



## REPORT

# Foundation Investigation Report

*Stormwater Management Pond Extension and Flow Control Structures  
Highway 400 Widening, Langstaff Road to Major Mackenzie Drive  
Vaughan, Ontario  
GWP 2836-02-00*

Submitted to:

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21490972-R-Rev0-SWM

December 6, 2023

**GEOCRES NO.: 30M13-304**

Latitude: 43.810112°

Longitude: -79.543880°



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## 1.0 INTRODUCTION

WSP Canada Inc. (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, the existing stormwater management pond located in the southeast quadrant of the Langstaff Road interchange will be extended approximately 20 m to the south, and three flow control structures will be constructed about 150 m to 400 m north of the Langstaff Road Underpass.

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 stormwater management pond extension and the three flow control structures.

## 2.0 SITE DESCRIPTION

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 slightly 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 existing stormwater management pond and proposed extension running parallel to the highway, and the three proposed flow control structures located within the highway ditch and oriented perpendicular to the highway in a generally east-west direction.

The topography in the area surrounding the stormwater management pond and flow control structures is relatively flat and land use is primarily commercial.

### 2.1 Flow Control Structures

The three flow control structures are to be located between Stations 14+290 and 14+550 as shown on Drawing 1; two structures (designated FCS 1 and FCS 2) will be located in the southbound highway ditch and one structure (designated FCS 3) will be located in the northbound highway ditch. This section of Highway 400 has a road surface elevation ranging from about 207.5 m near STA 14+290 to about 208.5 m near STA 14+550, gently rising northward. In the southbound direction, the ditch is separated by a concrete barrier. The bottom elevation of the highway ditches adjacent to the flow control structures range from about Elevation 205 m to 206.5 m (i.e., about 2 m below highway grade). The highway ditches are vegetated with bullrushes and have side slope inclinations of about 4H:1V or flatter.

### 2.2 Stormwater Management (SWM) Pond

Two watercourses (Black Creek and West Don River Tributary A) cross Highway 400 through culverts within the project limits. Black Creek begins northwest of the project limits and flows south through a culvert under Langstaff Road and continues south through a culvert under the Highway 400 offramp. The existing stormwater management pond outlets into this watercourse between Langstaff Road and the offramp as shown on Drawing 2.

The existing stormwater management pond (detention pond) covers some 1,500 m<sup>2</sup> in area across the southeast quadrant of the Langstaff Road interchange and provides drainage quality and quantity control for Highway 400. The southeast quadrant of the Langstaff Road interchange is landscaped with grass cover and a few limited zones of tree cover around the perimeter of the pond. The pond has a maximum depth of about 2 m and a base

elevation ranging from about 204 m to 204.5 m. The existing side slopes are shallow and have inclinations ranging from about 3H:1V to 9H:1V, depending on proximity to nearby culvert outlets/headwalls. The pond is currently vegetated with bullrushes.

The existing ground surface conditions in the vicinity of the SWM pond are shown on Photographs 1 and 2.

### 3.0 INVESTIGATION PROCEDURES

The field work for this subsurface exploration program consisted of three (3) boreholes (designated SWMP-1, FC-1 and FC-2). These boreholes were advanced between July 17 and July 19, 2023, at the approximate locations shown on Drawings 1 and 2. One borehole and one monitoring well, designated MS-8 and MW-D, were advanced on June 12, 2022, and April 26, 2023, respectively, as part of the field investigation for other foundation components of the project and were used to augment borehole coverage for flow control structure FCS 3. Borehole MS-8 and MW-D were advanced at the approximate locations shown on Drawing 1.

Boreholes FC-1, FC-2, MS-8 and MW-D were advanced through the existing roadway embankment at the median and shoulders, and Borehole SWMP-1 was advanced in the southeast quadrant of the Langstaff Road interchange, within the proposed SWM pond extension footprint. The boreholes were advanced using a track-mounted CME 75 drill rig equipped with 168 mm outside diameter hollow stem augers or 156 mm outside diameter solid stem augers. The drilling equipment was supplied and operated by 3D Drilling of Whitchurch-Stouffville, Ontario. 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 general accordance with Standard Penetration Test (SPT) procedures (ASTM D1586)<sup>1</sup>. 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 general 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 drilled to a depth of approximately 6 m at the location of MW-D 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 at the bottom of the hole within a filtered sand pack. The borehole and annulus surrounding the piezometer pipe above the filter sand pack was backfilled to near ground surface with bentonite pellets. The standpipe piezometer was installed in a 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 general 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.

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

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 depths are summarized below.

Borehole No.	MTM NAD83 Northing (Latitude, °)	MTM NAD83 Easting (Longitude, °)	Ground Surface Elevation (m)	Borehole / Monitoring Well Depth (m)
FC-1	4,852,566.0 (43.813050)	301,188.5 (-79.544891)	208.5	8.2
FC-2	4,852,370.6 (43.811292)	301,212.0 (-79.544598)	208.0	8.2
MS-8	4,852,243.5 (43.810156)	301,276.9 (-79.543794)	206.9	6.7
SWMP-1	4,852,017.4 (43.808113)	301,385.4 (-79.542441)	205.3	6.7
MW-D	4,852,220.0 (43.809945)	301,306.4 (-79.543427)	206.8	6.1

## 4.0 SITE GEOLOGY

### 4.1 Regional Geology

As delineated in The Physiography of Southern Ontario (Chapman and Putnam, 1984)<sup>2</sup>, 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)<sup>3</sup>, 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 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. For the purposes of interpreting the subsurface conditions at any given flow control structure and the stormwater pond extension location, reference should be made to the closest borehole location. However, the subsurface conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions near the flow control structure locations (beneath Highway 400) consist of the existing pavement structure underlain by cohesive fill comprised of clayey silt to sandy clayey silt having a firm

<sup>2</sup> 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.)

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

to stiff consistency. The cohesive fill is underlain by a cohesive deposit of glacial till consisting of clayey silt-silt, clayey silt, and silty clay having a variable, firm to hard consistency. Interlayers of non-cohesive sandy silt having a compact to dense state of compactness were encountered within the cohesive glacial till deposit.

In general, the subsurface conditions within the stormwater management pond extension consist of surficial topsoil underlain by a 2 m thick layer of cohesive fill comprised of silty clay to clay having a stiff consistency. The cohesive fill is underlain by a cohesive glacial till deposit of sandy clayey silt-silt having a stiff to hard consistency.

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

#### **4.2.1 Flow Control Structures**

Three boreholes were advanced near the proposed flow control structure locations, as shown on Drawing 1. Boreholes FC-1 and FC-2 were advanced through the southbound road shoulder of Highway 400, adjacent to FCS 1 and FCS 2, respectively. Borehole MS-8, which was advanced as part of the median sewer foundation field investigation for the project, was used to augment borehole coverage for FCS 3. The subsurface conditions encountered in these boreholes are summarized below.

##### **4.2.1.1 Asphalt**

A layer of asphalt 380 mm thick was encountered at ground surface in all boreholes (FC-1, FC-2 and MS-8).

##### **4.2.1.2 SAND (SP-SM) to SAND (SW) and Gravel (FILL)**

A layer of granular fill varying in composition from sand, trace gravel to sand and gravel was encountered underlying the asphalt in Boreholes FC-1, FC-2 and MS-8. The granular fill includes portions of the pavement structure and was encountered at a depth of about 0.4 m below ground surface (approximately Elevations 208.1 m to 206.5 m) and was about 0.3 m to 1.8 m thick, extending down to depths of 0.7 m to 2.2 m below ground surface (approximately Elevations 207.1 m to 205.8 m).

The SPT "N"-values measured within the granular fill range from 28 to 54 blows per 0.3 m of penetration, indicating a compact to very dense state of compactness.

Grain size distribution testing was carried out on a sample of the granular fill and the results are presented on Figure B1 in Appendix B. The water content measured on samples of the granular fill ranges from about 4% to 15%.

##### **4.2.1.3 CLAYEY SILT (CL) (FILL)**

A layer of cohesive fill consisting of clayey silt was encountered underlying the granular fill in Boreholes FC-1, FC-2 and MS-8. The cohesive fill was encountered at depths ranging from approximately 0.7 m to 2.2 m below ground surface (approximately Elevations 207.1 m to 205.8 m) and was about 0.8 m to 2.3 m thick, extending down to a depth of 3.0 m (approximately Elevations 205.5 m to 203.9 m).

The SPT "N"-values measured within the cohesive fill range from 5 to 13 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

Grain size distribution testing was carried out on two samples of the cohesive fill and the results are presented on Figure B2 in Appendix B (Borehole FC-1 Sample 3 and Borehole MS-8 Sample 2). Atterberg limit testing was carried out on two samples of the cohesive fill and the results are presented on a plasticity chart in Figures B3 in Appendix B (Borehole FC-1 Sample 3 and Borehole MS-8 Sample 2). The Atterberg limits tests measured liquid

limits of about 29% and 33%, plastic limits of about 15% and 17%, and corresponding plasticity indices of about 14% and 16%. The Atterberg limits tests indicate a clayey silt of low plasticity. The water content measured on samples of the cohesive fill was about 18%, generally near the plastic limit of the material.

#### **4.2.1.4 CLAYEY SILT-SILT (CL-ML) to SILTY CLAY (CI) (TILL) – Upper Deposit**

An upper cohesive deposit of glacial till varying in composition from clayey silt-silt to silty clay was encountered underlying the cohesive fill layer in Boreholes FC-1, FC-2 and MS-8. The upper cohesive till deposit was encountered at a depth of about 3.0 m below ground surface (approximately Elevations 205.5 m to 203.9 m) and extended to the termination depth of 8.2 m (Elevation 200.3 m) in Borehole FC-1. In Boreholes MS-8 and FC-2, the upper cohesive deposit was about 0.7 m and 2.6 m thick, extending down to depths of about 3.7 m and 5.6 m.

The SPT “N”-values measured within the upper cohesive deposit range from 7 to 63 blows per 0.3 m of penetration, suggesting a variable, firm to hard consistency.

Grain size distribution testing was carried out on two samples of the upper cohesive till and the results are presented on Figure B4 in Appendix B (Borehole FC-1 Sample 6 and Borehole FC-2 Sample 4). Atterberg limit testing was carried out on two samples of the upper cohesive till and the results are presented on a plasticity chart in Figure B5 in Appendix B (Boreholes FC-1 Sample 6 and Borehole FC-2 Sample 4). The Atterberg limits tests measured liquid limits of about 20% and 39%, plastic limits of about 13% and 18%, and corresponding plasticity indices of about 7% and 21%. The Atterberg limits tests indicate a clayey silt-silt to silty clay of low to intermediate plasticity. The water content measured on samples of the upper cohesive till ranges from about 11% to 21%, generally near the plastic limit of the material.

#### **4.2.1.5 Sandy SILT (ML)**

A non-cohesive deposit of sandy silt was encountered underlying the upper cohesive till in Boreholes MS-8 and FC-2. The non-cohesive deposit was encountered at depths of 3.7 m and 5.6 m below ground surface (approximately Elevations 203.2 m and 202.4 m) and extended to the termination depth of 8.2 m (Elevation 199.8 m) in Borehole FC-2. In Borehole MS-8, the non-cohesive deposit was about 1.9 m thick, extending down to a depth of about 5.6 m (approximately Elevation 201.3 m).

The SPT “N”-values measured within the non-cohesive deposit range from 11 to 44 blows per 0.3 m of penetration, indicating a compact to dense state of compactness.

Grain size distribution testing was carried out on a sample of the non-cohesive deposit and the results are presented on Figure B6 in Appendix B. Atterberg limit testing was carried out on the fines portion of a sample of the non-cohesive deposit and the results are presented on a plasticity chart in Figure B7 in Appendix B. The Atterberg limits measured a liquid limit of about 13%, a plastic limit of about 11% and a corresponding plasticity index of about 2%. These results indicate that the fines portion of the non-cohesive deposit has slight plasticity. The water content measured on samples of the non-cohesive deposit ranges from about 8% to 10%.

#### **4.2.1.6 Sandy CLAYEY SILT (CL) (TILL) – Lower Deposit**

A lower cohesive deposit of glacial till consisting of sandy clayey silt was encountered underlying the non-cohesive sandy silt deposit in Borehole MS-8. The lower cohesive deposit was encountered at a depth of 5.6 m below ground surface (Elevation 201.3 m) and extended to the termination depth of 6.7 m (Elevation 200.2 m).

The SPT “N”-value measured within the lower cohesive deposit was 28 blows per 0.3 m of penetration, suggesting a very stiff consistency.



Grain size distribution testing was carried out on a sample of the lower cohesive till and the results are presented on Figure B8 in Appendix B. Atterberg limit testing was carried out on a sample of the lower cohesive till and the results are presented on a plasticity chart in Figure B9 in Appendix B. The Atterberg limits test measured a liquid limit of about 21%, a plastic limit of about 11% and a corresponding plasticity index of about 10%. The Atterberg limits test indicates a clayey silt of low plasticity. The water content measured on a sample of the lower cohesive till was about 14%, generally near the plastic limit of the material.

#### **4.2.2 Stormwater Management Pond Extension**

One borehole, designated SWMP-1, was advanced within the proposed SWM pond extension footprint, as shown on Drawing 2. The following subsurface conditions were encountered in Borehole SWMP-1.

##### **4.2.2.1 Topsoil**

A 200 mm thick layer of topsoil was encountered at ground surface (Elevation 205.3 m).

##### **4.2.2.2 CLAY (CH) (FILL)**

A 1.9 m thick layer of cohesive clay fill was encountered underlying the topsoil, extending between Elevations 205.0 m and 203.1 m. The clay fill contained variable amounts of sand.

The SPT “N”-values measured within the cohesive clay fill range from 8 to 12 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

Grain size distribution testing was carried out on a sample of the cohesive clay fill and the results are presented on Figure B2 in Appendix B. Atterberg limit testing was carried out on a sample of the cohesive clay fill and the results are presented on a plasticity chart in Figure B3 in Appendix B (Borehole SWMP-1 Sample 3). The Atterberg limits test measured a liquid limit of about 51%, a plastic limit of about 18%, and a corresponding plasticity index of about 33%. The Atterberg limits test indicates a clay of high plasticity. The water content measured on a sample of the cohesive clay fill was about 23%.

##### **4.2.2.3 Sandy CLAYEY SILT-SILT (CL-ML) (TILL)**

A cohesive deposit of glacial till consisting of sandy clayey silt-silt was encountered underlying the cohesive clay fill. The cohesive till deposit was encountered at a depth of about 2.2 m (approximately Elevation 203.1 m) and Borehole SWMP-1 was terminated in the cohesive till after penetrating 4.5 m into the deposit (to about Elevation 198.6 m).

The SPT “N”-values measured within the cohesive till range from 10 to 54 blows per 0.3 m of penetration, suggesting a stiff to hard consistency.

Grain size distribution testing was carried out on a sample of the cohesive till deposit and the results are presented on Figure B4 in Appendix B (Borehole SWMP-1 Sample 7). Atterberg limit testing was carried out on a sample of the cohesive till and the results are presented on a plasticity chart in Figure B5 in Appendix B (Borehole SWMP-1, Sample 7). The Atterberg limits test measured a liquid limit of about 18%, a plastic limit of about 12%, and a corresponding plasticity index of about 6%. The Atterberg limits test indicates a clayey silt-silt of low plasticity. The water content measured on samples of the cohesive till ranges from about 11% to 19%.

### **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 No.	Unstabilized Groundwater Level		Date of Reading
	Depth (m)	Elevation (m)	
FC-1	4.0	204.5	July 19, 2023
FC-2	5.5	202.5	July 19, 2023
MS-8	5.6	201.3	June 12, 2022
SWMP-1	5.0	200.3	July 17, 2023

A standpipe piezometer was installed within an augered and unsampled hole about 50 m north of the Langstaff Road Underpass (about 100 m south of Flow Control Structure 3). The location of this piezometer, designated MW-D, is shown on Drawing 1. The stabilized groundwater level recorded in the piezometer was at a depth of about 2.3 m below ground surface (approximately Elevation 204.5 m) on October 31, 2023.

Based on the colour transition from brown to grey and presence of water in recovered soil samples from the boreholes, it is interpreted that the stabilized groundwater level near the flow control structures is approximately 3 to 4 m below the highway surface (Elevations 204 m to 205 m). In Borehole SWMP-1, it is inferred that the stabilized groundwater level is at a depth of about 3 m below ground surface (Elevation 202.4 m).

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. The groundwater levels will be influenced by the adjacent watercourses and perched groundwater is anticipated to be present within the variable fill soils above the cohesive fills and cohesive clayey till deposit.

#### 4.4 Analytical Testing of Soil

Three soil samples (one from each borehole associated with the flow control structures) 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 for Boreholes MS-8, FC-1 and FC-2 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)
MS-8, SA3	7.44	210	4810	2900	<200
FC-1, SA3	7.47	270	3640	2100	220
FC-2, SA2	7.85	730	1370	560	310

## 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. Kevin Bentley, P.Eng., a Geotechnical Engineer and MTO Principal Foundations Contact for WSP, conducted an independent technical and quality control review of this report.

## Signature Page

### WSP Canada Inc.



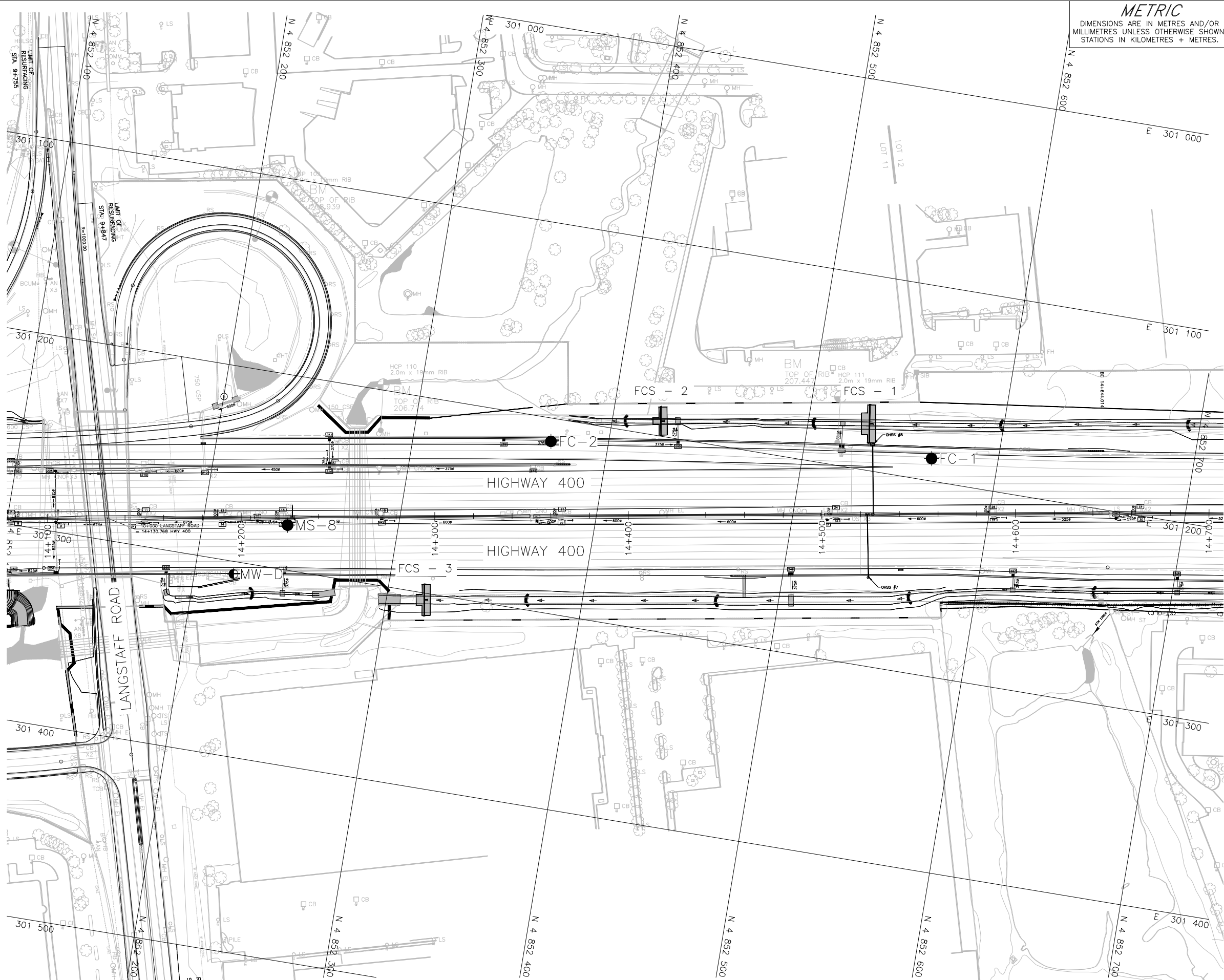
Mark Henderson, P.Eng.  
*Geotechnical Engineer*



Kevin J. Bentley, P.Eng.  
*MTO Principal Foundations Contact*

MH/KJB/al

[https://golderassociates.sharepoint.com/sites/152126/project files/6 deliverables/3. foundations/2. reports/06. swmp & fcs/final/21490972-r-rev0\\_2023'12'06 fir swmp and fcs.docx](https://golderassociates.sharepoint.com/sites/152126/project%20files/6%20deliverables/3.%20foundations/2.%20reports/06.%20swmp%20&%20fcs/final/21490972-r-rev0_2023'12'06%20fir%20swmp%20and%20fcs.docx)

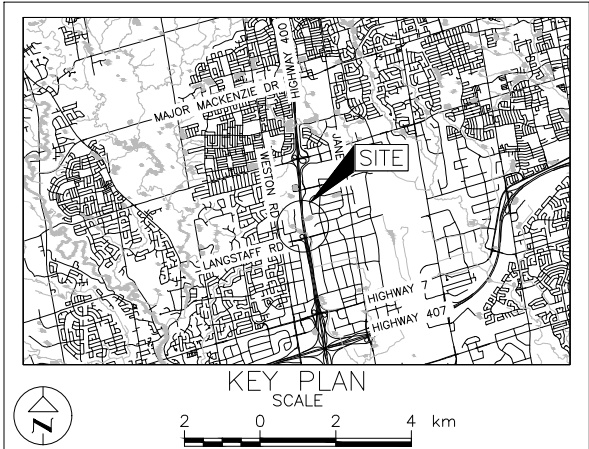


**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No.2836-02-00

HIGHWAY 400 WIDENING  
FLOW CONTROL STRUCTURES  
BOREHOLE LOCATION PLAN

SHEET



KEY PLAN  
SCALE  
2 0 2 4 km

LEGEND

- Borehole – Current Investigation
- Monitoring Well – Current Investigation
- Flow Control Structure

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
FC-1	208.5	4852566.0	301188.5
FC-2	208.0	4852370.6	301212.0
MS-8	206.9	4852243.5	301276.9
MW-D	206.8	4852220.0	301306.4



NOTES

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

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.  
Design plan provided by Parsons, file no. H400-478918-ROD-PLN-S\_Binded 2023-10-18.dwg, received October 18, 2023.  
Horizontal alignment provided in digital format by Parsons, drawing file no. Hwy 400 Alignments.xml, received October 24, 2023.

NO.	DATE	BY	REVISION
Geocres No. 30M13-304			
HWY. 400	PROJECT NO. 21490972		DIST. .
SUBM'D. MH	CHKD. MH	DATE: 12/06/2023	SITE: .
DRAWN: DD	CHKD. MH	APPD. KJB	DWG. 1





SHEET

נשיא



### LEGEND

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
SWMP-1	205.3	4852017.4	301385.4

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.

Base plans provided in digital format by Parsons, drawing file nos. Hwy400\_Existing Survey-Topo.dwg, H400-ROD-PLN.dwg, 73-400.xml, received June 1, 2022.

Design plan provided by Parsons, file no. H400-478918-ROD-PLN-S\_Binded 2023-10-18.dwg, received October 18, 2023.

Horizontal alignment provided in digital format by Parsons, drawing file no. Hwy 400 Alignments.xml, received October 24, 2023.

NO.	DATE	BY	REVISION	
Geocres No. 30M13-304				
HWY. 400		PROJECT NO. 21490972		DIST. .
SUBM'D. MH	CHKD. MH	DATE: 12/06/2023		SITE:
DRAWN: DD	CHKD. MH	APPD. KJB		DWG. 2





**Photograph 1: Looking south from Langstaff Road towards Black Creek (i.e., towards southeast quadrant of the Langstaff Road interchange). The culvert under the Highway 400 off-ramp can be seen at the top left corner of the photograph.**



**Photograph 2: Looking northwest at existing stormwater management pond.**

**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	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<sup>1,2</sup>

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 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (*q<sub>t</sub>*), porewater pressure (*u*) and sleeve friction (*f<sub>s</sub>*) are recorded electronically at 25 mm penetration intervals.

#### Dynamic Cone Penetration Resistance (DCPT); N<sub>d</sub>:

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 <sub>p</sub>	plastic limit
LL, w <sub>L</sub>	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
D <sub>R</sub>	relative density (specific gravity, G <sub>s</sub> )
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 <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

### COARSE-GRAINED SOILS

#### Compactness<sup>1</sup>

Term	SPT 'N' (blows/0.3m) <sup>2</sup>
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' <sup>1,2</sup> (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

$\pi$	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

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta\sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	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
$\gamma'$	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  $\rho$ . Unit weight symbol is  $\gamma$ .  
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
$\sigma'_p$	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$c'$	effective cohesion
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	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	<b>RECORD OF BOREHOLE</b>		<b>No. FC-1</b>	Sheet 1 of 1	<b>METRIC</b>
G.W.P.	2836-02-00	LOCATION	N 4852566; E 301188.5 NAD83 / MTM Zone 10 (LAT. 43.81305; LONG. -79.544891)			ORIGINATED BY T.T.
DIST	CENTRAL HWY 400	BOREHOLE TYPE	Power Auger; 168 mm O.D. Hollow Stem Augers			COMPILED BY M.L.
DATUM	Geodetic Surface Elevation:208.5 m	DATE	Jul 19, 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 <sub>p</sub>	NMC W	LL W <sub>L</sub>		GR	SA	SI	CL	
208.5								20	40	60	80	100	20	40	60	kN/m <sup>3</sup>					
0.0	ASPHALT (380 mm)																				
0.4																					
208.1	SAND (SP), trace gravel (FILL) Compact Brown Dry		1	SS	28		208														
207.1																					
1.4	CLAYEY SILT (CL), some sand to sandy, trace gravel (FILL) Stiff Brown to grey (Mottled) Moist		2	SS	10		207														
			3	SS	9		206										1	24	44	31	
205.5																					
3.0	CLAYEY SILT-SILT (CL-ML), trace sand to sandy, trace gravel (TILL) Very stiff to hard Brown; becoming grey at approximately 4.9 m depth (Elev. 203.6 m) Moist		4	SS	17		205														
			5	SS	22		204														
			6	SS	21		203														
			7	SS	33		202										2	27	54	17	
			8	SS	63		201														
8.2																					
200.3	End of Borehole NOTES:  1. Borehole caved to a depth of 5.2 m below ground surface (Elevation 203.3 m) upon completion of drilling  2. Water measured inside caved borehole at a depth of 4.0 m below ground surface (Elevation. 204.5 m) upon completion of drilling.																				

+<sup>3</sup>, x<sup>3</sup> : Numbers refer to Sensitivity o<sup>3</sup>% STRAIN AT FAILURE

PROJECT	21490972	RECORD OF BOREHOLE	No. FC-2	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	LOCATION	N 4852370.6; E 301212 NAD83 / MTM Zone 10 (LAT. 43.811292; LONG. -79.544598)	ORIGINATED BY	T.T.
DIST	CENTRAL HWY 400	BOREHOLE TYPE	Power Auger; 168 mm O.D. Hollow Stem Augers	COMPILED BY	M.L.
DATUM	Geodetic Surface Elevation:208.0 m	DATE	Jul 19, 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 <sub>p</sub>	W	W <sub>L</sub>							NP Nonplastic
208.0								20	40	60	80	100	20	40	60	kn/m³						
0.0	ASPHALT (380 mm)																					
0.4																						
207.6	SAND (SP-SM), trace gravel, trace silt, trace clay (FILL) Compact to very dense Brown Dry		1	SS	54		207											2	92	4	2	
			2	SS	30		206															
205.8																						
2.2	CLAYEY SILT (CL), trace sand, trace gravel, trace organics (FILL) Stiff Brown Moist		3	SS	9																	
205.0							205															
3.0	SILTY CLAY (CI), some sand, trace gravel (TILL) Firm to very stiff Brown; becoming grey at about 3.8 m depth (Elevation 204.2 m) Moist		4	SS	7													1	11	42	46	
			5	SS	29		204															
			6	SS	15		203															
202.4																						
5.6	Sandy SILT (ML), trace clay Dense Grey Moist		7	SS	44		202											3	40	48	9	
							201															
8.2			8	SS	33		200															
199.8	End of Borehole																					
	NOTES:  1. Borehole caved to a depth of 6.4 m below ground surface (Elevation 201.6 m) upon  2. Water measured inside caved borehole at a depth of 5.5 m below ground surface (Elevation. 202.5 m) upon  completion of drilling.																					

+<sup>3</sup>, x<sup>3</sup> : Numbers refer to Sensitivity o<sup>3</sup>% STRAIN AT FAILURE



PROJECT 21490972			RECORD OF BOREHOLE No MS-8			SHEET 1 OF 1			METRIC							
G.W.P. 2836-02-00			LOCATION N 4852243.5; E 301276.9 MTM NAD 83 ZONE 10 (LAT. 43.810156; LONG. -79.543794)			ORIGINATED BY JNS										
DIST CENTRAL HWY 400			BOREHOLE TYPE Power Auger; 156 mm O.D. Solid Stem Auger			COMPILED BY MH										
DATUM Geodetic			DATE June 12, 2022			CHECKED BY DAM										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
206.9	GROUND SURFACE															
0.0	ASPHALT (380 mm)															
206.5																
0.7	SAND (SW) and gravel, trace silt (FILL) Brown Moist		1	SS	13											
	SAND (SW), trace gravel, trace silt (FILL) Brown Moist		2	SS	9											
	CLAYEY SILT (CL), some sand to Sandy CLAYEY SILT (CL), trace gravel (FILL) Firm to stiff Brown to grey Moist		3	SS	5											
203.9																
3.0	SILTY CLAY (CI), some sand (TILL) Firm Brown to grey (mottled) Moist		4	SS	7											
203.2																
3.7	Sandy SILT (ML), some gravel Compact Brown Moist		5	SS	11											
			6	SS	30											
201.3																
5.6	Sandy CLAYEY SILT (CL) (TILL) Very stiff Grey Moist		7	SS	28											
200.2																
6.7	END OF BOREHOLE															
NOTES: 1. Borehole open upon completion of drilling. 2. Water measured inside open borehole at a depth of 5.6 m below ground surface (Elevation 201.3 m) upon completion of drilling.																

PROJECT	21490972	LOCATION	N 4852017.4; E 301385.4 NAD83 / MTM Zone 10 (LAT. 43.808113; LONG. -79.542441)	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger	ORIGINATED BY	T.T.
DIST	CENTRAL HWY 400	DATE	Jul 17, 2023	COMPILED BY	T.T.
DATUM	Geodetic Surface Elevation:205.3 m			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 <sub>p</sub>	NMC W	LL W <sub>L</sub>						
205.3								20	40	60	80	100	20	40	60						
0.0 0.2 205.0	TOPSOIL		1	SS	8		205														
	CLAY (CH), some sand to sandy, trace gravel (FILL) Stiff Brown to dark brown Moist		2	SS	12		204														
			3	SS	10												4	27	37	32	
203.1							203														
2.2	Sandy CLAYEY SILT-SILT (CL-ML), trace gravel (TILL) Stiff to hard Brown; becoming grey at about 2.9 m depth (Elev. 202.4 m) Moist; becoming wet at about 3.7 m depth (Elev. 201.6 m).		4	SS	19		202														
			5	SS	10		201														
			6	SS	26		200										2	33	51	14	
			7	SS	38		199														
			8	SS	54																
198.6 6.7	End of Borehole						198														
	NOTES:  1. Borehole caved to a depth of 6.3 m (Elev. 199.0 m) upon completion of drilling.  2. Water measured inside caved borehole at a depth of 5.0 m (Elev. 200.3 m) upon completion of drilling.						197														
							196														

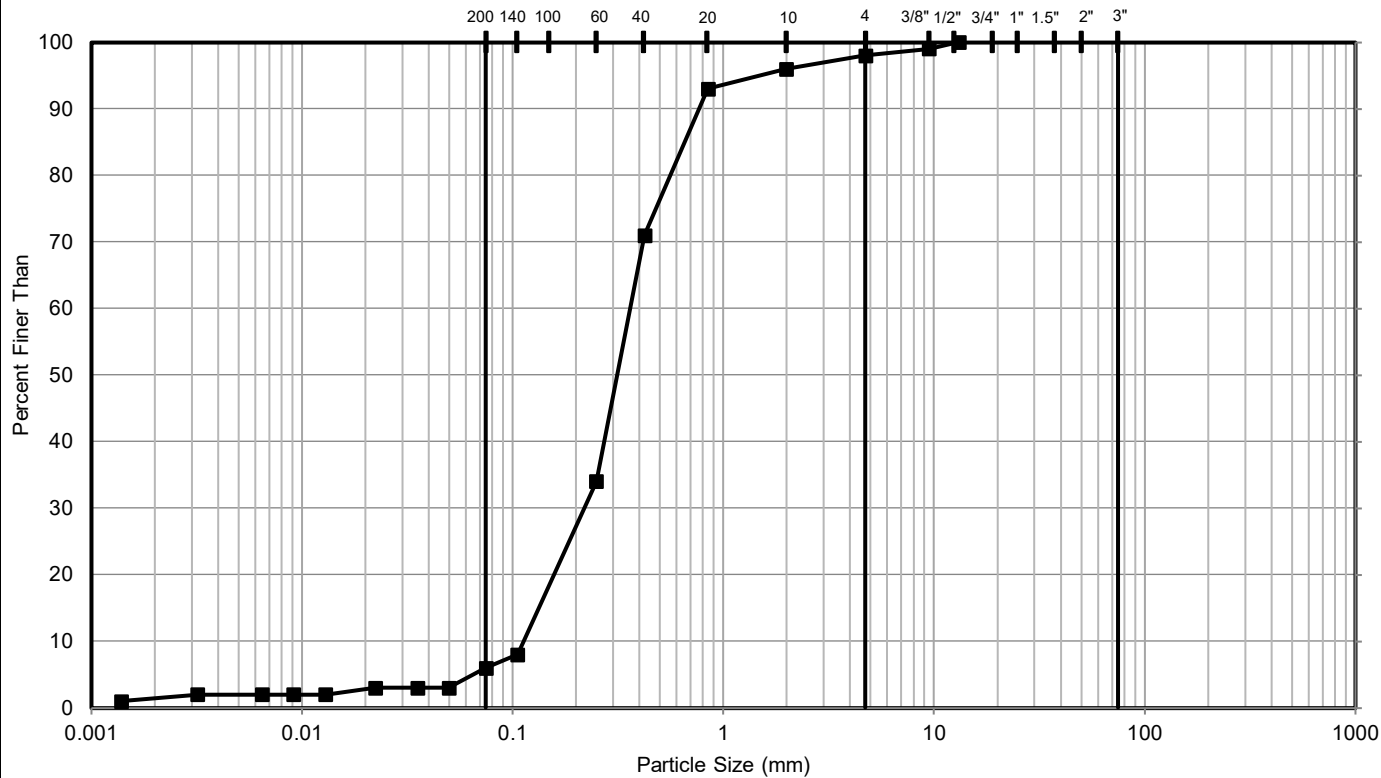
+<sup>3</sup>, x<sup>3</sup> : Numbers refer to Sensitivity o<sup>30</sup>% STRAIN AT FAILURE

**APPENDIX B**

# Geotechnical Laboratory Test Results




GRAIN SIZE DISTRIBUTION

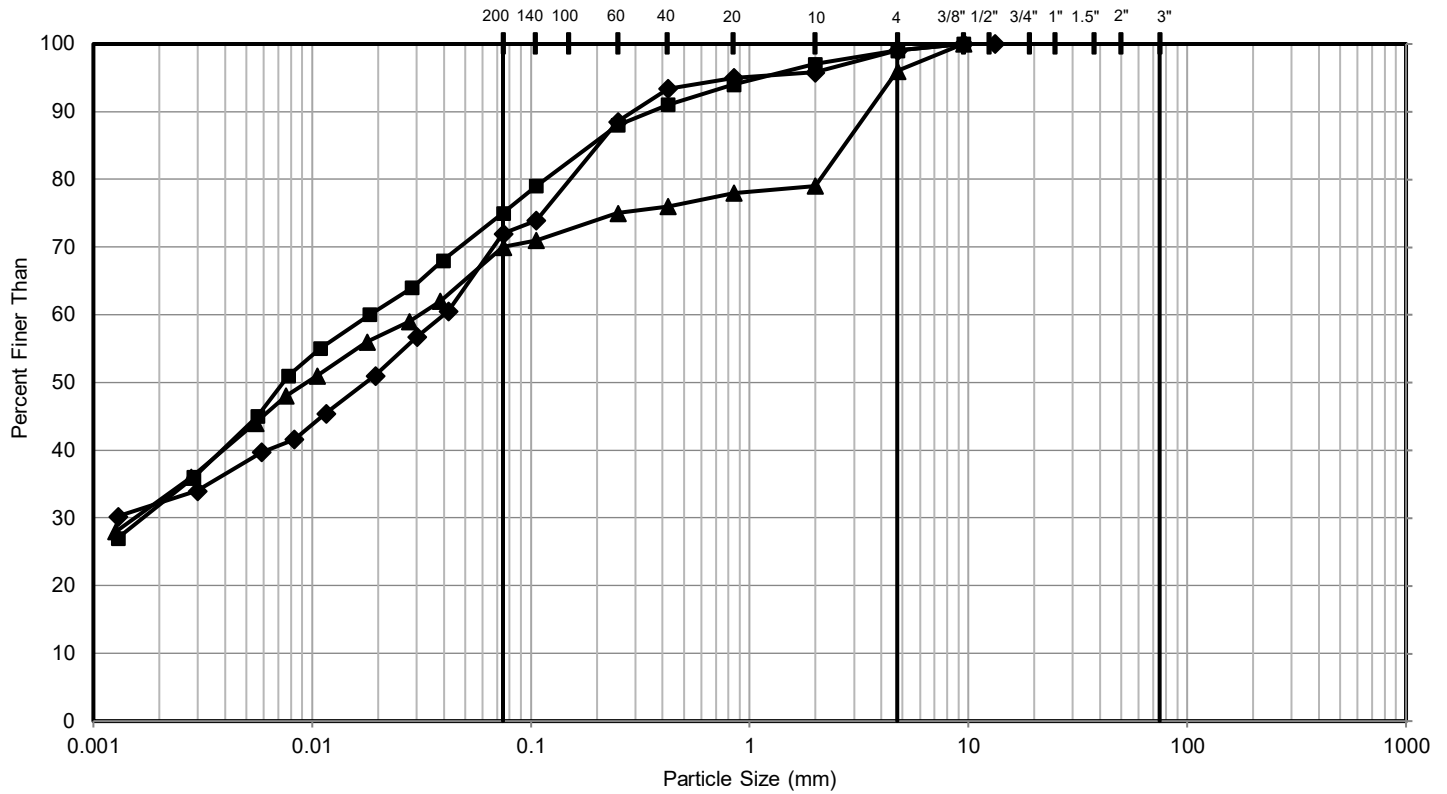


FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	FC-2	2	1.5 - 2.1	206.5 to 205.9

CLIENT		PROJECT	
Parsons / MTO		Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00	
 <b>GOLDER</b>	YYYY-MM-DD	2023-09-01	TITLE
	DESIGNED	SA	GRAIN SIZE DISTRIBUTION
	PREPARED	SA	SAND (SP-SM) FILL
	REVIEWED	MH	PROJECT NO.
	APPROVED	LCC	CONTROL
			REV.
			FIGURE
		21490972	0
			0
			B1

# GRAIN SIZE DISTRIBUTION



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

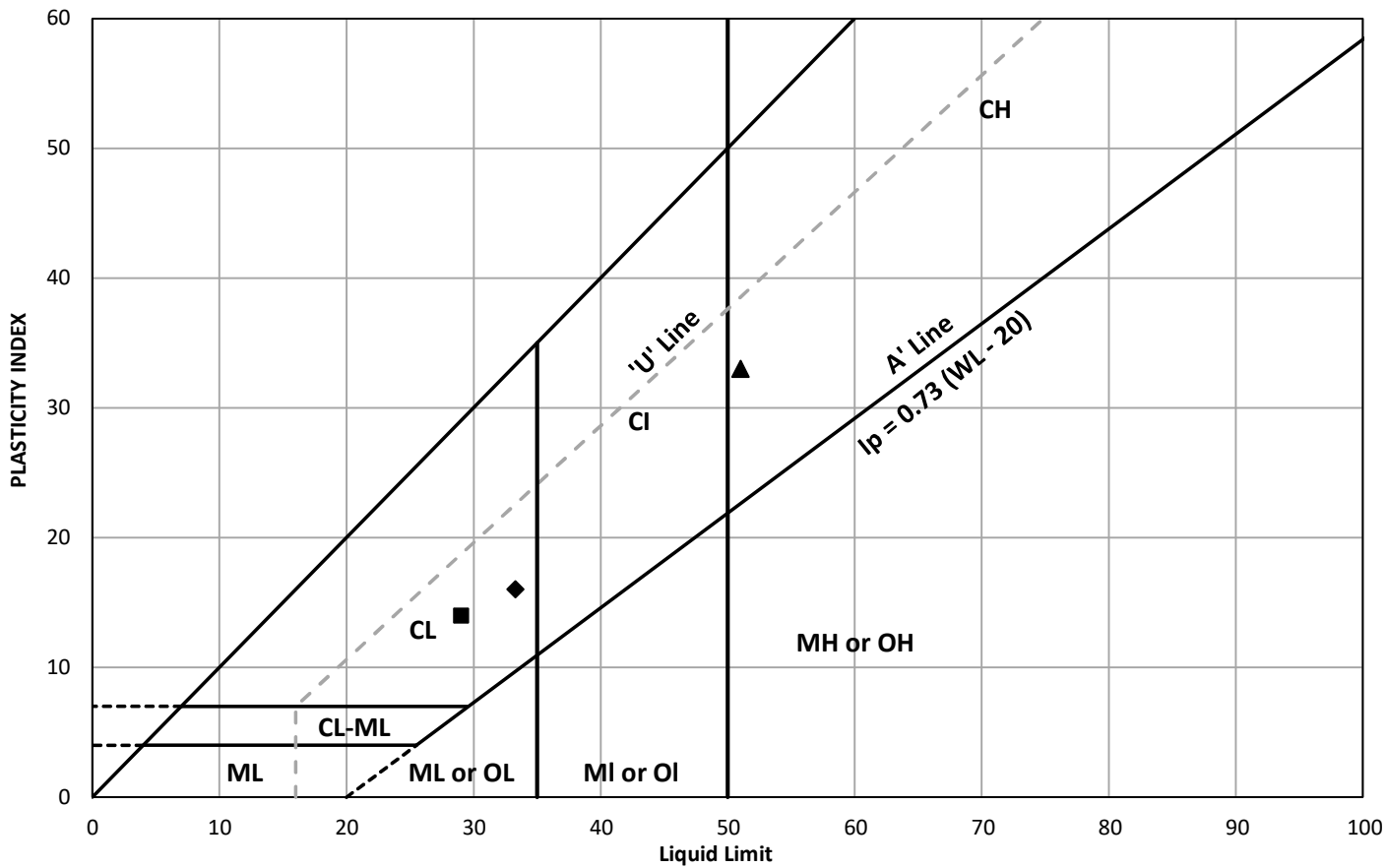
Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	FC-1	3	2.3 - 2.9	206.2 to 205.6
◆	MS-8	2	1.5 - 2.1	205.4 to 204.8
▲	SWMP-1	3	1.5 - 2.1	203.8 to 203.2

CLIENT	
Parsons / MTO	
CONSULTANT	
YYYY-MM-DD	2023-09-01
DESIGNED	SA
PREPARED	SA
REVIEWED	MH
APPROVED	LCC



PROJECT			
Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00			
TITLE			
GRAIN SIZE DISTRIBUTION CLAYEY SILT (CL) TO SILTY CLAY (CI) FILL			
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B2

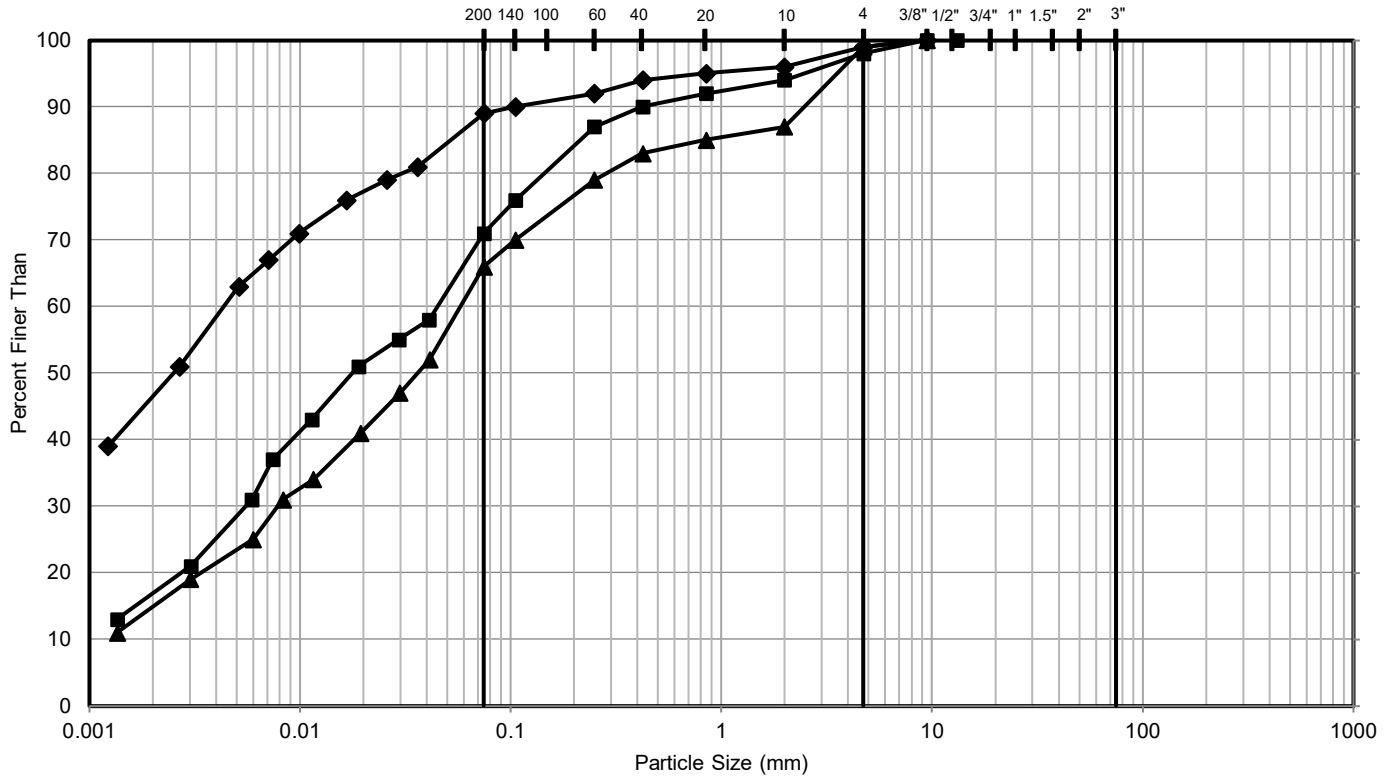
PLASTICITY CHART



	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	FC-1	3	2.3 - 2.9	17.8	29	15	14	0.20
◆	MS-8	2	1.5 - 2.1	18.3	33.3	17	16	0.08
▲	SWMP-1	3	1.5 - 2.1	-	51	18	33	-

CLIENT			PROJECT			
Parsons / MTO			Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00			
CONSULTANT			TITLE			
			PLASTICITY CHART			
			CLAY (CH) to CLAYEY SILT (CL) FILL			
			PROJECT NO.	CONTROL	REV.	FIGURE
			21490972	0	0	B3
			YYYY-MM-DD	DESIGNED	SA	
			2023-09-01	PREPARED	SA	
				REVIEWED	MH	
				APPROVED	LCC	

# GRAIN SIZE DISTRIBUTION



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

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	FC-1	6	4.6 - 5.2	203.9 to 203.3
◆	FC-2	4	3.0 - 3.7	205.0 to 204.3
▲	SWMP-1	7	4.6 - 5.2	200.7 to 200.1

CLIENT

Parsons / MTO

CONSULTANT



YYYY-MM-DD 2023-09-01

DESIGNED SA

PREPARED SA

REVIEWED MH

APPROVED LCC

PROJECT

Stormwater Management Pond Extension & Flow Control Structures - 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

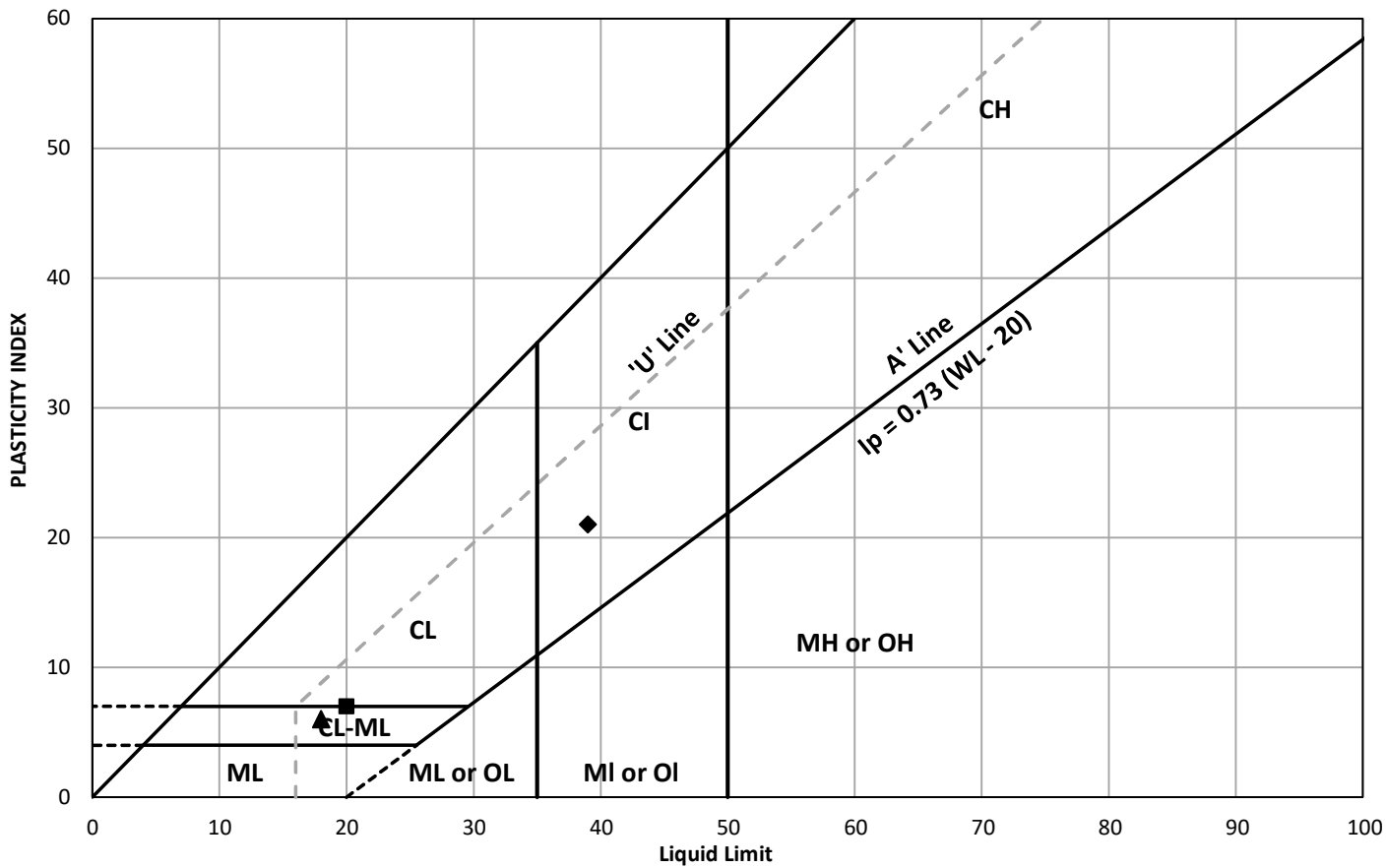
REV.

0

FIGURE

B4

PLASTICITY CHART

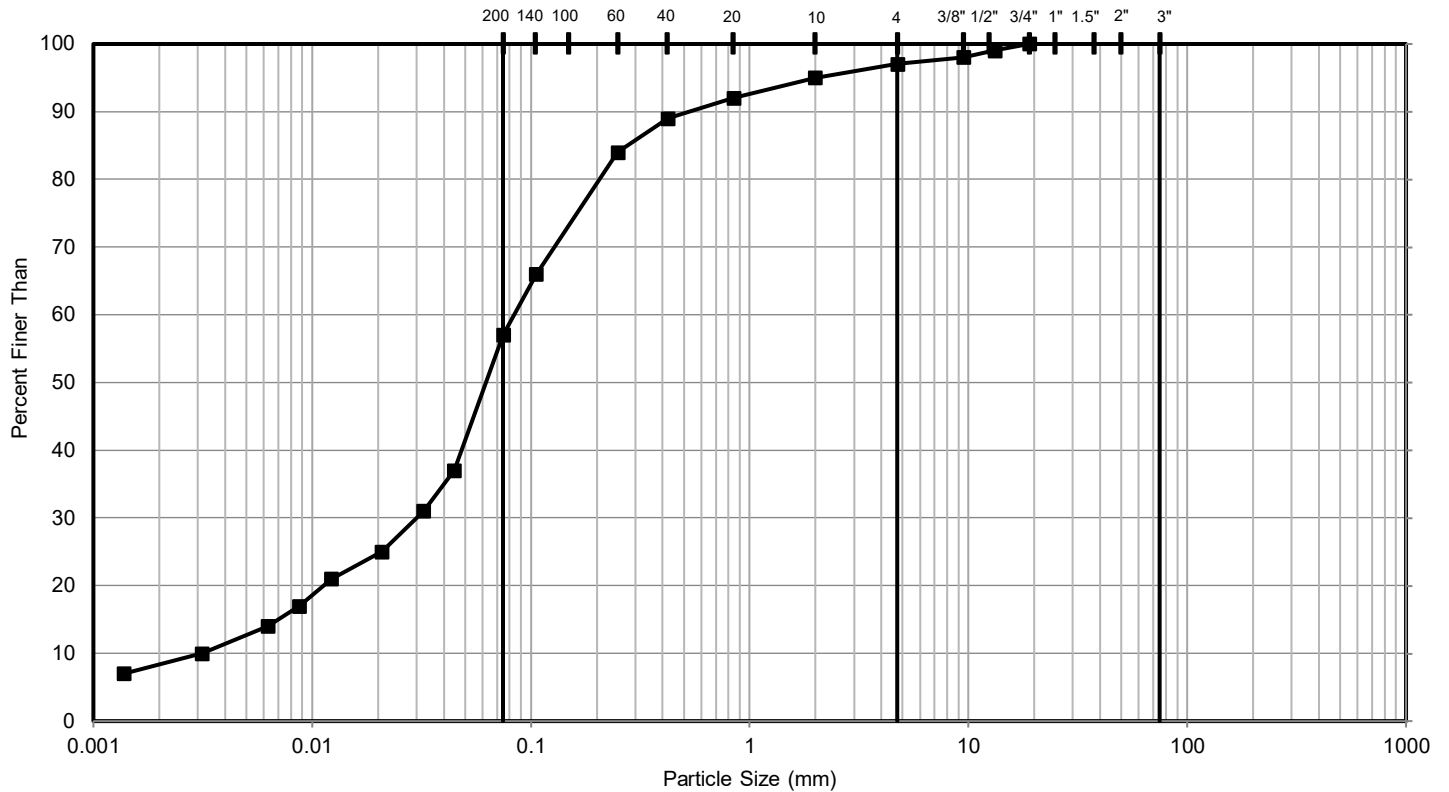


	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	FC-1	6	4.6 - 5.2	11	20	13	7	-0.29
◆	FC-2	4	3.0 - 3.7	21.5	39	18	21	0.17
▲	SWMP-1	7	4.6 - 5.2	-	18	12	6	-

CLIENT		
Parsons / MTO		
	CONSULTANT	YYYY-MM-DD
	DESIGNED	SA
	PREPARED	SA
	REVIEWED	MH
	APPROVED	LCC

PROJECT			
Stormwater Management Pond Extension & Flow Control Structures - 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



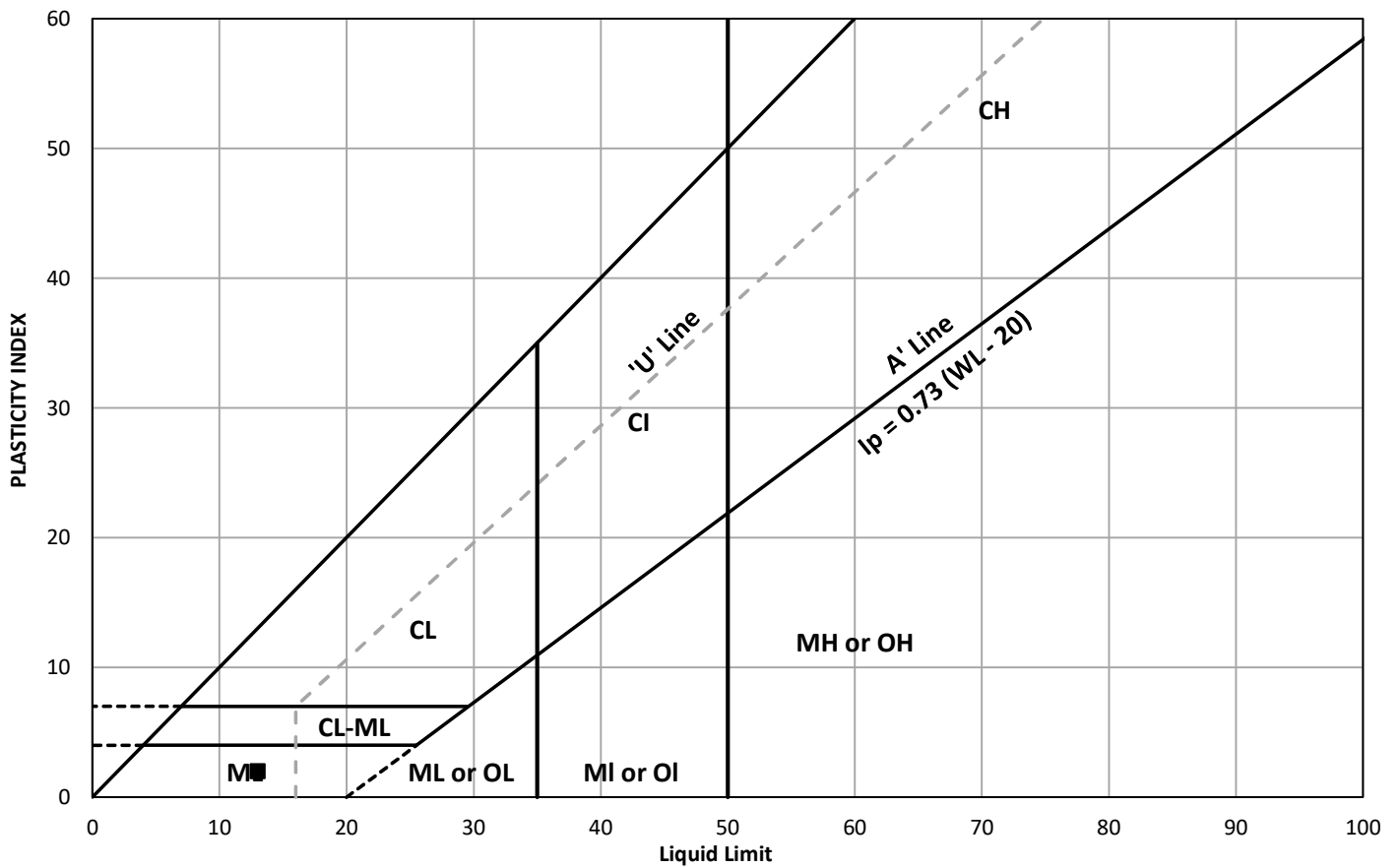
FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	FC-2	7	6.1 - 6.7	201.9 to 201.3

CLIENT		PROJECT	
Parsons / MTO		Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00	
CONSULTANT		TITLE	
		GRAIN SIZE DISTRIBUTION	
		Sandy SILT (ML)	
		PROJECT NO.	CONTROL
		21490972	0
		REV.	FIGURE
YYYY-MM-DD 2023-09-01 DESIGNED SA PREPARED SA REVIEWED MH APPROVED LCC		0	B6



PLASTICITY CHART




	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	FC-2	7	6.1 - 6.7	7.8	13	11	2	-1.60

CLIENT

Parsons / MTO

CONSULTANT

 **GOLDER**

YYYY-MM-DD

2023-09-01

DESIGNED

SA

PREPARED

SA

REVIEWED

MH

APPROVED

LCC

PROJECT

Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00

TITLE

PLASTICITY CHART  
SILT (ML)

PROJECT NO.

21490972

CONTROL

0

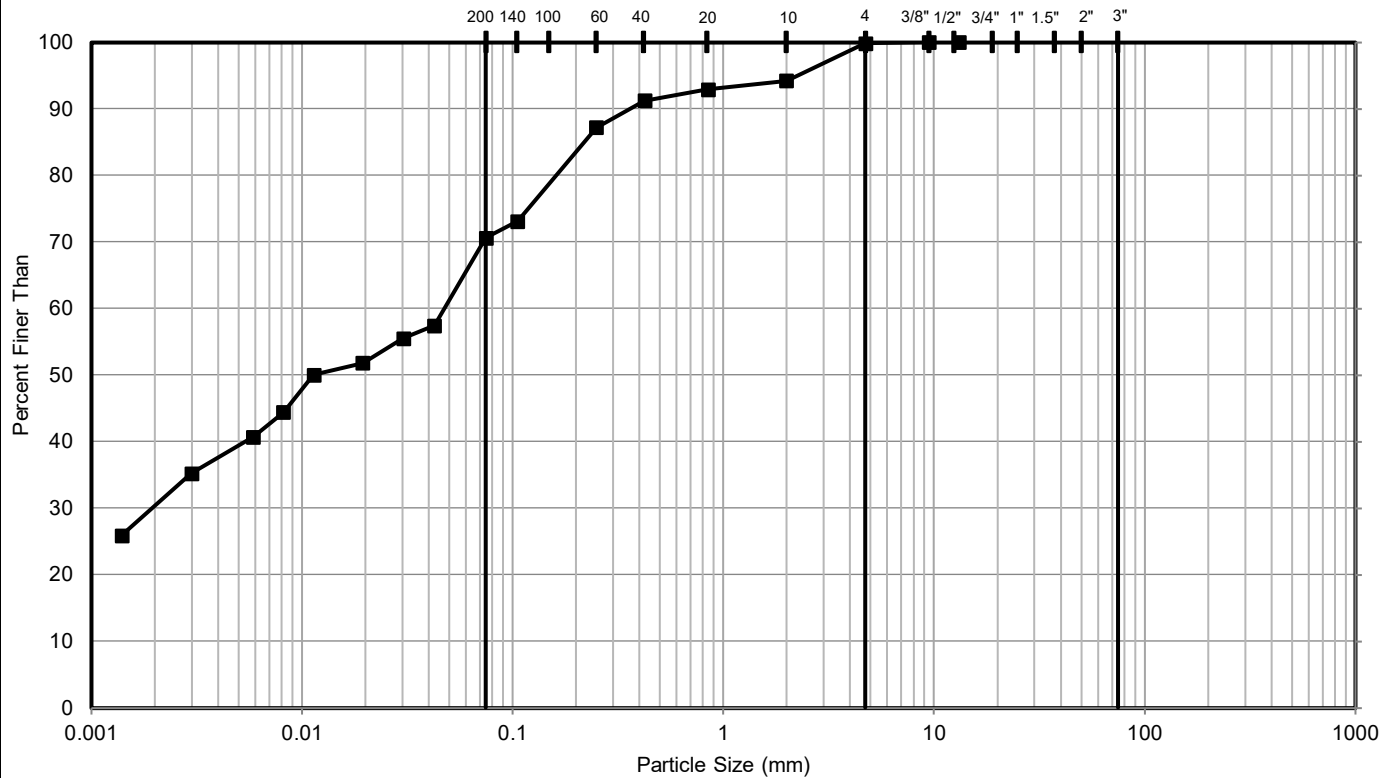
REV.

0

FIGURE

B7

GRAIN SIZE DISTRIBUTION



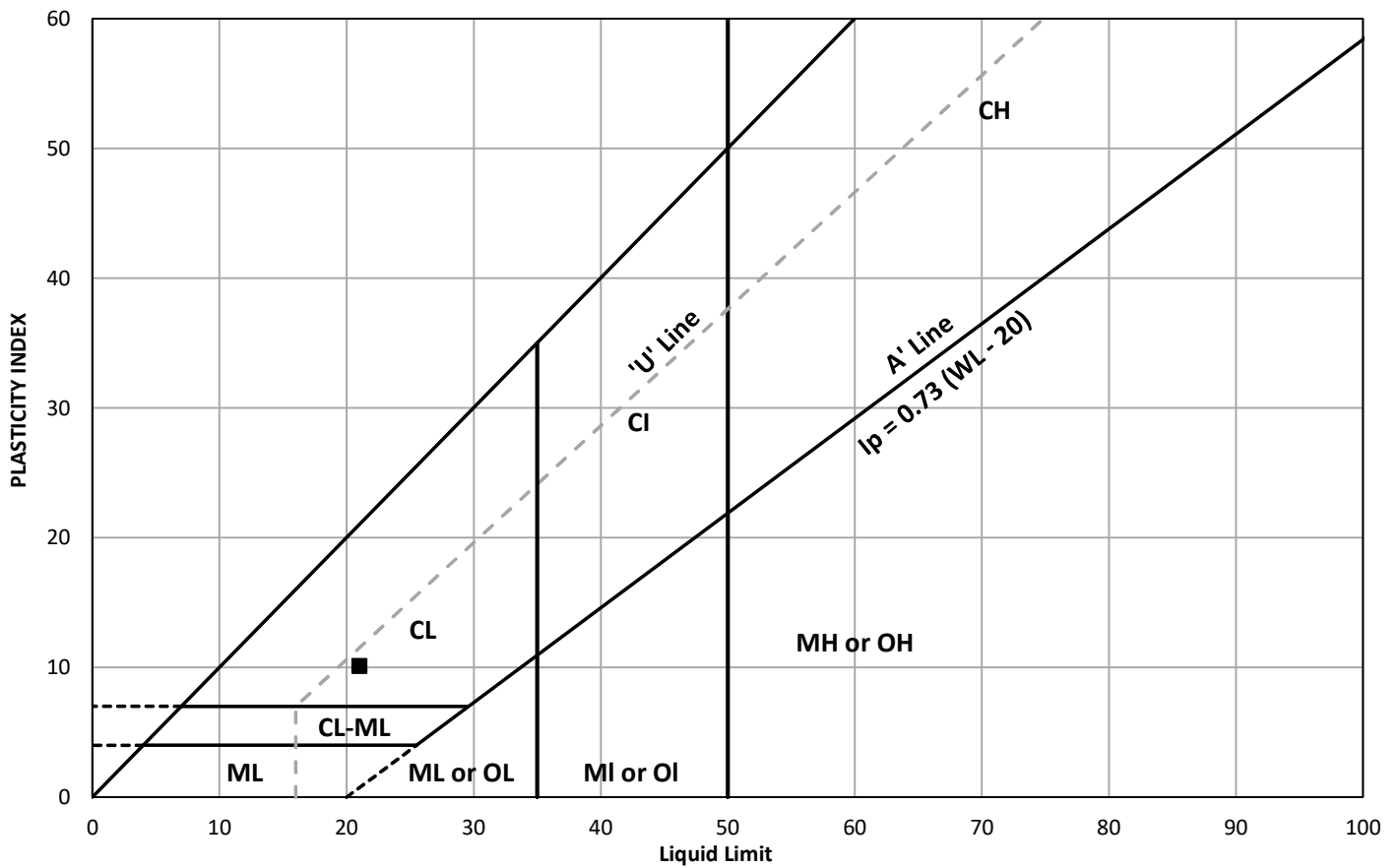
FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	MS-8	7	6.1 - 6.7	200.8 to 200.2

CLIENT		PROJECT	
Parsons / MTO		Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00	
CONSULTANT	YYYY-MM-DD	2023-09-01	
	DESIGNED	SA	
	PREPARED	SA	
	REVIEWED	MH	
	APPROVED	LCC	
TITLE		GRAIN SIZE DISTRIBUTION	
		CLAYEY SILT (CL) TILL	
PROJECT NO.	CONTROL	REV.	FIGURE
21490972	0	0	B8



PLASTICITY CHART




	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	MS-8	7	6.1 - 6.7	13.8	21	11	10.1	0.28

CLIENT

Parsons / MTO

CONSULTANT

 **GOLDER**

YYYY-MM-DD

2023-09-01

DESIGNED

SA

PREPARED

SA

REVIEWED

MH

APPROVED

LCC

PROJECT

Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00

TITLE

PLASTICITY CHART  
CLAYEY SILT (CL) TILL

PROJECT NO.

21490972

CONTROL

0

REV.

0

FIGURE

B9

**APPENDIX C**

# Analytical Laboratory Test Results



Your Project #: 21490972  
Site#: 21490972  
Site Location: HWY 400 LANGSTAFF OF MAJOR MAC

**Attention: Anastasia Poliacik**

WSP Canada Inc.  
100 Scotia Crt  
Whitby, ON  
CANADA L1N 8Y6

Your C.O.C. #: 847598-83-01, 844039-01-01, 844140-18-01

**Report Date: 2023/09/05**

Report #: R7797696

Version: 2 - Revision

**CERTIFICATE OF ANALYSIS – REVISED REPORT**

**BUREAU VERITAS JOB #: C2H6445**

**Received: 2022/06/24, 14:58**

Sample Matrix: Soil  
# Samples Received: 1

Analyses	Date		Laboratory Method	Analytical Method
	Quantity	Date Extracted / Analyzed		
Chloride (20:1 extract)	1	2022/06/28 2022/06/29	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	1	2022/06/28 2022/06/28	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 3)	1	N/A 2022/07/05	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	1	N/A 2022/07/04	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	1	2022/06/29 2022/06/29	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	1	2022/06/25 2022/06/28	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	1	2022/06/28 2022/06/29	CAM SOP-00464	MOE E3013 m
Redox Potential (2, 4)	1	N/A N/A		

**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.



Your Project #: 21490972  
Site#: 21490972  
Site Location: HWY 400 LANGSTAFF OF MAJOR MAC

**Attention: Anastasia Poliacik**

WSP Canada Inc.  
100 Scotia Crt  
Whitby, ON  
CANADA L1N 8Y6

Your C.O.C. #: 847598-83-01, 844039-01-01, 844140-18-01

**Report Date: 2023/09/05**

Report #: R7797696

Version: 2 - Revision

**CERTIFICATE OF ANALYSIS – REVISED REPORT**

**BUREAU VERITAS JOB #: C2H6445**

**Received: 2022/06/24, 14:58**

- (1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE , Calgary, AB, T2E 6P8
- (2) This test was performed by Eurofins Environment Testing Canada, 146 Colonnade Road, Unit #8 , Ottawa, ON, K2E 7Y1
- (3) Offsite analysis requires that subcontracted moisture be reported.
- (4) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

**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

=====

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.



### SOIL CORROSIVITY PACKAGE (SOIL)

<b>Bureau Veritas ID</b>		SZS800		
<b>Sampling Date</b>		2022/06/12		
<b>COC Number</b>		847598-83-01		
	<b>UNITS</b>	<b>MS-8 SA3 HWY 400 LANG STAFF TO MAJOR MAC</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>				
Resistivity	ohm-cm	210		8075295
<b>Inorganics</b>				
Soluble (20:1) Chloride (Cl-)	ug/g	2900	100	8078410
Conductivity	umho/cm	4810	2	8078415
Available (CaCl2) pH	pH	7.44		8081077
Soluble (20:1) Sulphate (SO4)	ug/g	<200 (1)	200	8078412
Sulphide	mg/kg	<0.5 (2)	0.5	8092084
<b>Physical Testing</b>				
Moisture-Subcontracted	%	29	0.30	8092083
RDL = Reportable Detection Limit QC Batch = Quality Control Batch (1) Due to colour interferences, sample required dilution. Detection limit was adjusted accordingly. (2) Sample extracted past method-specified hold time. Sample contained greater than 10% headspace at time of extraction. Analyzed past method specified hold time				





BUREAU  
VERITAS

Bureau Veritas Job #: C2H6445

Report Date: 2023/09/05

WSP Canada Inc.

Client Project #: 21490972

Site Location: HWY 400 LANGSTAFF OF MAJOR MAC

Sampler Initials: JS

## TEST SUMMARY

**Bureau Veritas ID:** SZS800  
**Sample ID:** MS-8 SA3 HWY 400 LANG STAFF TO MAJOR MAC  
**Matrix:** Soil

**Collected:** 2022/06/12  
**Shipped:**  
**Received:** 2022/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8078410	2022/06/28	2022/06/29	Alina Dobreanu
Conductivity	AT	8078415	2022/06/28	2022/06/28	Roya Fathitil
Moisture (Subcontracted)	BAL	8092083	N/A	2022/07/05	Maren Glaser
Sulphide in Soil	SPEC	8092084	N/A	2022/07/04	Bailey Morrison
pH CaCl2 EXTRACT	AT	8081077	2022/06/29	2022/06/29	Taslima Aktar
Resistivity of Soil		8075295	2022/06/28	2022/06/28	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8078412	2022/06/28	2022/06/29	Chandra Nandlal
Redox Potential	COND	8096334	2022/07/07		Ankita Bhalla



### GENERAL COMMENTS

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

Package 1	7.0°C
-----------	-------

Revised Report [2023/09/05]: Split report required as per client request.

**Results relate only to the items tested.**



## QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8078410	ADB	Matrix Spike [SZS792-01]	Soluble (20:1) Chloride (Cl-)	2022/06/29		NC	%	70 - 130
8078410	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2022/06/29		105	%	70 - 130
8078410	ADB	Method Blank	Soluble (20:1) Chloride (Cl-)	2022/06/29	<20		ug/g	
8078410	ADB	RPD [SZS792-01]	Soluble (20:1) Chloride (Cl-)	2022/06/29	6.5		%	35
8078412	C_N	Matrix Spike [SZS798-01]	Soluble (20:1) Sulphate (SO4)	2022/06/29		104	%	70 - 130
8078412	C_N	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2022/06/29		109	%	70 - 130
8078412	C_N	Method Blank	Soluble (20:1) Sulphate (SO4)	2022/06/29	<20		ug/g	
8078412	C_N	RPD [SZS798-01]	Soluble (20:1) Sulphate (SO4)	2022/06/28	NC		%	35
8078415	RFT	Spiked Blank	Conductivity	2022/06/28		100	%	90 - 110
8078415	RFT	Method Blank	Conductivity	2022/06/28	<2		umho/cm	
8078415	RFT	RPD [SZS804-01]	Conductivity	2022/06/28	0		%	10
8081077	TAK	Spiked Blank	Available (CaCl2) pH	2022/06/29		100	%	97 - 103
8081077	TAK	RPD	Available (CaCl2) pH	2022/06/29	0.25		%	N/A
8092083	MGL	Method Blank	Moisture-Subcontracted	2022/07/05	<0.30		%	
8092084	BYM	Matrix Spike [SZS791-01]	Sulphide	2022/07/04		71 (1)	%	75 - 125
8092084	BYM	Spiked Blank	Sulphide	2022/07/04		101	%	75 - 125
8092084	BYM	Method Blank	Sulphide	2022/07/04	<0.5		mg/kg	
8092084	BYM	RPD [SZS791-01]	Sulphide	2022/07/04	28		%	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.



BUREAU  
VERITAS

Bureau Veritas Job #: C2H6445  
Report Date: 2023/09/05

WSP Canada Inc.  
Client Project #: 21490972  
Site Location: HWY 400 LANGSTAFF OF MAJOR MAC  
Sampler Initials: JS

### VALIDATION SIGNATURE PAGE

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

Ankita Bhalla, Project Manager

Cristina Carriere, Senior Scientific Specialist

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

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

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

24-Jun-22 14:58

Page 3

Ema Gitej



C2H6445

ly:

Bottle Order #:

B47598

Project Manager:

Ema Gitej

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#2292 Golder Associates Ltd	Company Name:	WSP Golder	Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Ana Poljakic	P.O. #:	
Address:	100 Scotia Crt	Address:	100 Scotia Court, Whitby, ON	Project:	21490972
	Whitby ON L1N 8Y6			Project Name:	Hwy 400 Long Staff & Major Mac
Tel:	(905) 723-2727	Tel:	905 723 2277	Site #:	21490972
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	apoljakic@golder.com	Sampled By:	747

DSG

ENV-652



C#847598-83-01

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

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 #)

Regulation 153 (2011)		Other Regulations		Special Instructions
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> CCME	<input type="checkbox"/> Sanitary Sewer Bylaw	
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Comm	<input type="checkbox"/> Reg 558	<input type="checkbox"/> Storm Sewer Bylaw	
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agri/Other	<input type="checkbox"/> MISA	<input type="checkbox"/> Municipality	
<input type="checkbox"/> Table	<input type="checkbox"/> For RSC	<input type="checkbox"/> PWGO	<input checked="" type="checkbox"/> Reg 406 Table 1	
		<input type="checkbox"/> Other		

Include Criteria on Certificate of Analysis (Y/N)?

Field Filtered (please circle):  
Metals / Hg / Cr-VI

Conductivity Testing

Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr-VI	Conductivity Testing	# of Bottles	Comments
MS-16 SA3	Hwy 400 Long Staff to Major Mac	June/16/22			✓	✓	1	One 250mL Jar for Conductivity Testing
MS-17 SA2	Hwy 400 Long Staff to Major Mac	June/16/22			✓	✓	1	SAA (same as above)
MS-15 SA4	Hwy 400 Long Staff to Major Mac	June/16/22			✓	✓	1	SAA
MS-14 SA3	Hwy 400 Long Staff to Major Mac	June/16/22			✓	✓	1	SAA
MS-13 SA2a	Hwy 400 Long Staff to Major Mac	June/13/22			✓	✓	1	SAA
MS-12 SA3	Hwy 400 Long Staff to Major Mac	June/13/22			✓	✓	1	SAA
MS-11 SA4	Hwy 400 Long Staff to Major Mac	June/12/22			✓	✓	1	SAA
MS-10 SA2	Hwy 400 Long Staff to Major Mac	June/12/22			✓	✓	1	SAA
MS-9 SA3	Hwy 400 Long Staff to Major Mac	June/12/22			✓	✓	1	SAA
MS-8 SA3	Hwy 400 Long Staff to Major Mac	June/12/22			✓	✓	1	SAA

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	
Debarish Roy		22/06/23		P. Roy		20/06/24	14:58		Time Sensitive	Temperature (°C) on Receipt
										Intact

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' 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.BVLABS.COM/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.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

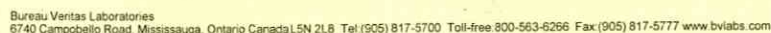
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs

Yellow: Client

Bureau Veritas Canada (2019) Inc.





<b>IMPORT TO:</b> Company Name: <b>#2292 Golder Associates Ltd</b> Attention: <b>Accounts Payable</b> Address: <b>100 Scotia Crt</b> <b>Whitby ON L1N 8Y6</b> Tel: <b>(905) 723-2727</b> Fax: <b>(905) 723-2182</b> Email: <b>CanadaAccountsPayableInvoices@golder.com</b>			<b>REPORT TO:</b> Company Name: <b>WSP Golder</b> Attention: <b>Sharon Guin - Ana Poliacik</b> Address: <b>100 Scotia Court, Whitby, ON</b> Tel: <b>905 723 2727</b> Fax: <b></b> Email: <b>sharon_guin@golder.com</b> <b>apolacik@golder.com</b>			<b>PROJECT INFORMATION:</b> Quotation #: <b>B80683</b> P.O. #: <b></b> Project: <b>2490972</b> Project Name: <b>Hwy 400 Long Staff of Major Mac</b> Site #: <b>2490972</b> Sampled By: <b>JS</b>			<b>Laboratory Use Only:</b> BV Labs Job #: <b></b> Bottle Order #: <b></b> COC #: <b></b> Project Manager: <b></b> C#844039-01-01 Ema Gitej											
<b>MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY</b>						<b>ANALYSIS REQUESTED (PLEASE BE SPECIFIC)</b>						<b>Turnaround Time (TAT) Required:</b> Please provide advance notice for rush projects								
<b>Regulation 153 (2011)</b> <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table _____			<b>Other Regulations</b> <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Municipality _____ <input type="checkbox"/> PWQO <input checked="" type="checkbox"/> Reg 406 Table <b>1</b> <input type="checkbox"/> Other: _____			<b>Special Instructions</b> _____ _____ _____			<b>Field Filtered (please circle):</b> Metals / Hg / Cr VI <div style="display: flex; justify-content: space-between;"> <div><input checked="" type="checkbox"/> Reg 153 Vectors Hg</div> <div><input checked="" type="checkbox"/> Reg 153 Vectors Metals</div> <div><input checked="" type="checkbox"/> Reg 153 Vectors Cr VI</div> <div><input checked="" type="checkbox"/> Reg 153 Vectors Hg</div> <div><input checked="" type="checkbox"/> Reg 153 Vectors Metals</div> <div><input checked="" type="checkbox"/> Reg 153 Vectors Cr VI</div> </div>						<b>Regular (Standard) TAT:</b> (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.					
<b>Include Criteria on Certificate of Analysis (Y/N)?</b>						<b>Job Specific Rush TAT (if applies to entire submission)</b> 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 MS-7 SA2		Hwy 400 Long Staff to Major Mac		June 7/22									1	One 250mL Jar for Corrosivity						
2 MS-6 SA3		Hwy 400 Long Staff to Major Mac		June 2/22									1	SAA (same as above)						
3 MS-5 SA4		Hwy 400 Long Staff to Major Mac		June 2/22									1	SAA						
4 MS-4 SA4		Hwy 400 Long Staff to Major Mac		June 2/22									1	SAA						
5 MS-8 SA2		Hwy 400 Long Staff to Major Mac		June 1/22									1	SAA						
6 MS-2 SA3		Hwy 400 Long Staff to Major Mac		June 1/22									1	SAA						
7 MS-1 SA4		Hwy 400 Long Staff to Major Mac		June 1/22									1	SAA						
8 MS-23 SA3		Hwy 400 Long Staff to Major Mac		June 14/22									1	SAA						
9 MS-22 SA4		Hwy 400 Long Staff to Major Mac		June 14/22									1	SAA						
10 MS-21 SA3		Hwy 400 Long Staff to Major Mac		June 14/22									1	SAA						
* 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						
Debarish K...				22/06/23		See Page 1							Time Sensitive		Temperature (°C) on Recci					
													Custody Seal		Yes	No				
													Present							
													Intact							
* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' 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.BVLABS.COM/TERMS-AND-CONDITIONS.																White: BV Labs      Yellow: Client				
* 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.																SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS				
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.																				





Bureau Veritas Laboratories  
6740 Campbell Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free: 800-563-6286 Fax: (905) 817-5777 www.bvlabs.com

# CHAIN OF CUSTODY RECORD

Page 3 of 3

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #2292 Golder Associates Ltd	Company Name: WSP Golder	Quotation #: B80683	BV Labs Job #:		Bottle Order #:		
Attention: Accounts Payable	Attention: Anna Poliacik	P.O. #:	844140		Barcode		
Address: 100 Scotia Crt	Address: 100 Scotia Court, Whitby, ON	Project: 21490972	COC #:		Project Manager:		
Whitby ON L1N 8Y6		Project Name: Hwy 400 Long Staff of Meyer Mac	Barcode		Ema Gitej		
Tel: (905) 723-2727	Tel: 905 723 2727	Site #:	C#944140-18-01				
Fax: (905) 723-2182	Fax:	Sampled By: JS					
Email: CanadaAccountsPayableInvoices@golder.com	Email: apolacik@golder.com						
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY				ANALYSIS REQUESTED (PLEASE BE SPECIFIC)		Turnaround Time (TAT) Required:	
Regulation 153 (2011)				Field Filtered (please circle):		Regular (Standard) TAT:	
Other Regulations				Metals / Hg / Cr / VI		(will be applied if Rush TAT is not specified)	
Special Instructions				Corrosivity testing		Standard TAT = 5-7 Working days for most tests.	
Include Criteria on Certificate of Analysis (Y/N)?						Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.	
Sample Barcode Label				Sample (Location) Identification		Job Specific Rush TAT (if applies to entire submission)	
Date Sampled				Time Sampled		Date Required:	
Matrix						Time Required:	
1 MS-19 SA2 Hwy 400 Long Staff to Major Mac				June 15/22		Rush Confirmation Number:	
2 MS-20 SA4 Hwy 400 Long Staff to Major Mac				June 15/22		(call lab for #)	
3 MS-18 SA3 Hwy 400 Long Staff to Major Mac				June 15/22		# of Bottles	
4						Comments	
5						1 one 250mL Jar for Corrosivity	
6						1 SAA	
7						1 SAA -	
8							
9							
10							
* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time
Debasish Roy / [Signature]		22/06/23		See Page 1			
# jars used and not submitted		Laboratory Use Only		Time Sensitive		Temperature (°C) on Recei	Custody Seal
		Present					Yes
		Intact					No
		White: BV Labs					Yellow: Client

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' 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.BVLABS.COM/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.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

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



Your Project #: 21490972  
Your C.O.C. #: 933554-04-01, 933554-03-01

**Attention: Maor Levy**

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

**Report Date: 2023/09/18**  
Report #: R7819977  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3R4090**

**Received: 2023/09/07, 08:40**

Sample Matrix: Soil  
# Samples Received: 13

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	13	2023/09/11	2023/09/12	CAM SOP-00463	MOE E3013 m
Conductivity	13	2023/09/12	2023/09/12	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	5	N/A	2023/09/17	AB SOP-00002	CCME PHC-CWS m
Moisture (Subcontracted) (1, 2)	8	N/A	2023/09/18	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	13	N/A	2023/09/18	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	3	2023/09/11	2023/09/11	CAM SOP-00413	EPA 9045 D m
pH CaCl2 EXTRACT	10	2023/09/12	2023/09/12	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	13	2023/09/11	2023/09/12	CAM SOP-00421	SM 2580 B
Resistivity of Soil	13	2023/09/08	2023/09/12	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	13	2023/09/11	2023/09/12	CAM SOP-00464	MOE E3013 m

**Remarks:**

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

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

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

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

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

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

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



Your Project #: 21490972  
Your C.O.C. #: 933554-04-01, 933554-03-01

**Attention: Maor Levy**

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

**Report Date: 2023/09/18**  
Report #: R7819977  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C3R4090**

**Received: 2023/09/07, 08:40**

\* 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.
- (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

=====

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 #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

### SOIL CORROSIVITY PACKAGE (SOIL)

<b>Bureau Veritas ID</b>		WXP810			WXP810			WXP811	WXP812		
<b>Sampling Date</b>		2023/07/19			2023/07/19			2023/07/19	2023/07/27		
<b>COC Number</b>		933554-04-01			933554-04-01			933554-04-01	933554-04-01		
	<b>UNITS</b>	<b>FC-2 SS2</b>	<b>RDL</b>	<b>QC Batch</b>	<b>FC-2 SS2 Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>	<b>FC-1 SS3</b>	<b>116-1 SS3</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Calculated Parameters</b>											
Resistivity	ohm-cm	730		8904860				270	400		8904860

<b>CONVENTIONALS</b>											
Redox Potential	mV	210	N/A	8908461				340	290	N/A	8908461

<b>Inorganics</b>											
Soluble (20:1) Chloride (Cl-)	ug/g	560	20	8907988				2100	1500	100	8907988
Conductivity	umho/cm	1370	2	8910743				3640	2480	2	8910743
Available (CaCl2) pH	pH	7.85		8908869				7.47	7.62		8910408
Soluble (20:1) Sulphate (SO4)	ug/g	310	20	8907991				220	120	20	8907991
Sulphide	mg/kg	0.6 (1)	0.5	8924774	0.7	0.5	8924774	<0.5 (1)	0.9 (1)	0.5	8924774

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

<b>Bureau Veritas ID</b>		WXP813			WXP814			WXP815	WXP816		
<b>Sampling Date</b>		2023/07/18			2023/07/18			2023/07/18	2023/07/18		
<b>COC Number</b>		933554-04-01			933554-04-01			933554-04-01	933554-04-01		
	<b>UNITS</b>	<b>100-1 SS4</b>	<b>QC Batch</b>	<b>75-1 SS3</b>	<b>RDL</b>	<b>0009N-3 SS2</b>	<b>0009S-3 SS2</b>	<b>RDL</b>	<b>QC Batch</b>		

<b>Calculated Parameters</b>											
Resistivity	ohm-cm	450		8904860	410			590	580		8904860

<b>CONVENTIONALS</b>											
Redox Potential	mV	230		8908461	370	N/A		370	330	N/A	8908461

<b>Inorganics</b>											
Soluble (20:1) Chloride (Cl-)	ug/g	1300		8907988	1400	100		910	920	20	8907988
Conductivity	umho/cm	2220		8910743	2460	2		1680	1730	2	8910743
Available (CaCl2) pH	pH	7.91		8908869	7.68			7.75	7.68		8910408
Soluble (20:1) Sulphate (SO4)	ug/g	56		8907991	54	20		73	64	20	8907991
Sulphide	mg/kg	1.1 (1)		8924774	1.5 (1)	0.5		<0.5 (2)	<0.5 (1)	0.5	8924774

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

(1) Extracted past method specified hold time

(2) Extracted past method specified hold time

Sample contained greater than 10% headspace at time of extraction.





### SOIL CORROSIVITY PACKAGE (SOIL)

<b>Bureau Veritas ID</b>		WXP816		WXP817		WXP818		WXP819		
<b>Sampling Date</b>		2023/07/18		2023/08/04		2023/08/04		2023/08/04		
<b>COC Number</b>		933554-04-01		933554-04-01		933554-04-01		933554-04-01		
	<b>UNITS</b>	<b>0009S-3 SS2 Lab-Dup</b>	<b>QC Batch</b>	<b>55-1 SS4</b>	<b>RDL</b>	<b>225-1 SS4</b>	<b>RDL</b>	<b>0008-3 SS3</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>										
Resistivity	ohm-cm			560		420		570		8904860
<b>CONVENTIONALS</b>										
Redox Potential	mV			360	N/A	300	N/A	310	N/A	8908461
<b>Inorganics</b>										
Soluble (20:1) Chloride (Cl-)	ug/g			920	20	1400	100	970	20	8907988
Conductivity	umho/cm			1780	2	2360	2	1770	2	8910743
Available (CaCl2) pH	pH	7.69	8910408	7.55		7.80		7.49		8910408
Soluble (20:1) Sulphate (SO4)	ug/g			38	20	120	20	56	20	8907991
Sulphide	mg/kg			1.4 (1)	0.5	<0.5 (2)	0.5	1.7 (1)	0.5	8924774
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 (2) Extracted past method specified hold time Sample contained greater than 10% headspace at time of extraction.										



BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090  
Report Date: 2023/09/18

WSP Canada Inc.  
Client Project #: 21490972  
Sampler Initials: TT

### SOIL CORROSIVITY PACKAGE (SOIL)

<b>Bureau Veritas ID</b>		WXP820		WXP821			WXP822		
<b>Sampling Date</b>		2023/08/02		2023/07/26			2023/07/25		
<b>COC Number</b>		933554-03-01		933554-03-01			933554-03-01		
	<b>UNITS</b>	<b>40-1 SS5</b>	<b>QC Batch</b>	<b>90A-3 SS4</b>	<b>RDL</b>	<b>QC Batch</b>	<b>9B-4 SS4</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>									
Resistivity	ohm-cm	440	8904860	360		8904860	690		8904860
<b>CONVENTIONALS</b>									
Redox Potential	mV	350	8908461	200	N/A	8908461	320	N/A	8908461
<b>Inorganics</b>									
Soluble (20:1) Chloride (Cl <sup>-</sup> )	ug/g	1200	8907988	1600	100	8907988	660	20	8907988
Conductivity	umho/cm	2280	8910743	2760	2	8910743	1440	2	8910743
Available (CaCl <sub>2</sub> ) pH	pH	7.36	8910408	7.82		8908869	7.63		8910408
Soluble (20:1) Sulphate (SO <sub>4</sub> )	ug/g	100	8907991	300	20	8907991	280	20	8907991
Sulphide	mg/kg	<0.5 (1)	8924774	2.4 (1)	0.5	8924774	2.9 (2)	0.5	8924774
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Extracted past method specified hold time (2) Extracted past method specified hold time Sample contained greater than 10% headspace at time of extraction.									



BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090  
Report Date: 2023/09/18

WSP Canada Inc.  
Client Project #: 21490972  
Sampler Initials: TT

### RESULTS OF ANALYSES OF SOIL

<b>Bureau Veritas ID</b>		WXP810	WXP811	WXP811	WXP812	WXP813	WXP814		
<b>Sampling Date</b>		2023/07/19	2023/07/19	2023/07/19	2023/07/27	2023/07/18	2023/07/18		
<b>COC Number</b>		933554-04-01	933554-04-01	933554-04-01	933554-04-01	933554-04-01	933554-04-01		
	<b>UNITS</b>	<b>FC-2 SS2</b>	<b>FC-1 SS3</b>	<b>FC-1 SS3 Lab-Dup</b>	<b>116-1 SS3</b>	<b>100-1 SS4</b>	<b>75-1 SS3</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Physical Testing</b>									
Moisture-Subcontracted	%	11	16	15	13	13	16	0.30	8924775
RDL = Reportable Detection Limit									
QC Batch = Quality Control Batch									
Lab-Dup = Laboratory Initiated Duplicate									

<b>Bureau Veritas ID</b>		WXP815	WXP816	WXP817		WXP818	WXP819		
<b>Sampling Date</b>		2023/07/18	2023/07/18	2023/08/04		2023/08/04	2023/08/04		
<b>COC Number</b>		933554-04-01	933554-04-01	933554-04-01		933554-04-01	933554-04-01		
	<b>UNITS</b>	<b>0009N-3 SS2</b>	<b>0009S-3 SS2</b>	<b>55-1 SS4</b>	<b>QC Batch</b>	<b>225-1 SS4</b>	<b>0008-3 SS3</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Physical Testing</b>									
Moisture-Subcontracted	%	15	17	11	8924775	18	19	0.30	8924776
RDL = Reportable Detection Limit									
QC Batch = Quality Control Batch									

<b>Bureau Veritas ID</b>		WXP820	WXP821	WXP822		
<b>Sampling Date</b>		2023/08/02	2023/07/26	2023/07/25		
<b>COC Number</b>		933554-03-01	933554-03-01	933554-03-01		
	<b>UNITS</b>	<b>40-1 SS5</b>	<b>90A-3 SS4</b>	<b>9B-4 SS4</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Physical Testing</b>						
Moisture-Subcontracted	%	24	19	19	0.30	8924776
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						



**BUREAU  
VERITAS**

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

## TEST SUMMARY

**Bureau Veritas ID:** WXP810  
**Sample ID:** FC-2 SS2  
**Matrix:** Soil

**Collected:** 2023/07/19  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8908869	2023/09/11	2023/09/11	Taslina Aktar
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee KAUAR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP810 Dup  
**Sample ID:** FC-2 SS2  
**Matrix:** Soil

**Collected:** 2023/07/19  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu

**Bureau Veritas ID:** WXP811  
**Sample ID:** FC-1 SS3  
**Matrix:** Soil

**Collected:** 2023/07/19  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee KAUAR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee KAUAR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP811 Dup  
**Sample ID:** FC-1 SS3  
**Matrix:** Soil

**Collected:** 2023/07/19  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel

**Bureau Veritas ID:** WXP812  
**Sample ID:** 116-1 SS3  
**Matrix:** Soil

**Collected:** 2023/07/27  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu

BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

## TEST SUMMARY

**Bureau Veritas ID:** WXP812  
**Sample ID:** 116-1 SS3  
**Matrix:** Soil

**Collected:** 2023/07/27  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP813  
**Sample ID:** 100-1 SS4  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8908869	2023/09/11	2023/09/11	Taslina Aktar
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP814  
**Sample ID:** 75-1 SS3  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP815  
**Sample ID:** 0009N-3 SS2  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk



**BUREAU  
VERITAS**

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

## TEST SUMMARY

**Bureau Veritas ID:** WXP815  
**Sample ID:** 0009N-3 SS2  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP816  
**Sample ID:** 0009S-3 SS2  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee Kaur
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee Kaur
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP816 Dup  
**Sample ID:** 0009S-3 SS2  
**Matrix:** Soil

**Collected:** 2023/07/18  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee Kaur

**Bureau Veritas ID:** WXP817  
**Sample ID:** 55-1 SS4  
**Matrix:** Soil

**Collected:** 2023/08/04  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924775	N/A	2023/09/18	Manthan Patel
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee Kaur
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee Kaur
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP818  
**Sample ID:** 225-1 SS4  
**Matrix:** Soil

**Collected:** 2023/08/04  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924776	N/A	2023/09/17	Olha Kovalenko
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu



BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

## TEST SUMMARY

**Bureau Veritas ID:** WXP818  
**Sample ID:** 225-1 SS4  
**Matrix:** Soil

**Collected:** 2023/08/04  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP819  
**Sample ID:** 0008-3 SS3  
**Matrix:** Soil

**Collected:** 2023/08/04  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924776	N/A	2023/09/17	Olha Kovalenko
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP820  
**Sample ID:** 40-1 SS5  
**Matrix:** Soil

**Collected:** 2023/08/02  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924776	N/A	2023/09/17	Olha Kovalenko
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurpartee K AUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP821  
**Sample ID:** 90A-3 SS4  
**Matrix:** Soil

**Collected:** 2023/07/26  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924776	N/A	2023/09/17	Olha Kovalenko
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8908869	2023/09/11	2023/09/11	Taslina Aktar
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurpartee K AUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk



BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

## TEST SUMMARY

**Bureau Veritas ID:** WXP821  
**Sample ID:** 90A-3 SS4  
**Matrix:** Soil

**Collected:** 2023/07/26  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan

**Bureau Veritas ID:** WXP822  
**Sample ID:** 9B-4 SS4  
**Matrix:** Soil

**Collected:** 2023/07/25  
**Shipped:**  
**Received:** 2023/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8907988	2023/09/11	2023/09/12	Massarat Jan
Conductivity	AT	8910743	2023/09/12	2023/09/12	Leily Karimi
Moisture (Subcontracted)	BAL	8924776	N/A	2023/09/17	Olha Kovalenko
Sulphide in Soil	SPEC	8924774	N/A	2023/09/18	Ly Vu
pH CaCl2 EXTRACT	AT	8910408	2023/09/12	2023/09/12	Gurparteek KAUR
Redox Potential	COND	8908461	2023/09/11	2023/09/12	Gurparteek KAUR
Resistivity of Soil		8904860	2023/09/12	2023/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8907991	2023/09/11	2023/09/12	Massarat Jan



### GENERAL COMMENTS

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

Package 1	5.7°C
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Results relate only to the items tested.



BUREAU  
VERITAS

Bureau Veritas Job #: C3R4090

Report Date: 2023/09/18

## QUALITY ASSURANCE REPORT

WSP Canada Inc.

Client Project #: 21490972

Sampler Initials: TT

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8907988	Soluble (20:1) Chloride (Cl-)	2023/09/12	NC	70 - 130	95	70 - 130	<20	ug/g	6.7	35
8907991	Soluble (20:1) Sulphate (SO4)	2023/09/12	99	70 - 130	97	70 - 130	<20	ug/g	NC	35
8908461	Redox Potential	2023/09/12			102	95 - 105			14	35
8908869	Available (CaCl2) pH	2023/09/11			101	N/A			0.21	N/A
8910408	Available (CaCl2) pH	2023/09/12			101	N/A			0.21	N/A
8910743	Conductivity	2023/09/12			99	90 - 110	<2	umho/cm	0.39	10
8924774	Sulphide	2023/09/18	94	75 - 125	90	75 - 125	<0.5	mg/kg	13	30
8924775	Moisture-Subcontracted	2023/09/18					<0.30	%	2.0	20
8924776	Moisture-Subcontracted	2023/09/17					<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  $\leq 2 \times \text{RDL}$ ).



## VALIDATION SIGNATURE PAGE

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

Anastassia Hamanov, Scientific Specialist

Cristina Carriere, Senior Scientific Specialist

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

Jingyuan Song, QP, Organics – Senior Analyst

Sandy Yuan, M.Sc., QP, Scientific Specialist

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







Bureau Veritas  
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# CHAIN OF CUSTODY RECORD

Page 2 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #1326 WSP Canada Inc.	Company Name: <u>WSP Canada Inc.</u>	Quotation #: C31027	Bureau Veritas Job #:		Bottle Order #:		
Attention: Accounts Payable	Attention: <u>Maor Levy</u>	P.O. #:	COC #:		Project Manager:		
Address: 6925 Century Ave Suite 100	Address:	Project: 21490972 ( <u>10035</u> )	COC #:		Project Manager:		
Mississauga ON L5N 7K2		Project Name:	COC #:		Project Manager:		
Tel: (905) 567-4444 Fax: (905) 567-6561	Tel:	Site #:	COC #:		Project Manager:		
Email: CAPayablesInvoice@wsp.com	Email: <u>maor.levy@wsp.com</u>	Sampled By: <u>J.I. and S.A.</u>	COC #:		Project Manager:		
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)		Turnaround Time (TAT) Required:		Please provide advance notice for rush projects	
Regulation 153 (2011)		Field Filtered (please circle):		Regular (Standard) TAT:		<input checked="" type="checkbox"/>	
Other Regulations		Metals / Hg / Cr VI		(will be applied if Rush TAT is not specified):			
Special Instructions		Soil Contaminant Package		Standard TAT = 5-7 Working days for most tests.			
Include Criteria on Certificate of Analysis (Y/N)?				Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.			
Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Municipality <input type="checkbox"/> PWQO <input type="checkbox"/> Reg 405 Table <input type="checkbox"/> Other:	Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> For RSC	Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC	Table 4 <input type="checkbox"/> Other:	Table 5 <input type="checkbox"/> Other:	Table 6 <input type="checkbox"/> Other:	Table 7 <input type="checkbox"/> Other:	Table 8 <input type="checkbox"/> Other:
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	# of Bottles	Comments	
1	40-1 SSS	23/08/03	A.M.	Soil	2		
2	4A-3 SSS	23/07/26	A.M.	Soil	2		
3	4B-4 SSS	23/07/25	A.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
<u>M. Talha Ishaq</u>		23/09/02		<u>[Signature]</u>	20/10/02	08:40	
Time Sensitive		Temperature (°C) on Receipt		Custody Seal Present		Yes	No
		5/15		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/COC-TERMS-AND-CONDITIONS.				SAMPLER MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS			
* 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.				White: Bureau Veritas Yellow: Client			
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.							

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