



REPORT

Foundation Investigation and Design 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:

Parsons Inc.

625 Cochrane Drive, Suite 300
Markham, Ontario L3R 9R9

Submitted by:

WSP Canada Inc.

6925 Century Avenue, Suite 600, Mississauga, Ontario L5N 7K2

+1 905 567 4444

21490972-R-Rev0-SWM

December 6, 2023

GEOCRES NO.: 30M13-304

Latitude: 43.810112°

Longitude: -79.543880°



Distribution List

1 PDF Copy - MTO Central Region

1 PDF Copy - MTO Foundations Section

1 PDF Copy - Parsons Inc.

1 PDF Copy - WSP Canada Inc.

Table of Contents

PART A – FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	1
2.1 Flow Control Structures	1
2.2 Stormwater Management (SWM) Pond	1
3.0 INVESTIGATION PROCEDURES	2
4.0 SITE GEOLOGY	3
4.1 Regional Geology	3
4.2 Subsurface Conditions	3
4.2.1 Flow Control Structures	4
4.2.1.1 Asphalt	4
4.2.1.2 SAND (SP-SM) to SAND (SW) and Gravel (FILL)	4
4.2.1.3 CLAYEY SILT (CL) (FILL)	4
4.2.1.4 CLAYEY SILT-SILT (CL-ML) to SILTY CLAY (CI) (TILL) – Upper Deposit	5
4.2.1.5 Sandy SILT (ML)	5
4.2.1.6 Sandy CLAYEY SILT (CL) (TILL) – Lower Deposit	5
4.2.2 Stormwater Management Pond Extension	6
4.2.2.1 Topsoil	6
4.2.2.2 CLAY (CH) (FILL)	6
4.2.2.3 Sandy CLAYEY SILT-SILT (CL-ML) (TILL)	6
4.3 Groundwater Conditions	6
4.4 Analytical Testing of Soil	7
5.0 CLOSURE	8

PART B – FOUNDATION DESIGN REPORT

6.0 DISCUSSION AND FOUNDATION ENGINEERING RECOMMENDATIONS	10
6.1 General	10
6.2 Project Understanding	10
6.2.1 Flow Control Structures	10

6.2.2	Stormwater Management Pond Extension	10
6.3	Founding Elevations for Flow Control Structures.....	11
6.4	Geotechnical Resistances for Flow Control Structures	12
6.4.1	Resistance to Lateral Loads	12
6.5	Lateral Earth Pressures for Design of Flow Control Structure Walls	12
6.6	Stormwater Management Pond Extension	13
6.6.1	Estimated Hydraulic Conductivity	13
6.6.2	Permanent Pond Cuts and Erosion Protection	14
6.6.3	Headwall at Pipe Outlet	14
6.7	Construction Considerations	15
6.7.1	Site Preparation	15
6.7.2	Temporary Excavations	15
6.7.3	Temporary Excavation Support Systems	16
6.7.4	Control of Groundwater and Surface Water During Construction	16
6.8	Corrosion Assessment and Protection.....	17
6.8.1	Potential for Sulphate Attack.....	18
6.8.2	Potential for Corrosion	18
7.0	CLOSURE	18

REFERENCES

DRAWINGS

- Drawing 1 Borehole Location Plan – Flow Control Structures
Drawing 2 Borehole Location Plan – Stormwater Management Pond Extension

PHOTOGRAPHS

Photographs 1 and 2

APPENDICES

APPENDIX A – Borehole Records

List of Symbols and Abbreviations
Record of Boreholes FC-1, FC-2, MS-8, SWMP-1

APPENDIX B – Geotechnical Laboratory Test Results

- Figure B1 Grain Size Distribution – SAND (SP-SM) (FILL)
- Figure B2 Grain Size Distribution – CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)
- Figure B3 Plasticity Chart – CLAY (CH) to CLAYEY SILT (CL) FILL
- Figure B4 Grain Size Distribution – CLAYEY SILT-SILT (CL-ML) TO SILTY CLAY (CI) (TILL) – Upper
- Figure B5 Plasticity Chart – CLAYEY SILT-SILT (CL-ML) to SILTY CLAY (CI) (TILL) – Upper
- Figure B6 Grain Size Distribution – Sandy SILT (ML)
- Figure B7 Plasticity Chart – SILT (ML)
- Figure B8 Grain Size Distribution – CLAYEY SILT (CL) (TILL) – Lower
- Figure B9 Plasticity Chart – CLAYEY SILT (CL) (TILL) – Lower

APPENDIX C – Analytical Laboratory Test Results

Certificate of Analysis – Bureau Veritas Report Numbers R7797696 and R7819977

APPENDIX D – Non-Standard Special Provisions

- SP FOUN0001 – Working Slab
- SP SP 517F01 – Dewatering System, Temporary Flow Passage System

PART A

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

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 m² 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)¹. The split-spoon samplers used in the investigation limits the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions.

The groundwater conditions were noted in the boreholes during and upon completion of drilling and were backfilled in 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.

¹ 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)², this section of Highway 400 lies within the region known as the Peel Plain and consists of level to undulating tracts of clayey glacial till soils, which are presumed to have been derived from moraines, interspersed with non-cohesive silts and sands from interstadial stages of Wisconsinan glaciation.

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

4.2 Subsurface Conditions

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

The 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

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

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

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 fidr 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%20fidr%20swmp%20and%20fcs.docx)

PART B

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

6.0 DISCUSSION AND FOUNDATION ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical/foundation design recommendations for the stormwater management pond extension in the southeast quadrant of the Langstaff Road interchange and the three flow control structures to be constructed as part of the widening and rehabilitation works along Highway 400 from south of Langstaff Road to Major Mackenzie Drive in the City of Vaughan, Ontario.

These recommendations are based on interpretation of the data obtained from the boreholes advanced during the current field investigations. The discussion and recommendations presented are intended to provide the designers with information to carry out the detail design of the stormwater management pond extension and flow control structures. The discussion and recommendations in this Foundation Design Report are intended for the use of MTO and its designers and shall not be used or relied upon for any other purpose or by any other parties, including the construction contractor. Contractors must make their own interpretation based on the factual data presented in the Foundation Investigation Report (Part A of this report). Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required in the Contract Documents. Those requiring information on aspects of construction must make their own interpretation of the data provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Project Understanding

6.2.1 Flow Control Structures

Based on the typical detail drawing provided by Parsons on June 1, 2023, the flow control structures consist of 15 m to 20 m long by 2.6 m to 3 m high cast-in-place concrete walls (about 0.3 m thick) supported on a 1 m wide strip footing. The embedment depth of the flow control structure foundations should be 1.4 m below the ditch bottom (i.e., frost depth). A 2 m long perforated PVC Class DR35 pipe encapsulated with 50 mm clear stone and filter fabric connects to the concrete wall at the upstream side of the structure. Both sides of the flow control structure incorporate a 350 mm (upstream end) to 450 mm (downstream end) layer of rip-rap at the bottom of the ditch.

A summary of the relevant information related to the flow control structures is provided in the table below.

FCS ID	Structure Location (See Dwg 1)	Wall Dimensions (m)			Footing Dimensions (m)		Ditch Bottom Elev. (m)
		Length	Width	Height	Thickness	Width	
FCS-1	14+525	15.0	0.3	2.6	0.4	1.1	205.9
FCS-2	14+417	20.0		2.9			206.4
FCS-3	14+294	16.5		3.0			204.8

6.2.2 Stormwater Management Pond Extension

Based on the cross section and plan drawings provided by Parsons on June 1, 2023, the existing stormwater management pond in the southeast quadrant of the Langstaff Road interchange will be extended approximately 20 m to the south. The existing ground surface in the vicinity of the pond extension footprint is at about Elevation 205.8 m. In addition to the excavations for the pond extension, the remainder of the pond will be cleaned out to

restore the original design elevation of 203.6 m. The maximum depth of excavation for the pond extension and clean out will be about 2 m.

A 900 mm diameter pipe from the Highway 400 storm sewer system will outlet into a 65 m long open channel lined with cable concrete which transitions into the stormwater management pond. At the transition from the pipe outlet to the open channel, a headwall is proposed that will be in accordance with OPSD 804.030. There is also a proposed new spillway and weir (15 m long and lined with cable concrete) that leads to an existing gabion weir between the existing Black Creek watercourse and the sharp bend in the proposed new open channel leading to the stormwater pond.

Permanent interior side slopes for the existing and proposed new pond extension will be sloped at 9H:1V, although the 60 m and 15 m long channels (to be lined with cable concrete) will have side slope inclinations of 3H:1V and 2H:1V, respectively.

6.3 Founding Elevations for Flow Control Structures

Strip footing (shallow) foundations are feasible for supporting the flow control structures and should be founded on the native clayey silt-silt to silty clay till soils or native sandy silt, and below any existing fills, softened/loosened surficial soils or organic soils. Fill materials were encountered at all three borehole locations advanced at Highway 400 grade adjacent to the proposed flow control structure locations. These fill materials extended to about Elevation 205.5 m (near FCS-1), Elevation 205.0 (near FCS-2) and Elevation 203.9 m (near FCS 3) and were underlain by firm to hard (but generally very stiff) clayey silt-silt to silty clay till which was further underlain by compact to dense sandy silt at some locations.

All footings should be founded at a minimum depth of 1.4 m below the adjacent final grade to provide adequate protection against frost penetration, in accordance with OPSD 3090.101 (*Foundation, Frost Penetration Depths for Southern Ontario*).

The subgrade soils will be susceptible to disturbance and degradation on exposure to water, including potential for ongoing seepage associated with the highway ditch and water-bearing non-cohesive soils. Therefore, it is recommended that a concrete working slab be placed over the subgrade to protect the integrity of the foundation soils. A Special Provision should be included in the Contract Documents for a working slab, a copy of which is provided in Appendix D (FOUN0001).

The following maximum (highest) founding elevations for the flow control structures are recommended for footings founded on a competent native stratum.

Structure ID	Applicable Borehole	Ditch Bottom Elevation (m)	Maximum (Highest) Design Founding Elevation ¹ (m)
FCS-1	FC-1	205.9	204.5
FCS-2	FC-2	206.4	205.0
FCS-3	MS-8	204.8	203.4

The footing subgrade should be inspected by qualified geotechnical personnel following excavation, in accordance with OPSS 902 (*Excavating and Backfilling Structures*) to check that all existing fill and/or other unsuitable material have been removed. Where sub-excavation of fill or unsuitable materials is required, the sub-excavated area should be backfilled with granular material meeting OPSS.PROV 1010 Granular 'A' or Granular 'B' Type II that is placed and compacted in accordance with OPSS.PROV 501 (*Compacting*).

6.4 Geotechnical Resistances for Flow Control Structures

Strip footings constructed on the properly prepared subgrade, at or below the design elevations given in Section 6.3, should be designed based on the factored geotechnical resistance at the Ultimate Limit State (f-ULS) and the factored net geotechnical reaction at the Serviceability Limit State (f-SLS) given below. These values are based on 25 mm of total settlement and uniformly distributed vertical loading.

Structure ID	Anticipated Founding Stratum	f-ULS (kPa)	f-SLS (kPa)
FCS-1	Very stiff clayey silt-silt till	225	150
FCS-2	Very stiff clayey silt till		
FCS-3	Compact to dense sandy silt		

The factored ultimate and serviceability geotechnical resistances are dependent on the footing width, founding elevation, and loading conditions and as such, the geotechnical resistances should be reviewed if the footing width varies from that specified above, if the founding elevations differ from that given in Section 6.3, or if there is eccentric loading conditions.

6.4.1 Resistance to Lateral Loads

Resistance to lateral forces / sliding between the concrete footing and the subgrade should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). The coefficient of friction, $\tan \phi'$, for a cast-in-place concrete footing or working slab on the native soils are presented below. The coefficient of friction between a cast-in-place concrete footing and a cured concrete working slab is as interpreted from Naval Facility Engineering Command (NAVFAC, 1986).

Subgrade Material	Coefficient of Friction, $\tan \phi'$
Cast-in-place concrete footing or working slab on native very stiff clayey silt-silt to clayey silt till	0.60
Cast-in-place concrete footing or working slab on native compact to dense sandy silt	0.62
Cast-in-place concrete footing on concrete working slab	0.70

6.5 Lateral Earth Pressures for Design of Flow Control Structure Walls

The lateral earth pressures acting on the cast-in-place flow control structure walls will depend on the type and method of placement of backfill materials, the nature of the soils behind the backfill, the presence of groundwater or surface water, the magnitude of the surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the wall.

If the wall support allows lateral yielding, active earth pressures may be used in the geotechnical design of the structure. The movement required to allow active pressures to develop behind the wall, and thereby assume an unrestrained structure for design, should be calculated in accordance with Section C6.12.1 and Table C6.12 of the *Commentary to the CHBDC*, 2019.

If the wall does not allow lateral yielding (i.e., restrained structure where the rotational or horizontal movement is not sufficient to mobilize an active earth pressure condition), at-rest earth pressures should be assumed for geotechnical design.

The following geotechnical design parameters may be used for determining the unbalanced horizontal earth pressure acting on the flow control structure walls.

Soil Type	Unit Weight ¹	Friction Angle	Coefficient of Lateral Earth Pressure ²		
	(γ , kN/m ³)	(ϕ' , degrees)	Active, K_a	At-Rest, K_o	Passive, K_p ³
Existing Cohesive Fill	18	28	0.36	0.53	2.8
Clayey Silt-Silt to Silty Clay Till	19	30	0.33	0.50	3.0
Sandy Silt	20	32	0.31	0.47	3.2
New Granular Fill	21	34	0.28	0.44	3.5

Note 1: Saturated unit weights may be calculated by multiplying the bulk unit weights by 1.1; buoyant unit weights may be calculated by subtracting 1,000 kg/m³ from the saturated unit weights. Hydrostatic pressures should be added where buoyant unit weights are assumed.

Note 2: The earth pressure coefficients noted above are based on a horizontal surface adjacent to the flow control structure wall.

Note 3: In accordance with Figure C6.27 and Table C6.12 of the *Commentary to the CHBDC*, 2019, the passive resistance in front of the flow control structure wall may be calculated based on the values of K_p but reduced by an appropriate factor that considers the allowable wall movement to account for the fact that a large strain would be required for mobilization of the full passive resistance.

6.6 Stormwater Management Pond Extension

The existing SWM pond is a dry pond with no liner, and stormwater is allowed to infiltrate into the ground. It is understood that the pond will continue to function as a dry unlined pond after construction of the extension.

Borehole SWMP-1 measured an unstabilized groundwater level at about 5 m below ground surface (Elevation 200.3 m), and wet samples were observed during drilling at a depth of about 3.7 m below ground surface (Elevation 201.6 m). The colour transition of the till soil from brown to grey in Borehole SWMP-1 occurred around a depth of 2.9 m below ground surface (Elevation 202.4 m), which is about 1.2 m below the design base of the pond (Elevation 203.6 m).

Accordingly, given the relatively competent soils and inferred groundwater level below the design base of pond, the proposed pond extension is considered feasible from a foundations perspective.

6.6.1 Estimated Hydraulic Conductivity

Based on Borehole SWMP-1, the base of the pond is expected to consist of cohesive clay fill underlain by sandy clayey silt-silt till. An estimated hydraulic conductivity of the cohesive clay fill was determined using the formula shown below (*Predicting the Hydraulic Conductivity of Saturated Clays Using Plasticity-Value Correlations*, Applied Clay Science, Dolinar, 2009):

$$k = \frac{6.31 \times 10^{-7}}{(PI - 8.74p)^{3.03}} e^{2.66(PI - 8.74p)^{0.234}}$$

Where: k = hydraulic conductivity in metres per second (m/s)

PI = plasticity index in percent (%)

e = void ratio (approximated by taking the product of the natural water content and the specific gravity of the soil, G_s)

p = percentage of clay minerals in the soil divided by 100

Based on the formula and Atterberg limit test carried out on the cohesive clay fill, the hydraulic conductivity of the cohesive clay fill is estimated to be about 1.2×10^{-12} m/s. However, based on the visual classification and grain size distribution performed on a sample of the clay fill, there is a considerable amount of sand and the in-situ hydraulic conductivity is expected to be lower than the calculated value which is based on purely cohesive soil.

For the borderline cohesive sandy clayey silt-silt till, the empirical correlation developed by Hazen and referenced in Craig, 2012 ($K = D_{10}^2 / 100$ where K is the hydraulic conductivity in m/s and D_{10} is the grain size for which 10% of the particles are finer in mm) was utilized to estimate the hydraulic conductivity. This correlation yielded a hydraulic conductivity estimate of 1.0×10^{-8} m/s.

6.6.2 Permanent Pond Cuts and Erosion Protection

Based on the cross section and plan drawings provided by Parsons on June 1, 2023, permanent cuts for the new SWM pond will be up to 2 m deep and will be sloped at 9H:1V, thus, global stability is not considered to be a concern.

To reduce the potential for erosion due to surface water run-off, erosion protection measures consisting of vegetation in accordance with OPSS.PROV 804 (Temporary Erosion Control) and OPSS.PROV 803 (Vegetative Cover) should be incorporated along the interior pond side slopes.

The 60 m long channel (connecting flow from the 900 mm diameter storm sewer pipe to the stormwater pond) and the 15 m long spillway channel to towards Black Creek will have permanent cuts up to about 1 m and 0.5 m deep and side slope inclinations of 3H:1V and 2H:1V, respectively. These side slopes are considered to be adequate to meet global stability requirements. At a minimum, erosion protection measures at these locations should consist of rip-rap, rock protection or granular sheeting meeting the requirements of OPSS.PROV 1004 (Aggregates – Miscellaneous), as amended by SSP 110S16, which is to be placed and compacted in accordance with OPSS.PROV 511 (Rip-Rap, Rock Protection and Granular Sheeting). The size and thickness of the erosion protection system must be designed by the hydraulic engineer. Alternatively, erosion protection measures could consist of a geotextile and cable concrete system installed in accordance with the manufacturer's specifications. The geotextile should meet the specifications for OPSS.PROV 1860 (Geotextiles) Class II with a filtration opening size (FOS) not greater than 212 μ m.

6.6.3 Headwall at Pipe Outlet

As mentioned in Section 6.2.2, the proposed headwall at the outlet location of the 900 mm storm sewer pipe onto the cable concrete channel is proposed to be founded at about Elevation 203.3 m. The headwall at the pipe outlet should be in general accordance with OPSD 804.030 (Concrete Headwalls for Pipe Less than 900 mm Diameter).

Based on the results of Borehole SWMP-1, minor sub-excavation (on the order of about 0.3 m) should be expected to penetrate through the cohesive clay fill and found the headwall on the native stiff to very stiff sandy clayey silt-silt till subgrade. The stiff to very stiff sandy clayey silt-silt till will form an acceptable subgrade for the headwall foundation.

Rip-rap may be required adjacent to the pipe outlet and headwalls to minimize erosion of the existing embankment side-slopes. A geotextile is recommended below the rip-rap, as a separator from the existing fill soils and/or native clayey silt-silt soils. The geotextile should meet the specifications for OPSS.PROV 1860 (Geotextiles) Class II with a filtration opening size (FOS) not greater than 212 µm.

6.7 Construction Considerations

6.7.1 Site Preparation

Prior to constructing the headwall for the SWM pond and the flow control structures, all existing fill, organic material (including topsoil, peat, and/or mixed organic soils) and any disturbed/softened native soils should be sub-excavated below the plan limits of the proposed works to expose undisturbed native soil. The subgrade should be inspected immediately following sub-excavation to ensure that all organics and other unsuitable materials have been removed.

For the flow control structures and headwall, any additional backfill material required to raise the grade up to the underside of design footing elevation shall consist of Granular 'A' or Granular 'B' (Type II) meeting the requirements of OPSS.PROV 1010. All engineered fill shall be placed in accordance with OPSS.PROV 501 (Compacting).

For the lined channels, regrading and cleaning out the existing channel base and side slopes will be required prior to installation of the geotextile and cable concrete. All existing organic material (including topsoil, peat, and/or mixed organic soils) and any disturbed/softened soils should be sub-excavated below the plan limits of the proposed works. It is anticipated that the subgrade for the new channels will consist of cohesive earth fill and/or sandy clayey silt-silt till. The subgrade should be checked to confirm that all poorly performing areas or any unsuitable soils have been removed and replaced with engineered fill prior to placing the geotextile and cable concrete as per the manufacturer specifications. Where the design channel grade needs to be re-established (where soft or poorly performing areas are subexcavated), consideration can be given to reusing soil excavated from the pond extension footprint (or from elsewhere on the project) provided the soils are accepted by qualified geotechnical personnel. If imported soil is required, consideration can be given to using Select Subgrade Material (SSM) as OPSS.PROV 1010.

Any new fill materials should be benched into the existing side slopes as per OPSD 208.010 (Benching of Earth Slopes) and regrading operations should be in accordance with the requirements of OPSS.PROV 206 (Construction Specifications for Grading) and OPSS.PROV 501 (Compacting).

6.7.2 Temporary Excavations

Temporary excavations will be required to construct the walls and footings for the flow control structures, SWM pond headwall, and possibly to remove unsuitable soils as part of the SWM Pond extension (and associated channels). Temporary excavations are anticipated to extend up to about 3 m to 4 m below ground surface for the flow control structures and headwall.

All excavations should be carried out in accordance with the latest version of the Ontario Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects. Within the anticipated excavation depths, the existing firm to stiff cohesive fill, firm to very stiff native cohesive till soils, and compact to dense non-cohesive soils are all considered to be Type 3 soils above the groundwater table. All soils below the groundwater table are considered to be Type 4 soils. Unsupported temporary excavations within Type 3 soils should be made with side slopes at 1H:1V or flatter, whereas unsupported temporary excavations within Type 4 soils should be made with

side slopes at 3H:1V or flatter. However, depending upon the construction procedures, season of year, weather conditions and groundwater seepage conditions at the time of construction/excavation, some local flattening of the slopes may be required, especially where softer zones are expected (i.e., excavations near Black Creek and in the highway ditches). Some local flattening of the slopes may also be required where localized seepage is encountered and/or if perched groundwater is encountered.

All excavated material should be stockpiled away from the sides of the excavation as per the OHSA. Care must also be taken during excavation to ensure that adequate support is provided for any existing structures, roadways and underground services located adjacent to the excavation.

6.7.3 Temporary Excavation Support Systems

Given the proximity of the existing Highway 400 embankment to the headwall/flow control structures and anticipated excavation depths, temporary protection systems (sheet piles or soldier pile and lagging system) may be required. The presence of cobbles and/or boulders within the native till deposit could impede installation of the temporary protection systems and therefore, pre-drilling and/or removal of obstructions to facilitate construction of the temporary protection systems may be required.

The design and construction of all temporary excavation support systems is the responsibility of the Contractor and must be in accordance with the latest version of the *Ontario Occupational Health and Safety Act for Construction Projects (OHSA)*, as amended. Recommended values of the geotechnical parameters for use in design of temporary protection systems are provided in section 6.5. Where both total stress and effective stress parameters are provided, the temporary excavation support system design should be verified using each independent analytical method (i.e., total stress versus effective stress).

The temporary protection systems should be designed and constructed in accordance with OPSS.PROV 539 (*Temporary Protection Systems*). The lateral movement of the protection systems should meet Performance Level 2 as specified in OPSS.PROV 539 within the roadway, provided that adjacent utilities and structures can tolerate this magnitude of deformation. Depending on the Contractors sequence of operations / excavation, the temporary global stability of the highway embankment should be checked as per OPSS.PROV 539 and the applicable loads / pressures must be incorporated into the design of the temporary protection system. The owners of utilities located adjacent to or that cross the proposed excavation should be contacted to understand their owner's requirements and tolerances for movement.

6.7.4 Control of Groundwater and Surface Water During Construction

Based on the boreholes, excavations for the SWM pond and associated structures (lined channels and headwall) are generally expected to be above the groundwater table. Nevertheless, some groundwater seepage into the open excavations should be expected, especially considering their proximity to nearby watercourse / drainage features and if perched groundwater is encountered. The temporary excavations for the flow control structures are anticipated to range from about Elevation 203.2 to 204.5 m, and groundwater is estimated to range from about Elevation 203 m to 205 m, thus, excavations are anticipated to be at or below the groundwater level.

Excavations below the groundwater are expected to generally encounter cohesive fill or native cohesive till soils and, as such, it is likely that groundwater can be controlled by trenching or diversion ditches with sufficient sumps and pumps located within the excavations. For flow control structure FCS-3, it is possible that excavations will extend into water-bearing non-cohesive sandy silt soils (depending on sub-excavation requirements in the highway ditch) in which case more robust dewatering efforts would be required to facilitate construction of the flow

control structure foundation and maintain a dry excavation. Should excavations extend into water-bearing non-cohesive soils, dewatering will require installation of a series of perimeter well points, water wells, or an eductor system. The groundwater level should be drawn down to at least 1 m below the base of the excavation until the subgrade is checked and accepted, concrete is placed and cured, and the excavation is backfilled at least 0.5 m above the static groundwater level. Design of temporary dewatering systems is the responsibility of the Contractor, who should retain a specialist dewatering subcontractor to design and oversee dewatering operations. The Contractor and the specialist dewatering subcontractor are also responsible for confirming that the radius of groundwater drawdown does not impact the existing embankment and any surrounding features.

Considering the flow control structures and stormwater pond extension are located directly within an active stormwater drainage system and near a natural watercourse, flow diversion will be required during construction. Flow diversion / Dewatering operations should be carried out/managed in accordance with OPSS.PROV 902 (Excavation and Backfilling – Structures) and OPSS.PROV 517, as amended by Special Provision 517F01 (Dewatering System, Temporary Flow Passage System). For flow control structure 3, the fill-in Table A of Special Provision 517F01 should indicate that a preconstruction survey is required at a distance equal to the groundwater drawdown zone of influence. It is recommended that the design engineer have a minimum of 5 years' experience in designing systems of similar nature and scope to the required work and therefore the fill-in in Table A of Special Provision 517F01 should indicate "Yes" for the "Design Engineer Requirements". The remaining fill-ins of Special Provision 517F01 should be provided by the drainage engineer. For the other flow control structure locations and for the stormwater management pond, the fill-in Table A of Special Provision 517F01 should indicate that a preconstruction survey is not required ("N/A"). A copy of SP 517F01 is provided in Appendix D.

Construction water takings in excess of 50,000 L/day are regulated by the Ministry of the Environment, Conservation and Parks (MECP). Certain takings of groundwater for construction dewatering purposes with a combined total less than 400,000 L/day qualify for self registration on the MECP's Environmental Activity and Sector Registry (EASR), requiring a "Water Taking Plan" and a "Discharge Plan" (to be developed by the Design-Build). A Category 3 PTTW would be required for water takings in excess of 400,000 L/day. The contractor will be responsible for obtaining any required discharge approvals. Based on discussions with Parsons, it is expected that an EASR or PTTW will not be required specific to the flow control structure locations and the stormwater management pond extension, although an overall EASR or PTTW may be applicable for the full project limits.

Consideration should be given to constructing temporary cofferdam / flow diversion structures to reduce surface water and groundwater infiltration and reduce dewatering efforts.

Surface water and stormwater should be directed away from the excavation areas to prevent ponding and/or flowing water that could result in disturbance and loosening/softening of the foundation or pond/lined channel subgrade.

6.8 Corrosion Assessment and Protection

Soil corrosivity may affect the concrete or steel elements (e.g. reinforcing steel) of foundations or related structures buried in the soil. The long-term performance and durability of the foundations are directly related to their respective corrosion resistance. Generally, the corrosivity potential to a structure can be assessed based on indicators such as soil resistivity / electrical conductivity, hydrogen ion concentration (pH), and salts (chloride and sulphate) concentrations. The analytical results of these indicators for the soil samples submitted for testing (Borehole MS-8 Sample 3, Borehole FC-1 Sample 3, and Borehole FC-2 Sample 2) are summarized in Section 4.4 and discussed below, and the analytical laboratory test report is included in Appendix C.

6.8.1 Potential for Sulphate Attack

The analytical test results were compared to CSA Standard, CAN/CSA-A23.1-14 Table 3 ("*Additional requirements for concrete subjected to sulphate attack*") to assess potential sulphate attack on concrete. The sulphate concentrations measured in the tested samples is below the exposure class of S-3 (Moderate). Therefore, based on the soil sample tested, when the designer is selecting the exposure class for foundations or buried structures, the effects of sulphates may not need to be considered. However, given the proximity of the flow control structures, headwall and stormwater pond to de-icing salt used on the highway, consideration should be given by the designer to designing for a "C" type exposure class as defined by CSA A23.1 Table 1.

6.8.2 Potential for Corrosion

According to MTO's *Gravity Pipe Design Guidelines* (2014), the pH is not considered detrimental to steel durability as it is less than a pH of 8.5.

The resistivity measured in the tested soil samples (210 to 730 ohm-cm) indicates that the soil corrosiveness is "severe" ($R < 2,000$ ohm-cm) as per Table 3.2 of MTO's *Gravity Pipe Design Guidelines* (2014) and therefore, some level of corrosion protection should be applied to the flow control structures and headwall.

7.0 CLOSURE

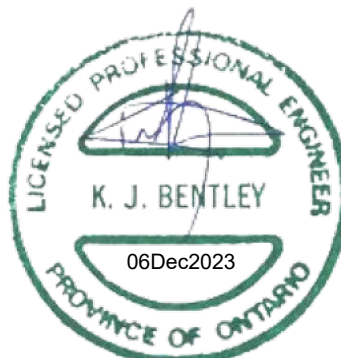
This Foundation Design Report was prepared by Mr. Mark Henderson, P.Eng., a Geotechnical Engineer with WSP. Mr. Kevin Bentley, P.Eng., a Geotechnical Engineer and MTO Principal Foundations Contact for WSP, conducted an independent technical and quality control review of this report.

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 FIDR 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%20FIDR%20SWMP%20and%20FCS.docx)

REFERENCES

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.).

Canadian Standards Association (CSA), 2019. *Canadian Highway Bridge Design Code and Commentary on CSA S6:19*.

Craig, R.F. and Knappett, J.A., 2012. *Craig's Soil Mechanics*, Eighth Edition, Spon Press, New York.

Dolinar, B. 2009. Predicting the Hydraulic Conductivity of Saturated Clays Using Plasticity-Value Correlations. *Applied Clay Science*, Volume 45.

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

Naval Facilities Engineering Command. 1986. *Foundations & Earth Structures*. Design Manual 7.2. U.S. Navy, Alexandria, Virginia.

Occupational Health and Safety Act and Regulation, Ontario Regulation 213 for Construction Projects (as amended).

ASTM International

ASTM D1586 Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils

Commercial Software

Settle3 Settle3 (Version 11.0.1.21429) by Geo-Slope International Ltd.

Ontario Provincial Standard Drawing (OPSD)

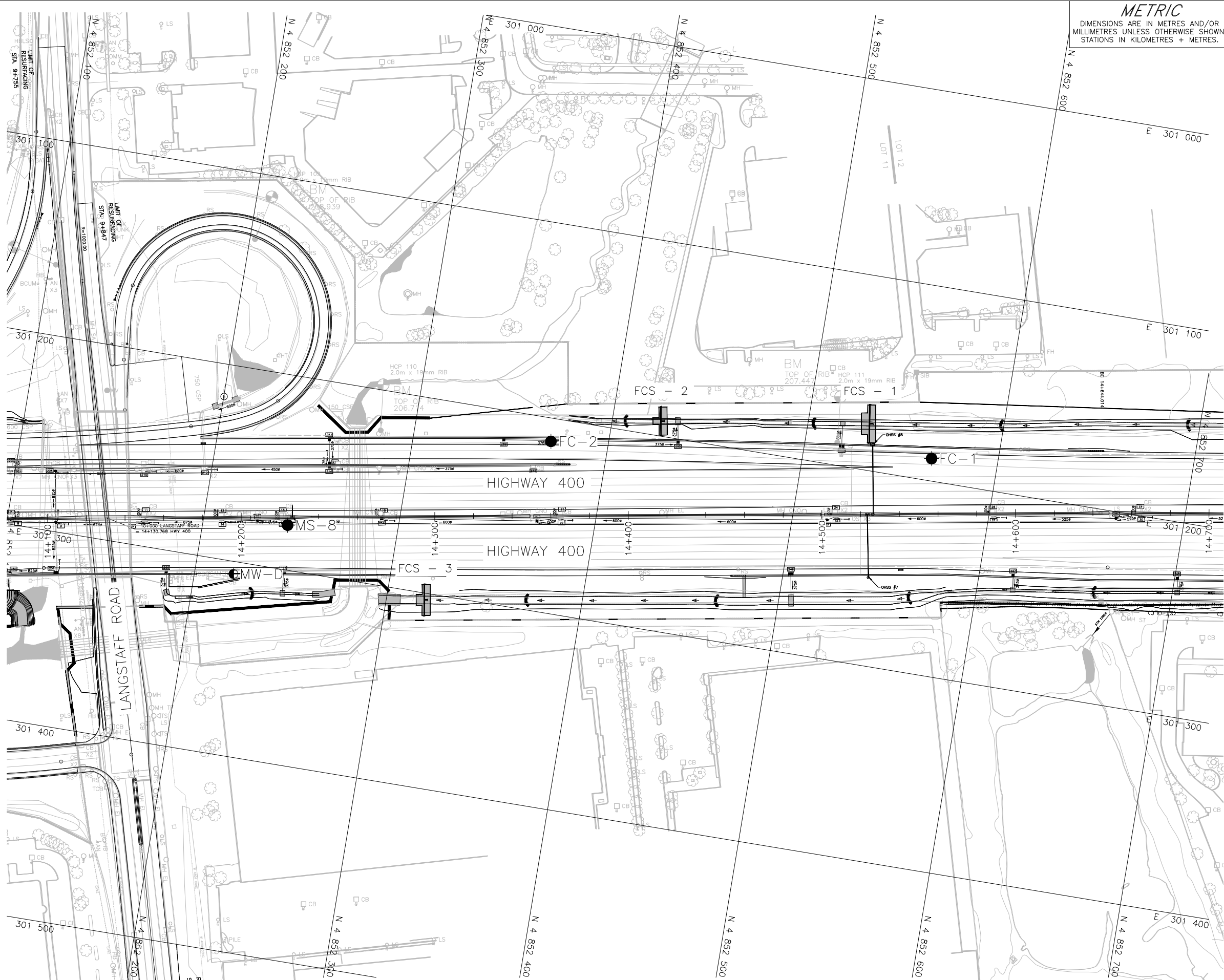
OPSD 208.010 Benching of Earth Slopes
 OPSD 804.030 Concrete Headwall for Pipe Less than 900 mm Diameter
 OPSD 3090.101 Foundation Frost Penetration Depths for Southern Ontario

Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 206 Construction Specification for Grading
 OPSS.PROV 501 Construction Specification for Compacting
 OPSS.PROV 511 Construction Specification for Rip-Rap, Rock Protection and Granular Sheetting
 OPSS.PROV 517 Construction Specification for Dewatering
 OPSS.PROV 539 Construction Specification for Temporary Protection Systems
 OPSS.PROV 803 Construction Specification for Vegetative Cover
 OPSS.PROV 804 Construction Specification for Temporary Erosion Control
 OPSS.PROV 1004 Material Specification for Aggregates – Miscellaneous
 OPSS.PROV 1010 Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
 OPSS.PROV 1860 Material Specification for Geotextiles

Ontario Water Resource Act

Regulation 903 Wells (as amended)

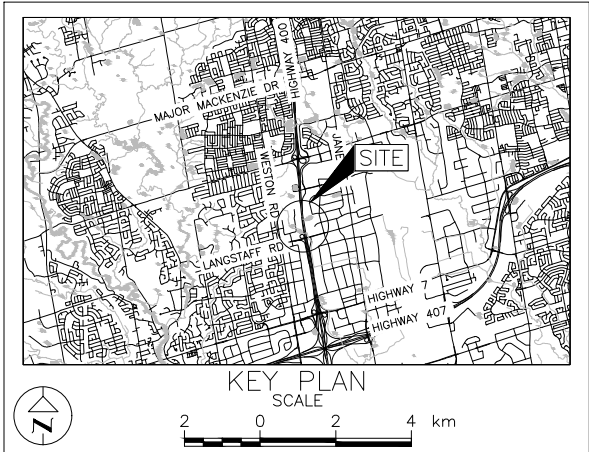


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No.2836-02-00

HIGHWAY 400 WIDENING
FLOW CONTROL STRUCTURES
BOREHOLE LOCATION PLAN

SHEET



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



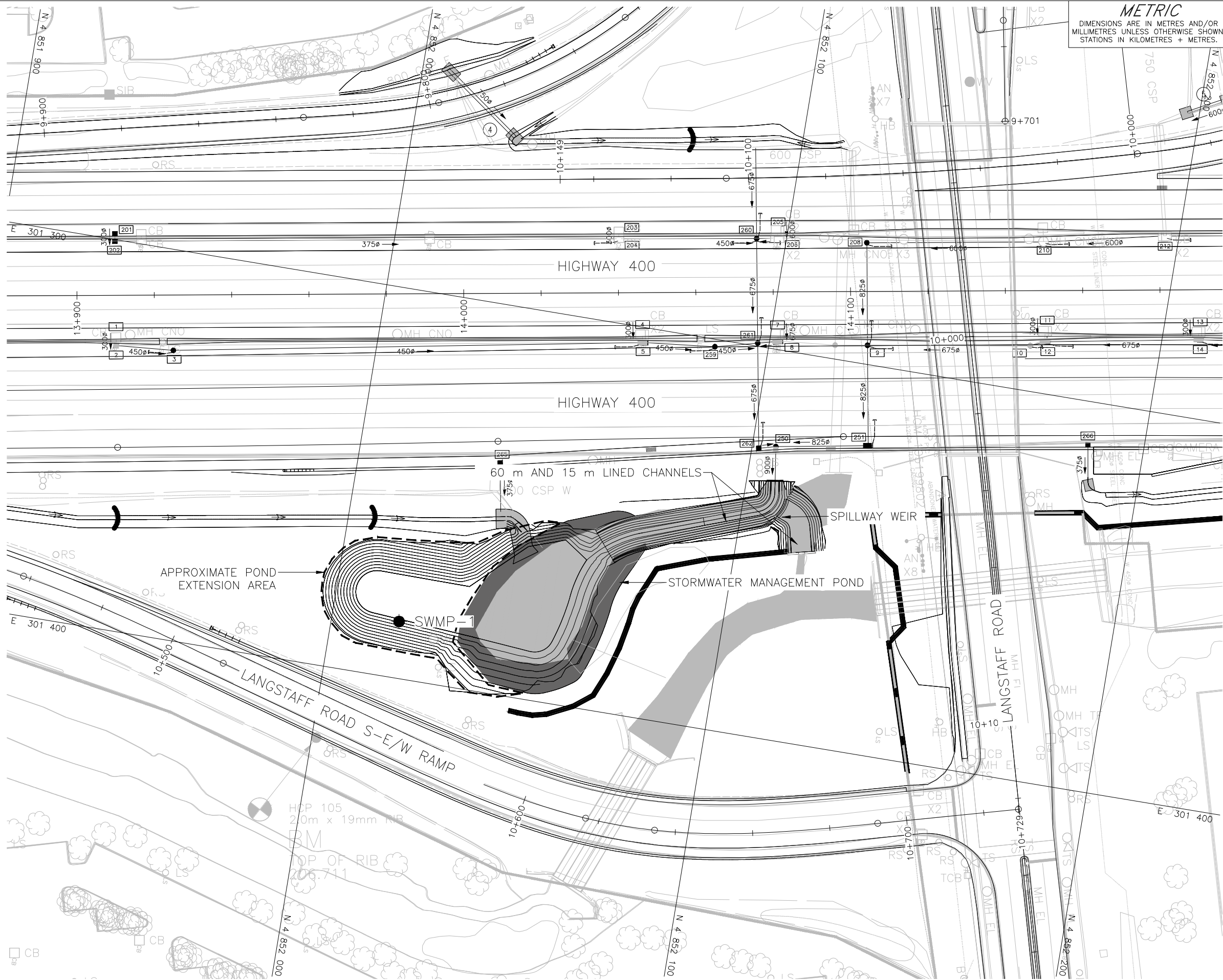
NOTES

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



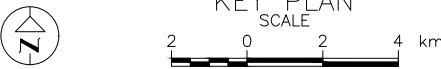
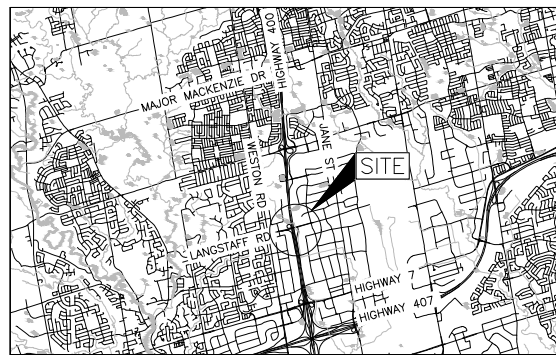
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No.2836-02-00

HIGHWAY 400 WIDENING
STORMWATER MANAGEMENT POND EXTENSION
BOREHOLE LOCATION PLAN



SHEET



LEGEND

● Borehole - Current Investigation

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



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_Extstg 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_Bind 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 Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

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

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

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

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (*q_t*), porewater pressure (*u*) and sleeve friction (*f_s*) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

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

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness¹

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

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

2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

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

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

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

Field Moisture Condition

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

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

PROJECT	21490972	RECORD OF BOREHOLE		No. FC-1	Sheet 1 of 1	METRIC
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 Y	GR	SA	SI	CL	REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L						
208.5	ASPHALT (380 mm)							20	40	60	80	100	20	40	60						
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														
			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.																				

+³, x³ : Numbers refer to Sensitivity o³⁰% 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					REMARKS
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL W _p	NMC W	LL W _L		GR	SA	SI	CL	
208.0	ASPHALT (380 mm)							20	40	60	80	100	20	40	60						
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	SS	30		206										2	92	4	2	
205.8																					
2.2	CLAYEY SILT (CL), trace sand, trace gravel, trace organics (FILL) Stiff Brown Moist		3	SS	9		205														
205.0																					
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		204										1	11	42	46	
			5	SS	29		203														
			6	SS	15		202														
202.4																					
5.6	Sandy SILT (ML), trace clay Dense Grey Moist		7	SS	44		201														
			8	SS	33		200														
8.2																					
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.																				

+³, x³ : Numbers refer to Sensitivity o³% 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 NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L			
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.													

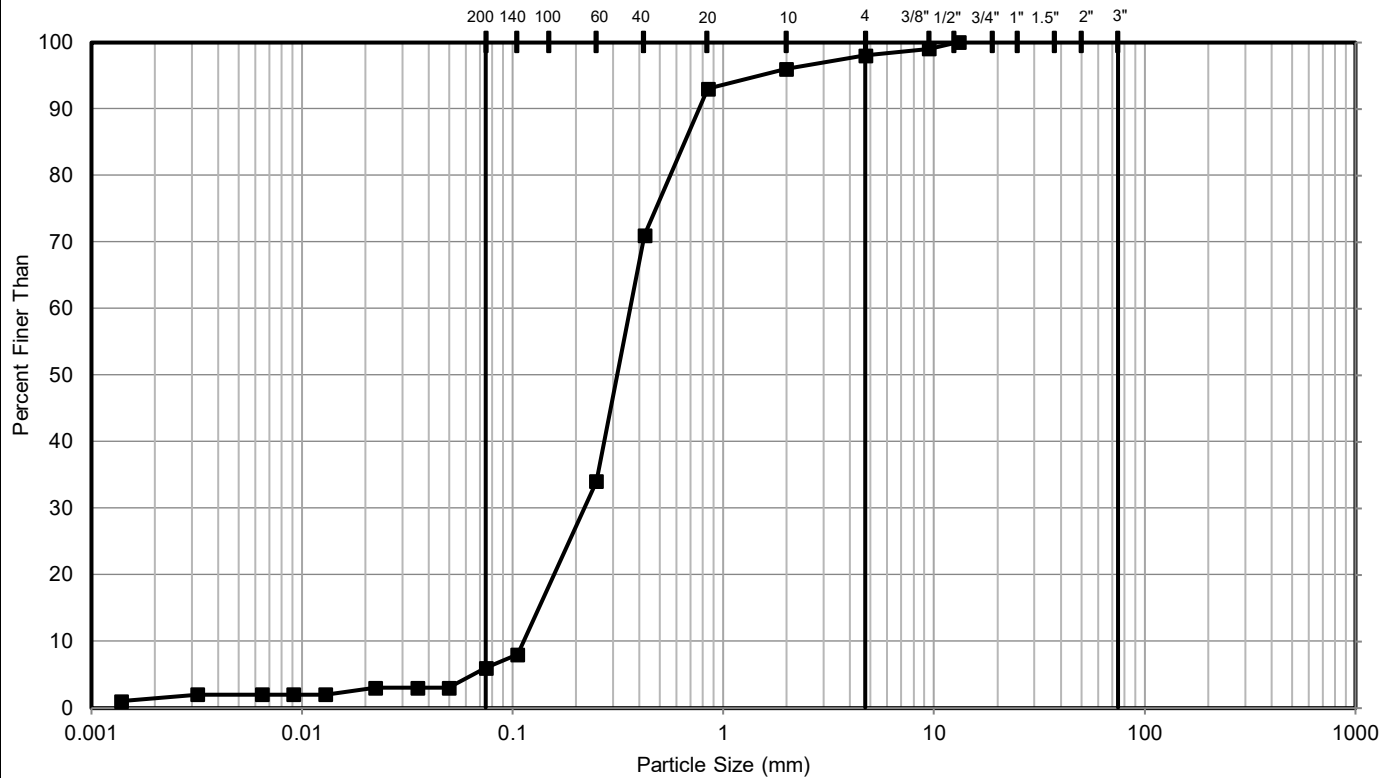
PROJECT	21490972	LOCATION	N 4852017.4; E 301385.4 NAD83 / MTM Zone 10 (LAT. 43.808113; LONG. -79.542441)	Sheet 1 of 1	METRIC
G.W.P.	2836-02-00	BOREHOLE TYPE	168 mm O.D. Hollow Stem Auger	ORIGINATED BY	T.T.
DIST	CENTRAL HWY 400	DATE	Jul 17, 2023	COMPILED BY	T.T.
DATUM	Geodetic Surface Elevation:205.3 m			CHECKED BY	M.H.

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					WATER CONTENT (%)				UNIT WEIGHT Y kN/m³	GR	SA	SI	CL	REMARKS
ELEV. ----- DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					PL	NMC	LL							
								Field Vane					W _p	W	W _L							
								Remoulded Pocket Pen Quick Triaxial Unconfined					NP Nonplastic									
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																	
203.1 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		203															
			5	SS	10		202															
			6	SS	26		201															
			7	SS	38		200															
			8	SS	54	199																
198.6 6.7	End of Borehole																					
	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.						198															
							197															
							196															

APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

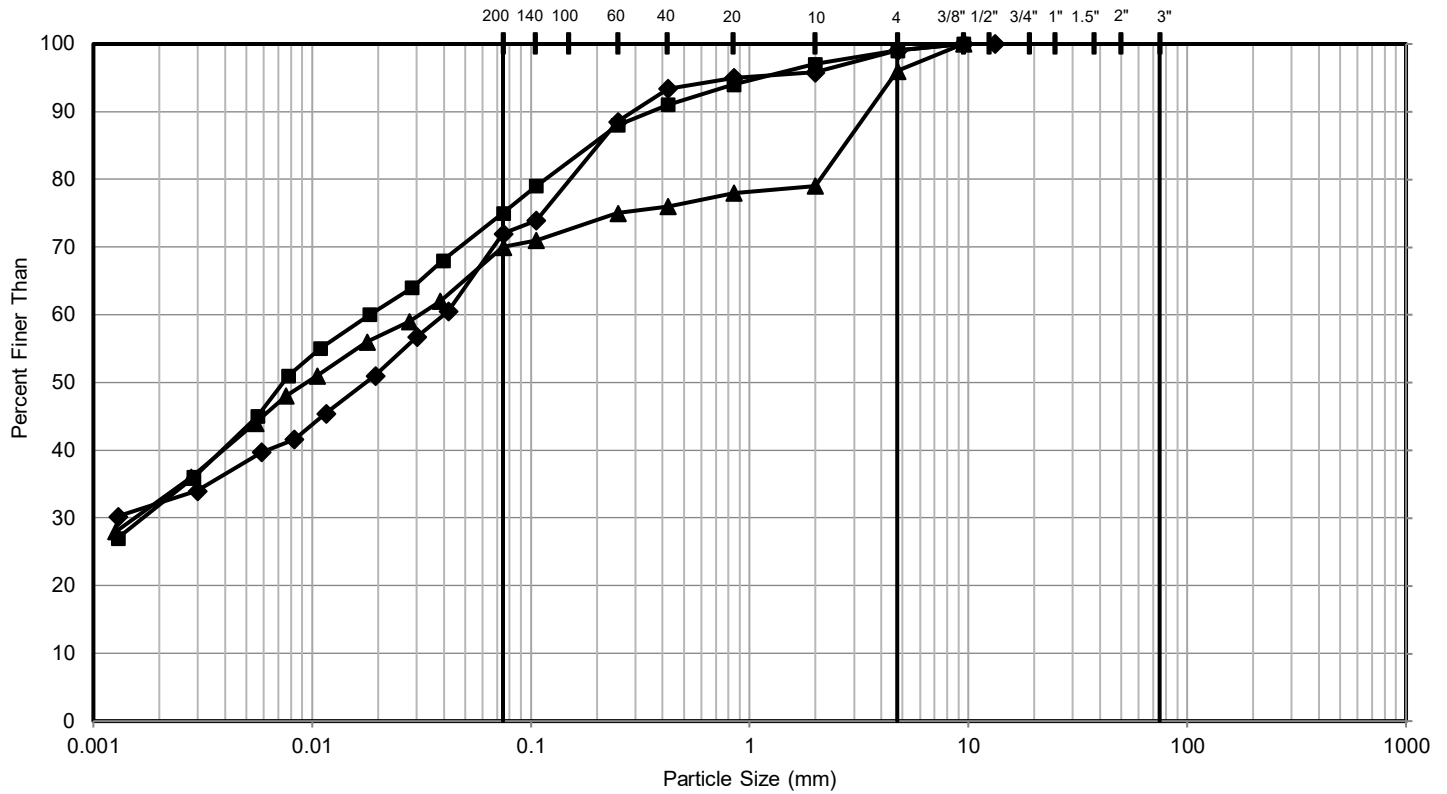


FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

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	
CONSULTANT	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
wsp GOLDER		REV.	FIGURE
		0	0
		21490972	B1

GRAIN SIZE DISTRIBUTION



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

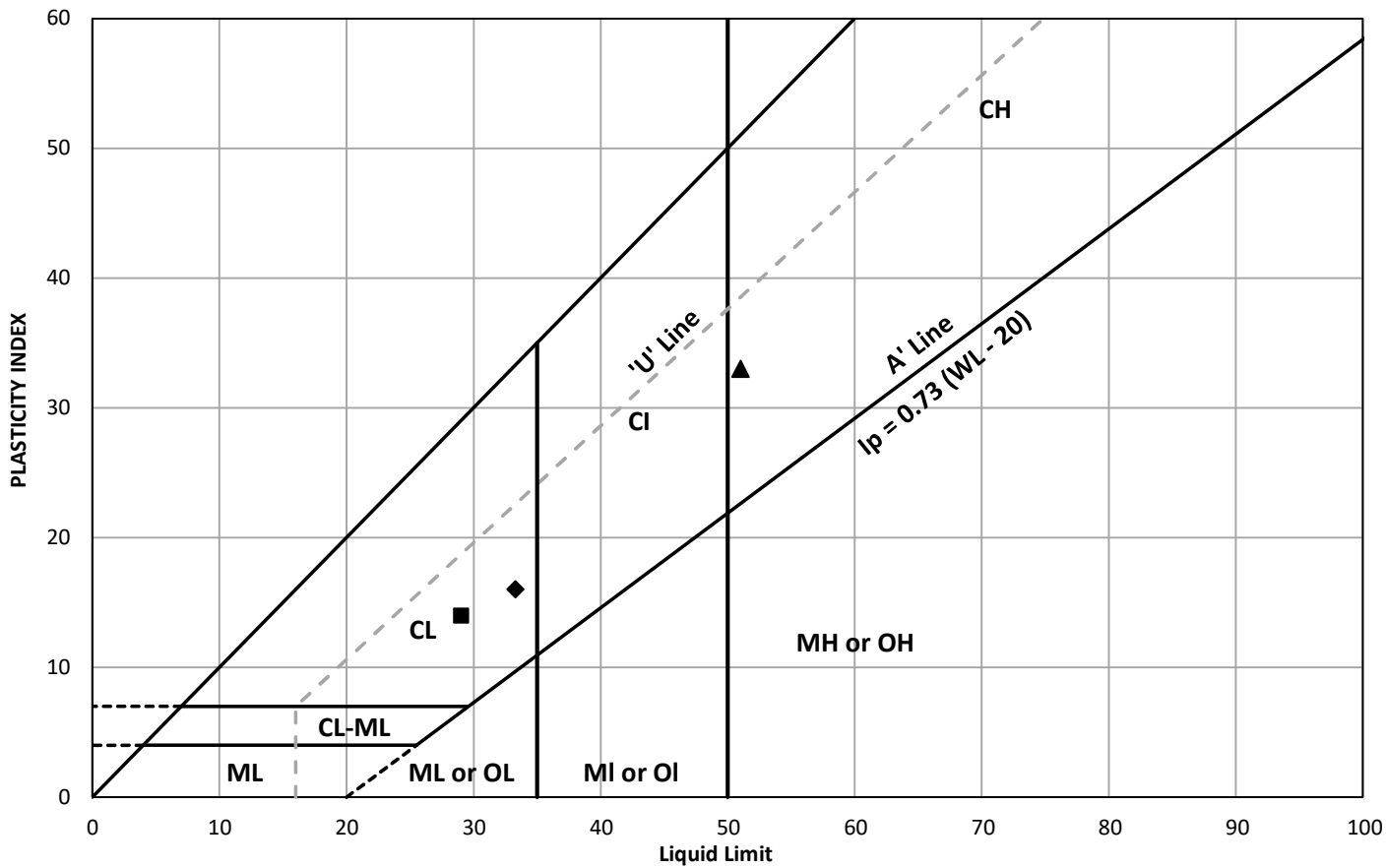
Symbol	Sample Location	Sample Number	Depth (m)	Elevation (m)
■	FC-1	3	2.3 - 2.9	206.2 to 205.6
◆	MS-8	2	1.5 - 2.1	205.4 to 204.8
▲	SWMP-1	3	1.5 - 2.1	203.8 to 203.2

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

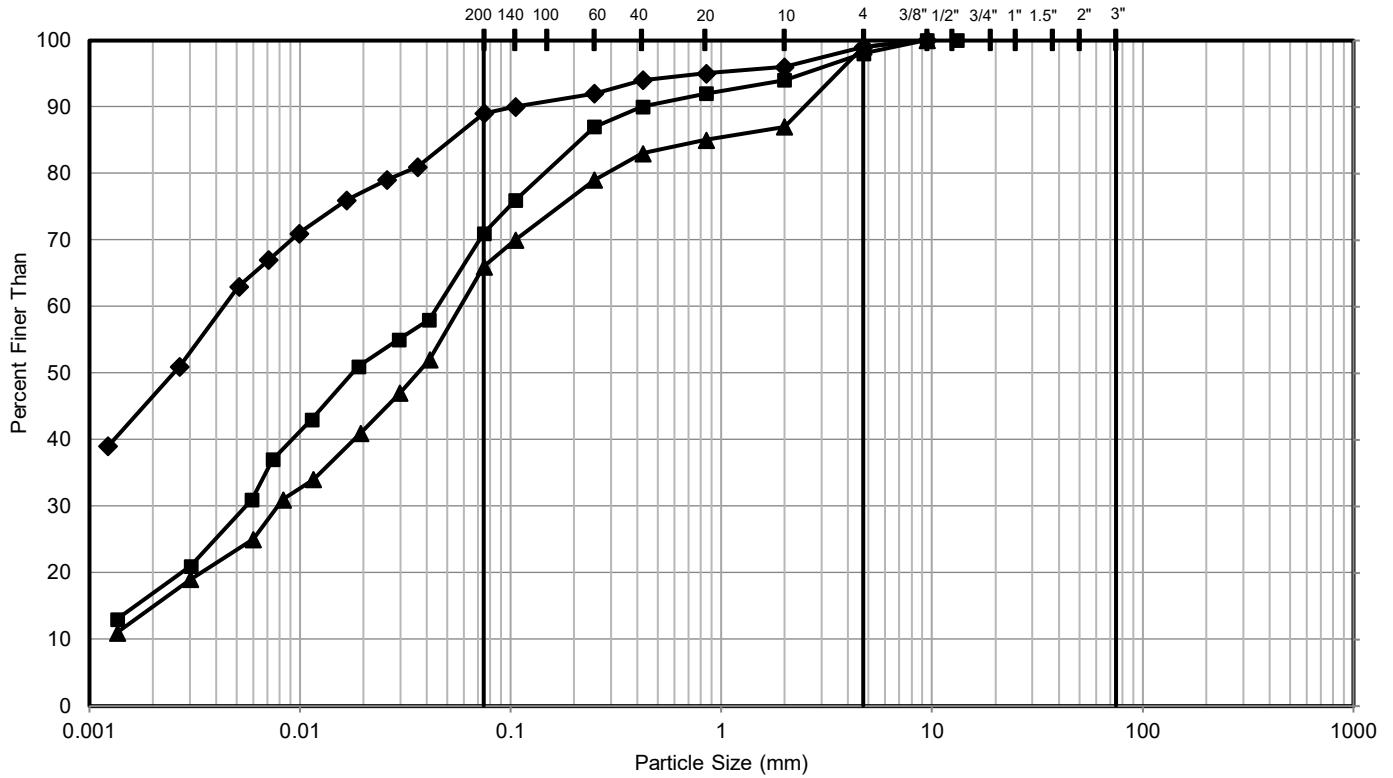
PLASTICITY CHART



	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

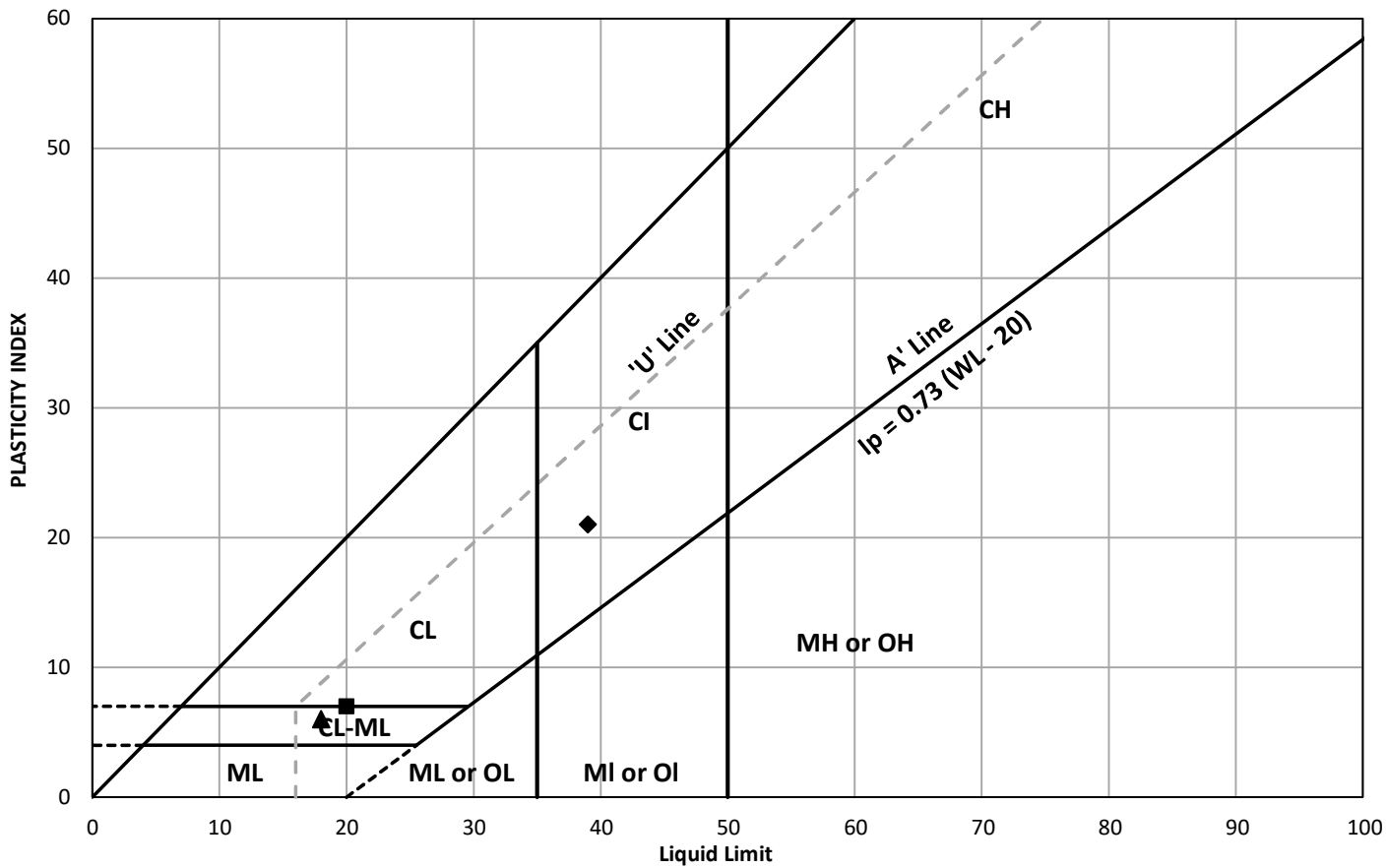
REV.

0

FIGURE

B4

PLASTICITY CHART

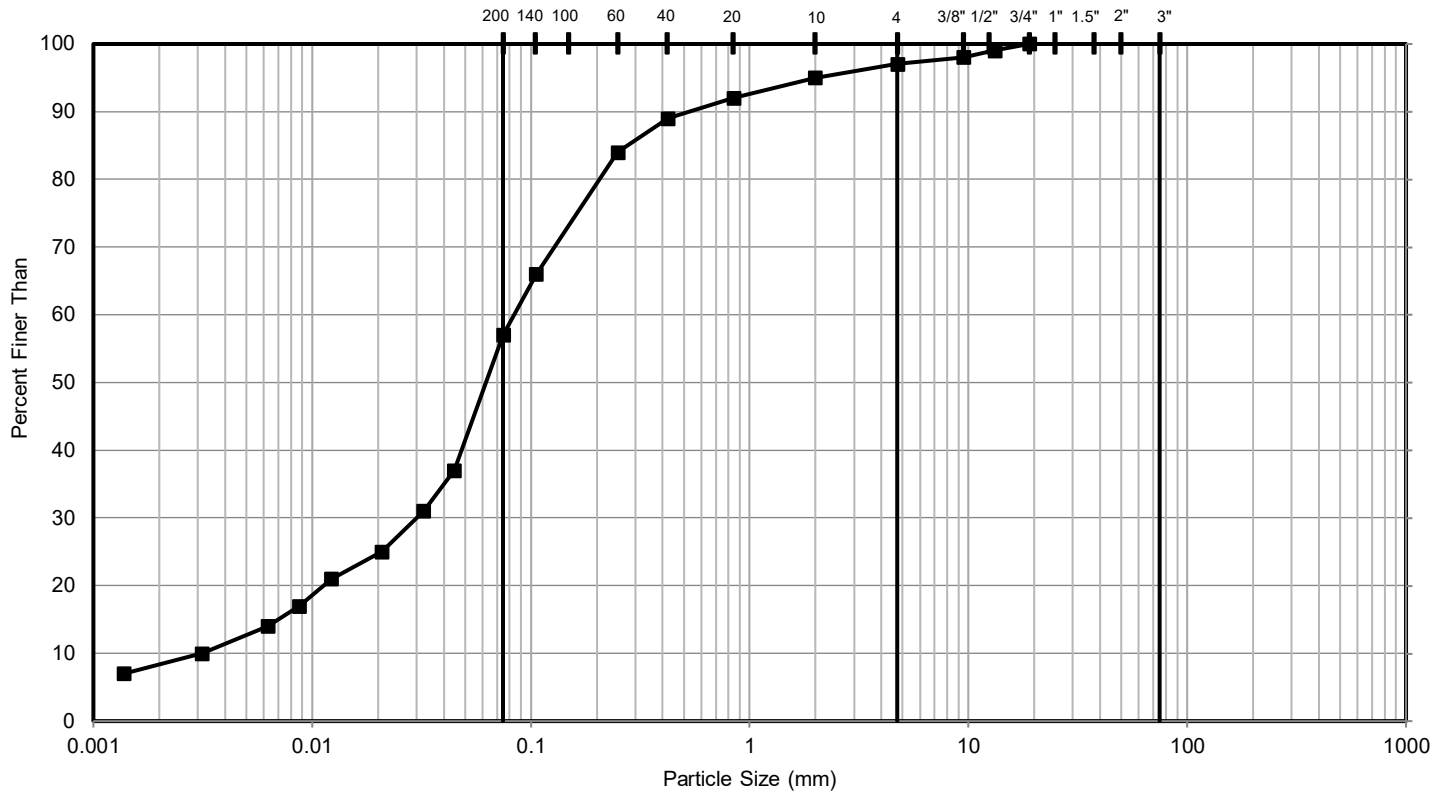


	Sample Location	Sample / Specimen Number	Depth (m)	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
■	FC-1	6	4.6 - 5.2	11	20	13	7	-0.29
◆	FC-2	4	3.0 - 3.7	21.5	39	18	21	0.17
▲	SWMP-1	7	4.6 - 5.2	-	18	12	6	-

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

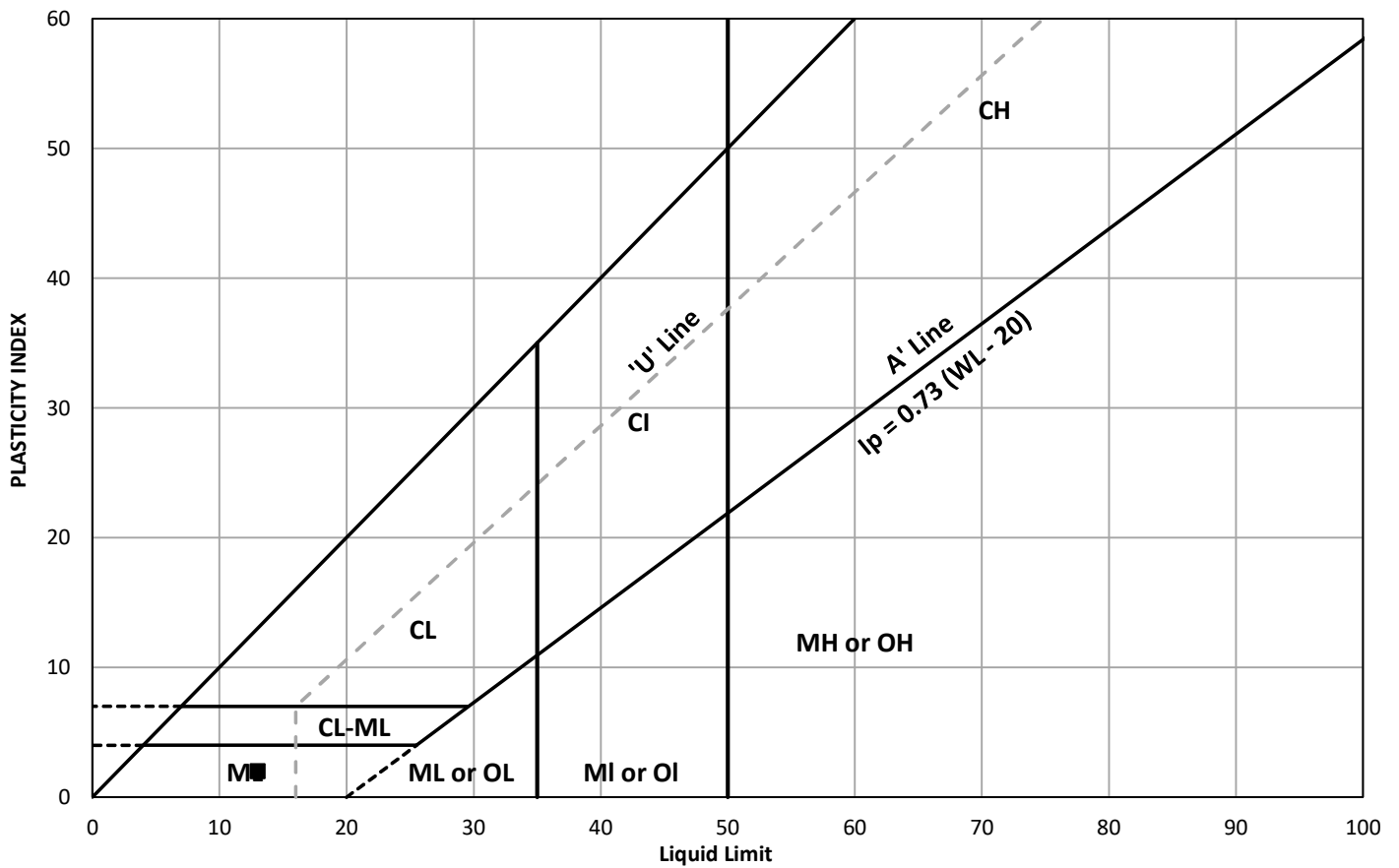


FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

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

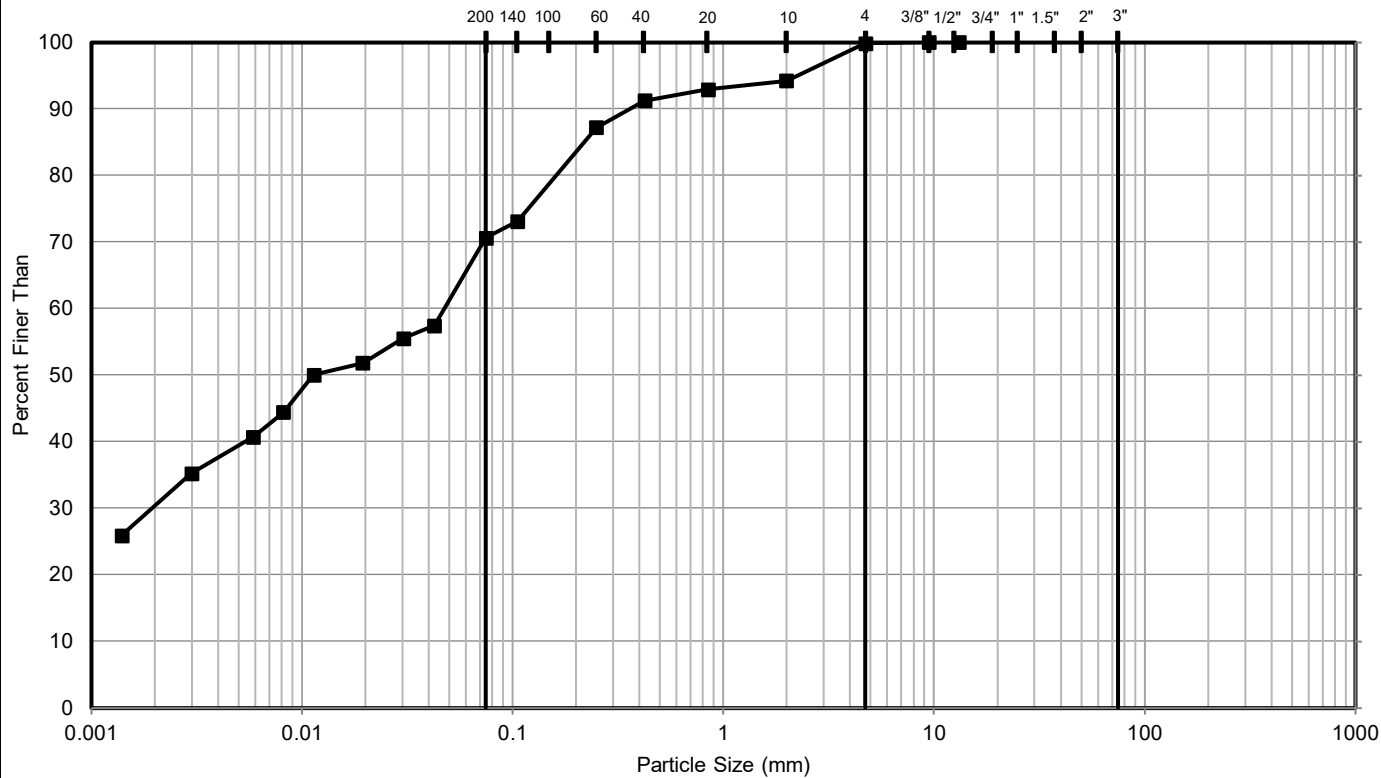
PLASTICITY CHART



	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			PROJECT			
Parsons / MTO			Stormwater Management Pond Extension & Flow Control Structures - Highway 400 Widening, GWP 2836-02-00			
	CONSULTANT	YYYY-MM-DD	2023-09-01	TITLE		
		DESIGNED	SA	PLASTICITY CHART		
		PREPARED	SA	SILT (ML)		
		REVIEWED	MH	PROJECT NO.	CONTROL	REV.
		APPROVED	LCC	21490972	0	0
				FIGURE		
				B7		

GRAIN SIZE DISTRIBUTION



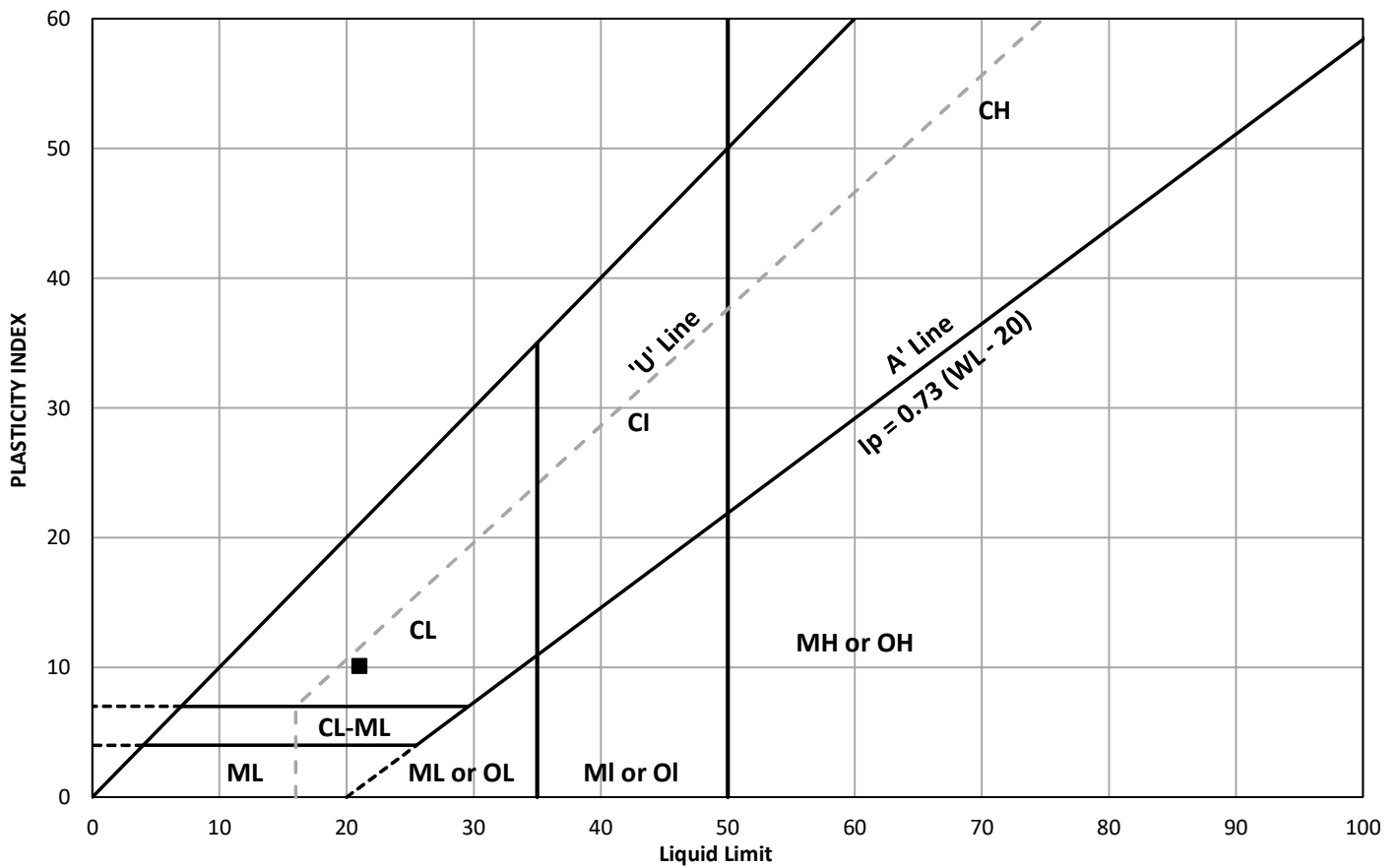
FINES (Silt, Clay)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

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

Bureau Veritas ID		SZS800		
Sampling Date		2022/06/12		
COC Number		847598-83-01		
	UNITS	MS-8 SA3 HWY 400 LANG STAFF TO MAJOR MAC	RDL	QC Batch
Calculated Parameters				
Resistivity	ohm-cm	210		8075295
Inorganics				
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
Physical Testing				
Moisture-Subcontracted	%	29	0.30	8092083
<p>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</p>				



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

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



Bureau Veritas 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 to 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

COC #:



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 14/22			✓		✓	1	One 250mL Jar for Conductivity Testing
MS-17 SA2	Hwy 400 Long Staff to Major Mac	June 14/22			✓		✓	1	SAA (same as above)
MS-15 SA4	Hwy 400 Long Staff to Major Mac	June 14/22			✓		✓	1	SAA
MS-14 SA3	Hwy 400 Long Staff to Major Mac	June 14/22			✓		✓	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	Custody Seal Present	Yes	No
										17.7	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.



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

CHAIN OF CUSTODY RECORD

Page 2 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 #:	
Attention: Accounts Payable		Attention: Sharon Guin - Ana Poliacik		P.O. #:		Bottle Order #:	
Address: 100 Scotia Crt		Address: 100 Scotia Court, Whitby, ON		Project: 2490972		COC #:	
Whitby ON L1N 8Y6				Project Name: Hwy 400 Long Staff & Major Mac		Project Manager:	
Tel: (905) 723-2727 Fax: (905) 723-2182		Tel: 905 723 2727 Fax:		Site #: 2490972		Ema Gitej	
Email: CanadaAccountsPayableInvoices@golder.com		Email: sharon.guin@golder.com, apolacik@golder.com		Sampled By: JS		C#544039-01-01	

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:					
Regulation 153 (2011)				Other Regulations				Special Instructions					
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine				<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw				Field Filtered (please circle): Metals / Hg / Cr VI D-Reg-HS-VOCs by HS E-Reg-HS-404/405 Metals F-Reg-HS-404/405 by HS G-Reg-HS-404/405 by HS H-Reg-HS-404/405 by HS I-Reg-HS-404/405 by HS J-Reg-HS-404/405 by HS K-Reg-HS-404/405 by HS L-Reg-HS-404/405 by HS M-Reg-HS-404/405 by HS N-Reg-HS-404/405 by HS O-Reg-HS-404/405 by HS P-Reg-HS-404/405 by HS Q-Reg-HS-404/405 by HS R-Reg-HS-404/405 by HS S-Reg-HS-404/405 by HS T-Reg-HS-404/405 by HS U-Reg-HS-404/405 by HS V-Reg-HS-404/405 by HS W-Reg-HS-404/405 by HS X-Reg-HS-404/405 by HS Y-Reg-HS-404/405 by HS Z-Reg-HS-404/405 by HS					
<input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse				<input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw									
<input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC				<input type="checkbox"/> MISA <input type="checkbox"/> Municipality									
<input type="checkbox"/> Table <input type="checkbox"/> PWQO <input type="checkbox"/> Reg 406 Table 1				<input type="checkbox"/> Other									
Include Criteria on Certificate of Analysis (Y/N)?								Job Specific Rush TAT (if applies to entire submission)					
								Date Required: Time Required: Rush Confirmation Number: (call lab for #)					
Sample Barcode Label		Sample (Location) Identification		Date Sampled		Time Sampled		Matrix		# of Bottles		Comments	
1 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 12/22						1		SAA (same as above)	
3 MS-5 SA4		Hwy 400 Long Staff to Major Mac		June 12/22						1		SAA	
4 MS-4 SA4		Hwy 400 Long Staff to Major Mac		June 12/22						1		SAA	
5 MS-3 SA2		Hwy 400 Long Staff to Major Mac		June 11/22						1		SAA	
6 MS-2 SA3		Hwy 400 Long Staff to Major Mac		June 11/22						1		SAA	
7 MS-1 SA4		Hwy 400 Long Staff to Major Mac		June 11/22						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 Receipt			
														Custody Seal Present Intact Yes No			

* 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



Page 2 of 2

Bureau Veritas Canada (2019) Inc.



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)

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

Calculated Parameters											
Resistivity	ohm-cm	730		8904860				270	400		8904860

CONVENTIONALS											
Redox Potential	mV	210	N/A	8908461				340	290	N/A	8908461

Inorganics											
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

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

Calculated Parameters											
Resistivity	ohm-cm	450		8904860	410			590	580		8904860

CONVENTIONALS											
Redox Potential	mV	230		8908461	370	N/A		370	330	N/A	8908461

Inorganics											
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)

Bureau Veritas ID		WXP816		WXP817		WXP818		WXP819		
Sampling Date		2023/07/18		2023/08/04		2023/08/04		2023/08/04		
COC Number		933554-04-01		933554-04-01		933554-04-01		933554-04-01		
	UNITS	0009S-3 SS2 Lab-Dup	QC Batch	55-1 SS4	RDL	225-1 SS4	RDL	0008-3 SS3	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm			560		420		570		8904860
CONVENTIONALS										
Redox Potential	mV			360	N/A	300	N/A	310	N/A	8908461
Inorganics										
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)

Bureau Veritas ID		WXP820		WXP821			WXP822		
Sampling Date		2023/08/02		2023/07/26			2023/07/25		
COC Number		933554-03-01		933554-03-01			933554-03-01		
	UNITS	40-1 SS5	QC Batch	90A-3 SS4	RDL	QC Batch	9B-4 SS4	RDL	QC Batch
Calculated Parameters									
Resistivity	ohm-cm	440	8904860	360		8904860	690		8904860
CONVENTIONALS									
Redox Potential	mV	350	8908461	200	N/A	8908461	320	N/A	8908461
Inorganics									
Soluble (20:1) Chloride (Cl ⁻)	ug/g	1200	8907988	1600	100	8907988	660	20	8907988
Conductivity	umho/cm	2280	8910743	2760	2	8910743	1440	2	8910743
Available (CaCl ₂) pH	pH	7.36	8910408	7.82		8908869	7.63		8910408
Soluble (20:1) Sulphate (SO ₄)	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

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

Physical Testing

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

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

Physical Testing

Moisture-Subcontracted	%	15	17	11	8924775	18	19	0.30	8924776
------------------------	---	----	----	----	---------	----	----	------	---------

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

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

Physical Testing

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
-----------	-------

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

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:		(will be applied if Rush TAT is not specified):	
Other Regulations		Metals / Hg / Cr VI		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.	
Special Instructions		Soil Contaminant Package		Job Specific Rush TAT (if applies to entire submission)		Date Required: Time Required:	
Include Criteria on Certificate of Analysis (Y/N)?				Rush Confirmation Number:		(call lab for #)	
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		Laboratory Use Only		Custody Seal Present		Yes	No
Temperature (°C) on Receipt		Intact					
57.5							
* 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		White: Bureau Veritas 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.							
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCs.							

Bureau Veritas Canada (2019) Inc.

APPENDIX D

Non-Standard Special Provisions

WORKING SLAB - Item No.

Special Provision

1.0 SCOPE

This Special Provision covers the requirements for the supply and placement of a concrete working slab under retaining wall foundations.

2.0 REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 902 Excavating and Backfilling - Structures

3.0 DEFINITIONS - Not Used

4.0 DESIGN AND SUBMISSION REQUIREMENTS - Not Used

5.0 MATERIALS

Concrete for working slabs shall have a minimum 28 day strength of 20 MPa.

6.0 EQUIPMENT - Not Used

7.0 CONSTRUCTION

7.01 Excavation

Excavation for the working slab shall be according to OPSS 902.

7.02 Protection of Founding Soil

Following inspection and approval of the prepared subgrade, a working slab with a minimum thickness of 100 mm shall be placed on the foundation subgrade as specified in the Contract Documents.

7.03 Protection of Founding Bedrock

The surface of the footing founding rock shall be exposed, cleaned and any loose or fractured parts removed so that sound rock is exposed. The working slab shall be placed on the exposed cleaned sound founding rock surface as specified in the Contract Documents.

Thickness of the mass concrete pad shall depend on the slope and irregularities in the exposed founding rock surface. A nominal thickness and a footprint plan view area has been specified on the Contract Documents

7.04 Dewatering

Dewatering shall be carried out according to OPSS 902.

8.0 **QUALITY ASSURANCE - Not Used**

9.0 **MEASUREMENT FOR PAYMENT - Not Used**

10.0 **BASIS OF PAYMENT**

10.01 **Working Slab - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material to do the work.

DEWATERING SYSTEM - Item No.
TEMPORARY FLOW PASSAGE SYSTEM - Item No.

Special Provision No. 517F01

July 2017

Amendment to OPSS 517, November 2016

Design Storm Return Period and Preconstruction Survey Distance

517.01 SCOPE

Section 517.01 of OPSS 517 is deleted in its entirety and replaced with the following:

This specification covers the requirements for the design, operation, and removal of a dewatering or temporary flow passage system or both to control water during construction, and the control of the water prior to discharge to the natural environment and sewer systems.

517.04 DESIGN AND SUBMISSION REQUIREMENTS

517.04.01 Design Requirements

Subsection 517.04.01 of OPSS 517 is amended by deleting the first paragraph in its entirety and replacing it with the following:

A dewatering or temporary flow passage system or both shall be designed to control water at the locations specified in the Contract Documents and at any other location where a system is necessary to complete the work. The design of the system shall be sufficient to permit the work at each location to be carried out as specified in the Contract Documents.

Subsection 517.04.01 of OPSS 517 is further amended by deleting the second last paragraph in its entirety and replacing it with the following:

Temporary flow passage systems shall be designed, as a minimum, for a 2 year design storm return period and groundwater discharge, except for the work specified in Table A. For the work specified in Table A, the temporary flow passage system shall be designed, as a minimum, for the design storm return period specified in Table A and groundwater discharge. A longer return period shall be used when determined appropriate for the work.

Intensity-Duration Factor (IDF) curve location, site specific minimum return period, return period flow estimates, and other information is provided in Table A. The IDF information can be accessed through the MTO IDF Curve Look up Tool on the Drainage and Hydrology page of MTO's website. The return period flow estimates do not include flow volumes from groundwater discharge. The Owner specifically excludes these flow estimates from the warranty in the Reliance on Contract Documents subsection of OPSS 100, MTO General Conditions of Contract.

Table A

IDF Curve Location	Latitude: *		Longitude: *			
Temporary Flow Passage Systems						
Site Name / Station Reference	Minimum Return Period (Years)	Return Period Flow Estimates (m ³ /s)				Design Engineer Requirements (Note 1)
		2 Year	5 Year	10 Year	25 Year	
**	***	****	****	****	****	*****
Dewatering Systems						
Site Name / Station Reference	Preconstruction Survey Distance (Note 2) (m)				Design Engineer Requirements (Note 1)	
Stormwater Management Pond	N/A				No	
Flow Control Structure 1	N/A				No	
Flow Control Structure 2	N/A				No	
Flow Control Structure 3	Drawdown zone of influence				Yes	
<p>Note:</p> <p>1. “Yes” means the design Engineer and design-checking Engineer shall have a minimum of 5 years of experience in designing systems of similar nature and scope to the required work. “No” means a minimum experience level is not required for the design Engineer and design-checking Engineer.</p> <p>2. “N/A” indicates a preconstruction survey is not required.</p>						

NOTES TO DESIGNER:**Designer Fill-in for Table A:**

- * Enter the latitude and longitude co-ordinates of the IDF Curve as obtained using the MTO IDF Curve Look up Tool. Create additional tables, as necessary, if more than one (1) IDF curve was used on the contract (i.e. on a very long contract there may be two IDF curves used to better represent rainfall events for two (2) different sections of the contract).
- ** Fill-in site name, work, and station reference as appropriate for the dewatering system and/or temporary flow passage system item locations.
- *** For temporary flow passage system item locations, fill-in the minimum design storm return period for the site based on MTO Drainage Design Standard TW-1.
- **** For temporary flow passage system item locations, fill-in the design flow rate estimates for the various return periods.
- ***** Insert “Yes” when recommended by the Foundation Engineer. Insert “No” otherwise.
- ***** Fill-in the required distance for preconstruction survey if recommended by the Foundation Engineer. Fill-in “N/A” if not recommended



wsp.com