



FINAL REPORT

Foundation Investigation Report

Replacement of CNR Overhead No. 11X-0164/B0

Highway 401/Canadian National Railway (CNR), Belleville, Ontario

MTO GWP 4053-18-00, WP 4079-20-01, Agreement No. 4020-E-0012-3

Submitted to:

Ministry of Transportation Ontario

1355 John Counter Boulevard

Kingston, Ontario K7K 0E5

Submitted by:

WSP Canada Inc.

1931 Robertson Road, Ottawa, Ontario, K2H 5B7, Canada

20148061B-CNR

October 04, 2024

GEOCREs No.: 31C03-004

Latitude: 44.198880°

Longitude: -77.376444°



Distribution List

1 e-copy: MTO Eastern Region

1 e-copy: MTO Foundations Section

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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 from 1 km west of Wallbridge-Loyalist Road to 4.3 km east of Highway 37 in Belleville, Ontario as part of GWP 4053-18-00, with foundation investigation services delivered under MTO Agreement No. 4020-E-0012. 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 / Canadian National Railway (CNR) Overhead (MTO Structure Site No. 11X-0164/B0).

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 Site Description

The CNR Overhead structure is located at about Station 13+047 on Highway 401 approximately 2 km east of Highway 62 in Belleville, Ontario. The site location is shown on Drawing 1 – Key Plan.

At this location, Highway 401 is a divided highway with a four-lane cross section with two eastbound and two westbound through lanes with paved shoulders. The existing overhead consists of a three-span concrete bridge. Parapet walls are present along the overhead and steel beam guiderails are also present immediately adjacent to the overhead structure on both sides of the highway.

The existing abandoned CN railway runs generally north-south below the overhead structure and is disconnected from any other existing rail lines at University Ave to the south.

There are existing culverts that run perpendicular to Highway 401 under the existing approaches to the overhead structure. One of these culverts is located within the proposed approach embankment footprint on the west side of the overhead structure. The locations of the existing culvert alignments are shown on Drawing 1.

The lands north and south of the site are generally grass-covered with some mature trees. There are commercial developments in the vicinity of the overhead structure. Further to the north and south of the overhead, the lands are predominantly industrial.

The result of the utility locates carried out at the site prior to the commencement of the field work indicates that there are both public and private buried utilities within the proposed alignment running parallel to the railway tracks and under the overpass structure.

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

2.2 Regional Geology

As delineated in *The Physiography of Southern Ontario*¹, the proposed overhead 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.

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

3.0 INVESTIGATION PROCEDURES

3.1 Current Investigation

The field work for this investigation was carried out in two mobilizations that included advancing a total six boreholes, (CNR-01 to CNR-06). Boreholes CNR-05 and CNR-06 (Embankment Boreholes) were advanced on October 25 and 26, 2022. Due to the delay in receiving the access permits from CNR, Boreholes CNR-01 to CNR-04 (Track Boreholes) were not advanced until February 26, 2024. The borehole locations are shown on Drawing 1.

Boreholes CNR-01 to CNR-04 were advanced using a track-mounted CME 55 drill rig supplied and operated by George Downing Estate Drilling Ltd. of Hawkesbury, Ontario.

Boreholes CNR-05 and CNR-06 were advanced using a truck-mounted CME 55 drill rig supplied and operated by CCC Geotechnical & Environmental Drilling Ltd. (CCC) of Ottawa, Ontario.

Railway flagging required to monitor rail traffic while carrying out field operations was provided by the Canadian National Railway while drilling Boreholes CNR-01 to CNR-04.

Soil samples were obtained using a 50 mm outer diameter split-spoon sampler in general accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586²). Soil samples were obtained at vertical sampling intervals of about 0.76 m and 1.5 m. HQ or NQ-sized sized bedrock core samples were obtained using rotary diamond drilling technique and a triple-tube core-barrel at Boreholes CNR-01 to CNR-04.

Monitoring wells were installed at Boreholes CNR-02 and CNR-03 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 records for CNR-02 and CNR-03 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 wells have been left in place to allow for monitoring of groundwater levels up to the future design-build assignment. As part of the construction, the monitoring wells will need to be decommissioned by qualified personnel in accordance with O.Reg. 903, as amended.

The field work was supervised on a full-time basis by members of 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.

Three 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).

² ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

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 Trimble R10 GPS data has a vertical accuracy of approximately 0.1 m and a horizontal accuracy of approximately 0.5 m. 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 (°))			
CNR-01	4895803.8 (44.198880)	234746.1 (-77.376444)	98.0	4.6	Bedrock cored 3.7 m
CNR-02	4895755.9 (44.198451)	234761.1 (-77.376250)	97.8	4.8	Bedrock cored 3.7 m
CNR-03	4895811.1 (44.198947)	234756.4 (-77.376317))	98.2	4.8	Bedrock cored 3.7 m
CNR-04	4895761.4 (44.198501)	234771.3 (-77.376123)	98.3	4.9	Bedrock cored 3.4 m
CNR-05	4895767.9 (44.198556)	234733.9 (-77.376592)	106.0	9.6	–
CNR-06	4895798.9 (44.198840)	234780.8 (-77.376010)	106.0	9.6	Refusal on Inferred Bedrock

3.2 Previous (2020) Desktop Study Report

A previous Desktop Study Report was carried out to summarize the existing subsurface information pertinent to Site No. 11X-0164/B0. The subsurface information and results of the original investigation are contained in the following report:

- **MTO GEOCREs No. 31C-295:** “Desktop Study Report Preliminary Foundation Investigation and Design Widening or Replacement of Highway 401 overhead at CNR. Site No. 11X-0164, Highway 401 Widening, Belleville, Ontario G.W.P. 4193-15-00” dated December 2020, prepared by Thurber Engineering Ltd.

The above Desktop Study Report references the four boreholes provided in the following report:

- **MTO GEOCREs No. 31C00-026:** Foundation Investigation, Thurlow Township, Bridge No. 6 Report No. S-500-501/55/T-63-1. Prepared by Racey, MacCallum, and Associates for the Department of Highways Ontario (DHO) dated March 17, 1955.

The original Foundation Investigation for the then proposed alignment has been reviewed and a copy of the Borehole Location and Soil Strata Drawing and borehole records are provided for reference in Appendix C. In general, the bedrock elevations encountered during the 1955 investigation are consistent with the current investigation.

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 B8 provided in Appendix B.

Photographs of the core recovered from the underlying bedrock at the boreholes are shown on Figures A1 to A8, provided in Appendix A. The results of the analytical testing completed on select soil samples are provided in Appendix D.

The borehole locations and the interpreted stratigraphic profile and cross-sections projected along the proposed overhead alignment and abutments are provided in Drawings 1 and 2.

The stratigraphic boundaries shown on the borehole and drillhole records and on the interpreted stratigraphic sections 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 deposits and bedrock geology conditions 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 CNR-01 to CNR-03, with thickness ranging from about 100 mm to 300 mm.

Asphaltic concrete with thicknesses of about 200 mm and 100 mm were encountered at the ground surface at Boreholes CNR-05 and CNR-06, respectively.

4.1.2 Fill

Fill ranging from silty sand to clayey gravel was encountered at the ground surface at Borehole CNR-04 and below the topsoil and asphaltic concrete at Boreholes CNR-01 to CNR-03, and CNR-05 to CNR-06. The top of this layer was encountered at elevations ranging from 97.5 m to 96.7 m to 105.9 m. The total thickness of the fill layer ranges from about 0.7 m to 8.8 m. At the Embankment Boreholes (CNR-05 and CNR-06) the fill thickness ranged from 6.0 m to 8.8 m while at the Track Boreholes (CNR-01 to CNR-04) the fill thickness ranged from 0.7 m to 1.5 m. The SPT N-values within the fill ranged from 2 blows to 60 blows per 0.3 m of penetration but more commonly 11 blows to 46 blows per 0.3 m of penetration indicating a compact to dense state of compactness.

The measured water content of eleven samples of the fill tested ranged from 3% to 12%. The results of grain size distribution testing carried out on eleven samples of the fill material are provided in Figures B1 and B2 in Appendix B. The results of Atterberg limits testing completed on four samples of the fill indicate liquid limits ranging from 14 to 20, plastic limits ranging from 11 to 14 and plasticity indices ranging from 3 to 6. The Atterberg limits analysis results are provided on Figure B3 in Appendix B and indicate the fines fraction of the fill consists of silt (ML) to clayey silt (CL).

4.1.3 Buried Topsoil

A buried topsoil layer with a thickness of 100 mm was encountered below the fill layers at Borehole CNR-05 at Elevation 97.0 m.

4.1.4 Clayey Silt-Silt and Sand

A clayey silt-silt and sand deposit with a thickness of 1.5 m was encountered below the fill layers at Borehole CNR-06. The top of this layer encountered an Elevation of 99.9 m. The SPT N-values within this deposit were the weight of the hammer (WH) and 36 blows per 0.3 m of penetration indicating a firm to stiff consistency.

The measured water content of two samples of clayey silt-silt and sand was 8% and 10%. The results of grain size distribution testing carried out on a single sample of this material are provided in Figure B4 in Appendix B. The results of Atterberg limits testing completed on one sample of the clayey silt-silt and sand material indicate a liquid limit of 18, a plastic limit of 12, and a plasticity index of 6. The Atterberg Limits analysis results are provided on Figure B5 in Appendix B and indicate a clayey silt-silt (CL-ML).

4.1.5 Till

A till deposit consisting of gravelly sand with varying amounts of clay and silt was encountered below the buried topsoil at Borehole CNR-05 and below the clayey silt-silt and sand deposit at Borehole CNR-06. The top of this deposit was encountered at Elevations 98.4 m and 96.9 m at Boreholes CNR-06 and CNR-05, respectively. Both Boreholes CNR-05 and CNR-06 were terminated within this layer.

SPT N-values ranging from 28 blows to 50 blows per 0.3 m of penetration were recorded within the till layer indicating a compact to very dense state of compactness.

The measured water content of three samples of till tested ranged from 8% to 15%. The results of grain size distribution testing carried out on two samples of this material are provided in Figure B6 in Appendix B. The results of Atterberg limits testing completed on a single sample of till deposit indicate a liquid limit of 18, a plastic limit of 12 and a plasticity index of 6. The Atterberg limits analysis results are provided on Figure B7 in Appendix B and indicate the fines fraction of this deposit consists of clayey silt-silt (CL-ML).

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)
CNR-01	98.0	0.9	97.1
CNR-02	97.8	1.1	96.7
CNR-03	98.2	1.1	97.1
CNR-04	98.3	1.5	96.9
CNR-06 ¹	106.0	9.6	96.4

1. Bedrock inferred based on split spoon refusal and adjacent boreholes bedrock elevations.

Rock Quality Designation (RQD) values measured on the recovered limestone bedrock core samples range from about 0% to 96%, but more typically 26% to 94%, indicating a poor to excellent rock quality. The results of UCS testing carried out on three limestone bedrock core samples measured UCS values of 63 MPa to 109 MPa, indicating a strong to very strong bedrock. The results of UCS testing are provided in Figure B8 in Appendix B.

4.2 Groundwater Conditions

A monitoring well was installed in Boreholes CNR-02 and CNR-03 to measure the groundwater levels at the site. The groundwater levels measured in the monitoring wells, and the open hole water levels measured upon completion of drilling, are presented in Table 3.

It is noted that Borehole CNR-05 was 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)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
Monitoring Well Water Levels					
CNR-02	Bedrock	97.8	0.5	97.3	February 27, 2024
CNR-03	Bedrock	98.2	1.0	97.2	February 27, 2024
Open Borehole Water Levels					
CNR-06	N/A	106.0	8.9	97.1	October 26, 2022

4.3 Analytical Laboratory Testing Results

Three 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)
CNR-02	0.6-1.0	0.009	0.01	0.45	7.95	2,222
CNR-05	3.8 to 4.3	0.016	0.03	0.43	8.82	2,381
CNR-06	1.5 to 2.1	0.024	0.03	0.78	8.91	1,300

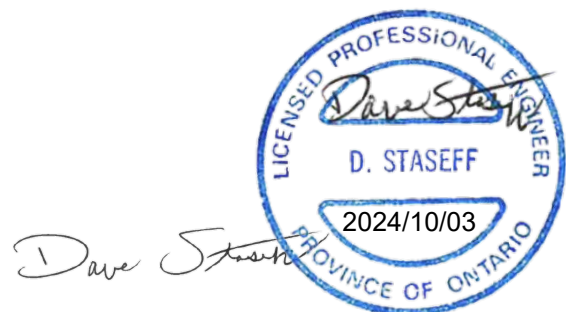
5.0 CLOSURE

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 a MTO Principal Foundations Contact for WSP conducted an independent technical and quality review of this report.

WSP Canada Inc.



Kenton Power, P.Eng.
Senior Geotechnical Engineer



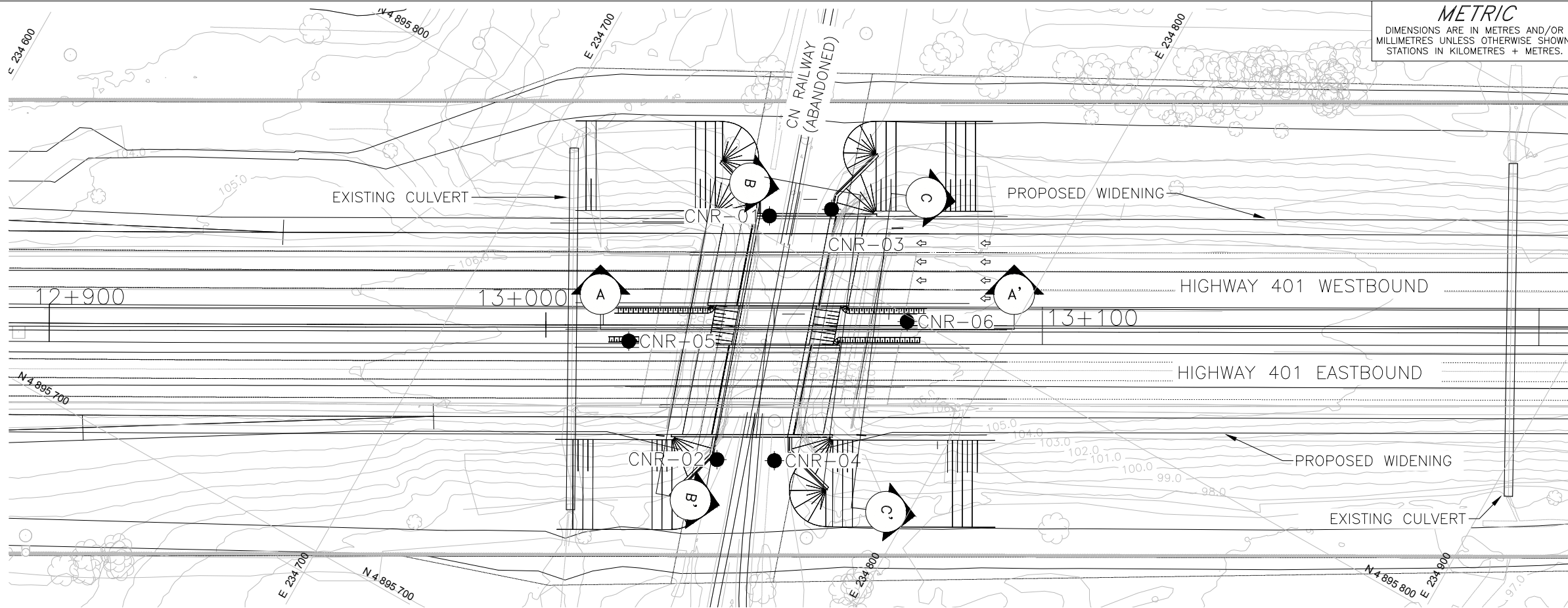
David Staseff, P.Eng.
MTO Principal Foundations Contact

BW/KCP/DS/yj

[https://wsponline.sharepoint.com/sites/gld-152692/project files/6 deliverables/11-cnr overhead/final/gwp 4053-18-00 rev0 final fir site 11x-0164 \(20148061b-cnr\) 2024-09-25.docx](https://wsponline.sharepoint.com/sites/gld-152692/project%20files/6%20deliverables/11-cnr%20overhead/final/gwp%204053-18-00%20rev0%20final%20fir%20site%2011x-0164%20(20148061b-cnr)%202024-09-25.docx)

DRAWINGS

Drawings 1 and 2 – Borehole Locations and Soil Strata

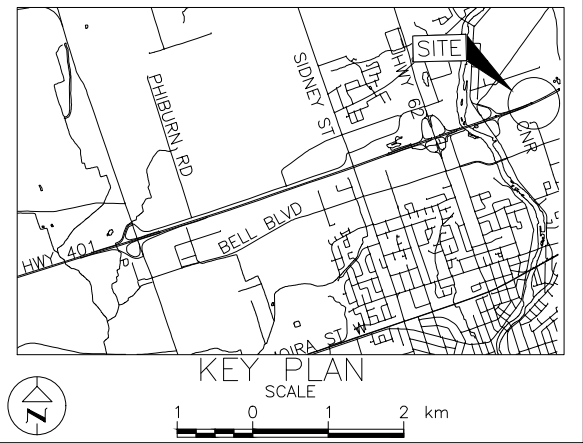


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 4079-20-01

HIGHWAY 401 WIDENING
REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0
BOREHOLE LOCATION PLAN AND
SOIL STRATA

SHEET



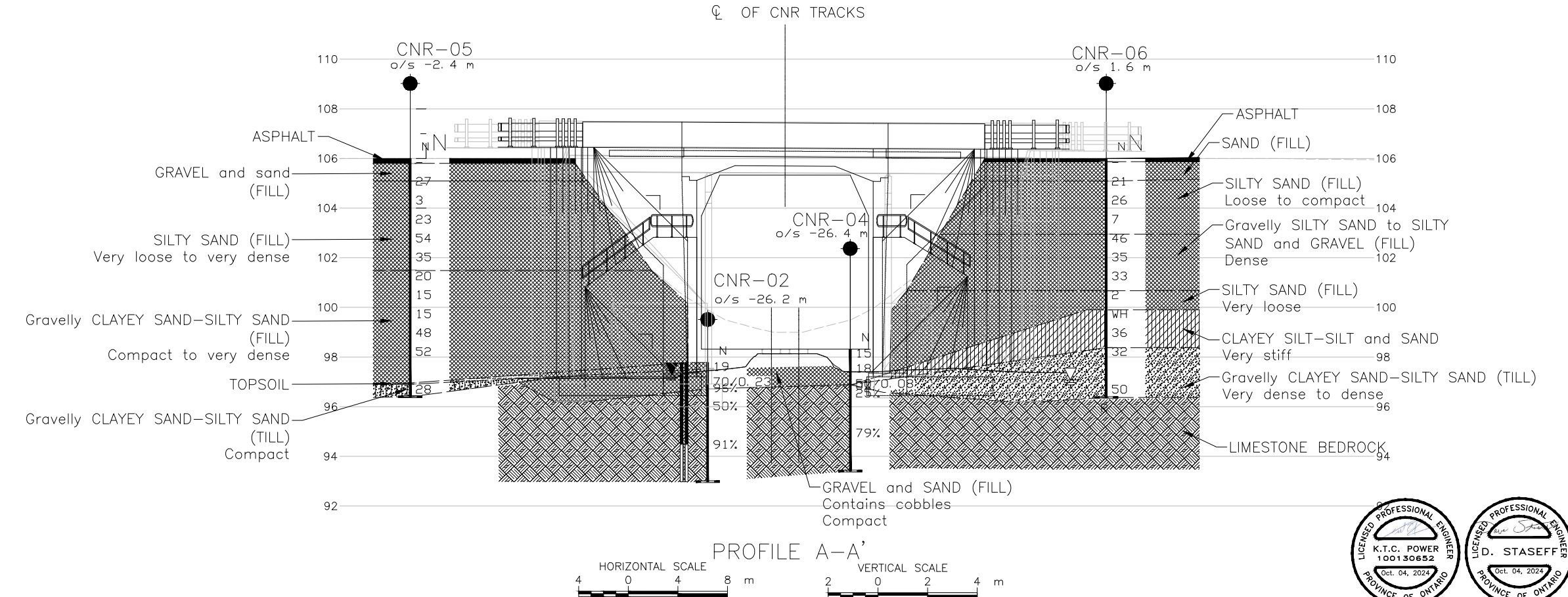
LEGEND	
	Borehole - Current Investigation
	Seal
	Piezometer
	N Standard Penetration Test Value
	16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
	100% Rock Quality Designation (RQD)
	WL in piezometer, measured on February 27, 2024
	WL upon completion of drilling

BOREHOLE CO-ORDINATES NAD83 MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
CNR-01	98.0	4895803.8	234746.1
CNR-02	97.8	4895755.9	234761.1
CNR-03	98.2	4895811.1	234756.4
CNR-04	98.3	4895761.4	234771.3
CNR-05	106.0	4895767.9	234733.9
CNR-06	106.0	4895798.9	234780.8

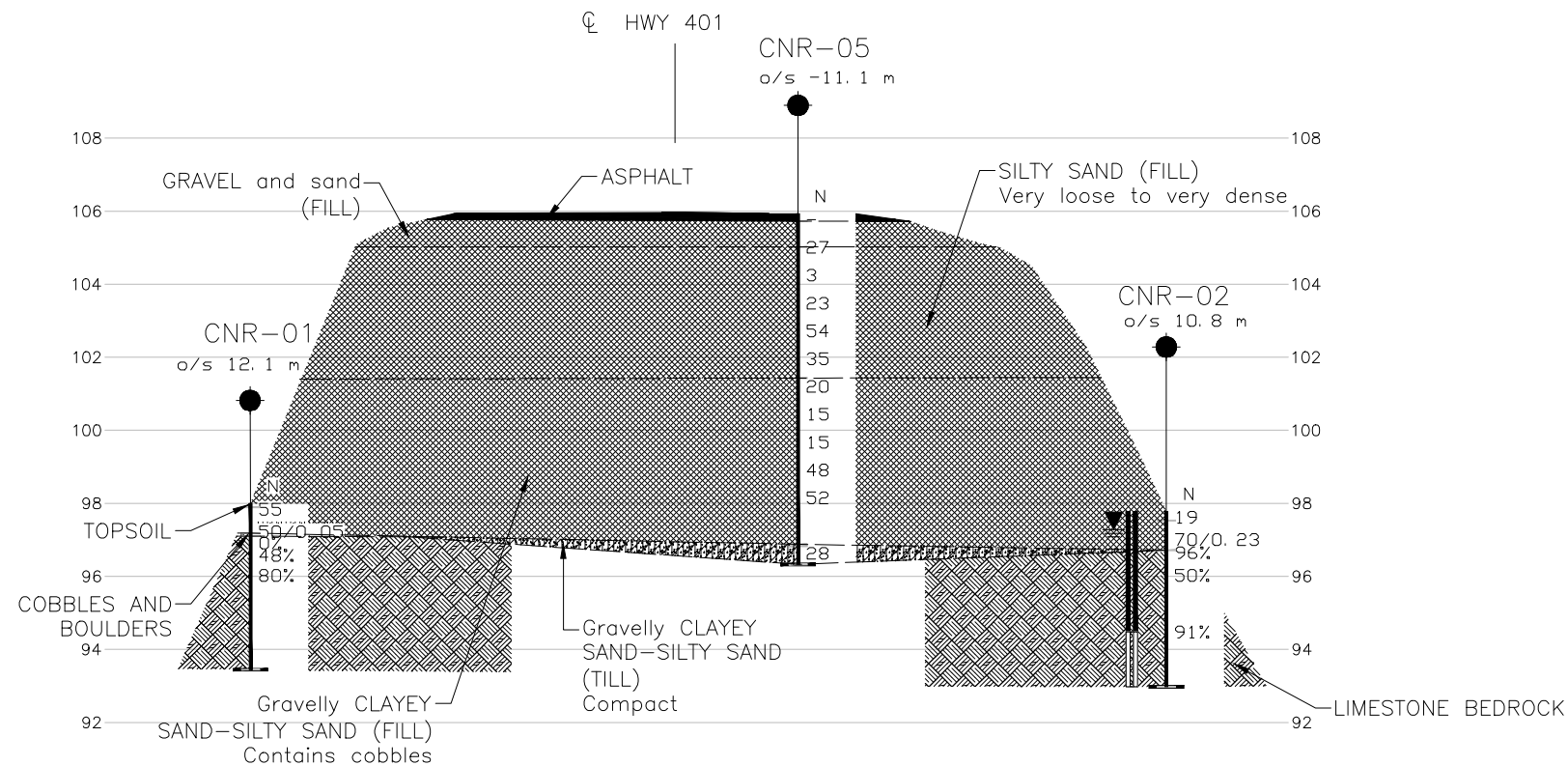
Structural Site Location: Latitude: 44.198880 Longitude: -77.376444

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.

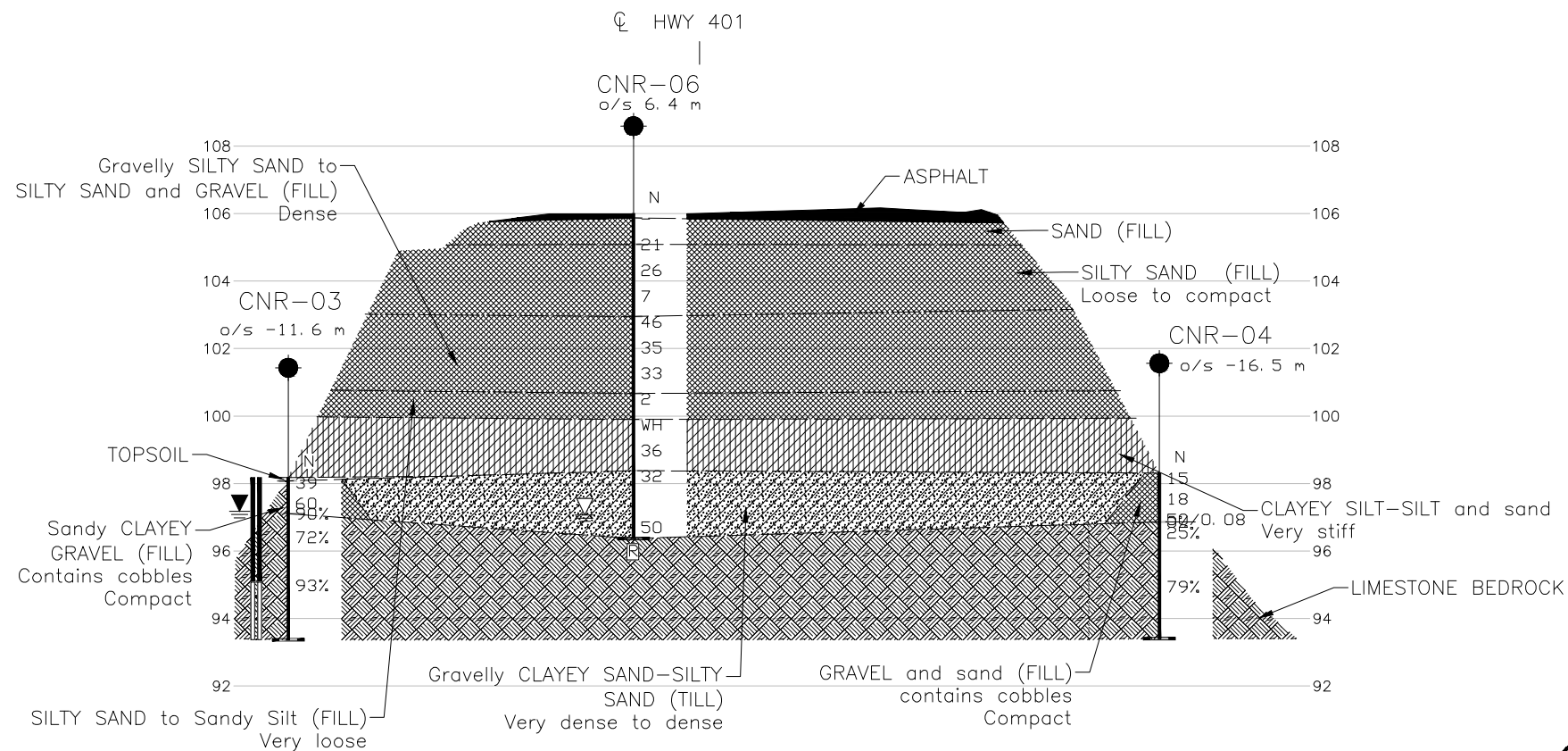
REFERENCES
Base plans provided in digital format by MTO, drawing file nos 3216057-EP.dwg and 3216057-Hwy 401 -8 Lanes Design-ACAD.dwg, received Oct. 13 2022, and General Arrangement Drawing file no. S16M-01435-01-320-001XG.dwg, received February 11, 2024. Contours source - Belleville 2022 DTM, The Ontario Lidar Digital Terrain Model (DTM) Land Information Ontario (LIO) Dataset.



NO.	DATE	BY	REVISION
Geocres No. 31C03-004			
HWY. 401		PROJECT NO. 20148061B	DIST. EASTERN
SUBM'D. BW	CHKD. BW/KCP	DATE: 10/3/2024	SITE: 11X-0164/B0
DRAWN: ZS/SA	CHKD. KCP	APPD. DS	DWG. 1



CROSS-SECTION B-B'-WEST ABUTMENT



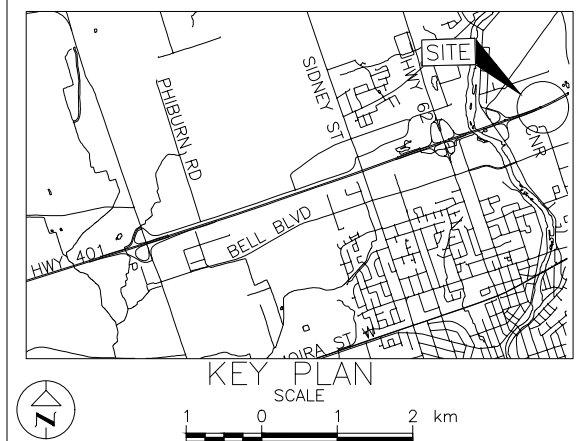
CROSS-SECTION C-C'-EAST ABUTMENT











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

CONT No.
WP No. 4079-20-01

HIGHWAY 401 WIDENING REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0	C
SOIL STRATA	



LEGEND

- | | |
|---|--|
|  | Borehole – Current Investigation |
|  | Seal |
|  | Piezometer |
|  | Standard Penetration Test Value |
|  | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |
|  | Rock Quality Designation (RQD) |
|  | WL in piezometer, measured on February 27, 2024 |
|  | WL upon completion of drilling |

BOREHOLE CO-ORDINATES NAD83 MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
CNR-01	98.0	4895803.8	234746.1
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CNR-03	98.2	4895811.1	234756.4
CNR-04	98.3	4895761.4	234771.3
CNR-05	106.0	4895767.9	234733.9
CNR-06	106.0	4895798.9	234780.8

Structural Site Location: Latitude: 44.198880 Longitude: -77.376444

NOTES

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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.

REFERENCES

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, and General Arrangement Drawing file no.
S16M-01435-01-320-001XG.dwg, received February 11, 2024.
Contours source – Belleville 2022 DTM, The Ontario Lidar Digital Terrain
Model (DTM) Land Information Ontario (LIO) Dataset.

NO.	DATE	BY	REVISION			
Geocres No. 31C03-004						
HWY. 401			PROJECT NO. 20148061B		DIST. EASTERN	
SUBM'D. BW		CHKD. BW/KCP	DATE: 10/3/2024		SITE: 1X-0164/B0	
DRAWN: ZS/SA		CHKD. KCP	APPD. DS		DWG. 112	



APPENDIX A

Borehole Records and Bedrock Core Photographs

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.e., SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (i.e., some sand)
≤ 10	trace (i.e., trace fines)

1. Only applicable to components not described by Primary Group Name.

2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 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)
γ	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

(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

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

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



PROJECT20148061B

RECORD OF BOREHOLE No CNR-01

SHEET 1 OF 1

METRIC

G.W.P.4053-18-00

LOCATIONN 4895803.8; E 234746.1 MTM NAD 83 ZONE 9 (LAT. 44.198880; LONG. -77.376444)

ORIGINATED BYBW

DISTEasternHWY401

BOREHOLE TYPEPower Auger, 200 mm Dia. (Hollow Stem), NQ Coring

COMPILED BYBW

DATUMGeodetic

DATEFebruary 26, 2024

CHECKED BYKCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMITNATURAL MOISTURE CONTENTLIQUID 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		
98.0	GROUND SURFACE																
0.0	TOPSOIL Brown Moist		1	SS	55											52 33 (15)	
97.2	Sandy SILTY GRAVEL (GM), contains cobbles (FILL) Very dense Brown to grey Moist		2	SS	50/0.05												
0.9	COBBLES AND BOULDERS LIMESTONE (BEDROCK)		1	RC	REC 100%											RQD = 0%	
	Bedrock cored from 0.9 m to 4.6 m For rock coring details see Record of Drillhole CNR-1		2	RC	REC 100%											RQD = 48%	
			3	RC	REC 100%											RQD = 80%	
93.5	END OF BOREHOLE																
4.6																	

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SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Downing

[illegible]

DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP



PROJECT20148061B

RECORD OF BOREHOLE No CNR-02

SHEET 1 OF 1

METRIC

G.W.P.4053-18-00

LOCATIONN 4895755.9; E 234761.1 MTM NAD 83 ZONE 9 (LAT. 44.198451; LONG. -77.376250)

ORIGINATED BYBW

DISTEasternHWY401

BOREHOLE TYPEPower Auger, 200 mm Dia. (Hollow Stem), HQ Coring

COMPILED BYBW

DATUMGeodetic

DATEFebruary 26, 2024

CHECKED BYKCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
97.8	GROUND SURFACE																
0.0	TOPSOIL																
0.3	Brown Moist		1	SS	19											51 27 14 8	
96.7	Sandy CLAYEY GRAVEL (GC), contains cobbles (FILL)		2	SS	70/0.23												
1.1	Compact Brown to grey Moist		1	RC	REC 100%											RQD = 96%	
	LIMESTONE (BEDROCK)																
	Bedrock cored from 1.0 m to 4.8 m		2	RC	REC 100%											RQD = 50%	
	For rock coring details see Record of Drillhole CNR-2		3	RC	REC 100%											RQD = 91%	
93.0	END OF BOREHOLE																
4.8	NOTE: 1. Groundwater level measured in well screen at 0.5 m below ground surface (Elev. 97.3 m) on February 27, 2024.																

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+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PROJECT: 20148061B

RECORD OF DRILLHOLE: CNR-02

SHEET 1 OF 1

LOCATION: N 4895755.87 ;E 234761.15

DRILLING DATE: February 26, 2024

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Downing

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY															FEATURES	PIEZOMETER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				DEPTH (m)	FLUSH RETURN		RECOVERY		R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA					WEATH- ERING INDEX					Diametral Point Load Index (MPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
							TOTAL CORE %	SOLID CORE %			DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jzon	W1	W2	W3	W4	W5				W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP

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PROJECT 20148061B

RECORD OF BOREHOLE No CNR-03

SHEET 1 OF 1

METRIC

G.W.P. 4053-18-00

LOCATION N 4895811.1; E 234756.4 MTM NAD 83 ZONE 9 (LAT. 44.198947; LONG. -77.376317)

ORIGINATED BY BW

DIST Eastern HWY 401

BOREHOLE TYPE Power Auger, 200 mm Dia. (Hollow Stem), HQ Coring

COMPILED BY BW

DATUM Geodetic

DATE February 26, 2024

CHECKED BY 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					
98.2	GROUND SURFACE																
0.0	TOPSOIL Brown Moist		1	SS	39												
97.1	Sandy GRAVEL (GW-GM), trace non-plastic fines, contains cobbles (FILL) Dense to very dense Grey to brown Moist		2	SS	60											63 28 (9)	
1.1	LIMESTONE (BEDROCK)		1	RC	REC 100%											RQD = 90%	
	Bedrock cored from 1.1 m to 4.8 m For rock coring details see Record of Drillhole CNR-3		2	RC	REC 100%											RQD = 72%	
			3	RC	REC 100%											RQD = 93%	
93.4	END OF BOREHOLE																
4.8	NOTE: 1. Ground water level measured in well screen at 1.0 m below ground surface (Elev. 97.2 m) on February 27, 2024.																

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PROJECT: 20148061B

RECORD OF DRILLHOLE: **CNR-03**

SHEET 1 OF 1

LOCATION: N 4895811.07 ;E 234756.36

DRILLING DATE: February 26, 2024

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing

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)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP

GTA-RCK 046 S:\CLIENTS\MT\HWY 401 BELLEVILLE\02 DATA\GINT\HWY 401 BELLEVILLE.GPJ GAL-MISS.GDT 8/26/24



PROJECT 20148061B

RECORD OF BOREHOLE No CNR-04

SHEET 1 OF 1

METRIC

G.W.P. 4053-18-00

LOCATION N 4895761.4; E 234771.3 MTM NAD 83 ZONE 9 (LAT. 44.198501; LONG. -77.376123)

ORIGINATED BY BW

DIST Eastern HWY 401

BOREHOLE TYPE Power Auger, 200 mm Dia. (Hollow Stem), NQ Coring

COMPILED BY BW

DATUM Geodetic

DATE February 26, 2024

CHECKED BY 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					
98.3	GROUND SURFACE																
0.0	GRAVEL (GW-GM) and sand, some non-plastic fines, contains cobbles (FILL) Compact Brown to grey Moist		1	SS	15												
			2	SS	18												
96.9			3	SS	50/0.08												
1.5	LIMESTONE (BEDROCK) Bedrock cored from 1.5 m to 4.9 m For rock coring details see Record of Drillhole CNR-4		1	RC	REC 100%												
			2	RC	REC 100%												
			3	RC	REC 100%												
93.4																	
4.9	END OF BOREHOLE																

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PROJECT: 20148061B

RECORD OF DRILLHOLE: CNR-04

SHEET 1 OF 1

LOCATION: N 4895761.39 ;E 234771.33

DRILLING DATE: February 26, 2024

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing

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	DISCONTINUITY DATA					WEATH- ERING INDEX					Diametral Point Load Index (MPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
						TOTAL CORE %	SOLID CORE %			DIP W/L CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jsm	W1	W2	W3	W4	W5		W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
		Continued from Record of Borehole CNR-4		96.86 1.45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				</

DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP

GTA-RCK 046 S:\CLIENTS\MT\HWY 401 BELLEVILLE\02 DATA\GINT\HWY 401 BELLEVILLE.GPJ GAL-MISS.GDT 8/26/24



PROJECT		RECORD OF BOREHOLE		No CNR-05		SHEET 1 OF 1		METRIC													
G.W.P. 4053-18-00		LOCATION		N 4895767.9; E 234733.9 MTM NAD 83 ZONE 9 (LAT. 44.198556; LONG. -77.376592)		ORIGINATED BY		BW													
DIST Eastern HWY 401		BOREHOLE TYPE		CME 55, Power Auger 200 mm Dia. (Hollow Stem)		COMPILED BY		GS													
DATUM Geodetic		DATE		October 25, 2022		CHECKED BY															
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
106.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	25 50 75											
0.0	ASPHALT CONCRETE																				
0.2	GRAVEL (GW-GM) and sand, some non-plastic fines (FILL) Brown to grey Moist		1	AS	-																
105.1																					
0.9	SILTY SAND (SM), some gravel (FILL) Very loose to very dense Brown to grey		2	SS	27		105														
			3	SS	3		104													12 41 35 12	
			4	SS	23		103													19 39 31 11	
			5	SS	54		102														
			6	SS	35		101														
101.5																					
4.5	Gravelly CLAYEY SAND-SILTY SAND (SC-SM) (FILL) Compact to very dense Brown Moist		7	SS	20		100													26 37 (37)	
			8	SS	15		99														
			9	SS	15		98														
			10	SS	48		97													22 39 28 11	
			11	SS	52		96														
97.0																					
9.1	TOPSOIL																				
96.4	Gravelly CLAYEY SAND-SILTY SAND (SC-SM/GC) (TILL) Compact Brown		12	SS	28		95													28 30 28 14	
9.6	END OF BOREHOLE																				
	NOTE: 1. Borehole dry upon completion.																				



PROJECT		RECORD OF BOREHOLE		No CNR-06		SHEET 1 OF 1		METRIC												
G.W.P. 4053-18-00		LOCATION		N 4895798.9; E 234780.8 MTM NAD 83 ZONE 9 (LAT. 44.198840; LONG. -77.376010)		ORIGINATED BY		BW												
DIST Eastern HWY 401		BOREHOLE TYPE		CME 55, Power Auger 200 mm Dia. (Hollow Stem)		COMPILED BY		GS												
DATUM Geodetic		DATE		October 26, 2022		CHECKED BY														
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	γ	GR	SA	SI	CL			
106.0	GROUND SURFACE																			
0.0	ASPHALT CONCRETE																			
0.1	SAND (SP-SM), some gravel, trace non-plastic fines (FILL) Brown to grey Moist		1	AS	-									14	76	(10)				
105.1	Gravelly SILTY SAND (SM), some gravel (FILL) Loose to compact Brown Moist		2	SS	21		105													
0.9			3	SS	26		104													
			4	SS	7		103							16	41	(43)				
103.0	Gravelly SILTY SAND to SILTY SAND and GRAVEL (SM/GW), contains wood fragments (FILL) Dense Brown and grey Moist		5	SS	46		102													
3.1			6	SS	35		101													
			7	SS	33		100													
100.7	SILTY SAND (SM), some gravel (FILL) Very loose		8	SS	2		99							15	43	33	9			
5.3	CLAYEY SILT-SILT (CL-ML) and sand, trace gravel Firm to stiff Brown		9	SS	WH		98							6	42	35	17			
99.9			10	SS	36		97													
6.1	CLAYEY GRAVEL-SILTY GRAVEL (GC-GM/SC) and sand (TILL) Very dense to dense Brown Moist to wet		11	SS	32															
98.4			12	SS	50									37	36	19	8			
7.6	END OF BOREHOLE Split spoon refusal on INFERRED BEDROCK																			
96.4	Note: 1. Water level measured in open borehole at a depth of 8.9 m upon completion of drilling.																			
9.6																				

CNR-01 (Dry)
Core Box 1 of 1



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0
GWP: 4053-18-00 WP 4079-20-01

Highway 401 / Canadian National Railway
Belleville, Ontario

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A1

CNR-01 (Wet)
Core Box 1 of 1



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0

GWP: 4053-18-00 WP 4079-20-01

Highway 401 / Canadian National Railway
Belleville, Ontario

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A2

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



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0

GWP: 4053-18-00 WP 4079-20-01

**Highway 401 / Canadian National Railway
Belleville, Ontario**

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A3

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



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0

GWP: 4053-18-00 WP 4079-20-01

**Highway 401 / Canadian National Railway
Belleville, Ontario**

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A4

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



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0
GWP: 4053-18-00 WP 4079-20-01
Highway 401 / Canadian National Railway
Belleville, Ontario

Project No. 20148061B
Drawn: BW
Date: 2024-05-01
Checked: KCP
Review: DS

Figure A5

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



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0

GWP: 4053-18-00 WP 4079-20-01

**Highway 401 / Canadian National Railway
Belleville, Ontario**

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A6

CNR-04 (Dry)
Core Box 1 of 1



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0

GWP: 4053-18-00 WP 4079-20-01

**Highway 401 / Canadian National Railway
Belleville, Ontario**

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A7

CNR-04 (Wet)
Core Box 1 of 1



REPLACEMENT OF CNR OVERHEAD SITE 11X-0164/B0
GWP: 4053-18-00 WP 4079-20-01
Highway 401 / Canadian National Railway
Belleville, Ontario

Project No. 20148061B

Drawn: BW

Date: 2024-05-01

Checked: KCP

Review: DS

Figure A8

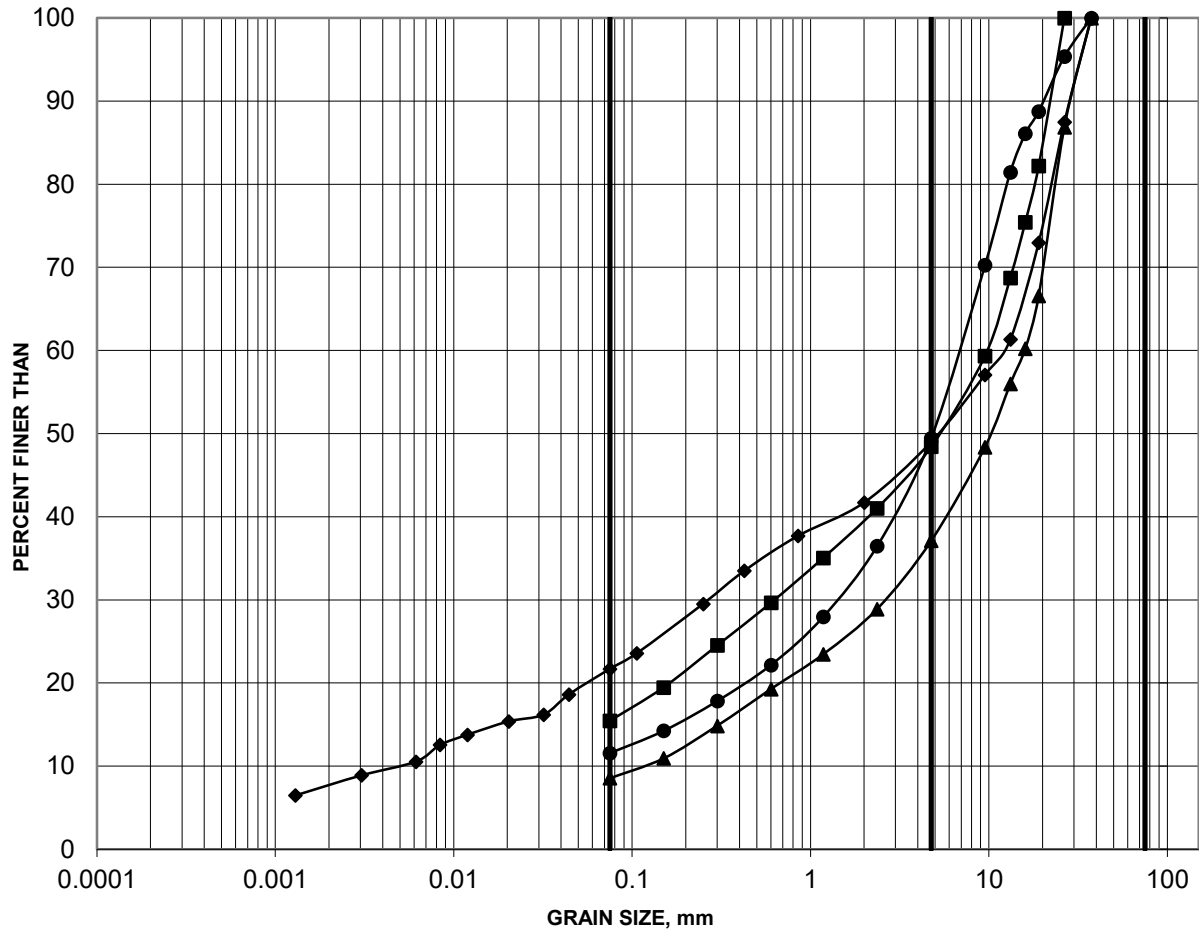
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

FIGURE B1

Sandy GRAVEL (GW-GM) to Sandy CLAYEY GRAVEL (GC) (FILL)



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

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	CNR-01	1	0.10-0.61	52	33	15	
◆	CNR-02	1	0.25-0.61	51	27	14	8
▲	CNR-03	2	0.61-1.07	63	28	9	
●	CNR-04	2	0.61-1.22	51	37	12	

Project: 20148061B-3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/2020/20148061B/figures/CNR/>

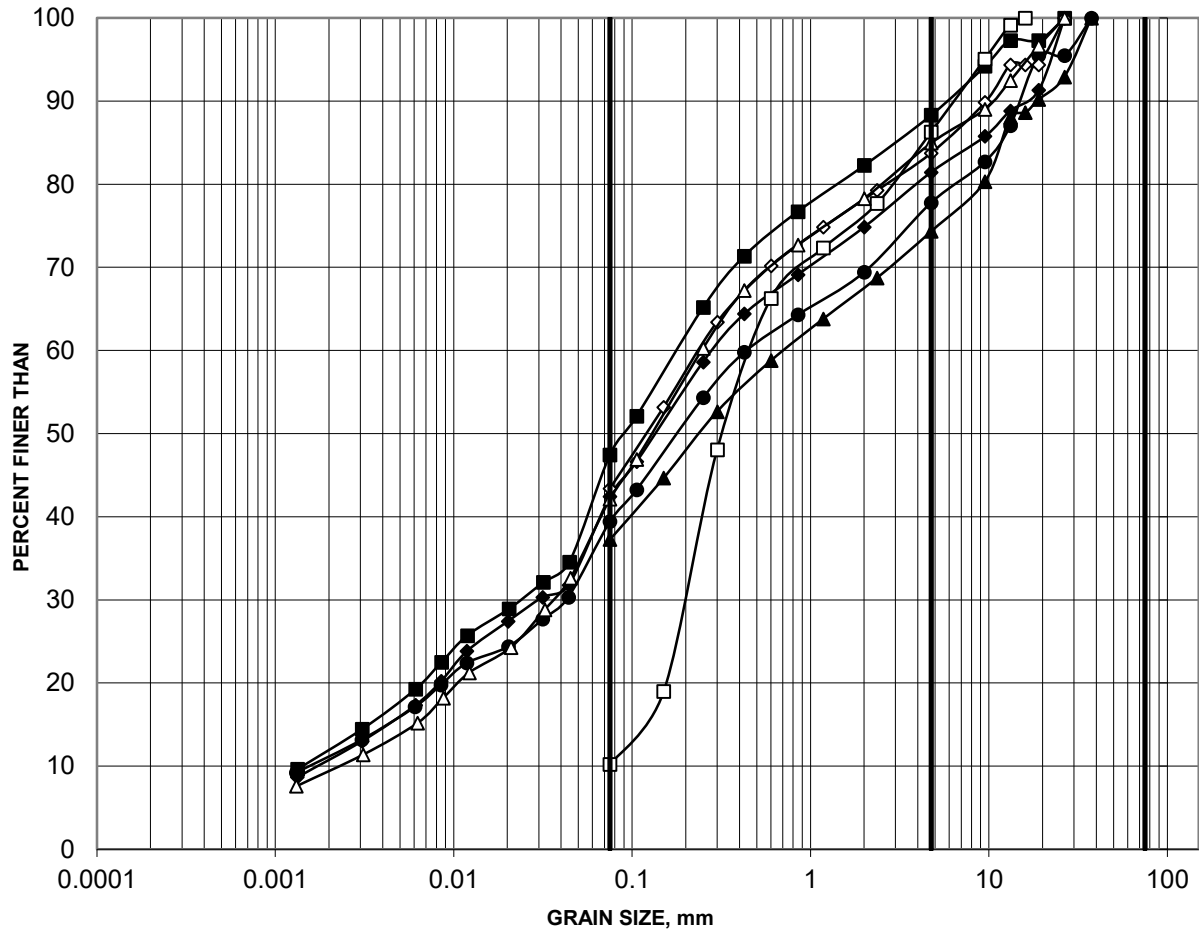
Created by: MI

Checked by: CW

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND (SP-SM) to Gravelly SILTY SAND (SM) (FILL)



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

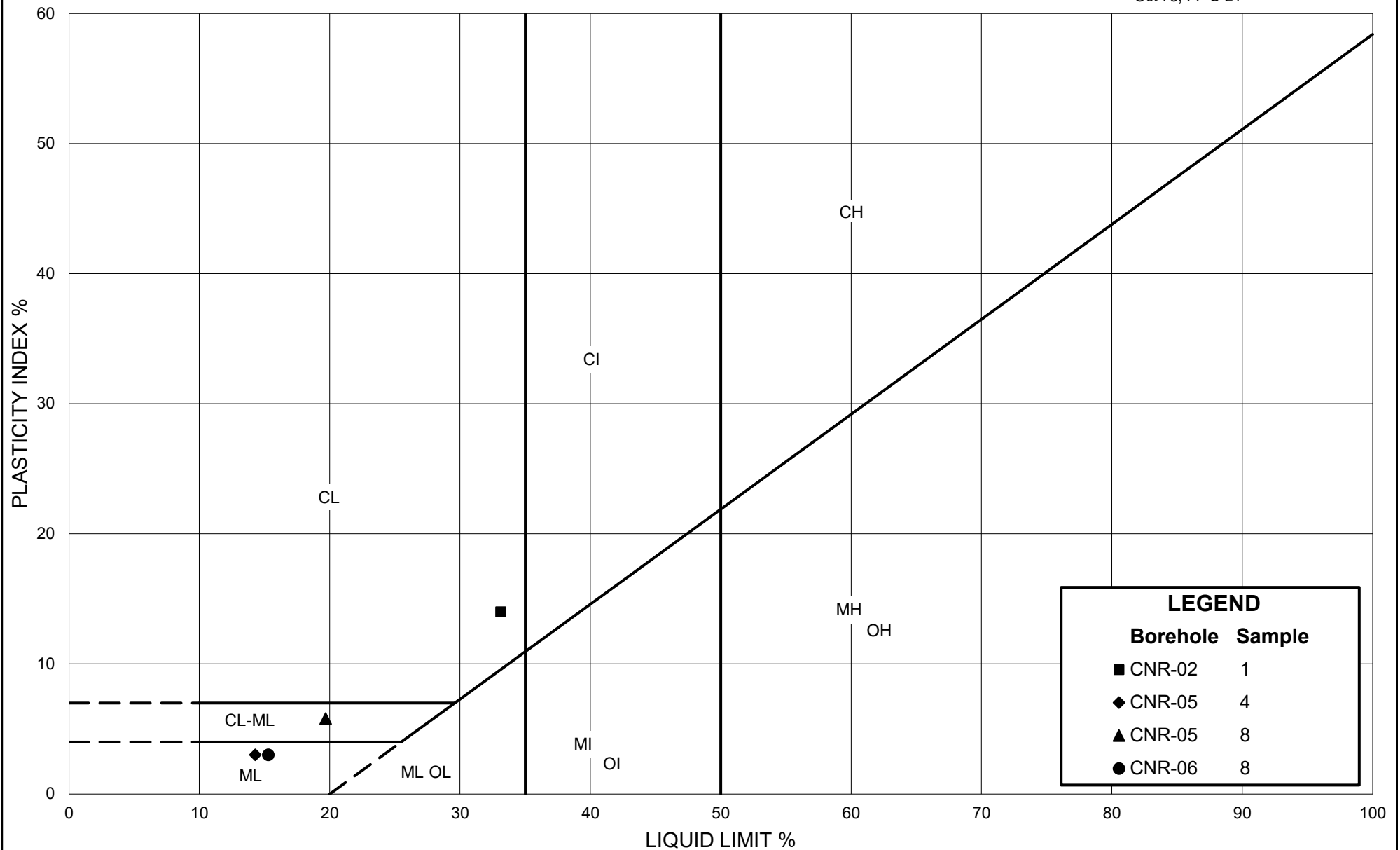
	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	CNR-05	3	1.52-2.13	12	41	35	12
◆	CNR-05	4	2.29-2.90	19	39	31	11
▲	CNR-05	7	4.57-5.18	26	37		37
●	CNR-05	10	6.86-7.47	22	39	28	11
□	CNR-06	1	0.00-0.76	14	76		10
◇	CNR-06	4	2.29-2.90	16	41		43
△	CNR-06	8	5.33-5.94	15	43	33	9

Project: 20148061B-3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/2020/20148061B/figures/CNR/>

Created by: MI

Checked by: CW



Ministry of Transportation

Ontario

PLASTICITY CHART

SILTY SAND (SM) TO SANDY CLAYEY GRAVEL (GC), TO GRAVELLY CLAYEY SAND-SILTY SAND (SC-SM) (FILL)

Figure: B3

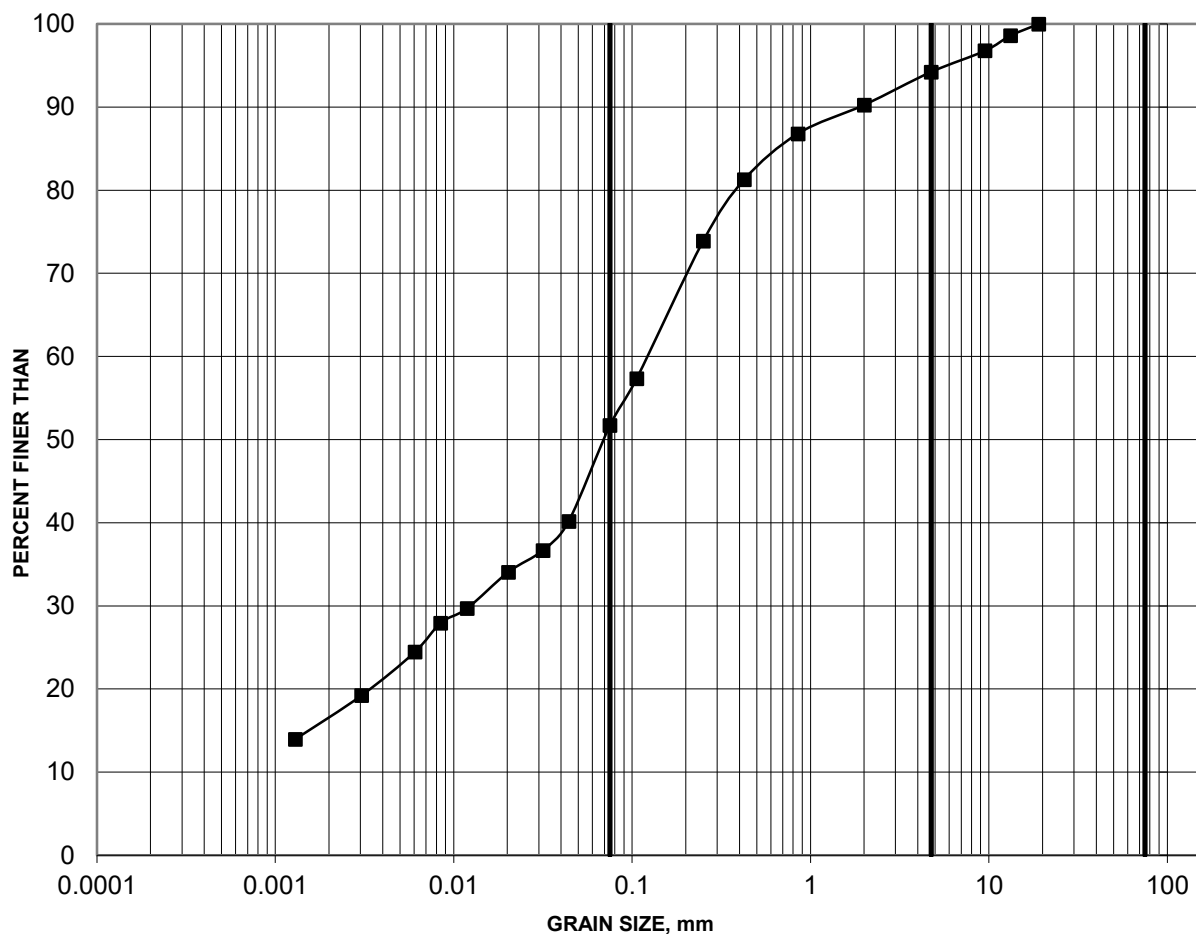
Project: 20148061B-3000

Created By: MI Checked By: CW

GRAIN SIZE DISTRIBUTION

FIGURE B4

CLAYEY SILT-SILT (CL-ML) and sand



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

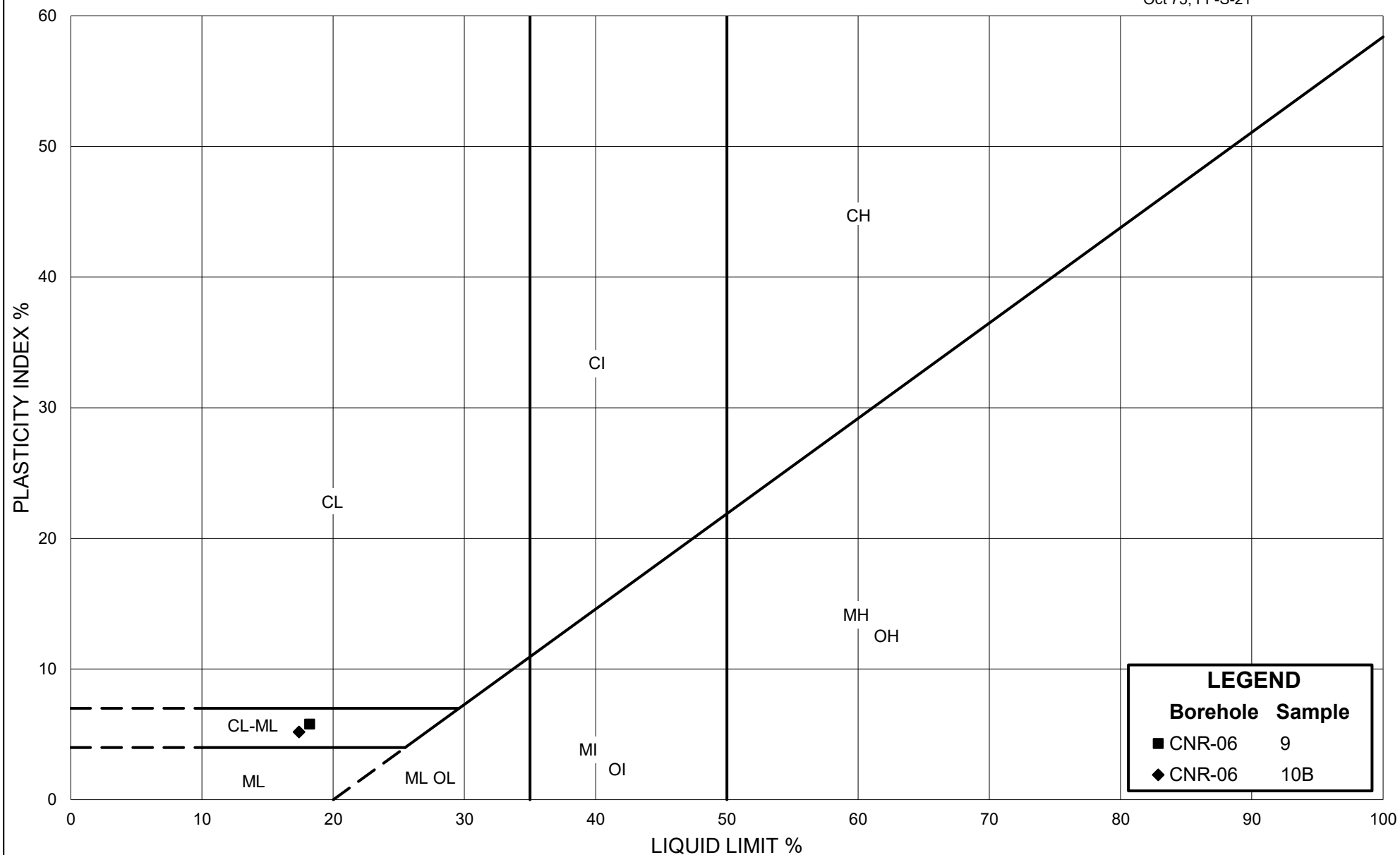
	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	CNR-06	10B	7.01-7.47	6	42	35	17

Project: 20148061B-3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/2020/20148061B/figures/CNR/>

Created by: MI

Checked by: CW



Ontario

Ministry of Transportation

PLASTICITY CHART

CLAYEY SILT-SILT (CL-ML) AND SAND

Figure: B5

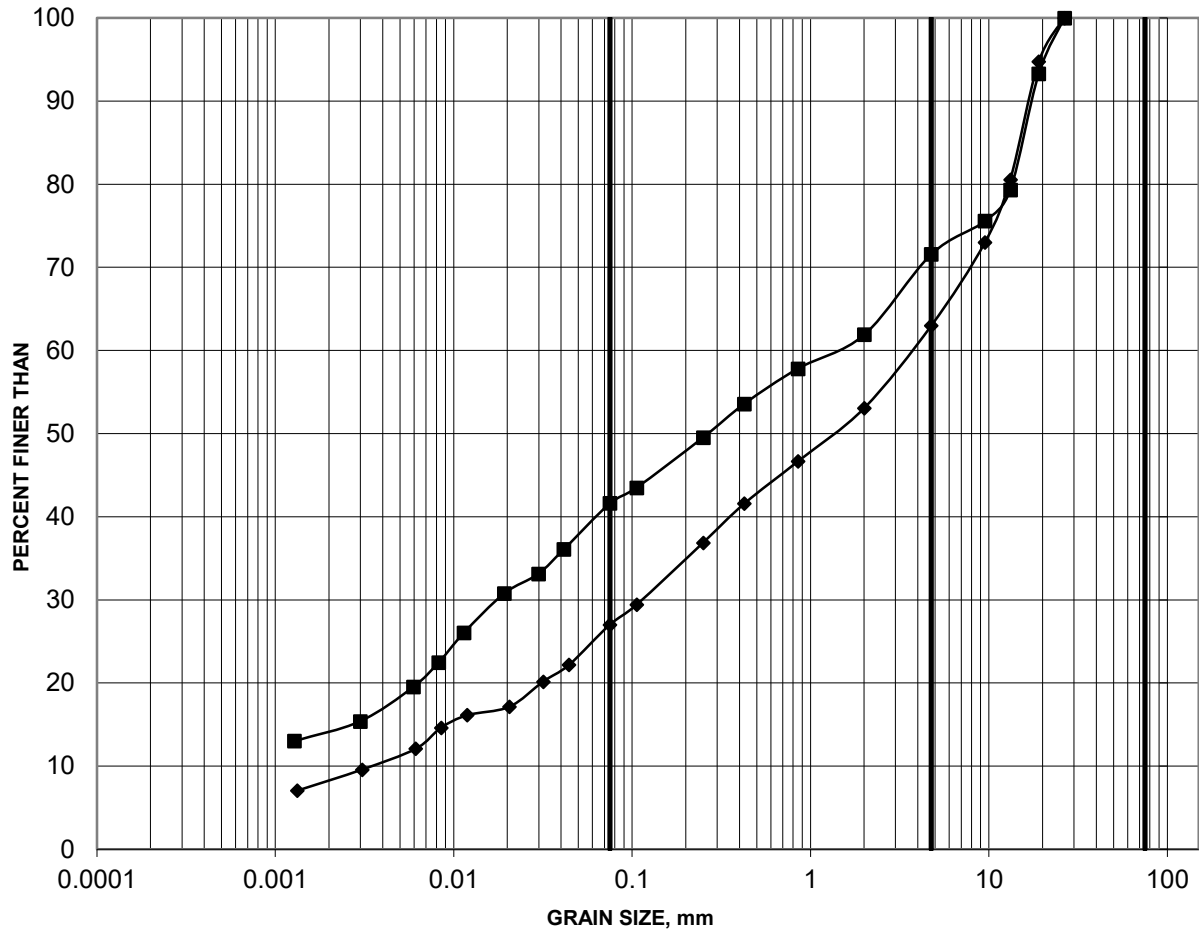
Project: 20148061B-3000

Created By: MI Checked By: CW

GRAIN SIZE DISTRIBUTION

FIGURE B6

Gravelly SILTY SAND (SM) (TILL)



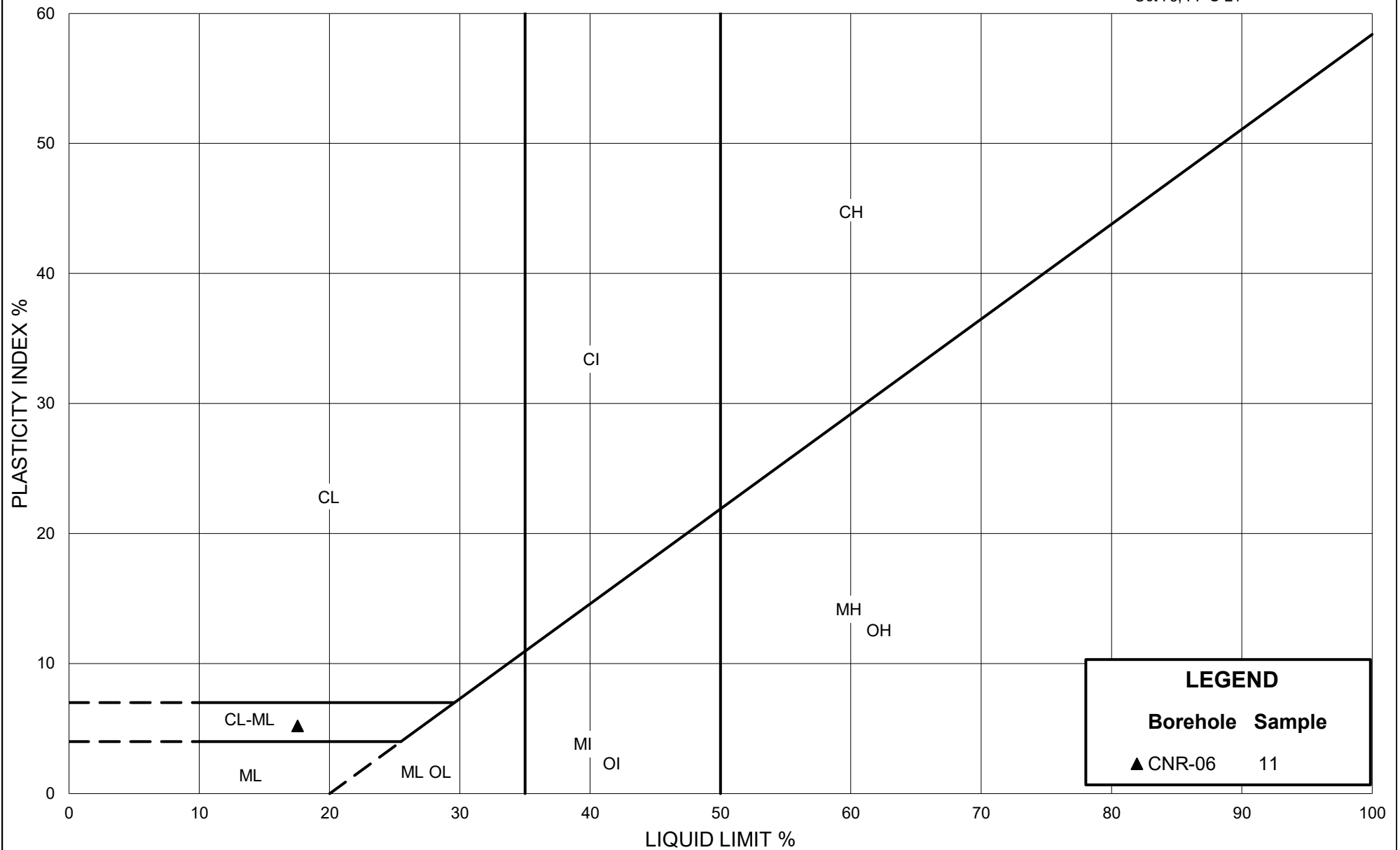
SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	CNR-05	12	9.14-9.75	28	30	28	14
◆	CNR-06	12	9.14-9.63	37	36	19	8

Project: 20148061B-3000

<https://wsponlinecan.sharepoint.com/Sites/Global-OttawaLab/Shared Documents/Active/2020/20148061B/figures/CNR/>

Created by: MI
Checked by: CW



Ministry of Transportation

PLASTICITY CHART

CLAYEY GRAVEL-SILTY GRAVEL (GC-GM/SC) and sand

Figure: B7

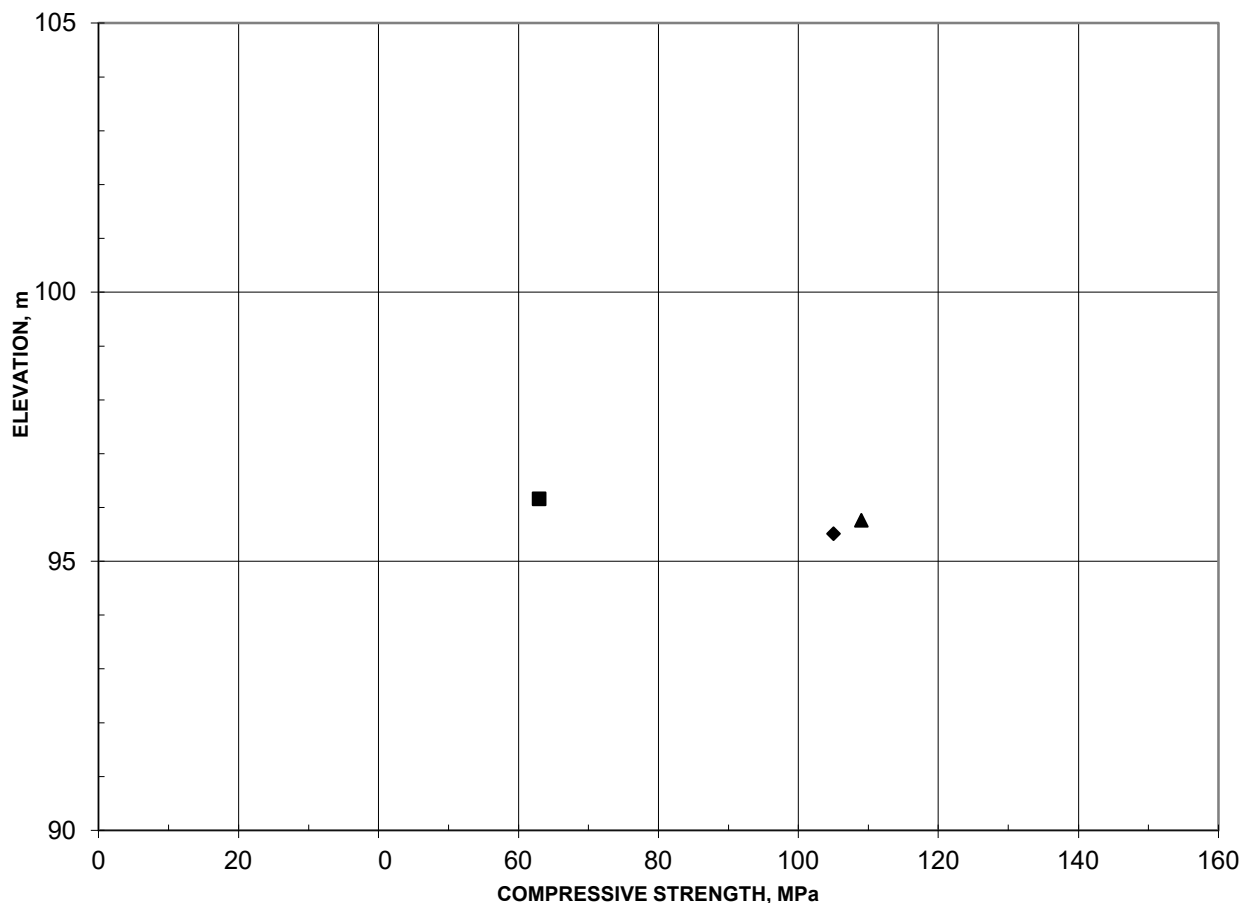
Project: 20148061B

Created By: MI

Checked By: CW

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

FIGURE B8



	Borehole	Depth (m)	L/D	Bulk Density (kg/m ³)	Lithology	UCS (MPa)	Failure Type
■	CNR-02 RC1	1.6	1.5	2667	Limestone	63	1
◆	CNR-03 RC1	2.7	1.8	2666	Limestone	105	1
▲	CNR-04 RC1	2.5	1.9	2688	Limestone	109	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: 20148061B-3000

Created by: BW

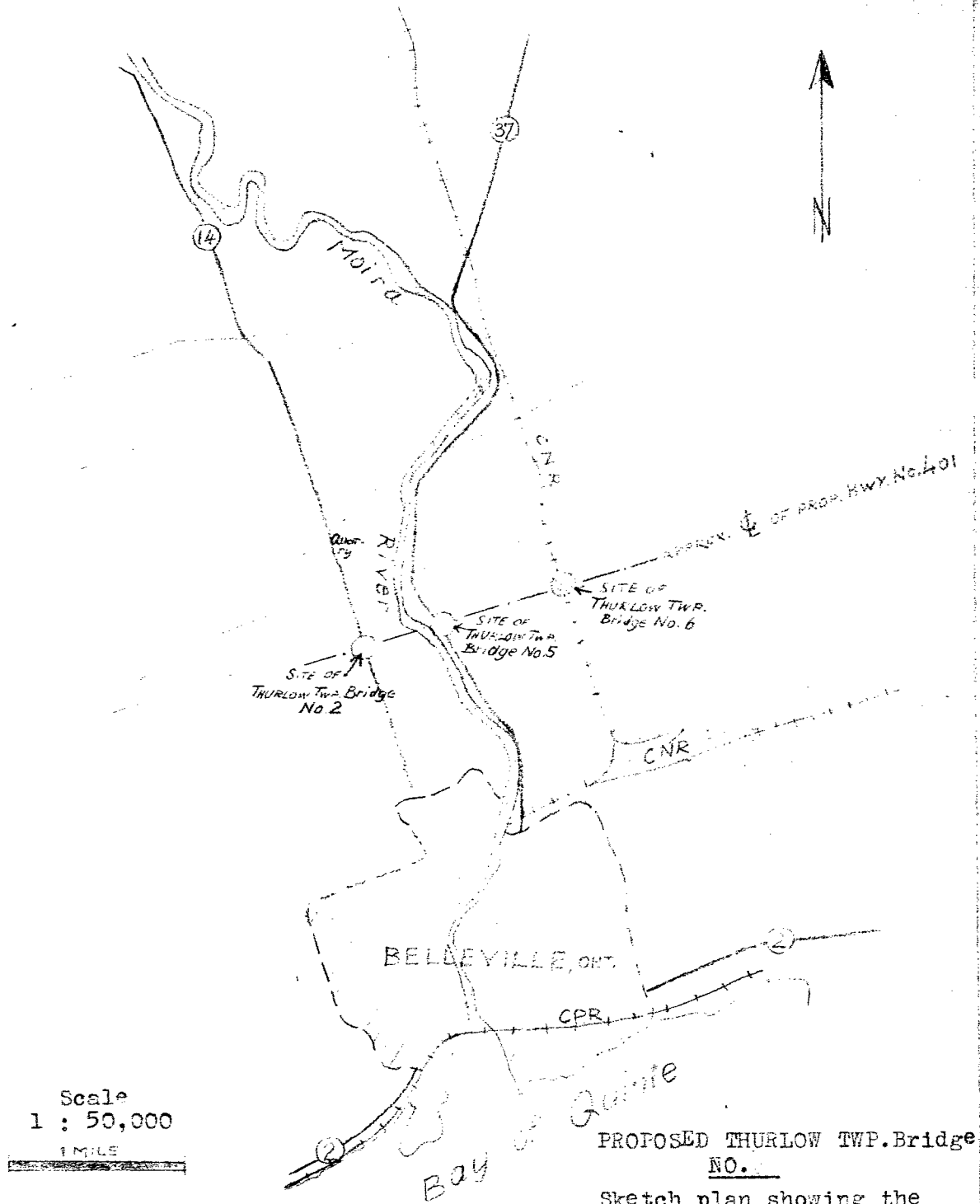
Checked by: MI

APPENDIX C

Previous Investigation Results

S-500-501/55/T-61

FRAN & BRAVINI K.T.



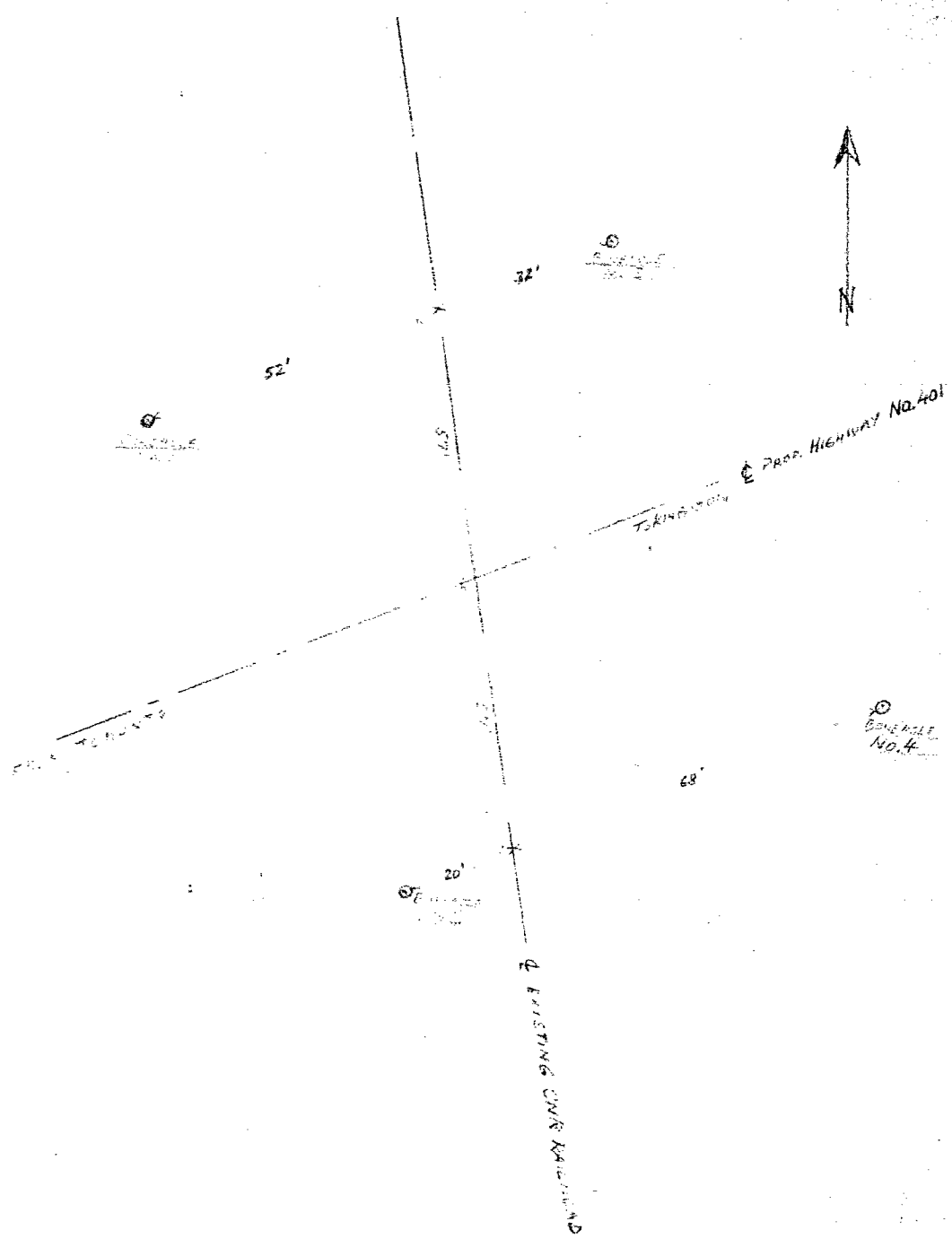
Scale
1 : 50,000

1 MILE

PROPOSED THURLOW TWP. Bridge
NO. 6

Sketch plan showing the
location of the site.

S-500-501/53/T-63



LOCATION OF BOREHOLES
Site of
THURLOW TWP. Bridge NO. 6

Order No.: S-500-501/55/T-63 RACEY, MacCALLUM AND ASSOCIATES

A. McCadden

Dated

Limited

Driller

Day Month Year

Foundation Engineering Division

Hole Begun 18/2/55

D. McCurdy

Hole Ended 19/2/55

Engineering Data Sheet for Borehole: 1

Helper

Job Name: THURLOW TWP. BRIDGE No. 6

K. TUBBESING

Job Located: INTERSECTION CNR TRACK AND PROP. HWY. NO. 401, ~2 MILES N OF

Checked by

Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN.

BELLEVILLE, ONT.

Hole Elevation: 319.8 Datum: M.S.L.

25/2/55

Day Month Year

DEPTH	EL.	THICKNESS	W	SYMBOL	NARRATIVE	TANGENTIAL VALUES					SAMPLING
						20	40	60	80	100	
0	319.8				GROUND SURFACE	20%	40%	60%	80%	100%	100% CORE RECOVERY
-0.7'	319.1				FROZEN GROUND						
-2'	317.8				BROWN, SANDY AND GRAVELLY SILT WITH COARSE GRAVEL (GRANITE ETC.)						
					REFUSAL (BEDROCK)						CORE RECOVERY 66%
					GREY TO DARK GREY, ARGILLACEOUS AND FOSSILIFEROUS LIMESTONE, INTERBEDDED WITH MORE SHALY CALCAREOUS CLAYSTONE, DARK GREY.						CORE 66%
					BEDDING CLOSE TO THE HORIZONTAL, THICKNESS OF BEDS VARYING FROM FRACTIONS OF ONE INCH TO ~6".						LOST 75%
					SOUND AND SOLID ROCK.						93%
											100%
											78%
											98%
-14.7'	305.1				END OF BORE HOLE						
					WATER LEVEL IN PIPE AT START OF WORK (HOLE AT 8'), 19/2/55.						

ABBREVIATIONS

W. WATER, S. SATURATED, M. MOST, H. HUMID, D. DRY

S.S. SPLIT, D.D. DOWN, T.W. TWIN WALL (SAMPLES)

Order No.: S-500-501/55/T-63 RACEY, MacCALLUM AND ASSOCIATES

Dated

Limited

Driller

Day Month Year

Foundational Engineering Division

Role Begun 21/2/55

D. MC CURDY

Hole Ended 23/2/55

Engineering Data Sheet for Borehole: 2

Helper

Job Name: THURLOW TWP. BRIDGE NO. 6

K. TUBBESING

Job Located: INTERSECTION CNR-TRACK AND PROP. HWY. NO. 401 ~ 2 MILES N OF

Checked by

Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN

BELLEVILLE, ONT.

Hole Elevation: 319.5 Datum: M.S.L.

25/2/55

Day Month Year

DEPTH	EL	THICKNESS	W	SYMBOL	NARRATIVE	TABULAR VALUES				SAMPLING	
						20	40	60	80		
0	319.0				GROUND SURFACE	20%	40%	60%	80%	100%	BLANK
1	318.0				OVERBUNDEN (TPOSSIL) REFUSAL (BEDROCK)						CORE RECOVERY
					GREY TO DARK GREY						56%
					ARGILLACEOUS AND FOSSILIFEROUS						70%
					LIMESTONE						63%
					INTERBEDDED WITH DARK GREY						66%
					TALLENLOUS CLAYSTONE, SLIGHTLY						100%
					SHALY						86%
					BEDDING ALMOST HORIZONTAL,						94%
					THICKNESS OF BEDS VARYING FROM						
					FRACTIONS OF ONE INCH TO TWO						
10.5	308.5				END OF BOREHOLE						

12.5

100%

94%

86%

100%

66%

63%

70%

56%

NOTES:

W WATER; S SATURATED; M MUD; H HUMID;
D DRY

S.S. ONLY FROM THE SAND W. (SMALLER)

Order No. S-500-501/55/T-63 RACEY, MacCORMACK AND ASSOCIATES

F. LUSK

Dated

Limited

Driller

Day Month Year

Foundation Engineering Division

Hole Begun 23/2/55

W. LINTON

Hole Ended 24/2/55Engineering Data Sheet for Porehole: 3

Helper

Job Name: THURLOW TWP. BRIDGE NO. 6

K. TUBBESING

Job Located: INTERSECTION CNR TRACK AND PROPOSED HWY #401, ~2 MILES N. OF

Checked by

Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN

BELLEVILLE, ONT.

Hole Elevation: 320.6' Datum: M. S. L.

1/3/55

Day Month Year

DEPTH	EL.	THICKNESS	W	SIMUL.	NARRATIVE	TENSILE VALUES					SAMPLING
						20%	40%	60%	80%	100%	
0	320.6				GROUND SURFACE						BLDNG/PT.
					TOPSOIL						CORE RECOVERY
1.5	319.1				REFUSAL (BEDROCK)						100%
					GREY TO DARK GREY,						
					ARENACEOUS, FOSSILIFEROUS						
					LIMESTONE,						100%
					INTERBEDDED WITH DARK GREY,						
					CALCAREOUS CLAYSTONE, SLIGHTLY SHALE,						
					BEDDING ALMOST HORIZONTAL.						100%
					THICKNESS OF BEDS VARYING FROM FRAGMENTS OF ONE INCH TO 10"						
11.5	309.1				END OF POREHOLE						

REMARKS

W. WATER SATURATED, M. MOST IN PUMP

D. DRY

S.S., 10% SOON, TW. TH. WALL SAMPLED

APPENDIX D

Analytical Laboratory Test Results

Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario

Attention: Mr. Kenton Power

PO#:

Invoice to: Golder Associates Ltd

Report Number: 1990084
Date Submitted: 2022-11-17
Date Reported: 2022-11-24
Project: 20148061B MTO Belleville
COC #: 902953

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:

Emma-Dawn Ferguson, 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

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1931 Robertson Road,
Ottawa, Ontario

Attention: Mr. Kenton Power

PO#:

Invoice to: Golder Associates Ltd

Report Number: 1990084
Date Submitted: 2022-11-17
Date Reported: 2022-11-24
Project: 20148061B MTO Belleville
COC #: 902953

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1663118 Soil 2022-10-21 H62-02 SA4 7.5'-9.5'	1663119 Soil 2022-10-25 CNR-05 SA6 12.5'-14.5'	1663120 Soil 2022-10-26 CNR-06 SA3 5'-7'	1663121 Soil 2022-10-27 SS-04 SA2 2.5'-4.5'
Anions	SO4	0.01	%			0.02	0.03	0.03	0.02
Cl in Concrete	Cl	0.002	%			0.025	0.016	0.024	0.046
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.59	0.43	0.78	1.00
	pH	2.00				8.87	8.82	8.91	8.80
	Resistivity	1	ohm-cm			1724	2381	1300	1010

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1663122 Soil 2022-10-27 SS-05 SA5 10'-12'	1663123 Soil 2022-10-05 C-11 SA6 10'-12'	1663124 Soil 2022-10-04 C-13 SA2 2'-4'	1663125 Soil 2022-10-23 C-15 SA3 5'-7'
Anions	SO4	0.01	%			0.04	0.03	0.04	0.04
Cl in Concrete	Cl	0.002	%			0.061	0.005	0.043	0.025
General Chemistry	Electrical Conductivity	0.05	mS/cm			1.38	0.23	0.77	0.75
	pH	2.00				9.22	8.50	8.33	8.81
	Resistivity	1	ohm-cm			725	4540	1320	1350

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

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Invoice to: Golder Associates Ltd

Report Number: 1990084
Date Submitted: 2022-11-17
Date Reported: 2022-11-24
Project: 20148061B MTO Belleville
COC #: 902953

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 433754 Analysis/Extraction Date 2022-11-23 Analyst AET Method C CSA A23.2-4B			
Chloride	<0.002 %	97	80-120
Run No 433839 Analysis/Extraction Date 2022-11-24 Analyst IP Method AG SOIL			
SO4	<0.01 %	105	70-130
Run No 433849 Analysis/Extraction Date 2022-11-24 Analyst MW Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	99	90-110
pH	6.81	99	90-110
Resistivity			

Guideline = * = **Guideline Exceedence**

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Client: WSP Canada Inc.
1931 Robertson Road,
Ottawa, Ontario
K2H 5B7

Attention: Mr. Kenton Power

PO#:

Invoice to: WSP Canada Inc.

Report Number: 3005969
Date Submitted: 2024-03-19
Date Reported: 2024-03-26
Project: 20148061B
COC #: 913518

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:

Emma-Dawn Ferguson, Chemist

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Certificate of Analysis

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

Report Number: 3005969
Date Submitted: 2024-03-19
Date Reported: 2024-03-26
Project: 20148061B
COC #: 913518

Lab I.D.
Sample Matrix
Sample Type
Sampling Date
Sample I.D.

1721322
Soil
2024-02-26
CNR-02 Sa2/2-3.25'

Group	Analyte	MRL	Units	Guideline	
Anions	Cl	0.002	%		0.009
	SO4	0.01	%		0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.45
	pH	2.00			7.95
	Resistivity	1	ohm-cm		2222

Guideline =

* = Guideline Exceedence

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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

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K2H 5B7
Attention: Mr. Kenton Power
PO#:
Invoice to: WSP Canada Inc.

Report Number: 3005969
Date Submitted: 2024-03-19
Date Reported: 2024-03-26
Project: 20148061B
COC #: 913518

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 457449 Analysis/Extraction Date 2024-03-22 Analyst IP Method AG SOIL			
SO4	<0.01 %	96	70-130
Run No 457478 Analysis/Extraction Date 2024-03-22 Analyst AsA Method C CSA A23.2-4B			
Chloride	<0.002 %	93	90-110
Run No 457576 Analysis/Extraction Date 2024-03-26 Analyst IP Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	101	90-110
pH	6.30	99	90-110
Resistivity			

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
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APPENDIX E

Site Photographs



Photograph 1: Looking south along existing overhead eastern abutment; February 27, 2024



Photograph 2: Looking north toward Boreholes CNR-01 and CNR-03 along existing overhead embankment side slopes; February 27, 2024



Photograph 3: Looking south toward Borehole CNR-03 and existing overhead western abutment; February 27, 2024



Photograph 4: Looking north from Borehole CNR-02 toward existing overhead eastern abutment; February 27, 2024



Photograph 5: Looking south toward the CNR Overhead and Highway 401; February 27, 2024

