



FINAL REPORT

Foundation Investigation Report

*Replacement of Underpass Structure No. 11X-0157/B0 Highway 401/Wallbridge
Loyalist Road, Belleville, Ontario*

MTO GWP 4053-18-00, WP 4088-19-01, Agreement No. 4020-E-0012-5

Submitted to:

Ministry of Transportation Ontario

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Kingston, Ontario K7K 0E5

Submitted by:

WSP Canada Inc.,

1931 Robertson Road Ottawa,
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CA0006099.3147-Wallbridge Rev1

June 14, 2024

GEOCREs No.: 31C03-002

Latitude: 44.179990°

Longitude: -77.447650°



Distribution List

1 e-Copy - Ministry of Transportation Ontario

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1.0 INTRODUCTION

WSP Canada Inc. (WSP, formerly Golder Associates Ltd., amalgamated with WSP in 2023) has been retained by the Ministry of Transportation, Ontario (MTO) to support future procurement-ready design phases of the widening of Highway 401 through Belleville, Ontario as part of GWP 4053-18-00, delivered under MTO Agreement No. 4020-E-0012. The project limits extend from 1.2 km west of the Wallbridge-Loyalist Road interchange to 4.3 km east of the Highway 37 interchange. The overall project includes the replacement of six bridges, several structural and non-structural culverts, and operational improvements and reconfiguration of existing interchanges.

This report presents the results of the detailed foundation investigation carried out for the replacement of the Highway 401/ Wallbridge Loyalist Underpass (MTO Structure No. 11X-0157/B0). In addition to the detailed design foundation scope, additional environmental soil sampling and laboratory testing were carried out to provide information for the development of an excess soil management plan for this project.

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 Site Description

The Wallbridge Loyalist Road Underpass structure is located at about Station 22+138 on Highway 401 approximately 4 km west of Highway 62 in Belleville, Ontario. The site location is shown on the key plan in Drawings 1 and 2.

At this location, Highway 401 is a divided highway with a six-lane cross section with two eastbound and two westbound through lanes with unpaved shoulders, plus a speed change lane at the interchange ramps in both directions. Steel beam guiderails are also present immediately adjacent to the underpass structure on both sides of the highway.

Also at this location, the existing underpass consists of a four-span concrete girder bridge, with one northbound and one southbound through lanes. Parapet walls with railing are present along the bridge and steel beam guiderails are present along both sides of Wallbridge Loyalist Road beyond the bridge.

There are existing ditchline culverts that run parallel to Highway 401 under the existing underpass foreslopes. A portion of these culverts is located within the proposed approach embankment footprint. The locations of the existing culvert alignments are shown in Drawings 1 and 2.

The lands north and south of the site are generally grass covered with some mature trees. There are cattails and wet areas located to the west of the site on both sides of the highway. There are commercial and institutional developments in the vicinity of the underpass structure. Further to the north and south of the interchange, the lands are predominantly agricultural.

Site photographs showing the general conditions of the site and proposed alignment are presented in Appendix E.

2.2 Regional Geology

As delineated in *The Physiography of Southern Ontario*¹, the proposed bridge site lies within a physiographic region known as the Napanee Plain which is characterized as a flat-to-undulating plain of limestone of the Gull River and Bobcaygeon Formations overlain by glacially worked thin overburden deposits.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out over a five-day period between June 26 and July 26, 2023, and included advancing seven boreholes (WL-01 to WL-07) along the general location of the proposed alignment to the west of the existing underpass structure. The borehole locations are shown on Drawings 1 and 2.

Boreholes WL-01, WL-02, WL-05, and WL-06 were advanced using a track mounted Multipower limit access (LAD) drill rig. Boreholes WL-03, WL-04, and WL-07 were advanced using a truck-mounted CME 55 drill rig. Both drilling rigs were supplied and operated by CCC Geotechnical & Environmental Drilling Ltd. (CCC) of Ottawa, Ontario.

Soil samples were obtained using a 50 mm outer diameter split-spoon sampler in general accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). Soil samples were obtained at vertical sampling intervals of about 0.76 m. HQ or NQ-sized bedrock core samples were obtained using a rotary diamond drilling technique and a triple-tube core-barrel at Boreholes WL-01 to WL-04 and WL-07.

Monitoring wells were installed at Boreholes WL-01 and WL-04 to observe the groundwater level at the site. The monitoring wells consist of a 52 mm outside diameter PVC tube with a 1.5 m long slotted screen. Installation details are shown on the borehole logs for WL-01 and WL-04 provided in Appendix A.

The boreholes without monitoring wells were backfilled with bentonite within the bedrock, and bentonite mixed with soil cuttings within the overburden. The boreholes were backfilled in general accordance with the intent of Ontario Regulation (O.Reg.) 903, as amended. The site conditions were restored following the completion of the field work. The monitoring well has been left in place to allow for the monitoring of groundwater levels up to the time of construction. As part of the construction, the monitoring well will need to be decommissioned by qualified personnel in accordance with Ontario Regulation 903 (amended).

The field work was supervised on a full-time basis by WSP's technical staff who located the boreholes in the field, directed the drilling, sampling, and in-situ testing operations, and logged the boreholes. The soil and bedrock samples were identified in the field, placed in labelled containers, and transported to WSP's laboratory in Ottawa for further examination and testing. Index and classification tests consisting of water content determinations, grain size distribution analyses, and Atterberg limits testing were carried out on selected soil samples and uniaxial compressive strength (UCS) testing was carried out on selected samples of the bedrock. The laboratory tests were carried out to MTO LS and/or ASTM Standards, as applicable, at WSP's Ottawa laboratory.

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

In addition to the borehole investigation environmental sampling, in-situ and laboratory testing was carried out at Boreholes WL-02 and WL-03 to provide information for the development of an excess soil management plan for this project. During drilling, the collected soils samples from Boreholes WL-02 and WL-03 were field screened to measure headspace combustible and organic vapour concentrations using a portable RKI Eagle 2 gas monitoring instrument, calibrated to n-hexane for combustible gas measurements and to isobutylene for organic vapour measurement. The field headspace screening results are presented on the borehole records for Boreholes WL-02 and WL-03 in Appendix A. In addition to in-situ testing, two soil samples were submitted to AGAT Laboratories for environmental laboratory testing/analysis for metals/inorganics, PAHs, and PHCs/BTEX.

Two soil samples were submitted to Eurofins Environmental Testing Canada Inc. (Eurofins) for basic chemical analysis related to the potential corrosion of buried steel elements and sulphate attack on buried concrete elements (corrosion and sulphate attack).

The borehole locations and elevations were surveyed by WSP using a Trimble R10 GPS unit referenced to the NAD83 CSRS CBNv6-2010.0 MTM Zone 9 geodetic datum. The borehole locations, including northing and easting coordinates, ground surface elevations, and drilled depths are summarized in Table 1.

Table 1: Summary of Borehole Locations

Borehole	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Drilled Depth (m)	Comments
	Northing (m) (Latitude (°))	Easting (m) (Longitude (°))			
WL-01	4893769.4 (44.179990)	229030.0 (-77.447650)	104.1	11.3	Bedrock cored
WL-02	4893758.2 (44.179890)	229013.3 (-77.447860)	103.3	9.9	Bedrock cored
WL-03	4893713.3 (44.179490)	229052.5 (-77.447360)	103.2	11.2	Bedrock cored
WL-04	4893704.0 (44.179400)	229028.7 (-77.447660)	102.7	10.9	Bedrock cored
WL-05	4893782.0 (44.180100)	229016.3 (-77.447830)	104.1	5.9	—
WL-06	4893699.9 (44.179370)	229048.3 (-77.447410)	103.6	5.9	—
WL-07	4893731.8 (44.179663)	229029.3 (-77.447659)	103.5	11.0	Bedrock cored

3.1 1957 and 1958 Original Investigation

The field work associated with the investigation for the original construction of the then proposed Highway 401 / Wallbridge Loyalist Road interchange alignment was carried out in two separate parts. The initial field work consisted of two sampled boreholes with dynamic cone penetration tests and two separate dynamic cone penetration tests carried out in November 1957. Upon completion of the 1957 investigation, a revised alignment was proposed for the crossing and as a result a supplementary investigation was carried out in March 1958. The 1958 investigation confirmed similar subsoil findings at both the investigated sites. The results of the original

investigations indicated that the site is underlain by dense glacial clay till overlying limestone bedrock. It is noted that bedrock was not cored as part of the original investigations.

The results of the original investigations are contained in the following report:

- MTO GEOCREs No. 31C00-023: "Foundation Report on Hwy. 401, Line "C" & County Road Revision Lots 30 & 31, Con's. II & III, Twp. of Sidney, approximately 2 Miles West of Belleville. Dated August 1959.

The original Foundation investigations for the then proposed alignments have been reviewed and a copy of the Borehole Location and Soil Strata Drawing and borehole records are provided for reference in Appendix C.

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 Site Stratigraphy Overview

The subsurface soil, bedrock, and groundwater conditions encountered in the boreholes and the results of in-situ testing from the investigation are shown on the Record of Borehole, and Drillhole sheets in Appendix A. The results of the in-situ field tests as presented in the borehole records and in Section 4.0, are uncorrected and are based on the use of an automatic hammer for the SPT. The results of the geotechnical laboratory testing carried out during the investigation are presented on the borehole records as well as on Figures B1 to B7.

Photographs of the core recovered from the underlying bedrock are shown on Figures A1 to A10, provided in Appendix A. The results of the analytical testing completed on select soil samples are provided in Appendix D. The environmental test results are also provided in Appendix D.

The borehole locations and the interpreted stratigraphic profile projected along the proposed underpass alignment are provided in Drawings 1 and 2.

The stratigraphic boundaries shown on the borehole and drillhole records and on the interpreted stratigraphic section in Drawings 1 and 2 are inferred from observations of the drilling progress and non-continuous soil sampling and therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

At the borehole locations, the subsurface conditions generally consist of a topsoil or pavement structure (asphalt and pavement granular material) over embankment fill, overlying a glacial till, all underlain by limestone bedrock.

A more detailed description of the overburdened soil and bedrock deposits encountered during the field investigation is provided in the following sections.

4.1.1 Surface Cover/ Surficial Materials

Topsoil was encountered at the ground surface at Boreholes WL-01 to WL-06, with thickness ranging from about 100 mm to 200 mm.

Asphaltic concrete with a thickness of 100 mm was encountered at the ground surface at Borehole WL-07.

4.1.2 Fill

Fill consisting of sand, gravelly silty sand, gravelly sand, and sandy gravel was encountered below the topsoil and asphaltic concrete at Boreholes WL-03 to WL-06, and WL-07, respectively. The top of this layer was encountered at elevations ranging from 102.6 m to 104.0 m. The total thickness of the fill layer ranges from about 0.8 m to

3.5 m. The SPT N-values within the fill ranged from 6 blows to 40 blows per 0.3 m of penetration, indicating a loose to dense state of compactness.

The measured water content of a single sample of the fill tested was 8%. The results of grain size distribution testing carried out on a single sample of gravelly silty sand fill material is provided in Figure B1 in Appendix B.

4.1.3 Buried Topsoil

A buried topsoil layer with a thickness of 500 mm and 300 mm was encountered at Elevations 101.8 m and 102.5 m at Borehole WL-04 and WL-06, respectively.

4.1.4 Non-Cohesive Till

A heterogenous non-cohesive till deposit consisting of gravelly clayey sand-silty sand to gravelly silty sand was encountered below the topsoil at Boreholes WL-01 and WL-02, below the fill at Boreholes WL-03, WL-05 and WL-07, and below the buried topsoil at Boreholes WL-04 and WL-06. The top of this deposit was encountered at elevations ranging from 103.9 m and 99.5 m and has a thickness ranging from 4.1 m to 7.3 m. Boreholes WL-05 and WL-06 were terminated in this layer. The till deposit contains cobbles and boulders, and coring techniques were required to advance the boreholes through the cobbles and boulders layers encountered in the till.

Weathered rock fragments were encountered near the base of the layer at Boreholes WL-03 and WL-07.

A gravelly silty sand till layer containing cobbles and boulders was encountered below cohesive till at Boreholes WL-01 and WL-02. The top of this layer was encountered at Elevations 98.8 m and 98.0 m, with thicknesses of 1.6 m and 2.6 m.

The SPT N-values within the non-cohesive till layers ranged from 6 blows to greater than 100 blows per 0.3 m of penetration but more typically 10 blows to 36 blows were measured in the till indicating a compact to dense state of compaction compactness. The higher blow counts (e.g., 55 blows/0.05m, 50 blows/0.1m), however, have likely been influenced by the presence of cobbles and boulders in the till or the proximity to the bedrock surface rather than the actual consistency of the soil matrix.

The measured water content of 13 samples of non-cohesive till ranged from 6% to 10%. The results of grain size distribution testing carried out on 13 samples of the non-cohesive till material are provided in Figures B2 and B3 in Appendix B. The results of Atterberg limits testing completed on five samples of the non-cohesive till indicate liquid limits ranging from 13 to 16, plastic limits ranging from 10 to 11, and plasticity indices ranging from 3 to 6. The Atterberg limits analysis results are provided on Figure B4 in Appendix B and indicate the fines fraction of this till deposit consists of clayey silt-silt (CL-ML) to silt of slight plasticity.

4.1.5 Cohesive Till

A heterogenous cohesive till deposit consisting of clay and silt with varying amounts of sand and gravel was encountered within the non-cohesive till layers at Boreholes WL-01, and WL-02. The top of this deposit was encountered at Elevations 99.5 m and 98.4 m and has a thickness of 0.7 m and 0.4 m at Boreholes WL-01, and WL-02 respectively.

An SPT N-value of 13 blows per 0.3 m of penetration was recorded within the cohesive till layer indicating a stiff consistency.

The measured water content of two samples of cohesive till tested were 9% and 13%. The results of grain size distribution testing carried out on two samples of this material are provided in Figure B5 in Appendix B. The results of Atterberg limits testing completed on two samples of cohesive till indicate liquid limits of 14 and 22, plastic limits of 10 to 12, and plasticity indices of 4 to 10. The Atterberg Limits analysis results are provided on Figure B6 in Appendix B and indicate a clayey silt-silt (CL-ML) to clayey silt (CL).

4.1.6 Bedrock

The overburden materials are underlain by limestone bedrock.

Table 2 summarizes the depths and the elevations of the bedrock surface as encountered at the borehole locations.

Table 2: Summary of Bedrock Surface Depths and Elevations

Borehole	Existing Ground Surface Elevation (m)	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)
WL-01	104.1	7.9	96.2
WL-02	103.3	6.9	96.4
WL-03	103.2	7.8	95.4
WL-04	102.7	7.5	95.2
WL-07	103.5	8.2	95.3

Rock Quality Designation (RQD) values measured on the recovered limestone bedrock core samples range from about 42% to 100%, but more typically 72% to 100%, indicating a fair to excellent rock quality. The results of UCS testing carried out on five limestone bedrock core samples measured UCS values of 76 MPa to 142 MPa, but typically 76 MPa to 89 MPa, indicating a strong bedrock. The results of UCS testing are provided in Figure B7 in Appendix B.

4.2 Groundwater Conditions

A monitoring well was installed at Boreholes WL-01 and WL-04 to measure the groundwater levels at the site. The groundwater levels measured in the monitoring well, and the open-hole water levels, are presented in Table 3.

It is noted that Boreholes WL-05 and WL-06 were dry upon completion of drilling.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 3: Summary of Groundwater Conditions

Borehole	Screened Interval	Ground Surface Elevation (m)	Depth to Groundwater Level (m)	Groundwater Elevation (m)	Date
Monitoring Well Water Levels					
WL-01	Till and Bedrock	104.1	1.3	102.8	July 26, 2023
			1.0	103.1	August 25, 2023
			0.9	103.2	February 16, 2024
WL-04	Till	102.7	0.7	102.0	August 25, 2023
			0.8	101.9	February 16, 2024
Open Borehole Water Levels					
WL-02	N/A	103.3	1.0	102.6	July 25, 2023
WL-07	N/A	103.5	5.6	97.9	June 26, 2023

4.3 Analytical Laboratory Testing Results

Two soil samples were submitted to Eurofins for chemical testing/analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix D and are summarized in Table 4.

Table 4: Steel Corrosion and Sulphate Attack, Chemical Analysis

Borehole	Sample Depth (m)	Chloride (%)	Sulphate (%)	Electrical Conductivity (mS/cm)	pH	Resistivity (ohm-cm)
WL-01	0.8-1.4	0.002	<0.01	0.11	8.30	9,091
WL-04	1.5-2.1	0.030	0.01	0.70	8.74	1,429

In addition to in-situ environmental testing, three soil samples were submitted to AGAT Laboratories for environmental laboratory testing/analysis for metals/inorganics, PAHs, and PHCs/BTEX. The test results are provided in Appendix D.

5.0 CLOSURE

This report was prepared by Ben Waechter, EIT, and was reviewed by Kenton Power, P.Eng., a senior geotechnical engineer with WSP. David Staseff, P.Eng., a Senior Principal Geotechnical Engineer and MTO Principal Foundations Contact for WSP conducted an independent technical and quality review of this report.

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Geotechnical Engineer-in-training

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Senior Geotechnical Engineer

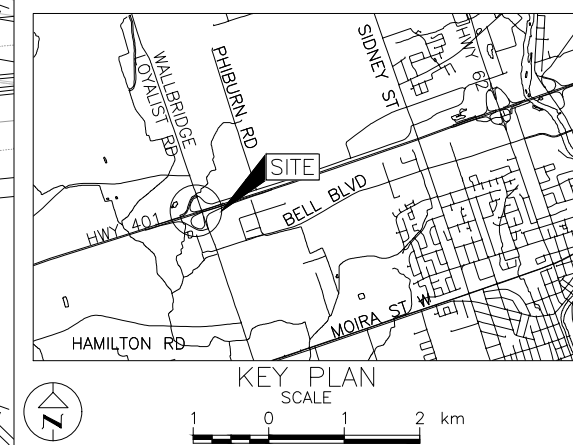
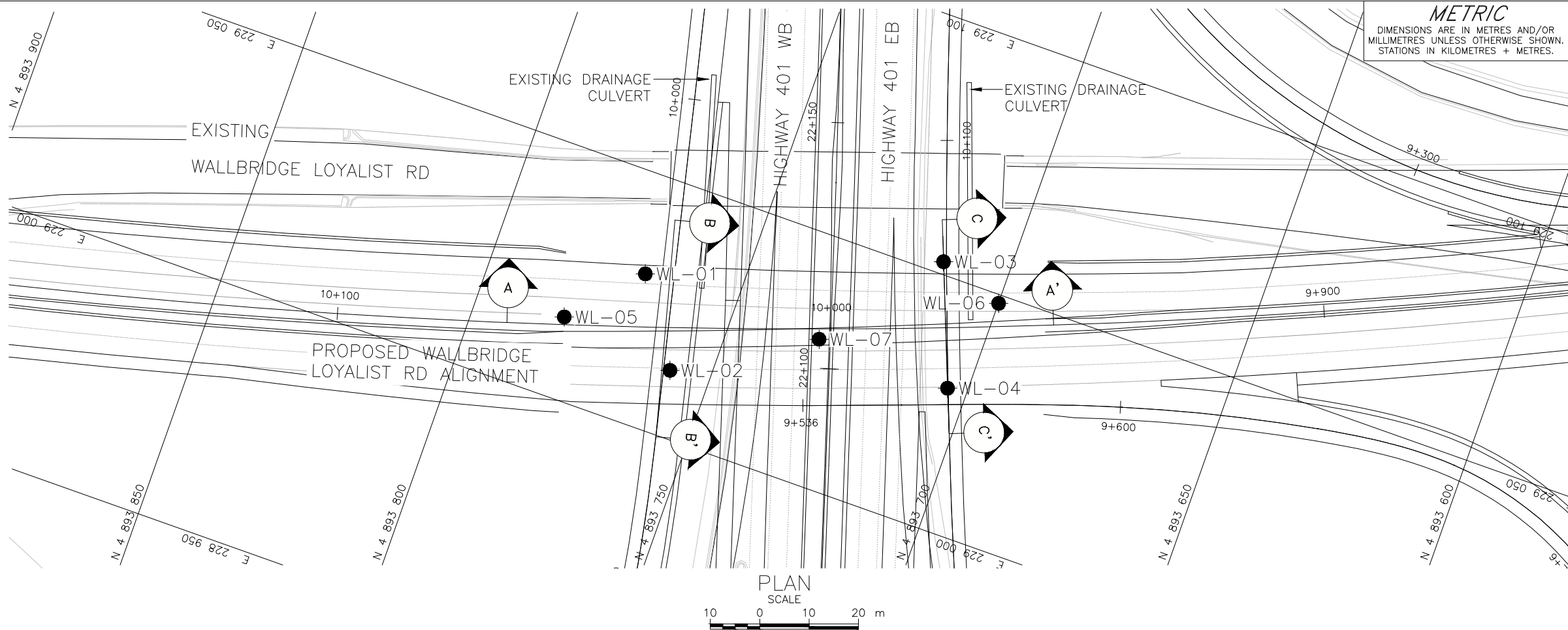
David Staseff, P.Eng.
MTO Principal Foundations Contact

BW/KCP/DS/yj

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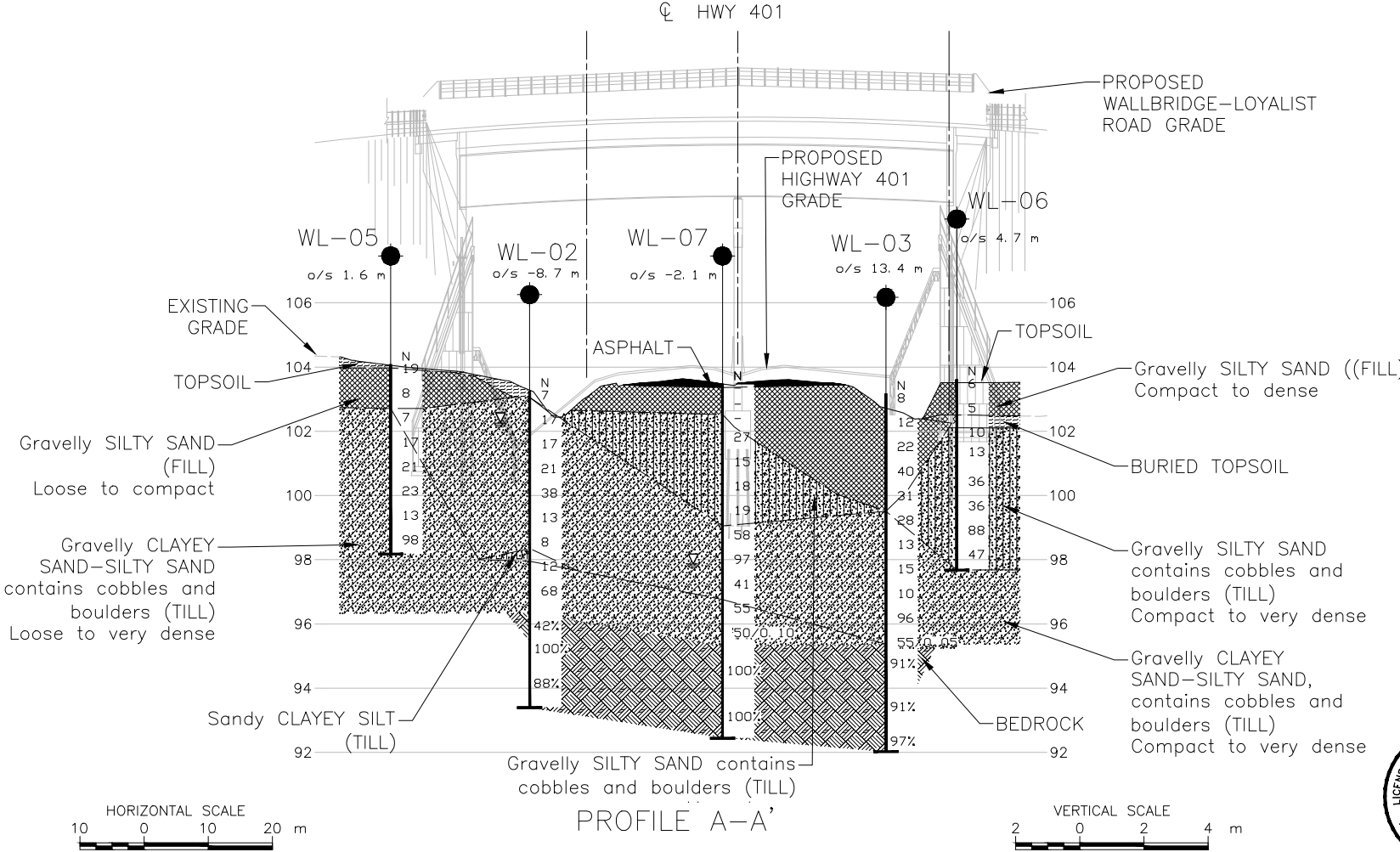
DRAWINGS

Drawing 1
Borehole Locations and Soil Strata



- LEGEND**
- Borehole - Current Investigation
 - ⊥ Seal
 - ⊥ Piezometer
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - 100% Rock Quality Designation (RQD)
 - ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
WL-01	104.1	4893769.4	229030.0
WL-02	103.3	4893758.2	229013.3
WL-03	103.2	4893713.3	229052.5
WL-04	102.7	4893704.0	229028.7
WL-05	104.1	4893782.0	229016.3
WL-06	103.6	4893699.9	229048.3
WL-07	103.5	4893731.8	229029.3



Structural Site Location: Latitude: 44.179990 Longitude: -77.447650

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 Procurement-Ready Design Documents.

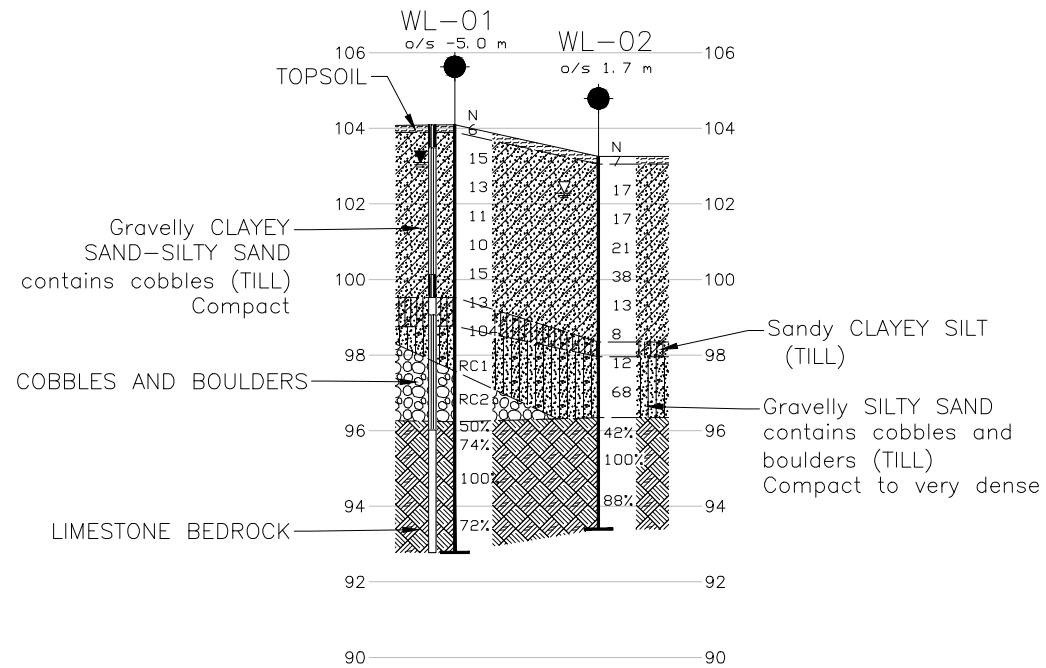
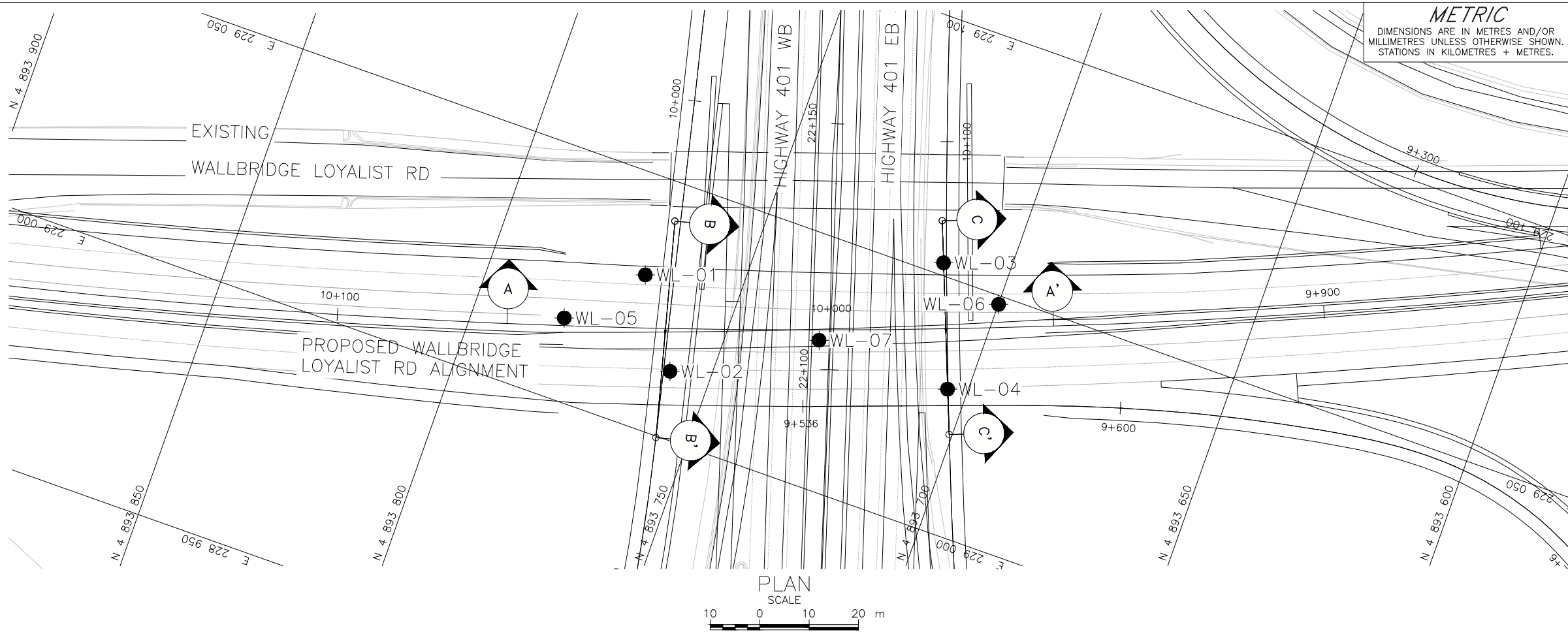
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

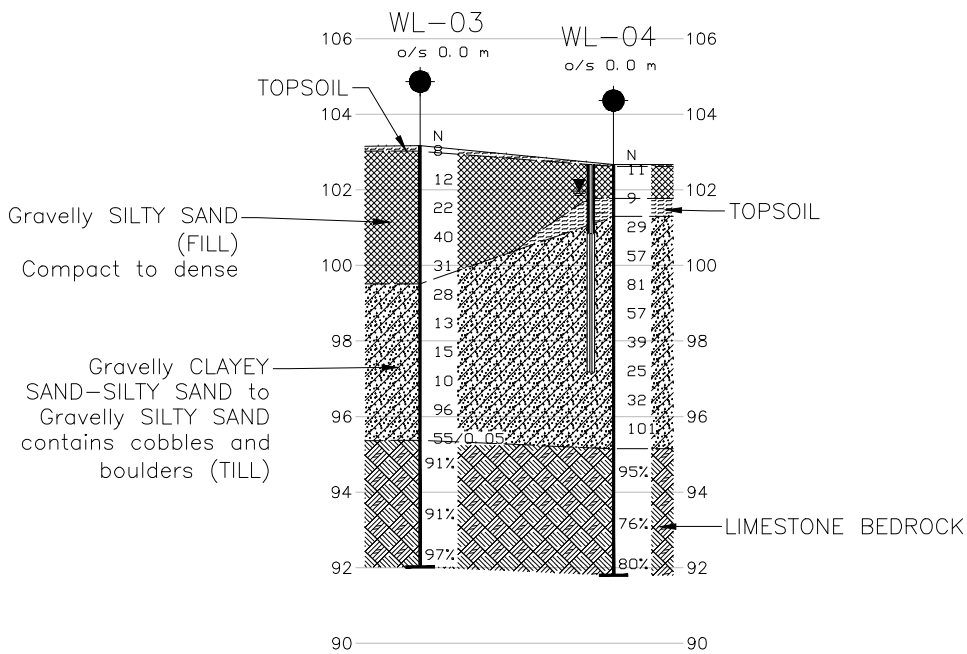
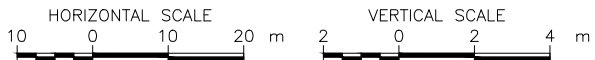
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General Arrangement provided by WSP file nos. S16M-01435-01-340-001GA.dwg and S16M-01435-01-340-002GA.dwg, received January 25, 2024.



NO.	DATE	BY	REVISION
Geocres No. 31C03-002			
HWY. 401	PROJECT NO. CA0006099.3147		
SUBM'D. KG	CHKD. KG	DATE: 05/09/24	SITE: 11X-0157/B0
DRAWN: JM/SA	CHKD. KCP	APPD. DS	DWG. 1



CROSS-SECTION B-B'



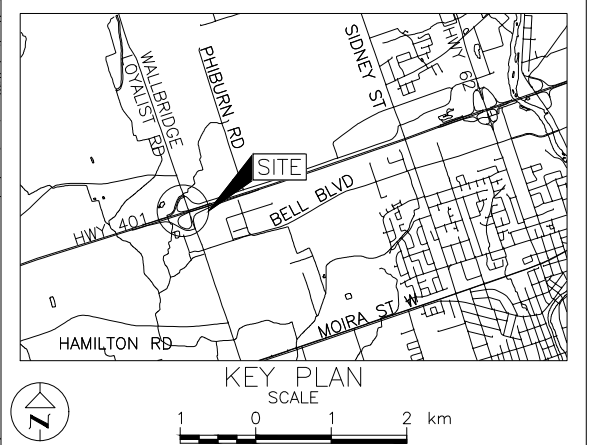
CROSS-SECTION C-C'

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

CONT No.
GWP No. 4053-18-00

HIGHWAY 401 WIDENING
REPLACEMENT OF WALLBRIDGE-LOYALIST UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on August 25, 2023
- WL upon completion of drilling

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
WL-01	104.1	4893769.4	229030.0
WL-02	103.3	4893758.2	229013.3
WL-03	103.2	4893713.3	229052.5
WL-04	102.7	4893704.0	229028.7
WL-05	104.1	4893782.0	229016.3
WL-06	103.6	4893699.9	229048.3
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Structural Site Location: Latitude: 44.179990 Longitude: -77.447650

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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 MTO, drawing file nos 3216057-EP.dwg and 3216057-Hwy 401 _8 Lanes Design_ACAD.dwg, received Oct. 13, 2022.
General Arrangement provided by WSP file nos. S16M-01435-01-340-001GA.dwg and S16M-01435-01-340-002GA.dwg, received January 25, 2024.



NO.	DATE	BY	REVISION
Geocres No. 31C03-002			
HWY. 401	PROJECT NO. CA0006099.3147		
SUBM'D. KG	CHKD. KG	DATE: 05/09/2024	SITE: 11X-0157/B0
DRAWN: JM/SA	CHKD. KCP	APPD. DS	DWG. 2

APPENDIX A

Borehole Records

Lists of Abbreviations and Symbols

Lithological and Geotechnical Rock Description Terminology

Records of Boreholes and Drill Holes

Bedrock Core Photographs, Figures A1 and A10

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	19 to 75	0.75 to 3
	Fine	4.75 to 19	(4) to 0.75
		2.00 to 4.75	(10) to (4)
SAND	Coarse	0.425 to 2.00	(40) to (10)
	Medium	0.075 to 0.425	(200) to (40)
	Fine		
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>i.e.</i> , SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (<i>i.e.</i> , some sand)
≤ 10	trace (<i>i.e.</i> , 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 cm² 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, G_s)
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)
Y	unit weight

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

COARSE-GRAINED SOILS

Compactness¹

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 grain size. 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.

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

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
ν	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
$C_{a(e)}$	secondary compression index
C_a	rate of secondary compression
$C_{a(e)}$	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 = $\tan \delta$
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
2

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



PROJECT CA0006099.3147

RECORD OF BOREHOLE No WL-01

SHEET 1 OF 2

METRIC

G.W.P. 4053-18-00

LOCATION N 4893769.4; E 229030.0 MTM NAD 83 ZONE 9 (LAT. 44.179990; LONG. -77.447650)

ORIGINATED BY BW

DIST Eastern HWY 401

BOREHOLE TYPE Power Auger, 108mm Dia. (Hollow Stem), NQ Coring

COMPILED BY NV

DATUM Geodetic

DATE July 24, 2023

CHECKED BY KG/KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
104.1	GROUND SURFACE																			
0.0	TOPSOIL																			
0.2	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), contains cobbles (TILL) Compact Brown to grey Moist to wet		1	SS	6															
			2	SS	15															
			3	SS	13															
			4	SS	11															
			5	SS	10															
			6	SS	15															
99.5																				
4.6	CLAYEY SILT-SILT (CL-ML/ML) and sand, to SILT trace gravel (TILL) Stiff Grey Moist to wet		7	SS	13															
98.8																				
5.3	Gravelly SILTY SAND (SM) to SAND (SP), contains cobbles and boulders (TILL) Very dense Grey Wet - Cobbles and boulders from 5.8 m to 7.9 m		8	SS	104															
			1	RC																
			2	RC																
96.2																				
7.9	LIMESTONE (BEDROCK) Bedrock cored from 7.9 m to 11.3 m For rock coring details see Record of Drillhole WL-01		3	RC	REC 100%											RQD = 50%				
			4	RC	REC 99%											RQD = 74%				
			5	RC	REC 100%											RQD = 100%				
			6	RC	REC 99%											RQD = 72%				
92.8																				
11.3	END OF BOREHOLE NOTE: 1. Water level measured in standpipe piezometer: Date Depth (m) Elev. (m) 26-Jul-23 1.3 102.8 25-Aug-23 1.0 103.1 16-Feb-24 0.9 103.2																			

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PROJECT: CA0006099.3147

RECORD OF DRILLHOLE: WL-01

SHEET 2 OF 2

LOCATION: N 4893769.40 ;E 229030.04

DRILLING DATE: July 25, 2023

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: Multipower

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																FEATURES	PIEZOMETER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KG/KCP



PROJECT		RECORD OF BOREHOLE		No WL-02		SHEET 1 OF 2		METRIC								
G.W.P. 4053-18-00		LOCATION		N 4893758.2; E 229013.3 MTM NAD 83 ZONE 9 (LAT. 44.179890; LONG. -77.447860)		ORIGINATED BY		BW								
DIST Eastern HWY 401		BOREHOLE TYPE		Power Auger, 108mm Dia. (Hollow Stem), NQ Coring		COMPILED BY		NV								
DATUM Geodetic		DATE		July 25, 2023		CHECKED BY		KG/KCP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
103.3	GROUND SURFACE															
0.0	TOPSOIL															
0.2	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), contains cobbles and boulders (TILL) Compact to dense Brown to grey Moist to wet		1	SS	7											
			2	SS	17											
			3	SS	17											
			4	SS	21											
			5	SS	38											
			6	SS	13											
98.4			7A	SS	8											
98.0	Sandy CLAYEY SILT (CL), trace gravel (TILL) Grey Wet		7B													
5.3	Gravelly SILTY SAND (SM), contains cobbles and boulders (TILL) Compact to very dense Brown to grey Moist to wet		8	SS	12											
			9	SS	68											
96.4																
6.9	LIMESTONE (BEDROCK) Bedrock cored from 6.9 m to 9.9 m For rock coring details see Record of Drillhole WL-02		1	RC	REC 100%											
			2	RC	REC 100%											
			3	RC	REC 100%											
93.4																
9.9	END OF BOREHOLE Auger Refusal at 6.9 m NOTES: 1. Water level measured in open borehole at a depth of 1.0 m (Elev. 102.6 m) prior to the introduction of water for rotary coring. 2. The following soil sample headspace vapour readings were obtained in the field: Samp. No HEX (ppm) IBL (ppm) 1 30 15 2 0 15 3 0 14 4 0 12 5 0 12 6 0 12 7 0 11 8 0 10 9 0 10 Background 0 17															

PROJECT: CA0006099.3147

RECORD OF DRILLHOLE: WL-02

SHEET 2 OF 2

LOCATION: N 4893758.17 ;E 229013.30

DRILLING DATE: July 26, 2023

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: Multipower

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																FEATURES	PIEZOMETER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KG/KCP

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PROJECT <u>CA0006099.3147</u>			RECORD OF BOREHOLE No WL-03			SHEET 1 OF 2			METRIC								
G.W.P. <u>4053-18-00</u>			LOCATION <u>N 4893713.3; E 229052.5 MTM NAD 83 ZONE 9 (LAT. 44.179490; LONG. -77.447360)</u>			ORIGINATED BY <u>AK</u>											
DIST <u>Eastern</u> HWY <u>401</u>			BOREHOLE TYPE <u>Power Auger, 108mm Dia. (Hollow Stem), NQ Coring</u>			COMPILED BY <u>NV</u>											
DATUM <u>Geodetic</u>			DATE <u>July 18, 2023</u>			CHECKED BY <u>KG/KCP</u>											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
103.2	GROUND SURFACE						20	40	60	80	100						
0.0	TOPSOIL		1A		8												
0.2	Brown Moist		1B	SS													
	Gravelly SILTY SAND (SM) (FILL)																
	Compact to dense		2	SS	12												28 34 (38)
	Brown to grey Moist																
			3	SS	22												
			4	SS	40												
			5	SS	31												
99.5	- Contains asphalt fragments																
3.7	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), some gravel, contains cobbles and boulders (TILL)		6	SS	28												21 38 29 12
	Compact to very dense		7	SS	13												
	Brown to grey Moist		8	SS	15												18 37 (45)
	- Black staining		9	SS	10												
			10	SS	96												
	- Contains weathered rock fragments from 6.9 m to 7.8 m depth		11	SS	55/0.05												
95.4	- Wet																
7.8	LIMESTONE (BEDROCK)		1	RC	REC 100%												RQD = 91%
	Bedrock cored from 7.8 m to 11.2 m		2	RC	REC 100%												RQD = 91%
	For rock coring details see Record of Drillhole WL-03		3	RC	REC 100%												RQD = 97%
92.1	END OF BOREHOLE																
11.2	Auger Refusal at 7.8 m																
	NOTE:																
	1. The following soil sample headspace vapour readings were obtained in the field:																
	Samp. No HEX (ppm) IBL (ppm)																
	2 5 6																



PROJECT		RECORD OF BOREHOLE		No WL-04		SHEET 1 OF 2		METRIC					
G.W.P. 4053-18-00		LOCATION		N 4893704.0; E 229028.7 MTM NAD 83 ZONE 9 (LAT. 44.179400; LONG. -77.447660)		ORIGINATED BY		AK					
DIST Eastern HWY 401		BOREHOLE TYPE		Power Auger, 108mm Dia. (Hollow Stem), NQ Coring		COMPILED BY		NV					
DATUM Geodetic		DATE		July 18, 2023		CHECKED BY		KG/KCP					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	GR SA SI CL
102.7	GROUND SURFACE												
0.9	TOPSOIL		1	SS	11		102						
101.8	SAND (SP), some silt, trace gravel, contains organics (FILL) Compact Brown Moist		2A										
0.9	TOPSOIL		2B	SS	9								
101.3	Gravelly SILTY SAND (SM), contains cobbles and boulders (TILL) Compact to very dense Brown to grey Moist to wet		3	SS	29		101						
1.4			4	SS	57		100						26 38 25 11
			5	SS	81		99						
			6	SS	57		98						
			7	SS	39		97						27 37 (36)
			8	SS	25		96						
			9	SS	32		95						
			10	SS	101		94						
95.2	LIMESTONE (BEDROCK)												
7.5	Bedrock cored from 7.5 m to 10.9 m For rock coring details see Record of Drillhole WL-04		1	RC	REC 100%		93						RQD = 95%
			2	RC	REC 95%		92						RQD = 76%
			3	RC	REC 100%								RQD = 80%
91.8	END OF BOREHOLE Auger Refusal at 7.5 m												
10.9	NOTE: 1. Water level measured in standpipe piezometer: Date Depth (m) Elev. (m) 25-Aug-23 0.7 102.0 16-Feb-24 0.8 101.9												

PROJECT: CA0006099.3147

RECORD OF DRILLHOLE: WL-03

SHEET 2 OF 2

LOCATION: N 4893713.27 ;E 229052.50

DRILLING DATE: July 18, 2023

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55, Truck

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES	PIEZOMETER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
						RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP W/L CORE AXIS	DISCONTINUITY DATA				WEATH- ERING INDEX	Diametral Point Load Index (MPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
						TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jzon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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DEPTH SCALE

1 : 50



LOGGED: AK

CHECKED: KG/KCP



PROJECT CA0006099.3147

RECORD OF BOREHOLE No WL-05

SHEET 1 OF 1

METRIC

G.W.P. 4053-18-00

LOCATION N 4893782.0; E 229016.3 MTM NAD 83 ZONE 9 (LAT. 44.180100; LONG. -77.447830)

ORIGINATED BY BW

DIST Eastern HWY 401

BOREHOLE TYPE Power Auger, 108mm Dia. (Hollow Stem), NQ Coring

COMPILED BY NV

DATUM Geodetic

DATE July 24, 2023

CHECKED BY KG/KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
								20	40	60	80	100					
104.1	GROUND SURFACE																
0.0	TOPSOIL																
	Gravelly SILTY SAND (SM), some clay (FILL) Loose to compact Grey to brown Moist		1	SS	19												
			2	SS	8												
102.7																	
1.4	Gravelly SILTY SAND (SM) contains cobbles and boulders (TILL) Loose to very dense Brown to grey Moist to wet		3	SS	7											12 41 33 14	
			4	SS	17												
			5	SS	21												
			6	SS	23											26 36 (38)	
			7	SS	13												
			8A	SS	98												
			8B														
98.2	END OF BOREHOLE																
5.9	NOTE: 1. Borehole dry upon completion of drilling on July 24, 2023.																

GTA-MTO 001 S:\CLIENTS\MTOWHY_401_BELLEVILLE\02_DATA\GINT\HWY_401_BELLEVILLE.GPJ GAL-GTA.GDT 5/9/24



PROJECT CA0006099.3147

RECORD OF BOREHOLE No WL-06

SHEET 1 OF 1

METRIC

G.W.P. 4053-18-00

LOCATION N 4893699.9; E 229048.3 MTM NAD 83 ZONE 9 (LAT. 44.179370; LONG. -77.447410)

ORIGINATED BY BW

DIST Eastern HWY 401

BOREHOLE TYPE Power Auger, 108mm Dia. (Hollow Stem), NQ Coring

COMPILED BY NV

DATUM Geodetic

DATE July 26, 2023

CHECKED BY KG/KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
								20	40	60	80	100					
103.6	GROUND SURFACE																
0.0	TOPSOIL		1	SS	6												
0.1	SAND (SP), some silt (FILL) Loose Brown Moist		2A	SS	5												
102.5			2B														
102.2	TOPSOIL																
1.4	Gravelly SILTY SAND (SM/GM), contains cobbles and boulders (TILL) Compact to very dense Grey to brown Moist		3	SS	10											23 38 27 12	
			4	SS	13												
			5	SS	36											32 35 (33)	
			6	SS	36												
			7	SS	88												
			8	SS	47												
97.7																	
5.9	END OF BOREHOLE																
	NOTE: 1. Borehole dry upon completion of drilling on July 26, 2023.																

GTA-MTO 001 S:\CLIENTS\MTOWHY_401_BELLEVILLE\02_DATA\GINT\HWY_401_BELLEVILLE.GPJ GAL-GTA.GDT 5/9/24

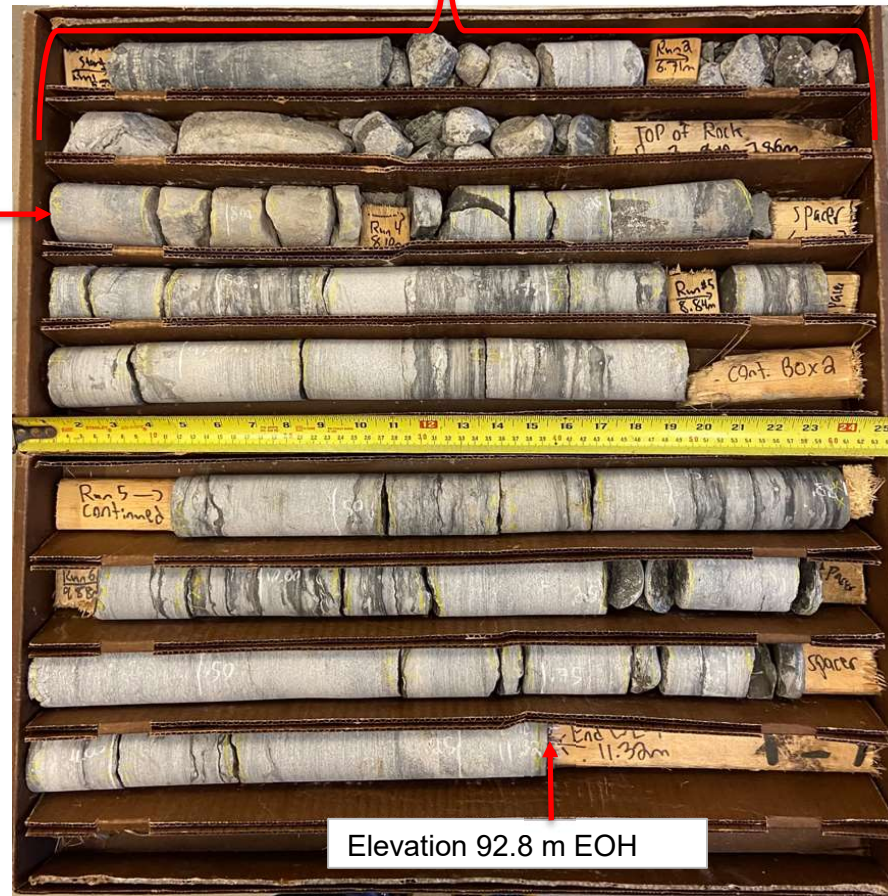


PROJECT		RECORD OF BOREHOLE				No WL-07		SHEET 1 OF 2		METRIC						
G.W.P. 4053-18-00		LOCATION		N 4893731.8; E 229029.3 MTM NAD 83 ZONE 9 (LAT. 44.179663; LONG. -77.447659)				ORIGINATED BY DG								
DIST Eastern HWY 401		BOREHOLE TYPE		Power Auger, 108mm Dia. (Hollow Stem), NQ Coring				COMPILED BY NV								
DATUM Geodetic		DATE		June 26, 2023				CHECKED BY KG/KCP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
103.5	GROUND SURFACE						20	40	60	80	100					
0.0	ASPHALT		1	GS	-											
0.1	Gravelly SAND (SP), contains asphalt fragments (FILL)		2	GS	-											
102.6	Grey to brown															
1.0	Gravelly SILTY SAND (SM), contains cobbles (TILL)		3	GS	-											
	Compact		4	SS	27											
	Brown to grey-brown															
	Moist to wet		5	SS	15											
			6	SS	18											
			7	SS	19											
99.1	CLAYEY SAND-SILTY SAND (SC-SM), some gravel, contains cobbles and boulders (TILL)		8	SS	58											
4.4	Dense to very dense		9	SS	97											
	Brown to grey-brown		10	SS	41											
	Moist to wet		11	SS	55											
96.8	Gravelly SILTY SAND (SM), contains weathered rock fragments (TILL)		12	SS	50/0/10											
6.7	Very dense															
	Grey															
	Moist to wet															
95.3	LIMESTONE (BEDROCK)		1	RC	REC 100%											
8.2	Bedrock cored from 8.2 m to 11.0 m		2	RC	REC 100%											
	For rock coring details see Record of Drillhole WL-07															
92.5	END OF BOREHOLE															
11.0	Auger Refusal at 8.2 m															
	NOTE:															
	1. Water level measured in open borehole at 5.6 m (Elev. 97.9 m) below ground surface on June 26, 2023.															

WL-01 (Dry)
Core Box 1 to 2 of 2

Elevation 96.2 m Top of Bedrock

Cobbles and Boulders



Elevation 92.8 m EOH



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

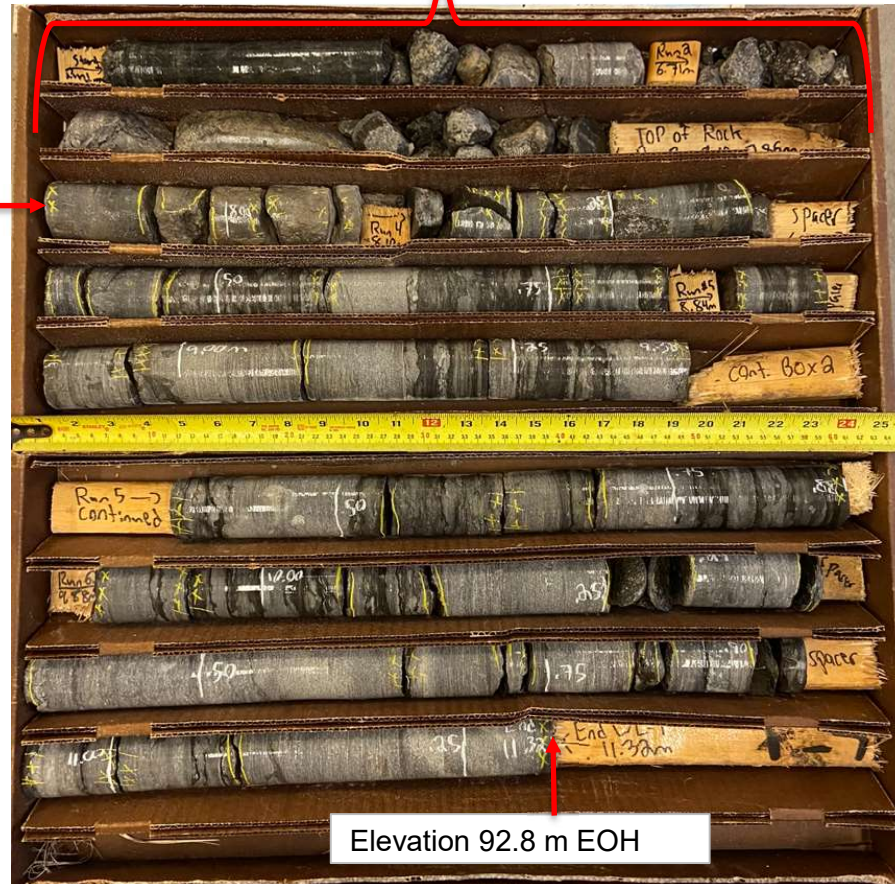
Review: LCC

Figure A1

WL-01 (Wet)
Core Box 1 to 2 of 2

Elevation 96.2 m Top of Bedrock

Cobbles and Boulders



Elevation 92.8 m EOH



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A2

WL-02 (Dry)
Core Box 1 to 2 of 2

Cobbles and Boulders

Elevation 96.4 m Top of Bedrock



Elevation 93.4 m EOH



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

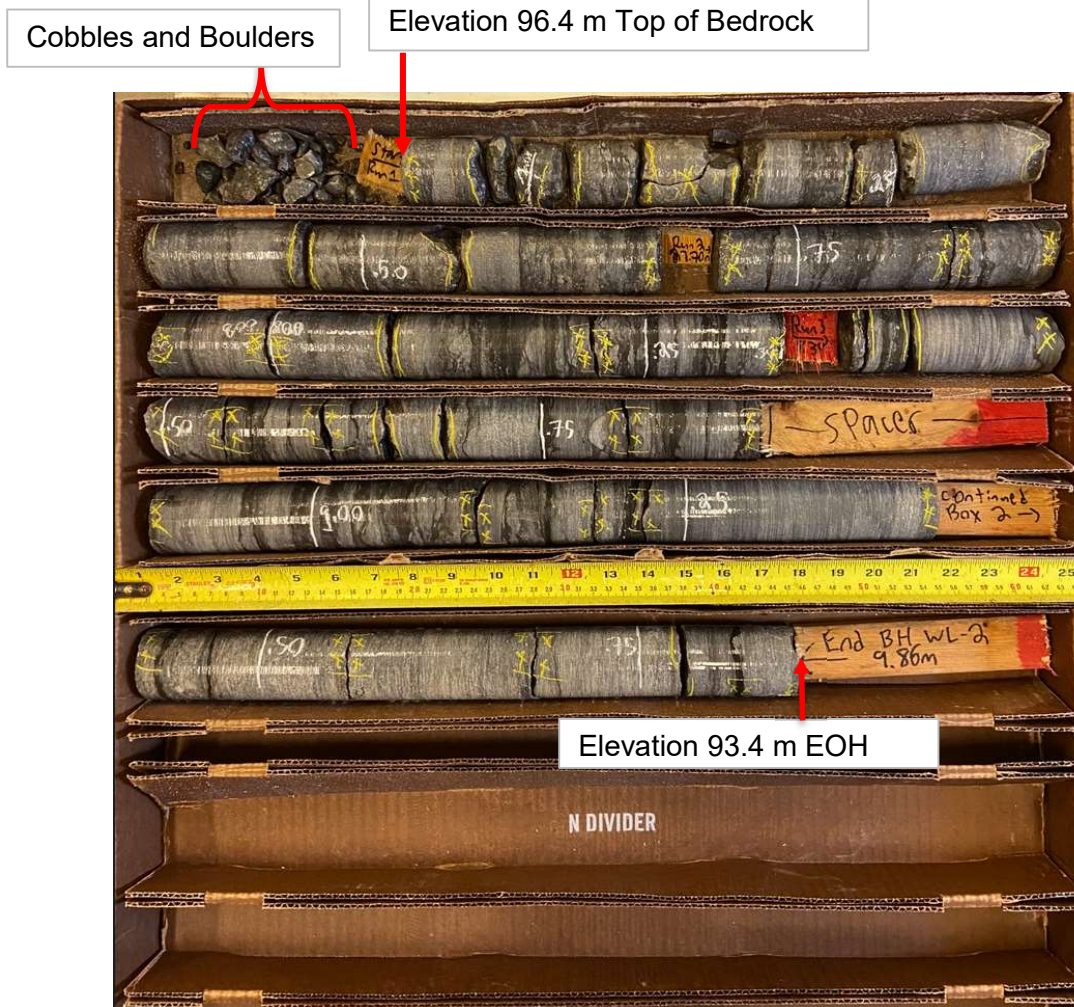
Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A3

WL-02 (Wet)
Core Box 1 to 2 of 2



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01
Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A4

WL-03 (Dry)
Core Box 1 to 2 of 2

Cobbles
and
Boulders

Elevation 95.4 m Top of Bedrock



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A5

WL-03 (Wet)
Core Box 1 to 2 of 2

Cobbles
and
Boulders

Elevation 95.4 m Top of Bedrock



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

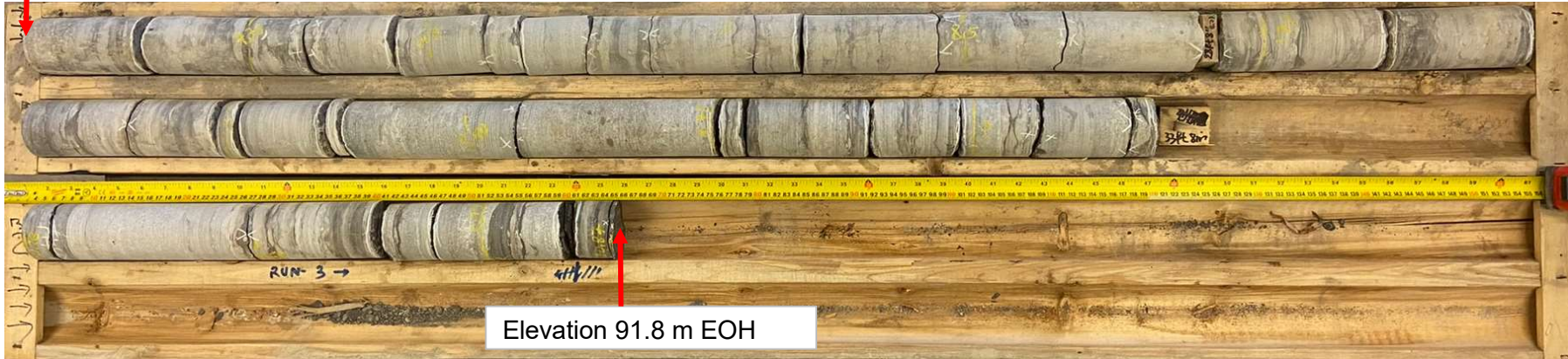
Checked: KCP

Review: LCC

Figure A6

WL-04 (Dry)
Core Box 1 to 2 of 2

Elevation 95.2 m Top of Bedrock



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A7

WL-04 (Wet)
Core Box 1 to 2 of 2

Elevation 95.2 m Top of Bedrock



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A8

WL-07 (Dry)
Core Box 1 of 1

Elevation 95.3 m Top of Bedrock



Elevation 92.5 m EOH



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01
Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario

Project No. CA0006099.3147
Drawn: KG
Date: 2024-02-23
Checked: KCP
Review: LCC

Figure A9

Core Box 1 of 1

Elevation 95.3 m Top of Bedrock



Elevation 92.5 m EOH



Foundation Investigation
Replacement of Underpass Structure No. 11X-0157/B0
GWP: 4053-18-00 WP: 4088-19-01

**Highway 401 / Wallbridge Loyalist Road,
Belleville, Ontario**

Project No. CA0006099.3147

Drawn: KG

Date: 2024-02-23

Checked: KCP

Review: LCC

Figure A10

APPENDIX B

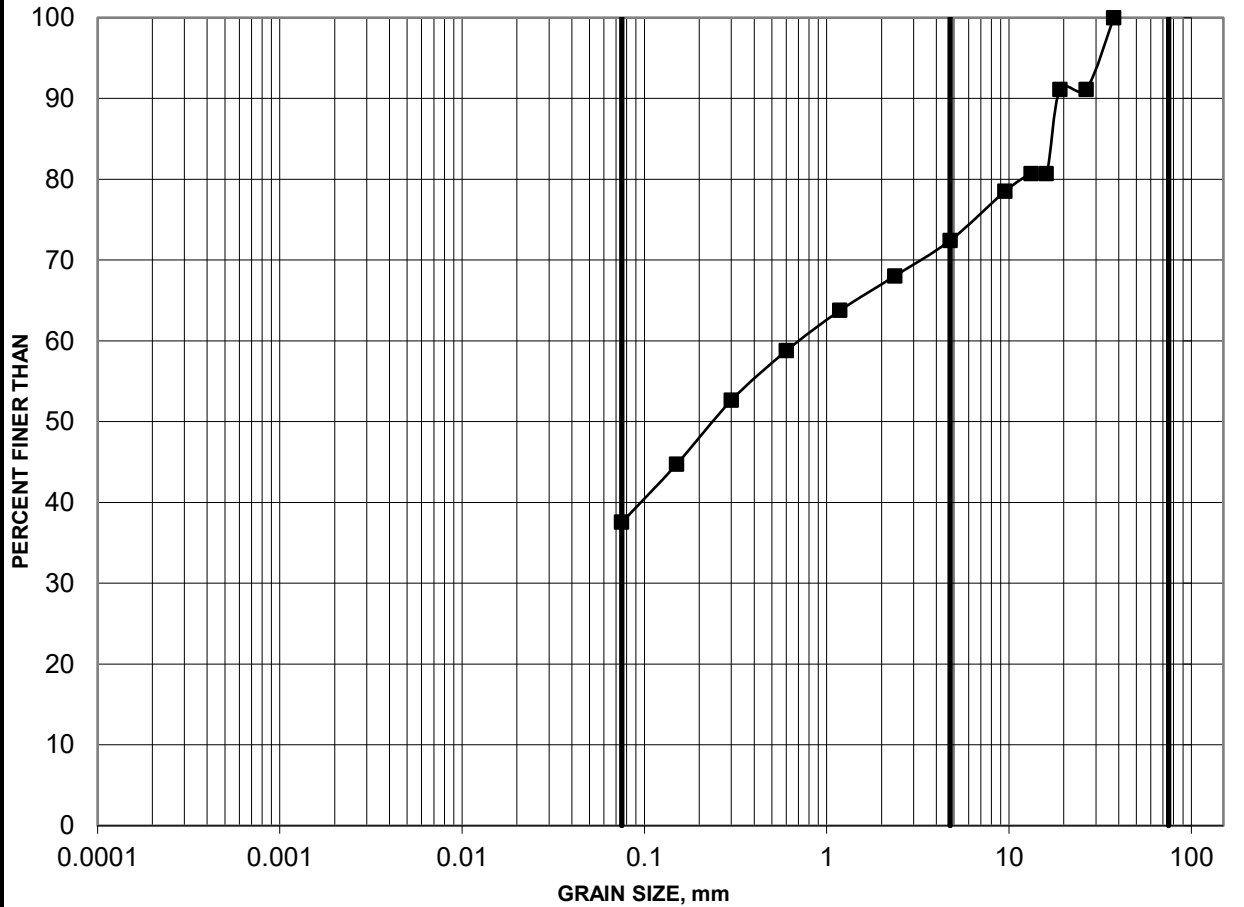
Geotechnical Laboratory Test Results

Figures B1 to B7

GRAIN SIZE DISTRIBUTION

FIGURE B1

Gravelly SILTY SAND (SM) (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■ WL-03	2	0.76-1.37	28	34	38	

Project: CA0006099.3147/3000

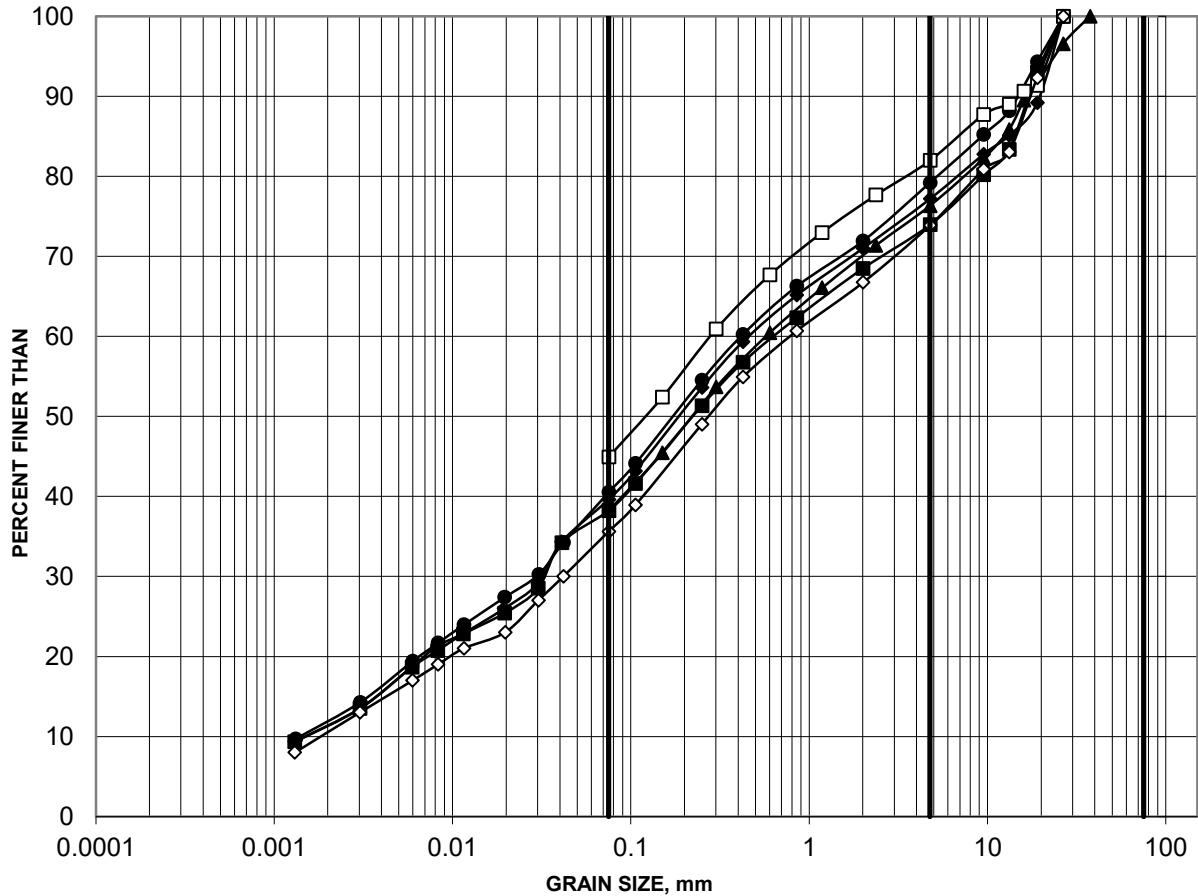
wsp

Created by: MI
Checked by: CW

GRAIN SIZE DISTRIBUTION

FIGURE B2

Gravelly CLAYEY SAND-SILTY SAND (SC-SM) to Silty Sand some gravel (TILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	WL-01	4	2.29-2.90	26	36	27	11
◆	WL-02	3	1.52-2.13	23	37	29	11
▲	WL-02	4	3.05-3.66	24	38	38	
●	WL-03	6	3.81-4.42	21	38	29	12
□	WL-03	8	5.33-5.94	18	37	45	
◇	WL-04	4	2.29-2.90	26	38	25	11

wsp

Project: CA0006099.3147/3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/CA0006099.3147/phase 3000 Wallbridge/Figures/>

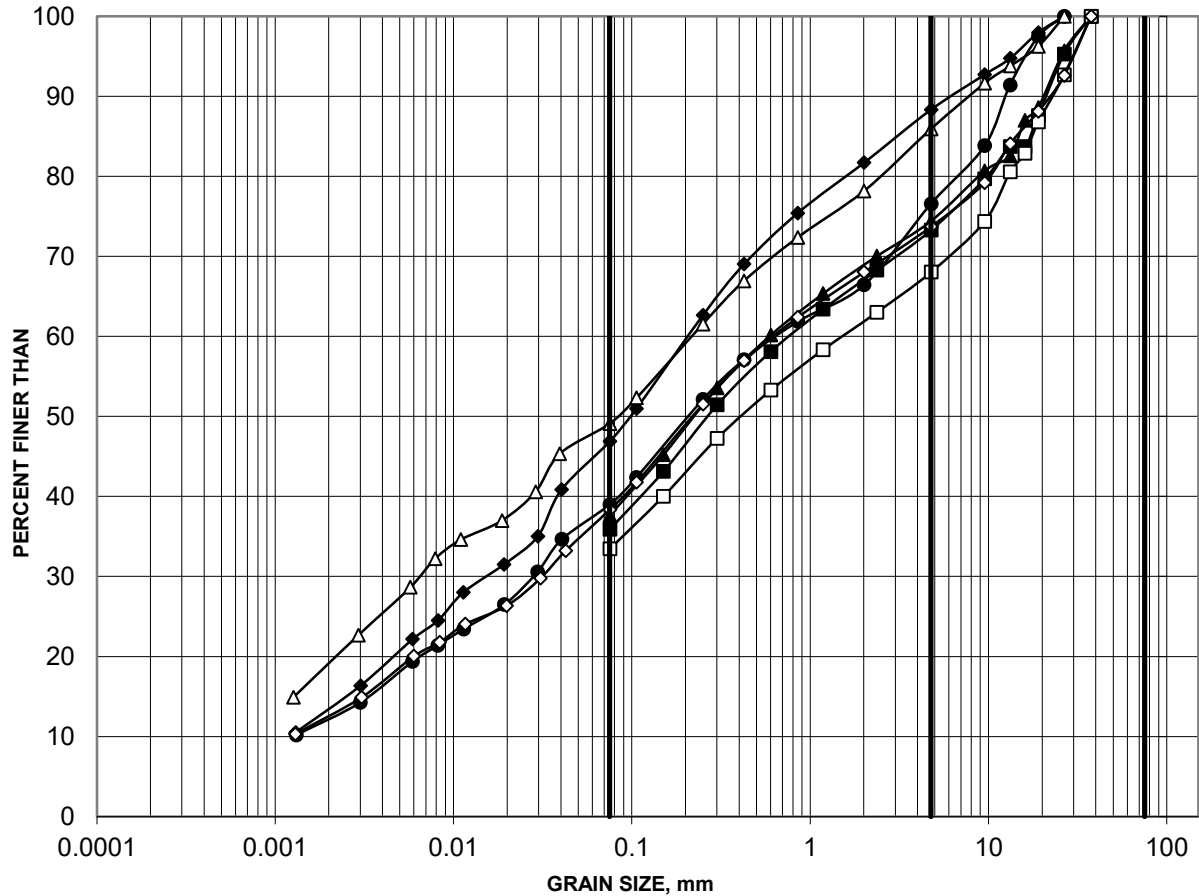
Created by: CW

Checked by: MI

GRAIN SIZE DISTRIBUTION

FIGURE B3

Gravelly SILTY SAND (SM) to CLAYEY SAND-SILTY SAND (SC-SM), some gravel (TILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
■	WL-04	7	4.57-5.18	27	37		36
◆	WL-05	3	1.52-2.13	12	41	33	14
▲	WL-05	6	3.81-4.42	26	36		38
●	WL-06	3	1.52-2.13	23	38	27	12
□	WL-06	5	3.05-3.66	32	35		33
◇	WL-07	6	3.05-3.66	26	36	25	13
△	WL-07	9	5.33-5.94	14	37	30	19

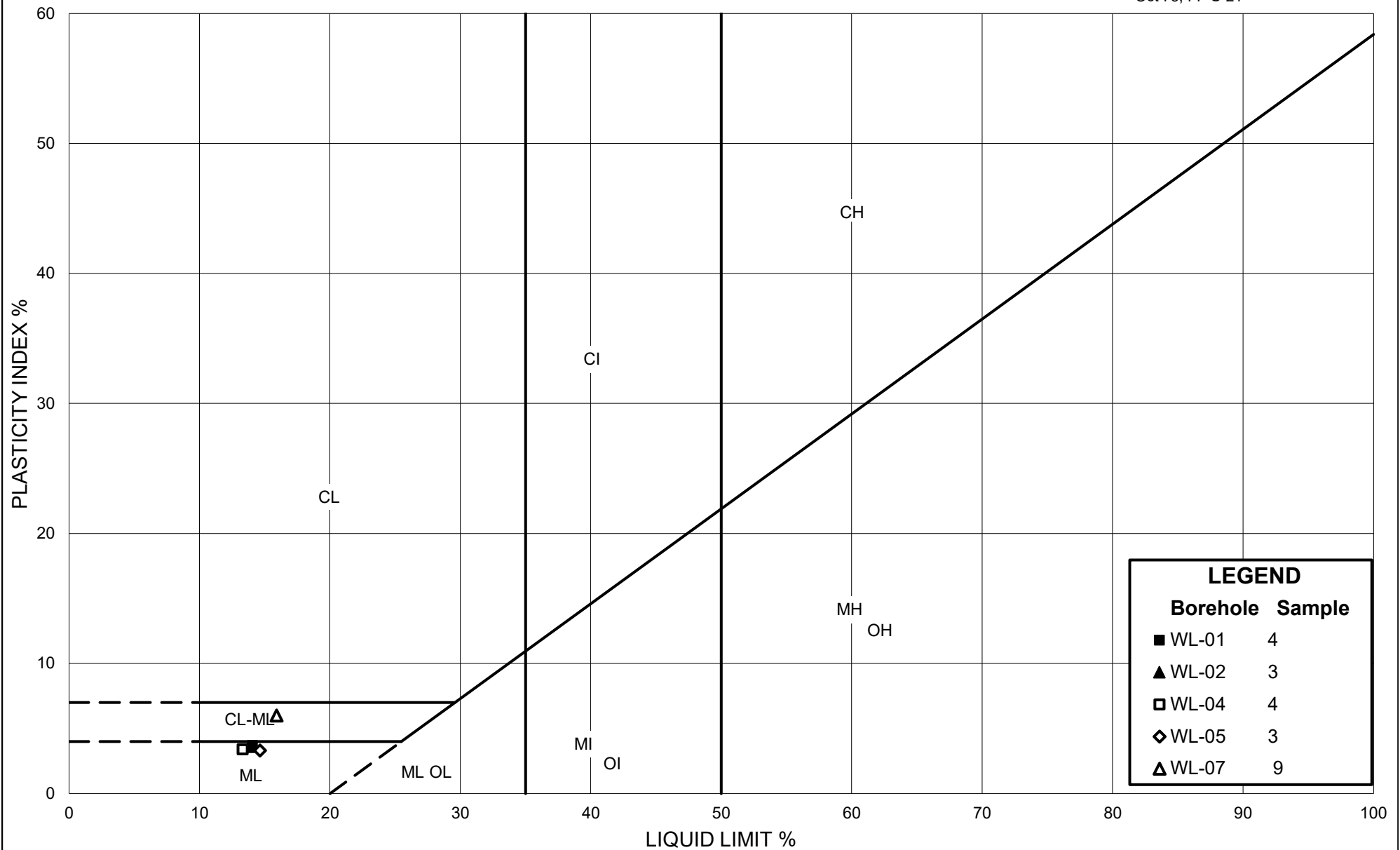
wsp

Project: CA0006099.3147/3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/CA0006099.3147/phase 3000 Wallbridge/Figures/>

Created by: CW

Checked by: MI



Ministry of Transportation

PLASTICITY CHART

Gravelly CLAYEY SAND-SILTY SAND (SC-SM) to Silty Sand some gravel (TILL)

Figure: B4

Project: CA0006099.3147/3000

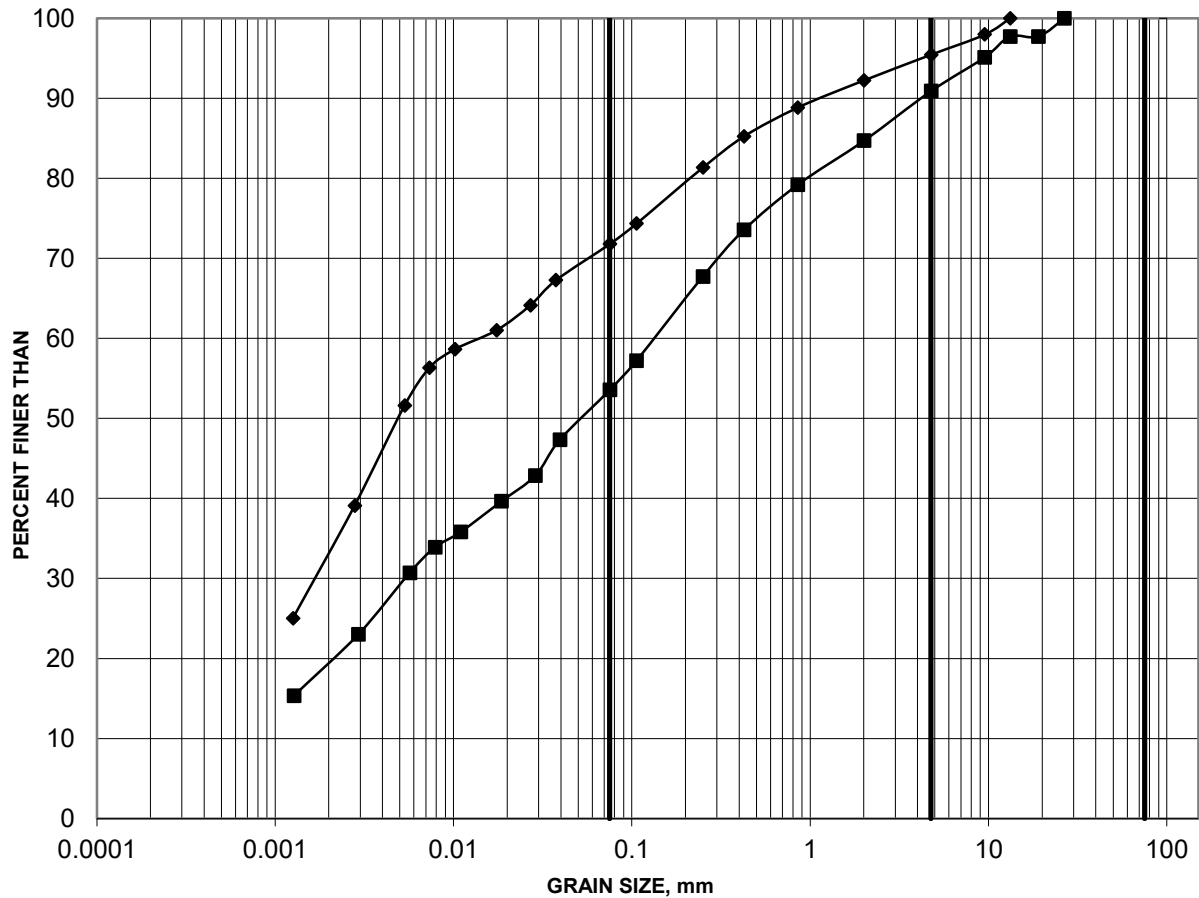
Created By: MI

Checked By: CW

GRAIN SIZE DISTRIBUTION

FIGURE B5

CLAYEY SILT - SILT (CL-ML) to SILT (ML) (TILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
■	WL-01	7	4.57-5.18	9	37	34	20
◆	WL-02	7B	4.88-5.18	5	23	39	33

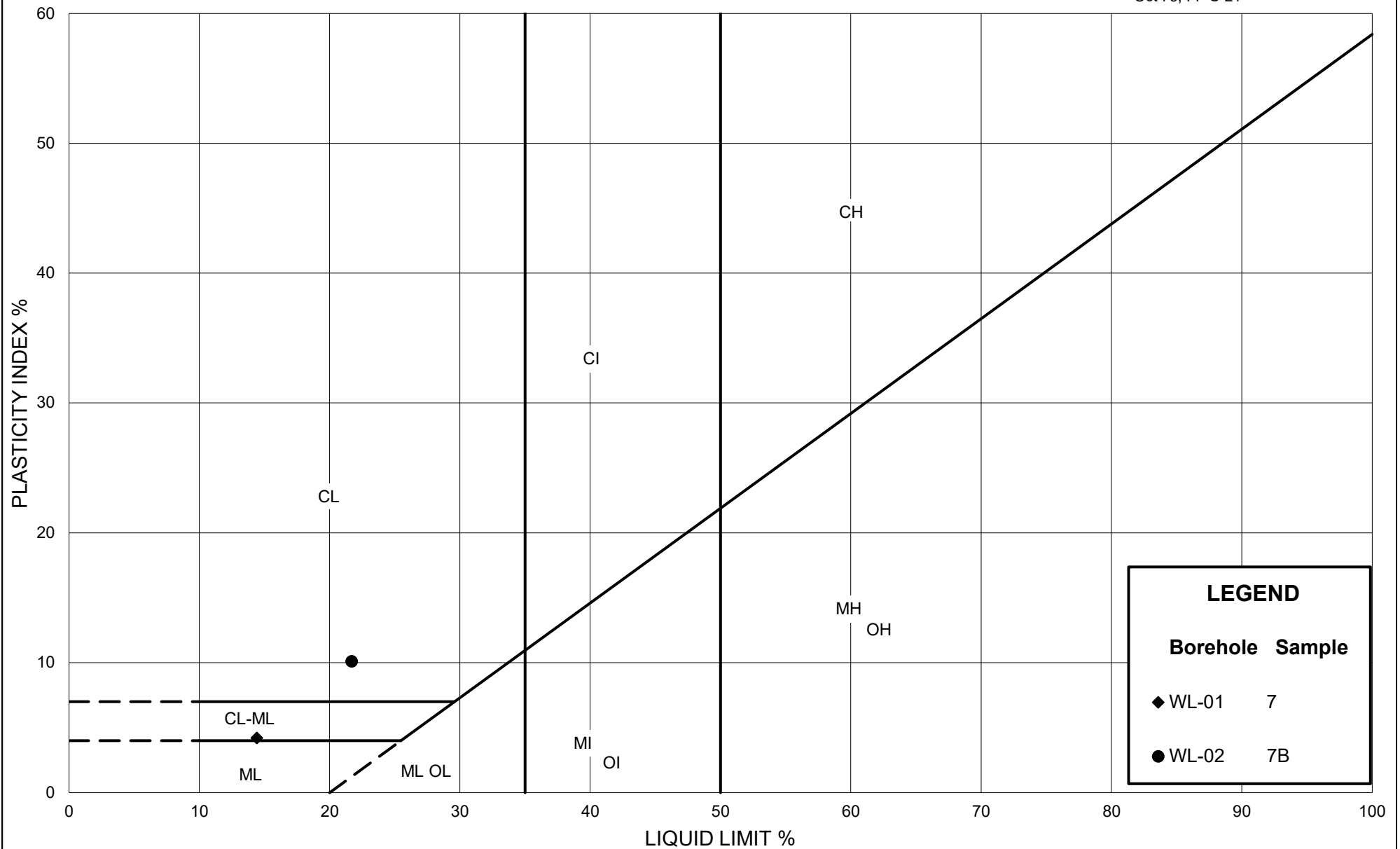
wsp

Project: CA0006099.3147/3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/CA0006099.3147/phase 3000 Wallbridge/Figures/>

Created by: CW

Checked by: MI



Ministry of Transportation

PLASTICITY CHART

Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML/ML) to SILT (TILL)

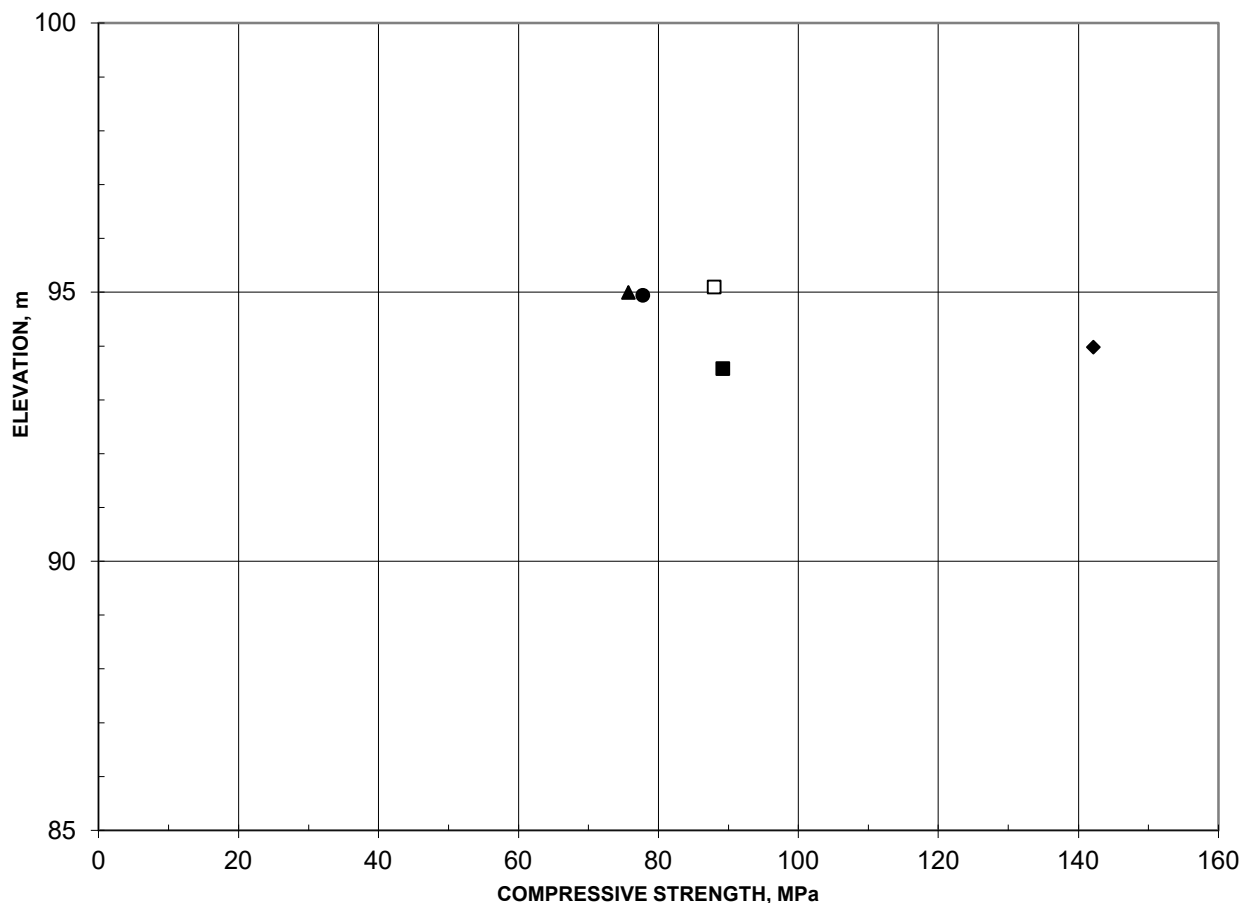
Figure: B6

Project: CA0006099.3147/3000

Created By: CW Checked By: MI

ASTM D7012 - Method C
UNIAXIAL UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE
SUMMARY OF LABORATORY TEST RESULTS

FIGURE B7



	Borehole	Depth (m)	L/D	Bulk Density (kg/m ³)	Lithology	UCS (MPa)	Failure Type
■	WL-01 RC1	10.5	2.6	2686	Limestone	89	1
◆	WL-02 RC1	9.3	2.5	2673	Limestone	142	1
▲	WL-03 RC1	8.2	2.3	2646	Limestone	76	1
●	WL-04 RC1	7.7	2.2	2642	Limestone	78	1
□	WL-07 RC1	8.5	2.5	2650	Limestone	88	1

Notes:

Failure Types

1. Well formed cones on both ends
2. Well formed cones on one end, vertical cracks through cap
3. Columnar vertical cracking through both ends
4. Diagonal fracture with no cracking through ends
5. Side fractures at top or bottom
6. Side fractures at both sides of top or bottom

Remarks

- Cores tested in vertical direction.
- Cores tested in air-dry condition.
- Time to failure > 2 and < 15 minutes.

wsp

Project: CA0006099.3147/3000

Created by: MI

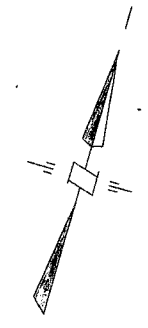
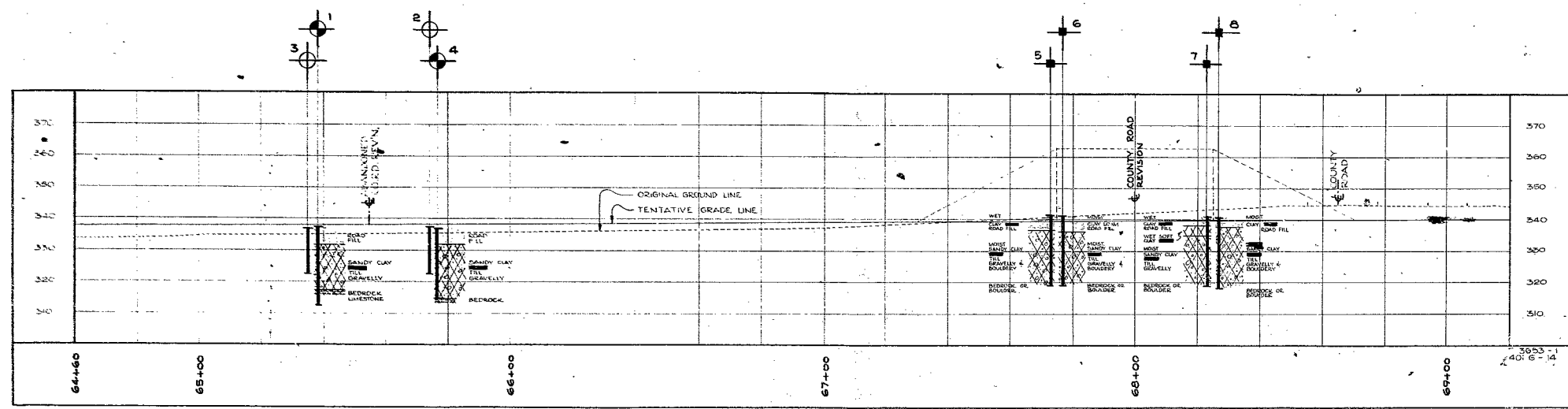
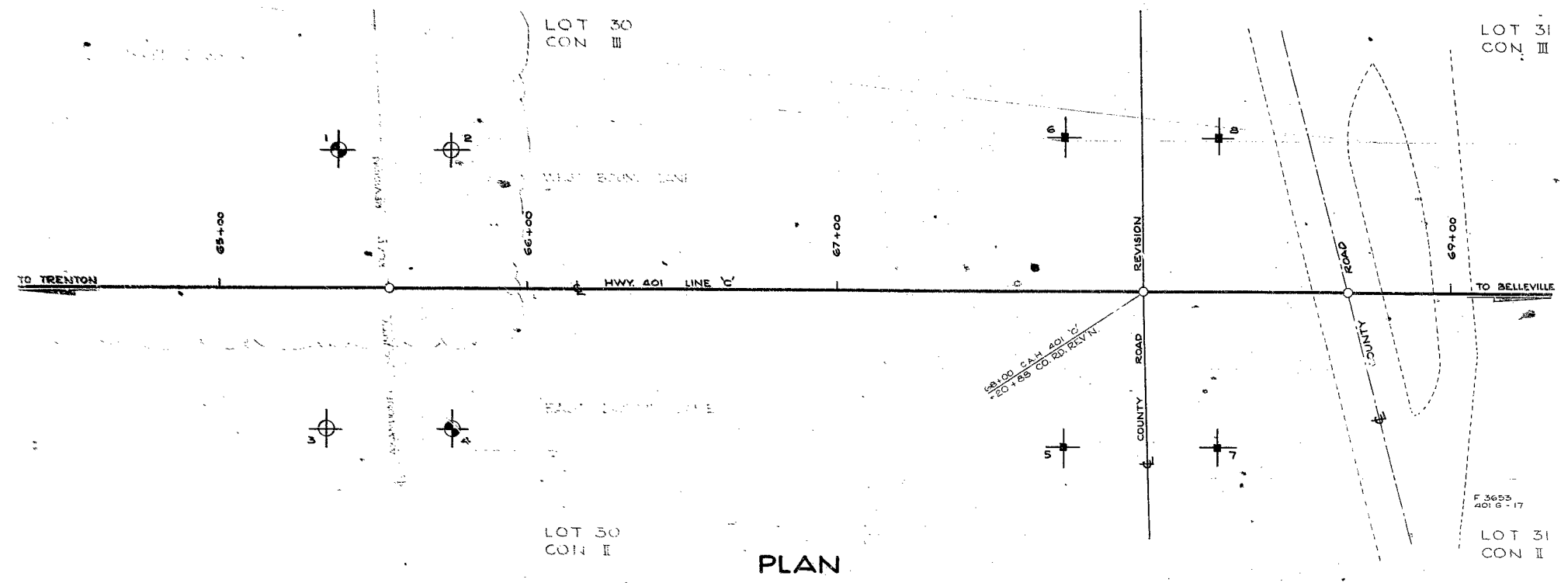
Checked by: CW

APPENDIX C

Previous Investigations

Results from 1957 and 1958 Original Investigation GEOCREs No. 31C00-023

SOME DEFECTS IN NEGATIVE DUE
TO CONDITION OF ORIGINAL DOCUMENTS



LEGEND			
AUGER HOLE			
BORE HOLE			
PENETRATION HOLE			
BORE & PENETRATION HOLE			

HOE NO	ELEVATION	STATION	DISTANCE FROM E
1	337.5'	65+36'	45' LT
2	337.5'	65+75'	45' LT
3	336.8'	65+35'	45' RT
4	337.0'	65+76'	45' RT
5	341.74'	67+75'	50' RT
6	341.43'	67+75'	50' LT
7	341.17'	68+25'	50' RT
8	340.99'	68+25'	50' LT

NOTE

THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM CORRELATIONAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO		
MATERIALS & RESEARCH SECTION - DOWNSVIEW		
COUNTY ROAD REVISION		
PR. 2 M. 15D ROSSING		
W. C. BELLEVILLE		
SHOW. SITION & ELEVATION OF HOLES		
HWY. NO. 401 LINE 'C'	W.P. 45-57	DIV. NO. 5
CO. HASTINGS		
TWP. SIDNEY	LOTS 30 & 31	CON'S I & II
SCALE	SUBMITTED BY	DATE
1 IN = 20 FT		28 APRIL 58
DRAWN BY	APPROVED BY	DRAWING NO.
R.E.F.		F-57-45A

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 45-57 BORE HOLE NO. 1

JOB F57 - 45 STATION 65 + 38 (45' LT)




DATUM Elev. 337.5' COMPILED BY A.L.

BORING DATE Nov. 6/57 CHECKED BY -----

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) _____	O
VANE TEST (C) AND SENSITIVITY (S) _____	+S
NATURAL MOISTURE AND	
LIQUIDITY INDEX _____	LI
LIQUID LIMIT _____	X
PLASTIC LIMIT _____	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	↓ Ground level				
	Clay fill	337.5	0		
			5		
		331.5	10		
	Dense sandy clay till gravelly		15		
			20		
	Bedrock	317.5	25		
	Limestone	312.5	30		
	End of hole				

BLOWS/FT.

50 100 150 200

Ref. 9 @ 10' to 32.5'

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 45-57 BORE HOLE NO. 2

JOB F57 - 45 STATION 68/75 (45' LT)

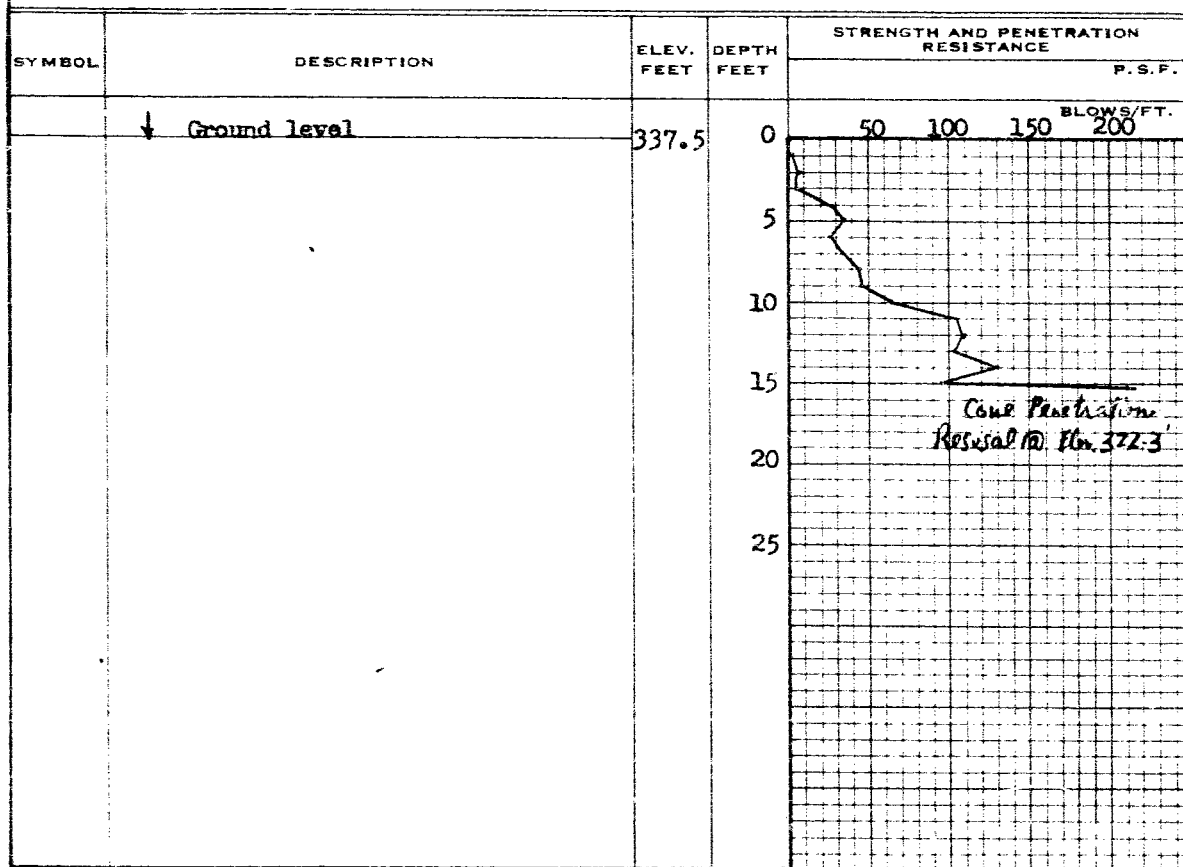
DATUM Elev. 337.5 _____ COMPILED BY A.J. _____

BORING DATE Nov. 1/57 CHECKED BY _____

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) -----	○
VANE TEST (C) AND SENSITIVITY (S) -----	+s
NATURAL MOISTURE AND LIQUIDITY INDEX -----	LI
LIQUID LIMIT -----	X
PLASTIC LIMIT -----	○

[illegible]

MATERIALS AND RESEARCH SECTION

BORING DATE Nov. 2/57 CHECKED BY _____

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

1/2 UNCONFINED COMPRESSION (Qu) --- 0
VANF TEST (C) AND SENSITIVITY (S) --- +
NATURAL MOISTURE AND LIQUIDITY INDEX --- X
LIQUID LIMIT ---
PLASTIC LIMIT ---

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
					P.S.F.
↓	Ground level	336.8	0	BLOWS/FT.	
			5		
			10		
			15	Cone Penetration Refusal @ Elev. 322.3	
			20		
			25		

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

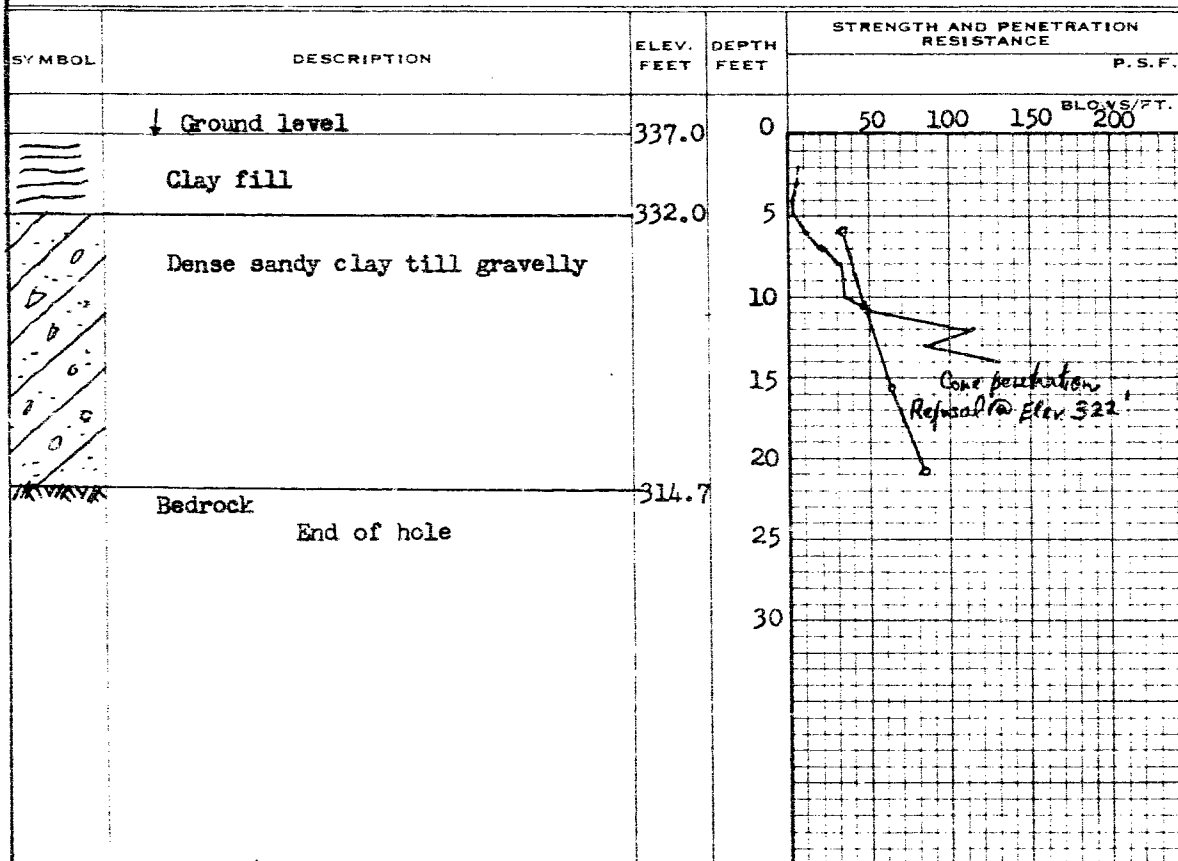
MATERIALS AND RESEARCH SECTION

W.P. 45-5 BORE HOLE NO. 4
 JOB F57-45 STATION 65+76 (45' RT)
 DATUM Elev. 337.0' COMPILED BY A.L.
 BORING DATE Nov. 7/57 CHECKED BY _____

2" DIA. SPLIT TUBE _____
 2" SHELBY TUBE _____
 2" SPLIT TUBE _____
 2" DIA. CONE _____
 2" SHELBY _____
 CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Q_u) _____ O
 VANE TEST (C) AND SENSITIVITY (S) _____ +
 NATURAL MOISTURE AND LIQUIDITY INDEX _____ LI
 LIQUID LIMIT _____ X
 PLASTIC LIMIT _____



CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.				
10	20	30		
	*		TW1	135.0
	*		TW2	140.0
		*	SS3	-----
	*		SS4	-----

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 45 - 57 BORE HOLE NO. 5

JOB F57 - 45 STATION 67475 (50' BT)




DATUM Elev. 341.7 _____ COMPILED BY _____ A.L. _____

BORING DATE Mar. 26/58 CHECKED BY _____

2" DIA. SPLIT TUBE _____
 2" SHELBY TUBE _____
 2" SPLIT TUBE _____
 2" DIA. CONE _____
 2" SHELBY _____
 CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) ---	O
VANE TEST (C) AND SENSITIVITY (S) ---	S
NATURAL MOISTURE AND	
LIQUIDITY INDEX ---	LI
LIQUID LIMIT ---	X
PLASTIC LIMIT ---	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	↓ Ground level	341.7	0		
	Clay fill	336.7	5		
	Dense grey sandy clay till gravelly	319.2	10		
			15		
			20		
	Probably bedrock		25		
	end of auger borehole		30		

[illegible]


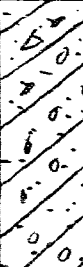

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 45 - 57 ----- BORE HOLE NO. 6
JOB F57 - 45 ----- STATION 67+75 (50' LT)
DATUM Elev. 341.4 ----- COMPILED BY A.L.
BORING DATE Mar. 26/58 ----- CHECKED BY -----

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) — 0
VANE TEST (C) AND SENSITIVITY (S) — +
NATURAL MOISTURE AND LIQUIDITY INDEX — LI
LIQUID LIMIT — X
PLASTIC LIMIT —

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F. BLOWS/FT.	
	Ground level	341.4	0		
	Clay fill	336.4	5		
	Dense grey sandy clay till gravelly		10		
			15		
			20		
	Probably bedrock	319.4	25		
	end of auger borehole		30		

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 45 - 57 BORE HOLE NO. 7

JOB F57-45 STATION 68/25 (50' RT)

DATUM Elev. 341.2 COMPILED BY A.L.

BORING DATE Mar. 26/58 CHECKED BY _____

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) _____	O
VANE TEST (C) AND SENSITIVITY (S) _____	+ S
NATURAL MOISTURE AND	
LIQUIDITY INDEX _____	X
LIQUID LIMIT _____	
PLASTIC LIMIT _____	


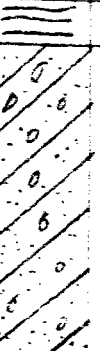

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE					
				P.S.F.					
	↓ Ground level ∇ W.L.								
	Clay fill	341.2	0						
	Soft grey sandy clay (very wet)	338.2	5						
	Dense grey sandy clay till, gravelly	335.2	10						
	Probably bedrock end of auger borehole	319.2	25						
			30						

[illegible]

W.P. 45 - 57 BORE HOLE NO. 8
JOB F57 - 45 STATION 68+25 (50' IT)
DATUM Elev. 341' COMPILED BY A.J.
BORING DATE Mar. 26/58 CHECKED BY _____

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

1/2 UNCONFINED COMPRESSION (Qu) -----	○
VANE TEST (C) AND SENSITIVITY (S) -----	+ S
NATURAL MOISTURE AND	
LIQUIDITY INDEX -----	LI
LIQUID LIMIT -----	X
PLASTIC LIMIT -----	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
					P. S. F.
	Ground level	341.0	0		
	Clay fill	338.0			
	Dense grey sandy clay till, gravelly		5		
			10		
			15		
			20		
	Probably bedrock end of auger borehole	318.5	25		

[illegible]

APPENDIX D

**Analytical Laboratory Test Results and
Results of Environmental Analysis**

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
K2H 5B7
Attention: Mr. Kenton Power
PO#:
Invoice to: WSP Canada Inc.

Report Number: 3000351
Date Submitted: 2023-08-14
Date Reported: 2023-08-21
Project: CA0006099.3147
COC #: 909875

Page 1 of 3

Dear Kenton Power:

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

Report Comments:

APPROVAL:

Raheleh Zafari, Environmental Chemist

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

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

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

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

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

Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
K2H 5B7
Attention: Mr. Kenton Power
PO#:
Invoice to: WSP Canada Inc.

Report Number: 3000351
Date Submitted: 2023-08-14
Date Reported: 2023-08-21
Project: CA0006099.3147
COC #: 909875

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	
Group	Analyte	MRL	Units	Guideline	1699359 Soil 2023-07-24 WL-01 Sa2 / 2.5-4.5'	1699360 Soil 2023-07-18 WL-04 Sa3 / 5-7'
Anions	Cl	0.002	%		0.002	0.030
	SO4	0.01	%		<0.01	0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.11	0.70
	pH	2.00			8.30	8.74
	Resistivity	1	ohm-cm		9091	1429

Guideline = * = Guideline Exceedence

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

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

Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
K2H 5B7
Attention: Mr. Kenton Power
PO#:
Invoice to: WSP Canada Inc.

Report Number: 3000351
Date Submitted: 2023-08-14
Date Reported: 2023-08-21
Project: CA0006099.3147
COC #: 909875

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 447453 Analysis/Extraction Date 2023-08-18 Analyst IP Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	99	90-110
pH	6.46	99	90-110
Resistivity			
Run No 447529 Analysis/Extraction Date 2023-08-21 Analyst AsA Method C CSA A23.2-4B			
Chloride	<0.002 %	112	90-110
Run No 447538 Analysis/Extraction Date 2023-08-21 Analyst IP Method AG SOIL			
SO4	<0.01 %	94	70-130

Guideline = * = **Guideline Exceedence**

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

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

CLIENT NAME: WSP CANADA INC.
1931 ROBERTSON ROAD
OTTAWA, ON K2H5B7
(613) 592-9600

ATTENTION TO: Ben Weachter; Kenton Power

PROJECT: CA0006099.3147 (Phase 3000)

AGAT WORK ORDER: 23Z049784

SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Lab Team Leader

TRACE ORGANICS REVIEWED BY: Radhika Chakraborty, Trace Organics Lab Manager

DATE REPORTED: Jul 31, 2023

PAGES (INCLUDING COVER): 13

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: South Approach, Highway 401

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2023-07-20

DATE REPORTED: 2023-07-31

SAMPLE DESCRIPTION: WL-03 SA2

SAMPLE TYPE: Soil

DATE SAMPLED: 2023-07-18
14:30

5160037

Parameter	Unit	G / S	RDL	
Antimony	µg/g		0.8	<0.8
Arsenic	µg/g		1	3
Barium	µg/g		2.0	32.5
Beryllium	µg/g		0.5	<0.5
Boron	µg/g		5	8
Boron (Hot Water Soluble)	µg/g		0.10	<0.10
Cadmium	µg/g		0.5	<0.5
Chromium	µg/g		5	10
Cobalt	µg/g		0.8	3.9
Copper	µg/g		1.0	4.6
Lead	µg/g		1	3
Molybdenum	µg/g		0.5	<0.5
Nickel	µg/g		1	12
Selenium	µg/g		0.8	<0.8
Silver	µg/g		0.5	<0.5
Thallium	µg/g		0.5	<0.5
Uranium	µg/g		0.50	<0.50
Vanadium	µg/g		2.0	15.7
Zinc	µg/g		5	14
Chromium, Hexavalent	µg/g		0.2	<0.2
Cyanide, WAD	µg/g		0.040	<0.040
Mercury	µg/g		0.10	<0.10
Electrical Conductivity (2:1)	mS/cm		0.005	0.428
Sodium Adsorption Ratio (2:1) (Calc.)	N/A		N/A	3.39
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.33

Certified By:





AGAT Laboratories

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: South Approach, Highway 401

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2023-07-20

DATE REPORTED: 2023-07-31

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5160037 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl₂ extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



K. Power



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: South Approach, Highway 401

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2023-07-20

DATE REPORTED: 2023-07-31

SAMPLE DESCRIPTION: WL-03 SA2

SAMPLE TYPE: Soil

DATE SAMPLED: 2023-07-18
14:30

Parameter	Unit	G / S	RDL	5160037
Naphthalene	µg/g		0.05	<0.05
Acenaphthylene	µg/g		0.05	<0.05
Acenaphthene	µg/g		0.05	<0.05
Fluorene	µg/g		0.05	<0.05
Phenanthrene	µg/g		0.05	<0.05
Anthracene	µg/g		0.05	<0.05
Fluoranthene	µg/g		0.05	<0.05
Pyrene	µg/g		0.05	<0.05
Benz(a)anthracene	µg/g		0.05	<0.05
Chrysene	µg/g		0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.05	<0.05
Benzo(k)fluoranthene	µg/g		0.05	<0.05
Benzo(a)pyrene	µg/g		0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g		0.05	<0.05
Dibenz(a,h)anthracene	µg/g		0.05	<0.05
Benzo(g,h,i)perylene	µg/g		0.05	<0.05
1 and 2 Methyl naphthalene	µg/g		0.05	<0.05
Moisture Content	%		0.1	<0.1

Surrogate	Unit	Acceptable Limits	
Naphthalene-d8	%	50-140	80
Acridine-d9	%	50-140	110
Terphenyl-d14	%	50-140	85

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5160037 Results are based on the dry weight of the soil.

Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&j)Fluoranthene isomers because the isomers co-elute on the GC column.
2- and 1-Methyl Naphthalene is a calculated parameter. The calculated value is the sum of 2-Methyl Naphthalene and 1-Methyl Naphthalene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

R. Chakraborty



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: South Approach, Highway 401

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2023-07-20

DATE REPORTED: 2023-07-31

SAMPLE DESCRIPTION: WL-03 SA2

SAMPLE TYPE: Soil

DATE SAMPLED: 2023-07-18
14:30

Parameter	Unit	G / S	RDL	5160037
Benzene	µg/g		0.02	<0.02
Toluene	µg/g		0.05	<0.05
Ethylbenzene	µg/g		0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05
o-Xylene	µg/g		0.05	<0.05
Xylenes (Total)	µg/g		0.05	<0.05
F1 (C6 - C10)	µg/g		5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5
F2 (C10 to C16)	µg/g		10	<10
F2 (C10 to C16) minus Naphthalene	µg/g		10	<10
F3 (C16 to C34)	µg/g		50	<50
F3 (C16 to C34) minus PAHs	µg/g		50	<50
F4 (C34 to C50)	µg/g		50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA
Moisture Content	%		0.1	11.1

Surrogate	Unit	Acceptable Limits
Toluene-d8	% Recovery	60-140
Terphenyl	%	60-140

Certified By:

R. Chakraborty



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: South Approach, Highway 401

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2023-07-20

DATE REPORTED: 2023-07-31

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5160037

Results are based on sample dry weight.

The C6-C10 fraction is calculated using toluene response factor.

Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.

C6-C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.

The calculated parameters are non-accredited. The parameters that are components of the calculation are accredited.

The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.

Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.

The chromatogram has returned to baseline by the retention time of nC50.

Total C6 - C50 results are corrected for BTEX and PAH contributions.

C>10 - C16 (F2- Naphthalene) is a calculated parameter. The calculated value is F2 - Naphthalene.

C>16 - C34 (F3-PAH) is a calculated parameter. The calculated value is F3-PAH (PAH: sum of Phenanthrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene,

Fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-c,d)pyrene and Pyrene).

This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.

nC10, nC16 and nC34 response factors are within 10% of their average.

C50 response factor is within 70% of nC10 + nC16 + nC34 average.

Linearity is within 15%.

Extraction and holding times were met for this sample.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

R. Chakraborty

Quality Assurance

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147 (Phase 3000)

SAMPLING SITE: South Approach, Highway 401

AGAT WORK ORDER: 23Z049784

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

Soil Analysis

RPT Date: Jul 31, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	5163737		<0.8	<0.8	NA	< 0.8	126%	70%	130%	98%	80%	120%	71%	70%	130%
Arsenic	5163737		3	3	NA	< 1	116%	70%	130%	103%	80%	120%	112%	70%	130%
Barium	5163737		97.5	97.2	0.3%	< 2.0	100%	70%	130%	101%	80%	120%	110%	70%	130%
Beryllium	5163737		0.6	0.6	NA	< 0.5	92%	70%	130%	94%	80%	120%	101%	70%	130%
Boron	5163737		9	8	NA	< 5	74%	70%	130%	101%	80%	120%	93%	70%	130%
Boron (Hot Water Soluble)	5158774		0.92	0.95	3.2%	< 0.10	113%	60%	140%	102%	70%	130%	108%	60%	140%
Cadmium	5163737		<0.5	<0.5	NA	< 0.5	114%	70%	130%	101%	80%	120%	108%	70%	130%
Chromium	5163737		22	21	NA	< 5	105%	70%	130%	105%	80%	120%	103%	70%	130%
Cobalt	5163737		8.2	8.1	1.2%	< 0.8	104%	70%	130%	101%	80%	120%	100%	70%	130%
Copper	5163737		14.3	14.3	0.0%	< 1.0	93%	70%	130%	106%	80%	120%	98%	70%	130%
Lead	5163737		9	9	0.0%	< 1	112%	70%	130%	100%	80%	120%	103%	70%	130%
Molybdenum	5163737		<0.5	<0.5	NA	< 0.5	114%	70%	130%	100%	80%	120%	109%	70%	130%
Nickel	5163737		19	20	5.1%	< 1	106%	70%	130%	108%	80%	120%	107%	70%	130%
Selenium	5163737		<0.8	<0.8	NA	< 0.8	137%	70%	130%	105%	80%	120%	111%	70%	130%
Silver	5163737		<0.5	<0.5	NA	< 0.5	106%	70%	130%	99%	80%	120%	98%	70%	130%
Thallium	5163737		<0.5	<0.5	NA	< 0.5	113%	70%	130%	107%	80%	120%	111%	70%	130%
Uranium	5163737		0.55	0.54	NA	< 0.50	130%	70%	130%	102%	80%	120%	112%	70%	130%
Vanadium	5163737		35.5	34.5	2.9%	< 2.0	119%	70%	130%	112%	80%	120%	107%	70%	130%
Zinc	5163737		47	46	2.2%	< 5	101%	70%	130%	105%	80%	120%	112%	70%	130%
Chromium, Hexavalent	5160046		<0.2	<0.2	NA	< 0.2	106%	70%	130%	93%	80%	120%	88%	70%	130%
Cyanide, WAD	5162858		<0.040	<0.040	NA	< 0.040	103%	70%	130%	107%	80%	120%	98%	70%	130%
Mercury	5163737		<0.10	<0.10	NA	< 0.10	112%	70%	130%	97%	80%	120%	104%	70%	130%
Electrical Conductivity (2:1)	5165449		0.183	0.176	3.9%	< 0.005	90%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	5159213		1.90	1.82	4.3%	NA									
pH, 2:1 CaCl2 Extraction	5158804		6.55	6.72	2.6%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Certified By:


Subhinder Kaur Randhawa



Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLING SITE: South Approach, Highway 401

SAMPLED BY: Prosper

Trace Organics Analysis

RPT Date: Jul 31, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

Benzene	5159956	<0.02	<0.02	NA	< 0.02	90%	60%	140%	110%	60%	140%	110%	60%	140%
Toluene	5159956	<0.05	<0.05	NA	< 0.05	94%	60%	140%	108%	60%	140%	104%	60%	140%
Ethylbenzene	5159956	<0.05	<0.05	NA	< 0.05	99%	60%	140%	91%	60%	140%	97%	60%	140%
m & p-Xylene	5159956	<0.05	<0.05	NA	< 0.05	102%	60%	140%	96%	60%	140%	110%	60%	140%
o-Xylene	5159956	<0.05	<0.05	NA	< 0.05	105%	60%	140%	113%	60%	140%	80%	60%	140%
F1 (C6 - C10)	5159956	<5	<5	NA	< 5	98%	60%	140%	116%	60%	140%	114%	60%	140%
F2 (C10 to C16)	5159957	<10	<10	NA	< 10	99%	60%	140%	101%	60%	140%	114%	60%	140%
F3 (C16 to C34)	5159957	<50	<50	NA	< 50	99%	60%	140%	84%	60%	140%	87%	60%	140%
F4 (C34 to C50)	5159957	<50	<50	NA	< 50	89%	60%	140%	81%	60%	140%	95%	60%	140%

O. Reg. 153(511) - PAHs (Soil)

Naphthalene	5159475	<0.05	<0.05	NA	< 0.05	109%	50%	140%	83%	50%	140%	83%	50%	140%
Acenaphthylene	5159475	<0.05	<0.05	NA	< 0.05	79%	50%	140%	78%	50%	140%	80%	50%	140%
Acenaphthene	5159475	<0.05	<0.05	NA	< 0.05	95%	50%	140%	98%	50%	140%	85%	50%	140%
Fluorene	5159475	<0.05	<0.05	NA	< 0.05	104%	50%	140%	88%	50%	140%	83%	50%	140%
Phenanthrene	5159475	<0.05	<0.05	NA	< 0.05	100%	50%	140%	110%	50%	140%	78%	50%	140%
Anthracene	5159475	<0.05	<0.05	NA	< 0.05	102%	50%	140%	88%	50%	140%	83%	50%	140%
Fluoranthene	5159475	0.10	0.11	NA	< 0.05	113%	50%	140%	75%	50%	140%	65%	50%	140%
Pyrene	5159475	0.08	0.10	NA	< 0.05	105%	50%	140%	85%	50%	140%	73%	50%	140%
Benz(a)anthracene	5159475	<0.05	<0.05	NA	< 0.05	78%	50%	140%	103%	50%	140%	105%	50%	140%
Chrysene	5159475	<0.05	<0.05	NA	< 0.05	98%	50%	140%	113%	50%	140%	113%	50%	140%
Benzo(b)fluoranthene	5159475	<0.05	<0.05	NA	< 0.05	95%	50%	140%	85%	50%	140%	90%	50%	140%
Benzo(k)fluoranthene	5159475	<0.05	<0.05	NA	< 0.05	110%	50%	140%	80%	50%	140%	85%	50%	140%
Benzo(a)pyrene	5159475	<0.05	<0.05	NA	< 0.05	78%	50%	140%	90%	50%	140%	88%	50%	140%
Indeno(1,2,3-cd)pyrene	5159475	<0.05	<0.05	NA	< 0.05	71%	50%	140%	110%	50%	140%	100%	50%	140%
Dibenz(a,h)anthracene	5159475	<0.05	<0.05	NA	< 0.05	66%	50%	140%	83%	50%	140%	83%	50%	140%
Benzo(g,h,i)perylene	5159475	<0.05	<0.05	NA	< 0.05	71%	50%	140%	80%	50%	140%	78%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

R. Chakraborty

QC Exceedance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

ATTENTION TO: Ben Weachter; Kenton Power

RPT Date: Jul 31, 2023					REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER					Sample Id	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
							Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - Metals & Inorganics (Soil)

Selenium

137% 70% 130% 105% 80% 120% 111% 70% 130%

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Method Summary

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147 (Phase 3000)

SAMPLING SITE: South Approach, Highway 401

AGAT WORK ORDER: 23Z049784

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLED BY: Prosper

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, WAD	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	SEGMENTED FLOW ANALYSIS
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6075	modified from EPA 9045D, MCKEAGUE 3.11 E3137	PC TITRATE

Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLING SITE: South Approach, Highway 401

SAMPLED BY: Prosper

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluorene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Phenanthrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benz(a)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Chrysene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(a)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
1 and 2 Methylnaphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Naphthalene-d8	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acridine-d9	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Terphenyl-d14	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Moisture Content	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Benzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Toluene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Ethylbenzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
m & p-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
o-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Xylenes (Total)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
F1 (C6 - C10)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
Toluene-d8	VOL-91-5009	modified from EPA SW-846 5030C & 8260D	(P&T)GC/MS
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID



Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 23Z049784

PROJECT: CA0006099.3147 (Phase 3000)

ATTENTION TO: Ben Weachter; Kenton Power

SAMPLING SITE: South Approach, Highway 401

SAMPLED BY: Prosper

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
F3 (C16 to C34) minus PAHs	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

CLIENT NAME: WSP CANADA INC.**1931 ROBERTSON ROAD
OTTAWA, ON K2H5B7
(613) 592-9600****ATTENTION TO: Ben Waechter/Kenton Power****PROJECT: CA0006099.3147****AGAT WORK ORDER: 23P052203****SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer****TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist****DATE REPORTED: Aug 04, 2023****PAGES (INCLUDING COVER): 12****VERSION*: 1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
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- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23P052203

PROJECT: CA0006099.3147

5835 COOPERS AVENUE
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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: Belleville WLB & M. River

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2023-07-28

DATE REPORTED: 2023-08-04

SAMPLE DESCRIPTION:				RW-06	RW-05	WL-2 SA2	MR-01	MR-06
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2023-07-24 11:30	2023-07-24 14:30	2023-07-25 11:30	2023-07-25 09:30	2023-07-27 11:30
Parameter	Unit	G / S	RDL	5178220	5178222	5178223	5178224	5178225
Antimony	µg/g		0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g		1	2	8	2	7	20
Barium	µg/g		2.0	108	358	170	333	638
Beryllium	µg/g		0.5	<0.5	0.9	0.5	0.8	1.3
Boron	µg/g		5	11	19	14	24	18
Boron (Hot Water Soluble)	µg/g		0.10	0.28	0.51	1.20	0.40	0.23
Cadmium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g		5	19	32	10	32	44
Cobalt	µg/g		0.8	6.3	14.8	3.2	12.8	13.5
Copper	µg/g		1.0	16.1	15.4	4.8	17.1	13.8
Lead	µg/g		1	21	28	7	44	19
Molybdenum	µg/g		0.5	<0.5	0.7	0.9	0.7	1.4
Nickel	µg/g		1	10	26	2	22	29
Selenium	µg/g		0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	µg/g		0.50	0.54	0.56	2.55	0.57	1.90
Vanadium	µg/g		2.0	22.0	37.9	11.1	38.4	63.4
Zinc	µg/g		5	45	65	18	70	129
Chromium, Hexavalent	µg/g		0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide, WAD	µg/g		0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g		0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm		0.005	0.151	0.356	0.839	0.278	0.128
Sodium Adsorption Ratio (2:1) (Calc.)	N/A		N/A	0.257	2.75	4.52	1.99	0.377
pH, 2:1 CaCl2 Extraction	pH Units		NA	6.99	7.01	9.13	7.47	7.11

Certified By:



Ben Waechter



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AGAT WORK ORDER: 23P052203

PROJECT: CA0006099.3147

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: Belleville WLB & M. River

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2023-07-28

DATE REPORTED: 2023-08-04

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5178220-5178225 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl₂ extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Nivine Basly



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AGAT WORK ORDER: 23P052203

PROJECT: CA0006099.3147

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: Belleville WLB & M. River

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2023-07-28

DATE REPORTED: 2023-08-04

SAMPLE DESCRIPTION:				RW-06	RW-05	WL-2 SA2	MR-01	MR-06
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2023-07-24 11:30	2023-07-24 14:30	2023-07-25 11:30	2023-07-25 09:30	2023-07-27 11:30
Parameter	Unit	G / S	RDL	5178220	5178222	5178223	5178224	5178225
Naphthalene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene	µg/g		0.05	0.42	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g		0.05	0.07	<0.05	<0.05	<0.05	<0.05
Fluoranthene	µg/g		0.05	0.56	<0.05	<0.05	<0.05	<0.05
Pyrene	µg/g		0.05	0.43	<0.05	<0.05	<0.05	<0.05
Benz(a)anthracene	µg/g		0.05	0.07	<0.05	<0.05	<0.05	<0.05
Chrysene	µg/g		0.05	0.12	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.05	0.09	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1 and 2 Methyl naphthalene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Moisture Content	%		0.1	7.0	24.3	9.8	25.6	24.8
Surrogate	Unit	Acceptable Limits						
Naphthalene-d8	%	50-140		75	70	75	85	80
Acridine-d9	%	50-140		85	80	75	75	75
Terphenyl-d14	%	50-140		75	80	95	75	90

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5178220-5178225 Results are based on the dry weight of the soil.

Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&j)Fluoranthene isomers because the isomers co-elute on the GC column.
2- and 1-Methyl Naphthalene is a calculated parameter. The calculated value is the sum of 2-Methyl Naphthalene and 1-Methyl Naphthalene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

N Popmukolof



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Certificate of Analysis

AGAT WORK ORDER: 23P052203

PROJECT: CA0006099.3147

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: Belleville WLB & M. River

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2023-07-28

DATE REPORTED: 2023-08-04

SAMPLE DESCRIPTION:				RW-06	RW-05	WL-2 SA2	MR-01	MR-06
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2023-07-24 11:30	2023-07-24 14:30	2023-07-25 11:30	2023-07-25 09:30	2023-07-27 11:30
				5178220	5178222	5178223	5178224	5178225
Parameter	Unit	G / S	RDL					
Benzene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylenes (Total)	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 - C10)	µg/g	5	<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	5	<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	<10	<10	<10	<10	<10	<10
F2 (C10 to C16) minus Naphthalene	µg/g	10	<10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	50	<50	<50	<50	<50	<50	<50
F3 (C16 to C34) minus PAHs	µg/g	50	<50	<50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	50	<50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	7.0	24.3	9.8	25.6	24.8
Surrogate	Unit	Acceptable Limits						
Toluene-d8	% Recovery	60-140	106	103	95	96	90	
Terphenyl	%	60-140	62	75	70	62	76	

Certified By:

N Popmukolof



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 23P052203

PROJECT: CA0006099.3147

5835 COOPERS AVENUE
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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE: Belleville WLB & M. River

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2023-07-28

DATE REPORTED: 2023-08-04

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5178220-5178225 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.
C6-C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
The calculated parameters are non-accredited. The parameters that are components of the calculation are accredited.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX and PAH contributions.
C>10 - C16 (F2- Naphthalene) is a calculated parameter. The calculated value is F2 - Naphthalene.
C>16 - C34 (F3-PAH) is a calculated parameter. The calculated value is F3-PAH (PAH: sum of Phenanthrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-c,d)pyrene and Pyrene).
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Quality Assurance

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147

SAMPLING SITE: Belleville WLB & M. River

AGAT WORK ORDER: 23P052203

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

Soil Analysis

RPT Date: Aug 04, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	5180330		<0.8	<0.8	NA	< 0.8	114%	70%	130%	99%	80%	120%	80%	70%	130%
Arsenic	5180330		3	3	NA	< 1	110%	70%	130%	86%	80%	120%	89%	70%	130%
Barium	5180330		60.3	58.0	3.9%	< 2.0	105%	70%	130%	102%	80%	120%	98%	70%	130%
Beryllium	5180330		<0.5	<0.5	NA	< 0.5	119%	70%	130%	116%	80%	120%	117%	70%	130%
Boron	5180330		7	7	NA	< 5	92%	70%	130%	113%	80%	120%	107%	70%	130%
Boron (Hot Water Soluble)	5182048		0.33	0.32	NA	< 0.10	103%	60%	140%	99%	70%	130%	106%	60%	140%
Cadmium	5180330		<0.5	<0.5	NA	< 0.5	89%	70%	130%	111%	80%	120%	107%	70%	130%
Chromium	5180330		17	16	NA	< 5	106%	70%	130%	105%	80%	120%	109%	70%	130%
Cobalt	5180330		4.5	4.6	2.2%	< 0.8	102%	70%	130%	106%	80%	120%	105%	70%	130%
Copper	5180330		10.8	10.5	2.8%	< 1.0	98%	70%	130%	103%	80%	120%	103%	70%	130%
Lead	5180330		19	18	5.4%	< 1	107%	70%	130%	103%	80%	120%	98%	70%	130%
Molybdenum	5180330		0.9	<0.5	NA	< 0.5	118%	70%	130%	111%	80%	120%	108%	70%	130%
Nickel	5180330		9	9	0.0%	< 1	102%	70%	130%	102%	80%	120%	103%	70%	130%
Selenium	5180330		<0.8	<0.8	NA	< 0.8	101%	70%	130%	101%	80%	120%	104%	70%	130%
Silver	5180330		<0.5	<0.5	NA	< 0.5	105%	70%	130%	110%	80%	120%	102%	70%	130%
Thallium	5180330		<0.5	<0.5	NA	< 0.5	103%	70%	130%	98%	80%	120%	97%	70%	130%
Uranium	5180330		0.56	0.53	NA	< 0.50	108%	70%	130%	100%	80%	120%	99%	70%	130%
Vanadium	5180330		26.3	25.7	2.3%	< 2.0	106%	70%	130%	106%	80%	120%	106%	70%	130%
Zinc	5180330		56	56	0.0%	< 5	105%	70%	130%	105%	80%	120%	102%	70%	130%
Chromium, Hexavalent	5178225	5178225	<0.2	<0.2	NA	< 0.2	109%	70%	130%	110%	80%	120%	90%	70%	130%
Cyanide, WAD	5179547		<0.040	<0.040	NA	< 0.040	86%	70%	130%	105%	80%	120%	107%	70%	130%
Mercury	5180330		<0.10	<0.10	NA	< 0.10	106%	70%	130%	99%	80%	120%	108%	70%	130%
Electrical Conductivity (2:1)	5180313		0.177	0.177	0.0%	< 0.005	111%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	5180313		0.268	0.270	0.7%	NA									
pH, 2:1 CaCl2 Extraction	5174597		6.43	6.66	3.5%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:


Nivine Basily



Quality Assurance

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147

SAMPLING SITE: Belleville WLB & M. River

AGAT WORK ORDER: 23P052203

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

Trace Organics Analysis

RPT Date: Aug 04, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

Benzene	5177700		<0.02	<0.02	NA	< 0.02	77%	60%	140%	87%	60%	140%	84%	60%	140%
Toluene	5177700		<0.05	<0.05	NA	< 0.05	88%	60%	140%	101%	60%	140%	119%	60%	140%
Ethylbenzene	5177700		<0.05	<0.05	NA	< 0.05	106%	60%	140%	110%	60%	140%	116%	60%	140%
m & p-Xylene	5177700		<0.05	<0.05	NA	< 0.05	102%	60%	140%	94%	60%	140%	96%	60%	140%
o-Xylene	5177700		<0.05	<0.05	NA	< 0.05	102%	60%	140%	103%	60%	140%	108%	60%	140%
F1 (C6 - C10)	5177700		<5	<5	NA	< 5	109%	60%	140%	109%	60%	140%	82%	60%	140%
F2 (C10 to C16)	5176405		<10	<10	NA	< 10	94%	60%	140%	91%	60%	140%	95%	60%	140%
F3 (C16 to C34)	5176405		<50	<50	NA	< 50	105%	60%	140%	98%	60%	140%	96%	60%	140%
F4 (C34 to C50)	5176405		<50	<50	NA	< 50	88%	60%	140%	105%	60%	140%	113%	60%	140%

O. Reg. 153(511) - PAHs (Soil)

Naphthalene	5174618		<0.05	<0.05	NA	< 0.05	110%	50%	140%	88%	50%	140%	83%	50%	140%
Acenaphthylene	5174618		<0.05	<0.05	NA	< 0.05	117%	50%	140%	80%	50%	140%	83%	50%	140%
Acenaphthene	5174618		<0.05	<0.05	NA	< 0.05	108%	50%	140%	103%	50%	140%	83%	50%	140%
Fluorene	5174618		<0.05	<0.05	NA	< 0.05	93%	50%	140%	88%	50%	140%	93%	50%	140%
Phenanthrene	5174618		<0.05	<0.05	NA	< 0.05	111%	50%	140%	95%	50%	140%	108%	50%	140%
Anthracene	5174618		<0.05	<0.05	NA	< 0.05	101%	50%	140%	73%	50%	140%	80%	50%	140%
Fluoranthene	5174618		<0.05	<0.05	NA	< 0.05	86%	50%	140%	80%	50%	140%	75%	50%	140%
Pyrene	5174618		<0.05	<0.05	NA	< 0.05	81%	50%	140%	78%	50%	140%	105%	50%	140%
Benz(a)anthracene	5174618		<0.05	<0.05	NA	< 0.05	118%	50%	140%	78%	50%	140%	80%	50%	140%
Chrysene	5174618		<0.05	<0.05	NA	< 0.05	110%	50%	140%	85%	50%	140%	90%	50%	140%
Benzo(b)fluoranthene	5174618		<0.05	<0.05	NA	< 0.05	84%	50%	140%	95%	50%	140%	93%	50%	140%
Benzo(k)fluoranthene	5174618		<0.05	<0.05	NA	< 0.05	101%	50%	140%	85%	50%	140%	80%	50%	140%
Benzo(a)pyrene	5174618		<0.05	<0.05	NA	< 0.05	102%	50%	140%	108%	50%	140%	110%	50%	140%
Indeno(1,2,3-cd)pyrene	5174618		<0.05	<0.05	NA	< 0.05	105%	50%	140%	85%	50%	140%	100%	50%	140%
Dibenz(a,h)anthracene	5174618		<0.05	<0.05	NA	< 0.05	114%	50%	140%	105%	50%	140%	93%	50%	140%
Benzo(g,h,i)perylene	5174618		<0.05	<0.05	NA	< 0.05	95%	50%	140%	110%	50%	140%	108%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

N Popmukohof

Method Summary

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147

SAMPLING SITE: Belleville WLB & M. River

AGAT WORK ORDER: 23P052203

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, WAD	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	SEGMENTED FLOW ANALYSIS
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6075	modified from EPA 9045D, MCKEAGUE 3.11 E3137	PC TITRATE



Method Summary

CLIENT NAME: WSP CANADA INC.

PROJECT: CA0006099.3147

SAMPLING SITE: Belleville WLB & M. River

AGAT WORK ORDER: 23P052203

ATTENTION TO: Ben Waechter/Kenton Power

SAMPLED BY: Rob Ireland / Ben Waechter

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluorene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Phenanthrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benz(a)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Chrysene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(a)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
1 and 2 Methlynaphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Naphthalene-d8	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acridine-d9	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Terphenyl-d14	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Moisture Content	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Benzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Toluene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Ethylbenzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
m & p-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
o-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Xylenes (Total)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
F1 (C6 - C10)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
Toluene-d8	VOL-91-5009	modified from EPA SW-846 5030C & 8260D	(P&T)GC/MS
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

Method Summary

CLIENT NAME: WSP CANADA INC.**PROJECT:** CA0006099.3147**SAMPLING SITE:** Belleville WLB & M. River**AGAT WORK ORDER:** 23P052203**ATTENTION TO:** Ben Waechter/Kenton Power**SAMPLED BY:** Rob Ireland / Ben Waechter

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
F3 (C16 to C34) minus PAHs	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:
 Company: WSP Canada
 Contact: Ben Waechter / Kenton Powers
 Address: 1931 Robertson Rd.
 Ottawa, Ont. K2H 5B7
 Phone: 613-592-9600 Fax: 613-592-9601
 Reports to be sent to:
 1. Email: ben.waechter@wsp.com
 2. Email: kenton.powers@wsp.com

Project Information:
 Project: CA 0006099.3147
 Site Location: Bellefonte - WL3 W & M. River
 Sampled By: Rob Ireland / Ben Waechter
 AGAT Quote #: _____ PO: _____

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company: WSP Canada

Contact: ~~Joe~~ Julie Ethridge

Address: 300-2611 Queensview Drive, Ottawa

Email: capayables.invoice@wsp.com

Regulatory Requirements:

(Please check all applicable boxes)

<input type="checkbox"/> Regulation 153/04 Table _____ Indicate One <input checked="" type="checkbox"/> Ind/Com <input type="checkbox"/> Res/Park <input type="checkbox"/> Agriculture Soil Texture (Check One) <input checked="" type="checkbox"/> Coarse <input type="checkbox"/> Fine	<input checked="" type="checkbox"/> Regulation 406 Table _____ Indicate One <input type="checkbox"/> Regulation 558 <input type="checkbox"/> CCME	<input type="checkbox"/> Sewer Use <input type="checkbox"/> Sanitary <input type="checkbox"/> Storm _____ Region <input type="checkbox"/> Prov. Water Quality Objectives (PWQO) <input type="checkbox"/> Other _____ Indicate One
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Is this submission for a
Record of Site Condition?

Report Guideline on Certificate of Analysis

Sample Matrix Legend

GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

[illegible]

Samples Relinquished By (Print Name and Sign): <i>Bob Ireland</i>	Date <i>7-23-23</i>	Time <i>08:35</i>	Samples Received By (Print Name and Sign): <i>Randy Jones</i>	Date <i>July 28/23</i>	Time <i>835</i>
Samples Relinquished By (Print Name and Sign): <i>[Signature]</i>	Date <i>July 28/23</i>	Time <i>1600</i>	Samples Received By (Print Name and Sign): <i>[Signature]</i>	Date <i>July 29/2023</i>	Time <i>10:10 am</i>
Samples Relinquished By (Print Name and Sign): <i>[Signature]</i>	Date	Time	Samples Received By (Print Name and Sign): <i>[Signature]</i>	Date	Time
			Page <u>1</u> of <u>1</u>		
			No: T-145524		

APPENDIX E

Site Photographs



Photograph 1: Looking south along proposed underpass alignment and Highway 401; July 10, 2023



Photograph 2: Looking north towards Borehole WL-02 along proposed underpass alignment and existing north approach embankment side slope; February 20, 2024



Photograph 3: Looking south towards Borehole WL-04 along proposed underpass alignment and existing south approach embankment side slope; February 20, 2024



Photograph 4: Looking east from Borehole WL-04 at existing south underpass foreslope and Highway 401 ditchline; February 20, 2024



Photograph 5: Existing ditchline culvert under the proposed south foreslope footprint typical; July 10, 2023



Photograph 6: Looking west from Borehole WL-04 along Highway 401 south ditchline; July 10, 2023

