



## **FINAL REPORT**

### **FOUNDATION INVESTIGATION REPORT**

**Highway 11 Structural Culvert at Highway 117 Interchange (Site No. 42-194),  
Bracebridge, Ontario**  
*(Latitude 45.084724; Longitude -79.297552)*

**Agreement No. 9016-E-0009  
Assignment No. 1  
W.O. 2017-11021  
MTO GEOCRES No. 31E-383**

**Prepared for:**

**Ontario Ministry of Transportation**  
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**exp Services Inc.**  
October 18, 2018

# Ontario Ministry of Transportation

## Pavement and Foundation Section

### Foundation Investigation Report

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Foundation Investigation and Design Report for Highway 11 Structural Culvert at Highway 117 Interchange (Site No. 42-194), Bracebridge, Ontario  
(Latitude 45.084724; Longitude -79.297552)

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# 1 FOUNDATION INVESTIGATION REPORT

## 1.1 Introduction

This foundation investigation report presents the results of a geotechnical investigation completed by **exp** Services Inc. (**exp**) for a new and existing culverts, as part of rehabilitation of Highway 11 Structural Culvert at Highway 117 Interchange, Site No. 42-194 (*Latitude 45.084724; Longitude -79.297552*), located in Bracebridge, Ontario. The work was undertaken under Agreement # 9016-E-0009, Assignment No. 1, GWP 5158-12-00. The terms of reference (TOR) were as presented in the MTO email dated July 7, 2017.

Based on email/ TOR, it is understood that the original scope of work included replacement of the existing Structural Culvert, with a new culvert, either on the existing alignment or new alignment by using trenchless methods. Since the concern was expressed that Highway 11 embankments consist of rockfill, the preliminary investigation was conducted at the current culvert alignment and at the initially propose new alignment (18 m north of the culvert) in the spring 2017 by Golder Associates (Golder). to identify if rockfill was present at the site. The results of that investigation were presented in the technical memorandum dated April 12, 2017. Later, the prime consultant, Morrison Hershfield (MH), together with the MTO design team has revised the scope of work suggesting the lining of the existing culvert. However, by lining the existing culvert, the channel size will be reduced, and the invert elevation will be at a higher elevation due to the liner. As a result, an additional culvert is proposed to accommodate for the flow and fisheries. It is also noted that some discontinuities were identified in the base slab of the existing culvert at the two locations (i.e. approximately 5 m east of the culvert outlet and approximately 44 m west of the culvert inlet).

It is understood that the new culvert with a 1.95 m diameter and approximate length of 76 m is proposed to be installed approximately 6.4 m south of the centreline of the existing culvert. It is further understood that the new culvert invert elevation will be at the same elevation or below the existing culvert invert elevations, at approximately Elev. 272.59 m at the inlet and Elev. 272.46 m at the outlet.

The purposes of the current investigation are: (i) to determine the subsurface conditions along the proposed alignment to permit detailed design for installation of an overflow culvert, and (ii) an assessment of subsurface conditions at two areas of suspected base failure at the existing culvert to provide detailed recommendations with clear alternatives to rectify problems. The site specific geotechnical investigation consisted of borings of vertical and horizontal boreholes, soil sampling, borehole logging, and field and laboratory testing.

The foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of the investigation and the laboratory testing completed for this project.

## 1.2 Site Description and Geological Setting

### 1.2.1 Site Description

The existing approximately 3 m wide cast-in place concrete box culvert is located on Highway 11 (STA. 16+312), approximately 200 m south of the Highway 117 overpass in Bracebridge. The culvert was originally constructed in the 1960s, but then extended in 1973 as part of the highway widening, resulting in a total length of approximately 76 m. Highway 11 at the site location is a four-lane divided highway with paved shoulders and a posted speed limit of 100 km/hr. The highway embankment above the creek bed is about 9.5 m high with side slopes of about 2.3H:1V to 2H:1V on east and west side, respectively. The site key plan is shown on Drawing 1 in Appendix B. Photographs of the site and existing culvert are presented in Appendix A.

During the site investigation, the general site conditions were assessed. At the site location, Highway 11 runs in a generally north-south direction and the creek flows from east to west direction crossing Highway 11 and Highway 11/117 IC (N-E/W and S-E/W) ramps. The creek crossing starts from east of Highway 11/117 IC and crosses Highway 11/117 IC N-E/W ramp via the SPCSP culvert discharging on the east side of Highway 11 at the inlet of structural box culvert, which further crosses Highway 11 and discharges west of Highway 11 (see Photo 10 in Appendix A). The creek further crosses Highway 11/117 IC S-E/W ramp via a twin concrete box culvert and ultimately it flows towards High Fall. The top of Highway 11 surface elevation at the existing culvert location is about 282 m. At the time of investigation, the water level at the inlet and outlet of the existing culvert was approximately at Elevations 272.7 m and 272.6 m, respectively.

The vicinity of inlet and outlet of the culvert is heavily vegetated with trees (Photos 5, 6 and 7 in Appendix A). Some fallen trees were observed on the outlet side (Photo 7 in Appendix A). The road surface of Highway 11 was generally in good shape with a few cracks along the existing culvert alignment (Photos 1 to 4 in Appendix A). The slopes of the embankment were covered with grass and trees (Photos 5 and 6 in Appendix A). Bedrock outcrops were observed in the vicinity of proposed site, adjacent to Highway 11/117 IC E/W-S ramp on west side of the culvert outlet. The immediate surrounding of proposed culvert site is cleared for utilities. Some street light poles were observed on shoulder of the Highway 11 at about 110 m south and north of the existing culvert location.

### 1.2.2 Geological Setting

In accordance with the Ministry of Northern Development and Mines Map 2556, Quaternary Geology of Ontario, Southern Sheet, the site is generally consisting of glaciofluvial outwash deposits of gravel and sand including proglacial river and deltaic deposits.

In accordance with the Ministry of Northern Development and Mines Map 2544, Bedrock Geology of Ontario, Southern Sheet, the bedrock at the site consists of migmatitic rocks and gneisses of undetermined protolith: commonly layered biotite gneisses and migmatites; locally includes quartzofeldspathic gneisses, orthogneisses, paragneisses.

## 1.3 Investigation Procedures

### 1.3.1 Site Investigation and Field Testing

The field investigation was performed between August 29, 2017 and September 7, 2017. The field program consisted of drilling nine (9) vertical boreholes (BH-1 to BH-9) and one horizontal borehole (HP-1). Boreholes BH-1 to BH-8 were sampled using the Standard Penetration Test method (SPT), accordance with ASTM D1586. Vertical Borehole BH-9 and horizontal borehole HP-1 were non-sampled boreholes. The locations of these nine vertical boreholes and one horizontal borehole are shown on Drawing 1 in Appendix B.

Five (5) vertical boreholes (BH-1, BH-2, BH-3, BH-4 and BH-5) were strategically located along the proposed culvert alignment to provide subsurface information for the design of the proposed new culvert. Boreholes BH-5 and BH-4 were advanced at accessible locations near the inlet and outlet of the proposed culvert, respectively. BH-1 and BH-3 were advanced within the east side of NBL and west side of SBL, respectively, located about 2 m south of the proposed culvert centerline, while BH-2 was advanced approximately 2 m north of the proposed culvert centerline in the grass median. Two (2) vertical boreholes (BH-6 and BH-7) were advanced at the two areas of suspected base failure locations on centerline of the existing culvert alignment (i.e. approximately 44 m west of the inlet and 5 m east of outlet, respectively). Additional two (2) vertical boreholes (BH-8 and BH-9) were advanced from the top of Highway 11 at the locations of obstacles encountered during drilling of the horizontal borehole HP-1. Borehole BH-8 was advanced at about the middle of two SBLs and BH-9 was advanced within the east side shoulder of SBL, located about the centerline of proposed culvert alignment.

The vertical boreholes drilled from the road surface/ median ditch (BH-1, BH-2, BH-3, BH-6, BH-8 and BH-9) were advanced to depths ranging from 9.2 m to 19.8 m below the ground surface; while boreholes advanced at the inlet and outlet locations of proposed culvert (BH-4 and BH-5) were advanced to depths ranging from 11.6 m to 15.2 m below ground surface. Borehole BH-7 advanced at outlet of the existing culvert was advanced to depths about 11.6 m below ground surface.

The horizontal borehole HP-1 was advanced about 76.2 m in length from the inlet side along the centerline of the proposed culvert alignment (see Drawing 1 in Appendix B). The elevation of the entry point was approximately at 274.5 m, while the exit point of the drilling rod was measured approximately 2.6 m below the ground surface at approximate Elev. 272.5 m. The objective of this horizontal borehole drilling along the proposed culvert alignment was to investigate potential presence of some obstacles (i.e. boulders) at the trenchless installed pipe pathway. BH-8 and BH-9 were drilled at locations where possible obstacles were encountered based on the horizontal probe.

The preliminary investigation at the current culvert location and at the initially proposed new alignment (18 m north of the existing culvert) performed by Golder Associates in the spring 2017 included drilling of five (5) vertical boreholes numbered 17-1, 17-2, 17-2B, 17-3 and 17-4 to a maximum depth ranging from 8.2 to 24.4 m (Elev. 273.8 m to 257.7 m). The locations of boreholes 17-2 and 17-2B which

were drilled at the location of current culvert are shown on Drawing 1 in Appendix B. The other boreholes were drilled north of the existing culvert along the initially proposed culvert alignment.

Boreholes drilled from the embankment crest/median ditch (BH-1, BH-2, BH-3, BH-6, BH-8 and BH-9) and the borehole drilled at the inlet location (BH-5) were advanced using a truck mounted CME-55 drill rig; while the boreholes drilled at the proposed outlet location (BH-4) and at the existing culvert outlet location (BH-7) were advanced using a portable drilling equipment Hilti DD 250. The drill rig and portable equipment equipped with a hollow stem auger and standard soil/ rock sampling equipment were operated by a specialist drilling contractor Marathon Drilling Company Ltd (Marathon). A wash boring technique with casing was used to advance boreholes through the embankment. When cobbles and boulders were encountered, the core barrel was used to advance the borehole and obtain rock core samples. The horizontal borehole advanced through highway embankment was a pilot hole of a Horizontal Directional Drilling (HDD) equipment Ditch with 2720 drilling rig operated by Marathon as well. A platform was prepared at the inlet side to accommodate the HDD equipment as shown on photos in Appendix A.

Locations of boreholes (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were temporary surveyed by **exp's** personnel using the Temporary Benchmark (TBM) set on BH 17-2 at Highway 11. The TBM elevation of 282.0 m was then obtained from provided information in the Golder's report. A summary of borehole locations (northing and easting given relative to NAD83 MTM Zone 10, as well as latitude and longitude), ground surface elevations and borehole depth are presented in the Record of Borehole sheets in Appendix C and summarized in Table 1.1 below.

Table 1.1. Summary of boreholes drilled

Borehole	MTM NAD 83 Coordinates Zone 10		Latitude and Longitude Coordinates		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing	Easting	Latitude	Longitude		
BH-1	4993880.6	320753.0	45.084721	-79.297362	282.2	19.7
BH-2	4993881.9	320737.2	45.084733	-79.297565	280.5	18.1
BH-3	4993873.9	320726.4	45.084663	-79.297694	281.6	19.8
BH-4	4993869.4	320709.2	45.084621	-79.297911	275.4	11.6
BH-5	4993888.7	320780.5	45.084797	-79.297004	275.1	15.2
BH-6	4993884.7	320733.9	45.084761	-79.297602	280.7	18.1
BH-7	4993877.4	320706.3	45.084694	-79.297947	275.4	11.6
BH-8	4993876.6	320727.1	45.084681	-79.297693	281.8	9.8
BH-9	4993877.5	320730.5	45.084689	-79.297642	282.0	9.2



During the drilling of vertical boreholes, soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586) at intervals ranging from 0.75 m to 1.5 m in depth when drilled with the drilling rig or 0.61 m to 1.22 m in depth with the portable equipment, as shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT “N” values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM, pg. 40) and used to provide an assessment of in-situ consistency or relative density of non-cohesive soils. However, in the case of sampling done by the portable equipment with a manually lifting portable hammer (31.7 kg, half weight of conventional hammer weight) at BH-7, the corresponding blow counts were factored by 0.5. Since the sampling at BH-4 was performed, using a 51 mm outside diameter (O.D.) split-spoon sampler and 140 lbs (63.5 kg) hammer with portable tripod for lifting, the corresponding blow counts were not factored. When a hard stratum was reached (refusal of split spoon), sampling of hard material was performed by diamond core drilling using a 1.5 m long NQ double tube wireline core barrel during drilling with the drilling rig, while a 0.61 m BQ core barrel was used during drilling with the portable equipment. The horizontal borehole was drilled as a 2.5-inch pilot hole using a pilot steering drill bit, without any soil sampling.

Upon completion of the boreholes, ground water level measurements were carried out in the vertical boreholes in accordance with the MTO guidelines. However, vertical boreholes were advanced using a wash boring technique, so the stabilized ground water level could not be established by short term observations in boreholes. The drilled boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act). The existing culvert cored were plugged and cemented with quick setting cement.

The fieldwork was supervised by members of **exp**'s engineering who directed the drilling and sampling operations, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification.

All the recovered soil samples placed in labelled moisture-proof bags were returned to **exp**'s Brampton laboratory for additional visual, textual, olfactory examination and selective testing.

### 1.3.2 Previous Investigation

The following previous investigation report from the spring 2017 investigation was provided by MTO:

- Technical Memorandum- Assignment 5015-E-0045- Work Order 1; Culvert at Highway 11/ Highway 117 Interchange, Highway 11 STA 16+312, Site No. 42-194 Bracebridge, Ontario; April 12, 2017 by Golder Associates.

The borehole logs from the previous investigation report prepared by Golder Associates are attached in Appendix F of this report. The details of the borehole locations and elevations completed by Golder Associates are outlined in Table 1.2.

*Table 1.2. Summary of boreholes completed by Golder*

BH No.	Borehole Locations (Station and Offset from the Centreline)	Ground Elevation (m)	Borehole Depth (m)	Borehole Bottom Elevation (m)	Piezometer/ Monitoring Well
BH 17-1*	SBL, north side of existing culvert	280.9	21.6	259.3	None
BH 17-2	NBL, drilled at existing culvert	282	8.2	173.8	None
BH 17-2B	NBL, south side of existing culvert	282.1	24.4	257.7	None
BH 17-3*	SBL, north side of previously proposed culvert	280.7	21.3	259.4	None
BH 17-4*	NBL, south side of previously proposed culvert	281.6	10.3	271.3	None

*Note: \* - BH 17-1, BH 17-3 and BH17-4 were drilled for previously proposed culvert alignment located north of the existing culvert alignment. Therefore, these boreholes will not be discussed further for describing stratigraphic section at the existing culvert and the new proposed culvert locations.*

### 1.3.3 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content on all samples and particle size distribution for approximately 25% of the collected soil samples. All the laboratory tests were carried out according to MTO and/or ASTM Standards as appropriate.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of the grain size analyses tests are presented graphically in Appendix D. The laboratory test results from Golder's investigation is provided on the attached borehole log sheets in Appendix F.

## 1.4 Subsurface Conditions

A borehole location plan and stratigraphic sections are provided in Appendix B. The locations of obstacles encountered during drilling of the horizontal borehole are also marked on those plan and sections. The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C. Laboratory test results are provided in Appendix D. The "Explanation of Terms Used in Report" preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report.

It should be noted that the stratigraphic boundaries indicated on the borehole logs and stratigraphic sections are inferred from semi-continuous sampling in vertical boreholes, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent interpreted

transitions from one soil type to another and should not be viewed as exact planes of geological change. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

The general stratigraphy encountered within the investigated depths of previous and current investigations are inline. In general, the subsoil condition at the site consist of a layer of embankment fill (consisting of sand, rockfill, sand to gravelly sand and silty sand to sand and silt) followed by native deposit of sand and silt, sandy silt and silty sand to sand.

A detailed description of subsurface conditions encountered in drilled boreholes are discussed further in subsequent sections. It should be noted that the following sections are based on the geotechnical investigations conducted by **exp** and Golder.

### 1.4.1 Proposed New Culvert Location

#### 1.4.1.1 Asphalt

An asphalt layer, approximately 0.11 m to 0.20 m thick, was encountered at the surface of boreholes advanced on the paved area, i.e. BH-1, BH-3, BH-8 and 17-2B .

#### 1.4.1.2 Fill: Sand

A sand fill layer was encountered below the asphalt in boreholes BH-1, BH-3, BH-8 and 17-2B or at the surface of borehole BH-2. The sand fill extended to depth ranging between 3.1 m and 6.1 m below the ground surface with elevations ranging between 279.2 m and 274.4 m. The explored thickness of this layer was between 2.9 m and 6.1 m.

The composition of this fill layer was generally sand with trace to some silt, trace to some gravel and occasional cobbles and boulders. The material was brown to dark brown in color, and dry to moist. The SPT 'N' values within this layer ranged from 2 to 72 blows per 0.3 m penetration, suggesting very loose to very dense material, but generally compact in relative density.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content: (**exp** and Golder)

- 1.2% to 19.1%

Grain Size Distribution: (**exp** and Golder)

- 3% to 9 % gravel;
- 74% to 87% sand;
- 14% to 19% silt and clay; or
- 9% silt; and
- 1% clay.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 1 in Appendix D. The results of tests performed by Golder are shown on the borehole logs attached in Appendix F.

#### **1.4.1.3 Fill: Rockfill**

A layer of rockfill was encountered below the sand fill in BH-1 and 17-2B, which extended to depth ranging between 3.8 m and 5.8 m below the ground surface with corresponding elevations ranging between 278.4 m and 276.3 m. The explored thickness of this layer was between 0.7 m and 2.3 m.

The composition of this layer was generally cobbles and boulders with some sand and some gravel. The SPT 'N' values within this layer was above 100 blows per 0.3 m penetration.

#### **1.4.1.4 Fill: Sand to Gravelly Sand**

A sand to gravelly sand fill layer was encountered below the rockfill layer in borehole BH-1, which extended to depth of 6.9 m below the ground surface with corresponding elevation of 275.3 m. The explored thickness of this layer was about 3.1 m.

The composition of this fill layer was generally sand with some gravel, trace to some silt and trace organics. The material was brown in color, and wet. The SPT 'N' values within this layer ranged from 4 to 59 blows per 0.3 m penetration, suggesting very loose to very dense in relative density.

Laboratory testing performed on selected samples consisted of moisture content tests and results are as follows:

Moisture Content: (**exp**)

- 1.3 to 6.2%

The results of moisture content tests are provided on the record of borehole sheets in Appendix C.

#### **1.4.1.5 Fill: Silty Sand/ Sand and Silt**

A silty sand/ sand and silt fill layer was encountered below the sand to gravelly sand layer in BH-1; below the sand fill layer in BH-2, BH-3 and BH-8; rockfill in borehole 17-2B; below topsoil in BH-4 or at the surface of BH-5. The silty sand/sand and silt fill extended to depth ranging between 1.5 m and 10.1 m below the ground surface with corresponding elevations ranging between 273.6 m and 272.0 m. The explored thickness of this layer was between 1.5 m and 4.3 m.

The composition of this fill layer was generally silt and sand with trace gravel, trace clay, occasional cobbles and boulders, trace to some organics and occasional wood log. The material was brown to greyish brown in color, and moist to wet. The SPT 'N' values within this layer ranged from 1 to 24

blows per 0.3 m penetration, suggesting very loose to compact in relative density. One SPT 'N' value of 50 blows per 0.05 m penetration was also obtained within this layer which could be influence of a wood log encountered.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution tests, and their results are as follows:

Moisture Content: (**exp** and Golder)

- 2.1% to 54.3%

Grain Size Distribution: (**exp** and Golder)

- 0% to 4 % gravel;
- 48% to 67% sand;
- 29% to 47% silt and clay; or
- 45% to 51% silt; and
- 1% to 4% clay.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 2 in Appendix D. The results of tests performed by Golder are shown on the borehole logs attached in Appendix F.

During drilling of the horizontal borehole HP-1, obstacles were encountered in this layer about middle of two SBLs and within the east side shoulder of SBL. Borehole BH-8 and BH-9 were advanced at those two locations, and the findings suggest that those obstacles might be smaller boulders.

#### 1.4.1.6 Sand and Silt

A native sand and silt layer was encountered below silty sand/sand and silt fill in boreholes BH-1, BH-3, BH-8 and 17-2B. The native sand and silt layer extended to depth ranging between 9.8 m and 14.7 m below the ground surface with corresponding elevations ranging between 272.0 m and 267.4 m. The explored thickness of this layer was between 0.6 m and 4.6 m. BH-8 was terminated within this layer.

The composition of this layer was generally silt and sand with trace clay, organics, and rootlets. The material was blackish brown to dark brown in color, and moist to wet. The SPT 'N' values within this layer ranged from 3 to 11 blows per 0.3 m penetration, suggesting very loose to compact in relative density.

Laboratory testing performed on selected samples consisted of moisture content tests, grain size distribution tests, organic content tests and Atterberg Limit tests. The test results are as follows:

Moisture Content: (**exp** and Golder)

- 23.6% to 43.9%

Grain Size Distribution: (**exp** and Golder)

- 0 % gravel;
- 39% to 60% sand;
- 39% to 58% silt; and
- 1% to 3% clay.

Organic Content: (exp and Golder)

- Organic content ranges from 3.3% to 4.8%

Two Atterberg Limits tests were conducted by Golder on selected samples of the silt and sand deposit and returned non-plastic results.

The result of moisture content, grain size distribution and organic content tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 3 in Appendix D. The results of tests performed by Golder are shown on the borehole logs attached in Appendix F.

#### 1.4.1.7 Sandy Silt with Organics

A native sandy silt layer was encountered below silty sand/sand and silt fill in boreholes BH-4 and BH-5. The sandy silt layer extended to depth ranging between 3.7 m and 4.4 m below the ground surface with corresponding elevations ranging between 271.7 m and 270.7 m. The explored thickness of this layer was between 1.3 m and 2.9 m.

The composition of this layer was generally silt and sand with trace gravel trace to some clay, trace to some organics, trace roots and rootlets. The material was black to dark grey in color, and wet. The SPT 'N' values within this layer ranged from WH to 6 blows per 0.3 m penetration, suggesting very loose to loose in relative density.

Laboratory testing performed on selected samples consisted of moisture content tests, grain size distribution tests, organic content test and Atterberg Limit tests. The test results are as follows:

Moisture Content: (**exp**)

- 41.8% to 132.4%

Grain Size Distribution: (**exp**)

- 0 % gravel;
- 17% to 27% sand;
- 70% to 80% silt; and
- 3% to 4% clay.

Organic Content: (**exp**)

- Organic content about 7.3%

Two Atterberg Limits tests were conducted on selected samples of sandy silt deposit and returned non-plastic results.

The result of moisture content, grain size distribution and organic content tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 4 in Appendix D.

**1.4.1.8 Silty Sand to Sand**

A native silty sand to sand layer was encountered below sand and silt layer in boreholes BH-1, BH-3 and 17-2B; below silty sand fill in BH-2; and below sandy silt with organics in BH-4 and BH-5. The silty sand to sand layer extended to depths ranging between 9.8 m and 19.7 m below the ground surface with corresponding elevations ranging between 265.6 m and 261.4 m. The explored thickness of this layer was between 4.2 m and 9.7 m. BH- 1 and BH-2 were terminated within this layer.

The composition of this layer was generally sand some silt, trace gravel, trace clay and occasional cobbles. The material was brown to greyish brown in color, and wet. The SPT 'N' values within this layer ranged from 4 to 37 blows per 0.3 m penetration, suggesting very loose to dense, but generally compact in relative density. The dynamic cone penetration test (DCPT) was also performed below this layer in boreholes BH-3, BH-4, BH-5 and 17-2B, which extended to depths ranging between 11.6 m and 24.4 m with corresponding elevations ranging between 263.8 m and 257.7 m. Boreholes BH-3, BH-4, BH-5 and 17-2B were terminated at the end of DCPT.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution tests, and the test results are as follows:

Moisture Content: (**exp**)

- 12.6% to 25.4%

Grain Size Distribution: (**exp** and Golder)

- 0% to 3% gravel;
- 72% to 95% sand;
- 5% to 28% silt and clay; or
- 11% to 14% silt; and
- 1% clay.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on

Figure 5 and Figure 6 in Appendix D. The results of tests performed by Golder are shown on the borehole logs attached in Appendix F.

## 1.4.2 Existing Culvert Location

### 1.4.2.1 Asphalt

An asphalt layer about 0.20 m thick, was encountered at the surface of borehole advanced on the paved area, i.e. 17-2.

### 1.4.2.2 Fill: Sand

A sand fill layer was encountered below the asphalt in boreholes 17-2 or at the surface of boreholes BH-6 and BH-7. The layer encountered was also interbedded with rockfill in the borehole 17-2. The upper sand fill extended to depth ranging between 1.2 m and 6.5 m below the ground surface with corresponding elevations ranging between 279.4 m to 274.2 m. The lower sand fill layer extended to depth of about 5.3 m with corresponding elevation of 276.7 m. The explored thickness of upper sand fill layer was between 1.2 m and 6.5 m and lower sand fill layer was 1.0 m.

The composition of this fill layer was generally sand with trace to some silt, trace to some gravel and occasional cobbles. The material was blackish brown to brown in color, and moist. The SPT 'N' values within this layer ranged from 1 to 44 blows per 0.3 m penetration, suggesting very loose to dense in relative density. Some SPT 'N' values of above 50 blows per 0.025 m penetration was obtained within this layer which could be an influence of underlying boulder or concrete culvert.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution test, and the test results are as follows:

Moisture Content: (**exp** and Golder)

- 5.8% to 14.8%

Grain Size Distribution: (**exp**)

- 0% gravel;
- 89% sand; and
- 11% silt and clay.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test are also provided on Figure 7 in Appendix D.

### 1.4.2.3 Fill: Rockfill

A layer of rockfill was encountered below sand fill in borehole 17-2. The upper rockfill layer extended to depth of about 4.3 m below the ground surface with elevation of 277.7 m and the lower rockfill



layer extended to depth of about 6.9 m below ground surface with elevation of 275.1 m. The explored thickness of upper and lower rockfill layers were 1.7 m and 1.6 m, respectively.

The composition of this layer was generally cobbles and boulders with some sand and some gravel. One SPT 'N' value obtained within this layer was 44 blows per 0.3 m penetration suggesting dense relative density.

#### **1.4.2.4 Fill: Silty Sand and Gravel**

A silty sand and gravel fill layer was encountered below rockfill in borehole 17-2, which extended to depth about 8.2 m below the ground surface with elevation of 273.8 m. The explored thickness of this layer was 1.3 m. Borehole 17-2 was terminated below this layer at the existing culvert.

The composition of this fill layer was generally silt and sand with trace to some gravel. The material was brown in color, and moist. One SPT 'N' values within this layer obtained was 50 blows per 0.13 m penetration, suggesting very dense in relative density, which could be an influence of the underlying culvert.

Laboratory testing performed on selected samples consisted of moisture content test and grain size distribution test, and the test results are as follows:

Moisture Content: (Golder)

- 18%

Grain Size Distribution: (Golder)

- 36% gravel;
- 42% sand; and
- 22% silt and clay.

The results of tests performed by Golder are shown on the borehole logs attached in Appendix F.

#### **1.4.2.5 Silt**

A native silt layer was encountered below the existing culvert in BH-7. The silt layer extended to depth of about 5.5 m below the ground surface with elevation of 269.9 m. The explored thickness of this layer was 2.2 m.

The composition of this layer was generally silt and some fine sand trace gravel. The material was grey in color, and wet. The SPT 'N' values within this layer ranged from 3 to 8 blows per 0.3 m penetration, suggesting very loose to loose in relative density.

Laboratory testing performed on selected samples consisted of moisture content tests, and the test results are as follows:

Moisture Content: (**exp**)

- 17.4% to 18.3%

The results of the moisture content tests are provided on the record of borehole sheets in Appendix C.

#### 1.4.2.6 Silty Sand to Sand

A native silty sand to sand layer was encountered below the silt layer in BH-7 and below the existing culvert in BH-6, which extended to depths ranging between 11.6 m and 18.1 m below the ground surface with corresponding elevations ranging between 263.8 m and 262.2 m. The explored thickness of this layer was between 6.1 m and 9.5 m. In BH-7, about 2.5 m thick layer of sandy silt was encountered between sand layer. The sandy silt layer was encountered at a depth of 7.3 m below the ground surface at elevation of 268.1 m. BH-6 and BH-7 were terminated within the silty sand to sand layer.

The composition of this layer was generally sand, some silt, trace to some gravel and trace clay. The material was brown to greyish brown in color, and wet. The SPT 'N' values within this layer ranged from 4 to 25 blows per 0.3 m penetration, suggesting very loose to compact in relative density.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution tests, and the test results are as follows:

Moisture Content: **(exp)**

- 16.8% to 25.4%

Grain Size Distribution: **(exp)**

- 0% to 12% gravel;
- 30% to 87% sand;
- 8% to 58% silt and clay; or
- 29% silt; and
- 1% clay.

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 8 in Appendix D.

## 1.5 Ground Water Conditions

Information regarding groundwater levels at the site was obtained by measuring water levels in open boreholes after completion of drilling. The groundwater levels measured in boreholes are shown on Table 1.2 and borehole logs. Water levels measured in open boreholes might not be stabilized due to a short-term observation, as well as due to using of a wash boring technique to advance the boreholes.

The groundwater levels measured in open boreholes upon completion of drilling were recorded at depths ranging between 1.83 m (BH-4) and 8.5 m (BH-8) below the ground surface with corresponding elevations ranging between 273.4 m and 274.5. At the time of investigation, the water level measured at the creek was approximately at elevation 272.7 m. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year. Some mounding under the embankment should be expected.

Table 1.2 Groundwater levels recorded at the site

Borehole	Location Relative to Hwy 11 CL	Date of Drilling	Groundwater Level (Elevation, m)
BH-1	NBL (east)	08/29/2017	Dry (borehole caved at 279.15 m)
BH-2	Median ditch	08/30/2017	274.4
BH-3	SBL (west)	08/31/2017	273.4
BH-4	Toe (west)	09/7/2017	273.5
BH-5	Toe (East)	09/1/2017	273.0
BH-6	Median (Existing Culvert)	08/30/2017	Not Measured
BH-7	Outlet (Existing Culvert)	09/6/2017	Not Measured
BH-8	SBL (west)	09/5/2017	273.3
BH-9	SBL (west)	09/5/2017	Not Measured
BH 17-2	NBL (east, existing culvert)	02/28/2017	Not Measured
BH 17-2B	NBL (east)	02/28/2017	274.5

## 1.6 Chemical Analyses

Two soil samples were selected for chemical analysis and were sent to Maxxam laboratories, a CALA-certified and accredited laboratory in Mississauga, Ontario. The analytical laboratory results are presented in Appendix E, and are summarized in Table 1.3.

Table 1.3. Corrosivity chemical analysis

Sample Identification	pH (unitless)	Soluble Chloride (ppm)	Soluble Sulphate (ppm)	Resistivity (ohm-cm)	Conductivity (umho/cm)	Redox Potential (mV)	Sulphide (ppm)
BH4-SS6	5.17	410	<20	1500	689	160	1.24
BH5-SS5	5.74	310	<20	1900	518	140	0.85

The chemical data indicates low resistivity and low pH (i.e. acidic environment) of the tested soil.

October 18, 2018

## 2 CLOSURE

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This Foundation Investigation Report has been prepared by Mr. Nimesh Tamrakar, M.Eng, EIT. and Dr. S. Micic, Ph.D., P. Eng. and reviewed by Mr. T.C. Kim, M.E.Sc., P.Eng. and Mr. S.E. Gonsalves, M.Eng., P.Eng. designated MTO foundation contact. The field investigation was conducted by Mr. Nimesh Tamrakar, M.Eng, EIT.

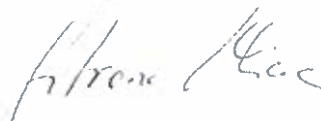
We trust that these comments provide you with sufficient information to for your present requirements. Should you have any questions, please do not hesitate to contact this office

Yours truly,

**exp Services Inc.**



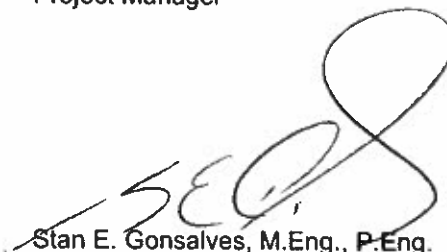
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Stan E. Gonsalves, M.Eng., P.Eng.  
Principal Engineer  
Designated MTO Foundation Contact



Encl.

### 3 LIMITATIONS AND USE OF REPORT

#### BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of exp may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by exp. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and exp's recommendations. Any reduction in the level of services recommended will result in exp providing qualified opinions regarding the adequacy of the work. exp can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the borehole results contained in the Report. The number of boreholes necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to exp to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

#### RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to exp by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. exp has relied in good faith upon such representations,

information and instructions and accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to exp.

## **STANDARD OF CARE**

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, expressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

## **COMPLETE REPORT**

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to exp by its client ("Client"), communications between exp and the Client, other reports, proposals or documents prepared by exp for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions expressed in the Report, reference must be made to the Report in its entirety. exp is not responsible for use by any party of portions of the Report.

## **USE OF REPORT**

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report in whole or in part without the written consent of exp. Any use of the Report, or any portion of the Report, by a third party are the sole responsibility of such third party. exp is not responsible for damages suffered by any third party resulting from unauthorised use of the Report.

## **REPORT FORMAT**

Where exp has submitted both electronic file and a hard copy of the Report, or any document forming part of the Report, only the signed and sealed hard copy shall be the original documents for record and working purposes. In the event of a dispute or discrepancy, the hard copy shall govern. Electronic files transmitted by exp have utilize specific software and hardware systems. exp makes no representation about the compatibility of these files with the Client's current or future software and hardware systems. Regardless of format, the documents described herein are exp's instruments of professional service and shall not be altered without the written consent of exp.

## **Appendix A – Photographs**





Photo 1: Hwy 11 NBL looking north from proposed culvert location

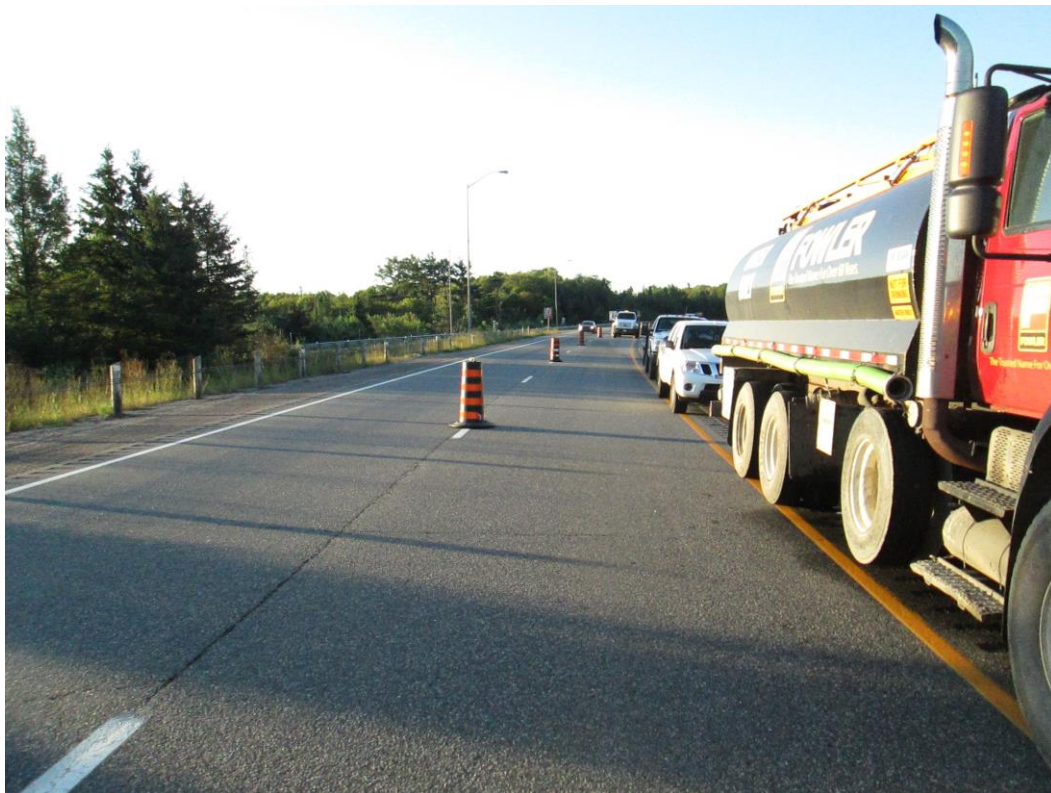


Photo 2: Hwy 11 NBL looking south from proposed culvert location





Photo 3: Hwy 11 SBL looking south from north of proposed culvert location



Photo 4: Hwy 11 SBL looking north from north of proposed culvert location





Photo 5: West embankment slope looking south from north of the existing culvert



Photo 6: West embankment slope looking north from north of the existing culvert





Photo 7: Looking west from outlet side of the existing culvert



Photo 8: Building platform for HDD and access for drill rig for BH-5





Photo 9: Reinstatement of slope to original condition



Photo 10: Existing Box Culvert inlet and outlet of CSP culvert





Photo 11: Existing Box Culvert outlet



Photo 12: Looking Internal view of existing Box Culvert from inlet side





Photo 13: Starting point of horizontal probe hole at inlet side



Photo 14: Location of BH-5 at proposed culvert inlet location





Photo 15: Portable drill at BH-7 location looking east from existing culvert outlet



Photo 16: Existing culvert at inlet and silt fence looking north from BH-5 location

## **Appendix B – Drawings**



NER Agreement No. 9016-E-0009  
Assignment No. 1  
GWP 5158-12-00



HIGHWAY 11 CULVERT AT HIGHWAY 117 INTERCHANGE,  
BRACEBRIDGE  
Latitude 45.084724°; Longitude -79.297552°  
BOREHOLE LOCATION PLAN AND SOIL STRATA

SHEET

exp. exp Services Inc.

KEY PLAN



LEGEND

- New Vertical Borehole by EXP (2017)
- Previous Vertical Borehole by Golder (2017)
- New Horizontal Borehole by EXP (2017)
- Water Level Upon Completion of Drilling
- N Standard Penetration Test (Blows/0.3 m)

SOIL STRATA SYMBOLS

- ASPHALT
- FILL/ ROCK FILL
- TOPSOIL
- SILT
- SAND
- SANDY SILT/ SILTY SAND

BH No.	APPROX. ELEV.	MTM CO-ORDINATES (ZONE ON-10)	
		NORTHING	EASTING
BH-1	282.2	4993880.6	320753.0
BH-2	280.5	4993881.9	320737.2
BH-3	281.6	4993873.9	320726.4
BH-4	275.4	4993869.4	320709.2
BH-5	275.1	4993888.7	320780.5
BH-6	280.7	4993884.7	320733.9
BH-7	275.4	4993877.4	320706.3
BH-8	281.8	4993876.6	320727.1
BH-9	282.0	4993877.5	320730.5
17-1	280.9	4993890.5	320717.0
17-2	281.8	4993890.1	320750.6
17-2B	282.0	4993883.5	320753.3
17-4	281.6	4993901.1	320745.7

NOTE

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

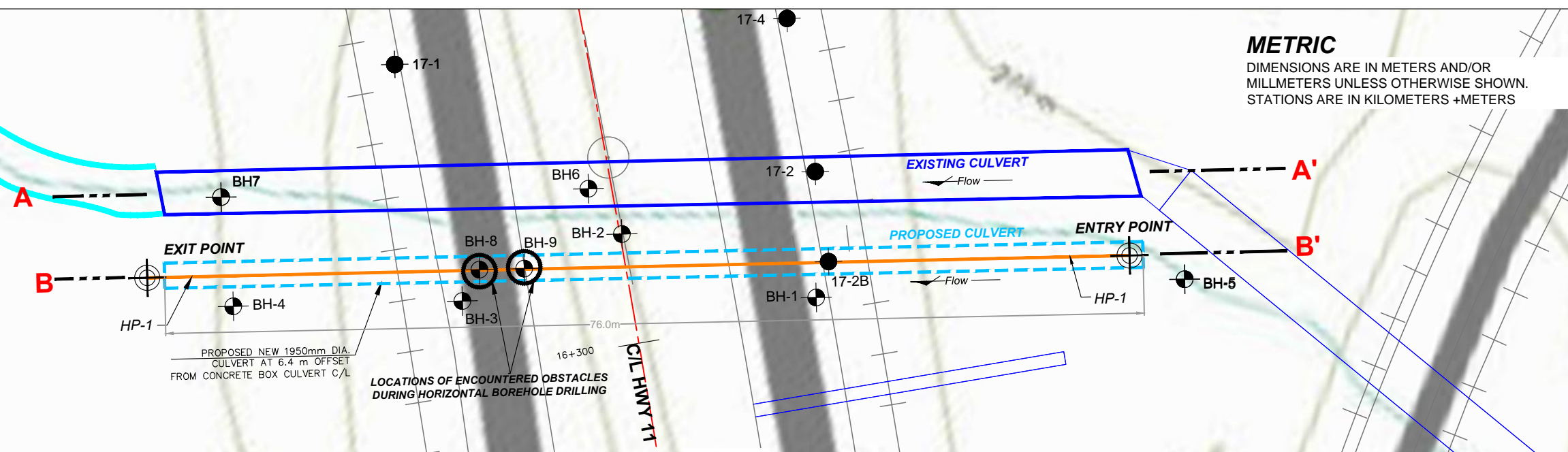
The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in the report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

SCALE 0 10 m

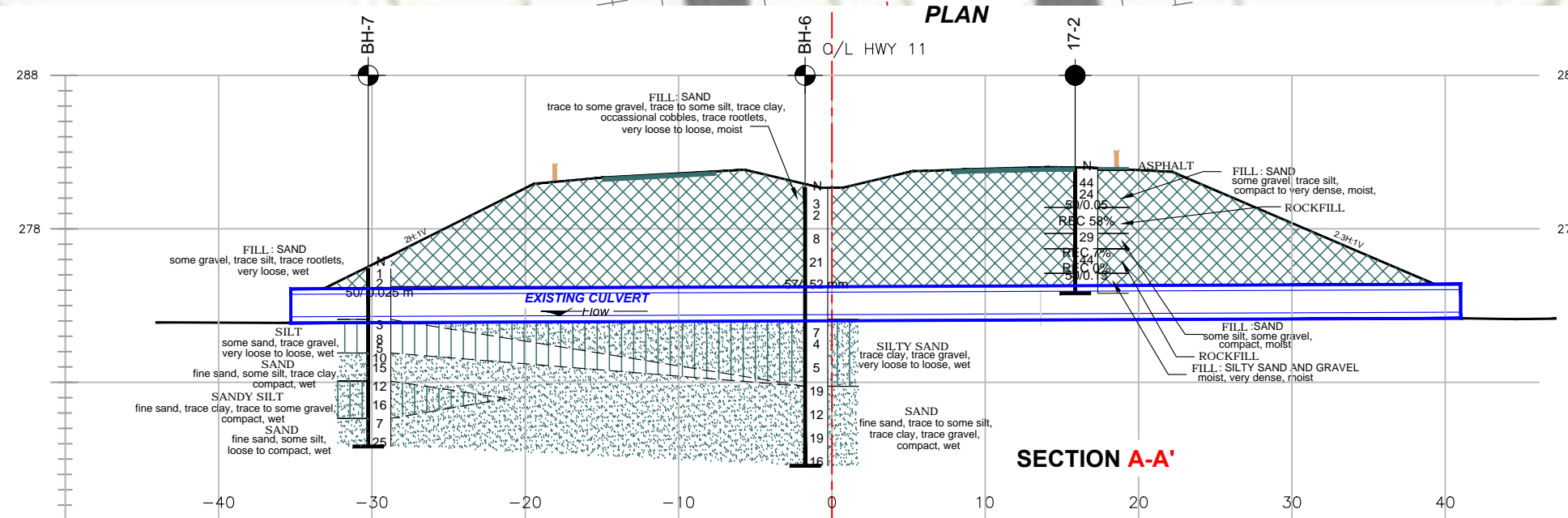
19/10/2018	-	SUBMISSION FOR MTO REVIEW
DATE	BY	DESCRIPTION
		GEOCRE NO. 31E-383
		PROJECT NO. ADM-00241971-A0
SUBM'D SH	CHECKED SM	DATE 19/10/2018
DRAWN SH	CHECKED SM	APPROVED SG DWG. 01

## METRIC

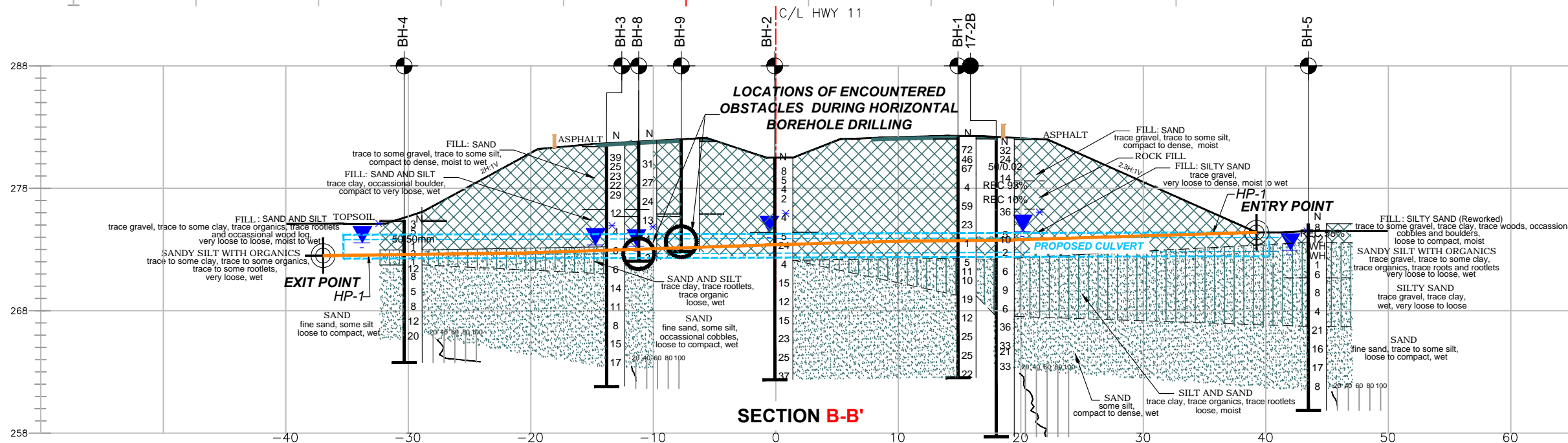
DIMENSIONS ARE IN METERS AND/OR MILLIMETERS UNLESS OTHERWISE SHOWN.  
STATIONS ARE IN KILOMETERS +METERS



PLAN



SECTION A-A'



SECTION B-B'



## **Appendix C – Boreholes Logs**

Brampton, Ontario

## RECORD OF BOREHOLE No BH-1

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993657.27, 320738.7 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.29 - 2017.08.29 LATITUDE 45.084721 LONGITUDE -79.297362 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER									
282.2	Road Surface						20	40	60	80	100						GR SA SI CL
282.0	ASPHALT - about 175 mm																
0.2	FILL: SAND -trace to some gravel, trace to some silt, occassional cobbles and boulder, brown, dry to moist, dense to very dense		1	AS		282							○				8 74 (18)
			2	SS	72	281							○				
			3	SS	46	280							○				
	-becoming sand with cobbles @ 2.3 m		4	SS	67								○				
279.2	-Switch to wash boring below 3.05 m		5	SS		279											
3.1	ROCK FILL Spoon bouncing on boulder @ 3.05 m																
278.4	FILL: SAND TO GRAVELLY SAND -trace to some silt, trace organic spot, brown, wet, very loose to very dense		6	SS	4	278							○				
3.8						277											
	- becoming gravelly sand @ 5.3 m		7	SS	59	276							○				
275.3																	
6.9	FILL: SILTY SAND -trace gravel, trace clay, greyish brown, wet, very loose to compact		8	SS	23	275							○				3 58 (39)
			9	SS	1	274							○				
						273											
272.3																	
9.9	SAND AND SILT -trace clay, trace organics, trace rootlets, greyish brown to brown/black, wet, loose to compact		10	SS	5	272								○			0 39 58 3 Organic Content = 4.8%
			11	SS	11	271								○			
			12	SS	10									○			

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO, GPJ, ONTARIO MTO, GDT, 10/18/18

Brampton, Ontario

## RECORD OF BOREHOLE No BH-1

2 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993657.27, 320738.7 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.29 - 2017.08.29 LATITUDE 45.084721 LONGITUDE -79.297362 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL X P. PENETROMETER										
								20	40	60	80	100						

ONTARIO MTO ASSIGNMENT#1, MERO\_GPJ\_ONTARIO MTO.GDT 10/18/18

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE


Brampton, Ontario

## RECORD OF BOREHOLE No BH-2

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993658.5, E320722.9 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.30 - 2017.08.30 LATITUDE 45.084733 LONGITUDE -79.297565 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER										
280.5	Ground Surface						20	40	60	80	100							
0.0	<b>FILL: SAND</b> -trace to some gravel, trace to some silt, trace clay, occassional cobbles, trace rootlets, blackish-brown to brown, moist, very loose to loose		1	AS														
			2	SS	8													
			3	SS	5													
			4	SS	4													
			5	SS	2													
			6	SS	4													

Continued Next Page

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO GPJ ONTARIO MTO GDT 10/18/18

Brampton, Ontario

# RECORD OF BOREHOLE No BH-2

2 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993658.5, E320722.9 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.30 - 2017.08.30 LATITUDE 45.084733 LONGITUDE -79.297565 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						W <sub>p</sub> W                      W <sub>L</sub>			GR	SA	SI	CL	
								○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIALX P. PENETROMETER						WATER CONTENT (%)							
								20	40	60	80	100		20	40	60					
							268														
			12	SS	15		267							○						0	88   11   1
							266							○							
			13	SS	23		265														
							264							○							
			14	SS	25		263														
														○						0	92   (8)
262.4 18.1			15	SS	37																
	END OF BOREHOLE AT 18.14 m DEPTH																				
	Notes: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Groundwater level was measured in open hole after completion of drilling. Since wash boring method was used to advanced boreholes, water levels measured in open boreholes might not be stabilized.																				



Brampton, Ontario

## RECORD OF BOREHOLE No BH-3

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993650.5, E320712.1 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.31 - 2017.08.31 LATITUDE 45.084663 LONGITUDE -79.297694 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL X P. PENETROMETER									
281.6	Road Surface						20	40	60	80	100						
281.0	ASPHALT - about 200 mm						20	40	60	80	100						
0.2	FILL: SAND -trace to some gravel, trace to some silt, blackish brown to brown, moist to wet, compact to dense		1	AS													
			2	SS	39												
			3	SS	25												
			4	SS	23												
			5	SS	22												
			6	SS	29												
276.3	FILL: SAND AND SILT- trace clay, occasional boulder, brown, wet, compact to very loose		7	SS	12												
5.3																	
			8	SS	4												
	- boulder encountered @ 7.85 m depth																
273.2	SAND AND SILT -trace clay, trace rootlets, trace organic, blackish-brown to dark brown, wet, loose		9	SS	6												
8.4																	
			10	SS	6												
270.2	SAND -fine sand, some silt, occasional cobbles, brown to greyish brown, wet, loose to compact		11	SS	14												
11.4																	

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO\_GPJ ONTARIO MTO GDT 10/18/18

**METRIC**

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE



Brampton, Ontario

## RECORD OF BOREHOLE No BH-4

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993646, E320694.9 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE Portable Hilty DD-250 /tripod/BW COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.09.07 - 2017.09.07 LATITUDE 45.084621 LONGITUDE -79.297911 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL	P. PENETROMETER						
275.4	Ground Surface															
275.0	<b>TOPSOIL - topsoil-rootmat about 100 mm</b>		1	SS	3	▽	275									
0.1	<b>FILL: SAND AND SILT</b> -trace gravel, trace to some clay, trace organics, trace rootlets and occasional wood log, brown, moist to wet, very loose to loose		2	SS	5		274									1 50 45 4
	-spoon bounce on wood log @ 1.52, cored wood log from 1.52 m to 1.68 m		3	SS	50/50mm		273									
			4	SS	1		272									
273.0	<b>SANDY SILT WITH ORGANICS</b> - trace to some clay, trace to some organics, trace to some rootlets, blackish-brown, wet, very loose		5	SS	3		273						132.4	○	0 17 80 4 non-plastic; organic content =7.3%	
2.4			6	SS	1		272						100.4	○		
271.7	<b>SAND</b> -fine sand, some silt, brown to greyish brown, wet, loose to compact		7	SS	12		271								0 80 (20)	
3.7			8	SS	8		270									
			9	SS	5		269									
			10	SS	8		268									
			11	SS	12		267									
			12	SS	20		266								0 95 (5)	
265.6	- Sand blow up @ 9.75 m, split spoon and casing jammed, switch to DCPT						265									
9.8	<b>END OF BOREHOLE</b> START OF DCPT						264									
263.8	DCPT bounce on possible boulder @ 11.63 m															
11.6	<b>END OF BOREHOLE AND DCPT</b>															

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO GPJ ONTARIO MTO GDT 10/18/18

Brampton, Ontario

2 OF 2

## METRIC

W.P.	W.O. 2017-11021	LOCATION	Hwy 11, Bracebridge, MTM ON10 N4993646, E320694.9			ORIGINATED BY	NT			
DIST	Muskoka	HWY	11	BOREHOLE TYPE	Portable Hilty DD-250 /tripod/BW			COMPILED BY	NT	
DATUM	TBM set on BH 17-2 ( Elev. 282.0 m)		DATE	2017.09.07 - 2017.09.07	LATITUDE	45.084621	LONGITUDE	-79.297911	CHECKED BY	SM

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO.GPJ ONTARIO MTO.GDT 10/18/18

Brampton, Ontario

## RECORD OF BOREHOLE No BH-5

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993665.3, E320766.1 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/HSA/NW Casing COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.09.01 - 2017.09.05 LATITUDE 45.084797 LONGITUDE -79.297004 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER											
275.1	Ground Surface						20	40	60	80	100	20	40	60		GR SA SI CL			
0.0	<b>FILL: SILTY SAND (Reworked)</b> - trace to some gravel, trace clay, trace woods, occasional cobbles and boulders, moist, loose to compact -boulder from 0.61 m to 0.91 m		1	SS	8		275												
			2	NQ	REC 58%		274												
	-cobbles on tip of spoon		3	SS	12														
273.6	<b>SANDY SILT WITH ORGANICS</b> -trace gravel, trace to some clay, trace organics, trace roots and rootlets, black to dark grey, wet, very loose to loose		4	SS	WH		273												
1.5			5	SS	WH		272												
			6	SS	1		271												
			7	SS	6		270												
270.7	<b>SILTY SAND</b> - trace gravel, trace clay, brown, wet, very loose to loose		8	SS	8		269												
4.4		9	SS	4	268														
					267														
266.7	<b>SAND</b> -fine sand, trace to some silt, brown, wet, loose to compact		10	SS	21		266												
8.4			11	SS	16		265												
						264													
			12	SS	17														

Continued Next Page

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO\_GPJ ONTARIO MTO GDT 10/18/18

2 OF 2

METRIC



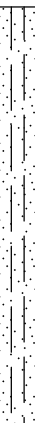
DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.09.01 - 2017.09.05 LATITUDE 45.084797 LONGITUDE -79.297004 CHECKED BY SM

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

## 1 OF 2

METRIC

DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.08.30 - 2017.08.30 LATITUDE 45.084761 LONGITUDE -79.297602 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa							WATER CONTENT (%)			
280.7	Ground Surface						20 40 60 80 100							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub>			
0.0	FILL: SAND-trace to some gravel, trace to some silt, trace clay, occasional cobbles, trace rootlets, blackish-brown to brown, moist, very loose to loose		1	AS			○ UNCONFINED + FIELD VANE							○ QUICK TRIAXIAL X P. PENETROMETER			
			2	SS	3												
			3	SS	2												
			4	SS	8												
			5	SS	21												
274.3	EXISTING BOX CULVERT -from 6.45 m to 8.61 m		6	SS	57/ 152 mm												
6.5																	
272.1	SILTY SAND - trace clay, trace gravel, brown, wet, very loose to loose																
8.6																	
			7	SS	7												
			8	SS	4												
			9	SS	5												

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO.GPJ ONTARIO MTO.GDT 10/18/18

2 OF 2

METRIC

W.P.	W.O. 2017-11021	LOCATION	Hwy 11, Bracebridge, MTM ON10 N4993661.3, E320719.5			ORIGINATED BY	NT			
DIST	Muskoka	HWY	11	BOREHOLE TYPE	CME-55/HSA/NW Casing			COMPILED BY	NT	
DATUM	TBM set on BH 17-2 ( Elev. 282.0 m)		DATE	2017.08.30 - 2017.08.30	LATITUDE	45.084761	LONGITUDE	-79.297602	CHECKED BY	SM

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO.GPJ ONTARIO MTO.GDT 10/18/18


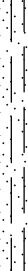

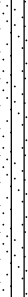
Brampton, Ontario

## RECORD OF BOREHOLE No BH-7

1 OF 2

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993654, E320692 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE Portable Hilti DD-250 /Manual Hammer/BW COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.09.06 - 2017.09.06 LATITUDE 45.084694 LONGITUDE -79.297947 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X P. PENETROMETER									
275.4 0.0	Ground Surface <b>FILL: SAND</b> some gravel, trace silt, trace rootlets, brown, wet, very loose		1	SS	1	20	40	60	80	100							
274.2 1.2	<b>EXISTING BOX CULVERT</b> -from 1.22 m to 3.3 m		3	SS	50/ 0.025 m												
272.1 3.3	<b>SILT</b> -some sand, trace gravel, grey, wet, very loose to loose  -becoming some sand, trace gravel		4	SS	3												
			5	SS	8												
			6	SS	5												
269.9 5.5	<b>SAND</b> -fine sand, some silt, trace clay, brown to greyish brown, wet, compact		7	SS	10												
			8	SS	15												
268.1 7.3	<b>SANDY SILT</b> -fine sand, trace clay, trace to some gravel, brown , wet, compact		9	SS	12												
			10	SS	16												
265.6 9.8	<b>SAND</b> -fine sand, some silt, brown to greyish brown, wet, loose to compact		11	SS	7												
			12	SS	25												
263.8 11.6	- Sand blow up @ 11.58 m, split spoon and casing jammed <b>END OF BOREHOLE AT 11.58 m DEPTH</b>																

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO, GPJ, ONTARIO MTO, GDT, 10/18/18



2 OF 2

METRIC

W.P.	W.O. 2017-11021	LOCATION	Hwy 11, Bracebridge, MTM ON10 N4993654, E320692			ORIGINATED BY	NT			
DIST	Muskoka	HWY	11	BOREHOLE TYPE	Portable Hilti DD-250 /Manual Hammer/BW			COMPILED BY	NT	
DATUM	TBM set on BH 17-2 ( Elev. 282.0 m)		DATE	2017.09.06 - 2017.09.06	LATITUDE	45.084694	LONGITUDE	-79.297947	CHECKED BY	SM

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO.GPJ ONTARIO MTO.GDT 10/18/18


Brampton, Ontario

## RECORD OF BOREHOLE No BH-8

1 OF 1

METRIC

W.P. W.O. 2017-11021 LOCATION Hwy 11, Bracebridge, MTM ON10 N4993653.2, E320712.8 ORIGINATED BY NT  
 DIST Muskoka HWY 11 BOREHOLE TYPE CME-55/Continuous flight HSA COMPILED BY NT  
 DATUM TBM set on BH 17-2 ( Elev. 282.0 m) DATE 2017.09.05 - 2017.09.05 LATITUDE 45.084681 LONGITUDE -79.297693 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  w <sub>p</sub>	NATURAL MOISTURE CONTENT  w	LIQUID LIMIT  w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
281.8	Road Surface																						
0.0	ASPHALT - about 200 mm																						
0.2	FILL: SAND -trace to some gravel, trace to some silt, trace asphalt, blackish brown to brown, dry to moist, compact to dense		1	AS																			
							281																
			2	SS	31		280																
							279																
			3	SS	27		278																
			4	SS	24		277																
							276																
275.7																							
6.1	FILL: SAND AND SILT- trace clay, occasional cobbles and boulder, brown, moist to wet, compact to very loose		5	SS	13		275											0	48	51	1		
			6	SS	4		274																
	- Auger grinding @8.53 m depth; becoming very loose						273																
272.7																							
9.2	SAND AND SILT -trace clay, trace rootlets, trace organic, blackish-brown to dark brown, wet, very loose		7	SS	3																		
272.0																							
9.8	END OF BOREHOLE AT 9.76 m DEPTH																						
	Notes: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Groundwater level was measured in open hole after completion of drilling. Since wash boring method was used to advance boreholes, water levels measured in open boreholes might not be stabilized.																						

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO ASSIGNMENT#1, MERO GPJ ONTARIO MTO.GDT 10/18/18

Brampton, Ontario

1 OF 1

**METRIC**

W.P.	W.O. 2017-11021	LOCATION	Hwy 11, Bracebridge, MTM ON10 N4993654.1, E320716.1			ORIGINATED BY	NT
DIST	Muskoka	HWY	11	BOREHOLE TYPE	CME-55/HSA	COMPILED BY	NT
DATUM	TBM set on BH 17-2 ( Elev. 282.0 m)	DATE	2017.09.05 - 2017.09.05	LATITUDE	45.084689	LONGITUDE	-79.297642
						CHECKED BY	SM

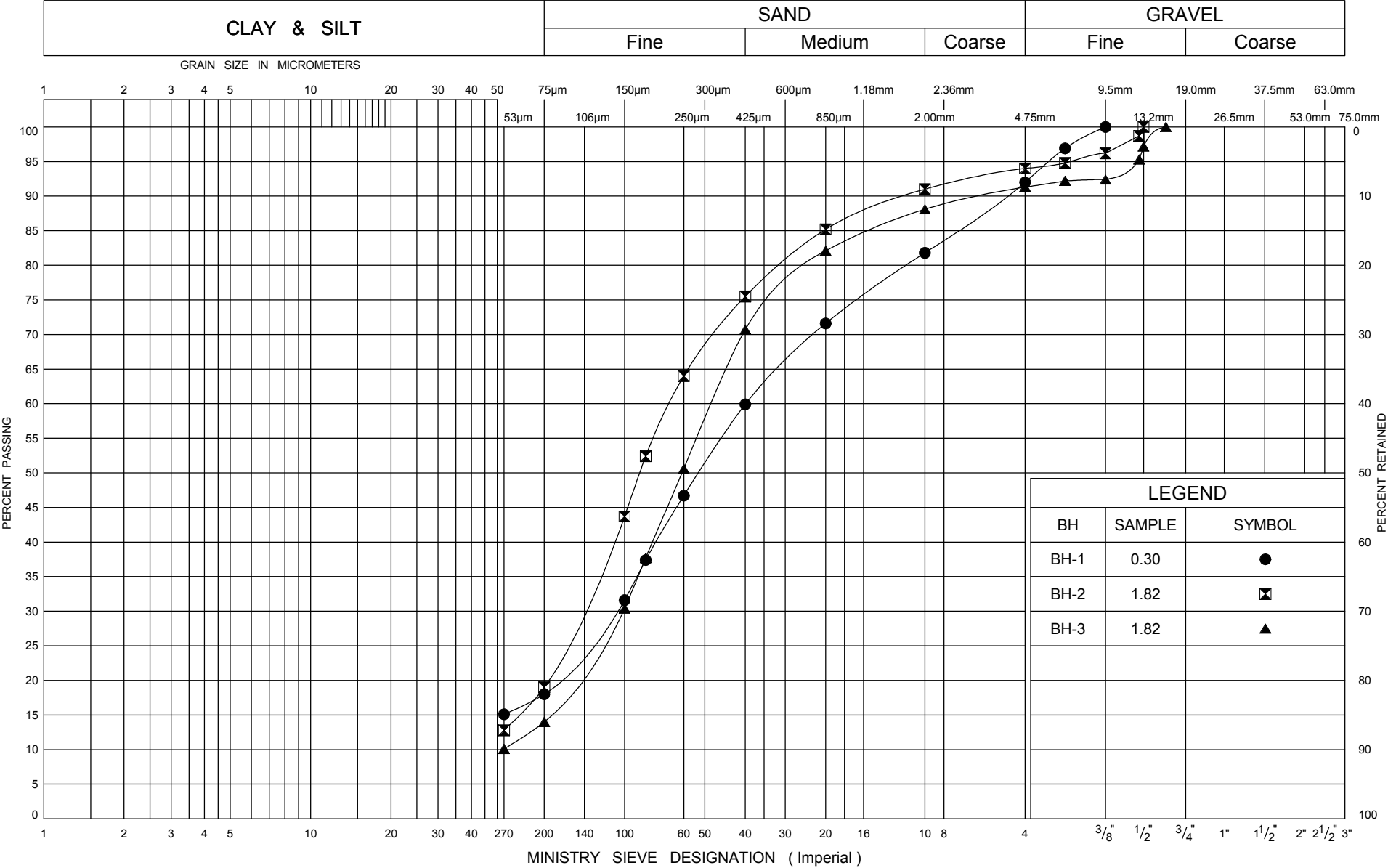
[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

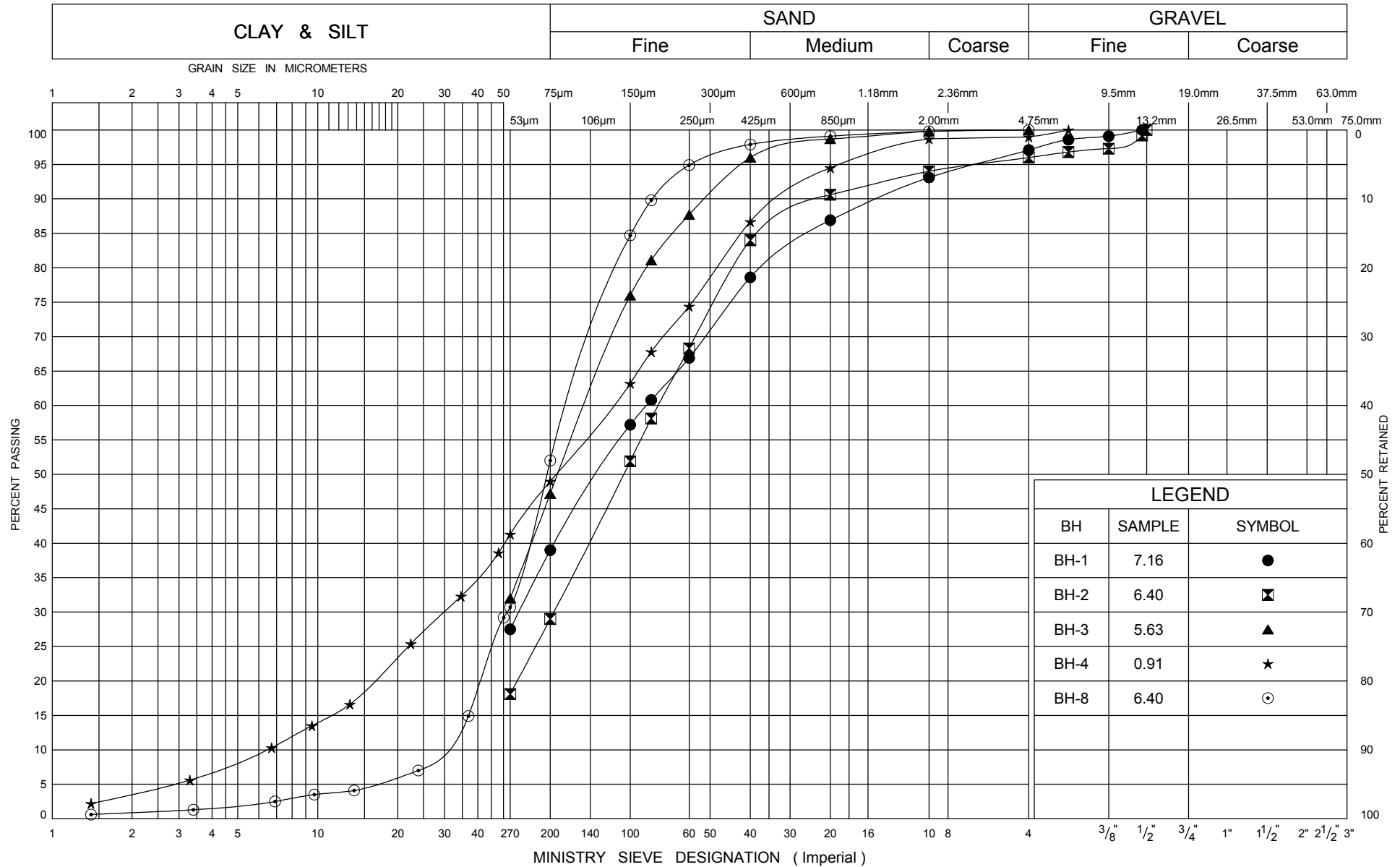
ONTARIO MTO ASSIGNMENT#1, MERO.GPJ ONTARIO MTO.GDT 10/18/18

## **Appendix D – Laboratory Test Results**

UNIFIED SOIL CLASSIFICATION SYSTEM



## UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
FILL: SILTY SAND/ SAND AND SILT

FIG No 2

W P.W.O. 2017-11021

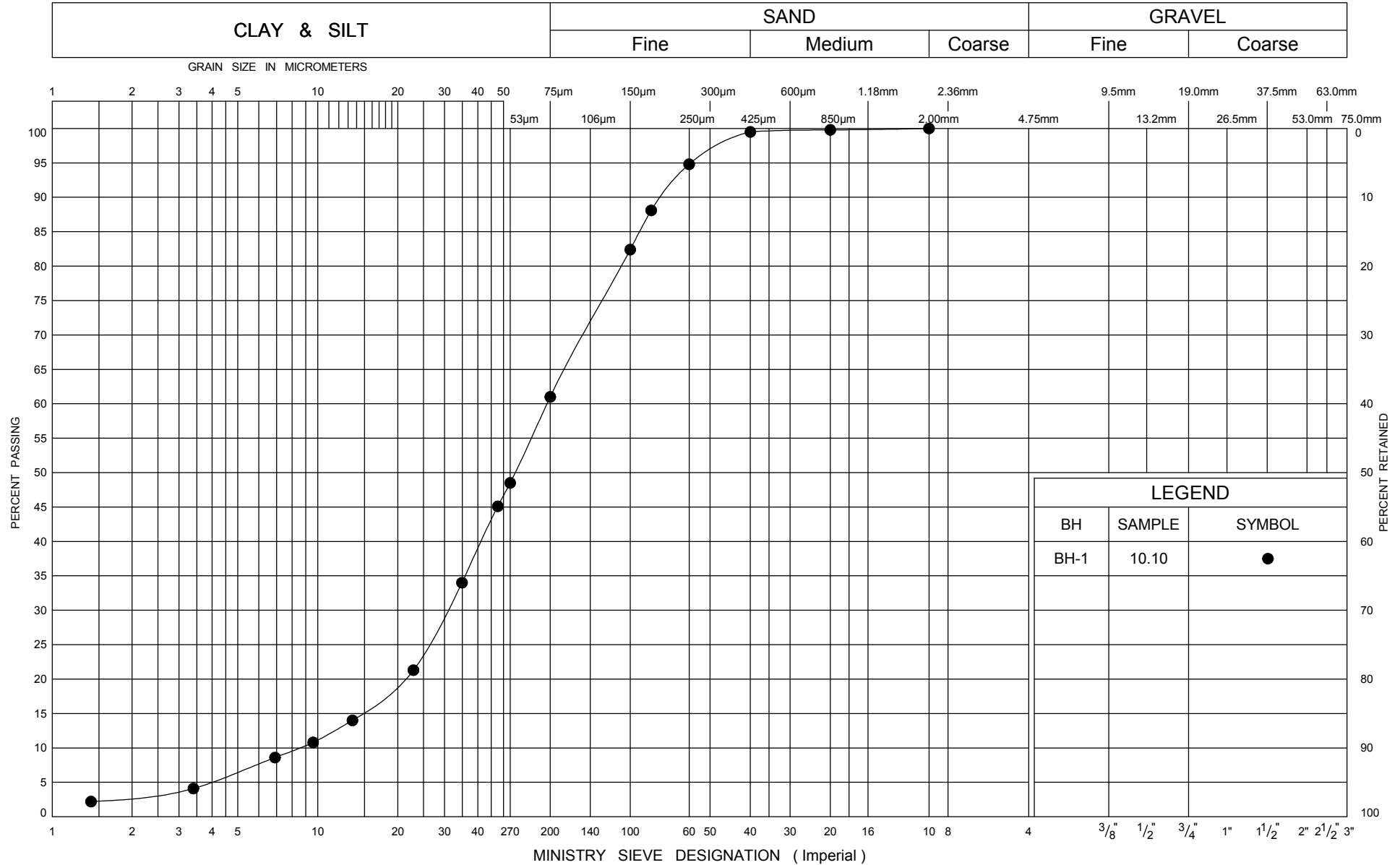
9016--E-0009, Assignment 1



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Ontario

## UNIFIED SOIL CLASSIFICATION SYSTEM



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Transportation

## GRAIN SIZE DISTRIBUTION SAND AND SILT

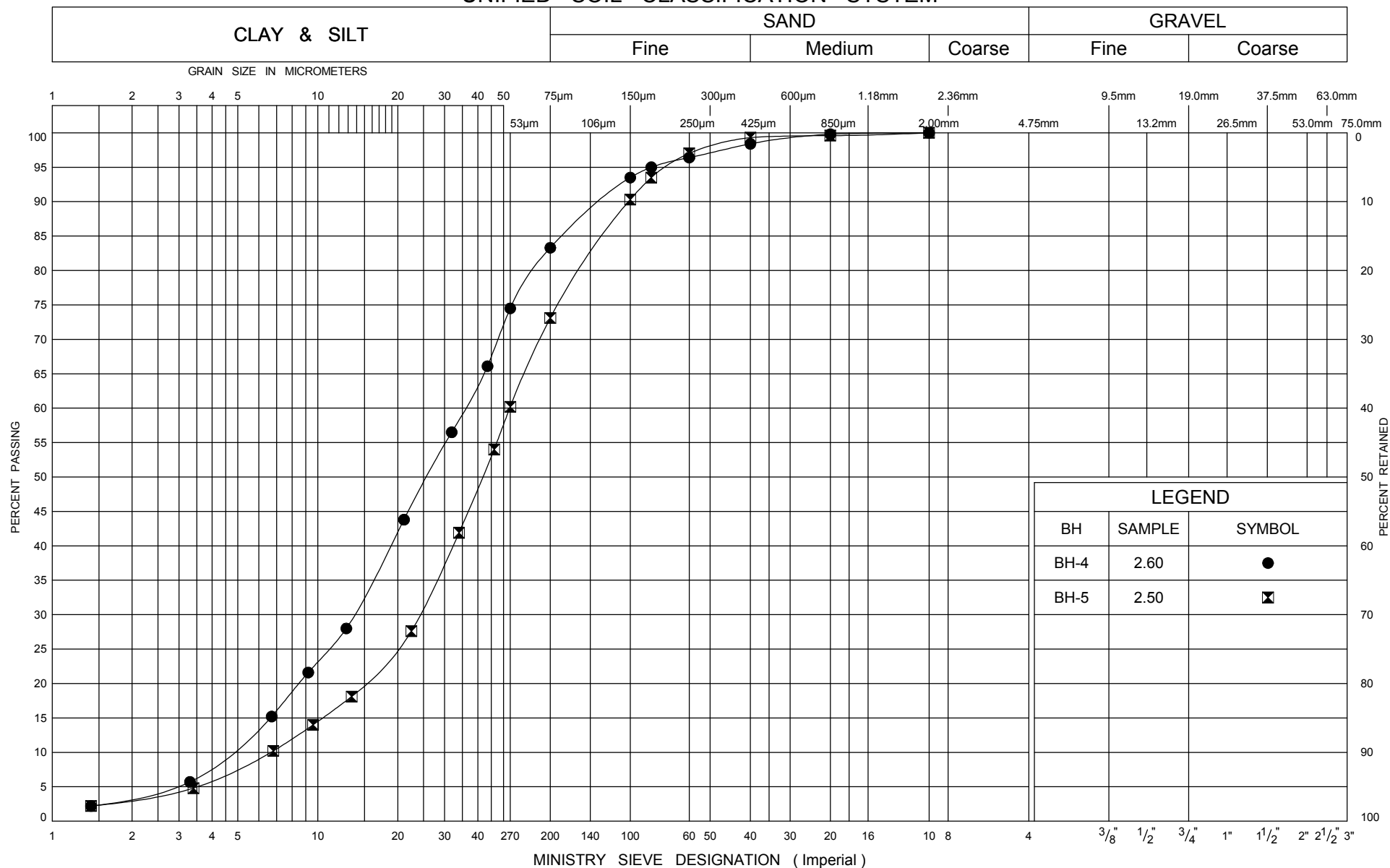
FIG No 3

W P.W.O. 2017-11021

9016--E-0009, Assignment 1



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
SANDY SILT WITH ORGANICS

FIG No 4

W P.W.O. 2017-11021

9016--E-0009, Assignment 1

## UNIFIED SOIL CLASSIFICATION SYSTEM

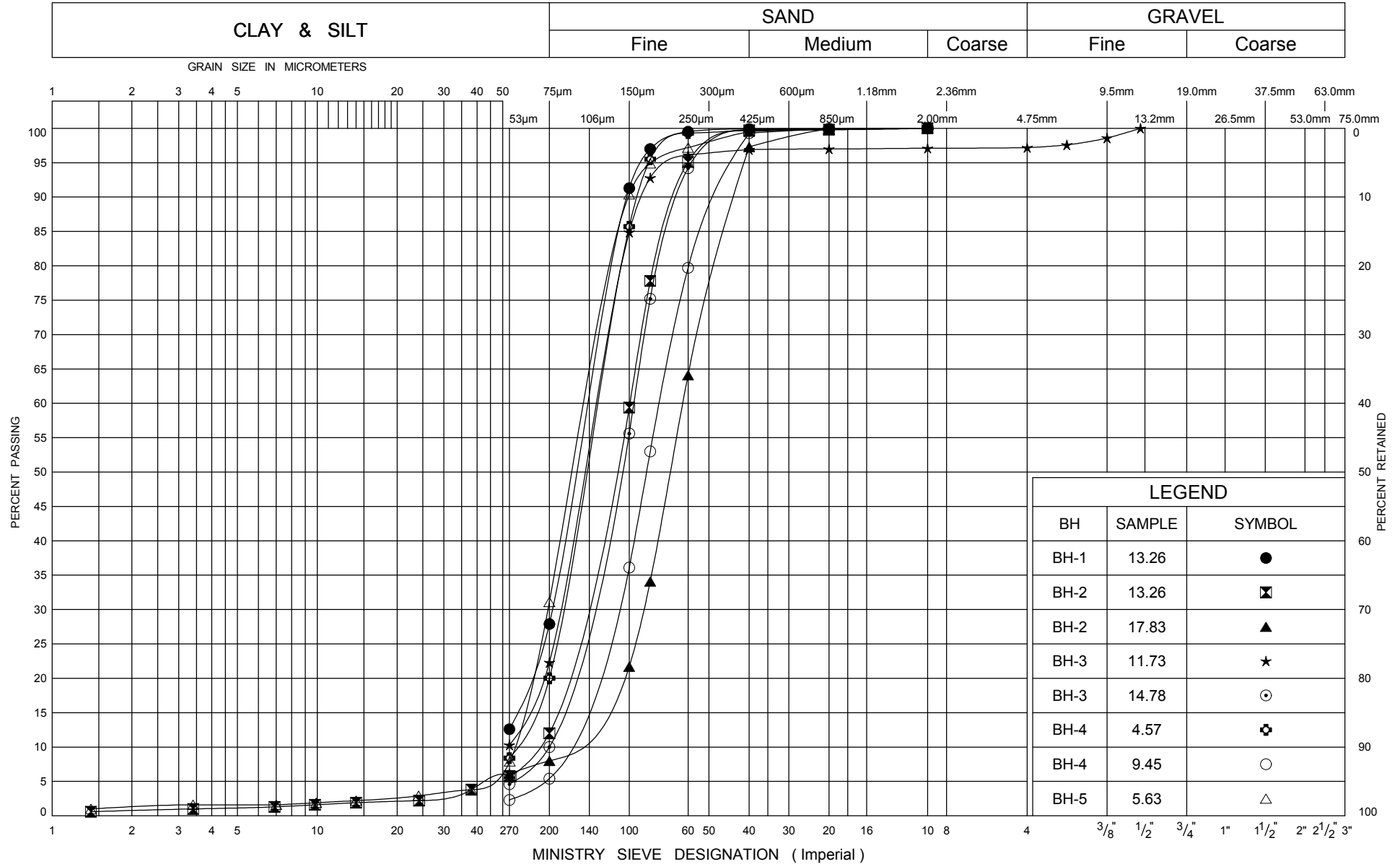
GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SAND

FIG No 5

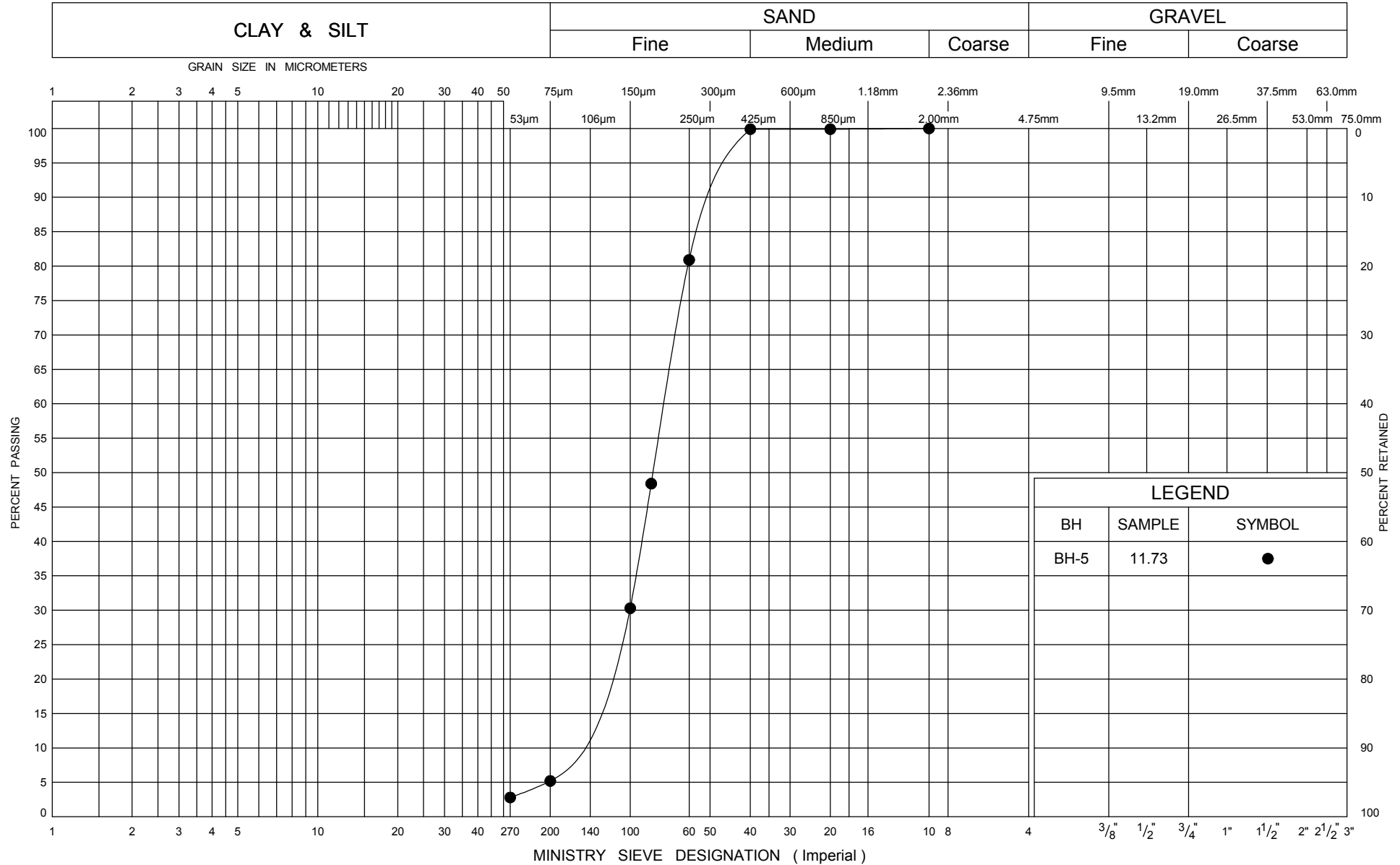
W P.W.O. 2017-11021

9016--E-0009, Assignment 1

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## UNIFIED SOIL CLASSIFICATION SYSTEM



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Transportation

## GRAIN SIZE DISTRIBUTION SILTY SAND TO SAND

FIG No 6

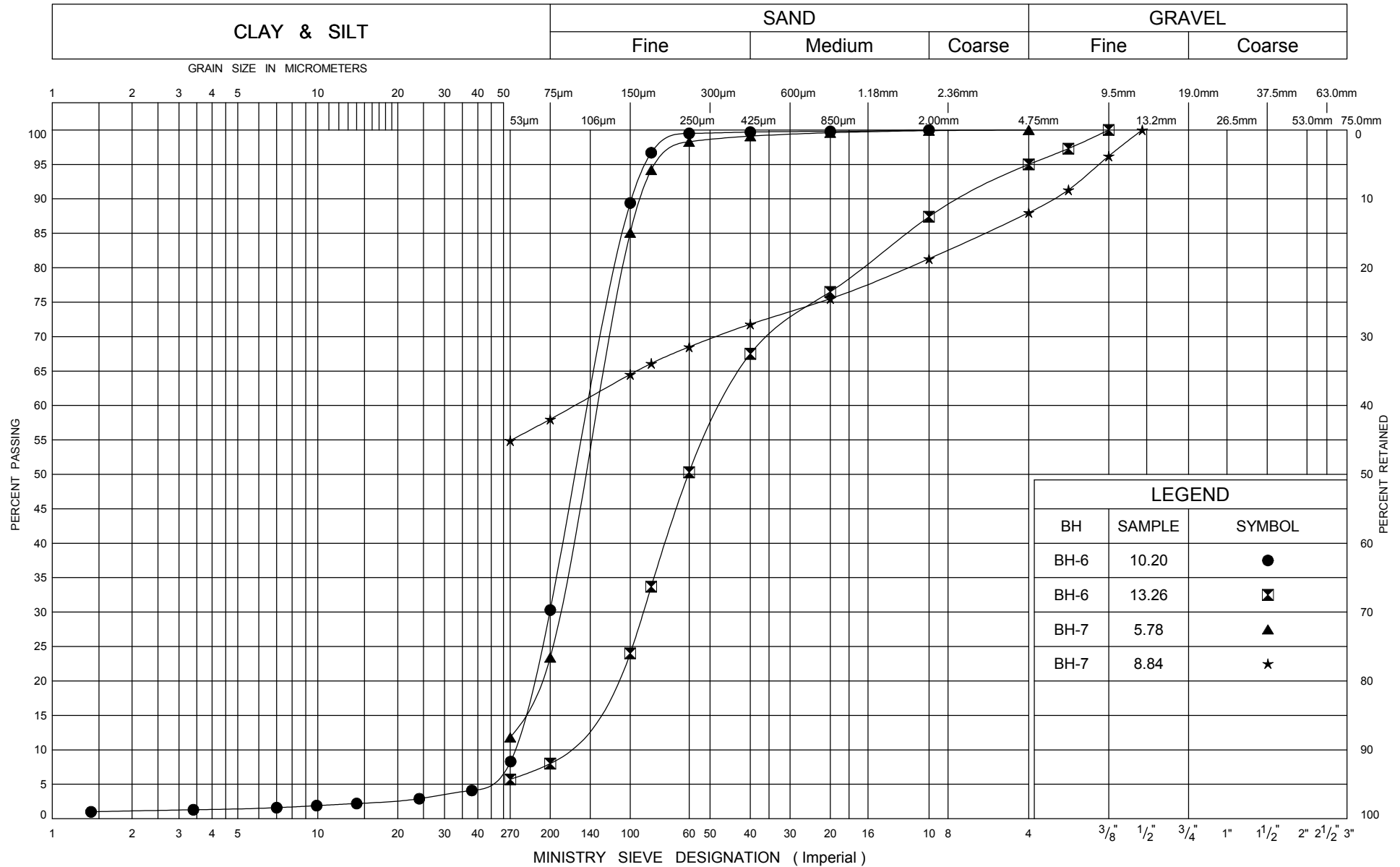
W P.W.O. 2017-11021

9016--E-0009, Assignment 1



FIG No 7
W PW.O. 2017-11021
9016--E-0009, Assignment 1

## UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SAND  
(Existing Culvert Location)

FIG No 8

W P.W.O. 2017-11021

9016--E-0009, Assignment 1



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Ontario

## **Appendix E – Chemical Analyses**

Your P.O. #: GEO  
Your Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your C.O.C. #: 68647

**Attention:Nimesh Tamrakar**

exp Services Inc  
1595 Clark Blvd  
Brampton, ON  
L6T 4V1

**Report Date: 2017/09/19**

Report #: R4720236

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7J6282**

**Received: 2017/09/08, 18:06**

Sample Matrix: Soil  
# Samples Received: 2

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Chloride (20:1 extract)	2	N/A	2017/09/13	CAM SOP-00463	EPA 325.2 m
Conductivity	2	N/A	2017/09/13	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	2	2017/09/13	2017/09/13	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2017/09/09	2017/09/14	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	2	N/A	2017/09/13	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



**Attention:Nimesh Tamrakar**

exp Services Inc  
1595 Clark Blvd  
Brampton, ON  
L6T 4V1

Your P.O. #: GEO  
Your Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your C.O.C. #: 68647

**Report Date: 2017/09/19**  
Report #: R4720236  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7J6282**

**Received: 2017/09/08, 18:06**

**Encryption Key**

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Deepthi Shaji, Project Manager  
Email: dshaji@maxxam.ca  
Phone# (905)817-5700 Ext:5807

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7J6282  
Report Date: 2017/09/19

exp Services Inc  
Client Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO  
Sampler Initials: NI

### SOIL CORROSIVITY PACKAGE (SOIL)

Maxxam ID		FCB639	FCB640		
Sampling Date		2017/09/05 11:00	2017/09/07 03:00		
COC Number		68647	68647		
	<b>UNITS</b>	<b>BH5 SS5</b>	<b>BH4 SS6</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Calculated Parameters</b>					
Resistivity	ohm-cm	1900	1500		5157113
<b>Inorganics</b>					
Soluble (20:1) Chloride (Cl)	ug/g	310	410	20	5161620
Conductivity	umho/cm	518	689	2	5161515
Available (CaCl2) pH	pH	5.74	5.17		5159921
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	5161621
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					

Maxxam Job #: B7J6282  
Report Date: 2017/09/19

exp Services Inc  
Client Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO  
Sampler Initials: NI

## TEST SUMMARY

**Maxxam ID:** FCB639  
**Sample ID:** BH5 SS5  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5161620	N/A	2017/09/13	Alina Dobreanu
Conductivity	AT	5161515	N/A	2017/09/13	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5159921	2017/09/13	2017/09/13	Tahir Anwar
Resistivity of Soil		5157113	2017/09/14	2017/09/14	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5161621	N/A	2017/09/13	Alina Dobreanu

**Maxxam ID:** FCB640  
**Sample ID:** BH4 SS6  
**Matrix:** Soil

**Collected:** 2017/09/07  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5161620	N/A	2017/09/13	Alina Dobreanu
Conductivity	AT	5161515	N/A	2017/09/13	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5159921	2017/09/13	2017/09/13	Tahir Anwar
Resistivity of Soil		5157113	2017/09/14	2017/09/14	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5161621	N/A	2017/09/13	Alina Dobreanu

Maxxam Job #: B7J6282  
Report Date: 2017/09/19

exp Services Inc  
Client Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO  
Sampler Initials: NI

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.7°C
-----------	-------

**Results relate only to the items tested.**

## QUALITY ASSURANCE REPORT

exp Services Inc  
Client Project #: ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO  
Sampler Initials: NI

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5159921	Available (CaCl <sub>2</sub> ) pH	2017/09/13			99	97 - 103			0.34	N/A
5161515	Conductivity	2017/09/13			99	90 - 110	<2	umho/cm	0.90	10
5161620	Soluble (20:1) Chloride (Cl)	2017/09/13	NC	70 - 130	107	70 - 130	<20	ug/g	6.6	35
5161621	Soluble (20:1) Sulphate (SO <sub>4</sub> )	2017/09/13	NC	70 - 130	105	70 - 130	<20	ug/g	2.5	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)



### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

*Cristina Carriere*

---

Cristina Carriere, Scientific Service Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

**Attention: SUBCONTRACTOR**

MAXXAM ANALYTICS INC.  
MISSISSAUGA CAMPO  
6740 Campobello Rd  
MISSISSAUGA, ON  
Canada L5N 2L8

Your P.O. #: GEO  
Your Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your C.O.C. #: B7J6282-MFOY-01-01

**Report Date: 2017/09/14**  
Report #: R2318848  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B755670**

**Received: 2017/09/12, 10:30**

Sample Matrix: SOIL  
# Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Primary Reference
Redox Potential***	2	2017/09/13	2017/09/13	QUE SOP-00151	SM 2580 B

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

Note: RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

\*\*\* This analysis is not subject to MDDELCC accreditation.

**Attention:SUBCONTRACTOR**

MAXXAM ANALYTICS INC.  
MISSISSAUGA CAMPO  
6740 Campobello Rd  
MISSISSAUGA, ON  
Canada L5N 2L8

Your P.O. #: GEO  
Your Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your C.O.C. #: B7J6282-MFOY-01-01

**Report Date: 2017/09/14**  
Report #: R2318848  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B755670**  
**Received: 2017/09/12, 10:30**

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Diane Goulet, Project Manager Assistant

Email: DGoulet@maxxam.ca

Phone# (418)658-5784 Ext:6442

=====

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Maxxam Job #: B755670  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO

### CONVENTIONAL PARAMETERS (SOIL)

<b>Maxxam ID</b>		EO1774	EO1775	
<b>Sampling Date</b>		2017/09/05 11:00	2017/09/05 15:00	
<b>COC Number</b>		B7J6282-MFOY-01-01	B7J6282-MFOY-01-01	
	<b>Units</b>	<b>FCB639-BH5 SS5</b>	<b>FCB640-BH4 SS6</b>	<b>QC Batch</b>
<b>CONVENTIONALS</b>				
Redox Potential	mV	140	160	1836707
QC Batch = Quality Control Batch				

Maxxam Job #: B755670  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO

### GENERAL COMMENTS

All results are calculated on a dry weight basis except where not applicable.

#### CONVENTIONAL PARAMETERS (SOIL)

Please note that the results have not been corrected for QC recoveries nor for the method blank results.

**Results relate only to the items tested.**



Maxxam Job #: B755670  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO

### QUALITY ASSURANCE REPORT

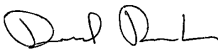

QA/QC									
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits	
1836707	CB8	Spiked Blank	Redox Potential	2017/09/13		99	%	80 - 120	
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.									

Maxxam Job #: B755670  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J6282/ADM-00241921-AO  
Site Location: BRACEBRIDGE, HWY11  
Your P.O. #: GEO

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

David Provencher, B.Sc., Chemist, Senior Analyst

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required	
Company Name: <u>EXP SERVICES INC</u>	Company Name: <u>EXP SERVICES INC</u>	Quotation #: <u>      </u>	<input type="checkbox"/> Regular TAT (5-7 days) Most analyses		<input type="checkbox"/> Rush TAT (Surcharges will be applied)		
Contact Name: <u>Nimesh Tamrakar</u>	Contact Name: <u>NIMESH TAMRAKAR</u>	P.O. #/ AFE#: <u>GEO</u>	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS		<input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3-4 Days		
Address: <u>56 Queen St E, Suite 301</u>	Address: <u>      </u>	Project #: <u>ADM-0024921-AD</u>	Site Location: <u>Bracebridge, Hwy 11</u>		Date Required: <u>      </u>		
Phone: <u>905-746-3200</u> Fax: <u>      </u>	Phone: <u>      </u> Fax: <u>      </u>	Site #: <u>      </u>	Sampled By: <u>Nimesh</u>		Rush Confirmation #: <u>      </u>		
Email: <u>NIMESH.TAMRAKAR@EXP.COM</u>	Email: <u>      </u>	MSE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY		LABORATORY USE ONLY			
<b>Regulation 153</b> <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/ Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/ Other <input type="checkbox"/> Table <u>      </u> FOR RSC (PLEASE CIRCLE) Y / N		<b>Other Regulations</b> <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> PWQO <input type="checkbox"/> Region <input type="checkbox"/> Other (Specify) <u>      </u> <input type="checkbox"/> REG 558 (MIN. 3 DAY TAT REQUIRED)		<b>Analysis Requested</b> REFER TO BACK OF COC REG 153 METALS & INORGANICS REG 153 ICPMS METALS REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B) <u>Continuity Package</u>		CUSTODY SEAL Y / N Present Intact <u>  </u> <u>  </u> COOLER TEMPERATURES <u>61819</u> COOLING MEDIA PRESENT: <input checked="" type="radio"/> Y <input type="radio"/> N	
Include Criteria on Certificate of Analysis: Y / N SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM							
SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX / PHC F1	PHC F2 - F4
1 <u>BH5 SS5</u>	<u>2017/09/05</u>	<u>11:00</u>	<u>Soil</u>	<u>2</u>	<u>  </u>	<u>  </u>	<u>  </u>
2 <u>BH6 SS6</u>	<u>2017/09/07</u>	<u>3:00</u>	<u>Soil</u>	<u>2</u>	<u>  </u>	<u>  </u>	<u>  </u>
3							
4							
5							
6							
7							
8							
9							
10							
RELINQUISHED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME: (HH:MM)
<u>Nimesh Tamrakar</u>		<u>2017/09/08</u>	<u>15:00</u>	<u>Deepthi Shaji</u>		<u>2017/09/08</u>	<u>18:06</u>

**Attention: Deepthi Shaji**

MAXXAM ANALYTICS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

Your P.O. #: GEO  
Your Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your C.O.C. #: B7J6282-M058-01-01

**Report Date: 2017/09/15**  
Report #: R2444926  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B778284**

**Received: 2017/09/12, 13:20**

Sample Matrix: Soil  
# Samples Received: 2

Analyses	Date		Date Analyzed	Laboratory Method	Analytical Method
	Quantity	Extracted			
Moisture	2	2017/09/13	2017/09/14	BBY8SOP-00017	BCM0E BCLM Dec2000 m
Sulphide in Soil	2	2017/09/12	2017/09/14	BBY6SOP-00006	SM 22 4500 S2- D m

**Remarks:**

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All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

**Attention:Deepthi Shaji**

MAXXAM ANALYTICS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

Your P.O. #: GEO  
Your Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your C.O.C. #: B7J6282-M058-01-01

**Report Date: 2017/09/15**  
Report #: R2444926  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B778284**  
**Received: 2017/09/12, 13:20**

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Amandeep Nagra, Account Specialist

Email: ANagra@maxxam.ca

Phone# (604)639-2602

=====

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Maxxam Job #: B778284  
Report Date: 2017/09/15

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

### RESULTS OF CHEMICAL ANALYSES OF SOIL

<b>Maxxam ID</b>		RY3020		RY3021		RY3021		
<b>Sampling Date</b>		2017/09/05		2017/09/07		2017/09/07		
<b>COC Number</b>		B7J6282-M058-01-01		B7J6282-M058-01-01		B7J6282-M058-01-01		
	<b>UNITS</b>	<b>BH5 SS5 (FCB639)</b>	<b>RDL</b>	<b>BH4 SS6 (FCB640)</b>	<b>RDL</b>	<b>BH4 SS6 (FCB640) Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>MISCELLANEOUS</b>								
Sulphide	ug/g	0.85 (1)	0.60	1.24 (1)	0.50	0.71	0.55	8755809
RDL = Reportable Detection Limit								
Lab-Dup = Laboratory Initiated Duplicate								
(1) Headspace in sample jar was noted at the time of extraction. RDL raised due to high sample moisture content.								

Maxxam Job #: B778284  
Report Date: 2017/09/15

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

### PHYSICAL TESTING (SOIL)

<b>Maxxam ID</b>		RY3020	RY3021		
<b>Sampling Date</b>		2017/09/05	2017/09/07		
<b>COC Number</b>		B7J6282-M058-01-01	B7J6282-M058-01-01		
	<b>UNITS</b>	<b>BH5 SS5 (FCB639)</b>	<b>BH4 SS6 (FCB640)</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Physical Properties</b>					
Moisture	%	39	33	0.30	8756467
RDL = Reportable Detection Limit					

Maxxam Job #: B778284  
Report Date: 2017/09/15

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

## TEST SUMMARY

**Maxxam ID:** RY3020  
**Sample ID:** BH5 SS5 (FCB639)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/12

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8756467	2017/09/13	2017/09/14	Lolita Obusan
Sulphide in Soil	SPEC/COL	8755809	2017/09/12	2017/09/14	Karen Brunn

**Maxxam ID:** RY3021  
**Sample ID:** BH4 SS6 (FCB640)  
**Matrix:** Soil

**Collected:** 2017/09/07  
**Shipped:**  
**Received:** 2017/09/12

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8756467	2017/09/13	2017/09/14	Lolita Obusan
Sulphide in Soil	SPEC/COL	8755809	2017/09/12	2017/09/14	Karen Brunn

**Maxxam ID:** RY3021 Dup  
**Sample ID:** BH4 SS6 (FCB640)  
**Matrix:** Soil

**Collected:** 2017/09/07  
**Shipped:**  
**Received:** 2017/09/12

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide in Soil	SPEC/COL	8755809	2017/09/12	2017/09/14	Karen Brunn

Maxxam Job #: B778284  
Report Date: 2017/09/15

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C
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**Results relate only to the items tested.**

Maxxam Job #: B778284  
Report Date: 2017/09/15

## QUALITY ASSURANCE REPORT

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8755809	Sulphide	2017/09/14	112 (1)	75 - 125	82	75 - 125	<0.50	ug/g	NC (2)	30
8756467	Moisture	2017/09/14					<0.30	%	5.9 (3)	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference  $\leq 2 \times \text{RDL}$ ).

(1) Matrix Spike Parent ID [RY3021-01]

(2) Duplicate Parent ID [RY3021-01]

(3) Duplicate Parent ID



Maxxam Job #: B778284  
Report Date: 2017/09/15

MAXXAM ANALYTICS  
Client Project #: MB7J6282  
Site Location: ADM-00241921-AO  
Your P.O. #: GEO  
Sampler Initials: NI

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, B.Sc., Scientific Spécialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

**Appendix F –  
Record of boreholes and laboratory data (Golder  
Associates)**

1 OF 2 **METRIC**

W.P.	LOCATION	N 4993667.2; E 320702.6 (LAT. 45.084815; LONG. -79.297809)	ORIGINATED BY	IK
DIST	HWY	11 (SBL)	BOREHOLE TYPE	108 mm I.D. Hollow Stem Augers
DATUM	GEODETIC	DATE	February 27, 2017	CHECKED BY
				SEMP

[illegible]

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

MSUD-MTO 001 LAT/LONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT <u>1651997</u>				<b>RECORD OF BOREHOLE No 17-1</b>				2 OF 2 <b>METRIC</b>						
W.P. _____				LOCATION <u>N 4993667.2; E 320702.6 (LAT. 45.084815; LONG. -79.297809)</u>				ORIGINATED BY <u>IK</u>						
DIST _____ HWY <u>11 (SBL)</u>				BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>				COMPILED BY <u>TB</u>						
DATUM <u>GEODETIC</u>				DATE <u>February 27, 2017</u>				CHECKED BY <u>SEMP</u>						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT W <sub>p</sub> W W <sub>L</sub>			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED						
	SAND, trace to some gravel, trace to some silt Loose to compact Brown Wet		12	SS	9		268						19 75 (6)	
							267							
			13	SS	7		266							
							265							
			14	SS	13		264							
							263							
			15	SS	12		262							
							261							
			16	SS	9		260							
262.2 18.7	END OF BOREHOLE START OF DCPT													
259.3 21.6	END OF DCPT													
	Note:  1. Groundwater level not recorded due to water introduced during drilling to mitigate heaving sand.													

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT		RECORD OF BOREHOLE No 17-2				1 OF 1 METRIC								
W.P. _____		LOCATION N 4993666.5; E 320736.3 (LAT. 45.084808; LONG. -79.297382)				ORIGINATED BY IK								
DIST _____ HWY 11 (NBL)		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers and HQ Casing/Coring				COMPILED BY TB								
DATUM GEODETIC		DATE February 28, 2017				CHECKED BY SEMP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
282.0	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	ASPHALT (200 mm)													
0.2	Sand, some gravel, trace silt (FILL) Compact to very dense Brown Moist		1	AS	-									
			2	SS	44									
			3	SS	24									
			4	SS	50/0.05									
279.4	Auger grinding from 2.5 m to 2.6 m depth.													
2.6	ROCK FILL													
			R1	RC	REC 58%									
277.7														
4.3	Sand, some silt, some gravel (FILL) Compact Brown Moist		5A	SS	29									
276.7														
5.3	ROCK FILL													
			R2	RC	REC 7%									
			5B	SS	44									
			R3	RC	REC 0%									
275.1	No recovery in Sample 5B.													
6.9	Silty sand and gravel (FILL) Very dense Brown Moist													
			6	SS	50/0.13									
273.8														
8.2	END OF BOREHOLE													
	Note:  1. Cored through existing culvert at 8.2 m depth. Culvert obvert plugged and borehole backfilled.													

SUD-MTO 001 LAT/LONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

**RECORD OF BOREHOLE No 17-2B**

1 OF 3 **METRIC**

PROJECT 1651997  
W.P. LOCATION N 4993660.2; E 320739.0 (LAT. 45.084752; LONG. -79.297347) ORIGINATED BY IK  
DIST HWY 11 (NBL) BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers and HQ Casing/Coring COMPILED BY TB  
DATUM GEODETIC DATE February 28 and March 8, 2017 CHECKED BY SEMP


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)							
								○ UNCONFINED   + FIELD VANE			w <sub>p</sub> w   w <sub>L</sub>							
								● QUICK TRIAXIAL   × REMOULDED										
282.1	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT (110 mm)																	
0.1	Sand, trace to some silt, trace gravel (FILL) Compact to dense Brown to dark brown Moist		1	AS	-		282											
			2	SS	32		281										3   87   9   1	
			3	SS	24													
	Split-spoon sampler bouncing on inferred cobble at 2.3 m depth.		4	SS	50/0.02		280											
	Auger grinding from 3.0 to 3.5 m depth.		5	SS	14		279											
278.6	ROCK FILL		R1	RC	REC 93%		278											
3.5			R2	RC	REC 10%		277											
276.3	Silty sand, trace gravel (FILL) Very loose to dense Brown to dark brown Moist to wet		6	SS	36		276											
5.8			7	SS	5		275											
			8	SS	10		274											
			9	SS	2		273											
272.0	SILT and SAND, trace clay, trace organics, trace rootlets Loose Black Moist		10A 10B	SS	6		272											
10.1							271											

Continued Next Page

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:



PROJECT <u>1651997</u>				<b>RECORD OF BOREHOLE No 17-2B</b>				2 OF 3 <b>METRIC</b>						
W.P. _____				LOCATION <u>N 4993660.2; E 320739.0 (LAT. 45.084752; LONG. -79.297347)</u>				ORIGINATED BY <u>IK</u>						
DIST _____ HWY <u>11 (NBL)</u>				BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers and HQ Casing/Coring</u>				COMPILED BY <u>TB</u>						
DATUM <u>GEODETIC</u>				DATE <u>February 28 and March 8, 2017</u>				CHECKED BY <u>SEMP</u>						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED		WATER CONTENT (%) W <sub>p</sub> W W <sub>L</sub>				
--- CONTINUED FROM PREVIOUS PAGE ---														
267.4	SILT and SAND, trace clay, trace organics, trace rootlets Loose Black Moist		11	SS	9		270							0 60 39 1
							269							
							268							
							267							
							266							
							265							
14.7	SAND, some silt Compact to dense Brown Wet		13	SS	36		264							0 85 14 1
						263								
						262								
						261								
263.2	END OF BOREHOLE START OF DCPT		14	SS	33		260							
18.9			15	SS	21		259							
			16	SS	33									

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

<b>PROJECT</b> 1651997		<b>RECORD OF BOREHOLE No 17-2B</b>		3 OF 3 <b>METRIC</b>	
W.P. _____		LOCATION N 4993660.2; E 320739.0 (LAT. 45.084752; LONG. -79.297347)		ORIGINATED BY IK	
DIST _____ HWY 11 (NBL)		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers and HQ Casing/Coring		COMPILED BY TB	
DATUM GEODETIC		DATE February 28 and March 8, 2017		CHECKED BY SEMP	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED							W <sub>p</sub> W W <sub>L</sub>		
257.7							258											
24.4	END OF DCPT  Note:  1. Water level at a depth of 7.6 m below ground surface (Elev. 274.5) upon completion of drilling.																	

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT 1651997		<b>RECORD OF BOREHOLE No 17-3</b>				1 OF 2 <b>METRIC</b>						
W.P. _____		LOCATION N 4993676.9; E 320698.4 (LAT. 45.084903; LONG. -79.297863)				ORIGINATED BY IK						
DIST _____ HWY 11 (SBL)		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers and NQ Casing/Coring				COMPILED BY TB						
DATUM GEODETIC		DATE March 8, 2017				CHECKED BY SEMP						
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>			
280.7	GROUND SURFACE											
0.0	ASPHALT (110 mm)		1	AS	-		280					
0.1	Sand, trace to some silt, trace to some gravel (FILL) Compact to dense Brown to dark brown Moist		2	SS	38							
			3	SS	17		279					
			4	SS	12		278					0 84 16 0
			5	SS	20							
			6	SS	19		277					
			7	SS	20		276					
			8	SS	16		275					
							274					
273.5	Silty sand, trace clay, trace organics (FILL) Compact Brown Moist		9	SS	21		273					OC = 1.2% 0 75 24 1
							272					
272.1	SILT and SAND, trace clay, trace gravel Loose to compact Grey to brown Moist to wet		10	SS	10		271					0 48 52 0
							270					
			11	SS	7		269					

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

SUD-MTO 001 LAT/LONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT 1651997				RECORD OF BOREHOLE No 17-3				2 OF 2 METRIC										
W.P. _____				LOCATION N 4993676.9; E 320698.4 (LAT. 45.084903; LONG. -79.297863)				ORIGINATED BY IK										
DIST _____ HWY 11 (SBL)				BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers and NQ Casing/Coring				COMPILED BY TB										
DATUM GEODETIC				DATE March 8, 2017				CHECKED BY SEMP										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
	--- CONTINUED FROM PREVIOUS PAGE ---						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)						
266.0	SILT and SAND, trace clay, trace gravel Loose to compact Grey to brown Moist to wet  Seam of coarse sand encountered in Sample 12.  0.3 m of sand heaving in augers at 12.2 m depth.		12	SS	8		20	40	60	80	100							
			13	SS	8													
14.7	SAND, trace silt Compact Grey to brown Moist to wet																	
265.0			14	SS	17													
15.7	END OF BOREHOLE START OF DCPT																	
259.4																		
21.3	END OF DCPT																	

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT 1651997				RECORD OF BOREHOLE No 17-4				1 OF 2 METRIC						
W.P. _____				LOCATION N 4993677.7; E 320731.4 (LAT. 45.084909; LONG. -79.297443)				ORIGINATED BY IK						
DIST _____ HWY 11 (NBL)				BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TB						
DATUM GEODETIC				DATE March 8, 2017				CHECKED BY SEMP						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
281.6	GROUND SURFACE													
0.0	ASPHALT (120 mm)													
0.1	Sand, trace to some silt, trace gravel (FILL) Dense Brown Moist		1	AS	-									
			2	SS	37									
			3	SS	30									
279.5	Sand and gravel, trace to some silt, containing cobbles (FILL) Dense to very dense Grey Moist		4	SS	50/0.08									2 92 (6)
2.1			5	SS	30									
277.9	Sand, trace to some silt, trace to some gravel (FILL) Compact to dense Brown Moist		6	SS	15									54 36 (10)
3.7	Auger grinding from 2.3 m to 5.3 m depth.		7	SS	46									7 86 (7)
			8	SS	26									
274.3	GRANITE (BEDROCK) Bedrock cored from 7.3 m to 10.3 m depth. For coring details see Record of Drillhole 17-4.		1	RC	REC 95%									RQD = 86%
7.3			2	RC	REC 100%									RQD = 100%
271.3	END OF BOREHOLE													
10.3	Note:  1. Water level at a depth of 7.3 m below ground surface (Elev. 274.3) upon completion of drilling.													

SUD-MTO 001 LAT/LONG 1651997.GPJ GAL-MISS.GDT 07/04/17 DATA INPUT:

PROJECT: 1651997

**RECORD OF DRILLHOLE: 17-4**

SHEET 2 OF 2

LOCATION: N 4993677.7; E 320731.4 (LAT. 45.084909; LONG. -79.297443)

DRILLING DATE: March 8, 2017

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Downing Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										Q AVG.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA						ROCK STRENGTH INDEX	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja			Jn	R1	R2	R3	W1	W2	W3	W4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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DEPTH SCALE

1 : 60

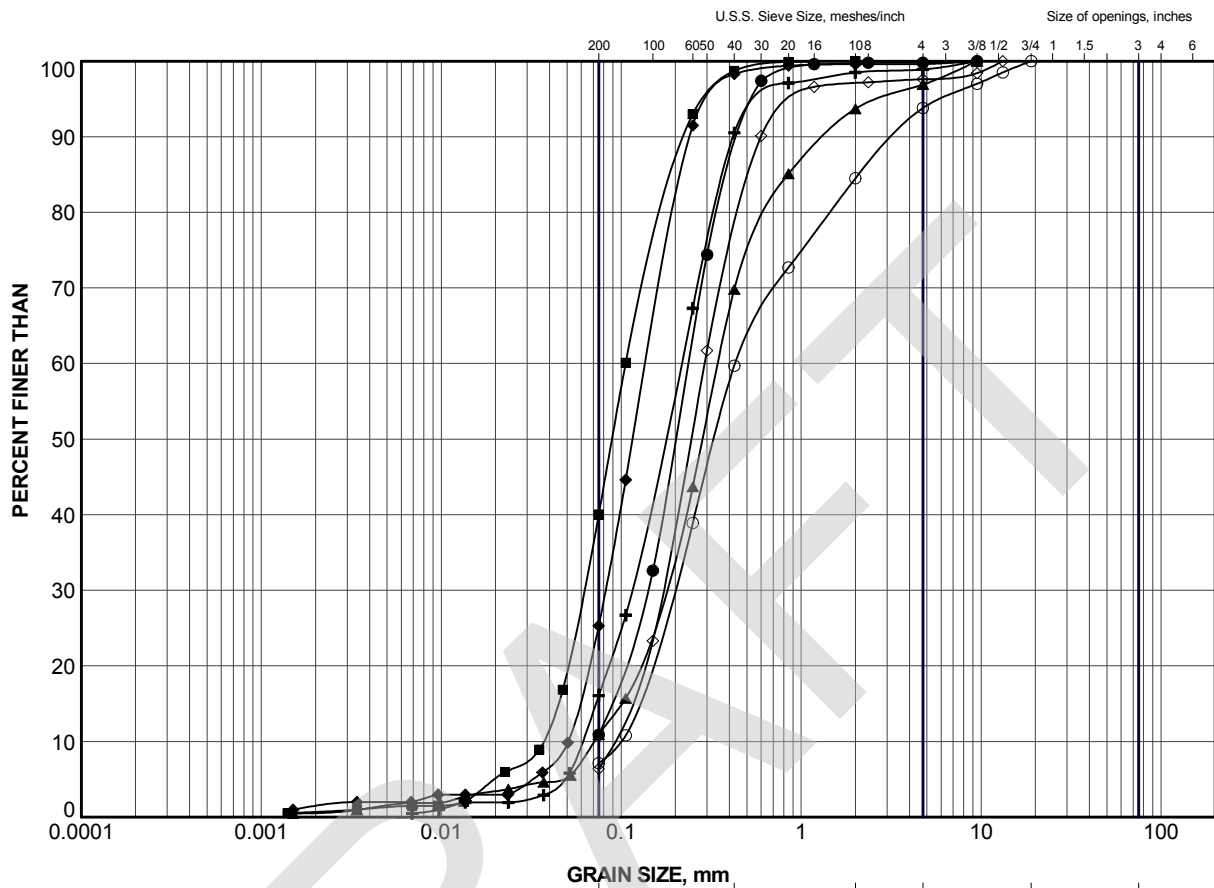


LOGGED: IK

CHECKED: SEMP

SUD-RCK (LAT/LONG) 1651997.GPJ GAL-MISS.GDT 31/03/17 DATA INPUT:




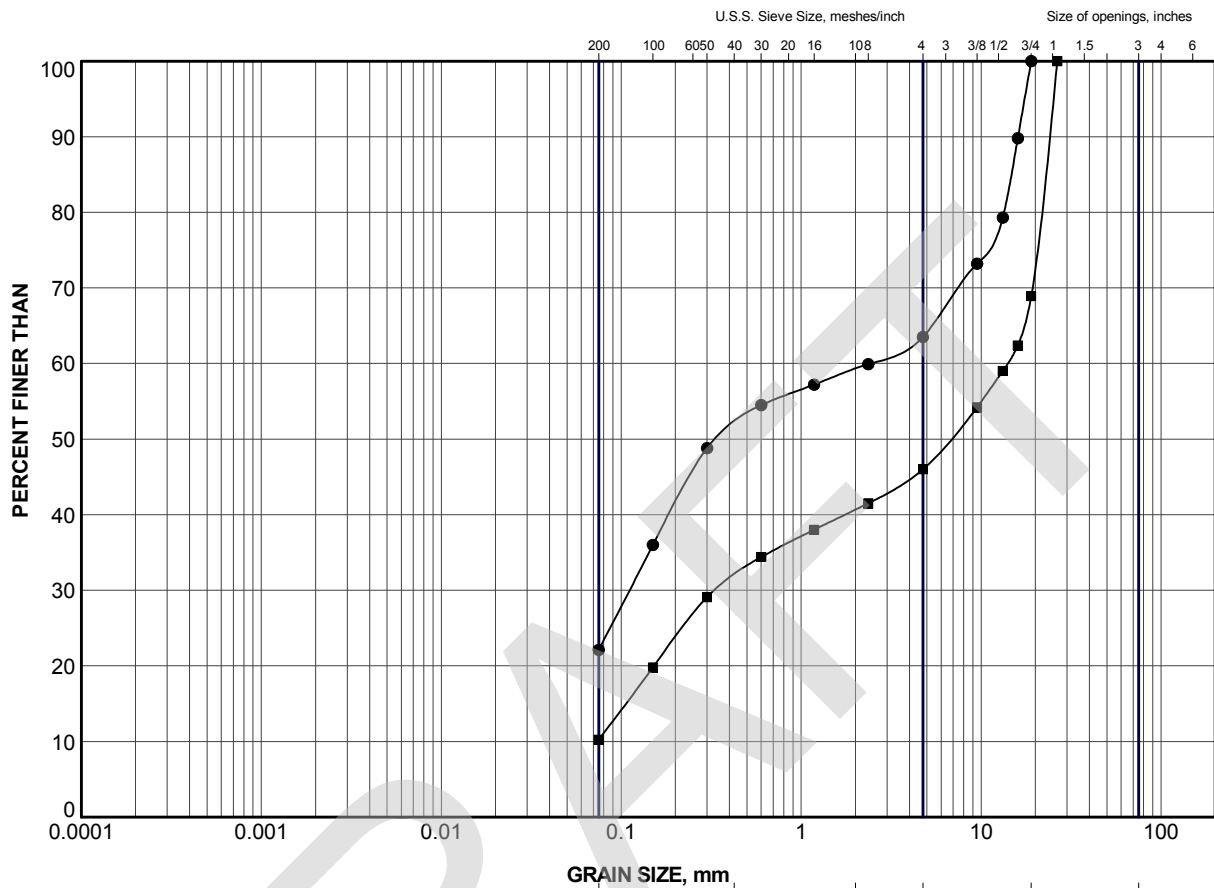


CLAY AND SILT	SAND SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	17-1	5	277.6
■	17-1	9	273.1
▲	17-2B	2	281.1
+	17-3	4	278.2
◆	17-3	9	272.9
◇	17-4	3	279.9
○	17-4	7	276.8

PROJECT						HIGHWAY 11 BRACEBRIDGE CULVERT STA 16+312					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND, SILTY SAND, SAND (FILL)					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Mar 2017	SCALE	N/A	REV.						
CHECK	SEMP	Mar 2017									
APPR	LCC	Mar 2017									
 <b>Golder Associates</b> SUDBURY, ONTARIO			<b>FIGURE 1</b>								



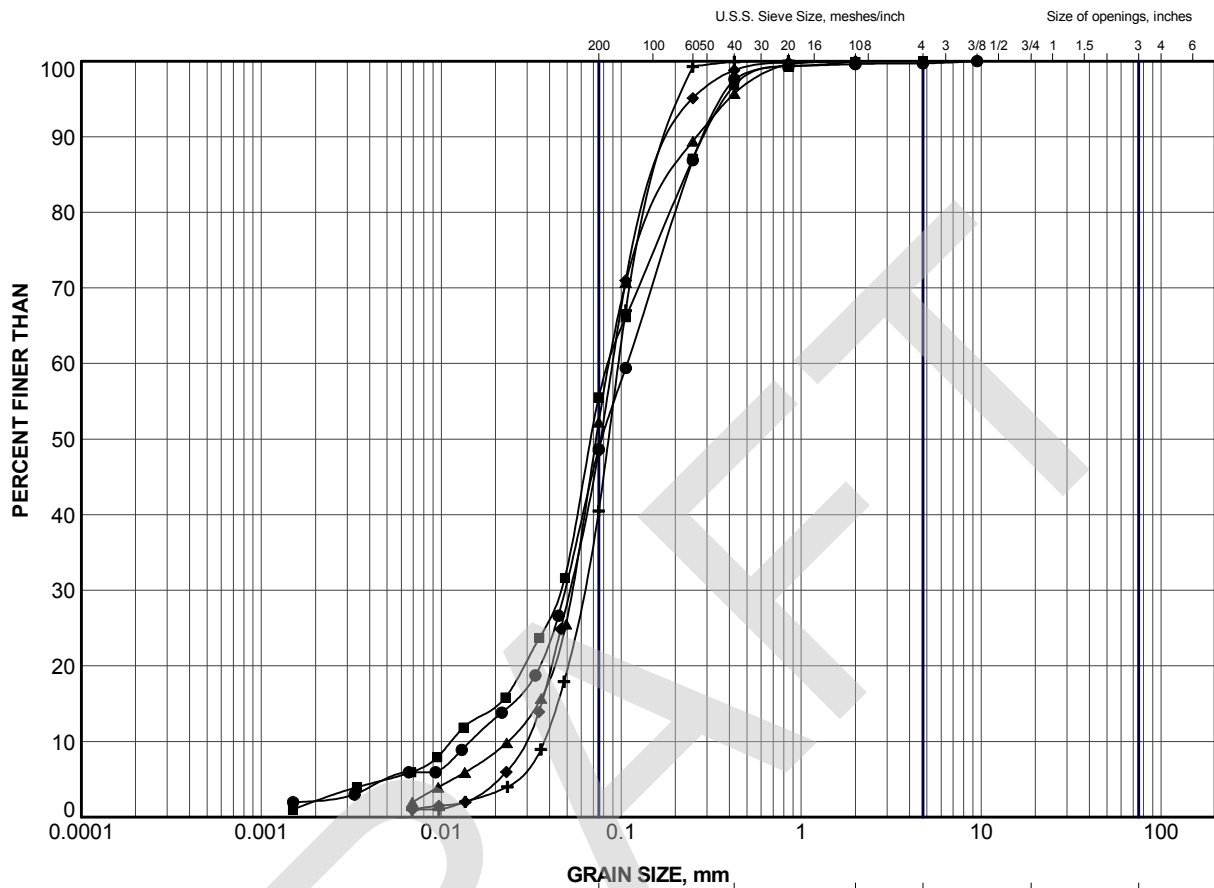
CLAY AND SILT	SAND SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	17-2	6	274.3
■	17-4	5	278.4

PROJECT						HIGHWAY 11 BRACEBRIDGE CULVERT STA 16+312					
TITLE						GRAIN SIZE DISTRIBUTION SAND and GRAVEL (FILL)					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Mar 2017	SCALE	N/A	REV.						
CHECK	SEMP	Mar 2017									
APPR	LCC	Mar 2017									
						FIGURE 2					





#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	17-1	10	271.5
■	17-2B	10A	271.3
▲	17-2B	10B	271.1
+	17-2B	12	268.2
◆	17-3	10	271.3

PROJECT

HIGHWAY 11  
BRACEBRIDGE CULVERT STA 16+312

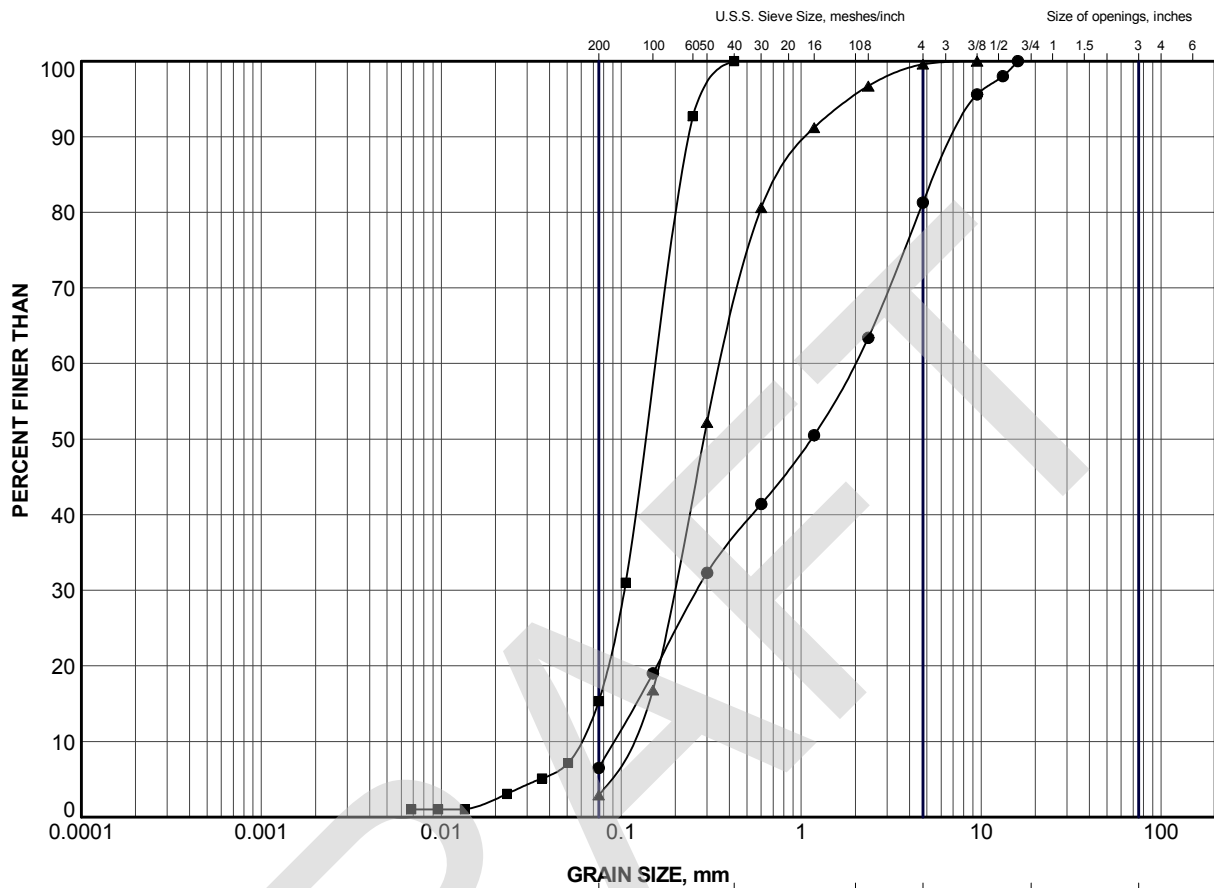
TITLE

**GRAIN SIZE DISTRIBUTION**  
SILT and SAND



**Golder  
Associates**  
SUDBURY, ONTARIO

PROJECT No. 1651997			FILE No. 1651997.GPJ		
DRAWN	TB	Mar 2017	SCALE	N/A	REV.
CHECK	SEMP	Mar 2017	<b>FIGURE 3</b>		
APPR	LCC	Mar 2017			



### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	17-1	12	268.5
■	17-2B	16	263.5
▲	17-3	14	265.2

PROJECT					
HIGHWAY 11 BRACEBRIDGE CULVERT STA 16+312					
TITLE					
GRAIN SIZE DISTRIBUTION SAND					
PROJECT No.		1651997		FILE No. 1651997.GPJ	
DRAWN	TB	Mar 2017	SCALE	N/A	REV.
CHECK	SEMP	Mar 2017	FIGURE 4		
APPR	LCC	Mar 2017			

