



REPORT

Foundation Investigation Report

*Bass Pro Mills Drive and Rutherford Road S-E/W Ramp Retaining Walls
Highway 400 Widening from Langstaff Road to Major Mackenzie Drive
Vaughan, Ontario
GWP 2836-02-00*

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1.0 INTRODUCTION

WSP Canada Inc. (WSP, formerly Golder Associates Ltd., amalgamated with WSP in 2023) has been retained by Parsons Inc. (Parsons) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detail design of the Highway 400 widening and rehabilitation, extending from 1.3 km south of the Langstaff Road interchange to 1.5 km north of Major Mackenzie Drive (a length of approximately 7.3 km) in the City of Vaughan, Ontario. As part of the Highway widening and rehabilitation program, two retaining walls will be constructed on the S-E/W ramps of the Bass Pro Mills Drive and Rutherford Road interchanges (referred to hereinafter as “the Bass Pro Mills Drive retaining wall” and “the Rutherford Road retaining wall”, respectively).

The purpose of these investigations is to assess the subsurface soil and groundwater conditions near the retaining wall locations through borehole drilling, in situ testing, and laboratory testing of selected soil samples.

This report summarizes the factual results of field and laboratory work (including field investigation procedures, borehole stratigraphy, and geotechnical and analytical laboratory test results) and provides a description of interpreted soil and groundwater conditions for the Bass Pro Mills Drive and Rutherford Road retaining walls.

2.0 SITE DESCRIPTION

2.1 General

The orientation (i.e., north, south, east, and west) stated in the text of this report is referenced to project north and therefore may differ from magnetic north shown on Drawings 1 and 2. For the purpose of this report, Highway 400 is considered to be oriented in a north-south direction, with the Bass Pro Mills Drive S-E/W ramp retaining wall parallel to the highway in a north-south direction, and the Rutherford Road S-E/W ramp retaining wall on a skew to Highway 400 in a west-east direction.

At the Bass Pro Mills Drive and Rutherford Road S-E/W ramps, Highway 400 has generally been constructed near the existing ground surface, with no significant sections of cut or fill; the Bass Pro Mills Drive and Rutherford Road crossing roads and associated interchange ramps have been constructed on embankment fill adjacent to the Highway 400 corridor. This section of Highway 400 is currently an eight-lane urban freeway with paved shoulders divided by a concrete median barrier. Land use surrounding the retaining wall sites is primarily commercial.

2.2 Bass Pro Mills Drive S-E/W Ramp

The existing road surface elevation of the Bass Pro Mills Drive S-E/W interchange ramp adjacent to the proposed retaining wall is about Elevation 210 m to 211 m. The ramp will be widened to the east, towards the existing roadside ditch, which is currently heavily vegetated with bulrushes and has a ditch bottom elevation ranging from about Elevation 208 m to 209 m (i.e., about 2 m below the road surface of the ramp). The roadside ditch has side slope inclinations shallower than 3H:1V. There is a guardrail along the east edge of Highway 400 that extends from the south end of the proposed wall to an overhead sign about 70 m north.

2.3 Rutherford Road S-E/W Ramp

The existing road surface elevation of the Rutherford Road S-E/W interchange ramp adjacent to the proposed retaining wall is about Elevation 223 m. The ramp will be widened to the south, beyond the limits of the existing roadside ditch, which is currently heavily vegetated with bulrushes and a few limit zones of tree cover along the fence line (which runs parallel to the interchange ramp and separates the highway right-of-way with commercial

properties to the south). The existing ditch has a bottom elevation of about 221.5 m (i.e., about 1.5 m below the road surface of the ramp).

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface exploration program consisted of 7 boreholes (designated as RW-1 to RW-7) and one monitoring well (designated RW-MW); five boreholes (RW-1 to RW-5) along the Bass Pro Mills Drive S-E/W interchange ramp and two boreholes (RW-6 and RW-7) along the Rutherford Road S-E/W interchange ramp. These boreholes and the monitoring well were advanced between July 11 and July 27, 2023, at the approximate locations shown on Drawings 1 and 2.

The boreholes were advanced through the existing roadway shoulder of the interchange ramps using a truck-mounted CME 75 drill rig supplied and operated by 3D Drilling of Whitchurch-Stouffville, Ontario. The boreholes were advanced through the overburden using 159 mm outside diameter hollow stem augers. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outside diameter split spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586)¹. The split-spoon samplers used in the investigation limits the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions.

The groundwater conditions were noted in the boreholes during and upon completion of drilling and were backfilled in accordance with Ontario Regulation 903 (Wells, as amended), and the asphalt surface was capped with tamped cold patch asphalt. A standpipe piezometer was installed within an augered hole on the road shoulder of the Rutherford Road S-E/W ramp between Boreholes RW-6 and RW-7 to allow monitoring of the groundwater level. The installed piezometer consists of a 50 mm diameter PVC pipe, with a 3.0 m long slotted screen within a filtered sand pack. The borehole and annulus surrounding the piezometer pipe above the filter sand pack were backfilled to near ground surface with bentonite pellets. The standpipe piezometer was installed in a metal protective casing flush with the pavement surface.

The field work was observed by members of WSP's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, and logged the boreholes. The samples were identified in the field, placed in appropriate containers, labelled, and transported to WSP's Mississauga laboratory where the samples underwent further visual examination. Geotechnical laboratory testing (water content, grain size distribution, and Atterberg limits) was carried out on select soil samples, in accordance with MTO and/or ASTM Standards, as appropriate. In addition, select soil samples were submitted to Bureau Veritas Laboratories of Mississauga, Ontario for analysis of select parameters to assess for the potential corrosion of buried steel and deterioration of concrete.

The as-drilled borehole and monitoring well locations and elevations were surveyed by WSP using a Trimble Geo 7x GPS unit. The locations are referenced to NAD 83(CSRS)v6 MTM Zone 10 coordinates and the ground surface elevations are referenced to CGVD28 Geodetic datum benchmark. The borehole locations, including geographic coordinates, ground surface elevations, and borehole/monitoring well depths are summarized below. All boreholes were advanced to a depth of 6.7 m below existing ground surface.

¹ ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

Location	Borehole No.	MTM NAD83 Northing (Latitude, °)	MTM NAD83 Easting (Longitude, °)	Ground Surface Elevation (m)
Bass Pro Mills Drive S-E/W Ramp	RW-1	4,852,935.5 (43.816376)	301,196.7 (-79.544792)	209.3
	RW-2	4,852,987.1 (43.816841)	301,193.1 (-79.544837)	209.6
	RW-3	4,853,039.0 (43.817308)	301,193.6 (-79.544832)	209.6
	RW-4	4,853,093.1 (43.817795)	301,192.4 (-79.544847)	209.8
	RW-5	4,853,141.4 (43.818230)	301,188.5 (-79.544895)	210.1
Rutherford Road S-E/W Ramp	RW-6	4,854,121.2 (43.827049)	301,292.6 (-79.543608)	222.8
	RW-MW	4,854,142.7 (43.827252)	301,320.2 (-79.543268)	222.8
	RW-7	4,854,164.6 (43.827440)	301,345.4 (-79.542952)	222.9

4.0 SITE GEOLOGY

4.1 Regional Geology

As delineated in The Physiography of Southern Ontario (Chapman and Putnam, 1984)², this section of Highway 400 lies within the region known as the Peel Plain and consists of level to undulating tracts of clayey glacial till soils, which are presumed to have been derived from moraines, interspersed with non-cohesive silts and sands from interstadial stages of Wisconsinan glaciation.

Based on geological mapping by the Ministry of Northern Development and Mines (MNDM)³, the site is underlain by bedrock from the Upper Ordovician era consisting of shale, limestone, dolostone, and siltstone.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing from the investigation are shown on the borehole records presented in Appendix A. The detailed results of the geotechnical laboratory testing are presented in Appendix B. The results of the in situ field tests (i.e., SPT 'N'-values) as presented on the borehole records and in Section 4.2 are uncorrected. The results of the analytical testing completed on select soil samples are provided in Appendix C.

The stratigraphic boundaries shown in the borehole records are inferred from non-continuous sampling and, therefore, these boundaries represent transitions between soil types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions near the proposed Bass Pro Mills Drive S-EW ramp retaining wall consist of the existing pavement structure underlain by a layer of cohesive fill consisting of clayey silt-silt to silty clay, which

² Chapman, L.J. and Putnam, D.F., 1984, The Physiography of Southern Ontario, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

³ Ministry of Northern Development of Mines. Bedrock Geology of Ontario – Southern Sheet, Ontario Geological Survey - Map 2544.

extends to elevations ranging from about Elevation 207 m to 208 m. The cohesive fill is underlain by cohesive deposits of clayey silt-silt to silty clay; this deposit is generally stiff to very stiff, but the upper portion of the deposit is firm to stiff in some of the boreholes (i.e., SPT-“N” values on the order of 4 to 8 blows per 0.3 m of penetration). In Borehole RW-3, this deposit was further underlain by a non-cohesive deposit of compact sandy silt.

In general, the subsurface conditions near the proposed Rutherford Road S-EW Ramp retaining wall consist of the existing pavement structure underlain by a layer of cohesive fill consisting of clayey silt-silt to clayey silt, which extends to about Elevation 220 m to 221 m. The cohesive fill is underlain by a non-cohesive deposit of compact to dense silt, which is further underlain by a cohesive deposit of clayey silt having a hard consistency.

A more detailed description of the major stratigraphic units encountered in the boreholes is described in the sections below.

4.2.1 Bass Pro Mills Drive S-E/W Ramp

Five boreholes (Boreholes RW-1 to RW-5) were advanced through the existing road shoulder of the Bass Pro Mills Drive S-E/W ramp adjacent to the proposed retaining wall. The following subsurface conditions were encountered in Boreholes RW-1 to RW-5.

- **Asphalt:** A layer of asphalt between 200 mm and 220 mm thick was encountered at the ground surface in all boreholes.
- **Granular Fill (Pavement Structure):** A layer of granular fill between 0.6 m and 1.3 m thick was encountered underlying the asphalt in all boreholes, extending between Elevations 209.3 m to 208.1 m. The SPT “N”-values measured within the granular fill range from 15 to 37 blows per 0.3 m of penetration, indicating a compact to dense state of compactness. The results of grain size distribution testing completed on two samples of the granular fill from Boreholes RW-2 and RW-4 are presented in Figure B1. The water content measured on samples of the granular fill ranges from about 4% to 9%.
- **Clayey Silt-Silt (CL-ML) to Silty Clay (CI) Fill:** A layer of cohesive fill consisting of clayey silt-silt to silty clay was encountered underlying the granular fill in Boreholes RW-1 to RW-5. The cohesive fill was encountered at depths ranging from approximately 0.8 m to 1.4 m below ground surface (approximately Elevations 209.3 m to 208.1 m) and was about 0.8 m to 1.4 m thick, extending down to a depth of 2.2 m (approximately Elevations 207.9 m to 207.1 m). The SPT “N”-values measured within the cohesive fill range from 4 to 22 blows per 0.3 m of penetration, indicating a soft to very stiff consistency. The results of grain size distribution testing completed on two samples of the cohesive fill from Boreholes RW-3 and RW-5 are presented in Figure B2 in Appendix B. Atterberg limit testing was carried out on two samples of the cohesive fill and the results are presented on a plasticity chart in Figure B4 in Appendix B. The Atterberg limits test measured liquid limits of about 22% and 42%, plastic limits of about 13% and 19%, and a corresponding plasticity index of about 9% and 23%. Based on the grain size distribution tests, together with the results of the Atterberg limits tests, one sample of the cohesive fill is classified as clayey sand fill of low plasticity, and one sample of the cohesive fill is classified as silty clay of intermediate plasticity. The water content measured on samples of the cohesive fill ranges from about 8% to 15%.
- **Clayey Silt-Silt (CL-ML) to Silty Clay (CI) Till:** A cohesive deposit of glacial till varying in composition from clayey silt-silt to silty clay was encountered underlying the cohesive fill in all boreholes. The cohesive till deposit was encountered at a depth of 2.2 m below ground surface (approximately Elevations 207.9 m to 207.1 m) and extended to the termination depth of 6.7 m (Elevations 203.4 m to 202.6 m) in Boreholes RW-1, RW-2, RW-4, and RW-5. In Borehole RW-3, the cohesive till deposit was approximately 3.2 m thick,

extending down to a depth of 5.4 m (Elevation 204.2 m). The SPT “N”-values measured within the cohesive till deposit range from 4 to 59 blows per 0.3 m of penetration; softer zones with SPT “N”-values of 4 to 8 blows per 0.3 m of penetration were generally limited to the upper 0.5 to 2 m of the deposit. The results of grain size distribution testing completed on seven samples of the cohesive till deposit are presented in Figure B4 in Appendix B. Atterberg limit testing was carried out on seven samples of the cohesive till deposit and the results are presented on a plasticity chart on Figure B5 in Appendix B. The Atterberg limits tests measured liquid limits ranging from about 17% to 47%, plastic limits ranging from about 11% to 20%, and corresponding plasticity indices ranging from 6% to 27%. The Atterberg limits tests generally indicate a clayey silt-silt to silty clay of low to intermediate plasticity, with one sample (Borehole RW-1 Sample 3) indicating a silty clay of intermediate plasticity. The water content measured on samples of the cohesive till deposit ranges from about 8% to 28%. Although not specifically encountered in the boreholes, the presence of cobbles and boulders should be expected in the cohesive till deposit.

- **Sandy Silt (ML):** A non-cohesive deposit consisting of sandy silt was encountered underlying the cohesive till deposit in Borehole RW-3. The non-cohesive deposit was encountered at a depth of 5.4 m below ground surface (Elevation 204.2 m) and extended to the termination depth of 6.7 m (Elevation 202.9 m). The SPT “N”-value measured within the non-cohesive deposit was 20 blows per 0.3 m of penetration, indicating a compact state of compactness. The results of grain size distribution testing completed on a sample of the non-cohesive deposit is presented in Figure B6 (Borehole RW-3 Sample 8) in Appendix B. Atterberg limit testing was carried out on a sample of the non-cohesive deposit and the results are presented on a plasticity chart in Figure B7 (Borehole RW-3 Sample 8) in Appendix B. The Atterberg limits test measured a liquid limit of about 15%, a plastic limit of about 12% and a corresponding plasticity index of about 3%. These results indicate that the fines portion of the sandy silt deposit has slight plasticity. The water content measured on a sample of the non-cohesive deposit was about 11%.

4.2.2 Rutherford Road S-E/W Ramp

Two boreholes (Boreholes RW-6 and RW-7) were advanced through the existing road shoulder of the Rutherford Road S-E/W ramp adjacent to the proposed retaining wall. The following subsurface conditions were encountered in Boreholes RW-6 and RW-7.

- **Asphalt:** A layer of asphalt between 100 mm and 180 mm thick was encountered at ground surface in both boreholes.
- **Granular Fill (Pavement Structure):** A layer of granular fill between 0.6 m and 0.7 m thick was encountered underlying the asphalt in both boreholes, extending to an Elevation of 222.0 m. The SPT “N”-values measured within the granular fill range from 10 to 18 blows per 0.3 m of penetration, indicating a compact state of compactness. The results of grain size distribution testing completed on a sample of the granular fill (Borehole RW-6 Sample 1) is presented in Figure B1. The water content measured on a sample of the granular fill was about 4%.
- **Clayey Silt-Silt (CL-ML) to Clayey Silt (CL) Fill:** A layer of cohesive fill consisting of clayey silt-silt to clayey silt was encountered underlying the granular fill in both boreholes. The cohesive fill was encountered at depths ranging from 0.7 m to 0.9 m below ground surface (approximately Elevation 222.0 m) and was about 0.7 m to 1.3 m thick, extending down to depths ranging from 1.5 m to 2.2 m (approximately Elevations 221.3 m to 220.7 m). The SPT-“N” values measured within the cohesive fill range from 9 to 13 blows per 0.3 m of penetration, indicating a stiff consistency. The water content measured on samples of the cohesive fill ranges from about 13% to 15%.

- **Clayey Silt-Silt (CL-ML) to Clayey Silt (CL) Till – Upper Deposit:** An upper deposit of glacial till varying in composition from clayey silt-silt to clayey silt was encountered underlying the cohesive fill in Borehole RW-7. The upper cohesive till deposit was encountered at a depth of 2.2 m below ground surface (Elevation 220.7 m) and extended to a depth of 3.0 m (Elevation 220.0 m). The SPT “N”-value measured within the upper cohesive till deposit was 25 blows per 0.3 m of penetration, indicating a very stiff consistency. The results of grain size distribution testing completed on a sample of the upper cohesive till deposit is presented in Figure B4 (Borehole RW-7 Sample 3) in Appendix B. Atterberg limit testing was carried out on a sample of the upper cohesive deposit and the results are presented on a plasticity chart in Figure B5 in Appendix B (Borehole RW-7 Sample 3). The Atterberg limits test measured a liquid limit of about 23%, a plastic limit of about 17% and a corresponding plasticity index of about 6%. The Atterberg limits test indicates a clayey silt-silt of low plasticity. Although not specifically encountered in the boreholes, the presence of cobbles and boulders should be expected in the upper cohesive till deposit.
- **Silt (ML):** A non-cohesive deposit of silt was encountered underlying the cohesive fill in Borehole RW-6 and underlying the upper cohesive deposit in Borehole RW-7. The non-cohesive deposit was encountered at depths ranging from 1.4 m to 3.0 m below ground surface (approximately Elevations 221.3 m to 220.0 m) and was about 3.6 m to 4.4 m thick, extending down to depths of 5.8 m to 6.6 m (Elevations 217.0 m to 216.4 m). The SPT “N”-values measured in the non-cohesive deposit ranges from 14 to 36 blows per 0.3 m of penetration, indicating a compact to dense state of compactness. The results of grain size distribution testing completed on three samples of the non-cohesive deposit are presented in Figure B6. Atterberg limit testing was carried out on three samples of the non-cohesive deposit; two Atterberg limits tests indicated a non-plastic silt, and the other Atterberg limits test (the results of which are presented on a plasticity chart in Figure B7 in Appendix B) measured a liquid limit of 16%, a plastic limit of 15%, and a corresponding plasticity index of 1%, which indicates a silt of slight plasticity. The water content measured on samples of the non-cohesive deposit ranges from about 17% to 25%.
- **Clayey Silt (CL) Till – Lower Deposit:** A lower cohesive deposit of glacial till consisting of clayey silt was encountered underlying the non-cohesive deposit in both boreholes. The lower cohesive till deposit was encountered at depths ranging from 5.8 m to 6.6 m below ground surface (approximately Elevations 217.0 m to 216.4 m) and extended to the termination depth of 6.7 m (Elevations 216.2 m to 216.1 m). One SPT “N”-value measured in the lower cohesive till deposit yielded 33 blows per 0.3 m of penetration, indicating a hard consistency. Atterberg limit testing was carried out on a sample of the lower cohesive till deposit and the results are presented on a plasticity chart in Figure B5 (Borehole RW-7 Sample 7B) in Appendix B. The Atterberg limits test measured a liquid limit of about 22%, a plastic limit of about 14% and a corresponding plasticity index of about 8%. The Atterberg limits test indicates a clayey silt of low plasticity. The water content measured on a sample of the lower cohesive till deposit was about 9%. Although not specifically encountered in the boreholes, the presence of cobbles and boulders should be expected in the lower cohesive till deposit.

4.3 Groundwater Conditions

The groundwater levels measured in the open boreholes at the time of the investigation are not considered representative of the stabilized hydrostatic groundwater levels at the site. All water levels recorded in the boreholes as part of this subsurface exploration program were taken shortly after drilling operations and therefore represent an unstabilized groundwater level. The unstabilized groundwater levels measured in the open boreholes upon completion of drilling are presented in the borehole records in Appendix A and are summarized below. Borehole RW-4 caved to a depth of 1.1 m (Elevation 208.7 m) and a water level was not recorded.

Location	Borehole No.	Groundwater Level in Open Borehole (Does Not Represent Stabilized Level)		Date of Reading
		Depth (m)	Elevation (m)	
Bass Pro Mills Drive S-E/W Ramp	RW-1	5.2	204.1	July 11, 2023
	RW-2	5.2	204.3	July 11, 2023
	RW-3	5.4	204.2	July 11, 2023
	RW-4	N/A	N/A	July 11, 2023
	RW-5	5.6	204.5	July 11, 2023
Rutherford Road S-E/W Ramp	RW-6	4.9	217.9	July 12, 2023
	RW-7	4.6	218.3	July 12, 2023

Based on the colour transition from brown to grey in the boreholes at the Bass Pro Drive Mills S-E/W ramp location, it is estimated that the groundwater level is between approximately Elevation 205 m to 206.5 m.

A standpipe piezometer was installed within an augered hole at the Rutherford Road S-E/W ramp between Boreholes RW-6 and RW-7. The location of this piezometer, designated RW-MW, is shown on Drawing 2. The groundwater level in the piezometer was measured at a depth of about 4.6 m (Elevation 218.2 m) on October 31, 2023.

The groundwater level and hydrostatic head at depth at this site will be subject to seasonal fluctuations and precipitation events; the water levels should be expected to be higher during the spring season or during and following periods of heavy precipitation and snow melt.

4.4 Analytical Testing of Soil

Three soil samples (two from the boreholes advanced in the vicinity of the Bass Pro Mills Drive S-E/W ramp retaining wall and one from the boreholes advanced in the vicinity of the Rutherford Road S-E/W ramp retaining wall) were submitted for laboratory analysis of parameters used to assess the potential corrosivity of the site soil to steel and concrete. Detailed analytical test results are included in Appendix C and the test results are summarized below.

Borehole No., Sample No.	pH	Resistivity (ohm-cm)	Electrical Conductivity (µmho/cm)	Soluble Chloride (µg/g)	Soluble Sulphate (µg/g)
RW-2, SS5	7.88	360	2750	1400	220
RW-4, SS3	7.72	620	1610	740	260
RW-6, SS3	7.99	640	1550	750	52

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Sunduss Asghar, EIT, and Mr. Mark Henderson, P.Eng., a Geotechnical Engineer with WSP. Mr. David Staseff, P.Eng., a Senior Principal and MTO Principal Foundations Contact for WSP, and Ms. Lisa Coyne, P.Eng., Geotechnical Engineering Fellow and an MTO Principal Foundations Contact for WSP, conducted an independent technical and quality control review of this report.

Signature Page

WSP Canada Inc.



Mark Henderson, P.Eng.
Geotechnical Engineer

A handwritten signature in black ink that reads "Dave Staseff".

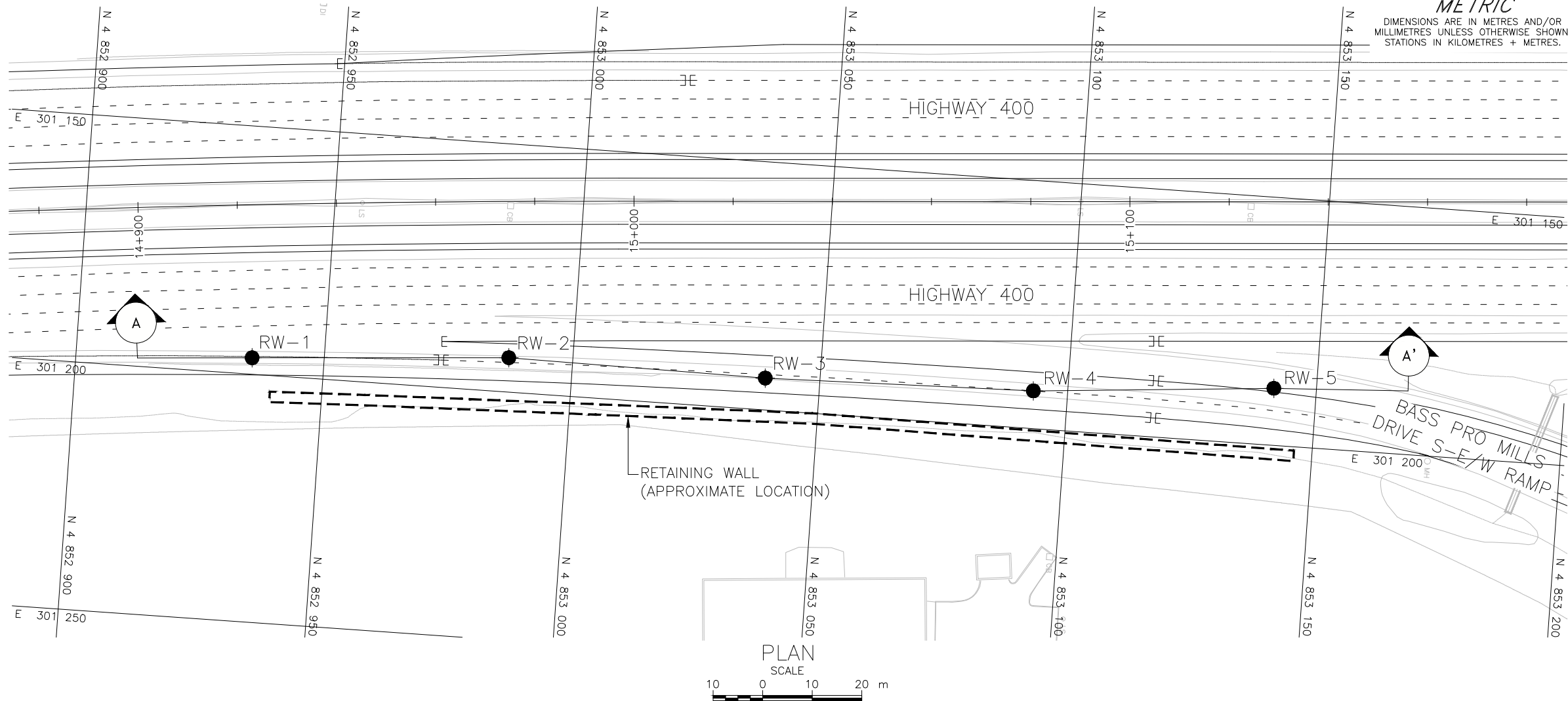
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MH/DS/LCC/ljv/al

[https://golderassociates.sharepoint.com/sites/152126/project files/6 deliverables/3. foundations/2. reports/07. retaining walls/final/21490972-r-rev0_05dec2023_fir_retaining_walls.docx](https://golderassociates.sharepoint.com/sites/152126/project%20files/6%20deliverables/3.%20foundations/2.%20reports/07.%20retaining%20walls/final/21490972-r-rev0_05dec2023_fir_retaining_walls.docx)

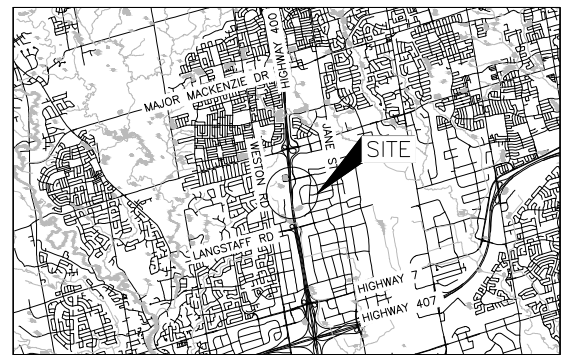


CONT No.
GWP No.2836-02-00



HIGHWAY 400 WIDENING
BASS PRO MILLS DRIVE S-E/W RAMP RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

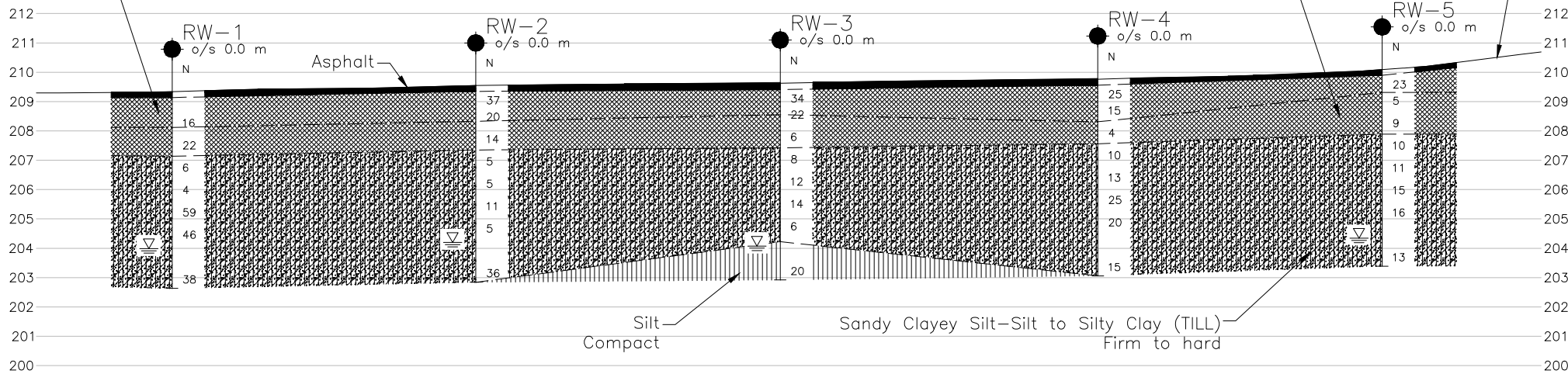
- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
RW-1	209.3	4852935.5	301196.7
RW-2	209.5	4852987.1	301193.1
RW-3	209.6	4853039.0	301193.6
RW-4	209.8	4853093.1	301192.4
RW-5	210.1	4853141.4	301188.5

Gravelly Sand (FILL)
Compact to dense

Sandy Clayey Silt-Silt to Silty Clay (FILL)
Firm to very stiff

Existing Road Surface



NOTES

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

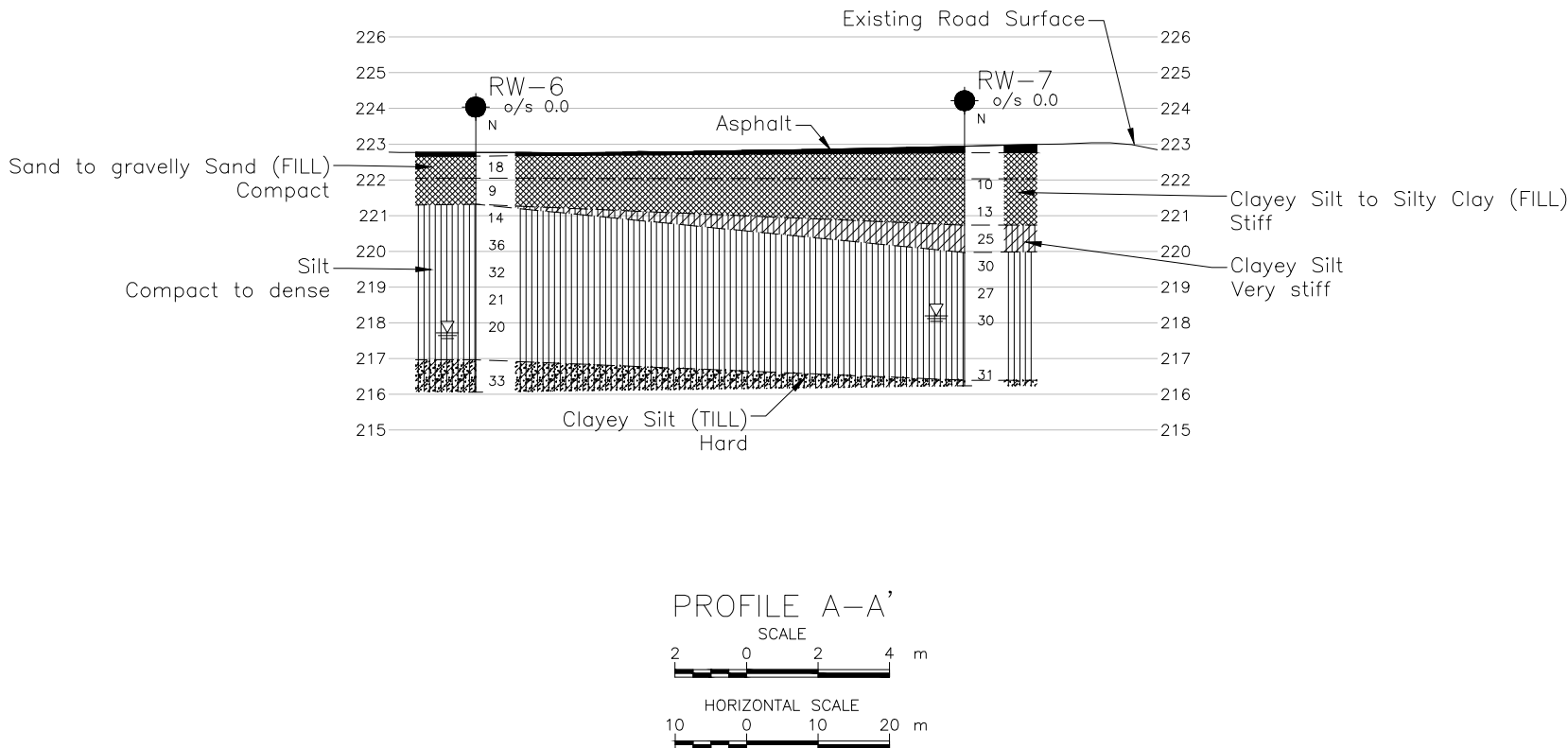
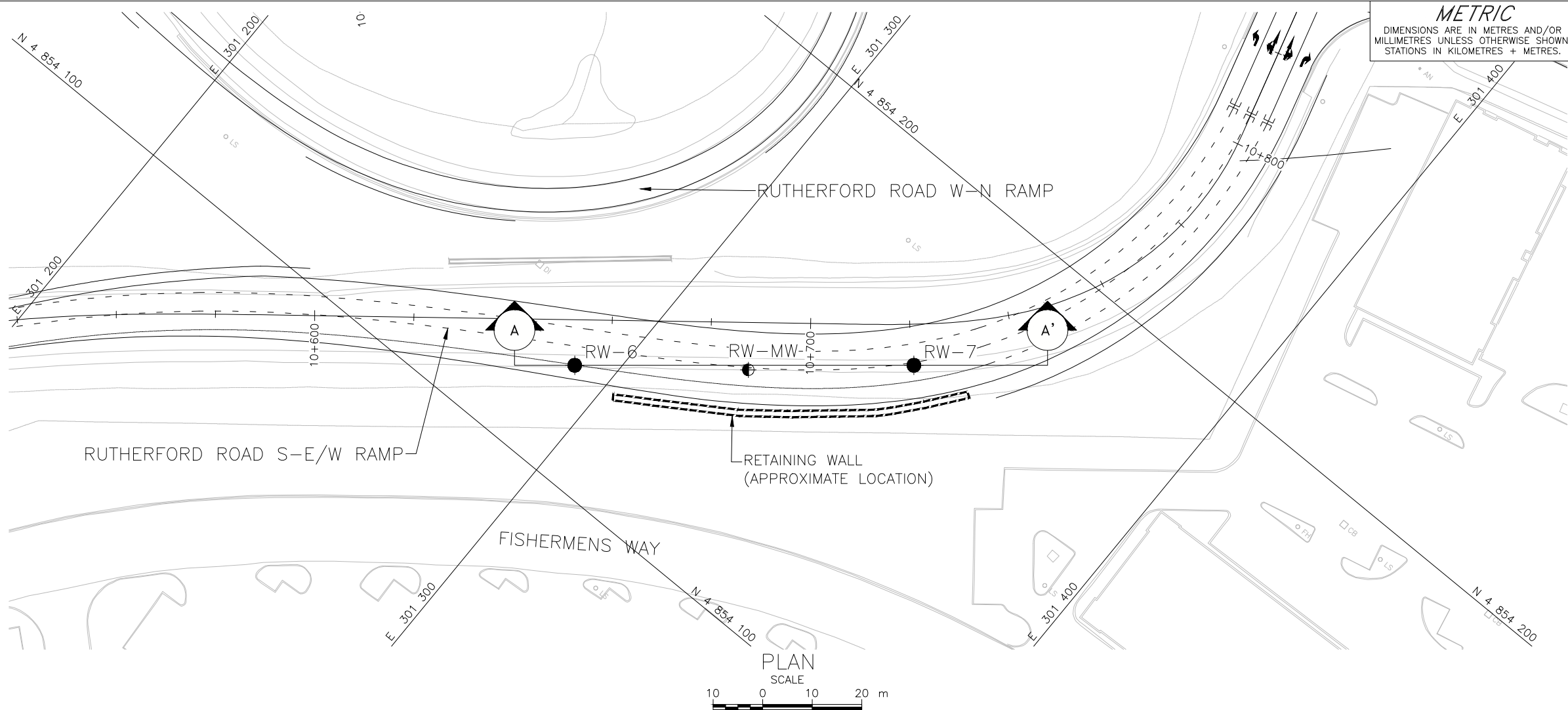
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plans provided in digital format by Parsons, drawing file nos. Hwy400_Extsting Survey-Topo.dwg, H400-ROD-PLN.dwg, 73-400.xml, received June 1, 2022.
Culvert plan provided by Parsons, file no. H400-DRN-PLN.dwg, received September 29, 2022.
Design plan provided by Parsons, file no. Existing OHS Footing Locations - H400-478198-ROD-PMK.dwg, received March 8, 2023.



NO.	DATE	BY	REVISION
Geocres No.		PROJECT NO. 21490972	DIST. .
HWY. 400	CHKD. MH	DATE: 12/05/2023	SITE: .
SUBM'D. MH	CHKD. MH	APPD. LCC	DWG. 1

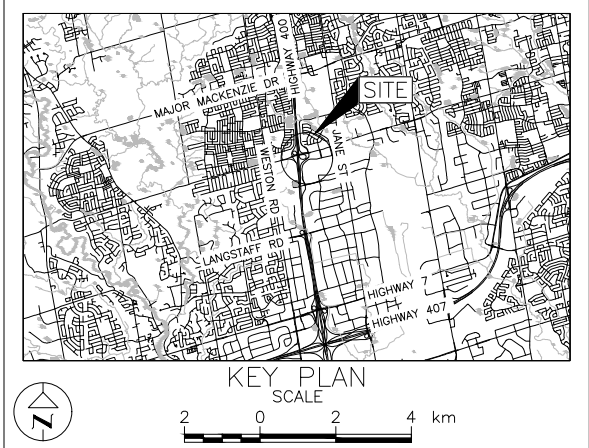


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No.2836-02-00

HIGHWAY 400 WIDENING
RUTHERFORD ROAD S-E/W RAMP RETAINING WALL
BOREHOLE LOCATIONS AND SOIL
STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- Monitoring Well - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
RW-6	222.8	4854121.2	301292.6
RW-7	222.9	4854164.6	301345.4
RW-MW	222.8	4854142.7	301320.2

NOTES

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

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

REFERENCE

Base plans provided in digital format by Parsons, drawing file nos. Hwy400_Extsting Survey-Topo.dwg, H400-ROD-PLN.dwg, 73-400.xml, received June 1, 2022.

Culvert plan provided by Parsons, file no. H400-DRN-PLN.dwg, received September 29, 2022.

Design plan provided by Parsons, file no. Existing OHS Footing Locations - H400-478198-ROD-PMK.dwg, received March 8, 2023.



NO.	DATE	BY	REVISION
Geocres No., PROJECT NO. 21490972 DIST. .			
HWY. 400	CHKD. MH	DATE: 12/05/2023	SITE: .
SUBM'D. MH	CHKD. MH	APPD. LCC	DWG. 2

APPENDIX A

Borehole Records

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

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

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (<i>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)
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

* 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

PROJECT	21490972		RECORD OF BOREHOLE		No. RW-1	Sheet 1 of 1	METRIC	
G.W.P.	2836-02-00		LOCATION	N 4852935.5; E 301196.7 NAD83 / MTM Zone 10 (LAT. 43.816376; LONG. -79.544792)			ORIGINATED BY	T.T.
DIST	CENTRAL	HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger			COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:209.3 m		DATE	Jul 11, 2023			CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT					REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L		GR	SA	SI	CL	
209.3								20	40	60	80	100	20	40	60						
0.0	ASPHALT																				
0.2																					
209.1	Gravelly SAND (SW), some silt (FILL) Compact Grey Moist						209														
			1A	SS	16																
208.1																					
1.2	CLAYEY SILT (CL), trace gravel (FILL), contains organics Very stiff Dark brown Moist		1B				208														
			2	SS	22																
207.1																					
2.2	SILTY CLAY (CI), some sand, contains oxidation staining (TILL) Brown and grey mottled Firm Moist		3	SS	6		207														
206.4																					
3.0	Sandy CLAYEY SILT - SILT (CL- ML), trace gravel (TILL) Grey Hard Moist		4	SS	4		206														
			5	SS	59		205														
			6	SS	46		204														
			7	SS	38		203														
6.7																					
202.6	End of Borehole																				
	NOTES: 1. Borehole caved to a depth of 5.8 m (Elev. 203.5 m) upon completion of drilling. 2. Water measured inside borehole at a depth of 5.2 m (Elev. 204.1 m) upon completion of drilling.																				

PROJECT	21490972		RECORD OF BOREHOLE		No. RW-2	Sheet 1 of 1	METRIC	
G.W.P.	2836-02-00		LOCATION	N 4852987.1; E 301193.1 NAD83 / MTM Zone 10 (LAT. 43.816841; LONG. -79.544837)			ORIGINATED BY	T.T.
DIST	CENTRAL	HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger			COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:209.5 m		DATE	Jul 11, 2023			CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT	GR	SA	SI	CL	REMARKS
ELEV. ----- DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL	NMC	LL						
209.5																					
0.0	ASPHALT																				
0.2																					
209.3	SAND (SW), and gravel, some silt (FILL) Compact to dense Brown to grey Moist		1	SS	37		209										36	51	11	2	
			2A	SS	20																
208.3			2B																		
1.2	CLAYEY SILT - SILT (CL-ML), trace sand, trace gravel (FILL) Stiff Dark Grey Moist		3A	SS	14		208														
			3B																		
207.3	2.0 - 2.1 m depth: organic sand pocket encountered . (Elev. 207.5 to 207.0 m)																				
2.2	CLAYEY SILT (CL) to CLAYEY SILT - SILT (CL-ML), some sand to sandy (TILL) Firm to hard Brown; becoming grey at about 5.6 m depth (Elev. 203.9 m) Moist		4	SS	5		207										0	11	65	24	
			5	SS	5		206														
			6	SS	11		205														
			7	SS	5		204										1	22	56	21	
			8	SS	36		203														
6.7																					
202.8	End of Borehole																				
NOTES:																					
1. Borehole caved to a depth of 5.9 m (Elev. 203.6 m) upon completion of drilling.																					
2. Water measured inside borehole at a depth of 5.2 m (Elev. 204.3 m) upon completion of drilling.																					

PROJECT	21490972	RECORD OF BOREHOLE	No. RW-3	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	LOCATION	N 4853039; E 301193.6 NAD83 / MTM Zone 10 (LAT. 43.817308; LONG. -79.544832)	ORIGINATED BY	T.T.
DIST	CENTRAL HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger	COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:209.6 m	DATE	Jul 11, 2023	CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT Y	GR	SA	SI	CL	REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L						
209.6	ASPHALT							20	40	60	80	100	20	40	60						
0.0	ASPHALT																				
209.4	SAND (SW) and gravel, some silt (FILL)		1	SS	34		209														
0.2	Dense Brown to grey Moist		2A	SS	22																
208.6	CLAYEY SAND (SC) with gravel (FILL)		2B	SS																	
1.1	Loose to compact Dark Grey Moist		3	SS	6		208														
	0.8-1.1 m depth : organic pocket encountered (Elev. 208.8 m to 208.5 m)																				
207.4	CLAYEY SILT (CL) to SILTY CLAY (CI), some sand, contains oxidation stains (TILL)		4	SS	8		207														
2.2	Firm to stiff Light brown to brown; becoming grey at about 4.4 m depth (Elev. 205.2 m)		5	SS	12		206														
	Moist		6	SS	14																
			7	SS	6		205														
204.2	Sandy SILT (ML), some clay, trace gravel						204														
5.4	Compact Dark grey Moist		8	SS	20																
6.7	End of Borehole						203														
202.9	NOTES: 1. Borehole open upon completion of drilling. 2. Water measured inside open borehole at a depth of 5.4 m (Elev. 204.2 m) upon completion of drilling.																				

+³, x³ : Numbers refer to Sensitivity o³⁰% STRAIN AT FAILURE

PROJECT	21490972	RECORD OF BOREHOLE			No. RW-4	Sheet 1 of 1	METRIC		
G.W.P.	2836-02-00	LOCATION	N 4853093.1; E 301192.4 NAD83 / MTM Zone 10 (LAT. 43.817795; LONG. -79.544847)			ORIGINATED BY	T.T.		
DIST	CENTRAL	HWY	400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger			COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:209.8 m			DATE	Jul 11, 2023			CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT	GR	SA	SI	CL	REMARKS																																																			
ELEV. ----- DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL	NMC	LL																																																									
								Field Vane	Remoulded	Pocket Pen	Quick Triaxial	Unconfined	W _p	W	W _L																																																									
209.8							20	40	60	80	100	20	40	60	Y																																																									
0.0	ASPHALT						209																																																																	
0.2	Gravelly SAND (SW), some silt (FILL) Compact Brown Moist		1	SS	25																																																																			
209.6			2	SS	15																																																																			
208.3	1.4	Sandy CLAYEY SILT (CL), trace gravel (FILL) Soft to Firm Brown and grey Moist																																																																						
207.6	2.2																																		CLAYEY SILT - SILT (CL - ML) and sand to sandy, contains oxidation stains (TILL) Stiff to very stiff Brown; becoming grey at about 3.7 m depth (Elev. 206.1 m) Moist																																					
	4	SS	10																																																																					
	5	SS	13																																																																					
	6	SS	25																																																																					
	7	SS	20																																																																					
	8	SS	15																																																																					
203.1	End of Borehole																																																																							
6.7	NOTES: 1. Borehole caved to a depth of 1.1 m (Elev. 208.7 m) upon completion of drilling and water level could not be recorded.																																																																							

PROJECT	21490972	RECORD OF BOREHOLE	No. RW-5	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	LOCATION	N 4853141.4; E 301188.5 NAD83 / MTM Zone 10 (LAT. 43.81823; LONG. -79.544895)	ORIGINATED BY	T.T.
DIST	CENTRAL HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger	COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:210.1 m	DATE	Jul 11, 2023	CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT	GR	SA	SI	CL	REMARKS
ELEV. ----- DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL	NMC	LL						
210.1							Field Vane					W _p	W	W _L							
0.0	ASPHALT						Remoulded					NP Nonplastic			Y						
209.9	Gravelly SAND (SW), some silt (FILL)		1	SS	23		Pocket Pen														
0.2	Compact Brown Moist						Quick Triaxial														
209.3							Unconfined														
0.8	SILTY CLAY (CI), some sand (FILL)		2	SS	5																
	Firm to stiff																				
	Light brown to brown and grey mottled		3	SS	9																
	Moist																				
207.9																					
2.2	CLAYEY SILT (CL) to CLAYEY SILT - SILT (CL-ML), some sand to sandy, trace gravel, contains oxidation stains to about 2.2 m depth (Elev. 207.9 m), (TILL) Stiff to very stiff Brown; becoming grey at about 3.7 m depth (Elev. 206.4 m) Moist		4	SS	10																
			5	SS	11																
			6	SS	15																
			7	SS	16																

PROJECT	21490972	RECORD OF BOREHOLE		No. RW-6	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	LOCATION	N 4854121.2; E 301292.6 NAD83 / MTM Zone 10 (LAT. 43.827049; LONG. -79.543608)			ORIGINATED BY T.T.
DIST	CENTRAL	HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger		COMPILED BY P.T.
DATUM	Geodetic Surface Elevation:222.8 m		DATE	Jul 11, 2023		CHECKED BY M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT Y	GR	SA	SI	CL	REMARKS
ELEV. ----- DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L						
222.8								20	40	60	80	100	20	40	60						
0.0	ASPHALT																				
0.1	Gravelly SAND (SW)																				
222.7	Compact		1	SS	18													16	73	10	1
	Brown																				
	Moist																				
222.0							222														
0.7	CLAYEY SILT (CL), some sand, trace gravel (FILL), contains shale fragments		2	SS	9																
	Stiff																				
	Brown																				
	Moist																				
221.3																					
1.4	SILT (ML), trace to some sand, trace gravel, trace clay, contains oxidation stains		3	SS	14		221														
	Compact to dense																				
	Brown																				
	Moist; becoming wet at about 3.7 m depth (Elev. 219.1 m)																				
			4	SS	36		220									NP		0	3	94	3
			5	SS	32																
							219														
			6	SS	21																
			7	SS	20		218											2	18	76	4
217.0																					
5.8	CLAYEY SILT (CL), some sand, trace gravel (TILL)						217														
	Hard																				
	Grey		8	SS	33																
	Moist																				
6.7																					
216.1	End of Borehole																				
	NOTES:																				
	1. Borehole caved to a depth of 5.4 m (Elev. 217.4 m) upon completion of drilling.																				
	2. Water measured inside borehole at a depth of 4.9 m (Elev. 217.9 m) upon completion of drilling.																				

PROJECT	21490972		RECORD OF BOREHOLE		No. RW-7	Sheet 1 of 1	METRIC	
G.W.P.	2836-02-00		LOCATION	N 4854164.6; E 301345.4 NAD83 / MTM Zone 10 (LAT. 43.82744; LONG. -79.542952)			ORIGINATED BY	T.T.
DIST	CENTRAL	HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger			COMPILED BY	P.T.
DATUM	Geodetic Surface Elevation:222.9 m		DATE	Jul 11, 2023			CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT	GR	SA	SI	CL	REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L						
222.9								20	40	60	80	100	20	40	60						
0.0	ASPHALT																				
222.8 0.2	SAND (SP), some gravel (FILL) Dark brown Moist																				
222.0			1A				222														
0.9	CLAYEY SILT (CL) to CLAYEY SILT - SILT (CL-ML) some sand (FILL), contains oxidation stains Stiff Light brown Moist		1B	SS	10																
			2	SS	13		221														
220.7																					
2.2	CLAYEY SILT-SILT (CL-ML), some sand, contains oxidation stains (TILL) Very stiff Light brown Moist		3	SS	25		220										0	14	68	18	
220.0																					
3.0	SILT (ML), trace sand, trace clay Compact to dense Brown Wet		4	SS	30																
							219														
			5	SS	27																
			6	SS	30		218										0	5	92	3	
							217														
			7A	SS	31																
216.4																					
6.6	CLAYEY SILT (CL), some sand, trace gravel (TILL)		7B																		
6.7	Grey																				
216.2	Moist																				
	End of Borehole																				
	NOTES:																				
	1. Borehole caved to a depth of 5.1 m (Elev. 217.8 m) upon completion of drilling.																				
	2. Water measured inside borehole at a depth of 4.6 m (Elev. 218.3 m) upon completion of drilling.																				

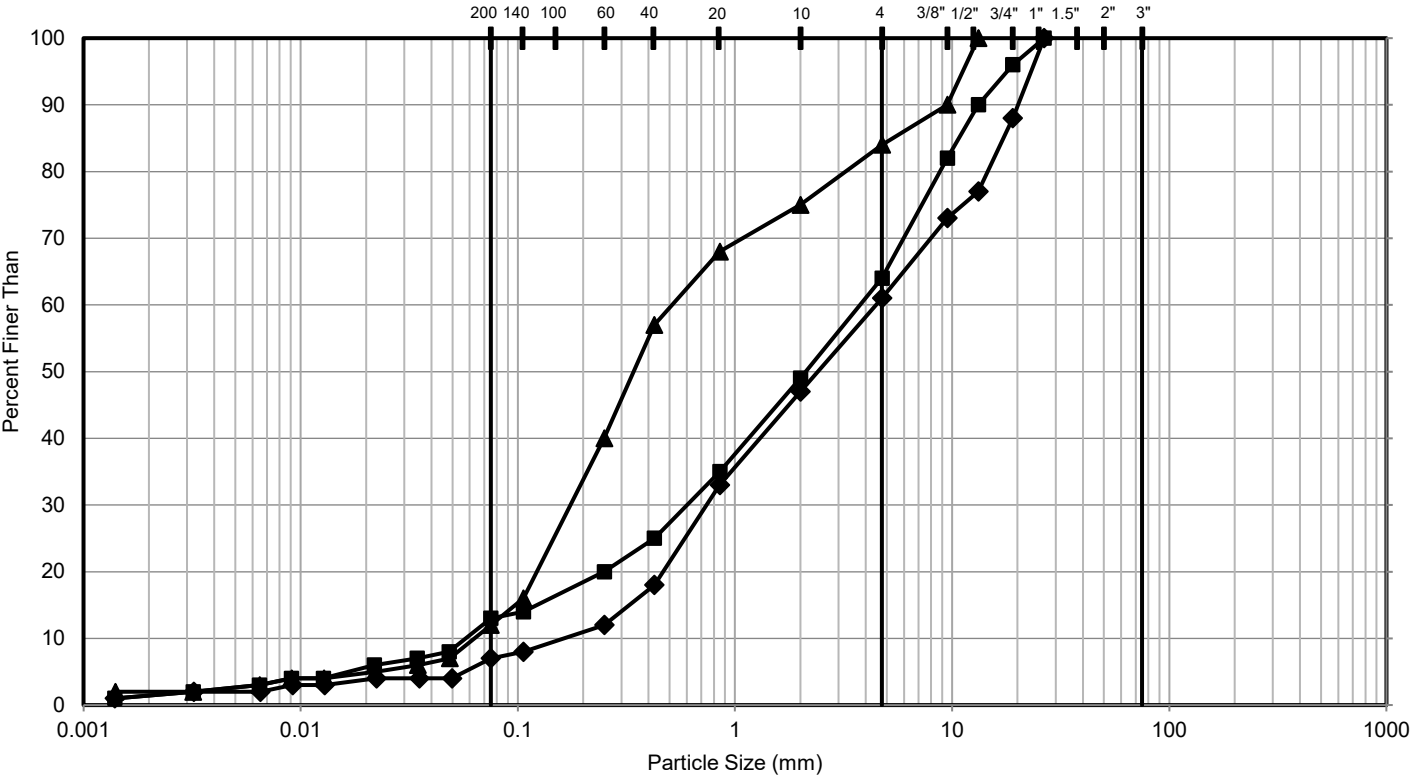
PROJECT	21490972	RECORD OF BOREHOLE	No. RW-MW	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	LOCATION	N 4854142.7; E 301320.2 NAD83 / MTM Zone 10 (LAT. 43.827252; LONG. -79.543268)		ORIGINATED BY S.A.
DIST	CENTRAL HWY 400	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger		COMPILED BY S.A.
DATUM	Geodetic Surface Elevation:222.8 m	DATE	Jul 27, 2023 - Jul 28, 2023		CHECKED BY M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)			UNIT WEIGHT Y	GR	SA	SI	CL	REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L						
222.8								Field Vane	Remoulded	Pocket Pen	Quick Triaxial	Unconfined	NP Nonplastic								
0.0	ASPHALT (150 mm)							20	40	60	80	100	20	40	60						
222.7	SAND (SP) and gravel (FILL)																				
0.2	Brown Moist																				
222.0																					
0.9	CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML) FILL Stiff Brown Moist																				
221.0																					
1.9	CLAYEY SILT-SILT (CL-ML), some sand Very stiff Brown Moist																				
220.4																					
2.5	SILT (ML), trace to some sand, trace gravel Compact to dense Brown Moist to wet																				
217.1																					
5.8	CLAYEY SILT (CL), trace to some sand, trace gravel																				
216.8	(TILL) Hard																				
6.1	Grey Moist																				
End of Borehole																					
NOTES: 1. Borehole open and dry upon completion of drilling. 2. Soil Stratigraphy inferred from surrounding boreholes (RW-6 and RW-7). 3. Water level measured in standpipe piezometer at a depth of about 4.6 m below ground surface (Elev. 218.2 m) on October 31, 2023.																					

APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION



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

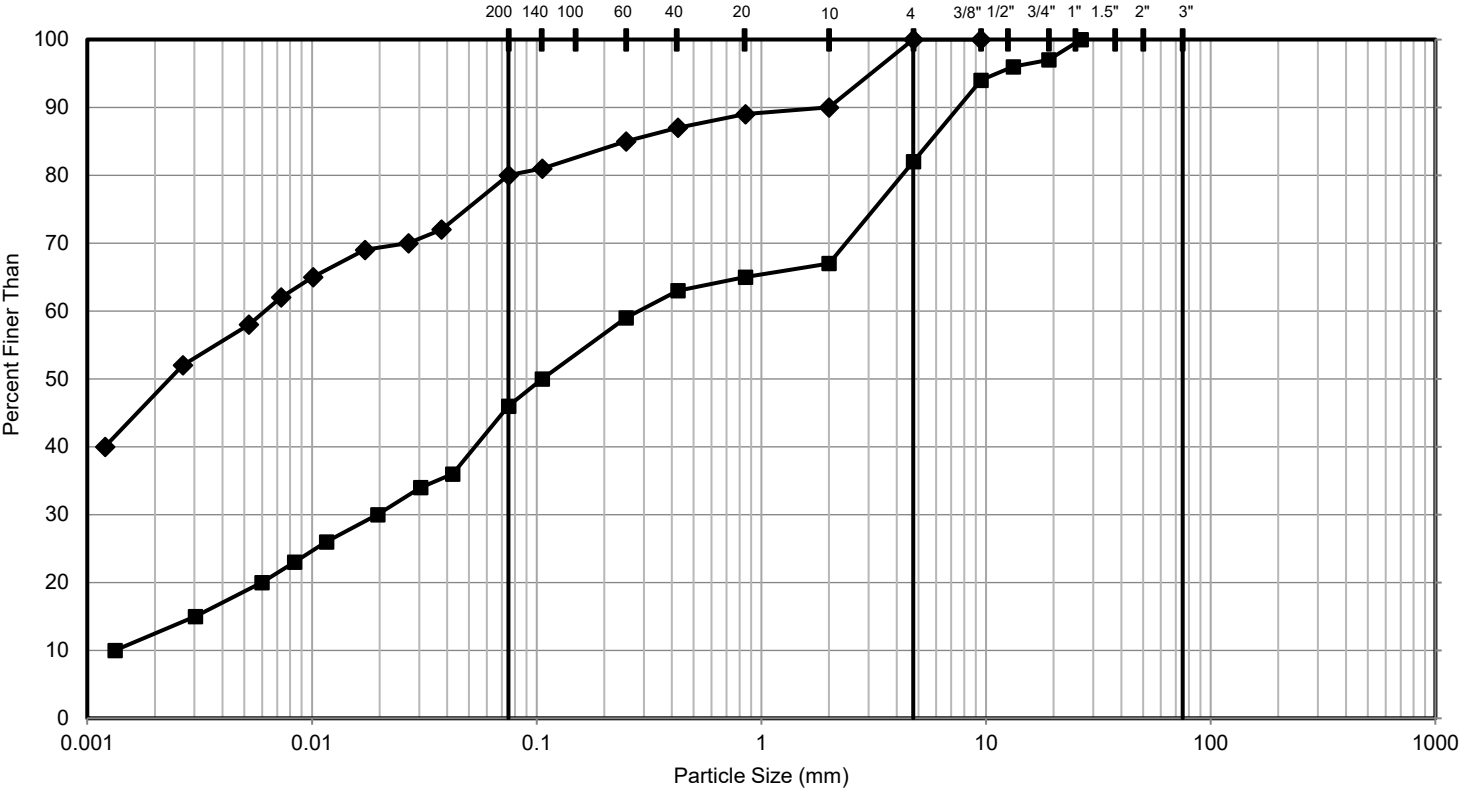
Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	RW-2	1	0.2 - 0.8	209.3 to 208.7
◆	RW-4	2	0.8 - 1.4	209.0 to 208.4
▲	RW-6	1	0.1 - 0.7	222.7 to 222.1

CLIENT		PROJECT	
PARSONS / MTO		RETAINING WALLS HIGHWAY 400 WIDENING GWP 2836-02-00	
CONSULTANT	YYYY-MM-DD	2023-08-11	
	DESIGNED	TT	
	PREPARED	TT	
	REVIEWED	MH	
	APPROVED	LCC	
TITLE		GRAIN SIZE DISTRIBUTION SAND (SW) and gravel to gravelly (FILL)	
		PROJECT NO.	CONTROL
		21490972	0
		REV.	0
		FIGURE	B1



PATH: C:\Users\jld_MHenderson\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Bentley\OpenGround\Excel Extension\Temporary | FILE NAME: Laboratory Particle Size Distribution MTO.xlsm

GRAIN SIZE DISTRIBUTION



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

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	RW-3	3	1.5 - 2.1	208.1 to 207.5
◆	RW-5	3	1.5 - 2.1	208.6 to 208.0

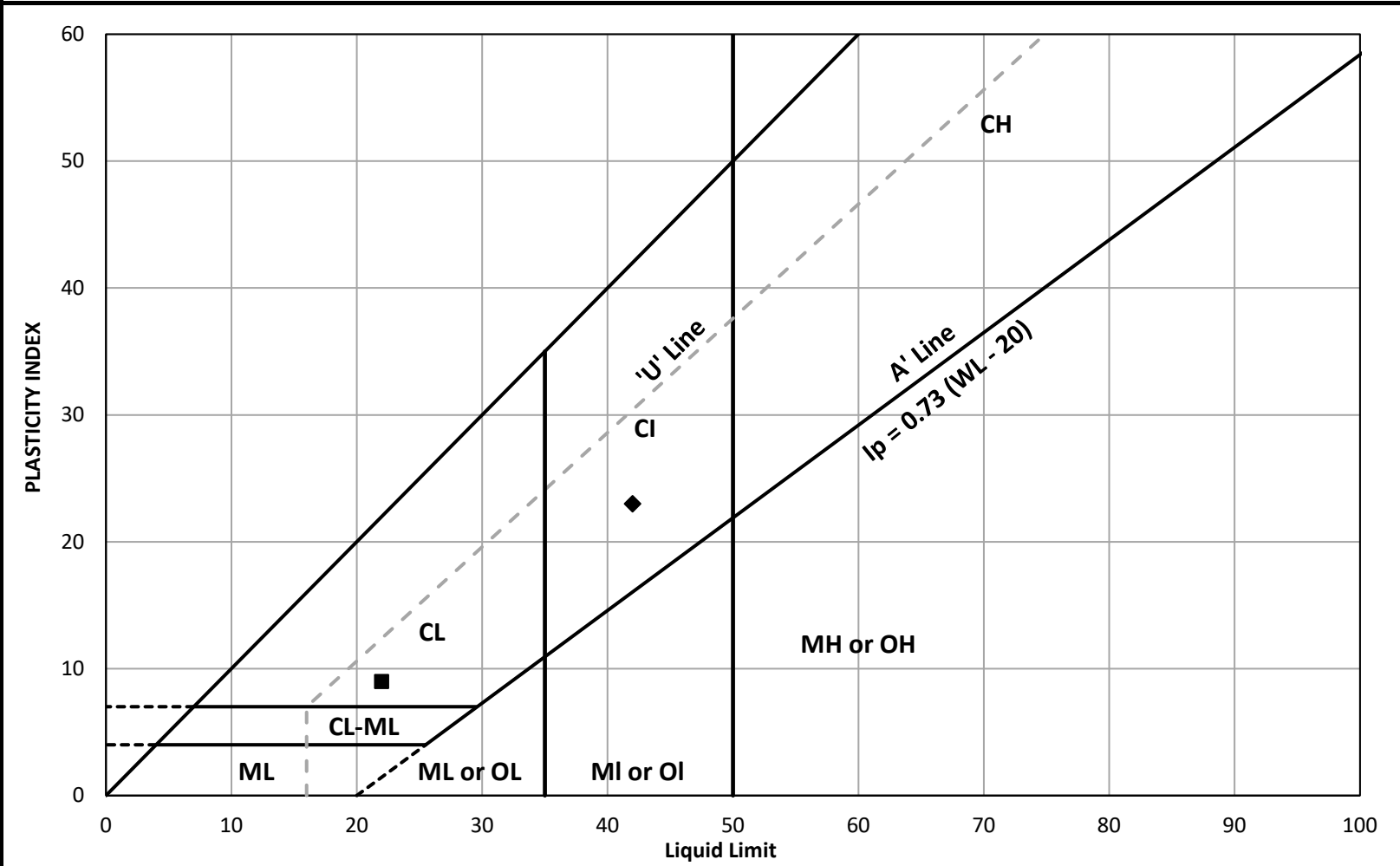
CLIENT	
PARSONS / MTO	
CONSULTANT	YYYY-MM-DD 2023-08-11
	DESIGNED TT
	PREPARED TT
	REVIEWED MH
	APPROVED LCC



PROJECT			
RETAINING WALLS			
HIGHWAY 400 WIDENING			
GWP 2836-02-00			
TITLE			
GRAIN SIZE DISTRIBUTION			
Sandy CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)			
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B2

PATh: https://wsponline-my.sharepoint.com/personal/mark_henderson_wsp_com/Documents/MT0/FIDR/21490972 | FILE NAME: Retaining Walls Atterberg Working File.xlsm

PLASTICITY CHART



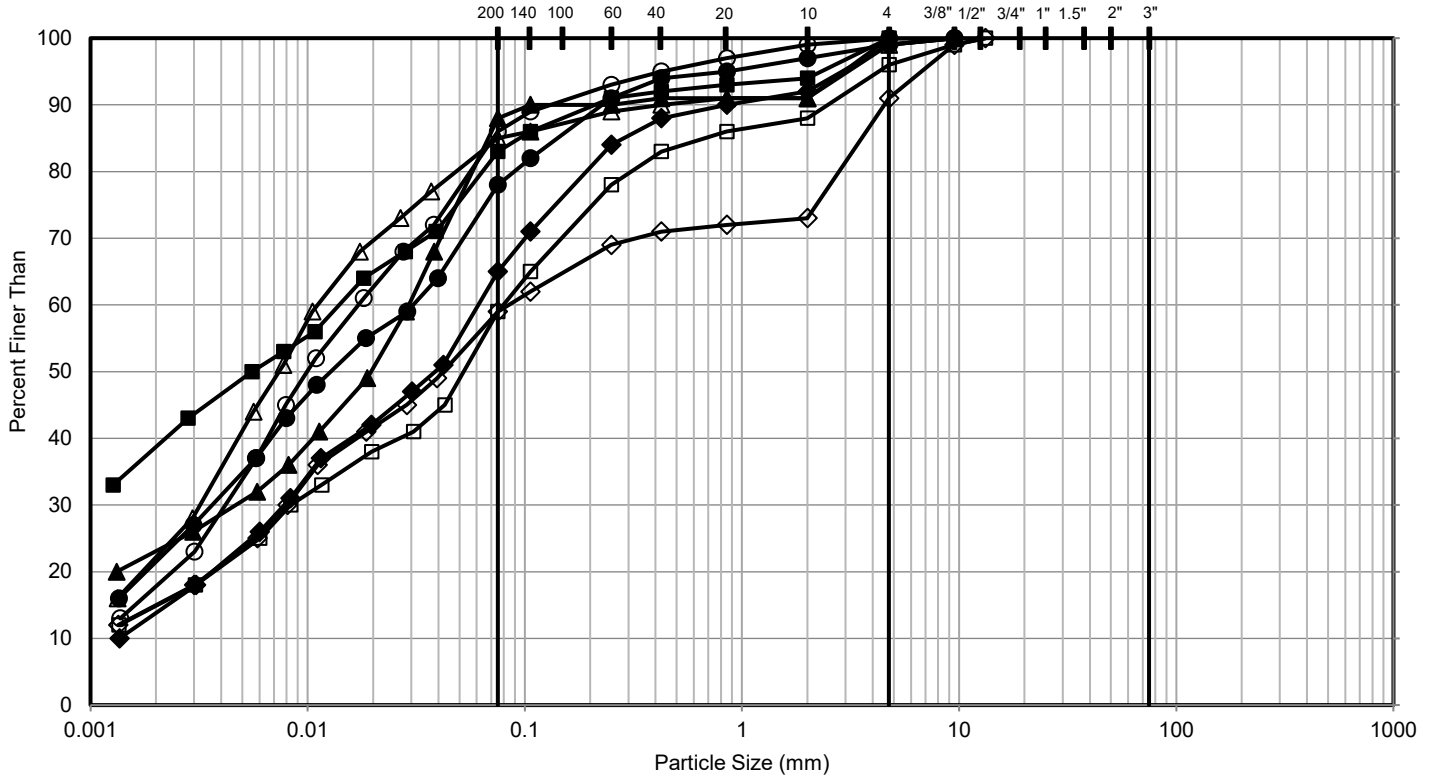
	Sample Location	Sample / Specimen Number	Elevation (m)	Liquid Limit	Plastic Limit	Plasticity Index		
■	RW-3	3	208.10 to 207.49	22	13	9		
◆	RW-5	3	208.57 to 207.96	42	19	23		

CLIENT		
PARSONS / MTO		
CONSULTANT	YYYY-MM-DD	2023-08-11
	DESIGNED	TT
	PREPARED	TT
	REVIEWED	MH
	APPROVED	LCC



PROJECT			
RETAINING WALLS HIGHWAY 400 WIDENING GWP 2836-02-00			
TITLE			
PLASTICITY CHART Sandy CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)			
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B3

GRAIN SIZE DISTRIBUTION



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

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	RW-1	3	2.3 - 2.9	207.1 to 206.4
◆	RW-1	6	4.6 - 5.2	204.8 to 204.2
▲	RW-2	4	2.3 - 2.9	207.3 to 206.6
●	RW-2	7	4.6 - 5.2	205.0 to 204.4
□	RW-4	4	2.3 - 2.9	207.5 to 206.9
◇	RW-4	7	4.6 - 5.2	205.2 to 204.6
△	RW-5	6	3.8 - 4.4	206.3 to 205.7
○	RW-7	3	2.3 - 2.9	220.7 to 220.0

CLIENT

PARSONS / MTO

CONSULTANT



YYYY-MM-DD 2023-08-11

DESIGNED TT

PREPARED TT

REVIEWED MH

APPROVED LCC

PROJECT

RETAINING WALLS
HIGHWAY 400 WIDENING
GWP 2836-02-00

TITLE

GRAIN SIZE DISTRIBUTION
CLAYEY SILT-SILT (CL-ML) to SILTY CLAY (CI) (TILL)

PROJECT NO.

21490972

CONTROL

0

REV.

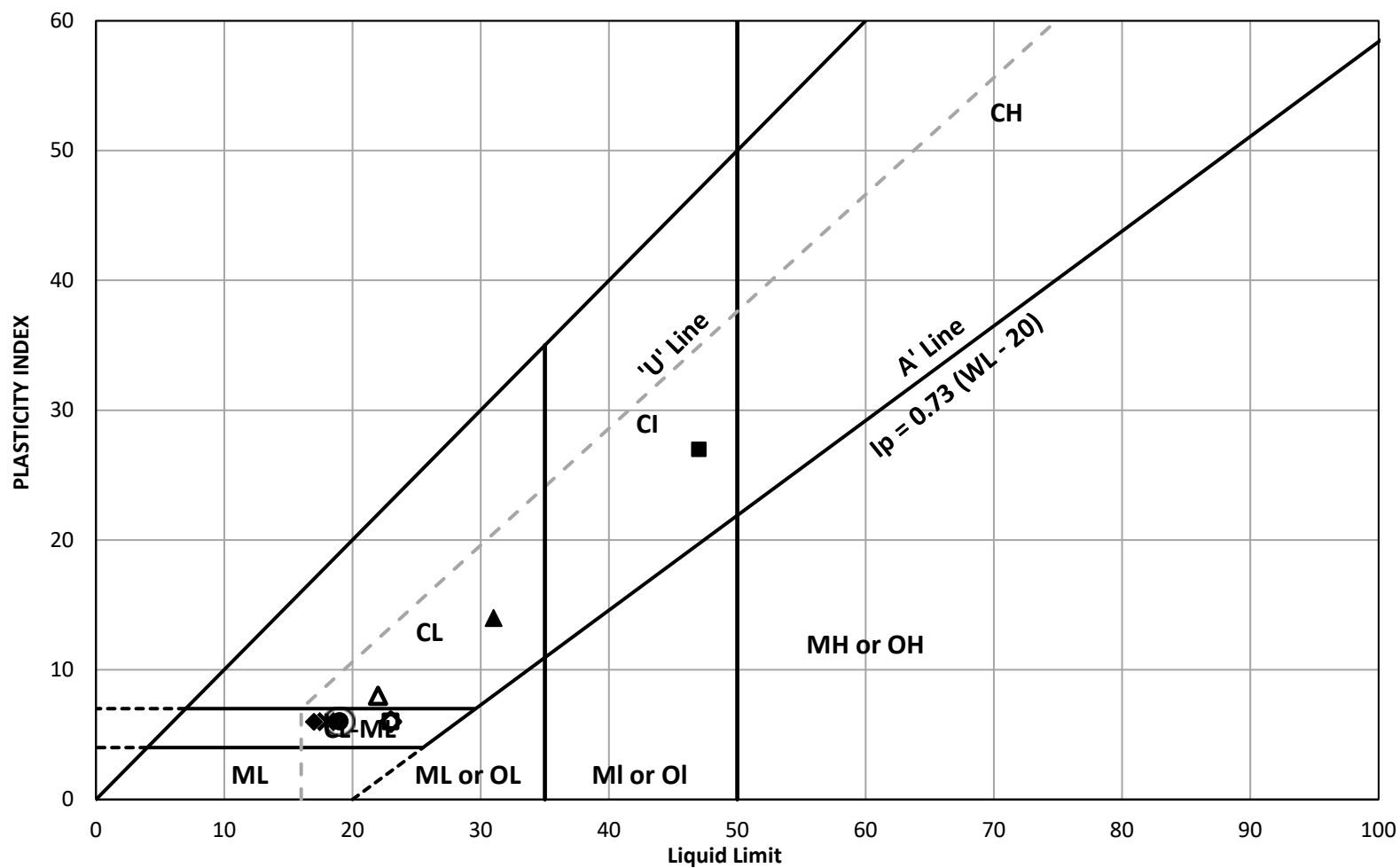
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FIGURE


B4

PATH: https://wsponline-my.sharepoint.com/personal/mark_henderson_wsp_com/_f/Documents/MT0/FIDR/21490972 | FILE NAME: Retaining Walls Atterberg Working File.xlsm

PLASTICITY CHART

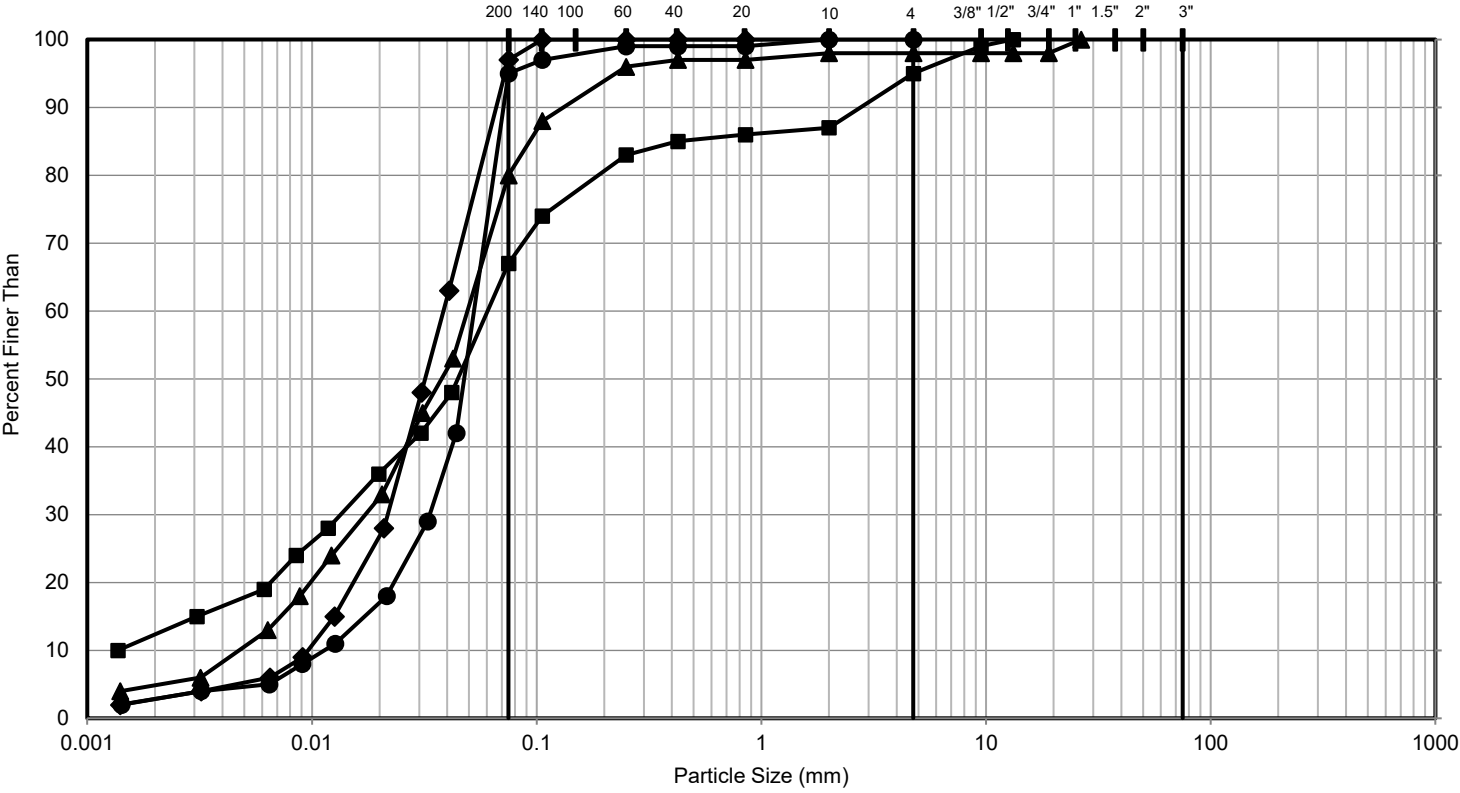


	Sample Location	Sample / Specimen Number	Elevation (m)	Liquid Limit	Plastic Limit	Plasticity Index		
■	RW-1	3	207.05 to 206.44	47	20	27		
◆	RW-1	6	204.76 to 204.16	17	11	6		
▲	RW-2	4	207.26 to 206.65	31	17	14		
●	RW-2	7	204.98 to 204.37	19	13	6		
✱	RW-4	4	207.47 to 206.86	18	12	6		
⊗	RW-4	7	205.19 to 204.58	19	13	6		
□	RW-5	6	206.28 to 205.67	23	17	6		
◇	RW-7	3	220.66 to 220.04	23	17	6		
△	RW-7	7B	216.39 to 216.23	8	22	14		

CLIENT		
PARSONS / MTO		
CONSULTANT	YYYY-MM-DD	2023-08-11
	DESIGNED	TT
	PREPARED	TT
	REVIEWED	MH
	APPROVED	LCC
		

PROJECT			
RETAINING WALLS			
HIGHWAY 400 WIDENING			
GWP 2836-02-00			
TITLE			
PLASTICITY CHART			
CLAYEY SILT-SILT (CL-ML) to SILTY CLAY (CI) (TILL)			
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B5

GRAIN SIZE DISTRIBUTION



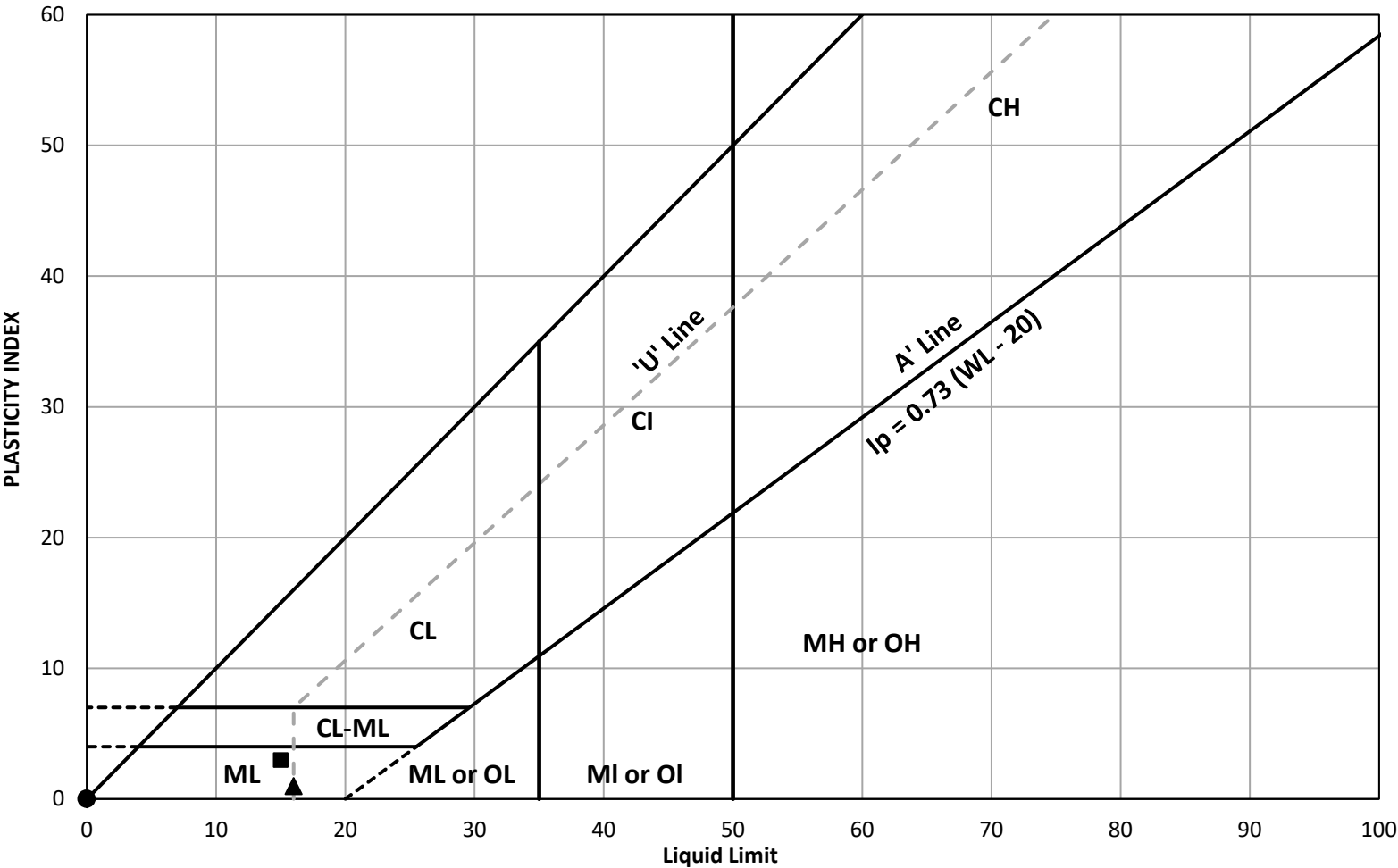
FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	RW-3	8	6.1 - 6.7	203.5 to 202.9
◆	RW-6	4	2.3 - 2.9	220.5 to 219.9
▲	RW-6	7	4.6 - 5.2	218.2 to 217.6
●	RW-7	6	4.6 - 5.2	218.4 to 217.8

CLIENT	
PARSONS / MTO	
CONSULTANT	
	YYYY-MM-DD 2023-08-11
	DESIGNED TT
	PREPARED TT
	REVIEWED MH
	APPROVED LCC

PROJECT			
RETAINING WALLS			
HIGHWAY 400 WIDENING			
GWP 2836-02-00			
TITLE			
GRAIN SIZE DISTRIBUTION			
SILT (ML), trace sand to sandy			
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B6

PLASTICITY CHART




	Sample Location	Sample / Specimen Number	Elevation (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	
■	RW-3	8	203.53 to 202.91	11.1	15	12	3	
◆	RW-6	4	220.48 to 219.87	-		NP		
▲	RW-6	7	218.19 to 217.59	-	16	15	1	
●	RW-7	6	218.37 to 217.76	21.5		NP		

CLIENT

PARSONS / MTO

CONSULTANT

 **GOLDER**

YYYY-MM-DD2023-08-11

DESIGNEDTT

PREPAREDTT

REVIEWEDMH

APPROVEDLCC

PROJECT

RETAINING WALLS
HIGHWAY 400 WIDENING
GWP 2836-02-00

TITLE

PLASTICITY CHART
SILT (ML), trace sand to sandy

PROJECT NO.

CONTROL

REV.

FIGURE

21490972

0

0

B7

APPENDIX C

Analytical Laboratory Test Results



Your Project #: 21490972 (1003.5)
Site Location: HWY 400 BTWN LANGSTAFF AND MAJOR MAC
Your C.O.C. #: 947287-01-01

Attention: Maor Levy

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

Report Date: 2023/08/18
Report #: R7770150
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C3N8555

Received: 2023/08/08, 17:18

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	3	2023/08/14	2023/08/15	CAM SOP-00463	MOE E3013 m
Conductivity	3	2023/08/14	2023/08/14	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	3	N/A	2023/08/16	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	3	N/A	2023/08/15	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	3	2023/08/15	2023/08/15	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	3	2023/08/16	2023/08/17	CAM SOP-00421	SM 2580 B
Resistivity of Soil	3	2023/08/09	2023/08/15	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	3	2023/08/14	2023/08/15	CAM SOP-00464	MOE E3013 m

Remarks:

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

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

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

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

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

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

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

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

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

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



Your Project #: 21490972 (1003.5)
Site Location: HWY 400 BTWN LANGSTAFF AND MAJOR MAC
Your C.O.C. #: 947287-01-01

Attention: Maor Levy

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

Report Date: 2023/08/18
Report #: R7770150
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C3N8555

Received: 2023/08/08, 17:18

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

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:

Ankita Bhalla, Project Manager

Email: Ankita.Bhalla@bureauveritas.com

Phone# (905) 817-5700

=====

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

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



BUREAU
VERITAS

Bureau Veritas Job #: C3N8555

Report Date: 2023/08/18

WSP Canada Inc.

Client Project #: 21490972 (1003.5)

Site Location: HWY 400 BTWN LANGSTAFF AND MAJOR MAC

Sampler Initials: ML

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		WQA768			WQA768			WQA769		
Sampling Date		2023/07/12			2023/07/12			2023/07/13		
COC Number		947287-01-01			947287-01-01			947287-01-01		
	UNITS	RW-2 SS5	RDL	QC Batch	RW-2 SS5 Lab-Dup	RDL	QC Batch	RW-4 SS3	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm	360		8842215				620		8842215
CONVENTIONALS										
Redox Potential	mV	310	N/A	8855362				300	N/A	8855362
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	1400	100	8850602	1500	100	8850602	740	20	8850602
Conductivity	umho/cm	2750	2	8851156				1610	2	8851156
Available (CaCl2) pH	pH	7.88		8852867				7.72		8852867
Soluble (20:1) Sulphate (SO4)	ug/g	220	20	8850609	230	20	8850609	260	20	8850609
Sulphide	mg/kg	3.9 (1)	0.5	8857768				1.2 (1)	0.5	8857768
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										
N/A = Not Applicable										
(1) Extracted past method specified hold time										

Bureau Veritas ID		WQA769			WQA770		
Sampling Date		2023/07/13			2023/07/13		
COC Number		947287-01-01			947287-01-01		
	UNITS	RW-4 SS3 Lab-Dup	RDL	QC Batch	RW-6 SS3	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm				640		8842215
CONVENTIONALS							
Redox Potential	mV				260	N/A	8855362
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g				750	20	8850602
Conductivity	umho/cm	1500	2	8851156	1550	2	8851156
Available (CaCl2) pH	pH				7.99		8852867
Soluble (20:1) Sulphate (SO4)	ug/g				52	20	8850609
Sulphide	mg/kg				1.7 (1)	0.5	8857768
RDL = Reportable Detection Limit							
QC Batch = Quality Control Batch							
Lab-Dup = Laboratory Initiated Duplicate							
N/A = Not Applicable							
(1) Extracted past method specified hold time							



RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		WQA768	WQA769	WQA770		
Sampling Date		2023/07/12	2023/07/13	2023/07/13		
COC Number		947287-01-01	947287-01-01	947287-01-01		
	UNITS	RW-2 SS5	RW-4 SS3	RW-6 SS3	RDL	QC Batch
Physical Testing						
Moisture-Subcontracted	%	18	13	14	0.30	8857791
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						



BUREAU
VERITAS

Bureau Veritas Job #: C3N8555
Report Date: 2023/08/18

WSP Canada Inc.
Client Project #: 21490972 (1003.5)
Site Location: HWY 400 BTWN LANGSTAFF AND MAJOR MAC
Sampler Initials: ML

TEST SUMMARY

Bureau Veritas ID: WQA768
Sample ID: RW-2 SS5
Matrix: Soil

Collected: 2023/07/12
Shipped:
Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8850602	2023/08/14	2023/08/15	Alina Dobreanu
Conductivity	AT	8851156	2023/08/14	2023/08/14	Gurpartee K AUR
Moisture (Subcontracted)	BAL	8857791	N/A	2023/08/16	Margarita Aguilera
Sulphide in Soil	SPEC	8857768	N/A	2023/08/15	Ly Vu
pH CaCl2 EXTRACT	AT	8852867	2023/08/15	2023/08/15	Surinder Rai
Redox Potential	COND	8855362	2023/08/16	2023/08/17	Gurpartee K AUR
Resistivity of Soil		8842215	2023/08/15	2023/08/15	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8850609	2023/08/14	2023/08/15	Alina Dobreanu

Bureau Veritas ID: WQA768 Dup
Sample ID: RW-2 SS5
Matrix: Soil

Collected: 2023/07/12
Shipped:
Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8850602	2023/08/14	2023/08/15	Alina Dobreanu
Sulphate (20:1 Extract)	KONE/EC	8850609	2023/08/14	2023/08/15	Alina Dobreanu

Bureau Veritas ID: WQA769
Sample ID: RW-4 SS3
Matrix: Soil

Collected: 2023/07/13
Shipped:
Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8850602	2023/08/14	2023/08/15	Alina Dobreanu
Conductivity	AT	8851156	2023/08/14	2023/08/14	Gurpartee K AUR
Moisture (Subcontracted)	BAL	8857791	N/A	2023/08/16	Margarita Aguilera
Sulphide in Soil	SPEC	8857768	N/A	2023/08/15	Ly Vu
pH CaCl2 EXTRACT	AT	8852867	2023/08/15	2023/08/15	Surinder Rai
Redox Potential	COND	8855362	2023/08/16	2023/08/17	Gurpartee K AUR
Resistivity of Soil		8842215	2023/08/15	2023/08/15	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8850609	2023/08/14	2023/08/15	Alina Dobreanu

Bureau Veritas ID: WQA769 Dup
Sample ID: RW-4 SS3
Matrix: Soil

Collected: 2023/07/13
Shipped:
Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	8851156	2023/08/14	2023/08/14	Gurpartee K AUR

Bureau Veritas ID: WQA770
Sample ID: RW-6 SS3
Matrix: Soil

Collected: 2023/07/13
Shipped:
Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8850602	2023/08/14	2023/08/15	Alina Dobreanu
Conductivity	AT	8851156	2023/08/14	2023/08/14	Gurpartee K AUR



BUREAU
VERITAS

Bureau Veritas Job #: C3N8555

Report Date: 2023/08/18

WSP Canada Inc.

Client Project #: 21490972 (1003.5)

Site Location: HWY 400 BTWN LANGSTAFF AND MAJOR MAC

Sampler Initials: ML

TEST SUMMARY

Bureau Veritas ID: WQA770

Sample ID: RW-6 SS3

Matrix: Soil

Collected: 2023/07/13

Shipped:

Received: 2023/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture (Subcontracted)	BAL	8857791	N/A	2023/08/16	Margarita Aguilera
Sulphide in Soil	SPEC	8857768	N/A	2023/08/15	Ly Vu
pH CaCl2 EXTRACT	AT	8852867	2023/08/15	2023/08/15	Surinder Rai
Redox Potential	COND	8855362	2023/08/16	2023/08/17	Gurpartee Kaur
Resistivity of Soil		8842215	2023/08/15	2023/08/15	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8850609	2023/08/14	2023/08/15	Alina Dobreanu



GENERAL COMMENTS

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

Package 1	5.0°C
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Results relate only to the items tested.



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QUALITY ASSURANCE REPORT

WSP Canada Inc.

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QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8850602	Soluble (20:1) Chloride (Cl ⁻)	2023/08/15	NC	70 - 130	96	70 - 130	<20	ug/g	2.6	35
8850609	Soluble (20:1) Sulphate (SO ₄)	2023/08/15	NC	70 - 130	100	70 - 130	<20	ug/g	1.2	35
8851156	Conductivity	2023/08/14			103	90 - 110	<2	umho/cm	7.3	10
8852867	Available (CaCl ₂) pH	2023/08/15			100	97 - 103			0.31	N/A
8855362	Redox Potential	2023/08/17			101	95 - 105			6.8	35
8857768	Sulphide	2023/08/15	27 (1)	75 - 125	87	75 - 125	<0.5	mg/kg	NC	30
8857791	Moisture-Subcontracted	2023/08/16					<0.30	%		

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



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VALIDATION SIGNATURE PAGE

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

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

Cristina Carriere, Senior Scientific Specialist

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

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

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by {0}, {1} responsible for {2} {3} laboratory operations.



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

08-Aug-23 17:18

Ankita Bhalla

C3N8555

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INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name: #1326 WSP Canada Inc.	Company Name: WSP Canada Inc.	Quotation #: C31027			
Attention: Accounts Payable	Attention: Maor Levy	P.O. #: 21490972 (1003.5)			
Address: 6925 Century Ave Suite 100	Address:	Project: Hwy 400 between Longstaff and McLeod			
Mississauga ON L5N 7K2		Site #: T.T.			
Tel: (905) 567-4444 Fax: (905) 567-6561	Tel:	Sampled By:			
Email: CAPayablesInvoice@wsp.com	Email: maor.levy@wsp.com				

Bottle Order #:

947287

Project Manager:

Ankita Bhalla

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)		Other Regulations		Special Instructions		Field Filtered (please circle): Metals / Hg / Cr / V	ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required: Please provide advance notice for rush projects	
<input type="checkbox"/> Table 1 <input type="checkbox"/> Table 2 <input type="checkbox"/> Table 3 <input type="checkbox"/> Table	<input type="checkbox"/> Res/Park <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Agri/Other <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Coarse <input type="checkbox"/> For RSC	<input type="checkbox"/> CCME <input type="checkbox"/> Reg 558 <input type="checkbox"/> MISA <input type="checkbox"/> PWQO <input type="checkbox"/> Other	<input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> Municipality <input type="checkbox"/> Reg 406 Table														Regular (Standard) TAT: (will be applied if Rush TAT is not specified) Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details. Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: Rush Confirmation Number: (call lab for #)	
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix												# of Bottles	Comments	
1	RW-2 S55	2023/6/7/12	A.M.	Soil		✓										2		
2	RW-4 S53	2023/6/7/13	A.M.	Soil		✓										2		
3	RW-6 S53	2023/6/7/13	P.M.	Soil		✓										2		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
Maor Levy		2023/08/02	17:15	[Signature]		2023/08/02	17:18		Time Sensitive	Temperature (°C) on Reel	Custody Seal Present	Yes	No
										5/6/4	Intact		

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

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

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

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

White: Bureau Veritas Yellow: Client

On ice

