



Foundation Investigation Report

Rehabilitation/Replacement of 25 Non-Structural Culverts at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto - **Highway 401 CSP Culvert Extension Replacement (CV-0005-0401-00N1)**

GWP: 2045-23-00

Assignment No. 2020-E-0028

MTO Central Region

Latitude: 43.876780; Longitude: -78.799940

Geocres No.: 30M15-349

Type of Document:

Final Report

EXP Project Number:

ADM-22007871-A0

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Date Submitted:

April 19, 2024

Foundation Investigation Report

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Issue and Revised Record

Rev.	Date	Format	Prepared by	Reviewed by	Approved by	Description
A	April 10, 2024	pdf	S. Fredericks N. Tamrakar	T.C. Kim	S. Gonsalves	Draft Report
B	April 19, 2024	pdf	S. Fredericks N. Tamrakar	T.C. Kim	S. Gonsalves	Final Report

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*Foundation Investigation Report
Highway 401 CSP Culvert Replacement (CV-0005-0401-00N1)
GWP 2045-23-00
Assignment No. 2020-E-0028
Date: April 19, 2024*

Part I: Foundation Investigation Report

Rehabilitation/Replacement of 25 Non-Structural Culverts at various locations of Highway 9, Highway 12, Highway, 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and City of Toronto - **Highway 401 CSP Culvert Replacement (CV-0005-0401-00N1)**

1.0 Introduction

EXP Services Inc. (EXP) was retained by CONSOR Engineers LLC (CONSOR) on behalf of The Ministry of Transportation (MTO) to provide detailed foundation investigation and engineering services and pavement engineering services for the proposed rehabilitation/replacement of 25 Non-Structural Culverts project at various locations on Highway 9, Highway 12, Highway 400, Highway 401, Hwy 404 in Simcoe County, York Region, Durham Region, and the City of Toronto. The findings, analyses, and recommendations related to the foundation scope are presented in a Foundation Investigation Design Report created for each culvert location. The work was undertaken under GWP 2045-23-00, Assignment No. 2020-E-0028. The terms of reference (TOR) and the scope of work for the foundation investigation are outlined in the Ministry of Transportation Ontario's (MTO) Request for Proposal, dated February 2022. The scope of this report is specifically limited to the temporary roadway protection alternatives for the proposed replacement of the existing Corrugated Steel Pipe (CSP) culvert extension on one side under the Highway 401 embankment slope (CV-0005-0401-00N1).

The general design drawings for the proposed culvert replacement were provided to EXP by CONSOR. The purpose of the investigation was to evaluate the subsurface conditions along the potential roadway protection systems (if any), and based on this data, to permit detailed design of roadway protection systems for the partial road closure open cut full replacement of the existing CSP culvert extension on one side only.

The site-specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field and laboratory testing. The field and laboratory work for this structure was performed by EXP. Based on collected geotechnical data, this report provides an assessment of the geotechnical issues, geotechnical design parameters, and geotechnical foundation design recommendations for the proposed structure. Geotechnical-related construction recommendations are also provided.

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

2.0 Structure Description

The contract drawings titled New Construction CV-0005-0401-00N1 (Plate No. CONT 2024-2026, GWP 2045-23-00) prepared by CONSOR, dated January 24, 2023, shows the design configuration of the new construction of non-structural culvert of the Highway 401 culvert. A summary of the proposed structure is as follows:

- The existing culvert extension is a 600 mm CSP culvert under the southwestern embankment of highway 401; the total length is approximately 12 m. It is proposed to be replaced with a 600 mm diameter CSP/HDPE culvert. The existing concrete culvert under the Highway 401 will remain in place. Based on the 90% contract drawing, the invert level of the new culvert is proposed at approximately Elev. 90.03 m. The new replacement culvert will be located in the same alignment.
- The existing Highway 401 profile grade is planned to remain unchanged. It is understood that a partial road closure open-cut construction approach will be used for full replacement of the existing CSP culvert extension.

- The design recommendations on the proposed partial replacement of the non-structural culvert and pavement reinstatement are provided in a Pavement Design Report (GWP 2045-23-00) under a separate cover.

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

3.0 Site Description and Geological Setting

3.1 Site Description

The CSP culvert is located on Highway 401, about 3.0 km northwest of the intersection of Highway 401 with Bloor Street East overpass in the Durham region (Latitude: 43.876780; Longitude: -78.799940) in the Ministry of Transportation (MTO) Central Region. Highway 401 generally runs in the east-west direction, however, at the location of Culvert CV-0005-0401-00N1, Highway 401 runs in a southeast-northwest direction. At the site, Highway 401 is a six lane roadway with the eastbound lane (EBL) and westbound lane (WBL) separated by existing shoulders (one lane each direction). The existing CSP culvert is positioned in a southwest direction at a skew angle almost perpendicular to the highway central line. The elevation of highway pavement centerline at the site is approximately 96.0 m.

The general site conditions were assessed during field investigation works that took place by EXP on September 06, 2023. Selected photographs of the site and existing culvert are presented in Appendix A. The site plan and cross-section profiles for the proposed culvert alignment are shown on the drawings attached in Appendix B.

3.2 Geological Setting

According to the Ministry of Northern Development and Mines, Map 2556 (Quaternary Geology of Ontario, Southern Sheet, 1991) the surface conditions in the vicinity of the project area typically consists of undifferentiated till, predominantly of sand to silty sand matrix, commonly rich in clasts, often high in total matrix carbonate content. In addition, Map 2544 (Bedrock Geology of Ontario, Southern Sheet, 1991), the bedrock geology at the site consists of limestone, dolostone, shale, arkose, and sandstone belonging to the Ottawa Group and Simcoe Group of the Shadow Lake Formation.

4.0 Previous Investigations

There are no available previous geotechnical reports directly at this site in the MTO GEOCREs library. However, two reports closest to the site of Culvert CV-0005-0401-00N1 pertaining to geotechnical investigations were sourced. The reports are listed below for reference:

Geocres No. 30M15-008: "Foundation Investigation Report", Proposed Widening of the Bridge Structure at the Crossing of Highway 401 and Farewell Creek (Site No.22-183), W.P. 72-11128, District 6 – Township of Whitby

Geocres No. 30M15-311: "Foundation Investigation and Design Report", Highway 401 Structural Culvert, Site No. 21-487/C Structural Culvert Rehabilitation/Replacement, Highway 35/115 and Highway 401; G.W.P. No. 2242-14-00", Prepared by Golder Associates Ltd., dated June 12, 2017

Project reference Geocres No. 30M15-008, is located approximately 2.0 km west of Culvert CV-0005-0401-00N1. The project entailed subsurface investigations aimed at providing requisite geotechnical design data for a proposed widening of a bridge structure at the crossing of highway 401 and Farewell Creek. The subsoil at the site was generally a combination of either silty sand fill or native silty sand at the ground surface which was underlain by native clayey silt layers which were further underlain by shale bedrock.

Project reference Geocres reference No. 30M15-311 is located approximately 1.5 km east of Culvert CV-0005-0401-00N1. The project entailed subsurface investigations aimed at providing requisite geotechnical design data for the rehabilitation/replacement of a structural culvert. The subsoil at the site was generally a combination of asphalt or cohesionless fills (silty sand/gravelly sand/sand) being encountered at the surface underlain predominantly by cohesive fills (clayey silt/clayey silt to silt/silty clay) which is further underlain by cohesive layers (clayey silt to silty clay till/silty clay till/silty clay/clayey silt. Layers of native silty sand were also encountered between the cohesive layers.

5.0 Field Investigation and Laboratory Analyses

5.1 Site Investigation and Field Testing

A site-specific investigation was undertaken by EXP between September 05, 2023 to September 06, 2023, and it included the following:

1. A walkover site assessment was carried out by a Geotechnical Engineer from EXP;
2. Subsequent to the borehole layouts in the field, existing utilities were cleared by public utility companies;
3. Traffic control required to close the driving lanes of Highway 401 Road during the drilling of on-road boreholes was provided by Barricade Traffic Services.
4. The program involved the drilling of three (3) boreholes for sampling, consisting of 1 pavement borehole and 2 geotechnical boreholes, numbered PV401-5N1-01, BH401-5N1-01 and BH401-5N1-02 respectively. The location along with the coordinates, elevations and depths of each borehole drilled is summarized in Table 1.1 below. The locations of the boreholes drilled by EXP during this investigation are also shown on Drawing 1 in Appendix C.
5. The boreholes drilled during this fieldwork were advanced using a MARL M5T Rubber track drill and CME 75 truck mounted drill owned and operated by Drilltech drilling Ltd. The machines are equipped with solid stem augers and fitted with capability for Standard Penetration Testing (SPT).
6. Soil samples in the boreholes were taken at frequent intervals of depth by the Standard Penetration Test method (SPT), in general accordance with ASTM D1586. The test consists of freely dropping a 63.5 kg hammer a vertical distance of 0.76 m to drive a 51 mm O.D. split barrel (SS-split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance, or the N-value, of the soil which is indicative of the compactness of granular (or cohesionless) soils (gravels, sands, and silts) or the consistency of cohesive soils (clays and clayey soils);

7. The fieldwork was supervised by a member of EXP's engineering staff who directed the drilling and sampling operation, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification;
8. All spoon samples obtained in the Standard Penetration Tests (SPT, ASTM D-1586) were placed in moisture proof bags after field classification. Samples were allocated from the spoon samples for moisture content testing without delay. They were subsequently re-examined under controlled laboratory conditions prior to assigning other laboratory tests;
9. Selected soil samples for chemical analytical testing were sent to the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario. The selected soil samples for the analytical testing were placed in a laboratory prepared glass jar, labelled, and stored in a secure cooler.
10. The borehole locations and their ground surface elevations were surveyed by EXP using a Trimble DA2 GNSS receiver with Trimble Catalyst GNSS positioning, having an accuracy of ± 0.10 m horizontal and vertical directions. MTM NAD83 Zone 10 coordinates and the geodetic elevation for the boreholes are listed in Table 1.1 below. It can also be found on the Record of Borehole Sheet (Appendix D); and
11. Upon completion of drilling and field testing, the boreholes were backfilled with a mixture of bentonite and auger cuttings.
12. Groundwater level measurements were taken using a water level meter tape upon completion of drilling (or as otherwise stated on the borehole logs) of boreholes in accordance with MTO guidelines. The recorded groundwater levels after the completion of drilling boreholes were presented in the borehole log sheets in Appendix D. No monitoring well was installed for this site.
13. The borehole decommissioning was in general accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the Ontario Water Resources Act).

Table 1.1: Summary of boreholes completed

Borehole No.	Borehole Location	Location (MTM NAD83 Zone 10)		Latitude	Longitude	Borehole Elevation (m)	Borehole Depth (m)
		Northing	Easting				
PV401-5N1-01	Southbound Lane	4859902	361058	43.876954	-78.799948	95.7	3.7
BH401-5N1-01	Shoulder, west of culvert	4859892	361076	43.876863	-78.799724	95.9	18.9
BH401-5N1-02	Shoulder, east of culvert	4859897	361072	43.876902	-78.799774	95.8	18.9

5.2 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. In addition, unit weight, Atterberg limits and grain size analysis (sieve and hydrometer) tests were performed on selected soil samples (performed by EXP). Chemical analyses were

also carried out on one soil samples selected by EXP. The samples were tested at the Bureau Veritas Laboratories (formerly Maxxam Analytics), a CALA-certified and accredited laboratory in Mississauga, Ontario. All the laboratory tests were carried out according to MTO and/or ASTM Standards as appropriate. The performed laboratory testing program is listed in Table 1.2.

Table 1.2: List of Laboratory Test Completed by EXP

Borehole No.	Moisture Content	Atterberg Limits	Sieve	Hydrometer	Corrosivity
PV401-5N1-01	5	1	-	1	-
BH401-5N1-01	16	1	2	1	1
BH401-5N1-02	14	2	2	1	-

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

6.0 Subsurface Conditions

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

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

In general, the subsoil condition at the site consists of asphalt underlain by cohesionless fills further underlain by a combination of native silty sand till followed by clayey silt till.

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

6.1 Subsoils

6.1.1 Asphalt

An asphaltic surface was encountered at the ground surface in all boreholes. The thickness of asphalt ranged from approximately 127 mm to 177 mm.

6.1.2 Sand and Gravel/Gravelly Sand (SW-GW) Fill

Sand and gravel/gravelly sand fill was encountered below asphalt in all boreholes. The fill layer was extended to depths ranging between 0.8 m to 1.5 m below ground surface with elevation ranging between 94.2 m to 95 m. The explored thickness of this layer ranged between 0.6 m to 1.4 m.

The composition of this layer was generally sand and gravel. The layer was dry to moist and brown in color. The SPT “N” values within this layer ranged from 30 to 73 blows per 300 mm penetration, corresponding to dense to very dense in compactness condition.

Moisture Content:

- 2% to 33%

Grain Size Distribution:

- 27% gravel;
- 53% sand;
- 20% silt and clay;

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

6.1.3 Sand and Silt (SM) Fill

A cohesionless fill layer consisting of sand and silt was encountered below sand and gravel/gravelly sand fill in all boreholes. Borehole PV401-5N1-01 was terminated within this layer. The approximate elevations of the surface and base of each fill layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.3 below:

Table 1.3: Summary of Sand and Silt Fill Layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT “N” Value Range
	Top	Bottom				
PV401-5N1-01	95.0	92.1	0.8	2.9	Sand and Silt	10-34
BH401-5N1-01	94.2	89.6	1.5	4.6	Sand and Silt	12 - 31
BH401-5N1-02	94.4	91.2	1.5	3.2	Sand and Silt	18 - 59

The fill layer is generally comprised of sand and silt with trace to some clay and occasional organics. Cobbles and/or boulders should always be anticipated within the fill layer. The layer was dry to moist and brown in color. The SPT “N” values within this layer ranged from 10 to 59 blows per 300 mm penetration, corresponding to compact to very dense, but generally compact to dense in compactness condition.

Moisture Content:

- 7% to 16%

Grain Size Distribution:

- 2% to 22% gravel;
- 40% to 62% sand;
- 36% to 39% silt;
- 9% to 12% clay;
- 16% to 54% silt and clay;

Atterberg Limits:

- Liquid Limit: 17% to 19%
- Plastic Limit: 11%
- Plasticity Index: 6% to 8%

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix D. The results of the grain size distribution and Atterberg limit tests are also provided on Figure 2 and Figure 4 respectively in Appendix E.

6.1.4 Silty Sand (SM) Till

A silty sand till deposit was encountered below the fill layer in BH401-5N1-01 and BH401-5N1-02. The approximate elevations of the surface and base of the till layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.4 below:

Table 1.4: Summary of Silty Sand Till Layers

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT "N" Value Range
	Top	Bottom				
BH401-5N1-01	89.6	85.0	6.1	4.6	Silty Sand till	>100
BH007-05-02	91.2	88.3	4.7	2.9	Silty Sand till	76 – >100

The till deposit mainly consists of silt and sand, trace to some clay, trace to some gravel, and occasional cobbles. As highlighted in boreholes, cobbles and/or boulders should always be anticipated within the glacial till deposit due to their mode of deposition. In general, the layer was dry to wet with color ranging from brown to grey. SPT "N" values ranged from 76 to >100 blows per 300 mm penetration, corresponding to very dense in compactness condition.

Moisture Content:

- 5% to 9%

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

6.1.5 Clayey Silt (CL) Till

A clayey silt till deposit was encountered below silty sand till deposit in BH401-5N1-01 and BH401-5N1-01. Both of these boreholes are terminated within this layer. The approximate elevations of the surface and base of the till layer, thickness, description and SPT (N Value) encountered in boreholes are summarized in Table 1.5 below:

Table 1.5: Summary of Clayey Silt Till Layers

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)	Layer Description	SPT "N" Value Range
	Top	Bottom				
BH401-5N1-01	85.0	76.8	10.7	8.2	Clayey Silt till	33 >100
BH401-5N1-02	88.3	77.0	7.6	11.3	Clayey Silt till	19-89

The till deposit mainly consists of clay and silt, trace to some sand, and trace gravel. Cobbles and/or boulders should always be anticipated within the glacial till deposit due to their mode of deposition. In general, the layer was moist to slightly wet with color ranging from brown to grey. SPT "N" values ranged from 19 to greater than 100 blows per 300 mm penetration, corresponding to very stiff to hard in consistency.

Moisture Content:

- 6% to 31%

Grain Size Distribution:

- 2% gravel;
- 24% sand;
- 41% silt;
- 33% clay;

Atterberg Limits:

- Liquid Limit: 30%
- Plastic Limit: 13%
- Plasticity Index: 17%

The results of the moisture content, grain size distribution and Atterberg limit tests are provided on the record of borehole sheets in Appendix D. The results of the grain size distribution and Atterberg limit tests are also provided on Figure 3 and Figure 5 respectively in Appendix E.

6.2 Groundwater and Surface Water Conditions

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

Table 1.6: Summary of observed Groundwater Levels

Borehole	Ground Surface Elevation (m)	Water Level Depth/ Elevation (m) ¹	Date Measured	Comments
PV401-5N1-01	95.7	Dry	Sept. 6, 2023	No groundwater encountered in borehole
BH401-5N1-01	95.9	8.5/87.4	Sept. 6, 2023	Measured upon completion of drilling
BH401-5N1-02	95.8	18.1/77.7	Sept. 6, 2023	Measured upon completion of drilling

Note:

1. Depths are relative to the ground surface

At the time of field investigation, no water flow was observed through the culvert.

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

6.3 Chemical Analysis

One soil sample was selected for chemical analysis during the current investigations performed by EXP. The soil sample collected by EXP was tested at a CALA-certified and accredited laboratory. The results of the corrosion potential chemical analysis testing including sulfide, chloride, sulfate, pH, electrical conductivity, resistivity, and redox potential are included in Appendix E and summarized in Table 1.7.

Table 1.7. Summary of chemical analysis results

Borehole ID	Sample	Depth (m)	Chloride (ppm)	Sulphate (ppm)	pH	Electrical Conductivity (umho/cm)	Resistivity (ohm-cm)	Redox Potential (mV)
BH401-5N1-01	SS14	18.9	33	<20	7.83	343	2900	310

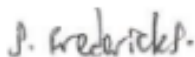
7.0 CLOSURE

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

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

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

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8.0 REFERENCES

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

Ministry of Transportation, April 2014. MTO Gravity Pipe Design Guidelines. Circular Culverts and Storm Sewers.

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

ASTM International:

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

Ontario Water Resources Act:

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

Ontario Occupational Health and Safety Act (OHSA):

Ontario Regulation 213/91 Construction Projects

9.0 LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

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

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

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

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

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

RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to EXP by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. EXP has relied in good faith upon such representations, information and instructions and accepts no responsibility 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: Looking Northeast -Front view of existing CSP culvert at outlet side – September 06, 2023



Photograph 2: General site condition along the East Bound Lane embankment looking east from culvert outlet
– September 06, 2023



Photograph 3: Drilling of PV401-5N1-01- Looking east – September 06, 2023

Appendix B – General Arrangement Drawings

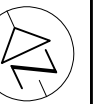
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DATE PLOTTED: 1/24/2024 1:53:11 PM BY: RMISTRY

2016-10
ANSI-D
MINISTRY OF TRANSPORTATION, ONTARIO

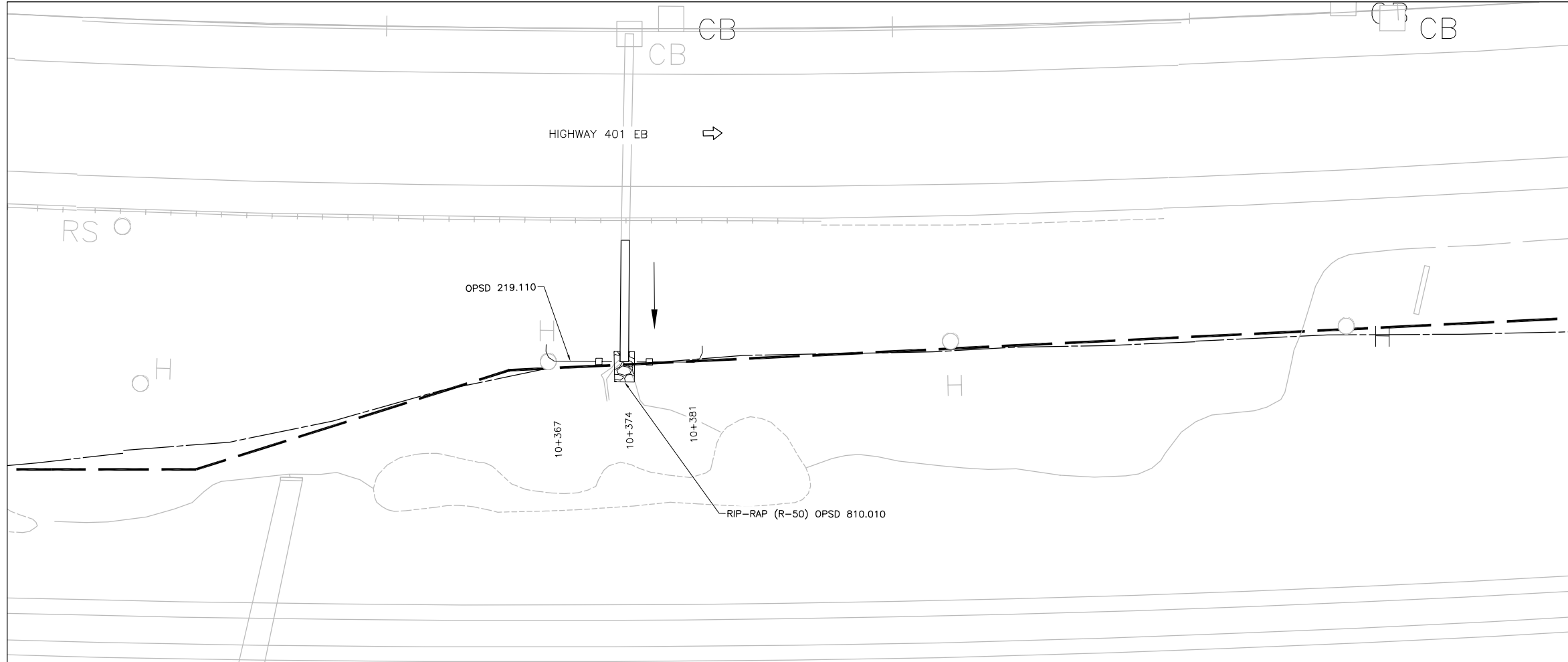
CV-0005-0401-00N1
(HWY 401 - CITY OF TORONTO)

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

PLATE No
CONT 2024-2026
GWP 2045-23-00
NEW CONSTRUCTION
CV-0005-0401-00N1



SHEET
19



GENERAL NOTES:

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

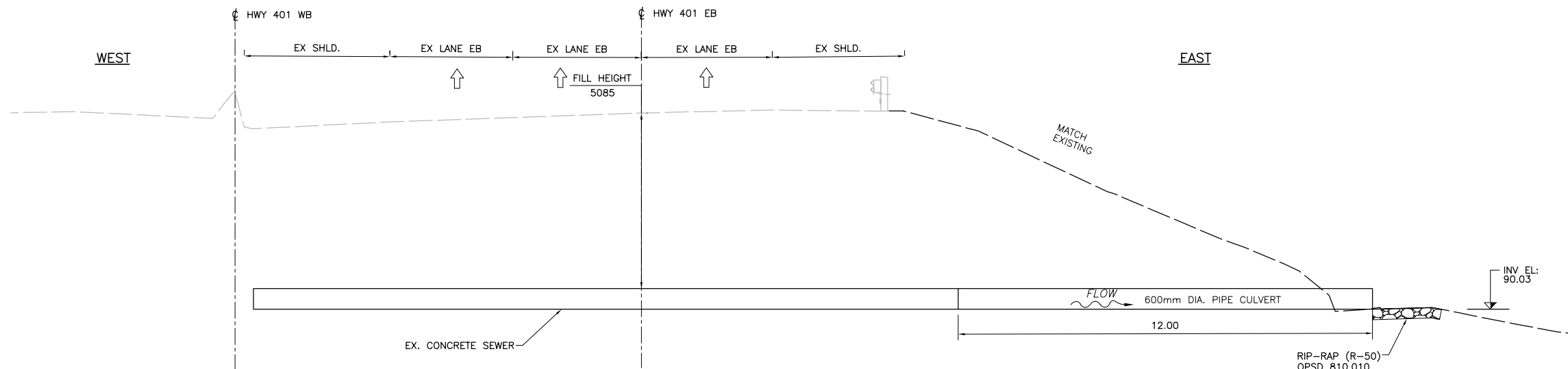
LEGEND

- RIP-RAP
- CULVERT REPLACEMENT
- CURB AND GUTTER
- GUARDRAIL
- LIGHT-DUTY SILT FENCE BARRIER
- FLOW DIRECTION
- BOTTOM OF DITCH
- TOE OF SLOPE
- MTO ROW
- FENCE LINE

1	SOLID YELLOW,10cm
2	SOLID DOUBLE YELLOW,10cm
3	363 BROKEN YELLOW,10cm
4	SOLID YELLOW,20cm
5	SOLID WHITE,10cm
6	333 BROKEN WHITE,10cm
7	363 BROKEN WHITE,10cm
8	393 BROKEN WHITE,10cm
9	SOLID WHITE,20cm
10	111 BROKEN WHITE,20cm
11	333 BROKEN WHITE,20cm
12	333 BROKEN WHITE ,30cm
13	SOLID WHITE,30cm
14	SOLID WHITE,45cm
15	SOLID WHITE,60cm
20	SYMBOLS
] [LIMITS OF MARKINGS	

NOTES:

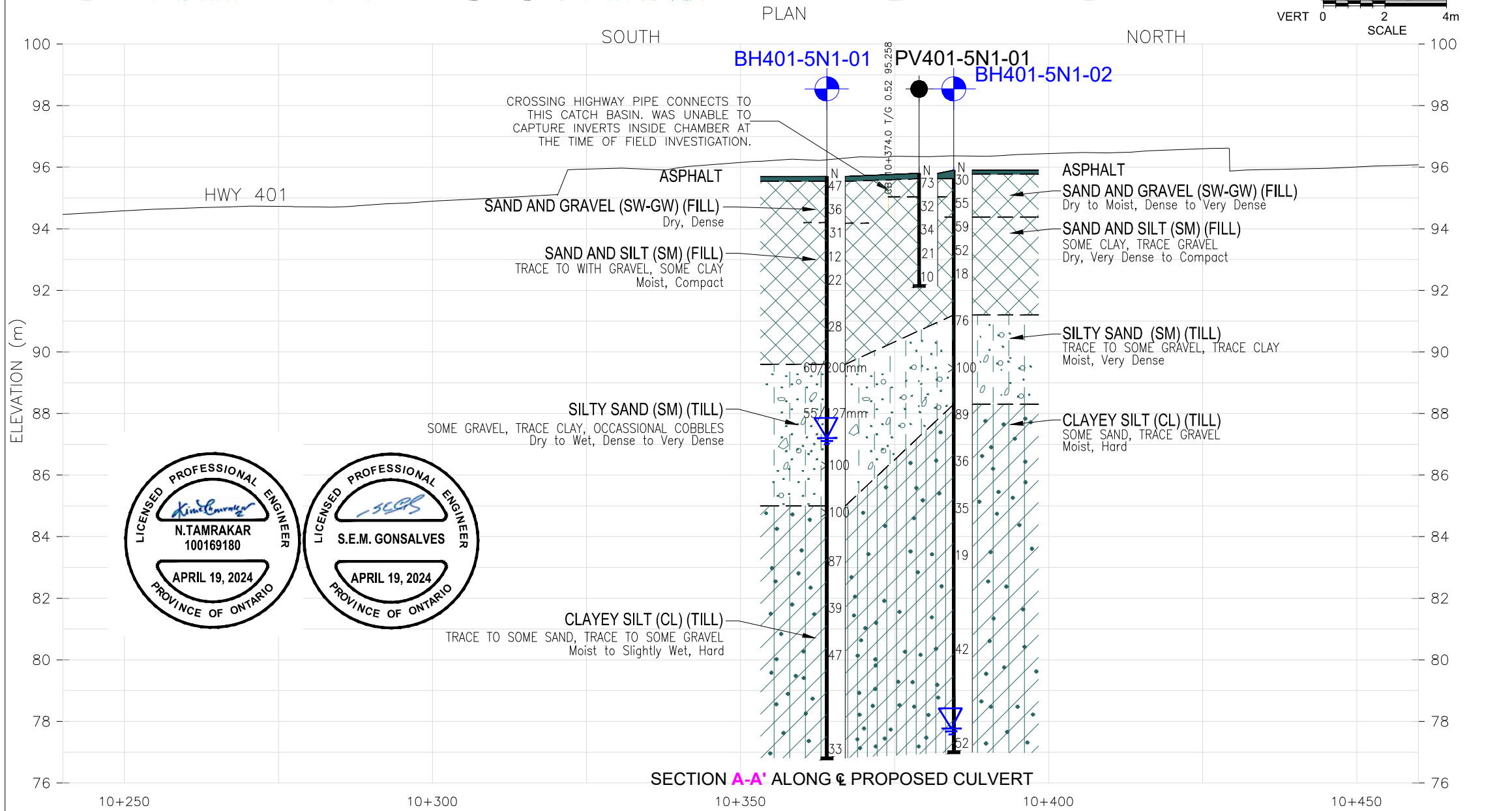
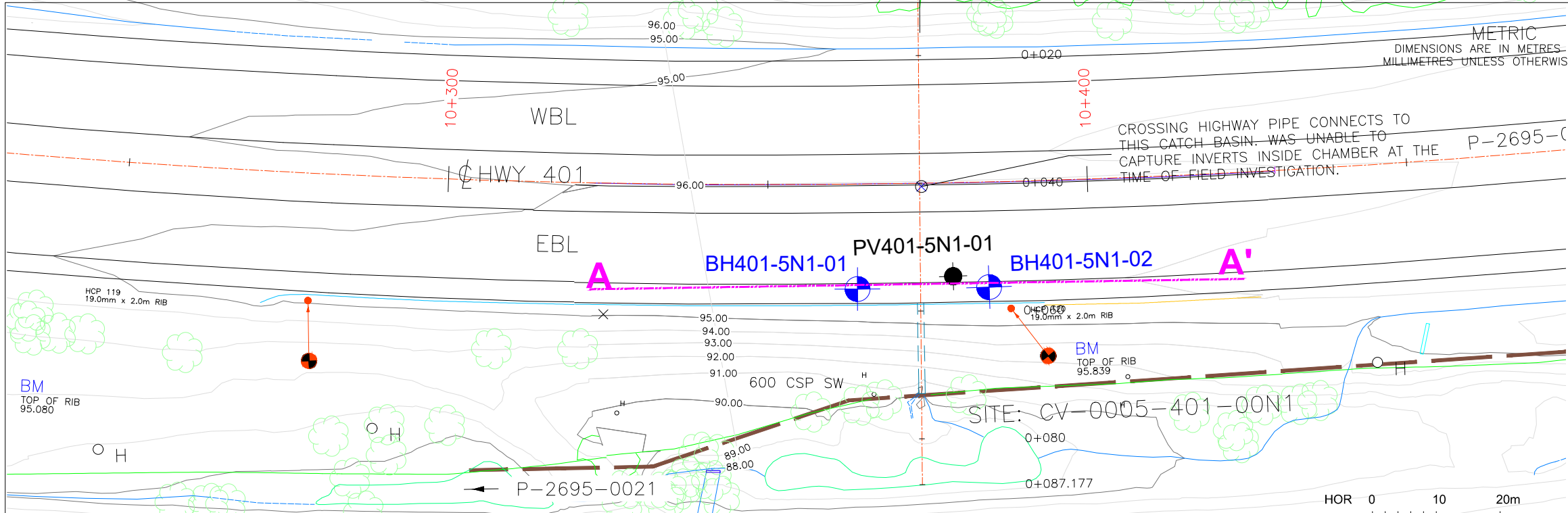
1. 333, 363, 393, DENOTES PAVEMENT MARKING SPACING (ie., 3 m line,3 m gap, 3 m line)
2. Use ① to Denote PAVEMENT MARKING
3. Use 1 to Denote PAVEMENT MARKING,TEMPORARY
4. Use Δ to Denote PAVEMENT MARKING, TEMPORARY- REMOVABLE
5. Use ① to Denote PAVEMENT MARKING, DURABLE
6. FROST TAPERS are based on OPSD 803.030, 803.031



SCALE
5m 0 10m

Appendix C – Borehole Location Plan and Soil Strata

FILE NAME: I:\2003-Brampton\Proposals\Projects\International\WTO Projects\WTO 2020-E-0028 25 culverts\working drawings\CAD drafting\CV-0005-0401-00N1_borehole location plan & soil strata.dwg
MODIFIED: 2024-04-18 13:09



ASSIG No. 2020-E-0028

GWP No. 2045-23-00

HIGHWAY 401 CULVERT REPLACEMENT, SIMCOE, ON
CV0005-0401-00N1
Latitude: 43.876780° Longitude: -78.799940°

BOREHOLE LOCATION PLAN & SOIL STRATA



SHEET

1



EXP SERVICES INC.



KEY PLAN
N.T.S.

LEGEND

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

SOIL STRATA SYMBOLS

- ASPHALT
- FILL
- SILTY SAND (TILL)
- CLAYEY SILT (TILL)

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

BH No.	ELEV.	NORTHING	EASTING
BH401-5N1-01	95.7	4859902.8	361058.8
BH401-5N1-02	95.9	4859892.9	361076.9
PV401-5N1-01	95.8	4859897.2	361072.8

NOTES

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

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

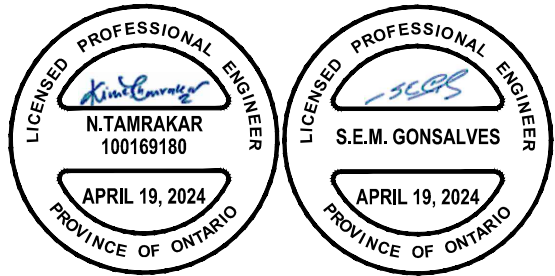
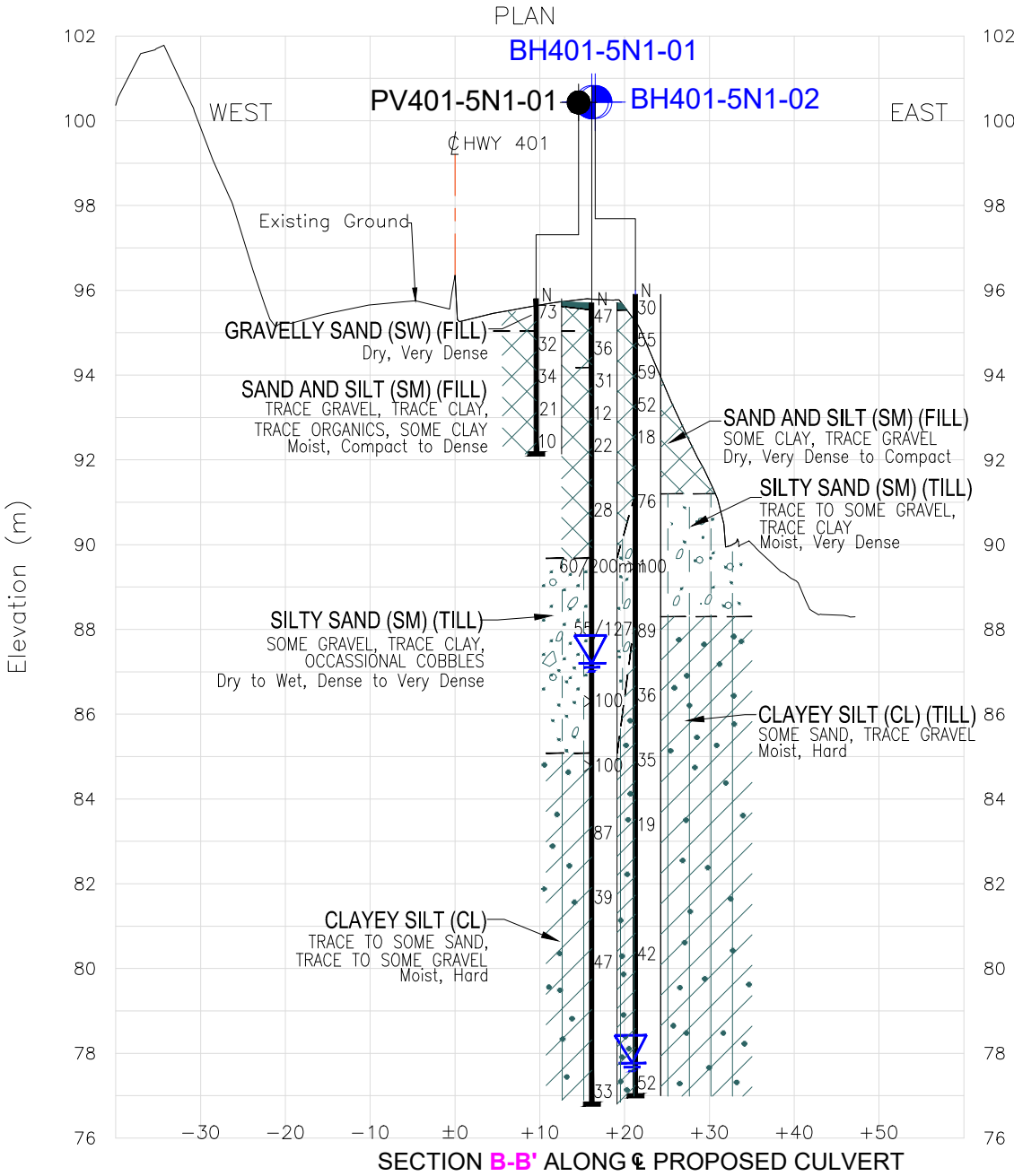
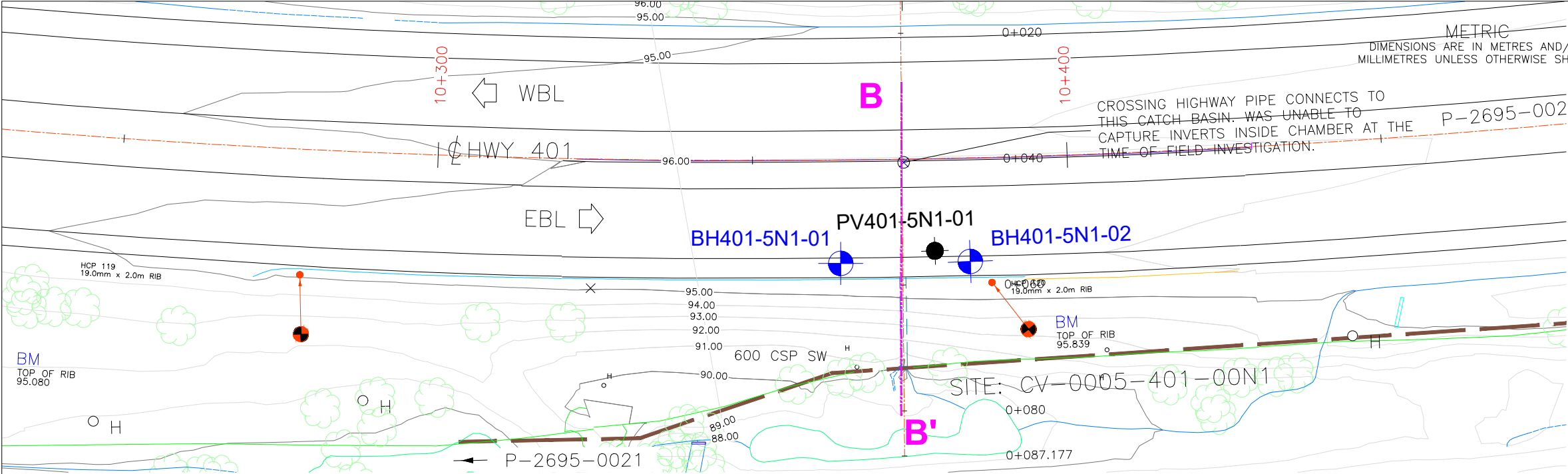
The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in the report and related documents are specifically excluded in accordance with the conditions of Section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

REVISIONS

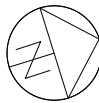
NO	DATE	BY	DESCRIPTION

PROJECT No.	ADM-22007871-A0	GEOCREs No.	30M15-349
SUBM'D SH	CHKD. NT	DATE	APRIL 19, 2024
DRAWN SH	CHKD. TC	APPRD SG	DWG 01

FILE NAME: I:\2003-Brampton\Proposals\Projects\International\WTO 2020-E-0028 25 culverts\working drawings\CAD drafting\CV-0005-0401-00N1_borehole location plan & soil strata.dwg
MODIFIED: 2024-04-18 13:09



ASSIG No. 2020-E-0028
GWP No. 2045-23-00



HIGHWAY 401 CULVERT REPLACEMENT, SIMCOE, ON
CV0005-0401-00N1
Latitude: 43.876780° Longitude: -78.799940°
BOREHOLE LOCATION PLAN & SOIL STRATA

SHEET
2



EXP SERVICES INC.



KEY PLAN
N.T.S.

LEGEND

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

SOIL STRATA SYMBOLS

- ASPHALT
- FILL
- SILTY SAND (TILL)
- CLAYEY SILT (TILL)

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

BH No.	ELEV.	NORTHING	EASTING
BH401-5N1-01	95.7	4859902.8	361058.8
BH401-5N1-02	95.9	4859892.9	361076.9
PV401-5N1-01	95.8	4859897.2	361072.8

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SUBMISSION FOR MTO REVIEW			
NO	DATE	BY	DESCRIPTION
PROJECT No.	ADM-22007871-A0	GEOCREs No.	30M15-349
SUBM'D SH	CHKD. NT	DATE	APRIL 19, 2024 SITE-
DRAWN SH	CHKD. TC	APPRD SG	DWG 02

Appendix D – Borehole Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

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

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

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

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

Terminology describing soil structure:

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

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

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

Fissured: material breaks along plane of fracture.

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

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

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

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

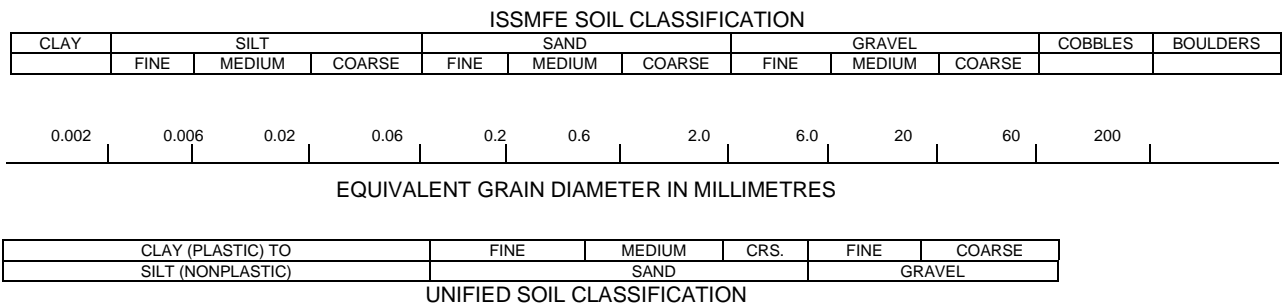
Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

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

Uniformly Graded: predominantly on grain size.

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



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

Table a: Percent or Proportion of Soil

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

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

Table b: Apparent Density of Cohesionless Soil

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

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

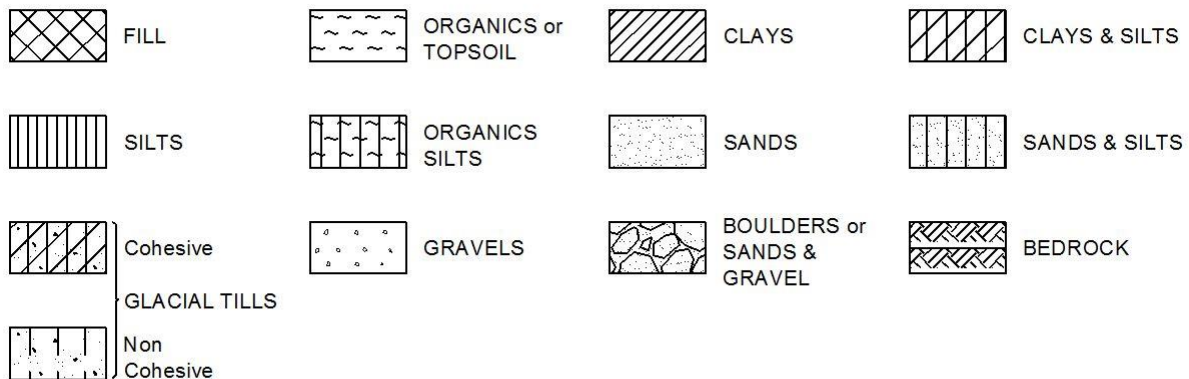
Table c: Consistency of Cohesive Soil

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

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

STRATA PLOT

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



WATER LEVEL MEASUREMENT



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	Pore water pressure
r_u	1	Pore pressure ratio
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 BH401-5N1-01

1 OF 2

METRIC

W.P. GWP-2045-23-00 LOCATION CV-0005-0401-00N1, Durham Region, ON, MTM ON-10 361058.8E 4859902.8N ORIGINATED BY SF
 DIST Durham HWY 401 BOREHOLE TYPE Track Mounted M5T/ Track Mounted CME 75/SSA COMPILED BY IL
 DATUM Geodetic DATE 2023.09.05 - 2023.09.06 LATITUDE 43.876954 LONGITUDE -78.799948 CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
95.7	GROUND SURFACE							20	40	60	80	100					
95.8	ASPHALT - (159mm)							20	40	60	80	100					
0.2	SAND AND GRAVEL (SW-GW) (FILL) - brown, dry, dense		SS1	SS	47		95										27 53 (20)
			SS2	SS	36												
94.2																	
1.5	SAND AND SILT (SM) (FILL) - trace to with gravel, some clay, brown, dark grey embedded, moist, compact		SS3	SS	31		94										
			SS4	SS	12		93										9 43 36 12
			SS5	SS	22		92										
	-becoming gravelly sand		SS6	SS	28		91										22 62 (16)
							90										
89.6																	
6.1	SILTY SAND (SM) (TILL) - some gravel, trace clay, occasional cobbles, brown to grey, dry to wet, dense to very dense		SS7	SS	60/ 200mm		89										
			SS8	SS	55/ 27mm		88										
	- Spoon bounce @ 7.7 m, possible cobbles																
							87										
	- sand with gravel to gravelly sand with 4" clayey silt embedment layer, brown to grey, wet		SS9	SS	>100		86										

Continued Next Page

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

ONTARIO MTO CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MTO.GDT 4/19/24

Brampton, Ontario

2 OF 2

METRIC

W.P.	GWP-2045-23-00	LOCATION	<u>CV-0005-0401-00N1, Durham Region, ON, MTM ON-10 361058.8E 4859902.8N</u>			ORIGINATED BY	SF		
DIST	Durham	HWY	401	BOREHOLE TYPE	Track Mounted M5T/ Track Mounted CME 75/SSA		COMPILED BY	IL	
DATUM	Geodetic	DATE	2023.09.05 - 2023.09.06	LATITUDE	43.876954	LONGITUDE	-78.799948	CHECKED BY	NT

[illegible]

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

ONTARIO MTO CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MTO GDT 4/19/24

Brampton, Ontario

RECORD OF BOREHOLE No BH401-5N1-02

1 OF 2

METRIC

W.P. GWP-2045-23-00 LOCATION CV-0005-0401-00N1, Durham Region, ON, MTM ON-10 361076.9E 4859892.9N ORIGINATED BY SF
 DIST Durham HWY 401 BOREHOLE TYPE Track Mounted M5T/ Track Mounted CME 75/SSA COMPILED BY IL
 DATUM Geodetic DATE 2023.09.06 - 2023.09.06 LATITUDE 43.876863 LONGITUDE -78.799724 CHECKED BY NT

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL P. PENETROMETER									
95.9	GROUND SURFACE							20	40	60	80	100					
95.9	ASPHALT - (159 mm)							20	40	60	80	100					
0.2	SAND AND GRAVEL (SW-GW) (FILL) - brown, dry to moist, dense to very dense		SS1	SS	30		95							○			
														○			
			SS2	SS	55												
94.4																	
1.5	SAND AND SILT (SM) (FILL) - some clay, trace gravel, grey, dry, very dense to compact		SS3	SS	59		94							○			6 40 (54)
			SS4	SS	52		93							○			
			SS5	SS	18		92							○			2 52 36 10
91.2																	
4.7	SILTY SAND (SM) (TILL) - trace to some gravel, trace clay, grey to brown, moist, very dense		SS6	SS	76		91							○			
														○			
							90										
			SS7	SS	>100		89							○			
88.3																	
7.6	CLAYEY SILT (CL) (TILL) - some sand, trace gravel, grey, moist, hard		SS8	SS	89		88							○			
							87										
	-becoming sandy seams		SS9	SS	36									○			2 24 41 33
							86										

Continued Next Page

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

ONTARIO MTO CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MTO.GDT 4/19/24

METRIC

CHECKED BY _____ NT

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

ONTARIO MTO CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MTO.GDT 4/19/24

Brampton, Ontario

RECORD OF BOREHOLE No PV401-5N1-01

1 OF 1

METRIC

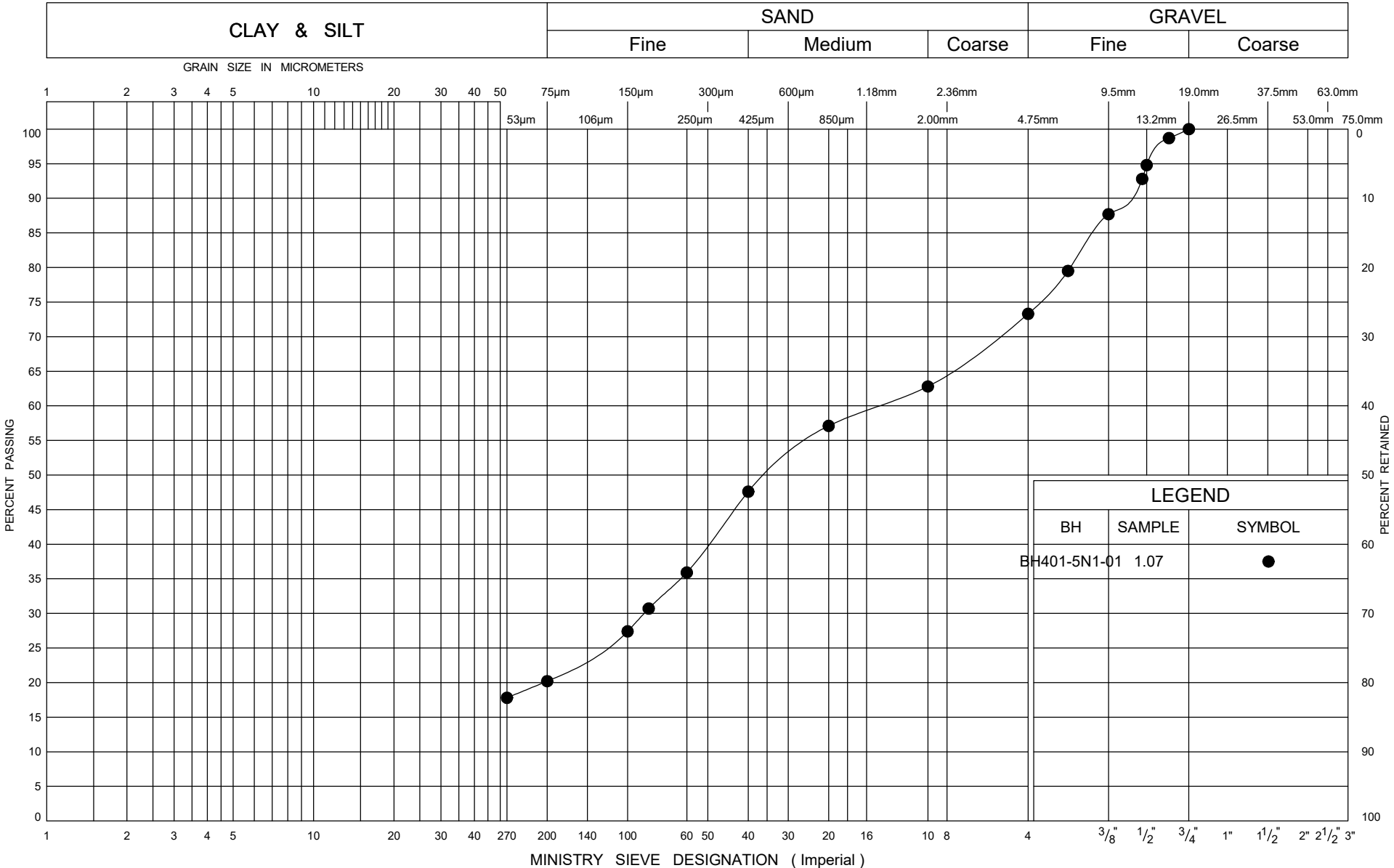
W.P. GWP-2045-23-00 LOCATION CV-0005-0401-00N1, Durham Region, ON, MTM ON-10 361072.8E 4859897.2N ORIGINATED BY SF
 DIST Durham HWY 401 BOREHOLE TYPE Track Mounted M5T/ Track Mounted CME 75/SSA COMPILED BY IL
 DATUM Geodetic DATE 2023.09.06 - 2023.09.06 LATITUDE 43.876902 LONGITUDE -78.799774 CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
95.8	GROUND SURFACE							20	40	60	80	100		W _P	W	W _L	kN/m ³	GR SA SI CL
95.8	ASPHALT - (177mm)																	
0.2	GRAVELLY SAND (SW) (FILL) - brown, dry, very dense		SS1	SS	73									○				7 45 39 9
95.0							95							○				
0.8	SAND AND SILT (SM) (FILL) - trace gravel, trace clay, brown, moist, compact to dense		SS2	SS	32									○				
														○				
			SS3	SS	34		94							○				
														○				
			SS4	SS	21		93							○				
	-trace organics, some clay, blackish brown													○				
92.1			SS5	SS	10													
3.7	END OF BOREHOLE																	
	NOTE: 1) No Groundwater was encountered in open borehole upon completion of drilling																	

ONTARIO MTO CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MTO.GDT 4/19/24

Appendix E – Laboratory Data

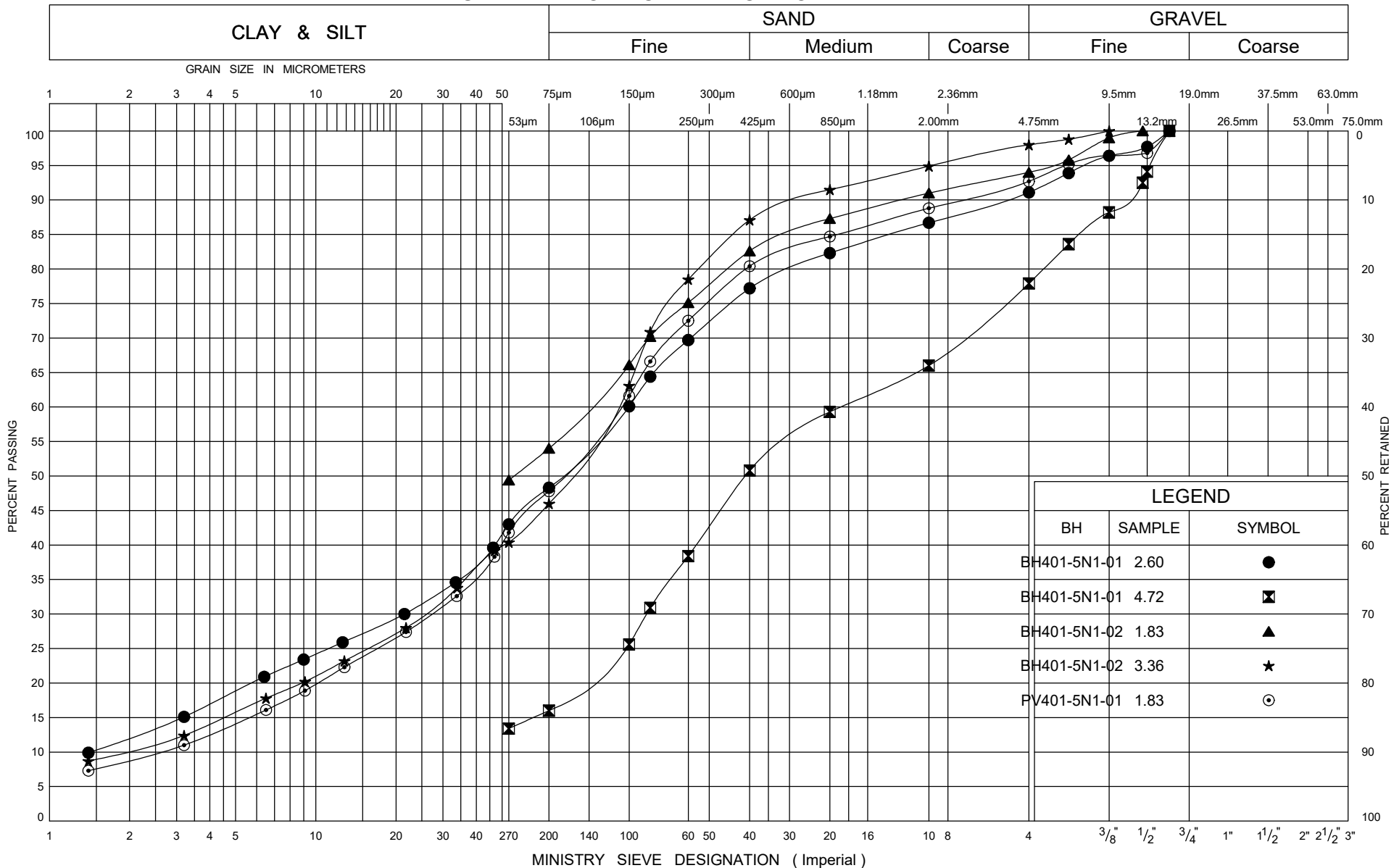
UNIFIED SOIL CLASSIFICATION SYSTEM



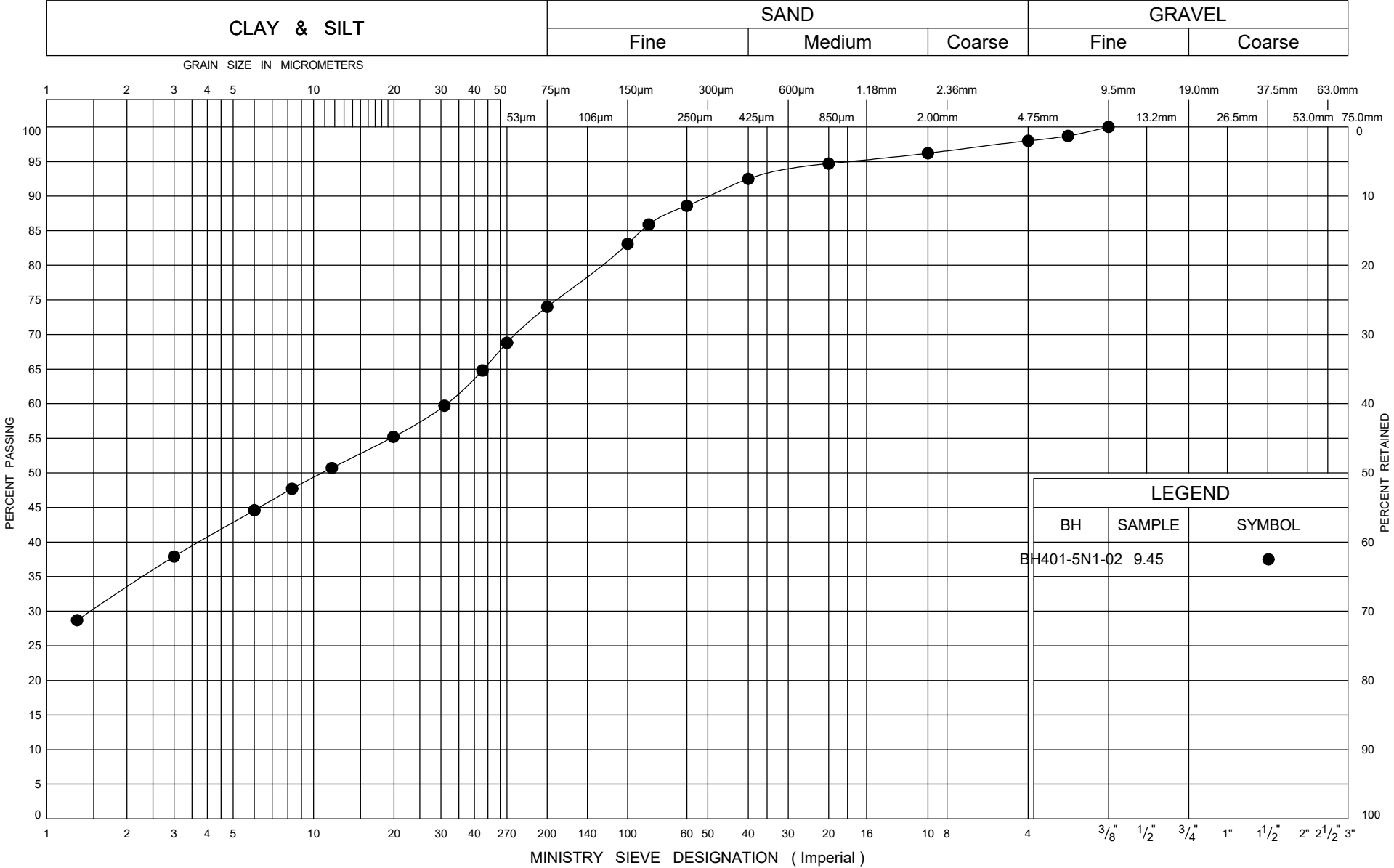
GRAIN SIZE DISTRIBUTION
GRAVELLY SAND/SAND AND GRAVEL (FILL)

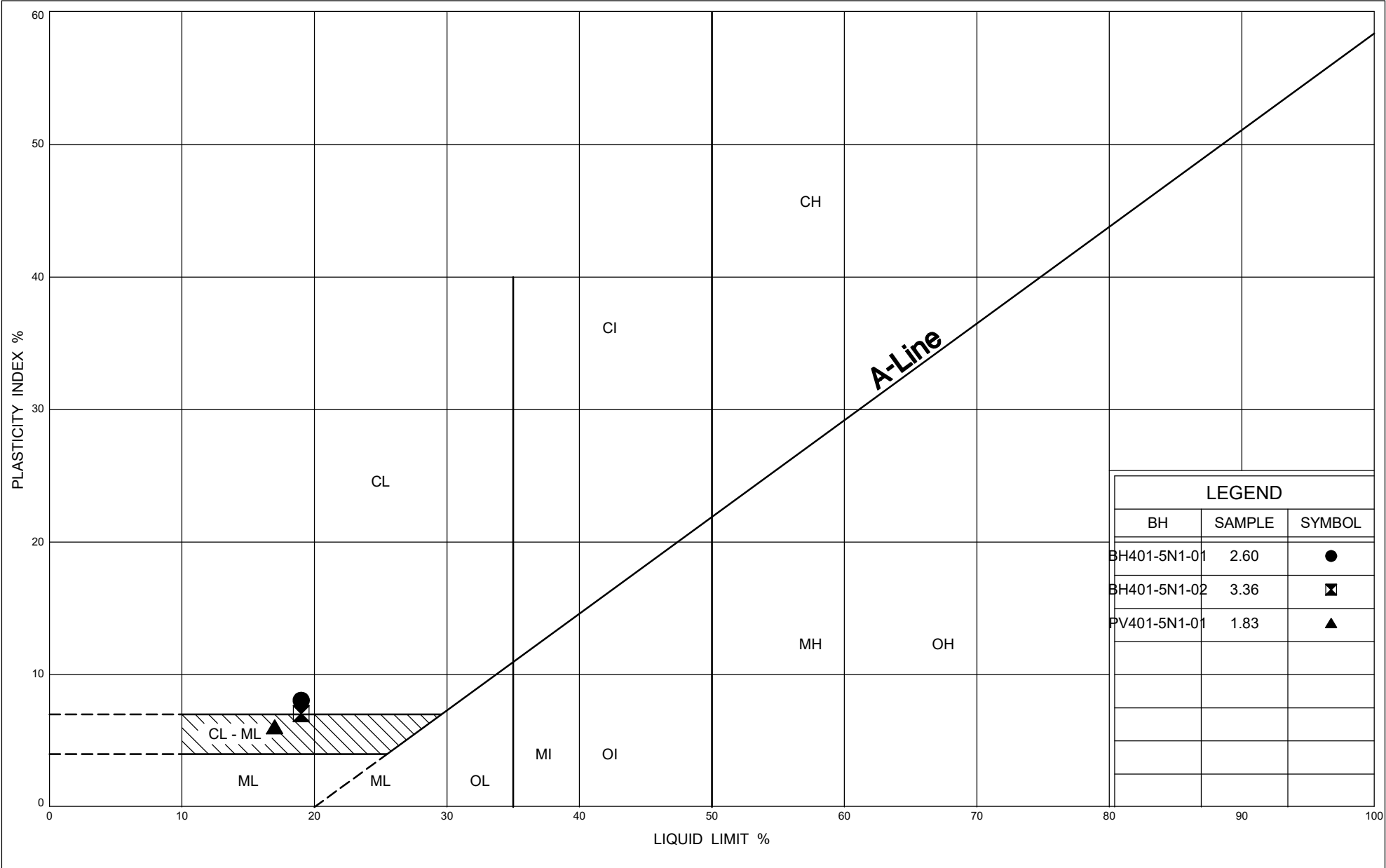
FIG No 1
W P
Replacement of 25 Culverts

UNIFIED SOIL CLASSIFICATION SYSTEM



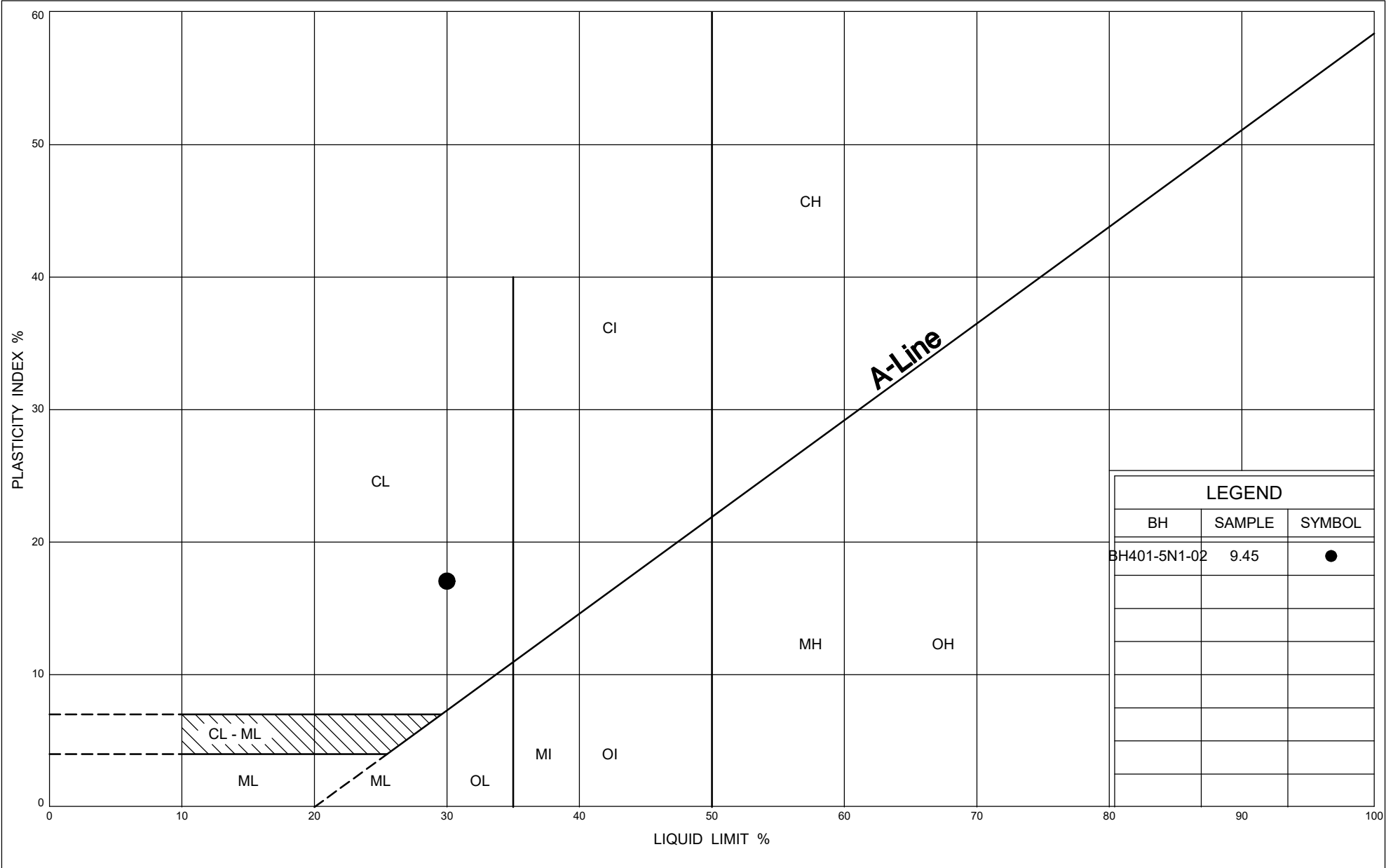
UNIFIED SOIL CLASSIFICATION SYSTEM





ONTARIO MOT PLASTICITY CHART CV-0005-0401-00N1 - UPDATED.GPJ ONTARIO MOT.GDT 4/17/24

Oct 75, FF - S - 21





Your Project #: ADM-22007871-A0
 Site Location: Culvert CV0005-0401-00N1 site (25 Culverts Project)
 Your C.O.C. #: 903374-13-01

Attention: Nimesh Tamrakar

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

Report Date: 2023/09/13
 Report #: R7810835
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C3R4331

Received: 2023/09/07, 13:13

Sample Matrix: Soil
 # Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	1	2023/09/11	2023/09/12	CAM SOP-00463	MOE E3013 m
Conductivity	1	2023/09/12	2023/09/12	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	1	N/A	2023/09/13	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	1	N/A	2023/09/13	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	1	2023/09/11	2023/09/11	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	1	2023/09/11	2023/09/12	CAM SOP-00421	SM 2580 B
Resistivity of Soil	1	2023/09/07	2023/09/12	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	1	2023/09/11	2023/09/12	CAM SOP-00464	MOE E3013 m

Remarks:

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

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

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

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

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

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

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

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

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

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



Your Project #: ADM-22007871-A0
Site Location: Culvert CV0005-0401-00N1 site (25 Culverts Project)
Your C.O.C. #: 903374-13-01

Attention: Nimesh Tamrakar

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

Report Date: 2023/09/13
Report #: R7810835
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C3R4331

Received: 2023/09/07, 13:13

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

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:

Patricia Legette, Project Manager
Email: Patricia.Legette@bureauveritas.com
Phone# (905)817-5799

=====

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

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SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		WXR024			WXR024		
Sampling Date		2023/09/06 23:45			2023/09/06 23:45		
COC Number		903374-13-01			903374-13-01		
	UNITS	BH401 SN101 SS14	RDL	QC Batch	BH401 SN101 SS14 Lab-Dup	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm	2900		8901046			
CONVENTIONALS							
Redox Potential	mV	310	N/A	8908461			
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	33	20	8907988	31	20	8907988
Conductivity	umho/cm	343	2	8910743			
Available (CaCl2) pH	pH	7.83		8908152			
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	8907991	<20	20	8907991
Sulphide	mg/kg	2.1	0.5	8915322	2.4	0.5	8915322
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable							



BUREAU
VERITAS

Bureau Veritas Job #: C3R4331

Report Date: 2023/09/13

exp Services Inc

Client Project #: ADM-22007871-A0

Site Location: Culvert CV0005-0401-00N1 site (25 Culverts
Project)

Sampler Initials: IB

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		WXR024		
Sampling Date		2023/09/06 23:45		
COC Number		903374-13-01		
	UNITS	BH401 SN101 SS14	RDL	QC Batch
Physical Testing				
Moisture-Subcontracted	%	17	0.30	8915323
RDL = Reportable Detection Limit				
QC Batch = Quality Control Batch				



BUREAU
VERITAS

Bureau Veritas Job #: C3R4331

Report Date: 2023/09/13

exp Services Inc

Client Project #: ADM-22007871-A0

Site Location: Culvert CV0005-0401-00N1 site (25 Culverts
Project)

Sampler Initials: IB

TEST SUMMARY

Bureau Veritas ID: WXR024
Sample ID: BH401 SN101 SS14
Matrix: Soil

Collected: 2023/09/06
Shipped:
Received: 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8915323	N/A	2023/09/13	Surinder Singh
Sulphide in Soil	SPEC	8915322	N/A	2023/09/13	Bailey Morrison
pH CaCl2 EXTRACT	AT	8908152	2023/09/11	2023/09/11	Gurparteek KAUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurparteek KAUR
Resistivity of Soil		8901046	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

Bureau Veritas ID: WXR024 Dup
Sample ID: BH401 SN101 SS14
Matrix: Soil

Collected: 2023/09/06
Shipped:
Received: 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Sulphide in Soil	SPEC	8915322	N/A	2023/09/13	Bailey Morrison
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan



GENERAL COMMENTS

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

Package 1	6.3°C
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Results relate only to the items tested.

BUREAU
VERITAS

Bureau Veritas Job #: C3R4331

Report Date: 2023/09/13

QUALITY ASSURANCE REPORT

exp Services Inc

Client Project #: ADM-22007871-A0

Culvert CV0005-0401-00N1 site (25 Culverts

Site Location: Project)

Sampler Initials: IB

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8907988	Soluble (20:1) Chloride (Cl-)	2023/09/12	NC	70 - 130	95	70 - 130	<20	ug/g	6.7	35
8907991	Soluble (20:1) Sulphate (SO4)	2023/09/12	99	70 - 130	97	70 - 130	<20	ug/g	NC	35
8908152	Available (CaCl2) pH	2023/09/11			100	97 - 103			1.9	N/A
8908461	Redox Potential	2023/09/12			102	95 - 105			14	35
8910743	Conductivity	2023/09/12			99	90 - 110	<2	umho/cm	0.39	10
8915322	Sulphide	2023/09/13	90	75 - 125	98	75 - 125	<0.5	mg/kg	17	30
8915323	Moisture-Subcontracted	2023/09/09					<0.30	%		

N/A = Not Applicable

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

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

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

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

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

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 #: C3R4331
Report Date: 2023/09/13

exp Services Inc
Client Project #: ADM-22007871-A0
Site Location: Culvert CV0005-0401-00N1 site (25 Culverts
Project)
Sampler Initials: IB

VALIDATION SIGNATURE PAGE

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

Anastassia Hamanov, Scientific Specialist

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

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

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

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #17488 exp Services Inc		Company Name: Nimesh Tamrakar		Quotation #: C20328		Bureau Veritas Job #:	
Attention: Accounts Payable		Attention: Nimesh Tamrakar		P.O. #:		Bottle Order #:	
Address: 1595 Clark Blvd		Address:		Project: ADM-22000797-A0		COC #:	
Brampton ON L6T 4V1		Tel: (905) 796-3200 Ext: 3026 Fax:		Project Name:		Project Manager:	
Tel: (905) 793-9800 Fax: (905) 793-0641		Email: Nimesh.Tamrakar@exp.com		Site #:		Patricia Legette	
Email: AP@exp.com; Karen.Burke@exp.com				Sampled By:		C#903374-13-01	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY				ANALYSIS REQUESTED (PLEASE BE SPECIFIC)												Turnaround Time (TAT) Required: Please provide advance notice for rush projects									
Regulation 153 (2011)				Other Regulations				Special Instructions				Field Filtered (please circle): Metals / Hg / Cr VI corrosivity												Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.	
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table				<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality <input type="checkbox"/> PWOO <input type="checkbox"/> Reg 406 Table <input type="checkbox"/> Other																				Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: Rush Confirmation Number: (call lab for #)	
Include Criteria on Certificate of Analysis (Y/N)?																									
Sample Barcode Label		Sample (Location) Identification		Date Sampled		Time Sampled		Matrix														# of Bottles			
1		BH 401 SN101 5514		SEP 6		11:45pm																			
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		# jars used and not submitted		Laboratory Use Only	
EVAN BALOO		23/09/07				Nimesh Tamrakar		23/09/07		13:13		Time Sensitive		Temperature (°C) or Reel	
												6/7/6		Custody Seal	
														Present	
														Intact	
														Yes	
														No	

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

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

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

White: Bureau Veritas Yellow: Client

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

notice