



Foundation Investigation Report

*Highway 11 – 2+1 Roadway Model Project: **Site SW12***

Assignment No. 5021-E-0038
GWP 5033-22-00
Geocres No. 31L13-008
(Latitude: 46.834600; Longitude: -79.797120)

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PART I - FOUNDATION INVESTIGATION REPORT

1 FACTUAL INFORMATION

1.1 Introduction

This report presents the results of the geotechnical investigation completed by EXP Services Inc. (EXP) for the proposed widening of Highway 11 and the corresponding embankment/roadway construction and extension of the existing culverts at site SW12. The site is located approximately 9.5 km north of the intersection of Highway 64 and Highway 11 from approximately Station 13+630 to 14+160 in the Township of Olive in the District of Nipissing, Ontario (Latitude: 46.834600; Longitude:-79.797120). The work was undertaken under Agreement No. 5021-E-0038, and the terms of reference (TOR) were provided by AECOM. The AutoCAD drawings for Highway 11 were also provided by AECOM.

The purpose of the investigation was to evaluate the subsurface conditions along the proposed widening of Highway 11 and the existing culvert alignment, and based on this data, to provide a borehole location plan, cross section subsurface profile, record of boreholes, laboratory test results, and a written description of the subsurface conditions to permit detailed design and recommendations for the construction of the new proposed embankment/roadway associated with the widening of the highway and the extension of the existing culvert. The site specific geotechnical investigation consisted of a field investigation program including visual inspections, drilling, soil sampling, and laboratory testing.

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.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The site is located approximately 9.5 km north of the intersection of Highway 64 and Highway 11 from approximately Station 13+660 to 14+160 in the Township of Olive in the District of Nipissing, Ontario. At the site, Highway 11 generally runs in a north-south direction, with a speed limit of 90 km/h (unless otherwise posted). At the site, Highway 11 is approximately 8.6 m wide with a 2.9 m wide gravel shoulder on the east side (northbound lane) and a 2.6 m wide gravel shoulder on the west side (southbound lane). In total, the existing roadway with both shoulders included is about 14.1 m wide.

As per drawings provided by AECOM, the site is divided into two segments: SW12-1, spanning from Sta. 13+630 to Sta. 14+004, and SW12-2, spanning from Sta. 14+004 to Sta. 14+160. Based on the AutoCAD drawings, the elevation of the highway pavement centerline along segment SW12-1 ranges from approximately Elev. 289.1 m to Elev. 291.1 m from south to north. The elevation of the highway pavement centerline along segment SW12-2 ranges from approximately Elev. 289.1 to Elev. 291.4 m from south to north. The height of the embankment generally ranges from 3 m to 5 m high on the west side and less than 1 m up to 5 m on the east side with side slopes ranging from approximately 2H:1V to 3H:1V.

A concrete box culvert crosses Highway 11 at Station 14+154 which runs in the east-west direction nearly perpendicular to the highway centreline. Additionally, a corrugated steel pipe (CSP) culvert crosses Highway 11 at Station 14+037, skewed approximately 35 degrees to the highway centerline in a northeast-southwest direction.

Based on the CAD drawings provided by AECOM, the existing concrete box culvert at Station 14+154 has a width and height of 1.25 m and total length of about 21.36 m. The fill cover at the culvert is about 3.75 m to 3.9 m high with the top of embankment being at Elev. 291.2 m. The invert of the culvert is approximately at Elev. 286.1 m and Elev. 285.8 m on the inlet (east) and outlet (west) side, respectively. The side slopes of the embankment at the concrete box culvert location were at approximately 1.25H:1V to 2H:1V on the east side and ranged from 1.8H:1V to 2.5H:1V on the west side. The corrugated steel pipe (CSP) culvert located at about Station 14+037 has a diameter of 0.9 m and total length of about 29.95 m. The fill cover is about 1.1 m with the top of embankment being at Elev. 289.0 m. The invert of the existing corrugated steel culvert is approximately at Elev. 287.0 m and Elev. 286.9 m on the inlet/east and outlet/west side, respectively. Select photographs of the site and existing culvert are presented in Appendix A. The site plan and cross-section profiles along the existing highway and culvert alignments are shown on the drawings attached in Appendix B.

The general site conditions were assessed during a site visit on September 13, 2023 as well as during the field investigation works between May 5, 2024, and July 30, 2024. During the site visit and field investigation works, the flow through the concrete box culvert was observed from east to west. In June 2024, the approximate top of water of the creek was measured to be at Elev. 286.4 m on the east (inlet) and west (outlet) side. Water was not observed to be flowing through the CSP at Station 14+037, but water was pooled at the base of the embankment at the outlet at approximately the same level as the creek/lake water level (~Elev. 286.4 m).

Both sides of the embankment were observed to be mostly comprised of gravel and/or grass with boulder-sized rock fill/riprap to protect against scour or erosion around the culvert. The west side of the embankment is adjacent to Red Canoe Lake with marshland predominantly existing directly at the toe of the embankment and adjacent to the lake and natural vegetation consisting of bushes and large conifers. The east side of the embankment is predominately adjacent to dense forests beyond the toe of the embankment with a section of marshland existing near the north end of the site near the creek flowing into the concrete box culvert. Large bedrock outcrops were observed approximately between Station 13+825 and 14+000.

Photographs 1 to 12 in Appendix A depict the site, culvert, road, and activities during drilling, taken by EXP between May and July 2024. Photographs 1 and 2 show the existing roadway surface shoulder, embankment side slope, and ground conditions/vegetation beyond embankment toe along the SBL side as well as the overhead power lines running adjacent to the SBL. Photographs 3 and 4 show the existing roadway surface and shoulder, cut side slope, bedrock outcrops and ground conditions/vegetation beyond the embankment toe along the NBL side. Photograph 5 shows the drilling of borehole BH12-3 which required the use of mats for access, while Photograph 6 shows the drilling of borehole BH12-11 with the Explo portable rig which was placed on a platform constructed on the swampy ground surface. Photograph 7 shows the locations of boreholes BH12-5, BH12-11, and BH-13, which needed to be accessed using an Argo ATV via the marshy and watery terrain. Photographs 8 and 9 show the inlet and outlet of the existing culvert and the surrounding area of the west and east side of the highway embankment, including the existing rip rap and vegetation. Photograph 10 was taken in May and shows the creek on the east side of the highway. Photographs 11 and 12 show the inlet and outlet of the existing CSP culvert, respectively.

1.2.2 Geological Setting

According to the Ministry of Northern Development and Mines, Map 2555 (Quaternary Geology of Ontario, East-Central Sheet, 1991) the surface conditions in the vicinity of the project area are expected to consist of glaciofluvial outwash deposits comprised of gravel and sand, including proglacial river and deltaic deposits, and Precambrian bedrock: undifferentiated igneous and metamorphic rock. The bedrock could be exposed at the surface or covered by a discontinuous, thin layer of drift. According to Map 2543 (Bedrock Geology of Ontario, East-Central Sheet, 1991),

the bedrock geology in the vicinity of the site consists of migmatic rocks and gneisses of undetermined protolith: commonly layered biotite gneisses and migmatites; locally includes quartzofeldspathic gneisses, orthogneisses, paragneisses. The site is also adjacent to foliated tonalite suite: tonalite to granodiorite which is foliated to massive and felsic igneous rocks: tonalite, granodiorite, monzonite, granite, syenite, and derived gneisses.

1.3 Previous Investigations

There are no available previous geotechnical reports at the location of the site in the MTO GEOCRETS library; the nearest available reports on Highway 11 are approximately 1.5 km southeast and 0.8 km northwest, respectively, from the site:

- *Geocres No. 31L00-141: "Preliminary field investigation for re-alignment of Highway 11 at three locations between HWY 64 and town of Latchford, Agreement NO.5004-E-0058", prepared by Shaheen & Peaker Limited., dated December 12,2005.*
- *Geocres No. 31L-123: "Foundation Investigation Report, Highway 11 at Pan Lake,10.6 km north of Highway 64, Station 14+750 to 14+950 in Olive township", prepared by AMEC Americas Limited. dated September 03, 2008.*

1.4 Investigation Procedures

1.4.1 Site Investigation and Field Testing

A site reconnaissance was conducted by an EXP representative on September 13, 2023 to evaluate the general site conditions for the proposed borehole locations.

The site investigation for the eight (8) roadway boreholes was performed between May 5 and 13, 2024 while the investigation of seven (7) off-road boreholes was performed between May 7 and July 30, 2024. In total, the entire field program consisted of drilling fifteen (15) sampled boreholes. The boreholes were strategically located along the highway and as close as possible to the existing culvert footprints to provide subsurface information for the widening of the highway and the culvert extensions. Boreholes BH12-6, BH12-12, BH12-15, BH12-16, BH12-17 and BH12-19 were advanced on the west side (southbound lane) of the highway while BH12-4 and BH12-8 were advanced on the east side (northbound lane). Boreholes BH12-11, BH12-13 and BH12-20 were advanced off-road beyond the toe of the existing embankment on the west side of the highway and boreholes BH12-1 and BH12-2 were advanced off-road beyond the toe of the existing embankment on the east side of the highway. BH12-6 was advanced on top of the embankment in the west (southbound) lane of the highway, about 7.5 m south of the existing culvert. Boreholes BH12-3 and BH12-5 were advanced at the inlet and outlet locations of the existing concrete box culvert, respectively, at the bottom of the roadway embankment. BH12-3 was located approximately 8.5 m southeast of the culvert inlet and BH12-5 was located approximately 7.3 m southwest of the culvert outlet.

The locations of the boreholes drilled during this investigation are shown on Drawing 1 in Appendix B. Roadway boreholes BH12-4, BH12-6, BH12-8, BH12-12, BH12-15, BH12-16, BH12-17 and BH12-19 were advanced to depths between 4.6 m and 15.6 m below ground surface. Off-road boreholes BH12-1, BH12-2, BH12-3, BH12-5, BH12-11, BH12-13 and BH12-20 were advanced to depths between 9.0 m and 13.9 m below ground surface.

The roadway boreholes drilled during this investigation were advanced using a truck mounted CME 75 drill rig, operated by a specialist drilling contractor Marathon Drilling Ltd. while the off-road boreholes drilled during the site investigation were advanced using a track mounted D50 drill rig, track mounted CME 55 drill rig, or a EXPLOR 691

portable rig, also operated by Marathon Drilling Ltd. All drill rigs were equipped with hollow stem augers, NW casing/NQ coring or HW casing/HQ coring, and standard soil sampling equipment. Due to the relatively steep highway embankments with limited access for the drill rig and swamp conditions, access (swamp) mats were used to create access to and a stable working surface for off-road boreholes and were provided and installed by Northern Mat & Bridge. Traffic control was provided by Demora Construction Services Inc.

The borehole locations (referenced to the MTM NAD83 Zone 10) and their ground surface elevations were surveyed by EXP personnel using a Trimble DA2 GNSS receiver with Trimble Catalyst GNSS positioning, having an accuracy of ± 0.1 m in the horizontal and vertical direction. Elevations for each borehole were referenced from the benchmark "HCP 123", which was a stake located on the southbound lane shoulder at Elev. 288.757 m by the surveyor. Ground surface elevations of the boreholes are summarized in Table 1.1 below.

During the drilling of the boreholes, a combination of Standard Penetration Tests (SPT) and rock coring was attempted to obtain soil and rock samples. Soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586) at intervals ranging from 0.75 m to 1.5 m in depth, as shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT "N" values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM, pg. 103) and used to provide an assessment of in-situ consistency of cohesive soils or compactness of non-cohesive soils. The SPT "N" values taken within the particles larger than diameter of split spoon sampler may not be reliable and collected samples are possibly not representative of the layer. When a hard stratum was reached (refusal of split spoon), sampling of hard material was performed by diamond core drilling using a 1.5 m long NQ double tube wireline core barrel.

Where possible, groundwater level measurements were carried out in the boreholes before coring and at the completion of the boreholes in accordance with MTO guidelines. However, all boreholes at this site were advanced using diamond coring procedures. Water was used during advancement of cores from the ground surface, therefore groundwater was not measured in boreholes due to the drilling method. A standpipe piezometer was installed in borehole BH12-1 to permit monitoring of the groundwater level on the east side of Hwy 11. The recorded groundwater levels are presented in the borehole log sheets in Appendix C. All other drilled boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act) upon completion of drilling.

The fieldwork was supervised by an EXP geotechnical representative who directed the drilling and sampling operations, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification and retrieved soil samples for subsequent laboratory testing and identification.

All recovered soil samples were placed in labelled moisture-proof bags and returned to EXP's laboratory for additional visual, textual, and olfactory examination, and selective testing. The rock cores were placed in wooden core boxes and photographed as shown in Appendix E.

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Table 1.1. Summary of boreholes completed

Borehole No.	Location	Location (MTM NAD 83 Zone 10)		Latitude	Longitude	Ground Surface Elevation ⁿ¹ (m)	Borehole Depth ² (m)
		Northing	Easting				
BH12-1	Off-road beyond toe of existing slope: east side of highway	5188610.6	282183.2	46.836644	-79.7964979	287.3	13.3
BH12-2	Off-road beyond toe of existing slope: east side of highway	5188562.9	282177.5	46.836215	-79.7965700	287.5	9.0
BH12-3	Off-road beyond toe of existing slope: east side of highway	5188654.4	282175.0	46.837038	-79.7966073	286.6	13.7
BH12-4	East (northbound) lane of highway	5188457.8	282150.9	46.835267	-79.7969139	289.2	4.6
BH12-5	Off-road beyond toe of existing slope: west side of highway	5188654.4	282144.0	46.837036	-79.7970150	286.6	11.7
BH12-6	West (southbound) lane of highway	5188654.2	282157.5	46.837034	-79.7968367	290.9	15.6
BH12-8	East (northbound) lane of highway	5188259.2	282144.3	46.833481	-79.7969897	290.0	7.7
BH12-11	Off-road beyond toe of existing slope: west side of highway	5188604.3	282137.9	46.836586	-79.7970906	288.4	11.9
BH12-12	West (southbound) lane of highway	5188562.8	282150.4	46.836212	-79.7969255	289.0	9.2
BH12-13	Off-road beyond toe of existing slope: west side of highway	5188522.2	282133.8	46.835846	-79.7971410	286.4	13.9
BH12-15	West Shoulder (southbound) lane of highway	5188413.3	282136.3	46.834867	-79.7971024	289.2	6.0
BH12-16	West (southbound) lane of highway	5188362.2	282140.3	46.834407	-79.7970483	289.6	7.7
BH12-17	West (southbound) lane shoulder of highway	5188312.2	282133.0	46.833957	-79.7971413	289.6	7.7
BH12-19	West (southbound) lane shoulder of highway	5188213.2	282133.6	46.833066	-79.7971287	290.2	9.1
BH12-20	Off-road beyond toe of existing slope: west side of highway	5188165.4	282115.6	46.832638	-79.7973600	286.7	11.4

Notes:

1. The ground surface elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

1.4.2 Laboratory Testing

All soil and rock samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content on all soil samples and particle size distribution for approximately 25% of the collected soil samples. Atterberg limits testing was done in conjunction with grain size distribution tests on select samples. All laboratory tests were carried out in accordance with MTO and/or ASTM standards as appropriate.

One (1) soil sample was selected for corrosivity analysis and sent to Bureau Veritas, a CALA-certified and accredited laboratory in Mississauga, Ontario. The selected soil sample for the analytical testing was placed in laboratory prepared glass jars, labelled and stored in a secure cooler.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of the grain size analyses are presented graphically in Appendix D.

1.5 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C. The "Explanation of Terms Used in Report" preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report.

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

Below the roadway, the subsurface conditions encountered within the investigated depths of the geotechnical investigation indicate the following subsurface sequence: sand and gravel to gravelly sand fill followed by either rock fill directly over bedrock or cohesionless fill consisting of varying amounts of predominantly silt and sand underlain by native soil comprised predominantly of silt and sand followed by glacial till consisting predominantly of cobbles and boulders in a silt, sand and gravel matrix underlain by bedrock. Peat was located under the fill in one borehole (BH12-19).

At the toe of the embankment along the east and west side of the highway, the encountered subsurface conditions were observed to generally consist of organic materials (topsoil, peat, organic silt) over silt and sand followed by glacial till comprised of cobbles and boulders in a silt, sand, and gravel soil matrix underlain by bedrock.

At the culvert inlet, outlet, and below the roadway (BH12-3, BH12-5, BH12-6) the encountered subsurface conditions were observed to generally consist of topsoil or organic silt followed by native soil consisting predominantly of silt and/or sand which is underlain by glacial till followed by bedrock.

A detailed description of the subsurface conditions encountered is discussed further in subsequent sections.

1.5.1 Subsoils

1.5.1.1 Asphalt Treatment

Asphalt treatment, ranging from approximately 75 mm to 150 mm in thickness, was encountered at the ground surface of roadway boreholes. Asphalt thicknesses may further vary beyond the borehole locations.

1.5.1.2 Topsoil

Topsoil, approximately 75 mm to 190 mm thick, was encountered at the ground surface of boreholes BH12-1 to BH12-3, BH12-11, BH12-13, and BH12-20.

Laboratory testing performed on a selected sample consisted of one (1) moisture content test. The test results are as follows:

Moisture Content:

- 117%

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

1.5.1.3 Peat

Peat was encountered below the silt fill in borehole BH12-19 and below the topsoil in borehole BH12-20. The approximate elevation of the surface and base of the peat and thickness as encountered in the boreholes are summarized below in Table 1.2.

Table 1.2. Summary of peat

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-19	287.2	286.2	3.0	1.0
BH12-20	286.6	284.2	0.1	2.4

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The peat encountered at the site ranged from fibrous to amorphous. The peat was mixed with silt and sand at the bottom of the layer in borehole BH12-20. The material was generally dark brown to dark grey in colour and wet. The SPT "N" values obtained within this material ranged from 1 to 7 blows per 0.3 m penetration suggesting that the peat layers were very soft to firm in consistency.

Laboratory testing performed on selected samples consisted of four (4) moisture content tests and two (2) organic content tests. The test results are as follows:

Moisture Content:

- 83% to 236%

Organic Content:

- 11.8% to 41.4%

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

1.5.1.4 Organic Silt

A layer of organic silt was encountered at the ground surface of borehole BH12-5, below the topsoil in boreholes BH12-11 and BH12-13, and below the peat in borehole 12-20. The approximate elevation of the surface and base of the organic silt layer and thickness as encountered in the boreholes are summarized below in Table 1.3.

Table 1.3. Summary of organic silt

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-5	286.6	283.6	0.0	3.0
BH12-11	288.3	282.3	0.1	6.0
BH12-13	286.2	280.3	0.2	5.9
BH12-20	284.2	283.3	2.5	0.9

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this material generally consisted of a mixture of organics with silt, a sand content ranging from trace sand to sandy, a clay content ranging from trace clay to being clayey, and trace gravel. The organic silt was generally dark brown to grey to black in colour and wet to saturated. The SPT "N" values in this material ranged from WH (weight of hammer) to 9 blows per 0.3 m penetration suggesting that this layer was very loose to loose, but generally very loose in consistency.

Laboratory testing performed on selected samples consisted of seventeen (17) moisture content tests, thirteen (13) organic content tests, four (4) grain size distribution tests, and three (3) Atterberg limit tests. The test results are as follows:

Moisture Content:

- 32% to 243%

Organic Content:

- 3.6% to 14.4%

Grain Size Distribution:

- 0% gravel to 7%
- 3% sand to 32%
- 58% to 96% silt
- 1% to 5% clay

Atterberg Limits:

- Non-plastic

The results of the moisture content, organic content, grain size distribution, and Atterberg limit tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 1 in Appendix D.

1.5.1.5 Cohesionless Fill: Gravelly Sand/Sand and Gravel/Silt and Gravel

Cohesionless fill material consisting of varying distributions of predominantly sand and gravel was encountered below the asphalt treatment in boreholes BH12-4, BH12-8, BH12-12 and BH12-16, and at the ground surface of Borehole BH12-15, BH12-17 and BH12-19. The approximate elevation of the surface and base of the fill and thickness as encountered in the boreholes are summarized below in Table 1.4.

Table 1.4. Summary of cohesionless fill: gravelly sand/sand and gravel/silt and gravel

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-4	289.0	288.0	0.2	1.0
BH12-8	289.8	288.8	0.2	1.0
BH12-12	288.8	287.5	0.2	1.3

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Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-15	289.2	287.4	0.0	1.8
BH12-16	289.4	287.9	0.2	1.5
BH12-17	289.6	288.8	0.0	0.8
BH12-19	290.2	287.9	0.0	2.3

Notes:

1. The elevations are referenced from HCP 123
2. Depths are relative to ground surface.

The composition of this fill material generally consisted of sand, gravel and silt in varying amounts with trace to some clay. Cobbles were also encountered in this layer. The fill was generally brown to dark brown to grey in colour and moist to wet. The SPT “N” values obtained within this material ranged from 13 blows per 0.3 m penetration to 100 blows per 0.13 m penetration (refusal on likely cobble), suggesting that this layer was compact to very dense but generally compact to dense in compactness.

Laboratory testing performed on selected samples consisted of fifteen (15) moisture content tests and five (5) grain size distribution tests. The test results are as follows:

Moisture Content:

- 3% to 14%

Grain Size Distribution:

- 30% to 39% gravel
- 5% to 65% sand
- 55% silt
- 3% clay
- 3% to 24% silt and clay

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

1.5.1.6 Cohesionless Fill: Sand/Sandy Silt/Silt

Cohesionless fill material consisting of varying distributions of predominantly silt and/or sand was encountered below the asphalt treatment in borehole BH12-6 and below the sand and gravel/gravelly sand fill in borehole BH12-

17 and BH12-19. The approximate elevation of the surface and base of the fill and thickness as encountered in the boreholes are summarized below in Table 1.5.

Table 1.5. Summary of cohesionless fill: sand/sandy silt/silt

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-6	290.8	286.3	0.1	4.5
BH12-17	288.8	287.3	0.8	1.5
BH12-19	287.9	287.2	2.3	0.7

Notes:

1. The elevations are referenced from HCP 123
2. Depths are relative to ground surface.

The composition of this fill material predominantly consisted of silt and/or sand with a gravel content ranging from trace gravel to becoming gravelly and trace to some clay. Cobbles were also encountered within the fill. The fill was generally grey in colour and moist to saturated. The SPT "N" values obtained within this material ranged from 4 to 64 blows per 0.3 m penetration, suggesting that this layer was very loose to very dense, but generally loose to compact in compactness.

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

Moisture Content:

- 7% to 26%

Grain Size Distribution:

- 0% to 22% gravel
- 2% to 22% sand
- 49% to 87% silt
- 7% to 11% clay

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

1.5.1.7 Rock Fill

Rock fill consisting of various sized fragments of rock in a soil matrix (gravel, sand and silt sized particles) was encountered below the sand and gravel/gravelly sand fill in boreholes BH12-4, BH12-8 BH12-12, and BH12-15. The

approximate elevation of the surface and base of the rock fill and thickness as encountered in the boreholes are summarized below in Table 1.6.

Table 1.6. Summary of rock fill

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-4	288.0	287.1	1.2	0.9
BH12-8	288.8	285.6	1.2	3.2
BH12-12	287.5	281.7	1.5	5.8
BH12-15	287.4	285.5	1.8	1.9

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this rock fill layer generally consisted of cobble to boulder sized rock fill with silt, sand and gravel sized particles within the in-fill soil matrix. The particle size within the rock fill varies from silt to boulder size (i.e. from 0.002 mm to greater than 300 mm).

A combination of SPT and coring was carried out during the exploration of this layer. Where possible, split spoon sampling was attempted to obtain samples from this layer. However, it should be noted that in most cases, obtained samples from this layer were either not adequate or did not accurately represent the particle size distribution of this material. The SPT "N" values obtained within this layer ranged from 5 to over 100 blows per 0.3 m penetration, suggesting that this layer was loose to very dense in relative density. In addition, refusal due to a cobble or boulder was likely encountered when the split spoon could not penetrate 0.3 m.

Laboratory testing was not performed on soil samples from this layer due to minimal sample recovery during the investigation.

1.5.1.8 Sand / Silty Sand / Silt and Sand

Native sand to silty sand to silt and sand was encountered below the topsoil in boreholes BH12-1, BH12-2 and BH12-3, below the fill in borehole BH12-19, below the organic silt/peat in boreholes BH12-5 and BH12-19, below the silt in borehole BH12-1, and below the sandy silt in borehole BH12-6. The approximate elevation of the surface and base of this layer and thickness as encountered in the boreholes are summarized below in Table 1.7.

Table 1.7. Summary of sand/silty sand layer/silt and sand layers

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-1	287.2	285.8	0.1	1.4
	280.4	279.0	6.9	1.4
BH12-2	287.4	286.7	0.1	0.7
BH12-3	286.4	281.3	0.2	5.1
BH12-6	284.0	281.0	6.9	3.0
BH12-19	286.2	284.1	4.0	2.1

Notes:

1. The elevations referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this material generally consisted of sand and silt with trace gravel to becoming gravelly, trace clay, and trace organics. Cobbles/boulders were also encountered. These layers were generally brown to grey in colour and moist to saturated. The SPT “N” values obtained within this material ranged from 2 to 25 blows per 0.3 m penetration, suggesting that this layer was very loose to compact in compactness.

Laboratory testing performed on selected samples consisted of ten (10) moisture content tests, four (4) grain size distribution test, one (1) Atterberg limit test, two (2) unit weight tests, and three (3) organic content tests. The test results are as follows:

Moisture Content:

- 14% to 43%

Grain Size Distribution:

- 0% to 21% gravel
- 41% to 54% sand
- 34% to 53% silt
- 0% to 4% clay

Atterberg Limits:

- Non-plastic

Unit Weight:

- 17.5 kN/m³ to 18.7 kN/m³

Organic Content:

- 1.6% to 4.9%

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

1.5.1.9 Silt/Sandy Silt

Native silt was encountered below the native sand/silty sand/silt and sand layer in boreholes BH12-1, BH12-2, BH12-3, BH12-6, below organic silt in boreholes BH12-5, BH12-11, BH12-13 and BH12-20, and below the fill material in borehole BH12-6, BH12-16, and BH12-17. The approximate elevation of the surface and base of this layer and thickness as encountered in the boreholes are summarized below in Table 1.8.

Table 1.8. Summary of silt/sandy silt layers

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-1	285.8	280.4	1.5	5.4
BH12-2	286.7	280.0	0.8	6.7
BH12-3	281.3	277.5	5.3	3.8
BH12-5	283.6	280.5	3.0	3.1
BH12-6	286.3	284.0	4.6	2.3
	281.0	280.2	9.9	9.9
BH12-11	282.3	276.8	6.1	5.5
BH12-13	280.3	273.6	6.1	6.7
BH12-16	287.1	283.9	2.5	3.2
BH12-17	287.3	286.5	2.3	0.8

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-20	283.3	277.1	3.4	6.2

Notes:

1. The elevations referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this material predominantly consisted of silt with trace sand to becoming sandy, trace to some gravel, trace to some clay, and trace organics. These layers were generally brown to grey in colour and were moist to saturated. The SPT “N” values obtained within this material ranged from WH (weight of hammer) to 39 blows per 0.3 m penetration, suggesting that this layer was very loose to dense, but generally loose to compact in compactness.

Laboratory testing performed on selected samples consisted of twenty-eight (28) moisture content tests, thirteen (13) grain size distribution tests, seven (7) Atterberg limit tests, and two (2) unit weight tests. The test results are as follows:

Moisture Content:

- 15% to 50%

Grain Size Distribution:

- 0% to 11% gravel
- 1% to 20% sand
- 72% to 94% silt
- 1% to 16% clay

Atterberg Limits:

- Non-plastic

Unit Weight:

- 16.4 kN/m³ to 20.3 kN/m³

The results of the moisture content, grain size distribution, Atterberg limit, and unit weight tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 5 and Figure 6 in Appendix D.

1.5.1.10 Clayey Silt

Native clayey silt was encountered below native silt in borehole BH12-5. The approximate elevation of the surface and base of this layer and thickness as encountered in borehole BH12-5 are summarized below in Table 1.9.

Table 1.9. Summary of clayey silt

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-5	280.5	278.2	6.1	2.3

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this material generally consisted of clay and silt with trace sand. This layer was grey in colour and saturated. The SPT “N” values obtained within this layer ranged from 2 to 6 blows per 0.3 m penetration, suggesting that it was very soft to firm in consistency.

Laboratory testing performed on selected samples consisted of two (2) moisture content tests, one (1) grain size distribution test, and one (1) unit weight test. The test results are as follows:

Moisture Content:

- 20% to 30%

Grain Size Distribution:

- 0% gravel
- 3% sand
- 74% silt
- 23% clay

Unit Weight:

- 17.7 kN/m³

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

1.5.1.11 Glacial Till: Cobbles and Boulders

Glacial till comprised of cobbles and boulders in a silt, sand, and gravel soil matrix were encountered below the native silt, clayey silt, and sandy silt layers in boreholes BH12-2, BH12-3, BH12-5, BH12-6, BH12-11, BH12-13, BH12-16, BH12-17 and BH12-20, and below the native sand in borehole BH12-1. Boreholes BH12-2, BH12-5, BH12-6, BH12-11, and BH12-13 were terminated within this layer. The approximate elevation of the surface and base of this layer and thickness as encountered in the boreholes are summarized below in Table 1.10.

Table 1.10. Summary of glacial till (cobbles and boulders) layer

Borehole	Elevation ¹ (m)		Layer Surface Depth ² (m)	Layer Thickness (m)
	Top	Bottom		
BH12-1	279.0	276.6	8.3	2.4
BH12-2	280.0	278.5	7.5	1.5
BH12-3	277.5	276.1	9.1	1.4
BH12-5	278.2	274.9	8.4	3.3
BH12-6	280.2	275.3	10.7	4.9
BH12-11	276.8	276.5	11.6	0.3
BH12-13	273.6	272.5	12.8	1.1
BH12-16	283.9	283.6	5.7	0.3
BH12-17	286.5	285.6	3.1	0.9
BH12-20	277.1	276.5	9.6	0.6

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The composition of this layer was generally comprised of cobbles and boulders with layers of silt, sand and gravel within the soil matrix. The particle size within the layer varied from clay to boulder size (i.e., from less 0.002 mm to greater than 300 mm).

A combination of SPT and coring was carried out during the exploration of this layer. Where possible, split spoon sampling was attempted to obtain samples from this layer. However, it should be noted that in most cases, obtained samples from this layer were either not adequate or did not accurately represent the particle size distribution of this material as particles larger than 35 mm (inside diameter of SPT sampler) could not be obtained.

The SPT "N" values obtained within the layers of silt/sand/gravel ranged from 24 blows per 0.3 m penetration was 100 blows per 0.125 m penetration, suggesting that these layers within the cobbles and boulders are compact to very dense. In addition, refusal due to a cobble or boulder was likely encountered when the split spoon could not penetrate 0.3 m.

Laboratory testing was not performed on soil samples from this layer due to minimal sample recovery during the Investigation.

1.5.2 Bedrock

Bedrock was encountered beneath the silty sand in borehole BH12-19, below the rock fill in borehole BH12-4, BH12-8, BH12-12, and BH12-15, and below the glacial till in boreholes BH12-1, BH12-3, BH12-16, BH12-17 and BH12-20. Elevations at the top of bedrock were between 276.1 m to 287.1 m. The bedrock was investigated by coring about 1.2 m to 3.7 m into the stratum. The bedrock surface depths and elevations encountered at these borehole locations are listed in Table 1.11. Photographs of the rock cores are included in Appendix E.

Table 1.11. Summary of bedrock

Borehole No.	Elevation ¹ (m)		Layer Surface Depth ² (m)
	Top	Bottom	
BH12-1	276.6	274.0	10.7
BH12-3	276.1	272.9	10.5
BH12-4	287.1	284.6	2.1
BH12-8	285.6	282.3	4.4
BH12-12	281.7	279.8	7.3
BH12-15	285.5	283.2	3.7
BH12-16	283.6	281.9	6.0
BH12-17	285.6	281.9	4.0
BH12-19	284.1	281.1	6.1
BH12-20	276.5	275.3	10.2

Notes:

1. The elevations referenced from HCP 123.
2. Depths are relative to ground surface.

Based on the bedrock NQ cores (~ core diameter 47 mm) recovered, the bedrock at the site generally consisted of felsic igneous rocks and migmatic rocks and gneisses. In general, the rock samples are described as light to dark grey and reddish/pink in colour. The Rock Quality Designation (RQD) measured on the core samples typically ranged from

approximately 21% to 100%, indicating a rock mass of very poor to excellent quality, but generally poor to good quality. The total core recovery (TCR) of bedrock cores ranged from 38% to 100%.

1.6 Groundwater and Surface Water Conditions

All boreholes at this site were advanced using diamond coring procedures. Water was used during the advancement of HQ casing and NQ cores from the ground surface. Therefore, groundwater was not measured in open boreholes upon completion due to the drilling method. The groundwater levels in the boreholes were observed in a piezometer. The groundwater levels measured in the piezometer installed in borehole BH12-1 are shown on the borehole logs and are presented below in Table 1.12.

Table 1.12. Groundwater levels measured in the piezometer

Borehole No.	Date Measured	Ground Surface Elevation ¹ (m)	Groundwater Depth ² /Elevation ¹ (m)
East side of Embankment			
BH12-1	May 15, 2024	287.3	0.5/286.8
	June 18, 2024		0.5/286.8
	July 31, 2024		0.4/286.9

Notes:

1. The elevations are referenced from HCP 123.
2. Depths are relative to ground surface.

The top of creek water level at the existing culvert location was measured to be at Elev. 286.4 m on the east (inlet) and west (outlet) side in June 2024.

It should be noted that fluctuations in the level of the groundwater may occur due to seasonal variations, (precipitation, snowmelt, rainfall), local soil permeability, construction remediation activities, and other related factors.

1.7 Chemical Analyses

One (1) soil sample was selected for chemical analyses during field investigation. The soil sample collected by EXP was tested at Bureau Veritas, a CALA-certified and accredited laboratory in Mississauga, Ontario.

Sample SS8 from borehole BH12-6 was subjected to corrosivity chemical analyses. The analytical results are summarized in Table 1.13 below and are presented in Appendix D.

Table 1.13. Summary of chemical analysis results

Sample Identification	pH (unitless)	Soluble Chloride (ppm)	Soluble Sulphate (ppm)	Resistivity (ohm-cm)	Conductivity (mS/cm)	Redox Potential (mV)
BH12-6 SS8	7.40	170	<20	2200	451 - 452	440 - 470

2 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 to assess this additional information and our recommendations as appropriate. It may then be necessary to conduct additional investigations and analyses.

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

This Foundation Investigation Report has been prepared by Daniel Mroz, M.E.Sc., P.Eng., and Silvana Micic, Ph.D., P.Eng. It was reviewed by TaeChul Kim, M.E.Sc., P.Eng. Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Principal Foundation Contact carried out an independent quality control and technical review.

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*Foundation Investigation Report
Highway 11, 2+1 Roadway Model Project: Site SW12
Assignment No. 5021-E-0038
Date: March 23, 2026*

REFERENCES

Canadian Geotechnical Society, 2023. Canadian Foundation Engineering Manual, 5th Edition. The Canadian Geotechnical Society, British Columbia.

Canadian Standards Association (CSA), 2019. Canadian Highway Bridge Design Code and Commentary on CAN/CSA-S6-19. CSA Special Publication.

Ministry of Northern Development and Mines, Map 2555. Quaternary Geology of Ontario, East-Central Sheet, 1991.

Ministry of Northern Development and Mines Map 2543. Bedrock Geology of Ontario, East-Central Sheet, 1991.

Ministry of Transportation, April 2022. Guideline for MTO Foundation Engineering Services, Version 03.

ASTM International:

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

Ontario Water Resources Act:

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

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,

*Foundation Investigation Report
Highway 11, 2+1 Roadway Model Project: Site SW12
Assignment No. 5021-E-0038
Date: March 23, 2026*

misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to EXP.

STANDARD OF CARE

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

COMPLETE REPORT

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

USE OF REPORT

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

REPORT FORMAT

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

Appendix A –
Site Photographs



Photograph 1. Roadway surface and shoulder, embankment side slope, and ground conditions beyond embankment toe along SBL (west) side, looking north (April 24, 2024)



Photograph 2. Roadway surface and shoulder, embankment side slope, and ground conditions beyond embankment toe along SBL (west) side, looking north (April 24, 2024)



Photograph 3. Roadway surface and shoulder, embankment side slope, and ground conditions beyond embankment toe along NBL (east) side, looking north (May 6, 2024)



Photograph 4. Roadway surface and shoulder SBL (west) side, looking south (May 8, 2024)



Photograph 5. East side of embankment at Borehole BH12-3 Location facing north (May 7, 2024)



Photograph 6. West side of embankment at Borehole BH12-5 Location facing west (June 5, 2024)



Photograph 7. West side of embankment at Borehole BH12-5 Location facing south (June 5, 2024)



Photograph 8. Concrete box culvert inlet and east side of embankment, facing west (May 7, 2024)



Photograph 9. Culvert outlet and west side of embankment, facing northeast (May 7, 2024)



Photograph 10. Concrete box culvert outlet and west side of embankment, facing east (May 7, 2024)



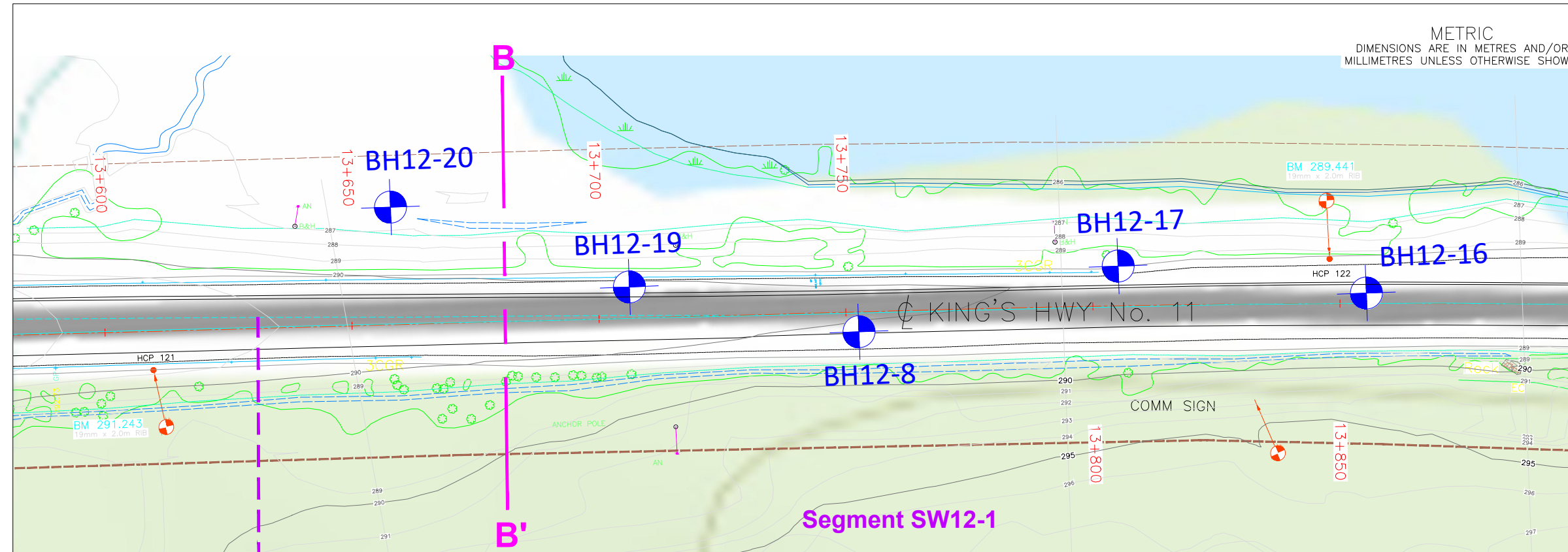
Photograph 11. Corrugated steel pipe culvert inlet and east side of embankment, facing west (May 7, 2024)



Photograph 12. Corrugated steel pipe culvert outlet and west side of embankment, facing east (May 7, 2024)

Appendix B –
Drawings

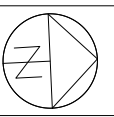
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.



PLAN



CONT No. 5021-E-0038
ASSIG No.
GWP No. 5033-22-00
Highway 11 from Sand Dam Road Northerly 13.8 Km
to Ellesmere Road (SW12)
Latitude: 46.834602°; Longitude: -79.797110°
BOREHOLE LOCATION PLAN & SOIL STRATA



SHEET
2

exp. EXP SERVICES INC.



KEY PLAN
N.T.S.

LEGEND

- Borehole Location (EXP)
- 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 COORDINATES/ NAD 83/ MTM ON-10

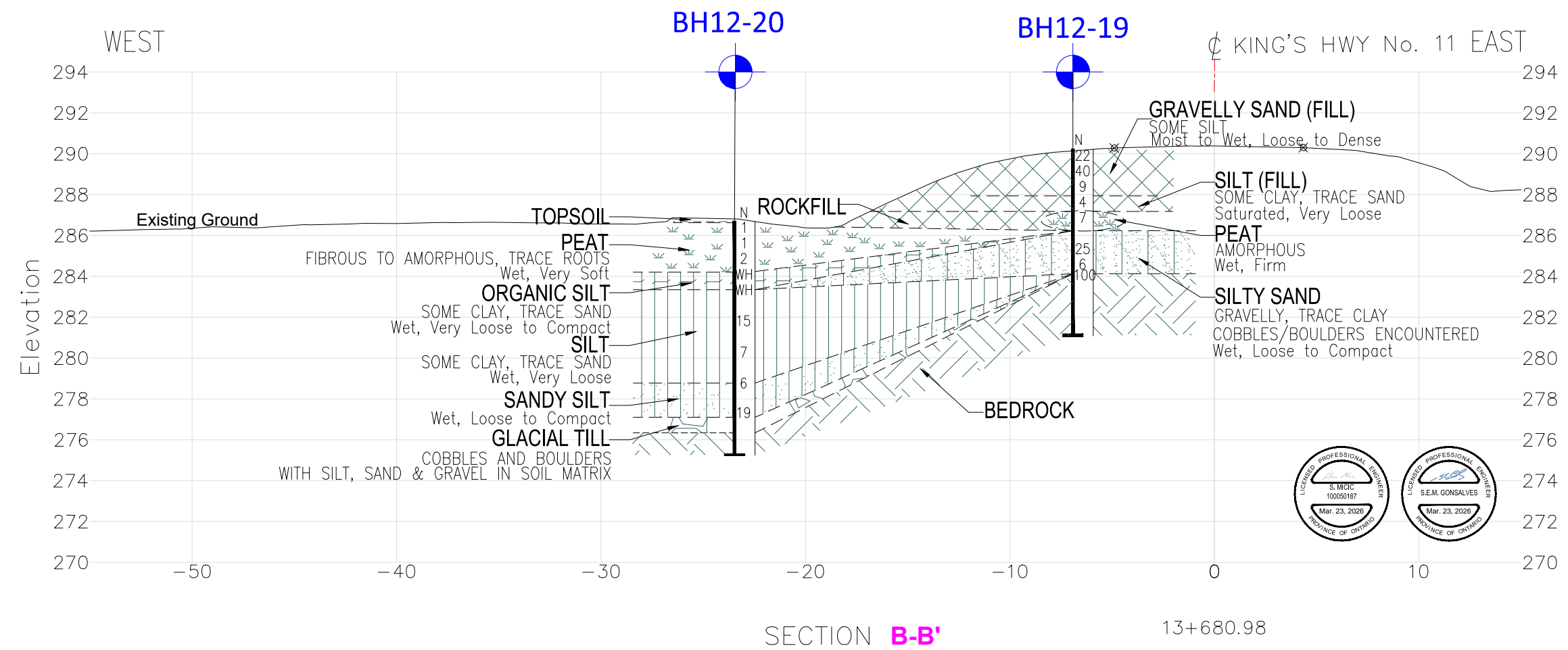
BH No.	ELEV.	NORTHING	EASTING
BH12-1	287.3	5188610.6	282183.2
BH12-2	287.5	5188562.9	282177.5
BH12-3	286.6	5188654.5	282175.0
BH12-4	289.2	5188457.8	282150.9
BH12-5	286.6	5188654.4	282144.0
BH12-6	290.9	5188654.2	282157.5
BH12-8	290.0	5188259.2	282144.3
BH12-11	288.4	5188604.3	282137.9
BH12-12	289.0	5188562.8	282150.4
BH12-13	286.4	5188522.2	282133.8
BH12-15	289.2	5188413.3	282136.3
BH12-16	289.6	5188362.2	282140.3
BH12-17	289.6	5188312.2	282133.0
BH12-19	290.2	5188213.2	282133.6
BH12-20	286.7	5188165.4	282115.6

NOTES

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

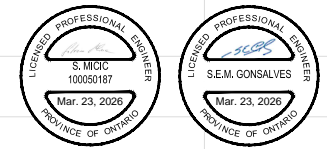
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

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



SECTION B-B'

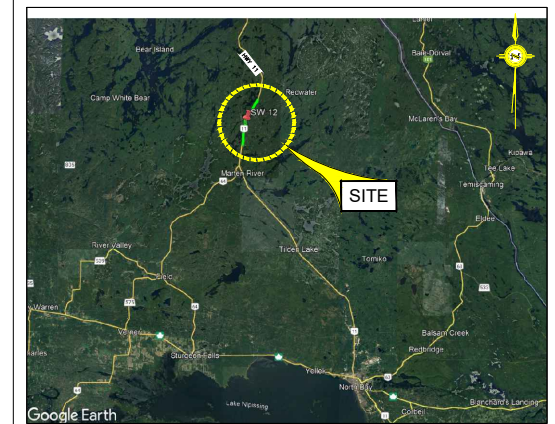
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MODIFIED: 2025-01-10 10:31

NO	DATE	BY	DESCRIPTION
SUBMISSION FOR MTO REVIEW			

PROJECT No.	ADM-23010055-A0	GEOCREs No.	31L13-008
SUBM'D SH	CHKD. SM	DATE	JAN. 22, 2025
DRAWN SH	CHKD. TL	APPRD	SG
			DWG 02



KEY PLAN
 N.T.S.

- LEGEND
- Borehole Location (EXP)
 - 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
- | | | |
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BOREHOLE COORDINATES/ NAD 83/ MTM ON-10

BH No.	ELEV.	NORTHING	EASTING
BH12-1	287.3	5188610.6	282183.2
BH12-2	287.5	5188562.9	282177.5
BH12-3	286.6	5188654.5	282175.0
BH12-4	289.2	5188457.8	282150.9
BH12-5	286.6	5188654.4	282144.0
BH12-6	290.9	5188654.2	282157.5
BH12-8	290.0	5188259.2	282144.3
BH12-11	288.4	5188604.3	282137.9
BH12-12	289.0	5188562.8	282150.4
BH12-13	286.4	5188522.2	282133.8
BH12-15	289.2	5188413.3	282136.3
BH12-16	289.6	5188362.2	282140.3
BH12-17	289.6	5188312.2	282133.0
BH12-19	290.2	5188213.2	282133.6
BH12-20	286.7	5188165.4	282115.6

NOTES

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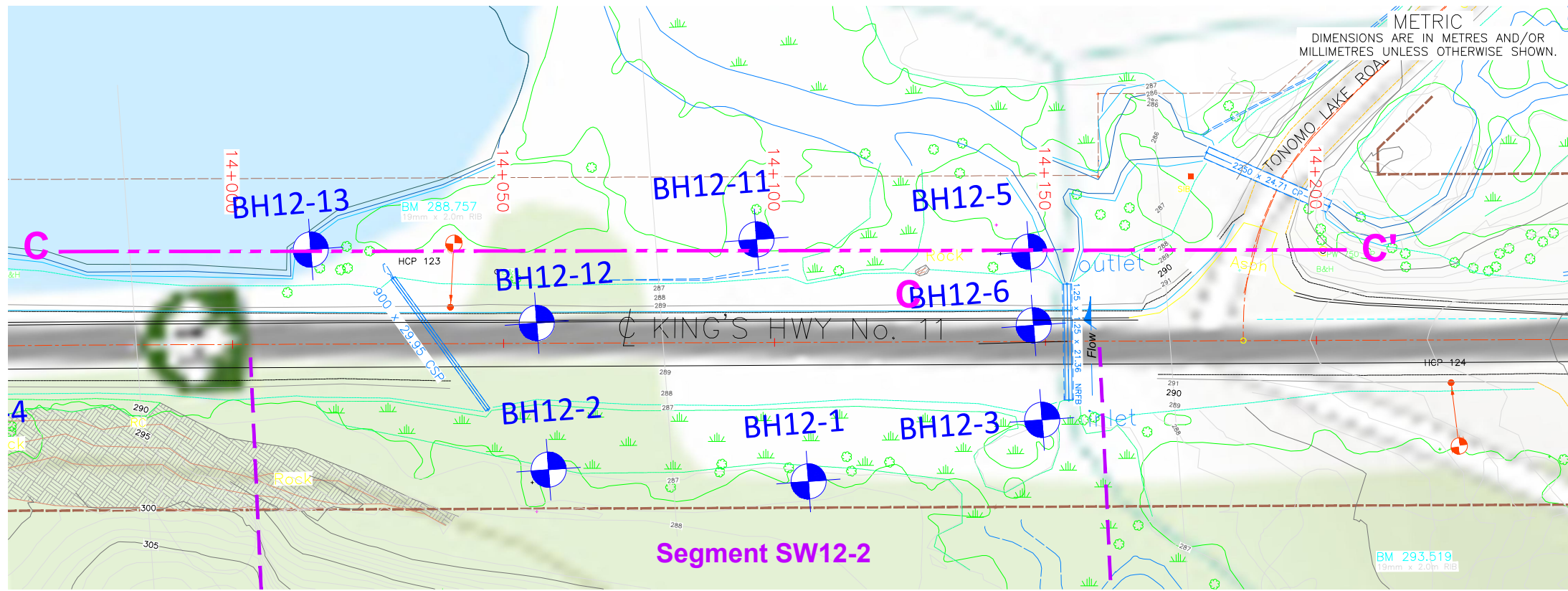
The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in the report and related documents are specifically excluded in accordance with the conditions of Section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

REVISIONS

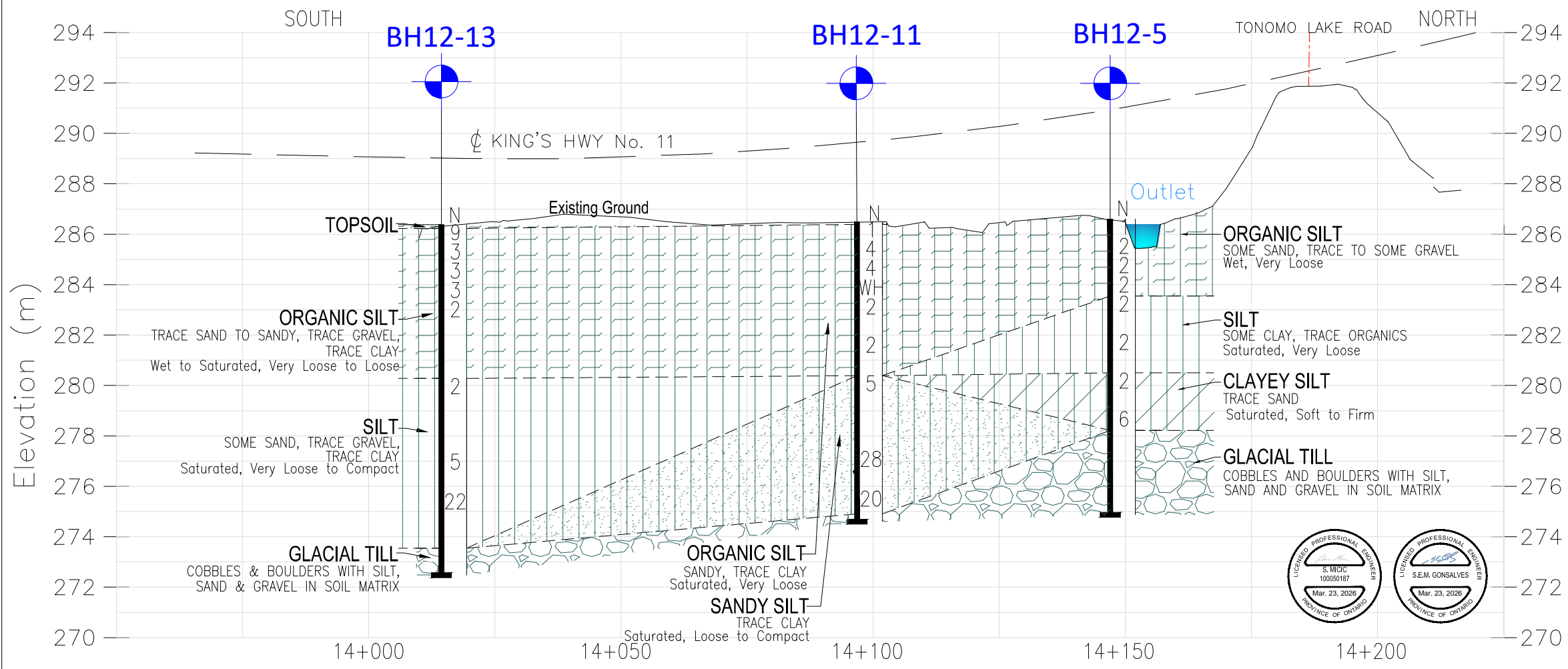
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SUBMISSION FOR MTO REVIEW

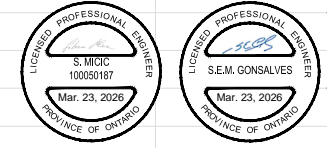
PROJECT No.	ADM-23010055-A0	GEOCREs No.	31L13-008
SUBM'D SH	CHKD. SM	DATE	JAN. 22, 2025
DRAWN SH	CHKD. TL	APPRD	SG
			DWG 03



PLAN



SECTION C-C'



FILE NAME: I:\2025-Brampton\Proposals\International\WTO Projects\WTO 5021-E-0038 - Hwy 11 with AECOM\00 Execution\64 CAD\Working drawings\SW12-SW12-SW12-SW12-plan & profile.dwg
 MODIFIED: 2025-01-10 10:31



KEY PLAN
 N.T.S.

- LEGEND
- Borehole Location (EXP)
 - 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
- | | | |
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BOREHOLE COORDINATES/ NAD 83/ MTM ON-10

BH No.	ELEV.	NORTHING	EASTING
BH12-1	287.3	5188610.6	282183.2
BH12-2	287.0	5188562.9	282177.5
BH12-3	286.6	5188654.5	282175.0
BH12-4	289.2	5188457.8	282150.9
BH12-5	286.6	5188654.4	282144.0
BH12-6	290.9	5188654.2	282157.5
BH12-8	290.0	5188259.2	282144.3
BH12-11	288.4	5188604.3	282137.9
BH12-12	289.0	5188562.8	282150.4
BH12-13	286.4	5188522.2	282133.8
BH12-15	289.2	5188413.3	282136.3
BH12-16	289.6	5188362.2	282140.3
BH12-17	289.6	5188312.2	282133.0
BH12-19	290.2	5188213.2	282133.6
BH12-20	286.7	5188165.4	282115.6

NOTES

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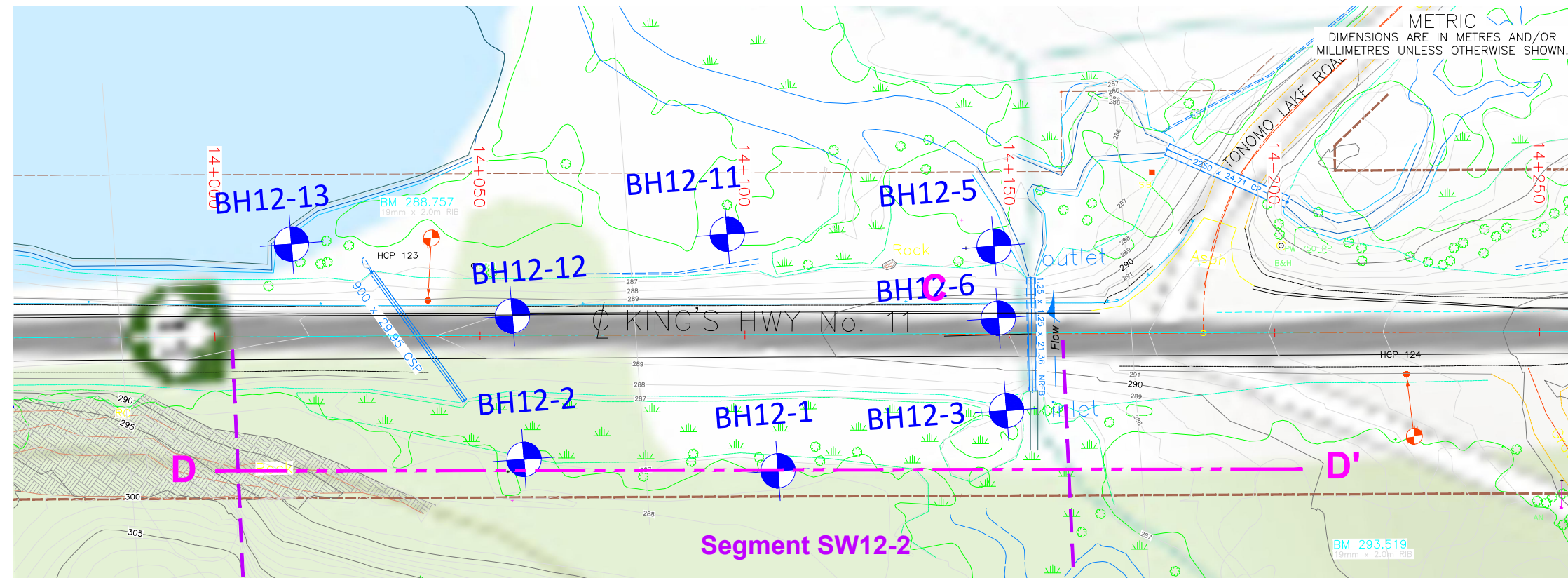
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REVISIONS

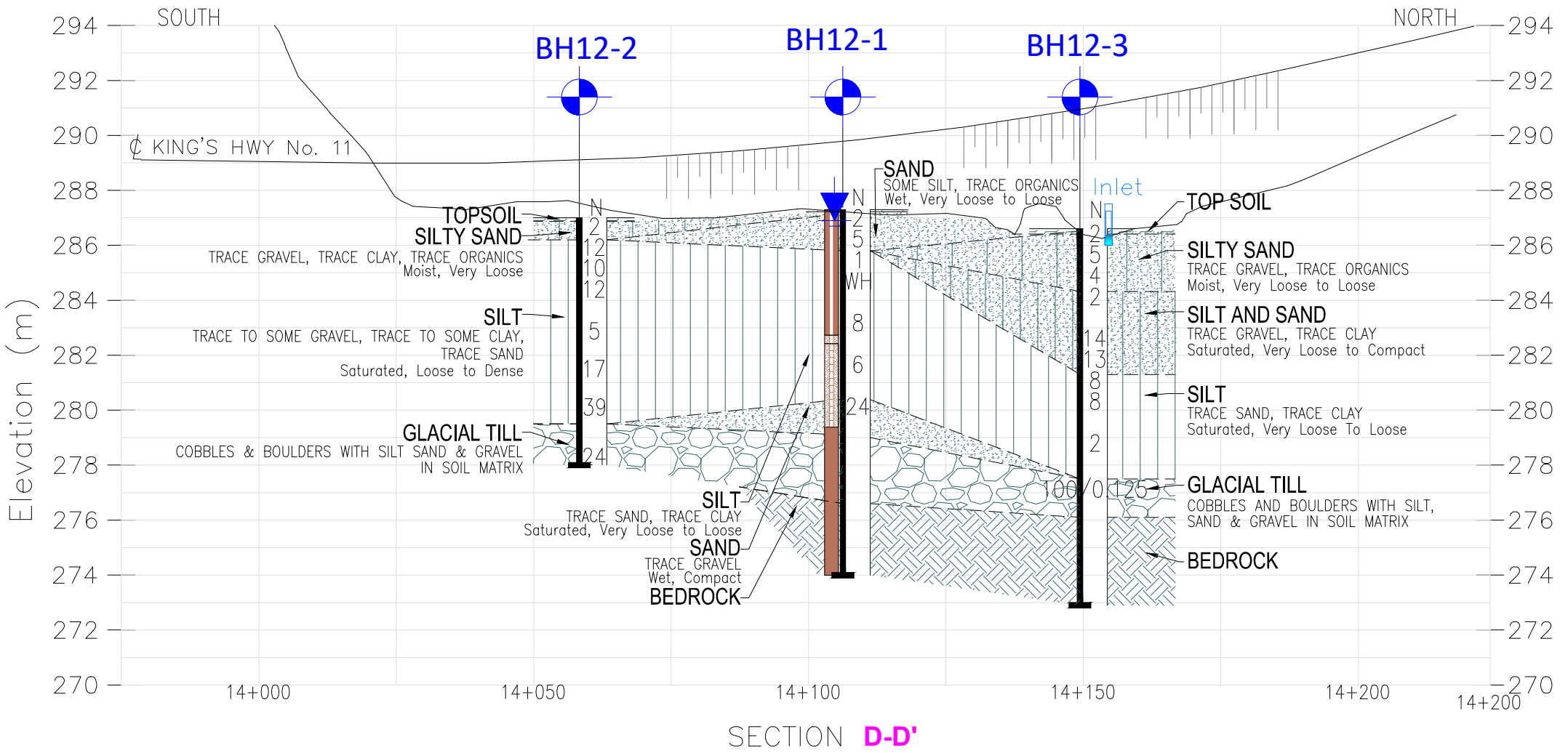
NO	DATE	BY	DESCRIPTION

SUBMISSION FOR MTO REVIEW

PROJECT No.	ADM-23010055-A0	GEOCREs No.	31L13-008
SUBM'D SH	CHKD. SM	DATE	JAN. 22, 2025
DRAWN SH	CHKD. TL	APPRD	SG DWG 04

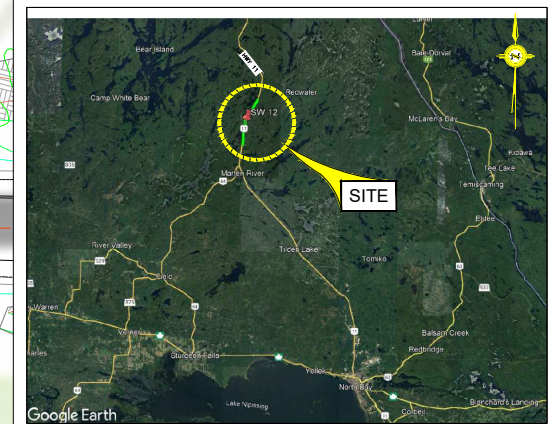


PLAN

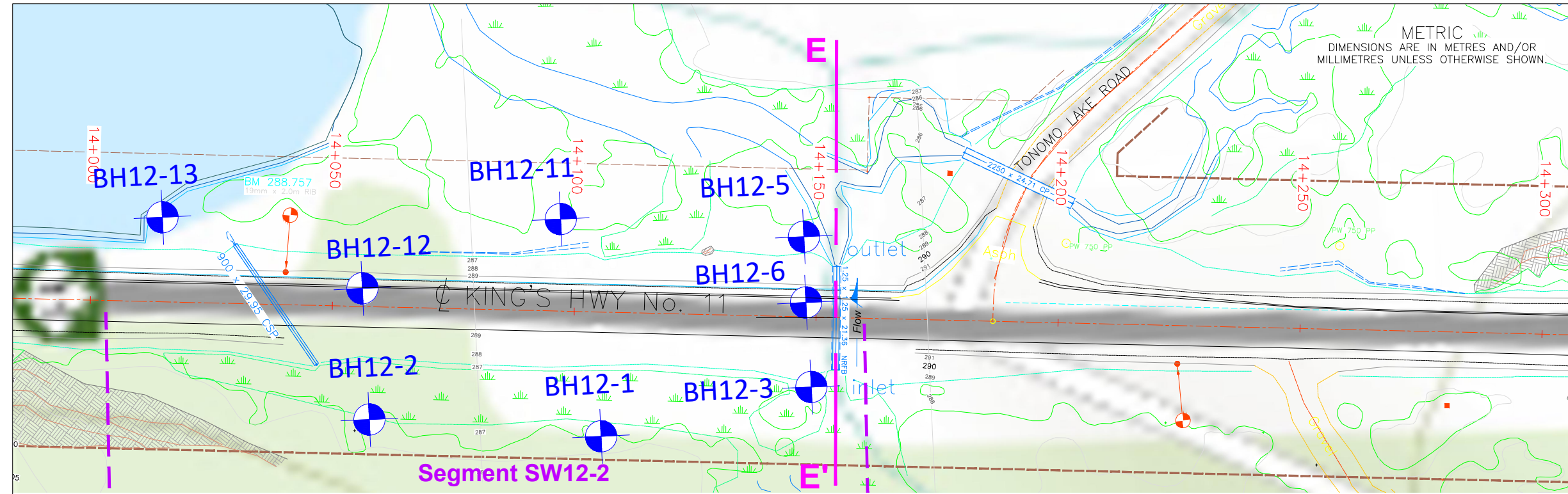


SECTION D-D'

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KEY PLAN
N.T.S.



PLAN



LEGEND

- Borehole Location (EXP)
- 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 COORDINATES/ NAD 83/ MTM ON-10

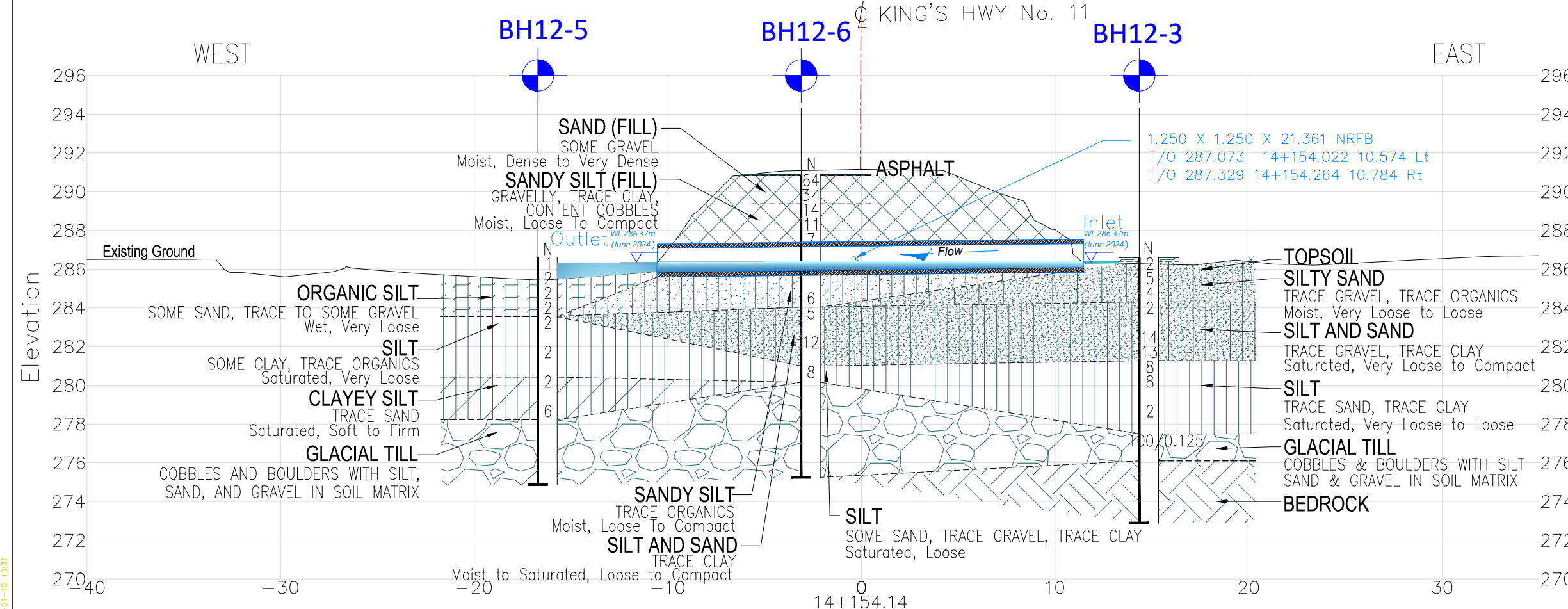
BH No.	ELEV.	NORTHING	EASTING
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BH12-2	287.0	5188562.9	282177.5
BH12-3	286.6	5188654.5	282175.0
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BH12-5	286.6	5188654.4	282144.0
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BH12-19	290.2	5188213.2	282133.6
BH12-20	286.7	5188165.4	282115.6

NOTES

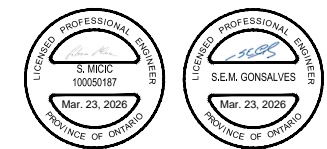
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SECTION E-E'

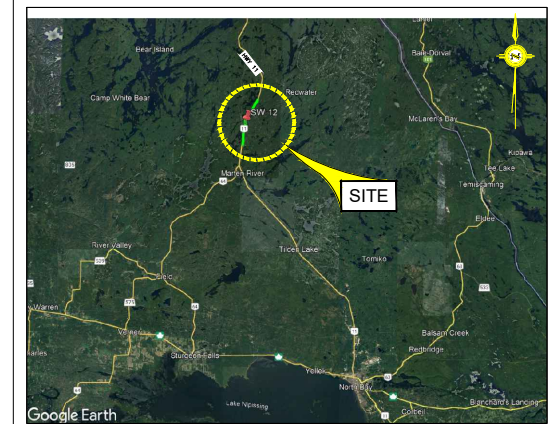


SUBMISSION FOR MTO REVIEW

NO	DATE	BY	DESCRIPTION

PROJECT No.	ADM-23010055-A0	GEOCREs No.	31L13-008
SUBM'D SH	CHKD. SM	DATE	JAN. 22, 2025
DRAWN SH	CHKD. TL	APPRD	SG
		DWG	05

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 MODIFIED: 2025-01-10 10:31



KEY PLAN
N.T.S.

LEGEND

- Borehole Location (EXP)
- 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

- TOPSOIL
- ASPHALT
- FILL/ROCKFILL
- PEAT
- SILTY SAND
- SAND
- CLAYEY SILT
- SILTY CLAY
- SANDY SILT
- SILT AND SAND
- SILT
- ORGANIC SILT
- GLACIAL TILL
- BEDROCK
- SANDY GRAVEL

BOREHOLE COORDINATES/ NAD 83/ MTM ON-10

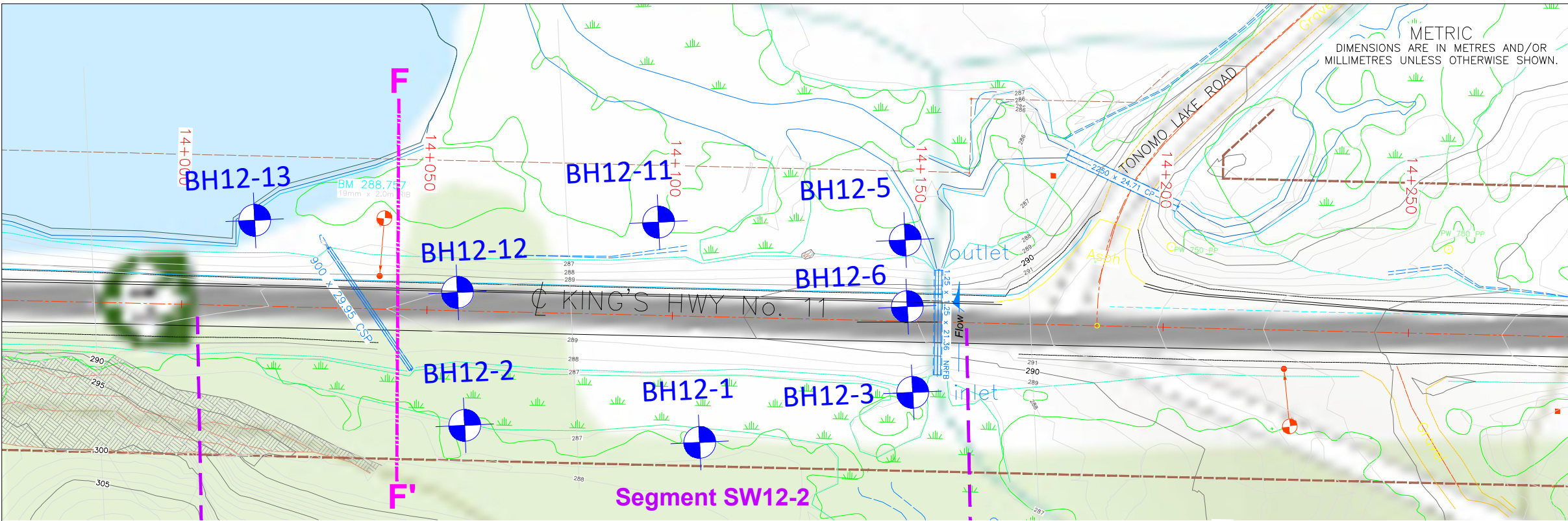
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BH12-2	287.0	5188562.9	282177.5
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BH12-19	290.2	5188213.2	282133.6
BH12-20	286.7	5188165.4	282115.6

NOTES

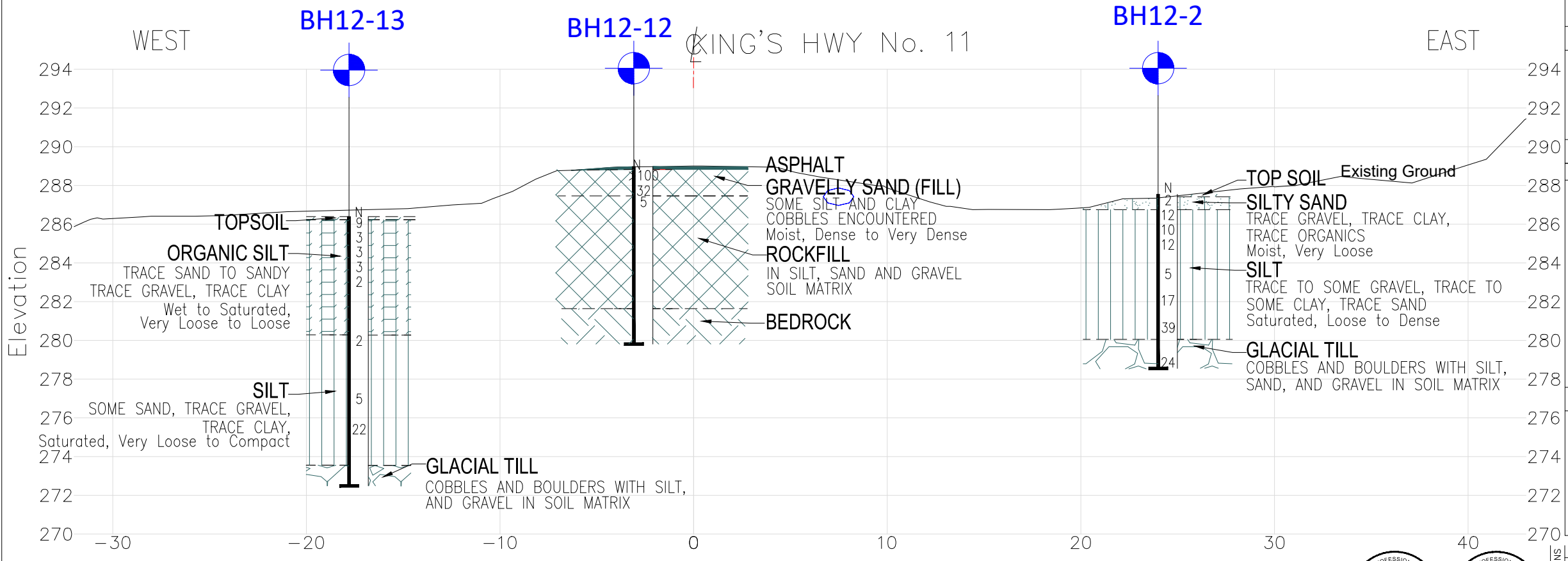
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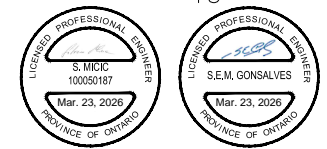
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PLAN



SECTION F-F'



NO	DATE	BY	DESCRIPTION

PROJECT No.	ADM-23010055-A0	GEOCREs No.	31L13-008
SUBM'D SH	CHKD. SM	DATE	JAN. 22, 2025
DRAWN SH	CHKD. TL	APPRD	SG
		SITE-	DWG 06

FILE NAME: I:\2003-Brampton\Proposals\Projects\International\WTO Projects\WTO 5021-E-0038 - Hwy 11 with AECOM\00 Execution\64 CAD\Working drawings\SW12-SW13.dwg
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Appendix C – Borehole Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

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

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

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

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

Terminology describing soil structure:

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

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

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

Fissured: material breaks along plane of fracture.

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

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

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

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

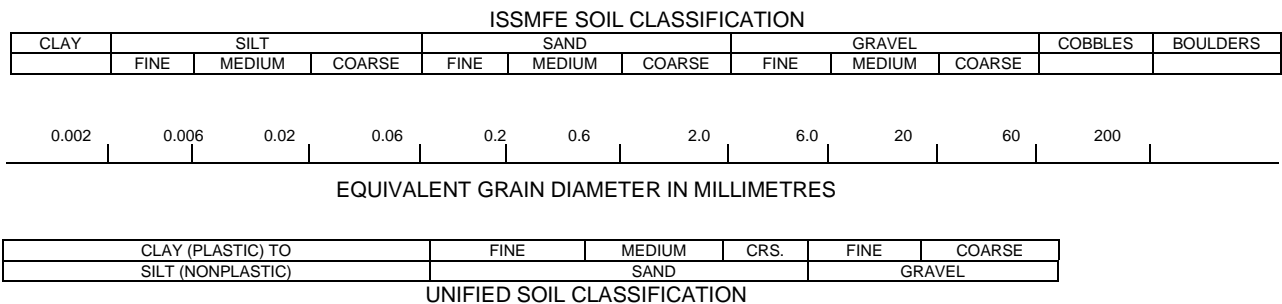
Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

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

Uniformly Graded: predominantly on grain size.

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



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

Table a: Percent or Proportion of Soil

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

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

Table b: Apparent Density of Cohesionless Soil

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

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

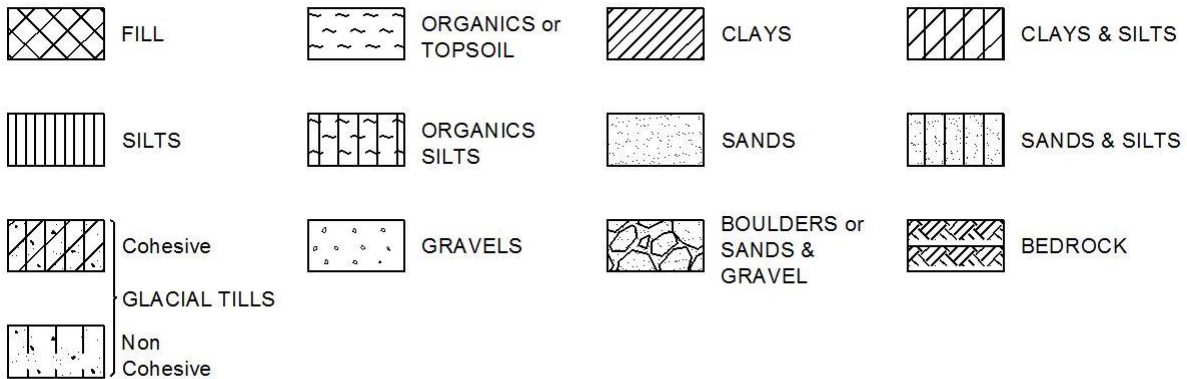
Table c: Consistency of Cohesive Soil

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

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

STRATA PLOT

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



WATER LEVEL MEASUREMENT



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	Coefficient of volume change
c_c	1	Compression index
c_s	1	Swelling index
c_r	1	Recompression index
c_v	m ² /s	Coefficient of consolidation
H	m	Drainage path
T_v	1	Time factor
U	%	Degree of consolidation
σ'_{v0}	kPa	Effective overburden pressure
σ'_p	kPa	Preconsolidation pressure
τ_f	kPa	Shear strength
c'	kPa	Effective cohesion intercept
ϕ'	—°	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	—°	Apparent angle of internal friction
τ_R	kPa	Residual shear strength
τ_r	kPa	Remoulded shear strength
S_t	1	Sensitivity = c_u/τ_r

PHYSICAL PROPERTIES OF SOIL

P_s	kg/m ³	Density of solid particles
γ_s	kN/m ³	Unit weight of solid particles
ρ_w	kg/m ³	Density of water
γ_w	kN/m ³	Unit weight of water
ρ	kg/m ³	Density of soil
γ	kN/m ³	Unit weight of soil
ρ_d	kg/m ³	Density of dry soil
γ_d	kN/m ³	Unit weight of dry soil
ρ_{sat}	kg/m ³	Density of saturated soil
γ_{sat}	kN/m ³	Unit weight of saturated soil
ρ'	kg/m ³	Density of submerged soil
γ'	kN/m ³	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 ³ /s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m ³	Seepage force

RECORD OF BOREHOLE No BH12-1

1 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188610.64N, 282183.182E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Track Mounted CME 55 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.08 LATITUDE 46.836644 LONGITUDE -79.7964979 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
287.3	GROUND SURFACE																	
287.4	TOPSOIL, ~75 mm thick	1	SS	2														Organic Content = 1.7%
	SAND, some silt, trace organics, grey, wet, very loose to loose	2	SS	5														
285.8																		
1.5	SILT, trace sand, trace clay, grey, saturated, very loose to loose	3	SS	1														0 5 88 7 Non-plastic
		4	SS	WH														
		5	SS	8														
		6	SS	6														0 5 89 6
280.4																		
6.9	SAND, trace gravel, grey, wet, compact	7	SS	24														
279.0																		
8.3	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix		NQ															
276.6																		
10.7	BEDROCK																	
	Run 1: Start/End: 10.7 to 12.2 m Recovery: 87% RQD: 53%	RUN 1	NQ															
	Run 2: Start/End: 12.2 to 13.3 m Recovery: 86% RQD: 61%	RUN 2	NQ															
274.0																		
13.3	BOREHOLE TERMINATED AT ~ 13.3 m DEPTH																	
	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. WH - weight of hammer 3. Borehole backfilled upon completion.																	

ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO.GDT 1/22/25

Continued Next Page

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-1

2 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188610.64N, 282183.182E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Track Mounted CME 55 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.08 LATITUDE 46.836644 LONGITUDE -79.7964979 CHECKED BY SM

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100	20					
	4. Monitoring Well Readings DATE DEPTH(M) ELEV. May 15/24 0.5 286.8 June 18/24 0.5 286.8 July 31/24 0.4 286.9																

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-2

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188562.977N, 282177.504E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Track Mounted CME 55 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.09 - 2024.05.09 LATITUDE 46.83621519 LONGITUDE -79.79657003 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
											○ UNCONFINED	+ FIELD VANE				
											● QUICK TRIAXIAL	× LAB VANE				
											WATER CONTENT (%)					
											20	40	60			
287.5	GROUND SURFACE															
287.4	TOPSOIL, ~125mm thick															
287.0	SILTY SAND, trace gravel, trace clay, trace organics, brown to grey, moist, very loose		1	SS	2											Organic Content =1.6%
286.7	SILT, trace to some gravel, trace to some clay, trace sand, grey, saturated, loose to dense		2	SS	12											
0.8			3	SS	10											11 2 72 15 Non-plastic
			4	SS	12											
			5	SS	5											20.3
			6	SS	17											1 5 93 1
			7	SS	39											
280.0	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix															
7.5			8	SS	24											
278.5	BOREHOLE TERMINATED AT ~9.0 m DEPTH															
9.0	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.															

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-3

1 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188654.481N, 282175.001E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Track Mounted CME 55 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.07 LATITUDE 46.83703829 LONGITUDE -79.79660737 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40
286.6	GROUND SURFACE																		
286.0	TOPSOIL, ~190 mm thick																		
0.2	SILTY SAND, trace gravel, trace organics, grey, moist, very loose to loose		1	SS	2														
			2	SS	5														
			3	SS	4														
284.3	SILT AND SAND, trace gravel, trace clay, grey, saturated, very loose to compact		4	SS	2														
2.3			5	SS	14														
			6	SS	13														
281.3	SILT, trace sand, trace clay, grey, saturated, very loose to loose		7	SS	8														
5.3			8	SS	8														
			9	SS	2														
277.5	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix		10	SS	100/ 125mm														
9.1					NQ														
276.1	BEDROCK Run 1: Start/End: 10.5 to 12.0 m Recovery: 100% RQD: 91% Run 2: Start/End: 12.0 to 13.7 m Recovery: 100% RQD: 82%																		
10.5					NQ														
						NQ													
272.9	BOREHOLE TERMINATED AT ~ 13.7 m DEPTH																		
13.7	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process.																		

ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO_GDT 1/22/25

Continued Next Page

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-3

2 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188654.481N, 282175.001E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Track Mounted CME 55 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.07 LATITUDE 46.83703829 LONGITUDE -79.79660737 CHECKED BY SM

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	2. Borehole backfilled upon completion.																

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-4

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188457.783N, 282150.872E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.06 - 2024.05.06 LATITUDE 46.83526794 LONGITUDE -79.79691394 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
289.2	GROUND SURFACE																	
289.0	ASPHALT, ~150 mm thick																	
0.2	SAND AND GRAVEL (FILL), trace silt, brown to dark brown, moist to wet, compact to dense		1	SS	41													39 58 (3)
			2	SS	28													
288.0	ROCKFILL, in silt, sand, and gravel soil matrix																	
1.2					NQ													
287.1	BEDROCK																	
2.1	Run 1: Start/End: 2.1 to 3.2 m Recovery: 100% RQD: 90%		RUN 1		NQ													
	Run 2: Start/End: 3.2 to 4.0 m Recovery: 100% RQD: 31%		RUN 2		NQ													
	Run 3: Start/End: 4.0 to 4.6 m Recovery: 100% RQD: 21%		RUN 3		NQ													
284.6	BOREHOLE TERMINATED AT ~4.6 m DEPTH																	
4.6	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.																	

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-5

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188654.381N, 282143.901E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE EXPLO 220 Geotechnical Drill Rig COMPILED BY AM
 DATUM Geodetic DATE 2024.05.30 - 2024.06.03 LATITUDE 46.83703634 LONGITUDE -79.79701507 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40
286.6	GROUND SURFACE																		
0.0	ORGANIC SILT , some sand, trace to some gravel, dark brown to grey, wet, very loose		1	SS	1														
			2	SS	2														
			3	SS	2														
			4	SS	2														
283.6	SILT , some clay, trace organics, grey, saturated, very loose		5	SS	2														
			6	SS	2														
280.5	CLAYEY SILT , trace sand, grey, saturated, soft to firm		7	SS	2														
			8	SS	6														
278.2	GLACIAL TILL , cobbles and boulders with silt, sand, and gravel in soil matrix																		
274.9	BOREHOLE TERMINATED AT ~ 11.7 m DEPTH																		
11.7																			

ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-6

2 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188654.18N, 282157.507E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.13 - 2024.05.13 LATITUDE 46.83703499 LONGITUDE -79.7968367 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
275.3	GLACIAL TILL , cobbles and boulders with silt, sand, and gravel in soil matrix (<i>continued</i>)			NQ												
15.6	BOREHOLE TERMINATED AT ~ 15.6 m DEPTH Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.															

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-8

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188259.248N, 282144.342E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.06 - 2024.05.06 LATITUDE 46.83348166 LONGITUDE -79.79698971 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60
290.0	GROUND SURFACE																			
289.8	ASPHALT, ~ 150 mm thick																			
0.2	GRAVELLY SAND (FILL), trace silt and clay, brown, moist to wet, compact to dense		1	SS	26															
			2	SS	31															
288.8			ROCKFILL, in silt, sand, and gravel soil matrix																	
1.2					NQ															
				3	SS	14														
			4	SS	20															
			5	SS	10															
285.6	BEDROCK, Run 1: Start/End: 4.4 to 5.4 m Recovery: 100% RQD: 75% Run 2: Start/End: 5.4 to 6.2 m Recovery: 38% RQD: 42% Run 3: Start/End: 6.2 to 7.7 m Recovery: 100% RQD: 97%		RUN 1	NQ																
4.4			RUN 2	NQ																
			RUN 3	NQ																
282.3	BOREHOLE TERMINATED AT ~ 7.7 m DEPTH																			
7.7	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.																			

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-11

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188604.348N, 282137.955E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE EXPLO 220 Geotechnical Drill Rig COMPILED BY AM
 DATUM Geodetic DATE 2024.06.05 - 2024.06.06 LATITUDE 46.836586 LONGITUDE -79.7970906 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
288.4	GROUND SURFACE																	
288.0	TOPSOIL, ~100 mm thick		1	SS	1													Organic Content =14.4%
	ORGANIC SILT, sandy, trace clay, brown to black, saturated, very loose		2	SS	4													Organic Content =3.6%
	- clayey silt layer at ~ 1.0 m depth		3	SS	4													0 28 69 3 Organic Content =7.3%
			4	SS	WH													Organic Content =7.7%
			5	SS	2													Organic Content =8.8%
			6	SS	2													Organic Content =11.4%
282.3	SANDY SILT, trace clay, grey, saturated, loose to compact		7	SS	5													0 20 73 7 Non-plastic
6.1			8	SS	28													
			9	SS	20													
276.8	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix				NQ													
11.6	BOREHOLE TERMINATED AT ~ 11.9 m DEPTH																	
276.5																		
11.9																		

ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO.GDT 1/22/25

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

RECORD OF BOREHOLE No BH12-13

1 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188522.17N, 282133.791E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE EXPLO 220 Geotechnical Drill Rig COMPILED BY AM
 DATUM Geodetic DATE 2024.06.18 - 2024.06.20 LATITUDE 46.835846 LONGITUDE -79.797141 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
286.4	GROUND SURFACE																	
286.0	TOPSOIL, ~150 mm thick																	
0.2	ORGANIC SILT, trace sand to sandy, trace gravel, trace clay, dark brown to black, wet to saturated, very loose to loose		1	SS	9													Organic Content =6.7%
			2	SS	3													Organic Content =10.7%
			3	SS	3													7 32 58 3 Non-plastic Organic Content =10.8%
			4	SS	3													5 23 67 5 Non-plastic Organic Content =9.2%
			5	SS	2													
280.3	SILT, some sand, trace gravel, trace clay, grey, saturated, very loose to compact		6	SS	2													5 10 82 3 Non-plastic
6.1																		
			7	SS	5													
			8	SS	22													
273.6	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix																	
12.8																		
272.5	BOREHOLE TERMINATED AT ~ 13.9 m DEPTH																	
13.9	Notes: 1. Groundwater level not measured in open hole due to water being																	

ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO.GDT 1/22/25

Continued Next Page

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-13

2 OF 2

METRIC

W.P. ADM-23010055-A0 LOCATION 5188522.17N, 282133.791E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE EXPLO 220 Geotechnical Drill Rig COMPILED BY AM
 DATUM Geodetic DATE 2024.06.18 - 2024.06.20 LATITUDE 46.835846 LONGITUDE -79.797141 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20	40	60	GR
	introduced in drilling/coring process. 2. Borehole backfilled upon completion.																				

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Brampton, Ontario

RECORD OF BOREHOLE No BH12-15

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188413.28N, 282136.321E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.07 LATITUDE 46.834867 LONGITUDE -79.7971024 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
289.2 0.0	GROUND SURFACE GRAVELLY SAND (FILL) , trace silt and clay, brown, moist to wet, compact to dense		1	SS	30													
			2	SS	16													
287.4 1.8	ROCKFILL , in silt, sand, and gravel soil matrix		3	SS	100/ 80mm													
				NQ														
				NQ														
285.5 3.7	BEDROCK Run 1: Start/End: 3.7 to 4.7 m Recovery: 100% RQD: 35.8% Run 2: Start/End: 4.7 to 6.0 m Recovery: 100% RQD: 49%		RUN 1	NQ														
			RUN 2	NQ														
283.2 6.0	BOREHOLE TERMINATED AT ~ 6.00 m DEPTH Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.																	

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-16

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188362.173N, 282140.259E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.07 LATITUDE 46.8344074 LONGITUDE -79.7970483 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa			
											○ UNCONFINED	+ FIELD VANE				GR	SA	SI	CL		
289.6	GROUND SURFACE																				
289.0	ASPHALT, ~ 150 mm thick																				
0.2	SAND AND GRAVEL (FILL), some silt, grey, moist to wet, compact to dense		1	SS	39						○										
			2	SS	21						○										
287.9	SILT AND GRAVEL (FILL), trace sand, trace clay, brown, compact		3	SS	13						○							37	5	55	3
287.1	SILT, trace sand, trace clay, brown, saturated, compact		4	SS	12						○										
283.9	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix BEDROCK, Run 1: Start/End: 6.0 to 6.3 m Recovery: 100% RQD: 100% Run 2: Start/End: 6.3 to 7.7 m Recovery: 100% RQD: 100% BOREHOLE TERMINATED AT ~ 7.7 m DEPTH		RUN 1	NQ																	
283.6			RUN 2	NQ																	
281.9																					
7.7																					

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-17

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188312.163N, 282132.976E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.07 - 2024.05.07 LATITUDE 46.8339573 LONGITUDE -79.79714133 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
289.6	GROUND SURFACE																	
0.0	SAND AND GRAVEL (FILL) , some silt, brown, moist, compact.		1	SS	13													
288.8																		
0.8	SAND (FILL) , some silt, brown, wet, compact.		2	SS	19													
288.1																		
1.5	SILT (FILL) , some gravel, contains cobbles, grey, wet, compact		3	SS	10													
287.3																		
2.3	SILT , trace sand, trace clay, brown, wet, loose		4	SS	8													
286.5																		
3.1	GLACIAL TILL , cobbles and boulders with silt, sand, and gravel in soil matrix			NQ														
285.6																		
4.0	BEDROCK Run 1: Start/End: 4.0 to 4.6 m Recovery: 96% RQD: 46% Run 2: Start/End: 4.6 to 6.1 m Recovery: 72% RQD: 30% Run 3: Start/End: 6.1 to 7.7 m Recovery: 100% RQD: 93%		RUN 1	NQ														
			RUN 2	NQ														
			RUN 3	NQ														
281.9																		
7.7	BOREHOLE TERMINATED AT ~ 7.7 m DEPTH Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.																	

0 2 91 7
Non-plastic

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-19

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188213.156N, 282133.56E, NAD83 MTM Zone 10 ORIGINATED BY AM
 DIST NER HWY 11 BOREHOLE TYPE Truck Mounted CME 75 COMPILED BY AM
 DATUM Geodetic DATE 2024.05.13 - 2024.05.13 LATITUDE 46.83306664 LONGITUDE -79.79712876 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa		
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)			GR	SA	SI	CL	
											● QUICK TRIAXIAL	× LAB VANE	20	40	60					
290.2	GROUND SURFACE																			
0.0	GRAVELLY SAND (FILL) , some silt, grey to brown, moist to wet, loose to dense		1	SS	22															
			2	SS	40															
			3	SS	9															
287.9	SILT (FILL) , some clay, trace sand, grey, saturated, very loose																			
2.3			4	SS	4															
287.2	PEAT , amorphous, dark brown, wet, firm																			
3.0			5	SS	7															
286.2	SILTY SAND , gravelly, trace clay, cobbles/boulders encountered, grey, wet, loose to compact																			
4.0			6	SS	25															
			7	SS	6															
284.1	BEDROCK Run 1: Start/End: 6.1 to 7.7 m Recovery: 100% RQD: 100% Run 2: Start/End: 7.7 to 9.1m Recovery: 100% RQD: 88%																			
6.1			RUN 1	NQ																
			RUN 2	NQ																
281.1	BOREHOLE TERMINATED AT ~9.1 m DEPTH Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. Borehole backfilled upon completion.																			

ONTARIO.MTO.HWY.11-SW12-AMIR-4.GPJ ONTARIO.MTO.GDT 1/22/25

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

Brampton, Ontario

RECORD OF BOREHOLE No BH12-20

1 OF 1

METRIC

W.P. ADM-23010055-A0 LOCATION 5188165.425N, 282115.647E, NAD83 MTM Zone 10 ORIGINATED BY BJ
 DIST NER HWY 11 BOREHOLE TYPE EXPLO 220 Geotechnical Drill Rig COMPILED BY AM
 DATUM Geodetic DATE 2024.07.29 - 2024.07.30 LATITUDE 46.83263843 LONGITUDE -79.79736006 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
286.7	GROUND SURFACE																	
286.9	TOPSOIL, ~75mm thick		1	SS	1													
	PEAT, fibrous to amorphous, trace roots, dark brown to dark grey, wet, very soft		2	SS	1													
			3	SS	2													
284.2	- amorphous peat mixed with clayey silt & sand at a depth of 2.3 m		4	SS	WH													
2.5	ORGANIC SILT, some clay, trace sand, dark brown, wet, very loose																	
283.3	SILT, some clay, trace sand, dark brown, wet, very loose to compact		5	SS	WH													
3.4																		
			6	SS	15													
			7	SS	7													
278.8	SANDY SILT, light grey to light brown, wet, loose to compact		8	SS	6													
7.9																		
	- spoon refusal; suspected cobbles/ boulders encountered, no recovery		9	SS	19													
277.1	GLACIAL TILL, cobbles and boulders with silt, sand, and gravel in soil matrix																	
9.6																		
276.5	BEDROCK,																	
10.2	Run 1: Start/End: 10.2 to 11.4 m Recovery: 90% RQD: 93%		RUN1		NQ													
275.3	BOREHOLE TERMINATED AT ~ 11.4 m DEPTH																	
11.4	Notes: 1. Groundwater level not measured in open hole due to water being introduced in drilling/coring process. 2. WH - weight of hammer 3. Borehole backfilled upon completion.																	

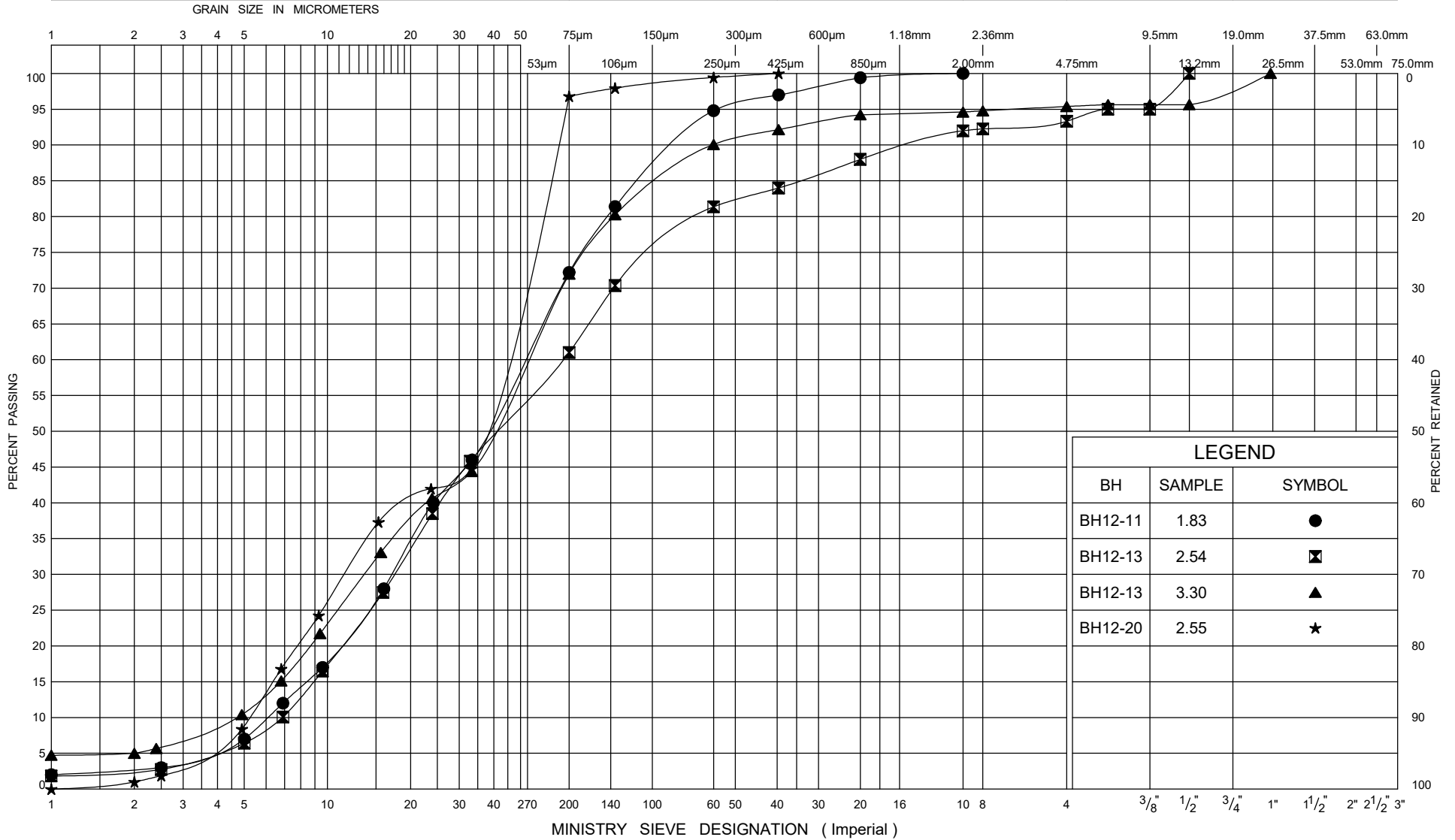
ONTARIO MTO HWY 11-SW12-AMIR-4.GPJ ONTARIO MTO.GDT 1/22/25

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

Appendix D –
Laboratory Data

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND		
BH	SAMPLE	SYMBOL
BH12-11	1.83	●
BH12-13	2.54	⊠
BH12-13	3.30	▲
BH12-20	2.55	★

ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25

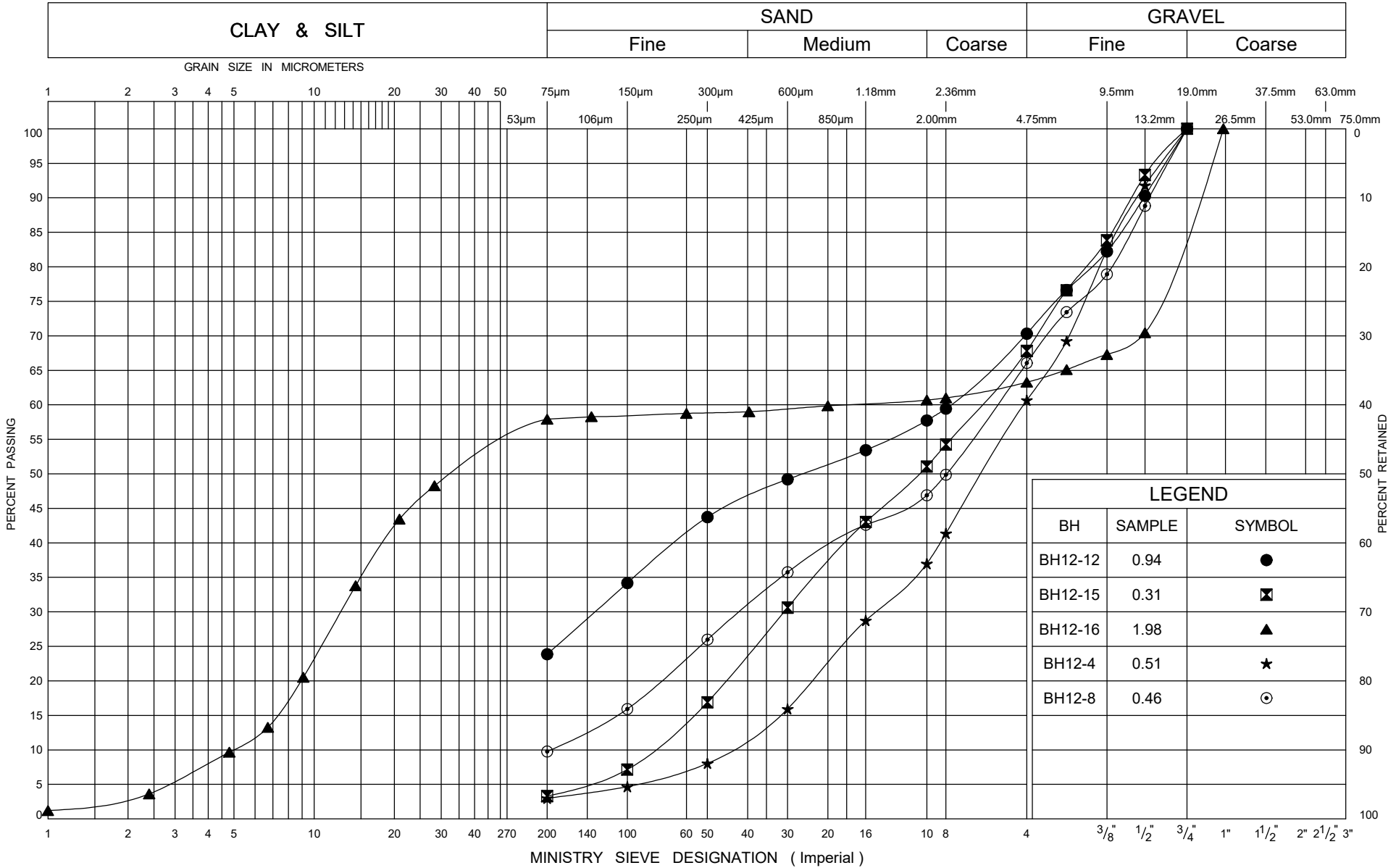


GRAIN SIZE DISTRIBUTION

Organic Silt

FIG No 1
 GWP 5033-22-00
 Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25

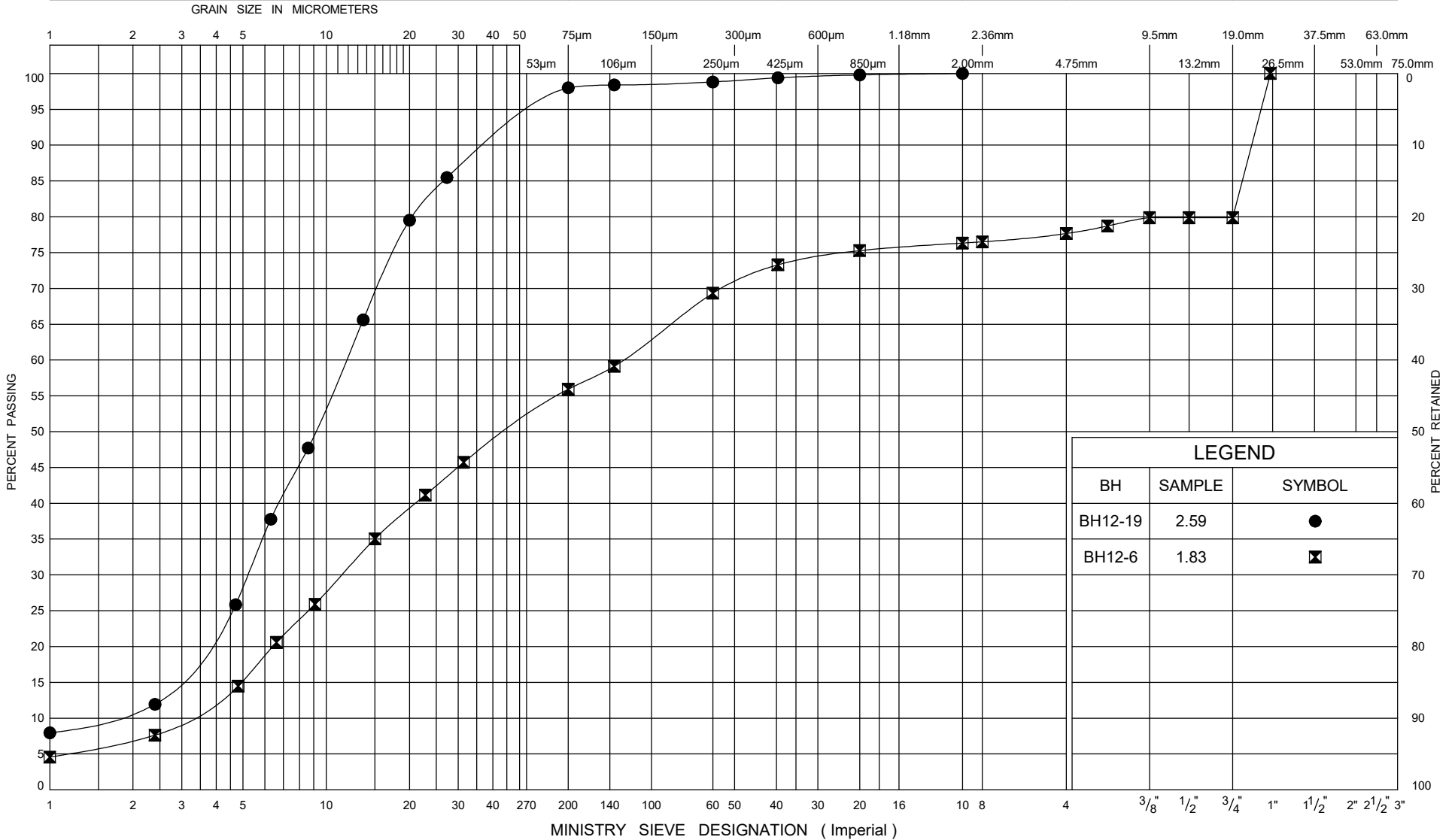


GRAIN SIZE DISTRIBUTION
Sand and Gravel/Gravelly Sand (Fill)

FIG No 2
GWP 5033-22-00
Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND		
BH	SAMPLE	SYMBOL
BH12-19	2.59	●
BH12-6	1.83	⊠

ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25



GRAIN SIZE DISTRIBUTION

Silt/Sandy Silt (Fill)

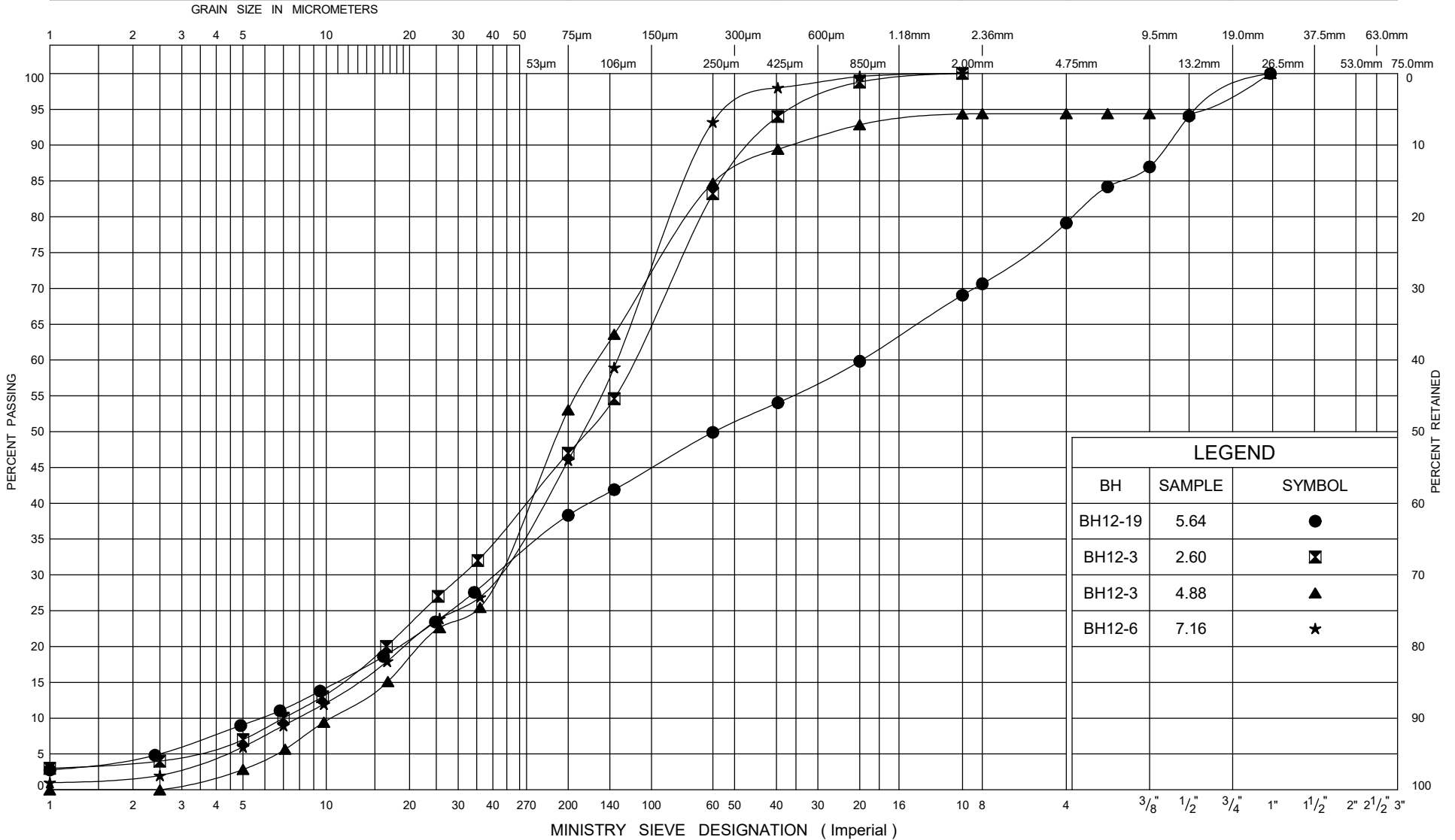
FIG No 3

GWP 5033-22-00

Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



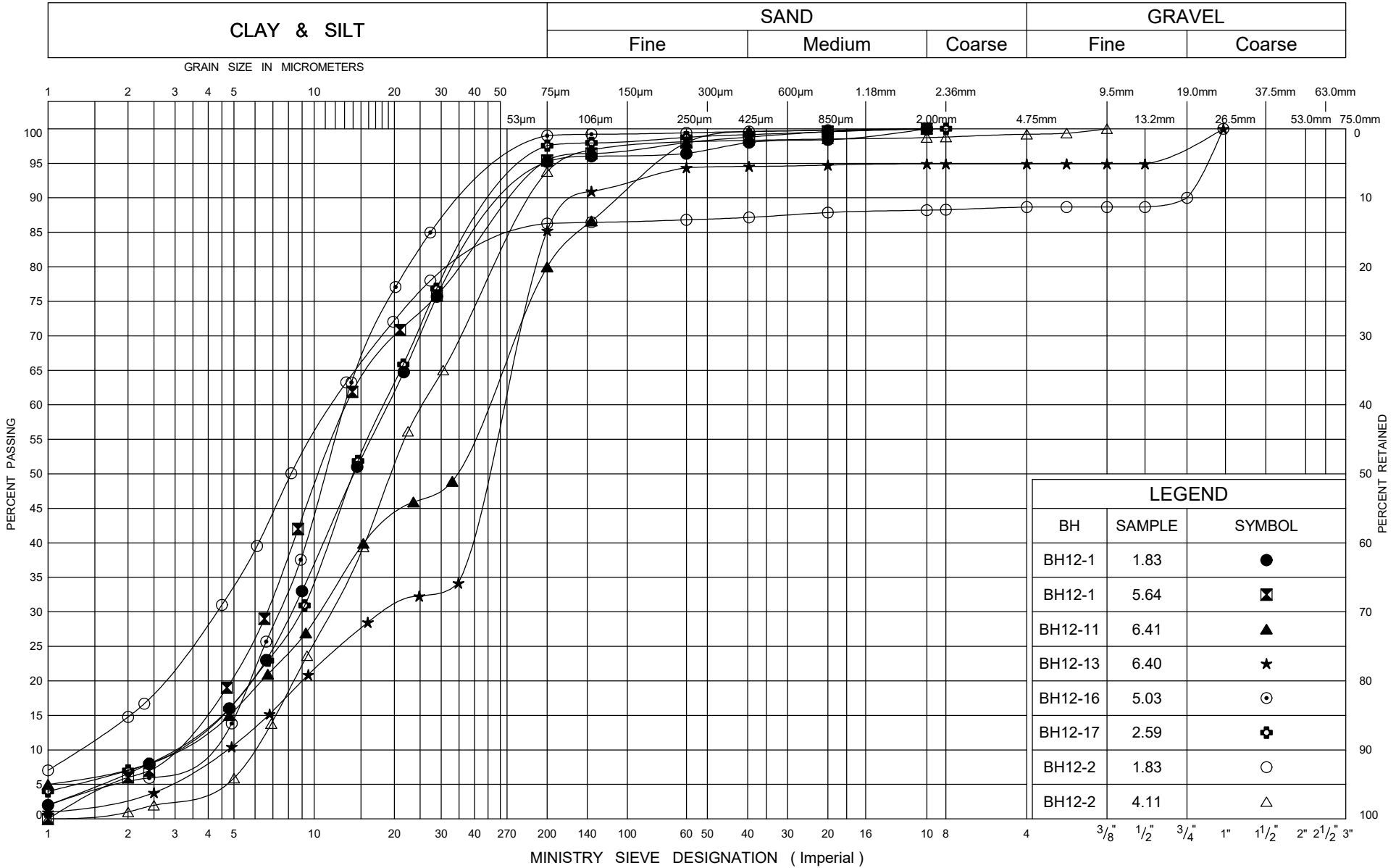
ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25



GRAIN SIZE DISTRIBUTION
Silt and Sand/Silty Sand

FIG No 4
GWP 5033-22-00
Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25



GRAIN SIZE DISTRIBUTION

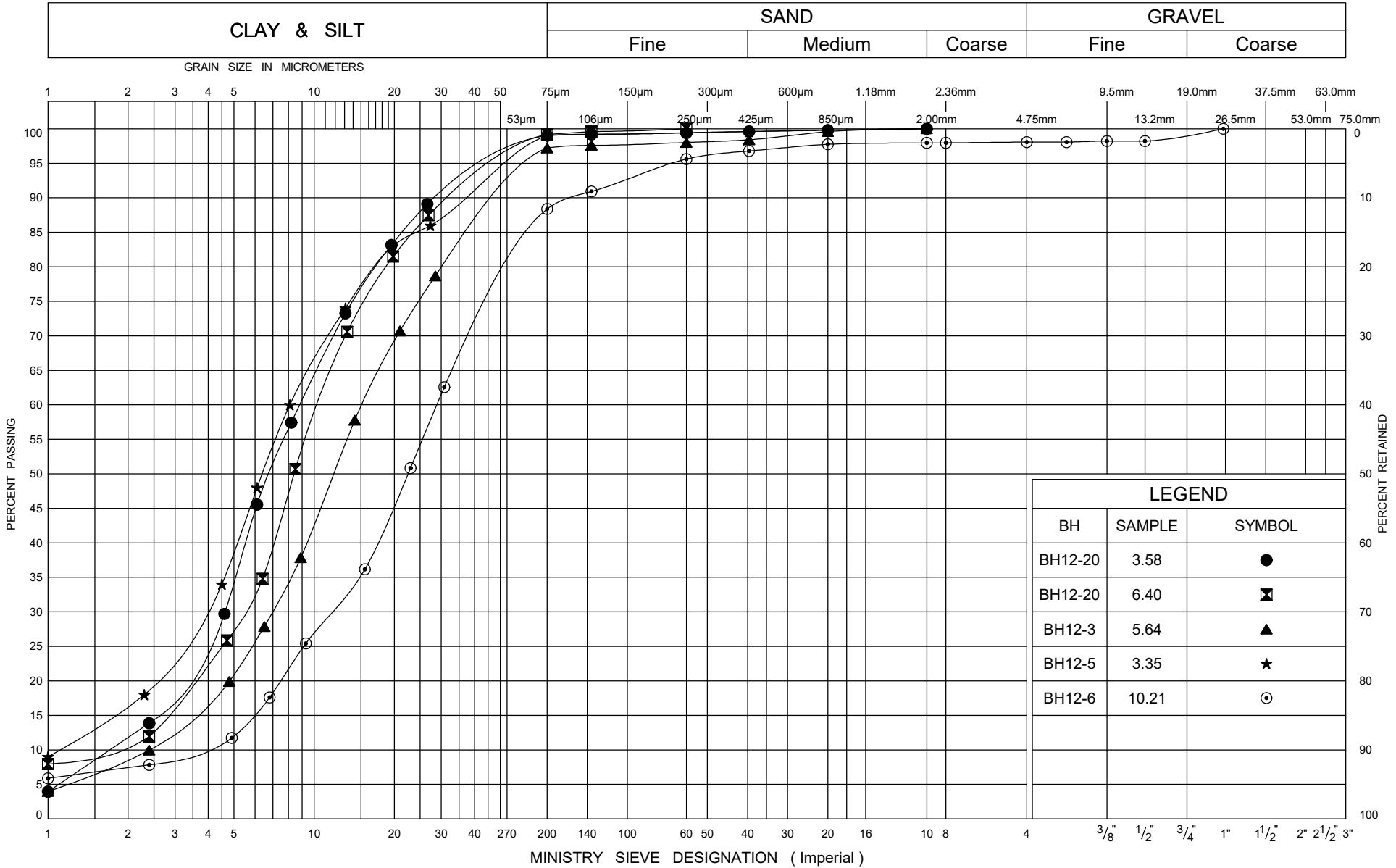
Silt/Sandy Silt

FIG No 5

GWP 5033-22-00

Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
BH12-20	3.58	●
BH12-20	6.40	⊠
BH12-3	5.64	▲
BH12-5	3.35	★
BH12-6	10.21	⊙

ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25



GRAIN SIZE DISTRIBUTION

Silt/Sandy Silt

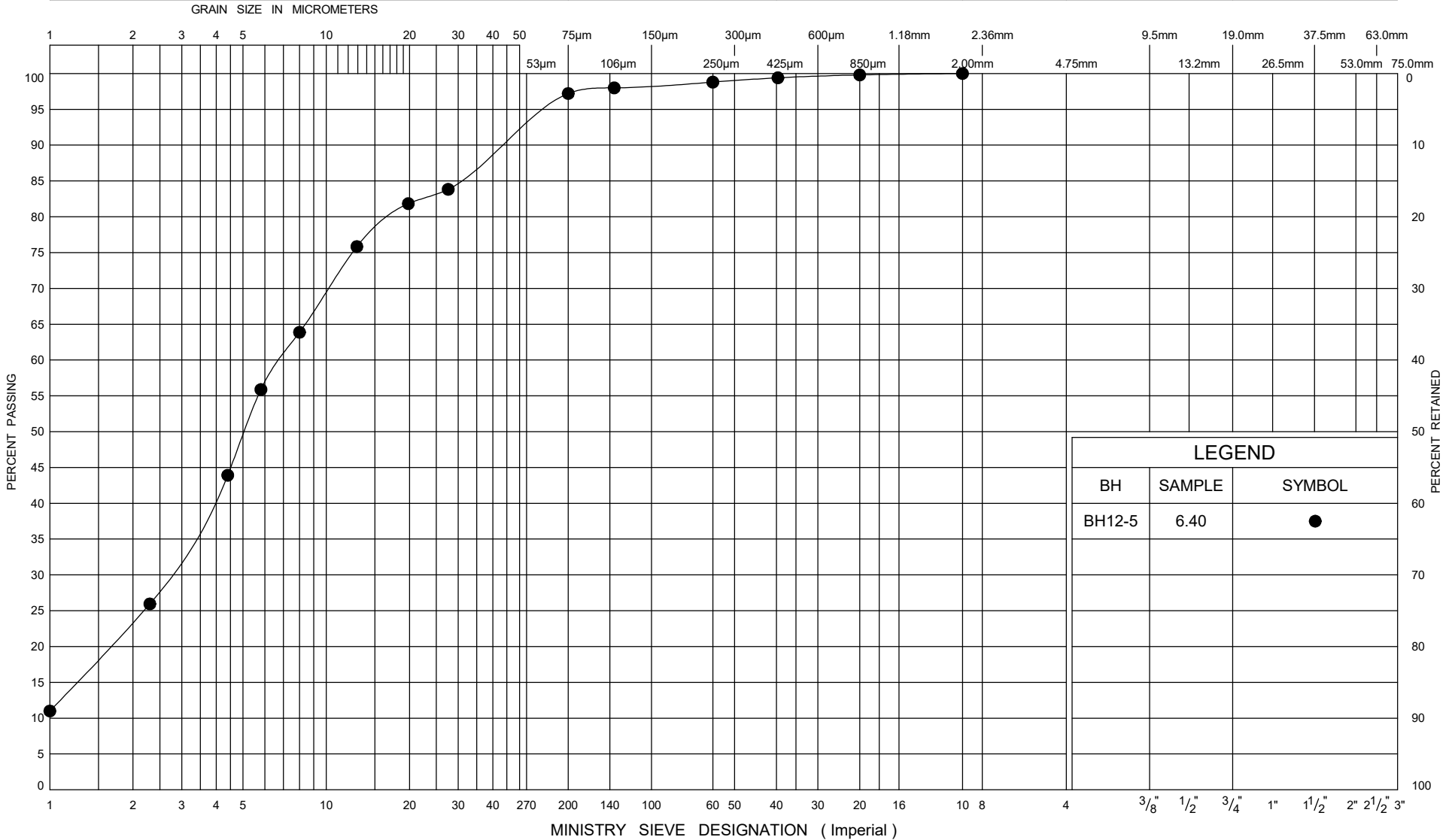
FIG No 6

GWP 5033-22-00

Highway 11 2+1, SW12

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND		
BH	SAMPLE	SYMBOL
BH12-5	6.40	●

ONTARIO MOT GRAIN SIZE HWY 11-SW12-AMIR -4.GPJ ONTARIO MOT.GDT 1/21/25



GRAIN SIZE DISTRIBUTION

Clayey Silt

FIG No 7

GWP 5033-22-00

Highway 11 2+1, SW12



Your Project #: ADM-23010055-A0
 Site Location: HWY11:2+1, SW12
 Your C.O.C. #: N/A

Attention: Elvis Lu

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

Report Date: 2024/05/29
 Report #: R8169404
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4F4764

Received: 2024/05/21, 15:39

Sample Matrix: Soil
 # Samples Received: 1

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	1	2024/05/29	2024/05/29	CAM SOP-00463	MOE E3013 m
Conductivity	1	2024/05/27	2024/05/27	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	1	N/A	2024/05/29	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	1	N/A	2024/05/28	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	1	2024/05/25	2024/05/25	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	1	2024/05/27	2024/05/27	CAM SOP-00421	SM 24 2580 B
Resistivity of Soil	1	2024/05/24	2024/05/27	CAM SOP-00414	SM 24 2510 m
Sulphate (20:1 Extract)	1	2024/05/29	2024/05/29	CAM SOP-00464	MOE E3013 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, EPA, APHA or the Quebec Ministry of Environment.

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-23010055-A0
Site Location: HWY11:2+1, SW12
Your C.O.C. #: N/A

Attention: Elvis Lu

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

Report Date: 2024/05/29
Report #: R8169404
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4F4764

Received: 2024/05/21, 15:39

(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 #: C4F4764
Report Date: 2024/05/29

exp Services Inc
Client Project #: ADM-23010055-A0
Site Location: HWY11:2+1, SW12
Sampler Initials: EL

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		ZGB196			ZGB196		
Sampling Date		2024/05/13 12:00			2024/05/13 12:00		
COC Number		N/A			N/A		
	UNITS	BH 12 -6, SS8	RDL	QC Batch	BH 12 -6, SS8 Lab-Dup	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm	2200		9412348			
CONVENTIONALS							
Redox Potential	mV	440	N/A	9415358	470	N/A	9415358
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	170	20	9420648			
Conductivity	umho/cm	452	2	9415204	451	2	9415204
Available (CaCl2) pH	pH	7.40		9413982			
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	9420675			
Sulphide	mg/kg	<0.5 (1)	0.5	9419502			
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable (1) Extracted past method specified hold time							



BUREAU
VERITAS

Bureau Veritas Job #: C4F4764
Report Date: 2024/05/29

exp Services Inc
Client Project #: ADM-23010055-A0
Site Location: HWY11:2+1, SW12
Sampler Initials: EL

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		ZGB196		
Sampling Date		2024/05/13 12:00		
COC Number		N/A		
	UNITS	BH 12 -6, SS8	RDL	QC Batch
Physical Testing				
Moisture-Subcontracted	%	22	0.30	9422476
RDL = Reportable Detection Limit QC Batch = Quality Control Batch				



BUREAU
VERITAS

Bureau Veritas Job #: C4F4764
Report Date: 2024/05/29

exp Services Inc
Client Project #: ADM-23010055-A0
Site Location: HWY11:2+1, SW12
Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: ZGB196
Sample ID: BH 12 -6, SS8
Matrix: Soil

Collected: 2024/05/13
Shipped:
Received: 2024/05/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9420648	2024/05/29	2024/05/29	Massarat Jan
Conductivity	AT	9415204	2024/05/27	2024/05/27	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9422476	N/A	2024/05/29	Basilla Ashrafi
Sulphide in Soil	SPEC	9419502	N/A	2024/05/28	Ly Vu
pH CaCl2 EXTRACT	AT	9413982	2024/05/25	2024/05/25	Kien Tran
Redox Potential	COND	9415358	2024/05/27	2024/05/27	Gurparteek KAUR
Resistivity of Soil		9412348	2024/05/27	2024/05/27	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9420675	2024/05/29	2024/05/29	Massarat Jan

Bureau Veritas ID: ZGB196 Dup
Sample ID: BH 12 -6, SS8
Matrix: Soil

Collected: 2024/05/13
Shipped:
Received: 2024/05/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	9415204	2024/05/27	2024/05/27	Gurparteek KAUR
Redox Potential	COND	9415358	2024/05/27	2024/05/27	Gurparteek KAUR



BUREAU
VERITAS

Bureau Veritas Job #: C4F4764
Report Date: 2024/05/29

exp Services Inc
Client Project #: ADM-23010055-A0
Site Location: HWY11:2+1, SW12
Sampler Initials: EL

GENERAL COMMENTS

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

Package 1	8.3°C
-----------	-------

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4F4764

Report Date: 2024/05/29

QUALITY ASSURANCE REPORT

exp Services Inc

Client Project #: ADM-23010055-A0

Site Location: HWY11:2+1, SW12

Sampler Initials: EL

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9413982	Available (CaCl2) pH	2024/05/25			100	97 - 103			0.071	N/A
9415204	Conductivity	2024/05/27			104	90 - 110	<2	umho/cm	0.23	10
9415358	Redox Potential	2024/05/27			102	95 - 105			6.6	35
9419502	Sulphide	2024/05/28	101	75 - 125	89	75 - 125	<0.5	mg/kg	31 (1)	30
9420648	Soluble (20:1) Chloride (Cl-)	2024/05/29	102	70 - 130	101	70 - 130	<20	ug/g	NC	35
9420675	Soluble (20:1) Sulphate (SO4)	2024/05/29	NC	70 - 130	94	70 - 130	<20	ug/g	21	35
9422476	Moisture-Subcontracted	2024/05/29					<0.30	%	1.2	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)

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 <= 2x 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 #: C4F4764
Report Date: 2024/05/29

exp Services Inc
Client Project #: ADM-23010055-A0
Site Location: HWY11:2+1, SW12
Sampler Initials: EL

VALIDATION SIGNATURE PAGE

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

Cristina Carriere, Senior Scientific Specialist

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

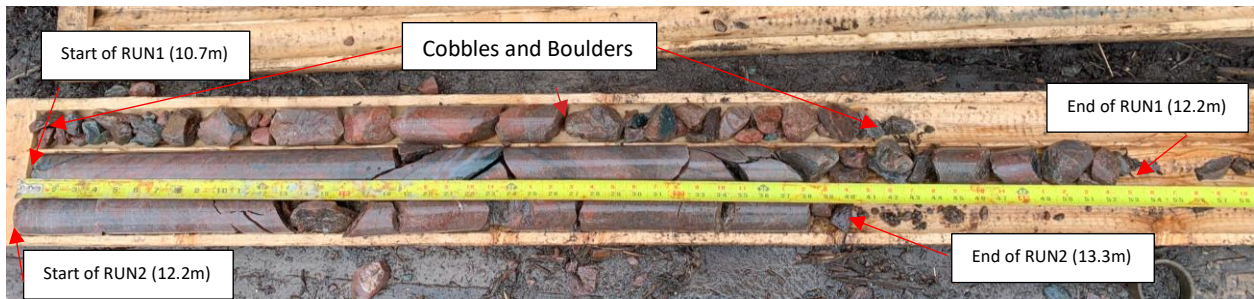


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Appendix E –
Bedrock Core Photographs



Photograph E1. Rock cores from BH12-1. Middle: Run 1, Bottom: Run 2.



Photograph E2. Rock cores from BH12-3. Top: Run 1, Middle/Bottom: Run 2.



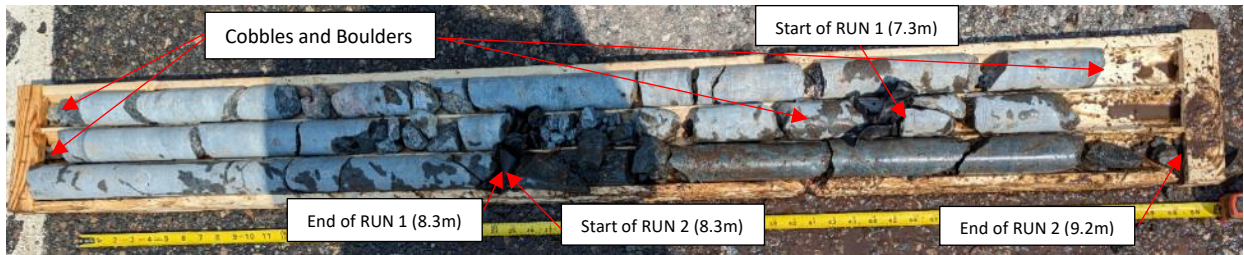
Photograph E3. Rock cores from BH12-4. Middle: Run 1, Bottom: Run 2.



Photograph E4. Rock cores from BH12-4. Top: Run 3.



Photograph E5. Rock cores from BH12-8. Top: Run 3, Middle: Run 2, Bottom: Run 1.



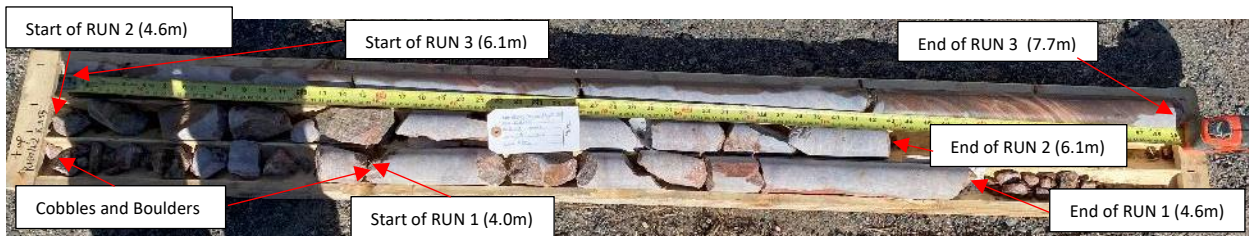
Photograph E6. Rock cores from BH12-12. Middle: Run 1, Bottom: Run 1&2.



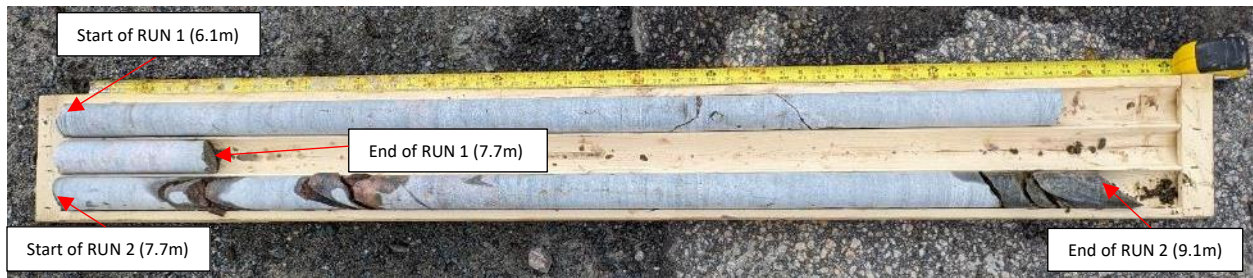
Photograph E7. Rock cores from BH12-15. Middle: Run 1, Bottom: Run 2.



Photograph E8. Rock cores from BH12-16. Top: Run 1/Run 2, Bottom: Run 2.



Photograph E9. Rock cores from BH12-17. Top: Run 3, Middle: Run 2, Bottom: Run 1.



Photograph E10. Rock cores from BH12-19. Top: Run 1, Middle: Run 1, Bottom: Run 2.



Photograph E11. Rock cores from BH1-7. Top: Run 1.