



## Foundation Investigation Report

Rehabilitation/Replacement of 25 Non-Structural Culverts at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto - **Highway 404 CSP Culvert Replacement (CV-0249-0404-00N3)**

GWP: 2459-16-00

Assignment No. 2020-E-0028

MTO Central Region

Latitude: 44.04846; Longitude:-79.4174

Geocres No. 31D03-001

**Type of Document:**

Final Report

**EXP Project Number:**

ADM-22007871-A0

**Prepared For:**

CONSOR Engineers LLC

5090 Explorer Drive, Unit 801

Mississauga, Ontario

L4W 4T9

Attn: Sharm Janaka Talagala, M.Eng., P.Eng.

**Prepared By:**

EXP Services Inc.

1595 Clark Boulevard

Brampton, ON L6T 4V1

Canada

**Date Submitted:**

March 28, 2024

CONSOR Engineers LLC

## Foundation Investigation Report

### Project Name:

Rehabilitation/Replacement of 25 Non-Structural Culverts at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto - **Highway 404 CSP Culvert Replacement (CV-0249-0404-00N3)**

GWP: 2459-16-00

Assignment No. 2020-E-0028

MTO Central Region

Latitude: 44.04846; Longitude:-79.4174

Geocres No. 31D03-001

### Type of Document:

Final Report

### EXP Project Number:

ADM-22007871-A0

### Issue and Revised Record

Rev.	Date	Format	Prepared by	Reviewed by	Approved by	Description
<b>A</b>	March 25, 2024	pdf	N. Tamrakar	T.C.KIM	S. Gonsalves	Final Report
<b>B</b>	March 28, 2024	pdf	N. Tamrakar	T.C.KIM	S. Gonsalves	Final Report

## Table of Contents

<b>Part I: Foundation Investigation Report .....</b>	<b>1</b>
<b>1.0 Introduction .....</b>	<b>2</b>
<b>2.0 Structure Description .....</b>	<b>2</b>
<b>3.0 Site Description and Geological Setting .....</b>	<b>3</b>
3.1 Site Description .....	3
3.2 Geological Setting.....	3
<b>4.0 Previous Investigations .....</b>	<b>3</b>
<b>5.0 Investigation Procedures.....</b>	<b>4</b>
5.1 Site Investigation and Field Testing.....	4
5.2 Laboratory Testing .....	5
<b>6.0 Subsurface Conditions.....</b>	<b>6</b>
6.1 Subsoils.....	6
6.1.1 Asphalt.....	6
6.1.2 Topsoil .....	6
6.1.3 Cohesionless Fill: Gravelly Sand .....	7
6.1.4 Cohesive Fill: Clayey Silt .....	7
6.1.5 Cohesionless Fill: Silty Sand/Sandy silt .....	7
6.1.6 Silty Sand/Sandy silt/ Sand and Silt .....	8
6.1.7 Silty Sand Till.....	9
6.2 Groundwater and Surface Water Conditions .....	10
6.3 Chemical Analysis .....	11
<b>7.0 CLOSURE .....</b>	<b>12</b>
<b>8.0 REFERENCES .....</b>	<b>13</b>
<b>9.0 LIMITATIONS AND USE OF REPORT .....</b>	<b>14</b>

## Appendices

APPENDIX A: SITE PHOTOGRAPHS

APPENDIX B: GENERAL ARRANGEMENT DRAWINGS

APPENDIX C: BOREHOLE LOCATION PLAN AND STRATIGRAPHIC STRATA

APPENDIX D: BOREHOLE LOGS

APPENDIX E: LABORATORY DATA

*Foundation Investigation Report  
Hwy 404 Culvert Replacement (CV-0249-0404-00N3)  
GWP 2459-16-00  
Assignment No. 2020-E-0028  
Date: March 28, 2024*

## Part I: Foundation Investigation Report

Rehabilitation/Replacement of 25 Non-Structural Culverts at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto - **Highway 404 CSP Culvert Replacement (CV-0249-0404-00N3)**

## 1.0 Introduction

EXP Services Inc. (EXP) was retained by CONSOR Engineers LLC (CONSOR) on behalf of The Ministry of Transportation (MTO) to provide detailed foundation investigation and engineering services and pavement engineering services for the proposed rehabilitation/replacement of 25 Non-Structural Culverts project at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto. The findings, analyses and recommendations related to foundation scope are presented in a Foundation Investigation Design Report created for each culvert location. The work was undertaken under GWP 2459-16-00, Assignment No. 2020-E-0028. The terms of reference (TOR) and the scope of work for the foundation investigation are outlined in Ministry of Transportation Ontario's (MTO) Request for Proposal, dated February 2022. The scope of this report is specifically limited to the proposed replacement of the Corrugated Steel Pipe (CSP) culvert on Highway 404 W-S Ramp (CV-0249-0404-00N3).

The general design drawings for the proposed culvert replacement were provided to EXP by CONSOR. The purpose of the investigation was to evaluate the subsurface conditions along the existing culvert, and based on this data, to permit detailed design for the culvert replacement and to examine the suitability of trenchless methods of replacement both at the existing culvert alignment and at a new alignment.

The site-specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field and laboratory testing. The field and laboratory work for this structure was performed by EXP.

This 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.

## 2.0 Structure Description

The preliminary contract drawings titled Trenchless Replacement Highway 404 CV-0249-0404-00N3, prepared by CONSOR, the preliminary design configuration of the proposed trenchless replacement of the Highway 404/Mulock Dr. I/C (W-S Ramp) culvert. A summary of the proposed structure is as follows:

- The existing culvert is a 600 mm CSP culvert with a total length is approximately 47.3 m. It is proposed to be replaced with a 840 mm diameter HDPE culvert about 5 m south from the existing culvert. Based on the preliminary contract drawing the invert level of the new culvert is proposed to match the invert levels of the existing culvert (approximately 265.6 m and 262.7 m at the inlet and outlet, respectively).
- The existing Highway 404/Mulock Dr. I/C (W-S Ramp) profile grade is planned to remain unchanged. It is understood that trenchless methods will be used to replace the existing culvert.

The preliminary contract drawings were included as part of this report is used for initial context to address the nature and scope of the investigation. It is understood that some changes might occur as a result of normal refinement or the findings of the geotechnical report.

## 3.0 Site Description and Geological Setting

### 3.1 Site Description

The existing CSP culvert is located on Highway 404/Mulock Dr. I/C (W-S Ramp) , about STA. 10+335 in the York region, Ontario, in the Ministry of Transportation (MTO) Central Region. Based on the preliminary contract drawings, the ramp at the culvert location is about 7.5 m wide from edge of pavement to edge of pavement with about 2.7 m width of the shoulder. The existing CSP culvert is positioned in a east-west direction crossing the ramp. The elevation of ramp pavement centerline at the site is about 271.4 m. The roadway embankment above the existing ground is about 4.5 m on the inlet side and 8.4 m on the outlet side. The sides of the embankment slope range from approximately 2H:1V on the west side and 4.1H:1V on the east side. The flow through the culvert is from west to east, following the natural topographic conditions in the vicinity of the site. The site plan and cross-section profiles for the proposed culvert alignment are shown on the drawings attached in Appendix B.

The general site conditions were assessed during a site reconnaissance on November 26, 2023, and during the field investigation works that took place EXP between November 27, 28 2023 and February 26 to March 5, 2024. At the time of the field investigation, the surficial flow of water was observed at the inlet and outlet of the culvert. No riprap to protect against scour or erosion was observed on the outlet of the culvert. However, inlet of the culvert was connected to the ditch manhole. Vegetation at the site consists predominantly of coniferous trees with some deciduous trees wild bushes and shrubs adjacent to the culvert area. The side slopes of the embankment are lightly vegetated. Photographs showing the site conditions are presented in Appendix A of this report. It can be seen that the culvert barrels are heavily corroded at the bottom, especially at the outlet side.

### 3.2 Geological Setting

Based on a review of geological maps of Southern Ontario (Chapman and Putnam, 1984), the site is situated within the Oak Ridges Moraine physiographic region. The subsoil for this region is generally comprised of sandy materials, which are underlain by glacial till. Interbeds of fine sand, silt, and clay are also common. Bedrock is generally deep below the ground surface in this region.

According to the Ministry of Northern Development and Mines, Map 2556 (Quaternary Geology of Ontario, Southern Sheet, 1991) the surface conditions in the vicinity of the project area typically consist of Newmarket till comprised predominantly of sandy silt to silt matrix, clasts content moderate to high, moderate to high in total matrix carbonate content. In addition, Map 2544 (Bedrock Geology of Ontario, Southern Sheet, 1991), the bedrock geology at the site consists of limestone, dolostone, shale, arkose, and siltstone belonging to the Georgian Bay formation.

## 4.0 Previous Investigations

There are no available reports of any previously performed geotechnical investigation at this site in the MTO GEOCREs library. The only available data is from the adjacent sites. The reports are listed below for reference.

- *Geocres No. 31D00-259. "Foundation Investigation Report for RR 12 Interchange, W.P. 160-74-39, Site 37-697, Hwy 404, District 6, Toronto, Engineering Material Office., dated July 24 1978.*
- *Geocres No. 31D00-261. "Foundation Investigation Report for Bogart Creek Bridge, W.P. 160-74-38, Hwy 404, District 6, Toronto, Engineering Material Office., dated August 3 1978.*

## 5.0 Investigation Procedures

### 5.1 Site Investigation and Field Testing

A site-specific investigation was undertaken by EXP between November 27, 28 2023 and February 26 to March 5, 2024, and it included the following:

1. A walkover site assessment was carried out by a Geotechnical Engineer from EXP;
2. Subsequent to the borehole layouts in the field, existing utilities were cleared by public utility companies;
3. Traffic control required to close the ramp of Highway 404/ Mulock Drive I/C during the drilling of boreholes was provided by Barricade Traffic Services.
4. The program involved the drilling of Three (3) boreholes for sampling numbered BH404-ON3-01 to BH404-ON3-03. Two (2) boreholes were located at each end of the proposed culvert, which were BH404-ON3-01 and BH404-ON3-02. BH404-ON3-03 was drilled on the roadway at the shoulder. The locations of the boreholes drilled during this investigation are shown on Drawing 1 in Appendix C. Table 1.1 provides a summary of the boreholes completed by EXP.
5. The roadway/median boreholes drilled during this fieldwork were advanced using a truck mounted M5T 94 drill rig. The offroad boreholes were advanced using tripod manual drilling. The drill rigs were owned and operated by Drilltech drilling Ltd and Walker Drilling Ltd, respectively. The drilling rig machine was equipped with solid stem augers and fitted with capability for Standard Penetration Testing (SPT). Whereas the tripod drilling was wash bored with casing and fitted with capability for Standard Penetration Testing (SPT).
6. Soil samples in the boreholes were taken at frequent intervals of depth by the Standard Penetration Test method (SPT), in general accordance with ASTM D1586. The test consists of freely dropping a 63.5 kg hammer a vertical distance of 0.76 m to drive a 51 mm O.D. split barrel (SS-split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance, or the N-value, of the soil which is indicative of the compactness of granular (or cohesionless) soils (gravels, sands and silts) or the consistency of cohesive soils (clays and clayey soils). Where the refusal to casing/split spoon encountered for manual drilling (tripod), the dynamic penetration cone (DCPT) was advanced to DCPT refusal (blow count greater than 200 per 0.3 m penetration);
7. The fieldwork was supervised by a member of EXP's engineering staff who directed the drilling and sampling operation, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification;
8. All spoon samples obtained in the Standard Penetration Tests (SPT, ASTM D-1586) were placed in moisture proof bags after field classification. Samples were allocated from the spoon samples for moisture content testing without delay. They were subsequently re-examined under controlled laboratory conditions prior to assigning other laboratory tests;
9. Selected soil samples for chemical analytical testing were sent to the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario. The selected soil samples for the analytical testing were placed in a laboratory prepared glass jar, labelled, and stored in a secure cooler.

10. The borehole locations and their ground surface elevations were surveyed by EXP using a Trimble DA2 GNSS receiver with Trimble Catalyst GNSS positioning, having an accuracy of  $\pm 0.10$  m horizontal and vertical directions. MTM NAD83 Zone 10 coordinates and the geodetic elevation for the boreholes are listed in Table 1.1 below. It can also be found on the Record of Borehole Sheet (Appendix D); and
11. Upon completion of drilling and field testing, the boreholes were backfilled with a mixture of bentonite and auger cuttings. groundwater level measurements were carried out in boreholes in accordance with MTO guidelines. The recorded groundwater levels after completion of drilling boreholes were presented in the borehole log sheets in Appendix D.
12. The borehole decommissioning was in general accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act).

**Table 1.1: Summary of boreholes completed**

Borehole No.	Borehole Location	Location (MTM NAD83 Zone 10)		Latitude	Longitude	Borehole Elevation (m)	Borehole Depth (m)
		Northing	Easting				
<b>BH404-0N3-01<sup>(1)</sup></b>	Outlet, off-road	4878713.2	311422.5	44.048378	-79.417356	263.0	2.4
<b>BH404-0N3-01A<sup>(1)</sup></b>	Outlet, off-road	4878713.2	311422.5	44.048378	-79.417356	263.0	3.3
<b>BH404-0N3-02</b>	Inlet, off-road	4878749.4	311456.9	44.048704	-79.416926	267.4	7.9
<b>BH404-0N3-03</b>	Road surface, Shoulder	4878735.3	311436.2	44.048577	-79.417185	271.3	12.6

Note:

1. Boreholes terminated prematurely at the very dense silty sand till due to the refusal (>200 blows per 300 mm penetration with a 63.5 kg hammer) was encountered to the casing/spoon/ DCPT drilled manually with the tripod.

## 5.2 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program performed by EXP included the determination of the natural moisture content on all samples and particle size distribution and Atterberg limits (for cohesive soils) for approximately 25% of the collected soil samples. Chemical analyses were also carried out on one soil sample selected by EXP. The samples were tested at the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario. All of the laboratory tests were carried out according to MTO and/or ASTM Standards as appropriate. The performed laboratory testing program is listed in Table 1.2.

**Table 1.2: List of Laboratory Test Completed by EXP**

Borehole No.	Moisture Content	Atterberg Limits	Sieve	Hydrometer	Corrosivity
<b>BH404-0N3-01</b>	3	-	-	2	
<b>BH404-0N3-02</b>	9	-	2	-	---



Borehole No.	Moisture Content	Atterberg Limits	Sieve	Hydrometer	Corrosivity
<b>BH404-0N3-03</b>	12	-	2	2	1

The laboratory test results are provided on the attached borehole log sheets in Appendix D as well as graphically in Appendix E.

## 6.0 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix D. Laboratory test results of grain size analyses and Atterberg limit tests are provided in Appendix E. The “Explanation of Terms Used in Report” preceding the borehole logs in Appendix D forms an integral part of and should be read in conjunction with this report.

A borehole location plan and cross section subsurface profiles are provided in Appendix C. It should be noted that the stratigraphic boundaries indicated on the borehole log and cross section stratigraphic profiles are inferred from semi-continuous sampling, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent transitions from one soil type to another and should not be regarded as exact planes of geological change. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

Below the roadway, the subsurface conditions encountered within the investigated depths of the geotechnical investigation indicates the following subsurface sequence: asphalt underlain by gravelly sand to silty sand fill. The embankment fill is underlain by silty sand followed by silty sand till.

At the culvert inlet, the encountered subsurface conditions were observed to consist of topsoil over sandy silt to sand and silt followed by silty sand till. At the outlet, the encountered subsurface conditions were observed to consist of topsoil over clayey silt to sandy silt fill followed by silty sand to sandy silt underlain by silty sand till.

A detailed description of the subsurface conditions encountered is discussed further in subsequent sections. It should be noted that the following sections are based on the geotechnical investigation conducted by EXP.

### 6.1 Subsoils

#### 6.1.1 Asphalt

A pavement structure consisting of asphalt was encountered at the ground surface in borehole BH404-0N3-03. The thickness of asphalt was about 250 mm.

#### 6.1.2 Topsoil

A topsoil layer was encountered at the ground surface of boreholes BH404-0N3-1/ 1A and BH404-0N3-02. The thickness of this layer was about 100 mm.

### 6.1.3 Cohesionless Fill: Gravelly Sand

Cohesionless fill consisting of sand and gravel was encountered below the pavement structure in borehole BH404-0N3-03. The fill layer was extended to depth about 0.8 m below the ground surface with elevation about 270.5 m. The explored thickness of this layer was about 0.5 m.

The composition of this fill was predominantly comprised of sand and gravel; trace asphalt fragments were observed near the surface of the layers near the pavement structure. The fill was generally brown to blackish brown in colour and dry.

Laboratory testing performed on selected samples consisted of One (1) moisture content test, which was about 2.1%.

The result of the moisture content test is provided on the record of borehole sheets in Appendix D.

### 6.1.4 Cohesive Fill: Clayey Silt

Cohesive fill layer consisting of clayey silt was encountered below the topsoil in borehole BH404-0N3-02. The fill layer was extended to depth about 0.8 m below the ground surface with elevation about 266.6 m. The explored thickness of this layer was about 0.7 m.

The composition of this fill was predominantly comprised clayey silt with trace sand and trace rootlets, trace organics. The fill was generally brown and moist.

Laboratory testing performed on selected sample consisted of One (1) moisture content test, which was about 17%. The test results are as follows:

The result of the moisture content test is provided on the record of borehole sheets in Appendix D.

### 6.1.5 Cohesionless Fill: Silty Sand/Sandy silt

Cohesionless fill layers consisting of sand and silt were encountered below the gravelly sand fill in borehole BH404-0N3-03 and below clayey silt fill in borehole BH404-0N3-02. The approximate elevations of the surface and base of each fill layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.3 below:

**Table 1.3: Summary of silty sand/sandy silt Fill Layers**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT "N" Value Range
	Top	Bottom				
BH404-0N3-02	266.6	265.6	0.8	1.0	Sandy silt	10-19
BH404-0N3-03	270.5	264.6	0.8	5.9	Silty Sand	21-86

The composition of this fill was predominantly comprised of sand and silt with trace to some gravel, trace clay, occasional clayey seams/layers. The fill was generally brown to greyish brown in colour and ranged from moist to wet. The SPT “N” values within this layer ranged from 10 - 86 blows per 300 mm penetration, corresponding to compact to very dense but generally compact to dense in compactness condition.

Laboratory testing performed on selected samples consisted of Seven (7) moisture content tests and Two (2) grain size distribution tests. The test results are as follows:

**Moisture Content:**

- 5% to 16%

**Grain Size Distribution:**

- 6% to 8% gravel;
- 44% to 47% sand;
- 39% silt;
- 9% clay;
- 47% silt and clay;

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix D. The result of the grain size distribution tests are also provided on Figure 1 in Appendix E.

### 6.1.6 Silty Sand/Sandy silt/ Sand and Silt

A native silty sand/sandy silt/ sand and silt deposit were encountered below the fill layer in boreholes BH BH404-ON3-02 and BH404-ON3-03 and below topsoil in BH404-ON3-01. The approximate elevations of the surface and base of each layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.3 below:

**Table 1.4: Summary of silty sand/sandy silt/ sand and silt Layers**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT “N” Value Range
	Top	Bottom				
BH404-ON3-01	262.9	261.5	0.1	1.4	Sandy silt/Sand and silt	6-30
BH404-ON3-02	265.6	261.3	1.8	4.3	Silty sand to Sandy silt	14-28
BH404-ON3-03	264.6	262.9	6.7	1.7	Silty Sand	25-49

The composition of this fill was predominantly comprised of sand and silt with trace to some gravel, trace clay, trace rootlets. The layer was generally blackish grey to grey in colour and ranged from moist to wet. The SPT “N” values

within this layer ranged from 6 - 49 blows per 300 mm penetration, corresponding to loose to dense but generally compact in compactness condition.

Laboratory testing performed on selected samples consisted of Eight (8) moisture content tests and Three (3) grain size distribution tests. The test results are as follows:

**Moisture Content:**

- 12% to 24%

**Grain Size Distribution:**

- 0% to 24% gravel;
- 28% to 47% sand;
- 30% to 49% silt;
- 4% to 6% clay;
- 70% silt and clay;

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix D. The result of the grain size distribution tests are also provided on Figure 2 in Appendix E.

### 6.1.7 Silty Sand Till

Native silty sand till was encountered below the silty sand/sandy silt/ sand and silt layer in all boreholes. All boreholes were terminated within this deposit. The approximate elevations of the surface and base of each layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.5 below:

**Table 1.5: Summary of Silty Sand till Layers**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT "N" Value Range
	Top	Bottom				
BH404-0N3-01	261.5	260.6	1.5	0.9	Silty sand till	54- 100/ 0.08m
BH404-0N3-02	261.3	259.5	6.1	1.8	Silty sand till	19-75/0.13m
BH404-0N3-03	262.9	258.7	8.4	4.2	Silty sand till	24-68/0.13m

This layer consisted primarily of silt and sand with trace to some clay, trace to some gravel, occasional cobbles. The soil was grey in color and wet. The SPT "N" values within this layer ranged from 19 blows per 300 mm penetration to 100 blow per 80 mm penetration, corresponding to compact to very dense in compactness condition.

Laboratory testing performed on selected samples consisted of Seven (7) moisture content tests and Three (3) grain size distribution tests. The test results are as follows:

**Moisture Content:**

- 8% to 16%

**Grain Size Distribution:**

- 6% to 18% gravel;
- 53% to 55% sand;
- 25% silt;
- 2% clay;
- 34% to 41% silt and clay;

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix D. The result of the grain size distribution tests are also provided on Figure 3 in Appendix E.

## 6.2 Groundwater and Surface Water Conditions

Groundwater levels were observed upon completion of the boreholes and in piezometers. Groundwater levels measured on completion of boreholes may not be considered stabilized and therefore may not represent the established long-term average groundwater table. A summary of the groundwater levels observed upon completion of the boreholes and in piezometers are summarized in Table 1.6 and are also presented on the record of borehole sheets in Appendix D.

**Table 1.5: Summary of Observed Groundwater Levels**

Borehole	Ground Surface Elevation (m)	Water Level Depth/ Elevation (m) <sup>1</sup>	Date Measured	Comments
BH404-0N3-01	263	0.4/262.6	02/26/2024	In open hole upon completion of drilling
BH404-0N3-02	267.4	2.8/ 264.6	11/28/2023	In open hole upon completion of drilling
BH404-0N3-03	271.3	7.0/264.3	11/27/2023	In open hole upon completion of drilling
		6.6/264.7	02/26/2024	Water level measured in piezometer
		3.9/267.4 <sup>2</sup>	03/06/2024	Water level measured in piezometer

Note:

1. Depths are relative to ground surface
2. Possible perched water

At the time of the field investigation, the surficial flow of water through the culvert was observed to be at approximate Elevation 265.6 m and 262.7 m at the inlet and outlet, respectively.

Groundwater levels would be expected to reflect levels in the adjacent open water and to fluctuate seasonally. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

### 6.3 Chemical Analysis

One soil sample was selected for chemical analysis during the current investigations performed by EXP. The soil sample collected by EXP was tested at a CALA-certified and accredited laboratory. The results of the corrosion potential chemical analysis testing including sulfide, chloride, sulfate, pH, electrical conductivity, resistivity and redox potential are included in Appendix E and summarized in Table 1.6.

**Table 1.6: Summary of chemical analysis results**

Borehole ID	Sample	Depth (m)	Chloride (ppm)	Sulphate (ppm)	pH	Electrical Conductivity (umho/cm)	Resistivity (ohm-cm)	Redox Potential (mV)
BH404-0N3-03	SS6	6.1 – 6.7	27	<20	7.83	195	5100	300

## 7.0 CLOSURE

A subsurface investigation is a limited sampling of a site; the subsurface conditions have been established only at the test hole locations. Should conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to assess this additional information and our recommendations, as appropriate. It may then be necessary to perform additional investigation and analysis.

Contractors bidding on or undertaking any proposed work at this site should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so they may draw their own conclusions as to how the subsurface conditions may affect them.

This Foundation Investigation and Design Report has been prepared by Ian Lee, and Nimesh Tamrakar, M.Eng., P.Eng. It was reviewed by TaeChul Kim, M.E.Sc., P.Eng. and by Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was supervised by Stephen Fredericks, M.Eng., P.Eng.

### EXP Services Inc.



Nimesh Tamrakar, M.Eng., P.Eng.  
Senior Geotechnical Engineer  
Project Manager



TaeChul Kim, M.E.Sc., P.Eng.  
Senior Geotechnical/Foundation Engineering  
Specialist



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



## 8.0 REFERENCES

- Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.
- Canadian Standards Association (CSA), 2019. Canadian Highway Bridge Design Code and Commentary on CAN/CSA-S6-19. CSA Special Publication.
- Highway Standards Branch, Provincial Memorandum, Material Engineering and Research Office (MERO) #2020-01, March 23, 2020
- Ministry of Northern Development and Mines, Map 2556. Quaternary Geology of Ontario, Southern Sheet, 1991
- Ministry of Northern Development and Mines Map 2544. Bedrock Geology of Ontario, Southern Sheet, 1991
- Ministry of Transportation, May 2007. MTO Gravity Pipe Design Guidelines. Circular Culverts and Storm Sewers.
- Ministry of Transportation, October 2020. Guideline for MTO Foundation Engineering Services, Version 02
- Molinas, A., and Mommandi, A., 2009. Development of New Corrosion/Abrasion Guidelines for Selection of Culvert Pipe Materials, Report No. CDOT-2009-11. Colorado Department of Transportation, DTD Applied Research and Innovation Branch.

### **ASTM International:**

ASTM D1586      Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

### **Ontario Water Resources Act:**

R.R.O 1990, Regulation 903 Wells, under Ontario Water Resources Act, R.S.O. 1990, c. O.40

### **Ontario Occupational Health and Safety Act (OHSA):**

Ontario Regulation 213/91 Construction Projects



## 9.0 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

*Foundation Investigation Report  
Hwy 404 Culvert Replacement (CV-0249-0404-00N3)  
GWP 2459-16-00  
Assignment No. 2020-E-0028  
Date: March 28, 2024*

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 utilized 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 – Site Photographs



Photograph 1: Ramp looking south-east



Photograph 2: Looking North east from the outlet



Photograph 3. Condition of culvert at outlet



Photograph 4: Condition of culvert at inlet manhole

## Appendix B – Preliminary Contract Drawings



CAD FILE LOCATION AND NAME: A:\\_V-TPD\Projects\CA\Projects\0220768CN\ 25 Culverts\Drafting\Sheets\Highways\Group B (Rebecca's Project)\0220768CN\_003\_GA (CV-0249-0404-00N3).dwg  
MODIFIED: 3/6/2024 5:18:31 PM BY: RMISTRY  
DATE PLOTTED: 3/6/2024 5:20:21 PM BY: RMISTRY

MINISTRY OF TRANSPORTATION, ONTARIO  
ANS-D  
2016-10

KEY PLAN (N.T.S)

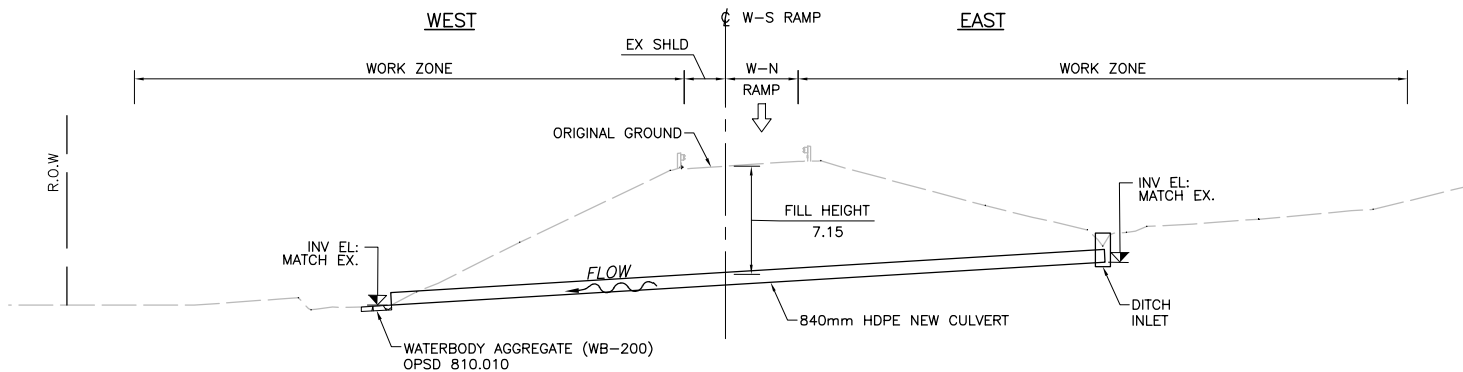
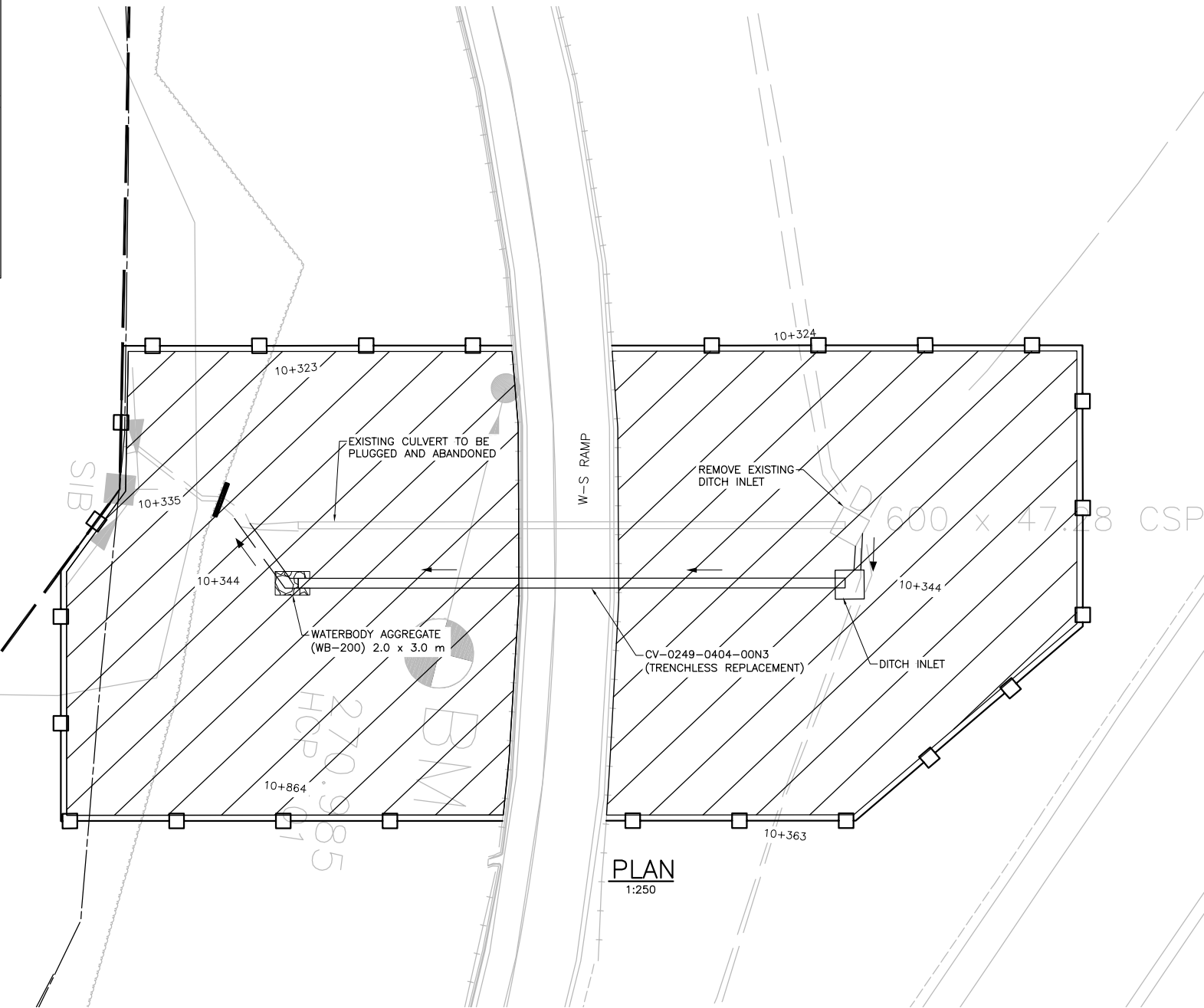
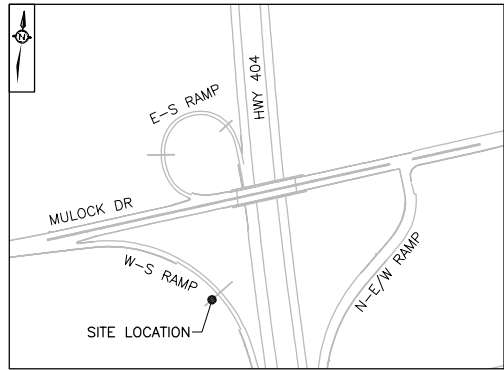


PLATE No  
CONT 2024-2012  
GWP 2111-19-00  
TRENCHLESS REPLACEMENT  
HIGHWAY 404  
CV-0249-0404-00N3



SHEET  
260A

#### GENERAL NOTES:

1. THE CONTRACTOR SHALL VERIFY THE EXISTING CULVERT DIMENSIONS, ELEVATIONS, WATER DEPTH, PROPOSED WORK AND DETAILS AND REPORT ANY DISCREPANCIES TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE WORK.
2. THE CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS PRIOR TO EXCAVATION AND PROVIDE ADEQUATE PROTECTION OF ALL UTILITIES, SERVICES, STRUCTURES, ROADWAYS, ETC. DURING CONSTRUCTION OPERATIONS.
3. TRAFFIC CONTROL SHALL BE IN ACCORDANCE WITH OTM BOOK 7.
4. ROADWAY DRAINAGE SHALL BE MAINTAINED AT ALL TIMES.

#### LEGEND

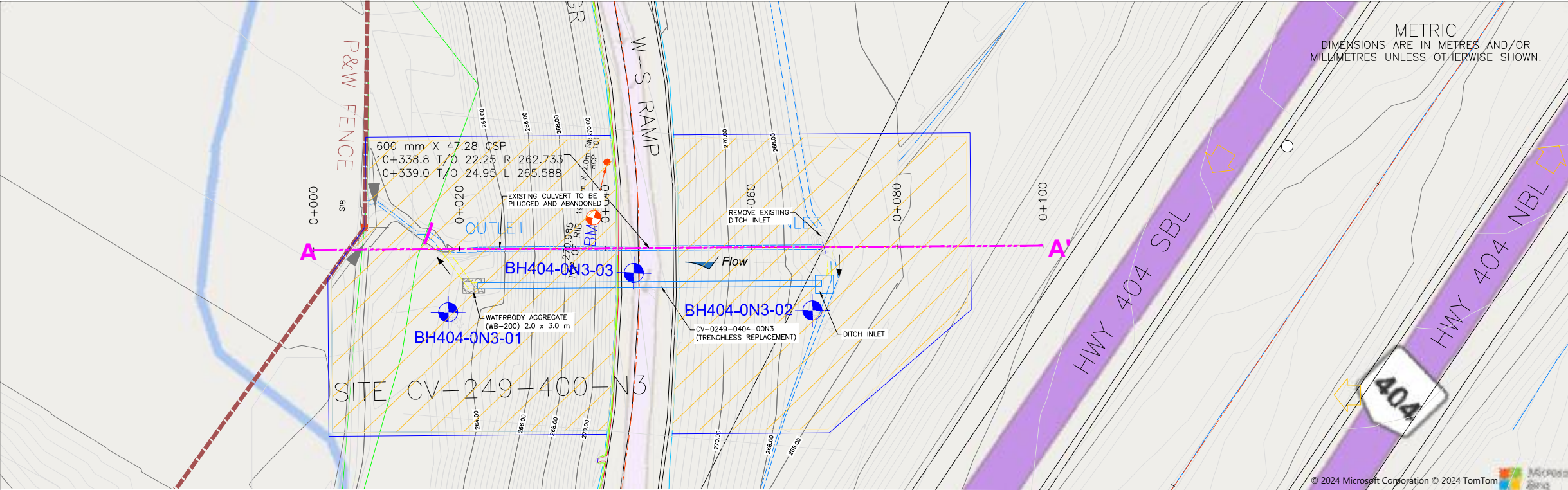
- TRENCHLESS CULVERT REPLACEMENT
- PROPOSED WORK ZONE
- WATERBODY AGGREGATE
- SEDIMENT FENCE
- DIRECTION OF FLOW
- CULVERT TO PLUGGED AND ABANDONED
- MTO ROW
- FIBRE ROLL BARRIERS

SCALE  
2.5m 0 5m

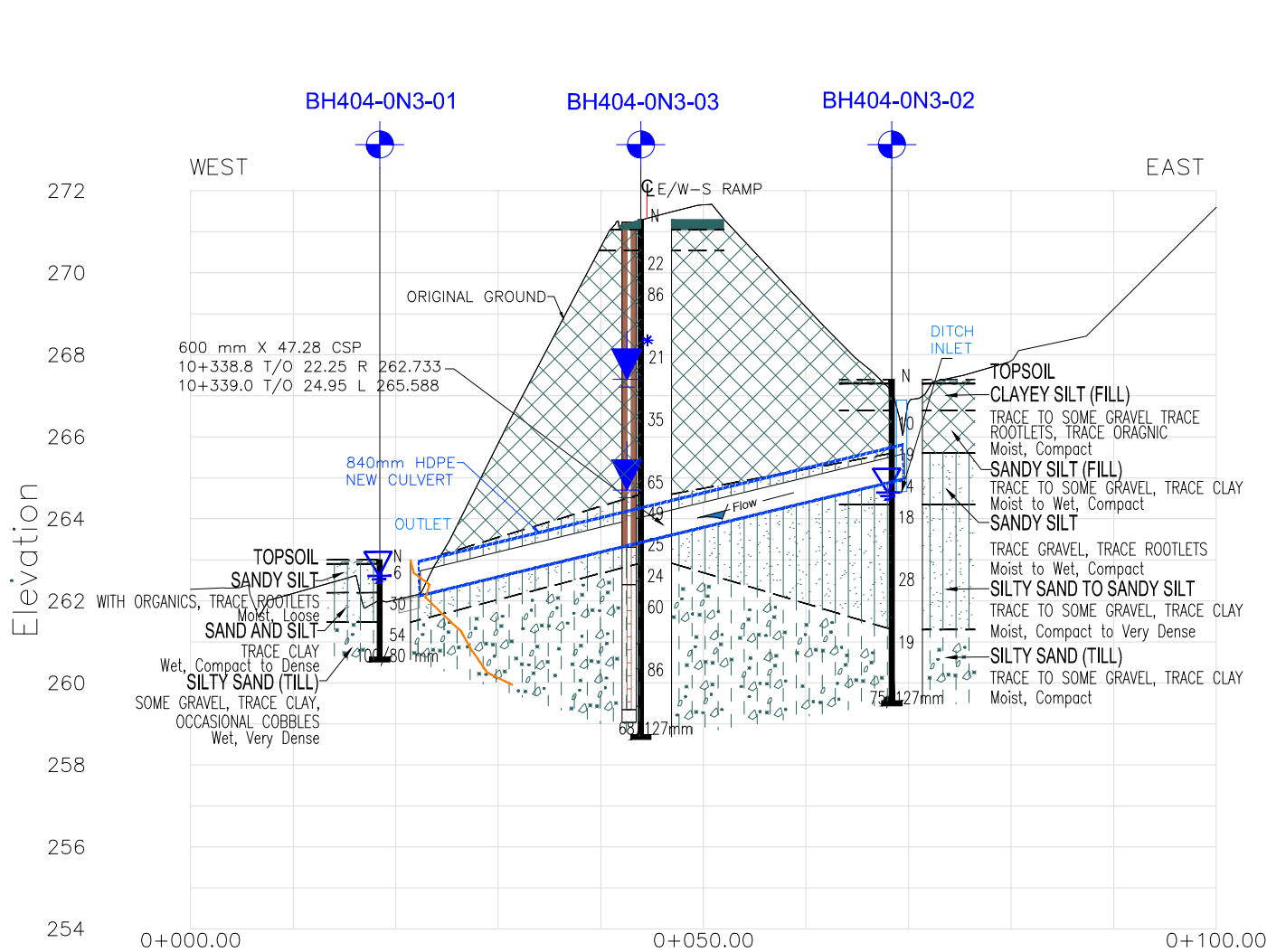
## Appendix C – Borehole Location Plan and Stratigraphic Strata



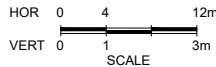
FILE NAME: I:\2003-Brampton\Proposals\Projects\International\WTO Projects\WTO 2020-E-0028 25 culverts\working drawings\CV-0249-0404-00N3\CV-249-404-00N3\_borehole location plan & soil strata.dwg  
MODIFIED: 2024-03-28 15:58



PLAN



SECTION A-A' ALONG C<sub>L</sub> PROPOSED CULVERT



ASSIG No. 2020-E-0028

GWP No. 2459-16-00

HIGHWAY 404 CULVERT REPLACEMENT, YORK, ON  
CV-0249-0404-00N3

Latitude: 44.048489° Longitude: -79.417409°

BOREHOLE LOCATION PLAN & SOIL STRATA



EXP SERVICES INC.

SHEET

1



KEY PLAN  
N.T.S.

LEGEND

- Borehole Location
- Water Level Upon Completion of Drilling  
(W. L. NOT STABILIZED)
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Water Level in Piezometer (most recent)  
(W. L. STABILIZED)
- Possible Perched Water
- Piezometer

SOIL STRATA SYMBOLS

- TOPSOIL
- ASPHALT
- FILL
- SILT AND SAND/SILTY  
SAND TO SANDY SILT
- SILTY SAND (TILL)

BOREHOLE CO-ORDINATES/ NAD 83/ MTM ON-10

BH No.	ELEV.	NORTHING	EASTING
BH404-0N3-01	263.0	4878713.2	311422.5
BH404-0N3-02	267.4	4878749.4	311456.9
BH404-0N3-03	271.3	4878735.3	311436.2
BH404-0N3-1A	263.0	4878713.2	311422.5

NOTES

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 boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

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.

REVISIONS	SUBMISSION FOR MTO REVIEW			
	NO	DATE	BY	DESCRIPTION
PROJECT No.	ADM-22007871-A0	GEOCRES No.		31D03-001
SUBM'D SH	CHKD. NT	DATE		MAR. 28, 2024 SITE-
DRAWN SH	CHKD. TC	APPRD SG		DWG 01

## Appendix D – Borehole Logs

# Explanation of Terms Used on Borehole Records

## SOIL DESCRIPTION

Terminology describing common soil genesis:

*Topsoil:* mixture of soil and humus capable of supporting good vegetative growth.

*Peat:* fibrous fragments of visible and invisible decayed organic matter.

*Fill:* where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

*Till:* the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

*Desiccated:* having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

*Stratified:* alternating layers of varying material or color with the layers greater than 6 mm thick.

*Laminated:* alternating layers of varying material or color with the layers less than 6 mm thick.

*Fissured:* material breaks along plane of fracture.

*Varved:* composed of regular alternating layers of silt and clay.

*Slickensided:* fracture planes appear polished or glossy, sometimes striated.

*Blocky:* cohesive soil that can be broken down into small angular lumps which resist further breakdown.

*Lensed:* inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

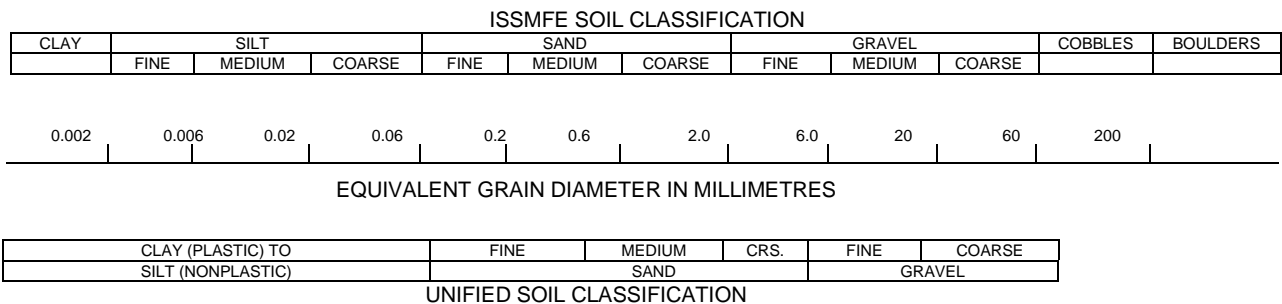
*Seam:* a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

*Homogeneous:* same color and appearance throughout.

*Well Graded:* having wide range in grain sized and substantial amounts of all predominantly on grain size.

*Uniformly Graded:* predominantly on grain size.

All soil sample descriptions included in this report follow generally the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) with some modification to reflect current MTO practices. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.



Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Canadian Foundation Engineering Manual (CFEM):

Table a: Percent or Proportion of Soil

Term	Description	Criteria
"trace"	trace gravel, trace sand, etc.	1% - 10%
"some"	some gravel, some sand, etc.	10% - 20%
Adjective	gravelly, sandy, silty and clayey	20% - 35%
"and"	and gravel, and sand, etc.	>35%
Noun	gravel, sand, silt, clay	>35% and main fraction

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	N<5
Loose	5≤N<10
Compact	10≤N<30
Dense	30≤N<50
Very Dense	50≤N

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

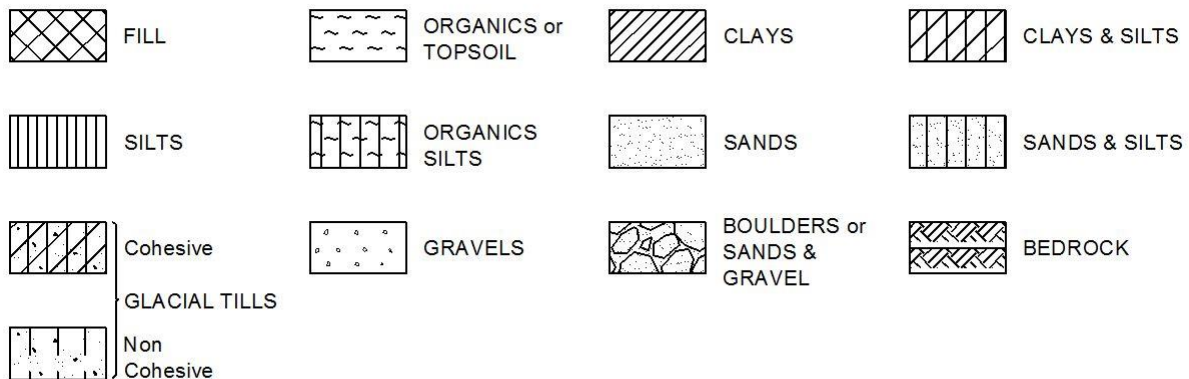
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

## STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



## WATER LEVEL MEASUREMENT



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe



## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

SS	Split spoon sample (obtained from the Standard Penetration Test)
WS	Wash sample
BS	Bulk sample
TW	Thin wall sample or Shelby tube
PS	Piston sample
AS	Auger sample
VT	Vane test
GS	Grab sample
HQ, NQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits

### STRESS AND STRAIN

$u_w$	kPa	Pore water pressure
$r_u$	1	Pore pressure ratio
$\sigma$	kPa	Total normal stress
$\sigma'$	kPa	Effective normal stress
$\tau$	kPa	Shear stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal stresses
$\varepsilon$	%	Linear strain
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
$\mu$	1	Coefficient of friction

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	Coefficient of volume change
$c_c$	1	Compression index
$c_s$	1	Swelling index
$c_r$	1	Recompression index
$c_v$	m <sup>2</sup> /s	Coefficient of consolidation
H	m	Drainage path
$T_v$	1	Time factor
U	%	Degree of consolidation
$\sigma'_{v0}$	kPa	Effective overburden pressure
$\sigma'_p$	kPa	Preconsolidation pressure
$\tau_f$	kPa	Shear strength
$c'$	kPa	Effective cohesion intercept
$\phi'$	—°	Effective angle of internal friction
$c_u$	kPa	Apparent cohesion intercept
$\phi_u$	—°	Apparent angle of internal friction
$\tau_R$	kPa	Residual shear strength
$\tau_r$	kPa	Remoulded shear strength
$S_t$	1	Sensitivity = $c_u/\tau_r$

### PHYSICAL PROPERTIES OF SOIL

$P_s$	kg/m <sup>3</sup>	Density of solid particles
$\gamma_s$	kN/m <sup>3</sup>	Unit weight of solid particles
$\rho_w$	kg/m <sup>3</sup>	Density of water
$\gamma_w$	kN/m <sup>3</sup>	Unit weight of water
$\rho$	kg/m <sup>3</sup>	Density of soil
$\gamma$	kN/m <sup>3</sup>	Unit weight of soil
$\rho_d$	kg/m <sup>3</sup>	Density of dry soil
$\gamma_d$	kN/m <sup>3</sup>	Unit weight of dry soil
$\rho_{sat}$	kg/m <sup>3</sup>	Density of saturated soil
$\gamma_{sat}$	kN/m <sup>3</sup>	Unit weight of saturated soil
$\rho'$	kg/m <sup>3</sup>	Density of submerged soil
$\gamma'$	kN/m <sup>3</sup>	Unit weight of submerged soil
$e$	1, %	Void ratio
$n$	1, %	Porosity
$w$	1, %	Water content
$S_r$	%	Degree of saturation
$W_L$	%	Liquid limit
$W_P$	%	Plastic limit
$W_s$	%	Shrinkage limit
$I_p$	%	Plasticity index = $(W_L - W_P)$
$I_L$	%	Liquidity index = $(W - W_P)/I_p$
$I_C$	%	Consistency index = $(W_L - W)/I_p$
$e_{max}$	1, %	Void ratio in loosest state
$e_{min}$	1, %	Void ratio in densest state
$I_D$	1	Density index = $(e_{max} - e)/(e_{max} - e_{min})$
D	mm	Grain diameter
$D_n$	mm	N percent - diameter
$C_u$	1	Uniformity coefficient
h	m	Hydraulic head or potential
q	m <sup>3</sup> /s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m <sup>3</sup>	Seepage force

Brampton, Ontario

RECORD OF BOREHOLE No BH404-N3-011 OF 1METRIC

W.P. GWP 2459-16-00LOCATION CV-0249-0404-00N3 York, ON, MTM ON-10 311422.5E 4878713.2NORIGINATED BY NT

DIST YorkHWY 404BOREHOLE TYPE Tripod / Wash BoringCOMPILED BY IL

DATUM GeodeticDATE 2024.02.26 - 2024.02.27LATITUDE 44.048378LONGITUDE -79.417356CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
263.0	GROUND SURFACE																
262.0	TOPSOIL - 100mm thick		1	SS	6												
0.1	SANDY SILT - with organics, trace rootlets, black, moist, loose																
262.2																	
0.8	SAND AND SILT - trace clay, brown to grey, wet, compact to dense		2	SS	30											0 47 49 4	
261.5																	
1.5	SILTY SAND (TILL) - some gravel, trace clay, occasional cobbles, brown to grey, wet, very dense		3	SS	54											18 55 25 2	
260.6																	
260.4			4	SS	100/80 mm												
2.4	-casing and spoon refusal, could not pass 2.3 m, switch to DCPT																
	END OF BOREHOLE																
	NOTE: 1) Groundwater level was encountered at a depth of 0.4 m and elevation of 262.6 m upon completion of borehole. 2) Borehole caved below depth of 1.52 m																


ONTARIO MTO CV-0249-0404-00N3.GPJ ONTARIO MTO.GDT 3/25/24

Brampton, Ontario

1 OF 1

**METRIC**

W.P.	GWP 2459-16-00	LOCATION	CV-0249-0404-00N3 York, ON, MTM ON-10 311422.5E 4878713.2N			ORIGINATED BY	NT
DIST	York	HWY	404	BOREHOLE TYPE	Tripod	COMPILED BY	IL
DATUM	Geodetic	DATE	2024.03.05 - 2024.03.05	LATITUDE	44.048378	LONGITUDE	-79.417356
						CHECKED BY	NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	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>			WATER CONTENT (%)
								○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE							
263.0 0.0	GROUND SURFACE - Borehole moved 1 m SW from BH404-N3-01														
							262					128			
							261					138			
												168			
												188			
							260					240			
259.7 3.3	END OF BOREHOLE  NOTE:  1) Refusal to Tripod														

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

ONTARIO MTO CV-0249-0404-00N3.GPJ ONTARIO MTO.GDT 3/25/24



Brampton, Ontario

## RECORD OF BOREHOLE No BH404-N3-02

1 OF 1

METRIC

W.P. GWP 2459-16-00 LOCATION CV-0249-0404-00N3 York, ON, MTM ON-10 311456.9E 4878749.4N ORIGINATED BY NT  
 DIST York HWY 404 BOREHOLE TYPE Rubber Track Drill - MARL M5T / SSA COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.28 - 2023.11.28 LATITUDE 44.048704 LONGITUDE -79.416926 CHECKED BY NT

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	× LAB VANE	20						40	60	80
267.4	GROUND SURFACE																			
267.0	TOPSOIL - 100mm thick																			
0.1	CLAYEY SILT (FILL) - trace to some gravel trace rootlets, trace oragnic, brown, moist, compact		1	AS			267													
266.6																				
0.8	SANDY SILT (FILL) - trace to some gravel, trace clay, brown, moist to wet, compact		2	SS	10		266													
265.6																				
1.8	SANDY SILT - trace gravel, trace rootlets, blackish grey, moist to wet, compact		3	SS	19		265										2 28 (70)			
264.4																				
3.1	SILTY SAND TO SANDY SILT - trace to some gravel, trace clay, grey, moist, compact		5	SS	18		264													
	- becoming wet sand with 6" gravel layer within silty sand		6	SS	28		263													
261.3																				
6.1	SILTY SAND (TILL) some gravel, trace clay, grey, wet, compact to very dense		7	SS	19		261										6 53 (41)			
							260													
259.5																				
7.9	END OF BOREHOLE		8	SS	75/ 127mm															
	NOTE:  1) Groundwater level was encountered at a depth of 2.8 m and elevation of 264.6 m upon completion of borehole. 2) Borehole caved below depth of 3.15 m																			

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

ONTARIO MTO CV-0249-0404-00N3.GPJ ONTARIO MTO GDT 3/25/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH404-N3-03

1 OF 2

METRIC

W.P. GWP 2459-16-00 LOCATION CV-0249-0404-00N3 York, ON, MTM ON-10 311436.2E 4878735.3N ORIGINATED BY NT  
 DIST York HWY 404 BOREHOLE TYPE Rubber Track Drill - MARL M5T / SSA COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.27 - 2023.11.27 LATITUDE 44.048577 LONGITUDE -79.417185 CHECKED BY NT

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									
271.3	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT - 250mm thick																
271.1																	
0.3	GRAVELLY SAND (FILL) - blackish brown		1	AS			271										
270.5																	
0.8	SILTY SAND (FILL) - trace clay, trace gravel, greyish brown, moist, compact to very dense		2	SS	22		270										
			3	SS	86		269										
			4	SS	21		268										
							267										
			5	SS	35		266										
							265										
	- becoming silty sand, some gravel, some clay, occasional blackish brown to brown, moist		6	SS	65												
264.6																	
6.7	SILTY SAND - some gravel, trace clay, grey, moist to wet, compact to dense		7	SS	49		264										
			8	SS	25		263										
262.9																	
8.4	SILTY SAND (TILL) - some gravel, trace clay, grey, moist to wet, compact to very dense		9	SS	24		262										
			10	SS	60												

Hex: 90 ppm  
read at start  
VOC: 0 ppm  
6 47 (47)

Hex: 0 ppm VOC:  
0 ppm

8 44 39 9

24 40 30 6

12 54 (34)

Continued Next Page

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

ONTARIO MTO CV-0249-0404-00N3.GPJ ONTARIO MTO.GDT 3/25/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH404-N3-03

2 OF 2

METRIC

W.P. GWP 2459-16-00 LOCATION CV-0249-0404-00N3 York, ON, MTM ON-10 311436.2E 4878735.3N ORIGINATED BY NT  
DIST York HWY 404 BOREHOLE TYPE Rubber Track Drill - MARL M5T / SSA COMPILED BY IL  
DATUM Geodetic DATE 2023.11.27 - 2023.11.27 LATITUDE 44.048577 LONGITUDE -79.417185 CHECKED BY NT

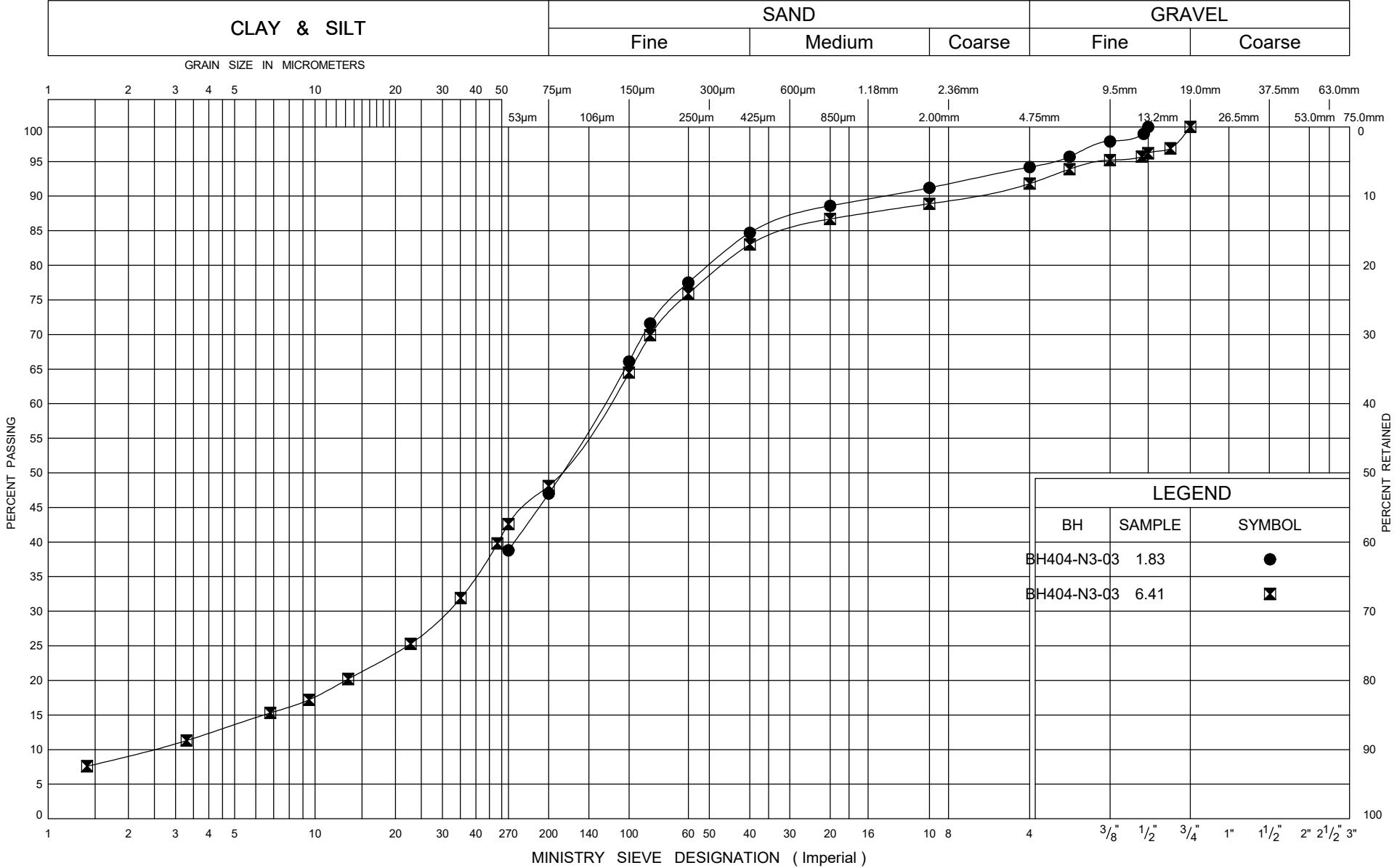
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub> W                      W <sub>L</sub>							
								○ UNCONFINED                      + FIELD VANE ● QUICK TRIAXIAL                      x LAB VANE					WATER CONTENT (%)							
							20   40   60   80   100													
			11	SS	86															
			12	SS	68/ 127mm															
258.7							261													
12.6	END OF BOREHOLE																			
	NOTE:  1) Groundwater level was encountered at a depth of 7.0 m and elevation of 264.3 m upon completion of borehole. 2) Borehole caved below depth of 12.2 m 3) Monitoring Well Readings Date                      Depth                      Elev. Feb. 26/24                      6.6 m                      264.7 m Mar. 06/24                      3.9 m                      267.4 m																			

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

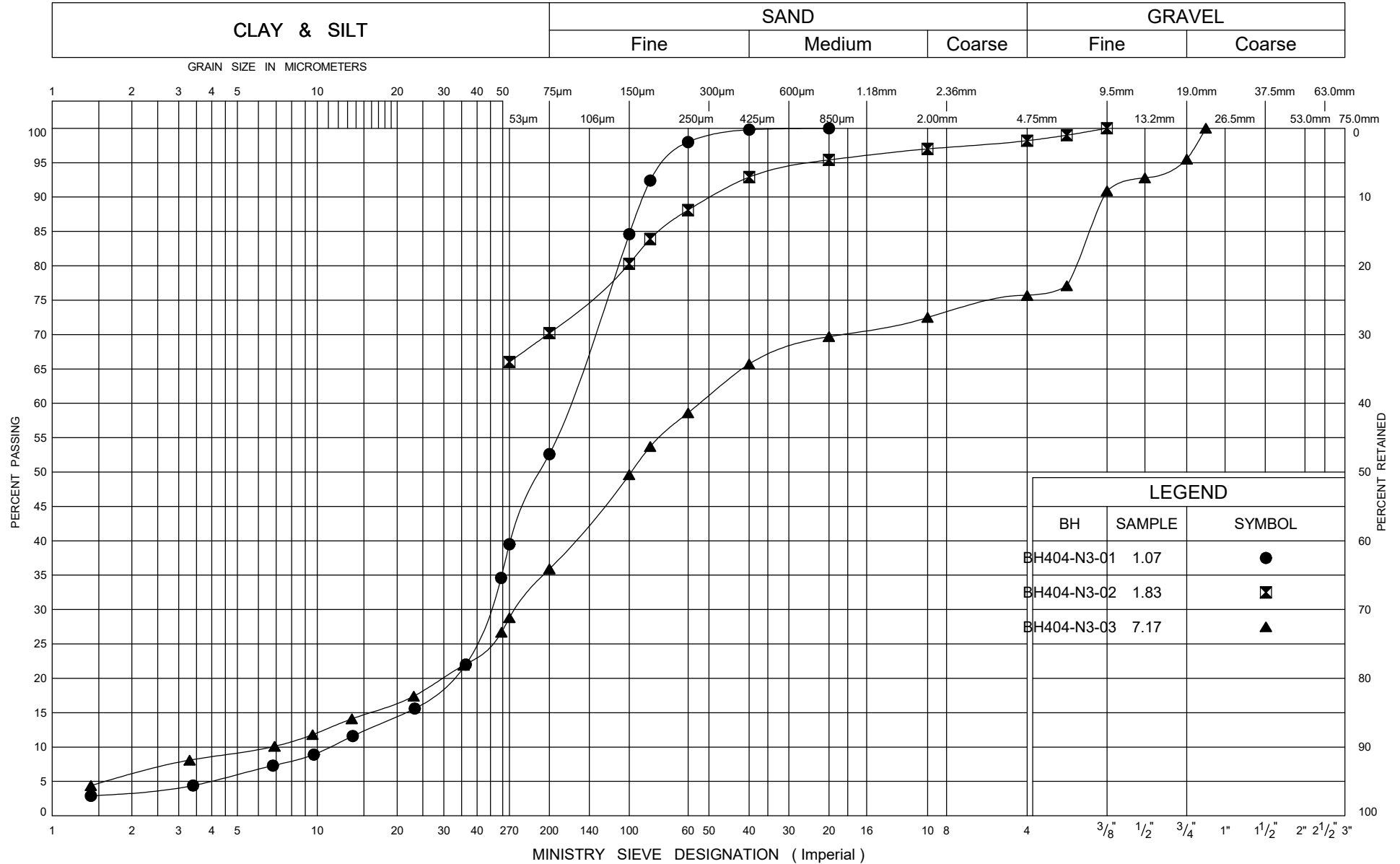
ONTARIO MTO CV-0249-0404-00N3.GPJ ONTARIO MTO.GDT 3/25/24

## Appendix E – Laboratory Data

UNIFIED SOIL CLASSIFICATION SYSTEM



## UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

SILTY SAND/ SANDY SILT/ SAND AND SILT

FIG No 2

W P

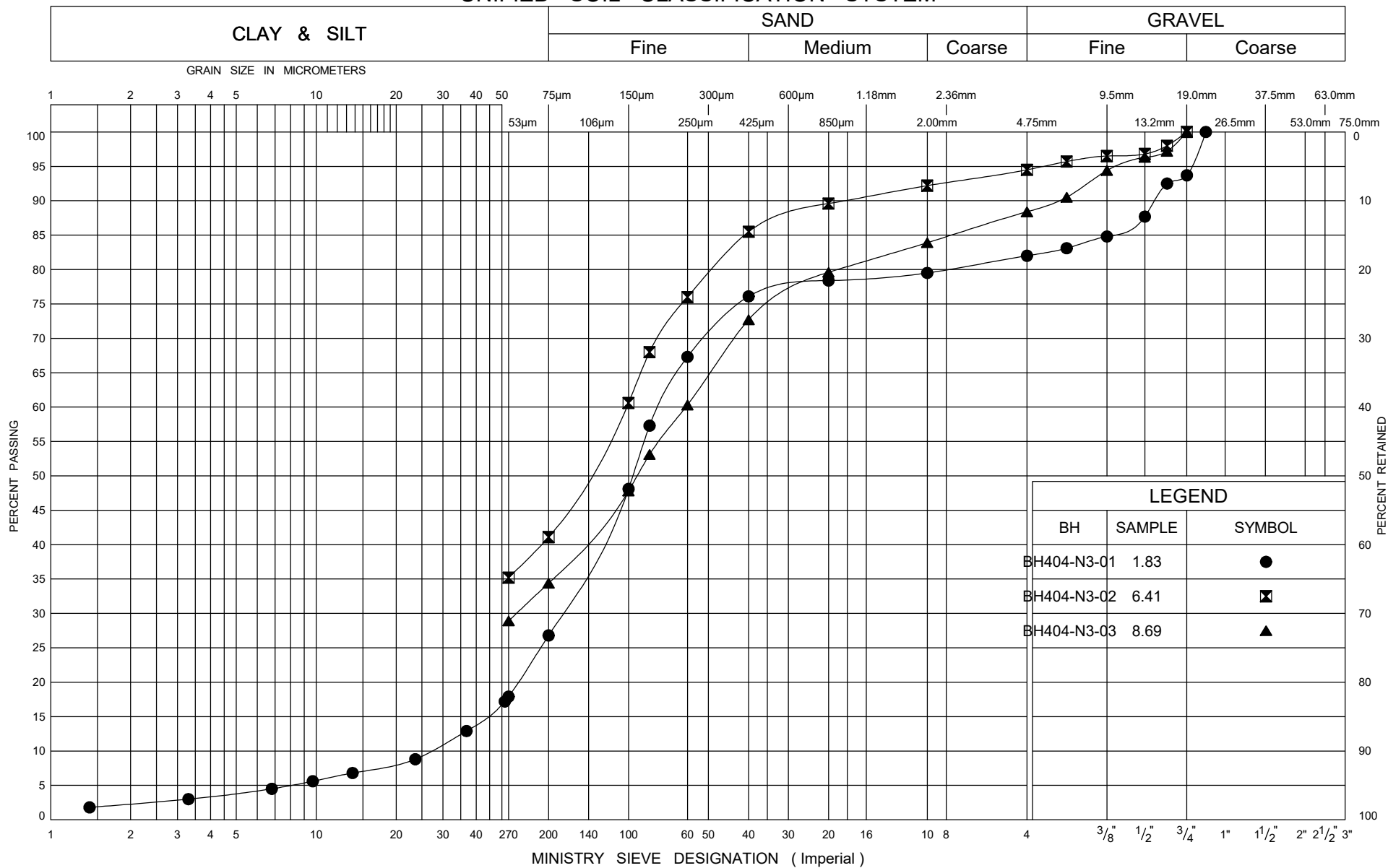
Replacement of 25 Culverts



Ministry of  
Transportation

Ontario

## UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

SILTY SAND (TILL)

FIG No 3

W P

Replacement of 25 Culverts

Ministry of  
Transportation

Ontario



Your Project #: ADM-22007871-A0  
 Site Location: 25 COLVERTS  
 Your C.O.C. #: 949883-03-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2023/12/21**  
 Report #: R7965708  
 Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3BB981**

**Received: 2023/12/11, 11:15**

Sample Matrix: Soil  
 # Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Methylnaphthalene Sum	1	N/A	2023/12/13	CAM SOP-00301	EPA 8270D m
Methylnaphthalene Sum	2	N/A	2023/12/14	CAM SOP-00301	EPA 8270D m
Hot Water Extractable Boron	3	2023/12/14	2023/12/15	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum	3	N/A	2023/12/14		EPA 8260C m
Chloride (20:1 extract)	2	2023/12/14	2023/12/15	CAM SOP-00463	MOE E3013 m
Free (WAD) Cyanide	3	2023/12/14	2023/12/14	CAM SOP-00457	OMOE E3015 m
Conductivity	2	2023/12/14	2023/12/14	CAM SOP-00414	OMOE E3530 v1 m
Conductivity	3	2023/12/14	2023/12/14	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (2)	3	2023/12/14	2023/12/14	CAM SOP-00436	EPA 3060A/7199 m
Petroleum Hydrocarbons F2-F4 in Soil (3)	1	2023/12/11	2023/12/12	CAM SOP-00316	CCME CWS m
Petroleum Hydrocarbons F2-F4 in Soil (3)	2	2023/12/12	2023/12/13	CAM SOP-00316	CCME CWS m
Acid Extractable Metals by ICPMS	3	2023/12/14	2023/12/15	CAM SOP-00447	EPA 6020B m
Total Metals in SPLP Leachate by ICPMS	3	2023/12/14	2023/12/14	CAM SOP-00447	EPA 6020B m
Moisture (Subcontracted) (1, 4)	2	N/A	2023/12/20	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2023/12/19	AB SOP-00080	EPA9030B/SM4500S2-DF
Moisture	3	N/A	2023/12/12	CAM SOP-00445	Carter 2nd ed 70.2 m
Modified SPLP extraction - Weight	3	N/A	2023/12/13	CAM SOP-00941	OMOECP LaSB E9003 R3
PAH Compounds in Soil by GC/MS (SIM)	1	2023/12/12	2023/12/12	CAM SOP-00318	EPA 8270E
PAH Compounds in Soil by GC/MS (SIM)	1	2023/12/12	2023/12/13	CAM SOP-00318	EPA 8270E
PAH Compounds in Soil by GC/MS (SIM)	1	2023/12/13	2023/12/14	CAM SOP-00318	EPA 8270E
pH CaCl2 EXTRACT	3	2023/12/14	2023/12/14	CAM SOP-00413	EPA 9045 D m
Redox Potential (5)	2	2023/12/14	2023/12/15	CAM SOP-00421	SM 24 2580 B
Resistivity of Soil	2	2023/12/11	2023/12/14	CAM SOP-00414	SM 23 2510 m
Sodium Adsorption Ratio (SAR)	3	N/A	2023/12/15	CAM SOP-00102	EPA 6010C
Sulphate (20:1 Extract)	2	2023/12/14	2023/12/15	CAM SOP-00464	MOE E3013 m
Volatile Organic Compounds and F1 PHCs	3	N/A	2023/12/13	CAM SOP-00230	EPA 8260C m

**Remarks:**

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCCFP, EPA, APHA.





Your Project #: ADM-22007871-A0  
Site Location: 25 COLVERTS  
Your C.O.C. #: 949883-03-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2023/12/21**  
Report #: R7965708  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3BB981**

**Received: 2023/12/11, 11:15**

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by Bureau Veritas, results relate to the supplied 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.

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE, Calgary, AB, T2E 6P8

(2) Soils are reported on a dry weight basis unless otherwise specified.

(3) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

(4) Offsite analysis requires that subcontracted moisture be reported.

(5) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode. The test is therefore, not SCC accredited for this matrix.



Your Project #: ADM-22007871-A0  
Site Location: 25 COLVERTS  
Your C.O.C. #: 949883-03-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2023/12/21**  
Report #: R7965708  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3BB981**

**Received: 2023/12/11, 11:15**

**Encryption Key**

Please direct all questions regarding this Certificate of Analysis to:

Patricia Legette, Project Manager

Email: Patricia.Legette@bureauveritas.com

Phone# (905)817-5799

=====

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



Your Project #: Campobello job# C3BB981

**Attention: Patricia Legette**

BUREAU VERITAS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

**Report Date: 2023/12/21**

Report #: R3444276

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3A0805**

**Received: 2023/12/13, 10:20**

Sample Matrix: Soil  
# Samples Received: 2

Analyses	Date		Date Analyzed	Laboratory Method	Analytical Method
	Quantity	Extracted			
Moisture	2	N/A	2023/12/20	AB SOP-00002	CCME PHC-CWS m
Sulphide	2	2023/12/19	2023/12/19	AB SOP-00080	EPA9030B/SM4500S2-DF

**Remarks:**

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by Bureau Veritas, results relate to the supplied 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.



Your Project #: Campobello job# C3BB981

**Attention: Patricia Legette**

BUREAU VERITAS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

**Report Date: 2023/12/21**

Report #: R3444276

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3A0805**

**Received: 2023/12/13, 10:20**

**Encryption Key**

Please direct all questions regarding this Certificate of Analysis to:  
Customer Solutions, Western Canada Customer Experience Team  
Email: customersolutionswest@bvlabs.com  
Phone# (403) 291-3077

=====

This report has been generated and distributed using a secure automated process.

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Scott Cantwell, General Manager responsible for Alberta Environmental laboratory operations.



### RESULTS OF CHEMICAL ANALYSES OF SOIL

<b>Bureau Veritas ID</b>		CGJ325	CGJ325	CGJ326		
<b>Sampling Date</b>		2023/11/27 11:50	2023/11/27 11:50	2023/11/29 11:52		
	<b>UNITS</b>	<b>BH 404 -ON3 -03</b>	<b>BH 404 -ON3 -03 Lab-Dup</b>	<b>BH 404 -ON3 -03</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Misc. Inorganics</b>						
Sulphide	mg/kg	1.9 (1)	2.1	5.0 (1)	0.5	B237529
RDL = Reportable Detection Limit						
Lab-Dup = Laboratory Initiated Duplicate						
(1) Extracted past method specified hold time						



BUREAU  
VERITAS

Bureau Veritas Job #: C3A0805

Report Date: 2023/12/21

BUREAU VERITAS

Client Project #: Campobello job# C3BB981

Sampler Initials: IB

### PHYSICAL TESTING (SOIL)

<b>Bureau Veritas ID</b>		CGJ325	CGJ326		
<b>Sampling Date</b>		2023/11/27 11:50	2023/11/29 11:52		
	<b>UNITS</b>	<b>BH 404 -ON3 -03</b>	<b>BH 404 -ON3 -03</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Physical Properties</b>					
Moisture	%	8.3	23	0.30	B238640
RDL = Reportable Detection Limit					



BUREAU  
VERITAS

Bureau Veritas Job #: C3A0805

Report Date: 2023/12/21

BUREAU VERITAS

Client Project #: Campobello job# C3BB981

Sampler Initials: IB

## TEST SUMMARY

**Bureau Veritas ID:** CGJ325  
**Sample ID:** BH 404 -ON3 -03  
**Matrix:** Soil

**Collected:** 2023/11/27  
**Shipped:**  
**Received:** 2023/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	B238640	N/A	2023/12/20	Surinder Singh
Sulphide	SPEC	B237529	2023/12/19	2023/12/19	Ly Vu

**Bureau Veritas ID:** CGJ325 Dup  
**Sample ID:** BH 404 -ON3 -03  
**Matrix:** Soil

**Collected:** 2023/11/27  
**Shipped:**  
**Received:** 2023/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	SPEC	B237529	2023/12/19	2023/12/19	Ly Vu

**Bureau Veritas ID:** CGJ326  
**Sample ID:** BH 404 -ON3 -03  
**Matrix:** Soil

**Collected:** 2023/11/29  
**Shipped:**  
**Received:** 2023/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	B238640	N/A	2023/12/20	Surinder Singh
Sulphide	SPEC	B237529	2023/12/19	2023/12/19	Ly Vu



### GENERAL COMMENTS

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

Package 1	8.0°C
-----------	-------

Results relate only to the items tested.





BUREAU  
VERITAS

Bureau Veritas Job #: C3A0805

Report Date: 2023/12/21

## QUALITY ASSURANCE REPORT

BUREAU VERITAS

Client Project #: Campobello job# C3BB981

Sampler Initials: IB

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
B237529	Sulphide	2023/12/19	105	75 - 125	107	75 - 125	<0.5	mg/kg	6.9	30
B238640	Moisture	2023/12/20					<0.30	%	4.1	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.



BUREAU  
VERITAS

Bureau Veritas Job #: C3A0805

Report Date: 2023/12/21

BUREAU VERITAS

Client Project #: Campobello job# C3BB981

Sampler Initials: IB

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Suwan (Sze Yeung) Fock, B.Sc., Scientific Specialist

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

---

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Scott Cantwell, General Manager responsible for Alberta Environmental laboratory operations.

BUREAU  
VERITAS

Bureau Veritas Job #: C3BB981

Report Date: 2023/12/21

exp Services Inc

Client Project #: ADM-22007871-A0

Site Location: 25 COLVERTS

Sampler Initials: IB

**SOIL CORROSIVITY PACKAGE (SOIL)**

Bureau Veritas ID		XVU129			XVU129		
Sampling Date		2023/11/27 11:50			2023/11/27 11:50		
COC Number		949883-03-01			949883-03-01		
	<b>UNITS</b>	<b>BH404-0N3-03 (SS6, 20'-22')</b>	<b>RDL</b>	<b>QC Batch</b>	<b>BH404-0N3-03 (SS6, 20'-22') Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>							
Resistivity	ohm-cm	5100		9103679			
<b>CONVENTIONALS</b>							
Redox Potential	mV	300	N/A	9111369			
<b>Inorganics</b>							
Soluble (20:1) Chloride (Cl-)	ug/g	27	20	9111970	32	20	9111970
Conductivity	umho/cm	195	2	9111363	195	2	9111363
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	9111971	<20	20	9111971
Sulphide	mg/kg	1.9 (1)	0.5	9127412	2.1	0.5	9127412
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable (1) Extracted past method specified hold time							

Bureau Veritas ID		XVU131		
Sampling Date		2023/11/29 11:52		
COC Number		949883-03-01		
	<b>UNITS</b>	<b>BH404-0N4-03 (SS6, 17.5'-19.5')</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>				
Resistivity	ohm-cm	1700		9103679
<b>CONVENTIONALS</b>				
Redox Potential	mV	330	N/A	9111369
<b>Inorganics</b>				
Soluble (20:1) Chloride (Cl-)	ug/g	210	20	9111970
Conductivity	umho/cm	591	2	9111363
Soluble (20:1) Sulphate (SO4)	ug/g	20	20	9111971
Sulphide	mg/kg	5.0 (1)	0.5	9127412
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Extracted past method specified hold time				