



Foundation Investigation Report

*CCTV Camera Pole Installation along Highway 401 from
Gardiners Road (Sta. 17+950 Kingston Twp.) to Highway 15
(Sta. 11+500 Pittsburgh Twp.), Kingston, ON*

Agreement No. 4020-E-0008

Assignment No. 5

GWP 4047-20-00

Geocres No. 31C-312

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*Ministry of Transportation Ontario
Eastern Region*

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1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This report presents the results of a geotechnical investigation completed by EXP Services Inc. (EXP) for the installation of 11 Closed-Circuit Television (CCTV) camera poles along Highway 401 in Kingston, Ontario; specifically, from the interchange of Gardiners Road (Sta. 17+950 Kingston Twp.) to the interchange of Highway 15 (Sta. 11+500 Pittsburgh Twp.), a distance of approximately 12 km. The proposed CCTV camera poles within this section of Highway 401 were named CCTV 07 to CCTV 17. The work was undertaken under Agreement No. 4020-E-0008, Assignment No. 5. The terms of reference (TOR) were provided by MTO in an email dated September 8, 2021.

The purpose of the investigation is to evaluate the subsurface condition at each proposed CCTV camera pole location and based on this data, to provide borehole locations plans, records of boreholes, laboratory test results and a written description of the subsurface conditions to permit detailed design for the pole foundations. The site specific geotechnical investigation consisted of a field investigation program including visual inspections, drilling, soil sampling, and laboratory testing at each CCTV location, approximately every km.

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 along Highway 401 in Kingston, Ontario, from the interchange of Gardiners Road (Sta. 17+950 Kingston Twp.) to the interchange of Highway 15 (Sta. 11+500 Pittsburgh Twp.) (see drawings in Appendix B). The total investigated area is approximately 12 km long. At the site location, Highway 401 is oriented in the east-west direction. The vicinity of the proposed CCTV camera poles generally consisted of residential and commercial on the southern extent while areas on the eastern extent were surrounded by trees and shrubs. Bedrock outcrops were observed at many of the CCTV locations. All proposed CCTV poles were located on or adjacent to the shoulder of Highway 401 eastbound lane, with the exception of CCTV 17 (easternmost location) which was located adjacent to the Highway 15 southbound lane. The general site conditions were assessed during the site reconnaissance on November 10, 2021 and during the investigation between December 6 to December 21, 2021.

Select photographs of the site are presented in Appendix A. The site plan for the proposed CCTV camera poles and borehole locations are shown on the drawings attached in Appendix B.

1.2.2 Geological Setting

The project area lies within the Napanee Plain physiographic region (Chapman and Putnam, 1984). According to the Ministry of Northern Development and Mines, Map 2556 (Quaternary Geology of Ontario, Southern Sheet, 1991) the at the project area is situated within three quaternary sediments or landform deposits:

1. Organic deposits: peat, muck and marl;
2. Glaciomarine deposits: silt and clay, minor sand basin and quiet water deposits; and

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3. Paleozoic bedrock: undifferentiated carbonate and clastic sedimentary rock, exposed at surface or covered by discontinuous, thin layer of drift.

According to Map 2544 (Bedrock Geology of Ontario, Southern Sheet, 1991), the bedrock geology of the site is of Ottawa Group; Simcoe Group; Shadow Lake Formation - limestone, dolostone, shale, arkose, sandstone or Late felsic plutonic rocks – granodiorite, granite, syenite, pegmatite, alkalic granite, migmatitic gneisses.

1.3 Previous Investigations

The following previous geotechnical reports at the site in the MTO GEOCREs library were reviewed:

- *Geocres No. 31C-235: "Foundation Investigation and Design: Culvert Extension Highway 401 – Station 10+490 Kingston, Ontario", prepared by Golder Associates, November 2015.*
- *Geocres No. 31C-076: "Soil Conditions Cataraqui River Bridge Kingston, Ontario", prepared by FENCO, April 28, 1954.*
- *Geocres No. 31C-215: "Preliminary Foundation Investigation and Design: Cataraqui River Bridge Widening Structure Site No. 7-70 Highway 401, Kingston, Ontario", prepared by Golder Associates, November 2013.*
- *Geocres No. 31C-202: "Foundation Investigation and Design Report: CNR Bridge Rehabilitation and Widening Highway 401, Kingston, Ontario", prepared by Golder Associates, January 2011.*
- *Geocres No. 31C-204: "Foundation Investigation and Design Report: Noise Wall Barrier West of Montreal Street, Kingston, Ontario", prepared by Golder Associates, January 2011.*
- *Geocres No. 31C-176: "Foundation Investigation and Design Report: Division Street Overpass Widening Highway 401 Widening from West of Sydenham Road to West of Montreal Street, Kingston, Ontario", prepared by Golder Associates, August 2008.*
- *Geocres No. 31C-143: "Feasibility Foundation Investigation Report for Sir John A. MacDonald Blvd. Overpass and Approaches", prepared by MTO Foundation Design Section, January 3, 1989.*
- *Geocres No. 31C-179: "Foundation Investigation and Design Report: High Fill Embankment Widening Highway 401 Widening from West of Sydenham Road to West of Montreal Street, Kingston, Ontario", prepared by Golder Associates, August 2008.*
- *Geocres No. 31C-158: "Foundation Investigation and Design: CP Rail Overhead Recreational Culvert Highway 401 from 2.7 km West of Highway 38, Easterly to Highway 15, District 41, Kingston, Eastern Region", prepared by Golder Associates, October 2000.*
- *Geocres No. 31C-240: "Foundation Investigation and Design Report: Interchange Improvements at Kingston Road 38, Highway 401, City of Kingston, Ontario", prepared by Thurber Engineering, March 15, 2015.*

1.4 Investigation Procedures

1.4.1 Site Investigation and Field Testing

The field investigation was performed between December 6 and December 21, 2021. The field program consisted of drilling eleven (11) sampled boreholes spaced at approximately 1 km, numbered from BH21-07 to BH21-17, with one borehole at each proposed CCTV location. The boreholes were strategically located as close as possible to the locations of the proposed CCTV poles. All boreholes were situated on or adjacent to the shoulder of Highway 401 eastbound lane, except for BH21-17 (easternmost location) which was located adjacent to the Highway 15 southbound lane. BH21-09A was located on the shoulder of Highway 401 approximately 150 m east of the CCTV 09 stake, because the CCTV 09 location was not accessible by a drill rig and the drilling on the shoulder was not

permitted because it required the lane closure of the southeast ramp of Sydenham Rd. The locations of boreholes drilled during this investigation are shown in the Drawings 1 to 4 in Appendix B. A summary of boreholes completed by EXP are listed in Table 1.1 below.

All boreholes drilled during the field program were advanced using a track mounted CME 850 drill rig, equipped with hollow stem augers and standard soil sampling equipment, operated by a specialist drilling contractor, CCC Geotechnical and Environmental Drilling Ltd. All boreholes were advanced to a depth between 4.7 m and 11.5 m below ground surface. Traffic control during the drilling of boreholes was provided by Beacon Lite (Ottawa) Ltd.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were surveyed by EXP personnel using a GPS and a basic level and survey rod, respectively, having an accuracy of ± 1 m in the horizontal directions and 0.1 m in the vertical direction. The horizontal distance from the location of proposed CCTV pole to the location of associated borehole were also measured by a measuring tape, where viable. Geodetic elevations for each borehole were referenced from survey drawings prepared by GeoVerra, dated October 2021. Ground surface elevations ranged from Elev. 77.3 m to 113.8 m.

For the drilling program, 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. 40) and used to provide an assessment of the in-situ relative density of non-cohesive soils and consistency of cohesive soils. In addition, in situ vane testing use the MTO 'N' Vane was carried in cohesive soils. When a hard stratum was reached sampling of hard material was performed by diamond core drilling, using a 1.5 m long NQ double tube wireline core barrel.

The ground water conditions in the open holes were observed during and immediately following the drilling operations. The recorded groundwater levels boreholes were presented in the borehole log sheets in Appendix C. The boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act).

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

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

Selected soil samples for analytical testing were sent to the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario. The selected soil samples for the analytical testing were placed in a laboratory prepared glass jars, labelled, and stored in a secure cooler.

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Table 1.1. Summary of boreholes completed

CCTV						Borehole						
Location	Location (MTM NAD 83 Zone 9)		Latitude	Longitude	Ground Surface Elevation ¹ (m)	Reference Borehole No.	Location (MTM NAD 83 Zone 9)		Latitude	Longitude	Ground Surface Elevation ¹ (m)	Borehole Depth ² (m)
	Northing	Easting					Northing	Easting				
CCTV 07	4905056.66	299157.42	44.285492	-76.570698	109.1	21-07	4905056.70	299158.50	44.285492	-76.570684	109.1	4.7
CCTV 08	4904513.91	300187.28	44.280614	-76.557790	113.2	21-08	4904510.10	300185.80	44.280580	-76.557808	112.7	7.1
CCTV 09	4904117.43	301207.60	44.277051	-76.545004	103.4	21-09A	4904103.60	301315.40	44.276927	-76.543653	103.6	7.3
CCTV 10	4903964.35	302139.40	44.275678	-76.533330	93.1	21-10	4903968.70	302142.00	44.275717	-76.533298	94.1	5.7
CCTV 11	4903535.94	303282.33	44.271825	-76.519011	87.8	21-11	4903539.60	303285.20	44.271858	-76.518975	88.1	11.5
CCTV 12	4903221.78	304788.48	44.268999	-76.500144	85.2	21-12	4903230.70	304790.90	44.269079	-76.500114	88.0	11.5
CCTV 13	4903513.58	305885.28	44.271624	-76.486405	110.4	21-13	4903516.80	305884.40	44.271653	-76.486416	110.8	7.2
CCTV 14	4904157.92	306881.06	44.277422	-76.473929	95.9	21-14	4904157.70	306879.00	44.277420	-76.473955	96.2	5.3
CCTV 15	4904605.22	308227.07	44.281442	-76.457064	77.3	21-15	4904605.20	308228.50	44.281442	-76.457046	77.3	10.8
CCTV 16	4904981.86	309391.75	44.284826	-76.442469	77.4	21-16	4904981.90	309393.30	44.284826	-76.442450	77.4	8.4
CCTV 17	4905378.64	310379.04	44.288390	-76.430095	113.8	21-17	4905378.70	310381.00	44.288391	-76.430070	113.8	7.6

Notes: 1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
 2. Depths are relative to ground surface

1.4.2 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content on all samples and particle size distribution for approximately 25% of the collected soil samples (sieve and hydrometer, 21 tests performed), with Atterberg limit testing done in conjunction with grain size distribution tests for cohesive soils (13 tests performed). One soil sample from each borehole was selected for chemical analysis and tested at a CALA-certified and accredited laboratory (11 tests performed). Uniaxial compression tests were carried out on selected rock core samples (11 tests performed). All the laboratory tests were carried out in accordance with MTO and/or ASTM standards as appropriate.

1.5 Subsurface Conditions

A borehole location plan along Highway 401 is provided in Appendix B. The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C. Laboratory test results of moisture content tests, grain size distribution tests, Atterberg limits, and unconfined compression strength tests are provided in Appendix D. The “Explanation of Terms Used in Report” preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report. It should be noted that the stratigraphic boundaries indicated on the borehole logs 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.

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

1.5.1 BH21-07 (CCTV 07)

Table 1.2 below summarizes the encountered stratigraphy during the field investigation at BH21-07. The borehole was drilled at location of proposed CCTV 07.

Table 1.2. Summary of stratigraphy encountered in BH21-07

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	109.1	108.7	0	0.4	N/A
Shaly Limestone/Dolostone	108.7	104.4	0.4	4.3	152.3

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.1.1 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered at the ground surface at BH21-07. The granular fill layer extended to a depth of 0.4 m below the ground surface with an Elevation of 108.7 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry. One (1) SPT “N” value measured within this layer was 46 blows per 0.3 m penetration, suggesting that this layer was dense in relative density.

Laboratory testing performed on selected samples up to date consisted of one (1) moisture content test and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 4%

Grain Size Distribution:

- 43% gravel;
- 49% sand;
- 8% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.1.2 Bedrock

Bedrock was encountered directly beneath the fill layer at a depth of about 0.4 m below the ground surface with an Elevation of 108.7 m. The bedrock was investigated by coring approximately 4.3 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores (~ core diameter 47 mm) recovered, the encountered bedrock at the BH21-07 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The Rock Quality Designation (RQD) measured on the core samples typically ranged from approximately 63% to 84%, indicating a rock mass of fair to good quality. The total core recovery (TCR) of shaly limestone/dolostone cores was 90% to 100%. The uniaxial compressive strength (UCS) of the shaly limestone/dolostone was measured to be 152.3 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m to 1.0 m from the top of the bedrock.

1.5.1.3 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.2 BH21-08 (CCTV 08)

Table 1.3 below summarizes the encountered stratigraphy during the field investigation at BH21-08. CCTV 08 stake was not present at the time of the site investigation. In reference to the survey provided by the MTO, BH21-08 was drilled approximately 4 m south of the proposed CCTV 08 location.

Table 1.3. Summary of stratigraphy encountered in BH21-08

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Silty Clay to Clayey Silt	112.5	109.0	0.2	3.5	N/A
Shaly Limestone/Dolostone	109.0	105.6	3.7	3.4	160.5

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.2.1 Topsoil

A topsoil layer, roughly 150 mm in thickness, was encountered at the ground surface of BH21-08.

1.5.2.2 Silty Clay to Clayey Silt

A cohesive material consisting of native silty clay to clayey silt was encountered directly beneath the topsoil. The encountered native cohesive layer extended to a depth of 3.7 m below ground surface with an Elevation of 109.0 m. The total encountered thickness of this layer was approximately 3.5 m. In addition, within the native cohesive layer a thin sand lens, 0.3 m in thickness, was also encountered at 3.1 m below ground.

Generally, the composition of this material consisted of silt and clay with trace sand and trace gravel. The native cohesive layer was brownish grey to grey in colour and moist to wet. The SPT "N" values obtained within this layer ranged from 4 to 15 blows per 0.3 m penetration, corresponding to firm to very stiff in consistency. The Atterberg limits tests suggest that this cohesive layer at BH21-08 was of low to high plasticity.

Laboratory testing performed on selected samples up to date consisted of six (6) moisture content tests, two (2) grain size distribution tests, and two (2) Atterberg limits tests. The test results are as follows:

Moisture Content:

- 8% to 56%

Grain Size Distribution:

- 0% to 8% gravel;
- 2% to 38% sand;
- 31% to 37% silt;
- 23% to 61% clay

Atterberg Limits:

- Liquid Limit: 29% to 57%;
- Plastic Limit: 13% to 24%;
- Plasticity Index: 16 to 33

The results of the moisture content, grain size distribution, and Atterberg limits tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figure 2 and Figure 5, respectively, in Appendix D.

1.5.2.3 Bedrock

Bedrock was encountered directly beneath the native cohesive layer at a depth of about 3.7 m below the ground surface with an Elevation of 109.0 m. The bedrock was investigated by coring approximately 3.4 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at BH21-08 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 68% to 78%, indicating a rock mass of fair to good quality. The TCR of shaly limestone/dolostone cores was 97% to 100%. The UCS of the shaly limestone/dolostone was measured to be 160.5 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m from the top of the bedrock.

1.5.2.4 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.3 BH21-09A (CCTV 09)

Table 1.4 below summarizes the encountered stratigraphy during the field investigation at BH21-09A. Due to machine access issues, BH21-09A was drilled approximately 150 m east of the proposed CCTV 09 location. A manual test pit was attempted at the stake location to confirm the depth to bedrock. However, due to the frozen ground and working time restrictions, bedrock was not encountered at the stake location through manual methods. Bedrock outcrops adjacent to the stake location were observed, suggesting that the bedrock is present at a shallow depth.

Table 1.4. Summary of stratigraphy encountered in BH21-09A

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	103.6	101.6	0	2.0	N/A
Shaly Limestone/Dolostone	101.6	96.3	2.0	5.3	202.4

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.3.1 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered at the ground surface at BH21-09A. This granular fill layer extended to a depth of 2.0 m below the ground surface with an Elevation of 101.6 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry. The SPT “N” values measured within this layer ranged from 56 to 70 blows per 0.3 m penetration suggesting that this layer was very dense in relative density.

Laboratory testing performed on selected samples up to date consisted of three (3) moisture content tests and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 2% to 3%

Grain Size Distribution:

- 39% gravel;
- 54% sand;
- 7% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.3.2 Bedrock

Bedrock was encountered directly beneath the fill layer at a depth of about 2.0 m below the ground surface with an Elevation of 101.6 m. The bedrock was investigated by coring approximately 5.3 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-09A consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 10% to 87%, indicating a rock mass of very poor to very good quality. The TCR of shaly limestone/dolostone cores was 100%. The UCS of the shaly limestone/dolostone was measured to be 202.4 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 1.0 m to 1.5 m from the top of the bedrock.

1.5.3.3 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.4 BH21-10 (CCTV 10)

Table 1.5 below summarizes the encountered stratigraphy during the field investigation at BH21-10. Due to the sloping ground in the vicinity of CCTV 10, BH21-10 was drilled approximately 4 m north of the proposed CCTV 10 location.

Table 1.5. Summary of stratigraphy encountered in BH21-10

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	93.9	92.1	0.2	1.8	N/A
Shaly Limestone/Dolostone	92.1	88.4	2.0	3.7	164.4

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.4.1 Asphalt

Asphalt, approximately 175 mm thick, was encountered at the surface of BH21-10.

1.5.4.2 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered below the asphalt at BH21-10. This granular fill layer extended to a depth of 2.0 m below the ground surface with an Elevation of 92.1 m. The total encountered thickness of this layer was approximately 1.8 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry to moist. The SPT “N” values measured within this layer ranged from 44 to 94 blows per 0.3 m penetration suggesting that this layer was dense to very dense in relative density.

Laboratory testing performed on selected samples up to date consisted of three (3) moisture content tests and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 3% to 5%

Grain Size Distribution:

- 56% gravel;
- 39% sand;
- 5% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.4.3 Bedrock

Bedrock was encountered directly beneath the fill layer at a depth of about 2.0 m below the ground surface with an Elevation of 92.1 m. The bedrock was investigated by coring approximately 3.7 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-10 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 52% to 100%, indicating a rock mass of fair to very good quality. The TCR of shaly limestone/dolostone cores ranged from 94% to 100%. The UCS of the shaly limestone/dolostone was measured to be 164.4 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m to 1.0 m from the top of the bedrock.

1.5.4.4 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.5 BH21-11 (CCTV 11)

Table 1.6 below summarizes the encountered stratigraphy during the field investigation at BH21-11. Due to machine access issues in the vicinity of CCTV 11, BH21-11 was drilled approximately 4 m north of the proposed CCTV 11 location.

Table 1.6. Summary of stratigraphy encountered in BH21-11

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	87.9	87.0	0.2	0.9	N/A
Clayey Silt to Silty Clay	87.0	77.3	1.1	9.7	N/A
Sand	77.3	76.6	10.8	0.7	N/A

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.5.1 Asphalt

Asphalt, approximately 200 mm thick, was encountered at the surface of BH21-11.

1.5.5.2 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered beneath the asphalt at BH21-11. This granular fill layer extended to a depth of 1.1 m below the ground surface with an Elevation of 87.0 m. The total encountered thickness of this layer was approximately 0.9 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry to moist. One (1) SPT "N" value measured within this layer was 81 blows per 0.3 m penetration suggesting that this layer was very dense in relative density.

Laboratory testing performed on selected samples up to date consisted of two (2) moisture content tests. The test results are as follows:

Moisture Content:

- 2% to 8%

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

1.5.5.3 Clayey Silt to Silty Clay

A cohesive material consisting of native clayey silt to silty clay was encountered beneath the granular fill. The encountered native cohesive layer extended to a depth of 10.8 m below ground surface with an Elevation of 77.3 m and was about 9.7 m in thickness.

The composition of this material consisted of silt and clay with sand and trace gravel. The native cohesive layer was brownish grey to grey in colour and moist to wet. The SPT “N” values obtained within this layer ranged from 2 to 25 blows per 0.3 m penetration corresponding to soft to very stiff in consistency. In addition, measured undrained shear strength from field vane tests, ranged from 24 kPa to greater than 50 kPa with a sensitivity of 3.3 to 3.8. Atterberg limits tests suggest that this cohesive layer at BH21-11 was of low to high plasticity.

Laboratory testing performed on selected samples up to date consisted of eleven (11) moisture content tests, four (4) grain size distribution tests, and three (3) Atterberg limits tests. The test results are as follows:

Moisture Content:

- 16% to 37%

Grain Size Distribution:

- 0% to 6% gravel;
- 1% to 11% sand;
- 31% to 76% silt;
- 23% to 65% clay

Atterberg Limits:

- Liquid Limit: 22% to 57%;
- Plastic Limit: 6% to 26%;
- Plasticity Index: 16 to 34

The results of the moisture content, grain size distribution, and Atterberg limit tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figure 2 and Figure 5, respectively, in Appendix D.

1.5.5.4 Sand

A layer of sand was encountered beneath the native cohesive material at BH21-11. The encountered sand layer was about 0.7 m in thickness and extended to a depth of 11.5 m below ground surface with an Elevation of 76.6 m.

The composition of this material generally consisted of sand with some silt, trace gravel, and trace clay. The sand layer was generally grey in colour and moist. One (1) SPT “N” value measured within this layer was 36 blows per 0.3 m penetration suggesting that this layer was dense in relative density.

Laboratory testing performed on selected samples up to date consisted of one (1) moisture content test and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 17%

Grain Size Distribution:

- 5% gravel;
- 71% sand;
- 24% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 4 in Appendix D.

1.5.5.5 Groundwater

Borehole was observed to be dry upon the completion of drilling.

1.5.6 BH21-12 (CCTV 12)

Table 1.7 below summarizes the encountered stratigraphy during the field investigation at BH21-12. Due to machine access issues in the vicinity of CCTV 12, BH21-12 was drilled approximately 9 m north of the proposed CCTV 12 location.

Table 1.7. Summary of stratigraphy encountered in BH21-12

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sandy Gravel (Fill)	87.8	82.7	0.2	5.1	N/A
Silty Clay	82.7	76.5	5.3	6.2	N/A

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.6.1 Asphalt

Asphalt, approximately 150 mm thick, was encountered at the surface of BH21-12.

1.5.6.2 Sandy Gravel (Fill)

A fill layer consisting of sandy gravel was encountered beneath the asphalt at BH21-12. This granular fill layer extended to a depth of 5.3 m below the ground surface with an Elevation of 82.7 m. The total encountered thickness of this layer was approximately 5.1 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry to moist. The SPT “N” values measured within this layer ranged from 13 to 113 blows per 0.3 m penetration, suggesting that this layer is compact to very dense in relative density.

Laboratory testing performed on selected samples up to date consisted of four (4) moisture content tests and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 2% to 5%

Grain Size Distribution:

- 63% gravel;
- 31% sand;
- 6% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.6.3 Silty Clay

A cohesive material consisting of native silty clay was encountered beneath the granular fill. The encountered native cohesive layer extended to a depth of 11.5 m below ground surface with an Elevation of 76.5 m. The explored thickness of the layer was about 6.2 m.

The composition of this material consisted of silt and clay with trace gravel and sand. The native cohesive layer was brownish grey to grey in colour and moist to wet. The SPT “N” values obtained within this layer ranged from 14 to 34 blows per 0.3 m penetration, corresponding to stiff to hard in consistency. Atterberg limits tests suggest that this cohesive layer at BH21-12 was of high plasticity.

Laboratory testing performed on selected samples up to date consisted of eight (8) moisture content tests, two (2) grain size distribution tests, and two (2) Atterberg limits tests. The test results are as follows:

Moisture Content:

- 16% to 38%

Grain Size Distribution:

- 0% to 1% gravel;
- 2% to 6% sand;
- 27% to 42% silt;
- 52% to 70% clay

Atterberg Limits:

- Liquid Limit: 49% to 56%;
- Plastic Limit: 22% to 24%;
- Plasticity Index: 25 to 34

The results of the moisture content, grain size distribution, and Atterberg limits tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figure 2 and Figure 5, respectively, in Appendix D.

1.5.6.4 Groundwater

Borehole was observed to be dry upon the completion of drilling.

1.5.7 BH21-13 (CCTV 13)

Table 1.8 below summarizes the encountered stratigraphy during the field investigation at BH21-13. Due to machine access issues in the vicinity of CCTV 13, BH21-13 was drilled approximately 3 m north of the proposed CCTV 13 location.

Table 1.8. Summary of stratigraphy encountered in BH21-13

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	110.5	109.1	0.3	1.4	N/A
Shaly Limestone/Dolostone	109.1	103.6	1.7	5.5	185.1

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.7.1 Asphalt

Asphalt, approximately 300 mm thick, was encountered at the surface of BH21-13.

1.5.7.2 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered beneath the asphalt at BH21-13. This granular fill layer extended to a depth of 1.7 m below the ground surface with an Elevation of 109.1 m. The total encountered thickness of this layer was approximately 1.4 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry to moist. The SPT “N” values measured within this layer ranged from 107 to 113 blows per 0.3 m penetration, suggesting that this layer very dense in relative density.

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

Moisture Content:

- 4% to 5%

Grain Size Distribution:

- 47% gravel;
- 45% sand;
- 8% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.7.3 Bedrock

Bedrock was encountered directly beneath the fill layer at a depth of about 1.7 m below the ground surface with an Elevation of 109.1 m. The bedrock was investigated by coring approximately 5.5 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-13 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 55% to 84%, indicating a rock mass of fair to good quality. The TCR of shaly limestone/dolostone cores was 100%. The UCS of the shaly limestone/dolostone was measured to be 185.1 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m to 1.0 m from the top of the bedrock.

1.5.7.4 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.8 BH21-14 (CCTV 14)

Table 1.9 below summarizes the encountered stratigraphy during the field investigation at BH21-14. Due to the presence of sloping ground in the vicinity of CCTV 14, BH21-14 was drilled approximately 2 m west of the proposed CCTV 14 location.

Table 1.9. Summary of stratigraphy encountered in BH21-14

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	96.2	94.4	0	1.8	N/A
Shaly Limestone/Dolostone	94.4	90.9	1.8	3.5	169.4

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.8.1 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered at the ground surface at BH21-14. This granular fill layer extended to a depth of 1.8 m below the ground surface with an Elevation of 94.4 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and moist. SPT “N” values measured within this layer ranged from 21 to 26 blows per 0.3 m penetration, suggesting that the fill layer was compact in apparent density.

Laboratory testing performed on selected samples up to date consisted of three (3) moisture content tests and one (1) grain size distribution test. The test results are as follows:

Moisture Content:

- 7% to 8%

Grain Size Distribution:

- 44% gravel;
- 50% sand;

- 6% silt and clay

The results of the moisture content and grain size distribution tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution test performed by EXP is also provided on Figure 1 in Appendix D.

1.5.8.2 Bedrock

Bedrock was encountered directly beneath the fill layer at a depth of about 1.8 m below the ground surface with an Elevation of 94.4 m. The bedrock was investigated by coring approximately 3.5 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-14 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 72% to 94%, indicating a rock mass of fair to very good quality. The TCR of shaly limestone/dolostone cores ranged from 91% to 100%. The UCS of the shaly limestone/dolostone was measured to be 169.4 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m to 1.0 m from the top of the bedrock.

1.5.8.3 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.9 BH21-15 (CCTV 15)

Table 1.10 below summarizes the encountered stratigraphy during the field investigation at BH21-15. The borehole was drilled at the location of proposed CCTV 15.

Table 1.10. Summary of stratigraphy encountered in BH21-15

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	77.3	76.2	0	1.1	N/A
Clayey Silt to Silty Clay	76.2	69.5	1.1	6.7	N/A
Granite	69.5	66.5	7.8	3.0	218.6

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.9.1 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered at the ground surface at BH21-15. This granular fill layer extended to a depth of 1.1 m below the ground surface with an Elevation of 76.2 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey in colour and dry. One (1) SPT “N” value measured within this layer was 23 blows per 0.3 m penetration suggesting that this layer was compact in relative density.

Laboratory testing performed for this layer consisted of one (1) moisture content test. The test result is as follows:

Moisture Content:

- 3%

The result of the moisture content test performed by EXP is provided on the record of borehole sheets in Appendix C.

1.5.9.2 Clayey Silt to Silty Clay

A cohesive material consisting of native clayey silt to silty clay was encountered beneath the granular fill. The encountered native cohesive layer extended to a depth of 7.8 m below ground surface with an Elevation of 69.5 m. The explored thickness was about 6.7 m.

The composition of this material consisted of silt and clay with trace to some sand. The native cohesive layer was brownish grey to grey in colour and moist. The SPT “N” values obtained within this layer ranged from 6 to 29 blows per 0.3 m penetration corresponding to firm to very stiff in consistency. In addition, the undrained shear strength was measured to be greater than 50 kPa through a field vane test. Atterberg limits test results suggest that this cohesive layer at BH21-15 was of low to high plasticity.

Laboratory testing performed on selected samples up to date consisted of nine (9) moisture content tests, three (3) grain size distribution tests, and three (3) Atterberg limits tests. The test results are as follows:

Moisture Content:

- 28% to 35%

Grain Size Distribution:

- 0% gravel;
- 0% to 10% sand;
- 29% to 56% silt;
- 43% to 69% clay

Atterberg Limits:

- Liquid Limit: 33% to 55%;
- Plastic Limit: 15% to 26%;
- Plasticity Index: 18 to 34

The results of the moisture content, grain size distribution, and Atterberg limits tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figures 3, 5, and 6 respectively, in Appendix D.

1.5.9.3 Bedrock

Bedrock was encountered beneath the native cohesive layer at a depth of about 7.8 m below the ground surface with an Elevation of 69.5 m. The bedrock was investigated by coring approximately 3.0 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-15 consisted of granite.

The granite could generally be described as reddish pink and grey in colour, intensely to slightly fractured, medium to coarse grained, hard to very hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 72% to 77%, indicating a rock mass of fair to good quality. The TCR of granite ranged from 98% to 100%. The UCS of the granite was measured to be 218.6 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m from the top of the bedrock.

1.5.9.4 Groundwater

Borehole was observed to be dry prior to the commencement of bedrock coring.

1.5.10 BH21-16 (CCTV 16)

Table 1.11 below summarizes the encountered stratigraphy during the field investigation at BH21-16. The borehole was drilled at the location of proposed CCTV 16.

Table 1.11. Summary of stratigraphy encountered in BH21-16

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Clayey Silt to Silty Clay	77.3	72.0	0.1	5.3	N/A
Granite	72.0	69.0	5.4	3.0	229.9

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.10.1 Topsoil

A topsoil layer, roughly 80 mm in thickness, was encountered at the ground surface of BH21-16.

1.5.10.2 Clayey Silt to Silty Clay

A cohesive material consisting of native clayey silt to silty clay was encountered directly beneath the topsoil. The encountered native cohesive layer extended to a depth of 5.4 m below ground surface with an Elevation of 72.0 m. The explored thickness was about 5.3 m in thickness.

The composition of this material consisted of silt and clay with trace sand and gravel. The native cohesive layer was brownish grey to grey in colour and moist to wet. The SPT “N” values obtained within this layer ranged from 6 to 18 blows per 0.3 m penetration corresponding to firm to very stiff in consistency. Atterberg limits test results suggest that this cohesive layer at BH21-16 was of intermediate to high plasticity.

Laboratory testing performed on selected samples up to date consisted of eight (8) moisture content tests, two (2) grain size distribution tests, and two (2) Atterberg limits tests. The test results are as follows:

Moisture Content:

- 30% to 39%

Grain Size Distribution:

- 0% to 1% gravel;
- 1% to 4% sand;
- 37% to 42% silt;
- 53% to 62% clay

Atterberg Limits:

- Liquid Limit: 48% to 51%;
- Plastic Limit: 20% to 23%;
- Plasticity Index: 28

The results of the moisture content, grain size distribution, and Atterberg limits tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figure 3 and Figure 6, respectively, in Appendix D.

1.5.10.3 Bedrock

Bedrock was encountered beneath the native cohesive layer at a depth of about 5.4 m below the ground surface with an Elevation of 72.0 m. The bedrock was investigated by coring approximately 3.0 m into the stratum.

Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at the BH21-16 consisted of granite.

The granite could generally be described as reddish pink and grey in colour, intensely to slightly fractured, medium to coarse grained, hard to very hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 67% to 100%, indicating a rock mass of fair to very good quality. The TCR of granite was 100%. The UCS of the granite was measured to be 229.9 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m from the top of the bedrock.

1.5.10.4 Groundwater

The groundwater level was measured at 3.4 m below ground surface (Elevation of 74.0 m) in the open hole prior to bedrock coring. Artesian conditions were also encountered within the bedrock during rock coring at BH21-16. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

The groundwater levels encountered at BH21-16 are shown on the borehole logs and is presented below in Table 1.12.

Table 1.12. Groundwater levels at BH21-16

Date Measured	Groundwater Depth ² (m)	Groundwater Elevation ¹ (m)
Dec 14, 2021	3.4	74.0
Dec 15, 2021	5.4 – 8.4	72.0 – 69.0

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.11 BH21-17 (CCTV 17)

Table 1.13 below summarizes the encountered stratigraphy during the field investigation at BH21-17. The borehole was drilled at the location of proposed CCTV 17.

Table 1.13. Summary of stratigraphy encountered in BH21-17

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Sand and Gravel (Fill)	113.7	111.8	0.1	1.9	N/A

Soil Type/Stratum	Elevation ¹ (m)		Layer Surface Depth ² (m)	Encountered Layer Thickness (m) (MPa)	Uniaxial Compressive Strength - UCS (MPa)
	Top	Bottom			
Clayey Silt	111.8	110.3	2.0	1.5	N/A
Shaly Limestone/Dolostone	110.3	106.2	3.5	4.1	207.2

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.5.11.1 Topsoil

A topsoil layer, roughly 125 mm in thickness, was encountered at the ground surface of BH21-17.

1.5.11.2 Sand and Gravel (Fill)

A fill layer consisting of sand and gravel was encountered below the topsoil at BH21-17. This granular fill layer extended to a depth of 2.0 m below the ground surface with an Elevation of 111.8 m. The total encountered thickness of this layer was approximately 1.9 m.

The composition of this fill material consisted of sand and gravel with trace silt and clay. The fill was grey to brownish grey in colour and dry to moist. The SPT “N” values measured within this layer ranged from 13 to 46 blows per 0.3 m penetration suggesting that this layer was compact to dense in relative density.

Laboratory testing performed for this layer consisted of one (1) moisture content test. The test result is as follows:

Moisture Content:

- 5%

The result of the moisture content test performed by EXP is provided on the record of borehole sheets in Appendix C.

1.5.11.3 Clayey Silt

A cohesive material consisting of native clayey silt was encountered directly beneath the granular fill. The encountered native cohesive layer extended to a depth of 3.5 m below ground surface with an Elevation of 110.3 m. The explored thickness was about 1.5 m.

The composition of this material consisted of silt and clay with trace to some sand and gravel. The native cohesive layer was grey in colour and moist. The SPT “N” values obtained within this layer ranged from 9 to 11 blows per

0.3 m penetration corresponding to stiff in consistency. The Atterberg limits test suggests that this cohesive layer at BH21-17 was of intermediate plasticity.

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

Moisture Content:

- 15% to 27%

Grain Size Distribution:

- 10% gravel;
- 22% sand;
- 34% silt;
- 34% clay

Atterberg Limits:

- Liquid Limit: 43%;
- Plastic Limit: 21%;
- Plasticity Index: 22

The results of the moisture content, grain size distribution, and Atterberg limits tests performed by EXP are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg limits tests performed by EXP are also provided on Figure 3 and Figure 6, respectively, in Appendix D.

1.5.11.4 Bedrock

Bedrock was encountered directly beneath the native cohesive layer at a depth of about 3.5 m below the ground surface with an Elevation of 110.3 m. The bedrock was investigated by coring approximately 4.1 m into the stratum. Photographs of rock cores are included in Appendix D. Based on the bedrock NQ cores recovered, the encountered bedrock at BH21-17 consisted of shaly limestone/dolostone.

The shaly limestone/dolostone could generally be described as grey to dark grey in colour, intensely to slightly fractured, fine grained, moderately hard to hard, and slightly weathered to fresh. The RQD measured on the core samples typically ranged from approximately 84% to 97%, indicating a rock mass of good to very good quality. The TCR of shaly limestone/dolostone cores ranged from 98% to 100%. The UCS of the shaly limestone/dolostone was measured to be 207.2 MPa, indicating very strong (R5) rock, according to the CFEM. A weathered zone was assessed to be approximately 0.5 m to 1.0 m from the top of the bedrock.

1.5.11.5 Groundwater

The groundwater level was measured at 2.5 m below ground surface (Elevation of 111.3 m) in the open hole prior to bedrock coring. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

The groundwater level encountered at BH21-17 is shown on the borehole logs and is presented below in Table 1.14.

Table 1.14. Groundwater levels at BH21-17

Date Measured	Groundwater Depth ² (m)	Groundwater Elevation ¹ (m)
Dec 15, 2021	2.5	111.3

Notes:

1. The ground surface elevations were referenced from Canadian Geodetic Vertical Datum of 1928 (CGVD28) as shown in the survey dated October 2021 by GeoVerra.
2. Depths are relative to ground surface.

1.6 Chemical Analysis

One (1) soil sample from each borehole was selected for corrosion potential chemical analyses during the current investigation. The soil sample collected by EXP was tested at a CALA-certified and accredited laboratory. The results of the corrosion potential chemical analysis testing including sulfide, chloride, sulfate, pH, electrical conductivity, resistivity, and redox potential are included in Appendix D and summarized in Table 1.15.

Table 1.15. Summary of chemical analysis results

Borehole ID	Sample	Depth (m)	Chloride (ppm)	Sulphate (ppm)	pH	Electrical Conductivity (mS/cm)	Resistivity (ohm-cm)	Redox Potential (mV)
21-07	SS1	0 – 0.4	20	51	7.74	0.202	4900	337
21-08	SS3	1.5 – 2.1	850	45	7.73	1.540	650	283
21-09A	SS2	0.6 – 1.2	64	74	7.96	0.250	4000	296
21-10	SS2	0.8 – 1.4	25	390	7.78	0.455	2200	259
21-11	SS5	2.4 – 3.0	410	35	7.46	0.955	1000	226
21-12	SS6	6.1 – 6.7	470	300	7.53	1.180	850	234
21-13	SS2	0.8 – 1.4	91	1200	7.78	1.240	810	247
21-14	SS2	0.8 – 1.4	470	150	7.98	0.792	1300	233

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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 in order to assess this additional information and our recommendations, as appropriate. It may then be necessary to perform 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 and Design Report has been prepared by Elvis Lu, M.Eng, Daniel Mroz, M.E.Sc., E.I.T., and Silvana Micic, Ph.D., P.Eng. It was reviewed by TaeChul Kim, M.E.Sc., P.Eng. and by Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was supervised by Elvis Lu and Ivan Barua.

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3 REFERENCES

Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

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

Chapman, L.J., and Putnam, D.F., 1984. The physiography of Southern Ontario. Ontario Geological Survey, Special volume 2, 3rd Edition. Ontario Ministry of Natural Resources

Ministry of Northern Development and Mines Map 2544. Bedrock Geology of Ontario, Southern Sheet, 1991.

Ministry of Northern Development and Mines, Map 2556. Quaternary Geology of Ontario, Southern Sheet, 1991.

ASTM International:

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

ASTM D4543 Preparing Rock Cores as Cylindrical Test Specimens and Verifying Conformance to Dimensional And Shape Tolerances

ASTM D7012 Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Ontario Water Resources Act:

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

Ontario Occupational Health and Safety Act (OHSA):

Ontario Regulation 213/91 Construction Projects

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4 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

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

STANDARD OF CARE

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

COMPLETE REPORT

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

USE OF REPORT

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

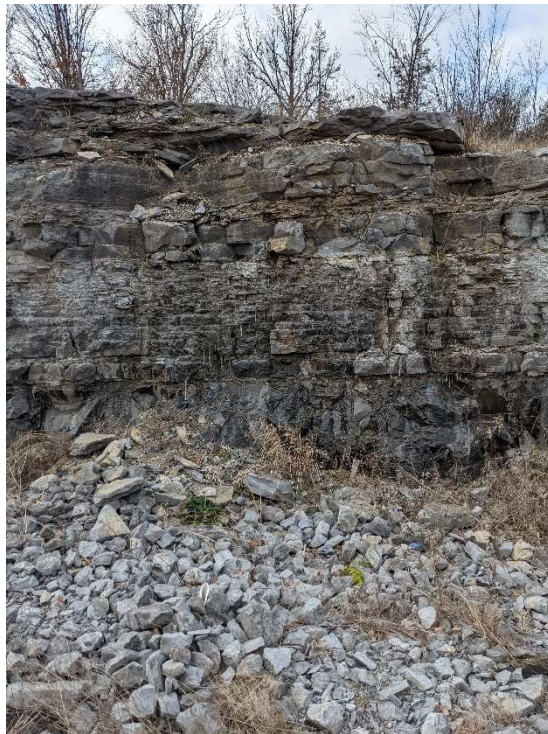
REPORT FORMAT

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

Appendix A – Site Photographs



Photograph 1. Drilling of BH21-07 (facing east), December 7, 2021



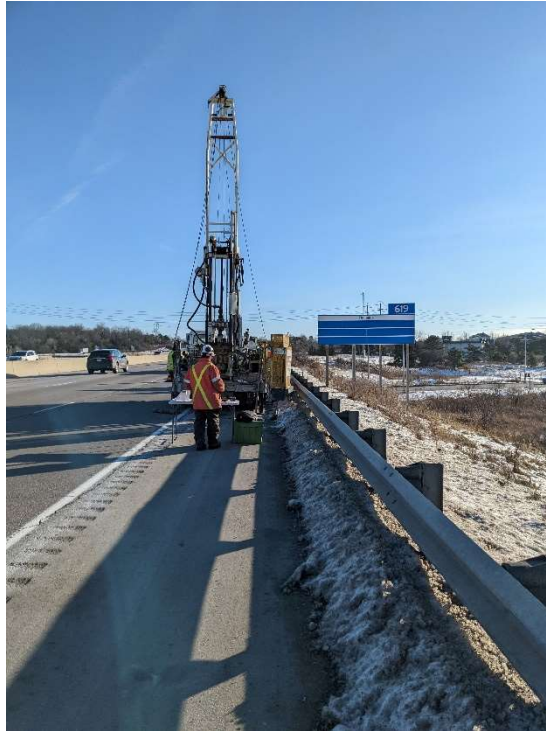
Photograph 2. Bedrock outcrop adjacent to BH21-07 (facing south), December 7, 2021



Photograph 3. CCTV 09 Location (facing east), November 10, 2021 (Note: BH21-09A was drilled on the other side of underpass shown on the photo, since there was no access behind the guardrail)



Photograph 4. Location of BH21-09A (facing west), December 9, 2021



Photograph 5. Drilling of BH21-12 at the shoulder (facing east), December 21, 2021 (Note: The location of CCTV 12 is on the other side of guardrail on the embankment slope)



Photograph 6. Drilling of BH21-15 (facing east), December 14, 2021

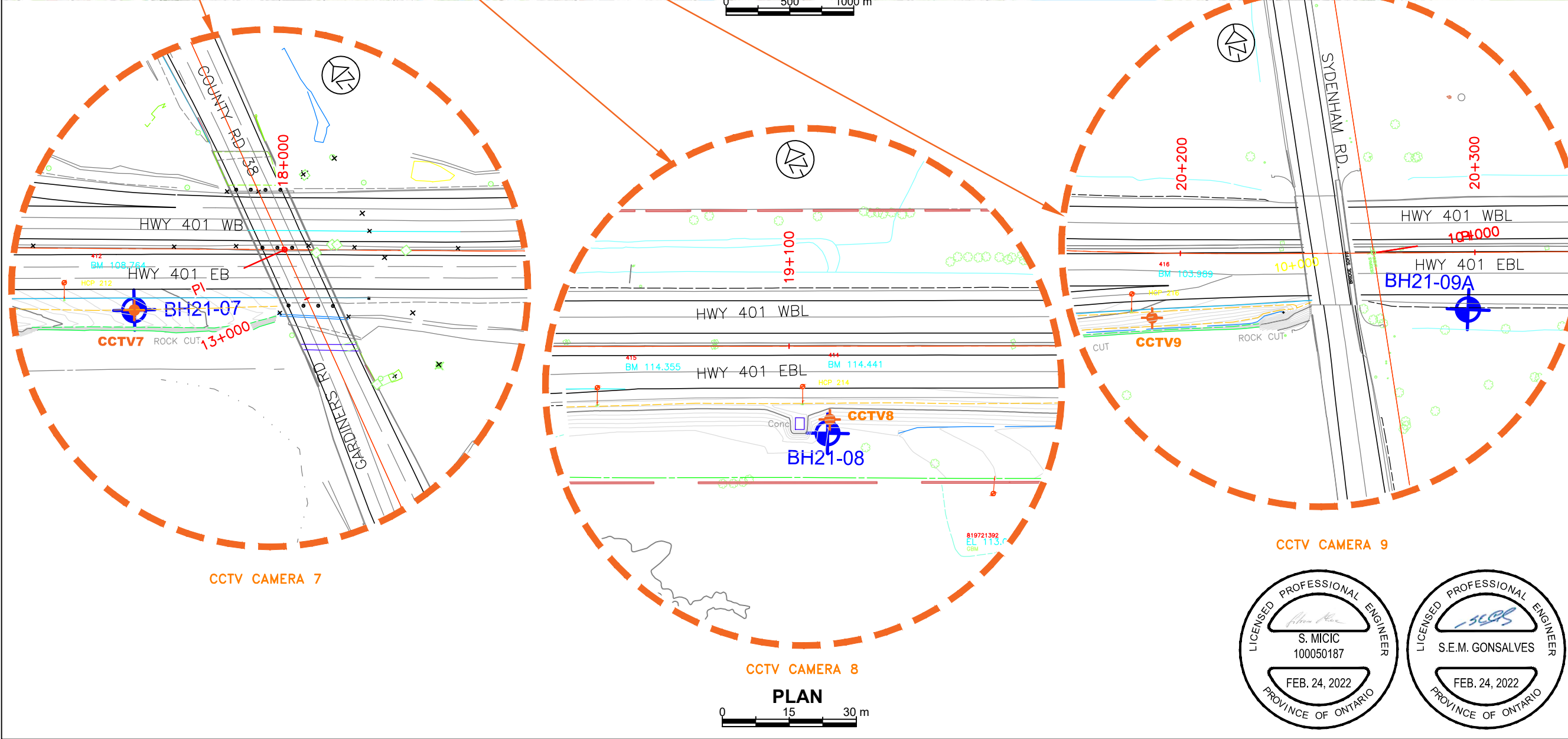
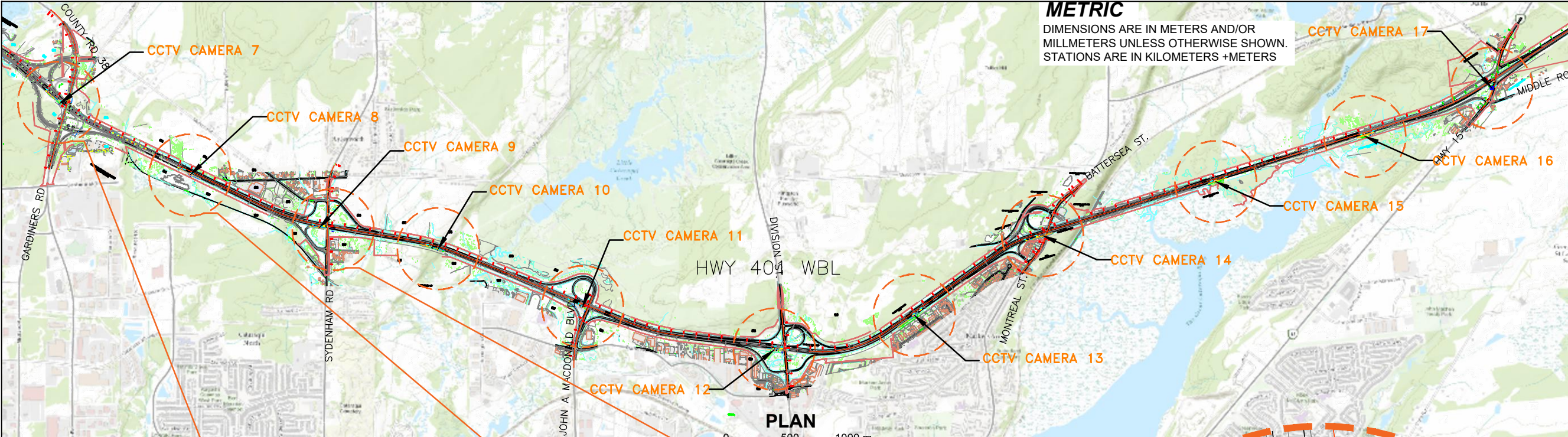


Photograph 7. Drilling of BH21-17, located off Hwy 15 (facing south), December 15, 2021



Photograph 8. Hwy 401 at location of BH21-17 (facing north), December 15, 2021

Appendix B – Drawings



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Assignment No. 5
GWP 4047-20-00

SHEET
1

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KEY PLAN

LEGEND

- Borehole Location
- Proposed CCTV Camera Location

BH No.	ELEV. (m)	MTM CO-ORDINATES NAD 83 (ZONE ON-9)	
		NORTHING	EASTING
BH21-07	108.8	4905056.7	299158.5
BH21-08	112.7	4904510.1	300185.8
BH21-09A	103.6	4904103.6	301315.4
BH21-10	94.1	4903968.7	302142.0
BH21-11	88.1	4903539.6	303285.2
BH21-12	88.3	4903230.7	304790.9
BH21-13	110.8	4903516.8	305884.4
BH21-14	98.2	4904157.7	306879.0
BH21-15	77.2	4904605.2	308228.5
BH21-16	77.6	4904981.9	309393.3
BH21-17	113.9	4905378.7	310381.0

SCALE

AS SHOWN

NOTES

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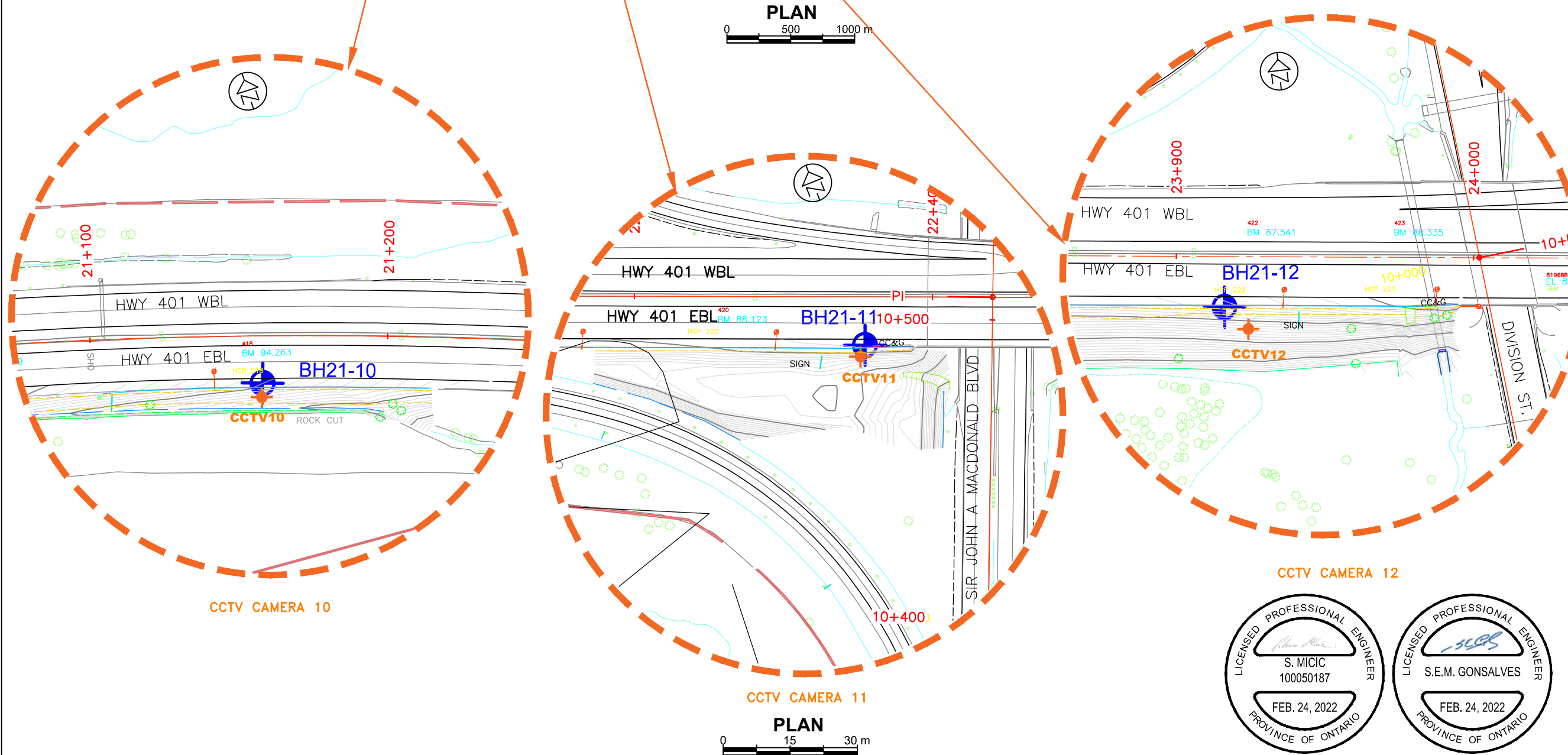
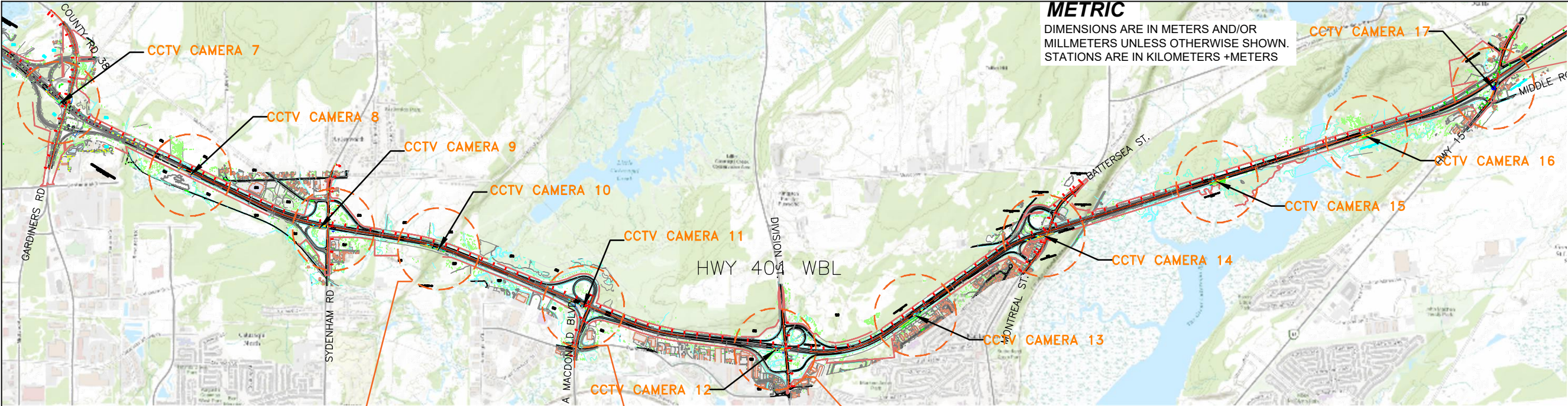
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REVISIONS			SUBMISSION FOR MTO REVIEW	
	DATE	BY	SM	DESCRIPTION

GEOCRES NO.	31C-312	PROJECT NO.	ADM-00263421-E0
SUBM'D SH	CHECKED SM	DATE	FEB. 24, 2022
DRAWN SH	CHECKED TC	APPROVED SG	DWG. 01

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S.E.M. GONSALVES
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FEB. 24, 2022
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Agreement No. 4020-E-0008 Assignment No. 5 GWP 4047-20-00	
CCTV Camera Pole Installation Along Highway 401, Interchanges Gardiners Road (Sta. 17+950 Kingston Twp.) to Highway 15 (Sta. 11+500 Pittsburgh Twp.) BOREHOLE LOCATION PLAN	SHEET 1

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LEGEND

	Borehole Location
	Proposed CCTV Camera Location

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SCALE
AS SHOWN

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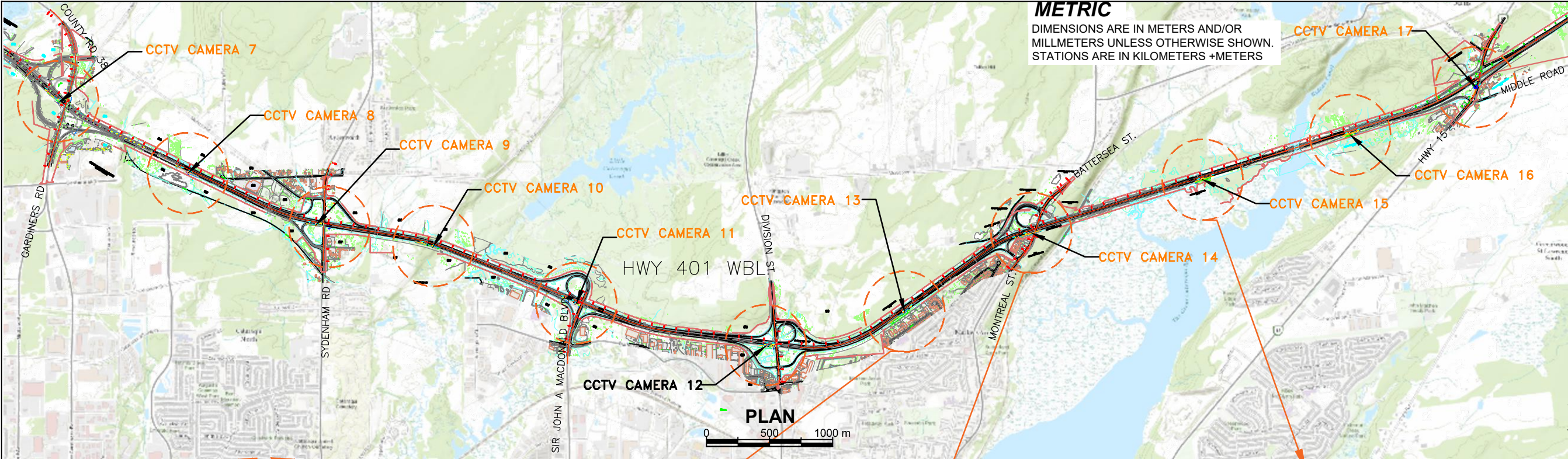
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				DESCRIPTION	

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SUBM'D SH	CHECKED SM	DATE	FEB. 24, 2022
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Agreement No. 4020-E-0008
Assignment No. 5
GWP 4047-20-00

CCTV Camera Pole Installation Along Highway 401, Interchanges Gardiners Road (Sta. 17+950 Kingston Twp.) to Highway 15 (Sta. 11+500 Pittsburgh Twp.)
BOREHOLE LOCATION PLAN

SHEET
1

EXP Services Inc.



LEGEND

- Borehole Location
- Proposed CCTV Camera Location

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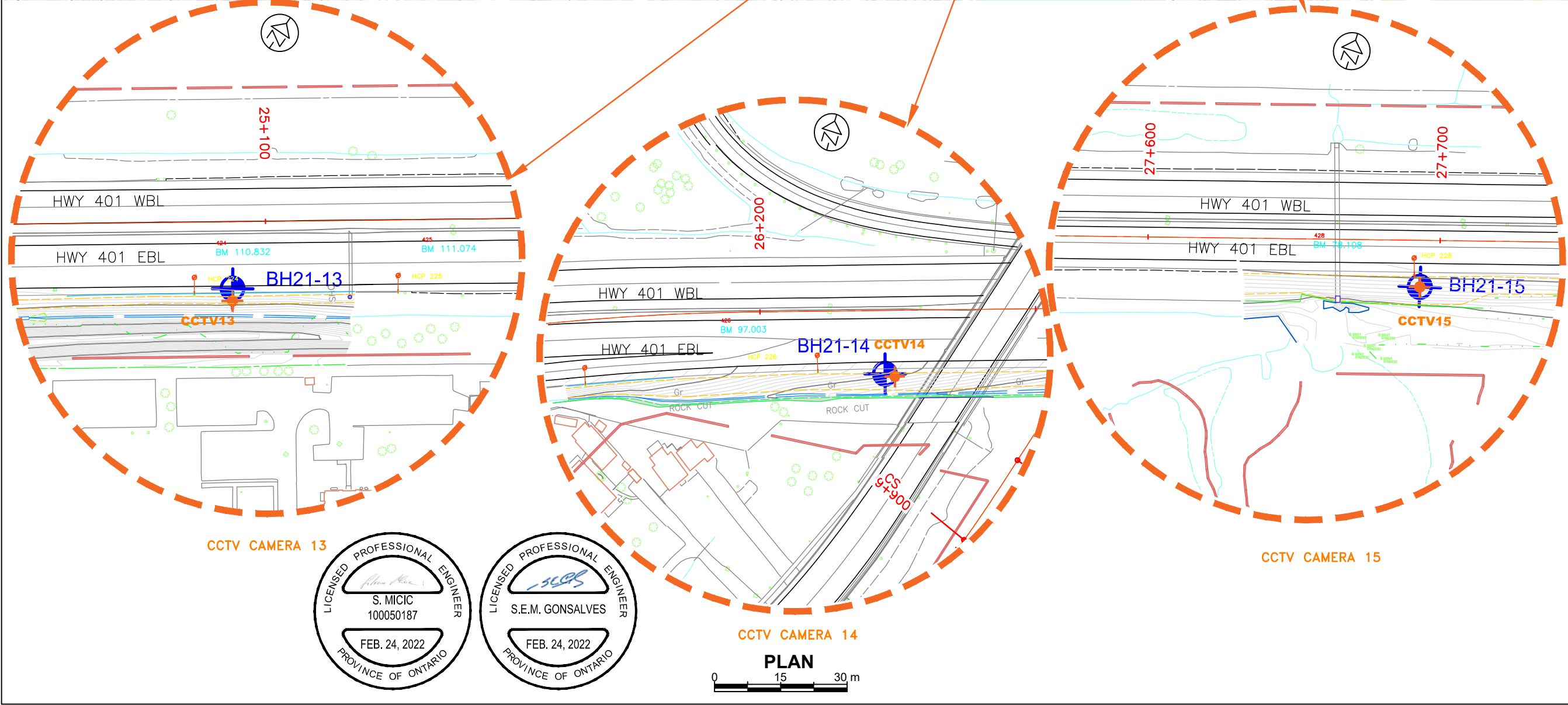
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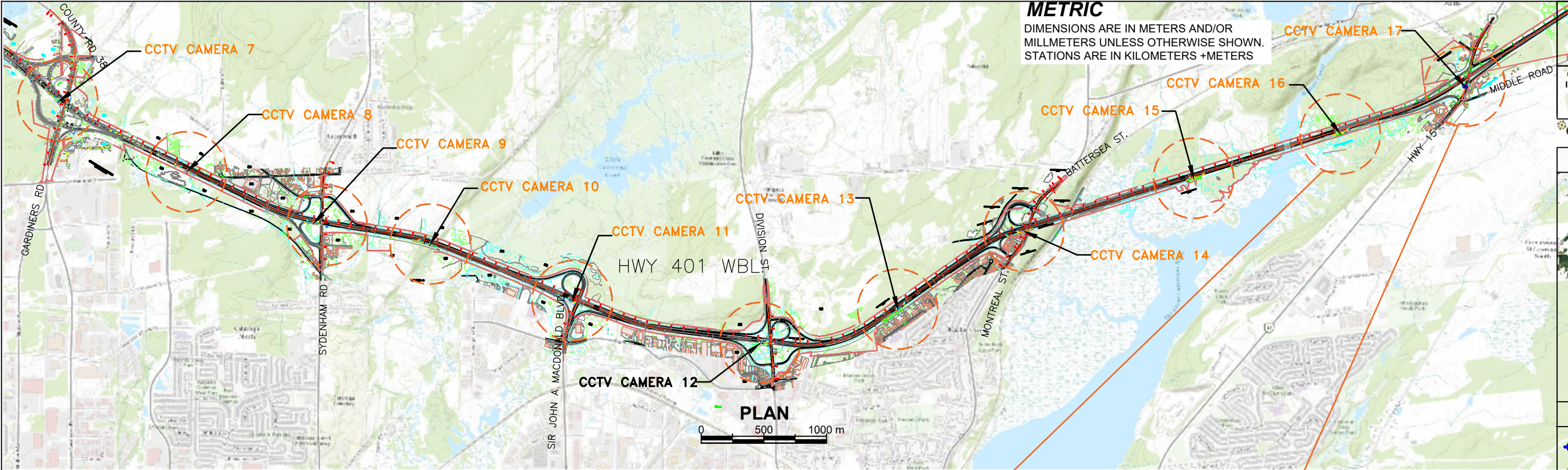
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SUBM'D SH		CHECKED SM	DATE FEB. 24, 2022
DRAWN SH		CHECKED TC	APPROVED SG DWG. 03



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PROVINCE OF ONTARIO



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

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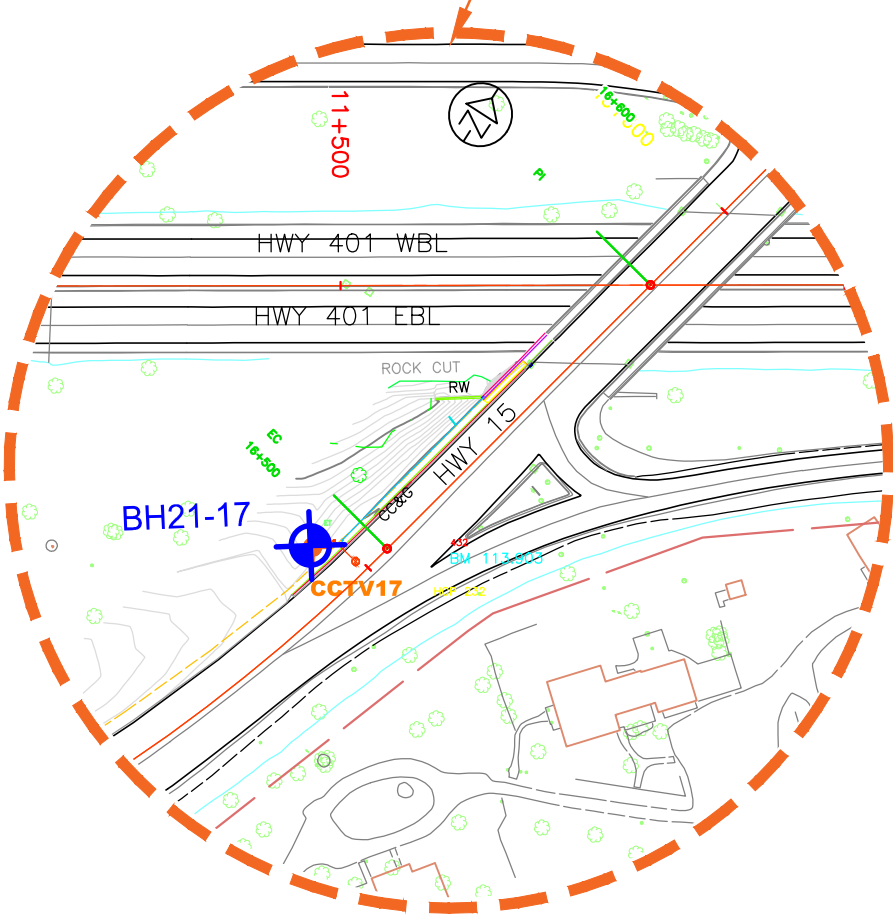
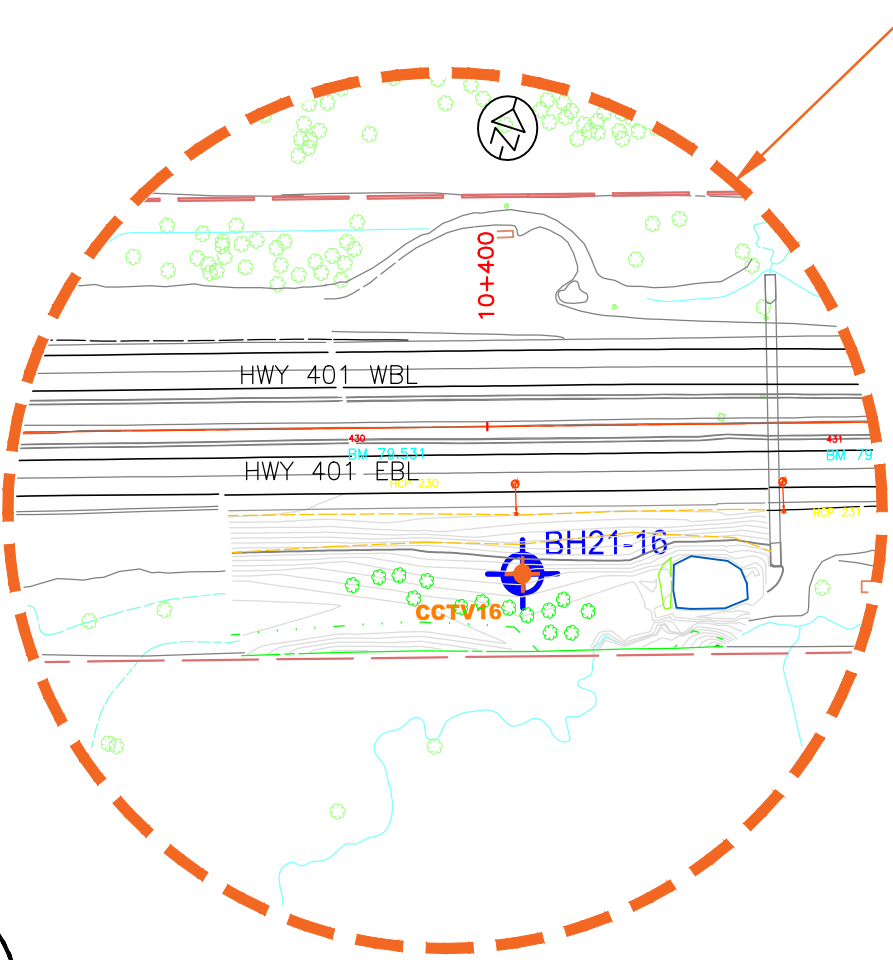
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exp. **EXP Services Inc.**



LEGEND

- Borehole Location
- Proposed CCTV Camera Location



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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.

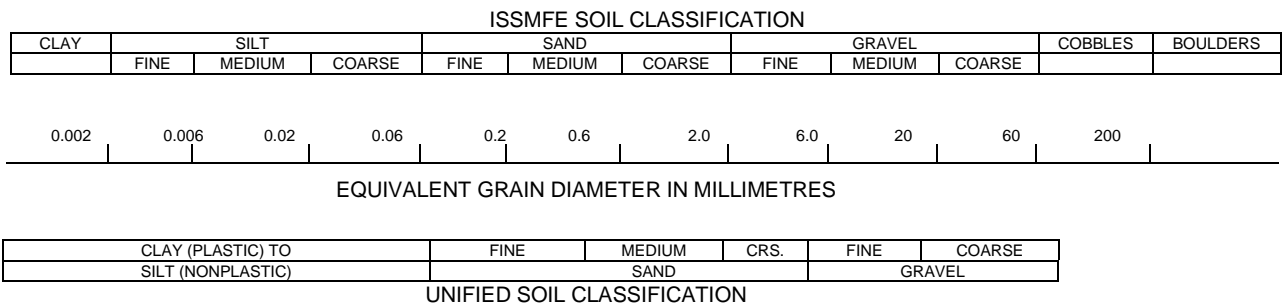
Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

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:

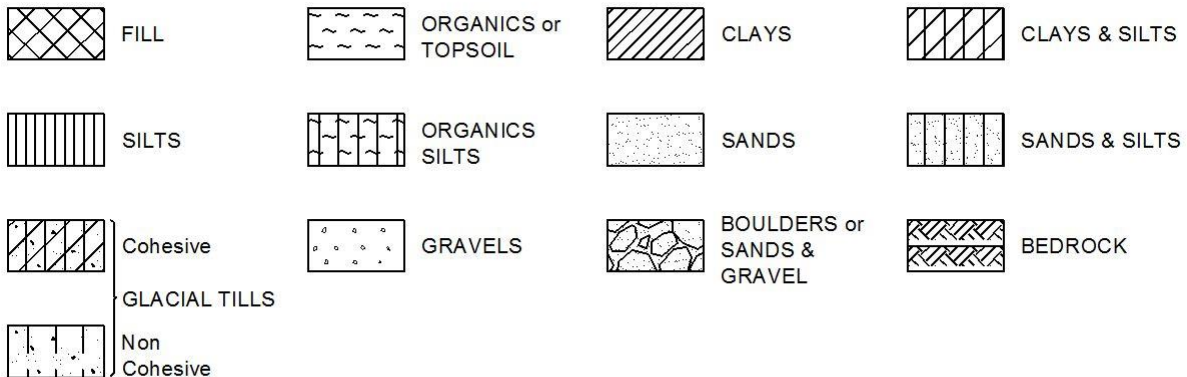
Table c: Consistency of Cohesive Soil

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



Brampton, Ontario

RECORD OF BOREHOLE No BH21-07

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4905056.7, E299158.5, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.07 - 2021.12.07 LATITUDE 44.285492 LONGITUDE -76.5706843 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			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE	○	○	○						○	○	○
109.1							20	40	60	80	100								
0.0	SAND AND GRAVEL (FILL) trace silt and clay, grey, dry, dense		SS1	SS	46											43 49 (8) Corrosivity Sample			
108.7																			
0.4	BEDROCK , shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ												UCS test at 0.9 m depth = 152.3 MPa REC = 90% RQD = 63%			
			Run 2	NQ												REC = 100% RQD = 80%			
			Run 3	NQ												REC = 100% RQD = 84%			
				</															

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22




Brampton, Ontario

RECORD OF BOREHOLE No BH21-08

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904510.1, E300185.8, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.09 - 2021.12.09 LATITUDE 44.2805797 LONGITUDE -76.5578081 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER					W _P	W	W _L		WATER CONTENT (%)	GR	SA	SI
112.7								20	40	60	80	100								
0.0	TOPSOIL, ~ 150 mm thick																			
112.5																				
0.2	SILTY CLAY TO CLAYEY SILT, trace sand, trace organics, brownish grey to grey, moist to wet, firm to stiff		SS1	SS	4															
							112													
			SS2	SS	9															
			SS3	SS	9		111													
	very stiff below ~ 2.3 m depth		SS4	SS	15		110													
	0.3 m thick sand lens at 3.1 m depth		SS5	SS	15															
			SS6																	
109.0							109													
3.7	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ			108													
			Run 2	NQ			107													
			Run 3	NQ			106													
105.6																				
7.1	BOREHOLE TERMINATED AT ~ 7.1 m DEPTH																			
	Note: 1. Borehole dry in open hole prior to rock coring at 3.7 m																			

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22




Brampton, Ontario

RECORD OF BOREHOLE No BH21-09A

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904103.6, E301315.4, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.09 - 2021.12.09 LATITUDE 44.2769273 LONGITUDE -76.5436534 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								20 40 60 80 100	W _p	W	W _L	20 40 60			
							○ UNCONFINED + FIELD VANE								
							● QUICK TRIAXIAL P. PENETROMETER								
103.6	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, dry, very dense		SS1	SS	56		103						○		Corrosivity Sample
0.0			SS2	SS	58								○		
			SS3	SS	70								○		
101.6															
2.0	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ			101								REC = 100% RQD = 10%
			Run 2	NQ											
			Run 3	NQ											
			Run 4	NQ											
96.3	BOREHOLE TERMINATED AT ~ 7.3 m DEPTH						97								REC = 100% RQD = 87%
7.3															
	Note: 1. Borehole dry in open hole prior to rock coring at 2.0 m														

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

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

Brampton, Ontario

RECORD OF BOREHOLE No BH21-10

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4903968.7, E302142.0, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.16 - 2021.12.16 LATITUDE 44.2757166 LONGITUDE -76.5332975 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 (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER												
94.1							20	40	60	80	100						GR	SA	SI	CL
0.0	ASPHALT, ~ 175 mm thick																			
93.9																				
0.2	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, dry to moist, dense to very dense		SS1	SS	94															
			SS2	SS	44															
			SS3	SS	54/ 0.2m															
92.1																				
2.0	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ																
			Run 2	NQ																
			Run 3	NQ																
88.4																				
5.7	BOREHOLE TERMINATED AT ~ 5.7 m DEPTH Note: 1. Borehole dry in open hole prior to rock coring at 2.0 m																			

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

Brampton, Ontario

RECORD OF BOREHOLE No BH21-11

1 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4903539.6, E303285.2, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.20 - 2021.12.20 LATITUDE 44.2718579 LONGITUDE -76.5189751 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
88.1								20 40 60 80 100		20 40 60				GR SA SI CL
0.0	ASPHALT, ~ 200 mm thick						88							
87.9														
0.2	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, dry to moist, very dense		SS1	SS	81									
			SS2											
87.0			SS3	SS	25		87							
1.1	CLAYEY SILT TO SILTY CLAY, some sand, trace gravel, brownish grey to grey, moist to wet, stiff													1 11 50 38
			SS4	SS	11									
			SS5	SS	8		86							6 7 31 56
														Corrosivity Sample
	very soft at 3.2 m depth		SS6	SS	2		85							
	very stiff at 4.0 m depth		SS7	SS	17		84							
			SS8	SS	8		83							0 1 34 65
			SS9	SS	9									
							82							
			SS10	SS	10									
			Vane	VANE			81	3.8						
	measured vane shear strength greater than 50 kPa at 7.4 m firm at 7.6 m depth													
			SS11	SS	6									0 1 76 23

Continued Next Page

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

METRIC

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

Brampton, Ontario

RECORD OF BOREHOLE No BH21-12

1 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4903230.7, E304790.9, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.21 - 2021.12.21 LATITUDE 44.2690792 LONGITUDE -76.500114 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			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL P. PENETROMETER									
88.0	ASPHALT, ~ 150 mm thick																	
87.9																		
0.2	SANDY GRAVEL (FILL), trace silt, trace clay, grey, dry to moist, very dense to dense		SS1	SS	106													
			SS2	SS	113													
			SS3	SS	33													
	compact below ~ 2.1 m depth																	
			SS4	SS	14													
	No recovery in split spoon from 3.0 m to 5.3 m due to possible rock			NR	13													
				NR	14													
				NR	13													
82.7																		
5.3	SILTY CLAY, trace sand, trace gravel, brownish grey to grey, moist, stiff to hard		SS5	SS	14													
			SS6	SS	18													
			SS7	SS	26													
			SS8	SS	34													

Continued Next Page

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

METRIC

DATUM CGVD28 DATE 2021.12.21 - 2021.12.21 LATITUDE 44.2690792 LONGITUDE -76.500114 CHECKED BY SM

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

ONTARIO MTO ADM-00263421-E0 - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

Brampton, Ontario

RECORD OF BOREHOLE No BH21-13

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4903516.8, E305884.4, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.16 - 2021.12.16 LATITUDE 44.2716534 LONGITUDE -76.4864164 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			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER											
110.8 0.0	ASPHALT, ~ 300 mm thick							20	40	60	80	100		20	40	60			
110.5 0.3	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, dry to moist, very dense		SS1	SS	113/ 0.28m		110						○					47 45 (8) Corrosivity Sample	
													○						
			SS2	SS	107														
109.1 1.7	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ			109											REC = 100% RQD = 67%	
							108												
			Run 2	NQ			107											UCS test at 4.0 m depth = 185.1 MPa REC = 100% RQD = 55%	
							106												
			Run 3	NQ			105											REC = 100% RQD = 76%	
							104											REC = 100% RQD = 84%	
			Run 4	NQ															
103.6 7.2	BOREHOLE TERMINATED AT ~ 7.2 m DEPTH Note: 1. Borehole dry in open hole prior to rock coring at 1.7 m																		

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22



Brampton, Ontario

RECORD OF BOREHOLE No BH21-14

1 OF 1

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904157.7, E306879.0, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.10 - 2021.12.10 LATITUDE 44.2774196 LONGITUDE -76.4739551 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			SHEAR STRENGTH kPa										
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER																		
96.2 0.0	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, moist, compact		SS1	SS	26		96										Corrosivity Sample 44 50 (6)	
			SS2	SS	21			95										
94.4 1.8	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		SS3	SS	29/ 0.1m												UCS test at 2.7 m depth = 169.4 MPa REC = 100% RQD = 72%	
			Run 1	NQ			94											
			Run 2	NQ			93										REC = 100% RQD = 94%	
			Run 3	NQ			92											
90.9 5.3	BOREHOLE TERMINATED AT ~ 5.3 m DEPTH Note: 1. Borehole dry in open hole prior to rock coring at 1.8 m						91									REC = 91% RQD = 77%		

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22



Brampton, Ontario

RECORD OF BOREHOLE No BH21-15

1 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904605.2, E308228.5, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.14 - 2021.12.14 LATITUDE 44.2814422 LONGITUDE -76.4570461 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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL & P. PENETROMETER		W _P	W	W _L			WATER CONTENT (%)			
77.3 0.0	SAND AND GRAVEL (FILL), trace silt, trace clay, grey, dry, compact		SS1	SS	23		77											
76.2 1.1			SS2	SS	6		76											
very stiff below 2.3 m depth	SS3	SS	13	75														
	SS4	SS	25	74														
	SS5	SS	29	73														
	SS6	SS	20	72														
stiff below ~ 4.6 m depth	SS7	SS	12	71														
	SS8	SS	11	70														
	SS9	SS	13															
measured vane shear strength greater than 50 kPa at 7.0 m	Vane	VANE																
	SS10	SS	6/ 0.2m															
69.5 7.8																		

Continued Next Page

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

Brampton, Ontario

RECORD OF BOREHOLE No BH21-16

1 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904981.9, E309393.3, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.14 - 2021.12.15 LATITUDE 44.2848262 LONGITUDE -76.4424496 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _P W W _L				
77.4								20 40 60 80 100						
0.0	TOPSOIL, ~ 80 mm thick													
0.1	CLAYEY SILT TO SILTY CLAY, trace sand, trace gravel, trace organics, brownish grey to grey, moist to wet, stiff to very stiff		SS1	SS	11		77							
			SS2	SS	13		76							Corrosivity Sample
	no organics below ~ 1.5 m depth													
			SS3	SS	18									1 4 42 53
							75							
			SS4	SS	12									0 1 37 62
			SS5	SS	13		74							
			SS6	SS	9		73							
	firm below ~ 4.6 m depth													
			SS7	SS	6									
72.0			SS8	SS	2/0.1m		72							
5.4	BEDROCK, granite, reddish pink and grey, intensely to slightly fractured, medium to coarse grained, hard to very hard, slightly weather to fresh		Run 1	NQ										UCS test at 5.8 m depth = 229.9 MPa REC = 100% RQD = 92%
			Run 2	NQ			71							
							70							REC = 100% RQD = 100%

Continued Next Page

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

Brampton, Ontario

RECORD OF BOREHOLE No BH21-16

2 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4904981.9, E309393.3, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.14 - 2021.12.15 LATITUDE 44.2848262 LONGITUDE -76.4424496 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 (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL P. PENETROMETER													
			Run 3	NQ				20	40	60	80	100	20	40	60		REC = 100% RQD = 67%					
69.0 8.4	BOREHOLE TERMINATED AT ~ 8.4 m DEPTH Notes: 1. Groundwater level was measured in open hole prior to commencement of rock coring at 3.4 m depth 2. Artesian groundwater conditions encountered within the bedrock							69														

Brampton, Ontario

RECORD OF BOREHOLE No BH21-17

1 OF 2

METRIC

W.P. Agreement No. 4020-E-0008, Assg. No. 5 LOCATION N4905378.7, E310381.0, NAD83 MTM Zone 9 ORIGINATED BY EL
 DIST E HWY 401 BOREHOLE TYPE Continuous Flight HSA, NW Casing, and NQ Core Barrel COMPILED BY EL
 DATUM CGVD28 DATE 2021.12.15 - 2021.12.15 LATITUDE 44.2883906 LONGITUDE -76.4300703 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
113.8								20	40	60	80	100					
0.0	TOPSOIL, ~ 125 mm thick																
0.1	SAND AND GRAVEL (FILL), trace silt, trace clay, grey to brownish grey, dry to moist, compact to dense		SS1	SS	13		113										
			SS2	SS	46												
			SS3	SS	43		112										
111.8	CLAYEY SILT, some sand, some gravel, grey, moist, stiff																
2.0			SS4	SS	11		111										
	trace sand below ~ 3.0 m depth																
			SS5	SS	9												
110.3	BEDROCK, shaly limestone/dolostone, grey to dark grey, intensely to slightly fractured, fine grained, moderately hard to hard, slightly weathered to fresh		Run 1	NQ			110										
3.5							109										
			Run 2	NQ			108										
			Run 3	NQ			107										
106.2	BOREHOLE TERMINATED AT ~ 7.6 m DEPTH																
7.6																	
	Notes:																

Continued Next Page

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

ONTARIO MTO ADM-00263421-EO - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

METRIC

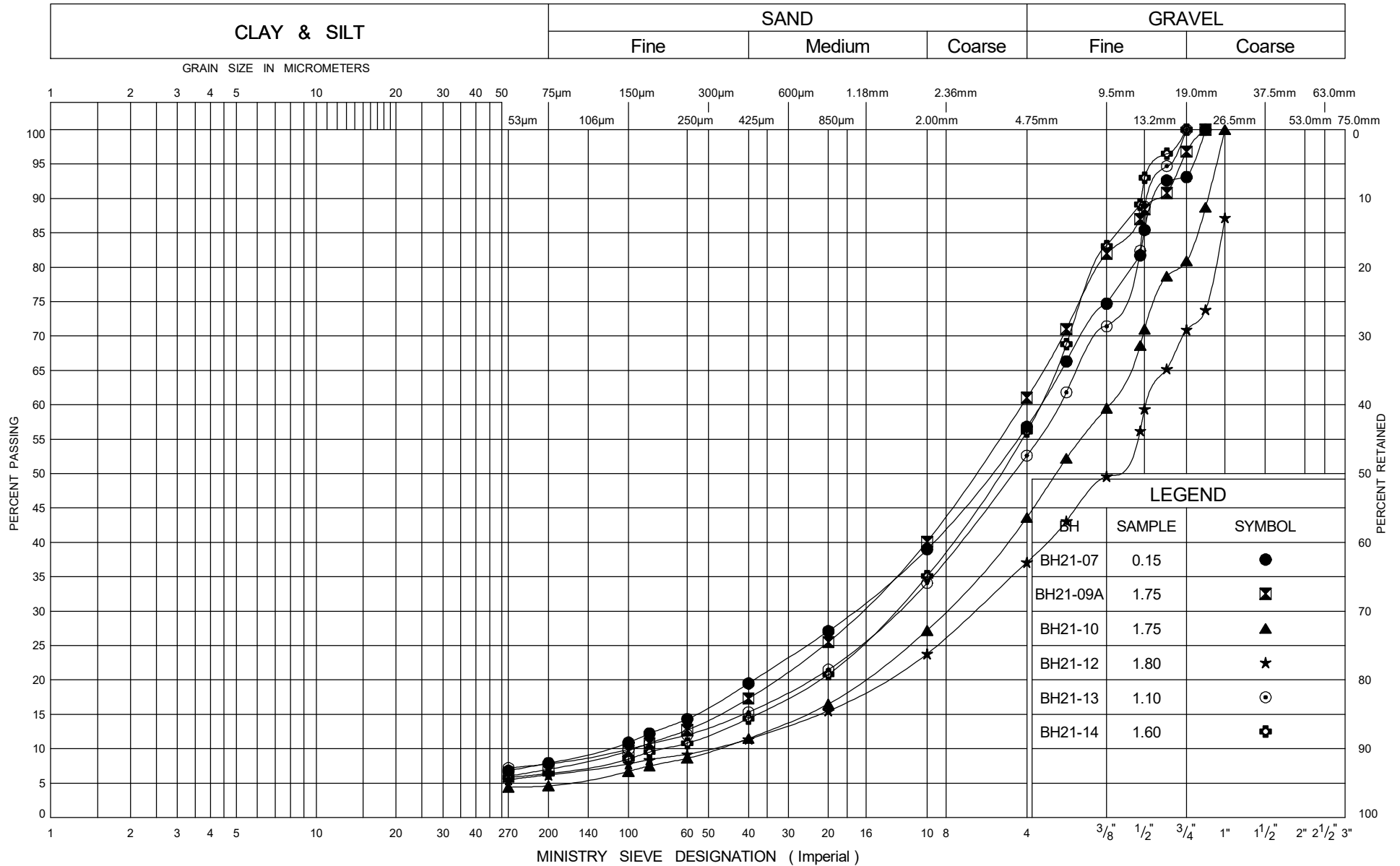
DATUM CGVD28 DATE 2021.12.15 - 2021.12.15 LATITUDE 44.2883906 LONGITUDE -76.4300703 CHECKED BY SM

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

ONTARIO MTO ADM-00263421-E0 - ASSIGNMENT 5.GPJ ONTARIO MTO.GDT 1/27/22

Appendix D – Laboratory Data and Bedrock Photos

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

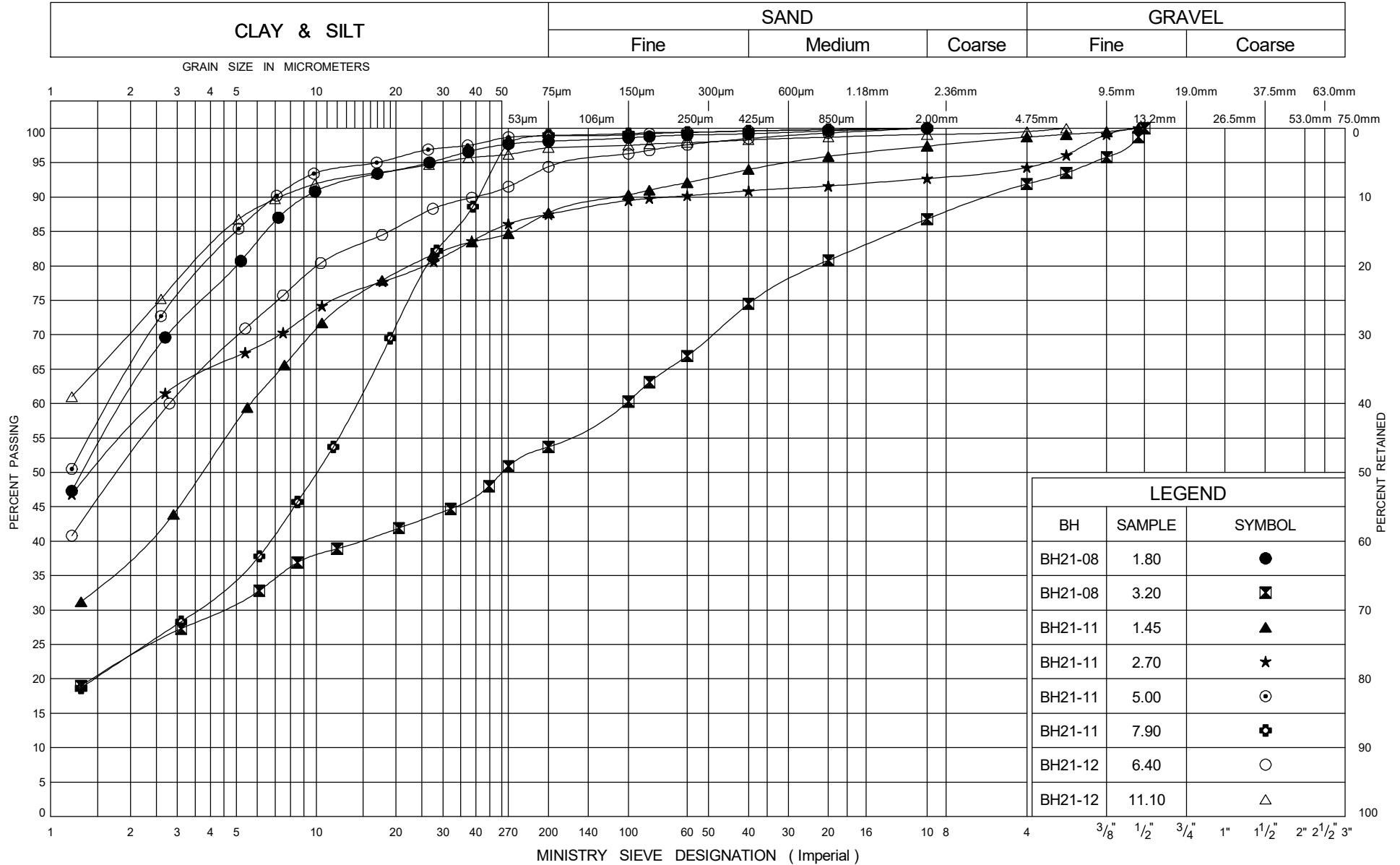
Sand and Gravel to Sandy Gravel (FILL)

FIG No 1

W-P Agreement No. 4020-E-0008

CCTV Hwy. 401 Kingston

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

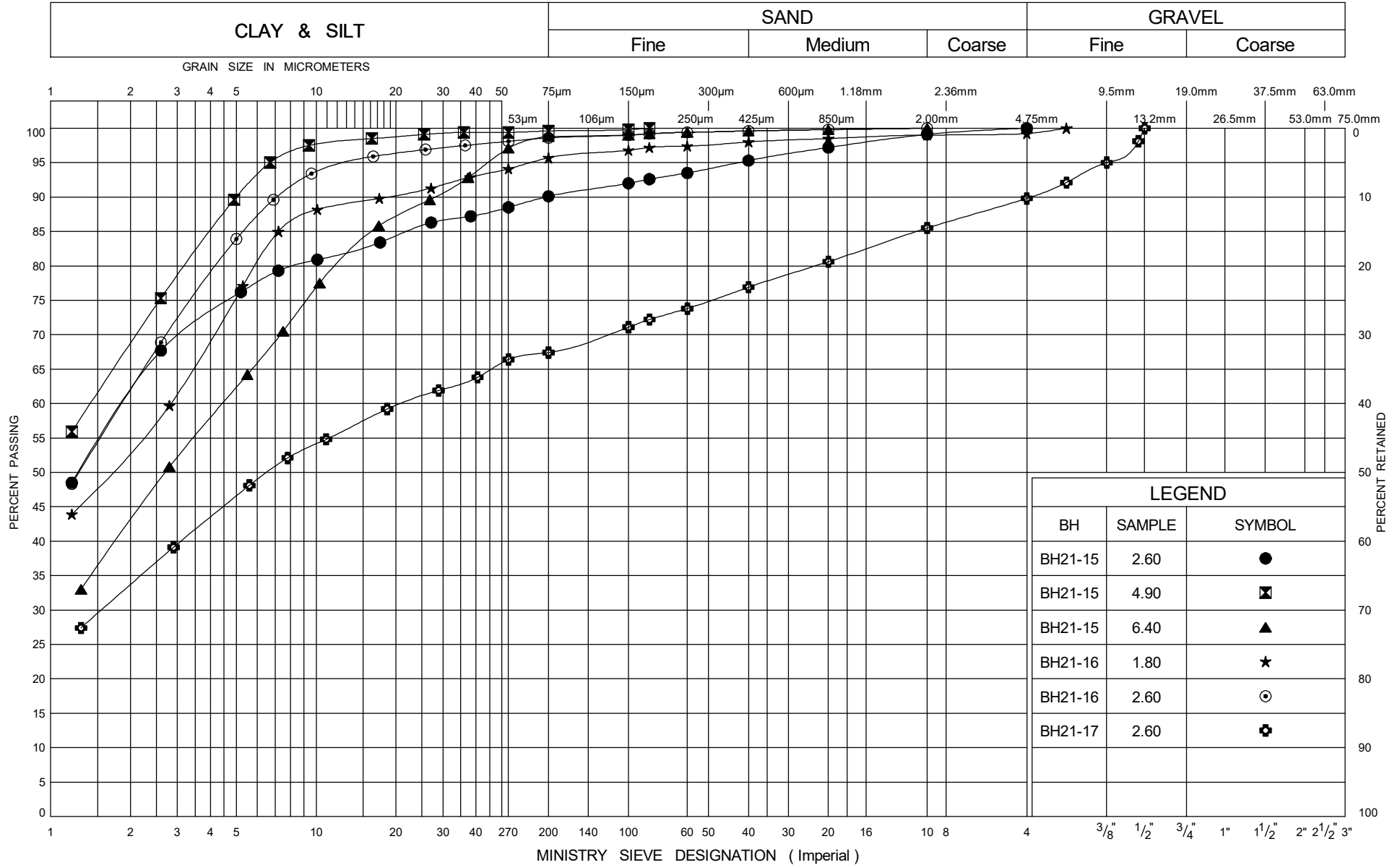
Clayey Silt to Silty Clay

FIG No 2

W-P Agreement No. 4020-E-0008

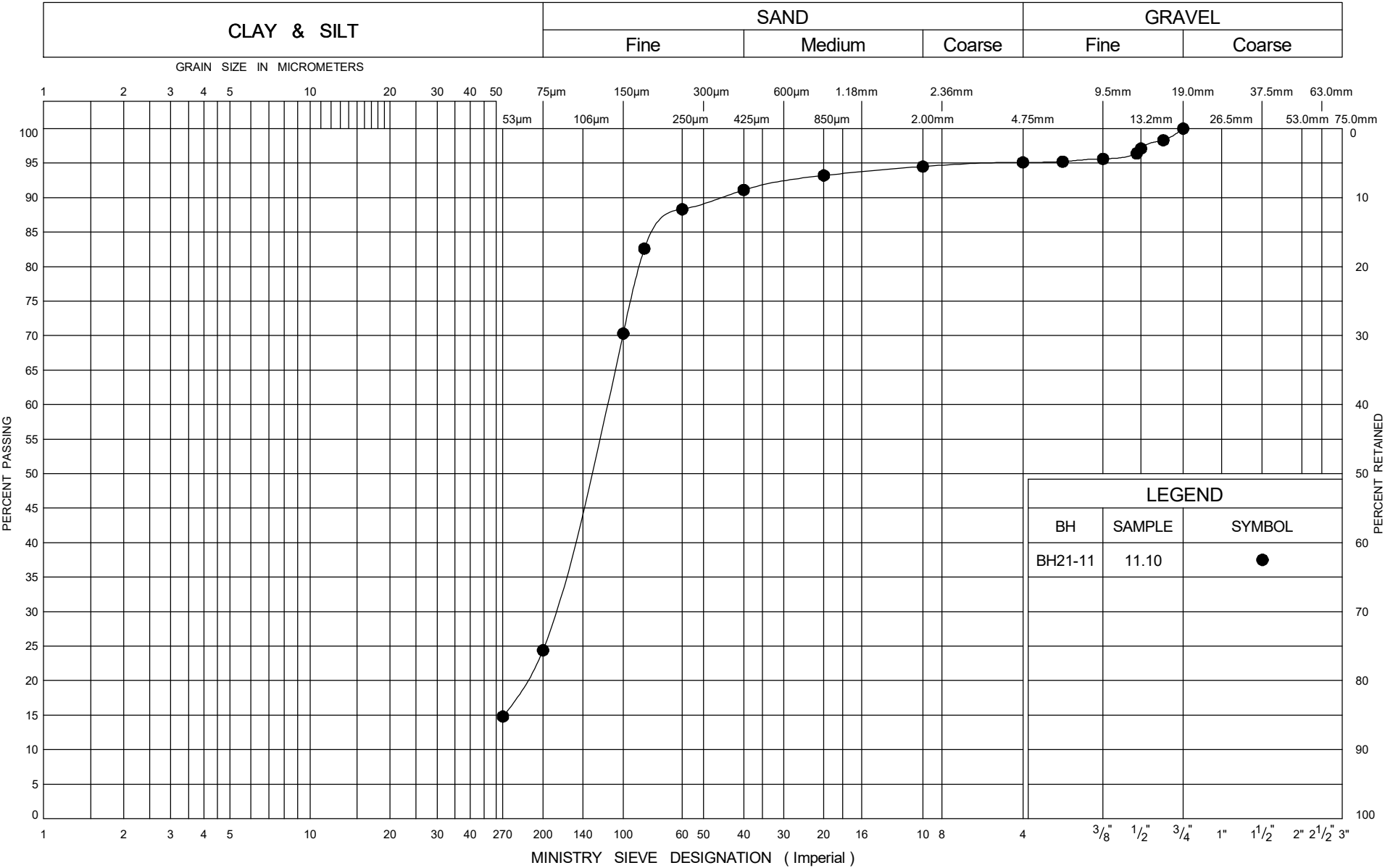
CCTV Hwy. 401 Kingston

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
BH21-15	2.60	●
BH21-15	4.90	⊠
BH21-15	6.40	▲
BH21-16	1.80	★
BH21-16	2.60	⊙
BH21-17	2.60	⊕

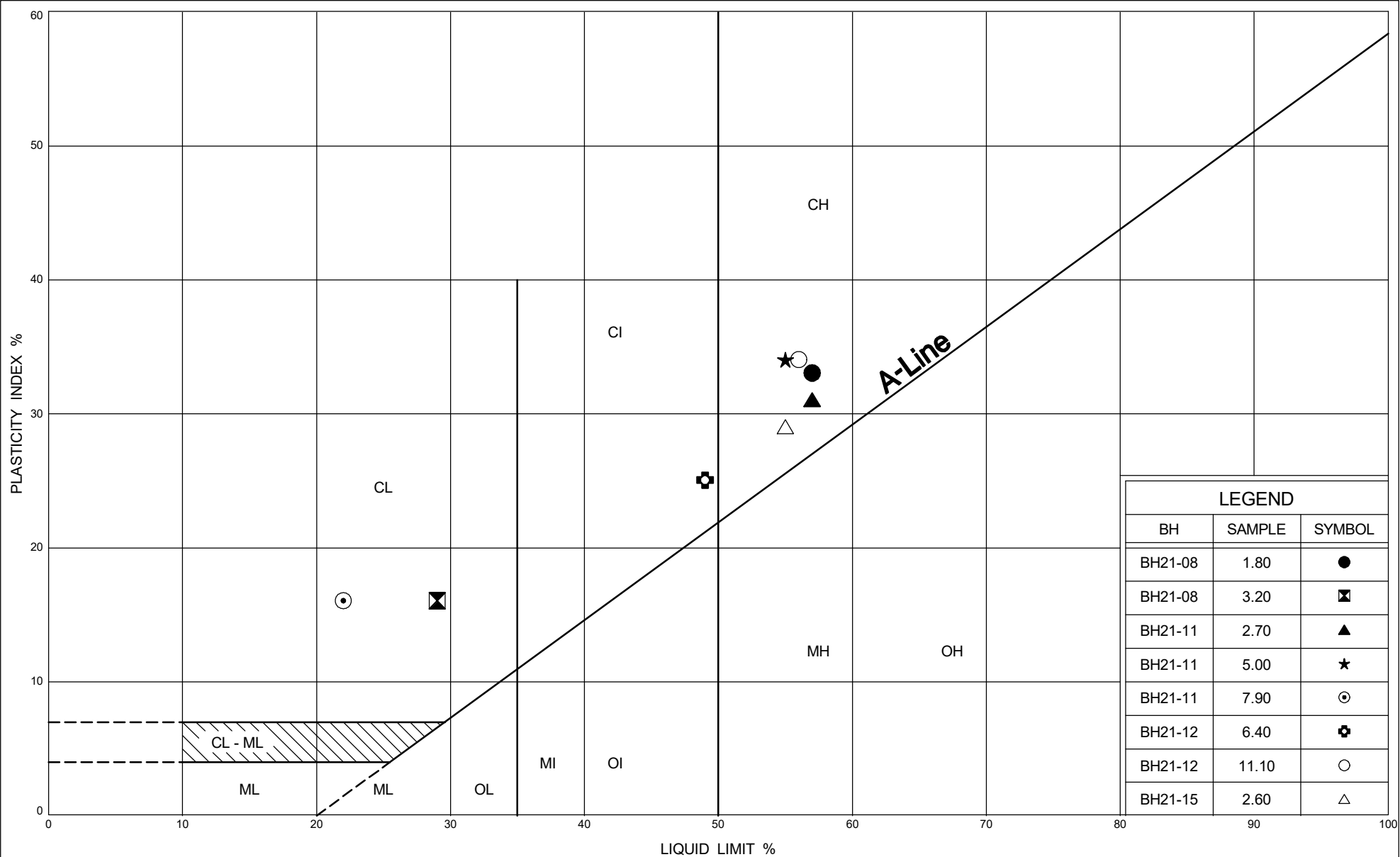
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Sand

FIG No 4
W-P Agreement No. 4020-E-0008
CCTV Hwy. 401 Kingston



Ministry of
Transportation

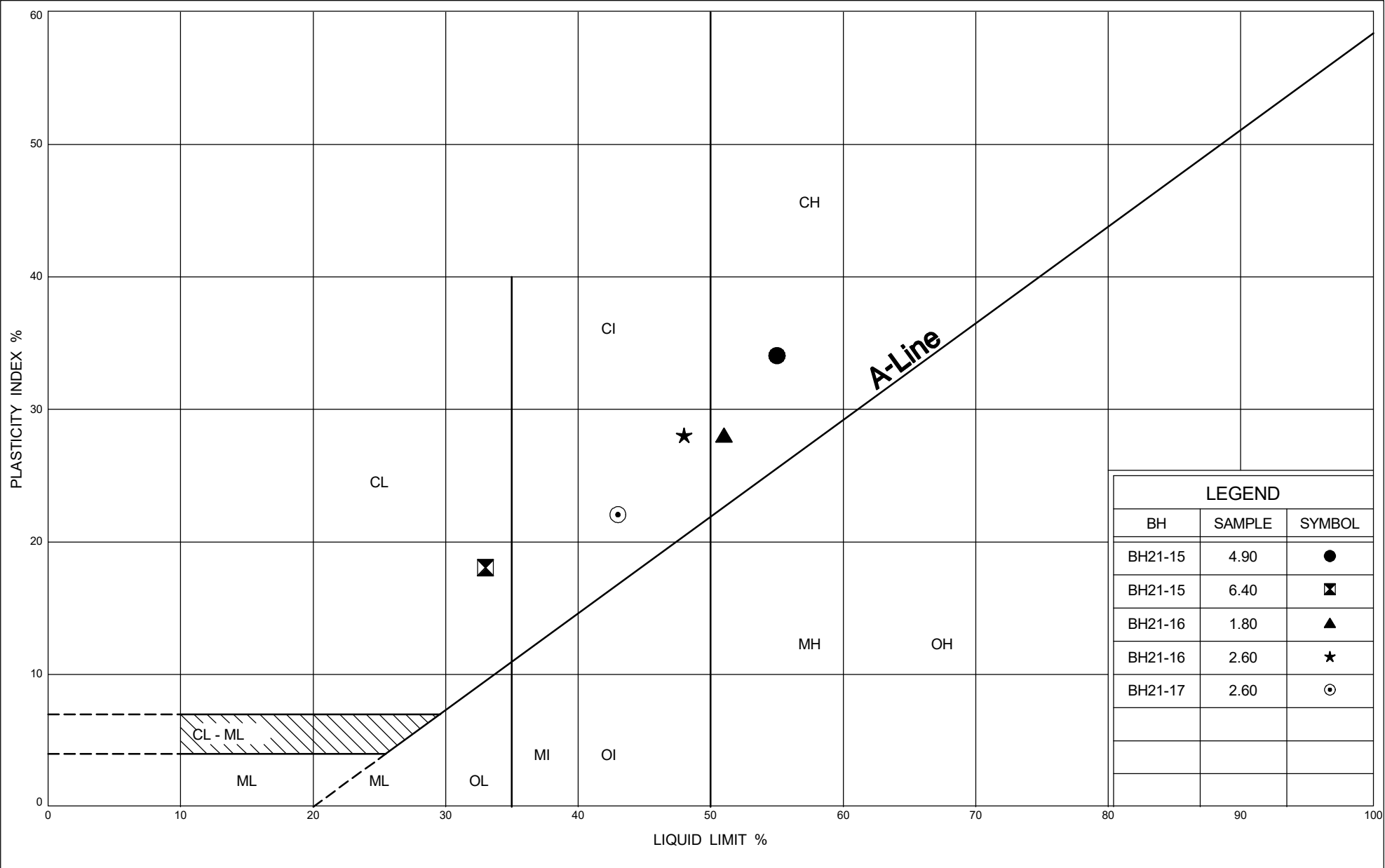
PLASTICITY CHART

Clayey Silt to Silty Clay

FIG No 5

W-P Agreement No. 4020-E-0008

CCTV Hwy. 401 Kingston





exp Services Inc.
1595 Clark Boulevard
Brampton, Ontario, L6T 4V1
Tel: (905) 793-9800
Fax: (905) 793-0641
www.exp.com

Uniaxial Compressive Strength of Rock Cores

Project Number: ADM-00263421-E0

Project Name: UCS Testing

Date: January 11, 2022

Sample No.	BH21-07	BH21-08	BH21-09A	BH21-10	BH21-13	BH21-14
Location	3'	14'10"	13'4"	15'2"	13'	8'11"
Date Cored	-	-	-	-	-	-
Date Tested	Jan 10	Jan 10	Jan 10	Jan 10	Jan 10	Jan 10
Height – [mm]	146	137	148	144	141	142
Average Diameter – [mm]	63	63	63	63	63	63
Area [mm ²]	3117.2	3117.2	3117.2	3117.2	3117.2	3117.2
L/D Ratio	2.32	2.17	2.35	2.29	2.24	2.25
Failure Load [kN]	474.78	500.29	630.97	512.58	576.98	528.17
Compressive Strength – [MPa]	152.3	160.5	202.4	164.4	185.1	169.4
Run Number	1	1	2	2	2	1
Remarks					Samples from Run 1 couldn't be used	

ASTM D4543: Preparing Rock Cores as Cylindrical Test Specimens and Verifying Conformance to Dimensional And Shape Tolerances

ASTM D7012: Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

L/D Ratio: 2.0- 2.5

Minimum Diameter: 47.0 mm



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Brampton, Ontario, L6T 4V1
Tel: (905) 793-9800
Fax: (905) 793-0641
www.exp.com

Uniaxial Compressive Strength of Rock Cores

Sample No.	BH21-15	BH21-16	BH21-17			
Location	27'5"	19'	14'6"			
Date Cored	-	-	-			
Date Tested	Jan 10	Jan 10	Jan 10			
Height – [mm]	146	145	149			
Average Diameter – [mm]	63	63	63			
Area [mm ²]	3117.2	3117.2	3117.2			
L/D Ratio	2.32	2.30	2.37			
Failure Load [kN]	681.58	716.80	646.01			
Compressive Strength – [MPa]	218.6	229.9	207.2			
Run Number	1	1	1			
Remarks						

ASTM D4543: Preparing Rock Cores as Cylindrical Test Specimens and Verifying Conformance to Dimensional And Shape Tolerances

ASTM D7012: Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

L/D Ratio: 2.0- 2.5

Minimum Diameter: 47.0 mm

Testing Laboratory Representative Signature
Mark Kennedy, C.E.T.

January 11, 2022

Date

exp Services Inc.

1595 Clark Blvd.
Brampton, Ontario, L6T 4V1
Tel.: (905) 793-9800
Fax.: (905) 793-0641
www.exp.com

Moisture Content (ST01)

Project_No: ADM-00263421-E0 200

Test Started: 12/29/2021

Project_Name: Labwork

Project PM: Silvana Micic

<i>(Test No)</i>	<i>(Borehole No)</i>	<i>(Sample Method)</i>	<i>(Sample No)</i>	<i>(Depth)</i>	<i>(Moisture %)</i>	<i>(Test Status)</i>
388764-1	BH 21-16	SS	1		38.9	Distributed
388765-1	BH 21-16	SS	2		35.4	Distributed
388766-1	BH 21-16	SS	3		31.8	Distributed
388767-1	BH 21-16	SS	4		36.9	Distributed
388768-1	BH 21-16	SS	5		34.9	Distributed
388769-1	BH 21-16	SS	6		30.3	Distributed
388770-1	BH 21-16	SS	7		33.6	Distributed
388771-1	BH 21-16	SS	8		32.6	Distributed
388772-1	BH 21-15	SS	1		2.7	Distributed
388773-1	BH 21-15	SS	2		33.8	Distributed
388774-1	BH 21-15	SS	3		34.8	Distributed
388775-1	BH 21-15	SS	4		29.0	Distributed
388776-1	BH 21-15	SS	5		31.5	Distributed
388777-1	BH 21-15	SS	6		32.4	Distributed
388778-1	BH 21-15	SS	7		33.0	Distributed
388779-1	BH 21-15	SS	8		29.8	Distributed
388780-1	BH 21-15	SS	9		27.5	Distributed
388781-1	BH 21-15	SS	10		30.1	Distributed
388782-1	BH 21-12	SS	1		3.3	Distributed
388783-1	BH 21-12	SS	2		2.1	Distributed
388784-1	BH 21-12	SS	3		4.8	Distributed
388785-1	BH 21-12	SS	4		4.4	Distributed
388786-1	BH 21-12	SS	5		28.6	Distributed
388787-1	BH 21-12	SS	6		27.5	Distributed
388788-1	BH 21-12	SS	7		18.4	Distributed
388789-1	BH 21-12	SS	8		16.2	Distributed
388790-1	BH 21-12	SS	9		30.8	Distributed
388791-1	BH 21-12	SS	10		31.2	Distributed

<i>(Test No)</i>	<i>(Borehole No)</i>	<i>(Sample Method)</i>	<i>(Sample No)</i>	<i>(Depth)</i>	<i>(Moisture %)</i>	<i>(Test Status)</i>
388792-1	BH 21-12	SS	11		33.5	Distributed
388793-1	BH 21-12	SS	12		37.9	Distributed
388794-1	BH 21-11	SS	1		2.2	Distributed
388795-1	BH 21-11	SS	2		7.5	Distributed
388796-1	BH 21-11	SS	3		28.4	Distributed
388797-1	BH 21-11	SS	4		29.4	Distributed
388798-1	BH 21-11	SS	5		37.3	Distributed
388799-1	BH 21-11	SS	6		33.6	Distributed
388800-1	BH 21-11	SS	7		34.0	Distributed
388801-1	BH 21-11	SS	8		35.3	Distributed
388802-1	BH 21-11	SS	9		32.0	Distributed
388803-1	BH 21-11	SS	10		30.0	Distributed
388804-1	BH 21-11	SS	11		29.4	Distributed
388805-1	BH 21-11	SS	12		19.1	Distributed
388806-1	BH 21-11	SS	13		15.6	Distributed
388807-1	BH 21-11	SS	14		16.5	Distributed
388808-1	BH 21-13	SS	1		5.1	Distributed
388809-1	BH 21-13	SS	2		4.4	Distributed
388810-1	BH 21-17	SS	1		5.2	Distributed
388813-1	BH 21-17	SS	4		15.3	Distributed
388814-1	BH 21-17	SS	5		27.2	Distributed
388815-1	BH 21-10	SS	1		3.5	Distributed
388816-1	BH 21-10	SS	2		3.4	Distributed
388817-1	BH 21-10	SS	3		5.2	Distributed
388818-1	BH 21-14	SS	1		6.7	Distributed
388819-1	BH 21-14	SS	2		7.6	Distributed
388820-1	BH 21-14	SS	3		6.5	Distributed
388821-1	BH 21-8	SS	1		55.8	Distributed
388822-1	BH 21-8	SS	2		34.2	Distributed
388823-1	BH 21-8	SS	3		32.2	Distributed
388824-1	BH 21-8	SS	4		29.0	Distributed
388825-1	BH 21-8	SS	5		14.1	Distributed
388826-1	BH 21-8	SS	6		7.6	Distributed
388827-1	BH 21-7	SS	1		3.8	Distributed
388828-1	BH 21-9A	SS	1		3.4	Distributed
388829-1	BH 21-9A	SS	2		2.2	Distributed
388830-1	BH 21-9A	SS	3		2.5	Distributed



Your P.O. #: GEO
 Your Project #: ADM-00263421-E0
 Site Location: KINGSTON, ON
 Your C.O.C. #: n/a

Attention: Silvana Micic

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

Report Date: 2022/01/18
 Report #: R6967146
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1AF803

Received: 2021/12/29, 12:02

Sample Matrix: Soil
 # Samples Received: 11

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	1	2022/01/18	2022/01/18	CAM SOP-00463	SM 23 4500-Cl E m
Chloride (20:1 extract)	10	2022/01/04	2022/01/06	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	1	2022/01/18	2022/01/18	CAM SOP-00414	OMOE E3530 v1 m
Conductivity	10	2022/01/04	2022/01/04	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 3)	11	N/A	2022/01/06	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	11	N/A	2022/01/05	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	11	2021/12/31	2021/12/31	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	1	2022/01/13	2022/01/18	CAM SOP-00414	SM 23 2510 m
Resistivity of Soil	10	2021/12/29	2022/01/04	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	1	2022/01/18	2022/01/18	CAM SOP-00464	EPA 375.4 m
Sulphate (20:1 Extract)	10	2022/01/04	2022/01/05	CAM SOP-00464	EPA 375.4 m
Redox Potential (2, 4)	11	N/A	N/A		

Remarks:

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

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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

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



Your P.O. #: GEO
Your Project #: ADM-00263421-E0
Site Location: KINGSTON, ON
Your C.O.C. #: n/a

Attention: Silvana Micic

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

Report Date: 2022/01/18
Report #: R6967146
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1AF803

Received: 2021/12/29, 12:02

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) This test was performed by Eurofins Environment Testing Canada, 146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1
- (3) Offsite analysis requires that subcontracted moisture be reported.
- (4) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

Encryption Key

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

Patricia Legette, Project Manager

Email: Patricia.Legette@bureauveritas.com

Phone# (905)817-5799

=====

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

**SOIL CORROSIVITY PACKAGE (SOIL)**

Bureau Veritas ID		RMO061		RMO062			RMO062		
Sampling Date		2021/12/07 09:30		2021/12/09 08:30			2021/12/09 08:30		
COC Number		n/a		n/a			n/a		
	UNITS	BH21-07 SS1	QC Batch	BH21-08 SS3	RDL	QC Batch	BH21-08 SS3 Lab-Dup	RDL	QC Batch

Calculated Parameters

Resistivity	ohm-cm	4900	7758147	650		7758147			
-------------	--------	------	---------	-----	--	---------	--	--	--

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	20	7762905	850	20	7762905			
Conductivity	umho/cm	202	7762826	1540	2	7762826	1530	2	7762826
Available (CaCl2) pH	pH	7.74	7761256	7.73		7761256			
Soluble (20:1) Sulphate (SO4)	ug/g	51	7762910	45	20	7762910	42	20	7762910
Sulphide	mg/kg	4.5 (1)	7767494	4.1 (2)	0.5	7767494			

Physical Testing

Moisture-Subcontracted	%	0.50	7768613	21	0.30	7768614			
------------------------	---	------	---------	----	------	---------	--	--	--

Subcontracted Analysis

Subcontract Parameter	mV	ATTACHED	7775760	ATTACHED	N/A	7775760			
-----------------------	----	----------	---------	----------	-----	---------	--	--	--

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable

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

Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time

(2) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RMO063	RMO064	RMO065		RMO066		
Sampling Date		2021/12/09 12:30	2021/12/16 09:30	2021/12/20 09:30		2021/12/21 09:30		
COC Number		n/a	n/a	n/a		n/a		
	UNITS	BH21-9A SS2	BH21-10 SS2	BH21-11 SS5	QC Batch	BH21-12 SS6	RDL	QC Batch

Calculated Parameters								
Resistivity	ohm-cm	4000	2200	1000	7758147	850		7758147
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	64	25	410	7762905	470	20	7762905
Conductivity	umho/cm	250	455	955	7762826	1180	2	7762826
Available (CaCl2) pH	pH	7.96	7.78	7.46	7761256	7.53		7761256
Soluble (20:1) Sulphate (SO4)	ug/g	74	390	35	7762910	300	20	7762910
Sulphide	mg/kg	5.6 (1)	5.6 (1)	0.8 (2)	7767494	1.0 (2)	0.5	7767494
Physical Testing								
Moisture-Subcontracted	%	1.5	4.4	32	7768614	22	0.30	7768613
Subcontracted Analysis								
Subcontract Parameter	mV	ATTACHED	ATTACHED	ATTACHED	7775760	ATTACHED	N/A	7775760

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

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

(2) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803
Report Date: 2022/01/18

exp Services Inc
Client Project #: ADM-00263421-E0
Site Location: KINGSTON, ON
Your P.O. #: GEO
Sampler Initials: EL

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RMO067			RMO067			RMO068		
Sampling Date		2021/12/16 12:30			2021/12/16 12:30			2021/12/10 08:30		
COC Number		n/a			n/a			n/a		
	UNITS	BH21-13 SS2	RDL	QC Batch	BH21-13 SS2 Lab-Dup	RDL	QC Batch	BH21-14 SS2	RDL	QC Batch

Calculated Parameters

Resistivity	ohm-cm							1300		7758147
-------------	--------	--	--	--	--	--	--	------	--	---------

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	91	20	7785642				470	20	7762905
Conductivity	umho/cm	1240	2	7785599	1230	2	7785599	792	2	7762826
Available (CaCl2) pH	pH	7.78		7761256				7.98		7761256
Soluble (20:1) Sulphate (SO4)	ug/g	1200	40	7785647				150	20	7762910
Sulphide	mg/kg	4.2 (1)	0.5	7767494				5.4 (2)	0.5	7767494

Physical Testing

Moisture-Subcontracted	%	2.8	0.30	7768613				5.0	0.30	7768614
------------------------	---	-----	------	---------	--	--	--	-----	------	---------

Subcontracted Analysis

Subcontract Parameter	mV	ATTACHED	N/A	7775760				ATTACHED	N/A	7775760
-----------------------	----	----------	-----	---------	--	--	--	----------	-----	---------

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable

(1) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time

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



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803
Report Date: 2022/01/18

exp Services Inc
Client Project #: ADM-00263421-E0
Site Location: KINGSTON, ON
Your P.O. #: GEO
Sampler Initials: EL

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RMO069		RMO070			RMO070	
Sampling Date		2021/12/14 08:30		2021/12/14 14:00			2021/12/14 14:00	
COC Number		n/a		n/a			n/a	
	UNITS	BH21-15 SS3	QC Batch	BH21-16 SS2	RDL	QC Batch	BH21-16 SS2 Lab-Dup	QC Batch

Calculated Parameters

Resistivity	ohm-cm	1200	7758147	980		7758147		
-------------	--------	------	---------	-----	--	---------	--	--

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	340	7762905	390	20	7762905		
Conductivity	umho/cm	855	7762826	1020	2	7762826		
Available (CaCl2) pH	pH	7.46	7761256	7.64		7761256	7.64	7761256
Soluble (20:1) Sulphate (SO4)	ug/g	21	7762910	210	20	7762910		
Sulphide	mg/kg	0.6 (1)	7767494	5.1 (1)	0.5	7767494		

Physical Testing

Moisture-Subcontracted	%	23	7768613	24	0.30	7768614		
------------------------	---	----	---------	----	------	---------	--	--

Subcontracted Analysis

Subcontract Parameter	mV	ATTACHED	7775760	ATTACHED	N/A	7775760		
-----------------------	----	----------	---------	----------	-----	---------	--	--

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable

(1) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction.

Analyzed past method specified hold time



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

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Your P.O. #: GEO

Sampler Initials: EL

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RMO071		
Sampling Date		2021/12/15 12:30		
COC Number		n/a		
	UNITS	BH21-17 SS3	RDL	QC Batch
Calculated Parameters				
Resistivity	ohm-cm	820		7758147
Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	490	20	7762905
Conductivity	umho/cm	1220	2	7762826
Available (CaCl ₂) pH	pH	7.33		7761256
Soluble (20:1) Sulphate (SO ₄)	ug/g	<20	20	7762910
Sulphide	mg/kg	1.0 (1)	0.5	7767494
Physical Testing				
Moisture-Subcontracted	%	22	0.30	7768613
Subcontracted Analysis				
Subcontract Parameter	mV	ATTACHED	N/A	7775760
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time				



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

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Your P.O. #: GEO

Sampler Initials: EL

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		RMO067	
Sampling Date		2021/12/16 12:30	
COC Number		n/a	
	UNITS	BH21-13 SS2	QC Batch
Calculated Parameters			
Resistivity	ohm-cm	810	7780330
QC Batch = Quality Control Batch			



BUREAU
VERITAS

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Report Date: 2022/01/18

exp Services Inc

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Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: RMO061
Sample ID: BH21-07 SS1
Matrix: Soil

Collected: 2021/12/07
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768613	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO062
Sample ID: BH21-08 SS3
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO062 Dup
Sample ID: BH21-08 SS3
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan

Bureau Veritas ID: RMO063
Sample ID: BH21-9A SS2
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: RMO063
Sample ID: BH21-9A SS2
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO064
Sample ID: BH21-10 SS2
Matrix: Soil

Collected: 2021/12/16
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO065
Sample ID: BH21-11 SS5
Matrix: Soil

Collected: 2021/12/20
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO066
Sample ID: BH21-12 SS6
Matrix: Soil

Collected: 2021/12/21
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768613	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: RMO067
Sample ID: BH21-13 SS2
Matrix: Soil

Collected: 2021/12/16
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7785642	2022/01/18	2022/01/18	Alina Dobreanu
Conductivity	AT	7785599	2022/01/18	2022/01/18	Kien Tran
Moisture (Subcontracted)	BAL	7768613	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7780330	2022/01/18	2022/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7785647	2022/01/18	2022/01/18	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO067 Dup
Sample ID: BH21-13 SS2
Matrix: Soil

Collected: 2021/12/16
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7785599	2022/01/18	2022/01/18	Kien Tran

Bureau Veritas ID: RMO068
Sample ID: BH21-14 SS2
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO069
Sample ID: BH21-15 SS3
Matrix: Soil

Collected: 2021/12/14
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768613	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: RMO070
Sample ID: BH21-16 SS2
Matrix: Soil

Collected: 2021/12/14
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768614	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner

Bureau Veritas ID: RMO070 Dup
Sample ID: BH21-16 SS2
Matrix: Soil

Collected: 2021/12/14
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar

Bureau Veritas ID: RMO071
Sample ID: BH21-17 SS3
Matrix: Soil

Collected: 2021/12/15
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7762905	2022/01/04	2022/01/06	Alina Dobreanu
Conductivity	AT	7762826	2022/01/04	2022/01/04	Kien Tran
Moisture (Subcontracted)	BAL	7768613	N/A	2022/01/06	Parveer Singh
Sulphide in Soil	SPEC	7767494	N/A	2022/01/05	Bailey Morrison
pH CaCl2 EXTRACT	AT	7761256	2021/12/31	2021/12/31	Taslina Aktar
Resistivity of Soil		7758147	2022/01/04	2022/01/04	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7762910	2022/01/04	2022/01/05	Avneet Kour Sudan
Redox Potential	COND	7775760	2022/01/11		Lims Auto Schedule Runner



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

GENERAL COMMENTS

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

Package 1	2.7°C
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Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

QUALITY ASSURANCE REPORT

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

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
7761256	Available (CaCl ₂) pH	2021/12/31			100	97 - 103			0.055	N/A
7762826	Conductivity	2022/01/04			100	90 - 110	<2	umho/cm	0.54	10
7762905	Soluble (20:1) Chloride (Cl ⁻)	2022/01/06	111	70 - 130	103	70 - 130	<20	ug/g	NC	35
7762910	Soluble (20:1) Sulphate (SO ₄)	2022/01/05	NC	70 - 130	103	70 - 130	<20	ug/g	6.9	35
7767494	Sulphide	2022/01/05	88	75 - 125	89	75 - 125	<0.5	mg/kg	NC	30
7768613	Moisture-Subcontracted	2022/01/06					<0.30	%		
7768614	Moisture-Subcontracted	2022/01/06					<0.30	%		
7785599	Conductivity	2022/01/18			98	90 - 110	<2	umho/cm	0.66	10
7785642	Soluble (20:1) Chloride (Cl ⁻)	2022/01/18	NC	70 - 130	106	70 - 130	<20	ug/g	1.2	35
7785647	Soluble (20:1) Sulphate (SO ₄)	2022/01/18	113	70 - 130	101	70 - 130	<20	ug/g	NC	35

N/A = Not Applicable

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

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

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

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

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

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).



BUREAU
VERITAS

Bureau Veritas Job #: C1AF803

Report Date: 2022/01/18

exp Services Inc

Client Project #: ADM-00263421-E0

Site Location: KINGSTON, ON

Your P.O. #: GEO

Sampler Initials: EL

VALIDATION SIGNATURE PAGE

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

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

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

Ewa Pranjić, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



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CHAIN OF CUSTODY RECORD

ENV CDC - 00014v2

Page 1 of 1

Invoice Information				Invoice to (requires report)				Report Information (if differs from invoice)				Project Information			
Company: EXP Services				Company: EXP Services				Quotation #:				29-Dec-21 12:02			
Contact Name: Ivan Barua				Contact Name: Silvana Micic				P.O. #/ AFER: Geo				Patricia Legette			
Street Address: 56 QUEEN ST E. suite 301				Street Address:				Project #: ADM-00263421-E0				C1AF803			
City: BRAMPTON Prov: ON Postal Code:				City: Prov: Postal Code:				Site #: Kingston				DTM DTM 1220			
Phone: 647-518-7208				Phone:				Site Location: ON							
Email: leonardo-ivan.barua@exp.com				Email:				Site Location: ON							
Copies:				Copies:				Sampled By: ELVIS W/ Ivan Barua							
Regulatory Criteria				1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22				Regular Turnaround Time (TAT)							
Table 1 Res/Park Med/Fine Table 2 Ind/Comm Course Table 3 Agri/other For RSC OTHER Reg 153 metals and inorganics Reg 153 CPMS metals Reg 153 CPMS metals HWS - B Carcinogenicity / Substances				Reg 153 CPMS metals HWS - B Carcinogenicity / Substances				Rush Turnaround Time (TAT) Surcharges apply							
Include Criteria on Certificate of Analysis (check if yes):				FIELD FILTERED FIELD PRESERVED LAB FILTRATION REQUIRED BTEX/ F1 P2 - F4 VOCs Reg 153 metals and inorganics Reg 153 CPMS metals Reg 153 CPMS metals HWS - B Carcinogenicity / Substances				Same Day 1 Day 2 Day 3 Day 4 Day							
SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS				Date Sampled Time (24hr) Matrix				Date Required: YY MM DD							
Sample Identification				YY MM DD HH MM				Comments							
1 BH21-07 SS1 21 12 7 9 30															
2 BH21-08 SS3 21 12 9 8 30															
3 BK21-9A SS2 21 12 9 12 30															
4 BH21-10 SS2 21 12 16 9 30															
5 BK21-11 SS5 21 12 20 9 30															
6 BK21-12 SS6 21 12 21 9 30															
7 BH21-13 SS2 21 12 16 12 30															
8 BK21-14 SS2 21 12 10 8 30															
9 BH21-15 SS3 21 12 14 8 30															
10 BH21-16 SS2 21 12 14 14 00															
11 BH21-17 SS3 21 12 15 12 30															
12															
*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY															
LAB USE ONLY Yes No Seal present Seal intact Cooling media present				LAB USE ONLY Yes No Seal present Seal intact Cooling media present				LAB USE ONLY Yes No Seal present Seal intact Cooling media present							
1 2 3				1 2 3				1 2 3							
Relinquished by: (Signature/ Print) Ivan Barua				Received by: (Signature/ Print) Othman, VIDHI BHAYSAR				Special Instructions							
YY MM DD HH MM				YY MM DD HH MM				YY MM DD HH MM							
21 12 29 12 01				2021 012 29 12 02											



6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266

CHAIN OF CUSTODY RECORD

ENV COC - 00014v2

Page 1 of

Invoice Information				Invoice to (requires report)				Report Information (if differs from invoice)				Project Information				29-Dec-21 12:02			
Company: EXP Services				Company: Exp Services				Quotation #:				P.O. #/AFER: Geo				Patricia Legette			
Contact Name: Ivan Barua				Contact Name: Silviana Micu				Project #:				A0M-00263421-EO				C1AF803			
Street Address: 56 Queen St. E Suite 501				Street Address:				Site #:				Kingston				RJM ENV-1320			
City: Brampton Prov: ON Postal Code:				City: Prov: Postal Code:				Site Location:				ON				O			
Phone: 647-518-7208				Phone:				Site Location Province:				Gloria Cu/Ivan Barua							
Email: leonardo-ivan.barua@expco.com				Email:				Sampled By:											
Copies:				Copies:															
Regulatory Criteria				1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22				Regular Turnaround Time (TAT)											
Table 1 Res/Park Med/Fine CCME Reg 406, Table: Table 2 Ind/Comm Course Reg 558* Table 3 Agri/other For RSC *min 3 day TAT MISA Storm Sewer Bylaw PWQO Municipality Other: Include Criteria on Certificate of Analysis (check if yes):				FIELD FILTERED FIELD PRESERVED LAB FILTRATION REQUIRED BTEX/F1 F2 - F4 VOCs Reg 153 metals and inorganics Reg 153 ICPMS metals Reg 153 metals (Hq. Cr-VI, ICPMS metals, HWS - B) Corrosivity Esulphates				# OF CONTAINERS SUBMITTED HOLD - DO NOT ANALYZE				Regular Turnaround Time (TAT) 5 to 7 Day 10 Day Rush Turnaround Time (TAT) Surcharges apply Same Day 1 Day 2 Day 3 Day 4 Day Date Required: YY MM DD Comments							
SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS																			
Sample Identification				Date Sampled Time (24hr) Matrix															
1 BH21-13 SS1				21 12 16 12 30															
2 Notes -																			
3 Relabel sample to BH21-13																			
4 SS 2																			
5 Ref BU Job C1AF803																			
6 cc. Patricia Legette																			
7																			
8																			
9																			
10																			
11																			
12																			
*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY.																			
LAB USE ONLY				LAB USE ONLY				LAB USE ONLY				LAB USE ONLY				Temperature reading by:			
Seal present				Seal present				Seal present				Seal present							
Seal intact				Seal intact				Seal intact				Seal intact							
Cooling media present				Cooling media present				Cooling media present				Cooling media present							
Relinquished by: (Signature/ Print)				Received by: (Signature/ Print)				Special instructions											
1 M. Permeant Mark Permeant				1 M. Permeant Mark Permeant				1 M. Permeant Mark Permeant				1 M. Permeant Mark Permeant							
2				2				2				2							



Your Project #: Campobello job# C1AF803

Attention: Patricia Legette

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

Report Date: 2022/01/06

Report #: R3118580

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C197064

Received: 2021/12/29, 14:38

Sample Matrix: Soil
Samples Received: 11

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Moisture	11	N/A	2022/01/06	AB SOP-00002	CCME PHC-CWS m
Sulphide	11	2022/01/05	2022/01/05	AB SOP-00080	EPA9030B/SM4500S2-DF

Remarks:

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

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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

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

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

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

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



Your Project #: Campobello job# C1AF803

Attention: Patricia Legette

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

Report Date: 2022/01/06

Report #: R3118580

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C197064

Received: 2021/12/29, 14:38

Encryption Key

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

Customer Solutions, Western Canada Customer Experience Team

Email: customersolutionswest@bureauveritas.com

Phone# (403) 291-3077

=====

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AMN819	AMN820	AMN821	AMN822	AMN823	AMN824	AMN825		
Sampling Date		2021/12/07 09:30	2021/12/09 08:30	2021/12/09 12:30	2021/12/16 09:30	2021/12/20 09:30	2021/12/21 09:30	2021/12/16 09:30		
	UNITS	BH21-07 SS1	BH21-08 SS3	BH21-9A SS2	BH21-10 SS2	BH21-11 SS5	BH21-12 SS6	BH21-13 SS2	RDL	QC Batch

Misc. Inorganics

Sulphide	mg/kg	4.5 (1)	4.1 (2)	5.6 (3)	5.6 (3)	0.8 (2)	1.0 (2)	4.2 (2)	0.5	A464238
----------	-------	---------	---------	---------	---------	---------	---------	---------	-----	---------

RDL = Reportable Detection Limit

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

Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time

(2) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time

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

Bureau Veritas ID		AMN826	AMN827	AMN828	AMN829		
Sampling Date		2021/12/10 08:30	2021/12/14 08:30	2021/12/14 14:00	2021/12/15 12:30		
	UNITS	BH21-14 SS2	BH21-15 SS3	BH21-16 SS2	BH21-17 SS3	RDL	QC Batch

Misc. Inorganics

Sulphide	mg/kg	5.4 (1)	0.6 (2)	5.1 (2)	1.0 (2)	0.5	A464238
----------	-------	---------	---------	---------	---------	-----	---------

RDL = Reportable Detection Limit

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

(2) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time



BUREAU
VERITAS

Bureau Veritas Job #: C197064

Report Date: 2022/01/06

BUREAU VERITAS

Client Project #: Campobello job# C1AF803

Sampler Initials: EL

PHYSICAL TESTING (SOIL)

Bureau Veritas ID		AMN819		AMN820	AMN821	AMN822	AMN823		
Sampling Date		2021/12/07 09:30		2021/12/09 08:30	2021/12/09 12:30	2021/12/16 09:30	2021/12/20 09:30		
	UNITS	BH21-07 SS1	QC Batch	BH21-08 SS3	BH21-9A SS2	BH21-10 SS2	BH21-11 SS5	RDL	QC Batch

Physical Properties									
Moisture	%	0.50	A464825	21	1.5	4.4	32	0.30	A464823
RDL = Reportable Detection Limit									

Bureau Veritas ID		AMN824	AMN825		AMN826		AMN827		
Sampling Date		2021/12/21 09:30	2021/12/16 09:30		2021/12/10 08:30		2021/12/14 08:30		
	UNITS	BH21-12 SS6	BH21-13 SS2	QC Batch	BH21-14 SS2	QC Batch	BH21-15 SS3	RDL	QC Batch

Physical Properties									
Moisture	%	22	2.8	A464825	5.0	A464823	23	0.30	A464825
RDL = Reportable Detection Limit									

Bureau Veritas ID		AMN828		AMN829		
Sampling Date		2021/12/14 14:00		2021/12/15 12:30		
	UNITS	BH21-16 SS2	QC Batch	BH21-17 SS3	RDL	QC Batch

Physical Properties						
Moisture	%	24	A464823	22	0.30	A464825
RDL = Reportable Detection Limit						



TEST SUMMARY

Bureau Veritas ID: AMN819
Sample ID: BH21-07 SS1
Matrix: Soil

Collected: 2021/12/07
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464825	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN820
Sample ID: BH21-08 SS3
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN821
Sample ID: BH21-9A SS2
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN822
Sample ID: BH21-10 SS2
Matrix: Soil

Collected: 2021/12/16
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN823
Sample ID: BH21-11 SS5
Matrix: Soil

Collected: 2021/12/20
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN824
Sample ID: BH21-12 SS6
Matrix: Soil

Collected: 2021/12/21
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464825	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison



BUREAU
VERITAS

Bureau Veritas Job #: C197064
Report Date: 2022/01/06

BUREAU VERITAS
Client Project #: Campobello job# C1AF803
Sampler Initials: EL

TEST SUMMARY

Bureau Veritas ID: AMN825
Sample ID: BH21-13 SS2
Matrix: Soil

Collected: 2021/12/16
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464825	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN826
Sample ID: BH21-14 SS2
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN827
Sample ID: BH21-15 SS3
Matrix: Soil

Collected: 2021/12/14
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464825	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN828
Sample ID: BH21-16 SS2
Matrix: Soil

Collected: 2021/12/14
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464823	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison

Bureau Veritas ID: AMN829
Sample ID: BH21-17 SS3
Matrix: Soil

Collected: 2021/12/15
Shipped:
Received: 2021/12/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A464825	N/A	2022/01/06	Parveer Singh
Sulphide	SPEC	A464238	2022/01/05	2022/01/05	Bailey Morrison



**BUREAU
VERITAS**

Bureau Veritas Job #: C197064

Report Date: 2022/01/06

BUREAU VERITAS

Client Project #: Campobello job# C1AF803

Sampler Initials: EL

GENERAL COMMENTS

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C197064

Report Date: 2022/01/06

QUALITY ASSURANCE REPORT

BUREAU VERITAS

Client Project #: Campobello job# C1AF803

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
A464238	Sulphide	2022/01/05	88	75 - 125	89	75 - 125	<0.5	mg/kg	NC	30
A464823	Moisture	2022/01/06					<0.30	%	15	20
A464825	Moisture	2022/01/06					<0.30	%	5.4	20

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

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

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

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

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



BUREAU
VERITAS

Bureau Veritas Job #: C197064

Report Date: 2022/01/06

BUREAU VERITAS

Client Project #: Campobello job# C1AF803

Sampler Initials: EL

VALIDATION SIGNATURE PAGE

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

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

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

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Patricia Legette
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1969612
Date Submitted: 2022-01-06
Date Reported: 2022-01-11
Project: C1AF803
COC #: 884804

Page 1 of 4

Dear Patricia Legette:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Patricia Legette
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1969612
Date Submitted: 2022-01-06
Date Reported: 2022-01-11
Project: C1AF803
COC #: 884804

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1604514 Soil 2021-12-07 RMO061-BH21-07 SS1	1604515 Soil 2021-12-09 RMO062-BH21-08 SS3	1604516 Soil 2021-12-09 RMO063-BH21-9A SS2	1604517 Soil 2021-12-16 RMO064-BH21-10 SS2
Redox Potential	REDOX Potential		mV			337	283	296	259

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1604518 Soil 2021-12-20 RMO065-BH21-11 SS5	1604519 Soil 2021-12-21 RMO066-BH21-12 SS6	1604520 Soil 2021-12-16 RMO067-BH21-13 SS2	1604521 Soil 2021-12-10 RMO068-BH21-14 SS2
Redox Potential	REDOX Potential		mV			226	234	247	233

Guideline = * = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Patricia Legette
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1969612
Date Submitted: 2022-01-06
Date Reported: 2022-01-11
Project: C1AF803
COC #: 884804

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.		
					1604522 Soil 2021-12-14 RMO069-BH21-15 SS3	1604523 Soil 2021-12-14 RMO070-BH21-16 SS2	1604524 Soil 2021-12-15 RMO071-BH21-17 SS3
Redox Potential	REDOX Potential		mV		239	250	210

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Patricia Legette
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1969612
Date Submitted: 2022-01-06
Date Reported: 2022-01-11
Project: C1AF803
COC #: 884804

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 415199 Analysis/Extraction Date 2022-01-07 Analyst MW Method C SM2580B			
REDOX Potential	181 mV	99	

Guideline = * = **Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Sent to: **Bureau Veritas Calgary (19th)**
4000 19th Street NE
Calgary, AB, T2E 6P8
Tel: (403) 291-3077

Sent To: Eurofins Environment Testing Canada
146 Colonnade Road, Unit #8
Ottawa, ON, K2E 7Y1
Tel: (613) 727-5692

Sent To: **Eurofins Environment Testing Canada**
146 Colonnade Road, Unit #8
Ottawa, ON, K2E 7Y1
Tel: (613) 727-5692



Photograph D1. Run 1 (Top) and Run 2 (Bottom), rock core from BH21-07



Photograph D2. Run 3, rock core from BH21-07



Photograph D3. Run 1 (Top) and Run 2 (Bottom), rock core from BH21-08



Photograph D4. Run 2 (Top) and Run 3 (Bottom), rock core from BH21-08



Photograph D5. Run 1, rock core from BH21-09A



Photograph D6. Run 2 (Top) and Run 3 (Bottom), rock core from BH21-09A



Photograph D7. Run 4, rock core from BH21-09A



Photograph D8. Run 1 (Top), rock core from BH21-10



Photograph D9. Run 2, rock core from BH21-10



Photograph D10. Run 3, rock core from BH21-10



Photograph D11. Run 1 (Top) and Run 2 (Bottom), rock core from BH21-13



Photograph D12. Run 3 (Top) and Run 4 (Bottom), rock core from BH21-13



Photograph D13. Run 1 (Top) and Run 2 (Bottom), rock core from BH21-14



Photograph D14. Run 3, rock core from BH21-14



Photograph D15. Run 1, rock core from BH21-15



Photograph D16. Run 2, rock core from BH21-15



Photograph D17. Run 1 (Bottom) and Run 2 (Top), rock core from BH21-16



Photograph D18. Run 3, rock core from BH21-16



Photograph D19. Run 1 (Top) and Run 2 (Bottom), rock core from BH21-17



Photograph D20. Run 3, rock core from BH21-17