



## Foundation Investigation and Design Report

Highway 401 Eastbound Express and Collector Lanes between Victoria Park Avenue and Neilson Road – **Earthworks- Embankment Widening between Birchmount Road to Kennedy Road**

Assignment No. 2021-E-0018  
MTO Central Region  
Geocres Number: 30M14-559

(Latitude: 43.772756, Longitude: -79.291198)

**Type of Document:**  
Draft Report

**Project Number:**  
ADM-22000797-A0

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**Date Submitted:**  
December 20, 2024

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## Issue and Revised Record

Rev.	Date	Format	Prepared by	Reviewed by	Approved by	Description
<b>Rev. 0</b>	September 19, 2024	PDF	I. Lee, N. Tamrakar	T.Lardner T.C. Kim	S. Gonsalves	Report
<b>Rev. 1</b>	December 20, 2024	PDF	T. Lardner	T.C. Kim	S. Gonsalves	Report

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## Part I: Foundation Investigation Report

Highway 401 Eastbound from Victoria Park Avenue to Neilson Road

Earthworks- Embankment Widening Between Birchmount Road and Kennedy Road

## 1 Introduction

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. EXP Services Inc. (EXP) was retained by AECOM on behalf of The Ministry of Transportation (MTO) to provide detailed foundation investigation and engineering services for the proposed Highway 401 Eastbound rehabilitation and construction project. The findings, analyses and recommendations are presented in a Foundation Investigation Design Report created for each structure along the proposed highway. The work was undertaken under Assignment No. 2021-E-0018. 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 June 2021.

The scope of this report is specifically limited to the earthworks on high fills (embankment height > 4.5 m). The work was carried out in accordance with the Earth Management Plan (EMP) for this project. The EMP supports provincial objectives for the conservation and the diversion of reusable earth material from landfill by considering all possible options and incorporating reasonable measures to ensure that the generation of excess earth is minimized for this project.

The purpose of the investigation was to evaluate the subsurface conditions along the structure alignment to permit detailed design for the high fills. The site-specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field and laboratory testing. The field and laboratory work for these earth structures was performed by EXP. Based on collected geotechnical data in these boreholes and other boreholes drilled by others for this project, this report provides an assessment of the geotechnical issues, geotechnical design parameters and geotechnical foundation design recommendations for the proposed earth structures. Management of excess fill is addressed by others under separate cover.

## 2 General Description

The Highway 401 Eastbound Core and Collectors rehabilitation and operational improvements is proposed to be between Victoria Park and Neilson Road, City of Toronto, ON. The Highway 401 embankment between the Birchmount Road overpass structure and Kennedy Road is about 6 m to 8 m high. Based on the visual observations, the existing south slope of the highway embankment in high fill area has performed well. Based on the provided information, it is understood that the existing highway embankment in this area will be widened by up to 18 m (relative to the existing embankment crest) on the south side (EBL). For the widening a grade raise up to 8 m high will be required adjacent to the existing highway.

## 3 Geological Setting

Based on a review of geological maps of Southern Ontario (Chapman and Putnam, 1984; 2007), the site is situated within the South Slope physiographic region where the predominate landforms are Till Plains (Drumlinized) and Drumlins. The South Slope represents the southern slope of the Oak Ridges Moraine but also includes a strip south of the Peel Plain, extending from the Niagara Escarpment to the Trent River. The South Slope gradually, fairly and uniformly slopes down towards Lake Ontario.

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 consists of Halton Till predominately silt to silty clay matrix, high in matrix carbonate content and clast poor with occasional sand to silt zones. In addition, Map 2544 (Bedrock Geology of Ontario, Southern Sheet, 1991), the bedrock geology at the site consists of shale, limestone, dolostone and siltstone: Georgian Bay Formation, Blue Mountain Formation, Bilings Formation, Collingwood Member, Eastview Member.

## 4 Previous Geotechnical Investigation

The following reports have been reviewed during the preparation of this report:

*Foundation Investigation and Design Report  
Highway 401 Eastbound from Victoria Park Avenue to Neilson Road  
Earthworks- Embankment Widening Between Birchmount Road and Kennedy Road  
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- Foundation Investigation Report for Proposed Extension of the Existing Bridge at Hwy. #401 and Birchmount Road, County of York, Township of Scarborough, District #6 (Toronto), W.J. 65-F-49, W.P. 256-61, Geocres No. 30M14-073, The Ministry of Transportation Ontario (MTO), Foundation Section, Materials and Testing Div., dated August 03, 1965.
- Geocres No. 30M14-338 *“Bridge Widening and Replacement Highway 401 Rehabilitation from Warden Avenue to Brock Road, Toronto, Ontario, W.O.07-20012.”* by Golder Associates Ltd., dated April 2012.
- Geocres No. 30M14-492 *“Birchmount Road Overpass Rehabilitation (Site No. 37-212) Highway 401 Westbound Core and Collector Lanes, Neilson Road to Warden Avenue, City of Toronto, Ontario, MTO G.W.P. 2162-11-00”*, by Golder Associates Ltd., dated January 16, 2019.
- Foundation Investigation Report for The Proposed Extension of Highway. #401 and C.P.R Overhead, Metropolitan Toronto, District #6, W.J. 66-F-89, W.P. 257-61, Geocres No. 30M14-075, The Ministry of Transportation Ontario (MTO), Foundation Section, Materials and Testing Div., dated January 17, 1967.
- Geocres No. 30M14-493 *“CP Rail Overhead Replacement (Site No. 37-213), Highway 401 Westbound Core and Collector Lanes, Neilson Road to Warden Avenue, City of Toronto, Ontario, G.W.P No. 2162-11-00.”* by Golder Associates Ltd., dated January 17, 2019.
- Geocres No. 30M14-69 *“Foundation Investigation Highway #401 at Kennedy Road”* by Department of Highways – Ontario, dated June 14, 1954.
- Geocres No. 30M14-71 *“Foundation Investigation Report for The Proposed New Structure at Hwy. 401 and Kennedy Intersection, Scarborough Twp., York County, District No. 6 (Toronto), W.J. 66-F-33, W.P. 858-61.”* by The Ministry of Transportation Ontario (MTO), Foundation Section, Materials and Testing Div., dated June 20, 1966.
- Geocres No. 30M14-486 *“Kennedy Road Overpass (Site No. 37-214) Rehabilitation and Northward Widening, Highway 401 Westbound Core and Collector Lanes, Neilson Road to Warden Avenue, City of Toronto, Ontario, G.W.P No. 2162-11-00.”* by Golder Associates Ltd., dated January 4, 2019
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The applicable previous MTO borehole logs are attached as Appendix F in this report.

**Table 1.1: Summary of Previous boreholes**

Borehole No.	Borehole Location	Location (MTM NAD83 Zone 10)		Latitude	Longitude	Borehole Elevation (m)	Borehole Depth (m)
		Northing	Easting				
<b>73-1</b>	Off Road adjacent to Birchmount Rd	4848066	321385	43.772368	-79.293985	176.5	11.1
<b>75-10</b>	Off Road- East of CPR Structure	4848053	321350	43.772252	-79.294421	178.8	18.7
<b>75-11</b>	Off Road- West of CPR Structure	4848073	321353	43.772432	-79.294383	177.0	15.7

## 5 Field Investigation and Laboratory Analyses

### 5.1 Site Investigation and Field Testing

A site-specific investigation was undertaken by EXP between October 11, 2022, to October 23, 2022, and October 5, 2023 to November 16, 2023 and it included the following:

- A walkover site assessment was carried out by a Geotechnical Engineer from EXP.
  - Subsequent to the borehole lay-outs in the field, existing utilities were cleared by public utility companies.
  - Twelve boreholes were drilled along the alignment as part of the additional investigation. A summary of boreholes completed by EXP is listed in Table 1.2 below and are also attached in Appendix D.
  - The road boreholes were drilled using a truck-mounted CME-75 machine and off-road boreholes were drilled by Marl MST (owned and operated by Drilltech drilling Ltd.) equipped with solid and hollow stem augers, mud rotary equipment, and fitted with capability for Standard Penetration Testing (SPT);
  - 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 condition of granular (or cohesionless) soils (gravels, sands and silts) or the consistency of cohesive soils (clays and clayey soils);
  - 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.
  - All spoon samples obtained in the Standard Penetration Test (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;
  - 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
  - Upon completion of drilling and field testing, the boreholes were backfilled with a mixture of bentonite and auger cuttings. 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 by EXP**

Borehole No.	Borehole Location	Location (MTM NAD83 Zone 10)		Latitude	Longitude	Borehole Elevation (m)	Borehole Depth (m)
		Northing	Easting				
<b>BH22-1-1</b>	Off Road-Birchmount Road	4848043	321370	43.772162	-79.294173	180	9.6
<b>BH22-1-3</b>	Hwy 401 EBL Collector South Shoulder	4848071.2	321390	43.772415	-79.293924	185.9	15.8



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Borehole No.	Borehole Location	Location (MTM NAD83 Zone 10)		Latitude	Longitude	Borehole Elevation (m)	Borehole Depth (m)
		Northing	Easting				
<b>BH22-1-7</b>	Off Road- East of Birchmount Road	4848052.4	321438.1	43.772245	-79.293327	179.2	9.8
<b>BH22-2-1</b>	Hwy 401 EBL Collector - West of CPR Structure	4848104	321489	43.772708	-79.292693	185.9	14.3
<b>BH22-2-2</b>	Hwy 401 EBL Collector South Shoulder- East of CPR Structure	4848125	321556	43.772896	-79.29186	185.1	15.8
<b>BH22-2-2A</b>	Hwy 401 EBL Collector South Shoulder- East of CPR Structure	4848127.9	321573.1	43.772921	-79.930503	184.7	15.9
<b>BH22-2-5</b>	Hwy 401 EBL Collector South Shoulder- East of CPR Structure	4848151.5	321647.6	43.773132	-79.290721	184	15.6
<b>BH22-2-6</b>	Hwy 401 -Kennedy Road W-NS Ramp	4848185.1	321734	43.773433	-79.289647	183.4	15.9
<b>BH22-2-7</b>	Hwy 401 -Kennedy Road W-NS Ramp	4848211.8	321822.6	43.77367	-79.2878	182	13
<b>BH22-2-8</b>	Hwy 401 -Kennedy Road – North of W-NS Ramp	4848235.9	321918.3	43.773886	-79.287356	182.4	15.9
<b>BH22-2-9</b>	Off Road- East of CPR RoW	4848109.6	321609.3	43.772756	-79.291198	180	9.6
<b>BH22-2-10</b>	Off Road- East of CPR RoW	4848140.1	321706.1	43.773028	-79.289995	177.1	9.5
<b>BH22-2-11</b>	Off Road- Toe of the Kennedy Road W-N/S Ramp	4848164.1	321796.2	43.773242	-79.288875	174.4	9.5
<b>BH22-2-12</b>	Off Road- Toe of the Kennedy Road W-N/S Ramp	4848183.7	321880.9	43.773417	-79.287822	171.8	9.8

## 5.2 Laboratory Testing

Selected samples were submitted for natural moisture content testing. In addition, Atterberg Limit and Grain size analysis (sieve and hydrometer) tests were performed on selected soil samples (performed by EXP). A minimum of 25% of the samples were tested for soil classification as per the MTO guidelines. The results of the laboratory tests are shown in table 1.3.

**Table 1.3: List of Laboratory Test Completed by EXP**

Borehole No.	Moisture Content	Atterberg Limits	Sieve	Hydrometer	Unit Weight	Corrosivity
BH22-1-1	10	2	3	3	1	---
BH22-1-3	13	2	4	4	5	1
BH22-1-7	9	1	2	2	---	---
BH22-2-1	13	1	3	2	1	1
BH22-2-2	15	1	4	3	2	---
BH22-2-2A	14	2	5	5	---	---
BH22-2-5	13	---	4	4	---	---
BH22-2-6	14	2	4	4	1	---
BH22-2-7	10	2	2	2	---	---
BH22-2-8	16	3	5	5	---	---
BH22-2-9	9	---	2	2	1	---
BH22-2-10	9	---	2	2	---	---
BH22-2-11	10	---	2	2	---	---
BH22-2-12	9	---	3	3	1	---

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

## 6 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix D. 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 stratigraphic sections are provided in Appendix C. It should be noted that the stratigraphic boundaries indicated on the borehole log and stratigraphic sections 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 interpreted 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 EXP’s geotechnical investigation indicates the following sub-surface sequence: a pavement structure composed of asphalt overlaying embankment fill consisting of layers of cohesionless and cohesive material underlain by native cohesionless till.

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

## 6.1 Subsoils

### 6.1.1 Asphalt/Pavement Structure/Topsoil

An asphalt/pavement structure layer was encountered at the surface of boreholes 22-1-1, 22-1-3, 22-2-1, 22-2-2, 22-2-2A, 22-2-5, 22-2-6, 22-2-7. The thickness of the asphalt/pavement structure was between 0.1 m to 0.43 m

A topsoil layer was encountered at the ground surface of boreholes 22-1-7, 22-2-8, 22-2-9, 22-2-10, 22-2-11, 22-2-12, 73-1. The thickness of topsoil was between 0.15 m to 0.22 m.

### 6.1.2 Cohesionless Fill: Gravelly Sand/ Silty Sand/ Sand and Gravel/Sand and Silt/Sand (Fill)

Gravelly Sand/ Silty Sand / Sand and gravel fill layers were encountered below asphalt layer in boreholes 22-1-1, 22-1-3, 22-2-1, 22-2-2, 22-2-2A, 22-2-5, 22-2-6 and 22-2-7 and below the topsoil in borehole. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in the boreholes are summarized in Table 1.4 below:

**Table 1.4: Summary of cohesionless fill layer**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
22-1-1	179.8	179.6	0.2	0.2
22-1-3	185.6	184.5	0.3	1.1
22-2-1	185.5	179.8	0.4	5.7
22-2-2	184.7	182.7	0.4	2.0
22-2-2A	183.8	182.9	0.2	0.9
22-2-5	182.4	181.7	0.1	0.7
22-2-6	180.5	179.9	0.2	0.6
	179.2	172.8	1.5	6.4
22-2-7	178.6	178.2	0.4	0.4
	174.4	172.9	4.6	1.5

This layer consists mainly of sand, gravel and silt and trace clay. The material is brown to grey in color and moist to wet. The SPT “N” values within this layer ranged from 10 to 49 blows per 300 mm penetration, corresponding to compact to dense in compactness condition.

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

Moisture Content: (EXP)

- 2% to 15%

Grain Size Distribution: (EXP)

- 2% to 28% gravel;
- 34% to 69% sand;
- 12% to 14% silt and clay;
- 22% to 43% silt;
- 3% to 18% clay;

**Atterberg Limits: (EXP)**

- Liquid Limit: 17% to 18%
- Plastic Limit: 11% to 12%
- Plasticity Index: 5% to 7%

The results of the moisture content test performed by EXP are provided on the record of borehole sheets in Appendix D. The results of the grain size distribution and Atterberg limit tests performed by EXP are also presented in figures attached in Appendix E.

### 6.1.3 Cohesive Fill: Clayey Silt (Fill)

A clayey silt fill layer was encountered below the topsoil/at the ground surface or below cohesionless fill in boreholes 22-2-1, 22-2-11, 22-2-2, 22-2-2A, 22-2-6, 22-2-7, 22-2-8. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in boreholes are summarized in Table 1.5 below:

**Table 1.5: Summary of clayey silt fill layer**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
<b>22-2-1</b>	179.8	176.8	6.1	3.0
<b>22-2-11</b>	174.2	173.6	0.2	0.6
<b>22-2-2</b>	182.7	177.5	2.4	5.2
<b>22-2-2A</b>	182.9	176.4	1.1	6.5
<b>22-2-6</b>	179.2	178.4	1.5	0.8
<b>22-2-7</b>	178.2	174.4	0.8	3.8
<b>22-2-8</b>	182.2	171.4	0.2	10.8

This layer consists mainly of clay and silt with trace to some sand and trace to some gravel. The material is brown to grey in color and moist. The SPT “N” values within this layer ranged from 5 to 34 blows per 300 mm penetration, corresponding to firm to hard in consistency.

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

**Moisture Content: (EXP)**

- 5% to 22%

**Grain Size Distribution: (EXP)**

- 0% to 7% gravel;
- 36% to 47% sand;
- 36% to 42% silt;
- 11% to 19% clay;

**Atterberg Limits: (EXP)**

- Liquid Limit: 16% to 27%
- Plastic Limit: 9% to 13%
- Plasticity Index: 5% to 14%

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix D. The results of the grain size distribution tests performed by EXP are also provided in Appendix E.

#### 6.1.4 Sand and Silt/Silty Sand

A layer comprised of sand and silt was encountered below the topsoil in boreholes 22-1-7, 22-2-9, 22-2-10 and at surface level in borehole 75-10. The approximate elevations of the surface and base of the till and its thickness as encountered in boreholes are summarized in Table 1.6 below:

**Table 1.6: Summary of sand and silt/silty sand layer**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
<b>22-1-7</b>	179	177.7	0.2	1.3
<b>22-2-9</b>	179.8	178.5	0.2	1.3
<b>22-2-10</b>	176.9	175.6	0.2	1.3
<b>75-10</b>	178.9	176.8	0	2.1

This layer consists mainly of silt and sand with some clay and trace gravel. The material is brown to grey in color and moist to wet. The SPT “N” values within this layer ranged from 24 to over 100 blows per 300 mm to compact to very dense, but mostly dense to very dense in compactness condition.

Laboratory testing performed on selected samples consisted of moisture content tests. The test results are as follow:

Moisture Content: (EXP and MTO)

- 2% to 19%

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix D.

#### 6.1.5 Silty Sand Till/ Sandy Silt/Sand and Silt Till

A silty sand/sandy silt till layer was encountered in all boreholes below the fill or sand and silt layer, below topsoil in borehole 73-1 and at surface level in borehole 75-11. All boreholes were terminated within this layer. The approximate elevations of the surface and base of the till layer and its thickness as encountered in the boreholes are summarized in Table 1.7 below:

**Table 1.7: Summary of silty sand till/ sandy silt till layer**

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
22-2-1	179.6	170.4	0.4	9.2
22-1-3	176.8	170.1	9.1	6.7
22-1-7	177.7	169.4	1.5	8.3
22-2-1	176.8	171.6	9.1	5.2
22-2-10	175.6	167.6	1.5	8.0
22-2-11	173.6	164.9	0.8	8.7
22-2-12	171.6	162.0	0.2	9.6
22-2-2	177.5	169.3	7.6	8.2
22-2-2A	176.4	168.1	7.6	8.3
22-2-5	176.1	166.9	6.4	9.2
22-2-6	172.8	164.8	7.9	8
22-2-7	172.9	166	6.1	6.9
22-2-8	171.4	166.5	11	4.9
22-2-9	178.5	170.4	1.5	8.1
73-1	176.2	165.4	0.3	10.8
75-10	176.8	160.1	2.1	16.6
75-11	177.7	162	0	15.7

This layer consists mainly of silt and sand with some clay and trace gravel. The material is brown to grey in color and moist to wet. The SPT “N” values within this layer ranged from 24 to over 100 blows per 300 mm to compact to very dense, but mostly dense to very dense in compactness condition.

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

Moisture Content: (EXP and MTO)

- 6% to 24%

Grain Size Distribution: (EXP and MTO)

- 0% to 19% gravel;
- 26% to 91% sand;
- 26% to 53% silt;
- 3% to 19% clay;
- 9% to 19% silt and clay;

Atterberg Limits: (EXP and MTO)

- Liquid Limit: 17% to 21%
- Plastic Limit: 11% to 13%
- Plasticity Index: 4% to 8%

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

#### 6.1.6 Groundwater 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 (phreatic surface).

A summary of the groundwater levels observed during and after the investigations are summarized in Table 1.8 and are also presented on the Record of Borehole Sheets in Appendix D and Appendix F.

Based on the water level measured in open hole the groundwater level is anticipated to be ranging between approximately Elev. 166.5 m to Elev. 168.1 m across the site. It should be noted that the groundwater is subject to seasonal fluctuations and fluctuations in response to major weather events.

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**Table 1.8. Summary of observed groundwater levels**

Borehole	Ground Surface Elevation (m)	Water level Depth/ Elevation (m)	Date	Comment
22-1-1	180	Dry	March 20, 2023	Taken upon completion of drilling
22-1-3	185.9	Dry	December 12, 2022	Taken upon completion of drilling
22-1-7	179.2	Dry	November 16, 2023	Taken upon completion of drilling
22-1-7	179.2	7.6/171.6	December 4, 2024	In piezometer
22-2-1	185.9	Dry	October 12, 2022	Taken upon completion of drilling
22-2-10	177.1	Dry	October 6, 2023	Taken upon completion of drilling
22-2-11	174.4	7.9/166.5	October 11, 2023	Taken upon completion of drilling
22-2-12	171.8	5.2/166.6	October 5, 2023	Taken upon completion of drilling
22-2-2	185.1	Dry	October 19, 2022	Taken upon completion of drilling
22-2-2A	184	Dry	October 23, 2022	Taken upon completion of drilling
22-2-5	182.5	Dry	October 12, 2023	Taken upon completion of drilling
22-2-6	180.7	Dry	November 4, 2023	Taken upon completion of drilling
22-2-7	179	Dry	November 2, 2023	Taken upon completion of drilling
22-2-8	182.4	14.3/168.1	October 5, 2023	Taken upon completion of drilling
22-2-9	180	Dry	October 6, 2023	Taken upon completion of drilling
73-1	176.5	8.6/167.9	May 12, 1965	Taken upon completion of drilling
75-10	178.8	10.3/168.5	December 2, 1966	Taken upon completion of drilling
75-11	177.7	9.1/168.6	December 2, 1966	Taken upon completion of drilling



### 6.1.7 Chemical Analysis

Two (2) soil samples were selected for chemical analysis during current investigation. The soils samples collected by EXP were tested at the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario.

The analytical results are summarized in Table 1.9 below and are presented in Appendix E.

**Table 1.9. Summary of chemical analysis results**

Sample Identification	pH (Unitless)	Soluble Chloride (ppm)	Soluble Sulphate (ppm)	Resistivity (ohm-cm)	Conductivity (umho/cm)	Redox Potential (mV)
BH22-1-03, SS10	7.87	560	<20	810	1.230	190
BH22-2-01, SS13	7.98	750 – 770	41	660	1.51 – 1.53	290

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## 7 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 investigations and analyses.


Details of the limitations of this report are presented as Appendix A, "Limitations and Use of Report".

This Foundation Investigation Report has been prepared by Nimesh Tamrakar, M.Eng., P.Eng., and Thomas Lardner, Ph.D., P.Eng. It was reviewed by TaeChul Kim, M.E.Sc., P.Eng. and Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was supervised by Elvis Lu, M.Eng.


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## Part II: Foundation Design Report

Highway 401 Eastbound from Victoria Park Avenue to Neilson Road

Earthworks- Embankment Widening Between Birchmount Road and Kennedy Road

## 8 Discussion and Recommendations

### 8.1 General

This section of the report provides geotechnical design recommendations for the proposed high fill embankment widening between Birchmount Road and Kennedy Road, associated with the southward widening of Highway 401 as part of the rehabilitation and operational improvements of the Highway 401 Eastbound Core and Collector lanes from Victoria Park Avenue to Neilson Road in the City of Toronto, Ontario. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current investigation at the site conducted by EXP and previous investigations by others used to aid in assessments. The recommendations are provided for the guidance of the Design Engineer; comments on construction are solely provided to highlight issues that could affect the design. Contractors and others undertaking the works must make their own interpretation of the subsurface information provided as it affects means and methods, costs, equipment selection, scheduling and the like.

Based on the provided information, it is understood that the existing highway embankment in this area will be widened by up to 18 m (relative to the existing embankment crest) on the south side (EBL). For the widening, a grade raise up to 8 m high will be required adjacent to the existing highway. Based on the visual observations, the existing south slope of the highway embankment in high fill areas, inclined as built, has performed well.

This part of the report presents the results of stability and settlement analyses of the embankments and recommendations for stable geometry, fill materials, and any mitigation required to enhance stability and reduce post-construction settlement, if and where required. The report also addresses potential construction concerns related to embankment construction as they inform design. Management of excess fill is addressed by others under separate cover.

### 8.2 High Fills

#### 8.2.1 General

It is recommended that embankment fills be constructed at an inclination no steeper than 2H:1V as stipulated in OPSD 202.010. Additionally, a minimum 2-m wide bench is required at maximum 8 m height intervals for sections of the slope exceeding 8 m in height (see OPSD 202.010), if any. It is recommended to place this bench at mid-height or close to mid-height of the embankment fill. In addition, embankment fill materials should be properly benched into the existing embankment in accordance with OPSD 208.010 and compacted.

#### 8.2.2 Seismic Hazard Site Classification and Values

Seismic characterization of the site should be compliant with the CHBDC. The potential for seismic loading must be considered for design in accordance with Section 6.14.7 of the CHBDC with respect to the soil conditions encountered at the site. Table 4.1 of the CHBDC shows site classification for seismic site response based on average soil properties in the top 30 m.

At this site, the subsoil conditions below the roadway generally consists of sand and gravel/gravelly sand and fill, followed by sand and silt, followed by clayey silt. The subsoil conditions at the bottom of the embankment generally consists of mixture of native cohesionless soils consisting of silt and sand. During the fieldwork, the groundwater level was measured at about Elev.166.5 m in the boreholes (BH22-2-11, BH22-2-12) and Elev.168.1 in the borehole (BH22-2-8) upon completion of drilling and later the groundwater level was measured at about Elev. 171.6 m in the piezometer (BH22-1-7). Based on the soil characteristics, the site class for this site is estimated to be Class "C" according to Table 4.1 of the CHBDC.

From the Natural Resources Canada website, 2020 NBC seismic hazard values are obtained using the site location coordinates and the site-adjusted damped reference spectral accelerations for the project site are shown in Table 2.2 below:

Table 2.1. Seismic design values

Probability of Exceedance in 50 Years (Return Period)	Sa(0.2) (g) <sup>1</sup>	Sa(0.5) (g)	Sa(1.0) (g)	Sa(2.0) (g)	PGA (g)
Latitude: 46.772756°; Longitude: -79.291198°					
2% (1 in 2475-year)	0.325	0.198	0.104	0.0481	0.176

Note:

1.  $g$  = acceleration due to gravity ( $9.81 \text{ m/s}^2$ )

These values are associated with an earthquake having a 2% probability of exceedance in a 50-year period (1 in 2475-year) for Site Class C and is also shown on the seismic hazard calculation data sheet for this site attached in Appendix H.

The site coefficients used to determine the design spectral acceleration and displacement values are a function of the Site Class and the reference peak ground acceleration ( $\text{PGA}_{\text{ref}}$ ). Since  $\text{Sa}(0.2)/\text{PGA}$  is less than 2.0 at this site,  $\text{PGA}_{\text{ref}}$  is equal to  $0.8 \times \text{PGA} = 0.141 \text{ g}$ , as per section 4.4.3.3. of the CHBDC (CAN/CSA-S6-19). The site coefficient  $F(\text{PGA})$ , for this site (Seismic Site Class C and  $\text{PGA}_{\text{ref}} = 0.141 \text{ g}$ ) is 1.

### 8.2.3 Stability Considerations

Limit equilibrium slope stability analyses were carried out for each high fill area at the selected cross-sections using the sub-surface information obtained from the current geotechnical investigation, and proposed embankment configuration provided in the drawings and cross-sections. Factors of safety were calculated using the SLOPE/W computer program and the Morgenstern-Price method for critical failure surfaces. A minimum factor of safety of 1.5 was adopted as the design criterion for short and long term static stability of embankments. A minimum factor of safety of 1.1 was adopted for seismic conditions under long term conditions.

Material parameters adopted in the slope stability analyses are summarized in Table 2.1. In addition, a traffic surcharge pressure of 16 kPa was adopted in the slope stability assessments. In the analyses, it is assumed that the topsoil or other organic material within the footprint of the new fill will be stripped and removed prior to embankment construction. In the performed analyses, it was assumed that the additional fill will be engineered earth fill.

Table 2.2 Soil strength parameters for slope stability assessment

Layer Name	Bulk Unit Weight, $\gamma$ (kN/m <sup>3</sup> )	Short Term Parameters		Long Term Parameters	
		$\phi$ (°)	C (kPa)	$\phi'$ (°)	C' (kPa)
Engineered Fill	20	30	0	30	-
Clayey Silt Fill (Firm to Stiff)	20	-	60	30	5
Sand and Silt Till (generally dense to very dense)	22	35	-	35	-

The results of the slope stability analyses are shown in Figures 1 through 3 in Appendix G of this report and are summarized in Table 2.2 below.

**Table 2.3 Summary of results of slope stability analyses**

Location	Maximum Height (m)	Conditions	Min FoS
Widened Embankment	8	Drained long-term conditions, static condition	1.5
		Undrained short-term conditions, static condition	1.8
		Drained long-term conditions, seismic condition	1.1

The calculated minimum factors of safety of critical surfaces for all high fills meet the design criteria for static conditions for short-term (undrained) and long-term (drained) conditions and seismic for long-term conditions with embankment side slopes of 2H:1V. Therefore, based on the results of stability analyses, new roadway widened embankment up to 8 m high embankment with slope inclination of not steeper than 2H:1V are anticipated to be stable.

## 8.2.4 Settlement Considerations

### 8.2.4.1 Settlement of Foundation Soils

Grade raise for the widening will cause settlements of the founding soils, which could warrant additional measures (such as, in general, extended pre-load times and ground improvement measures) to ensure smooth performance of the road embankment. The need for any additional measures will be determined through analysis of settlement monitoring results.

Parameters used to analyze the total magnitude of settlement were derived from correlations with Standard Penetration Test (SPT) results and from soil classification testing results, including grain size analyses, Atterberg limits, and water content (Bowles, 1984; Das 1998; Holtz and Kovaks, 1981). These results were augmented by our experience with the Halton Till and the available data adopted in the settlement analyses is summarized in Table 2.3.

A computer program, Settle3D (Rocscience) was employed for settlement calculation. Settle3D is a 3-dimensional program for the analysis of immediate and consolidation settlement under foundations, embankments and surface loads. The program combines the simplicity of one-dimensional analysis with the power and visualization capabilities of more sophisticated three-dimensional programs.

**Table 2.4: Soil parameters used in settlement analyses**

Soil Layers	Unit Weight (kN/m <sup>3</sup> )	E (MPa)	Compression Index (Cc)	Recompression Index (Cr)	Void Ratio (e)	Preconsolidation Pressure (p' <sub>c</sub> ) (kPa)
Clayey silt (firm to stiff)	20	-	0.15	0.02	0.65	225
Sand and silt till (Dense to Very dense)	22	120				

The summary of results of settlement analyses for the embankment is presented in Table 2.4 below and can be seen in figure attached in Appendix H.

**Table 2.5: Summary of results of settlement analyses**

Locations	Abutment Height (m)	Assumed Embankment Width (m)	Calculated Immediate Settlement (mm)	Calculated Consolidation Settlement (mm)	Calculated Total Settlement (mm)
Widened Embankment	8	18	13	17	30

The estimated total settlement under the widened embankment is expected to be about 30 mm (where surficial clay is present). Approximately 13 mm of this settlement is expected to occur during and immediately following construction of approach embankment. However, remaining post construction settlement, which is associated with long-term consolidation of firm surficial clayey silt under the widened approach embankment is anticipated to be completed within 15 days to a month of construction. Where no surficial clay is present, the total settlement is estimated to be less than 25 mm under the new embankments. Some differential settlements can be expected at the new/old embankment interface and structure/embankment interface, but these movements should be able to be accommodated during the paving process. A NSSP for Delay of Pavement to address the fill settlement is provided in Appendix K.

For new embankment approaches to structural elements, MTO settlement criteria are as follows: the post construction settlement is limited to 25 mm; 50 mm ; 75 mm ; >100 mm for 0 to 20 m ; 20 to 50 m ; 50 to 75 m ; and >75 m offsets from the abutment, respectively. These settlements are considered acceptable for 20 years post paving.

#### 8.2.4.2 Settlement of Embankment Fill

The fill is also expected to experience some settlement. It is estimated that the embankment itself will compress by about 0.5 to 1 percent of the embankment height under its self-weight. Depending on material type and assuming placement as indicated in this report. More granular material fills would compress less and over a shorter time period, typically within the period of embankment construction. Non- granular earth fills would exhibit some additional settlement over time. To minimize the post construction settlement, the fill materials may be compacted to 98% standard Proctor maximum dry density. Some differential settlements can be expected at the structure/embankment interface, but these movements should be able to be accommodated during the paving process ranging from 1 to 3 months depending on the nature of embankment fill employed. As stated above, where the granular fill is used, the required delay will be less.

If the delay of 1 to 3 months in the pavement construction as discussed above is not achievable, it is recommended that settlement should be monitored. This should be applied where the post construction settlement will affect pavement performance or a settlement sensitive structure (i.e. bridges) will be constructed on the embankment. The type of monitoring will depend on the magnitude and time frame of the settlement. For most monitoring programs, use of routine surveying methods are adequate. These methods are commonly used if paving should be delayed until embankment settlement is nearly complete. Individual geotechnical reports for structures where this is a concern will include the time period that the settlement should be monitored and the frequency of observations.

The maximum fill compression settlement rate will generally occur near the base of the embankment where the loads are greatest and diminish to nominal values near the top of the embankment. The major portion of such compression settlement should occur during embankment placement particularly if the fill material is more granular and compaction levels uniformly

exceed 95% SPMDD. More cohesive soils placed at moisture contents dry of their optimum compaction moisture content may compress more than this amount and over a longer period of time, particularly when subjected to saturation after placement.

This is particularly important at approaches to abutments where requirements for differential settlement are more stringent. Where appropriate, structure geotechnical reports will address, material type and use, delay required prior to pavement and nature and extent of any monitoring required.

### 8.2.5 Settlement Monitoring

The computed settlements are based on best assumptions and findings on the nature, consistency, compressibility, characteristics and thicknesses of the identified deposits within the zone of influence of loading. Actual settlements can differ somewhat, given the variable nature of soils and its deposition. Recommendations for monitoring instrumentation in the vicinity of structures with high fill embankments are provided in the structure specific reports of this Project.

### 8.2.6 Construction Considerations

#### 8.2.6.1 Site Preparation

Prior to the placement of new fill for the embankment widening, the sites will need to be cleared and grubbed of the existing trees and bushes. All surficial topsoil, organic, loose, soft and/or deleterious materials should be stripped from below the proposed embankment widening areas. Considering the findings in this investigation, the anticipated stripping depths/elevations at the borehole locations are given in Table 2.5 using data from the discrete locations of investigations.

**Table 2.6: Recommended Stripping Depths**

Reference Boreholes	Existing Ground Elevation at BH Location (m)	Recommended Stripping Depth/Elevation (m)
<b>BH22-1-7</b>	179.2	0.2/179
<b>BH22-2-8</b>	179.2	0.2/179
<b>BH22-2-9</b>	180.0	0.2/179.8
<b>BH22-2-10</b>	177.1	0.2/176.9
<b>BH22-2-11</b>	174.4	0.2/174.2
<b>BH22-2-12</b>	171.8	0.2/171.6

After stripping, the exposed subgrade should be inspected, approved, and properly compacted (i.e., proof rolled) from the surface, using a heavy compactor. The groundwater table should be lowered to at least 0.5 m in below the subgrade level, before any proof rolling and the application of significant compaction effort.



### 8.2.6.2 Embankment Construction

The materials used for the construction of the embankment fills should consist of approved, acceptable earth fill (e.g. Select Subgrade Materials-OPSS.PROV 1010 or Granular B Type I). SSM or approved granular fill is preferred and should be used where settlement must be mitigated.

Care must be taken to properly compact the embankments to reduce settlements associated with fill density changes. Fill used for construction of the embankments should be in accordance with OPSS.PROV 212 and fill placement should meet or exceed the requirements of OPSS.PROV 206 as amended by SSP 102S05, SSP 206F04 and SSP 206F06. Construction should be in accordance with OPSS.PROV 206. The fill should be placed in regular lifts with loose thickness not exceeding 300 mm and compacted to at least 95% of SPMDD. Each fill layer should be uniformly compacted with heavy compactors, suitable for the type of fill used. The final 600 mm lift of fill prior to placement of the roadway granular subbase and base courses should be compacted to 100% of SPMDD.

Quality assurance should be provided as per MTO Standard 501.08 (OPSS.PROV 501). Inspection and field density should be carried out by qualified personnel during placement operations to ensure that appropriate materials are used and that adequate levels of compaction have been achieved.

Consideration should be given to the time of year that construction will likely occur. Where embankments are built on existing hillsides or existing embankment slopes, the existing surface soil may form a plane of weakness unless the slope is benched (terraced or stepped). Benching breaks up the plane, increasing the strength of the entire system. The consequences of poor compaction at the sloping face of the embankment include increased risk of erosion and even surficial slope instability. This issue becomes especially problematic as the embankment slope steepness exceeds 2H:1V.

Approaches typically used to address compaction and surficial stability of embankment slopes include:

- Over-build the embankment laterally at the slope face approximately 600 mm, compact the soil, and then trim off the outer 600 mm of the embankment to produce a well compacted slope face.
- Use strips of geosynthetic placed in horizontal layers at the slope face as a compaction and surficial stability aid.

Embankment fill materials should be properly benched into the existing embankment in accordance with OPSD 208.010 and compacted. The surface of the existing side slopes to be widened should be scarified to remove any soil/vegetation to provide a good bond between the existing earth fill and the earth fill placed for the widening. The bench height should be between 0.3 m and 1.0 m. The bench width will depend on the extent of required removal of unsuitable surface soils. The back bench slope could be cut near vertical or to 1H:1V, depending on the height of the bench, available space and how long it will be exposed. Benches should be excavated one level at the time and the compacted new fill brought up before the next benching level is excavated. The horizontal bench surface should be graded down and away from the core of the existing embankment slope by approximately 2% to 3% to allow water drainage from the embankment core. Upon completion of the filling to the pavement subgrade level, the embankment side slopes should be trimmed to a final inclination.

To reduce surface erosion on the embankment side slopes, an erosion protection in accordance with OPSS.PROV 804 (Construction Specification for Seed and Cover) or pegged sod in accordance with OPSS 803 (Sodding) should be carried out as soon as possible after construction of the embankment. Measures to prevent excessive surface water flow over critical slopes such as a system of crest drains directed to vertical channels lined with rip-rap should be provided where necessary. If fill placement with a height more than 6 m has significant amount of fines, it is recommended that the erosion protection be in place before the first fall in order to avoid shallow slope slides due to soil saturation by capillarity.

In summary, the recommended mitigation measures during high fill constructions are:

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- Remove unsuitable soil (topsoil, organic soil, uncompact fill, etc.) with low blow counts (up to 2 m depth);
- Proof roll surface with heavy compacting equipment;
- Replace any highly organic or soft spots with compacted granular materials to 100 % SPMDD;
- The exposed competent embankment slope should be cut into benches before the new fill is placed in layers in accordance to OPSD 208.010;
- Examine excavated material to assess reusability (material has to be relatively clean and compactible);
- Place back the material and compact to min. 95% SPMDD.

The design of the temporary fill/fill slope must address the stability and settlement of the temporary fill itself as well as the impact of the temporary fill on the global stability and deformation of the of the overall slope on which the fill is located. The stability and movement of any temporary structures and construction equipment (e.g., cranes, compaction equipment, etc.) placed on the temporary fill shall also be addressed in the design. Temporary fills and fill slopes shall be designed such that the risk to health and safety of workers and the public is kept to an acceptable level and that adjacent facilities are not damaged. Seismic design of temporary fills and fill slopes is not required. As a minimum, the design of temporary fill slopes for stability by or under the supervision of a registered professional engineer shall include geotechnical calculations to address slope stability. This must be addressed during construction.

#### 8.2.6.3 Surface and Groundwater Control

Surface water should be always directed away from the excavation area(s). Some seepage of groundwater into excavations may occur. Any seepage of groundwater should be controllable by pumping from sumps in oversize excavations. Dewatering shall be carried out in accordance with OPSS.PROV 517 and SP517F01. It is the responsibility of the Contractor to propose a suitable dewatering system based on the time of construction, water levels and flow conditions.

## 9 Closure

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the team responsible for the design of the works described herein.

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.


Details of the limitations of this report are presented as Appendix A, "Limitations and Use of Report".

This Geotechnical Design Report has been prepared by Nimesh Tamrakar, M.Eng., P.Eng. and Thomas Lardner, Ph.D., P.Eng. It was reviewed by TaeChul Kim, M.E.Sc., P.Eng. and Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact.


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MTO Soil Classification Manual. Engineering Materials Office, Downsview, January 1980.

### **Ontario Provincial Standard Specifications (OPSS):**

OPSS.PROV 206	CONSTRUCTION SPECIFICATION FOR GRADING
OPSS.PROV 212	CONSTRUCTION SPECIFICATION FOR BORROW
OPSS.PROV 501	CONSTRUCTION SPECIFICATION FOR COMPACTING, MODIFIED BY SP 105S22
OPSS.PROV 517	CONSTRUCTION SPECIFICATION FOR DEWATERING AND TEMPORARY FLOW PASSAGE SYSTEMS
OPSS. PROV 802	CONSTRUCTION SPECIFICATIONS FOR TOPSOIL
OPSS. PROV 803	CONSTRUCTION SPECIFICATIONS FOR SODDING
OPSS .PROV 804	CONSTRUCTION SPECIFICATIONS FOR SEED AND COVER
OPSS. PROV 1010	AGGREGATES-BASE, SUBBASE, SELECT SUBGRADE, AND BACKFILL MATERIAL

### **Special Provisions (SP):**

SP 105S22	AMENDMENT TO OPSS 501
SSP 206F04	AMENDMENT TO OPSS 206
SSP 206F06	AMENDMENT TO OPSS 206
SSP 517F01	AMENDMENT TO OPSS 517

### **Ontario Provincial Standard Drawing (OPSD):**

OPSD 208.010	BENCHING OF EARTH SLOPES
OPSD202.010	SLOPE FLATTENING USING SURPLUS EXCAVATED MATERIAL ON EARTH OR ROCK EMBANKMENT

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

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

### **Environmental Protection Act:**

R.R.O 1990, Regulation 347, General – Waste Management, under Environmental Protection Act, R.S.O 1990, c. E.19

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

Ontario Regulation 213/91 Construction Projects

## Appendix A – Limitations and Use of Report



## **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.

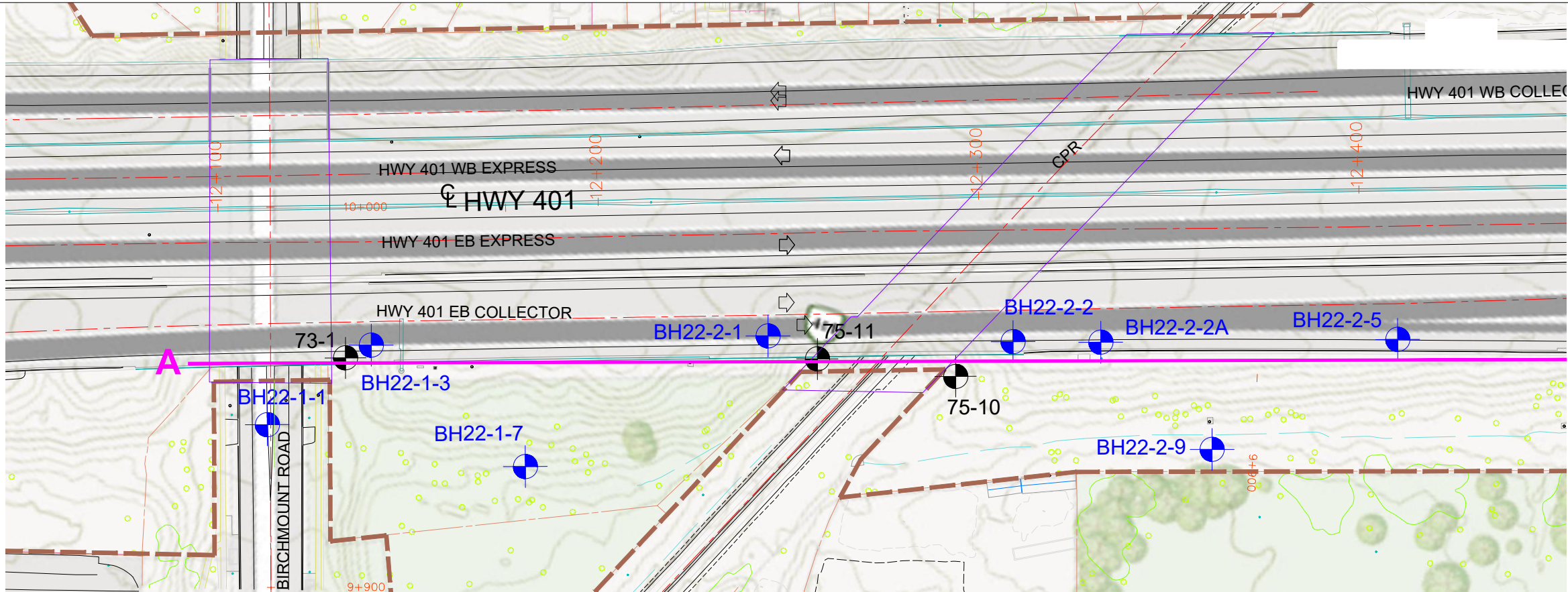
### **COMPLETE REPORT**

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.

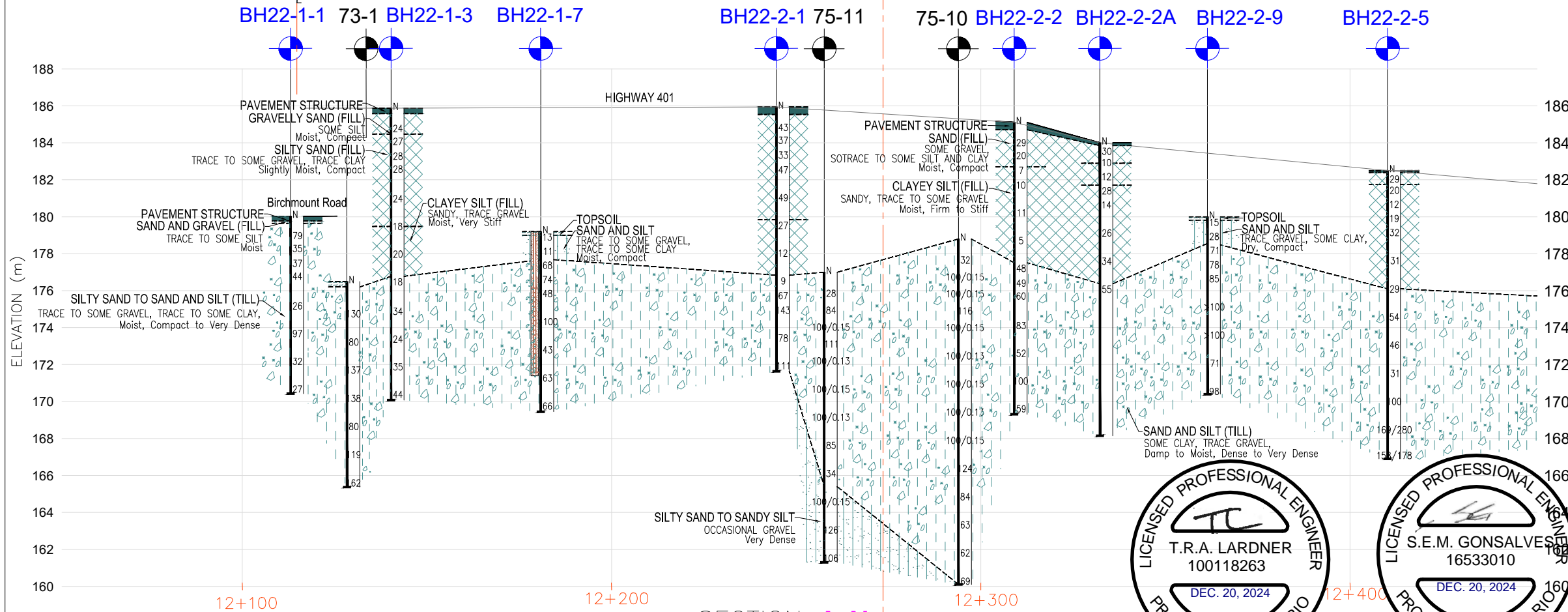
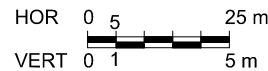
## Appendix B – Borehole Location Plan and Stratigraphic Profile



FILE NAME: I:\2003-Brampton\Proposals\International\Hwy 401 & Victoria Park Av. to Nelson\working drawings\Embankment-Birchmount to Kennedy\plan & profiling.dwg  
MODIFIED: 2024-06-28 14:17

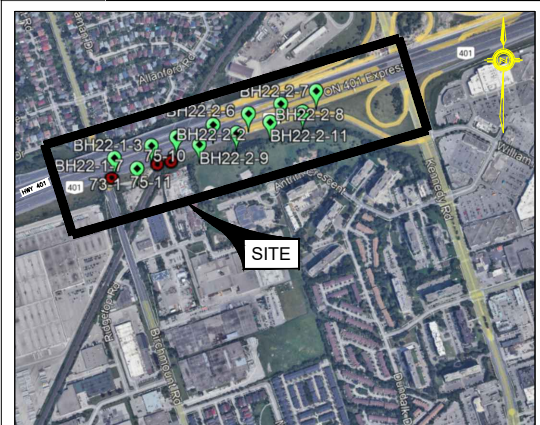


PLAN



SECTION A-A'

CONT No.	ASSIG No.	2021-E-0018	
GWP No.			
Earthworks-Embankment Widening Between Birchmount Road to Kennedy Road Latitude: 43.772525°, Longitude: -79.294316°			SHEET
BOREHOLE LOCATION PLAN & SOIL STRATA			1



KEY PLAN  
N.T.S.

LEGEND

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

SOIL STRATA SYMBOLS


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

BH No.	ELEV.	NORTHING	EASTING
BH22-1-1	180.0	4848043.0	321370.0
BH22-1-3	185.9	4848071.2	321390.0
BH22-1-7	179.2	4848052.4	321438.1
BH22-2-1	185.9	4848104.0	321489.0
BH22-2-2	185.1	4848121.3	321551.1
BH22-2-2A	184.0	4848127.9	321573.1
BH22-2-5	182.5	4848151.5	321647.6
BH22-2-6	180.7	4848185.1	321734.0
BH22-2-7	179	4848211.8	321822.6
BH22-2-8	182.4	4848235.9	321918.3
BH22-2-9	180.0	4848109.6	321609.3
BH22-2-10	177.1	4848140.1	321706.1
BH22-2-11	174.4	4848164.1	321796.2
BH22-2-12	171.8	4848183.7	321880.9
73-1	176.5	4848066	321385
75-10	178.8	4848053	321350
75-11	177.0	4848073	321353

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 O.P.S. Gen. Cond.


SUBMISSION FOR MTO REVIEW			
NO	DATE	BY	DESCRIPTION
PROJECT No.	ADM-22000797-A0	GEOCREs No.	-
SUBM'D SH	CHKD. NT	DATE	JUNE 28, 2024
DRAWN SH	CHKD. TC	APPRD SG	DWG 01






FILE NAME: I:\2003-Brampton\Proposals\International\ Hwy 401 & Victoria Park Av. to Nelson\working drawings\Embarkment-Birchmount to Kennedy\plan & profiling.dwg  
MODIFIED: 2024-06-28 14:17

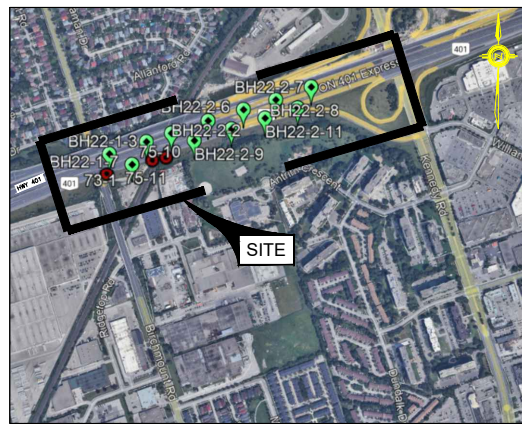
CONT No.  
ASSIG No. 2021-E-0018  
GWP No.

  
SHEET  
1

Earthworks-Embarkment Widening Between  
Birchmount Road to Kennedy Road  
*Latitude: 43.772525°, Longitude: -79.294316°*


BOREHOLE LOCATION PLAN & SOIL STRATA


 **EXP SERVICES INC.**


  
SITE


KEY PLAN  
N.T.S.


LEGEND


 New Borehole Location (EXP)

 Previous Borehole Location


 Water Level Upon Completion of Drilling (W. L. NOT STABILIZED)


 Blows/0.3m (Std. Pen. Test, 475 J/blow)


 Water Level in Piezometer (most recent) (W. L. STABILIZED)


 Piezometer


SOIL STRATA SYMBOLS


 PAVEMENT STRUCTURE


 FILL


 SILT


 SAND


 SILT AND SAND


 SANDY SILT


 SILTY SAND

 SANDY SILT TO SILTY SAND (TILL)

 CLAY

 CLAYEY SILT

 SILTY CLAY

 CLAYEY SILT TO SILTY CLAY (TILL)

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

BH No.	ELEV.	NORTHING	EASTING
BH22-1-1	180.0	4848043.0	321370.0
BH22-1-3	185.9	4848071.2	321390.0
BH22-1-7	179.2	4848052.4	321438.1
BH22-2-1	185.9	4848104.0	321489.0
BH22-2-2	185.1	4848121.3	321551.1
BH22-2-2A	184.0	4848127.9	321573.1
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BH22-2-10	177.1	4848140.1	321706.1
BH22-2-11	174.4	4848164.1	321796.2
BH22-2-12	171.8	4848183.7	321880.9
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NOTES

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REVISIONS

NO	DATE	BY	DESCRIPTION

SUBMISSION FOR MTO REVIEW

PROJECT No. ADM-22000797-A0  
SUBM'D SH CHKD. NT  
DRAWN SH CHKD. TC

GEOCREs No. 30M12-493  
DATE JUNE 28, 2024  
APPRD SG SITE- DWG 02

The drawing consists of two main parts: a PLAN view at the top and a SECTION A-A' view at the bottom.

**PLAN View:** Shows the layout of Highway 401 with lanes for WB Collector, WB Express, EB Express, and EB Collector. Borehole locations BH22-2-6 through BH22-2-12 are marked with blue circles. A pink line labeled 'A-A'' indicates the section line. Stationing markers are shown at 12+500, 12+600, and 12+700. A ramp for Kennedy Road is visible on the right.

**SECTION A-A' View:** A vertical cross-section showing the elevation (160 to 186 meters) and soil strata for each borehole. The strata are identified by patterns and text descriptions: Asphalt, Sand and Gravel, Silty Sand, Clayey Silt (Fill), Sand and Silt (Fill), Pavement Structure, Gravelly Sand (Fill), Clayey Silt (Fill), Sand and Silt (Till), and Topsoil. Water levels are indicated by blue triangles with 'N' for not stabilized and 'S' for stabilized. Piezometer locations are marked with red vertical lines. Blows per 0.3m are noted for some boreholes (e.g., 107, 280mm for BH22-2-11).

## Appendix C – Borehole Logs – Current Investigation

# 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.

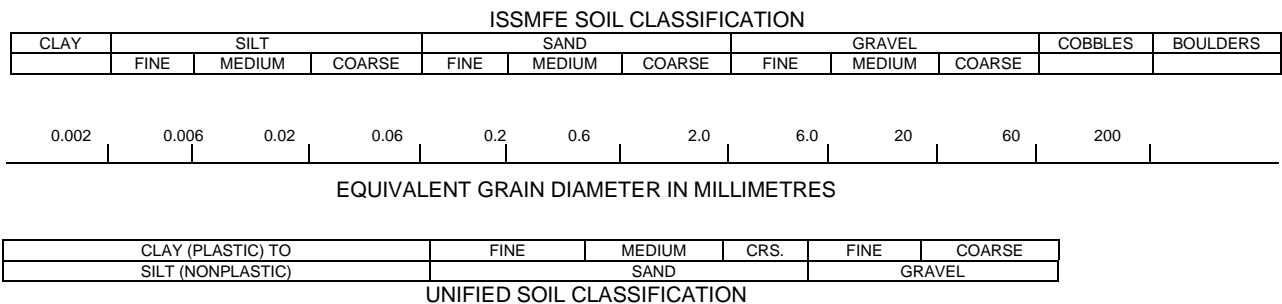
*Seam:* a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

*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:

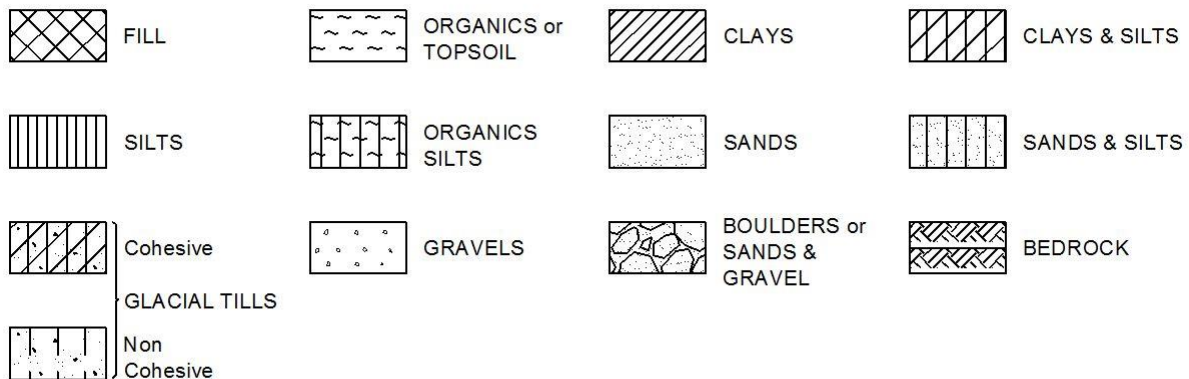
Table c: Consistency of Cohesive Soil

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 BH22-1-1

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - Birchmount Road O/P, Toronto, ON, MTM ON-10 321370.0E 4848043.0N ORIGINATED BY CA  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount MARL M10 / SSA COMPILED BY CA  
 DATUM Geodetic DATE 2023.03.20 - 2023.03.20 LATITUDE 43.772162 LONGITUDE -79.294173 CHECKED BY TL

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				W <sub>p</sub> W W <sub>L</sub>				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER				WATER CONTENT (%)				
180.0	GROUND SURFACE						20	40	60	80	100	20	40	60		
179.8	PAVEMENT STRUCTURE 25 mm of asphalt, and 230 mm of concrete															
179.7	SAND AND GRAVEL (FILL) trace to some silt, grey, moist		AS1	AS								○				
0.4	SILTY SAND TO SAND AND SILT (TILL) - trace to some gravel, trace to some clay, brown to brownish grey, moist, compact to very dense		SS2	SS	79							○				
			SS3	SS	35							○				3 52 35 10
			SS4	SS	37							○				
			SS5	SS	44											Corrosivity Sample
			SS6	SS	26							φ-H				19 46 25 10
			SS7	SS	97							○				
			SS8	SS	32							○				
												○				
	- brownish grey below ~ 9.1 m depth		SS9	SS	27							φ-H				23.3
170.4	END OF BOREHOLE															
9.6	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.															

ONTARIO MTO, BIRCHMOUNT KENNEDY - AM.GPJ, ONTARIO MTO.GDT, 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-1-3

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - Birchmount Road O/P, Toronto, ON, MTM ON-10 321390.0E 4848071.2N ORIGINATED BY SF/OD  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount CME 75 / SSA COMPILED BY SF/OD  
 DATUM Geodetic DATE 2022.12.12 - 2022.12.12 LATITUDE 43.772415 LONGITUDE -79.293924 CHECKED BY TL

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>		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL & P. PENETROMETER		WATER CONTENT (%)				
185.9	GROUND SURFACE							20 40 60 80 100						
0.0 185.6	PAVEMENT STRUCTURE 90 mm of asphalt, and 210 mm of concrete													
0.3	GRAVELLY SAND (FILL) some silt, brown, moist, compact		AS1	AS			185							
			SS2	SS	24									
184.5														
1.4	SILTY SAND (FILL)- trace to some gravel, trace clay, light brown to light grey, slightly moist, compact		SS3	SS	27		184							
			SS4	SS	28									
							183							12 63 22 3
			SS5	SS	28									
							182							
			SS6	SS	24		181							
							180						22.5	
179.5			SS7	SS	18									2 45 41 12
6.4	CLAYEY SILT (FILL)- sandy, trace gravel, light brown to grey, moist, very stiff						179							
			SS8	SS	20		178							
							177						22.9	
176.8														
9.1	SILTY SAND TO SAND AND SILT (TILL) - trace to some gravel, trace to some clay, light brown to grey, moist, compact to dense		SS9	SS	18		176							
	- becoming dark brown to grey below a depth of 10.7 m		SS10	SS	34		175						22.5	2 42 41 15
														Corrosivity Sample
							174							
			SS11	SS	24								22.8	
							173							
			SS12	SS	35		172							2 48 40 10
														Non-Plastic
							171							

Continued Next Page

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


ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24



Brampton, Ontario

RECORD OF BOREHOLE No BH22-1-3 2 OF 2 METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - Birchmount Road O/P, Toronto, ON, MTM ON-10 321390.0E 4848071.2N ORIGINATED BY SF/OD  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount CME 75 / SSA COMPILED BY SF/OD  
 DATUM Geodetic DATE 2022.12.12 - 2022.12.12 LATITUDE 43.772415 LONGITUDE -79.293924 CHECKED BY TL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  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>				WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER													
								20	40	60	80	100		20	40	60		GR	SA	SI	CL
170.1	SILTY SAND TO SAND AND SILT (TILL) - trace to some gravel, trace to some clay, light brown to grey, moist, compact to dense(continued)		SS13	SS	44									○			23.3				
15.8	END OF BOREHOLE  NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																				

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-1-7

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - Birchmount Road O/P, Toronto, ON, MTM ON-10 321438.1E 4848052.4N ORIGINATED BY SF/OD  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.16 - 2023.11.16 LATITUDE 43.772245 LONGITUDE -79.293327 CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
179.2	GROUND SURFACE													
179.0	TOPSOIL - 150mm thick													
0.2	SAND AND SILT- trace to some gravel, trace to some clay, brown to brownish grey, moist, compact		1	SS	13		179							
			2	SS	11		178							
177.7	SAND AND SILT (TILL)- trace to some gravel, trace clay, brown to brownish grey, moist, dense to very dense		3	SS	68		177							4 47 38 11
1.5			4	SS	74		176							
			5	SS	48		175							
			6	SS	>100		174							
			7	SS	43		173							4 48 42 6 -non-plastic
			8	SS	63		172							
			9	SS	66		171							
169.4	END OF BOREHOLE						170							
9.8	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling. 2) Monitoring Well Readings  DATE DEPTH(M) ELEV. Dec 4/24 7.6 171.6													

ONTARIO MTO, BIRCHMOUNT KENNEDY - AM.GPJ, ONTARIO MTO.GDT 12/6/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-1

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321489.0E 4848104.0N ORIGINATED BY EL  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount CME 75 / SSA COMPILED BY EL/OD  
 DATUM Geodetic DATE 2022.10.12 - 2022.10.12 LATITUDE 43.772708 LONGITUDE -79.292693 CHECKED BY SM/TL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
185.9	GROUND SURFACE													
0.0	PAVEMENT STRUCTURE 90 mm of asphalt and 340 mm of concrete													
185.5														
0.4	GRAVELLY SAND (FILL) trace to some silt and clay, brown to greyish brown, damp to moist, dense - occasional cobbles encountered		AS1	AS			185							28 60 (12)
			SS2	SS	43		184							
			SS3	SS	37		183							
			SS4	SS	33		182							
			SS5	SS	47		181							
			SS6	SS	49		180							
179.8							179							
6.1	CLAYEY SILT (FILL)- sandy, trace to some gravel, brown with black inclusions, moist, stiff to very stiff		SS7	SS	27		178							0 41 40 19
			SS8	SS	12		177							
176.8							176							1 52 40 7
9.1	SAND AND SILT (TILL)- trace to some gravel, trace to some clay, brown to brownish grey, moist, very dense		SS9	SS	9		175							
			SS10	SS	67		174							
			SS11	SS	143		173							
			SS12	SS	78		172							
			SS13	SS	111									Corrosivity Sample
171.6														
14.3	END OF BOREHOLE													
	NOTE: 1) No groundwater was encountered													

Continued Next Page

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

ONTARIO MTO, BIRCHMOUNT KENNEDY - AM.GPJ, ONTARIO MTO.GDT 12/1/24

## 2 OF 2

METRIC

W.P.	ADM-22006096-A4	LOCATION	Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321489.0E 4848104.0N	ORIGINATED BY	EL				
DIST	Toronto	HWY	401	BOREHOLE TYPE	Truck Mount CME 75 / SSA	COMPILED BY	EL/OD		
DATUM	Geodetic	DATE	2022.10.12 - 2022.10.12	LATITUDE	43.772708	LONGITUDE	-79.292693	CHECKED BY	SM/TL

[illegible]

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-2

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321556.0E 4848125.0N ORIGINATED BY EL  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount CME 75 / SSA COMPILED BY EL/OD  
 DATUM Geodetic DATE 2022.10.19 - 2022.10.19 LATITUDE 43.772896 LONGITUDE -79.29186 CHECKED BY SM/TL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT  γ	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>		20	40	60	GR	SA	SI
185.1	GROUND SURFACE						185															
0.0	PAVEMENT STRUCTURE 190 mm of asphalt and 215 mm of concrete																					
184.7																						
0.4	SAND (FILL)- some gravel, trace to some silt and clay, brown, moist, compact		AS1	AS																		
			SS2	SS	29		184												17	69	(14)	
			SS3	SS	20																	
							183															
182.7																						
2.4	CLAYEY SILT (FILL)- sandy, trace to some gravel, brown to grey, moist, firm to stiff		SS4	SS	7																	
							182															
			SS5	SS	10																	
							181															
			SS6	SS	11		180															
							179															
			SS7	SS	5																	
							178															
177.5																						
7.6	SAND AND SILT (TILL)- some clay, trace gravel, light brown to greyish brown, damp to moist, dense to very dense		SS8	SS	48		177												2	46	40	12
	- thin sand lenses interbedded within till layer																					
			SS9	SS	49																	
							176															
			SS10	SS	60														1	45	43	11
							175															
			SS11	SS	83		174															
							173															
			SS12	SS	52																	
							172															
			SS13	SS	100		171															

Continued Next Page

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-2

2 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321556.0E 4848125.0N ORIGINATED BY EL  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount CME 75 / SSA COMPILED BY EL/OD  
 DATUM Geodetic DATE 2022.10.19 - 2022.10.19 LATITUDE 43.772896 LONGITUDE -79.29186 CHECKED BY SM/TL

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  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>			WATER CONTENT (%)	GR	SA		SI	CL		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER															
169.3	<b>SAND AND SILT (TILL)</b> - some clay, trace gravel, light brown to greyish brown, damp to moist, dense to very dense ( <i>continued</i> )		SS14	SS	59		170														
15.8	<b>END OF BOREHOLE</b>  NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																				

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

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-2A

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321573.1E 4848127.9N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.11 - 2023.10.23 LATITUDE 43.772921 LONGITUDE -79.930503 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 (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL & P. PENETROMETER				W <sub>p</sub> W      W <sub>L</sub>						
								20	40	60	80	100		20	40	60		
184.0	GROUND SURFACE																	
183.8	ASPHALT- (150mm)																	
0.2	SAND AND GRAVEL (FILL) brown, dry, compact		1	SS	30													
182.9			2	SS	10		183											27 48 20 5
1.1	CLAYEY SILT (FILL)- sandy, trace to some gravel, brown to grey, moist, firm to very stiff																	2 48 40 10
			3	SS	12		182											3 47 40 10
			4	SS	28													
							181											
			5	SS	14													
							180											
			6	SS	26		179											
							178											
	-some rock pieces		7	SS	34		177											
176.4																		
7.6	SAND AND SILT (TILL)- trace gravel, trace clay, brown to grey, dry to moist, dense to very dense		8	SS	55		176											
							175											3 42 44 11
			9	SS	31													
							174											
			10	SS	52		173											4 44 44 8
							172											
			11	SS	87		171											
			12	SS	85		170											

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

RECORD OF BOREHOLE No BH22-2-2A 2 OF 2 METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321573.1E 4848127.9N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.11 - 2023.10.23 LATITUDE 43.772921 LONGITUDE -79.930503 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 (%)  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												
								20	40	60	80	100		20	40	60				
168.1	<b>SAND AND SILT (TILL)</b> trace gravel, trace clay, brown to grey, dry to moist, dense to very dense <i>(continued)</i>		13	SS	>100															
15.9	<b>END OF BOREHOLE</b>  NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																			

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24



Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-5

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321647.6E 4848151.5N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.12 - 2023.10.12 LATITUDE 43.773132 LONGITUDE -79.290721 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>				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER		WATER CONTENT (%)				
								20 40 60 80 100		20 40 60				
182.5	GROUND SURFACE													
182.4	ASPHALT- (100mm)													
182.0	SAND AND GRAVEL (FILL) some silt, brown, dry, compact		SS1	SS	29		182					○		
181.7	SAND AND SILT (FILL) trace to some gravel, trace to some clay, brown, dry to moist, compact to dense		SS2	SS	20		181					○		
0.8			SS3	SS	12		180					○		7 36 43 14
			SS4	SS	19		179					○		
			SS5	SS	32		178					○		19 34 36 11
							177							
							176					○		
							175					○		
	-with white stone pieces		SS6	SS	31		174					○		3 42 42 13
							173					○		
176.1	SAND AND SILT (TILL) trace gravel, some clay, brown, dry to moist, compact to very dense		SS7	SS	29		172					○		
6.4							171							
							170					○		3 32 58 6
							169							
							168					○		
													</	

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

2 OF 2

## METRIC

W.P.	ADM-22006096-A4	LOCATION	Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321647.6E 4848151.5N			ORIGINATED BY	SF		
DIST	Toronto	HWY	401	BOREHOLE TYPE	Truck Mount Marl M5-T / Solid Auger			COMPILED BY	IL
DATUM	Geodetic	DATE	2023.10.12 - 2023.10.12	LATITUDE	43.773132	LONGITUDE	-79.290721	CHECKED BY	NT

[illegible]

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-6

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321734.0E 4848185.1N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.04 - 2023.11.04 LATITUDE 43.773433 LONGITUDE -79.289647 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>						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL & P. PENETROMETER				WATER CONTENT (%)						
180.7	GROUND SURFACE							20	40	60	80	100		20	40	60		
180.6	ASPHALT- (200mm)							20	40	60	80	100						
0.2	SAND AND GRAVEL- some clay, some silt, dry, brown, very dense		1	SS	69		180							○				
179.9																		
0.8	SILTY SAND- some clay, some gravel, brown, dry, compact		2	SS	29									○				6   34   41   18
179.2																		
1.5	CLAYEY SILT (FILL)- some sand, trace gravel, brown, dry, stiff		3	SS	28		179							○				7   37   40   16
178.4														○				
2.3	SAND AND SILT (FILL)- some clay, trace gravel, brown, dry, compact to dense		4	SS	35		178							○				13   46   34   7
			5	SS	33									○				
							177											
			6	SS	28		176							○				
							175											
			7	SS	45		174							○				
							173							○				
172.8			8	SS	11									○	○			
7.9	SAND AND SILT (TILL)- some clay, trace gravel, some rootlets, black to brown, dry, compact to very dense						172											
			9	SS	70		171							○				5   47   40   9 -non-plastic
							170							○				
							169											
			11	SS	64		168							○				
							167							○				
			12	SS	64													
							166											

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

RECORD OF BOREHOLE No BH22-2-6 2 OF 2 METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321734.0E 4848185.1N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.04 - 2023.11.04 LATITUDE 43.773433 LONGITUDE -79.289647 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 (%)  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								
							20	40	60	80	100		20	40	60	
164.8	SAND AND SILT (TILL) some clay, trace gravel, some rootlets, black to brown, dry, compact to very dense (continued)		13	SS	77											
15.9	END OF BOREHOLE															
	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.															

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-7

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321822.6E 4848211.8N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.11.02 - 2023.11.02 LATITUDE 43.77367 LONGITUDE -79.2878 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 (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL & P. PENETROMETER									
179.0	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT- (360mm)																
178.6																	
0.4	SAND AND GRAVEL (FILL) some																
178.2	clay, some silt, dry, brown, very																
0.8	dense CLAYEY SILT (FILL)- trace gravel, trace to some sand, brown, moist, stiff to very stiff		1	SS	15		178										
			2	SS	13		177										5 36 43 17
			3	SS	6		176										
			4	SS	20		175										
174.4																	
4.6	SAND AND SILT (FILL) some clay, trace gravel, brown, dry to moist, compact		5	SS	24		174										9 42 40 9 -non-plastic
172.9							173										
6.1	SAND AND SILT (TILL) some clay, trace gravel, dry to moist, compact to very dense		6	SS	33		172										
			7	SS	12		171										
			8	SS	15		170										
			9	SS	44		168										
			10	SS	>100		167										
166.0	END OF BOREHOLE						166										
13.0	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																

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

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24


Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-8

1 OF 2

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321918.3E 4848235.9N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.05 - 2023.10.05 LATITUDE 43.773886 LONGITUDE -79.287356 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  <b>γ</b>  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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182.4	GROUND SURFACE							20 40 60 80 100					20 40 60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
180.0	TOPSOIL - (180mm)							20 40 60 80 100					20 40 60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
0.2	CLAYEY SILT (FILL)- some sand, trace to some gravel, brown to dark grey, moist to wet, stiff to hard			SS1	SS	34		182																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

Continued Next Page

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

ONTARIO MTO, BIRCHMOUNT KENNEDY - AM.GPJ, ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

RECORD OF BOREHOLE No BH22-2-8 2 OF 2 METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321918.3E 4848235.9N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.05 - 2023.10.05 LATITUDE 43.773886 LONGITUDE -79.287356 CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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			20	40	60	80	100		
166.5	SAND AND SILT (TILL) some clay, trace to some gravel, dark grey to black, moist to wet, compact to very dense (continued)		SS13	SS	70		167							
15.9	END OF BOREHOLE													
	NOTE: 1) Groundwater level measured at 14.3 m below ground surface upon completion of drilling.													

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-9

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321609.3E 4848109.6N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.06 - 2023.10.06 LATITUDE 43.772756 LONGITUDE -79.291198 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  <b>γ</b>  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>				
180.0	GROUND SURFACE							20	40	60	80	100					
179.8	TOPSOIL - (180 mm)																
0.2	SAND AND SILT- trace gravel, some clay, brown, dry, compact		1	SS	15		179							○			
			2	SS	28									○			
178.5																	
1.5	SAND AND SILT (TILL)- trace to some gravel, trace to some clay, brown, moist to partly wet, very dense		3	SS	71		178							○			
			4	SS	78		177							○			2 48 43 7
			5	SS	85		176							○			
			6	SS	>100		175							○			
							174							○		22.7	
							173										
			8	SS	71		172							○			3 47 39 11
							171										
170.4			9	SS	98									○			
9.6	END OF BOREHOLE																
	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

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



Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-10

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321706.1E 4848140.1N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.06 - 2023.10.06 LATITUDE 43.773028 LONGITUDE -79.289995 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/m³	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 P. PENETROMETER									
177.1	GROUND SURFACE						20	40	60	80	100						
176.9	TOPSOIL - (220 mm)						20	40	60	80	100						
0.2	SILTY SAND- trace gravel, trace clay, brown to grey, dry to moist, compact		1	SS	27								○				
			2	SS	24								○				
175.6	SILTY SAND TO SAND AND SILT (TILL) - trace gravel, trace clay, brown to grey, dry to moist, dense to very dense		3	SS	48								○			13 41 36 10	
1.5			4	SS	76								○				
			5	SS	55								○			2 56 34 8	
			6	SS	44								○				
			7	SS	55								○				
	-cobbles present		8	SS	>100								○				
	-becoming grey below 9.1m		9	SS	>100								○				
167.6	END OF BOREHOLE																
9.5	NOTE: 1) No groundwater was encountered in open borehole upon completion of drilling.																

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-11

1 OF 1

METRIC

W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321796.2E 4848164.1N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2023.10.11 - 2023.10.11 LATITUDE 43.773242 LONGITUDE -79.288875 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 (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER									
174.4	GROUND SURFACE						20	40	60	80	100						
174.0	TOPSOIL - 150mm thick																
0.2	CLAYEY SILT (FILL)- trace gravel, trace sand, brown, dry, stiff		SS1	SS	10								○			0 45 42 13	
173.6																	
0.8	SAND AND SILT (TILL)- trace gravel, trace to some clay, brown, dry to moist , dense to very dense		SS2	SS	17								○				
			SS3	SS	46								○				
			SS4	SS	46								○			2 46 40 12	
			SS5	SS	28								○				
	-becoming some gravel												○				
													○				

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

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

Brampton, Ontario

## RECORD OF BOREHOLE No BH22-2-12

1 OF 1

METRIC

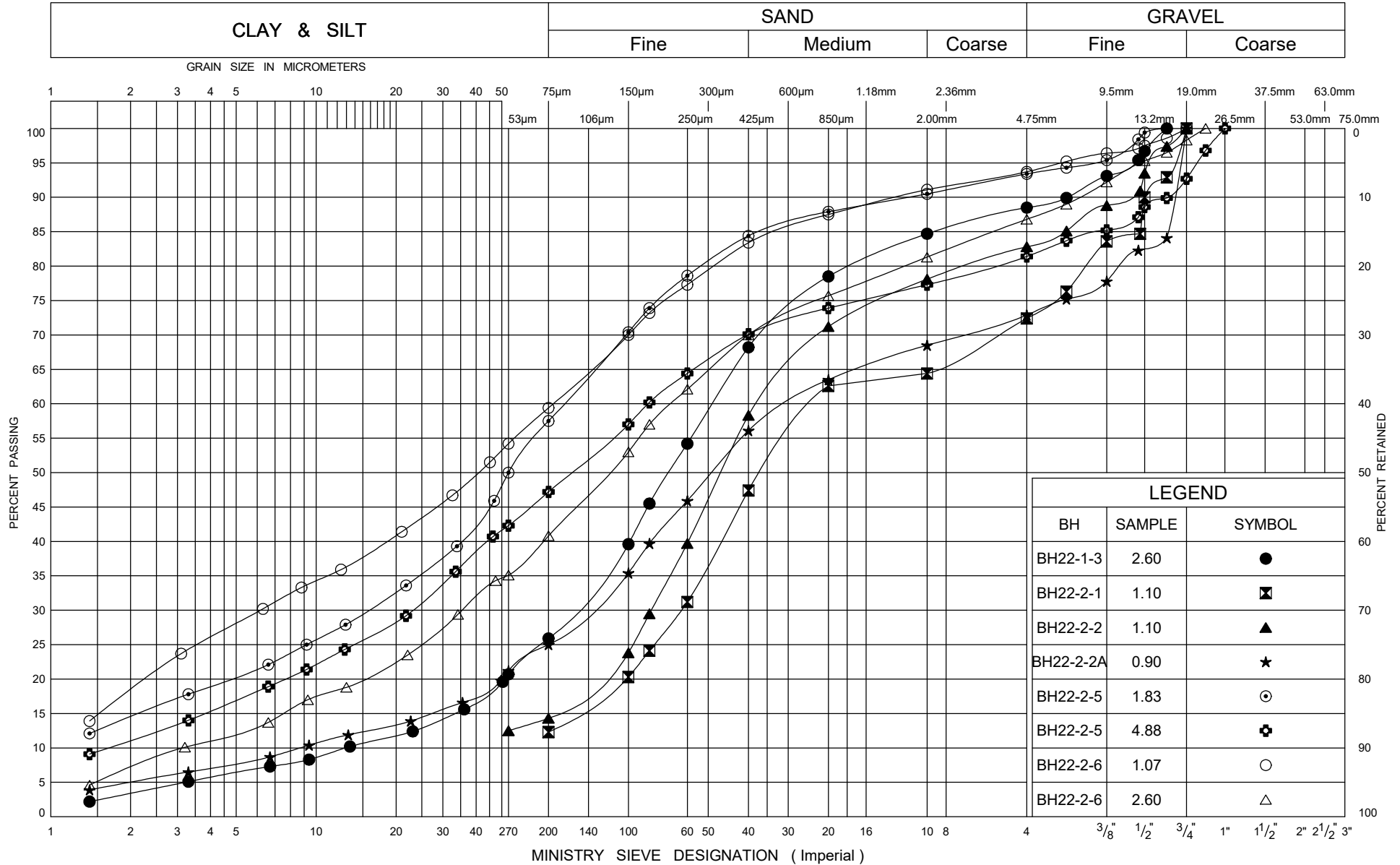
W.P. ADM-22006096-A4 LOCATION Hwy 401 - CPR O/P, Toronto, ON, MTM ON-10 321880.9E 4848183.7N ORIGINATED BY SF  
 DIST Toronto HWY 401 BOREHOLE TYPE Truck Mount Marl M5-T / Solid Auger COMPILED BY IL  
 DATUM Geodetic DATE 2022.10.05 - 2022.10.05 LATITUDE 43.773417 LONGITUDE -79.287822 CHECKED BY NT

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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171.8	GROUND SURFACE							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
170.6	TOPSOIL - (150mm)							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.2	SAND AND SILT (TILL) trace gravel, trace clay, brown to grey, dry to moist, compact to very dense		1	SS	11	▽	171								○																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

ONTARIO MTO BIRCHMOUNT KENNEDY - AM.GPJ ONTARIO MTO.GDT 12/1/24

## Appendix D – Laboratory Data – Current Investigation

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
SILTY SAND/SAND/SAND AND SILT/GRAVELLY SAND FILL

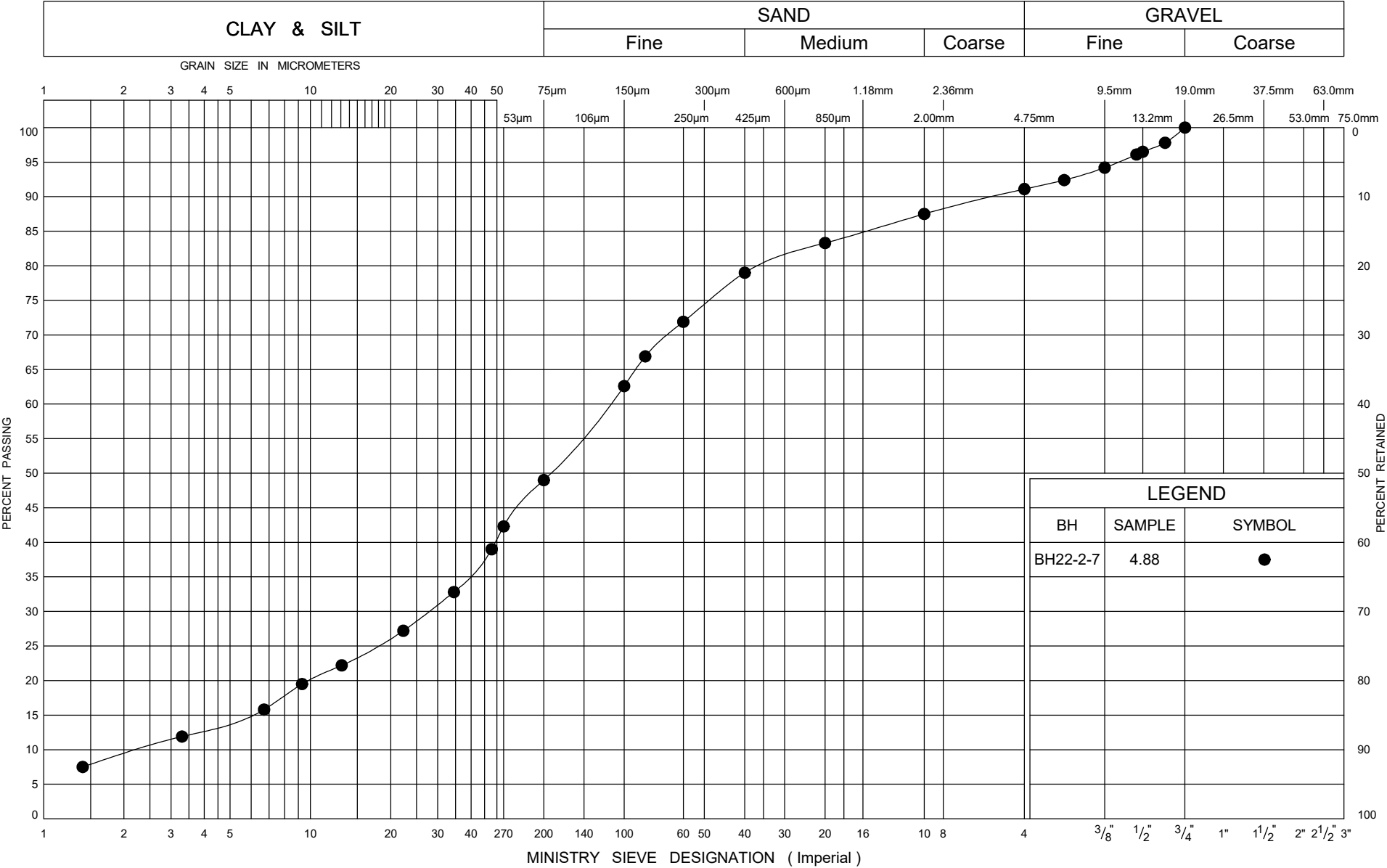
FIG No 1

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson

ONTARIO MOT GRAIN SIZE BIRCHMOUNT KENNEDY GPJ ONTARIO MOT.GOT 6/28/24

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

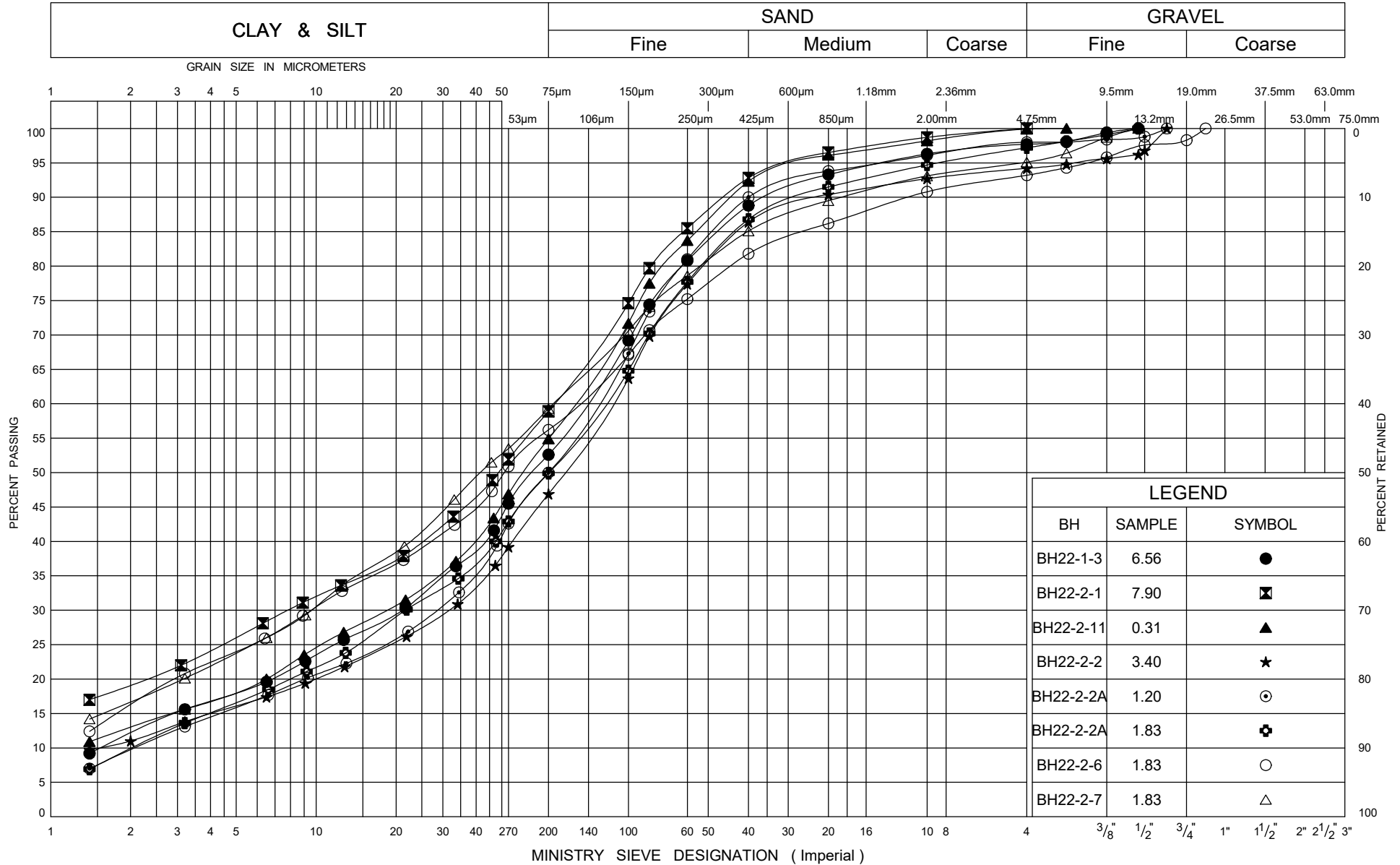
GRAIN SIZE DISTRIBUTION  
SILTY SAND/SAND/SAND AND SILT/GRAVELLY SAND FILL

FIG No 2

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

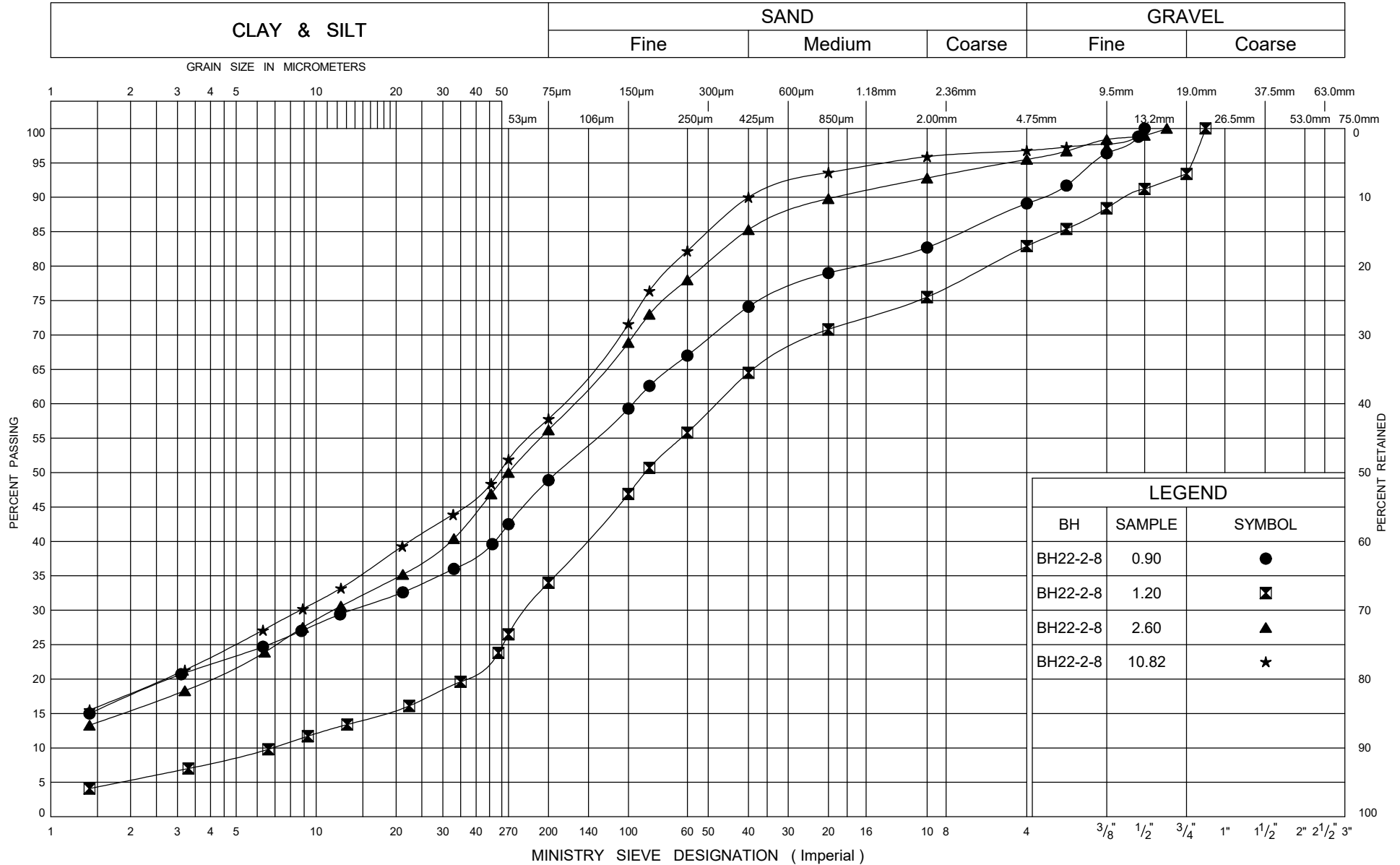
## GRAIN SIZE DISTRIBUTION CLAYEY SILT FILL

FIG No 3

W PADM-22006096-A4

Hwy. 401, Victoria av. to Nelson

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION CLAYEY SILT FILL

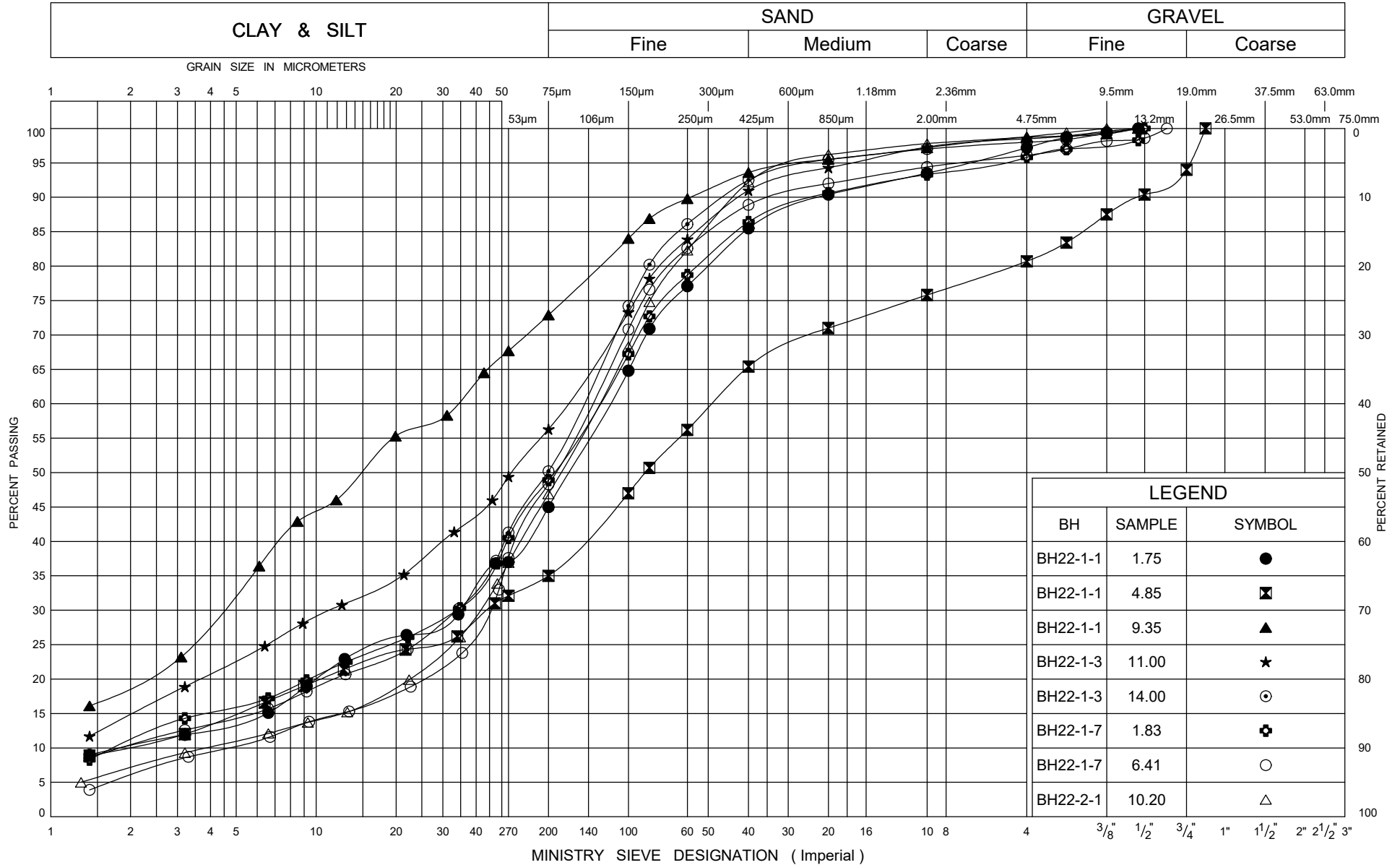
FIG No 4

W PADM-22006096-A4

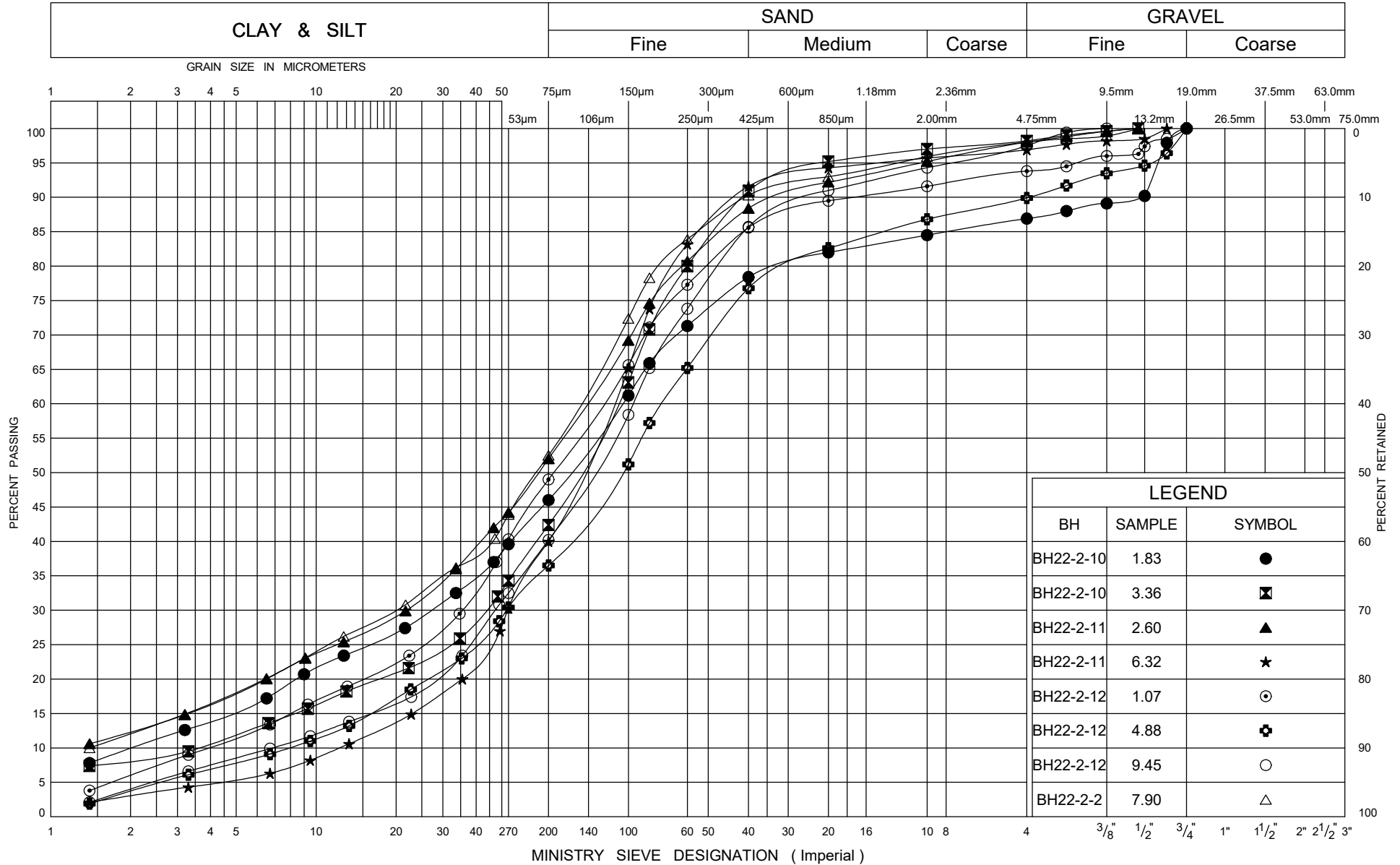
Hwy. 401, Victoria av. to Nelson



# UNIFIED SOIL CLASSIFICATION SYSTEM



# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

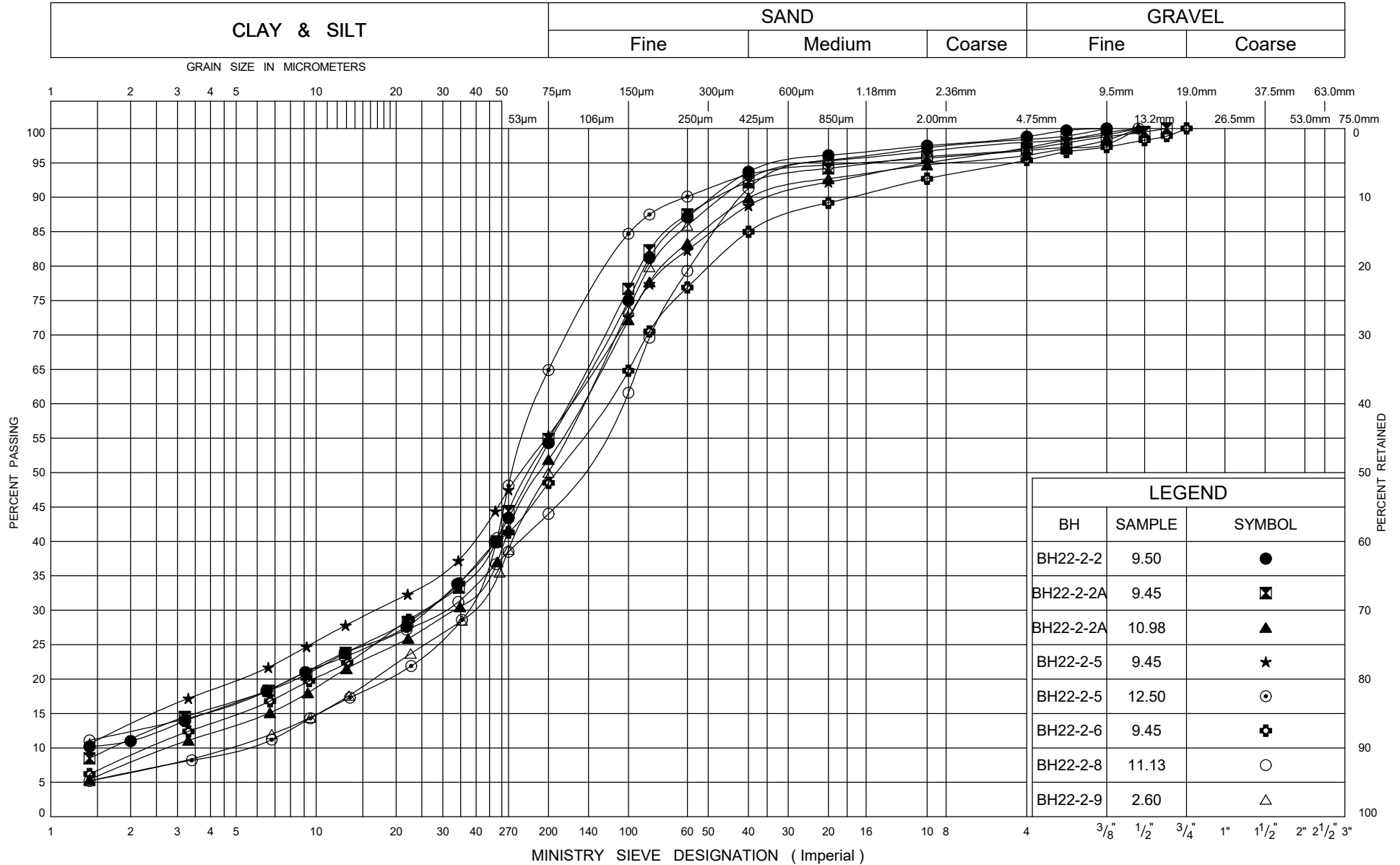
GRAIN SIZE DISTRIBUTION  
SILTY SAND/SAND AND SILT/SANDY SILT TILL

FIG No 6

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

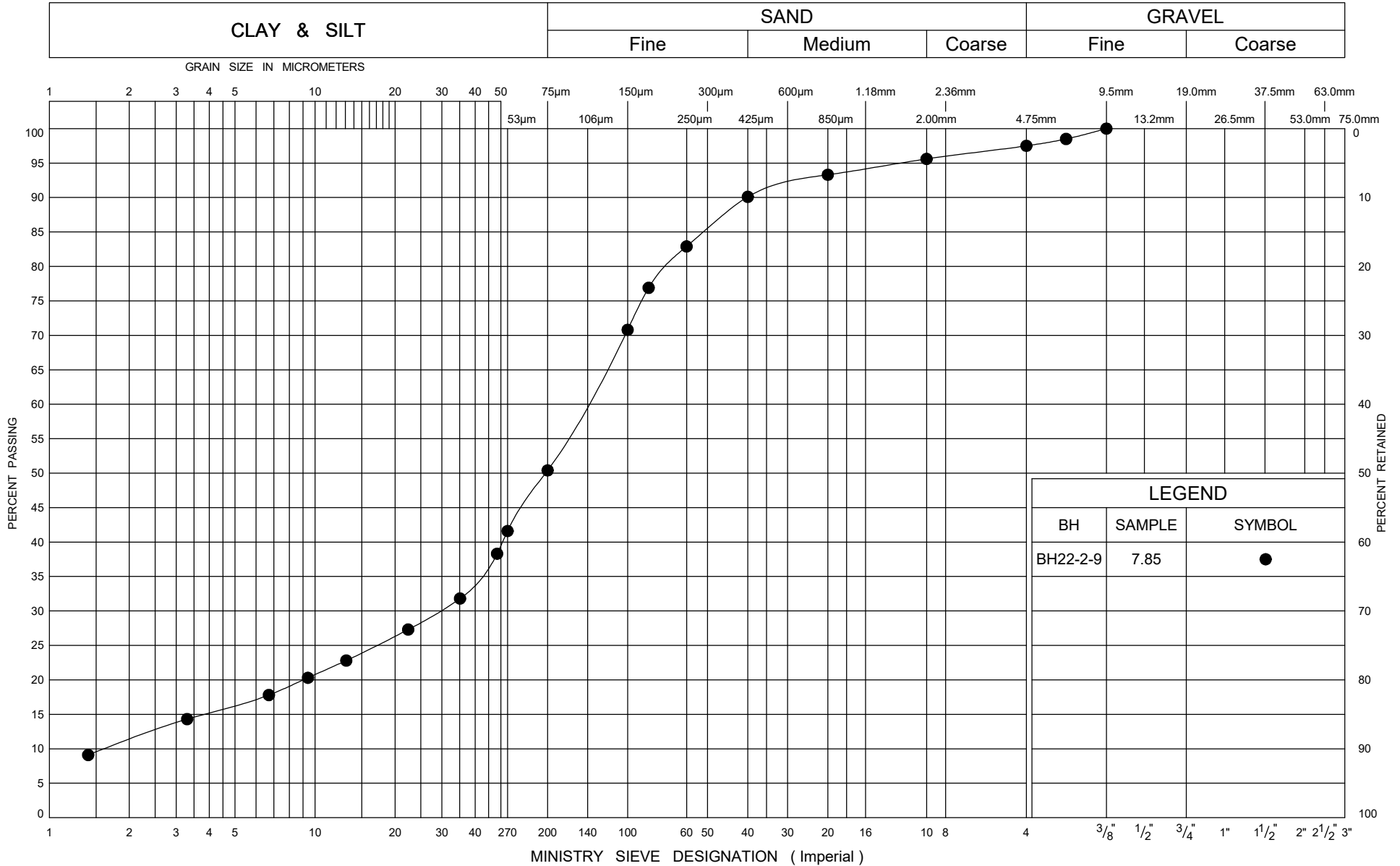
## GRAIN SIZE DISTRIBUTION SILTY SAND/SAND AND SILT/SANDY SILT TILL

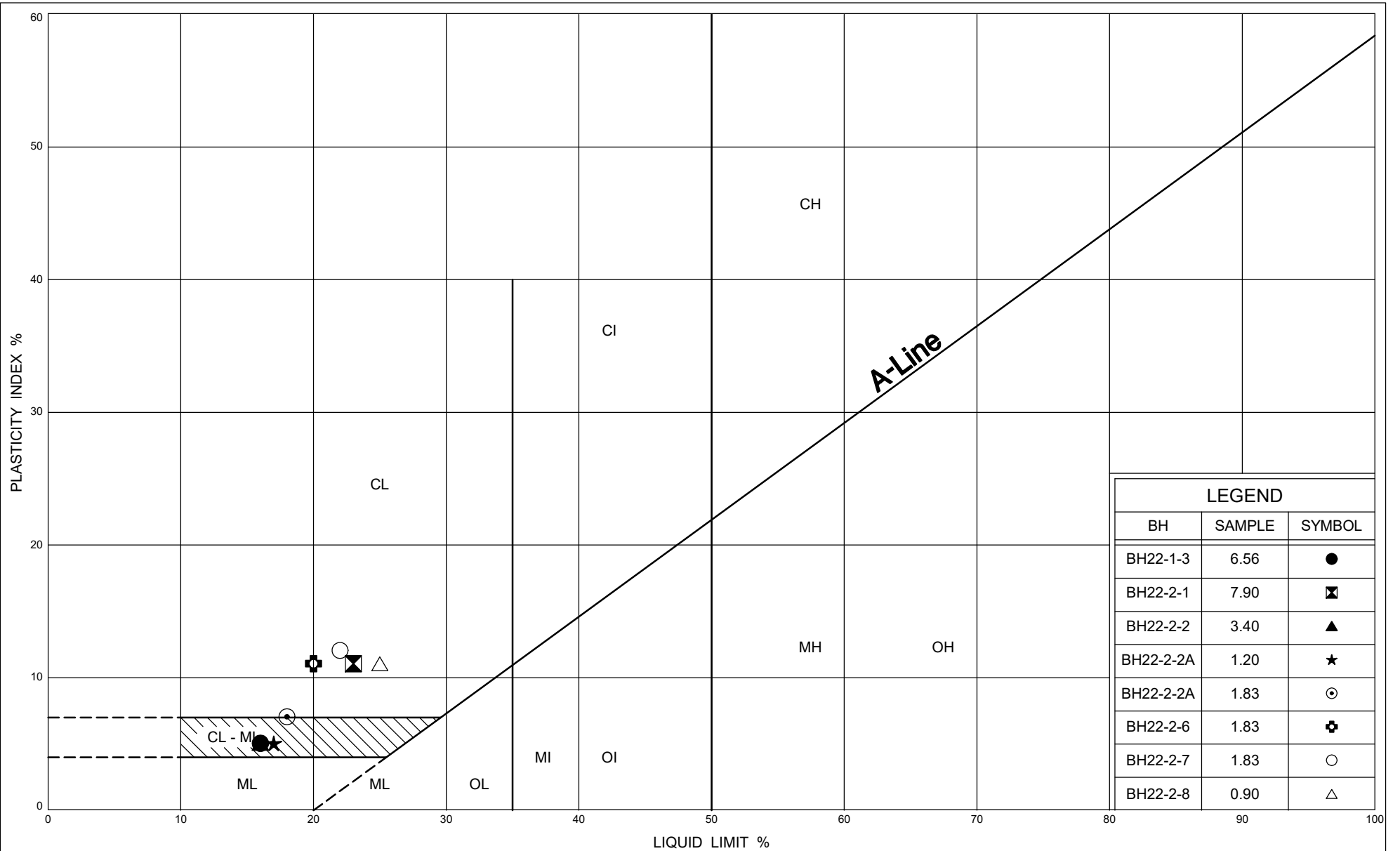
FIG No 7

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson

# UNIFIED SOIL CLASSIFICATION SYSTEM





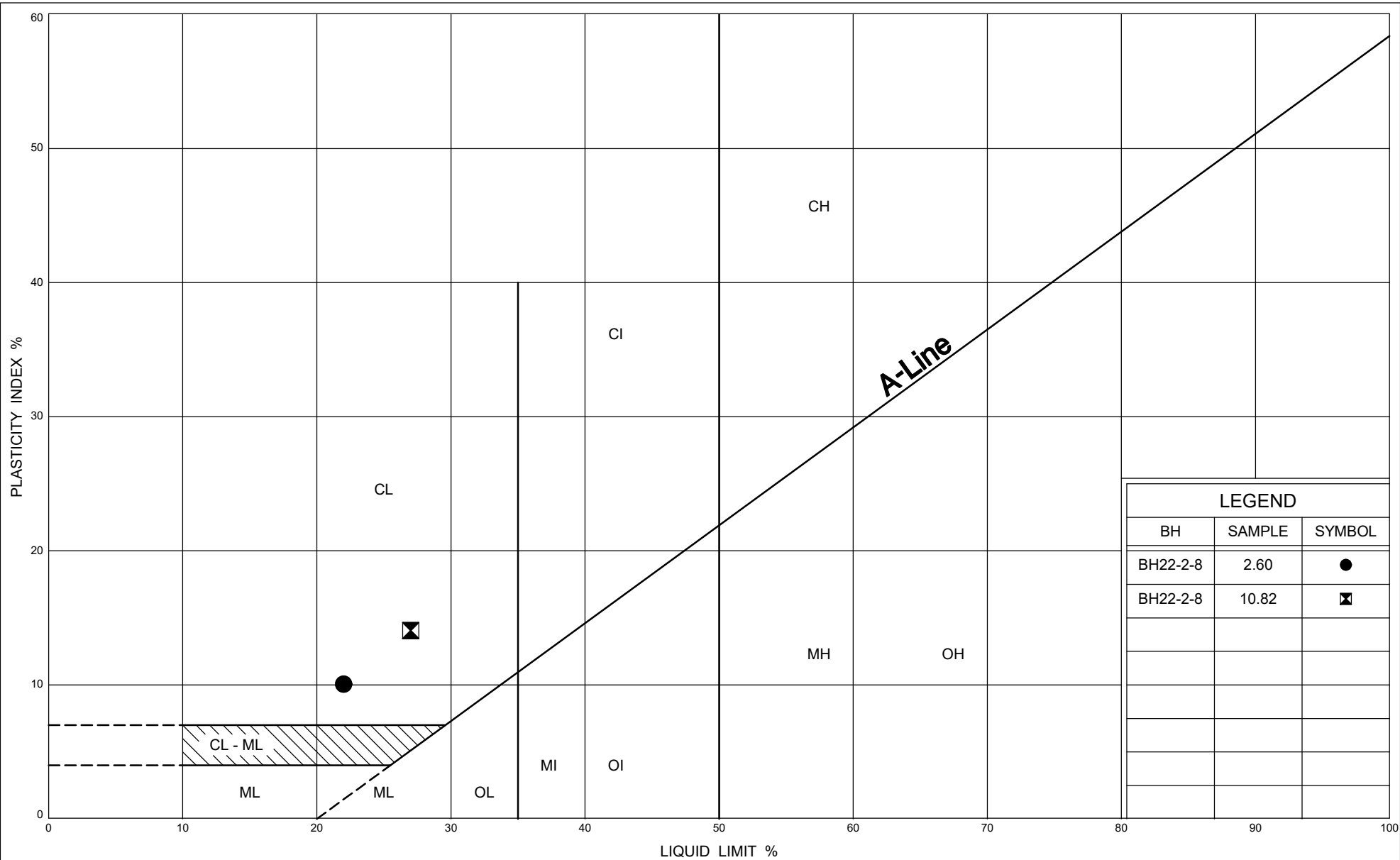
Ministry of  
Transportation

## PLASTICITY CHART CLAYEY SILT FILL

FIG No 9

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson



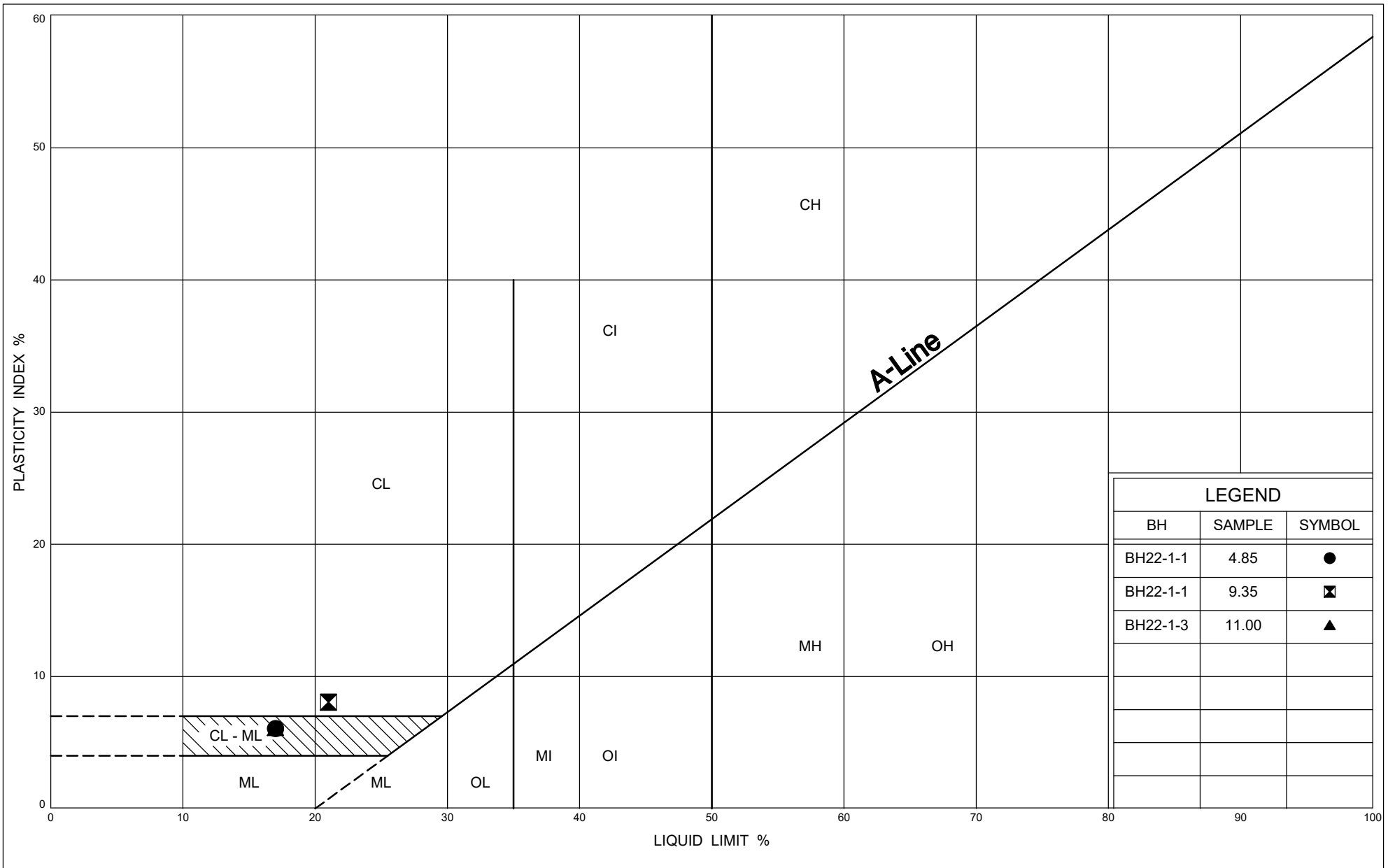
Ministry of  
Transportation

## PLASTICITY CHART CLAYEY SILT FILL

FIG No 10

W P ADM-22006096-A4

Hwy. 401, Victoria av. to Nelson





Your Project #: ADM-22000797-A0  
Site Location: HWY 401 FROM VICTORIA TO NELSON AVE, ON  
Your C.O.C. #: 903374-03-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2022/12/22**  
Report #: R7441694  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2AK310**

**Received: 2022/12/16, 14:56**

Sample Matrix: Soil  
# Samples Received: 2

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	2	2022/12/21	2022/12/21	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	2	2022/12/21	2022/12/21	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	2	N/A	2022/12/21	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2022/12/21	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	2	2022/12/21	2022/12/21	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	2	2022/12/22	2022/12/22	CAM SOP-00421	SM 2580 B
Resistivity of Soil	2	2022/12/16	2022/12/21	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	2022/12/21	2022/12/21	CAM SOP-00464	EPA 375.4 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, 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.

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

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





Your Project #: ADM-22000797-A0  
Site Location: HWY 401 FROM VICTORIA TO NELSON AVE, ON  
Your C.O.C. #: 903374-03-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2022/12/22**  
Report #: R7441694  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2AK310**

**Received: 2022/12/16, 14:56**

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

**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

=====

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BUREAU  
VERITAS

Bureau Veritas Job #: C2AK310

Report Date: 2022/12/22

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: HWY 401 FROM VICTORIA TO NELSON AVE, ON

Sampler Initials: IB

### SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		UPP166			UPP166			UPP167		
Sampling Date		2022/11/28 03:00			2022/11/28 03:00			2022/12/12 03:00		
COC Number		903374-03-01			903374-03-01			903374-03-01		
	<b>UNITS</b>	<b>BH22-1-2 SS3</b>	<b>RDL</b>	<b>QC Batch</b>	<b>BH22-1-2 SS3 Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>	<b>BH22-1-3 SS10</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Calculated Parameters</b>										
Resistivity	ohm-cm	1100		8409198				810		8409198

<b>CONVENTIONALS</b>										
Redox Potential	mV	37	N/A	8418394	58	N/A	8418394	190	N/A	8418394

<b>Inorganics</b>										
Soluble (20:1) Chloride (Cl-)	ug/g	430	20	8415999				560	20	8415999
Conductivity	umho/cm	870	2	8415978	852	2	8415978	1230	2	8415978
Available (CaCl2) pH	pH	10.1		8417188				7.87		8417188
Soluble (20:1) Sulphate (SO4)	ug/g	57	20	8416009	59	20	8416009	<20	20	8416009
Sulphide	mg/kg	2.2 (1)	0.5	8419188	1.9	0.5	8419188	2.0 (2)	0.5	8419188

<b>Physical Testing</b>										
Moisture-Subcontracted	%	3.4	0.30	8419187				11	0.30	8419187

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable

(1) Sample extracted past method-specified hold time. Analyzed past method specified hold time

(2) Sample contained greater than 10% headspace at time of extraction.



## TEST SUMMARY

**Bureau Veritas ID:** UPP166  
**Sample ID:** BH22-1-2 SS3  
**Matrix:** Soil

**Collected:** 2022/11/28  
**Shipped:**  
**Received:** 2022/12/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8415999	2022/12/21	2022/12/21	Samuel Law
Conductivity	AT	8415978	2022/12/21	2022/12/21	Gurpartee K AUR
Moisture (Subcontracted)	BAL	8419187	N/A	2022/12/21	Ashley Henderson
Sulphide in Soil	SPEC	8419188	N/A	2022/12/21	Ly Vu
pH CaCl2 EXTRACT	AT	8417188	2022/12/21	2022/12/21	Taslina Aktar
Redox Potential	COND	8418394	2022/12/22	2022/12/22	Surinder Rai
Resistivity of Soil		8409198	2022/12/21	2022/12/21	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8416009	2022/12/21	2022/12/21	Samuel Law

**Bureau Veritas ID:** UPP166 Dup  
**Sample ID:** BH22-1-2 SS3  
**Matrix:** Soil

**Collected:** 2022/11/28  
**Shipped:**  
**Received:** 2022/12/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	8415978	2022/12/21	2022/12/21	Gurpartee K AUR
Sulphide in Soil	SPEC	8419188	N/A	2022/12/21	Ly Vu
Redox Potential	COND	8418394	2022/12/22	2022/12/22	Surinder Rai
Sulphate (20:1 Extract)	KONE/EC	8416009	2022/12/21	2022/12/21	Samuel Law

**Bureau Veritas ID:** UPP167  
**Sample ID:** BH22-1-3 SS10  
**Matrix:** Soil

**Collected:** 2022/12/12  
**Shipped:**  
**Received:** 2022/12/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8415999	2022/12/21	2022/12/21	Samuel Law
Conductivity	AT	8415978	2022/12/21	2022/12/21	Gurpartee K AUR
Moisture (Subcontracted)	BAL	8419187	N/A	2022/12/21	Ashley Henderson
Sulphide in Soil	SPEC	8419188	N/A	2022/12/21	Ly Vu
pH CaCl2 EXTRACT	AT	8417188	2022/12/21	2022/12/21	Taslina Aktar
Redox Potential	COND	8418394	2022/12/22	2022/12/22	Surinder Rai
Resistivity of Soil		8409198	2022/12/21	2022/12/21	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8416009	2022/12/21	2022/12/21	Samuel Law



### GENERAL COMMENTS

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

Package 1	4.7°C
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Results relate only to the items tested.

BUREAU  
VERITAS

Bureau Veritas Job #: C2AK310

Report Date: 2022/12/22

## QUALITY ASSURANCE REPORT

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: HWY 401 FROM VICTORIA TO NELSON AVE, ON

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
8415978	Conductivity	2022/12/21			105	90 - 110	<2	umho/cm	2.1	10
8415999	Soluble (20:1) Chloride (Cl-)	2022/12/21	NC	70 - 130	105	70 - 130	<20	ug/g	11	35
8416009	Soluble (20:1) Sulphate (SO4)	2022/12/21	NC	70 - 130	110	70 - 130	<20	ug/g	3.6	35
8417188	Available (CaCl2) pH	2022/12/22			100	97 - 103			0.66	N/A
8418394	Redox Potential	2022/12/22			101	95 - 105			46	N/A
8419187	Moisture-Subcontracted	2022/12/21					<0.30	%		
8419188	Sulphide	2022/12/21	141 (1)	75 - 125	103	75 - 125	<0.5	mg/kg	14	30

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)

(1) Matrix spike exceeds acceptance limits due to matrix interference.



BUREAU  
VERITAS

Bureau Veritas Job #: C2AK310

Report Date: 2022/12/22

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: HWY 401 FROM VICTORIA TO NELSON AVE, ON

Sampler Initials: IB

## VALIDATION SIGNATURE PAGE

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


Anastassia Hamanov, Scientific Specialist

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

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

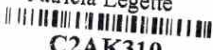


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Bureau Veritas  
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvna.com

Page of

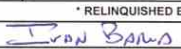
<b>INVOICE TO:</b> Company Name: #17488 exp Services Inc Attention: Accounts Payable Address: 1595 Clark Blvd Brampton ON L6T 4V1 Tel: (905) 793-9800 Fax: (905) 793-0641 Email: AP@exp.com; Karen.Burke@exp.com		<b>REPORT TO:</b> Company Name: Attention: Nimesh Tamrakar Address: Tel: (905) 796-3200 Ext: 3026 Fax: Email: Nimesh.Tamrakar@exp.com		<b>PROJECT INFORMATION:</b> Quotation #: C20328 P.O. #: Project: ADM-22000797-A0 Project Name: Site #: Sampled By:		16-Dec-22 14:56 Patricia Legette  <b>C2AK310</b> SBS ENV-1553  C#903374-03-01		<b>Bottle Order #:</b>  903374 <b>Project Manager:</b> Patricia Legette	
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**MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY**

<b>Regulation 153 (2011)</b> <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/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"/> For RSC <input type="checkbox"/> Table	<b>Other Regulations</b> <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Municipality <input type="checkbox"/> PWQO <input type="checkbox"/> Reg 406 Table <input type="checkbox"/> Other	<b>Special Instructions</b>
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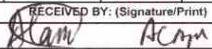
**Include Criteria on Certificate of Analysis (Y/N)?**

Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Analysis Requested (Please be Specific)	Turnaround Time (TAT) Required: Please provide advance notice for rush projects
1	BH22-1-2 SS3	Nov 28	3:00 AM		✓		<b>Regular (Standard) TAT:</b> (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details. <b>Job Specific Rush TAT (if applies to entire submission)</b> Date Required: Time Required: Rush Confirmation Number: (call lab for #)
2	BH22-1-2 SS3	Nov 28	3:00 AM		✓		
3	BH22-1-3 SS10	Dec 12	3:00 AM		✓		
4	BH22-1-3 SS10	Dec 12	3:00 AM		✓		
5							
6							
7							
8							
9							
10							

**\* RELINQUISHED BY: (Signature/Print)**  


**Date: (YY/MM/DD)**  
 22/12/16

**Time**  
 1456

**RECEIVED BY: (Signature/Print)**  


**Date: (YY/MM/DD)**  
 22/12/16

**Time**  
 1456

**# jars used and not submitted**

**Laboratory Use Only**  
 Time Sensitive  
 Temperature (°C) on Reel: 8/0/6  
 Custody Seal: Present  
 Intact

**Yes**  
☒

**No**  
☐

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

\* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

\*\* SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

White: Bureau Veritas Yellow: Client  
 No ice

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS



Your Project #: ADM-22000797-A0  
Site Location: Hwy 401 from Victoria to Nelson Ave, ON  
Your C.O.C. #: 893860-04-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2022/11/01**  
Report #: R7367904  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2U6020**

**Received: 2022/10/20, 12:51**

Sample Matrix: Soil  
# Samples Received: 1

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	1	2022/10/25	2022/10/28	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	1	2022/10/25	2022/10/25	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	1	N/A	2022/10/27	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	1	N/A	2022/10/27	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	1	2022/10/25	2022/10/25	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	1	2022/10/25	2022/10/26	CAM SOP-00421	SM 2580 B
Resistivity of Soil	1	2022/10/21	2022/10/26	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	1	2022/10/25	2022/10/26	CAM SOP-00464	EPA 375.4 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, 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.

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

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





Your Project #: ADM-22000797-A0  
Site Location: Hwy 401 from Victoria to Nelson Ave, ON  
Your C.O.C. #: 893860-04-01

**Attention: Nimesh Tamrakar**

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

**Report Date: 2022/11/01**  
Report #: R7367904  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2U6020**

**Received: 2022/10/20, 12:51**

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

**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

=====

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### SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		UBI927			UBI927		
Sampling Date		2022/10/12			2022/10/12		
COC Number		893860-04-01			893860-04-01		
	<b>UNITS</b>	<b>BH22-2-1 SS13</b>	<b>RDL</b>	<b>QC Batch</b>	<b>BH22-2-1 SS13 Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>							
Resistivity	ohm-cm	660		8298711			
<b>CONVENTIONALS</b>							
Redox Potential	mV	290	N/A	8303878			
<b>Inorganics</b>							
Soluble (20:1) Chloride (Cl-)	ug/g	750	20	8303802	770	20	8303802
Conductivity	umho/cm	1510	2	8303555	1530	2	8303555
Available (CaCl2) pH	pH	7.98		8303401			
Soluble (20:1) Sulphate (SO4)	ug/g	41	20	8303809	41	20	8303809
Sulphide	mg/kg	2.8 (1)	0.5	8310746			
<b>Physical Testing</b>							
Moisture-Subcontracted	%	9.2	0.30	8319509	9.9	0.30	8319509
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable (1) Sample extracted past method-specified hold time. Analyzed past method specified hold time							



BUREAU  
VERITAS

Bureau Veritas Job #: C2U6020

Report Date: 2022/11/01

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: Hwy 401 from Victoria to Nelson Ave, ON

Sampler Initials: IB

## TEST SUMMARY

**Bureau Veritas ID:** UBI927  
**Sample ID:** BH22-2-1 SS13  
**Matrix:** Soil

**Collected:** 2022/10/12  
**Shipped:**  
**Received:** 2022/10/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8303802	2022/10/25	2022/10/28	Alina Dobreanu
Conductivity	AT	8303555	2022/10/25	2022/10/25	Surinder Rai
Moisture (Subcontracted)	BAL	8319509	N/A	2022/10/27	Richard Ly
Sulphide in Soil	SPEC	8310746	N/A	2022/10/27	Bailey Morrison
pH CaCl <sub>2</sub> EXTRACT	AT	8303401	2022/10/25	2022/10/25	Taslina Aktar
Redox Potential	COND	8303878	2022/10/25	2022/10/26	Surinder Rai
Resistivity of Soil		8298711	2022/10/26	2022/10/26	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8303809	2022/10/25	2022/10/26	Samuel Law

**Bureau Veritas ID:** UBI927 Dup  
**Sample ID:** BH22-2-1 SS13  
**Matrix:** Soil

**Collected:** 2022/10/12  
**Shipped:**  
**Received:** 2022/10/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8303802	2022/10/25	2022/10/28	Alina Dobreanu
Conductivity	AT	8303555	2022/10/25	2022/10/25	Surinder Rai
Moisture (Subcontracted)	BAL	8319509	N/A	2022/10/27	Richard Ly
Sulphate (20:1 Extract)	KONE/EC	8303809	2022/10/25	2022/10/26	Samuel Law



### GENERAL COMMENTS

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

Package 1	1.3°C
-----------	-------

Results relate only to the items tested.

BUREAU  
VERITAS

Bureau Veritas Job #: C2U6020

Report Date: 2022/11/01

## QUALITY ASSURANCE REPORT

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: Hwy 401 from Victoria to Nelson Ave, ON

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
8303401	Available (CaCl <sub>2</sub> ) pH	2022/10/25			100	97 - 103			0.75	N/A
8303555	Conductivity	2022/10/25			106	90 - 110	<2	umho/cm	1.3	10
8303802	Soluble (20:1) Chloride (Cl <sup>-</sup> )	2022/10/28	NC	70 - 130	104	70 - 130	<20	ug/g	3.0	35
8303809	Soluble (20:1) Sulphate (SO <sub>4</sub> )	2022/10/26	NC	70 - 130	107	70 - 130	<20	ug/g	0.89	35
8303878	Redox Potential	2022/10/26			100	95 - 105			5.4	N/A
8310746	Sulphide	2022/10/27	52 (1)	75 - 125	100	75 - 125	<0.5	mg/kg		
8319509	Moisture-Subcontracted	2022/10/27					<0.30	%	7.3	20

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)

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



BUREAU  
VERITAS

Bureau Veritas Job #: C2U6020

Report Date: 2022/11/01

exp Services Inc

Client Project #: ADM-22000797-A0

Site Location: Hwy 401 from Victoria to Nelson Ave, ON

Sampler Initials: IB

## VALIDATION SIGNATURE PAGE

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

---

Cristina Carriere, Senior Scientific Specialist

---

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

---

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

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Bureau Veritas  
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free 800-563-6266 Fax: (905) 817-5777 www.bvna.com

# CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #17488 exp Services Inc		Company Name: <u>EXP Services</u>		Quotation #: C20328		Bureau Veritas Job #:	
Attention: Accounts Payable		Attention: Nimesh Tamrakar		P.O. #:		Bottle Order #:	
Address: 1595 Clark Blvd		Address:		Project: ADM-22000797-A0		COC #:	
Brampton ON L6T 4V1				Project Name: Hwy 401 from Victoria to Nelso		Project Manager:	
Tel: (905) 793-9800 Fax: (905) 793-0641		Tel: (905) 796-3200 Ext: 3026 Fax:		Site #:		C#893860-04-01	
Email: AP@exp.com; Karen.Burke@exp.com		Email: Nimesh.Tamrakar@exp.com		Sampled By:		Patricia Legette	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY						ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required: Please provide advance notice for rush projects							
Regulation 153 (2011)			Other Regulations			Special Instructions			Field Filtered (please circle): Metals / Hg / Cr VI	Soil Corrosivity Package											Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.		
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/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"/> For RSC <input type="checkbox"/> Table _____			<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality _____ <input type="checkbox"/> PWQO <input type="checkbox"/> Reg 406 Table _____ <input type="checkbox"/> Other _____																		Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Time Required: _____ Rush Confirmation Number: _____ (call lab for #)		
Include Criteria on Certificate of Analysis (Y/N)?																# of Bottles		Comments					
Sample Barcode Label		Sample (Location) Identification		Date Sampled		Time Sampled		Matrix															
1		BH22-2-1 SS13		2022/10/12				SOIL		✓													
2		BH22-2-1 SS13		2022/10/12				SOIL		✓													
3								SOIL															
4								SOIL															
5								SOIL															
6								SOIL															
7																							
8																							
9																							
10																							

20-Oct-22 12:51

Patricia Legette



C2U6020

ALCO ENV 511

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		# Jars used and not submitted		Laboratory Use Only			
<u>[Signature]</u> Juan Barua		22/10/20				<u>[Signature]</u> / Anmol		2022/10/20		12:51				Time Sensitive			
														Temperature (°C) on Reel			
														Custody Seal			
														Present			
														Intact			
														Yes			
														No			

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS.

\* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

\*\* SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client



Your Project #: Campobello job# C2U6020

**Attention: Patricia Legette**

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

**Report Date: 2022/11/01**

Report #: R3257319

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C282985**

**Received: 2022/10/21, 16:00**

Sample Matrix: Soil  
# Samples Received: 1

Analyses	Date		Date Analyzed	Laboratory Method	Analytical Method
	Quantity	Extracted			
Moisture	1	N/A	2022/10/27	AB SOP-00002	CCME PHC-CWS m
Sulphide	1	2022/10/26	2022/10/27	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# C2U6020

**Attention: Patricia Legette**

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

**Report Date: 2022/11/01**

Report #: R3257319

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C282985**

**Received: 2022/10/21, 16:00**

**Encryption Key**

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

=====

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BUREAU  
VERITAS

Bureau Veritas Job #: C282985

Report Date: 2022/11/01

BUREAU VERITAS

Client Project #: Campobello job# C2U6020

Sampler Initials: I.B

### RESULTS OF CHEMICAL ANALYSES OF SOIL

<b>Bureau Veritas ID</b>		BFB941		
<b>Sampling Date</b>		2022/10/12		
	<b>UNITS</b>	<b>BH22-2-1 SS13</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Misc. Inorganics</b>				
Sulphide	mg/kg	2.8 (1)	0.5	A773361
RDL = Reportable Detection Limit				
(1) Sample extracted past method-specified hold time. Analyzed past method specified hold time				



BUREAU  
VERITAS

Bureau Veritas Job #: C282985

Report Date: 2022/11/01

BUREAU VERITAS

Client Project #: Campobello job# C2U6020

Sampler Initials: I.B

### PHYSICAL TESTING (SOIL)

<b>Bureau Veritas ID</b>		BFB941	BFB941		
<b>Sampling Date</b>		2022/10/12	2022/10/12		
	<b>UNITS</b>	<b>BH22-2-1 SS13</b>	<b>BH22-2-1 SS13 Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Physical Properties</b>					
Moisture	%	9.2	9.9	0.30	A774882
RDL = Reportable Detection Limit					
Lab-Dup = Laboratory Initiated Duplicate					



BUREAU  
VERITAS

Bureau Veritas Job #: C282985  
Report Date: 2022/11/01

BUREAU VERITAS  
Client Project #: Campobello job# C2U6020  
Sampler Initials: I.B

## TEST SUMMARY

**Bureau Veritas ID:** BFB941  
**Sample ID:** BH22-2-1 SS13  
**Matrix:** Soil

**Collected:** 2022/10/12  
**Shipped:**  
**Received:** 2022/10/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A774882	N/A	2022/10/27	Richard Ly
Sulphide	SPEC	A773361	2022/10/26	2022/10/27	Bailey Morrison

**Bureau Veritas ID:** BFB941 Dup  
**Sample ID:** BH22-2-1 SS13  
**Matrix:** Soil

**Collected:** 2022/10/12  
**Shipped:**  
**Received:** 2022/10/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A774882	N/A	2022/10/27	Richard Ly



BUREAU  
VERITAS

Bureau Veritas Job #: C282985

Report Date: 2022/11/01

BUREAU VERITAS

Client Project #: Campobello job# C2U6020

Sampler Initials: I.B

### GENERAL COMMENTS

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

Package 1	2.7°C
Package 2	4.0°C

Results relate only to the items tested.



BUREAU  
VERITAS

Bureau Veritas Job #: C282985

Report Date: 2022/11/01

## QUALITY ASSURANCE REPORT

BUREAU VERITAS

Client Project #: Campobello job# C2U6020

Sampler Initials: I.B

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A773361	Sulphide	2022/10/27	52 (1)	75 - 125	100	75 - 125	<0.5	mg/kg	NC	30
A774882	Moisture	2022/10/27					<0.30	%	7.3	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) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



BUREAU  
VERITAS

Bureau Veritas Job #: C282985

Report Date: 2022/11/01

BUREAU VERITAS

Client Project #: Campobello job# C2U6020

Sampler Initials: I.B

## VALIDATION SIGNATURE PAGE

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

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

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

---

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## Appendix E – Borehole Logs - Previous Investigations



BH75-10

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 66-F-89 LOCATION Hwy. 401 & C.P.R. (Sta. 322 + 22 155' Rt.) ORIGINATED BY V.K.  
W.P. 257-61 BORING DATE December 2, 1966 COMPILED BY V.K.  
DATUM Geodetic BOREHOLE TYPE Pen-Drill Auger CHECKED BY \_\_\_\_\_

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT — W	WATER CONTENT %		
586.7	GROUND LEVEL											
0.0	(Brown)											
			1	SS	32							
			2	SS	100/6"	580						Gr. 2, Sa. 48 Si. 38 Cl. 12
			3	SS	100/6"							
			4	SS	116							Gr. 1, Sa. 46 Si. 44 Cl. 9
			5	SS	100/6"	570						
			6	SS	100/5"							
			7	SS	100/6"	560						
			8	SS	100/5"							
			9	SS	100/6"	550						
			10	SS	124							
			11	SS	84	540						
			12	SS	63							
			13	SS	62	530						
			14	SS	69							
525.2												
61.5	End of Borehole					520						

Dynamic Penetration Resistance Scale: 20, 40, 60, 80, 100  
Water Content Scale: 10, 20, 30  
Liquid Limit (WL) and Plastic Limit (WP) lines are plotted on the graph.

Remarks: Gr. 2, Sa. 48; Si. 38; Cl. 12; Gr. 1, Sa. 46; Si. 44; Cl. 9; El. 552.7; Gr. 0, Sa. 81; Si. & Cl. 19

## RECORD OF BOREHOLE NO. 11 BH75-11

FOUNDATION SECTION

JOB 66-F-89

LOCATION Hwy. 401 & C.P.R., Sta. 321 / 02, 131' Rt.

ORIGINATED BY V.K.

W. P. 257-61

BORING DATE December 2, 1966

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Drive BX Casing & Wash

**CHECKED BY**

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY Y P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT		PLASTIC LIMIT ——— wp				WATER CONTENT ——— w
							20	40	60	80			
							SHEAR STRENGTH P.S.F.		WATER CONTENT %				
									10	20	30		
583.0	GROUND LEVEL												
0.0	(Brown)												
	Clayey silt with pockets of silty sand and trace of gravel.  Very Stiff to Hard		1	SS	28	580							
			2	SS	84								
			3	SS	100/5"								
			4	SS	111	570							
			5	SS	100/5"								
			6	SS	100/6"	560							
			7	SS	100/5"								
			8	SS	85	550							
545.0			9	SS	34								
38.0	Silty sand to sandy silt, occasional gravel.  Very Dense.		10	SS	100/6"	540							
			11	SS	126								
531.5			12	SS	106								
51.5	End of Borehole					530							

BH73-1

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 65-F-49LOCATION Hwy. #401 & Birchmount Rd Hwy #401 Ch 316/92 130'-0" RtORIGINATED BY W.W.K.W.P. 256-61BORING DATE May 12, 1965.COMPILED BY W.W.K.DATUM 579.0BOREHOLE TYPE Penndrill 4" Auger.CHECKED BY K.G.S. *GR*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY  P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL		
579.0	Groundlevel															
578.0	Black Org. Topsoil															
1.0	Silty sand to sandy silt with traces of clay and gravel.		1	SS	130											
	Compact to very dense.		2	SS	80	570										
				for 4"												
			3	SS	137											
			4	SS	138	560										
			5	SS	80											
				for 4"		550										
			6	SS	119											
542.5			7	SS	162											
36.5	End of borehole.					540										

W.L. El.  
551.5Observed in  
Borehole.

## Appendix F – Results of Stability Analyses

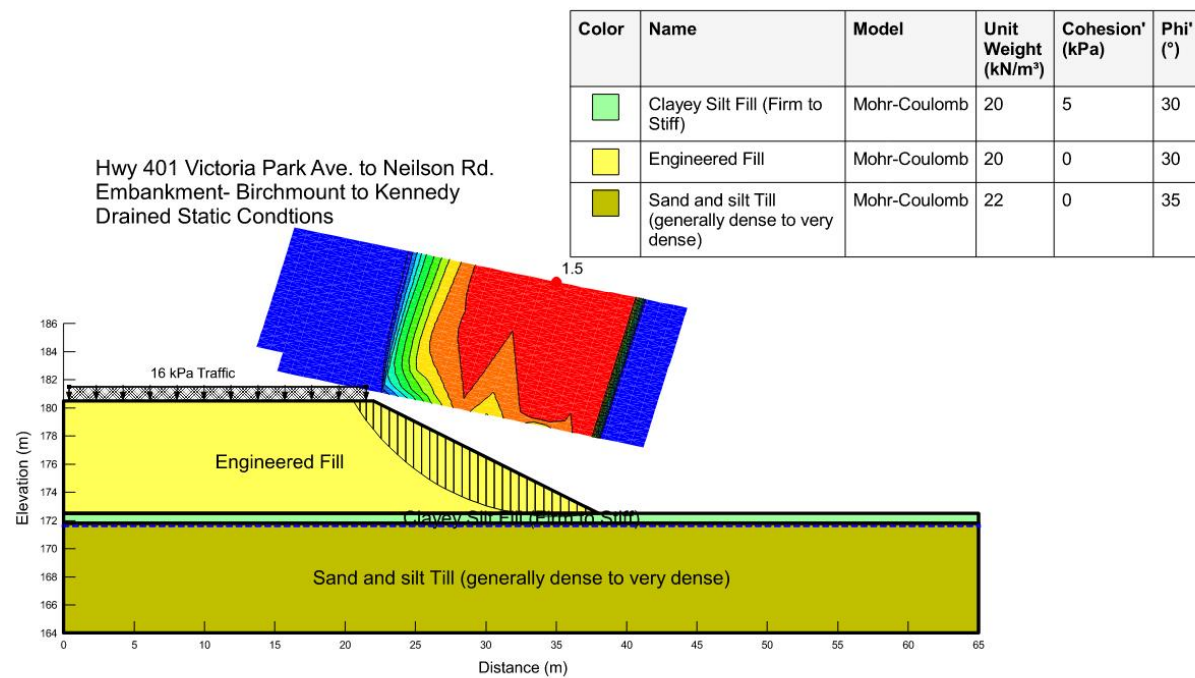


Figure 1: Slope stability analysis– drained static condition

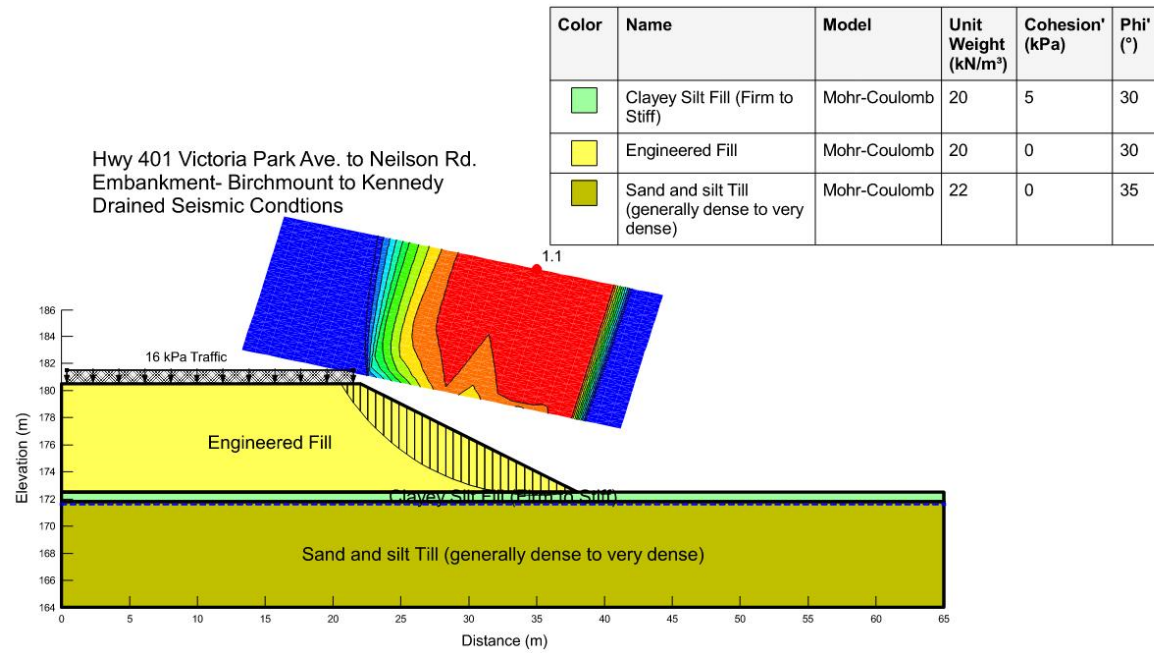


Figure 2: Slope stability analysis– drained seismic condition

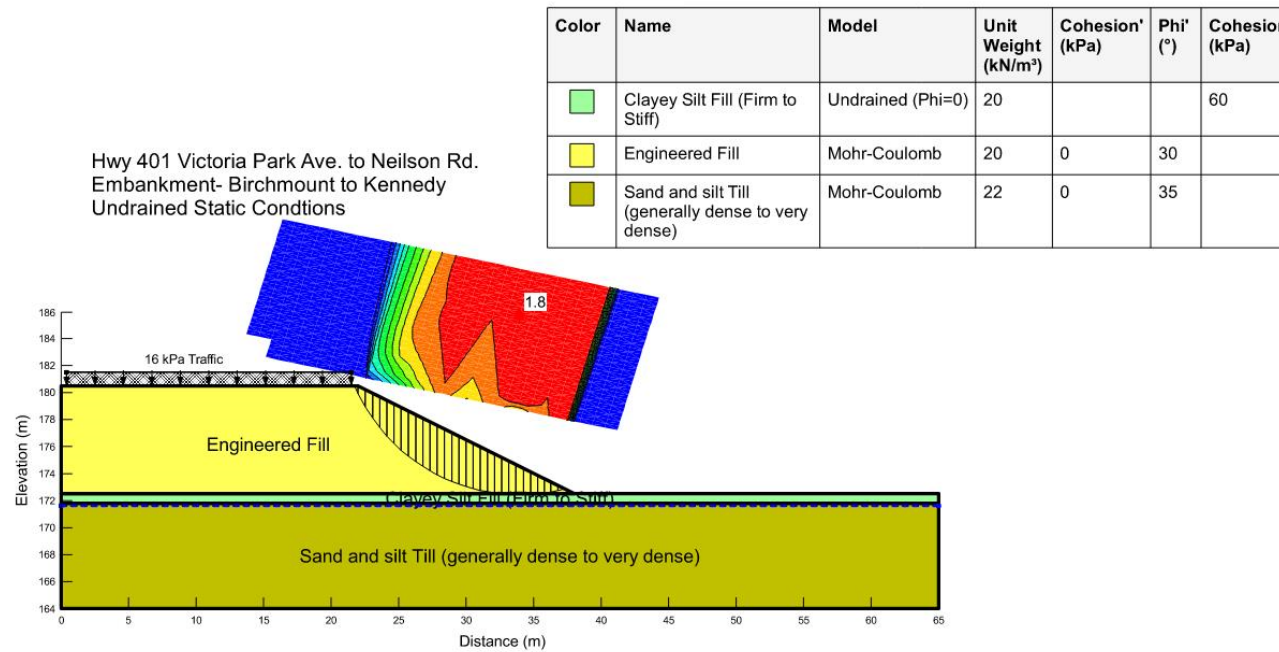
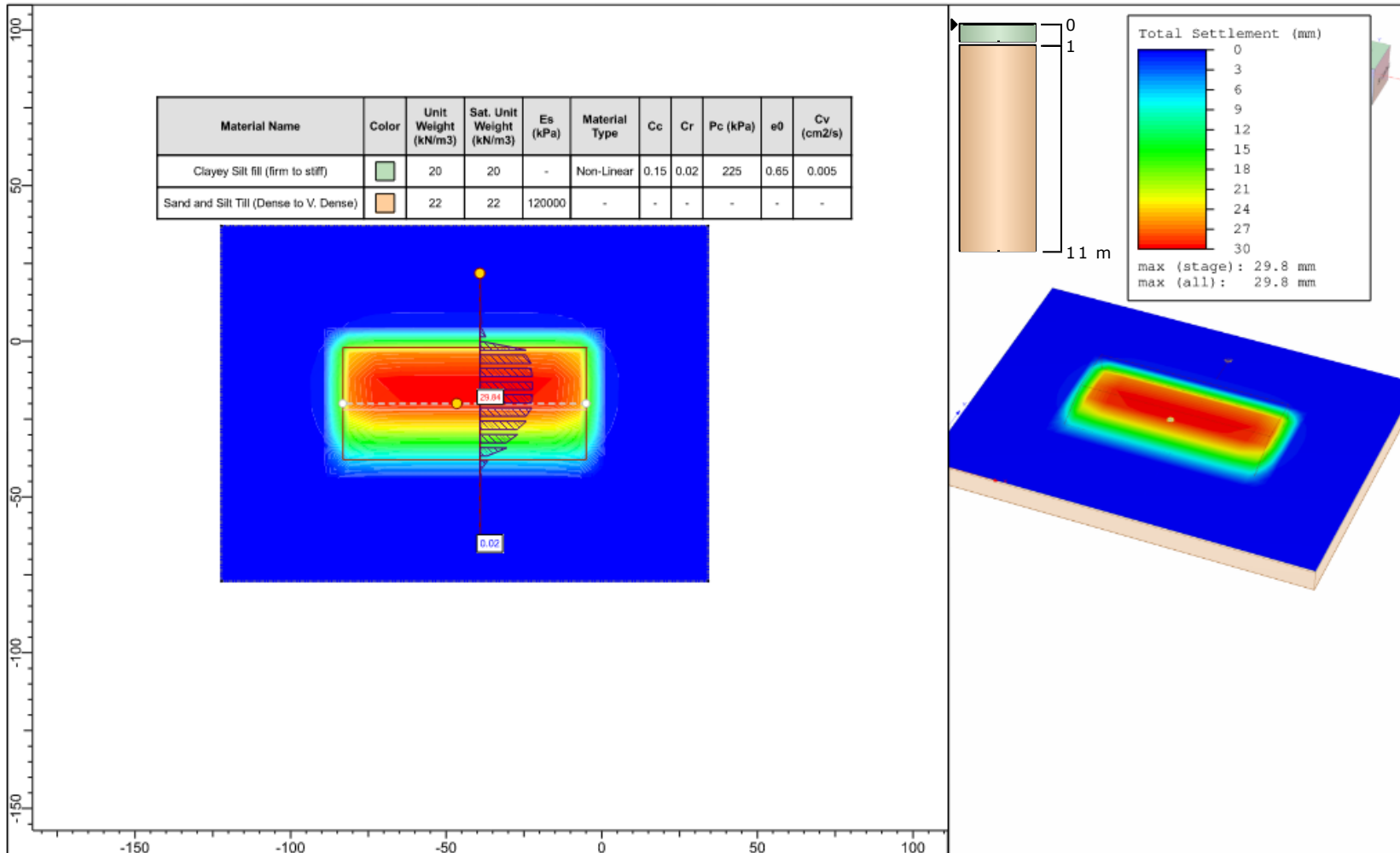


Figure 3: Slope stability analysis– undrained static condition

## Appendix G – Results of Settlement Analysis





*Project:* H401 East Bound Express and Collector Lanes between Victoria Park and Neilson Road Project

*Analysis Description:* Embankment – **Total Settlement**

*Figure No:* H1

*Company:* EXP Services Inc.

*Date:* June, 2024

*File Name:* Settlement Analysis – Embankment

## Appendix H— Seismic Hazard Values



Government  
of Canada

Gouvernement  
du Canada

[Canada.ca](#) › [Natural Resources Canada](#) › [Earthquakes Canada](#)

# 2020 National Building Code of Canada Seismic Hazard Tool

**i** This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

## Seismic Hazard Values

### User requested values

Code edition	NBC 2020
Site designation $X_s$	$X_c$
Latitude (°)	43.773
Longitude (°)	-79.291

Please select one of the tabs below.

NBC 2020

Additional Values

Plots

API

Background Information

The 5%-damped spectral acceleration ( $S_a(T, X)$ , where  $T$  is the period, in s, and  $X$  is the site designation) and peak ground acceleration ( $PGA(X)$ ) values are given in units of acceleration due to gravity ( $g$ ,  $9.81 \text{ m/s}^2$ ). Peak

ground velocity. (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

**NBC 2020 - 2%/50 years (0.000404 per annum) probability**

$S_a(0.2, X_C)$	$S_a(0.5, X_C)$	$S_a(1.0, X_C)$	$S_a(2.0, X_C)$	$S_a(5.0, X_C)$	$S_a(10.0, X_C)$	PGA( $X_C$ )	PGV( $X_C$ )
0.325	0.198	0.104	0.0481	0.0125	0.00424	0.176	0.13

The log-log interpolated 2%/50 year  $S_a(4.0, X_C)$  value is : **0.0174**

► Tables for 5% and 10% in 50 year values

Download CSV

◀ Go back to the [seismic hazard calculator form](#)

**Date modified:** 2021-04-06

## Appendix I— Non-Standard Special Provisions (NSSP)s

## **NSSP FOR DELAY OF PAVEMENT AT HIGH FILL EMBANKMENT**

---

### **Scope of Work**

The Contractor should be aware that High Fill embankment construction will result in settlements of the native material and the selected fill.

Embankment construction using Granular A fill and compacted to 98% SPMDD will require a minimum delay of pavement of 30 days. Embankment construction using SSM and compacted to 98% SPMDD will require a minimum delay of pavement of 90 days.

Prior to placing the pavement granular sub-base material and paving, the Contractor shall survey the embankment to confirm the elevation and place additional fill as required to achieve design requirements.

The Contractor shall not proceed with final granular base placement and paving until approval has been given by the Contracting Authority.

## **NSSP FOR DELAY OF PAVEMENT AT HIGH FILL EMBANKMENT**

---

### **Scope of Work**

The Contractor should be aware that High Fill embankment construction will result in settlements of the native material and the selected fill.

Embankment construction using Granular A fill and compacted to 98% SPMD will require a minimum delay of pavement of 30 days. Embankment construction using SSM and compacted to 98% SPMD will require a minimum delay of pavement of 90 days.

Prior to placing the pavement granular sub-base material and paving, the Contractor shall survey the embankment to confirm the elevation and place additional fill as required to achieve design requirements.

The Contractor shall not proceed with final granular base placement and paving until approval has been given by the Contracting Authority.