Stantec

(FINAL) Foundation Investigation Report – Highway 400 and Simcoe Road 88 Improvements – Stormwater Management Ponds and Dry Ditches

Highway 400, Bradford, West Gwillimbury, ON

Assignment Number 2018-E-0010
GWP 2331-16-00

Geocres No.: 31D04-007

Latitude: 44.103811
Longitude: -79.631891

Prepared for:
Ministry of Transportation Ontario

Prepared by:
Stantec Consulting Ltd.
300 – 675 Cochrane Drive
Markham, ON L3R 0B8

Project No. 165001095

April 12, 2024

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PART A - FOUNDATION INVESTIGATION REPORT
For
Assignment Number 2018-E-0010
GWP 2331-16-00

Highway 400 and Simcoe Road 88 Interchange Improvements
Stormwater Management Ponds and Dry Ditches
Bradford, West Gwillimbury, Ontario

1.0 INTRODUCTION

As a component of the Ministry of Transportation Ontario's (MTO's) improvements and widening of Highway 400, Stantec Consulting Ltd. (Stantec) was retained by the MTO to provide Total Project Management (TPM) Services for the portion of Highway 400 from approximately Simcoe Road 88 to Line 13. For reference, Simcoe Road 88 is also referred to as County Road 88 and Regional Road 88, but for purposes of this report is referred to as Simcoe Road 88 throughout.

MTO designations for this project and infrastructure are as follows:

GWP: 2331-16-00
Assignment Number: 2018-E-0010

The scope of foundation work for the assignment includes improvements to the Highway 400 and Simcoe Road 88 interchange (Site 30X-309/B0), evaluation of deep cut and high fill areas, and structural improvements to the culvert at 12th Line (Site 30-567C).

The planned improvements to the Simcoe Road 88 and Highway 400 interchange includes widening of the highway, replacement of the existing underpass at Site 30X-0309/B0, realignment of the interchange on and off-ramps, realignment of McKinstry Road and the replacement of an existing Variable Message Sign (VMS) approximately 2.1 km south of Simcoe Road 88. MTO subsequently requested Stantec modify the scope of the foundation engineering services to include foundation investigation and design input for two structural culverts (Fraser Creek Tributaries 1 and 2 culverts), Stormwater Management Ponds (SWMP1 and SWMP2) and Linear Dry Detention Ditches (SWMP3 and SWMP4).

This report has been prepared specifically and solely for the design and construction of the stormwater management ponds and linear dry detention ditches (referred to herein as SWMP1 to 4). It is noted that SWMP1 has been referred to as Pond 9N and SWMP8, SWMP2 has been referred to as Pond 11S and SWMP9, SWMP3 has been referred to as Pond 13S and SWMP4 has been referred to as Pond 13N in other documentation reviewed. However, for consistency with the current structural/contract drawings, these ponds are referred to herein as SWMP1 to 4.

Separate Foundation Investigation and Design Reports have been prepared for the other project components. These are as follows:

- The results of the investigation for the replacement of the existing underpass structure is provided in the report titled “Final Foundation Investigation and Design Report – Highway 400 Underpass Replacement at Simcoe Road 88 (Site No. 30X-0309/B0)”, GEOCRES No. 31D-810 dated October 4, 2023.
- The results of the investigation for the high fill, deep cut and sign support associated with the Simcoe Road 88 Underpass Replacement is provided in the report titled “Final Foundation Investigation and Design Report – Highway 400 and Simcoe Road 88 Interchange Improvements – High Fill, Deep Cut and Sign Support Sites”, GEOCRES No. 31D04-002 dated January 18, 2024.
- The results of the investigation for structural culverts associated with the Simcoe Road 88 Underpass Replacement is provided in the report titled “Final Foundation Investigation and Design Report – Highway 400 and Simcoe Road 88 Interchange Improvements – Replacement of Fraser Creek Tributary 1 and 2 Culverts”, GEOCRES No. 41A01-001 dated April 10, 2024.
- The results of the investigation for the rehabilitation of the Highway 400 structural culvert at Line 12 is provided in the report titled “Final Foundation Investigation and Design Report – Structural Culvert Rehabilitation – Highway 400 at Line 12”, GEOCRES No. 31D04-005 dated April 10, 2024.

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

SWMP1 and SWMP2 are within the southeast and northeast quadrants of the Highway 400/Simcoe Road 88 Interchange, respectively. SWMP3 is on the west side of Highway 400 between Stations 16+900 and 17+300 (approximately 750 m to 1150 m north of the Highway 400/Simcoe Road 88 Interchange) and SWMP4 is also on the west side of Highway 400 between Stations 17+350 to 17+480 (approximately 1200 m to 1400 m north of the Highway 400/Simcoe Road 88 Interchange).

The locations of the stormwater management facilities are shown on the Key Plan inset to Drawing Nos. 1 to 3 included in Appendix A.

Highway 400 is orientated north-south within the project limits. Highway 400 is currently a six-lane (three lanes in each direction) divided freeway. Chainage increases from south to north on Highway 400.

Simcoe Road 88 is orientated east to west within the project limits. Simcoe Road 88 has single lanes in each direction and center turning lanes for westbound traffic accessing Highway 400 south and for eastbound traffic accessing Highway 400 north. Chainage increases from west to east on Simcoe Road 88.

The existing drainage infrastructure consists of catch basins along the paved center median of the highway, leading to storm sewers, and ditches and culverts along the outside lanes of the highway and ramps.

2.2 SITE DESCRIPTIONS

2.2.1 Stormwater Management Pond 1 (SWMP1)

SWMP1 will be constructed in the southeast quadrant of the Highway 400/Simcoe Road 88 Interchange within the future W-N ramp loop. The future W-N ramp loop is bound by Highway 400 to the west, Simcoe Road 88 to the north and the S-E/W ramp to the east and south. The future W-N ramp is planned to have a single lane with shoulders on both sides.

There is an existing fill pile covering a portion of the lands of the future W-N ramp. The pile is up to approximately 5.5 m high. The bulk of the pile will be removed as part of the construction of SWMP1 and the interchange reconfiguration.

The existing Simcoe Road 88 east approach embankment has a maximum height in the order of 8 m but is approximately 2 m to 5 m high in proximity to the location of proposed SWMP1. The approach embankment has 2H:1V (Horizontal: Vertical) side-slopes. As a component of the interchange reconfiguration and replacement of the existing underpass structure, the approach embankment will be raised approximately 2.5 m with 6H:1V side-slopes over the added height.

The area of SWMP1 is shown on the photo below with the Simcoe Road 88 east approach embankment in the background.

Photo 1 – Area of Proposed SWMP1 Viewed From the Southwest

The ground surface topography in the area of the proposed SWMP 1 slopes down from the east (adjacent the existing N-E/W Ramp) to the west (adjacent Highway 400). The elevation of the travel surface of Highway 401 is approximately 241 m in this area.

The existing ground surface cover in the area of the proposed SWMP1 consists of rough grass and weeds with some shrubs concentrated mainly on the side-slopes of the Simcoe Road 88 approach embankment.

A review of available design drawings indicates that the existing Bell cable and Enbridge pipeline located to the north of SWMP1 will be relocated as part of the interchange improvements and reconfiguration. It is understood that the Enbridge pipeline relocation has already been completed. The drawings also indicate that new Rogers communication cables and a hydro line are to be installed to the south of SWMP1.

2.2.2 Stormwater Management Pond 2 (SWMP2)

SWMP2 will be located within the northeast quadrant of the Highway 400/Simcoe Road 88 Interchange, to the east of the future E-N ramp and current location of McKinstry Road (which will be moved further to the east as part of the interchange reconfiguration). The existing McKinstry Road is a single-lane gravel road and the future E-N ramp is planned to have a single lane with shoulders on both sides.

The area of the SWMP2 is shown on the photo below.

Photo 2 – Area of the Proposed SWMP2 Viewed From the South

In the area of the proposed SWMP 2, the travelled surface of McKinstry Road is at approximately the same elevation as the prevailing ground surface of the surrounding lands (i.e. approximately 238 m).

The existing E/W-N ramp is located approximately 40 m west of the current location of McKinstry Road. This ramp includes a single lane and has been constructed on an embankment that is at an elevation approximately 3.5 m higher than the prevailing ground surface to the east.

There are farm fields to the east of McKinstry Road. Beyond the limits of the farm fields, the ground surface cover within the area of the future SWMP2 consists of rough grass and weeds.

A review of available design drawings indicates that there is an existing watermain located on the east side of McKinstry Road. The drawings indicate that the watermain will be relocated further east in conjunction with the relocation/realignment of McKinstry Road.

2.2.3 Linear Dry Ditches (SWMP3 and SWMP4)

SWMP3 and SWMP4 will be located to the west of Highway 400, from approximately Station 16+980 to 17+480 (i.e., 750 m to 1400 m north of the Highway 400/Simcoe Road 88 Interchange). SWMP3 is located to the north of the deep cut area planned for widening of Highway 400.

In the area of SWMP3 and SWMP4, the existing Highway 400 profile slopes down towards the north, from approximately Elevation 255 m near Station 16+900 to 252 m near Station 17+475. The existing ground surface in the area of the proposed SWM Ponds is higher to the south, in the area of the deep cut required for widening of the existing highway, sloping down to the north. The ground surface is at approximately Elevation 256 m near Station 16+900, sloping down to approximately Elevation 250 m near Station 17+300, and ultimately to approximately Elevation 251.5 m near Station 17+475.

The existing ground surface at the locations of SWMP3 and SWMP4 is covered by vegetation including trees, brush, and grasses. Heavier tree cover is present near the south end of SWMP3. There are agricultural fields present to the west of the MTO ROW.

A review of contract drawings, confirmed by field observations, identified a marsh at the north end of SWMP3 and south end of SWMP4, near Station 17+300. At the time of the investigation, there was no visual indication of stability concerns with respect to the side slopes of the raised embankment for Highway 400 adjacent the locations of the proposed SWM Ponds.

Available utility drawings indicate the presence of a watermain and hydro cables crossing Highway 400 near Stations 17+460 and 17+500, respectively. These utilities are intended to remain in place.

A review of the contract drawings indicates the presence of two culverts (identified as C26 and C8) crossing Highway 400 near Stations 17+090 and Station 17+318, respectively. It is understood that the west half of C26 (near the location of SWMP3) is to be plugged and abandoned, and Culvert C8 is to remain.

The areas of SWMP3 and SWMP4 is shown on the photos below.

Photo 3 – Area of Proposed SWMP3 Viewed from the South

Photo 4 – Area of Proposed SWMP4 Viewed from the North

2.3 GEOLOGICAL INFORMATION

The stormwater management ponds and linear dry detention ditches are located in a physiographic region referred to as the Schomberg Clay Plains (Chapman and Putnam, 1984). The Schomberg Clay Plains consist predominantly of silt and clay soils. These deposits are underlain by glacial till and drumlins. The drumlins are buried by the silt and clay deposits or are exposed at the ground surface, subject to the size/height of the drumlin. The drumlins are generally orientated northeast to southwest.

The bedrock underlying the Study Area is of the Lindsay Formation consisting mainly of limestone.

3.0 PREVIOUS INVESTIGATIONS

3.1 OVERVIEW

The available information at the locations of SWMP1 and SWMP2 are summarized in the following sections. No background information was available for the locations of SWMP3 and SWMP4.

3.2 STORMWATER MANAGEMENT POND 1 (SWMP1)

A preliminary foundation investigation was completed in 2001 for the replacement of the Simcoe Road 88 Underpass. The report was referenced as follows:

GEOCRES Reference No. 31D-458

> Preliminary Foundation Investigation and Design Report, Simcoe Road 88 Underpass
> Structure Site 30-211
> Highway 400 Widening from York/Simcoe Boundary to 1 km South of Highway 89
> G.W.P. 40-00-00
> Prepared by Golder Associates for URS, Cole Sherman
> Dated November 2001.

The investigation included two boreholes, one on each side of Highway 400, south of the existing Simcoe Road 88 bridge. Borehole B3-2, was located on the east side of Highway 400 immediately south of the Simcoe Road approach embankment to the bridge over the highway, in the area of proposed SWMP 1.

The borehole was advanced to a depth of 23.3 m and encountered 0.2 m of clayey silt fill materials underlain by stiff to very stiff clayey silt to a depth of 16.8 m below grade (corresponding to Elevation 224.9) underlain by hard clayey silt till (the borehole was terminated at an Elevation of 218.4 m). The clayey silt contained trace sand and gravel and occasional sand seams below a depth of approximately 12 m. The till deposit contained occasional sand seams.

The groundwater level was observed at a depth of 0.7 m below grade (Elevation 241 m) during drilling and was recorded at a depth of 0.2 m below grade (Elevation 241.5 m) in the piezometer installed in the borehole.

For reference, copies of the Borehole Location Plan and the borehole record referenced herein are included in Appendix B. The location of the borehole extracted and used for the current report is shown on Drawing 1.

3.3 STORMWATER MANAGEMENT POND 2 (SWMP2)

Stantec completed a geotechnical investigation for the high fill embankments associated with the future E-N Ramp as part of the Highway 400 and Simcoe Road 88 Interchange Improvements in 2022. The report was referenced as follows:

GEOCRES Reference No. 31D04-002

> Foundation Investigation and Design Report – Highway 400and Simcoe Road 88 Interchnage Improvements – High Fill, Deep Cut and Sign Support Sites
> Highway 400, Bradford, West Gwillimbury, Ontario
> G.W.P. 2331-16-00
> Prepared by Stantec Consulting Ltd. for Ministry of Transportation Ontario
> Dated January 2024.

The investigation included three (3) boreholes (BH22-01, BH22-02 and BH22-03) advanced to depths of 22 m, 15.8 m and 12.8 m (corresponding to Elevations 215.2 m, 223 m and 228.2, respectively) to the west of McKinstry Road, near the future location of SWMP2.

The boreholes encountered fill materials to a maximum depth of 2.2 m underlain by native deposits of firm to very stiff clayey silt/silty clay and/or sandy clayey silt and clay. The clayey silt/silty clay soils contained trace sand and gravel and transitioned to a very stiff to hard consistency with increasing depth.

Groundwater levels were observed in the boreholes at depths of 2.4 m, 3 m and 8.8 n below grade (Elevations 234.7 m, 235.8 m and 232.2 m, respectively) on completion of drilling.

For reference, copies of the Borehole Location Plan and the borehole records from the report referenced herein are included in Appendix B. The location of the borehole extracted and used for the current report is shown on Drawing 2.

4.0 INVESTIGATION PROCEDURES

4.1 FIELD INVESTIGATION

The current investigation program consisted of advancing three (3) boreholes (BH SWMP1-1, BH SWMP1-2 and BH SWMP1-3) at the location of SWMP1, two (2) boreholes (BH SWMP2-1 and BH SWMP2-2) at the location of SWMP2 and two (2) boreholes (BH SWMP4-1 and BH SWMP4-3) at the location of SWMP4. It is noted that the scope of work for SWMP3 and SWMP4 was modified from that provided in Stantec's proposal based on access constraints, following consultation with MTO Foundations group.

Boreholes BH SWMP1-1, BH SWMP1-2 and BH SWMP1-3 were advanced through the existing fill pile in the southeast quadrant of the Highway 400/Simcoe Road 88 interchange. Borehole BH SWMP2-1 was advanced from on the shoulder of McKinstry Road at the access point to the adjacent farm fields. Borehole BH SWMP2-2 was advanced to the east of McKinstry Road. Boreholes BH SWMP4-1 and BH SWMP4-3 were advanced within the MTO ROW to the west of Highway 400. The locations of these boreholes are shown on the Borehole Location and Soil Strata Plans, Drawing Nos. 1 to 3, in Appendix A.

Prior to carrying out the investigation, Stantec contacted the public utility authorities to mark and clear the borehole locations of public and MTO owned utilities. A Road Occupancy Permit (ROP) was obtained from the Town of Bradford West Gwillimbury for Boreholes BH SWMP2-1 and BH SWMP2-2 advanced within the McKinstry Road ROW.

The boreholes were advanced between December 18th and 22nd, 2023 using a track-mounted drill rig equipped for soil sampling. The boreholes were advanced using a combination of continuous flight solid-stem and hollow-stem augers.

The subsurface stratigraphy encountered in the boreholes was recorded in the field by Stantec geotechnical personnel. Standard Penetration Tests (SPTs) were carried out in the boreholes and split spoon samples were collected at regular intervals (typically every 760 mm). The SPTs were conducted in accordance with the methods described in ASTM D1586. All recovered soil samples were returned to Stantec's Markham laboratory for detailed classification and testing.

In situ shear vane testing was attempted at select depths using an N-size vane to assess the undrained shear strengths of the cohesive soil deposits where encountered. The shear vane tests were conducted in accordance with the procedures outlined in ASTM D2573 and the MTO investigation procedures. The vane was inserted into the soil using a single uniform push (without torque) to 450 mm below the depth of augering/drilling, and typically included back-to-back tests, consistent with the method specified by MTO.

Dynamic cone penetration test (DCPT) was conducted in Borehole BH SWMP2-2. The DCPT was initiated to provide a general, qualitative assessment of the conditions below the termination depth of the borehole and to assess if a harder/denser stratum was present at depth.

Groundwater conditions were observed during and on completion of drilling of each borehole. Following completion of drilling, a groundwater monitoring well was installed in one borehole for each SWMP at the locations of Boreholes BH SWMP1-3, BH SWMP2-2 and BH SWMP4-1. The monitoring well screens consisted of 50 mm diameter, 3 m long slotted PVC pipe installed between depths of 6.1 m and 9.1 m in BH SWMP1-3, 4.6 m and 7.6 m in BH SWMP2-2 and 2 m to 5 m in BH SWMP4-1. The annulus around the slotted pipe section was backfilled with sand. The portion of the hole above and below the screen section with sand pack was backfilled with a combination of auger spoils and bentonite. An initial set of groundwater level measurements was obtained on January 16, 2024 and a second set on February 12, 2024.

After completion of drilling, the remaining boreholes were backfilled and sealed with bentonite.

4.2 BOREHOLE LOCATION AND ELEVATION SURVEY

The location and ground surface elevation at each borehole location were surveyed by Stantec's Geomatics Group. The survey data is considered accurate to 0.1 m for both location and elevation.

The location/coordinates, ground surface elevation, and related drilling information is provided in Table 4.1 below.

Table 4.1: Borehole Information Summary

Investigation Hole	MTM Zone 10 Coordinates		Ground Surface Elevation (m)	Total Depth Drilled (m)	End of Borehole Elevation (m)	Number of Soil Samples
	Northing	Easting				
SWMP1						
BH SWMP1-1	4883754.1	609715.0	243.3	12.8	230.5	13
BH SWMP1-2	4883800.9	609743.2	240.7	12.0	228.7	16
BH SWMP1-3	4883804.7	609709.9	243.2	12.8	230.4	17
SWMP2						
BH SWMP2-1	4884015.3	609756.7	238.4	9.3	229.1	11
BH SWMP2-2	4884035.6	609663.4	239.8	13.4	226.4	13
SWMP4						
BH SWMP4-1	4885034.1	609322.0	248.6	8.2	240.2	11
BH SWMP4-3	4885167.2	609297.6	251.2	8.2	243	11

4.3 LABORATORY TESTING

All samples recovered were transported to our Markham laboratory for review and classification. Samples were selected for laboratory testing based on the results of the review. It is noted that the total number of samples tested was reduced from the typical MTO requirement for testing of 25% of samples in consideration of the previous investigations conducted in the area following discussions with MTO Foundations staff.

The geotechnical laboratory testing program for the borehole samples is summarized in Table 4.2 below.

Table 4.2: Geotechnical Laboratory Testing Program

Test Description	Number of Tests		
	SWMP1	SWMP2	SWMP4
Moisture Content	56	25	23
Atterberg Limits	7	6	4
Grain Size Distribution (sieve & hydrometer)	8	6	4

Samples remaining after testing will be placed in storage for a period of one year after completion of this design assignment. After the storage period, the samples will be discarded unless Stantec is directed otherwise by MTO.

5.0 SUBSURFACE CONDITIONS

5.1 FRAMEWORK & OVERVIEW

The detailed soil and groundwater conditions encountered in the boreholes and the results of the in-situ and laboratory testing are shown on the Borehole Records included in Appendix C. An explanation of the symbols and terms used to describe the Borehole Records is also provided in Appendix C. The results of the geotechnical laboratory testing are presented in Appendix D.

Borehole location plans and stratigraphic sections of the soils encountered in the boreholes are provided on Drawing Nos. 1 to 3 in Appendix A.

The stratigraphic boundaries on the borehole records and the strata plot are inferred from non-continuous sampling and therefore represent transitions between soil types rather than exact boundaries between geological units. The subsurface conditions will vary between and beyond the borehole locations.

Detailed descriptions of the subsurface conditions encountered at each culvert location are provided in the following sections.

5.2 STORMWATER MANAGEMENT POND 1 (SWMP1)

5.2.1 Overview

In general, the subsurface stratigraphy encountered in the boreholes advanced for SWMP1 consisted of topsoil underlain by fill material comprising silty sand to gravelly sand to sand and gravel underlain by a deposit of clayey silt. A layer of sandy silty clay till, approximately 2 m thick, was encountered between the fill and clayey silt in BH SWMP1-1. The fill materials contained trace clay, trace rootlets and zones/inclusions of silt and silty clay and topsoil. The clayey silt deposit contained variable but minor amounts of sand and gravel.

The groundwater level was recorded at shallow depth in the order of 3 m below the existing ground surface.

More detailed descriptions of the subsurface conditions encountered in the boreholes are provided in the following sections.

5.2.2 Ground Surface Cover

Topsoil was encountered at the ground surface in BH SWM1-1 and SWMP1-3. The topsoil was approximately 180 mm and 75 mm thick in these boreholes, respectively.

Laboratory testing of the topsoil yielded moisture contents of approximately 19% and 15%.

5.2.3 Fill

Fill materials consisting of silty sand to gravelly sand to sand and gravel were encountered below the topsoil in BH SWMP1-1 and BH SWMP1-3 and at the ground surface in BH SWMP1-2. Samples obtained from the fill materials typically contained trace clay, trace rootlets, zones/inclusions of silt, silty clay and topsoil. Asphalt pieces were noted in the samples of fill materials obtained from Boreholes BH SWMP1-1 and SWMP1-3.

The fill extended to depths of approximately 5.6 m, 0.8 m and 4.2 m below ground surface (corresponding to approximate Elevations of 237.7 m, 240 m and 239 m) in BH SWMP1-1, BH SWMP1-2 and BH SWMP1-3, respectively.

SPT N-values ranging from 7 to 53 were recorded in the fill, indicating the fill materials were in a loose to very dense state. The range confirms the variability of the fill materials.

Laboratory testing of the fill materials yielded moisture contents ranging from approximately 5% to 17%.

Gradation analyses were carried out on a single representative sample of the fill materials. The test results are illustrated on the borehole record in Appendix C and on the gradation curve included on Figure No. D1 in Appendix D.

Based on the results of the laboratory tests, the sample tested has a group symbol of SM in accordance with the Unified Soil Classification System (USCS).

5.2.4 Sandy Silty Clay (Till)

A layer of grey sandy silty clay till was encountered below the fill materials in BH SWMP1-1. The sandy silty clay layer was described as glacial till based on the well-graded gradation curves and the low moisture contents that are typically characteristic of till deposits. Samples obtained from the sandy silty clay till layer typically contained some gravel. Cobbles and/or boulders were not inferred in the till layer at the time of the investigation; however, the glacial tills in southern Ontario typically contain cobbles and boulders and these materials were encountered in the till deposits in other portions of the study area.

The sandy silty clay till layer was approximately 1.9 m thick and extended to a depth of approximately 7.5 m below grade, corresponding to approximately elevation 235.8 m.

SPT N-values of 26, 14 and 20 were recorded in the sandy silty clay till layer. Based on the N-values and manual examination of the till samples, the till is considered to have a very stiff consistency.

Laboratory testing of the sandy silty clay samples yielded moisture contents of approximately 23%, 22% and 20%.

A gradation analysis was carried out on a single representative sample of the sandy silty clay till. The test results are illustrated on the borehole record in Appendix C and on the gradation curve included on Figure No. D2 in Appendix D.

An Atterberg Limits test conducted on a portion of the same sample referenced above yielded a Liquid Limit of 39%, a Plastic Limit of 19%, and a corresponding Plasticity Index of 20%. The results of these tests are illustrated on Figure No. D3 in Appendix D.

Based on the results of the laboratory tests, the samples of the sandy silty clay till have a group symbol of CI in accordance with the Unified Soil Classification System (USCS).

5.2.5 Clayey Silt

A brown to grey clayey silt deposit was encountered beneath the sandy silty clay till layer in BH SWMP1-1 and directly beneath the fill materials in BH SWMP1-2 and BH SWMP1-3. Samples obtained from the clayey silt deposit contained variable but minor amounts of sand and gravel. Sand seams were noted in one of the samples obtained from this deposit in BH SWMP1-3.

All three (3) boreholes were terminated in the clayey silt deposit after penetrating approximately 5.3 m, 11.2 m and 8.6 m into the stratum, corresponding to approximate elevations of 230.5 m, 228.7 m and 230.4 m.

SPT N-values ranging from 6 to 26 were recorded in the clayey silt deposit.

Two (2) in-situ shear vane tests (MTO N-vane) were completed in the clayey silt deposit. The results of the tests are summarized in Table 5.1 below.

Table 5.1: In-situ Shear Vane Test Results in Clayey Silt Stratum

Borehole	Depth (m)	Elevation (m)	Test Result (kPa)	Sensitivity
BH SWMP1-2	9.1	231.6	59	1.7
	10.7	230.0	83	2.3

An illustration of the undrained shear strength vs elevation for the in-situ shear vane tests is provided on Figure D8 included in Appendix D.

Based on the SPT and vane test results and examination of the samples recovered, the clayey silt deposit is considered to have a stiff to very stiff consistency.

Laboratory testing of the clayey silt samples yielded moisture contents ranging from approximately 11% to 27%.

Gradation analyses were carried out on six (6) representative samples of the clayey silt. The test results are illustrated on the borehole records in Appendix C and on the gradation curves on Figure No. D4 in Appendix D.

Atterberg Limits tests conducted on portions of the same six samples referenced above yielded Liquid Limits of 25% to 32%, Plastic Limits of 12% to 18%, and corresponding Plasticity Indices of 12% to 16%. The results of these tests are illustrated on Figure No. D5 in Appendix D.

Based on the results of the laboratory tests, the clayey silt samples have a group symbol of CL in accordance with the USCS.

5.2.6 Bedrock

Bedrock was not encountered to the termination depth of the boreholes.

5.2.7 Groundwater Conditions

Borehole BH SWMP1-1 was dry on completion of drilling. The groundwater was measured at a depth of approximately 9.8 m (Approximately Elevation 230.9 m) in Borehole BH SWMP1-2 on completion of drilling.

Groundwater levels were measured at depths of approximately 3.3 m and 3.2 m below grade (approximately Elevations 239.9 m and 240.0 m) in the monitoring well installed in Borehole BH SWMP1-3 on January 16, 2024 and February 12, 2024; thirty (30) and fifty-six (56) days following installation, respectively.

Groundwater levels will be subject to seasonal fluctuations and precipitation events and should be expected to be higher during the spring season or during and following periods of heavy precipitation or snow melt. Localized perched groundwater conditions may exist in the fill materials.

5.3 STORMWATER MANAGEMENT POND 2 (SWMP2)

5.3.1 Overview

In general, the subsurface stratigraphy encountered in the boreholes advanced for SWMP2 consisted of silty sand fill material (in BH SWMP2-1) underlain by layered native deposits ranging from firm to very stiff clayey silt to firm to very stiff sandy clayey silt till soils. The clayey silt soils contained various but minor amounts of sand and gravel. The till layers typically contained trace gravel.

The groundwater level was recorded at shallow depth of less than 1 m below the existing ground surface.

More detailed descriptions of the subsurface conditions encountered in the boreholes are provided in the following sections.

5.3.2 Fill

Fill materials consisting of silty sand were encountered at the ground surface in BH SWMP2-1. Samples obtained from the fill materials typically contained trace gravel and clay.

The fill extended to a depth of approximately 0.8 m below the ground surface (approximately Elevation 237.7 m).

An SPT N-value of 10 was recorded in the fill, indicating the fill is in a loose to compact state.

Laboratory testing of the fill materials yielded a moisture content of approximately 10%.

5.3.3 Clayey Silt

A layer of brown to grey clayey silt was encountered between the upper and lower sandy clayey silt till (described in the proceeding section) in BH SWMP2-1 and from the ground surface in BH SWMP2-2. Samples obtained from the clayey silt typically contained varying but minor amounts of sand and gravel. A sand seam was noted in one of the samples obtained from the clayey silt in BH SWMP2-2.

The clayey silt stratum was approximately 2.3 thick and extended to a depth of approximately 6 m below ground surface (corresponding to approximately Elevation 232.4 m) in BH SWMP2-1. Borehole BH SWMP2-2 was terminated in the clayey silt layer after penetrating approximately 12 m into the layer, at approximately elevation 227.8 m.

SPT N-values ranging from 6 to 18 were recorded in the clayey silt stratum.

In-situ shear vane tests (MTO N-vane) were completed in the clayey silt stratum at various depths. The results of the tests are summarized in Table 5.2 below.

Table 5.2: In-situ Shear Vane Test Results in Clayey Silt Stratum

Borehole	Depth (m)	Elevation (m)	Test Result (kPa)	Sensitivity
BH SWMP2-2	7.8	232.1	83	2.3
	8.1	231.7	73	2.0
	9.3	230.5	47	2.0
	9.6	230.2	53	2.3
	10.8	229.0	83	1.8
	11.1	228.7	89	2.1

An illustration of the undrained shear strength vs elevation for the in-situ shear vane tests is provided on Figure D8 included in Appendix D.

Based on the SPT and vane test results and examination of the samples recovered, the clayey silt stratum is considered to have a firm to very stiff consistency but is generally stiff.

Laboratory testing of the clayey silt samples yielded moisture contents ranging from approximately 18% to 27%.

Gradation analyses were carried out on four (4) representative samples of the clayey silt. The test results are illustrated on the borehole records in Appendix C and on the gradation curves on Figure No. D4 in Appendix D.

Atterberg Limits tests conducted on portions of the same samples referenced above yielded Liquid Limits of 30% to 35%, Plastic Limits of 14% to 17%, and corresponding Plasticity Indices of 15% to 18%. The results of these tests are illustrated on Figure No. D5 in Appendix D.

Based on the results of the laboratory tests, the samples tested consist of clayey silt that have a group symbol of CL in accordance with the USCS.

5.3.4 Sandy Clayey Silt (Till)

A layer of brown to grey sandy clayey silt till was encountered overlying and underlying the clayey silt stratum (described in the preceding section) in BH SWMP2-1. The sandy clayey silt strata are described as glacial till soils based on the well-graded gradation curves and the low moisture contents that are considered characteristic of till deposits. Samples obtained typically contained trace gravel. Cobbles and/or boulders were not inferred in till; however, the glacial tills in southern Ontario typically contain cobbles/boulders and these materials were encountered in the till deposits in other portions of the study area.

The upper sandy clayey silt till stratum was approximately 2.9 thick and extended to a depth of approximately 3.7 m below ground surface (corresponding to approximately Elevation 234.7 m). Borehole BH SWMP2-1 was terminated in the lower sandy clayey silt till stratum after penetrating approximately 3.3 m into the layer, at approximately elevation 229.1 m.

SPT N-values ranging from 0 to 19 were recorded in the sandy clayey silt till deposit. The single N-value of 0 (split spoon penetration under the weight of the hammer) was obtained at a depth of approximately 1.5 m below grade.

In-situ shear vane tests (MTO N-vane) were conducted immediately below the depth of the SPT test exhibiting the N-value of 0. The results of the tests are summarized in Table 5.3 below.

Table 5.3: In-situ Shear Vane Test Results in Sandy Clayey Silt Till Stratum

Borehole	Depth (m)	Elevation (m)	Test Result (kPa)	Sensitivity
BH SWMP2-1	2.4	236.0	59	3.3
	2.9	235.5	71	2.0

An illustration of the undrained shear strength vs elevation for the in-situ shear vane tests is provided on Figure D8 included in Appendix D.

Based on the SPT and vane test results and examination of the samples recovered, the sandy clayey silt till deposit is considered to have a firm to very stiff consistency.

Laboratory testing of the sandy clayey silt till samples yielded moisture contents ranging from approximately 6% to 25%.

Gradation analyses were carried out on two (2) representative samples of the sandy clayey silt till. The test results are illustrated on the borehole records in Appendix C and on the gradation curves on Figure No. D2 in Appendix D.

Atterberg Limits tests conducted on portions of the same samples referenced above yielded Liquid Limits of 15% and 20%, Plastic Limits of 10% and 15%, and corresponding Plasticity Indices of 5% and 10%. The results of these tests are illustrated on Figure No. D3 in Appendix D.

Based on the results of the laboratory tests, the sandy clayey silt till samples have group symbols of CL-ML to CL in accordance with the USCS.

5.3.5 Bedrock

Bedrock was not encountered to the termination depth of the boreholes.

5.3.6 Groundwater Conditions

BH SWMP2-1 was dry on completion of drilling. Groundwater levels were measured at depths of approximately 0.1 m and 0.8 m below grade (approximately Elevations 239.7 m and 239.0 m) in the monitoring well installed in borehole BH SWMP2-2 on January 16, 2024 and February 12, 2024; twenty-five (25) and fifty-two (52) days following installation, respectively.

Groundwater levels will be subject to seasonal fluctuations and precipitation events. The groundwater level should be expected to be higher during the spring season or during and following periods of heavy precipitation or snow melt. Localized perched groundwater conditions may exist in the fill materials.

5.4 LINEAR DRY DITCHES (SWMP3 AND SWMP4)

5.4.1 Overview

In general, the subsurface stratigraphy encountered in the boreholes advanced for SWMP3 and SWMP4 consisted of the following:

- Topsoil; underlain by,
- Silty sand fill materials (in BH SWMP4-3); underlain by,
- Firm to stiff clayey silt to silty clay; underlain by,
- Very stiff to hard sandy clayey silt to clayey silt till; underlain by,
- Compact to very dense sandy silt to silt and sand till.

The clayey silt to silty clay layer typically contained trace sand. The cohesive till layer typically contained trace gravel. Zones of clayey silt till were noted in the cohesionless till layer in BH SWMP4-3. The presence of cobbles and/or boulders was also inferred from drilling observations in the cohesionless till layer in BH SWMP4-3.

The groundwater level was recorded at shallow depth less than 1 m below the existing ground surface.

More detailed descriptions of the subsurface conditions encountered in the boreholes are provided in the following sections.

5.4.2 Ground Surface Cover

Topsoil was encountered at the ground surface in Borehole BH SWMP4-3. The topsoil was approximately 180 mm thick.

Laboratory testing of a sample of the topsoil yielded a moisture content of approximately 36%.

5.4.3 Fill

Fill materials consisting of silty sand were encountered at the ground surface in BH SWMP4-3. Samples of the fill materials typically contained trace clay.

The fill extended to a depth of approximately 0.8 m below the ground surface (approximately Elevation 250.4 m).

An SPT N-value of 3 was recorded in the fill, indicating the material is in a very loose condition.

Laboratory testing of a sample of the fill material yielded a moisture content of approximately 21%.

5.4.4 Clayey Silt to Silty Clay

A stratum of brown clayey silt to silty clay was encountered at the ground surface in BH SWMP4-1 and below the topsoil and fill materials in BH SWMP4-3. Samples obtained from the clayey silt to silty clay deposits typically contained trace sand. Trace rootlets were also observed in samples from BH SWMP4-3.

The clayey silt to silty clay stratum was approximately 2.2 m thick and extended to depths of approximately 2.2 m and 3 m below grade, corresponding to elevations of approximately 246.4 m and 248.2 m in BH SWMP4-1 and BH SWMP4-3, respectively.

SPT N-values of 3 to 12 were recorded in the clayey silt to silty clay. Based on the N-values and manual examination of the samples, the clayey silt to silty clay is considered to have a firm to stiff consistency.

Laboratory testing of the clayey silt to silty clay samples yielded moisture contents ranging from approximately 24% to 30%.

A gradation analysis was carried out on a single representative sample of the clayey silt to silty clay. The test results are illustrated on the borehole record in Appendix C and on the gradation curves on Figure No. D4 in Appendix D.

An Atterberg Limits test conducted on a portion of the same sample referenced above yielded a Liquid Limit of 37%, a Plastic Limit of 18%, and a corresponding Plasticity Index of 19%. The results of these tests are illustrated on Figure No. D5 in Appendix D.

Based on the results of the laboratory tests, the sample tested has a group symbol of CI in accordance with the Unified Soil Classification System (USCS).

5.4.5 Sandy Clayey Silt to Clayey Silt (Till)

Strata of brown sandy clayey silt and clayey silt till were encountered below the clayey silt/silty clay in BH SWMP4-1 and BH SWMP4-3. The sandy clayey silt to clayey silt strata are described as glacial till soils based on the well-graded gradation curves and the low moisture contents that are considered

characteristic of till deposits. Samples obtained from the till contained variable but minor amounts of sand and gravel. A general increase in the sand content was noted in samples below approximately 5 m depth in BH SWMP4-1. Cobbles and/or boulders were not inferred in the till; however, the glacial tills in southern Ontario typically contain cobbles/boulders and these materials were encountered in the till deposits in other portions of the study area.

The sandy clayey silt to clayey silt till was approximately 4.6 m and 1.5 m thick and extended to depths of approximately 6.8 m and 4.5 m below grade, corresponding to approximately elevations 241.8 m and 246.7 m, in BH SWMP4-1 and BH SWMP4-3, respectively.

SPT N-values ranging from 16 to 36 were recorded in the sandy clayey silt till in BH SWMP4-1. SPT N-values of 7 and 10 were recorded in the clayey silt till in BH SWMP4-3.

An in-situ shear vane test (MTO N-vane) was conducted in the clayey silt till in BH SWMP4-3. The results of the test are summarized in Table 5.4 below.

Table 5.4: In-situ Shear Vane Test Results in Clayey Silt Till Stratum

Borehole	Depth (m)	Elevation (m)	Test Result (kPa)
BH SWMP4-3	3.4	247.8	118

An illustration of the undrained shear strength vs elevation for the single in-situ shear vane test is provided on Figure D8 included in Appendix D.

Based on the SPT and vane test results and examination of the samples recovered, the sandy clayey silt to clayey silt till deposit is considered to have a very stiff to hard consistency.

Laboratory testing of the sandy clayey silt to clayey silt till samples yielded moisture contents ranging from approximately 12% to 20%.

A gradation analysis was carried out on a single representative sample of the sandy clayey silt to clayey silt till. The test results are illustrated on the borehole record in Appendix C and on the gradation curves on Figure No. D2 in Appendix D.

An Atterberg Limits test conducted on a portion of the same sample referenced above yielded a Liquid Limit of 25%, a Plastic Limit of 12%, and a corresponding Plasticity Index of 13%. The results of these tests are illustrated on Figure No. D3 in Appendix D.

Based on the results of the laboratory tests, the sample tested has a group symbol of CL in accordance with the Unified Soil Classification System (USCS).

5.4.6 Sandy Silt to Silt and Sand (Till)

Strata of brown to grey sandy silt to silt and sand till were encountered below the cohesive till soils described in the preceding section in both boreholes. The sandy silt to silt and sand soils are described as glacial till soils based on the well-graded gradation curves and the low moisture contents that are

considered characteristic of till deposits. Samples obtained from the sandy silt to silt and sand till typically contained some clay and trace gravel. Clayey silt till zones were also noted within the silt and sand till layer in BH SWMP4-3. Cobbles and boulders (characteristic of glacial tills in southern Ontario) were inferred to be present in BH SWMP4-3 based on drilling operations.

Both boreholes were terminated in the sandy silt to silt and sand till after penetrating approximately 1.4 m and 3.7 m into the layer, respectively.

SPT N-values ranging from 25 to 64 were recorded in the sandy silt to silt and sand till, indicating these materials are in a compact to very dense state, typically dense.

Laboratory testing of the sandy clayey silt to clayey silt till samples yielded moisture contents ranging from approximately 5% to 11%.

Gradation analyses were carried out on two (2) representative samples of the sandy silt to silt and sand till. The test results are illustrated on the borehole record in Appendix C and on the gradation curves on Figure No. D6 in Appendix D.

Atterberg Limits tests conducted on portions of the same samples referenced above yielded Liquid Limits of 15% and 17%, Plastic Limits of 12% and 9%, and corresponding Plasticity Indices of 3% and 8%. The results of these tests are illustrated on Figure No. D7 in Appendix D.

Based on the results of the laboratory tests, the sandy silt to silt and sand till has a group symbol of ML in accordance with the Unified Soil Classification System (USCS) and contains zones of clayey silt materials which have a group symbol of CL.

5.4.7 Bedrock

Bedrock was not encountered to the termination depth of the boreholes.

5.4.8 Groundwater Conditions

The groundwater level was measured at approximately 0.9 m below grade (Approximately Elevation 250.3 m) in BH SWMP4-3 on completion of drilling. The groundwater level was measured at approximately 0.1 m and 0.4 m below grade (approximately Elevations 248.5 m and 248.2 m) in the monitoring well installed in borehole BH SWMP4-1 on January 16, 2024 and February 12, 2024; twenty-six (26) and fifty-three (53) days following installation respectively.

Groundwater levels will be subject to seasonal fluctuations and precipitation events. The groundwater level should be expected to be higher during the spring season or during and following periods of heavy precipitation or snow melt. Localized perched groundwater conditions may exist in the fill materials.

6.0 MISCELLANEOUS

The field work was carried out under the supervision of Mr. Taylor Koson, EIT and Mr. Akshat Shukla, EIT, under the direction of Mr. John J. Brisbois, MScE., P. Eng.

The drilling equipment was supplied and operated by DBW Drilling Ltd. based in North York.

The location and elevation survey of the investigation holes was carried out by Stantec's Geomatics Group based in Markham.

Traffic control service was provided by On Track Safety Limited based in Thornhill.

Geotechnical laboratory testing was carried out at Stantec's Markham laboratory.

This report was prepared by Ms. Roshan Rashed, P. Eng. and reviewed by Mr. Kevin Nelson, P. Eng., and Mr. John J Brisbois, MScE., P. Eng., Designated Principal MTO Foundation Contact.

7.0 CLOSURE

A subsurface investigation is a limited sampling of a site. The subsurface conditions described herein are based on information obtained at the specific investigation hole locations. Some variation in conditions between and beyond these locations must be anticipated. Should any conditions at the site be encountered which differ from those described for the investigation hole locations, we request that we be notified immediately to review the additional information and assess if revisions or changes to the content of this report are warranted.

Respectfully Submitted;

STANTEC CONSULTING LTD.

Roshan Rashed, P. Eng.
Geotechnical Engineer

Kevin Nelson, P.Eng.
Principal, Senior Geotechnical Engineer

John J. Brisbois, MSc.E., P. Eng.
Principal, Geotechnical Engineering

Designated Principal MTO Foundation Contact

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APPENDIX A

A.1 DRAWING NO. 1 – BOREHOLE LOCATION PLAN AND SOIL STRATA PLOT – SWMP1

A.2 DRAWING NO. 2 – BOREHOLE LOCATION PLAN AND SOIL STRATA PLOT – SWMP1

A.3 DRAWING NO. 3 – BOREHOLE LOCATION PLAN AND SOIL STRATA PLOT – SWMP3 AND SWMP4

A.4 STORMWATER MANAGEMENT POND AND LINEAR DRY DITCH DETAILS

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT
WP 2331-16-00

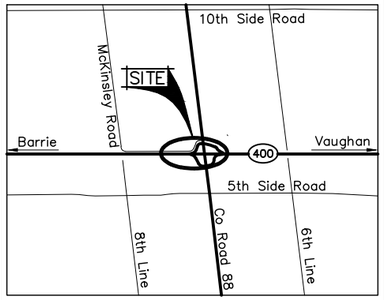
HWY400/SIMCOE ROAD 88
STORMWATER MANAGEMENT POND 1
BOREHOLE PLAN & SOIL STRATA

SHEET
–

Stantec

LICENSED PROFESSIONAL ENGINEER
J.J. BRISBOIS
2024-04-12
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NELSON
2024-04-12
PROVINCE OF ONTARIO



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PLAN

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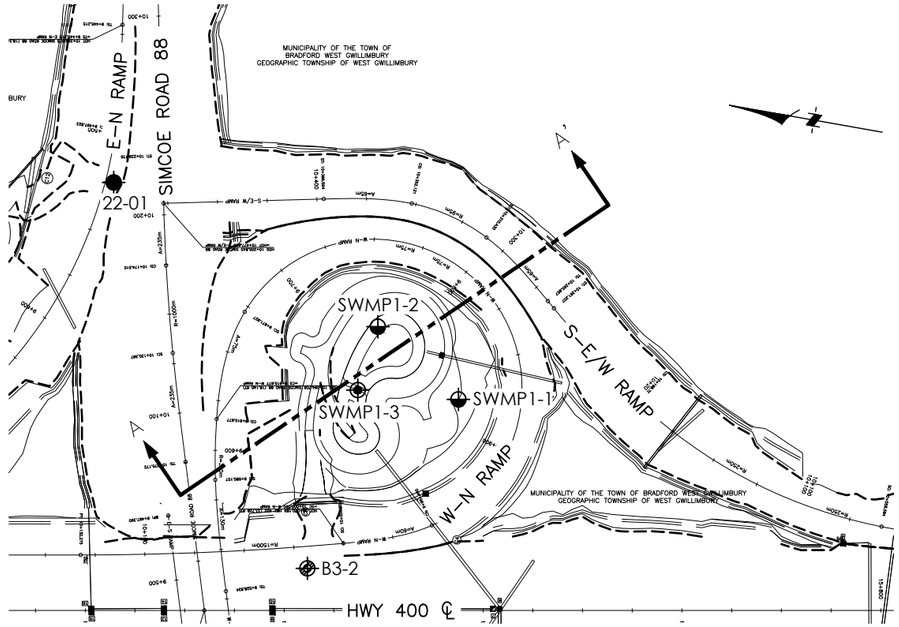

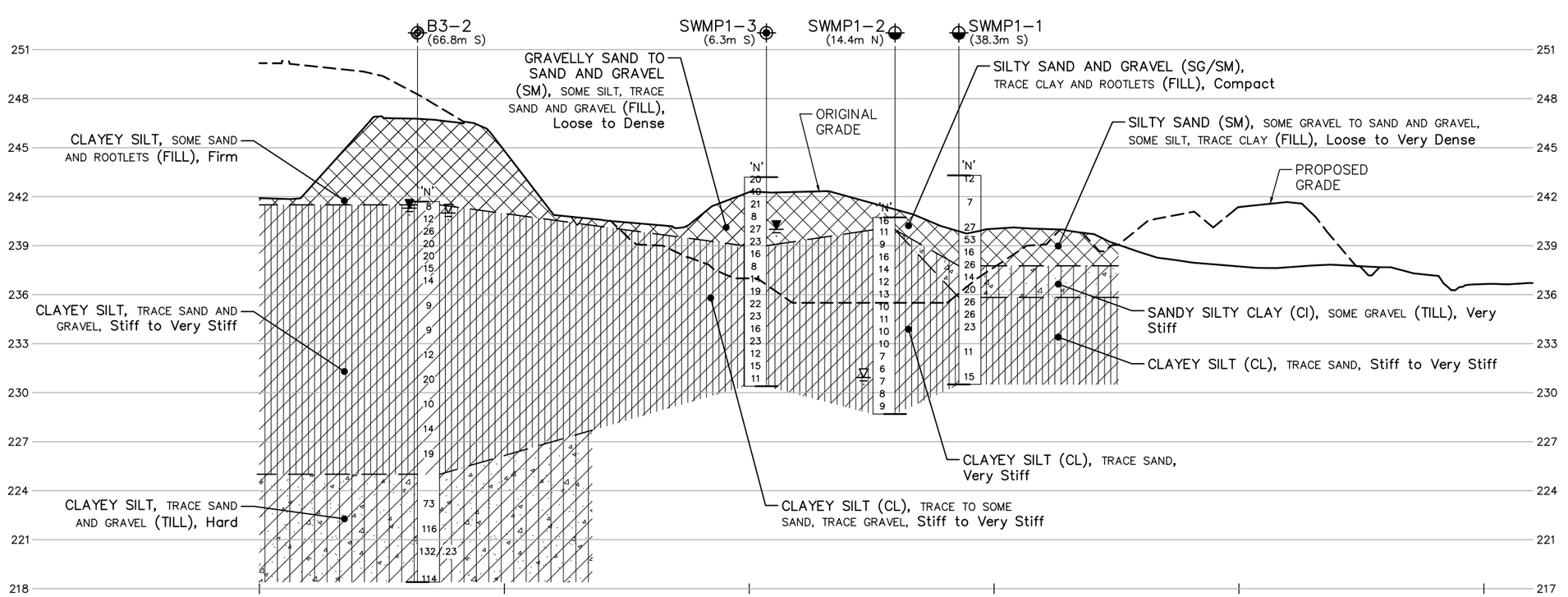

CROSS SECTION A–A'

SCALE
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3m 0 3 6m VERTICAL

LEGEND

- Borehole (Stantec, 2023)
- Monitoring Well (Stantec, 2023)
- Borehole (Golder, 2001)
- (x.x m) Offset from Cross Section Line in meters
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- WL at time of Investigation March 2001 (Golder) & December 2023 (Stantec)
- WL Measured on June 2001 (Golder) & January 2024 (Stantec)

No	ELEV	MTM ZONE 10 COORDINATES NORTH	EAST
SWMP1-1	243.3	4 884 314.4	294 450.1
SWMP1-2	240.7	4 884 360.7	294 479.1
SWMP1-3	243.2	4 884 365.1	294 445.9
B3-2	241.7	4 884 374.5	294 353.2

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS			
DATE	BY	DESCRIPTION	

GEOCRES No 31D04-007

HWY No 400			DIST
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MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT
WP 2331-16-00

HWY400/SIMCOE ROAD 88
STORMWATER MANAGEMENT POND 2
BOREHOLE PLAN & SOIL STRATA

SHEET
–

Stantec

PLAN
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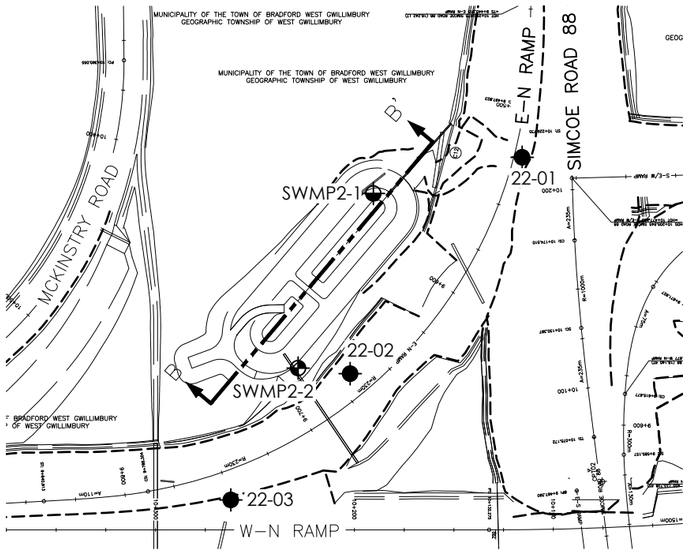

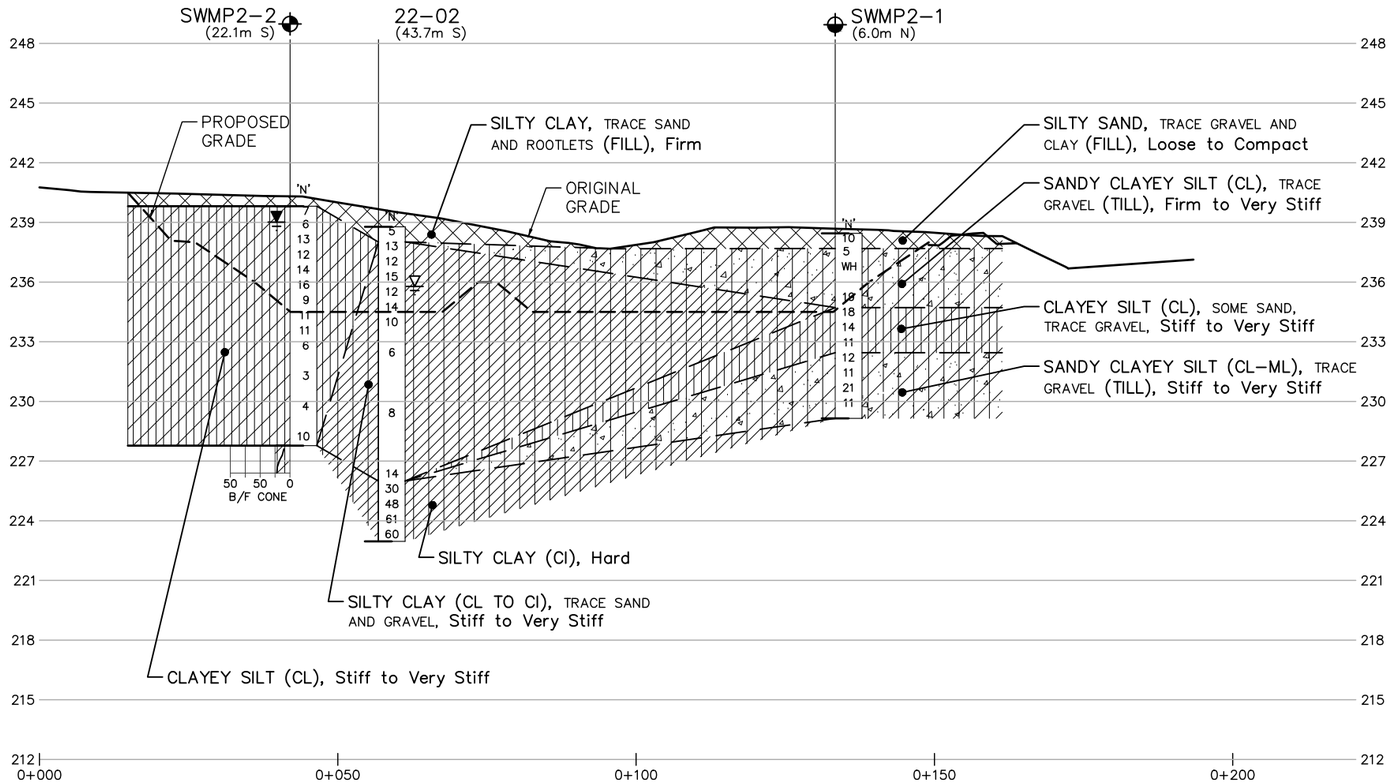

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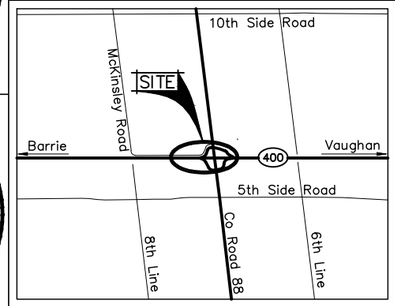

KEY PLAN
1 km 0 1 2 km

LICENSED PROFESSIONAL ENGINEER
J.J. BRISBOIS
2024-04-12
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NELSON
2024-04-12
PROVINCE OF ONTARIO

LEGEND

- Borehole (Stantec, 2023)
- Borehole & DCPT (Stantec, 2023)
- Borehole (Stantec, 2022)
- (x.x m) Offset from Cross Section Line in meters
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- WL at time of Investigation March 2001 (Golder) & December 2023 (Stantec)
- WL Measured on June 2001 (Golder) & January 2024 (Stantec)

No	ELEV	MTM ZONE 10 COORDINATES NORTH	EAST
SWMP2-1	238.4	4 884 574.6	494 496.5
SWMP2-2	239.8	4 884 596.6	494 403.5
22-01	237.1	4 884 504.1	294 527.4
22-02	238.8	4 884 570.4	294 405.3
22-03	241.0	4 884 618.4	294 332.4

NOTES

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REVISIONS		
DATE	BY	DESCRIPTION

GEOCRES No 31D04-007

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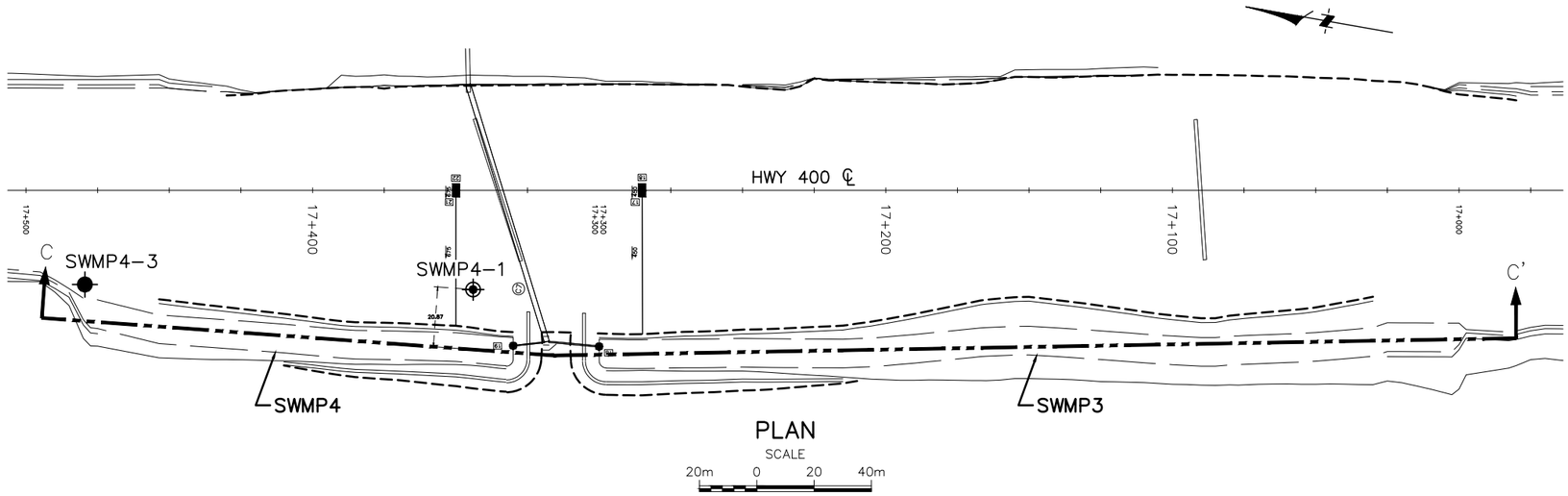

PLAN

SCALE

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METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No

CONT WP 2331-16-00

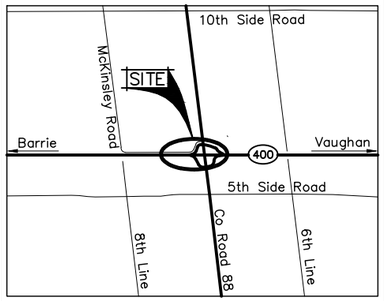
HWY400/SIMCOE ROAD 88
STORMWATER MANAGEMENT PONDS 3 & 4
BOREHOLE PLAN & SOIL STRATA

SHEET –

Stantec

LICENSED PROFESSIONAL ENGINEER
J.J. BRISBOIS
2024-04-12
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NELSON
2024-04-12
PROVINCE OF ONTARIO



KEY PLAN

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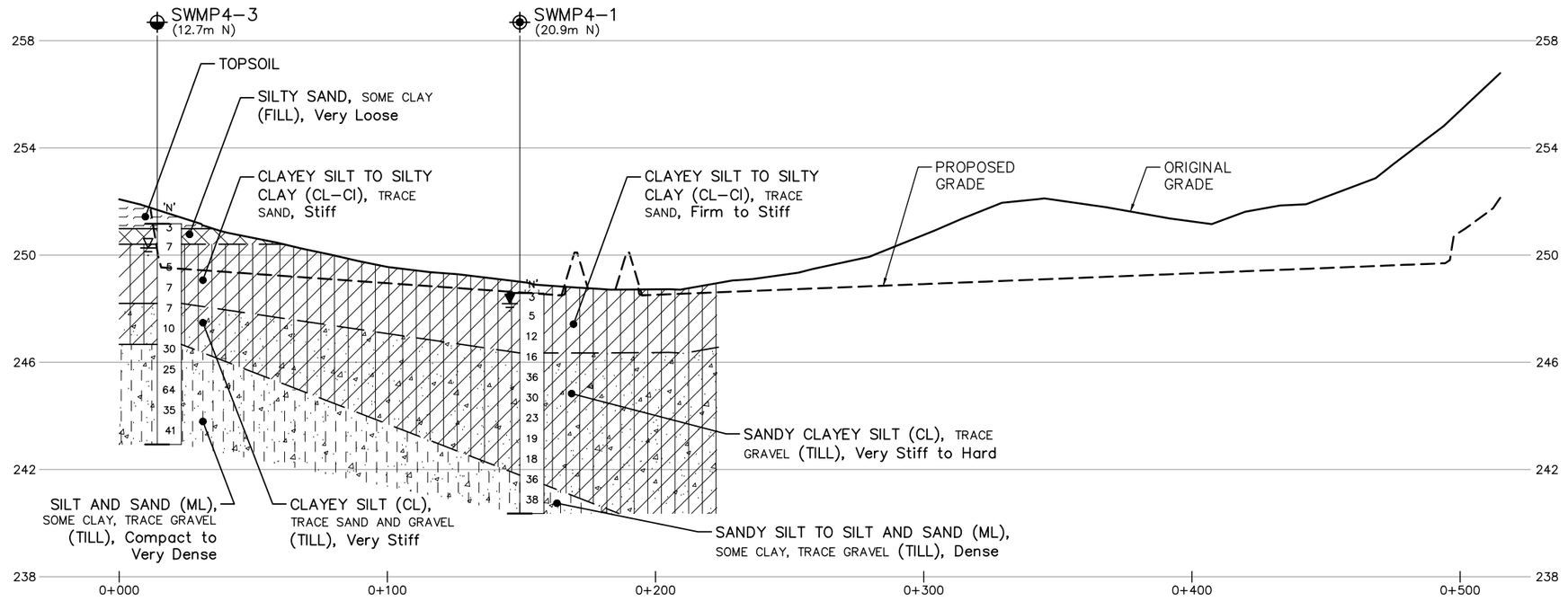

CROSS SECTION C-C'

SCALE

20m 0 20 40m HORIZONTAL

2m 0 2 4m VERTICAL

LEGEND

- Borehole (Stantec, 2023)
- Monitoring Well (Stantec, 2023)
- (x.x m) Offset from Cross Section Line in meters
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- WL at time of Investigation December 2023
- WL Measured on January 2024

No	ELEV	MTM ZONE 10 COORDINATES NORTH	EAST
SWMP4-1	248.6	4 884 601.4	294 080.3
SWMP4-3	251.2	4 884 735.1	294 058.5

NOTES

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

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NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS			
	DATE	BY	DESCRIPTION

GEOCRES No 31D04-007

HWY No 400				DIST
SUBM'D RR	CHECKED	DATE 2024-04-12		SITE –
DRAWN GBB	CHECKED	APPROVED		DWG 3

DRAWING NAME: 165001095_SWMP_Plan and Profile_240412.dwg
CREATED BY: GBB MODIFIED:
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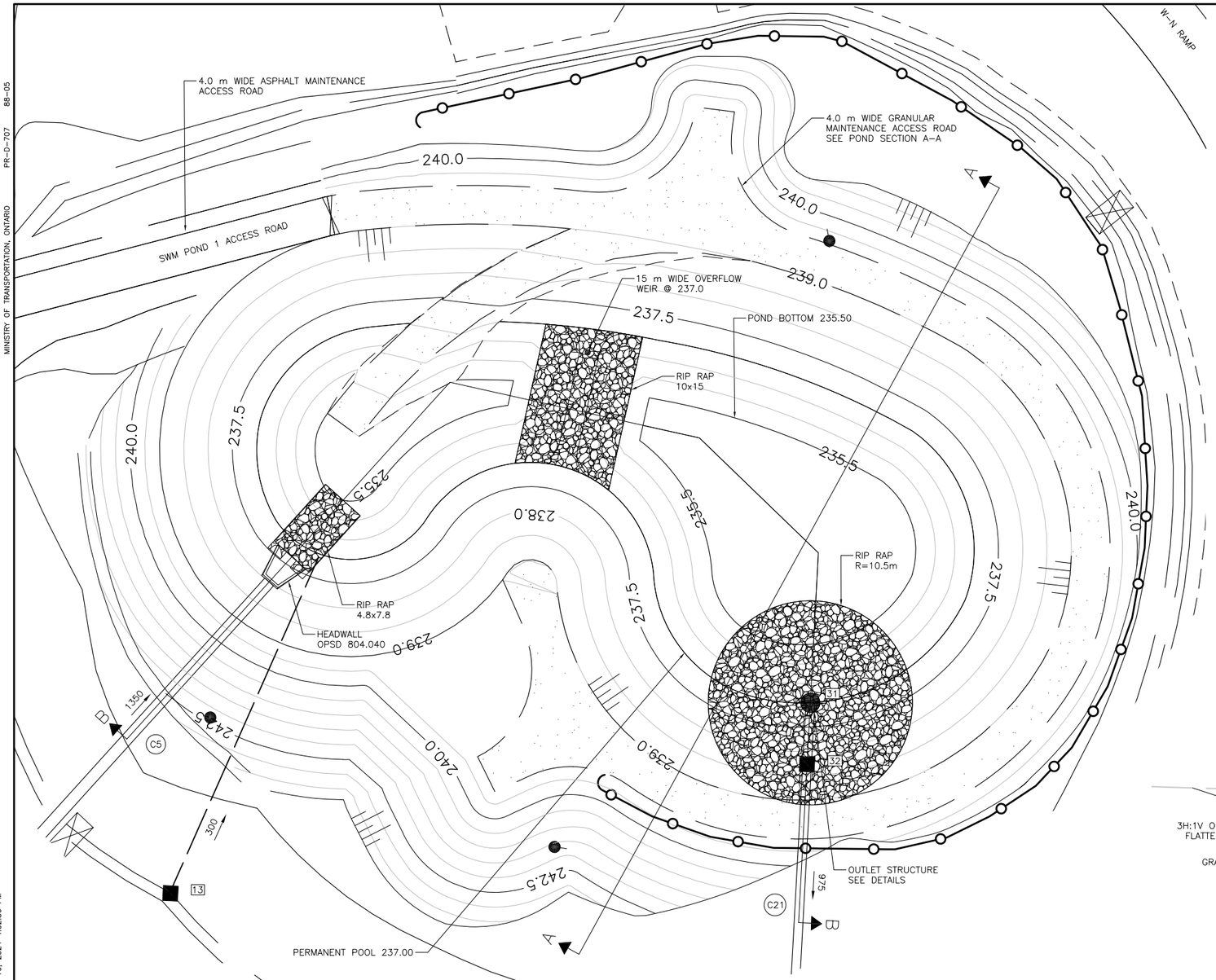
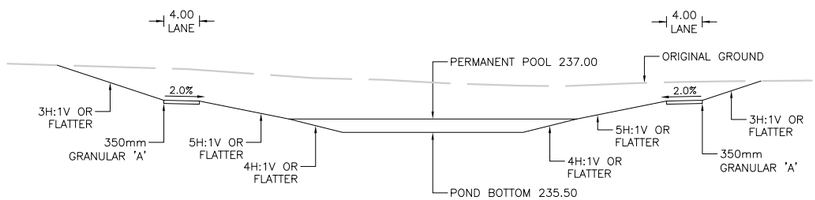
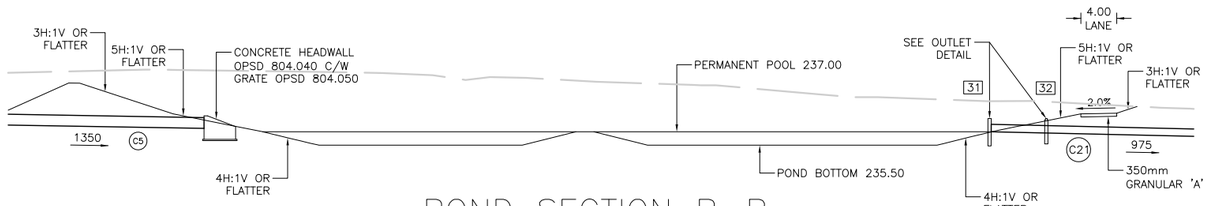


STORMWATER MANAGEMENT POND 1 (SWMF 9N)



POND SECTION A–A



POND SECTION B–B

N.T.S.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
J. A. M. INNES
100012372
2024/01/12
PROVINCE OF ONTARIO

PLATE No
CONT 2024–2006
WP 2331–16–00

DETAILS

SHEET 518

Stantec

NOTES:

1. ALL SERVICES, MATERIALS, CONSTRUCTION METHODS, AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE LATEST OPSS, AND OPSD
2. EROSION AND SEDIMENT CONTROL (ESC) MEASURES SHALL BE IMPLEMENTED AND IN WORKING ORDER PRIOR TO THE COMMENCEMENT OF ANY WORKS.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN ESC MEASURES AS REQUIRED TO MITIGATE THE POTENTIAL FOR MIGRATION OF SEDIMENT TO THE DOWNSTREAM RECEIVING SYSTEM.
4. ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
5. CONSTRUCTION/GRADING SHALL BE PHASED TO MINIMIZE THE AREA OF DISTURBANCE AT ALL TIMES.
6. INSTALL SEED AND MATRIX ON ALL SLOPES GREATER THAN 3:1.
7. ALL AREAS WHERE ACTIVE CONSTRUCTION IS NOT EXPECTED WITHIN 14 DAYS SHALL BE RE-VEGETATED WITH 50 MM OF TOPSOIL AND SEED AND MATRIX AS IDENTIFIED ELSEWHERE IN THE CONTRACT.
8. ALL MAINTENANCE, STORAGE, AND REFUELING ACTIVITIES SHALL BE COMPLETED A MINIMUM OF 30 M FROM ANY RECEIVING SYSTEM OR WATERWAY, AND WILL BE CONTROLLED TO PREVENT THE ENTRY OF ANY DELETERIOUS SUBSTANCE INTO THE WATERWAY.
9. ALL STOCKPILED MATERIAL IS TO BE LOCATED A MINIMUM OF 10 M AWAY FROM ANY RECEIVING SYSTEM AND INSIDE THE LIMITS OF CONSTRUCTION/GRADING, AND SHALL BE SURROUNDED BY SILT FENCE AND COVERED WITH A ROLLED EROSION CONTROL PROTECTION PRODUCT (E.G., POLY SHEETING, TARP, STRAW MATTING, ETC).
10. ANY MATERIAL OR MUD TRACKED ONTO ANY PUBLIC ROADWAY OR ADJACENT PRIVATE PROPERTIES SHALL BE REMOVED IMMEDIATELY BY HAND OR RUBBER TIRE LOADER.
11. ESC MEASURES SHALL REMAIN IN PLACE UNTIL AFTER THE COMPLETION OF ALL WORKS AND ALL DISTURBED SURFACES HAVE BEEN STABILIZED.

MINISTRY OF TRANSPORTATION, ONTARIO
PR–D–707 88–05

DRAWING NAME: 1095_swm–det.dwg
CREATED: January 16, 2024
MODIFIED: Tuesday, January 16, 2024 4:02:36 PM

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

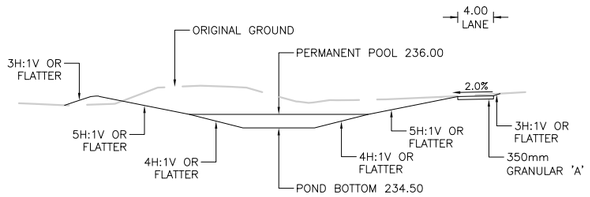
PLATE No
CONT 2024-2006
WP 2331-16-00

DETAILS

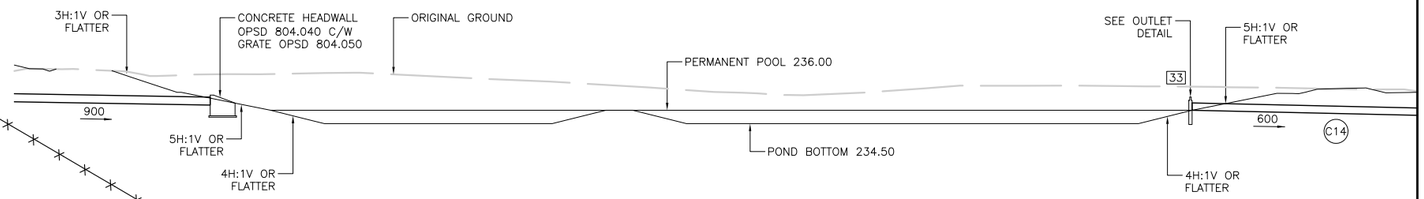
SHEET 519

Stantec

LICENSED PROFESSIONAL ENGINEER
J. A. M. INNES
100012372
2024/01/12
PROVINCE OF ONTARIO



POND SECTION A-A



POND SECTION B-B

STORM WATER MANAGEMENT POND 2 (SWMF 11S)

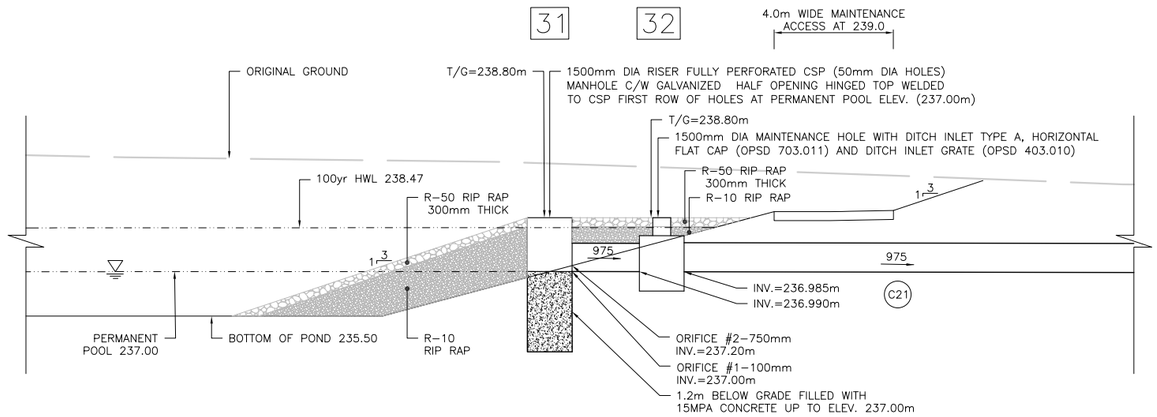
NOTES:

1. ALL SERVICES, MATERIALS, CONSTRUCTION METHODS, AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE LATEST OPSS, AND OPSD
2. EROSION AND SEDIMENT CONTROL (ESC) MEASURES SHALL BE IMPLEMENTED AND IN WORKING ORDER PRIOR TO THE COMMENCEMENT OF ANY WORKS.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN ESC MEASURES AS REQUIRED TO MITIGATE THE POTENTIAL FOR MIGRATION OF SEDIMENT TO THE DOWNSTREAM RECEIVING SYSTEM.
4. ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
5. CONSTRUCTION/GRADING SHALL BE PHASED TO MINIMIZE THE AREA OF DISTURBANCE AT ALL TIMES.
6. INSTALL SEED AND MATRIX ON ALL SLOPES GREATER THAN 3:1.
7. ALL AREAS WHERE ACTIVE CONSTRUCTION IS NOT EXPECTED WITHIN 14 DAYS SHALL BE RE-VEGETATED WITH 50 MM OF TOPSOIL AND SEED AND MATRIX AS IDENTIFIED ELSEWHERE IN THE CONTRACT.
8. ALL MAINTENANCE, STORAGE, AND REFUELING ACTIVITIES SHALL BE COMPLETED A MINIMUM OF 30 M FROM ANY RECEIVING SYSTEM OR WATERWAY, AND WILL BE CONTROLLED TO PREVENT THE ENTRY OF ANY DELETERIOUS SUBSTANCE INTO THE WATERWAY.
9. ALL STOCKPILED MATERIAL IS TO BE LOCATED A MINIMUM OF 10 M AWAY FROM ANY RECEIVING SYSTEM AND INSIDE THE LIMITS OF CONSTRUCTION/GRADING; AND SHALL BE SURROUNDED BY SILT FENCE AND COVERED WITH A ROLLED EROSION CONTROL PROTECTION PRODUCT (E.G., POLY SHEETING, TARP, STRAW MATTING, ETC).
10. ANY MATERIAL OR MUD TRACKED ONTO ANY PUBLIC ROADWAY OR ADJACENT PRIVATE PROPERTIES SHALL BE REMOVED IMMEDIATELY BY HAND OR RUBBER TIRE LOADER.
11. ESC MEASURES SHALL REMAIN IN PLACE UNTIL AFTER THE COMPLETION OF ALL WORKS AND ALL DISTURBED SURFACES HAVE BEEN STABILIZED.

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

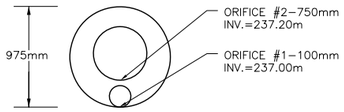
DRAWING NAME: 1095_swm-det.dwg
CREATED: January 16, 2024
MODIFIED: Tuesday, January 16, 2024 4:02:36 PM

MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707 88-05



OUTLET DETAIL SWM POND 1

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



ORIFICE PLATE DETAIL SWM POND 1

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

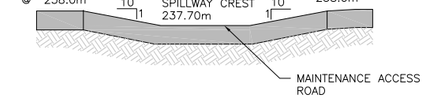
LICENSED PROFESSIONAL ENGINEER
J. A. M. INNES
100012372
2024/01/12
PROVINCE OF ONTARIO

PLATE No
CONT 2024-2006
WP 2331-16-00

DETAILS

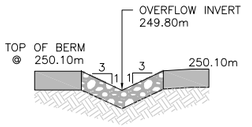
SHEET
520

Stantec



OVERFLOW WEIR DETAIL SWM POND 2

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



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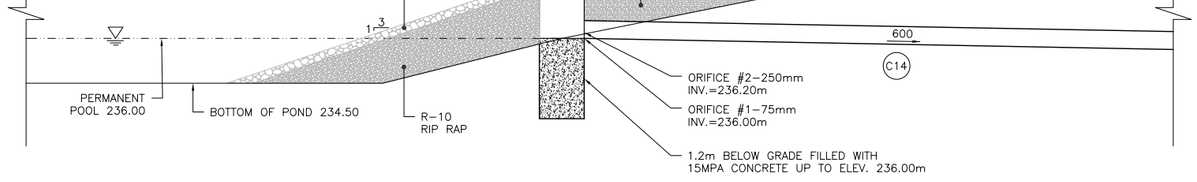
TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



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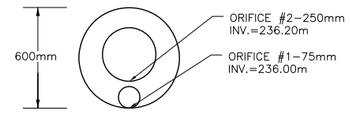
TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL

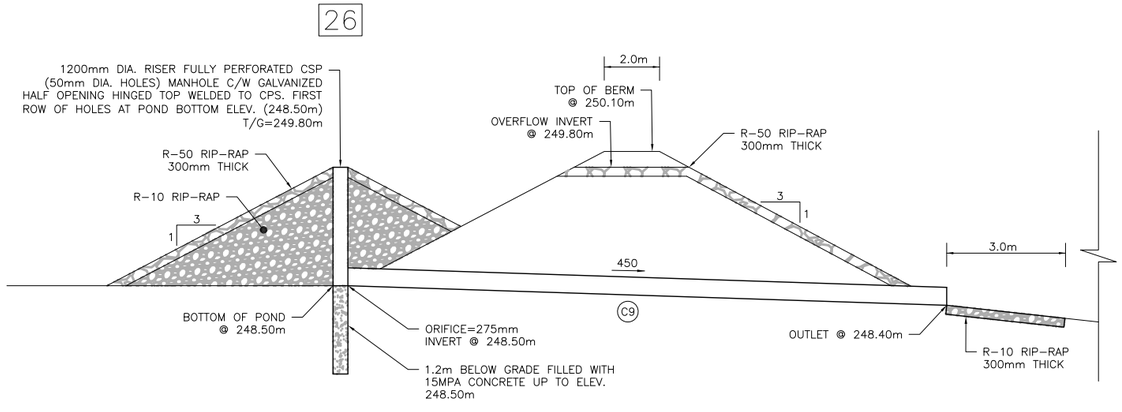


ORIFICE PLATE DETAIL SWM POND 2

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL

ORIFICE PLATE DETAIL SWM POND 3

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



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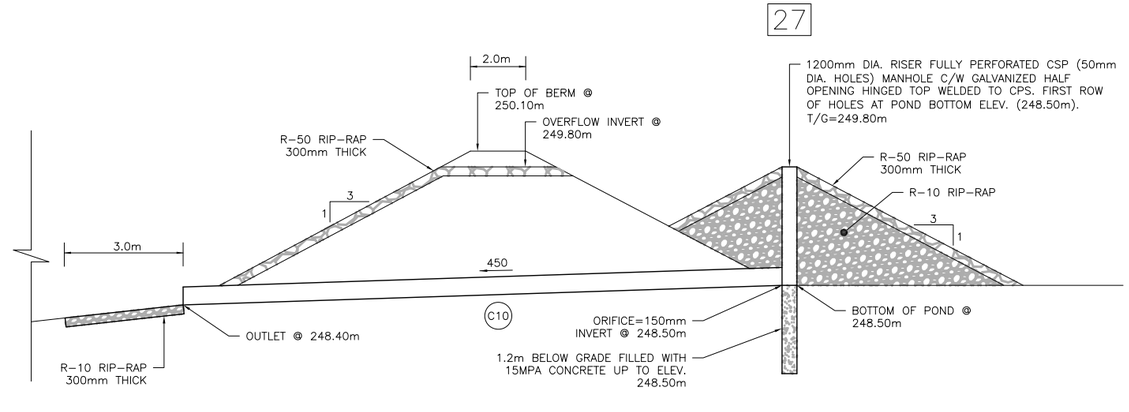
TO BE READ IN CONJUNCTION WITH THE
STORM WATER MANAGEMENT POND DETAIL



OUTLET DETAIL SWM POND 4

TO BE READ IN CONJUNCTION WITH THE
STORM WATER MANAGEMENT POND DETAIL

N.T.S.

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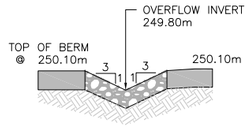
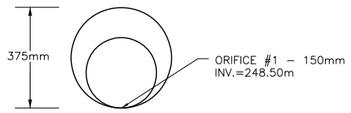
CREATED: January 16, 2024
MODIFIED: Tuesday, January 16, 2024 4:02:36 PM



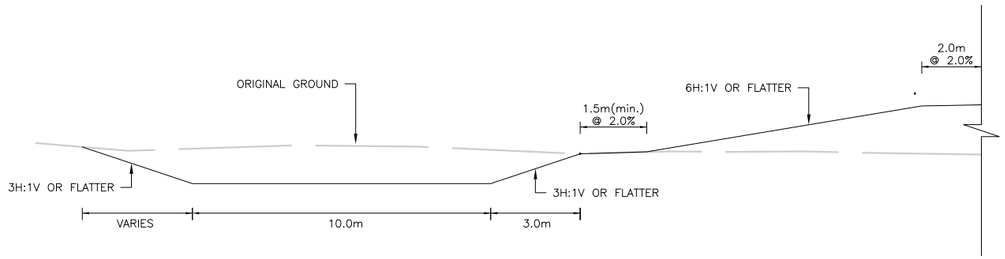
OVERFLOW WEIR DETAIL SWM POND 4

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



ORIFICE PLATE DETAIL SWM POND 4

TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT POND DETAIL



TYPICAL SWM POND 3 AND 4 SECTION

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

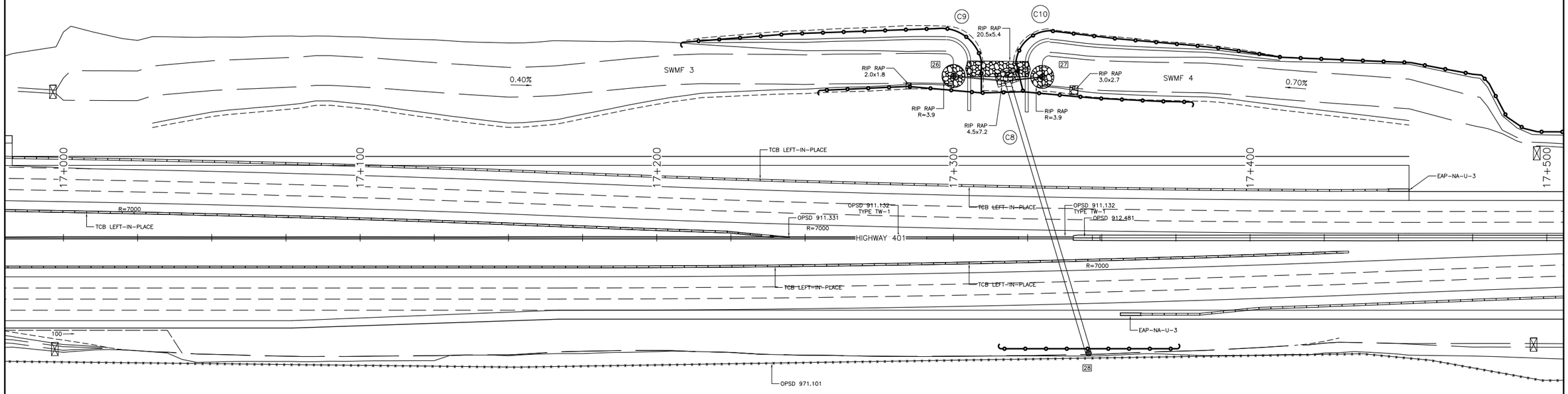
LICENSED PROFESSIONAL ENGINEER
J. A. M. INNES
100012372
2024/01/16
PROVINCE OF ONTARIO

PLATE No
CONT 2024-2006
WP 2331-16-00

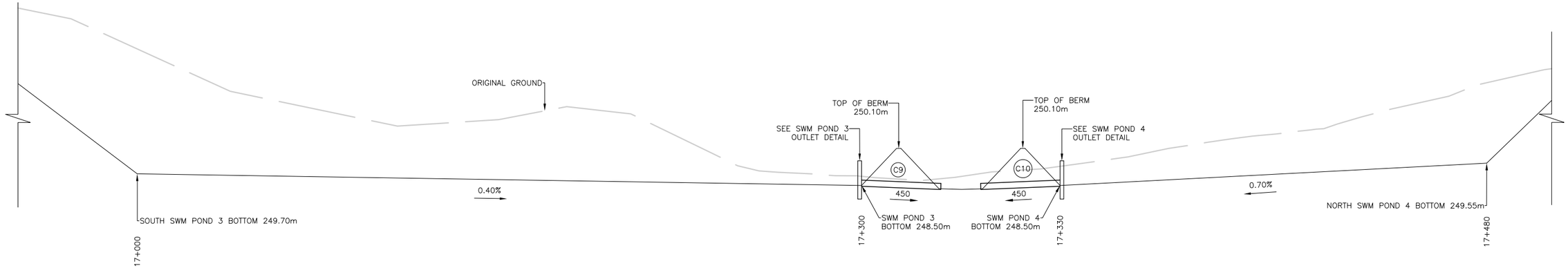
DETAILS

SHEET
521

Stantec



SWM POND 3 AND 4 PLAN



SWM POND 3 AND 4 PROFILE

N.T.S.

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

MODIFIED: Tuesday, January 16, 2024 4:02:36 PM

DRAWING NAME: 1095_swm-det.dwg
CREATED: January 16, 2024

APPENDIX B

B.1 AVAILABLE GEOCRES INFORMATION

Golder Associates Ltd.

2180 Meadowvale Boulevard
Mississauga, Ontario, Canada L5N 5S3
Telephone (905) 567-4444
Fax (905) 567-6561

PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN REPORT SIMCOE ROAD 88 UNDERPASS STRUCTURE SITE 30-211 HIGHWAY 400 WIDENING FROM YORK/SIMCOE BOUNDARY TO 1 KM SOUTH OF HIGHWAY 89 G.W.P. 40-00-00

Submitted to:

URS Cole, Sherman
75 Commerce Valley Drive East
Thornhill, Ontario
L3T 7N9

DISTRIBUTION:

1	Copy (Unbound)	-	URS Cole, Sherman, Thornhill, Ontario
2	Copies (Bound)	-	URS Cole, Sherman, Thornhill, Ontario
3	Copies	-	MTO Southwestern Region, London, Ontario
1	Copy	-	MTO Foundations Section, Downsview, Ontario
2	Copies	-	Golder Associates Ltd., Mississauga, Ontario

December 2001

001-1151-3

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. 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.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; 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

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
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
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	field vane (LV-laboratory vane test)
γ	unit weight

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

S:\FINALDAT\ABBREV\2000\LOFA-D00.DOC

LIST OF SYMBOLS

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
F factor of safety
V volume
W weight

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 stresses (major, intermediate, minor)
σ_{oct} mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ shear stress
u porewater pressure
E modulus of deformation
G shear modulus of deformation
K bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (con't.)

w water content
w_l liquid limit
w_p plastic limit
I_P plasticity Index = $(w_l - w_p)$
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)

(c) 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

(d) Consolidation (one-dimensional)

C_c compression index (normally consolidated range)
C_r recompression index (overconsolidated range)
C_S swelling index
C_α coefficient of secondary consolidation
m_v coefficient of volume change
c_v coefficient of consolidation
T_v time factor (vertical direction)
U degree of consolidation
σ'_p pre-consolidation pressure
OCR Overconsolidation ratio $= \sigma'_p / \sigma'_{vo}$

(e) Shear Strength

τ_p, τ_r peak and residual shear strength
ϕ' effective angle of internal friction
δ angle of interface friction
μ coefficient of friction = tan δ
c' effective cohesion
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 $(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u compressive strength $(\sigma_1 - \sigma_3)$
S_t sensitivity

Notes: 1. $\tau = c' + \sigma' \tan \phi'$
2. Shear strength = (Compressive strength)/2

RECORD OF BOREHOLE No B3-2 1 OF 2 METRIC

PROJECT 001-1151
W.P. 40-00-00
DIST SW HWY 400
DATUM Geodetic

LOCATION N 4884372.7; E 294253.7
BOREHOLE TYPE 162mm Diameter Hollow Stem Augers
DATE March 7-8, 2001

ORIGINATED BY GPD
COMPILED BY LCC
CHECKED BY ASP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
241.7	GROUND SURFACE						
0.0	Clayey Silt, some sand and rootlets (Fill) Firm Dark brown		1	SS	8	▽	241
0.2	Clayey Silt, trace sand and gravel Stiff to very stiff Brown becoming grey below 3.8m depth Moist		2	SS	12		
			3	SS	26		240
			4	SS	20		239
			5	SS	20		
			6	SS	15		238
			7	SS	14		237
			8	SS	9		236
			9	SS	9		235
			10	SS	12		234
			11	SS	20		233
	Occasional sand seams below 12.2m depth		12	SS	10		232
			13	SS	14		231
			14	SS	19		230
224.9							229
16.8	Clayey Silt, trace sand and gravel, occasional sand seams (Till) Hard Grey Moist		15	SS	73		228
							227
							226
							225
							224
							223
							222

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

PROJECT 001-1151

RECORD OF BOREHOLE No B3-2 2 OF 2 METRIC

W.P. 40-00-00 LOCATION N 4884372.7; E 294253.7 ORIGINATED BY GPD

DIST SW HWY 400 BOREHOLE TYPE 162mm Diameter Hollow Stem Augers COMPILED BY LCC

DATUM Geodetic DATE March 7-8, 2001 CHECKED BY ASP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	-- CONTINUED FROM PREVIOUS PAGE --										
	Clayey Silt, trace sand and gravel, occasional sand seams (Till) Hard Grey Moist		16	SS	116		221		o		
			17	SS	132/.23		220				
218.4			18	SS	114		219		o		
23.3	END OF BOREHOLE Notes: 1. Water level in open borehole during drilling operations at about 0.7m depth (Elev.241.0m). 2. The water level in the piezometer was measured at 0.2m depth (Elev.241.5m) on March 20, 2001 and at 0.4m depth (Elev.241.3m) on June 19, 2001.										

+³,×³: Numbers refer to Sensitivity O³% STRAIN AT FAILURE

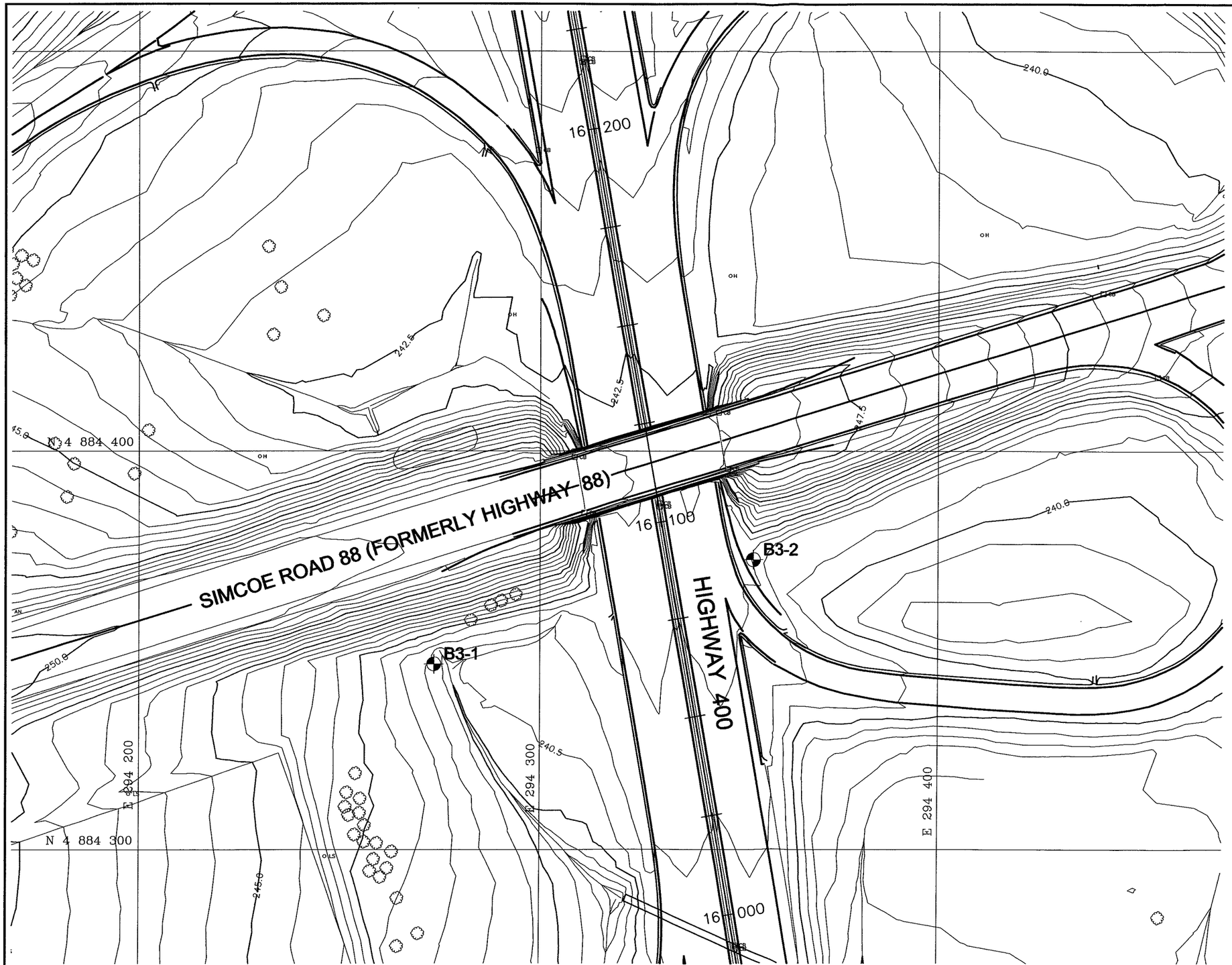
DIST HWY 400
CONT. No.
GWP No. 40-00-00

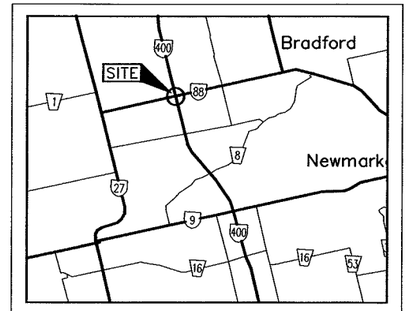
SIMCOE ROAD 88 UNDERPASS
HWY 400
BOREHOLE LOCATION PLAN

SHEET

Golder Associates

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA





KEY PLAN

0 2.0 4.0 6.0 8.0 10.0 20.0
SCALE IN KILOMETRES

LEGEND

- Borehole, previous investigation
- Borehole, present investigation

No.	ELEVATION	LOCATION NORTHING	LOCATION EASTING
B3-1	241.4	4,884,346.4	294,273.5
B3-2	241.7	4,884,372.7	294,253.7

REFERENCE
This drawing was created from digital file "33819.dwg" provided by URS Cole Sherman

0 10 20 30 40 50 100m
SCALE IN METRES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

NO.	DATE	BY	REVISION

Geocres No.

HWY. No. 400	PROJECT NO.: 001-1151		
SUBM'D. LCC	CHKD: ASP	DATE: JANUARY 2001	SITE 30-211
DRAWN: MHW	CHKD. LCC	APPD. ASP	DWG. 1

P1161008.DWG

Stantec

(FINAL) Foundation Investigation and Design Report – Highway 400 and Simcoe Road 88 Interchange Improvements - High Fill, Deep Cut and Sign Support Sites

Highway 400, Bradford, West Gwillimbury, ON

Assignment Number 2018-E-0010
GWP 2331-16-00

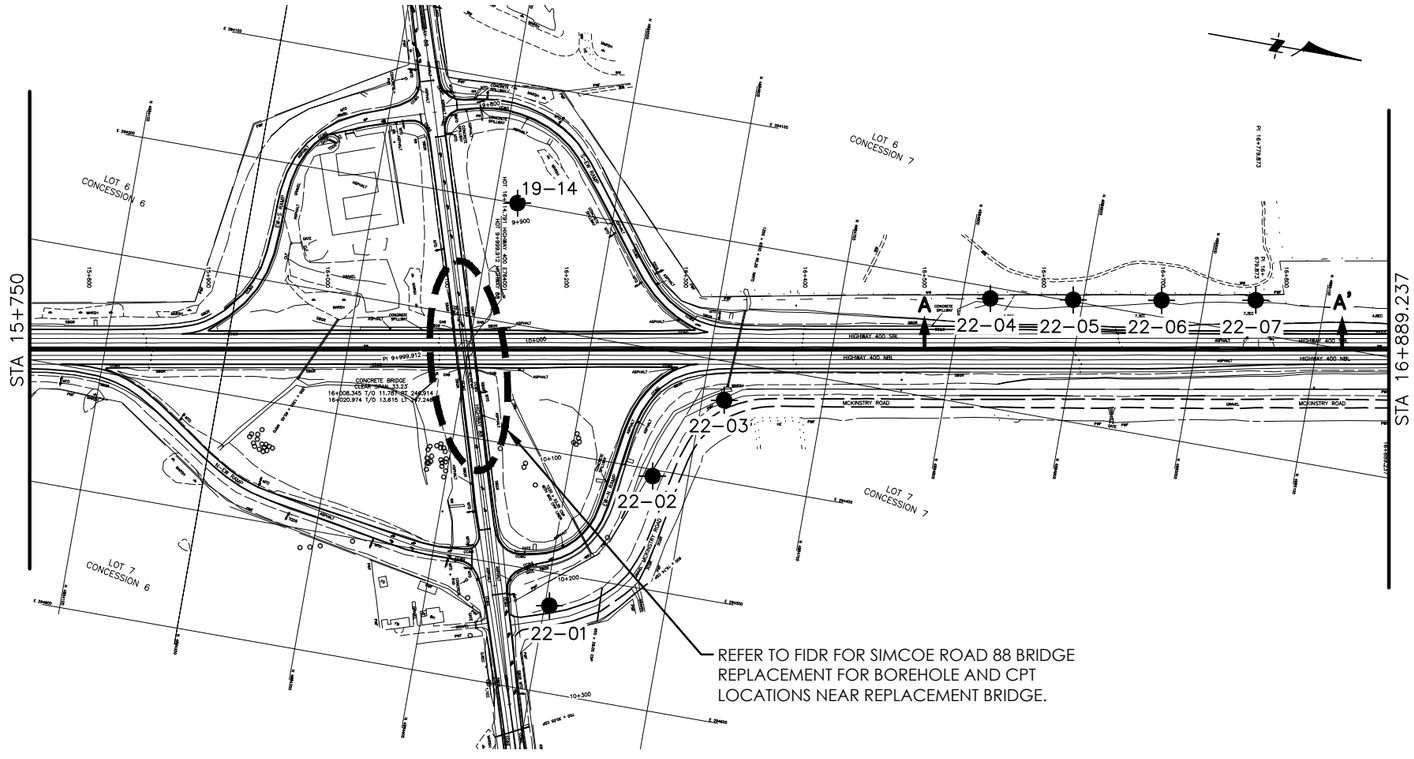
Geocres No. 31D04-002

Prepared for:
Ministry of Transportation Ontario

Prepared by:
Stantec Consulting Ltd.
300 – 675 Cochrane Drive
Markham, ON L3R 0B8

Project No. 165001095

January 18,2024



BOREHOLE PLAN

SCALE

50m 0 50 100m

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No

CONT
WP 2331–16–00

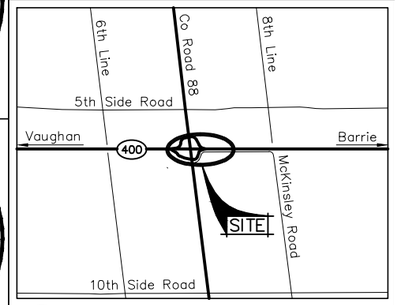
HWY400/SIMCOE ROAD 88
HIGH FILL AND DEEP CUT
STA 15+750 TO STA 16+889.2

SHEET
–

Stantec

LICENSED PROFESSIONAL ENGINEER
J.J. BRISBOIS
2024-01-18
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NELSON
2024-01-18
PROVINCE OF ONTARIO



KEY PLAN
1 km 0 1 2 km

LEGEND

Borehole (Stantec, 2021 and 2022)

No	ELEV	MTM ZONE 10 COORDINATES NORTH	EAST
22–01	237.1	4 884 504.1	294 527.4
22–02	238.8	4 884 570.4	294 405.3
22–03	241.0	4 884 618.4	294 332.4
22–04	255.4	4 884 823.2	294 209.6
22–05	259.7	4 884 891.9	294 198.7
22–06	261.8	4 884 964.8	294 186.3
22–07	262.3	4 885 042.5	294 172.5
19–14	249.7	4 884 419.1	294 199.8

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102–2 of Form 100.

REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No 31D04-002

HWY No 400				DIST	
SUBM'D JJB	CHECKED		DATE 2023–04–24	SITE	30–309
DRAWN GBB	CHECKED		APPROVED	DWG	1

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

DRAWING NAME: 165001095_HF&DC_Borehole Plan–1.dwg
CREATED BY: GBB MODIFIED:
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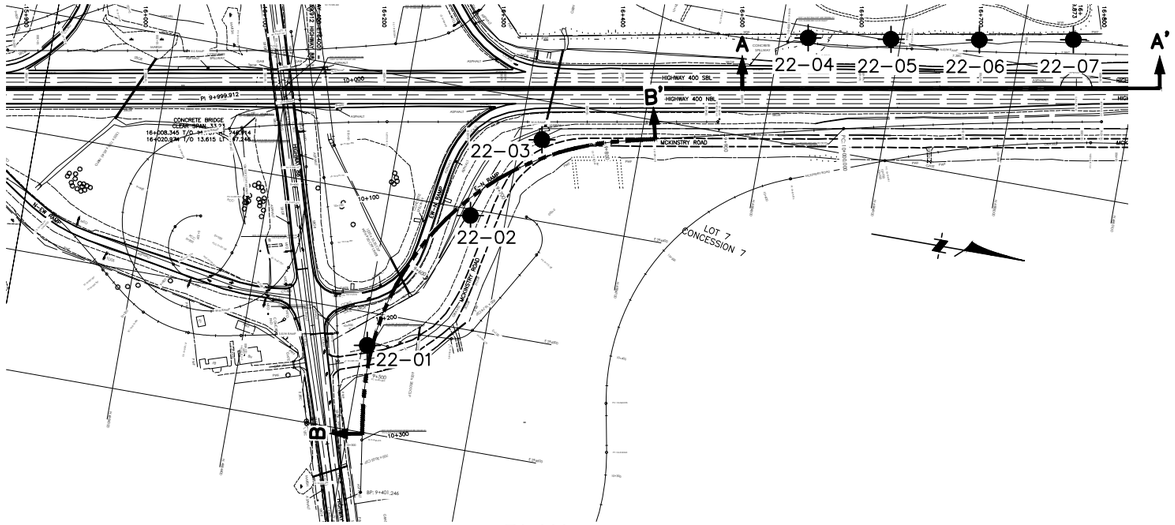
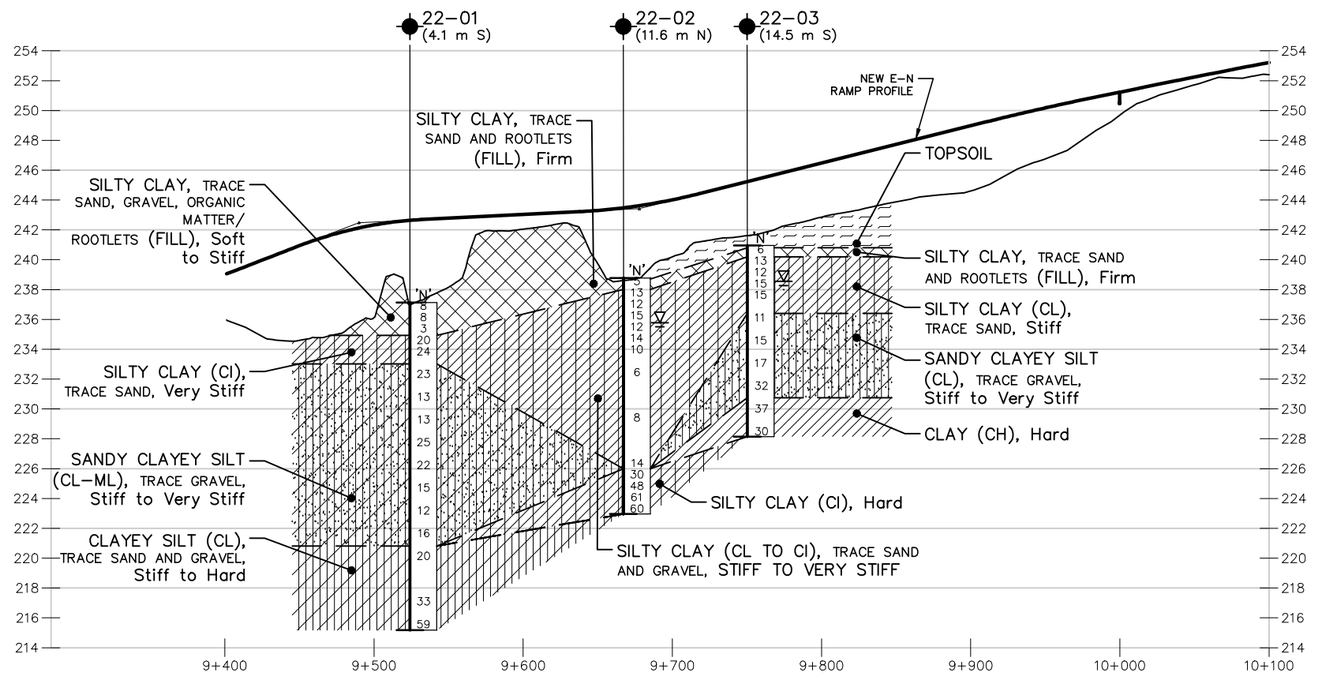


PLAN
SCALE
50m 0 50 100m



CROSS SECTION ALONG E-N RAMP

SCALE
40 m 0 40 80 m HORIZONTAL
4 m 0 4 8 m VERTICAL

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

PLATE No
CONT
WP 2331-16-00

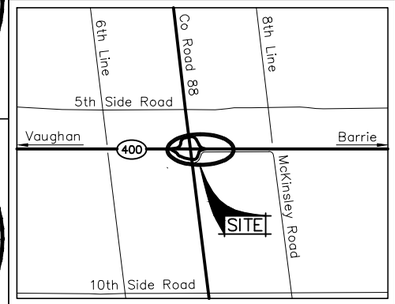
HWY400/SIMCOE ROAD 88
HIGH FILL AREA
BOREHOLE LOCATIONS & SOIL STRATA

SHEET
-

Stantec

LICENSED PROFESSIONAL ENGINEER
J.J. BRISBOIS
2024-01-18
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NELSON
2024-01-18
PROVINCE OF ONTARIO



KEY PLAN
1 km 0 1 2 km

LEGEND

⊕	Borehole (Stantec, 2022)
(X.X m)	Offset from Cross Section Line in meters
XX	N-value Obtained from Standard Penetration Test (ASTM D 1586M-18)
▽	WL at time of investigation November 2022

No	ELEV	MTM ZONE 10 COORDINATES NORTH	EAST
22-01	237.1	4 884 504.1	294 527.4
22-02	238.8	4 884 570.4	294 405.3
22-03	241.0	4 884 618.4	294 332.4
22-04	255.4	4 884 823.2	294 209.6
22-05	259.7	4 884 891.9	294 198.7
22-06	261.8	4 884 964.8	294 186.3
22-07	262.3	4 885 042.5	294 172.5
19-14	249.7	4 884 419.1	294 199.8

NOTES

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

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REVISIONS			
DATE	BY	DESCRIPTION	

GEOCRES No 31D04-002

HWY No 400				DIST	
SUBM'D JJB	CHECKED		DATE 2023-04-24	SITE	30-309
DRAWN GBB	CHECKED		APPROVED	DWG	4

RECORD OF BOREHOLE No BH22-01 1 OF 2 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Future E-N Ramp N:4884504.1 E:294527.4 ORIGINATED BY JM

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2022.11.29 - 2022.11.29 LATITUDE 44.100458 LONGITUDE -79.628308 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.1	Grass										
237.0 / 0.1	75 mm TOPSOIL						237				
	SILTY CLAY, trace sand, gravel, organic matter/rootlets (FILL) Brown Soft to stiff Moist		1	SS	8						
			2	SS	8		236				
			3	SS	3						0 3 49 48
234.9 / 2.2	SILTY CLAY, trace sand (Cl). Contains seams of sand. Brown Very stiff Moist to wet		4	SS	20	▽	235				
			5	SS	24		234				
233.0 / 4.1	Sandy CLAYEY SILT (CL-ML), trace gravel Brown Stiff to very stiff Moist to wet		6	SS	23		233				
	Grey below 6.1 m		7	SS	13		231				4 41 30 24
			8	SS	13		229				
			9	SS	25		228				
			10	SS	22		226				9 20 44 28
			11	SS	15		225				
			12	SS	12		223				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH22-01 2 OF 2 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Future E-N Ramp N:4884504.1 E:294527.4 ORIGINATED BY JM

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2022.11.29 - 2022.11.29 LATITUDE 44.100458 LONGITUDE -79.628308 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Sandy CLAYEY SILT (CL-ML), trace gravel Brown Stiff to very stiff Moist to wet *(continued)*		13	SS	16		222				
220.8							221				
16.3	CLAYEY SILT (CL), trace sand and gravel Grey Stiff to hard Wet		14	SS	20		220				2 6 44 48
							219	+ 1.2			
			14A	ST			218				
			15	SS	33		217				
							216				
215.2			16	SS	59						
22.0	END OF BOREHOLE Groundwater level and cave-in measured at approximately 2.4 m and 14.9 m below grade, respectively; in open borehole.										

+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH22-02 1 OF 2 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Future E-N Ramp N:4884570.4 E:294405.3 ORIGINATED BY JM

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2022.11.28 - 2022.11.28 LATITUDE 44.101053 LONGITUDE -79.629833 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	WATER CONTENT (%) (PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.8	Grass										
238.7 / 0.1	75 mm TOPSOIL										
	SILTY CLAY, trace sand and rootlets (FILL) Brown Firm Moist		1	SS	5		238				
238.0 / 0.8	SILTY CLAY (CL to CI), trace sand and gravel Brown Stiff to very stiff Moist to wet		2	SS	13						
			3	SS	12		237				
			4	SS	15	▽	236				1 3 37 59
			5	SS	12						
	Firm to stiff and grey below 4.0 m.		6	SS	14		235				
			7	SS	10		234				
			8	SS	6		233				0 4 47 49
			8A	ST			232	+ 1.8			Consolidation Test
			9	SS	8		231				
	Very stiff below 10.0 m.						230		+ 2.6		
							229		+ 3.2		
	Contains zones of silt (ML)		9A	ST			228				Consolidation Test
226.0			10	SS	14		227				
12.8	SILTY CLAY (CI) Grey Hard Moist to wet		11	SS	30		226				
			12	SS	48		225				0 0 24 76
			13	SS	61		224				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH22-02 2 OF 2 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Future E-N Ramp N:4884570.4 E:294405.3 ORIGINATED BY JM

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2022.11.28 - 2022.11.28 LATITUDE 44.101053 LONGITUDE -79.629833 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY (Cl) Grey Hard Moist to wet *(continued)*		14	SS	60		223		○		
223.0 15.8	SILTY CLAY (Cl) Grey Hard Moist to wet										
	END OF BOREHOLE Groundwater level and cave-in measured at approximately 3.0 m and 12.8 m below grade, respectively; in open borehole.										

+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH22-03

1 OF 1

METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Future E-N Ramp N:4884618.4 E:294332.4 ORIGINATED BY JM

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2022.11.25 - 2022.11.25 LATITUDE 44.101484 LONGITUDE -79.630745 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
241.0	Grass										
240.8	150 mm TOPSOIL										
0.2	SILTY CLAY, trace sand and rootlets (FILL) Brown/black Firm Moist		1	SS	6						
240.2											
0.8	SILTY CLAY, trace sand (CL) Brown Stiff Moist		2	SS	13		240				
			3	SS	12		239				
			4	SS	15						0 1 56 43
			5	SS	15		238				
	Shelby tube sample obtained at 3.8m depth in adjacent borehole		5A	ST			237				
236.4											
4.6	Sandy CLAYEY SILT, trace gravel (CL) Grey Stiff to very stiff Moist to wet Field shear vane tests conducted in adjacent borehole		6	SS	11		236		2.3 2.4		Su = 124 kPa Su = 183 kPa
			7	SS	15		235				3 30 33 35
			8	SS	17		234				
			9	SS	32	▽	233				
230.8							232				
10.2	CLAY (CH) Grey Hard Moist to wet		10	SS	37		231				
			11	SS	30		230				0 0 24 76
228.2							229				
12.8	END OF BOREHOLE Groundwater level in open borehole at approximately 8.8 m.										

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

Stantec

FINAL

Foundation Investigation and Design Report – Highway 400 Underpass Replacement at Simcoe Road 88 (Site No. 30X-0309/B0)

Highway 400, Bradford, West Gwillimbury, ON

Assignment Number 2018-E-0010
GWP 2331-16-00

Geocres No. 31D-810

Prepared for:
Ministry of Transportation Ontario

Prepared by:
Stantec Consulting Ltd.
300 – 675 Cochrane Drive
Markham, ON L3R 0B8

Project No. 165001195

October 4, 2023

RECORD OF BOREHOLE No BH19-02 1 OF 4 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Underpass (N:4884434.5 E:294359.2) ORIGINATED BY DS

DIST Central HWY HWY 400 BOREHOLE TYPE Mud Rotary COMPILED BY SR

DATUM Geodetic DATE 2019.06.05 - 2019.06.05 LATITUDE 44.099829 LONGITUDE -79.630406 CHECKED BY JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
242.0								20 40 60 80 100	20 40 60		
241.7 0.0	250 mm TOPSOIL										
0.3	CLAYEY SILT (CL) SS1and SS2 contain trace sand, rootlets and organic material Firm to stiff Brown Moist to wet		1	SS	10						
			2	SS	8		241				
			3	SS	10	▼					0 1 47 52
			4	SS	11		240				
			5	SS	14		239				
	Becomes grey		6	SS	10		238				0 0 55 45
			7	SS	14		237				
			8	SS	9		236				
	SS9 contains trace sand		9	SS	8		235				
232.8			10	SS	8		234				0 5 41 54
9.2	CLAYEY SILT (CL-ML), trace to some sand and gravel Firm to very stiff Grey Moist to wet		11	SS	7		233				
			12	SS	4		232				
	SS13 contains sand seams		13	SS	2		231				10 6 51 33
				VANE			230				Su= 177 kPa (Field Vane)
			14	SS	10		229				
							228				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH19-02 2 OF 4 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Underpass (N:4884434.5 E:294359.2) ORIGINATED BY DS

DIST Central HWY HWY 400 BOREHOLE TYPE Mud Rotary COMPILED BY SR

DATUM Geodetic DATE 2019.06.05 - 2019.06.05 LATITUDE 44.099829 LONGITUDE -79.630406 CHECKED BY JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
226.7											
15.2	CLAYEY SILT, some sand, trace gravel (CL to CL-ML) Very stiff to hard Grey Moist Inferred cobbles/boulder based on auger grinding from 15.2 m to 15.8 m		15	SS	110/ 76mm		226		○		
			16	SS	109		225		○		3 16 38 43
			17	SS	54		224		○		
			18	SS	118		223		○		
			19	SS	34		222		○		
			20	SS	113		221		○		0 13 41 46
			21	SS	46		220		○		
	Contains silt seams below 26.0 m		22	SS	23		219		○		
			23	SS	21		218		○		
			24	SS	28		217		○		
							216		○		
							215		○		
							214		○		
							213		○		

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH19-02 3 OF 4 METRIC

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Underpass (N:4884434.5 E:294359.2) ORIGINATED BY DS

DIST Central HWY HWY 400 BOREHOLE TYPE Mud Rotary COMPILED BY SR

DATUM Geodetic DATE 2019.06.05 - 2019.06.05 LATITUDE 44.099829 LONGITUDE -79.630406 CHECKED BY JJB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	CLAYEY SILT, some sand, trace gravel (CL to CL-ML) Very stiff to hard Grey Moist *(continued)*										
			25	SS	28		211		○		
							210				
							209				
	SS26 contains trace sand		26	SS	21		208		○		
							207				
							206				
			27	SS	22		205		○		
							204				
							203				
			28	SS	26		202		○		
							201				
							200				
			29	SS	34		199		○		
							198				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH19-02

4 OF 4 **METRIC**

W.P. GWP 2331-16-00 LOCATION Highway 400/Simcoe Road 88 Underpass (N:4884434.5 E:294359.2) ORIGINATED BY DS

DIST Central HWY HWY 400 BOREHOLE TYPE Mud Rotary COMPILED BY SR

DATUM Geodetic DATE 2019.06.05 - 2019.06.05 LATITUDE 44.099829 LONGITUDE -79.630406 CHECKED BY JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.3											
45.7	SANDY SILT (ML), (TILL) Very dense Grey Wet		30	SS	40/ 152mm		196		○		
							195				
							194				
192.6			31	SS	102		193		○		
49.4	End of Borehole Groundwater observation not made in open borehole due to mud rotary drilling. Monitoring well installed in borehole, screened from approximately 4.6 m to 7.6 m below grade. Groundwater level in monitoring well measured at approximately 1.6 m and 1.7 m below grade on October 22, 2020 and October 19, 2022, respectively.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

APPENDIX C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE RECORDS

C.2 BOREHOLE RECORDS

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

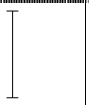
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

RECORD OF BOREHOLE No BH SWMP1-1 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 1, Highway 400/Simcoe Road 88 Interchange N:4883754.1 E:609715 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.19 - 2023.12.19 LATITUDE 44.09875 LONGITUDE -79.629269 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
243.3	Grass										
243.0	180 mm TOPSOIL										
0.2	Silty SAND, some gravel to SAND and GRAVEL, some silt (SM), trace clay. Contains zones/inclusions of silty clay. Loose to very dense Brown Moist		1	SS	12		243				
			2	SS	7		242				
			3	SS	27		241				
	10 mm thick asphalt piece at 4 m		4	SS	53		240				
			5	SS	16		239				
237.7	Sloughed materials from 5.3 m to 5.6 m		6	SS	26		238				
5.6	Sandy SILTY CLAY (Cl), some gravel (TILL) Very stiff Grey Moist to wet		7	SS	14		237				15 23 39 23
235.8			8	SS	20		236				
7.5	CLAYEY SILT (CL), trace sand Stiff to very stiff Grey Moist to wet		9	SS	26		235				
			10	SS	26		234				0 3 62 35
			11	SS	23		233				
			12	SS	11		232				
230.5			13	SS	15		231				
12.8	End of Borehole Borehole open and dry on completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH SWMP1-2 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 1, Highway 400/Simcoe Road 88 Interchange N:4883800.9 E:609743.2 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.20 - 2023.12.20 LATITUDE 44.099167 LONGITUDE -79.628908 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
240.7	Grass								
0.0	Silty SAND and GRAVEL (SM/GM), trace clay and rootlets (FILL) Compact Brown Moist		1	SS	16				
240.0							240		
0.8	50 mm thick TOPSOIL inclusion at 0.3 m								
	CLAYEY SILT (CL), trace sand Very stiff Brown Moist		2	SS	11				
			3	SS	9		239		
			4	SS	16				Su>177 kPa (N-vane refusal)
			5	SS	14		238		0 1 68 31
			6	SS	12		237		
			7	SS	13		236		
	Stiff to very stiff below 5.2 m		8	SS	10				
			9	SS	11		235		0 4 69 27
			10	SS	10		234		
			11	SS	10		233		
	Trace gravel below 8 m		12	SS	7		232		
			13	SS	6	▽	231		
			14	SS	7				
	Wet below 10.7 m		15	SS	8		230		
			16	SS	9		229		
228.7									
12.0	End of Borehole								

Groundwater level in open borehole at 9.8 m depth (~Elev. 230.9 m) on completion of drilling.

Sloughed material noted at 11.6 m on completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

+1.7 +2.3

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH SWMP1-3 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 1, Highway 400/Simcoe Road 88 Interchange N:4883804.7 E:609709.9 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.18 - 2023.12.18 LATITUDE 44.099206 LONGITUDE -79.629322 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
243.2	Grass										
243.0 / 0.1	75 mm TOPSOIL										
	Gravelly SAND to SAND and GRAVEL, some silt (SM), trace clay (FILL). Contains zones/inclusions of SILT, trace sand and gravel. Loose to dense Brown Moist		1	SS	20		243				
			2	SS	40		242				
	SS3 contains asphalt pieces		3	SS	21		241				
			4	SS	8	▽					28 49 15 8
			5	SS	27	▼	240				
239.0			6	SS	23		239				
4.2	CLAYEY SILT (CL), trace to some sand, trace gravel Stiff to very stiff Grey Moist		7	SS	16						0 3 70 27
			8	SS	8		238				
			9	SS	14		237				
			10	SS	19		236				
			11	SS	22		235				
	Sand seams observed in SS12		12	SS	23						1 13 58 28
	Grey below 9.1 m		13	SS	16		234				
			14	SS	23		233				
			15	SS	12		232				
			16	SS	15						2 13 53 32
230.4			17	SS	11		231				
12.8	End of Borehole										
	Slough/cave-in material measured at 2.4 m below grade on completion of drilling.										
	Monitoring well installed approximately 2 m east of borehole.										
	Groundwater level measured at approximately 3.2 m below grade (~Elev. 240.0 m) on February 12, 2024.										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH SWMP2-1 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 2, McKinstry Road N:4884015.3 E:609756.7 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.21 - 2023.12.21 LATITUDE 44.101092 LONGITUDE -79.628694 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.4	Gravel Road								
0.0	Silty SAND, trace gravel and clay (FILL) Loose to compact Brown Moist		1	SS	10		238		
237.7									
0.8	Sandy CLAYEY SILT (CL), trace gravel (TILL) Firm to very stiff Brown Moist		2	SS	5				
			3	SS	WH		237		6 35 45 14
				VANE					
				VANE			236		
			4	SS	19				
234.7							235		
3.7	CLAYEY SILT (CL), some sand, trace gravel Stiff to very stiff Brown Moist		5	SS	18				
			6	SS	14		234		
			7	SS	11		233		3 14 45 38
232.4									
6.0	Sandy CLAYEY SILT (CL-ML), trace gravel (TILL) Stiff to very stiff Grey Moist		8	SS	12		232		
			9	SS	11				
	Wet below 7.6 m						231		
			10	SS	21				6 43 41 11
			11	SS	11		230		
229.1									
9.3	End of Borehole								

No groundwater seepage noted in open borehole on completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

+3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH SWMP2-2 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 2, McKinstry Road N:4884035.6 E:609663.4 ORIGINATED BY AS

DIST Central HWY Hwy 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.22 - 2023.12.22 LATITUDE 44.101289 LONGITUDE -79.629856 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
239.8	Grass										
0.0	CLAYEY SILT (CL) Stiff to very stiff Brown Moist SS1 contains trace rootlets		1	SS	7						
			2	SS	6		239				PP=2.0
			3	SS	13		238				PP=2.5
			4	SS	12						PP=3.25
			5	SS	14		237				PP=2.25 0 0 60 40
	SS6 contains a sand seam Trace sand and gravel below 4 m		6	SS	16		236				PP=1.75
	Becomes grey and firm to stiff below 4.6 m		7	SS	9		235				PP=0.75
			8	SS	11		234				PP=1.25
			9	SS	11						PP=1.25 1 8 53 38
			10	SS	6		233				
				VANE			232	2.3, 2			
				VANE							
			11	SS	3		231	2, 2.3			
				VANE							
				VANE							
			12	SS	4		230				0 5 53 42
				VANE			229	1.8, 2.1			
				VANE							
227.8			13	SS	10		228				
12.0	End of Sampled Borehole Dynamic Cone Penetration Test (DCPT) from 12.2 m to 13.4 m below grade.										
226.4											
13.4	End of Dynamic Cone Penetration Test Groundwater level measured at approximately 0.1 m below grade (~ Elev. 239.7 m) on January 16, 2024 and at approximately 0.8 m below grade (~Elev. 239.0 m) on February 12, 2024.										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 165001095_CULVERTS_SWMPS.GPJ ONTARIO MTO.GDT 3/14/24

RECORD OF BOREHOLE No BH SWMP4-1 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 4, Highway 400, south of Line 8 N:4885034.1 E:609322.00 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.21 - 2023.12.21 LATITUDE 44.110328 LONGITUDE -79.633914 CHECKED BY KN/JJB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
248.6	Grass										
0.0	CLAYEY SILT to SILTY CLAY (CL to CI), trace sand Firm to stiff Brown Moist SS1 and SS2 contain trace rootlets		1	SS	3		248	○	○		
			2	SS	5			○	○		
			3	SS	12		247	○	⊢○⊣		0 1 58 40
246.4											
2.2	Sandy CLAYEY SILT (CL), trace gravel (TILL) Very stiff to hard Brown Moist		4	SS	16		246	○	○		
			5	SS	36			○	○		
			6	SS	30		245	○	○		
	Grey below 4.6 m		7	SS	23		244	○	⊢○⊣		2 29 41 28
	Sand content increases below 5.3 m		8	SS	19		243	○	○		
			9	SS	18			○	○		
241.8							242				
6.8	Sandy SILT to SILT and SAND (ML), some clay, trace gravel (TILL) Dense Grey Moist		10	SS	36			○	⊢○⊣		9 39 34 18
			11	SS	38		241	○	○		
240.4											
8.2	End of Borehole Cave-in measured at approximately 7.3 m on completion of drilling. Groundwater level measured at approximately 0.1 m below grade (~ Elev. 248.5 m) on January 16, 2024 and at approximately 0.4 m below grade (~ Elev. 248.2 m) on February 12, 2024.										

+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH SWMP4-3 1 OF 1 METRIC

W.P. GWP 2331-16-00 LOCATION SWMP 4, Highway 400, south of Line 8 N:4885167.2 E:609297.6 ORIGINATED BY TK

DIST Central HWY Hwy 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RR

DATUM Geodetic DATE 2023.12.21 - 2023.12.21 LATITUDE 44.111531 LONGITUDE -79.634189 CHECKED BY KN/JJB

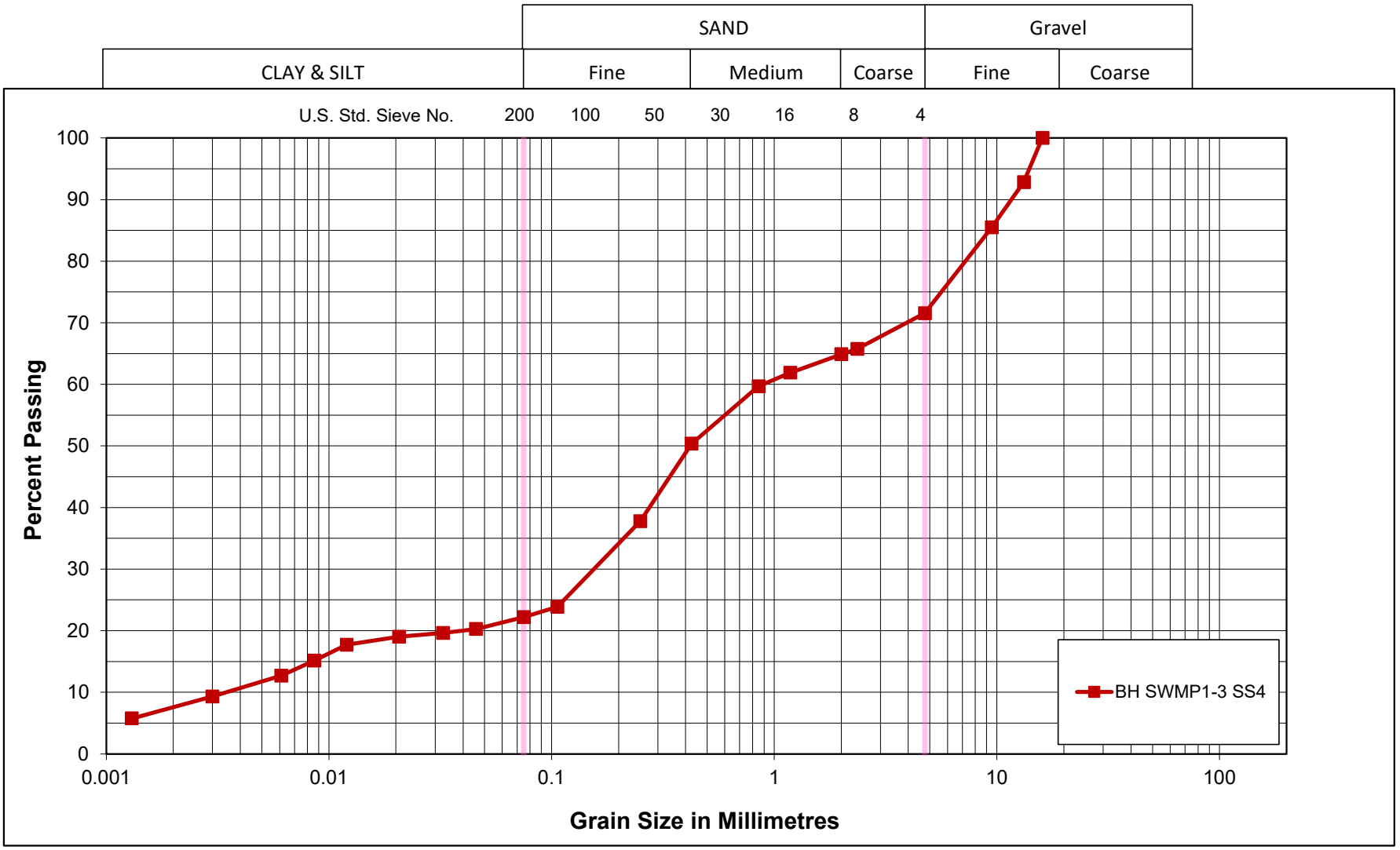
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
251.2	Grass										
251.0	180 mm TOPSOIL										
0.2	Silty SAND, some clay (FILL) Very loose Brown Moist		1	SS	3		251				
250.4											
0.8	CLAYEY SILT to SILTY CLAY (CL to CI), trace sand Stiff Brown Moist		2	SS	7	▽					
			3	SS	5		250				
			4	SS	7		249				
248.2											
3.0	CLAYEY SILT (CL), trace sand and gravel (TILL) Very stiff Brown Moist		5	SS	7		248	+			
			6	SS	10		247				
246.7											
4.5	SILT and SAND (ML), some clay, trace gravel (TILL). Cobbles and/or boulders inferred from drilling observations. Compact to very dense Brown Moist to wet Contains zones of CLAYEY SILT (CL) (TILL) Wet below 5.3 m		7	SS	30		246				
			8	SS	25						4 46 38 11
			9	SS	64		245				
			10	SS	35		244				
			11	SS	41						
243							243				
8.2	End of Borehole Groundwater level in open borehole at 0.9 m depth (~Elev. 250.3 m) on completion of drilling. Cave-in measured at approximately 4.9 m on completion of drilling.										

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

APPENDIX D

D.1 LABORATORY TEST RESULTS

Unified Soil Classification System



GRAIN SIZE DISTRIBUTION

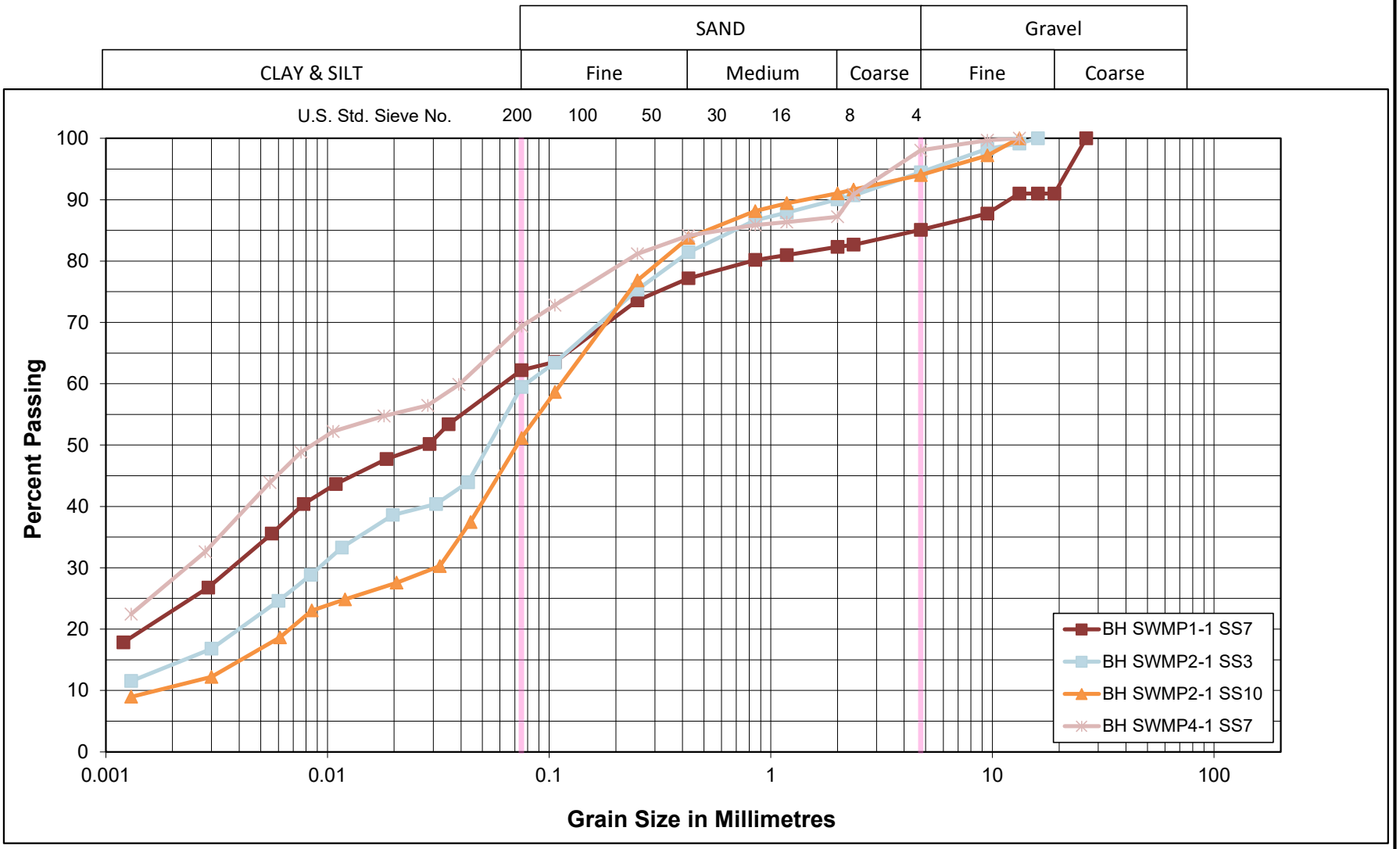
FILL: Gravelly SAND (SM)

Highway 400 Rehabilitation - SWMPs

Figure No. D1

Project No. 165001095

Unified Soil Classification System



Stantec

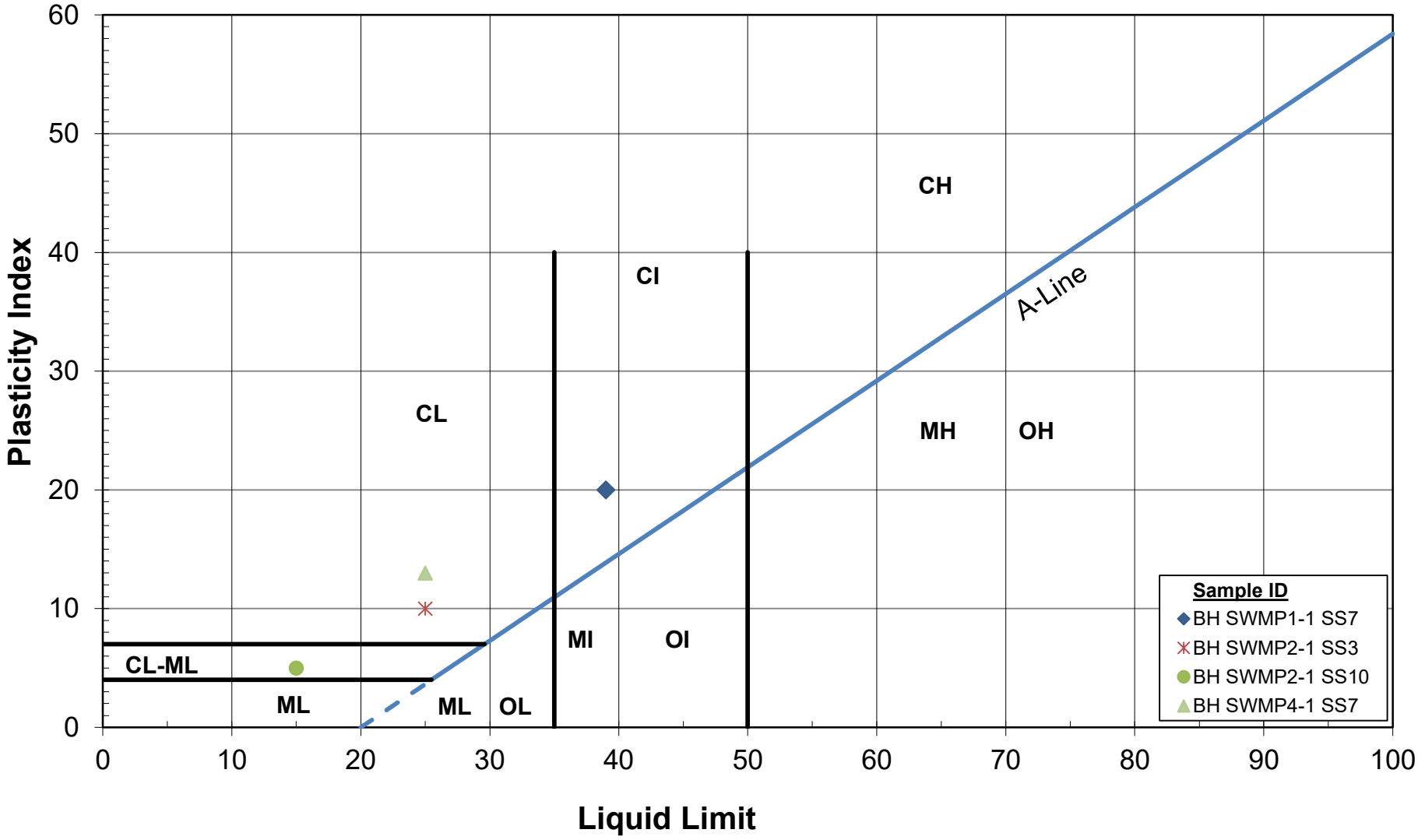
GRAIN SIZE DISTRIBUTION

TILL: Sandy SILTY CLAY (CI) to Sandy CLAYEY SILT (CL)

Highway 400 Rehabilitation - SWMPs

Figure No. D2

Project No. 165001095



Stantec

PLASTICITY CHART

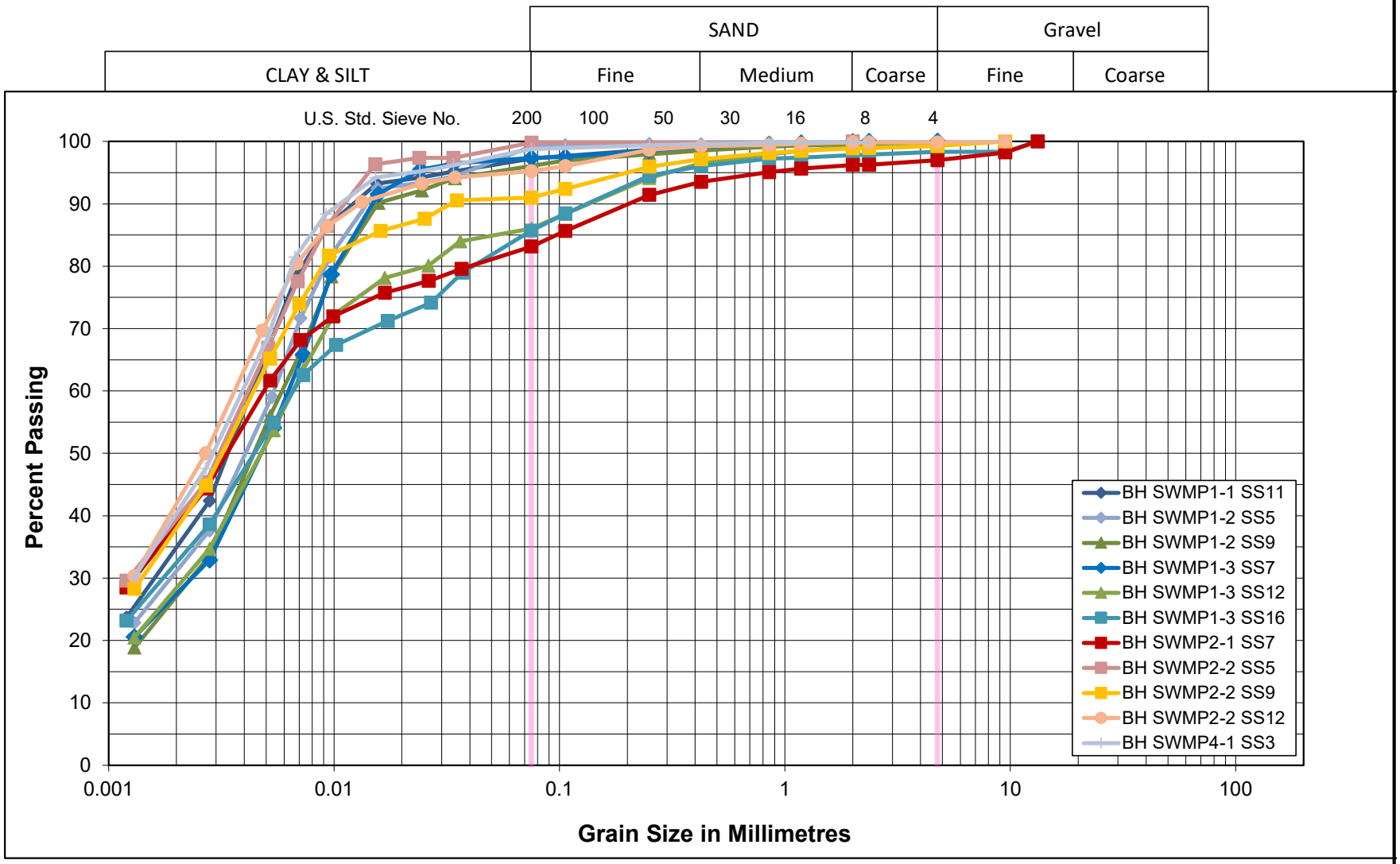
TILL: Sandy SILTY CLAY (CI) to Sandy CLAYEY SILT (CL)

Hwy 400 Rehabilitation - SWMPs

Figure No. D3

Project No. 165001095

Unified Soil Classification System



Stantec

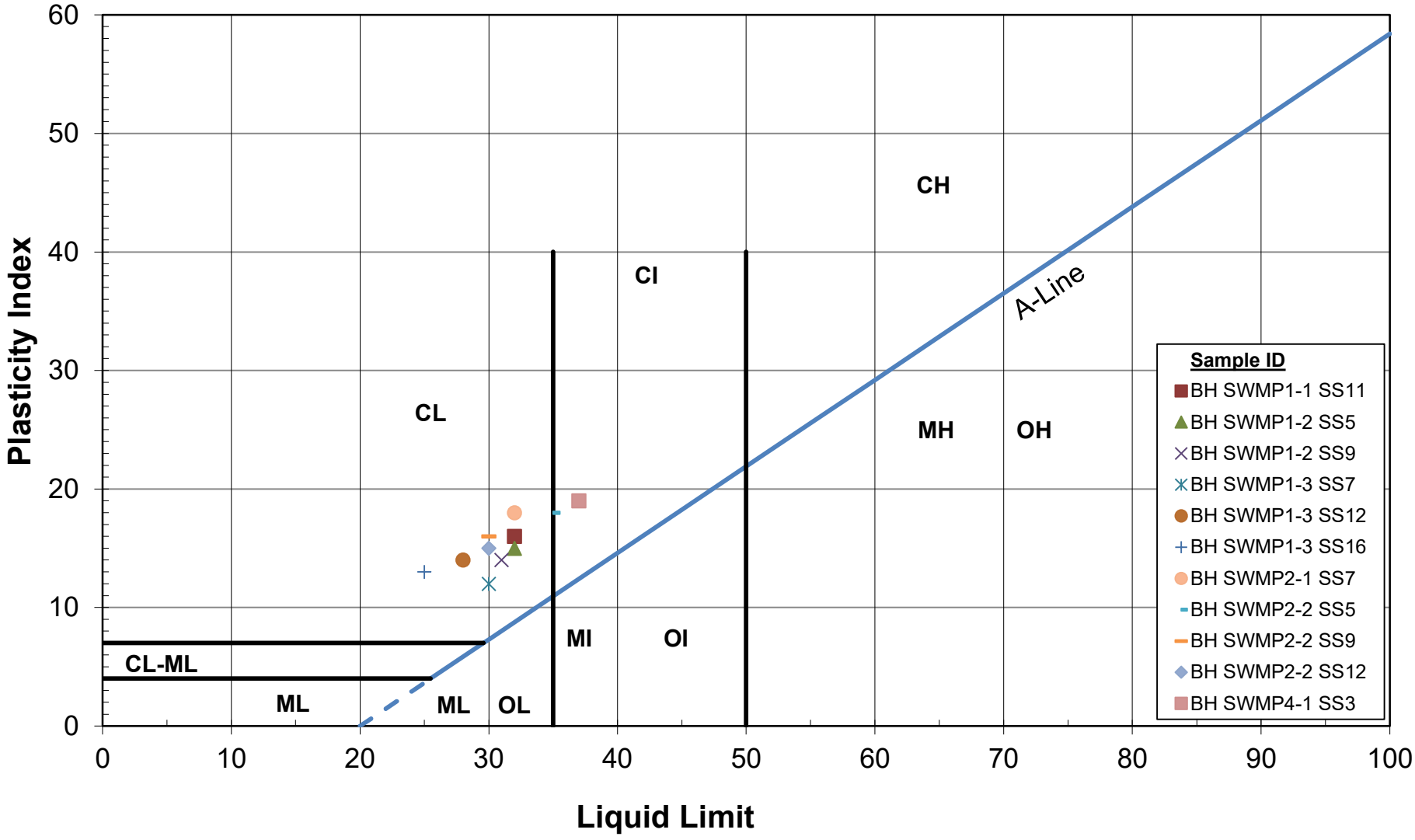
GRAIN SIZE DISTRIBUTION

CLAYEY SILT (CL) to SILTY CLAY CI)

Highway 400 Rehabilitation - SWMPs

Figure No. D4

Project No. 165001095



Stantec

PLASTICITY CHART

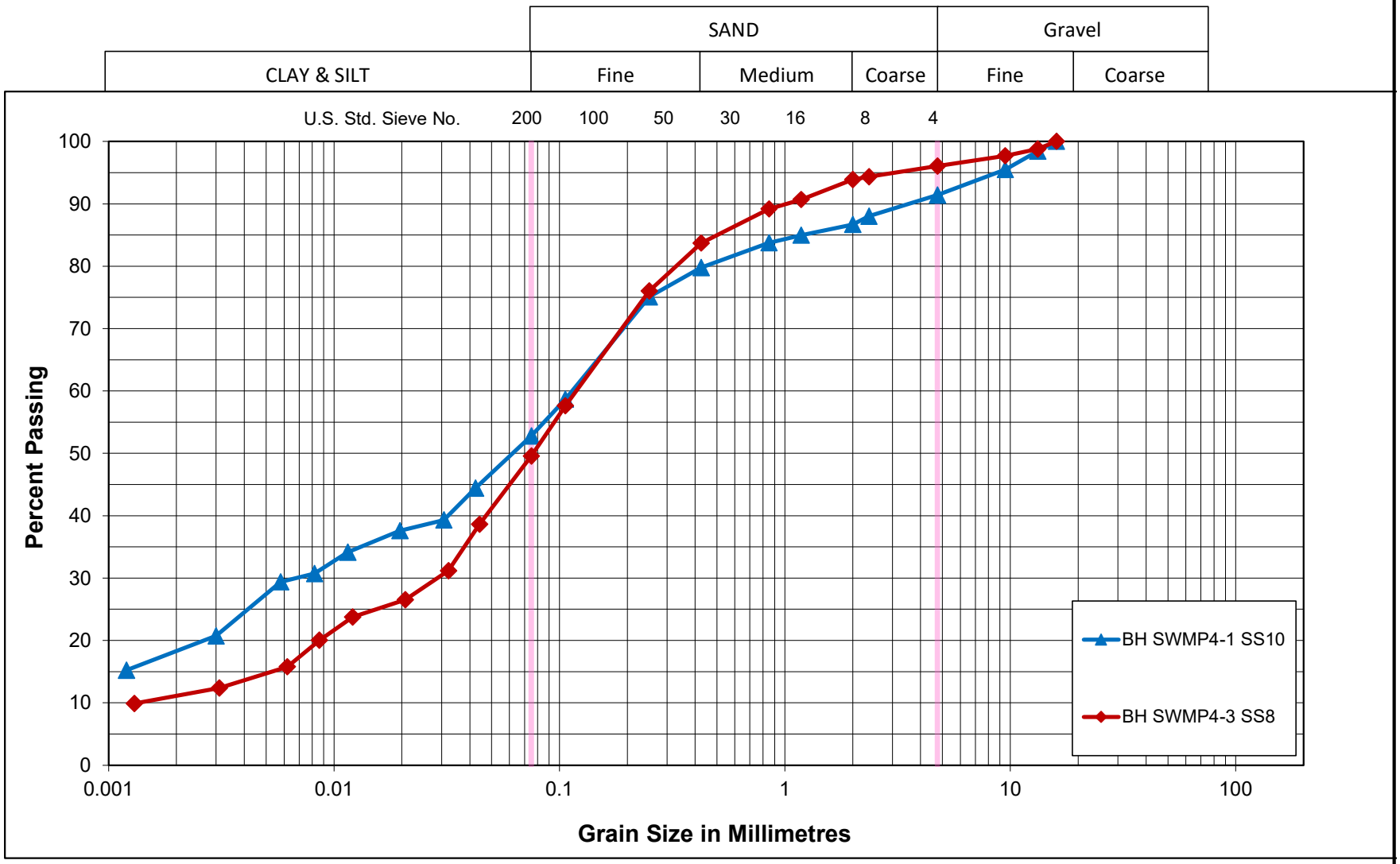
CLAYEY SILT (CL)

Hwy 400 Rehabilitation - SWMPs

Figure No. D5

Project No. 165001095

Unified Soil Classification System



Stantec

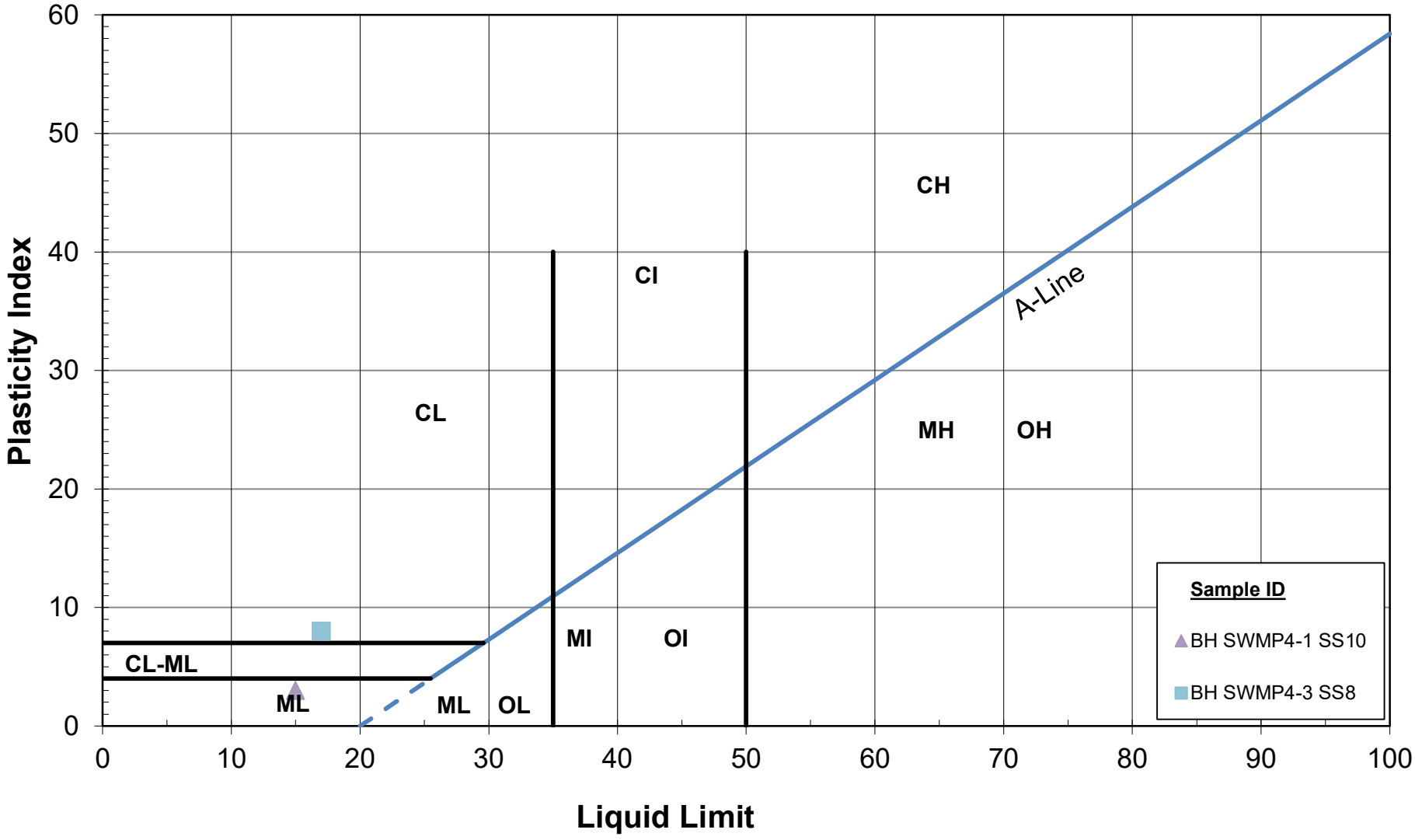
GRAIN SIZE DISTRIBUTION

Sandy SILT to SILT and Sand (ML), (TILL)

Highway 400 Rehabilitation - SWMPs

Figure No. D6

Project No. 165001095



Stantec

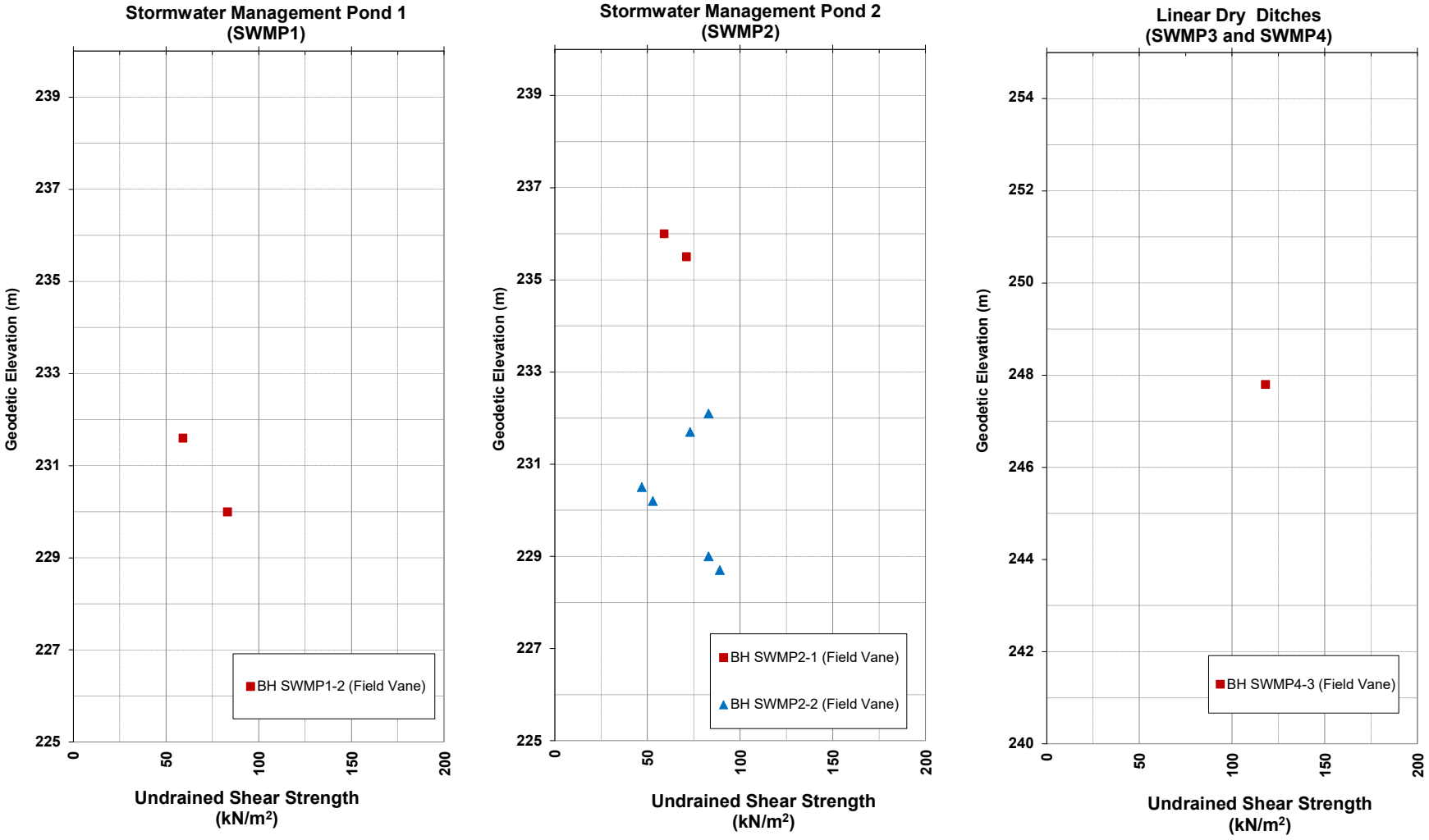
PLASTICITY CHART

Sandy SILT to SILT and Sand (ML), (TILL)

Hwy 400 Rehabilitation - SWMPs

Figure No. D7

Project No. 165001095



Stantec

Undrained Shear Strength vs. Elevation
Highway 400 Rehabilitation - Stormwater Management Ponds and Linear Dry Ditches

Figure No. D8

Project No. 165001095