		
221.50	SANDY SILT AND CLAY TILL: Grey, trace gravel, cohesive w~PL, very stiff to hard. (Continued)	[Hatched pattern]	9	SS	76							○						
10.00	SILTY SAND: Grey, wet, very dense.	[Dotted pattern]																
220.63			10	SS50/127m								○						
10.87	END OF BOREHOLE Notes: 1). Upon completion of drilling, groundwater level was at approximately 0.30 meter below ground surface (mbgs). 2). A 50mm diameter monitoring well was installed with screens from 7.6 mbgs to 10.6 mbgs. Water Level Reading: Date April 26, 2022 Depth (m bgs.) Water was at the top of casing and unable to read water level from monitoring well																	

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

WSP 2022-04-26 10:00 AM 2022-04-26 10:00 AM 2022-04-26 10:00 AM 2022-04-26 10:00 AM
 WSP 2022-04-26 10:00 AM 2022-04-26 10:00 AM 2022-04-26 10:00 AM 2022-04-26 10:00 AM



LOG OF BOREHOLE BH22-04

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-23-2022 to Mar-23-2022
BH LOCATION: N 4883052 E 614065	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80							100
Continued	CLAYEY SILT TILL: Grey, trace sand, trace gravel, cohesive w<PL, very stiff to hard.(Continued)	[Hatched Pattern]																
9			9	SS	39													
10																		
11			10	SS	28													
218.77																		

11.13	END OF BOREHOLE																	
	Notes: 1). Upon completion of drilling, groundwater level was at approximately 0.91 meter below ground surface (mbgs).																	

WSP SOIL PROFILE REPORT - 2022-03-23
 WSP 2022-03-23 11:05:22 (GMT-05:00)



LOG OF BOREHOLE BH22-05

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882763 E 614075

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-25-2022 to Mar-25-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)									
224.00	Ground Surface																
0.00	TOPSOIL: (450 mm)		1	SS	16												
223.55	SAND: Brown, some silt, trace to some gravel, cobble fragment, moist to wet, compact to dense.		2	SS	19												
0.45																	
1				3	SS	21											6 74 (20)
2				4	SS	39											
3				5	SS	28											2 5 35 58
4				6	SS	64											
218.50	SILTY CLAY TILL: Grey, trace gravel, trace sand, cohesive w<PL, very stiff to hard.																
5.50			7	SS	30												
6				8	SS50/270mm												
7																	
8																	

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity
 ○ ●=3% Strain at Failure

WSP SOIL LOGGING 2022 INC. 855249886.000
 2022-03-25 10:00:00 TO 2022-03-25 10:00:00



LOG OF BOREHOLE BH22-05

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-25-2022 to Mar-25-2022
BH LOCATION: N 4882763 E 614075	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20	40	60							80	100
Continued	SILTY CLAY TILL: Grey, trace gravel, trace sand, cohesive w<PL, very stiff to hard.(Continued)																	
9			9	SS	35													
10																		
213.13			10	SS	40													
10.87	END OF BOREHOLE Notes: 1). Upon completion of drilling, groundwater level was at approximately 0.30 meter below ground surface (mbgs). 2). A 50mm diameter monitoring well was installed with screens from 6.10mbgs to 9.14 mbgs. Water Level Reading: Date Depth (m bgs.) April 26, 2021 0.2																	

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3 , x 3 : Numbers refer to Sensitivity ○ ●=3% Strain at Failure

WSP SOIL REPORTING SYSTEM INC. 6555 SHEPPARD AVE. E. UNIT 101 SCARBOROUGH, ONTARIO M1S 4T8
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LOG OF BOREHOLE BH22-06

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882644 E 614056

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-29-2022 to Mar-29-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY: PM
 COMPILED BY: FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
220.70	Ground Surface														
0.00	TOPSOIL: (450 mm)		1	SS	10							○			
220.25	SILTY CLAY: Brown to grey, cohesive w<PL to w>PL, soft to very stiff.		2	SS	7							○			
0.45			3	SS	3								○		
1		w>PL		4	SS	15									
2		no soil sample recovery		5	SS	16								○	
3		grey		6	SS	7								○	
215.20	CLAYEY SILT TILL: Grey, some sand, trace gravel, cobbles fragment, cohesive w<PL, hard.		7	SS	56								○		
5.50			8	SS	89								○		
6															
7															
8															
															2 17 48 33

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

WSP SOIL ARCHIVE 2017 INC 652439868.008
 WSP SOIL LOG DATE: 17 MAR 2022 10:52:22 AM
 WSP SOIL LOG USER: J. L. L.



LOG OF BOREHOLE BH22-06

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-29-2022 to Mar-29-2022
BH LOCATION: N 4882644 E 614056	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)						WATER CONTENT (%)
						20 40 60 80 100					W _p	W	W _L	GR SA SI CL
							○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE				————○———— WATER CONTENT (%)			
Continued														
	CLAYEY SILT TILL: Grey, some sand, trace gravel, cobbles fragment, cohesive w<PL, hard.(Continued)													
			9	SS50/127mm										
			10	SS50/152mm										
209.78	END OF BOREHOLE													

Notes:
 1). Upon completion of drilling, groundwater level was at approximately 1.5 meter below ground surface (mbgs).
 2). A 50mm diameter monitoring well was installed with screens from 7.62 mbgs to 10.67 mbgs.

Water Level Reading:
 Date Depth (m bgs.)
 April 26, 2021 0.3

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3 , × 3 : Numbers refer to Sensitivity ○ ● =3% Strain at Failure

WSP SOIL REPORTING SYSTEM INC. 6555 SHEPPARD AVE. E. UNIT 101 SCARBOROUGH, ONTARIO M1S 4T8
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LOG OF BOREHOLE BH22-07

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882740 E 613889

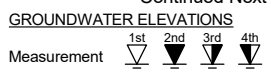
Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-23-2022 to Mar-23-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)								
229.10	Ground Surface															
0.00	TOPSOIL: (250 mm)															
228.85	SILTY CLAY: Brown, trace sand, trace gravel, cobble fragment, cohesive w~PL, firm to hard. ----- wet spon		1	SS	6											
0.25																
1					2	SS	7									
2					3	SS	17									
3					4	SS	20									
4			5	SS	38											
225.10	SILTY SAND: Brown, trace gravel, rock fragments, moist, very dense. ----- no soil sample recovery															
4.00																
5					6	SS50/152mm										
6																
7			7	SS50/25mm												
221.41	END OF BOREHOLE															
7.69					8	SS50/25mm										

WSP 2022-03-23 10:30 AM 23-07-22 BH22-07 LOG OF BOREHOLE BH22-07
 WSP 2022-03-23 10:30 AM 23-07-22 BH22-07 LOG OF BOREHOLE BH22-07

Notes: Continued Next Page



GRAPH NOTES + 3 , × 3 : Numbers refer to Sensitivity ○ ● = 3% Strain at Failure



LOG OF BOREHOLE BH22-07

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-23-2022 to Mar-23-2022
BH LOCATION: N 4882740 E 613889	Equipent: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV. DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)											W _p
	Continued																	
	1). Upon completion of drilling, borehole had caved at 5.4 meter below ground surface (mbgs).																	

WSP SOIL RECORDING SYSTEM INC. 6550 SHEPPARD AVE. E. UNIT 105 SCAR. ONT. M1S 1T7
 TEL: 416-291-1111 FAX: 416-291-1112 WWW.WSP-SOIL.COM

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES +³, ×³: Numbers refer to Sensitivity ○ ●=3% Strain at Failure



LOG OF BOREHOLE BH22-08

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882862 E 613947

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-24-2022 to Mar-24-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
228.10	Ground Surface															
0.00	TOPSOIL: (300 mm)															
227.80	CLAY AND SILT: Brown to grey, some sand, trace gravel, cohesive w<PL, firm to hard.		1	SS	6											
0.30																
1			2	SS	7											
2			3	SS	15											
3			4	SS	29											2 11 38 50
5	5	SS	34													
224.10	SILTY SAND: Grey, trace gravel, moist to wet, very dense.															
4.00			6	SS	97											
5																
6																
7																
220.35	END OF BOREHOLE		7	SS50/101mm												
7.75			8	SS	50											

WSP SOIL LOGS/LOGS/2022/03/24/22517668/BH22-08/BH22-08 LOGS/LOGS/2022/03/24/22517668

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure



LOG OF BOREHOLE BH22-08

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-24-2022 to Mar-24-2022
BH LOCATION: N 4882862 E 613947	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)											W _p
	Continued																	
	Notes: 1). Upon completion of drilling, borehole had caved at 4.2 meter below ground surface (mbgs) and groundwater was at approximate depth of 1.8 mbgs.																	

WSP SOIL LOGGING REPORT - PROJECT INFORMATION SHEET
 3000 10th Street, Unit 100, Brampton, Ontario L6Y 4R2
 TEL: 905.874.8888 FAX: 905.874.8889
 WWW.WSP-SOILLOGGING.COM

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ e=3% Strain at Failure



LOG OF BOREHOLE BH22-09

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883030 E 613927

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-23-2022 to Mar-23-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
231.60	Ground Surface														
0.00	TOPSOIL: (450 mm)		1	SS	4										
231.15	SILTY CLAY: Brown, trace sand, trace organics, cohesive w<PL, firm.		2	SS	4										
0.45			3	SS	6										
1			4	SS	8										
2			5	SS	17										
3			6	SS	34										
227.60	CLAYEY SILT TILL: Brown to grey, trace sand, trace gravel, cohesive w<PL to w~PL, very stiff to hard.		7	SS	24										
4.00			8	SS	28										
5															
6															
7															
8															

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity
 ○ = 3% Strain at Failure

WSP 2022-03-23 BH22-09 LOG OF BOREHOLE BH22-09
 WSP 2022-03-23 BH22-09 LOG OF BOREHOLE BH22-09



LOG OF BOREHOLE BH22-09

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-23-2022 to Mar-23-2022
BH LOCATION: N 4883030 E 613927	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)											
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100	10	20
Continued	CLAYEY SILT TILL: Brown to grey, trace sand, trace gravel, cohesive w<PL to w~PL, very stiff to hard.(Continued)		9	SS50/101m		223																			
							222																		
220.80					10	SS50/127m		221																	
10.80	END OF BOREHOLE Notes: 1). A 50mm diameter monitoring well was installed with screens from 7.62 mbgs to 10.67 mbgs. Water Level Reading: Date Depth (m bgs.) April 26, 2021 0.9																								

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3 , x 3 : Numbers refer to Sensitivity ○ ●=3% Strain at Failure

WSP SOIL LOGS MAY BE VIEWED AT: WSP.COM/CLIENTS/LOGS
 WSP SOIL LOGS MAY BE VIEWED AT: WSP.COM/CLIENTS/LOGS



LOG OF BOREHOLE BH22-10

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision CLIENT: Bradford Highlands Joint Venture PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario DATUM: UTM NAD , ZONE BH LOCATION: N 4883347 E 613849	Method: Solid Stem Auger Diameter: 152 mm Date: Mar-26-2022 to Mar-26-2022 Equipment: Drill Tech Geoprobe 420M	REF. NO.: 22517668 ENCL NO.: ORIGINATED BY PM COMPILED BY FJ
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SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)													
7.98	Continued END OF BOREHOLE Notes: 1). Upon completion of drilling, borehole had caved at 7.01 meter below ground surface (mbgs) and groundwater level was at approximately 4.8 meter below ground surface (mbgs).																GR SA SI CL	

WSP SOIL RECORDING SYSTEM INC. 6550 HWY 104, UNIT 10, BRANTFORD, ONTARIO N3S 1G5
 TEL: 519-751-1000 FAX: 519-751-1001 WWW.WSP-SOIL.COM

GROUNDWATER ELEVATIONS
 Measurement
 1st
 2nd
 3rd
 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure



LOG OF BOREHOLE BH22-11

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883581 E 613829

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-29-2022 to Mar-29-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY: PM
 COMPILED BY: FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80							100	W _p
241.90	Ground Surface																		
0.00	TOPSOIL: (450 mm)		1	SS	6							○							
241.45	SILTY CLAY: Brown, trace gravel, cohesive w<PL, firm to very stiff.		2	SS	11							○							
0.45																			
1																			
2																			
239.08	SAND: Brown, some silt, wet, dense to very dense.		3	SS	14							○							
2.82																			
3																			
4																			
236.40	SANDY CLAYEY SILT TILL: Grey, cohesive w<PL, hard.		4	SS	26							○							
5.50																			
235.05	SILTY SAND: Brown, wet, very dense.		5	SS50/127mm								○							
6.85																			
234.03	END OF BOREHOLE		6	SS50/101mm								○							
7.87																			

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity
 ○ = 3% Strain at Failure

WSP 2022-03-29 10:00 AM 2022-03-29 10:00 AM 2022-03-29 10:00 AM 2022-03-29 10:00 AM
 WSP 2022-03-29 10:00 AM 2022-03-29 10:00 AM 2022-03-29 10:00 AM 2022-03-29 10:00 AM



LOG OF BOREHOLE BH22-11

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-29-2022 to Mar-29-2022
BH LOCATION: N 4883581 E 613829	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)					W _p	W	W _L						
	Continued																	
	Notes: 1). Upon completion of drilling, borehole had caved at 6.1 meter below ground surface (mbgs) and groundwater level was at approximately 1.5 meter below ground surface (mbgs).																	

WSP SOIL LOGS MAY BE AT: WSP@GEOENGINEERING.COM
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GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-12

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883516 E 613608

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-28-2022 to Mar-28-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY: PM
 COMPILED BY: FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							W _p	W	W _L	GR SA SI CL
213.20	Ground Surface																	
0.00	TOPSOIL: (600 mm)		1	SS	5													
212.59	SILTY CLAY: Brown, cohesive w~PL, firm to stiff. wet spon		2	SS	7													
0.61			3	SS	11													
1			4	SS	17													2 48 36 15
2			5	SS	25													
3																		
209.20	SAND AND SILT TILL: Brown, some clay, trace gravel, moist, compact to very dense.		6	SS	36													
4.00			7	SS50/152mm														
5			8	SS50/101mm														
6																		
7																		
205.33	END OF BOREHOLE																	
7.87																		

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

WSP 2022-03-28 10:30 AM 2022-03-28 10:30 AM 2022-03-28 10:30 AM 2022-03-28 10:30 AM



LOG OF BOREHOLE BH22-12

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-28-2022 to Mar-28-2022
BH LOCATION: N 4883516 E 613608	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80	100						
	Continued																
	Notes: 1). Upon completion of drilling, groundwater level was at approximately 1.5 meter below ground surface (mbgs).																

WSP SOIL RECORDING REPORT - RICHMOND HILL OFFICE
 3000 SHEPPARD AVENUE EAST, SUITE 200, RICHMOND HILL, ONTARIO L4B 1N2

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-13

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-28-2022 to Mar-28-2022
BH LOCATION: N 4883307 E 613701	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)											W _p
	Continued																	
	Notes: 1). Upon completion of drilling, borehole had caved at approximately 7.3 meter below ground surface (mbgs).																	

WSP SOIL RECORDING REPORT - RECORDS@WSPINC.COM
 3000 10th Line East, Unit 10, 200 St. John's Road, Bradford, Ontario, Canada N4Y 2L2

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-14

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883207 E 613647

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-25-2022 to Mar-25-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							
242.80	Ground Surface														
0.00	TOPSOIL: (510 mm)		1	SS	5										
242.29	SILTY CLAY: Brown, trace rootlets, trace sand, cohesive w-PL, firm to stiff.		2	SS	4										
1															
2			3	SS	13										
3			4	SS	24										
4			5	SS	80										
238.80	CLAYEY SILT TILL: Brown to grey, trace sand, trace gravel, cohesive w<PL, very stiff to hard.		6	SS50/152mm											
4.00															
5			7	SS	46										
6															
7															
234.82			8	SS	52										

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity
 ○ = 3% Strain at Failure

WSP/2022/03/25/2022/22517668/BH22-14/LOG OF BOREHOLE BH22-14.DWG
 1:1
 2022/03/25/2022/22517668/BH22-14/LOG OF BOREHOLE BH22-14.DWG



LOG OF BOREHOLE BH22-14

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-25-2022 to Mar-25-2022
BH LOCATION: N 4883207 E 613647	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80	100						
7.98	Continued END OF BOREHOLE Notes: 1). Upon completion of drilling, groundwater was at approximately 0.9 meter below ground surface (mbgs).																

WSP SOIL RECORDING SYSTEM INC. 6550 SHEPPARD AVE. E. UNIT 101 SCARBOROUGH, ONTARIO M1S 4T8 TEL: 416-291-1111 FAX: 416-291-1112

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-15

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4883102 E 613793

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-23-2022 to Mar-23-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY: PM
 COMPILED BY: FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
235.60	Ground Surface															
0.00	TOPSOIL: (410 mm)		1	SS	4											
235.19	SILTY CLAY: Brown, cohesive w<PL, soft to very stiff. grey, w~PL		2	SS	10											
0.41																
1																
2																
3																
4			4	SS	50											
5			5	SS	51											
231.60	CLAYEY SILT TILL: Grey, trace gravel, trace sand, cobble fragments, cohesive w<PL, very stiff to hard.		6	SS	24											
4.00																
7			7	SS	83											
228.60	SILTY SAND: Grey, moist to wet, very dense.		8	SS	78											
7.00																
8																



LOG OF BOREHOLE BH22-15

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-23-2022 to Mar-23-2022
BH LOCATION: N 4883102 E 613793	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20	40	60	80						

227.50	Continued																	
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8.10	END OF BOREHOLE Notes: 1). Upon completion of drilling, borehole had caved at 5.2 meters below ground surface (mbgs).																	
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WSP SOIL RECORDING SYSTEM INC. 6555 SHEPPARD AVE. E. UNIT 101 SCARBOROUGH, ONTARIO M1S 4T8 TEL: 416-291-1111 FAX: 416-291-1112

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-16

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882952 E 613636

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-23-2022 to Mar-23-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)									
238.90	Ground Surface																
0.00 238.70	TOPSOIL: (200 mm)																
0.20	SAND: Brown, trace gravel, moist, loose.		1	SS	8												
238.29	SILTY CLAY: Brown, trace gravel, cohesive w<PL, very stiff to hard. wet spon		2	SS	15												
0.61			3	SS	32												
1			4	SS50/127mm													
2			5	SS50/152mm													
3			6	SS50/127mm													
234.90	SANDY CLAYEY SILT TILL: Brown to grey, trace gravel, cobble fragment, cohesive w<PL, hard.		7	SS50/152mm													
4.00			8	SS50/139mm													
5																	
6																	
7																	
231.18	END OF BOREHOLE		8	SS50/139mm													
7.72																	

WSP SOIL REPORTING 2017 INC. #652418986.000
 2017 03 23 10:58 AM 23 BROWNLEE DRIVE BRADFORD ONTARIO L6Y 4L6

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity
 ○ ● = 3% Strain at Failure



LOG OF BOREHOLE BH22-16

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision CLIENT: Bradford Highlands Joint Venture PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario DATUM: UTM NAD , ZONE BH LOCATION: N 4882952 E 613636	Method: Solid Stem Auger Diameter: 152 mm Date: Mar-23-2022 to Mar-23-2022 Equipent: Drill Tech Geoprobe 420M	REF. NO.: 22517668 ENCL NO.: ORIGINATED BY PM COMPILED BY FJ
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SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)					W _p	W	W _L			
Continued Notes: 1). Upon completion of drilling, groundwater level was at approximately 1.5 meters below ground surface (mbgs).															

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 3000 SHEPPARD AVENUE EAST, SUITE 200, RICHMOND HILL, ONTARIO L4B 1N2

GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure



LOG OF BOREHOLE BH22-17

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882531 E 613929

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-25-2022 to Mar-25-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60	80
219.90	Ground Surface																
0.00	TOPSOIL: (300 mm)																
219.60	SILTY CLAY: Brown to grey, trace sand, trace rootlets, cohesive w<PL, soft to very stiff. ----- wet ----- grey		1	SS	3												
0.30			2	SS	6												
1			3	SS	16											0 1 33 67	
2			4	SS	17												
3			5	SS	11												
215.90			SANDY CLAYEY SILT TILL: Grey, trace gravel, cohesive w<PL, hard.		6	SS	16										
4.00					7	SS	55										
5					8	SS	60										
6																	
211.88																	

WSP SOIL LOGGING & TESTING INC. 8525 CHESTER RD. UNIT 10, BRADFORD, ONTARIO L7R 4R7
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Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, x3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-17

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-25-2022 to Mar-25-2022
BH LOCATION: N 4882531 E 613929	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									

8.02	END OF BOREHOLE Notes: 1). Upon completion of drilling, borehole had caved at 7.3 meter below ground surface (mbgs) and borehole was dry.																
------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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 WSP SOIL RECORDING UNIT: 3852 J. BROWNLEE DRIVE BRADFORD ONTARIO L6S2P2

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure



LOG OF BOREHOLE BH22-18

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
 CLIENT: Bradford Highlands Joint Venture
 PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
 DATUM: UTM NAD , ZONE
 BH LOCATION: N 4882455 E 613650

Method: Solid Stem Auger
 Diameter: 152 mm
 Date: Mar-24-2022 to Mar-24-2022
 Equipment: Drill Tech Geoprobe 420M

REF. NO.: 22517668
 ENCL NO.:
 ORIGINATED BY PM
 COMPILED BY FJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
232.40	Ground Surface														
0.00	TOPSOIL: (610 mm)		1	SS	4										
231.79	SILTY CLAY: Brown cohesive w<PL, stiff.		2	SS	12										
0.61			3	SS	22										
1			4	SS	22										
2			5	SS	30										
229.60	CLAYEY SILTY SAND TILL: Brown, trace sand, trace gravel, cohesive w<PL, very stiff to hard.		6	SS50/127mm											
2.80			7	SS50/101mm											
3			8	SS50/101mm											
226.90	SILTY SAND: Brown, trace gravel, moist, very dense.														
5.50															
6															
7															
8															

Continued Next Page

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, x3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

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 TEL: 905.276.1500 FAX: 905.276.1501 WWW.WSP-SOIL.COM



LOG OF BOREHOLE BH22-18

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm
DATUM: UTM NAD , ZONE	Date: Mar-24-2022 to Mar-24-2022
BH LOCATION: N 4882455 E 613650	Equipment: Drill Tech Geoprobe 420M
	ORIGINATED BY PM
	COMPILED BY FJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									
Continued																	
224.30	8.10																
	<p>END OF BOREHOLE</p> <p>Notes: 1). Upon completion of drilling, groundwater level was at approximately 0.7 meter below ground surface (mbgs).</p>																

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GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

Enclosure 1-B: Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under “weight of hammer”

Dynamic Cone Penetration Resistance, N_d :

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to “A” size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT “N” value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT “N” Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w _p	Plastic limit
w _l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D _R	Relative density (specific gravity, G _s)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
Γ	Unit weight

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH1

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 11, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.	+ ⊕	- ⊖	Wp	W			Wi
0		GROUND SURFACE		249.32													
		TOPSOIL		0.00	1A												
		(ML) CLAYEY SILT, trace gravel, trace to some sand; mottled brown; cohesive, w>PL to w~PL, stiff to very stiff		0.13	1B	DO	8										
1					2	DO	15										
		(CL) SILTY CLAY and SAND, trace to some gravel; brown to greyish-brown, (TILL); cohesive, w<PL to w~PL, stiff to hard		247.95													
				1.37	3	DO	11									MH	
2																	
		Sand seam in sample 4			4	DO	45										
3																	
		Sand and gravel seam at 3.3 mbgs			5	DO	50/152 mm										
4																	
		Coarse sand seam at 4.2 mbgs			6	DO	91										
5																	
		End of Borehole		244.32	7	DO	89										
				5.00													
6		NOTE: 1. Groundwater measured at a depth of 4.3 m below existing grade in open borehole upon completion of drilling March 11, 2016.															
7																	
8																	
9																	
10																	

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DEPTH SCALE
1 : 50



LOGGED: CL
CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH10

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20		40		60				80	
0		GROUND SURFACE		237.49													
		TOPSOIL		0.00													
		(CL/ML) SILTY CLAY to CLAYEY SILT, trace sand; light brown; cohesive, w>PL to w~PL, stiff	[Hatched Pattern]	237.29	1	DO	8					○					
1					2	DO	15					○					
2					3	DO	11					○					
3					4	DO	11					○					
4				234.39	5	DO	16					○		MH			
		(CL) SILTY CLAY and SAND to sandy CLAY, trace to some gravel; greyish-brown, (TILL); cohesive, w~PL, very stiff to hard	[Hatched Pattern]	3.10													
5		End of Borehole		232.77	6	DO	50/152 mm					○		MH			
		NOTE: 1. Groundwater measured at a depth of 4.5 m below existing grade in open borehole upon completion of drilling March 15, 2016.		4.72													

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH11

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 16, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	nat V. + rem V. ⊕ U - ⊙	Wp	W			Wi
0		GROUND SURFACE		233.55													
		TOPSOIL		0.00	1	DO	12									Casing Silica Sand	
		(ML/CL) CLAYEY SILT to SILTY CLAY, trace gravel, trace to some sand; brown to mottled brown to brownish-grey to grey; cohesive, w>PL to w~PL, stiff to very stiff		233.14 0.41	2	DO	13										
1					3	DO	24										
2					4	DO	17									Hole Plug	
3					5	DO	19										
4	Buggy Mount D-90 8" O/D Hollow Stem Auger				6	DO	23										
5					7	DO	26										
6		(CL) SILTY CLAY and SAND, trace gravel; grey, (TILL); cohesive, w~PL, hard		227.99 5.56	8	DO	50/ 152 mm										
7					9	DO	68										
8		End of Borehole		226.23 7.32													
9		NOTE: 1. Borehole dry upon completion of drilling March 16, 2016. 2. Groundwater measured at a depth of 3.3 m below existing grade on September 23, 2016. 3. Groundwater measured at a depth of 4.4 m below existing grade on December 8, 2016.															
10																	

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH12

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								20		40		60		80			10 ⁻⁶
0		GROUND SURFACE		228.74													
		TOPSOIL		0.00													
		(CL) SILTY CLAY, trace to some sand, trace to some gravel, cobble fragments; greyish-brown, oxidation staining, (TILL); cohesive, w~PL to w>PL, very stiff to hard		228.23	1	DO	6										
1			0.51														
		(CL) SILTY CLAY and SAND, trace to some gravel; greyish-brown, (TILL); cohesive, w~PL, hard		227.04	3A	DO	46										
2			1.70														
			50/127 mm														
			50/127 mm														
3																	
				223.94	6	DO	76										
4				4.80													
5		End of Borehole															
6		NOTE: 1. Groundwater measured at a depth of 2.8 m below existing grade in open borehole upon completion of drilling March 15, 2016.															
7																	
8																	
9																	
10																	

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH13

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 21, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT						
								20		40		60		80			10 ⁻⁶	
0		GROUND SURFACE		228.16														
		TOPSOIL		0.00														
	D-25 RT 4 1/4" O/D Hollow Stem Auger	(CL) sandy CLAY, trace gravel, trace to some sand; brown to greyish-brown, (TILL); cohesive, w~PL to w<PL, stiff to very stiff		227.47	1	DO	8											
1				0.69	2	DO	8									MH		
						226.03												
2				(SM/SP-GW) SILTY SAND to SAND and GRAVEL; greyish-brown, (TILL); non-cohesive, moist to wet, dense		2.13	3	DO	23									
						225.26												
3		(CL) SILTY CLAY and SAND, some gravel; greyish-brown, (TILL); cohesive, w~PL, hard		2.90	4	DO	48											
				224.83	5	DO	50/ 127 mm											
		End of Borehole Refusal on Boulder		3.33														
4		NOTE: 1. Groundwater measured at a depth of 2.1 m below existing grade in open borehole upon completion of drilling March 21, 2016.																
5																		
6																		
7																		
8																		
9																		
10																		

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DEPTH SCALE
1 : 50



LOGGED: CL
CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH14

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 21, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		Q - U -			Wp
0		GROUND SURFACE		220.48													
		Mixed SILTY CLAY and TOPSOIL		0.00	1	DO	7									Casing Silica Sand 8-Dec-2016	
1		(CL) SILTY CLAY, trace sand; mottled brown to greyish-brown to brown, oxidation; cohesive, w>PL to w<PL, stiff to hard		219.79	2	DO	14										
				0.69	3	DO	21									Hole Plug	
2					4	DO	37										
3					5	DO	33									Silica Sand	
4					6	DO	17										
5					7	DO	22										
6																	
7		End of Borehole		213.93													
		NOTES: 1. Groundwater measured at a depth of 1.6 m below existing grade in open borehole upon completion of drilling March 21, 2016. 2. Groundwater measured at a depth of 0.7 m below existing grade September 12, 2016. 3. Grounwater measuted at a depth of 0.2 m below existing grade on December 8, 2016.		6.55													
8																	
9																	
10																	

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DEPTH SCALE
1 : 50



LOGGED: CL
CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH15

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 22, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	nat V. rem V.	+ ⊕	- ⊖			Wp
0		GROUND SURFACE		224.54													
		TOPSOIL		0.00	1A	DO	4										
		(CL) SILTY CLAY and SAND, some gravel; brown to mottled brown-grey, (TILL); cohesive, w-PL, very stiff to hard		224.06	1B												
				0.48													
1						2	DO	25									
2						3	DO	50									
	D-25 RT 4 1/4" O/D Hollow Stem Auger				4	DO	50/127 mm										
3																	
					5	DO	65									MH	
4																	
5					6	DO	82										
		End of Borehole		219.51													
		NOTE: 1. Groundwater measured at a depth of 1.5 m below existing grade in open borehole upon completion of drilling March 22, 2016.		5.03													

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH16

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 21, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20		40		60		80			10 ⁻⁶
0		GROUND SURFACE		231.66													
		TOPSOIL		0.00	1	DO	10									Casing Silica Sand	
		(ML/CL) CLAYEY SILT to SILTY CLAY, trace sand; mottled greyish-brown to grey; cohesive, w>PL to w<PL, stiff to very stiff		230.97 0.69	2	DO	11					○				Hole Plug	
1					3	DO	21					○					
2					4	DO	27					○					
3	D-25 RT 4 1/4" O/D Hollow Stem Auger				5	DO	21					○				Silica Sand	
4					6	DO	20					○				8-Dec-2016	
5					7	DO	21					○				10 Slot PVC Screen	
6				225.11 6.55													
7		End of Borehole															
8		NOTES: 1. Groundwater measured at a depth of 1.5 m below existing grade in open borehole upon completion of drilling March 21, 2016. 2. Groundwater measured at a depth of 2.8 m below existing grade September 12, 2016. 3. Grounwater measured at a depth of 4.0 m below existing grade December 8, 2016.															
9																	
10																	

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 23, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		Q - U		Wp			W
0		GROUND SURFACE		235.02													
		TOPSOIL		0.00	1A	DO	7										
		(CL/ML) SILTY CLAY to CLAYEY SILT, trace sand, trace gravel; mottled brown to grey, oxidation; cohesive, w~PL to w>PL, firm to very stiff		234.51 0.51	1B												
1					2	DO	18										
2		Coarse sand seams at 1.8 and 1.9 mbgs			3	DO	22										
					4	DO	27										
					5	DO	20										
4		(ML) sandy SILT, trace gravel; grey; non-cohesive, wet, very dense		230.98 4.04													
					6	DO	50/102 mm										
5		End of Borehole		230.19 4.83													
		NOTE: 1. Groundwater measured at a depth of 1.1 m below existing grade in open borehole upon completion of drilling March 23, 2016.															

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH18

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 23, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								20 40 60 80		nat V. + Q - rem V. ⊕ U - ⊙		10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³				Wp ----- W ----- WI	
0		GROUND SURFACE		236.95													
		TOPSOIL		0.00													
		(ML) CLAYEY SILT, trace sand, trace gravel; brownish-grey; cohesive, w~PL to w>PL, very stiff		236.52	1A	DO	11										
				0.43	1B												
1					2	DO	23										
2		Coarse sand seam at 1.9 mbgs			3	DO	29										
		(CL) sandy CLAY, trace to some gravel; mottled brown to grey, (TILL); cohesive, w~PL, hard		234.75	4	DO	80										
				2.20													
3					5	DO	80										
4					6	DO	54										
		End of Borehole on Refusal		232.68													
				4.27													
5		NOTES: 1. Groundwater measured at a depth of 0.9 m below existing grade in open borehole upon completion of drilling March 23, 2016. 2. Groundwater measured at a depth of 1.7 m below existing grade September 12, 2016. 3. Groundwater measured at a depth of 1.3 m below existing grade on December 8, 2016.															
6																	
7																	
8																	
9																	
10																	

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH19

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 23, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		-			Wp
0		GROUND SURFACE		241.21													
		TOPSOIL		0.00	1A												
		(CL) sandy SILTY CLAY, trace to some gravel; mottled brown grey to greyish brown, (TILL); cohesive, w<PL to w>PL, firm to very stiff		240.93	1B	DO	6										
1				0.28													
						2	DO	22									
						3	DO	21									
2																	
	D-25 RT 4" O.D. Solid Stem Auger	(SM) SILTY SAND, trace to some gravel; greyish brown, (TILL); non-cohesive, moist, very dense		239.08													
				2.13		4	DO	72									
3						5	DO	93/ 279 mm									
4																	
5		End of Borehole		236.51	6	DO	50/ 127 mm										
5		NOTE: 1. Groundwater measured at a depth of 1.6 m below existing grade in open borehole upon completion of drilling March 23, 2016.		4.70													

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH2

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 14, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	nat V. +	rem V. ⊕	Q -			U -
0	Truck Mount CME 55 8" O/D Hollow Stem Auger	GROUND SURFACE		245.66													
		TOPSOIL		0.00													
		FILL-(CL) SILTY CLAY, trace sand, trace to some gravel; brown; cohesive, w-PL, firm		0.15	1	DO	5										Casing Silica Sand Metals, inorganics
1		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w-PL, very stiff to hard		0.51													
					2	DO	28										Hole Plug
					3	DO	35										
2					4	DO	75										
					5	DO	90										
3					6	DO	95/279 mm										
				7	DO	50/51 mm											
4				8	DO	50/102 mm											
5		End of Borehole		240.22													
6		NOTE: 1. Groundwater measured at a depth of 3.2 m below existing grade in open borehole upon completion of drilling March 14, 2016. 2. Groundwater measured at a depth of 3.4 m below existing grade in monitoring well on December 8, 2016.		5.44													
7																	
8																	
9																	
10																	

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH3

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 11, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								20 40 60 80		nat V. + Q - rem V. ⊕ U - ⊙		10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³		Wp ----- W ----- Wi			
0	Buggy Mount D-90 8" O/D Hollow Stem Auger	GROUND SURFACE		245.36													
		FILL-(SW/GP) SAND and GRAVEL, some silt, asphalt fragments; brown; non-cohesive, moist, compact		0.00	1A										Metals, inorganic	Casing Silica Sand	
		FILL-(CL) SILTY CLAY, some sand, some gravel; brown; cohesive, w>PL, stiff		0.08	1B	DO	14										
1		(CL) SILTY CLAY and SAND, some gravel; brown to greyish-brown, (TILL); cohesive, w-PL, very stiff to hard		244.95													
				0.41													
					2	DO	49								VOC, PHC	Hole Plug	
2					3	DO	67									Silica Sand	
3				4	DO	81											
4				5	DO	67											
5				6	DO	80/ 229 mm											
6				7	DO	95/ 279 mm											
6				8	DO	75											
6		End of Borehole		239.44													
				5.92													
7		NOTES: 1. Groundwater measured at a depth of 2.8 m below existing grade in open borehole upon completion of drilling March 14, 2016. 2. Groundwater measured at a depth of 3.3 m below existing grade September 12, 2016. 3. Groundwater measured at a depth of 3.4 m below existing grade December 8, 2016.															
8																	
9																	
10																	

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH4

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 14, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	nat V. rem V.	+ ⊕	- ⊖			Q U
0	Truck Mount CME 55 8" O/D Hollow Stem Auger	GROUND SURFACE		245.21 0.00													
		FILL-(ML) CLAYEY SILT, some sand, some gravel; brown; cohesive, w>PL, stiff			1	DO	10										Casing Silica Sand Metals, inorganics
1		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w~PL, hard		244.52 0.69													Hole Plug
					2	DO	30										
					3	DO	34										Silica Sand
					4	DO	47										VOC, PHC
					5	DO	49										
					6	DO	50/25 mm										10 Slot PVC Screen
5				7	DO	91										VOC, PHC	
6		End of Borehole		239.57 5.64													
		NOTE: 1. Groundwater measured at a depth of 4.4 m below existing grade in open borehole upon completion of drilling March 14, 2016. 2. Monitoring well unable to be located due to golf course landscaping.															

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH5

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		Q - U -			Wp
0		GROUND SURFACE		248.16													
		TOPSOIL		0.00	1	DO	3									Casing Silica Sand	
		FILL-(ML) CLAYEY SILT and SAND; light brown; cohesive, w<PL to w>PL, firm		247.65 0.51	2	DO	6									Hole Plug	
		(CL) SILTY CLAY and SAND, some gravel; greyish-brown, (TILL); cohesive, w~PL to w>PL, hard		246.03 2.13	3	DO	6									MH	
		Coarse sand seam at 2.6 mbgs			4	DO	46									Silica Sand	
					5	DO	56									MH	
					6	DO	53									10 Slot PVC Screen	
					7	DO	50/76 mm										
		End of Borehole		241.84 6.32													
7		NOTES: 1. Groundwater measured at a depth of 3.4 m below existing grade in open borehole upon completion of drilling March 15, 2016. 2. Groundwater measured at a depth of 2.9 m below existing grade September 12, 2016. 3. Groundwater measured at a depth of 3.2 m below existing grade December 8, 2016.															

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DEPTH SCALE
 1 : 50



LOGGED: CL
 CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH6

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		Q - U		Wp			Wi
0		GROUND SURFACE		242.51													
		TOPSOIL		0.00													
		(CL) SILTY CLAY, trace sand; brown to mottled light brown; cohesive, w<PL to w~PL, stiff to very stiff		0.51	1	DO	4										
1					2	DO	12									MH	
					3	DO	21										
2		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown to grey, (TILL); cohesive, w~PL, hard		2.13	4	DO	49										
	Buggy Mount D-90 4" O.D. Solid Stem Auger			2.13	5	DO	75/ 279 mm										
3																	
4					6	DO	42										
					7	DO	36										
5		End of Borehole		5.03													
6		NOTE: 1. Groundwater measured at a depth of 4.7 m below existing grade in open borehole upon completion of drilling March 15, 2016.															
7																	
8																	
9																	
10																	

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DEPTH SCALE
1 : 50



LOGGED: CL
CHECKED: NL

PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH7

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		-			Wp
0		GROUND SURFACE		241.08													
		TOPSOIL		0.00													
		FILL-(ML) CLAYEY SILT, trace sand; light brown; cohesive, w>PL, stiff		240.62	1	DO	8										
1						2	DO	11									
					238.95	3	DO	11									
2		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w~PL, hard		2.13	4	DO	40										
3						5	DO	50/127 mm									
					236.05	6	DO	32									
5		End of Borehole		5.03													
6		NOTE: 1. Groundwater measured at a depth of 4.2 m below existing grade in open borehole upon completion of drilling March 15, 2016.															

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH8

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 10, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa		WATER CONTENT PERCENT		WATER CONTENT PERCENT			
								20	40	60	80	10 ⁻⁶	10 ⁻⁵		
0		GROUND SURFACE		236.62											
		FILL-(CL) SILTY CLAY, trace sand, mixed organics; brown to light brown; cohesive, w<PL, firm to stiff		0.00	1	DO	7								Casing
		(CL) sandy CLAY, trace to some gravel; mottled brown to brown to brownish-grey to grey, (TILL); cohesive, w>PL to w~PL, stiff to hard		235.93	2	DO	10								Hole Plug
1				0.69											Silica Sand
	Buggy Mount D-90 8" OD Hollow Stem Auger				3	DO	20								
2					4	DO	64/254 mm								
					5	DO	88							MH, BTEX, PHC	10 Slot PVC Screen
3															
4		End of Borehole		232.51	6	DO	50/152 mm							BTEX, PHC	
		NOTES: 1. Groundwater measured at a depth of 2.2 m below existing grade in open borehole upon completion of drilling March 10, 2016. 2. Groundwater measured at a depth of 1.5 m below existing grade September 12, 2016. 3. Monitoring well unable to be accessed due to damaged well cover.		4.11											

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PROJECT: 1543120
 LOCATION: See Figure 2

RECORD OF BOREHOLE: BH9

SHEET 1 OF 1
 DATUM: Geodetic

BORING DATE: March 11, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa		WATER CONTENT PERCENT				
								20	40	60			80	nat V. + rem V. ⊕ U - ⊙
0	Buggy Mount D-90 8" O/D Hollow Stem Auger	GROUND SURFACE		236.24										
		FILL-(SP/GP) SAND and GRAVEL, some silt; grey; non-cohesive, moist, compact		0.00	1A	DO	12						Casing	
		(CL) SILTY CLAY, trace sand; brown; cohesive, w>PL, stiff to very stiff to hard		0.51	1B								BTEX, PHC, pH	
1					2	DO	14						Hole Plug	
					3	DO	21						MH	
2					4	DO	37						BTEX, PHC, pH	
					5	DO	35						Silica Sand	
3			(CL) SILTY CLAY and SAND, trace to some gravel; greyish-brown to grey, (TILL); cohesive, w>PL, very stiff to hard		2.98									
					6	DO	60							10 Slot PVC Screen
4					7	DO	28						MH	
5				8	DO	46								
6				9	DO	29								
7		End of Borehole		6.55										
8		NOTE: 1. Groundwater measured at a depth of 4.9 m below existing grade in open borehole upon completion of drilling March 11, 2016. 2. Monitoring well unable to be located due to golf course landscaping.												
9														
10														

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DEPTH SCALE
1 : 50



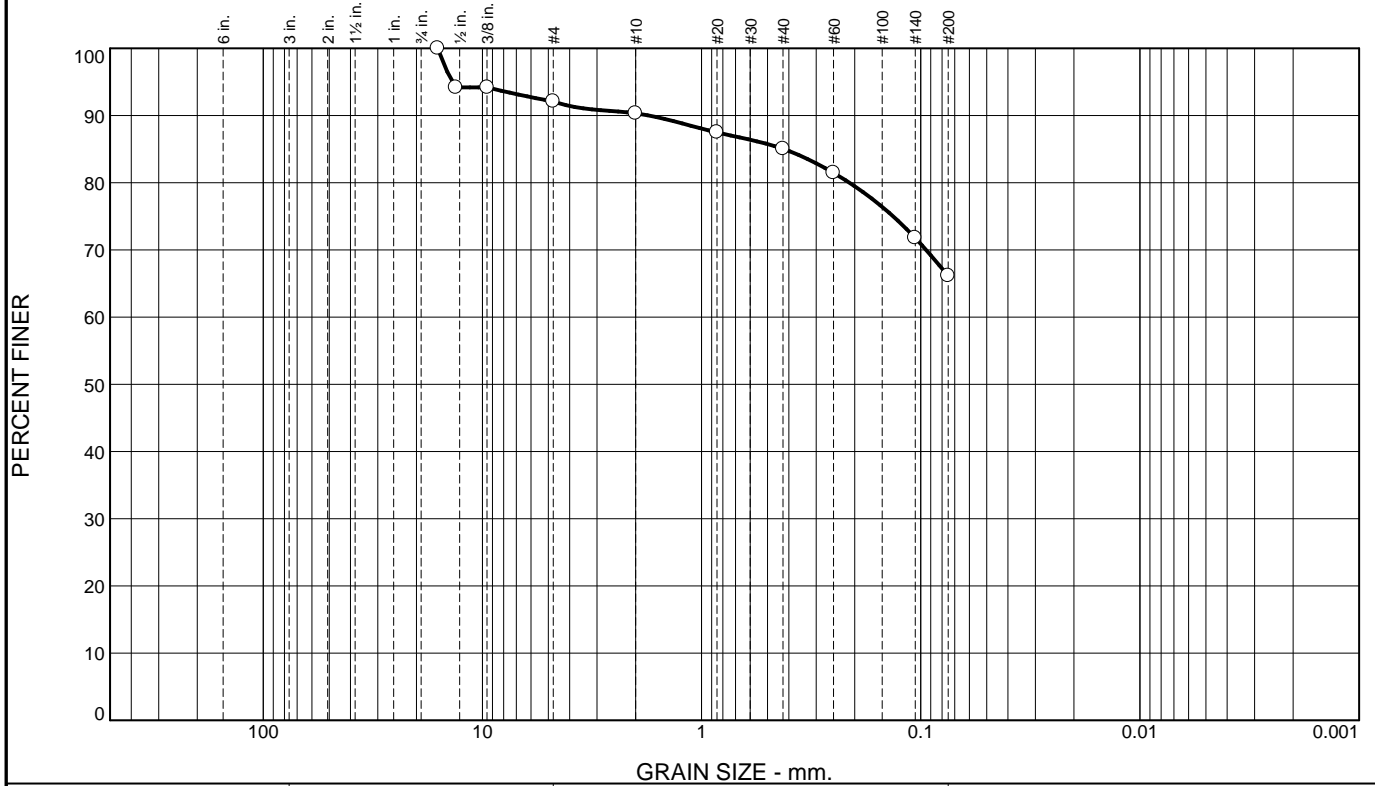
LOGGED: CL
CHECKED: NL

APPENDIX

B

GEOTECHNICAL LABORATORY TEST RESULTS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.9	1.8	5.3	18.8	66.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	94.2		
9.5mm	94.2		
4.75mm	92.1		
2mm	90.3		
0.850mm	87.5		
0.425mm	85.0		
0.250mm	81.5		
0.106mm	71.8		
0.075mm	66.2		

Soil Description

PL= **Atterberg Limits** PI=

 LL=

D₉₀= 1.7490 **Coefficients** D₆₀=

D₅₀= D₈₅= 0.4224 D₁₅=

D₁₀= C_u= C_c=


USCS= **Classification** AASHTO=

Remarks

* (no specification provided)

Location: BH22-4 SS6
Sample Number: R1844

Date: 11/04/22

	<p>Client: Bradford Highlands Joint Venture</p> <p>Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON</p> <p>Project No: 221-02423-00</p>
	Figure

Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.3	1.5	6.1	66.3	19.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	94.8		
9.5mm	94.8		
4.75mm	93.7		
2mm	92.2		
0.850mm	90.3		
0.425mm	86.1		
0.250mm	70.5		
0.106mm	32.3		
0.075mm	19.8		

Soil Description

PL= **Atterberg Limits** PI=

LL=

Coefficients

D₉₀= 0.6904 D₈₅= 0.4008 D₆₀= 0.1959

D₅₀= 0.1579 D₃₀= 0.0998 D₁₅=

D₁₀= C_u= C_c=

USCS= **Classification** AASHTO=

Remarks

* (no specification provided)

Location: BH22-5 SS3
Sample Number: R1844

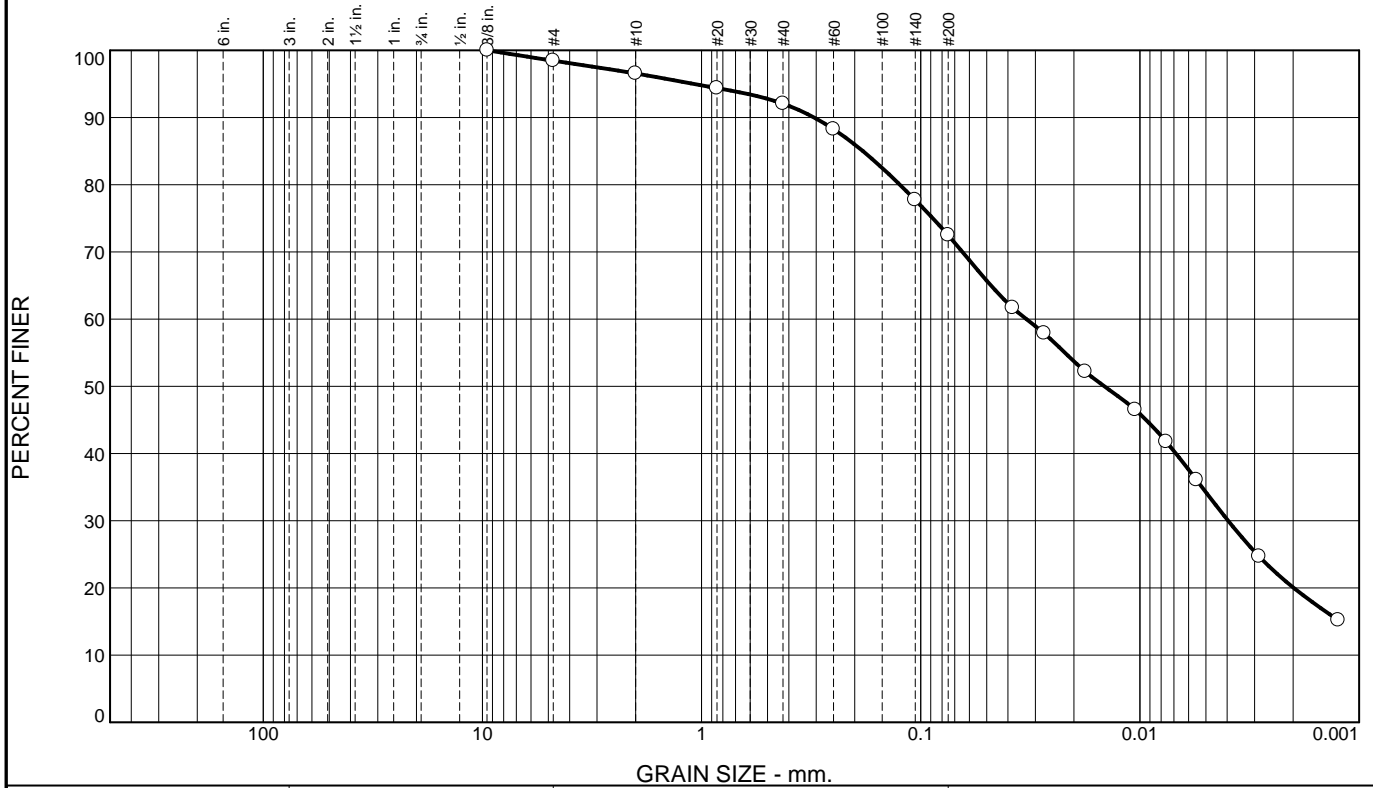
Date: 11/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON
Project No: 221-02423-00 **Figure**

Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	1.9	4.5	19.5	38.3	34.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.5mm	100.0		
4.75mm	98.4		
2mm	96.5		
0.850mm	94.4		
0.425mm	92.0		
0.250mm	88.3		
0.106mm	77.7		
0.075mm	72.5		
0.0380 mm.	61.7		
0.0274 mm.	57.9		
0.0178 mm.	52.2		
0.0105 mm.	46.5		
0.0076 mm.	41.8		
0.0055 mm.	36.1		
0.0029 mm.	24.7		
0.0012 mm.	15.2		

* (no specification provided)

Soil Description

PL= 12 **Atterberg Limits** LL= 20 PI= 8

Coefficients

D₉₀= 0.3069 D₈₅= 0.1838 D₆₀= 0.0330
D₅₀= 0.0145 D₃₀= 0.0040 D₁₅=
D₁₀= C_u= C_c=

USCS= CL **Classification** AASHTO= A-4(3)

Remarks

Location: BH22-2 SS4
Sample Number: R1844

Date: 12/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON
Project No: 221-02423-00 **Figure**

Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.8	1.5	3.9	21.6	34.5	34.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	98.4		
9.5mm	97.5		
4.75mm	96.2		
2mm	94.7		
0.850mm	93.1		
0.425mm	90.8		
0.250mm	86.7		
0.106mm	75.0		
0.075mm	69.2		
0.0382 mm.	60.5		
0.0275 mm.	56.8		
0.0178 mm.	52.1		
0.0105 mm.	46.5		
0.0076 mm.	41.9		
0.0055 mm.	36.3		
0.0028 mm.	27.0		
0.0012 mm.	15.8		

Soil Description

Atterberg Limits
 PL= 11 LL= 18 PI= 7

Coefficients
 D₉₀= 0.3719 D₈₅= 0.2131 D₆₀= 0.0366
 D₅₀= 0.0144 D₃₀= 0.0036 D₁₅=
 D₁₀= C_u= C_c=


Classification
 USCS= CL-ML AASHTO= A-4(1)

Remarks

* (no specification provided)

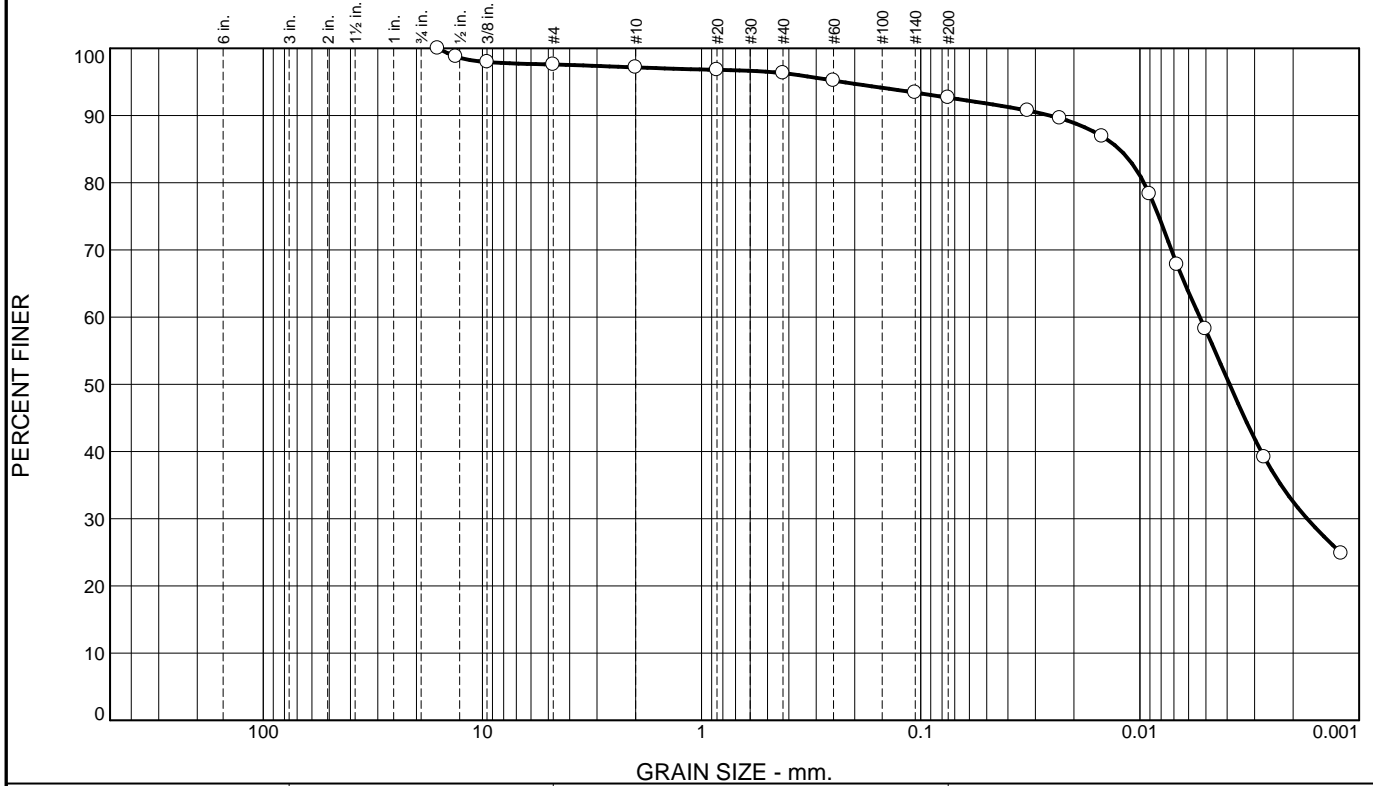
Location: BH22-3 SS8
Sample Number: R1844

Date: 12/04/22

	<p>Client: Bradford Highlands Joint Venture Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON</p> <p>Project No: 221-02423-00 Figure</p>
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Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	0.4	0.9	3.7	34.6	58.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	98.8		
9.5mm	98.0		
4.75mm	97.6		
2mm	97.2		
0.850mm	96.8		
0.425mm	96.3		
0.250mm	95.2		
0.106mm	93.4		
0.075mm	92.6		
0.0325 mm.	90.7		
0.0232 mm.	89.6		
0.0149 mm.	86.9		
0.0090 mm.	78.3		
0.0068 mm.	67.8		
0.0050 mm.	58.3		
0.0027 mm.	39.2		
0.0012 mm.	24.8		

Soil Description

Atterberg Limits
 PL= 16 LL= 26 PI= 10

Coefficients
 D₉₀= 0.0258 D₈₅= 0.0124 D₆₀= 0.0053
 D₅₀= 0.0039 D₃₀= 0.0017 D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= CL AASHTO= A-4(8)

Remarks

* (no specification provided)

Location: BH22-5 SS5
Sample Number: R1844

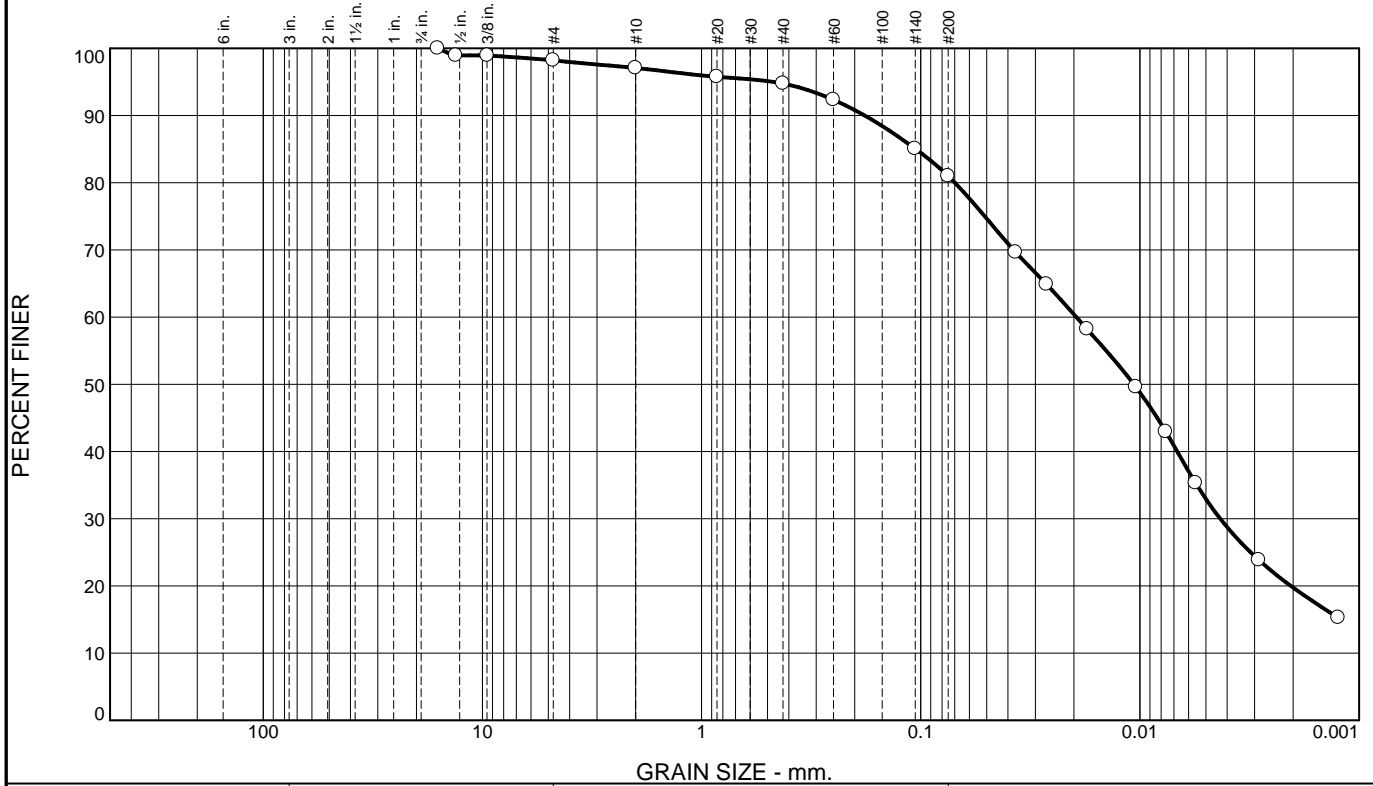
Date: 12/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON
Project No: 221-02423-00 **Figure**

Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	1.1	2.4	13.7	48.1	32.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	98.9		
9.5mm	98.9		
4.75mm	98.2		
2mm	97.1		
0.850mm	95.8		
0.425mm	94.7		
0.250mm	92.3		
0.106mm	85.1		
0.075mm	81.0		
0.0369 mm.	69.6		
0.0267 mm.	64.9		
0.0174 mm.	58.2		
0.0104 mm.	49.6		
0.0076 mm.	42.9		
0.0056 mm.	35.3		
0.0029 mm.	23.9		
0.0012 mm.	15.3		

Soil Description

Atterberg Limits
 PL= 12 LL= 19 PI= 7

Coefficients
 D₉₀= 0.1804 D₈₅= 0.1055 D₆₀= 0.0195
 D₅₀= 0.0107 D₃₀= 0.0043 D₁₅=
 D₁₀= C_u= C_c=


Classification
 USCS= CL-ML AASHTO= A-4(2)

Remarks

* (no specification provided)

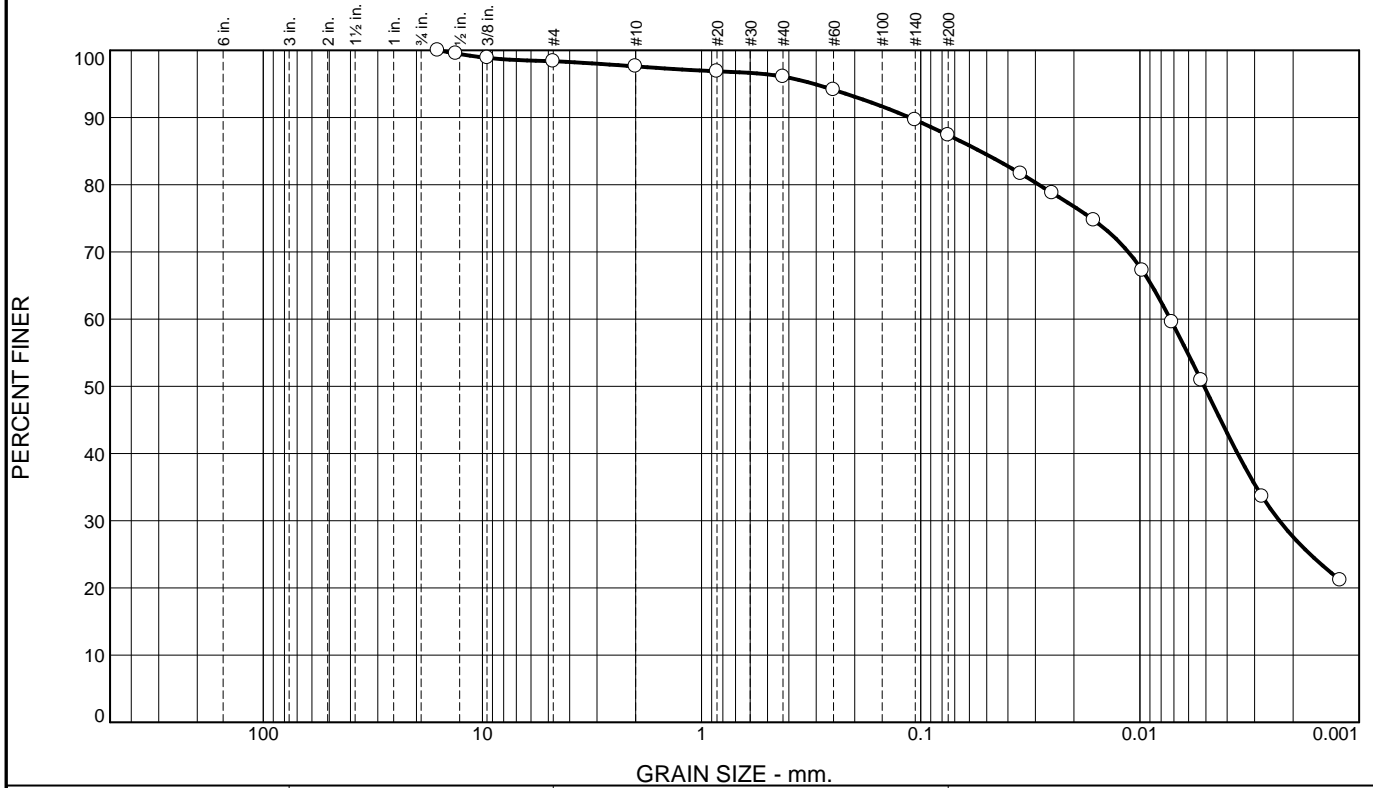
Location: BH22-6 SS8
Sample Number: R1844

Date: 12/04/22

	<p>Client: Bradford Highlands Joint Venture Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON</p> <p>Project No: 221-02423-00 Figure</p>
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Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	0.8	1.5	8.7	37.9	49.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	99.5		
9.5mm	98.9		
4.75mm	98.4		
2mm	97.6		
0.850mm	96.9		
0.425mm	96.1		
0.250mm	94.1		
0.106mm	89.6		
0.075mm	87.4		
0.0350 mm.	81.6		
0.0251 mm.	78.8		
0.0162 mm.	74.7		
0.0097 mm.	67.2		
0.0071 mm.	59.6		
0.0053 mm.	50.9		
0.0028 mm.	33.6		
0.0012 mm.	21.1		

Soil Description

Atterberg Limits
 PL= 16 LL= 26 PI= 10

Coefficients
 D₉₀= 0.1126 D₈₅= 0.0536 D₆₀= 0.0073
 D₅₀= 0.0051 D₃₀= 0.0023 D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= CL AASHTO= A-4(7)

Remarks

* (no specification provided)

Location: BH22-8 SS4
Sample Number: R1844

Date: 12/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON

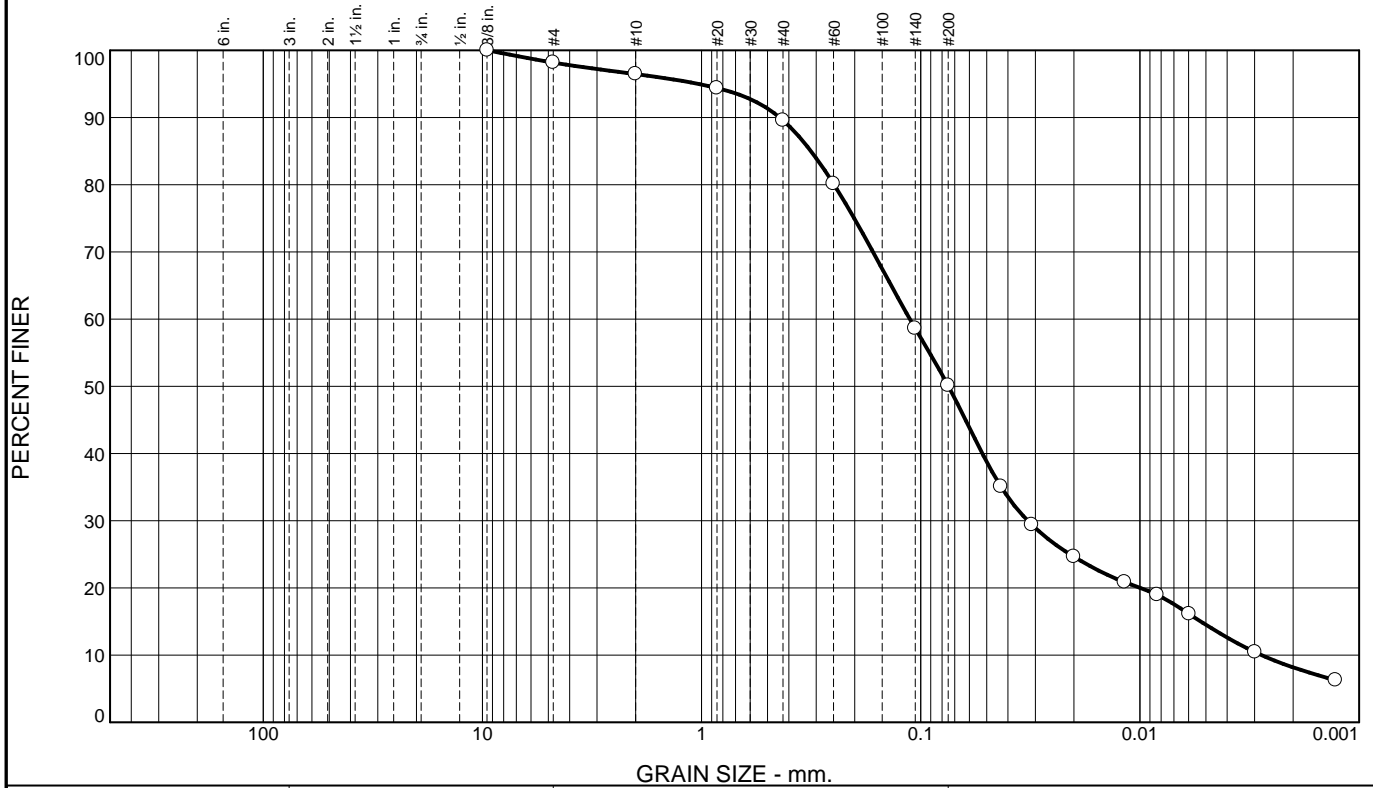
Project No: 221-02423-00

Figure

Tested By: MN

Checked By: MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	1.7	6.9	39.5	35.6	14.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.5mm	100.0		
4.75mm	98.2		
2mm	96.5		
0.850mm	94.4		
0.425mm	89.6		
0.250mm	80.1		
0.106mm	58.6		
0.075mm	50.1		
0.0431 mm.	35.1		
0.0311 mm.	29.4		
0.0200 mm.	24.6		
0.0117 mm.	20.9		
0.0083 mm.	19.0		
0.0060 mm.	16.1		
0.0030 mm.	10.4		
0.0013 mm.	6.3		

* (no specification provided)

Soil Description

PL= NP **Atterberg Limits** LL= NP PI= NP

Coefficients

D₉₀= 0.4404 D₈₅= 0.3171 D₆₀= 0.1122
D₅₀= 0.0747 D₃₀= 0.0325 D₁₅= 0.0053
D₁₀= 0.0028 C_u= 40.17 C_c= 3.37

USCS= ML **Classification** AASHTO= A-4(0)

Remarks

Location: BH22-12 SS4
Sample Number: R1844

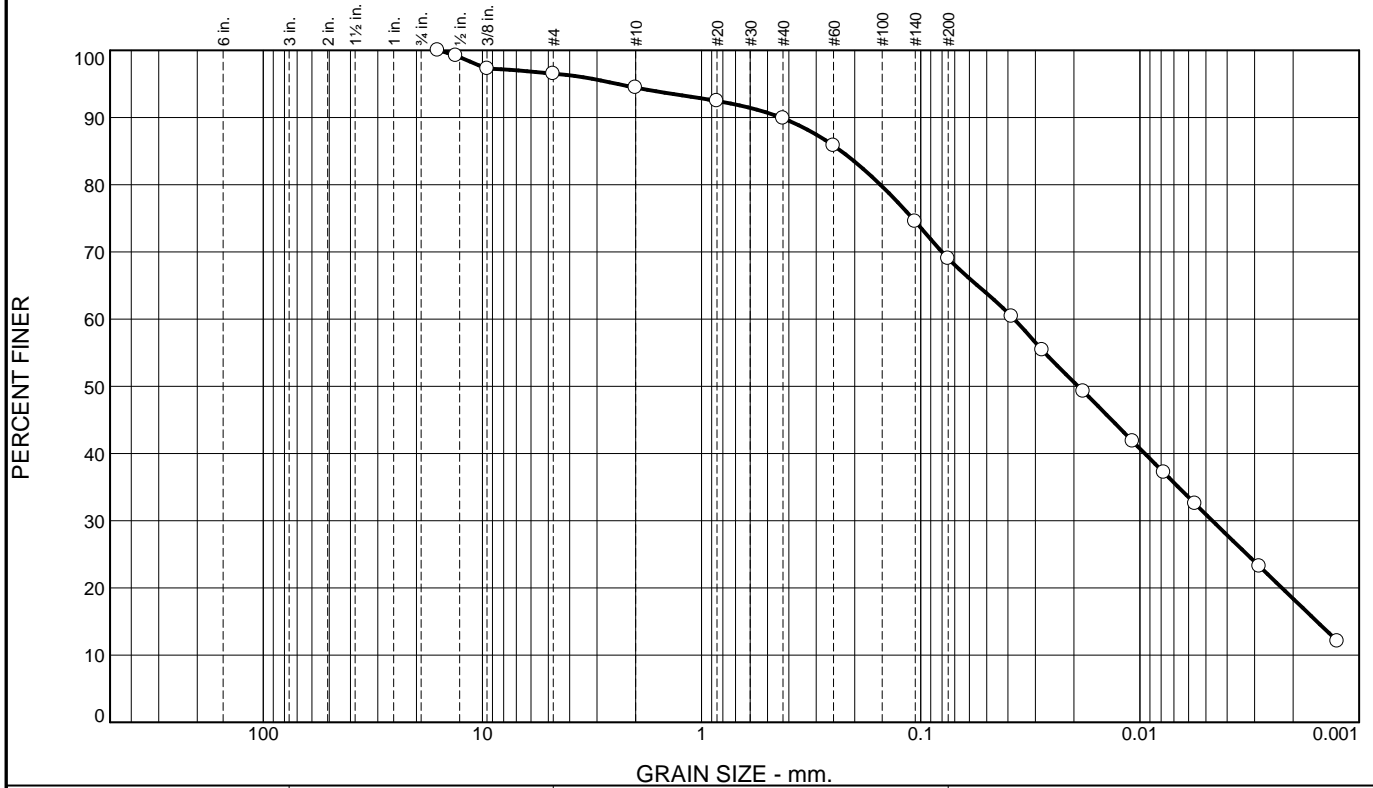
Date: 13/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON
Project No: 221-02423-00 **Figure**

Tested By: NM **Checked By:** MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.5	2.1	4.5	20.9	38.1	30.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	99.2		
9.5mm	97.3		
4.75mm	96.5		
2mm	94.4		
0.850mm	92.5		
0.425mm	89.9		
0.250mm	85.8		
0.106mm	74.5		
0.075mm	69.0		
0.0385 mm.	60.4		
0.0279 mm.	55.4		
0.0181 mm.	49.2		
0.0108 mm.	41.8		
0.0078 mm.	37.2		
0.0056 mm.	32.5		
0.0029 mm.	23.2		
0.0013 mm.	12.1		

Soil Description

Atterberg Limits
 PL= 13 LL= 20 PI= 7

Coefficients
 D₉₀= 0.4352 D₈₅= 0.2309 D₆₀= 0.0375
 D₅₀= 0.0191 D₃₀= 0.0047 D₁₅= 0.0016
 D₁₀= C_u= C_c=

Classification
 USCS= CL-ML AASHTO= A-4(2)

Remarks

* (no specification provided)

Location: BH22-13 SS3
Sample Number: R1844

Date: 13/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON

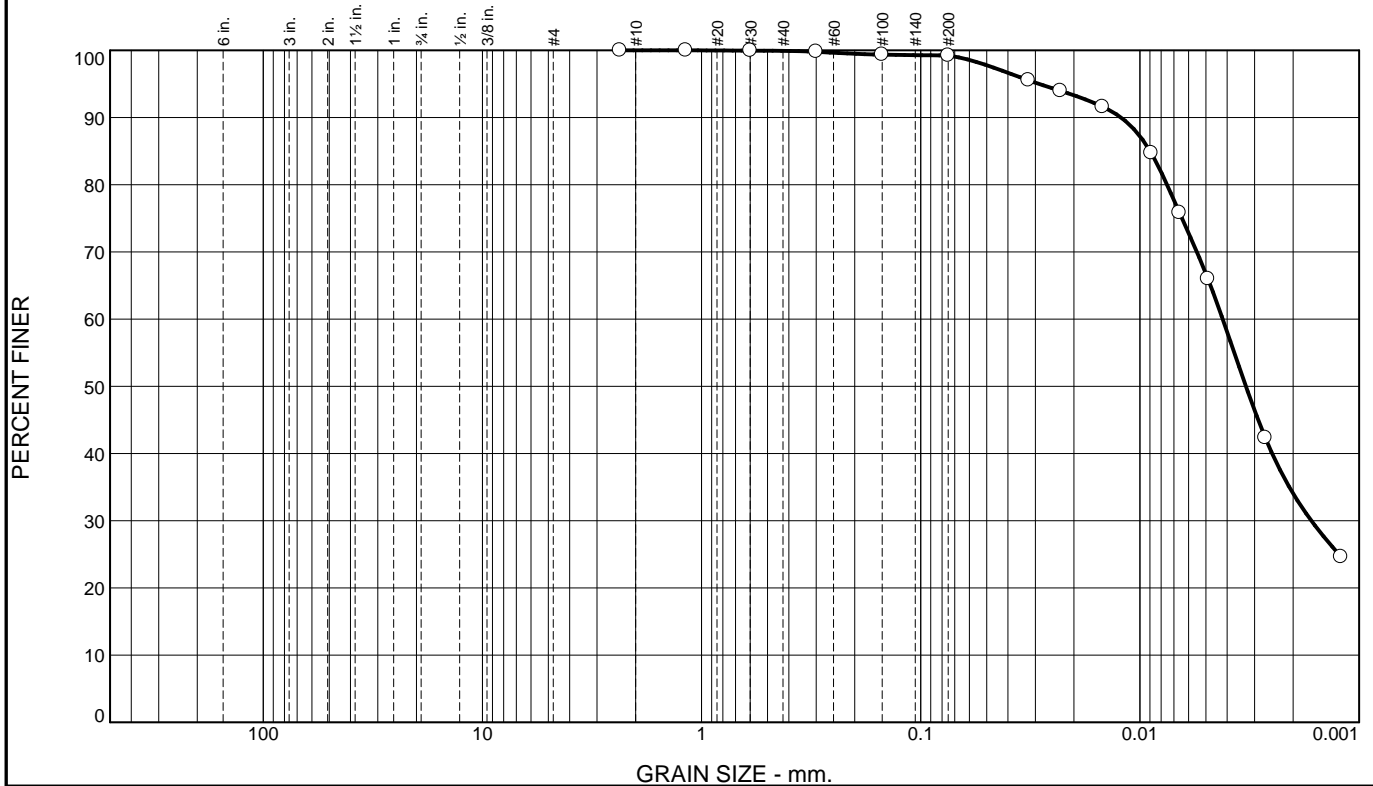
Project No: 221-02423-00

Figure

Tested By: NM

Checked By: MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	0.7	32.5	66.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.36mm	100.0		
1.18mm	100.0		
0.600mm	99.9		
0.300mm	99.8		
0.150mm	99.3		
0.075mm	99.2		
0.0323 mm.	95.5		
0.0230 mm.	94.0		
0.0148 mm.	91.6		
0.0089 mm.	84.7		
0.0066 mm.	75.8		
0.0049 mm.	66.0		
0.0027 mm.	42.3		
0.0012 mm.	24.6		

Soil Description

PL= 18 **Atterberg Limits** LL= 30 PI= 12

Coefficients

D₉₀= 0.0122 D₈₅= 0.0090 D₆₀= 0.0042
D₅₀= 0.0033 D₃₀= 0.0017 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(11)

Remarks

* (no specification provided)

Location: BH22-17 SS3
Sample Number: R1844

Date: 13/04/22



Client: Bradford Highlands Joint Venture
Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON

Project No: 221-02423-00

Figure

Tested By: NM

Checked By: MD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.9	1.8	5.8	34.5	34.9	20.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.2mm	100.0		
9.5mm	99.7		
4.75mm	97.1		
2mm	95.3		
0.850mm	93.2		
0.425mm	89.5		
0.250mm	82.7		
0.106mm	63.5		
0.075mm	55.0		
0.0418 mm.	42.1		
0.0302 mm.	36.5		
0.0195 mm.	31.8		
0.014 mm.	27.2		
0.0082 mm.	24.4		
0.0059 mm.	21.5		
0.0029 mm.	15.0		
0.0013 mm.	8.8		

Soil Description

Atterberg Limits
 PL= 12 LL= 16 PI= 4

Coefficients
 D₉₀= 0.4520 D₈₅= 0.2889 D₆₀= 0.0920
 D₅₀= 0.0606 D₃₀= 0.0158 D₁₅= 0.0029
 D₁₀= 0.0015 C_u= 60.57 C_c= 1.79


Classification
 USCS= CL-ML AASHTO= A-4(0)

Remarks

* (no specification provided)

Location: BH22-18 SS5
Sample Number: R1844

Date: 13/04/22

	<p>Client: Bradford Highlands Joint Venture Project: 221-02423-00 - 23 Brownlee Drive, Bradford, ON</p> <p>Project No: 221-02423-00 Figure</p>
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Tested By: NM **Checked By:** MD

APPENDIX

C

ENGINEERED FILL



GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

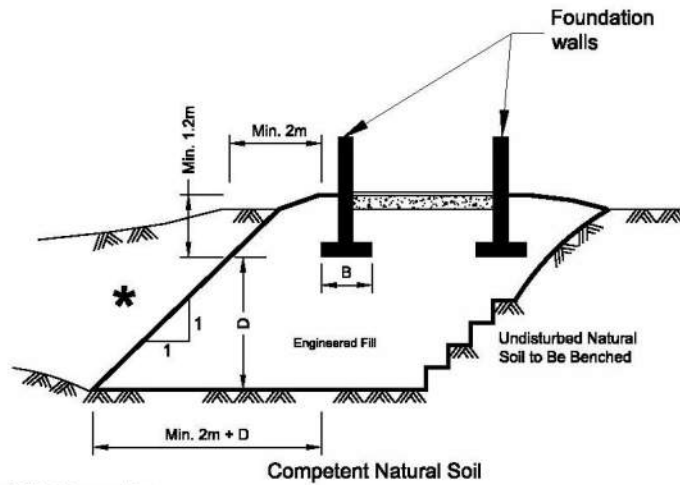
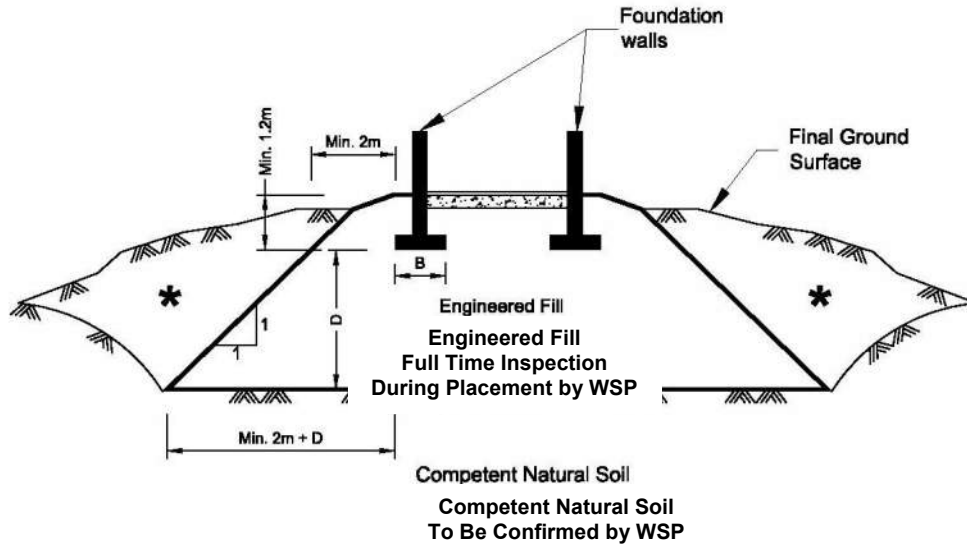
To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.
2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.
3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and WSP Canada Inc. Without this confirmation no responsibility for the performance of the structure can be accepted by WSP Canada Inc. Survey drawing of the pre and post fill location and elevations will also be required.
4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a WSP Canada Inc. engineer prior to placement of fill.



5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.
6. Full-time geotechnical inspection by WSP Canada Inc. during placement of engineered fill is required. Work cannot commence or continue without the presence of the WSP Canada Inc. representative.
7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.
8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.
9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from WSP Canada Inc. prior to footing concrete placements. All excavations must be backfilled under full time supervision by WSP Canada Inc. to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of WSP Canada Inc.
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.
12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.
13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with WSP Canada Inc. report attached.



* Backfill in this area to be as per WSP report.