



March 23, 2017

FOUNDATION INVESTIGATION REPORT

**SUDBURY MUNICIPAL ROAD 55 UNDERPASS - SITE 46-565
HIGHWAY 17 FOUR LANING EXTENSION FROM 20.5 KM WEST OF
HIGHWAY 144, EASTERLY FOR 6.5 KM
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 156-98-00, WP 5592-09-01**

Submitted to:

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GEOCRES NO.: 41I-350

Report Number: 11-1191-0007-08

Distribution:

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REPORT



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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by D.M. Wills Associates Ltd. (Wills) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering for the Sudbury Municipal Road 55 (SMR55) Underpass structure crossing over the proposed Highway 17 Eastbound Lanes (EBL) and Westbound Lanes (WBL). The proposed structure is part of the Highway 17 new interchange and extension of the existing four-lane section of Highway 17 at the west junction of Sudbury Municipal Road 55, from 20.5 km west of Highway 144, easterly for 6.5 km. The general location of the SMR55 Underpass structure is shown on the Key Plan on Drawing 1.

This report addresses the investigation carried out for the SMR55 Underpass structure and the associated approach embankments only. The foundation investigations for the high fill embankments, interchange structure at Den-Lou Road and culverts for this project are presented in separate reports.

Preliminary subsurface information for this project was supplied by MTO, in the reports and subsequent appendices titled:

- *Planning, Preliminary Design, and Environmental Supplementary Report, Highway 17, Town of Walden*, GWP 156-98-00, dated March 2009, by Stantec Consulting Limited; and
- *Preliminary Foundation Investigation and Design Report for Sudbury Municipal Road 55 Interchange Underpass, Highway 17, City of Greater Sudbury, District of Sudbury*, GWP 156-98-00, GEOCREs No. 411-229 Index No: 095FIDR, PML Ref: 05TF059F2, dated February 26, 2009, by Peto MacCallum Ltd. (PML).

2.0 SITE DESCRIPTION

The proposed SMR55 Underpass structure is located at the proposed intersection of the new Highway 17 four-lane alignment and new SMR55 alignment in the City of Greater Sudbury and the Township of Denison. The proposed two span structure will cross over the new Highway 17 four-lane extension, which will extend approximately parallel to and approximately 150 m south of the existing Highway 17 alignment. For the purpose of this report, the proposed Highway 17 four-lane section is oriented east-west with the proposed realigned SMR55 underpass structure oriented north-south on a slight skew to Highway 17.

In general, the topography of the structure site is an elevated area, with exposed bedrock near the south abutment. The terrain generally slopes downwards northerly and the area is densely populated with trees. The land is currently privately owned. The ground surface at the boreholes advanced for this current investigation in the area of the proposed underpass structure ranges from approximately Elevation 265.3 m at the south end of the bridge to Elevation 260.2 m at the north end of the bridge.

3.0 INVESTIGATION PROCEDURES

The current foundation investigation for the proposed SMR55 Underpass was carried out between March 21 to 30, 2016, during which time a total of eleven (11) boreholes (numbered S-1 to S-11) and three (3) Dynamic Cone Penetration Tests (DCPT) (numbered S-D1 to S-D3) were advanced at the locations of the proposed structure foundation elements as shown on Drawing 1. The Record of Borehole and Drillhole sheets (i.e. S-1 to S-11) for the current investigation of this bridge structure are presented in Appendix A.



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The current field investigation was carried out using a CME-55 track mounted drill rig supplied and operated by Landcore Drilling Inc. of Chelmsford, Ontario. The boreholes were advanced using 108 mm inner diameter hollow stem augers, NW casing using wash boring techniques and NQ size core barrel for bedrock coring. Soil samples were generally obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter split-spoon sample operated by an automatic hammer on the drill rig, in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils). All boreholes were backfilled upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The boreholes and DCPTs drilled as part of the current investigation were advanced to depths of up to 11.4 m below existing ground surface, including between 3.1 m and 6.6 m of bedrock coring in Boreholes S-1 to S-3, S-6, S-7 and S-11.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets. A standpipe piezometer was installed in Borehole S-2 to permit further monitoring of the groundwater level. The piezometer consists of a 50 mm diameter polyvinyl chloride pipe, with a 3.0 m long slotted screen, sealed within a sand filter pack at a selected depth interval within the borehole. Above the sand filter pack and piezometer screen, the annulus surrounding the piezometer was backfilled with an approximately 4 m thick bentonite seal, then backfilled to ground surface with cuttings and bentonite in accordance with Ontario Reg. 903 (as amended). The piezometer installation details and water level readings are indicated on the Record of Borehole sheets. The piezometer was subsequently decommissioned using cement grout about one week after installation and the groundwater level has been obtained.

The field work for the current investigation was observed by members of our engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes and examined and cared for the soil and bedrock samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Sudbury Geotechnical Laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. Uniaxial compression strength (UCS) testing was carried out on selected specimens of the rock core. The results of the laboratory testing for the current investigation are shown in Appendix B.

The foundation elements and highway centerline in the area of the structure was staked in the field by Exp Services Inc. (Exp) prior to the foundation investigation. Borehole locations, in station and offsets, were measured in reference to the locations staked by the surveyors and were subsequently converted to northing and easting coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to the ground surface elevations at the foundation elements provided by Exp. The borehole/drillhole locations shown on Drawing 1 are positioned relative to MTM NAD 83 (Zone 12) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole/drillhole locations, ground surface elevations and drilled depths are as follows:



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Borehole/DCPT No.	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole/DCPT Depth (m)
	Northing	Easting		
S-1	5 137 055.0	277 270.8	260.2	8.3*
S-2	5 137 047.9	277 255.4	260.4	11.0*
S-3	5 137 025.2	277 304.4	262.1	10.6*
S-4	5 137 023.7	277 306.1	261.9	5.3
S-5	5 137 018.5	277 288.9	262.5	8.3
S-6	5 137 016.9	277 290.4	262.5	11.4*
S-7	5 136 997.0	277 336.2	263.4	4.7*
S-8	5 136 995.5	277 337.9	263.3	0.3
S-9	5 136 992.8	277 329.2	263.8	0.2
S-10	5 136 990.1	277 320.5	265.1	0.2
S-11	5 136 988.7	277 322.2	265.3	6.6*
S-D1	5 137 023.0	277 302.0	262.2	6.6
S-D2	5 137 021.8	277 299.2	262.4	8.0
S-D3	5 137 021.9	277 292.3	262.6	7.8

*Includes bedrock core between 3.1 m and 6.6 m lengths.

The current investigation was supplemented with previous boreholes advanced during the aforementioned preliminary investigation carried out by PML. Five (5) boreholes were advanced by PML in May 2008 (Boreholes IC-1 to IC-5) as part of the preliminary investigation and the Record of Borehole Sheets are presented in Appendix C. The results of select laboratory testing from the PML boreholes are contained in Appendix C.

The boreholes drilled by PML as part of the preliminary investigation are also shown on Drawing 1 and were positioned based on the northing and easting coordinates and ground surface elevations provided on their Record of Borehole Sheets as follows:

Borehole No.	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing	Easting		
IC-1	5 136 972	277 355	266.1	0.0
IC-2	5 136 985	277 340	266.0	0.0
IC-3	5 137 023	277 296	262.5	8.8
IC-4	5 137 055	277 259	260.1	6.2
IC-5	5 137 071	277 244	259.7	6.1



4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in the NOEGTS¹ Mapping, the subsurface conditions in this section of the new Highway 17 four-laning are comprised of bedrock knobs, outcrops and ridges with undulating to rolling glaciolacustrine plain, alluvial plain and organic terrain deposits. In the lower-lying glaciolacustrine plain and alluvial plain areas the primary material consists of wet silts, sands and clays, while within the organic terrain deposit the primary material consists of peat. The drainage in the area could be considered dry to wet, with moderate to low relief.

Based on geological mapping by the Ministry of Natural Resources (Map 2542)², the site is underlain by rocks of the Paleoproterozoic Era belonging to the Huronian Supergroup and Elliot Lake Group consisting of conglomerate, wacke, arkose, quartz arenite, argillite, limestone and dolostone. Areas of mafic and related intrusive rocks comprised of diabase sills, dykes and related granophyre are also present in the vicinity of the site. Based on geological mapping by the Ontario Department of Mines (Map 2170)³ this area is characterized by extensive faults from distinct time periods. The Murray Fault has been identified to run parallel to the approximate proposed alignment of Highway 17.

4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the borings advanced during this investigation together with the results of the laboratory tests carried out on selected soil samples are presented on the Record of Borehole sheets and Drillhole sheets attached in Appendix B and the laboratory test results are detailed in Appendix B. The results of the in situ tests (i.e., SPT 'N'-values) as presented on the Record of Borehole sheets and in Section 4 are uncorrected. The Record of Borehole sheets for the boreholes from PML are attached in Appendix C. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling processes and the results of SPTs and in situ testing. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations. The inferred soil stratigraphy as encountered in the boreholes and drillholes is shown in profile/sections on Drawings 1 to 3.

Exposed bedrock is present in the general location of the south abutment and the south approach. Elsewhere, underlying the surficial organics/peat, the subsurface soil conditions in the underpass structure area (specifically the pier and north abutment) generally consist of a near surface thin deposit of clayey silt to silty clay underlain by a non-cohesive deposit comprised of various layers of silt, sandy silt and silt and sand underlain by bedrock. A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Organics/Peat

A layer of surficial dark brown, fibrous organics/peat was encountered in Boreholes S-1, S-4, S-5, S-7 to S-10, IC-3, IC-4 and IC-5. The thickness of the organic peat layer at the borehole locations ranged from about 25 mm to 200 mm.

¹Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Digital Map Reference Number 41ISW.

² Ministry of Natural Resources. Bedrock Geology of Ontario – West Central Sheet, Ontario Geological Survey - Map 2542

³ Ontario Department of Mines (1969). Sudbury Mining Area, Sudbury District, Map 2170.



4.2.2 Silty Clay to Clayey Silt

A deposit of brown to grey silty clay to clayey silt with trace to some sand was encountered at ground surface or underlying the organic layer in Boreholes S-1, S-2, S-3, S-4, IC-3 and IC-5 and underlying the upper silty sand to sandy silt in Boreholes S-5, S-6 and IC-4. The silty clay to clayey silt deposit ranged between 0.9 m and 1.9 m in thickness and extended to depths ranging from 1.3 m to 2.4 m below the existing ground surface.

The SPT 'N'-values measured within this deposit range from 3 blows to 37 blows per 0.3 m of penetration suggesting a soft to hard consistency. It should be noted that the higher 'N'-values in this deposit may be related to the ground being frozen.

Atterberg limits testing carried out on five samples of the silty clay to clayey silt from the boreholes of the current investigation and two samples of the silty clay from the previous investigation indicate liquid limits ranging from about 23 per cent to 48 per cent, plastic limits ranging from about 17 per cent to 24 per cent and plasticity indices calculated to be from about 6 per cent to 24 per cent. The results of the Atterberg limits testing indicate that the material is classified as a clayey silt of low plasticity to a silty clay of intermediate plasticity. The results of the Atterberg limits testing carried out on the five samples from the current investigation are shown on the plasticity chart on Figure B1 in Appendix B. The single grain size distribution of a sample of clayey silt from the current investigation is shown on Figure B2, in Appendix B. Laboratory results from the previous PML investigation are shown on the respective borehole logs and laboratory figures in Appendix C.

The natural water content measured on samples of the clayey silt to silty clay deposit range from about 19 per cent to 30 per cent.

4.2.3 Silt, Sandy Silt, Silt and Sand and Silty Sand

Upper non-cohesive deposits of brown, moist to wet silty sand to sandy silt with trace clay and trace organics were encountered surficially or below the peat in Boreholes S-6, S-7, S-8 and IC-4. The surface of the deposits was encountered between Elevation 263.3 m and 259.9 m and the thickness of these deposits is between 0.3 m and 1.5 m. In addition, lower non-cohesive brown to grey, moist to wet deposits of silt, sandy silt, silt and sand, silty sand and sand, trace to some clay, and trace gravel were encountered below the clayey silt to silty clay in Boreholes S-1 to S-6, IC-3, IC-4 and IC-5. The surface of the deposits was encountered between Elevation 260.8 m and 257.9 m and the thickness of these deposits is between 3.3 m and 6.7 m, where fully penetrated. Boreholes S-4, S-5, S-8, IC-3 and IC-5 were terminated in this deposit on auger refusal.

The SPT 'N'-values measured within the upper granular deposits range from 1 blows to 2 blows per 0.3 m of penetration, indicating a very loose relative density, with one SPT 'N'-value of 40 blows in proximity to the bedrock surface. The SPT 'N'-values measured within the lower granular deposits range from 13 blows to 90 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The results of grain size distributions of three samples of the silt and sandy silt and seven samples of silt and sand portion of the deposit from the current investigation are shown on Figures B3 and B4 in Appendix B. Laboratory results from the previous PML investigation are shown on the respective borehole logs and laboratory figures in Appendix C.

The natural water content measured on samples of the silt to silty sand deposit range from about 17 per cent to 25 per cent.



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4.2.4 Bedrock/Refusal

Bedrock was exposed at ground surface or encountered generally directly beneath the surficial organic layer in the vicinity of the south approach embankment and the south abutment between Elevations 266.1 m and 261.8 m. Bedrock or refusal was encountered generally below the silt to silty sand deposit in the vicinity of the centre pier, the north abutment and the north approach embankment between Elevations 256.6 m and 252.6 m. Boreholes S-1, S-2, S-3, S-6, S-7 and S-11 were cored for lengths between 3.1 m and 6.6 m. The depth to bedrock/refusal below ground surface and corresponding bedrock surface elevations (inferred or actual) are summarized below.

Foundation Element	Borehole No.	Depth to Bedrock Surface/Refusal (m)	Bedrock Surface/Refusal Elevation (m)	Comments
North Approach	IC-5	6.1	253.6	Split-spoon refusal
North Abutment	S-1	5.1	255.1	Bedrock cored
	IC-4	6.2	253.9	Split-spoon refusal
	S-2	7.8	252.6	Bedrock cored
	S-3	7.0	255.1	Bedrock cored
Center Pier	S-4	5.3	256.6	Split-spoon refusal
	S-D1	6.6	255.6	DCPT refusal
	S-D2	8.0	254.4	DCPT refusal
	IC-3	8.8	253.7	Auger refusal
	S-5	8.3	254.2	Split-spoon refusal
	S-D3	7.8	254.8	DCPT refusal
	S-6	8.1	254.4	Bedrock cored
	S-7	1.6	261.8	Bedrock cored
South Abutment	S-8	0.3	263.0	Split-spoon refusal
	S-9	0.2	263.6	Bedrock exposed with hand shovel
	S-10	0.2	264.9	Bedrock exposed with hand shovel
	S-11	0 (Outcrop)	265.3	Bedrock Cored
South Approach	IC-2	0 (Outcrop)	266.0	Exposed Bedrock
	IC-1	0 (Outcrop)	266.1	Exposed Bedrock

The recovered bedrock core from Boreholes S-1, S-2, S-3, S-6 and S-11 is generally described as grey, fine to medium grained, slightly weathered to fresh, medium strong to very strong mafic intrusive. The recovered bedrock core from Borehole S-7 is described as grey, fine grained, fresh, strong metasedimentary. The Total Core Recovery measured on the core samples taken from this current investigation range between 82 per cent and 100 per cent. The Rock Quality Designation is generally between 54 per cent and 100 per cent (except near the bottom of the core in Borehole S-2, which was measured to be 0 per cent due to a mechanically broken core zone), generally indicating a rock mass of fair to excellent quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006). Photographs of the bedrock core taken in the boreholes from the current investigation are shown on Figures B5 to B8 in Appendix B.



Laboratory UCS testing was carried out on six selected samples of the recovered bedrock core from the current investigation. The UCS values are presented on the Record of Drillhole sheets in Appendix A and are summarized below. The UCS values indicate that the bedrock is medium strong to very strong (R3 to R5, 25 MPa < UCS < 250 MPa) in accordance with Table 3.5 of CFEM (2006).

Borehole	Elevation (m)	UCS (MPa)
S-1	253.3	32
S-2	252.3	129
S-3	252.3	72
S-6	254.2	245
S-7	259.9	90
S-11	263.0	88

4.2.5 Groundwater Conditions

Details of the groundwater conditions encountered in the boreholes are shown on the Record of Borehole sheets. A standpipe piezometer was installed in Borehole S-2 to allow monitoring of the groundwater level at the site. Details of the piezometer installation is shown on the Record of Borehole sheet in Appendix A.

For the current investigation, the overburden samples taken in the boreholes were moist to wet. Boreholes S-4 and S-7 to S-10 were noted to be dry upon completion of drilling and the water level measured in the remaining boreholes upon completion of drilling during the current investigation varied between Elevations 259.9 m and 261.3 m, corresponding to depths between 1.2 m and 4.0 m below ground surface. The subsequent groundwater level measured in the piezometer installed in Borehole S-2 is Elevation 255.2 m on March 30, 2016, corresponding to a depth of 5.2 m below ground surface.

From the previous investigation, Borehole IC-5 was dry upon completion of drilling, and the groundwater was encountered during drilling in Boreholes IC-3 and IC-4 at depths of about 4.1 m and 0.3 m, corresponding to about Elevations 258.4 m and 259.8 m, respectively. The groundwater in Boreholes IC-3 and IC-4 were measured at depths of 5.0 m and 1.3 m below the ground surface, upon completion of drilling, corresponding to about Elevations 257.5 m and 258.8, respectively.

The groundwater levels in the area are subject to fluctuations seasonally and following precipitation events, and should be expected to be higher during wet periods of the year.

5.0 CLOSURE

The field drilling program for the current investigation was supervised by Mr. Cody Walter. This report was prepared by Mr. Alan Mohammad, P.Eng. and the technical aspects were reviewed by Sarah E. M. Poot, P.Eng., a senior geotechnical engineer and an Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant of Golder and Designated MTO Foundations Contact conducted an independent quality control review of this report.



Report Signature Page

GOLDER ASSOCIATES LTD.



Sarah E.M. Poot, P. Eng.
Senior Geotechnical Engineer, Associate

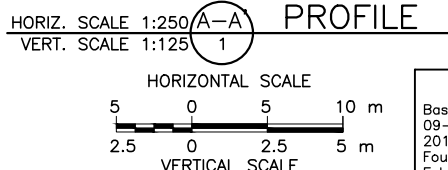
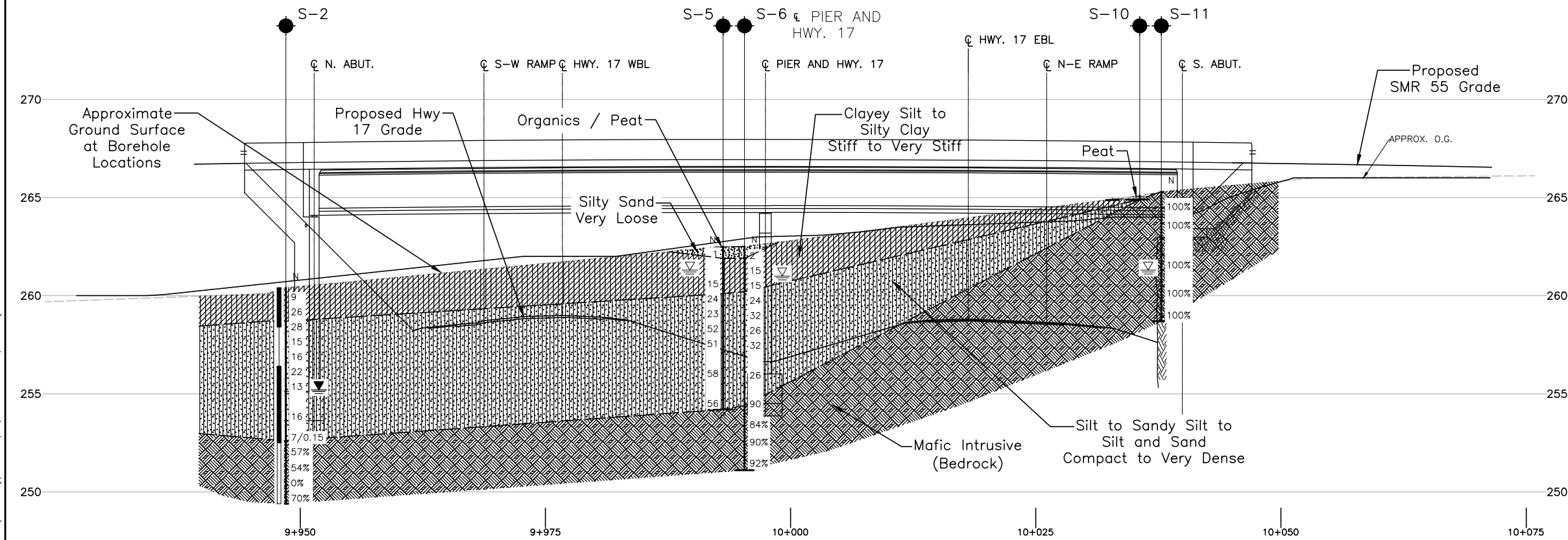
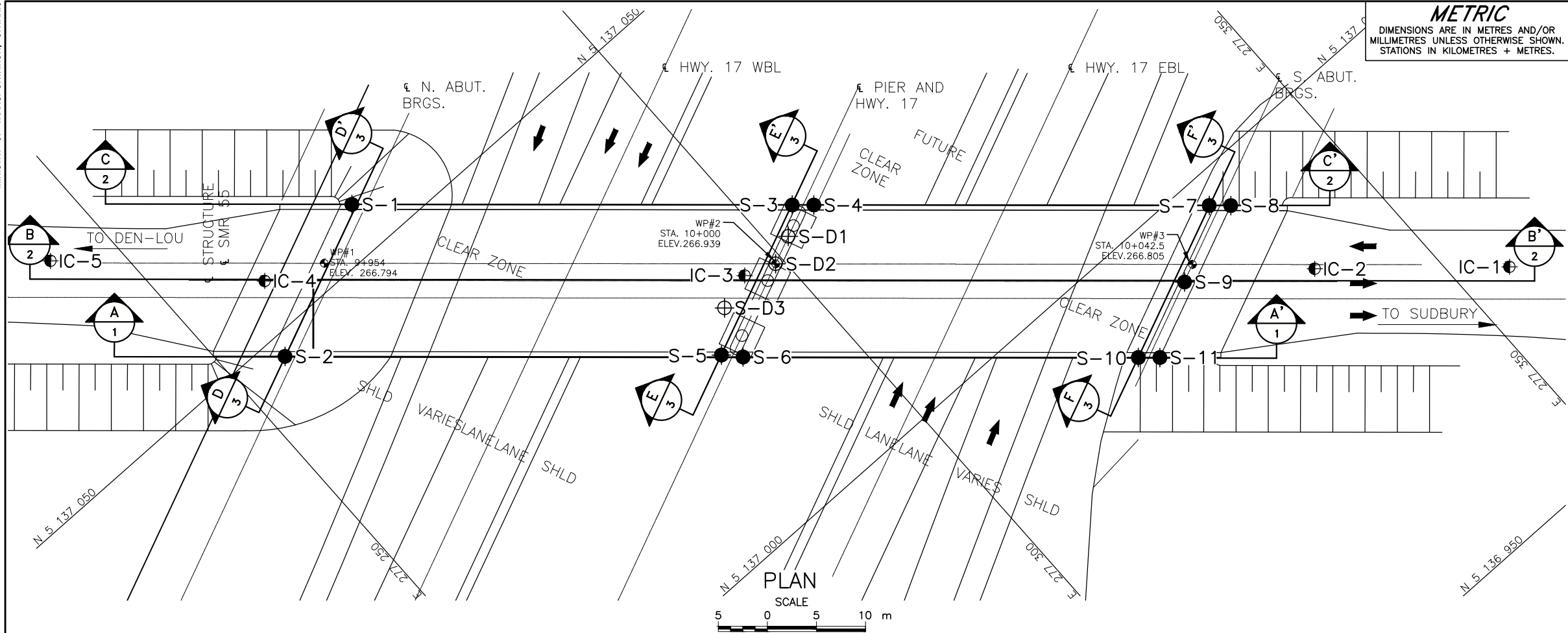


Jorge M.A. Costa, P. Eng.
Designated MTO Foundations Contact, Senior Consultant

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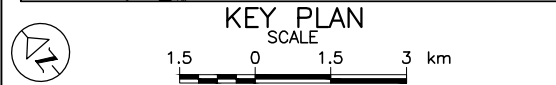
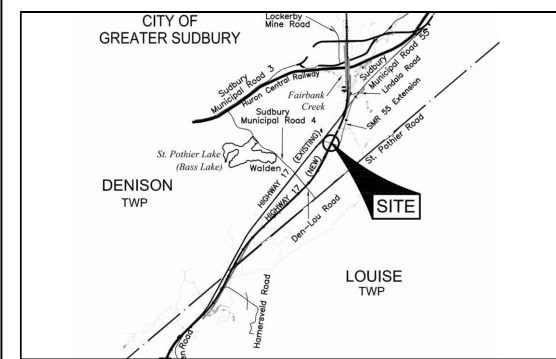


REFERENCE
Base plans provided in digital format by DM WILLIS, drawing file no. 09-4326 - SMR 55 Underpass GA - PA3 - Skew.dwg, received JUL 18, 2016. Supplemental boreholes IC-1 to IC-5 obtained from Preliminary Foundation Investigation and Design Report - Peto MacCallum Ltd., dated February 2009.

NOTES
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

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

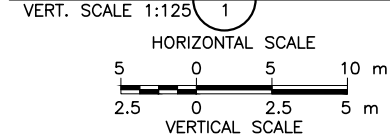
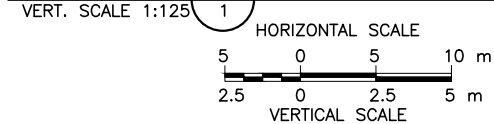
CONT No. WP No.5592-09-01
HIGHWAY 17
SMR 55 UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA



- LEGEND**
- Borehole - Current Investigation
 - Borehole - Previous Investigation PML (2008)
 - Dynamic Cone Penetration Test
 - Seal
 - Piezometer
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - 100% Rock Quality Designation (RQD)
 - WL in piezometer, measured on MAR 30, 2016
 - WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
IC-1	266.1	5136972.0	277355.0
IC-2	266.0	5136985.0	277340.0
IC-3	262.5	5137023.0	277296.0
IC-4	260.1	5137055.0	277259.0
IC-5	259.7	5137071.0	277244.0
S-1	260.2	5137055.0	277270.8
S-2	260.4	5137047.9	277255.4
S-3	262.1	5137025.2	277304.4
S-4	261.9	5137023.7	277306.1
S-5	262.5	5137018.5	277288.9
S-6	262.5	5137016.9	277290.4
S-7	263.4	5136997.0	277336.2
S-8	263.3	5136995.5	277337.9
S-9	263.8	5136992.8	277329.2
S-10	265.1	5136990.1	277320.5
S-11	265.3	5136988.7	277322.2
S-D1	262.2	5137023.0	277302.0
S-D2	262.4	5137021.8	277299.2
S-D3	262.6	5137021.9	277292.3

NO.	DATE	BY	REVISION
Geocres No. 411-350			
HWY. 17		PROJECT NO. 11-1191-0007	DIST. .
SUBM'D.	CHKD. AB	DATE: 3/21/2017	SITE: 46-565
DRAWN: TB	CHKD. SEMP	APPD. JMAC	DWG. 1



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NO.	DATE	BY	REVISION	
Geocres No. 411-350				
HWY. 17		PROJECT NO. 11-1191-0007		DIST. .
SUBM'D..	CHKD. AB	DATE: 3/21/2017		SITE: 46-565
DRAWN: TB	CHKD. SEMP	APPD. JMAG		DWG. 2

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

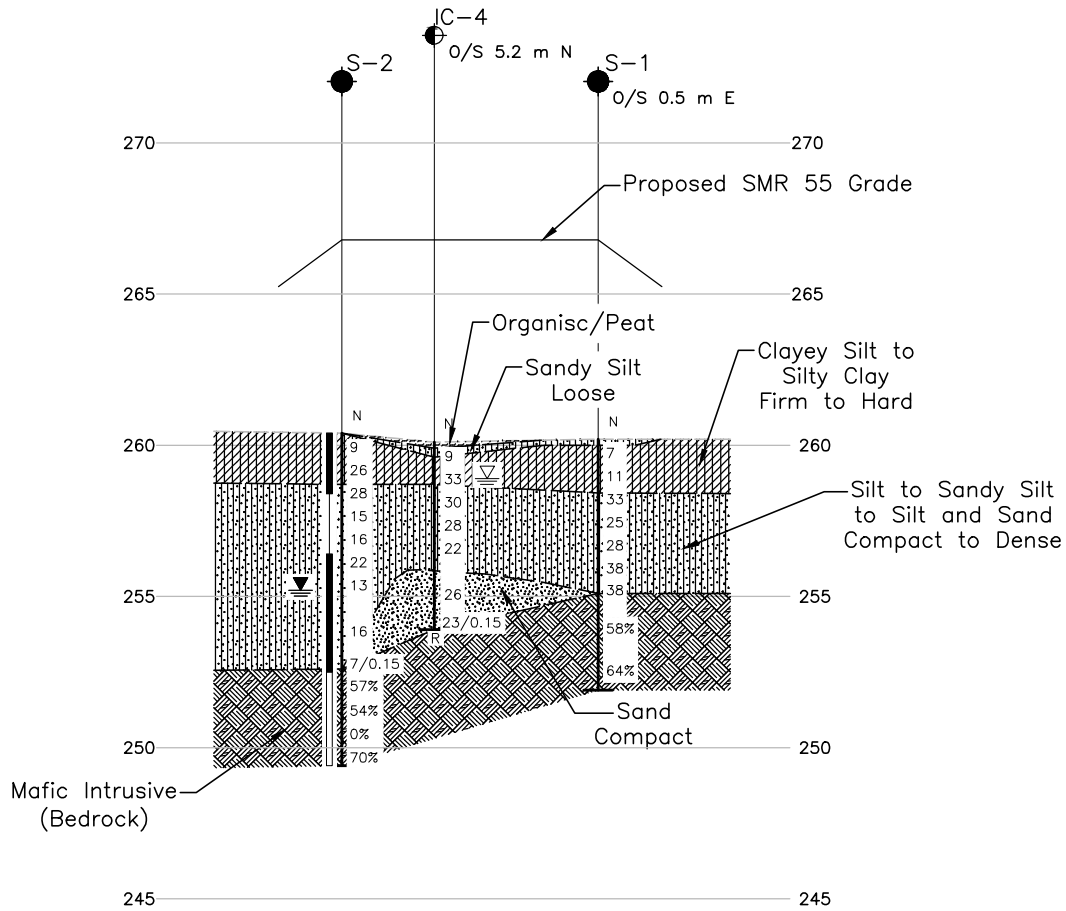
CONT No. WP No.5592-09-01	
HIGHWAY 17 SMR 55 UNDERPASS SOIL STRATA	SHEET



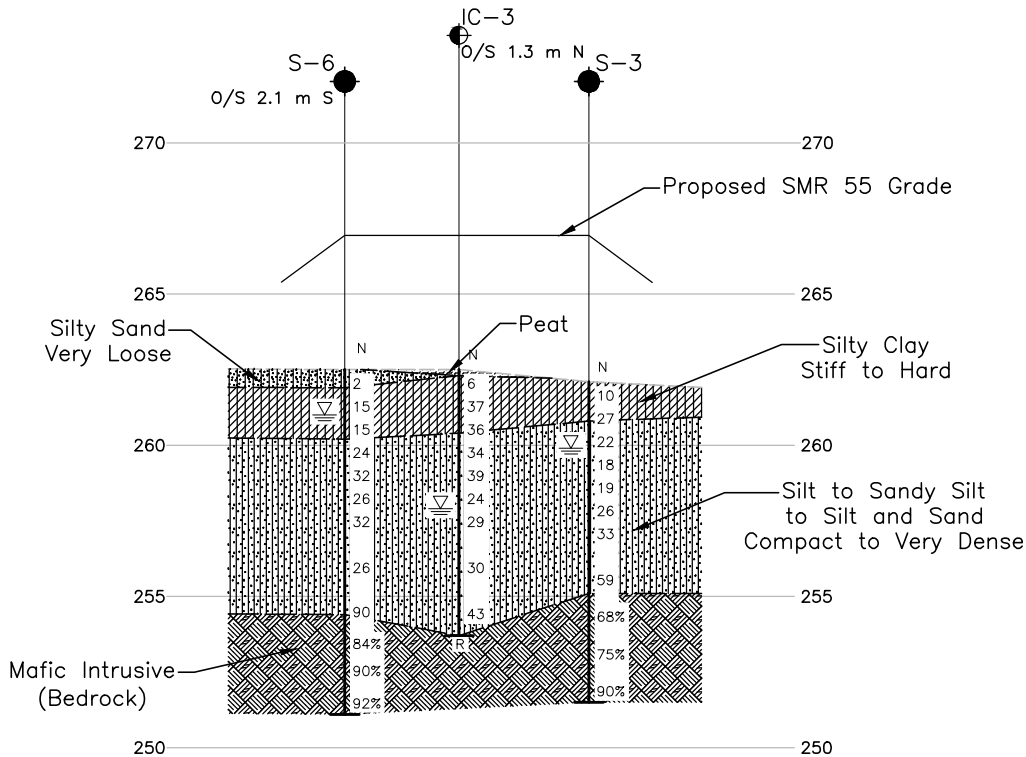
LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation PML (2008)
- Dynamic Cone Penetration Test
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on MAR 30, 2016
- WL upon completion of drilling

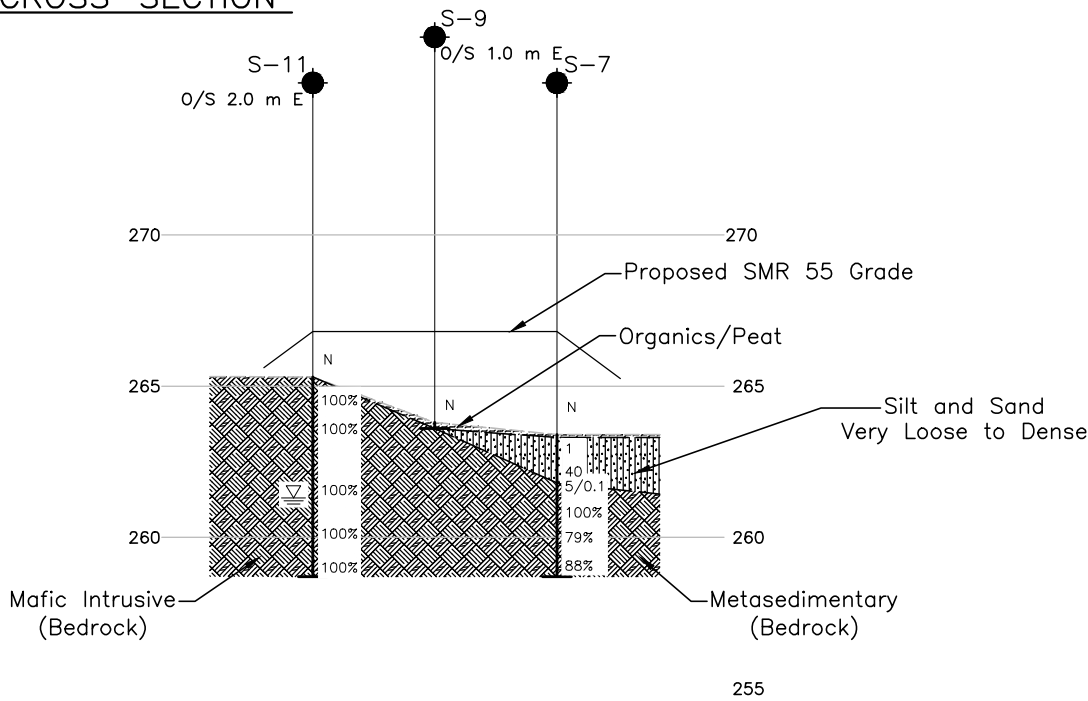
BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
IC-3	262.5	5137023.0	277296.0
IC-4	260.1	5137055.0	277259.0
S-1	260.2	5137055.0	277270.8
S-2	260.4	5137047.9	277255.4
S-3	262.1	5137025.2	277304.4
S-6	262.5	5137016.9	277290.4
S-7	263.4	5136997.0	277336.2
S-9	263.8	5136992.8	277329.2
S-11	265.3	5136988.7	277322.2



HORIZ. SCALE 1:250
VERT. SCALE 1:125
NORTH ABUTMENT CROSS-SECTION



HORIZ. SCALE 1:250
VERT. SCALE 1:125
CENTRE PIER CROSS-SECTION



HORIZ. SCALE 1:250
VERT. SCALE 1:125
SOUTH ABUTMENT CROSS-SECTION



NOTES

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

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

REFERENCE

Base plans provided in digital format by DM WILLS, drawing file no. 09-4326 - SMR 55 Underpass GA - PA3 - Skew.dwg, received JUL 18, 2016. Supplemental boreholes IC-1 to IC-5 obtained from Preliminary Foundation Investigation and Design Report - Peto MacCallum Ltd., dated February 2009.

NO.	DATE	BY	REVISION
Geocres No. 411-350			
HWY. 17	PROJECT NO. 11-1191-0007		DIST. .
SUBM'D.	CHKD. AB	DATE: 3/21/2017	SITE: 46-565
DRAWN: TB	CHKD. SEMP	APPD. JMAC	DWG. 3



APPENDIX A

Record of Boreholes



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
FoS	factor of safety

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
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

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

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



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
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
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 cm² 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) Non-Cohesive (Cohesionless) Soils

Density Index	N
Relative Density	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	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.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	

PROJECT 11-1191-0007				RECORD OF BOREHOLE No S-1				1 OF 2 METRIC									
W.P. 5592-09-01				LOCATION N 5137055.0; E 277270.8				ORIGINATED BY CW									
DIST HWY 17				BOREHOLE TYPE NW Casing and Wash Boring				COMPILED BY TB									
DATUM GEODETIC				DATE March 22, 2016				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
260.2	GROUND SURFACE						20	40	60	80	100						
0.0	ORGANICS / PEAT		1	SS	7												
	SILTY CLAY Firm to stiff Brown to grey, mottled Moist		2	SS	11												
258.4			3	SS	33												
1.8	SILT and SAND, trace clay Compact to dense Brown to grey Moist to wet		4	SS	25												
			5	SS	28												
			6	SS	38												
			7	SS	38												
255.1	Coarse gravel below 5.0 m depth.																
5.1	MAFIC INTRUSIVE (BEDROCK)		1	RC	REC 100%												
	Bedrock cored from 5.1 m to 8.3 m depth. For coring details see Record of Drillhole S-1.		2	RC	REC 100%												
251.9																	
8.3	END OF BOREHOLE																
	Note: 1. Water level not measured due to introduction of water for rock coring.																

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-1

SHEET 2 OF 2

LOCATION: N 5137055.0 ;E 277270.8

DRILLING DATE: March 22, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY				Diametral Point Load Index (MPa)	RMC -Q AVG	
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	CONDUCTIVITY k, cm/s									
								TOTAL CORE %	SOLID CORE %									10	10	10	10						
																						0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100			0 20 40 60 80 100
		REFER TO PREVIOUS PAGE		255.1																							
6	CME 55 NQ Coring	MAFIC INTRUSIVE Medium strong Fine grained Slightly weathered Grey		5.1	1	Grey 100																					
7																											
8																											
		END OF DRILLHOLE		251.9 8.3																							
9																											
10																											
11																											
12																											
13																											
14																											
15																											
16																											
17																											

DEPTH SCALE

1 : 60



LOGGED: CW

CHECKED: AB

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT 11-1191-0007		RECORD OF BOREHOLE No S-2				1 OF 2 METRIC					
W.P. 5592-09-01		LOCATION N 5137047.9; E 277255.4				ORIGINATED BY CW					
DIST _____ HWY 17		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TB					
DATUM GEODETIC		DATE March 21 and 22, 2016				CHECKED BY AB					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			
260.4	GROUND SURFACE							20 40 60 80 100	20 40 60		
0.0	CLAYEY SILT Stiff to very stiff Brown to grey Moist 200 mm silt and sand seam encountered at 1.2 m depth.		1	SS	9		260				
			2	SS	26		259				
258.7											
1.7	SILT, some sand to SILT and SAND, trace to some clay Compact Brown to grey Moist to wet		3	SS	28		258				
			4	SS	15		257				
			5	SS	16		256				
			6	SS	22		255				
			7	SS	13		254				
			8	SS	16		253				
			9	SS	7/0.15		252				
252.6	Fractured rockfragments encountered at 7.6 m depth. Split-spoon bounces at 7.8 m depth.						251				
7.8	MAFIC INTRUSIVE (BEDROCK) Bedrock cored from 7.8 m to 11.0 m depth. For coring details see Record of Drillhole S-2.		1	RC	REC 100%		250				
			2	RC	REC 93%						
			3	RC	REC 82%						
			4	RC	REC 94%						
249.4											
11.0	END OF BOREHOLE Note: 1. Water level in piezometer at a depth of 5.2 m below ground surface (Elev. 255.2 m) on March 30, 2016.										

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

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

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-2

SHEET 2 OF 2

LOCATION: N 5137047.9 ;E 277255.4

DRILLING DATE: March 22, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY				Diametral Point Load Index (MPa)	RMC -Q AVG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k _v cm/s	k _h cm/s	k _z cm/s																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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DEPTH SCALE

1 : 60



LOGGED: CW

CHECKED: AB

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT 11-1191-0007				RECORD OF BOREHOLE No S-3				1 OF 2 METRIC									
W.P. 5592-09-01				LOCATION N 5137025.2; E 277304.4				ORIGINATED BY CW									
DIST _____ HWY 17				BOREHOLE TYPE NW Casing and Wash Boring				COMPILED BY TB									
DATUM GEODETIC				DATE March 24 and 28, 2016				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
262.1	GROUND SURFACE							20	40	60	80	100					
0.0	SILTY CLAY Stiff to very stiff Brown Moist		1	SS	10												
260.8			2	SS	27												
1.3	SILT to SILT and SAND, trace to some clay Compact to very dense Brown to grey Moist to wet		3	SS	22												0 9 83 8
			4	SS	18												
			5	SS	19												
			6	SS	26												
			7	SS	33												0 50 46 4
			8	SS	59												
255.1	MAFIC INTRUSIVE (BEDROCK)																
7.0	Bedrock cored from 7.0 m to 10.6 m depth. For coring details see Record of Drillhole S-3.		1	RC	REC 100%												RQD = 68%
			2	RC	REC 100%												RQD = 75%
			3	RC	REC 100%												RQD = 90%
251.5	END OF BOREHOLE																
10.6	Note: 1. Water level at a depth of 2.2 m below ground surface (Elev. 259.9 m) upon completion of drilling inside casing.																

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-3

SHEET 2 OF 2

LOCATION: N 5137025.2 ;E 277304.4

DRILLING DATE: March 24, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q AVG					
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s							
																					JN - Joint	BD - Bedding	PL - Planar	PO - Polished	BR - Broken Rock
7	CME 55 NQ Coring	REFER TO PREVIOUS PAGE		255.1																					
		MAFIC INTRUSIVE Strong Slightly weathered Fine grained Grey		7.0																					
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									

DEPTH SCALE

1 : 60



LOGGED: CW

CHECKED: AB

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 1502/17 DATA INPUT:

PROJECT		11-1191-0007				RECORD OF BOREHOLE No S-4				1 OF 1 METRIC							
W.P.		5592-09-01		LOCATION		N 5137023.7; E 277306.1				ORIGINATED BY		CW					
DIST		HWY 17		BOREHOLE TYPE		NW Casing and Wash Boring				COMPILED BY		TB					
DATUM		GEODETIC		DATE		March 28, 2016				CHECKED BY		AB					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
261.9	GROUND SURFACE																
0.0	ORGANICS / PEAT																
0.1	CLAYEY SILT, trace to some sand Soft to very stiff Brown to grey Moist to wet		1	SS	3												0 10 70 20
			2	SS	18												
260.4																	
1.5	SILT and SAND, trace clay Compact to dense Grey Wet		3	SS	18												
			4	SS	18												
			5	SS	16												0 45 52 3
			6	SS	30												
			7	SS	35												
256.6	END OF BOREHOLE SPLIT-SPOON REFUSAL																
5.3	Note: 1. Borehole dry upon completion of drilling.																

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT 11-1191-0007			RECORD OF BOREHOLE No S-5				1 OF 1 METRIC							
W.P. 5592-09-01			LOCATION N 5137018.5; E 277288.9				ORIGINATED BY CW							
DIST _____ HWY 17			BOREHOLE TYPE NW Casing and Wash Boring				COMPILED BY TB							
DATUM GEODETIC			DATE March 23, 2016				CHECKED BY AB							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
262.5	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	ORGANICS / PEAT													
261.9	SILTY SAND, trace organics Very loose Brown Moist		1	SS	1									
0.6	SILTY CLAY Very stiff Brown Moist		2	SS	15									
260.1	SILT and SAND, trace to some clay Compact to very dense Brown Wet		3	SS	24									
2.4			4	SS	23									
			5	SS	52									
			6	SS	51									
			7	SS	58									
			8	SS	56									
254.2	Split-spoon bouncing at 8.3 m depth.													
8.3	END OF BOREHOLE SPLIT-SPOON REFUSAL Note: 1. Water level at a depth of 1.2 m below ground surface (Elev. 261.3 m) upon completion of drilling.													

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

MSUD-MTO 001 111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

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

PROJECT <u>11-1191-0007</u>		RECORD OF BOREHOLE No S-6				2 OF 3 METRIC										
W.P. <u>5592-09-01</u>		LOCATION <u>N 5137016.9; E 277290.4</u>				ORIGINATED BY <u>CW</u>										
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>NW Casing and Wash Boring</u>				COMPILED BY <u>TB</u>										
DATUM <u>GEODETIC</u>		DATE <u>March 23, 2016</u>				CHECKED BY <u>AB</u>										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W		
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					20 40 60 WATER CONTENT (%)				
	END OF BOREHOLE Note: 1. Water level at a depth of 1.5 m below ground surface (Elev. 261.0 m) upon completion of drilling.															

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-6

SHEET 3 OF 3

LOCATION: N 5137016.9 ;E 277290.4

DRILLING DATE: March 23, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG	
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn			k, cm/s
		REFER TO PREVIOUS PAGE		254.4																
	NW	MAFIC INTRUSIVE Very strong Fresh Fine to medium grained Dark grey to grey		8.1															UCS = 245 MPa	
9				1																
				2																
10	CME 55 NQ Coring																			
				3																
11																				
				END OF DRILLHOLE		251.1														
11.4																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				

DEPTH SCALE

1 : 60



LOGGED: CW

CHECKED: AB

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>				RECORD OF BOREHOLE No S-7				1 OF 2 METRIC									
W.P. <u>5592-09-01</u>		LOCATION <u>N 5136997.0; E 277336.2</u>				ORIGINATED BY <u>CW</u>											
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>NW Casing and Wash Boring</u>				COMPILED BY <u>TB</u>											
DATUM <u>GEODETIC</u>		DATE <u>March 28, 2016</u>				CHECKED BY <u>AB</u>											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
263.4	GROUND SURFACE							20	40	60	80	100					
0.0	ORGANICS / PEAT																
0.1	SILT and SAND, trace clay Very loose to dense Brown Moist to wet		1	SS	1		263										0 55 43 2
			2	SS	40		262										
261.8	METASEDIMENTARY (BEDROCK)		3	SS	5/0.1												
1.6	Bedrock cored from 1.6 m to 4.7 m depth. For coring details see Record of Drillhole S-7.		1	RC	REC 100%		261										RQD = 100%
			2	RC	REC 100%		260										RQD = 79%
			3	RC	REC 100%		259										RQD = 88%
258.7	END OF BOREHOLE																
4.7	Note: 1. Water level not measured due to introduction of water for rock coring.																

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-7

SHEET 2 OF 2

LOCATION: N 5136997.0 ;E 277336.2

DRILLING DATE: March 28, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY k, cm/s	Diametral Point Load Index (MPa)	RMC -Q AVG				
							RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA												
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION		Jr	Ja				Jn	k, cm/s	Diametral Point Load Index (MPa)	RMC -Q AVG
							RECOVERED CORE %	RECOVERED CORE %					TYPE AND SURFACE DESCRIPTION	TYPE AND SURFACE DESCRIPTION									
2	NW	REFER TO PREVIOUS PAGE		261.8																			
3	CME 55 NQ Coring	METASEDIMENTARY Strong Fresh Fine grained Grey		1.6	1																		
4					2																		
5					3																		
6		END OF DRILLHOLE		258.7																			
7				4.7																			
8																							
9																							
10																							
11																							
12																							
13																							

DEPTH SCALE

1 : 60




LOGGED: CW

CHECKED: AB

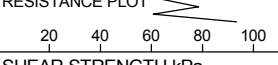

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>				RECORD OF BOREHOLE No S-8				1 OF 1 METRIC									
W.P. <u>5592-09-01</u>		LOCATION <u>N 5136995.5; E 277337.9</u>				ORIGINATED BY <u>CW</u>											
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>Split-spoon sampling</u>				COMPILED BY <u>TB</u>											
DATUM <u>GEODETIC</u>		DATE <u>March 28, 2016</u>				CHECKED BY <u>AB</u>											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
263.3	GROUND SURFACE							20	40	60	80	100					
0.0	ORGANICS		1	SS	2/0.15		263										
0.3	SILTY SAND, trace organics/wood Very loose Brown Moist END OF BOREHOLE SPLIT-SPOON REFUSAL (SPOON BOUNCING) Note: 1. Borehole dry upon completion of drilling.																



SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>		RECORD OF BOREHOLE No S-9				1 OF 1 METRIC					
W.P. <u>5592-09-01</u>		LOCATION <u>N 5136992.8; E 277329.2</u>				ORIGINATED BY <u>CW</u>					
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>Hand Excavation</u>				COMPILED BY <u>TB</u>					
DATUM <u>GEODETIC</u>		DATE <u>March 28, 2016</u>				CHECKED BY <u>AB</u>					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			
263.8	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED		20 40 60	
0.0	ORGANICS / PEAT										
0.2	END OF BOREHOLE EXPOSED BEDROCK WITH HAND SHOVEL Note: 1. Borehole dry upon completion of drilling.										

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>		RECORD OF BOREHOLE No S-10				1 OF 1 METRIC											
W.P. <u>5592-09-01</u>		LOCATION <u>N 5136990.1; E 277320.5</u>				ORIGINATED BY <u>CW</u>											
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>Hand Excavation</u>				COMPILED BY <u>TB</u>											
DATUM <u>GEODETIC</u>		DATE <u>March 28, 2016</u>				CHECKED BY <u>AB</u>											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L WATER CONTENT (%)			γ kN/m ³	GR SA SI CL
							20 40 60 80 100										
265.1	GROUND SURFACE																
0.0	ORGANICS / PEAT						265										
0.2	END OF BOREHOLE EXPOSED BEDROCK WITH HAND SHOVEL Note: 1. Borehole dry upon completion of drilling.																

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>		RECORD OF BOREHOLE No S-11				1 OF 2 METRIC													
W.P. <u>5592-09-01</u>		LOCATION <u>N 5136988.7; E 277322.2</u>				ORIGINATED BY <u>CW</u>													
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>NQ Coring</u>				COMPILED BY <u>TB</u>													
DATUM <u>GEODETIC</u>		DATE <u>March 28 and 29, 2016</u>				CHECKED BY <u>AB</u>													
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)						
265.3 0.0	GROUND SURFACE MAFIC INTRUSIVE (BEDROCK) Bedrock cored from surface to 6.6 m depth. For coring details see Record of Drillhole S-11.		1	RC	REC 100%		265											RQD = 100%	
			2	RC	REC 100%		264												RQD = 100%
			3	RC	REC 100%		263												
			4	RC	REC 100%		262												
			5	RC	REC 100%		261												
							260												
258.7 6.6	END OF BOREHOLE Note: 1. Water level at a depth of 4.0 m below ground surface (Elev. 261.3 m) upon completion of drilling.						259											RQD = 100%	

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT: 11-1191-0007

RECORD OF DRILLHOLE: S-11

SHEET 2 OF 2

LOCATION: N 5136988.7 ;E 277322.2

DRILLING DATE: March 28 and 29, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY k, cm/s	Diametral Point Load Index (MPa)	RMC -Q AVG		
							RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA					Jr				Ja	Jn
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION								
							24 														

DEPTH SCALE

1 : 60



LOGGED: CW

CHECKED: AB

SUD-RCK 1194 1111910007 MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>		RECORD OF DCPT No S-D1		1 OF 1 METRIC	
W.P. <u>5592-09-01</u>		LOCATION <u>N 5137023.0; E 277302.0</u>		ORIGINATED BY <u>CW</u>	
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>DYNAMIC CONE PENETRATION TEST</u>		COMPILED BY <u>TB</u>	
DATUM <u>GEODETIC</u>		DATE <u>March 29, 2016</u>		CHECKED BY <u>AB</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
								○ UNCONFINED + FIELD VANE	WATER CONTENT (%)					
							● QUICK TRIAXIAL × REMOULDED							
262.2 0.0	GROUND SURFACE START OF DCPT						262							
							261							
							260							
							259							
							258							
							257							
							256							
255.6 6.6	END OF DCPT REFUSAL TO FURTHER PENETRATION (DCPT BOUNCING)													

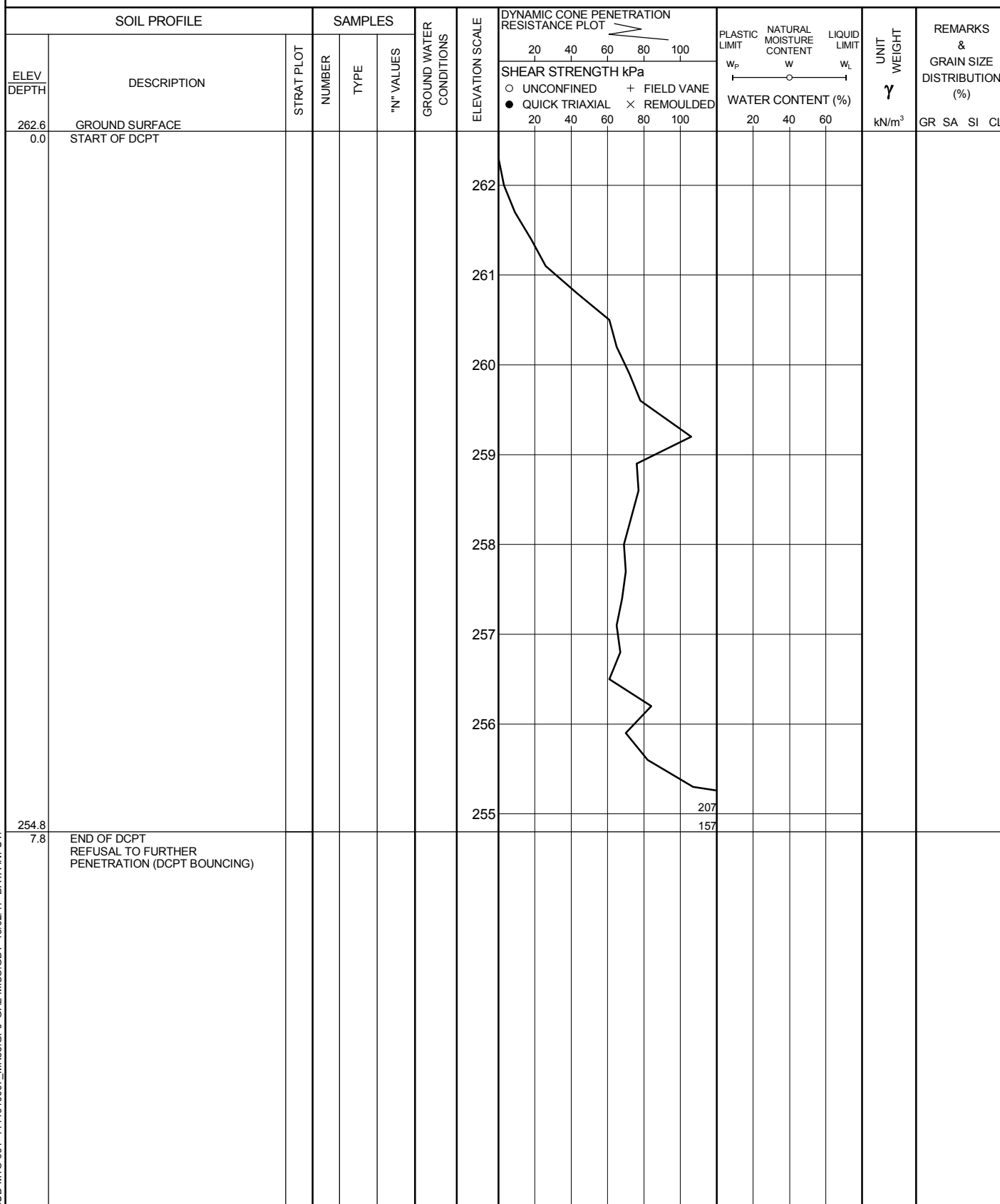
SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:

PROJECT <u>11-1191-0007</u>						RECORD OF DCPT No S-D2				1 OF 1 METRIC								
W.P. <u>5592-09-01</u>		LOCATION <u>N 5137021.8; E 277299.2</u>				ORIGINATED BY <u>CW</u>												
DIST <u> </u> HWY <u>17</u>		BOREHOLE TYPE <u>DYNAMIC CONE PENETRATION TEST</u>				COMPILED BY <u>TB</u>												
DATUM <u>GEODETIC</u>		DATE <u>March 29, 2016</u>				CHECKED BY <u>AB</u>												
SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
262.4 0.0	GROUND SURFACE START OF DCPT						20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)						
262																		
261																		
260																		
259																		
258																		
257																		
256																		
255																		
254.4 8.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (DCPT BOUNCING)																	

SUD-MTO 001 1111910007_MR55.GPJ GAL-MISS.GDT 15/02/17 DATA INPUT:



PROJECT 11-1191-0007		RECORD OF DCPT No S-D3		1 OF 1	METRIC
W.P. 5592-09-01	LOCATION N 5137021.9; E 277292.3	ORIGINATED BY CW			
DIST HWY 17	BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST	COMPILED BY TB			
DATUM GEODETIC	DATE March 29, 2016	CHECKED BY AB			

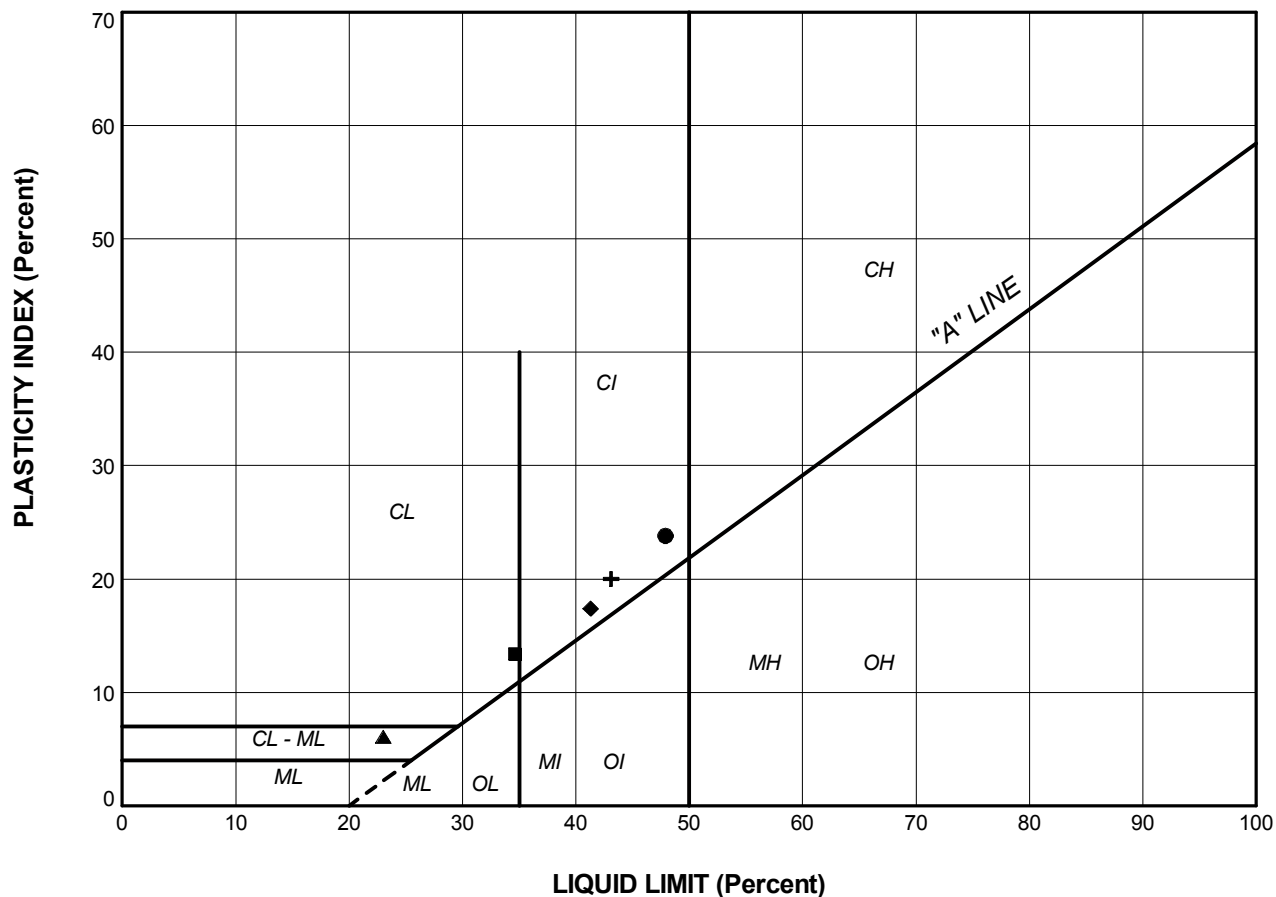


+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE




APPENDIX B

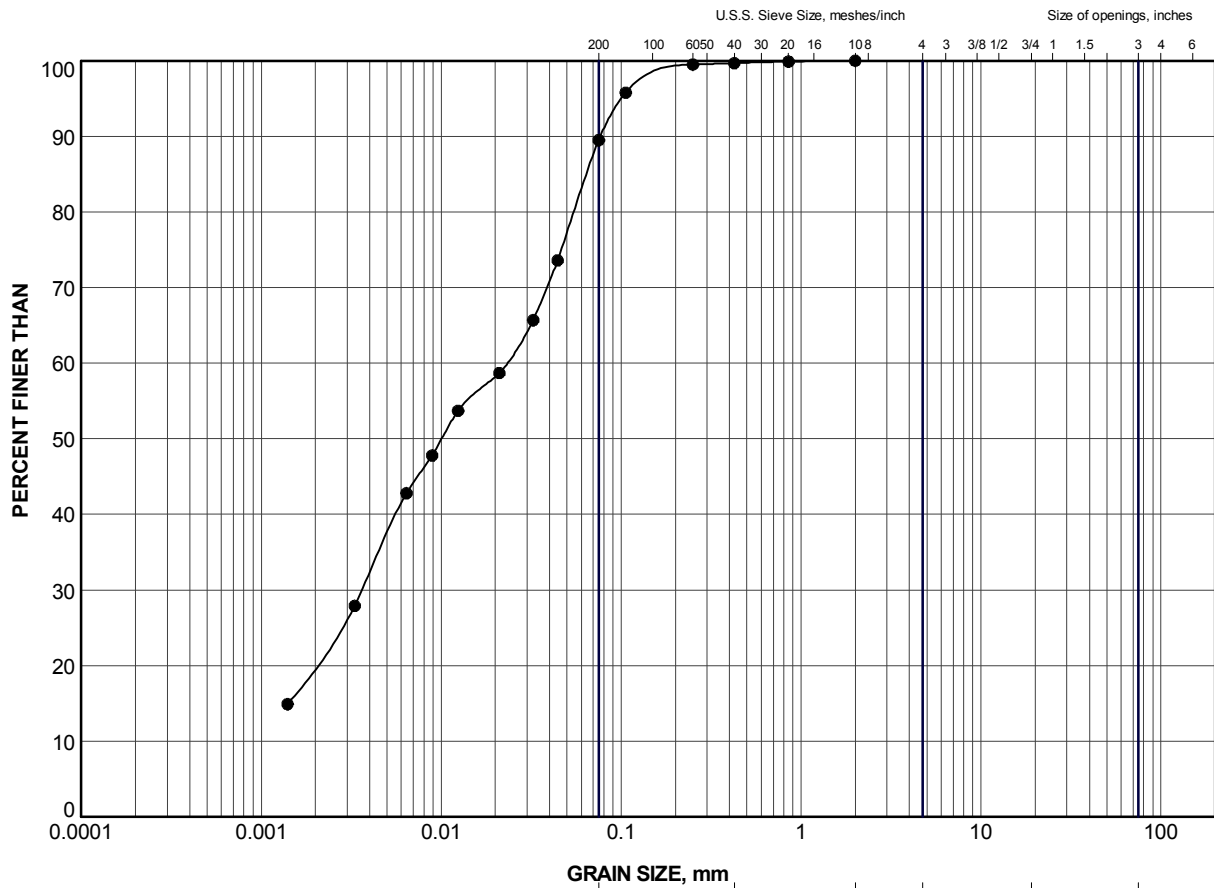
Laboratory Test Results



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	S-1	2	47.9	24.1	23.8
■	S-2	2	34.6	21.2	13.4
▲	S-4	1	23.0	16.9	6.1
+	S-5	2	43.1	23.1	20.0
◆	S-6	2	41.3	23.9	17.4


PROJECT					
HIGHWAY 17 SMR 55 UNDERPASS					
TITLE					
PLASTICITY CHART CLAYEY SILT to SILTY CLAY					
PROJECT No.		11-1191-0007		FILE No. 1111910007_MPS5.GPJ	
DRAWN	TB	Feb 2017	SCALE	N/A	REV.
CHECK	SEMP	Feb 2017			
APPR	JMAC	Feb 2017			
 Golder Associates SUDBURY, ONTARIO			FIGURE B1		

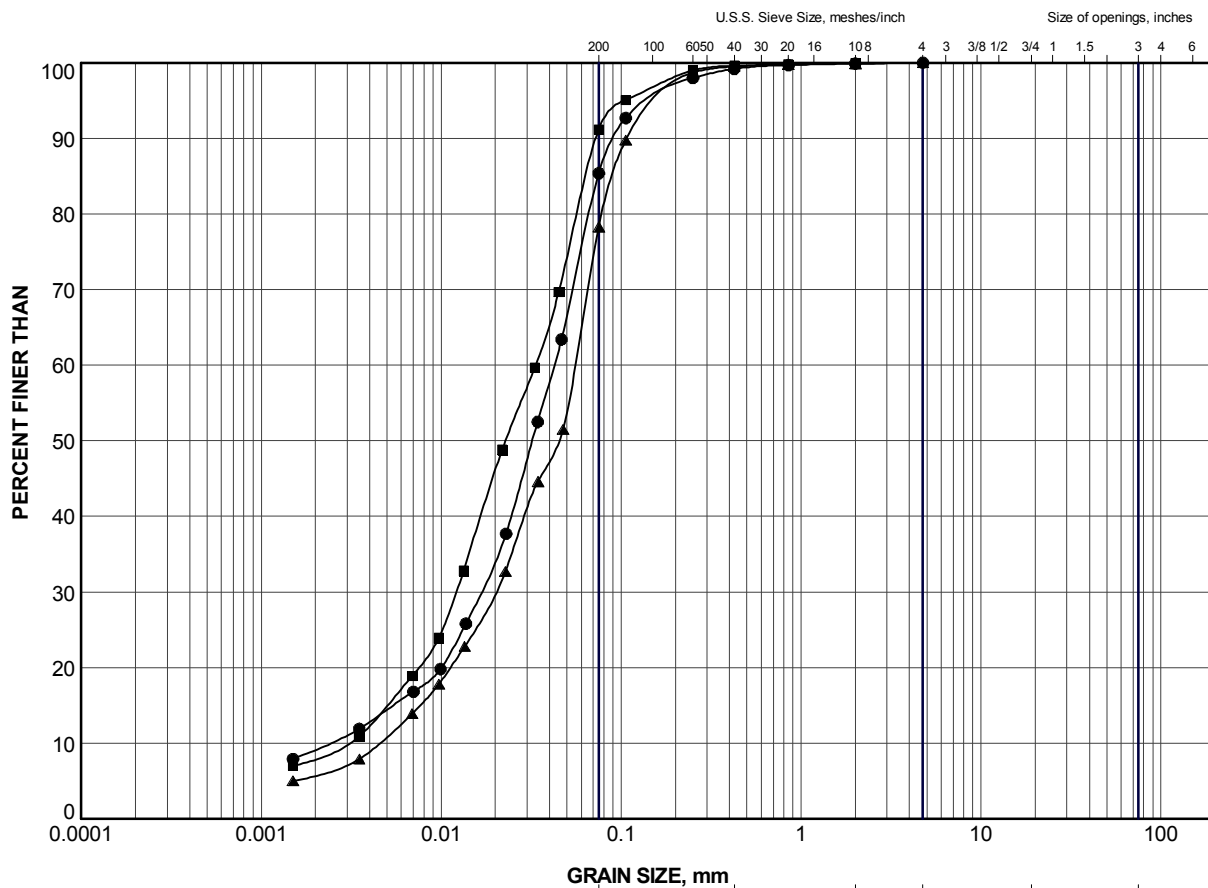


GRAVEL SIZE, mm						Cobble Size
CLAY AND SILT	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S-4	1	261.6

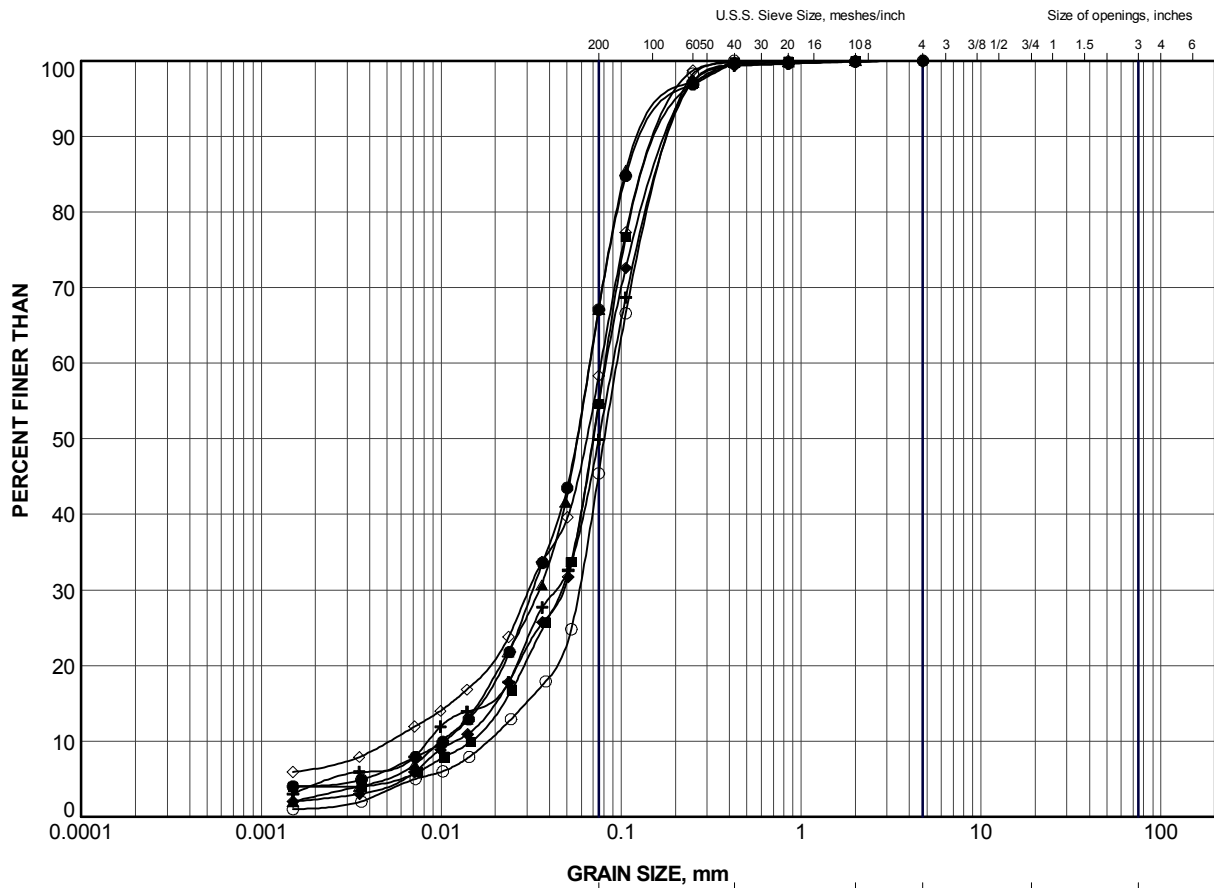
PROJECT						HIGHWAY 17 SMR 55 UNDERPASS					
TITLE						GRAIN SIZE DISTRIBUTION CLAYEY SILT					
PROJECT No.			11-1191-0007			FILE No.			1111910007_MR55.GPJ		
DRAWN	TB	Feb 2017	SCALE	N/A	REV.						
CHECK	SEMP	Feb 2017									
APPR	JMAC	Feb 2017									
 Golder Associates SUDBURY, ONTARIO						FIGURE B2					



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S-2	4	257.8
■	S-3	3	260.3
▲	S-6	4	259.9

PROJECT						HIGHWAY 17 SMR 55 UNDERPASS					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SANDY SILT					
PROJECT No.			11-1191-0007			FILE No.			1111910007_MR55.GPJ		
DRAWN	TB	Feb 2017	SCALE	N/A	REV.						
CHECK	SEMP	Feb 2017									
APPR	JMAC	Feb 2017									
 Golder Associates SUDBURY, ONTARIO			FIGURE B3								



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S-1	4	257.6
■	S-1	6	256.1
▲	S-2	8	254.0
+	S-3	7	257.2
◆	S-4	5	258.6
◇	S-5	6	257.6
○	S-7	2	262.3

PROJECT

HIGHWAY 17
SMR 55 UNDERPASS

TITLE

GRAIN SIZE DISTRIBUTION
SILT and SAND



Golder Associates
SUDBURY, ONTARIO

PROJECT No.	11-1191-0007	FILE No.	1111910007_MR55.GPJ
DRAWN	TB	Feb 2017	SCALE N/A
CHECK	SEMP	Feb 2017	REV.
APPR	JMAC	Feb 2017	

FIGURE B4

Borehole S-1



Box 1: 5.1 m – 8.3 m

Borehole S-2



Box 1: 7.8 m – 11.0 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

PROJECT

**Highway 17
SMR 55 Underpass**

TITLE

**Bedrock Core Photographs
Boreholes S-1 & S-2**



PROJECT No. 11-1191-0007

FILE No. ----

DESIGN AM FEB 17

SCALE NTS REV.

CADD -- --

CHECK SEMP FEB 17

REVIEW --

FIGURE B5

Borehole S-3



Box 1: 7.0 m – 10.6 m

Borehole S-6



Box 1: 8.1 m – 11.4 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

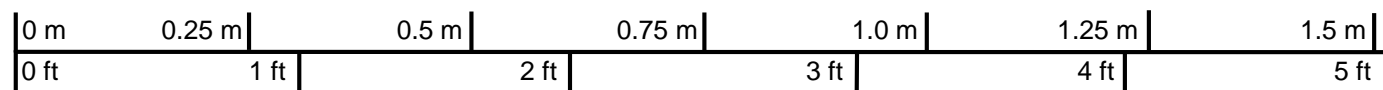
PROJECT					
Highway 17 SMR 55 Underpass					
TITLE					
Bedrock Core Photographs Boreholes S-3 & S-6					
PROJECT No. 11-1191-0007			FILE No. ----		
DESIGN	AM	FEB 17	SCALE	NTS	REV.
CADD	--	--	FIGURE B6		
CHECK	SEMP	FEB 17			
REVIEW	--	--			




Borehole S-7



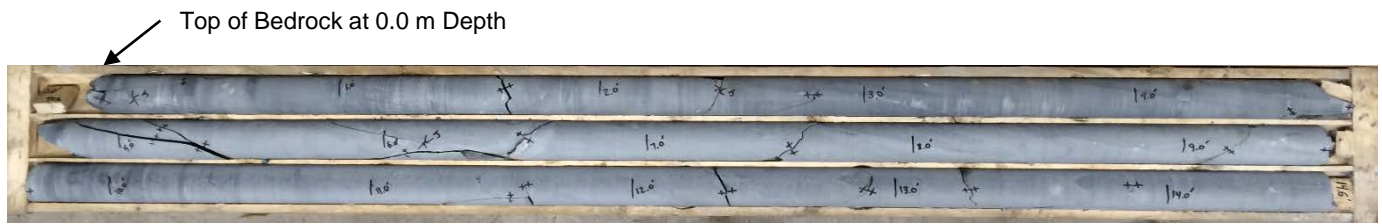
Box 1: 1.6 m – 4.7 m



Scale

PROJECT						
Highway 17 SMR 55 Underpass						
TITLE						
Bedrock Core Photographs Borehole S-7						
			PROJECT No. 11-1191-0007		FILE No. ----	
			DESIGN	AM	FEB 17	SCALE NTS
			CADD	-- --		REV.
			CHECK	SEMP	FEB 17	FIGURE B7
			REVIEW	--		

Borehole S-11




Box 1: 0.0 m – 4.4 m



Box 2: 4.4 m – 6.6 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

PROJECT								
Highway 17 SMR 55 Underpass								
TITLE								
Bedrock Core Photographs Borehole S-11								
			PROJECT No. 11-1191-0007		FILE No. ----			
			DESIGN	AM	FEB 17	SCALE	NTS	REV.
			CADD	-- --		FIGURE B8		
			CHECK	SEMP	FEB 17			
			REVIEW	--				





APPENDIX C

Record of Boreholes and Laboratory Testing – PML (2008)

RECORD OF BOREHOLE No IC-1

1 of 1

METRIC

G.W.P. 156-98-00 LOCATION Co-ords: 5 136 972 N; 277 355 E ORIGINATED BY F.P.
DIST 54 HWY SMR 55 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
(Realigned)
DATUM Geodetic DATE May 04, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100	W _p	W	W _L			
266.1	Ground Surface																
0.0	Bedrock at surface																
	* Borehole dry																

METRIC

[illegible]

METRIC

DATUM Geodetic (Realigned) DATE May 04, 2008 CHECKED BY C.N.

+⁷, ×⁵: Numbers refer to Sensitivity

METRIC

$+$ ⁷, \times ⁵: Numbers refer to Sensitivity

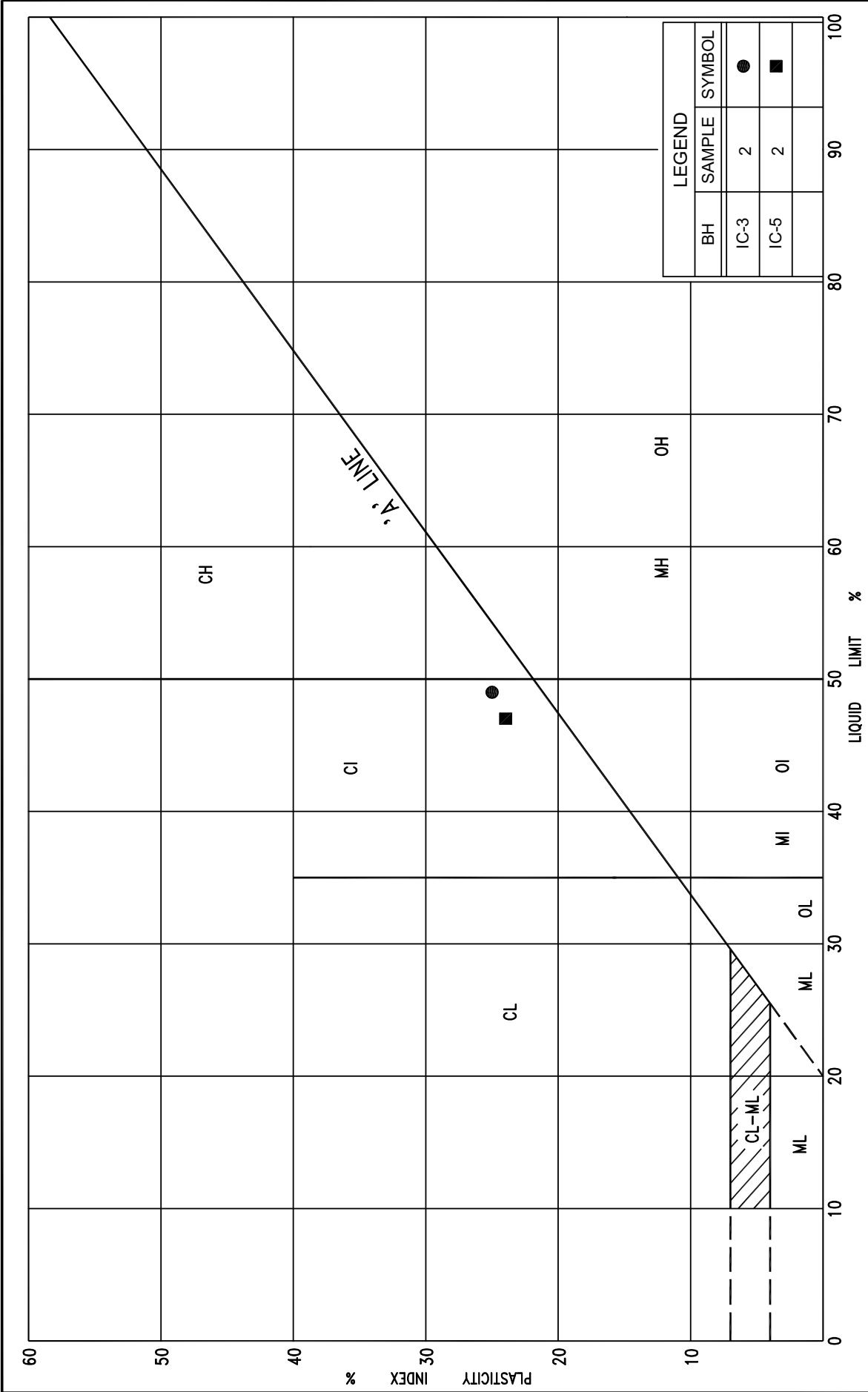


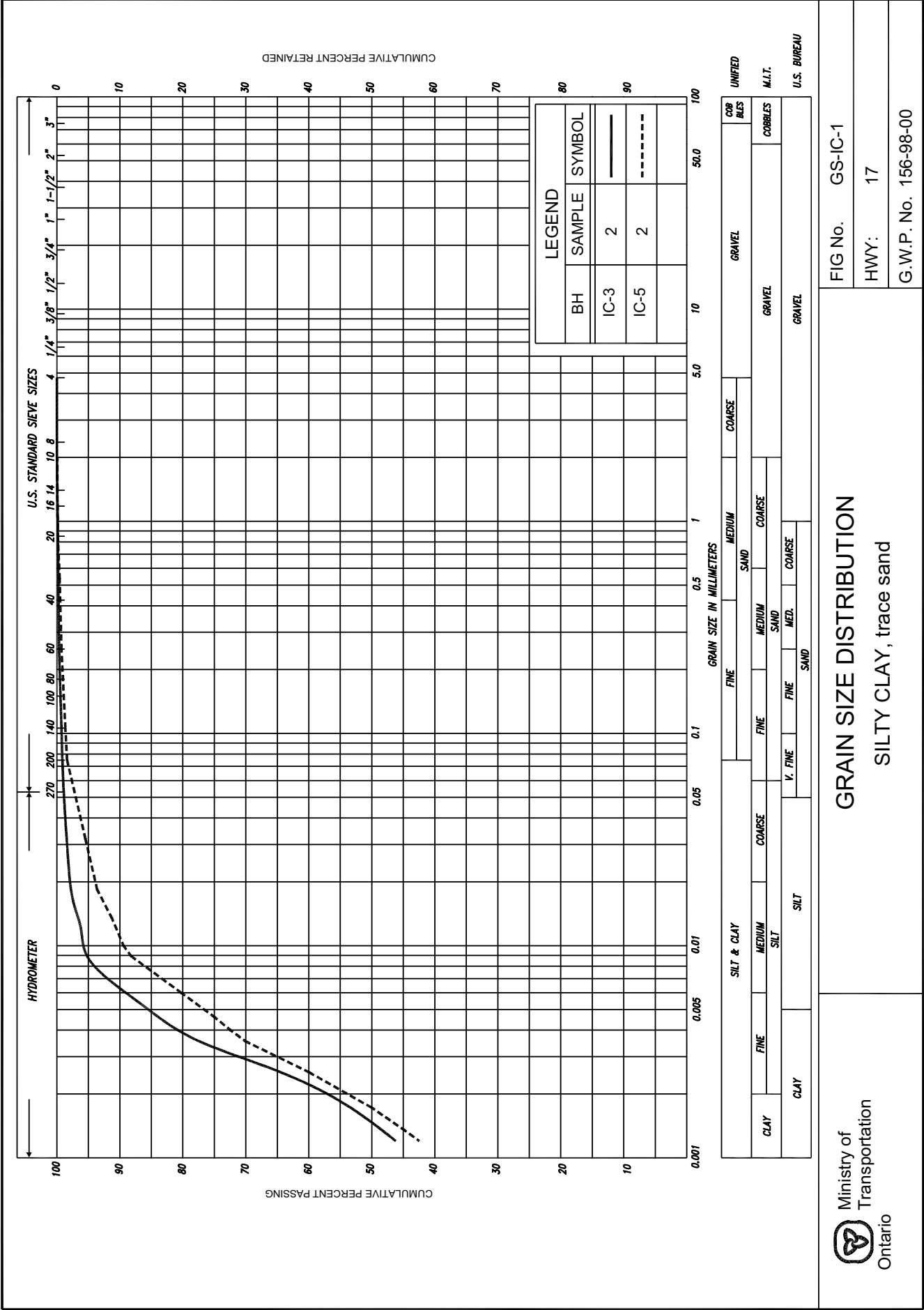
FIG No. PC-IC-1

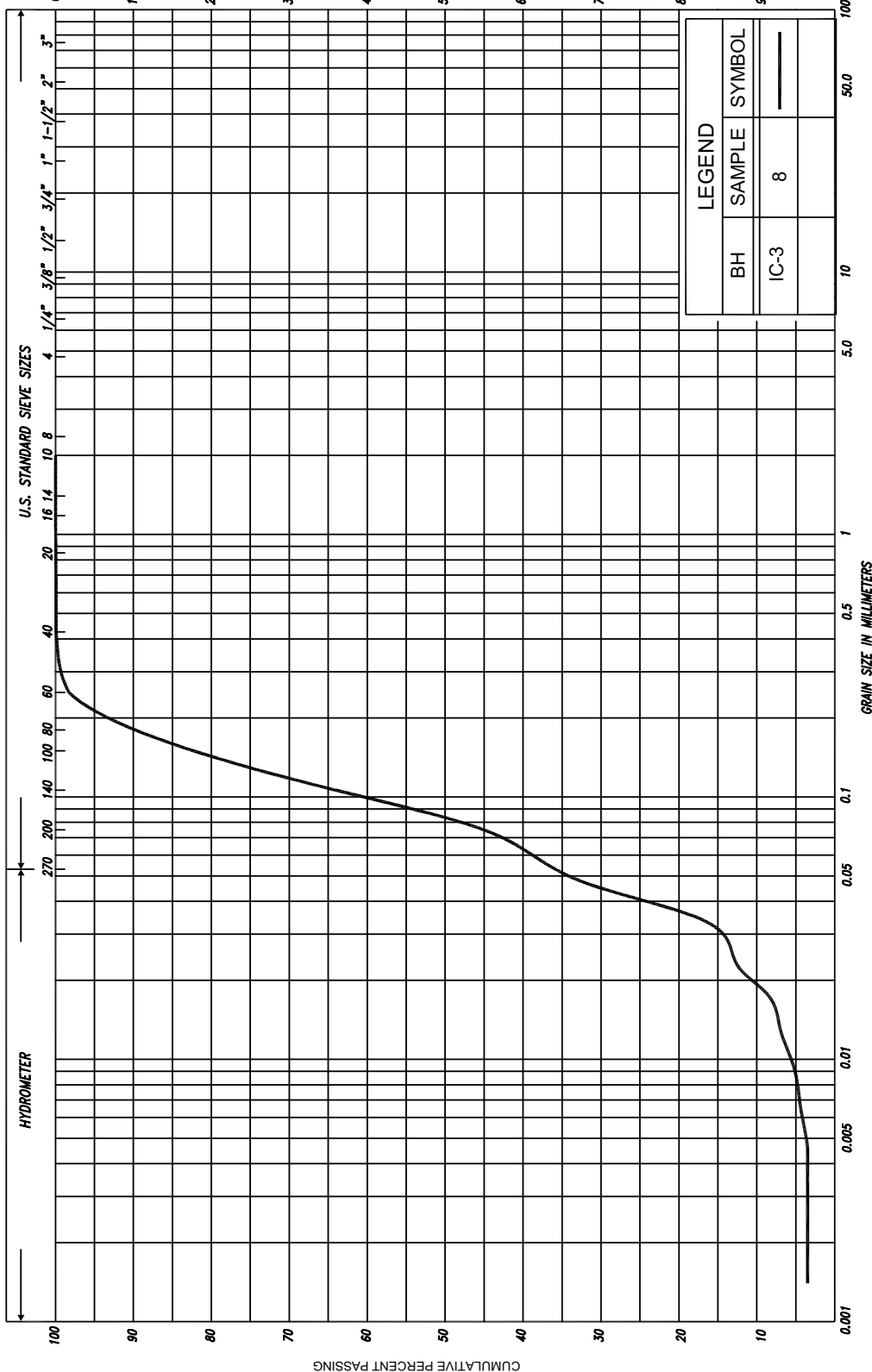
HWY: 17

G.W.P. No. 156-98-00

PLASTICITY CHART

SILTY CLAY, trace sand





LEGEND		
BH	SAMPLE	SYMBOL
IC-3	8	—

SILT & CLAY										FINE		MEDIUM		SAND		GRAVEL		COB RULES		UNIFIED
SILT										COARSE		FINE		MEDIUM		COARSE		GRAVEL		
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		SAND		COARSE		GRAVEL		COBBLES		M.I.T.	U.S. BUREAU
	CLAY		SILT		SILT		SILT		SILT		SILT		SILT		GRAVEL		GRAVEL			

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