REPORT

Foundation Investigation Report

Nicolston Culvert Replacement / Rehabilitation (Site No. 30X-0678/C0)
Highway 89, Alliston, Simcoe County, Ontario
MTO G.W.P. 2022-22-00; W.P. 2014-23-01; Assignment 2022-E-0046

Submitted to:

Ministry of Transportation, Ontario

159 Sir William Hearst Avenue
Toronto, ON M3M 0B7

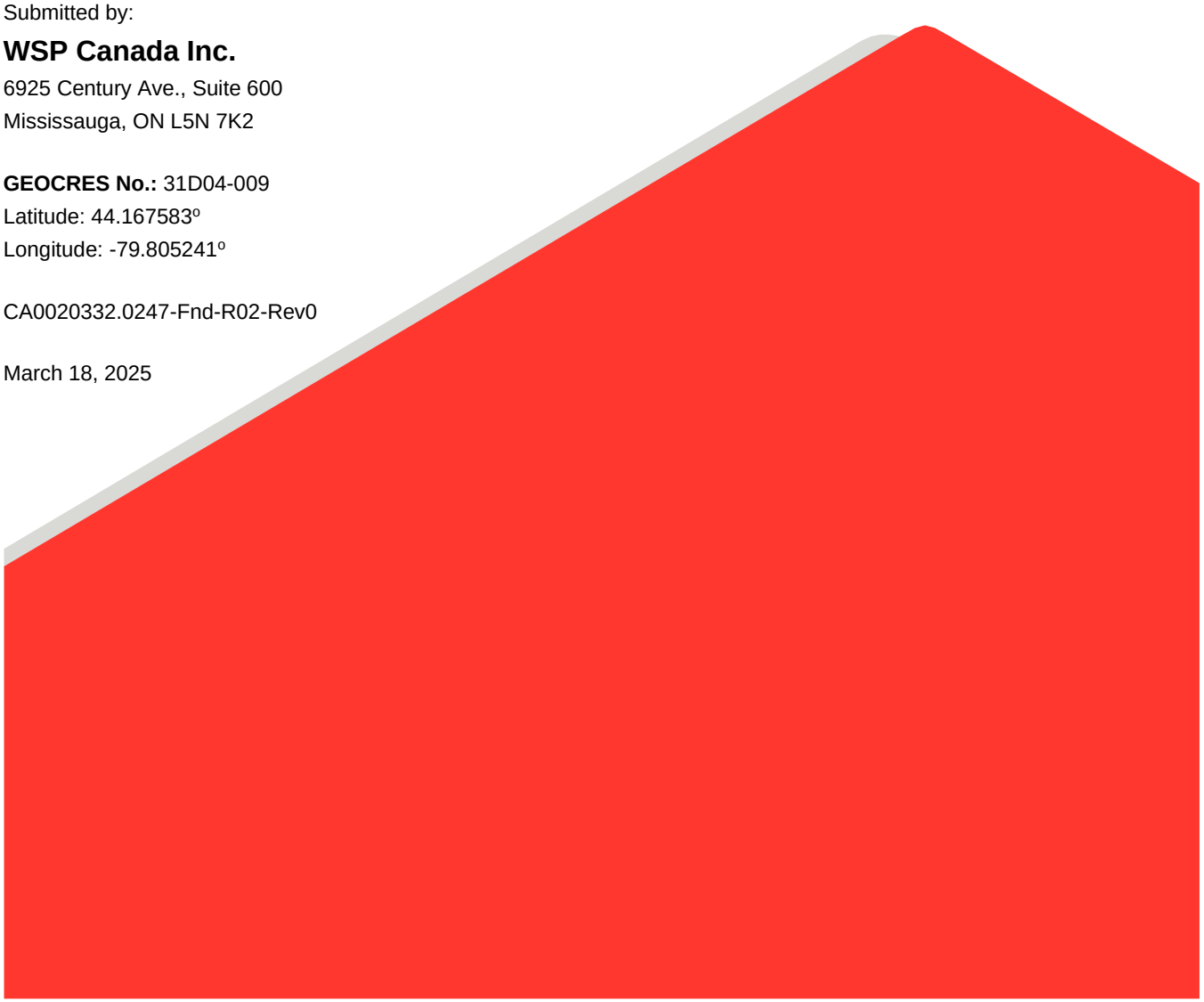
Submitted by:

WSP Canada Inc.
6925 Century Ave., Suite 600
Mississauga, ON L5N 7K2

GEOCRES No.: 31D04-009
Latitude: 44.167583º
Longitude: -79.805241º

CA0020332.0247-Fnd-R02-Rev0

March 18, 2025



Distribution List

1 Electronic Copy - MTO Central Region

1 Electronic Copy - MTO Foundations Section

1 Electronic Copy - WSP Canada Inc.

Table of Contents

1.0 INTRODUCTION

WSP Canada Inc. (WSP) has been retained by the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detail design of improvements to the Highway 89 / Essa 5th Line intersection, including widening of the Nottawasaga River bridge, and rehabilitation / replacement of the Nicolston Structural Culvert in Alliston, Ontario.

This report presents the results of the foundation investigation carried out for detail design of the Highway 89 Nicolston Structural Culvert (Site No. 30X-0678/C0). A separate report addresses the foundation investigation for the proposed widening of the Nottawasaga River bridge.

2.0 SITE DESCRIPTION

This section of Highway 89 is located between the towns of New Tecumseth and Cookstown, and between Essa 5th Line and Nottawasaga Resort Way. The culvert is located within the existing Highway 89 embankment that crosses over a ravine associated with a Nottawasaga River tributary watercourse. The location of the culvert site is shown on Drawing 1.

The area to the south of Highway 89, beyond the vegetated / wooded ravine, is occupied by mobile homes (i.e. the Rolling Acres Camp), as well as the Nottawasaga Resort located further east. The area to the north of Highway 89 consists of heavily vegetated / wooded ravine which leads up to the tableland which is currently used for agricultural purposes. There are some residential and/or small business properties on the north side of Highway 89, directly east of the ravine and culvert site.

The north slope of the Nottawasaga tributary ravine is considered an environmentally sensitive area. There is a permanent cut slope (up to about 10 m high) into the tableland that runs parallel to Highway 89 and adjacent to Essa 5th Line, approximately 30 m west of the culvert. There were previous surficial stability issues within the cut slope west of the site, as outlined in a previous Foundation Report[1] and technical memorandum issued to MTO and titled "*Permanent Remediation of Cut Slope Instabilities on Highway 89 near 5th Line, Essa Township, W.O. 2012-11010, GEOCRES No. 31D-537",* dated March 27, 2012. Based on observations of the cut slope during the current investigation, there was no obvious signs of instability or active erosion. The exiting conditions at the proposed locations of the temporary access roads are shown in Photographs 1 and 2 below.

Photograph 1 – North end of culvert (inlet), looking west

Photograph 2 – South end of culvert (outlet), looking northeast

[1] Golder Associates Ltd. 2009. *Foundation Investigation and Design Report: Highway 89 Nottawasaga River Bridge Rehabilitation/Widening & Retaining Wall and Cut Slope at Intersection of Essa 5th Line and Highway 89, Simcoe County, Ontario, G.W.P. 2503-04-00.*

Highway 89 runs in an east-west direction at this location, and the Nottawasaga River tributary (and culvert) generally runs northeast-southwest. The embankment side-slopes are generally covered with trees and shrubs, with increasing wooded area surrounding the Nottawasaga tributary watercourse, which drains into the Nottawasaga River approximately 275 m southwest of the culvert. The embankment at the location of the culvert is up to approximately 8 m high, with existing side slopes of about 2 horizontal to 1 vertical (2H:1V). There is an existing retaining wall (up to about 1.5 m high) at the crest of the embankment on the north side of Highway 89. The retaining wall was assessed as part of a separate study for this project and is considered to be performing satisfactorily with no signs of distortion or distress.

Based on observations during the field investigation and the site reconnaissance of the existing retaining wall discussed in WSP's retaining wall technical memorandum[2], the existing Highway 89 embankment side-slopes in the vicinity of the culvert inlet / outlet and proposed access roads appear to generally be performing adequately and visual signs of instability or active erosion were limited to some localized zones within the tributary watercourse channel near the headwall / wingwall at the inlet (north) side (see Photograph 3) and above the headwall at the outlet (south) side (see Photograph 4). Localized erosion of the natural drainage path leading from the Highway 89 ditch to the watercourse tributary, east of the retaining wall, was also observed (see Photograph 5). The majority of the embankment slope between the base of the retaining wall and the bottom of the embankment slope appeared to be stable and was heavily vegetated at the time of observation (see Photograph 6).

Photograph 3 – North culvert inlet, looking north (erosion near south/east side of culvert not shown) (Spring 2024)

Photograph 4 – South culvert inlet, looking north (Fall 2024)

[2] WSP. 2024. *Foundation Desktop Study and Site Reconnaissance, Existing Retaining Wall Northeast of Nicolston Culvert, Highway 89, Alliston, Simcoe County, MTO Assignment No. 2022-E-0046*. Technical Memorandum dated March 2024.

Photograph 5 – Erosion east of the retaining wall, looking northwest (Spring 2024)

Photograph 6 – North embankment slope below retaining wall (Early Fall 2023)

Based on the current design drawings, the existing Nicolston Culvert is a 63 m long (measured along centreline) open footing concrete box culvert consisting of an original structure with extensions on both ends. The original section is 18 m long, while the north and south extensions are about 29 m and 16 m long, respectively. The original and south sections are skewed relative to the Highway 89 alignment at an angle of about 41°, and the north extension is “kinked” to follow the direction of the existing watercourse. The culvert sections have a span of about 3.65 m and a rise of about 1.9 m (relative to the top of the open footings). There are concrete wing walls present at both the north (inlet) and south (outlet) ends of the culvert. The natural watercourse bed (streambed) is shown to be near or slightly below the top of the open footings. The width and depth of the existing open footings are not known.

The dates of both the original construction and the extensions are unknown, however it is assumed that the original structure was constructed in the early 1960’s. There are no original design or construction drawings available for the existing culvert. The original culvert section is assumed to be a non-rigid frame while the extensions are assumed to be rigid frame structures. The embankment soil cover above the existing culvert is up to about 6 m thick and Highway 89 currently consists of one lane of traffic in each direction. Highway 89 will not be permanently widened at the culvert location as part of the current design and there is no proposed grade raise.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between April 15 and 23 and November 14 and 27, 2024, during which time a total of six boreholes (designated Boreholes BH24-03 to BH24-06, BH24-09 and BH24-10) were advanced at the locations shown on Drawing 1.

Boreholes BH24-03, BH24-04, BH24-09, and BH24-10 were advanced using 210 mm outside diameter (O.D.) hollow stem augers using a CME 75 truck-mounted drill supplied and operated by Atcost Drilling Inc. of Gormley, Ontario. Boreholes BH24-05 and BH24-06 were advanced using BW sized casing and wash boring techniques with portable equipment supplied and operated by OGS Inc. of Almonte, Ontario. Soil samples were generally obtained at 0.75 m and 1.5 m intervals of depth using a 50 mm O.D. split spoon sampler. The split spoon sampler was driven with an automatic hammer in boreholes advanced with the truck mounted drill rigs in general

accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586[3]). The split spoon sampler was driven with a full weight hammer lifted manually with assistance of a cathead and dropped from the SPT height in boreholes advanced with portable equipment. The split-spoon samplers used in the investigation generally limit the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions. In-situ vane shear tests were carried out in cohesive soils for determination of undrained shear strengths in general accordance with the Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils (ASTM D2573[4]), using an MTO standard 'N'-size vane in boreholes advanced with the truck mount drill rig and an MTO standard 'B'-size vane in boreholes advanced with portable equipment. The boreholes were backfilled upon completion in general accordance with Ontario Regulation 903 Wells (as amended) and capped at the roadway surface using cold patch asphalt.

The water level was typically measured in the open boreholes (or inside the hollow stem augers or BW casing) during and after drilling operations. Standpipe piezometers were installed in Boreholes BH24-03 and BH24-04 and were screened within a silt/silty sand fill and clayey silt deposit, respectively. The installed piezometers consist of a 50 mm diameter PVC pipe, with a 1.5 m long slotted screen within a filter sand pack. The boreholes and annulus surrounding the piezometer pipe above the filter sand pack were backfilled to near ground surface with bentonite pellets in general accordance with Ontario Regulation 903 Wells (as amended) [5]. The monitoring wells were capped with flushmount casings.

The field work was monitored on a full-time basis by a member of WSP's engineering staff who located the boreholes in the field, directed the sampling and in-situ testing operations, logged the boreholes, and examined the soil samples. The soil samples were identified in the field, placed in labelled containers, and transported to WSP's laboratories in Mississauga and Whitby for further visual review and geotechnical laboratory testing. Index and classification testing consisting of natural moisture content, organic content, Atterberg limits and grain size distribution were conducted on selected samples. All laboratory tests were carried out in general accordance with MTO and / or ASTM Standards, as applicable.

Two soil samples obtained from Boreholes BH24-03 and BH24-04 were submitted to a specialist analytical laboratory (Bureau Veritas Laboratories of Mississauga, Ontario) under chain of custody procedures for testing of electrical conductivity / resistivity, pH, and chemical analysis of sulphate, sulphide and chloride content, to assess the potential for the soil to cause deterioration to buried concrete and corrosion to steel.

The borehole coordinates were surveyed in the field by WSP personnel using a Trimble Catalyst DA2 Global Positioning System (GPS) unit and the elevation was obtained from the digital terrain model (DTM) developed for the project. The locations given on the borehole records and shown on Drawing 1 are positioned relative to NAD 83 MTM (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum (CGVD28 datum). The borehole locations, including the geographic (Latitude / Longitude) coordinates, the ground surface elevations, and borehole depths are summarized below.

[3] ASTM D1586 Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

[4] ASTM D2573 Standard Test Method for Field Vane Strength Shear Test

[5] Ontario Regulation 903 Wells (as amended)

Table 1: Summary of Boreholes

Borehole No.	NAD 83 MTM Northing (m) (Latitude, °)	NAD 83 MTM Easting (m) (Longitude, °)	Ground Surface Elevation (m)	Borehole Depth (m)
BH24-03	4,891,998.5 (44.167577)	280,397.8 (-79.805134)	214.5	18.9
BH24-04	4,892,002.9 (44.167616)	280,382.3 (-79.805328)	214.2	18.9
BH24-05	4,891,977.2 (44.167385)	280,382.4 (-79.805326)	207.3	10.4
BH24-06	4,892,037.3 (44.167928)	280,443.4 (-79.804566)	209.8	9.8
BH24-09	4,891,999.0 (44.16758)	280,367.8 (-79.805509)	213.8	16.2
BH24-10	4,892,002.5 (44.167613)	280,413.3 (-79.80494)	215.0	16.2

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The site generally lies within the physiographic region known as the Simcoe Lowlands, between two sections of the region known as the Peterborough Drumlin Field, as delineated in *The Physiography of Southern Ontario*[6].

Most of the Nottawasaga Basin was at one time part of the floor of Lake Algonquin and its surface beds are deltaic and lacustrine origin. Within the Nottawasaga Basin in the Alliston area where the culvert site is located, near the confluence of the Nottawasaga River and Boyne River are the Essa Flats[7]. The Essa Flats portion of the Basin comprises of a sandy loam soil. The surficial geology in the area adjacent to the Nottawasaga River are described as modern alluvial deposits consisting of clay, silt, sand, and gravel which may contain organics[8].

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes from the current investigation, including piezometer installation details and water level readings, and the results of the in-situ and laboratory tests, are provided on the borehole records in Appendix A. The results of the in-situ field tests (i.e., SPT “N”-values) as presented on the borehole records and in Section 4 are uncorrected. The detailed results of the geotechnical laboratory testing on soil samples are presented on the laboratory test figures in Appendix B. The results of the analytical testing are provided in Appendix C.

The stratigraphic boundaries shown on the borehole records and on the stratigraphic profile on Drawing 2 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the soil encountered at this site consists of embankment fill associated with the highway (i.e. surficial layer of asphalt underlain by cohesive and non-cohesive fill) above peat or an organic silt, underlain by a clayey silt to clay deposit underlain by a till deposit consisting predominantly of clayey silt-silt and sand. More detailed

[6] Chapman, L. J. and Putnam, D. F. *The Physiography of Southern Ontario*, Ontario Geological Survey Special Volume 2, Third Edition, 1984. Accompanied by Map P.2715 Scale 1:600,000.

[7] Ministry of Northern Development and Mines, Ontario. 1988. Aggregate resources inventory of Essa and Tosorontio Townships, Simcoe County, Southern Ontario; Ontario Geological Survey. Aggregate Resources Inventory Paper 113.

[8] Ontario Geological Survey. 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 128 – Revised.

descriptions of the major soil layers encountered in the boreholes as well as a summary of laboratory results are provided in the following sections.

4.2.1 Asphalt

An approximately 45 mm to 180 mm thick layer of asphalt was encountered at ground surface in Boreholes BH24-03, BH24-04, BH24-09 and BH24-10, respectively.

4.2.2 Fill

A 3.5 m to 7.2 m thick layer of fill (cohesive and non-cohesive) was encountered below the asphalt in boreholes advanced through the road (BH24-03, BH24-04, BH24-09 and BH24-10) and a 1 m thick layer of silty sand fill was encountered at ground surface in Borehole BH24-05. The fill encountered in boreholes advanced through the road was primarily non-cohesive, consisting of sandy silt, silt and sand, silty sand, sand to gravelly sand, and sandy gravel. The cohesive fill consisted of clayey silt to sandy clayey silt. Trace organics were encountered throughout the fill soils in the majority of boreholes and trace asphalt fragments were encountered in the fill at Borehole BH24-03. The lower portion of the fill soils typically contained timber and wood fragments and/or shell fragments near the fill / native soil interface.

The SPT ‘N’-values measured within the non-cohesive fill range from 0 blows to 46 blows per 0.3 m of penetration, indicating a very loose to dense state of compactness.

The SPT ‘N’-values measured within the cohesive fill range from 2 to 8 blows per 0.3 m of penetration. In-situ field vane tests carried out within the cohesive fill measured shear strengths ranging from 48 kPa to 67 kPa with a calculated sensitivity between about 10 and 13. The combined SPT and field vane test results suggest that the deposit has a generally firm to stiff consistency.

Grain size distribution tests were carried out on six samples of the non-cohesive fill and the results are presented on Figure B1 in Appendix B. Atterberg limits testing was carried out on five samples of the non-cohesive fill. Four of the Atterberg limit tests measured the fines component of the non-cohesive fill as non-plastic. One Atterberg limits test taken on a fill sample containing organics from the lower portion of BH24-03 measured a liquid limit of about 27%, plastic limit of about 22%, and plasticity index of 5% (see Figure B2 in Appendix B) indicating the fines component of the fill is classified as a clayey silt-silt to silt or organic silt of low plasticity. A laboratory organic content test performed on the same sample from Borehole BH24-03 measured an organic content of about 5%.

A grain size distribution test carried out on one sample of the cohesive clayey silt fill is presented on Figure B3. An Atterberg limits test was carried out on one sample of the cohesive clayey silt fill and measured a liquid limit of about 33%, plastic limit of about 17%, and corresponding plasticity index of about 16%. The results of the Atterberg limits test are shown on the plasticity chart on Figure B4 and indicate the fill is classified as clayey silt of low plasticity.

The natural moisture content measured on samples of the non-cohesive fill range from 4% to 37%. The higher moisture contents can be attributed to the presence of organics and clayey interlayers. The natural moisture content measured on three samples of the cohesive fill range from 23% to 25%.

4.2.3 Organic Deposit – Peat (PT) / Organic Silt (OL)

A layer of peat (0.4 m thick) was encountered below the fill in Borehole BH24-09 at a depth of approximately 3.7 m below highway grade (Elevation 210.0 m). A 0.3 m thick layer of organic silt was encountered below the fill in Borehole BH24-10 at a depth of 4.2 m below highway grade (Elevation 210.8 m). The organic silt deposit contains wood pieces.

A SPT ‘N’-value measured at the interface between the peat and the underlying sandy silt deposit was 5 blows per 0.3 m of penetration, suggesting a firm consistency. The natural moisture content measured on a sample of the peat was about 120%. The organic content of a sample of peat was measured to be about 33%.

A SPT ‘N’-value measured at the interface between the organic silt and the overlying sandy silt fill was 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very loose state of compactness. The natural moisture content measured on a sample of the organic silt was 44%.

4.2.4 Sandy Silt (ML)

A 0.4 m thick deposit of brown to grey sandy silt was encountered below the organic deposit in Boreholes BH24-09 and BH24-10, respectively. The deposit was encountered between Elevations 209.7 m and 210.5 m respectively.

The SPT ‘N’-values measured within this deposit were 5 blows and 8 blows per 0.3 m of penetration, indicating a loose state of compactness.

The natural moisture content measured on two samples of the deposit was about 21% and 22%.

4.2.5 Clayey Silt (CL) to Clay (CH)

A native cohesive deposit consisting of clayey silt to clay with varying amounts of sand and gravel was encountered at ground surface in Borehole BH24-06, below the fill in Boreholes BH24-03 to BH24-05 and below the sandy silt deposit in Boreholes BH24-09 and BH24-10. The top of the clayey silt to clay deposit was encountered between Elevation 206.3 m and 210.1 m. Where the deposit was fully penetrated in two boreholes, it had a thickness of 8.8 m and 10.4 m. The deposit was penetrated for lengths between 9.4 m and 11.7 m in Boreholes BH24-03, BH24-05, BH24-06 and BH24-10 before the boreholes were terminated. The deposit contained pockets, laminations, and seams of gravel, sand and silt at various depths in Boreholes BH24-04, BH24-06, BH24-09, and BH24-10. In Borehole BH24-06 the deposit contained interlayers of organic silt and/or wood fragments from ground surface to a depth 3 m (Elevation 209.8 m to 206.8 m).

The SPT ‘N’-values measured within this deposit range from 0 blows (i.e., weight of hammer) to 10 blows per 0.3 m of penetration. In-situ field vane tests carried out within this deposit generally measured undrained shear strengths ranging from 26 kPa to 86 kPa with a calculated sensitivity between about 1 and 12. Several field vane tests achieved refusal of the testing equipment to penetrate the deposit due to the presence of gravel pockets. The combined SPT and field vane test results indicate that the deposit has a generally firm to stiff consistency.

Eight grain size distribution tests were carried out on samples of the clayey silt to clay deposit and the results are shown on Figure B5 in Appendix B.

Atterberg limits tests were carried out on 12 samples of the cohesive deposit and measured liquid limits between about 31% and 70%, plastic limits between about 17% and 22%, and corresponding plasticity indices between about 14% to 49%. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B6A/B in Appendix B and classify the cohesive deposit as clayey silt to clay of low to high plasticity.

The natural moisture content measured on 19 samples of the clayey silt to clay deposit were between about 18% and 47%. The organic content of a sample from the upper portion of the cohesive deposit containing organic silt interlayers in Borehole BH24-06 was measured to be about 4%.

4.2.6 Clayey Silt-Silt (CL-ML) - Till

A clayey silt-silt and sand (till) deposit was encountered underlying the cohesive clayey silt to clay deposit in Boreholes BH24-04 and BH24-09. The till deposit was encountered at Elevation 197.1 m and 200.5 m. Boreholes BH24-04 and BH24-09 were terminated within the clayey silt-silt till deposit after penetrating it for lengths of 1.8 m and 2.9 m, respectively.

The SPT 'N'-values measured within this deposit range from 6 blows to 10 blows per 0.3 m of penetration. Two in-situ field vane tests carried out within this deposit measured undrained shear strengths of approximately 67 kPa with a calculated sensitivity of about 3. The combined SPT and field vane test results suggest that the deposit has a stiff consistency.

Two grain size distribution tests were carried out on select samples of the clayey silt-silt till deposit and the results are shown on Figure B7 in Appendix B.

An Atterberg limits test carried out on two samples of the cohesive till deposit measured liquid limits of about 13% and 14%, plastic limits of about 9%, and corresponding plasticity indices of about 4% and 5%. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B8 in Appendix B and classify the till deposit as clayey silt-silt of low plasticity.

The natural moisture content measured on two samples of the clayey silt-silt till deposit was about 9% and 11%.

4.3 Groundwater Conditions

The water levels measured in the open boreholes and/or within the hollow stem augers or BW casing at the time of the investigation are shown on the borehole records in Appendix A and are not considered representative of the stabilized hydrostatic water levels at the site. Standpipe piezometers were installed in Boreholes BH24-03 and BH24-04 to allow monitoring of the stabilized hydrostatic groundwater level at this site. The groundwater levels recorded in the piezometers are shown on the borehole records in Appendix A and are summarized below.

Table 2: Summary of Piezometer Installation and Water Level Readings

Borehole No. (Piezometer)	Depth (Elevation) of Screen Interval (m)	Depth (bgs) to Water Level (m)	Water Level Elevation (m)	Date of Water Level Reading
BH24-03	6.1 – 7.6 (208.4 – 206.9)	4.0	210.5	August 26, 2024
		4.3	210.2	November 25, 2024
BH24-04	4.6 – 6.1 (209.6 – 208.1)	3.8	210.4	August 26, 2024
		3.9	210.3	November 27, 2024

The groundwater levels at this site will be subject to seasonal fluctuations and precipitation events; the water levels should be expected to be higher during the spring season or during and following periods of heavy precipitation and snow melt. Localized perched groundwater should also be anticipated above clayey zones within the fill soils.

4.4 Analytical Testing Results

Two soil samples were submitted for analysis of parameters used to assess the potential corrosivity of the site soil to steel and concrete. Detailed analytical test results are included in Appendix C and the test results are summarized below:

Table 3: Summary of Analytical Testing Results

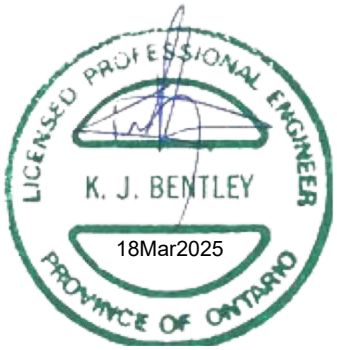
Borehole No., Sample No.	pH	Resistivity (ohm-cm)	Electrical Conductivity (µmho/cm)	Soluble Chloride (µg/g)	Soluble Sulphate (µg/g)	Sulphide (mg/kg)	Redox Potential (mV)
BH24-03, Sa#9	7.74	1800	561	200	35	2.4	270
BH24-04, Sa#8	7.56	5200	192	<20 *	49	3.3	270

Note: * Less than reportable detection limit.

5.0 CLOSURE

This foundation investigation report was prepared by Farhana Jabin, P.Eng., and Madison Kennedy, P.Eng., both Geotechnical Engineers with WSP. Kevin Bentley, P.Eng. a Geotechnical Engineer with WSP and MTO Principal Foundations Contact conducted a technical and quality control review of the report.

Madison Kennedy, M.A.Sc. P.Eng.
Geotechnical Engineer



Kevin Bentley, M.E.Sc., P.Eng.
MTO Principal Foundations Contact

FJ/MCK/KJB/al

MINISTRY OF TRANSPORTATION, ONTARIO

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

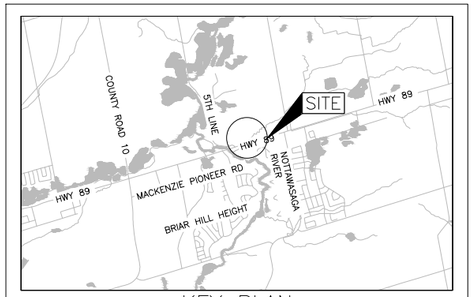
CONT No.
WP No. 2014-23-01

HIGHWAY 89
NICOLSTON CULVERT

BOREHOLE LOCATIONS PLAN

SHEET

PLAN
SCALE
5 0 5 10 m



KEY PLAN
SCALE
1 0 1 2 km

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH24-03	214.5	4891998.5	280397.8
BH24-04	214.2	4892002.9	280382.3
BH24-05	207.3	4891977.3	280382.4
BH24-06	209.8	4892037.3	280443.4
BH24-09	213.8	4891999.0	280367.8
BH24-10	215.0	4892002.5	280413.3

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.

REFERENCE

Base plans provided in digital format by WSP, drawing file no. BC-785-89-1.dwg, received September 26, 2024.
GA provided in digital format b WSP, drawing file no. CA0020332.0247
Culvert – Genaral Arrangement.dwg, received September 26, 2024.
Retaining Wall provided in digital format by WSP, drawing file no. B-785-89-1.dwg, received on October 10, 2024.

LICENSED PROFESSIONAL ENGINEER
M. C. KENNEDY
100547814
Mar. 18, 2025
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 18, 2025
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D04-009

HWY. HWY 89		PROJECT NO. CA0020332.0247	DIST.
SUBM'D. MCK	CHKD. FJ	DATE: 3/18/2025	SITE: 30X-0678/C0
DRAWN: SA	CHKD. MCK	APPD. KJB	DWG. 1

PLOT DATE: March 18, 2025
FILENAME: S:\Clients\MTO\Hwy_89_Eass\99_PROJ\CA0020332_0247\45_PROD\0007_Culvert\CA0020332_0247-0007-BG-0001.dwg

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

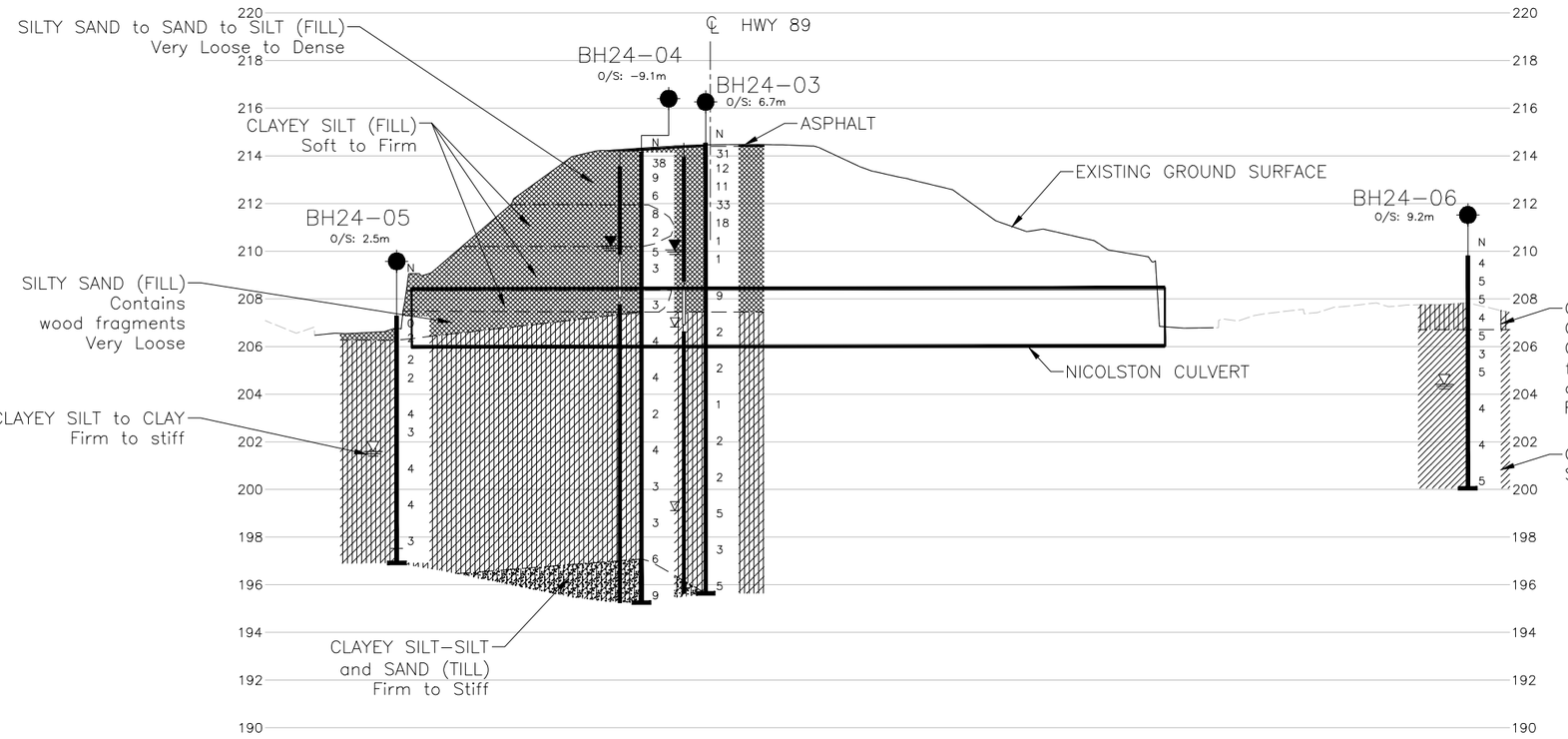
CONT No.
WP No. 2014-23-01

SHEET

HIGHWAY 89
NICOLSTON CULVERT

SOIL STRATA

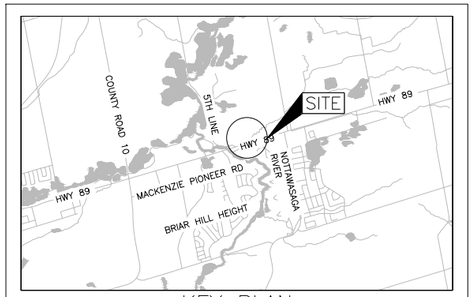
wsp



PROFILE A–A'

VERTICAL SCALE
2.5 0 2.5 5 m

HORIZONTAL SCALE
5 0 5 10 m



KEY PLAN
SCALE
1 0 1 2 km

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
BH24-03	214.5	4891998.5	280397.8
BH24-04	214.2	4892002.9	280382.3
BH24-05	207.3	4891977.3	280382.4
BH24-06	209.8	4892037.3	280443.4

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.

REFERENCE

Base plans provided in digital format by WSP, drawing file no. BC-785-89-1.dwg, received September 26, 2024.
GA provided in digital format b WSP, drawing file no. CA0020332.0247 Culvert – Genaral Arrangement.dwg, received September 26, 2024.

LICENSED PROFESSIONAL ENGINEER
M. C. KENNEDY
100547814
Mar. 18, 2025
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 18, 2025
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31D04-009

HWY. 89	PROJECT NO. CA0020332.0247		DIST.
SUBM'D. MCK	CHKD. FJ	DATE: 3/4/2025	SITE: 30X-0678/C0
DRAWN: SA	CHKD. MCK	APPD. KJB	DWG. 2

PLOT DATE: March 18, 2025
FILENAME: S:\Clients\MTO\Hwy_89_East\99_PROJ\CA0020332_0247\45_PROD\0007_Culvert\CA0020332_0247-0007-BS-0002.dwg

APPENDIX A

RECORD OF BOREHOLES

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS
MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS[1,2]

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (*i.e.,* SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (*i.e.,* some sand)
≤ 10	trace (*i.e.,* trace fines)

1. Only applicable to components not described by Primary Group Name.
2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

COARSE-GRAINED SOILS

Compactness[1]

Term	SPT 'N' (blows/0.3m)[2]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

1. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ. where $\gamma = \rho \cdot g$ (i.e., mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_P or PL	plastic limit
I_P or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
$C_{\alpha(e)}$	secondary compression index
C_α	rate of secondary compression
$C_{\alpha(\varepsilon)}$	modified secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
c′	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q or q'	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

AXJ Axial Joint
BD Bedding
BC Broken Core
CC Continuous Core
CL Closed
CO Contact
CU Curved
CT Coated
FLT Fault
FOL Foliation
FR Fracture
GO Gouge
IN Infilled
IR Irregular
JN Joint
KV Karstic Void
K Slickensided
LC Lost Core
MB Mechanical Break
PL Planar
PO Polished
RO Rough
SA Slightly Altered
SH Shear
SM Smooth
SR Slightly Rough
SY Stylolite
UN Undulating
VN Vein
VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-03

Sheet 1 of 2

METRIC

G.W.P. 2022-E-0046 LOCATION N 4891998.5; E 280397.8 NAD83 / MTM Zone 10 (LAT. 44.167577; LONG. -79.805134) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:214.5 m DATE Apr 15, 2024 - Apr 16, 2024 CHECKED BY MCK

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) (Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined) 20 40 60 80 100	WATER CONTENT (%) PL W_p NMC W LL W_l NP Nonplastic 20 40 60	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
0.0	ASPHALT (45 mm)														
214.4 / 0.1	SILTY SAND (SM) and gravel, (FILL) Dense Brown Moist		1A	SS	31										
214.1 / 0.5			1B				214								
	SILTY SAND (SM), trace gravel, trace organics, containing asphalt fragments, (FILL) Dense to compact Brown Moist		2	SS	12				○						
213.1 / 1.4	Sandy SILT (ML), trace gravel, trace organics, containing clayey silt pockets (FILL) Compact Brown Moist - 1.5 to 2.1 m: occasional clay pockets - 2.3 to 2.6 m: observed low plasticity		3	SS	11		213		○						
212.0 / 2.6	Gravelly SAND (SP), trace fines, (FILL) Dense Brown Moist		4A	SS	33		212		○						
211.6 / 3.0	SILT (ML) and sand, trace clay, trace gravel, (FILL) Compact to very loose Brown Moist to wet		4B												
			5	SS	18		211								
	- 3.8 m: becoming wet below a depth of 3.8 m		6	SS	1				○	NP	1	45	48	6	
			7	SS	1		210								
							209								
	- 6.1 to 6.4 m: Timber and wood fragments encountered in split spoon - 6.4 to 6.7 m: containing trace organics		8A	SS	9										
207.4 / 7.2			8B				208		⊖		3	42	47	8	OC = 4.7%
	CLAY (CH) to CLAYEY SILT (CL), trace sand Firm to stiff Grey Wet														
			9	SS	2		207								
							206	⊕ ×							
			10	SS	2		205				0	1	25	74	
								⊕ ×							

Continued on Next Page

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-03 Sheet 2 of 2 METRIC

G.W.P. 2022-E-0046 LOCATION N 4891998.5; E 280397.8 NAD83 / MTM Zone 10 (LAT. 44.167577; LONG. -79.805134) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:214.5 m DATE Apr 15, 2024 - Apr 16, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	UNIT WEIGHT	GR SA SI CL	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			⊕ Field Vane, ⊗ Remoulded, ■ Pocket Pen, ● Quick Triaxial, ○ Unconfined; 20 40 60 80 100	PL W_p — NMC W — LL W_l; NP Nonplastic; 20 40 60	γ kN/m³		
	CLAY (CH) to CLAYEY SILT (CL), trace sand Firm to stiff Grey Wet						204					
			11	SS	1		203					
			12	SS	2		202					
			13	SS	2		201					
			14	SS	5		200					
			15	SS	3		199				0 3 46 51	
			16	SS	5		198					
	- 18.3 to 18.9 m: trace sand, trace gravel						197					
195.6							196					
18.9	End of Borehole Notes: 1. Water encountered inside augers at a depth of 7.5 m (Elev. 207.0 mASL) during drilling. 2. Water level measured inside augers at a depth of 15.2 m (Elev. 199.3 mASL) on 16-Apr-2024, prior to resuming drilling at a depth of 16.8 m. 3. Water level measured inside augers at a depth of 5.9 m (Elev. 208.6 mASL) upon completion of drilling.. 4. Water level measured inside piezometer at a depth of 4.0 m (Elev. 210.5 mASL) on 26-Aug-2024. 5. Water level measured inside piezometer at a depth of 4.3 m (Elev. 210.2 mASL) on 25-Nov-2024.						195					

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-04 Sheet 1 of 2 METRIC

G.W.P. 2022-E-0046 LOCATION N 4892002.9; E 280382.3 NAD83 / MTM Zone 10 (LAT. 44.167616; LONG. -79.805328) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:214.2 m DATE Apr 16, 2024 - Apr 18, 2024 CHECKED BY MCK

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) (Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined) 20 40 60 80 100	WATER CONTENT (%) PL W_p NMC W LL W_l NP Nonplastic 20 40 60	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
0.0	ASPHALT (170 mm)														
214.0 / 0.2	Gravelly SILTY SAND (SM) to SAND (SP-SM), some gravel (FILL) Loose to dense Brown, oxidation staining Moist		1A 1B	SS	38		214								
213.2			2A												
0.9	SILTY SAND (SM) to Sandy SILT (ML), containing clayey silt pockets (FILL) Loose Brown Moist		2B	SS	9		213								
	- 1.8 m: becoming wet below 1.8 m		3	SS	6										
211.9							212								
2.2	Sandy CLAYEY SILT (CL), trace gravel, (FILL) Soft to firm Grey, oxidation staining Moist		4	SS	8										
	- 3.0 m: becoming wet below 3.0 m		5	SS	2		211								
210.2															
4.0	SILTY SAND (SM), trace clay, containing clayey silt pockets to a depth of 4.42 m, (FILL) Loose to very loose Brown Wet		6	SS	5		210								
	- 4.6 m: trace organics below a depth of 4.6 m		7	SS	3		209				NP	0	63	33	4
208.5															
5.6	CLAYEY SILT (CL), trace sand, trace gravel, trace organics, trace shell fragments, (FILL) Soft Grey, greenish-yellow to blueish-grey staining Wet		8	SS	3		208								
207.4															
6.7	SILTY CLAY (CI), trace sand Firm to stiff Grey Moist to wet		9	SS	4		207					0	2	25	73
							206								
			10	SS	4		205								

Continued on Next Page

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-04 Sheet 2 of 2 METRIC

G.W.P. 2022-E-0046 LOCATION N 4892002.9; E 280382.3 NAD83 / MTM Zone 10 (LAT. 44.167616; LONG. -79.805328) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:214.2 m DATE Apr 16, 2024 - Apr 18, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%) PL W_p NMC W LL W_l	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	NP Nonplastic 20 40 60						
	SILTY CLAY (CI), trace sand Firm to stiff Grey Moist to wet						204								
			11	SS	2						0	0	38	62	
							203								
	- 12.2 to 12.8 m: trace sand, trace gravel						202								
			12	SS	4										
							201								
			13	SS	3										
							200								
	- 15.2 m: trace gravel, trace sand, containing gravelly sand laminations below a depth of 15.2 - 15.2 m: becoming wet below a depth of 15.2 m						199								
			14	SS	3										
							198								
197.1			15 A	SS	6										
17.1	CLAYEY SILT-SILT (CL-ML) and SAND, trace gravel, (TILL) Firm to stiff Grey Moist		15 B				197								
							196								
195.2			16	SS	9						4	46	39	11	
18.9	End of Borehole Notes: 1. Water was encountered at a depth of 4.6 m (Elev. 209.6 mASL) during drilling on 16-Apr-2024. 2. Water level measured inside piezometer at a depth of 5.0 m (Elev. 209.2 m) upon installation. 2. Water level measured inside piezometer at a depth of 3.8 m (Elev. 210.4 mASL) on 26-Aug-2024. 3. Water level measured inside piezometer at a depth of 3.9 m (Elev. 210.3 mASL) on 27-Nov-2024.						195								

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-05 Sheet 1 of 2 METRIC

G.W.P. 2022-E-0046 LOCATION N 4891977.2; E 280382.4 NAD83 / MTM Zone 10 (LAT. 44.167385; LONG. -79.805326) ORIGINATED BY AM

DIST Central HWY 89 BOREHOLE TYPE Washboring, BW Casing; Portable Equipment COMPILED BY MTI

DATUM Surface Elevation:207.3 m DATE Nov 26, 2024 - Nov 27, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES												
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (SHEAR STRENGTH (kPa): Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined; 20 40 60 80 100)	WATER CONTENT (%) PL W_p NMC W LL W_l (NP Nonplastic; 20 40 60)	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
0.0	SILTY SAND (SM), some clay, trace gravel, trace organics containing wood fragments (FILL) Very Loose Grey Wet		1	SS	0		207		NP		1	49	34	16	
206.3			2A	SS	2										
1.0	CLAY (CH) Soft to firm Grey Moist to wet		2B				206								
			3	SS	2										
			4	SS	2		205								
			5	SS	4		204								
			6	SS	3		203								
			7	SS	4		202								
			8	SS	4		201								
			9	SS	3		200								
							199								
							198								

Continued on Next Page

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-05 Sheet 2 of 2 METRIC

G.W.P. 2022-E-0046 LOCATION N 4891977.2; E 280382.4 NAD83 / MTM Zone 10 (LAT. 44.167385; LONG. -79.805326) ORIGINATED BY AM

DIST Central HWY 89 BOREHOLE TYPE Washboring, BW Casing; Portable Equipment COMPILED BY MTI

DATUM Surface Elevation:207.3 m DATE Nov 26, 2024 - Nov 27, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT	WATER CONTENT (%)				
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH (kPa) ⊕ Field Vane, ■ Remoulded, ● Pocket Pen, ○ Quick Triaxial, × Unconfined; 20 40 60 80 100	PL W_p	NMC W	LL W_l	UNIT WEIGHT γ kN/m³	GR SA SI CL	REMARKS
196.9	CLAY (CH) Soft to firm Grey						197							
10.4	Moist to wet End of Borehole Note: 1. Water level measured at a depth of 5.5 mbgs (Elev. 201.8 m) inside the casing upon completion of drilling.						196 195 194 193 192 191 190 189 188		NP Nonplastic	20 40 60				

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-06 Sheet 1 of 1 METRIC

G.W.P. 2022-E-0046 LOCATION N 4892037.3; E 280443.4 NAD83 / MTM Zone 10 (LAT. 44.167928; LONG. -79.804566) ORIGINATED BY AM

DIST Central HWY 89 BOREHOLE TYPE Washboring, BW Casing; Portable Equipment COMPILED BY MTI

DATUM Surface Elevation:209.8 m DATE Nov 14, 2024 CHECKED BY MCK

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) (Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined) 20 40 60 80 100	WATER CONTENT (%) PL W_p NMC W LL W_l NP Nonplastic 20 40 60	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
0.0	CLAYEY SILT (CL) some sand to sandy, trace gravel, trace organics containing wood fragments Firm Brown to grey Moist		1	SS	4										
208.9							209								
0.9	CLAYEY SILT (CL) and SAND, trace organics, containing wood fragments and interlayers of organic silt Firm		2	SS	5										
	Grey to blackish-grey Moist		3	SS	5		208				1	40	35	24	OC = 4.3%
			4	SS	4										
206.8							207								
3.0	CLAY (CH), trace sand, trace organics to a depth of 3.7 m Soft to firm Grey Moist to wet - 3.7 m: Field vane refusal to advance - 3.7 to 5.2 m: Containing gravel pockets		5	SS	5										
			6	SS	3		206								
	- 4.6 m: Field vane refusal to advance		7	SS	5	▽	205								
							204								
			8	SS	4										
							203								
			9	SS	4		202								
							201								
			10	SS	5										
200.0															
9.8	End of Borehole Notes:						200								

1. Water level measured at a depth of 5.2 mbgs (Elev. 204.6 m) upon completion of drilling.

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-09

Sheet 1 of 2 **METRIC**

G.W.P. 2022-E-0046 LOCATION N 4891999; E 280367.8 NAD83 / MTM Zone 10 (LAT. 44.16758; LONG. -79.805509) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:213.8 m DATE Apr 18, 2024 - Apr 22, 2024 CHECKED BY MCK

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES	GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) (Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined) 20 40 60 80 100	WATER CONTENT (%) PL W_p NMC W LL W_l NP Nonplastic 20 40 60	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
0.0	ASPHALT (180 mm)														
213.6 / 0.2	SILTY SAND (SM), some gravel to gravelly, (FILL) Dense Brown Moist		1A, 1B	SS	46		213								
212.9 / 0.9	Sandy SILT (ML), trace gravel, (FILL) Compact Brown Moist		2A, 2B	SS	13										
212.1 / 1.7	CLAYEY SILT (CL), trace sand, trace gravel, trace organics (FILL) Stiff Brown Moist		3A, 3B	SS	4		212								
			4	SS	3		211				0	8	44	48	
210.6 / 3.2	Sandy SILT (ML). trace clay, trace organics, wood pieces, (FILL) Very loose Brown, blackish spots Wet		5	SS	2										
210.0 / 3.7	Peat (PT) Firm Black Wet		6A, 6B	SS	5		210			MC= 120					OC = 33.2%
209.7 / 4.1	Sandy SILT (ML), trace organics, Loose Brown, oxidation staining and blackish staining Wet														
209.3 / 4.5	CLAY (CH) to CLAYEY SILT (CL), trace sand, trace gravel Firm to stiff Brown Wet		7	SS	10		209								
	- 6.1 m: becoming grey and wet below a depth of 6.1 m		8	SS	5		208				0	4	21	75	
			9	SS	3		207								
	- 9.1 to 9.7 m: containing sand pockets		10	SS	4		206								
							205								
							204								

Continued on Next Page

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-09

Sheet 2 of 2

METRIC

G.W.P. 2022-E-0046 LOCATION N 4891999; E 280367.8 NAD83 / MTM Zone 10 (LAT. 44.16758; LONG. -79.805509) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:213.8 m DATE Apr 18, 2024 - Apr 22, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	UNIT WEIGHT	GR SA SI CL	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined; 20 40 60 80 100	PL W_p NMC W LL W_l; NP Nonplastic; 20 40 60	γ kN/m³		
	CLAY (CH) to CLAYEY SILT (CL), trace sand, trace gravel Firm to stiff Brown Wet						203					
			11	SS	4							
							202					
			12	SS	3							
200.5							201					
13.3	CLAYEY SILT-SILT (CL-ML) and sand, trace gravel (TILL) Stiff Grey Moist						200					
			13	SS	9						4 41 43 12	
							199					
			14	SS	10							
197.6							198					
16.2	End of Borehole Notes: 1. Borehole was advanced to a depth of 4.6 m on 18-Apr-2024. Water level measured inside augers at a depth of 4.6 m (Elev. 209.2 m) prior to drilling on 22-Apr-2024. 2. Borehole dry upon completion of drilling.						197					
							196					
							195					
							194					

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-10

Sheet 1 of 2

METRIC

G.W.P. 2022-E-0046 LOCATION N 4892002.5; E 280413.3 NAD83 / MTM Zone 10 (LAT. 44.167613; LONG. -79.80494) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:215.0 m DATE Apr 22, 2024 - Apr 23, 2024 CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%) PL W_p NMC W LL W_l	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined; 20 40 60 80 100	NP Nonplastic; 20 40 60						
0.0	ASPHALT (70 mm)														
214.9 / 0.1	Gravelly SILTY SAND (SM) (FILL) Dense Brown Moist		1	SS	40										
214.2 / 0.8	Sandy GRAVEL (GP-GM), trace to some fines, (FILL) Compact Grey Moist		2	SS	11		214								
213.6 / 1.4	Sandy SILT (ML) trace gravel, (FILL) Very loose to compact Brown and grey Moist to wet		3	SS	10		213				2	25	68	5	
	- 2.3 m: becoming wet below a depth of 2.3 m - 2.3 m: containing trace organics and silty clay pockets between a depth of 2.3 m and 2.9 m		4	SS	29										
	- 3.0 to 3.7 m: containing wood fragments between a depth of 3.0 m and 3.7 m		5	SS	1		212			NP	0	46	48	6	
210.8 / 4.2	ORGANIC SILT (OL), containing wood pieces Very loose Blackish grey Wet		6A	SS	0		211								
210.5 / 4.5			6B												
210.1 / 4.9	Sandy SILT (ML), trace clay, trace organics, Loose Grey Wet		7A	SS	8										
			7B				210								
	CLAYEY SILT (CL) to SILTY CLAY (CI), trace sand, trace gravel Firm to stiff Grey Wet		8	SS	7						0	9	38	53	
			9	SS	6		209								
			10	SS	4		208								
			11	SS	6		207								
			12	SS	2										
			13	SS	1		206								
	- 9.9 m: containing silt seams below a depth of 9.9 m														

Continued on Next Page

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

Ontario

PROJECT CA0020332.0247

RECORD OF BOREHOLE No. BH24-10

Sheet 2 of 2 **METRIC**

G.W.P. 2022-E-0046 LOCATION N 4892002.5; E 280413.3 NAD83 / MTM Zone 10 (LAT. 44.167613; LONG. -79.80494) ORIGINATED BY KR

DIST Central HWY 89 BOREHOLE TYPE 210 mm O.D. Hollow Stem Augers COMPILED BY MTI

DATUM Surface Elevation:215.0 m DATE Apr 22, 2024 - Apr 23, 2024 CHECKED BY MCK

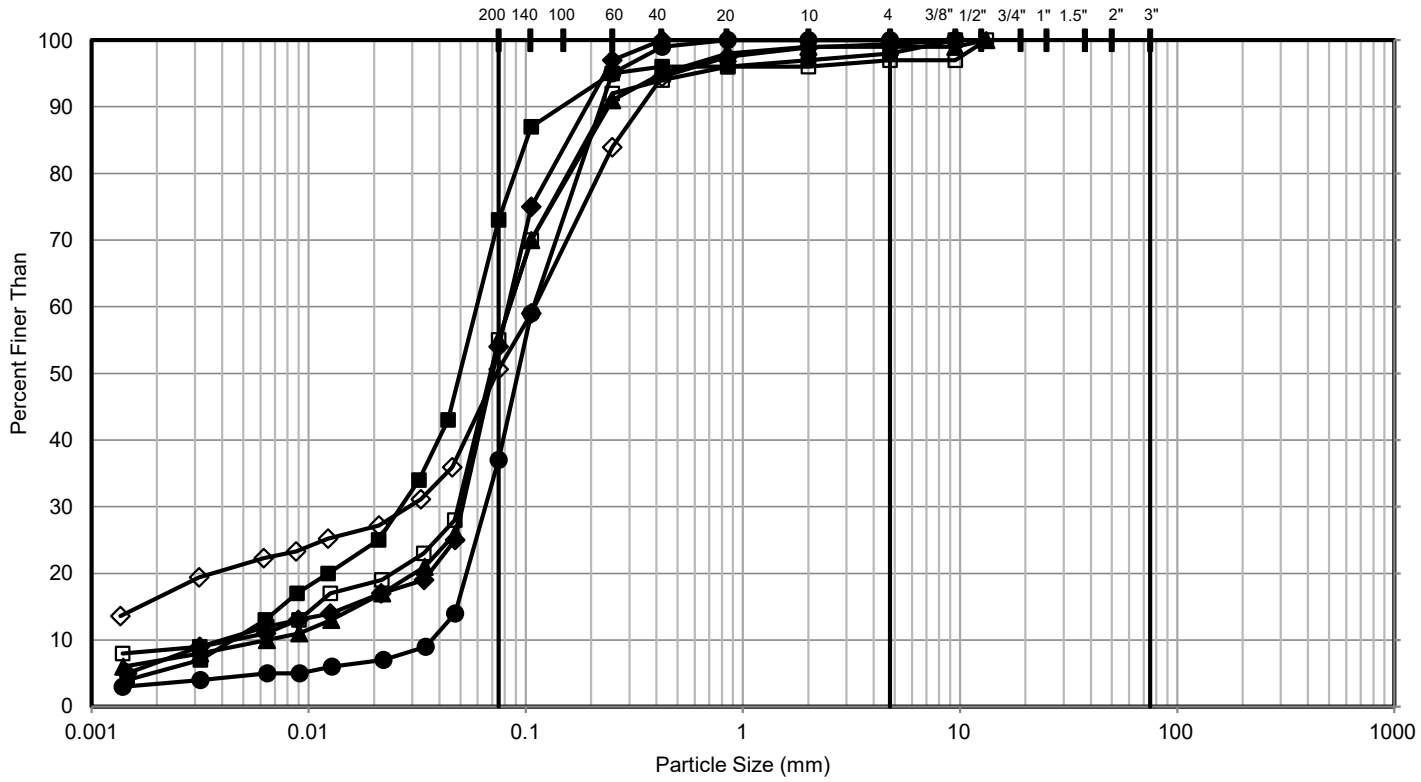
SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) (Field Vane, Remoulded, Pocket Pen, Quick Triaxial, Unconfined) 20 40 60 80 100	WATER CONTENT (%) PL W_p NMC W LL W_l NP Nonplastic 20 40 60	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES										
	CLAYEY SILT (CL) to SILTY CLAY (CI), trace sand, trace gravel Firm to stiff Grey Wet		14	SS	0										
			15	SS	0		204								
							203								
			16	SS	0										
							202								
			17	SS	0		201								
							200								
			18	SS	1						0	1	28	71	
198.8							199								
16.2	End of Borehole Notes: 1. Water encountered inside augers it a depth of 4.6 m (Elev. 210.4 mASL) during drilling on 22-Apr-2024. 2. Borehole dry at a depth of 6.1 m (Elev. 208.9 mASL) before resuming drilling on 23-Apr-2024. 3. Water encountered inside augers at a depth of 8.4 m (Elev. 206.6 mASL) during drilling on 23-Apr-2024. 4. Borehole dry upon completion of drilling.						198 197 196								

+³, x³ : Numbers refer to Sensitivity o³% STRAIN AT FAILURE

APPENDIX B

LABORATORY TEST RESULTS

GRAIN SIZE DISTRIBUTION



FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	BH24-10	3	1.5 - 2.1	213.5 to 212.9
◆	BH24-10	5	3.0 - 3.7	212.0 to 211.3
▲	BH24-03	6	3.8 - 4.4	210.7 to 210.1
●	BH24-04	7	4.6 - 5.2	209.6 to 209.0
□	BH24-03	8B	6.4 - 6.7	208.1 to 207.8
◇	BH24-05	1	0.0 - 0.6	207.3 to 206.7

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO), Highway 89, Alliston, Simcoe County, ON., MTO W.P. 2014-23-01; Assignment 2022-E-0046

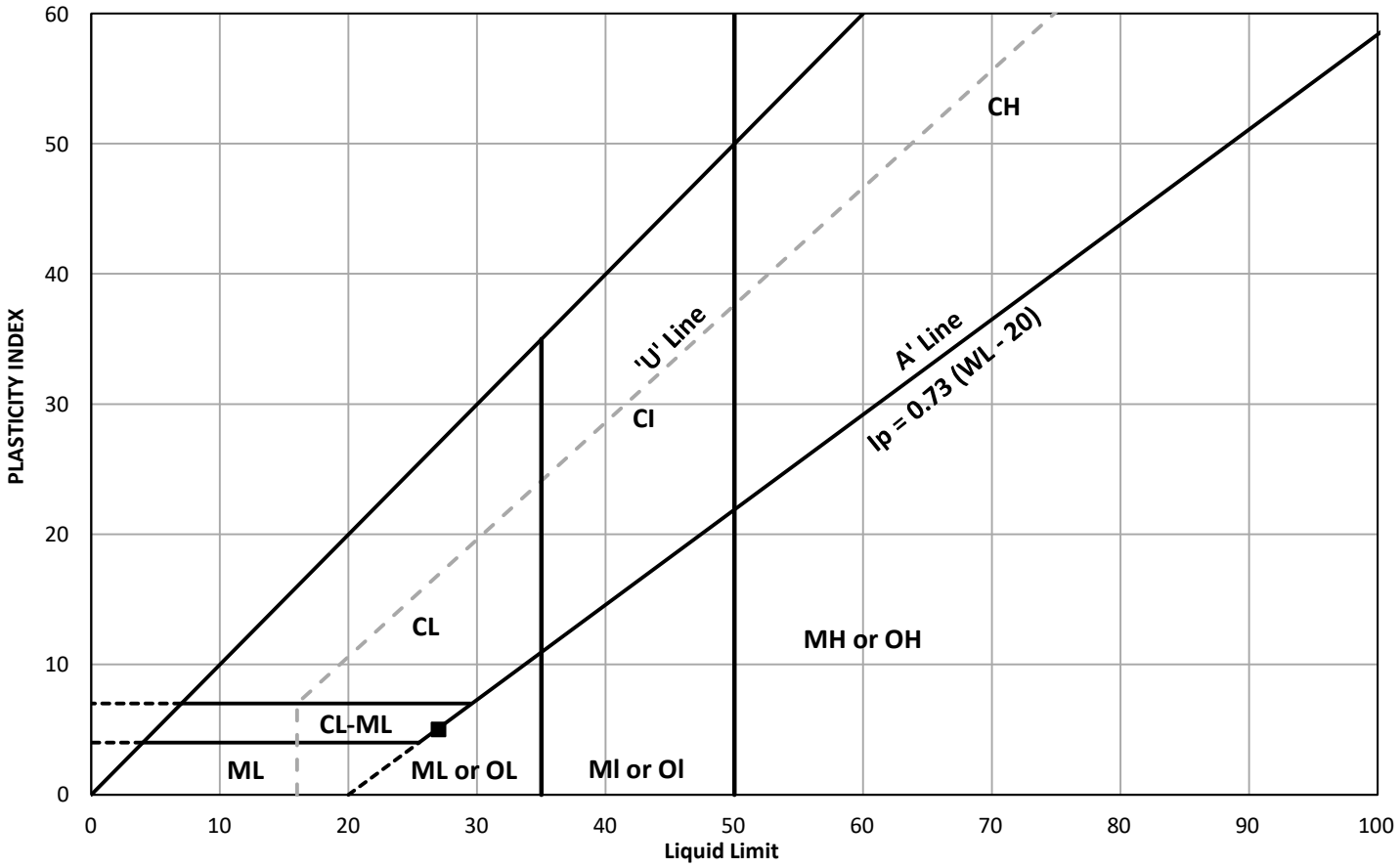
TITLE

Sandy SILT (ML) to SILTY SAND (SM) - FILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B1

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332.0247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Laboratory Particle Size Distribution MTO - Culvert.xlsm

PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	BH24-03	8B	6.4 - 6.7	26.7	27	22	5	0.94

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO)
Highway 89, Alliston, Simcoe County, ON.,
MTO W.P. 2014-23-01; Assignment 2022-E-0046

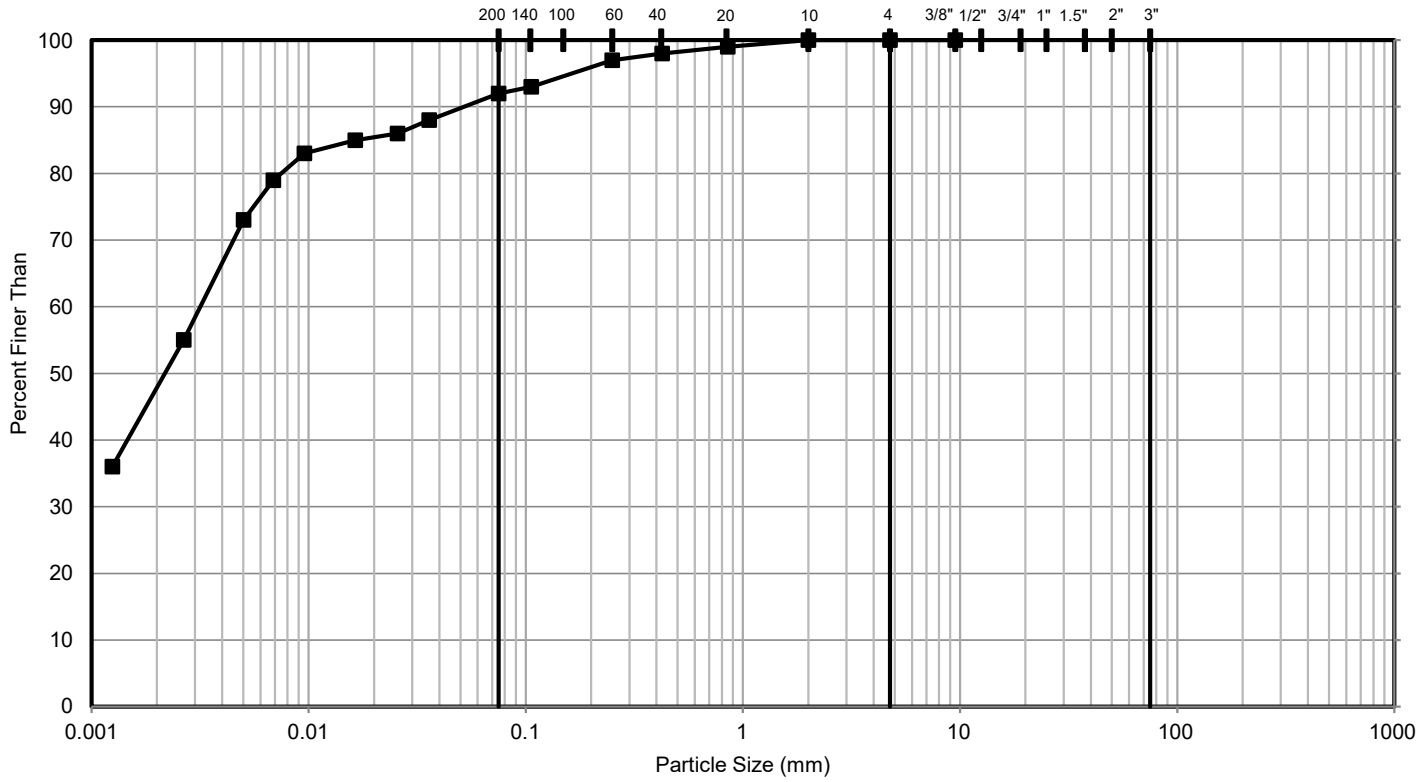
TITLE

Sandy SILT (ML) to SILTY SAND (SM) - FILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B2

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Atterberg Output MTO - Culvert.xlsm

GRAIN SIZE DISTRIBUTION



FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	BH24-09	4	2.4 - 2.9	211.3 to 210.9

CLIENT

Ministry of Transportation, Ontario

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO), Highway 89, Alliston, Simcoe County, ON., MTO W.P. 2014-23-01; Assignment 2022-E-0046

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

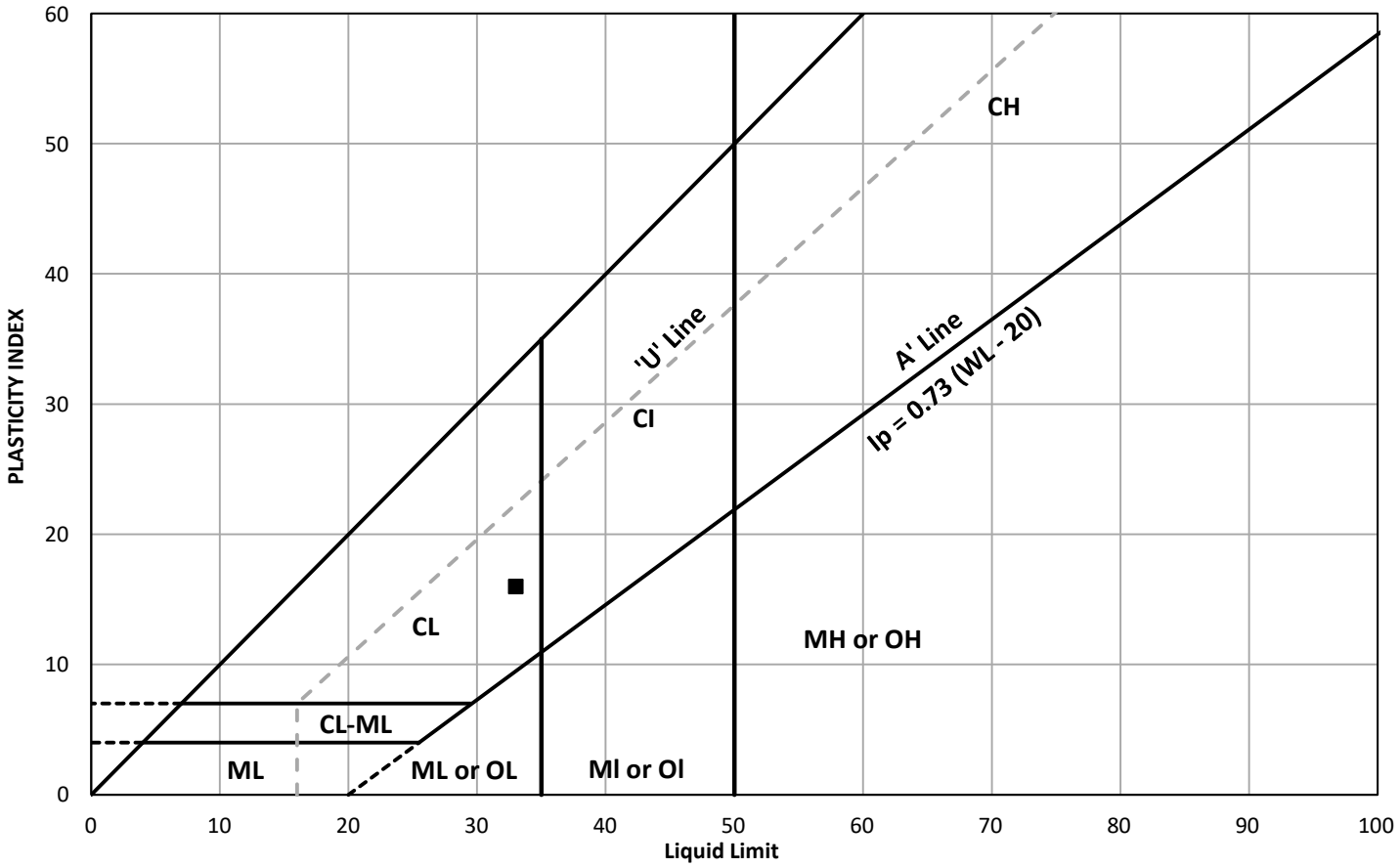
TITLE

CLAYEY SILT (CL) - FILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B3

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332.0247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Laboratory Particle Size Distribution MTO - Culvert.xlsm

PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	BH24-09	4	2.4 - 2.9	25.4	33	17	16	0.53

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO)
Highway 89, Alliston, Simcoe County, ON.,
MTO W.P. 2014-23-01; Assignment 2022-E-0046

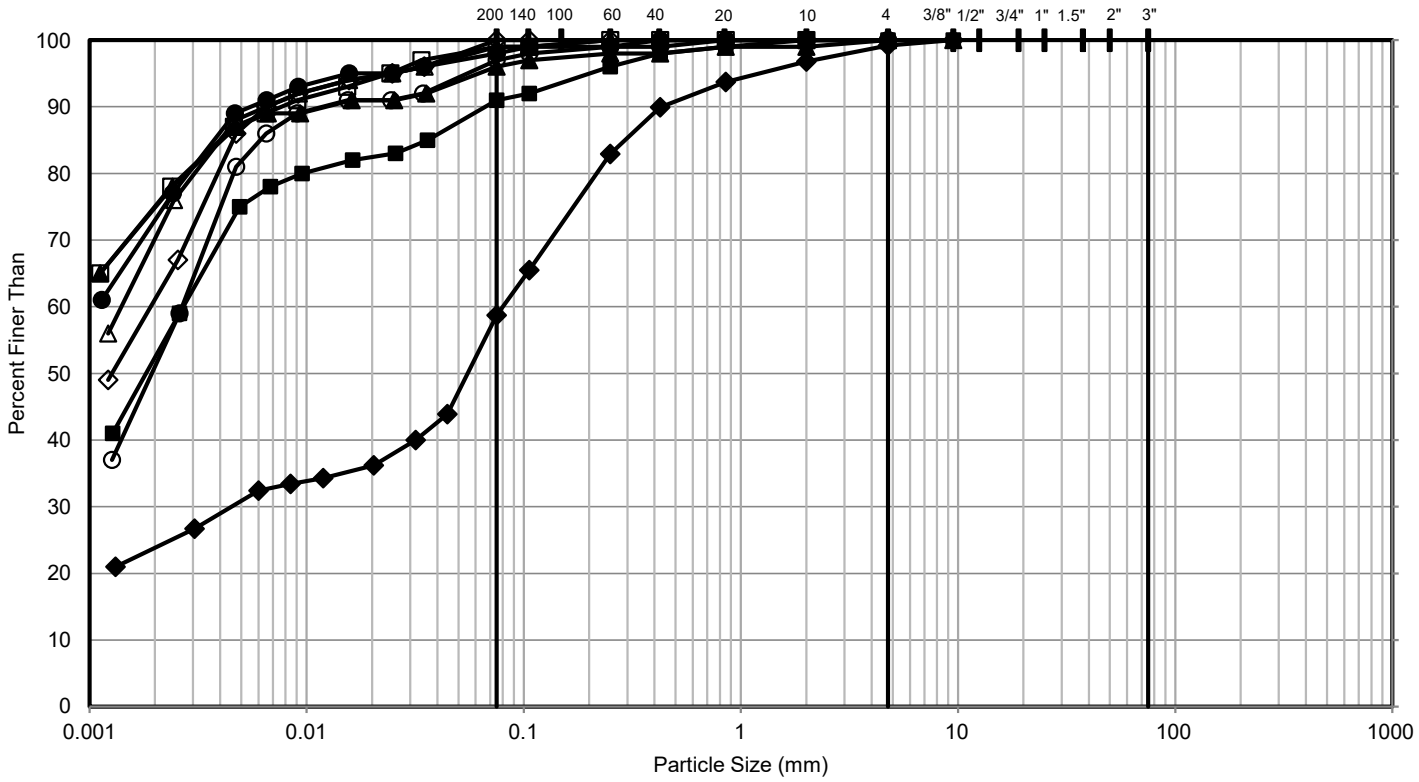
TITLE

CLAYEY SILT (CL) - FILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B4

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332024/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Atterberg Output MTO - Culvert.xlsm

GRAIN SIZE DISTRIBUTION



FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	BH24-10	8	5.3 - 5.9	209.7 to 209.1
◆	BH24-06	3	1.5 - 2.1	208.3 to 207.7
▲	BH24-09	8	6.1 - 6.7	207.7 to 207.1
●	BH24-04	9	7.6 - 8.2	206.5 to 205.9
□	BH24-03	10	9.1 - 9.8	205.4 to 204.8
◇	BH24-04	11	10.7 - 11.3	203.5 to 202.9
△	BH24-10	18	15.2 - 15.9	199.8 to 199.2
○	BH24-03	15	16.8 - 17.4	197.8 to 197.2

CLIENT

Ministry of Transportation, Ontario

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO), Highway 89, Alliston, Simcoe County, ON., MTO W.P. 2014-23-01; Assignment 2022-E-0046

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

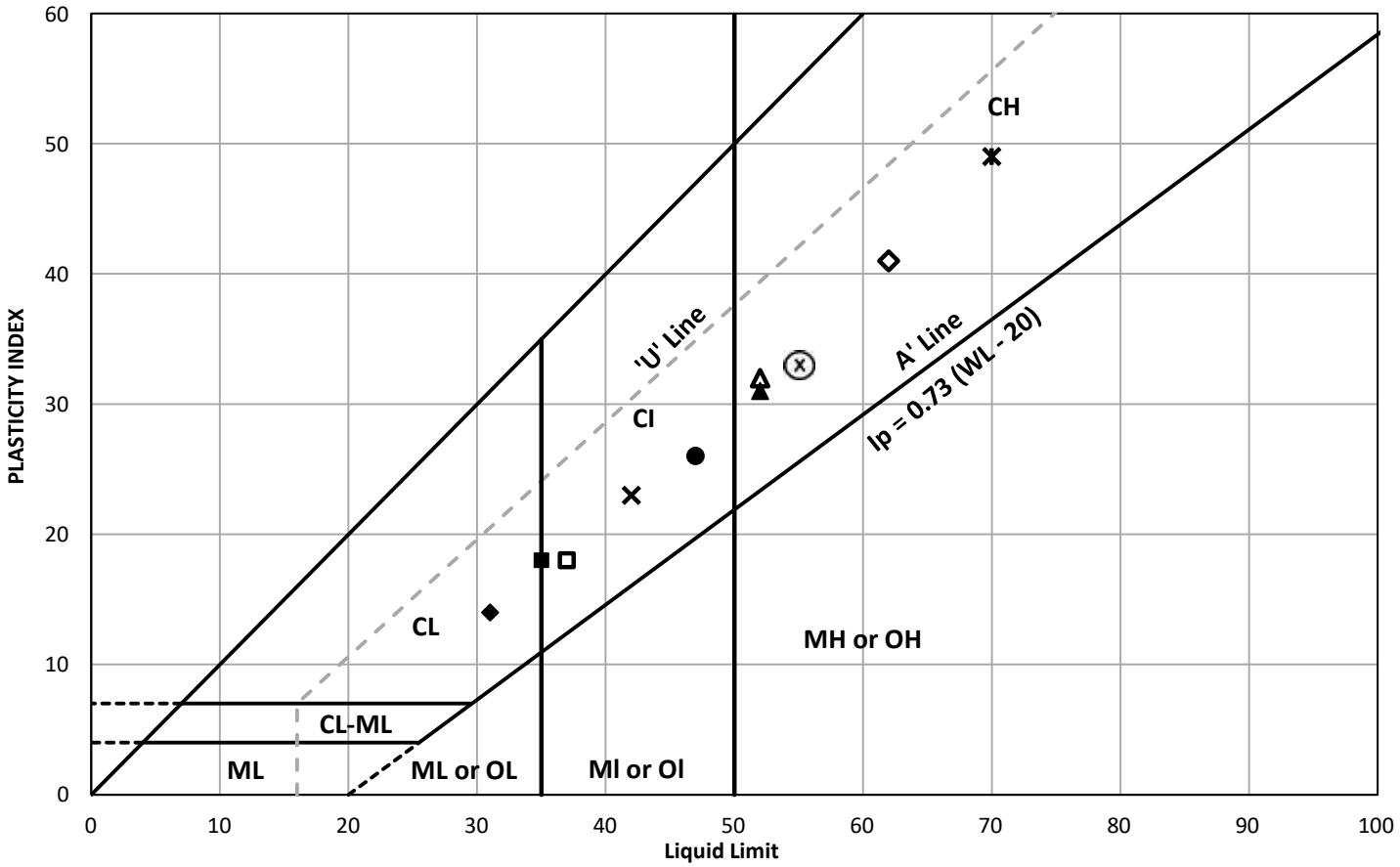
TITLE

CLAYEY SILT (CL) to CLAY (CH)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B5

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332.0247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Laboratory Particle Size Distribution MTO - Culvert.xlsm

PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	BH24-10	8	5.3 - 5.9	24.2	35	17	18	0.40
◆	BH24-06	3	1.5 - 2.1	47.3	31	17	14	2.16
▲	BH24-09	8	6.1 - 6.7	35.7	52	21	31	0.47
●	BH24-04	9	7.6 - 8.2	32.4	47	21	26	0.44
✳	BH24-06	6	3.8 - 4.4	42.1	70	21	49	0.43
⊗	BH24-03	10	9.1 - 9.8	42.3	55	22	33	0.62
□	BH24-04	11	10.7 - 11.3	27	37	19	18	0.44
◇	BH24-05	5	3.8 - 4.4	42.6	62	21	41	0.53
△	BH24-06	10	9.1 - 9.8	32.7	52	20	32	0.40
×	BH24-10	18	15.2 - 15.9	36.6	42	19	23	0.77

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO)
Highway 89, Alliston, Simcoe County, ON.,
MTO W.P. 2014-23-01; Assignment 2022-E-0046

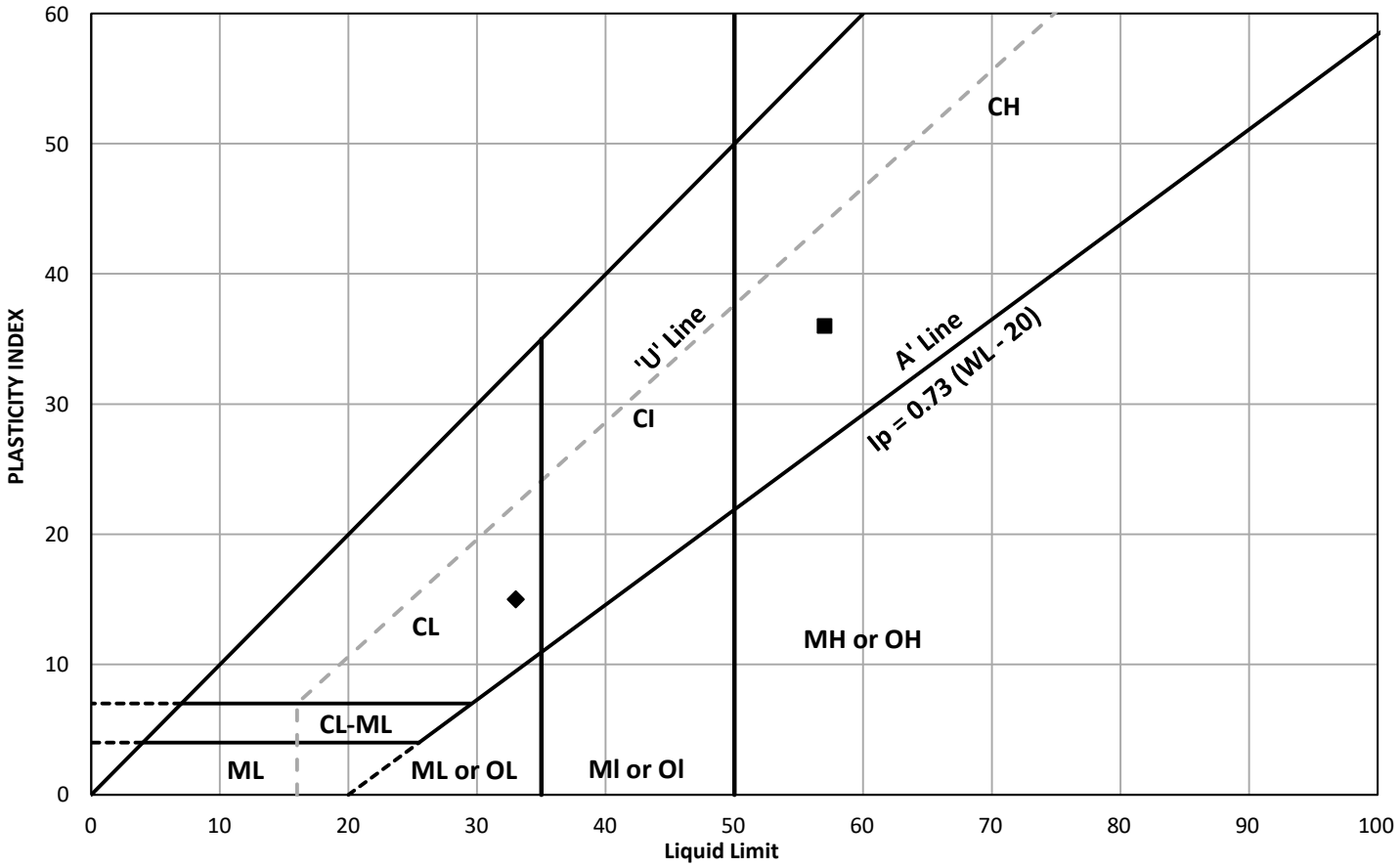
TITLE

CLAYEY SILT (CL) to CLAY (CH)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B6A

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA00203320247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Atterberg Output MTO - Culvert.xlsm

PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	BH24-05	8	7.6 - 8.2	40.5	57	21	36	0.54
◆	BH24-03	15	16.8 - 17.4	28.4	33	18	15	0.69

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO)
Highway 89, Alliston, Simcoe County, ON.,
MTO W.P. 2014-23-01; Assignment 2022-E-0046

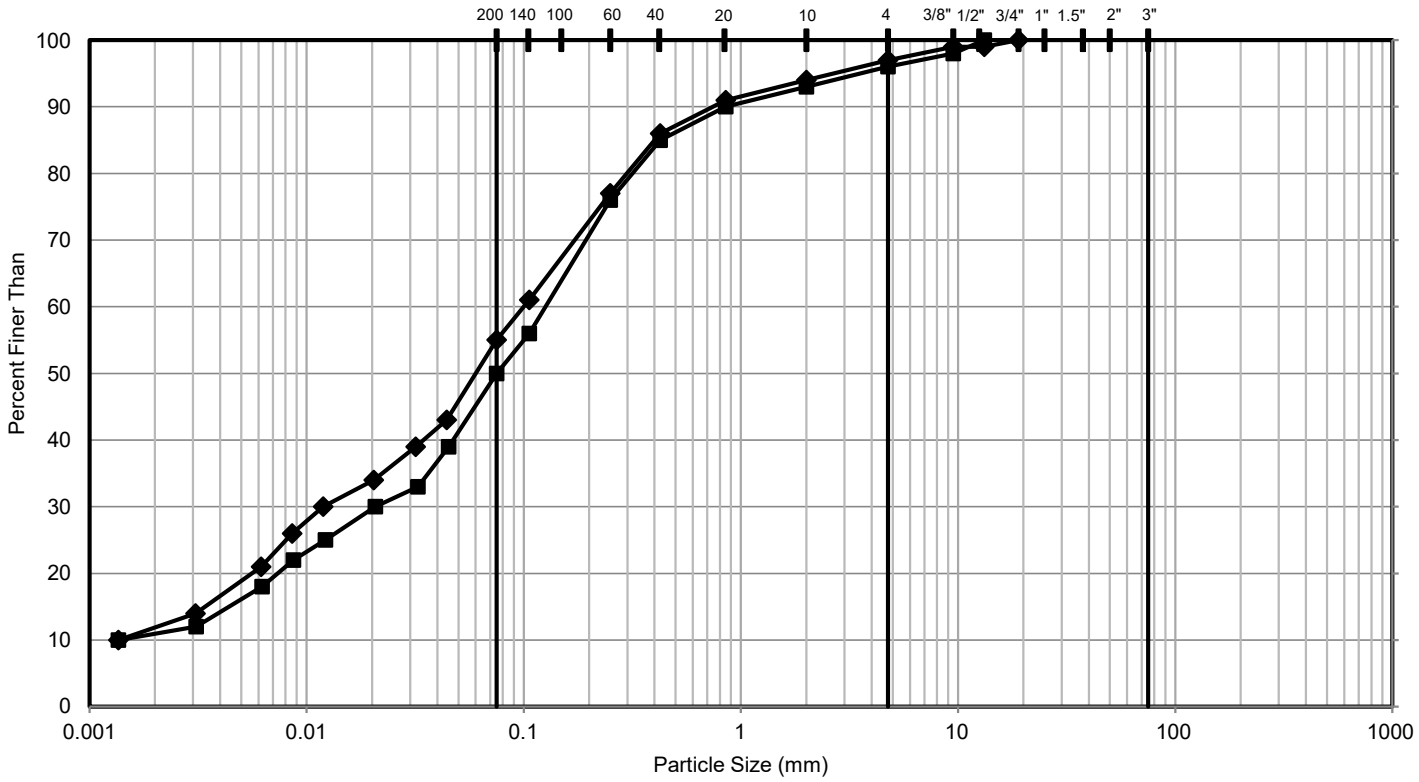
TITLE

CLAYEY SILT (CL) to CLAY (CH)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B6B

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332.0247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Atterberg Output MTO - Culvert.xlsm

GRAIN SIZE DISTRIBUTION



FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	BH24-04	16	18.3 - 18.9	195.9 to 195.3
◆	BH24-09	13	13.7 - 14.3	200.1 to 199.5

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO), Highway 89, Alliston, Simcoe County, ON., MTO W.P. 2014-23-01; Assignment 2022-E-0046

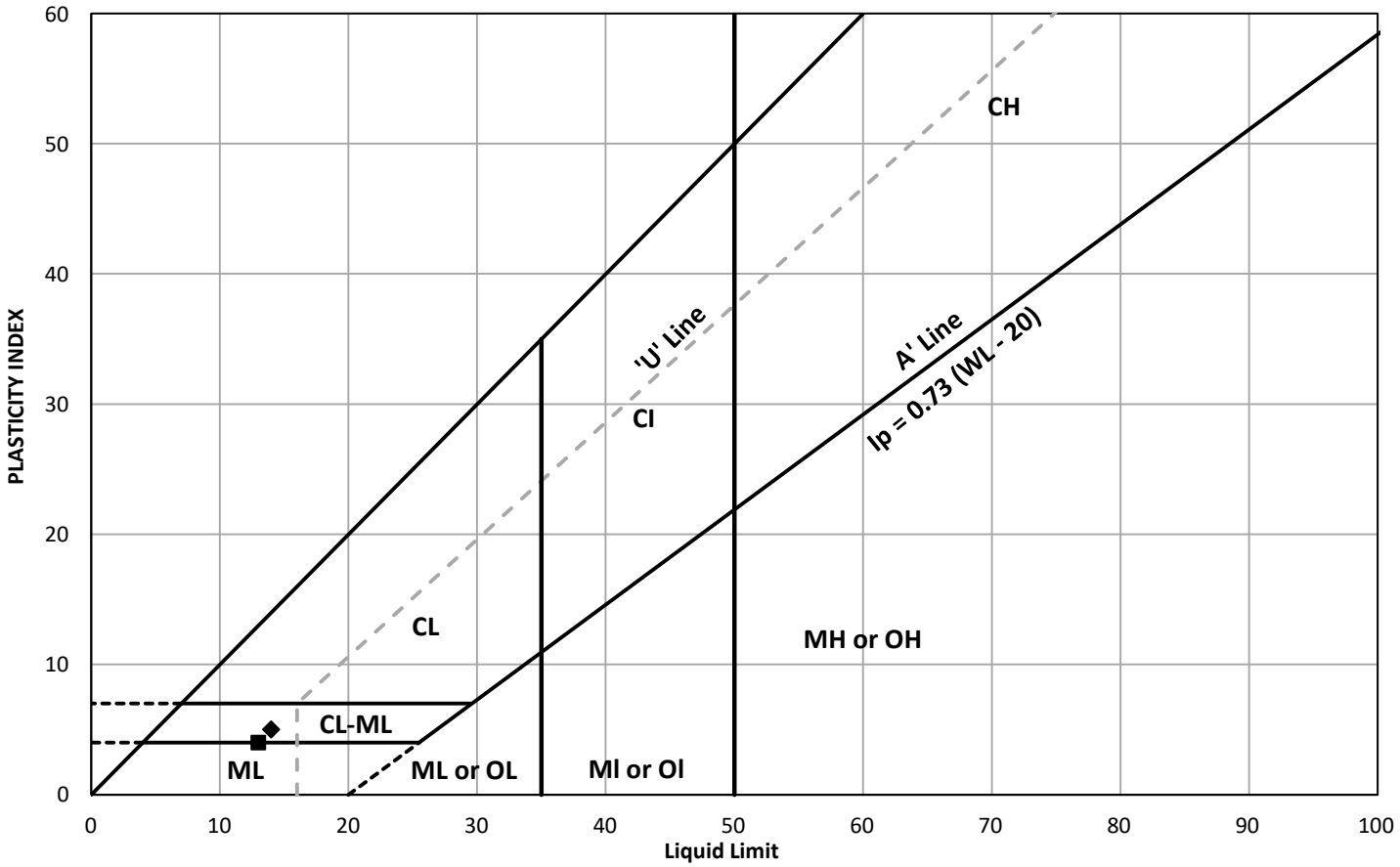
TITLE

CLAYEY SILT - SILT (CL-ML) - TILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B7

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Laboratory Particle Size Distribution MTO - Culvert.xlsm

PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	BH24-04	16	18.3 - 18.9	9.3	13	9	4	0.08
◆	BH24-09	13	13.7 - 14.3	10.7	14	9	5	0.34

CLIENT

Ministry of Transportation, Ontario

CONSULTANT

wsp

YYYY-MM-DD	2024-10-21
DESIGNED	-
PREPARED	FJ
REVIEWED	MCK
APPROVED	KJB

PROJECT

Nicolston Culvert Replacement/Rehabilitation (Site No. 30X-0678/CO)
Highway 89, Alliston, Simcoe County, ON.,
MTO W.P. 2014-23-01; Assignment 2022-E-0046

TITLE

CLAYEY SILT - SILT (CL-ML) - TILL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0020332.0247	0	0	B8

PATH: https://wsponlinecan.sharepoint.com/sites/CA-CA0020332.0247/Shared Documents/05. Technical/Foundations/5 - Reporting/5 - RPT Culvert/Appendix B-Lab Figures | FILE NAME: Atterberg Output MTO - Culvert.xlsm

APPENDIX C

ANALYTICAL TEST RESULTS

Your Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Your C.O.C. #: N/A

Attention: Madison Kennedy

WSP Canada Inc.
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2024/05/03
Report #: R8134623
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4C4317
Received: 2024/04/25, 14:52

Sample Matrix: Soil
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	9	2024/04/30	2024/05/01	CAM SOP-00463	MOE E3013 m
Conductivity	9	2024/04/30	2024/04/30	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	9	N/A	2024/05/01	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	9	N/A	2024/04/30	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	9	2024/04/29	2024/04/29	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	9	2024/05/02	2024/05/03	CAM SOP-00421	SM 24 2580 B
Resistivity of Soil	9	2024/04/26	2024/04/30	CAM SOP-00414	SM 24 2510 m
Sulphate (20:1 Extract)	9	2024/04/30	2024/05/01	CAM SOP-00464	MOE E3013 m

Remarks:

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

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

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

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE , Calgary, AB, T2E 6P8
(2) Offsite analysis requires that subcontracted moisture be reported.

Your Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Your C.O.C. #: N/A

Attention: Madison Kennedy

WSP Canada Inc.
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2024/05/03
Report #: R8134623
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4C4317

Received: 2024/04/25, 14:52

(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:
Ankita Bhalla, Project Manager
Email: Ankita.Bhalla@bureauveritas.com
Phone# (905) 817-5700

==========

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

Bureau Veritas Job #: C4C4317
Report Date: 2024/05/03

WSP Canada Inc.
Client Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Sampler Initials: MTI

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		YZU407		YZU408	YZU409			YZU409	
Sampling Date		2024/04/09		2024/04/10	2024/04/10			2024/04/10	
COC Number		N/A		N/A	N/A			N/A	
	UNITS	BH24-01 SA-5	RDL	BH24-01 SA-9	BH24-01 SA-12	RDL	QC Batch	BH24-01 SA-12 Lab-Dup	QC Batch
Calculated Parameters									
Resistivity	ohm-cm	410		870	4100		9358051		
CONVENTIONALS									
Redox Potential	mV	270	N/A	270	270	N/A	9368559	270	9368559
Inorganics									
Soluble (20:1) Chloride (Cl-)	ug/g	1400	40	550	21	20	9364082		
Conductivity	umho/cm	2470	2	1160	244	2	9364027		
Available (CaCl2) pH	pH	7.76		7.86	7.85		9361710		
Soluble (20:1) Sulphate (SO4)	ug/g	94	20	83	79	20	9364092		
Sulphide	mg/kg	3.2 (1)	0.5	1.5 (1)	1.8 (1)	0.5	9365692		

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Extracted past method specified hold time

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		YZU410	YZU411			YZU411		
Sampling Date		2024/04/08	2024/04/08			2024/04/08		
COC Number		N/A	N/A			N/A		
	UNITS	BH24-02 SA-2+3	BH24-02 SA-05	RDL	QC Batch	BH24-02 SA-05 Lab-Dup	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm	1200	2400		9358051			
CONVENTIONALS								
Redox Potential	mV	270	270	N/A	9368559			
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	330	100	20	9364082	110	20	9364082
Conductivity	umho/cm	843	420	2	9364027			
Available (CaCl2) pH	pH	8.05	7.96		9361710			
Soluble (20:1) Sulphate (SO4)	ug/g	40	24	20	9364092	24	20	9364092
Sulphide	mg/kg	1.8 (1)	0.9 (1)	0.5	9365692			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Extracted past method specified hold time

Bureau Veritas ID		YZU412		YZU413		YZU414		
Sampling Date		2024/04/08		2024/04/09		2024/04/15		
COC Number		N/A		N/A		N/A		
	UNITS	BH24-02 SA-10	QC Batch	BH24-02 SA-12	QC Batch	BH24-03 SA-9	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm	3500	9358051	4100	9358051	1800		9358051
CONVENTIONALS								
Redox Potential	mV	270	9368559	270	9368559	270	N/A	9368559
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	80	9364082	64	9364082	200	20	9364082
Conductivity	umho/cm	284	9364027	246	9364027	561	2	9364027
Available (CaCl2) pH	pH	7.92	9361710	7.90	9361722	7.74		9361710
Soluble (20:1) Sulphate (SO4)	ug/g	34	9364092	31	9364092	35	20	9364092
Sulphide	mg/kg	1.6 (1)	9365692	1.1 (1)	9365692	2.4 (1)	0.5	9365692

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
(1) Extracted past method specified hold time

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		YZU414			YZU415		
Sampling Date		2024/04/15			2024/04/16		
COC Number		N/A			N/A		
	UNITS	BH24-03 SA-9 Lab-Dup	RDL	QC Batch	BH24-04 SA-8	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm				5200		9358051
CONVENTIONALS							
Redox Potential	mV				270	N/A	9368559
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g				<20	20	9364082
Conductivity	umho/cm	564	2	9364027	192	2	9364027
Available (CaCl2) pH	pH				7.56		9361722
Soluble (20:1) Sulphate (SO4)	ug/g				49	20	9364092
Sulphide	mg/kg				3.3	0.5	9365692

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C4C4317
Report Date: 2024/05/03

WSP Canada Inc.
Client Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Sampler Initials: MTI

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		YZU407	YZU408	YZU408	YZU409	YZU410	YZU411		
Sampling Date		2024/04/09	2024/04/10	2024/04/10	2024/04/10	2024/04/08	2024/04/08		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	BH24-01 SA-5	BH24-01 SA-9	BH24-01 SA-9 Lab-Dup	BH24-01 SA-12	BH24-02 SA-2+3	BH24-02 SA-05	RDL	QC Batch
Physical Testing									
Moisture-Subcontracted	%	16	15	16	17	5.4	6.7	0.30	9368179

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas ID		YZU412	YZU413	YZU414	YZU415		
Sampling Date		2024/04/08	2024/04/09	2024/04/15	2024/04/16		
COC Number		N/A	N/A	N/A	N/A		
	UNITS	BH24-02 SA-10	BH24-02 SA-12	BH24-03 SA-9	BH24-04 SA-8	RDL	QC Batch
Physical Testing							
Moisture-Subcontracted	%	17	15	30	21	0.30	9368179

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

Bureau Veritas ID: YZU407 **Collected:** 2024/04/09
Sample ID: BH24-01 SA-5 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU408 **Collected:** 2024/04/10
Sample ID: BH24-01 SA-9 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU408 Dup **Collected:** 2024/04/10
Sample ID: BH24-01 SA-9 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson

Bureau Veritas ID: YZU409 **Collected:** 2024/04/10
Sample ID: BH24-01 SA-12 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

Bureau Veritas ID: YZU409 Dup
Sample ID: BH24-01 SA-12
Matrix: Soil
Collected: 2024/04/10
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR

Bureau Veritas ID: YZU410
Sample ID: BH24-02 SA-2+3
Matrix: Soil
Collected: 2024/04/08
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU411
Sample ID: BH24-02 SA-05
Matrix: Soil
Collected: 2024/04/08
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU411 Dup
Sample ID: BH24-02 SA-05
Matrix: Soil
Collected: 2024/04/08
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU412
Sample ID: BH24-02 SA-10
Matrix: Soil
Collected: 2024/04/08
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C4C4317
Report Date: 2024/05/03

WSP Canada Inc.
Client Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Sampler Initials: MTI

TEST SUMMARY

Bureau Veritas ID: YZU412 **Collected:** 2024/04/08
Sample ID: BH24-02 SA-10 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU413 **Collected:** 2024/04/09
Sample ID: BH24-02 SA-12 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361722	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU414 **Collected:** 2024/04/15
Sample ID: BH24-03 SA-9 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361710	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

Bureau Veritas ID: YZU414 Dup **Collected:** 2024/04/15
Sample ID: BH24-03 SA-9 **Shipped:**
Matrix: Soil **Received:** 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C4C4317
Report Date: 2024/05/03

WSP Canada Inc.
Client Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Sampler Initials: MTI

TEST SUMMARY

Bureau Veritas ID: YZU415
Sample ID: BH24-04 SA-8
Matrix: Soil

Collected: 2024/04/16
Shipped:
Received: 2024/04/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	SKAL/EC	9364082	2024/04/30	2024/05/01	Alina Dobreanu
Conductivity	AT	9364027	2024/04/30	2024/04/30	Gurparteek KAUR
Moisture (Subcontracted)	BAL	9368179	N/A	2024/05/01	Ashley Henderson
Sulphide in Soil	SPEC	9365692	N/A	2024/04/30	Irene Donita Villanueva
pH CaCl2 EXTRACT	AT	9361722	2024/04/29	2024/04/29	Taslima Aktar
Redox Potential	COND	9368559	2024/05/02	2024/05/03	Gurparteek KAUR
Resistivity of Soil		9358051	2024/04/30	2024/04/30	Automated Statchk
Sulphate (20:1 Extract)	SKAL/EC	9364092	2024/04/30	2024/05/01	Alina Dobreanu

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C4C4317
Report Date: 2024/05/03

WSP Canada Inc.
Client Project #: CA0020332.0247, TASK 900.910
Site Location: ALLISTON, ONTARIO
Sampler Initials: MTI

GENERAL COMMENTS

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

Package 1	3.3°C

Results relate only to the items tested.

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9361710	Available (CaCl2) pH	2024/04/29			100	97 - 103			0.44	N/A
9361722	Available (CaCl2) pH	2024/04/29			100	97 - 103			0.11	N/A
9364027	Conductivity	2024/04/30			102	90 - 110	<2	umho/cm	0.55	10
9364082	Soluble (20:1) Chloride (Cl-)	2024/05/01	NC	70 - 130	86	70 - 130	<20	ug/g	6.5	35
9364092	Soluble (20:1) Sulphate (SO4)	2024/05/01	91	70 - 130	90	70 - 130	<20	ug/g	0.52	35
9365692	Sulphide	2024/04/30	86	75 - 125	101	75 - 125	<0.5	mg/kg	24	30
9368179	Moisture-Subcontracted	2024/05/01					<0.30	%	3.2	20
9368559	Redox Potential	2024/05/03			103	95 - 105			0.50	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)

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

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

Cristina Carriere, Senior Scientific Specialist

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

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

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

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

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

NONT-2024-04-2573

ello Road, Mississauga, Ontario L5N 2L8
7-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
91/6

WORK ORDER

CHAIN OF CUSTODY RECORD

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: WSP Canada Inc	Company Name: WSP Canada Inc	Quotation #:	X Regular TAT (5-7 days) Most analyses
Contact Name: Canada Accounts Payable	Contact Name: Madison Kennedy	P.O. #/ AFE#: CA0020332.0247, task 900.910	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 6925 Century Ave. Suite ~~100~~ 600	Address: 6925 Century Ave. Suite ~~100~~ 600	Project #:	Rush TAT (Surcharges will be applied)
Mississauga, ON	Mississauga, ON L5N 7K2	Site Location: Alliston, Ontario	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Phone: 905-567-4444 Fax: 905-567-6561	Phone: ~~289-838-4608~~ 778-278-5756 Fax: 905-567-6561	Site #:	
Email: CAPayablesInvoice@wsp.com	Email: muhammad.irshad@wsp.com; madison.kennedy@wsp.com	Site Location Province: _____ Ontario	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY		Sampled By: _____ MTI + KR	Rush Confirmation #:

Regulation 153	Other Regulations
X Table 1 ☐ Res/Park ☐ Med/ Fine	☐ CCME ☐ Sanitary Sewer Bylaw
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ MISA ☐ Storm Sewer Bylaw
☐ Table 3 ☐ Agri/ Other	☐ PWQO Region _____
☐ Table _____	☐ Other (Specify) _____
FOR RSC (PLEASE CIRCLE) Y / N	☐ REG 558 (MIN. 3 DAY TAT REQUIRED)
	☐ REG 406 Table _____

Include Criteria on Certificate of Analysis: Y / N

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

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	Corrosivity Package (+ Sulphide)								HOLD- DO NOT ANALYZE	COMMENTS
1	BH24-01 SA-5	2024-04-09	PM	SOIL	2								X									2 Jars (250 mL and 120 mL)
2	BH24-01 SA-9	2024-04-10	AM	SOIL	2								X									2 Jars (250 mL and 120 mL)
3	BH24-01 SA-12	2024-04-10	AM	SOIL	2								X									2 Jars (250 mL and 120 mL)
4	BH24-02 SA-2+3	2024-04-08	AM	SOIL	2								X									2 Jars (250 mL and 120 mL)
5	BH24-02 SA-05	2024-04-08	AM	SOIL	2								X									2 Jars (250 mL and 120 mL)
6	BH24-02 SA-10	2024-04-08	PM	SOIL	2								X									2 Jars (250 mL and 120 mL)
7	BH24-02 SA-12	2024-04-09	AM	SOIL	2								X									2 Jars (250 mL and 120 mL)
8	BH24-03 SA-9	2024-04-15	PM	SOIL	2								X									2 Jars (250 mL and 120 mL)
9	BH24-04 SA-8	2024-04-16	PM	SOIL	2								X									2 Jars (250 mL and 120 mL)
10																						

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
M. Talha Irshad	2024-04-25	~~7:50~~ 7:50 PM		2024/04/25	19:52

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
N	N	3/5/2

COOLING MEDIA PRESENT: ~~Y~~ / N

BV JOB #

wsp.com