



September 7, 2017

FOUNDATION INVESTIGATION REPORT

HIGHWAY 17 CONISTON CPR OVERHEAD TEMPORARY DETOUR STRUCTURE, SITE NO. 46-123 SUDBURY DISTRICT, TOWNSHIP OF DRYDEN AGREEMENT NO. 5015-E-0045 - WORK ORDER 1

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REPORT





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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO), to provide foundation engineering services for a temporary modular bridge (TMB) and detour embankment widening associated with the rehabilitation of the Canadian Pacific Railway (CPR) Overhead structure located on Highway 17 in Coniston, Ontario, approximately 2.8 km west of the Highway 17-Highway 537 junction in the Sudbury Area. This work has been carried out under the Retainer Assignment Agreement # 5015-E-0045 – Work Order #1. The highway and structural engineering aspects of the project are being carried out under separate contract between Morrison Hershfield (MH) and MTO.

The purpose of this investigation is to establish the subsurface conditions at the locations of the foundation element of the temporary modular bridge and along the proposed detour embankment widening, adjacent to the Coniston CPR Overhead by methods of borehole drilling, in situ testing and laboratory testing of selected soil samples.

2.0 SITE DESCRIPTION AND BACKGROUND INFORMATION

We understand that the existing CPR Overhead is to be rehabilitated which requires a temporary detour (i.e. widening of the existing approach embankments) and a temporary modular bridge (TMB). We understand that a three-span TMB will be located about 4 m to the north of the existing bridge and the existing approach embankments will require widening along the north side slope.

The existing west approach embankment is about 10 m high and may have been constructed of a combination of granular fill layers and cohesive fill layers. Based on information presented in the previous bridge General Arrangement (GA) drawings and previous borehole information we understand that the east approach embankment is comprised of rock fill. Northeast of the existing east abutment there is a visible bedrock outcrop and the rock is dipping to the west (towards the rail tracks) and is 9 m high at the abutment front slope. Blast rock fill is visually noted along the north side of the east approach embankment.

In general, the topography in the area of the Overhead structure consists of rolling terrain, including densely treed areas, bedrock outcrops, and low-lying swamps containing organic soils and areas of standing water and various types of vegetation. The CPR right-of-way appears to be aligned within a natural valley between bedrock outcrops. The railway tracks are aligned in a northeast-southwest direction, while the Overhead structure and Highway 17 are aligned in an east-west direction, skewed to the track alignment. The existing ground surface along the proposed detour and TMB alignment varies greatly as the centreline of the detour is positioned approximately along the mid-slope of the north side of the existing Highway 17 approach embankments and due to the exposed sloping bedrock noted above. Select site photographs are attached following the text of this report.

2.1 Previous Investigations

Previous foundation investigations for the existing bridge at the site carried out in 1975 indicates that the native material at the site consists of deposits of varved silty clay to clayey silt underlain by a deposit of silty sand to gravelly sandy silt, which is in turn underlain by bedrock. The details of this subsurface investigation are presented in:

- Geocon Ltd., 1977. Foundation Investigation Report for CPR Overhead at Coniston W.P. 158-74-01, Site 46-123, Hwy. 17, District 17, Sudbury. Ministry of Transportation and Communications, Ontario. Geocres No. 411-140.

The locations of these boreholes have been converted from previous station and offset to approximate coordinates in MTM NAD83 (Zone12) along with the ground surface elevations as follows:



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Borehole	Location (MTM NAD 83, Zone12)		Ground Surface Elevation (m)
	Northing	Easting	
1	5149839.2	318797.0	262.1
2	5149851.8	318825.8	252.6
3	5149838.1	318849.8	262.4
4	5149837.4	318866.3	262.6
5	5149832.3	318785.0	262.1
6	5149832.5	318797.7	262.2
7	5149819.1	318822.0	253.8
8	5149830.3	318856.5	262.5

In 2016, Golder conducted a foundation investigation to support retaining walls adjacent to the tracks.

- Golder Associates Ltd., 2016. Foundation Investigation Report for RSS Walls at the Coniston CPR Overhead 2.8 km West of Highway 537/17 Junction, Site # 46-123, Sudbury Area, Assignment No. 15, Agreement No. 5013-E-0034, W.P. 5165-10-01. Geocres No. 41J-342

In summary, these boreholes encountered a 0.7 m to 1.5 m thick layer of gravelly silt sand to sand and gravel fill from ground surface in places underlain by layers of organic clay and/or sandy silt between about 0.2 to 0.8 m thick; in turn underlain by a deposit of varved clayey silt to clay between 4.6 m and 5.8 m thick, which is in places underlain by a 0.7 m thick and potentially up to 4.2 m thick deposits of silt and sand.

The locations of these boreholes in MTM NAD83 (Zone12) coordinates and ground surface elevations referenced to Geodetic datum are as follows:

Borehole	Location (MTM NAD 83, Zone12)		Ground Surface Elevation (m)
	Northing	Easting	
BH1	5149845.7	318819.3	253.9
BH2	5149825.5	318800.2	254.1
BH3	5149846.5	318844.3	254.0
BH4	5149824.0	318881.4	254.4

The locations of the 1975 and 2016 Foundations Investigations are shown on Drawing 1. The pertinent subsurface information from the 1975 and 2016 Foundations Investigations is presented in Appendices A and B, respectively.



3.0 INVESTIGATION PROCEDURE

The current investigation for the detour and TMB was carried out between April 18 and May 1, 2017, during which time a total of nine boreholes (C17-1 to C17-9) and four dynamic cone penetration tests (DCPT) were advanced at the locations shown on Drawing 1. The Record of Borehole and Drillhole sheets are presented in Appendix C.

The field investigation was carried out using a buggy-mounted CME 55 drill rig and portable Hilti core drilling equipment supplied and operated by Landcore Drilling Ltd. of Chelmsford, Ontario. Boreholes C17-1 and C17-2, were advanced using a 50 mm inside diameter core barrel advanced by a Hilti coring machine. Boreholes C17-3 to C17-9 were advanced using 108 mm inside diameter hollow stem augers with NW casing and wash boring techniques (where required). In general, soil samples were obtained at depth intervals of 0.75 m and 1.5 m, using a 50 mm O.D. split-spoon sampler driven by an automatic hammer, carried out in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Samples of the cohesive soils were obtained using 76 mm O.D. thin walled Shelby Tubes (ASTM D1587). Field vane shear tests were completed within cohesive deposits in accordance with ASTM D2573, using MTO Standard 'N' size vanes. All boreholes were backfilled with bentonite and cuttings upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The boreholes were sampled to depths between 2.3 m and 17.3 m below ground surface. In addition, dynamic cone penetration tests (DCPTs) were advanced 10 m west and 10 m east of Boreholes C17-8 and C17-9 along the existing embankment toe of slope to depths between 0.2 m and 2.7 m below ground surface for delineation of refusal/bedrock surface.

The groundwater conditions were observed in the open boreholes during and immediately following the drilling operations and a standpipe piezometer was installed in Borehole 17-4 to permit monitoring of the groundwater level. The piezometer consists of a 38 mm diameter polyvinyl chloride (PVC) pipe, with a 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 pipe was backfilled with bentonite pellets and/or bentonite grout to ground surface. The piezometer installation details and water level readings are indicated on the borehole records contained in Appendix A. All other boreholes were backfilled upon completion in accordance with Ontario Regulation 903 (Wells, as amended).

The fieldwork was supervised by a member of our engineering and technical staff, who observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and took custody of 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, grain size distribution and Atterberg limits) was carried out on selected samples. In addition two one-dimensional consolidation (oedometer) testes were carried out on selected soil samples. Unconfined compression strength (UCS) tests were carried out on selected bedrock core samples. The results of the laboratory testing on samples from the boreholes are presented on the Record of Borehole and Drillhole sheets and are included in Appendix D.

The approximate locations of the boreholes were determined based on preliminary drawings provided to Golder during the planning phase by MH as foundation element locations were not known at that time and confirmed with AECOM/MTO prior to drilling. The as-drilled locations and elevations of the boreholes were surveyed using a Trimble Geo7 GPS survey unit. A summary of the borehole locations (northing and easting coordinates given relative to NAD83 MTM Zone 12, as well as latitude and longitude) and Geodetic elevations are provided on the borehole records and together with the drilling depths are summarized below.



Borehole	Location (MTM NAD 83, Zone12)		Location (WGS84)		Ground Surface Elevation (m)	Borehole/ DCPT Depth (m)
	Northing	Easting	Latitude	Longitude		
C17-1	5149846.8	318881.4	46.488138	-80.816580	260.2	3.0*
C17-2	5149856.2	318871.2	46.488223	-80.816713	254.0	3.0*
C17-3	5149852.7	318815.9	46.488192	-80.817433	253.5	11.7*
C17-4	5149860.2	318800.5	46.488260	-80.817633	253.5	11.9*
C17-5	5149839.0	318787.1	46.488070	-80.817809	262.6	17.3
C17-6	5149865.0	318776.1	46.488304	-80.817951	253.1	10.7
C17-7	5149841.5	318720.8	46.488094	-80.818672	261.7	9.2*
C17-8	5149860.2	318720.0	46.488262	-80.818682	255.9	0.3
C17-8D1	5149860.2	318710.0	46.488262	-80.818812	256.2	0.2
C17-8D2	5149860.2	318730.0	46.488262	-80.818552	255.0	1.0
C17-9	5149857.5	318671.9	46.488239	-80.819309	257.1	2.3
C17-9D1	5149857.5	318661.9	46.488239	-80.819439	257.1	2.7
C17-9D2	5149857.5	318681.9	46.488238	-80.819178	257.1	2.1

*Includes between 1.0 and 3.1 m of bedrock core length.

The relevant borehole logs from this investigation used to supplement the current investigation are provided in Appendix C.

4.0 SUBSURFACE CONDITIONS

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are provided on the Record of Borehole sheets contained in Appendix C. The results of geotechnical laboratory testing are contained in Appendix D. The results of the in situ tests (i.e., SPT 'N'-values and field vanes) as presented on the Record of Borehole sheets and in Section 4 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profiles on Drawings 1 and 2 are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

4.1 Regional Geology

The site is located within a glaciolacustrine plain, with low relief and a suspected high water table¹. The published information indicated the site borders on areas characterized by bedrock knobs generally covered by a thin veneer (1 to 3 m in thickness) of bouldery sandy glacial till, with low relief and undulating topography¹.

4.2 Subsoil Conditions

In general, the subsoil conditions encountered at the borehole locations consist of embankment fill or a surface layer of topsoil, underlain by a native deposit of clayey silt to clay, which is underlain by a granular deposit ranging in composition from silt to sand in turn underlain by a till deposit comprised of gravelly silty sand to sand and gravel overlying bedrock. Generally, the stratigraphy noted in the current investigation is consistent with the previous investigations. A more detailed description of the soil deposits and groundwater conditions encountered in the boreholes is provided below.

¹ Garnet, J.F., 1980. Sudbury Area (NTS 41i/SE) District of Nipissing, Parry Sound and Sudbury; Ontario Geologic Society, Northern Ontario Engineering Geology Terrain Study 100.



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Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows)	Laboratory Testing
				Field Vane Results (kPa)	
				Consistency or Relative Density	
Asphalt	C17-5, C17-7	0.10	262.6, 261.7	n/a	n/a
Concrete ¹	C17-5	0.25	262.5	n/a	n/a
Sandy/Silty Topsoil and/or Peat	C17-3, C17-4, C17-6, C17-8, C17-9	0.1 – 0.2	257.1 – 253.1	n/a	n/a
(FILL) Sand and Gravel, Sand, Silty Sand, Sandy Silt ² , trace organics, brown; moist to wet,	C17-3 to C17-7 and C17-9	0.6 – 4.0 0.9 (lower fill in C17-5)	262.2 – 253.0	N = 6 - 57; 67/0.16	w = 7% – 10% 3 - M (Fig. D1) 1 - MH (Fig. D1)
				n/a	
				Loose to very dense	
(FILL) Clayey Silt, some to with sand, some gravel; brown; moist to wet	C17-4, C17-5, C17-7	0.9 – 4.9	258.3 – 252.8	N = 4 - 57	w = 18% – 20% 2 - MH (Fig. D2) 2 - AL (Fig. D3) w _i = 26% – 30% w _p = 17% I _p = 9% – 13%
				n/a	
				Firm to hard	
Clayey Silt to Clay, trace sand, trace gravel, varved; brown to grey; wet	C17-3 to C17-6	4.7 – 7.8	252.4 – 251.5	N = WH – 14	w = 28% – 47% 9 - MH (Fig. D4) 13 -AL (Fig. D5) w _i = 26% – 54% w _p = 19% – 24% I _p = 6% – 31% 2 - Oedometer (Fig. B6 and B7)
				S _u = 24 – >100	
				S = 4 - 9	
Sandy Silt, Silt and Sand, Silt, Sand ² , trace gravel, trace clay; grey; wet	C17-3, C17-4, C17-6, C17-9	0.4 – 2.6	256.0 – 243.8	N = 1 – 36	w = 14% – 31% 4 - MH (Fig. D8) 1 - AL (Fig. DB9) including 1-AL(N.P.) w _i = 18% w _p = 15% I _p = 3%
				n/a	
				Very loose to dense	
TILL - Sand and Gravel to Gravelly Silty Sand ² , trace clay; dark brown to grey; wet	C17-5, C17-7 to C17-9	0.2 - 2.6	256.1 – 246.4	N = 16 – 74; 10/0.2	w = 6% – 18% 3 - MH (Fig. D10)
				n/a	
				Compact to very dense	



Where:

- N = SPT 'N'-value; number of blows for 0.3 m of penetration
- s_u = Undrained Shear Strength from in situ field 'N'-vane (kPa)
- S = calculated sensitivity
- w = Natural Moisture Content (%)
- MH = Combined Sieve and Hydrometer analysis
- M = Sieve analysis for particle size
- AL = Atterberg Limits Test
- w_p = Plastic Limit (%)
- w_l = Liquid Limit (%)
- I_p = Plasticity Index (%)
- NP = Non-Plastic test result

Notes:

1. Concrete encountered in Borehole C17-5 is likely part of the concrete approach slab.
2. Cobbles were encountered in Boreholes C17-3, C17-5 within the native sandy silt to silt and in the sand and gravel to gravelly silty sand deposits up 110 mm in diameter. Cobbles were also encountered within the embankment fill and within the gravelly silty sand Till deposit in Borehole C17-7.

Laboratory consolidation (oedometer) tests were carried out on two Shelby Tube samples of the clayey silt to clay deposit, obtained from Shelby tube samples in Boreholes C17-3 and in a separate borehole drilled adjacent to Borehole C17-4. The preconsolidation stress was estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. A bulk unit weight of 18.0 kN/m³ and 18.7 kN/m³ and a specific gravity of 2.77 were measured on the consolidation test samples. The detailed results of the oedometer tests are shown on Figures D6 and D7 in Appendix D, and the test results are summarized below:

Borehole/ Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	e_o	C_c	C_r	c_v^* (cm ² /s)
C17-3/ Sample 7	5.5 m/ 248.0 m	65	140	75	2.2	0.96	0.19	0.02	6.3×10^{-3}
Adjacent to C17-4/ Sample 1	5.5 m/ 248.0 m	70	190	120	2.7	1.09	0.16	0.03	2.7×10^{-3}

*For the consolidation stress range 130 kPa to 250 kPa

- where: σ_{vo}' is the effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- OCR is the overconsolidation ratio
- e_o is the initial void ratio
- C_c is the compression index
- C_r is the recompression index
- c_v is the coefficient of consolidation in cm²/s

4.3 Bedrock/Refusal

On the northeast end of the existing bridge, an exposed bedrock knob is present dipping westerly towards the rail right-of-way. Another bedrock knob is present approximately 20 m north of Borehole 17-8 located beyond the toe of the embankment slope.

Based on the results of the DCPTs, previous geotechnical investigations at the site, and published geological information, the DCPTs are considered to have achieved "refusal" on the inferred bedrock surface. Further, boreholes where bedrock was not cored were terminated on "refusal" conditions on the inferred bedrock surface as indicated by auger refusal, refusal to further casing advancement and/or split-spoon refusal. Bedrock was cored in Boreholes C17-1 to C17-4 and C17-7 and the depth/elevation of the actual/inferred bedrock surface is presented below.



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Borehole No.	Depth to Bedrock/Refusal (below ground surface at borehole location) (m)	Bedrock Surface/DCPT Refusal Elevation (m)	Refusal Condition (m)
C17-1	Ground Surface	260.2	3.0 m bedrock core length
C17-2	Ground Surface	254.0	3.0 m bedrock core length
C17-3	8.6	244.9	3.1 m bedrock core length
C17-4	8.9	244.6	3.0 m bedrock core length
C17-5	17.3	245.3	Casing and split-spoon refusal
C17-6	10.7	242.4	Auger and split-spoon refusal
C17-7	8.2	253.5	1.0 m bedrock core length
C17-8	0.3	255.6	Auger and split-spoon refusal
C17-8D1	0.2	256.0	Hammer bouncing
C17-8D2	1.0	254.0	Hammer bouncing
C17-9	2.3	254.8	Auger and split-spoon refusal
C17-9D1	2.7	254.4	Hammer bouncing
C17-9D2	2.1	255.0	Hammer bouncing

The retrieved bedrock core from Boreholes C17-1 to C17-3 and C17-7 is described as slightly weathered to fresh, very fine grained, grey arkosic greywacke. In Borehole C17-4, the bedrock is described as very fine grained, grey to pink meta quartzite. More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix C. Photographs of the bedrock core samples are shown on Figure D11 in Appendix D. The bedrock properties, as encountered in the boreholes, are summarized below.

Borehole No.	Total Core Recovery (TCR)	Rock Quality Designation (RQD)	Quality Classification (Table 3.10 of CFEM 2006 ²)	UCS (MPa)	Strength Classification (Table 3.5 of CFEM 2006 ³)
C17-1	75% - 100%	18% - 67%	Very Poor to Fair	91	(R4) Strong
C17-2	100%	22% - 69%	Very Poor to Fair	142	(R5) Very Strong
C17-3	93% - 100%	45% - 81%	Poor to Good	87	(R4) Strong
C17-4	100%	81% - 100%	Good to Excellent	151	(R5) Very Strong
C17-7	100%	0%	Very Poor	-	-

4.4 Groundwater Conditions

Unstabilized groundwater levels measured in the open boreholes upon completion of drilling are summarized below. It should be noted that the introduction of drilling water to advance NW casing in the boreholes may impact the measured groundwater levels. Water levels may vary depending on the time of year and precipitation events.

² Canadian Geological Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.



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Borehole	Ground Surface Elevation (m)	Depth to Groundwater (mbgs)	Groundwater Elevation (m)
C17-3	253.5	2.1	251.4
C17-4 (Piezometer)	253.5	1.6 (April 27, 2017 and July 4, 2017)	251.9
C17-5	262.6	6.9	255.7
C17-6	253.1	5.9	247.2
C17-7	261.7	6.6	255.1
C17-9	257.1	1.8	255.3

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Tibor Berecz, and the technical aspects were reviewed by Ms. Sarah E.M. Poot, P.Eng. a senior geotechnical engineer and Associate of Golder. Mr. Jorge M.A. Costa, P.Eng., a Senior Consultant with Golder and Designated MTO Foundations Contact for Golder, conducted an independent quality control review of this report.



Report Signature Page

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TB/AC/SEMP/JMAC/kp/nh

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Site Photographs



North Side of Hwy 17 Overhead Looking East Across CPR Tracks



North Side of Hwy 17 Overhead Looking West Across CPR Tracks

Project No.	1651997-WO1
Date:	September, 2017

Golder Associates Ltd.

Inputted by:	TB
Checked by:	SP

Site Photographs



Looking North at South side of Hwy 17 Overhead

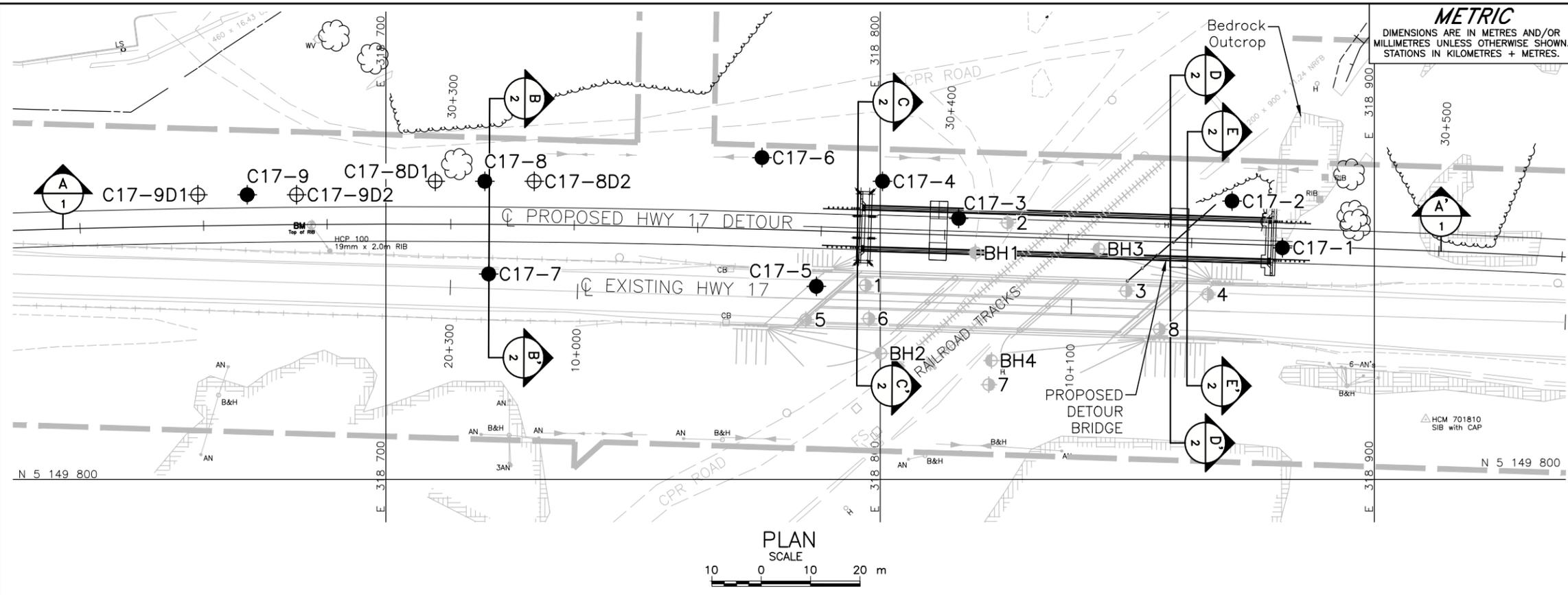


Looking South from Location of Borehole C17-3

Project No.	1651997-WO1
Date:	September, 2017

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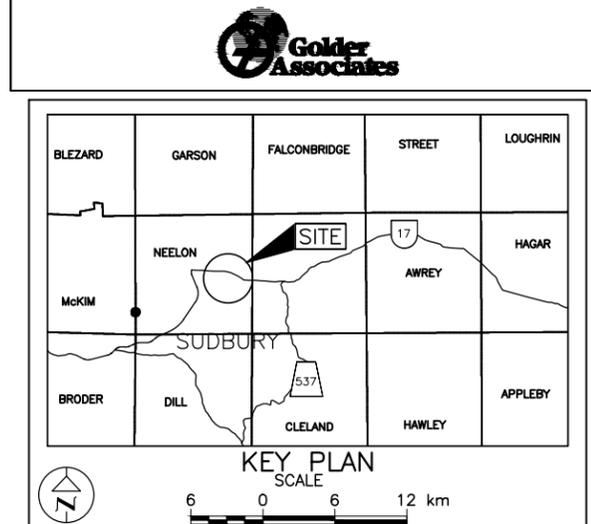
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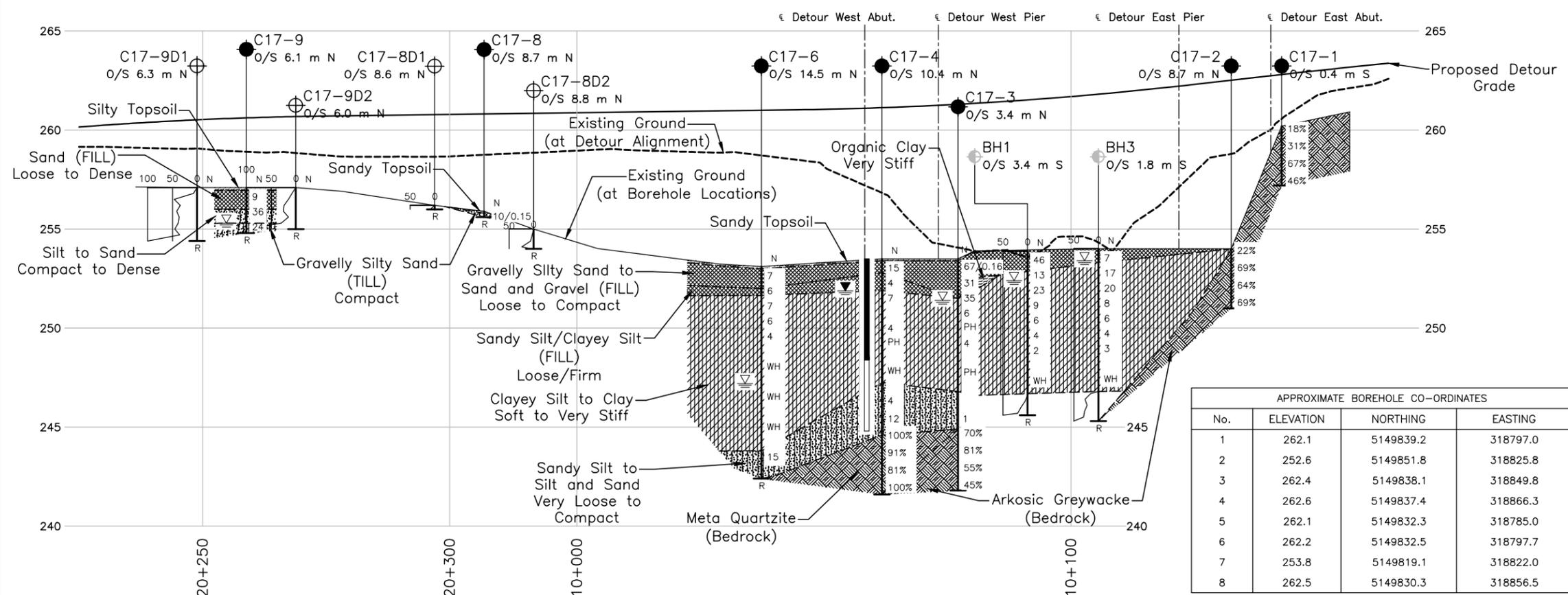
HIGHWAY 17
CONISTON CPR OVERHEAD
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates



LEGEND

- Borehole - 2017
- ⊕ Borehole - 2016 (Previous Investigation - Golder)
- ⊙ Borehole - 1975 (Previous Investigation - GEOCON)
- ⊕ Dynamic Cone Penetration Test
- ⊖ Seal
- ⊖ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- 100% Rock Quality Designation (RQD)
- ▽ WL in piezometer, measured on APR 27, 2017
- ▽ WL upon completion of drilling



APPROXIMATE BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
1	262.1	5149839.2	318797.0
2	252.6	5149851.8	318825.8
3	262.4	5149838.1	318849.8
4	262.6	5149837.4	318866.3
5	262.1	5149832.3	318785.0
6	262.2	5149832.5	318797.7
7	253.8	5149819.1	318822.0
8	262.5	5149830.3	318856.5

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
BH1	253.9	5149845.7	318819.3
BH2	254.1	5149825.5	318800.2
BH3	254.0	5149846.5	318844.3
BH4	254.4	5149824.0	318822.5
C17-1	260.2	5149846.8	318881.4
C17-2	254.0	5149856.2	318871.2
C17-3	253.5	5149852.7	318815.9
C17-4	253.5	5149860.2	318800.5
C17-5	262.6	5149839.0	318787.1
C17-6	253.1	5149865.0	318776.1
C17-7	261.7	5149841.5	318720.8
C17-8	255.9	5149860.2	318720.0
C17-8D1	256.2	5149860.2	318710.0
C17-8D2	255.0	5149860.2	318730.0
C17-9	257.1	5149857.5	318671.9
C17-9D1	257.1	5149857.5	318661.9
C17-9D2	257.1	5149857.5	318681.9

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.

NO.	DATE	BY	REVISION

Geocres No. 411-352

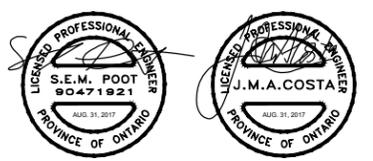
HWY. 17	PROJECT NO. 1651997	DIST. .
SUBM'D.	CHKD. AC	DATE: 8/31/2017
DRAWN: TB	CHKD. SEMP	APPD. JMAC
		SITE: 46-123
		DWG. 1

OVERHEAD DETOUR - CENTRELINER PROFILE

HORIZONTAL SCALE: 10 0 10 20 m
VERTICAL SCALE: 2.5 0 2.5 5 m

REFERENCE

Base plans provided in digital format by AECOM, drawing file nos. Base.dwg and x1124160_46-123_Detour Alignment.dwg, received MAY 31, 2017 and 46-123TMB_01 - Option 2.dwg, received June 15, 2017.



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

CONT No. WP No. 5165-10-01



HIGHWAY 17
CONISTON CPR OVERHEAD
SOIL STRATA



LEGEND

- Borehole - 2017
- ⊕ Borehole - 2016 (Previous Investigation - Golder)
- ⊖ Borehole - 1975 (Previous Investigation - GEOCON)
- ▬ Seal
- ▬ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- REC Recovery (%)
- 100% Rock Quality Designation (RQD)
- ▽ WL in piezometer, measured on APR 27, 2017
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
3	262.4	5149838.1	318849.8
4	262.6	5149837.4	318866.3
6	262.2	5149832.5	318797.7
8	262.5	5149830.3	318856.5
BH3	254.0	5149846.5	318844.3
C17-2	254.0	5149856.2	318871.2
C17-4	253.5	5149860.2	318800.5
C17-5	262.6	5149839.0	318787.1
C17-7	261.7	5149841.5	318720.8
C17-8	255.9	5149860.2	318720.0

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

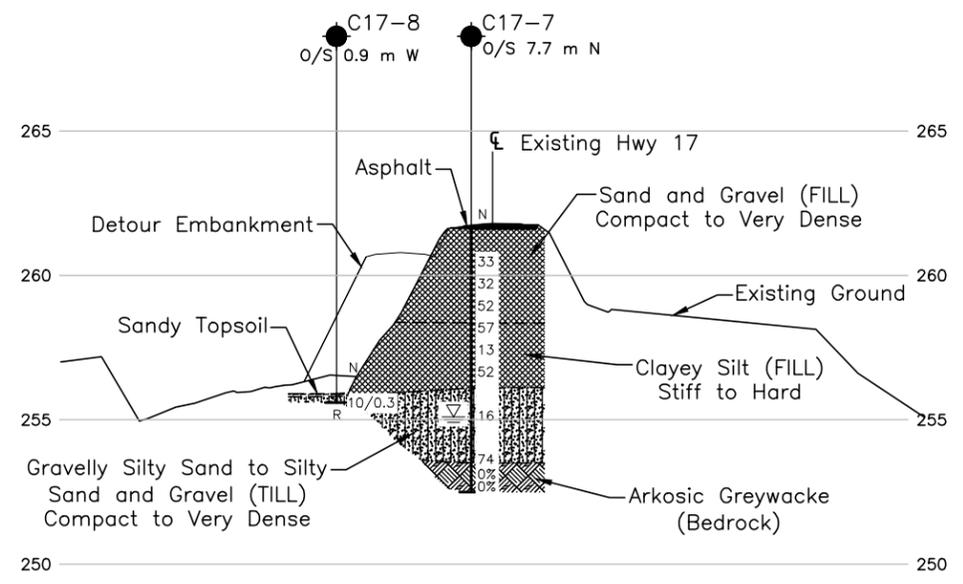
Base plans provided in digital format by AECOM, drawing file nos. Base.dwg and x124160_46-123_Detour Alignment.dwg, received MAY 31, 2017 and 46-123TMB_01 - Option 2.dwg, received June 15, 2017.



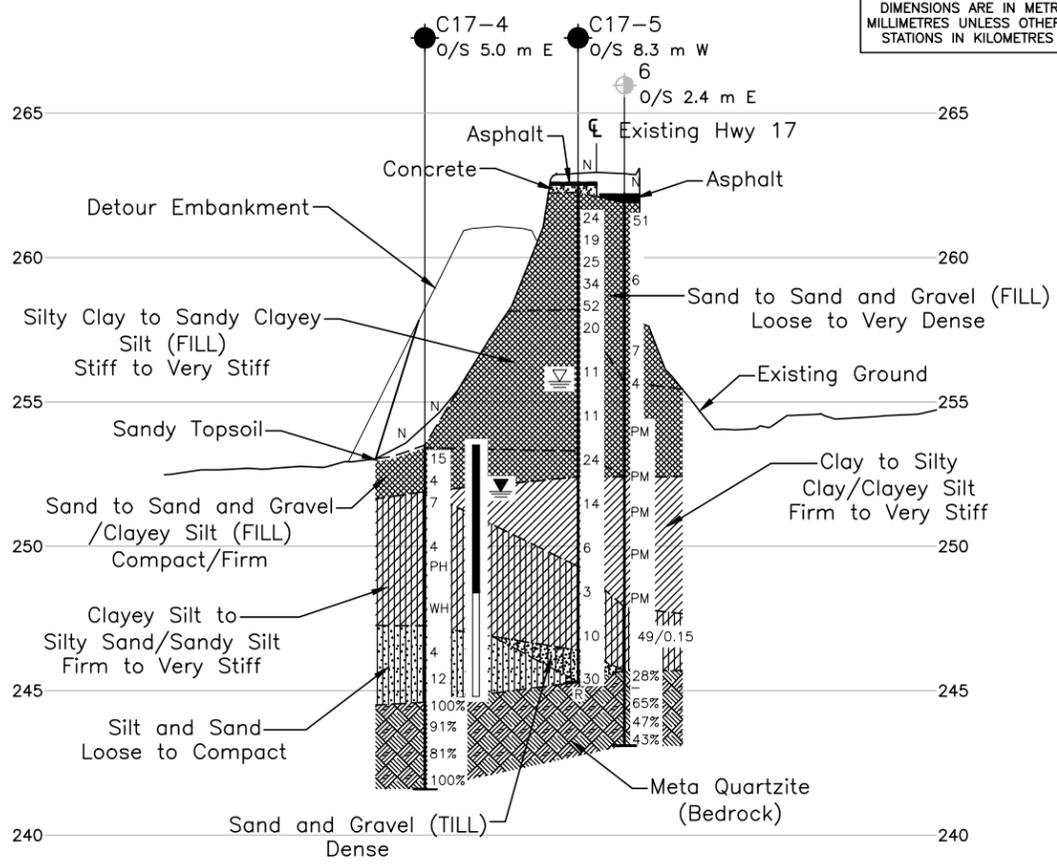
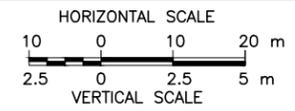
NO.	DATE	BY	REVISION

Geocres No. 411-352

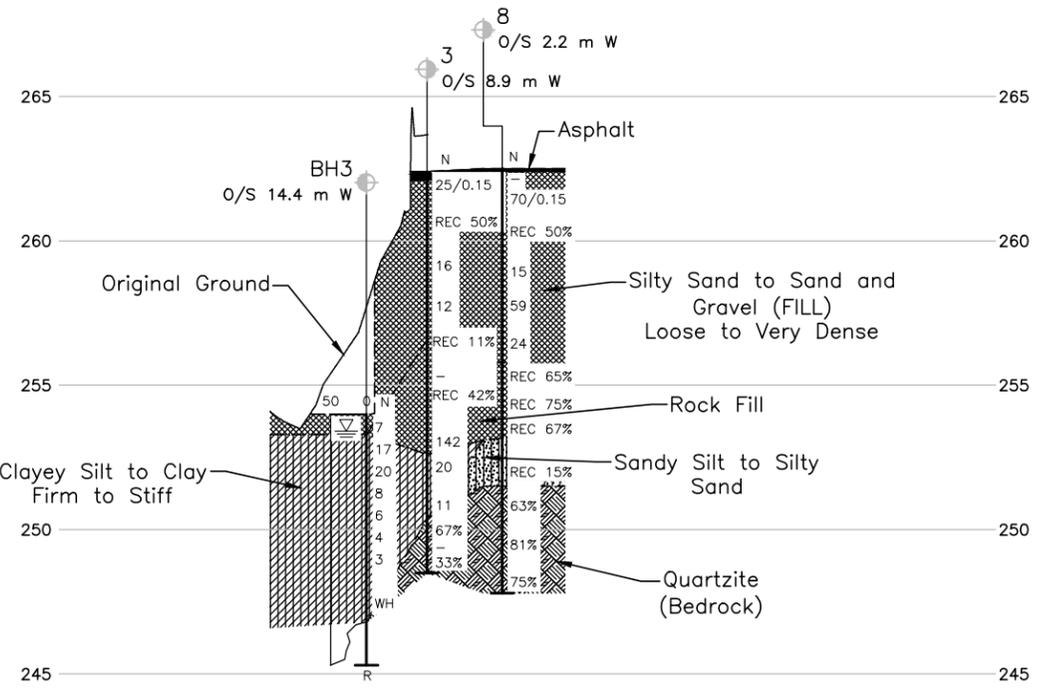
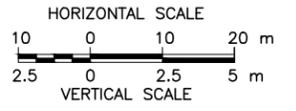
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SUBM'D.	CHKD. AC	DATE: 8/31/2017
DRAWN: TB	CHKD. SEMP	APPD. JMAC
		SITE: 46-123
		DWG. 2



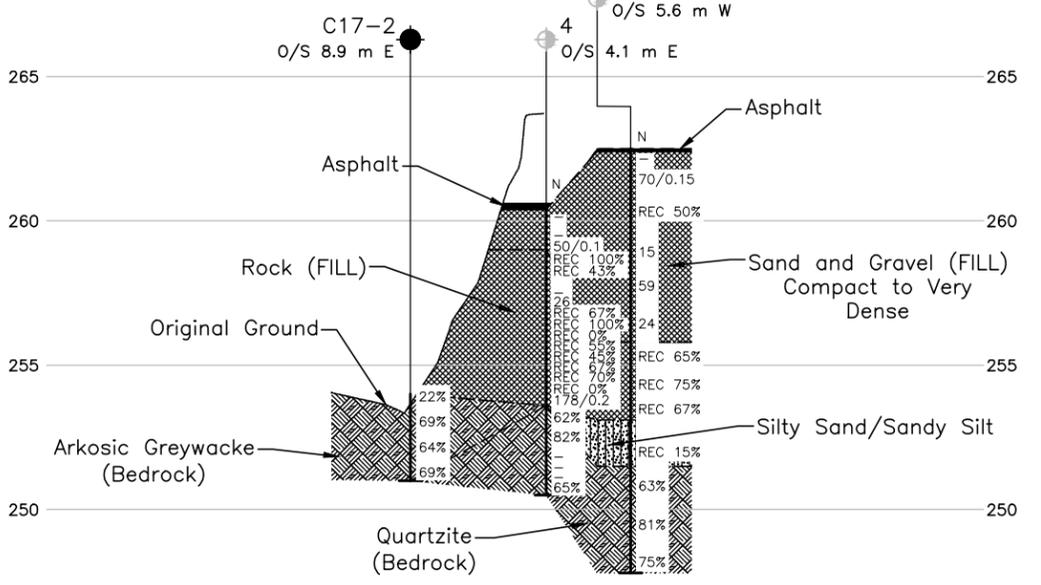
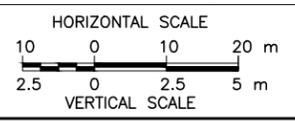
SECTION AT STA 20+308 (30+308 DETOUR)



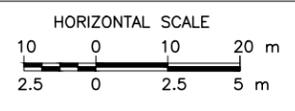
SECTION AT STA 10+057 (30+381 DETOUR)



SECTION AT STA 10+120 (30+446 DETOUR)



SECTION AT STA 10+123 (30+449 DETOUR)



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 PLOT TIME: 1:02:17
 PLOT USER: S:\Client\1651997\1651997_001\1651997_001.dwg



APPENDIX A

Borehole Records – GEOCON 1975

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 158-74-01 LOCATION Sta. 101 + 95 o/s 9.0 Lt. of Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 13, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE NW, NX & BX Casing, AXT Rock Core CHECKED BY RGG

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
860.0	Asphalt		1A	WS	-											
0.8	Fill Sand & gravel Compact		1B	WS	-											
			2	WS	-											
			3	WS	-											
			4	SS	30/3											
			5	SS	23	855										
851.0	Fill Silty clay/clayey silt Stiff		6	SS	8											0 12 58 30
9.0			7	TW	FM	845										
			8	SS	14	840										0 54 38 8 0 12 60 20
			9	SS	13	835										
831.3			10	SS	30	830										0 77 19 4
28.7	Silty sand & gravel Compact grey brown		11	WS	-											
828.4			12	SS	13	825										
31.6	Silty clay/clayey silt Varved Stiff		13	SS	13	820										
			14	SS	19	815										0 50 47 3
			15	SS	14	810										
819.0			16	SS	53	805										2 46 48 4
41.0	Silty clay/clayey silt Varved		17	AXT RC	93%	800										RQD 2%
816.0	Stiff to firm grey		18	AXT RC	98%											RQD 41%
44.0	Silty sand/sandy silt with occasional gravel Compact to very dense		19	AXT RC	91%											RQD 32%
807.8																
52.2	Bedrock															
	Note: Medium to fine grained grey, hard quartzite. Joint spacing close to very close. Core generally fractured.															
796.9																
63.1	End of Borehole															
	Note: W.L. Not Established															

OFFICE REPORT ON SOIL EXPLORATION

20
15-0-5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 158-74-01 LOCATION Sta. 102 + 86 o/s 48.5 Lt. of Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE December 10, 13, & 19, 1976 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE BX & AX Cased & Cored CHECKED BY RGC

OFFICE REPORT ON SOIL EXPLORATION

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W		UNIT WEIGHT γ	REMARKS
			NUMBER	TYPE	N VALUES		20	40	60	80	100	W _p		
828.6	Ground Level													
0.0	Silty Sand with gravel		1	SS	23	↓								
825.6	Compact brown													
3.0	Silty clay/clayey silt		2	SS	4	825								0 4 67 29
	Varved													
	Stiff to firm					820								
	brown		3	SS	4									
815.1														
13.5	Silty clay/clayey silt		4	TW	PM	815							115	0 2 74 24
	Varved													
	Firm					810								
	grey		5	TW	PM								111	0 2 78 20
803.6														
25.0	Silty sand/sandy silt		6	WS	-	805								
	with occasional gravel													
	Loose		7	SS	5	800								3 34 48 15
	brown													
			8	SS	10/11	795								28 75 (3)
792.1														RQD 22%
36.5	Bedrock		9	BX RC	100%	790								RQD 69%
	Note:		10	BX RC	92%									RQD -
	Medium to fine grained, grey.		11	BX RC	75%									RQD -
			12	BX RC	63%									RQD -
			13	AX RC	75%									RQD -
	Joint spacing close to very close. Core generally fractured.		14	AX RC	80%	785								RQD 43%
781.6														
47.0	End of Borehole													

R.Q.D. Rock Quality Designation

20
15 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 158-74-01 LOCATION Sta. 103 + 65 o/s 10.0 Lt. of Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 20 - 22, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE NX, BX & AX Casing, AXT Rock Core CHECKED BY BCC

OFFICE REPORT ON SOIL EXPLORATION

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS	
			NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L			
860.8	Ground Level																
0.0	Asphalt																
1.0	Fill Sand and gravel Compact to very dense grey brown Note: Cobbles and boulders up to 6 inches in size, encountered from 3 to 7 feet. NXCA drilled from 0 to 5 feet. BXCA drilled from 5 to 7 feet.		1	SS	25/6	860											
			2	BXL RC	50%	855											
			3	SS	16	850											
			4	SS	12	845											
841.8			5	BXL RC	11%												
19.0	Fill Rock Note: Rock up to 18 inches in size encountered. BXCA drilled from 19 to 21.8 feet. AXCA drilled from 21.8 to 29.8 feet.		6	BXL RC	-	840											
			7	BXL RC	42%	835											
828.8			8	SS	142	830											
32.0	Silty clay/clayey silt Stiff brown		9	SS	20	825											
821.3			10	SS	11										0 2 58 40		
39.5	Bedrock Note: Medium to fine grained, grey hard quartzite. Joint spacing close. Core reasonably sound.		11	AXT RC	88%	820									RQD 67%		
915.3			12	AXT RC	91%											RQD -	
49.5			13	AXT RC	100%											RQD 33%	
49.5	End of Borehole																
	Note: W.L. Not Established																

20
15 \diamond 5 % STRAIN AT FAILURE
10

R.Q.D. Rock Quality Designation

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP158-74-01 LOCATION Sta. 104 + 19 o/s 10.0 Lt. of Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 3 - 6, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE NX & BX Casing, BX & AX Rock Core CHECKED BY RGC

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PILOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
861.5	Ground Level															
0.0	Asphalt															
0.5	Fill		1	WS	-	860										
	Sand and gravel Very dense grey brown		2	WS	-											
856.1			3	SS	50%											
5.4	Fill		4	BX, RC	100%											
	Rock		5	BX RC	43%	855										
	Note: Rock up to 18 inches in size encountered. NXCA drilled from 5.4 to 8.5 feet. BXCA drilled from 8.5 to 22.9 feet.		6	BX, RC	-											
			7	SS	26	850										
			8	BX, RC	72%											
			9	BX, RC	100%											
			10	BX, RC	0%											
			11	BX RC	55%											
			12	BX RC	45%	845										
			13	BX RC	67%											
			14	BX RC	70%											
			15	BX, RC	0%	840										
838.6			16	SS	178/3"											
22.9	Bedrock		17	BX, RC	67%										RQD 62%	
	Note: Medium to fine grained grey, hard quartzite. Joint spacing close. Loss of return water down to 28'2". Core generally sound.		18	BX RC	94%	835									RQD 82%	
			19	BX	100%										RQD -	
			20	RC	100%										RQD -	
			21	RC	100%										RQD -	
			22	AX RC	100%	830									RQD 65%	
828.3																
33.2	End of Borehole															
	Note: W.L. Not Established															
															R.Q.D. Rock Quality Designation	

20
15 \diamond 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 158-74-01 LOCATION Sta. 101+56 O/S 12.5 Lt. & Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 26-29, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE H.S. Augers & AX Casing, AXT Rock Core CHECKED BY RGC

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT Y	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	W VALUES		20	40	60	80	100	w_p	w	w_L			GR	SA
859.8	Ground level																	
0.0	Asphalt																	
0.5	Fill Sand and gravel Very dense to compact					855												
			1	SS	14	850												
846.3																		
13.5	Fill Silty clay/clayey silt Stiff grey & brown		2	TW	PM	845												
			3	TW	PM	840												
			4	TW	PM	835												
032.0 27.0	Silty clay/clayey silt Varved Very stiff to stiff brown		5	TW	PM	830				2700								
			6	TW	PM	825												116
821.8																		
38.0	Silty clay/ clayey silt Varved Firm grey		7	TW	PM	820												122
			8	TW	PM	815												
813.4																		
46.4	Silty sand/sandy silt with occasional gravel Very dense grey brown		9	SS	51	810												
			10	SS	50	805												
57.7	Bedrock Note: Medium to fine grained grey, hard quartzite, joint spacing close to very close. Core generally fractured		11	AXT RC	882	800												RQD 42%
797.6			12	AXT RC	1002													RQD -
62.2	End of Borehole Notes: W.L. Not Established																	

R.O.D. Rock Quality Designation
 20
 15-5 % STRAIN AT FAILURE
 10

RECORD OF BOREHOLE NO 6

WP 158-74-01 LOCATION Sta. 101 + 98 o/s 11.0 Rte. 4 Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 25 - 28, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE H.S. Augers & AX Casing, AXT Rock Core CHECKED BY RGC

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL ▲ HAND VANE					WATER CONTENT % 20 40 60	
860.1	Ground Level																	
0.0	Asphalt																	
0.9	Fill Sand and gravel Very dense to loose grey brown	[Hatched]	1	SS	51	855												
			2	SS	6	850												
			3	SS	7	845												
			4	SS	4	840												
838.8 21.3	Fill Silty clay/clayey silt Stiff grey & brown	[Hatched]	5	TW	PM	835												
			6	TW	PM	830												
			7	TW	PM	825												
828.1 32.0	Silty clay/clayey silt Varved Stiff to firm brown	[Hatched]	8	TW	PM	820												
			9	TW	PM	815												
819.1 41.0	Silty clay/clayey silt Varved Firm grey	[Hatched]	10	SS	49/77	810												
			11	AXT RC	94%	805												RQD 28%
	Bedrock Note: Medium to fine grained grey, hard quartzite. Joint spacing close to very close.	[Hatched]	12	AXT RC	100%													
			13	AXT RC	82%													RQD 65%
			14	AXT RC	69%													RQD 47%
			15	AXT RC	92%	800												RQD 43%
797.5 62.6	End of Borehole Note: W.L. Not Established																	

70
15-5 % STRAIN AT FAILURE
10

R.C.D. Rock Quality Designation

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 158-74-01 LOCATION Sta. 102 + 78 o/s 47.5 Rt. & Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE December 15 & 16, 1976. COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE BX Casing, AX Rock Core CHECKED BY RCC

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	VALUES		20	40	60	80	100	w_p	w	w_L			GR
832.8	Ground Level																
0.0	Silty sand with gravel Loose brown		1	SS	6												
829.8						830											
3.0	Silty clay/clayey silt Varved Stiff to firm brown		2	SS	9												
			3	TW	PM												
			4	TW	PM	825											
819.8						820											
13.0	Silty clay/clayey silt Varved Firm grey		5	TW	PM												
			6	TW	PM	815											
809.8						810											
23.0	Silty sand/sandy silt with occasional gravel Loose grey		7	SS	6												
802.7						805											
30.1	Bedrock Note: Medium to fine grained grey, hard quartzite. Joint spacing close to very close. Core generally fractured.		8	AX RC	97%	800											RQD 50%
			9	AX RC	100%												
			10	AX RC	83%	795											
			11	AX RC	93%												
791.8																	
41.0	End of Borehole																

20
15 \diamond 5 % STRAIN AT FAILURE
10

R.Q.D. Rock Quality Designation

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 158-74-01 LOCATION Sta. 103 + 88 o/s 11.5' Rt. of Hwy. 17 ORIGINATED BY AEL
 DIST 17 HWY 17 BORING DATE January 25 - 26, 1977 COMPILED BY RAH
 DATUM Geodetic BOREHOLE TYPE BX & AX Casing, AXT & BX Rock Core CHECKED BY RCC

OFFICE REPORT ON SOIL EXPLORATION

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS		
			NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L			% GR SA SI CL	
861.2	Ground Level																	
0.3	Asphalt		1	MS	-	860												
	Fill Sand and gravel Compact to very dense grey brown Note: Cobbles and boulders up to 6 inches in size encountered from 3 to 9 feet. BXCA drilled from 0.8 to 16 feet. AXCA drilled from 16 to 22 feet.	[Hatched Pattern]	2	SS	70/5	"												
			3	BX RC	50%	855												
			4	BX RC	50%													
			5	SS	15	850												
			6	SS	59	845												
			7	SS	24	840												
839.2	Fill																	
22.0	Rock		8	AXT RC	65%													
	Note: Rock up to 18 inches encountered. AXCA drilled to 31 feet.	[Hatched Pattern]	9	AXT RC	75%	835												
			10	AXT RC	67%													
830.2							830											
31.0	Silty sand/sandy silt (probable) with occasional gravel		11	AXT RC	15%													
825.1	Bedrock																	
36.1	Note: Medium to fine grained grey, hard quartzite. Joint spacing close. Loss of return water 38.5 to 43.5 feet. Core generally sound.	[Hatched Pattern]	12	AXT RC	100%	825										RQD 63%		
			13	AXT RC	97%	820											RQD 81%	
			14	AXT RC	100%	815											RQD 75%	
813.0	End of Borehole																	
48.2	Note: W.L. Not Established															R.Q.D. Rock Quality Designation		

20
15 ϕ 5 % STRAIN AT FAILURE
10



APPENDIX B

Borehole Records – Golder 2016

RECORD OF BOREHOLE No BH1 1 OF 1 **METRIC**

PROJECT 14-1181-0014 LOCATION N 5149845.7; E 318819.3 ORIGINATED BY DM

G.W.P. _____ DIST HWY 17 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers COMPILED BY TB

DATUM GEODETIC DATE January 18, 2016 CHECKED BY SEMP

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	20	40	60	80						100	20
253.9	GROUND SURFACE																	
0.0	Gravelly silty sand, some cobbles (FILL) Compact/stiff below frozen material Brown Frozen to wet		1	SS	46													
	- 75 mm thick silty clay layer encountered at 0.8 m depth.		2	SS	13													
252.5	- 125 mm thick silty clay layer encountered at 1.2 m depth.																	
1.4	ORGANIC CLAY, some sand, trace fibrous peat Very stiff		A	SS	23													
251.9	Grey to black Moist		3	SS	23													
			B	SS	23													
2.2	Sandy SILT, trace gravel Grey Wet		4	SS	9													
	CLAYEY SILT to CLAY, trace to some sand, varved Firm to stiff Brown/grey Moist to wet		5	SS	6													
			6	SS	4													
			7	SS	2													
			8	SS	WH													
	Becoming grey below 6.1 m depth.																	
246.6	END OF BOREHOLE START OF DCPT																	
245.6	END OF DCPT DCPT REFUSAL (50 blows/0.08m)																	
8.3	Note(s): 1. Water level at a depth of 1.5 m below ground surface (Elev. 252.4 m) upon completion of drilling.																	

SUD-MTO 001 1411810014 CONISTON A15.GPJ GAL-MISS.GDT 15/04/16 DATA INPUT:

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

RECORD OF BOREHOLE No BH4 1 OF 2 **METRIC**

PROJECT 14-1181-0014 LOCATION N 5149824.0; E 318822.5 ORIGINATED BY DM

G.W.P. _____ DIST HWY 17 BOREHOLE TYPE NW Casing, Portable Equipment COMPILED BY TB

DATUM GEODETIC DATE January 20, 2016 CHECKED BY SEMP

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	20						40	60	80	100	20
254.4	GROUND SURFACE																	
0.0	Sand and gravel, some fines, trace organics, some cobbles (FILL) Loose Dark brown to brown Frozen to wet		1	SS	58	∇												38 49 (13)
			2	SS	8													
252.9																		
1.5	SILTY CLAY, trace sand, varved Firm to stiff Brown/grey Moist to wet		3	SS	8													
			4	SS	7													
			5	SS	6													
			6	SS	2													
	Becoming grey below 4.6 m depth.		7	SS	1													
			8	SS	1													
247.1	END OF BOREHOLE START OF DCPT																	
7.3																		
243.0																		
11.4																		

SUD-MTO 001 1411810014 CONISTON A15.GPJ GAL-MISS.GDT 15/04/16 DATA INPUT:

Continued Next Page

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



PROJECT 14-1181-0014 **RECORD OF BOREHOLE No BH4** 2 OF 2 **METRIC**
 G.W.P. _____ LOCATION N 5149824.0; E 318822.5 ORIGINATED BY DM
 DIST _____ HWY 17 BOREHOLE TYPE NW Casing, Portable Equipment COMPILED BY TB
 DATUM GEODETIC DATE January 20, 2016 CHECKED BY SEMP

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	20	40	60	80						100	20
	-- CONTINUED FROM PREVIOUS PAGE -- END OF DCPT DCPT REFUSAL (50 blows/0.15 m) Note(s): 1. Water level at a depth of 0.3 m below ground surface (Elev. 254.1 m) upon completion of drilling and maybe influenced by introduction of drilling water.																	

SUD-MTO 001 1411810014 CONISTON A15.GPJ GAL-MISS.GDT 15/04/16 DATA INPUT:

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



APPENDIX C

Current Investigation – Borehole Records



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.

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

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

	<u>kPa</u>	<u>C_u, S_u</u>	<u>psf</u>
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.



LIST OF SYMBOLS

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

I.	GENERAL	(a)	Index Properties (continued)
π	3.1416	w	water content
$\ln x$,	natural logarithm of x	w_l or LL	liquid limit
\log_{10}	x or log x, logarithm of x to base 10	w_p or PL	plastic limit
g	acceleration due to gravity	I_p or PI	plasticity index = $(w_l - w_p)$
t	time	w_s	shrinkage limit
FoS	factor of safety	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)
II.	STRESS AND STRAIN	(b)	Hydraulic Properties
γ	shear strain	h	hydraulic head or potential
Δ	change in, e.g. in stress: $\Delta \sigma$	q	rate of flow
ε	linear strain	v	velocity of flow
ε_v	volumetric strain	i	hydraulic gradient
η	coefficient of viscosity	k	hydraulic conductivity (coefficient of permeability)
ν	Poisson's ratio	j	seepage force per unit volume
σ	total stress		
σ'	effective stress ($\sigma' = \sigma - u$)	(c)	Consolidation (one-dimensional)
σ'_{vo}	initial effective overburden stress	C_c	compression index (normally consolidated range)
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)	C_r	recompression index (over-consolidated range)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$	C_s	swelling index
τ	shear stress	C_α	secondary compression index
u	porewater pressure	m_v	coefficient of volume change
E	modulus of deformation	C_v	coefficient of consolidation (vertical direction)
G	shear modulus of deformation	C_h	coefficient of consolidation (horizontal direction)
K	bulk modulus of compressibility	T_v	time factor (vertical direction)
		U	degree of consolidation
		σ'_p	pre-consolidation stress
		OCR	over-consolidation ratio = σ'_p / σ'_{vo}
III.	SOIL PROPERTIES	(d)	Shear Strength
(a)	Index Properties	τ_p, τ_r	peak and residual shear strength
$\rho(\gamma)$	bulk density (bulk unit weight)*	ϕ'	effective angle of internal friction
$\rho_d(\gamma_d)$	dry density (dry unit weight)	δ	angle of interface friction
$\rho_w(\gamma_w)$	density (unit weight) of water	μ	coefficient of friction = $\tan \delta$
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	c'	effective cohesion
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)	C_u, S_u	undrained shear strength ($\phi = 0$ analysis)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)	p	mean total stress $(\sigma_1 + \sigma_3)/2$
e	void ratio	p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
n	porosity	q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
S	degree of saturation	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

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

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



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 <u>1651997</u>	RECORD OF BOREHOLE No C17-1	1 OF 1 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149846.8; E 318881.4 (LAT. 46.488138; LONG. -80.81658)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>2" Hilti Core</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 26, 2017</u>	CHECKED BY <u>SEMP</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	GR
260.2	BEDROCK OUTCROP		1	RC	REC 93%													
0.0	ARKOSIC GREYWACKE (BEDROCK)		2	RC	REC 100%													
	For coring details see Record of Drillhole C17-1.		3	RC	REC 100%													
			4	RC	REC 75%													
257.2	END OF BOREHOLE																	
3.0	Note: 1. Borehole dry upon completion of coring.																	

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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

PROJECT: 1651997

RECORD OF DRILLHOLE: C17-1

SHEET 1 OF 1

LOCATION: N 5149846.8 ; E 318881.4 (LAT. 46.488138; LONG. -80.81658)

DRILLING DATE: April 26, 2017

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Hiiti

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.			
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	k, cm/s			10 ⁰	10 ¹	10 ²
								80000000	80000000			000000	000000	000000	000000	000000	000000	000000			000000	000000	000000
0		BEDROCK OUTCROP		260.2																			
0.0		ARKOSIC GREYWACKE Strong Slightly weathered Very fine grained Grey			1	Grey	100																
1		Oxidized joints throughout.																					
1	2" Core Bit Manual Hiiti	Weathered between 0.7 m and 0.8 m depth.			2	Grey	100																
2																							
2		Weathered, missing core between 2.7 m and 3.0 m depth.			3	Grey	100																
3		Weathered, missing core between 2.7 m and 3.0 m depth.			4	Grey	100																
3		END OF DRILLHOLE		257.2																			
3.0				3.0																			

UCS = 91 MPa

SUD-RCK-LAT/LONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

DEPTH SCALE
1 : 60



LOGGED: SA
CHECKED: SEMP

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-2	1 OF 1 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149856.2; E 318871.2 (LAT. 46.488223; LONG. -80.816713)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>2" Hilti Core</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 28 and May 1, 2017</u>	CHECKED BY <u>SEMP</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			W _L	
						20 40 60 80 100	○ UNCONFINED	+ FIELD VANE										
						20 40 60 80 100	● QUICK TRIAXIAL	× REMOULDED										
254.0	BEDROCK OUTCROP																	
0.0	ARKOSIC GREYWACKE (BEDROCK) For coring details see Record of Drillhole C17-2.	▨	1	RC	REC 100%													RQD = 22%
		▨	2	RC	REC 100%	253												RQD = 69%
		▨	3	RC	REC 100%	252												RQD = 64%
		▨	4	RC	REC 100%													RQD = 69%
251.0	END OF BOREHOLE					251												
3.0	Note: 1. Borehole dry upon completion of coring.																	

SUD-MTD 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-3	2 OF 3 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149852.7; E 318815.9 (LAT. 46.488192; LONG. -80.817433)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 25, 2017</u>	CHECKED BY <u>SEMP</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	20			40	60	80	100	W _p	W	W _L	20		
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Note: 1. Water level at a depth of 2.1 m below ground surface (Elev. 251.4 m) upon completion of drilling.																

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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



RECORD OF BOREHOLE No C17-4 2 OF 3 **METRIC**

PROJECT 1651997

W.P. 5165-10-01 LOCATION N 5149860.2; E 318800.5 (LAT. 46.48826; LONG. -80.817633) ORIGINATED BY SA

DIST _____ HWY 17 BOREHOLE TYPE NW Casing, Wash Boring and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE April 24, 2017 CHECKED BY SEMP

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	W _L		
	--- CONTINUED FROM PREVIOUS PAGE ---															
11.9	END OF BOREHOLE Notes: 1. Water level at a depth of 1.2 m below ground surface (Elev. 252.3 m) upon completion of drilling. 2. An additional shelly tube was obtained 2 m northeast of borehole at 5.2 m depth for consolidation testing. 3. Water level in piezometer measured at a depth of 1.6 m below ground surface (Elev. 251.9 m) on April 27, 2017 and on July 4, 2017.															

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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

PROJECT: 1651997

RECORD OF DRILLHOLE: C17-4

SHEET 3 OF 3

LOCATION: N 5149860.2 ; E 318800.5 (LAT. 46.48826; LONG. -80.817633)

DRILLING DATE: April 24, 2017

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.				
							FLUSH	TOTAL CORE %			SOLID CORE %	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn			k, cm/s	10 ⁰	10 ¹	10 ²
								% RETURN			%												
9	HQ	REFER TO PREVIOUS PAGE		244.6																			
		META QUARTZITE Very strong Fresh Very fine grained Grey-black		8.9	1	Grey	100														UCS = 151 MPa		
10		Partially healed quartz carbonate filled joints			2	Grey	100																
11					3	Grey	100																
					4	Grey	100																
12		END OF DRILLHOLE		241.6																			
				11.9																			
13																							
14																							
15																							
16																							
17																							
18																							
19																							
20																							

SUD-RCK LAT/LONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

DEPTH SCALE

1 : 60



LOGGED: SA

CHECKED: SEMP

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-5	2 OF 2 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149839.0; E 318787.1 (LAT. 46.48807; LONG. -80.817809)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers and NW Casing</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 19, 2017</u>	CHECKED BY <u>SEMP</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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
249.3 13.3	CLAY Very stiff Brown to grey Wet		11	SS	6	250							-----○-----			
	CLAYEY SILT, trace sand, silt seams throughout Very stiff to firm Grey Wet		12	SS	3	249							-----○-----			0 1 72 27
			13	SS	10	247							-----○-----			0 0 76 24
246.4 16.2	SAND and GRAVEL, trace to some silt, trace clay (TILL) Dense Brown Wet					246										
245.3 17.3	Cobble encountered at 16.9 m depth.		14	SS	30								○			40 50 8 2
	END OF BOREHOLE REFUSAL TO FURTHER CASING AND SPLIT-SPOON ADVANCEMENT Note: 1. Water level at a depth of 6.9 m below ground surface (Elev. 255.7 m) upon completion of drilling.															

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-7	1 OF 2 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149841.5; E 318720.8 (LAT. 46.488094; LONG. -80.818672)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 18, 2017</u>	CHECKED BY <u>SEMP</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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
											○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					
											WATER CONTENT (%)					
											20	40	60			
261.7	GROUND SURFACE															
0.0	ASPHALT (100 mm)															
0.1	Sand and gravel to gravelly sand, trace to some silt (FILL) Compact to very dense Brown Moist															
	Cobbles between 0.3 m and 3.4 m depth.		1	SS	33											
			2	SS	32							○				32 51 (17)
			3	SS	52											
			4	SS	57											
258.3	Clayey silt, some sand to sandy silt (FILL) Stiff to hard Brown Moist		5	SS	13											0 15 59 26
3.4			6	SS	52											
256.1	Silty SAND and GRAVEL, trace clay (TILL) Compact to very dense Reddish brown to grey Wet		7	SS	16							○				30 38 29 3
5.6	Trace organics in Sample 7 Cobbles below 6.1 m depth		8	SS	74							○				31 45 20 4
253.5	ARKOSIC GREYWACKE (BEDROCK)		1	RC	REC 100%											RQD = 0%
8.2	For coring details see Record of Drillhole C17-7.		2	RC	REC 100%											RQD = 0%
252.5	END OF BOREHOLE															
9.2	Note: 1. Water level at a depth of 6.6 m below ground surface (Elev. 255.1 m) upon completion of drilling.															

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-8	1 OF 1 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149860.2; E 318720.0 (LAT. 46.488262; LONG. -80.818682)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 20, 2017</u>	CHECKED BY <u>SEMP</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					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
255.9	GROUND SURFACE																
0.0	Sandy TOPSOIL	[diagonal hatching]	1	SS	10/0.2												
0.3	Gravelly Silty SAND (TILL) Compact Reddish brown END OF BOREHOLE AUGER AND SPLIT-SPOON REFUSAL Note: 1. Borehole dry upon completion of drilling. 2. Advanced dynamic cone penetration tests 10 m west (C17-8D1) and 10 m east (C17-8D2) of borehole. 3. A bedrock outcrop noted approximately 22 m northwest of borehole.																

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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



PROJECT 1651997 **RECORD OF PENETRATION TEST No C17-8D1** **1 OF 1 METRIC**
W.P. 5165-10-01 **LOCATION** N 5149860.2; E 318710.0 (LAT. 46.488262; LONG. -80.818812) **ORIGINATED BY** SA
DIST HWY 17 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** AC
DATUM GEODETIC **DATE** April 20, 2017 **CHECKED BY** SEMP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
256.2	GROUND SURFACE																
0.0																	
0.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)						256										

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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



PROJECT 1651997 **RECORD OF PENETRATION TEST No C17-8D2** 1 OF 1 **METRIC**

W.P. 5165-10-01 LOCATION N 5149860.2; E 318730.0 (LAT. 46.488262; LONG. -80.818552) ORIGINATED BY SA

DIST HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AC

DATUM GEODETIC DATE April 20, 2017 CHECKED BY SEMP

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									WATER CONTENT (%)
							20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
255.0	GROUND SURFACE																
0.0																	
254.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)					254											
1.0																	

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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

PROJECT <u>1651997</u>	RECORD OF BOREHOLE No C17-9	1 OF 1 METRIC
W.P. <u>5165-10-01</u>	LOCATION <u>N 5149857.5; E 318671.9 (LAT. 46.488239; LONG. -80.819309)</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>April 20, 2017</u>	CHECKED BY <u>SEMP</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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
257.1	GROUND SURFACE															
0.0	Silty TOPSOIL															
0.2	Sand, some gravel, some silt (FILL) Loose to dense Brown Moist		1	SS	9											
256.0																
1.1	SILT, trace to some sand, trace organics Dense Brown Moist		2	SS	36						H					
255.6																
1.5																
255.3												o				
1.8	SAND, trace gravel, trace to some silt Compact Reddish brown Wet		3	SS	24											1 88 9 2
254.8																
2.3	Gravelly Silty SAND (TILL) Compact Dark brown to grey Wet															
	END OF BOREHOLE AUGER AND SPLIT-SPOON REFUSAL															
	Note: 1. Water level at a depth of 1.8 m below ground surface (Elev. 255.3 m) upon completion of drilling. 2. Advanced dynamic cone penetration tests 10 m west (C17-9D1) and 10 m east (C17-9D2) of borehole.															

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:



PROJECT 1651997 **RECORD OF PENETRATION TEST No C17-9D1** 1 OF 1 **METRIC**

W.P. 5165-10-01 LOCATION N 5149857.5; E 318661.9 (LAT. 46.488239; LONG. -80.819439) ORIGINATED BY SA

DIST HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AC

DATUM GEODETIC DATE April 20, 2017 CHECKED BY SEMP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40					
257.1 0.0	GROUND SURFACE					257							
254.4 2.7	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)					255							

SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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



PROJECT 1651997 **RECORD OF PENETRATION TEST No C17-9D2** 1 OF 1 **METRIC**

W.P. 5165-10-01 LOCATION N 5149857.5; E 318681.9 (LAT. 46.488238; LONG. -80.819178) ORIGINATED BY SA

DIST HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AC

DATUM GEODETIC DATE April 20, 2017 CHECKED BY SEMP

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			20	40	60	80	100						20
257.1 0.0	GROUND SURFACE					257											
255.0 2.1	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)					255											

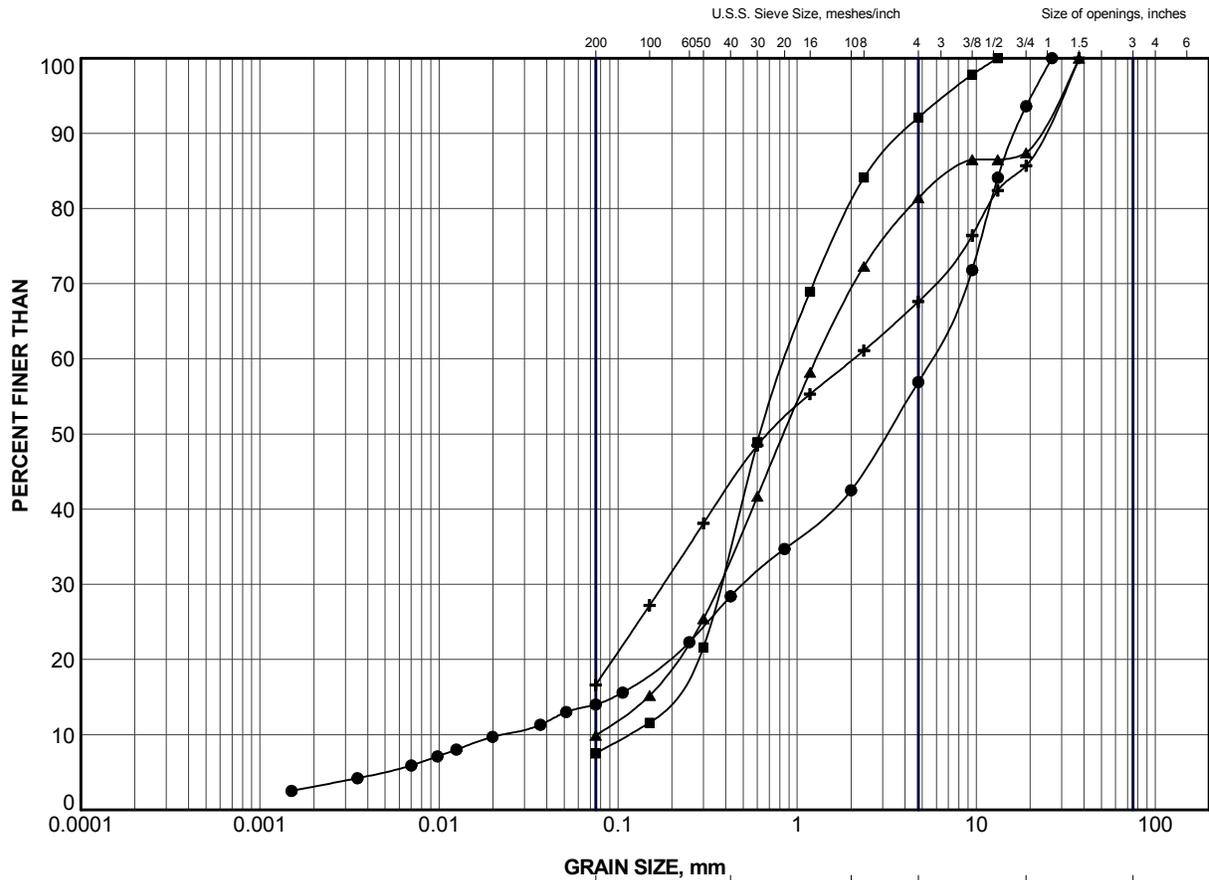
SUD-MTO 001 LATILONG 1651997.GPJ GAL-MISS.GDT 05/07/17 DATA INPUT:

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



APPENDIX D

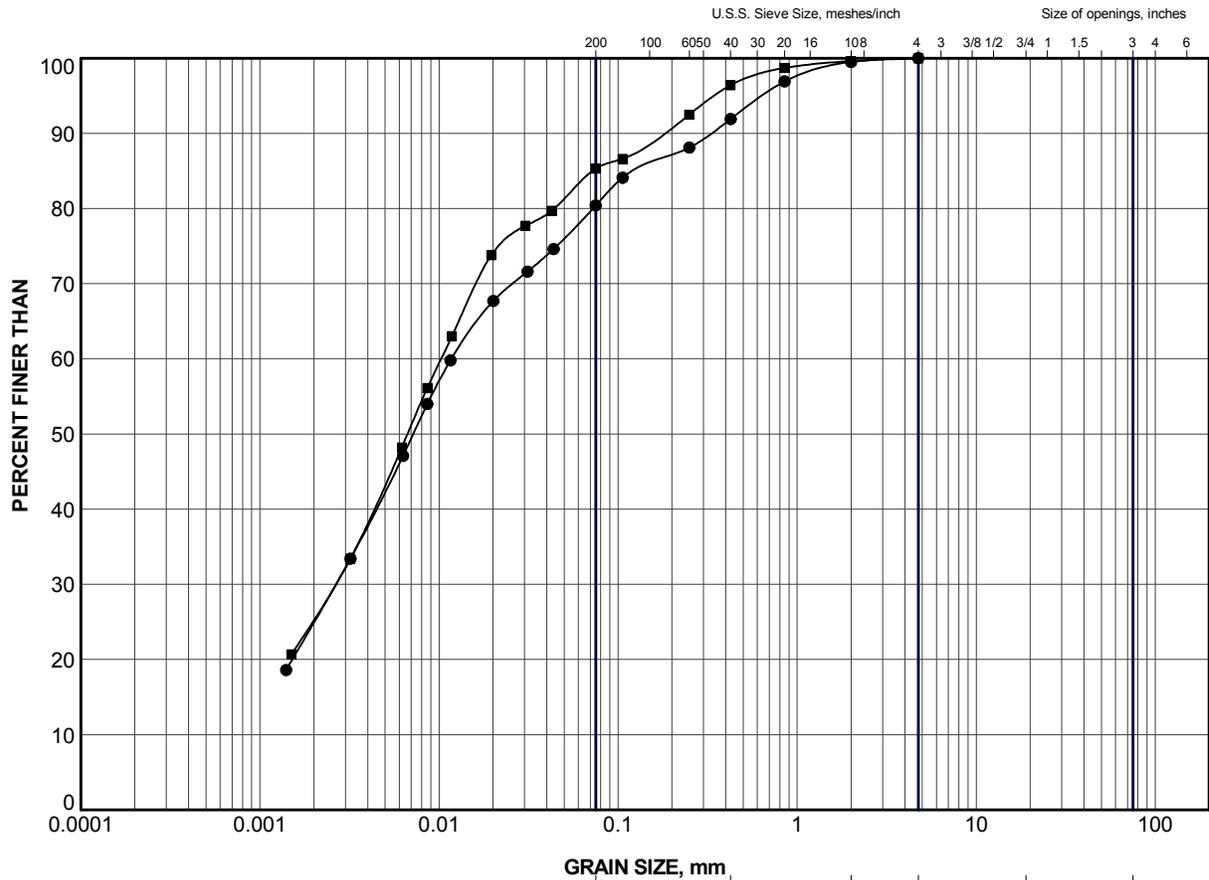
Current Investigation – Geotechnical Laboratory Test Results



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

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-3	1	253.3
■	C17-5	1	261.5
▲	C17-5	3	260.0
+	C17-7	2	259.9

PROJECT						HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE					
TITLE						GRAIN SIZE DISTRIBUTION SAND to SAND and GRAVEL (FILL)					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Sept 2017	SCALE	N/A	REV.	FIGURE D1					
CHECK	SEMP	Sept 2017									
APPR	JMAC	Sept 2017									
 Golder Associates SUDBURY, ONTARIO											



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

LEGEND

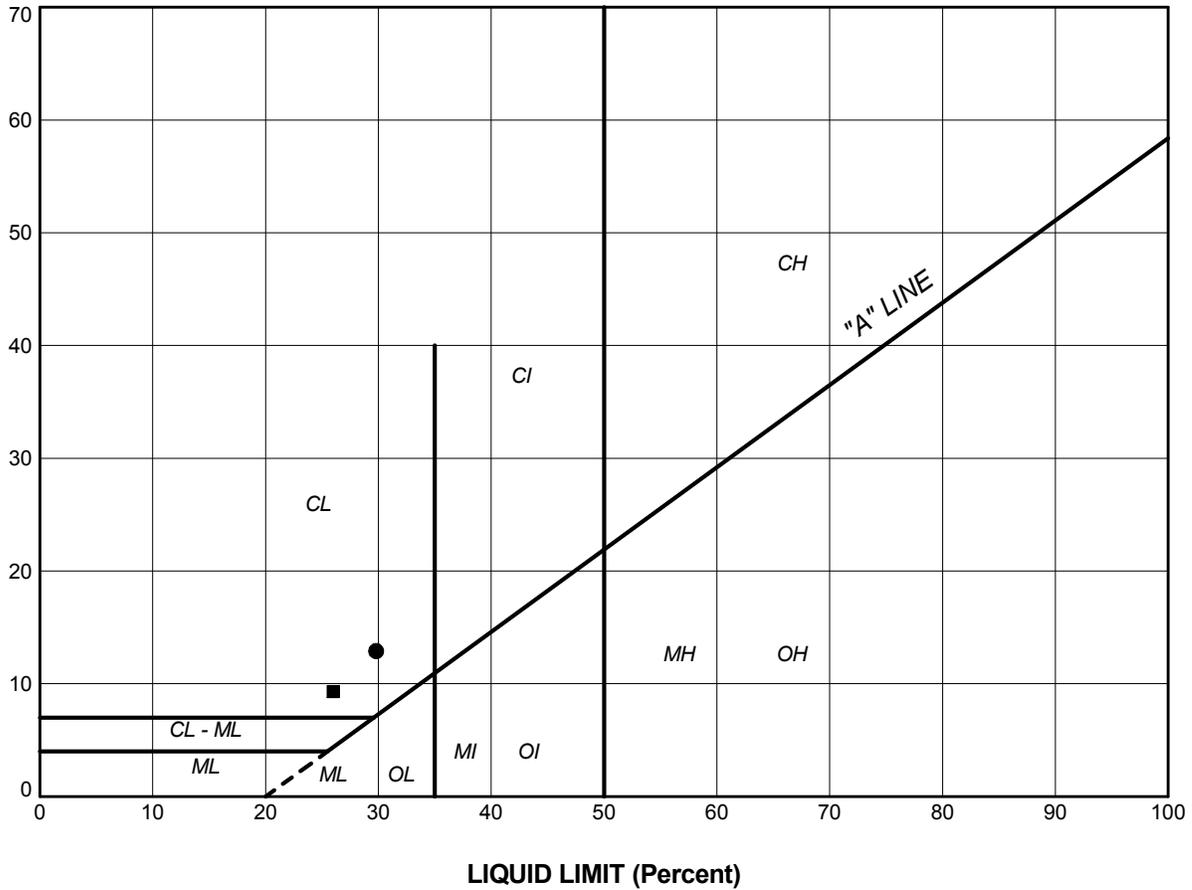
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-5	7	256.2
■	C17-7	5	257.6

PROJECT HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE					
TITLE GRAIN SIZE DISTRIBUTION CLAYEY SILT (FILL)					
PROJECT No.		1651997		FILE No. 1651997.GPJ	
DRAWN	TB	Sept 2017	SCALE	N/A	REV.
CHECK	SEMP	Sept 2017	FIGURE D2		
APPR	JMAC	Sept 2017			



SUD-MTO GSD (2016) GLDR_LDN.GDT

PLASTICITY INDEX (Percent)



SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

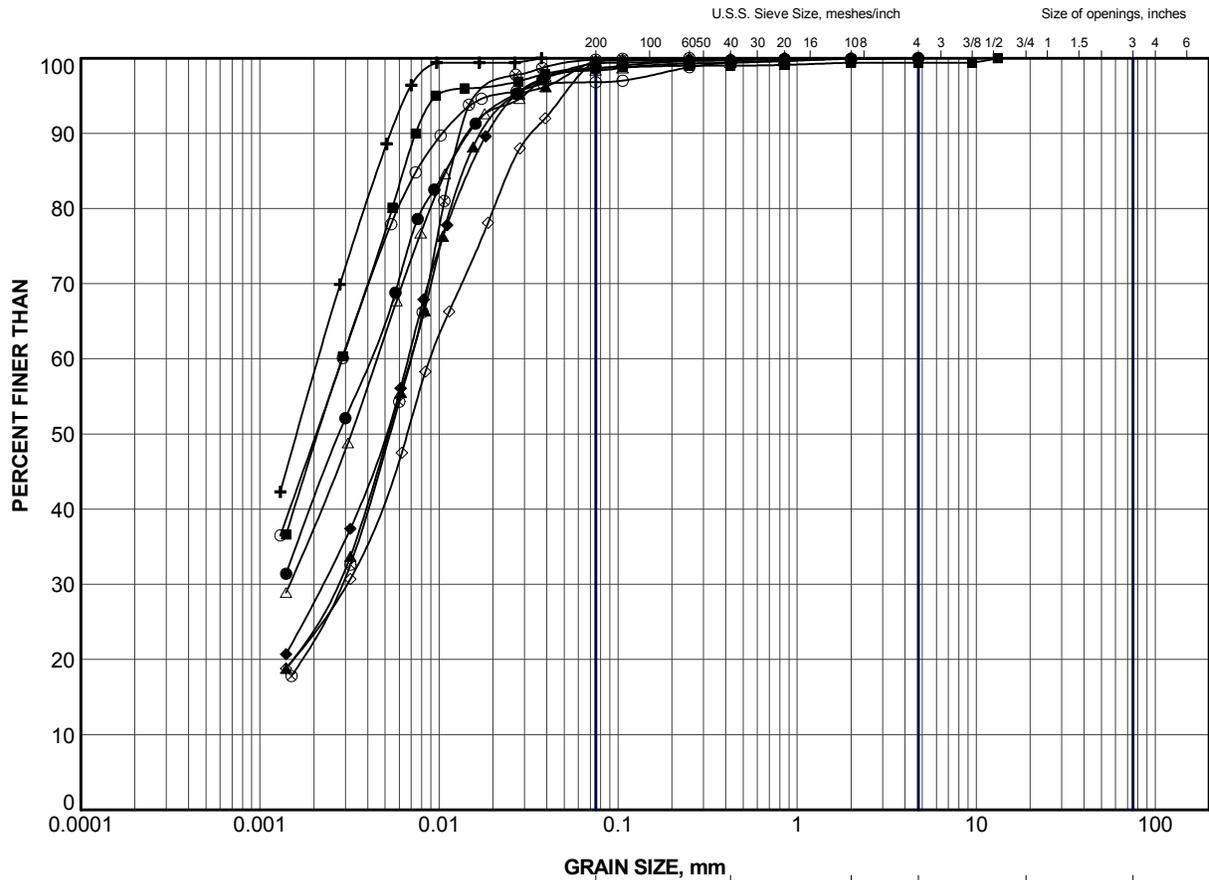
PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C17-5	7	29.8	16.9	12.9
■	C17-7	5	26.0	16.7	9.3

PROJECT						HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE		
TITLE						PLASTICITY CHART CLAYEY SILT (FILL)		
PROJECT No.		1651997		FILE No.		1651997.GPJ		
DRAWN	TB	Sept 2017		SCALE	N/A	REV.		
CHECK	SEMP	Sept 2017						
APPR	JMAC	Sept 2017		FIGURE D3				

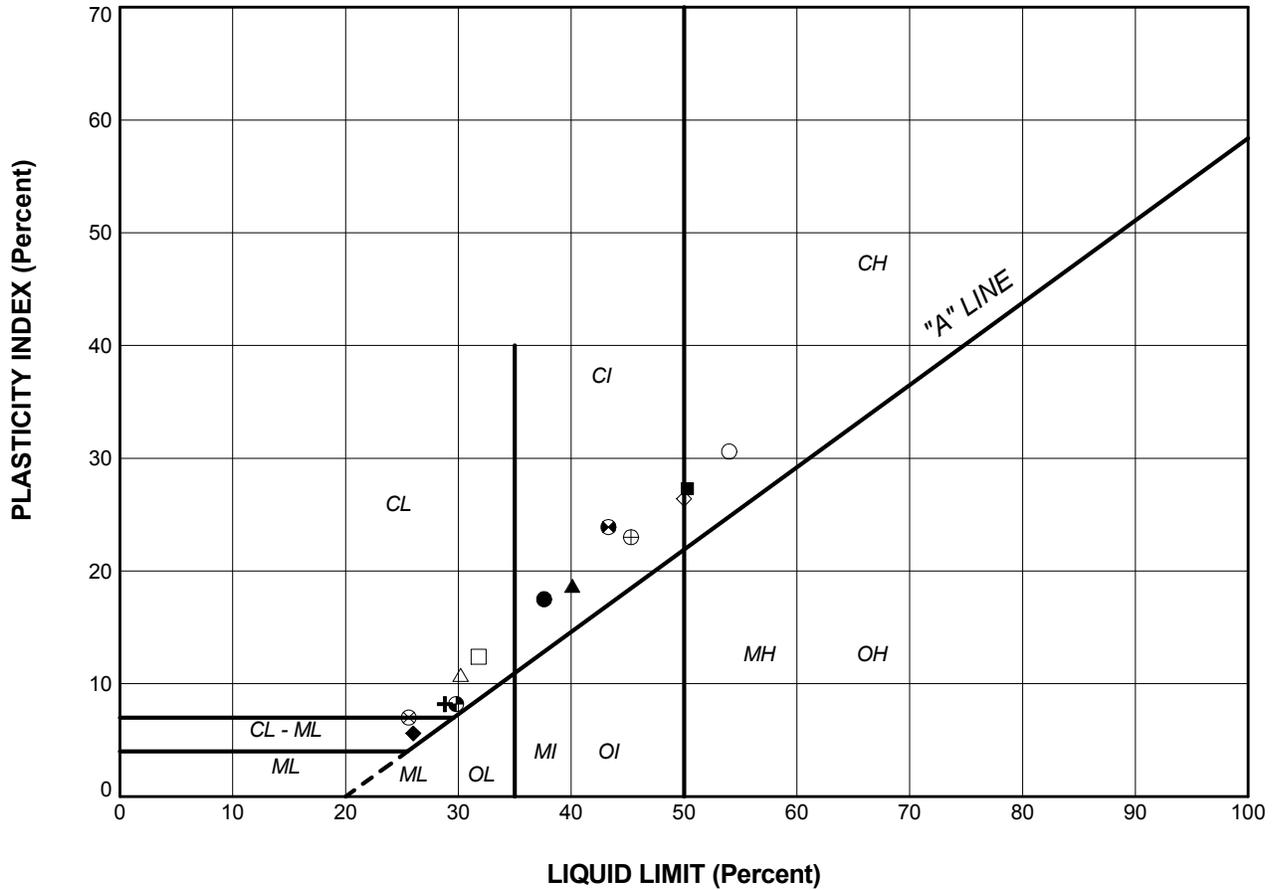




CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-3	4	250.9
■	C17-3	6	249.4
▲	C17-4	6A	248.2
+	C17-5	10	251.6
◆	C17-5	12	248.6
◇	C17-5	13	247.1
○	C17-6	3	251.3
△	C17-6	5	249.8
⊗	C17-6	7	246.7

PROJECT						HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE					
TITLE						GRAIN SIZE DISTRIBUTION CLAYEY SILT to CLAY					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Sept 2017	SCALE	N/A	REV.	FIGURE D4					
CHECK	SEMP	Sept 2017									
APPR	JMAC	Sept 2017									
 Golder Associates SUDBURY, ONTARIO											



SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C17-3	4	37.6	20.1	17.5
■	C17-3	6	50.3	23.0	27.3
▲	C17-3	7	40.1	21.4	18.7
+	C17-4	6A	28.8	20.6	8.2
◆	C17-4	6B	26.0	20.4	5.6
◇	C17-5	10	50.0	23.6	26.4
○	C17-5	11	54.0	23.4	30.6
△	C17-5	12	30.2	19.4	10.8
⊗	C17-5	13	25.6	18.6	7.0
⊕	C17-6	3	45.3	22.3	23.0
□	C17-6	5	31.8	19.4	12.4
⊗	C17-6	6	43.3	19.4	23.9
⊕	C17-6	7	29.8	21.6	8.2

PROJECT					HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE				
TITLE					PLASTICITY CHART CLAYEY SILT to CLAY				
PROJECT No.		1651997		FILE No.		1651997.GPJ			
DRAWN	TB	Sept 2017		SCALE	N/A	REV.			
CHECK	SEMP	Sept 2017		FIGURE D5					
APPR	JMAC	Sept 2017							
 Golder Associates SUDBURY, ONTARIO									

CONSOLIDATION TEST SUMMARY

FIGURE D6
Pg. 1 of 4

SAMPLE IDENTIFICATION

Project Number	1651997-1203	Sample Number	7
Borehole Number	C17-3	Sample Depth, m	5.5

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	2		
Date Started	May 17, 2017		
Date Completed	May 25, 2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.522	Unit Weight, kN/m ³	18.72
Sample Diameter, cm	6.358	Dry Unit Weight, kN/m ³	13.86
Area, cm ²	31.74	Specific Gravity, Measurec	2.766
Volume, cm ³	80.06	Solids Height, cm	1.289
Water Content, %	35.09	Volume of Solids, cm ³	40.91
Wet Mass, g	152.85	Volume of Voids, cm ³	39.15
Dry Mass, g	113.15		

TEST COMPUTATIONS

Pressure kPa	Primary Consolidation mm	Corr. Height cm	End of Primary Void Ratio	Average Height cm	t ₉₀ sec	cv, cm ² /s	mv m ² /kN	k cm/s	Total Work kJ/m ³
0	0	2.522	0.957	2.522					
4	0.07	2.510	0.952	2.516	375	0.0036	6.17E-04	2.16E-07	0.006
13	0.04	2.500	0.945	2.505	240	0.0055	4.18E-04	2.27E-07	0.038
31	0.06	2.481	0.936	2.491	135	0.0097	2.50E-04	2.39E-07	0.136
66	0.11	2.453	0.917	2.467	135	0.0096	2.71E-04	2.54E-07	0.606
137	0.18	2.403	0.890	2.428	135	0.0093	2.00E-04	1.81E-07	2.063
277	0.44	2.326	0.831	2.365	375	0.0032	2.14E-04	6.63E-08	8.506
558	0.31	2.265	0.781	2.295	240	0.0047	9.11E-05	4.16E-08	19.921
1140	0.28	2.205	0.736	2.235	60	0.0176	3.90E-05	6.75E-08	41.105
558	-0.05	2.210	0.715	2.207					
137	-0.14	2.224	0.726	2.217					
31	-0.16	2.241	0.739	2.232					
4	-0.12	2.252	0.748	2.246					

Note:
k calculated using cv based on t₉₀ values.
Void ratio for unloading (or rebound) calculated for the end of increment

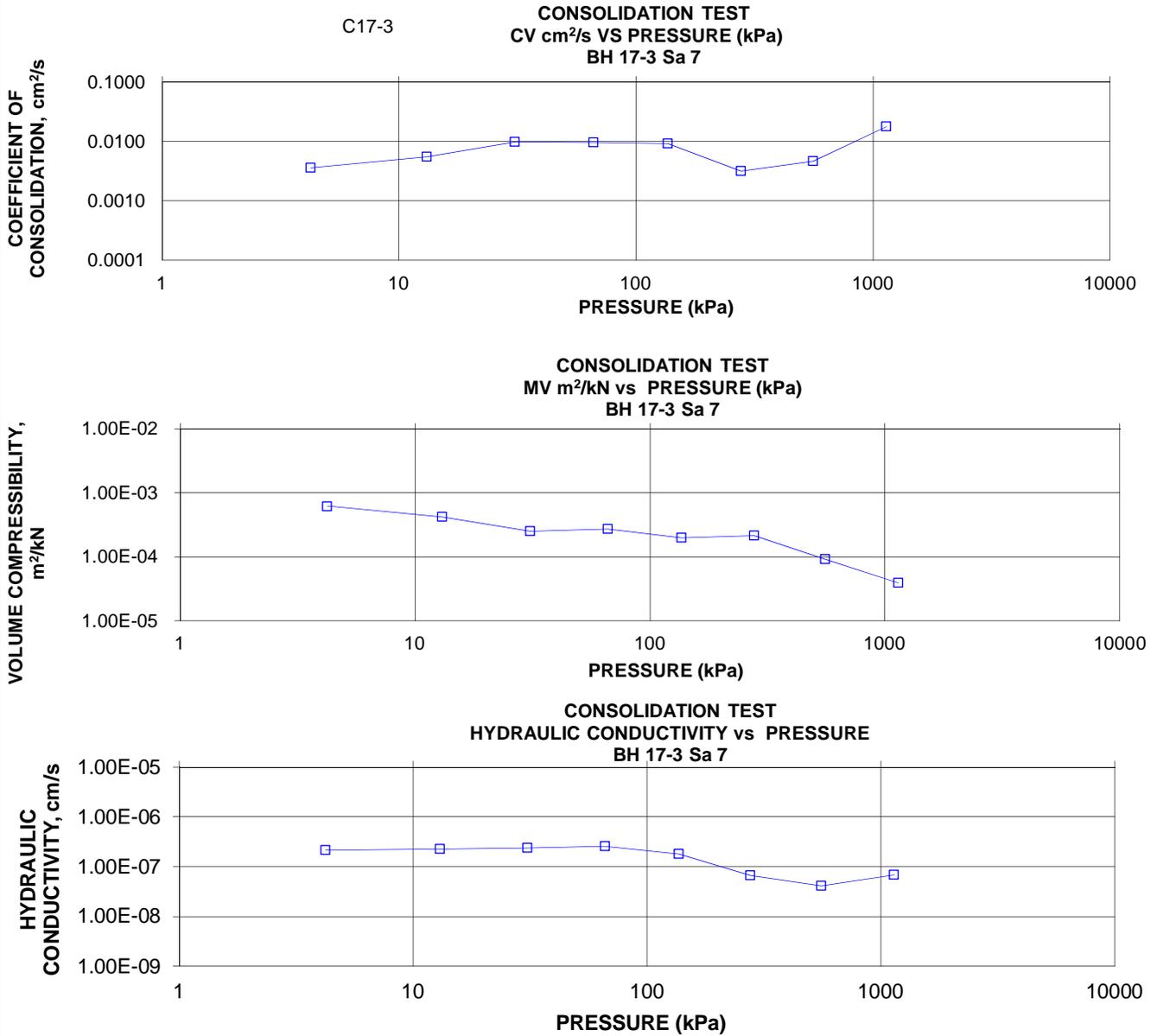
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.423	Unit Weight, kN/m ³	18.31
Sample Diameter, cm	6.36	Dry Unit Weight, kN/m ³	14.42
Area, cm ²	31.74	Specific Gravity, Measurec	2.766
Volume, cm ³	76.93	Solids Height, cm	1.289
Water Content, %	26.95	Volume of Solids, cm ³	40.91
Wet Mass, g	143.64	Volume of Voids, cm ³	36.02
Dry Mass, g	113.15		

Prepared By: TC

Golder Associates

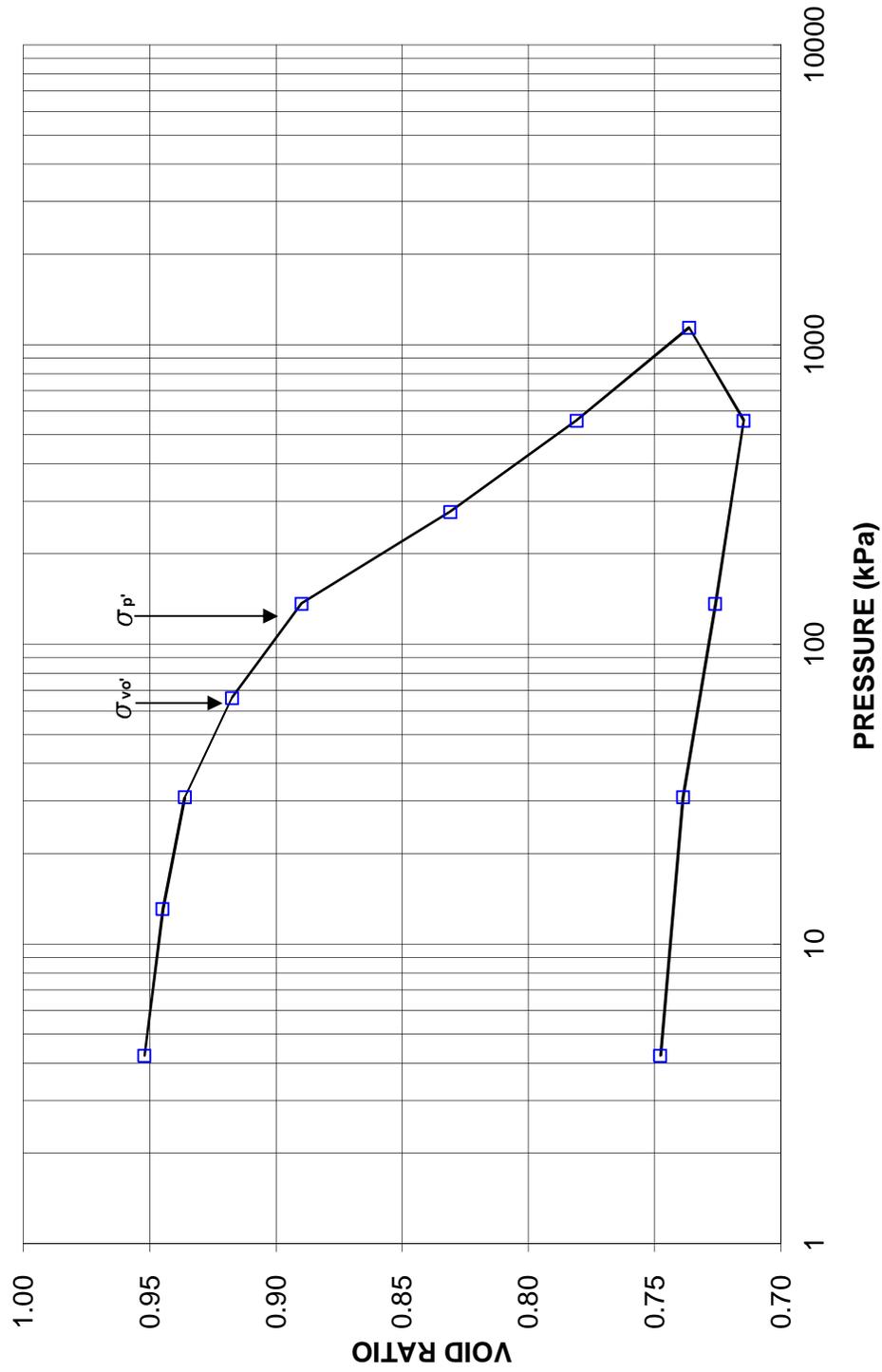
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CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE D6
Pg. 3 of 4

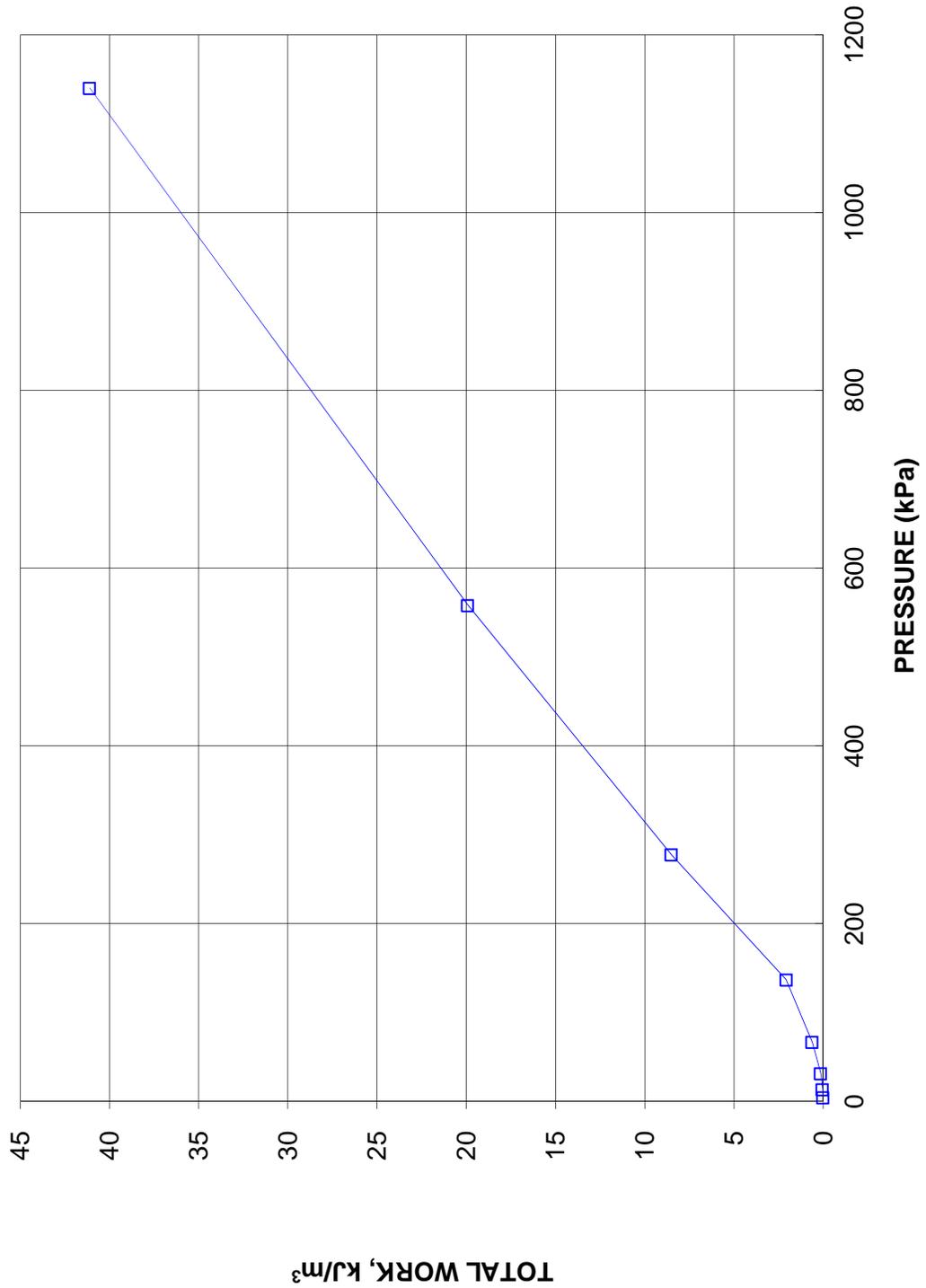
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH 17-3 Sa 7



**CONSOLIDATION TEST
TOTAL WORK VS PRESSURE**

FIGURE D6
Pg. 4 of 4

**CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs PRESSURE
BH 17-3 Sa 7**



CONSOLIDATION TEST SUMMARY

FIGURE D7
Pg. 1 of 4

SAMPLE IDENTIFICATION

Project Number	1651997-1203	Sample Number	1
Borehole Number	C17-4	Sample Depth, m	5.5

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	May 9, 2017		
Date Completed	May 25, 2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.544	Unit Weight, kN/m ³	18.00
Sample Diameter, cm	6.357	Dry Unit Weight, kN/m ³	12.99
Area, cm ²	31.74	Specific Gravity, measured	2.765
Volume, cm ³	80.75	Solids Height, cm	1.219
Water Content, %	38.53	Volume of Solids, cm ³	38.69
Wet Mass, g	148.20	Volume of Voids, cm ³	42.06
Dry Mass, g	106.98		

TEST COMPUTATIONS

Pressure kPa	Primary Consolidation mm	Corr. Height cm	End of Primary Void Ratio	Average Height cm	t ₉₀ sec	cv, cm ² /s	mv m ² /kN	k cm/s	Total Work kJ/m ³
0	0.00	2.544	1.087	2.544					
9	0.01	2.526	1.086	2.535	375	0.00363	4.40E-05	1.57E-08	0.002
18	0.04	2.512	1.068	2.519	540	0.00249	9.59E-04	2.34E-07	0.117
35	0.14	2.485	1.050	2.499	844	0.00157	5.21E-04	8.01E-08	0.356
69	0.17	2.447	1.025	2.466	470	0.00274	3.42E-04	9.19E-08	0.975
143	0.24	2.396	0.988	2.422	540	0.00230	2.45E-04	5.52E-08	2.936
285	0.33	2.311	0.939	2.353	375	0.00313	1.66E-04	5.09E-08	8.238
570	0.65	2.206	0.842	2.258	540	0.00200	1.63E-04	3.19E-08	29.574
1140	0.48	2.121	0.770	2.163	240	0.00413	6.00E-05	2.43E-08	62.723
570	-0.05	2.126	0.744	2.123					
143	-0.18	2.144	0.759	2.135					
35	-0.20	2.164	0.775	2.154					
9	-0.19	2.182	0.790	2.173					

Note:
k calculated using α based on t₉₀ values.
Void ratio for unloading (or rebound) calculated for the end of increment

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.400	Unit Weight, kN/m ³	17.57
Sample Diameter, cm	6.36	Dry Unit Weight, kN/m ³	13.77
Area, cm ²	31.74	Specific Gravity, measured	2.765
Volume, cm ³	76.17	Solids Height, cm	1.219
Water Content, %	27.58	Volume of Solids, cm ³	38.69
Wet Mass, g	136.49	Volume of Voids, cm ³	37.48
Dry Mass, g	106.98		

Prepared By: TG

Golder Associates

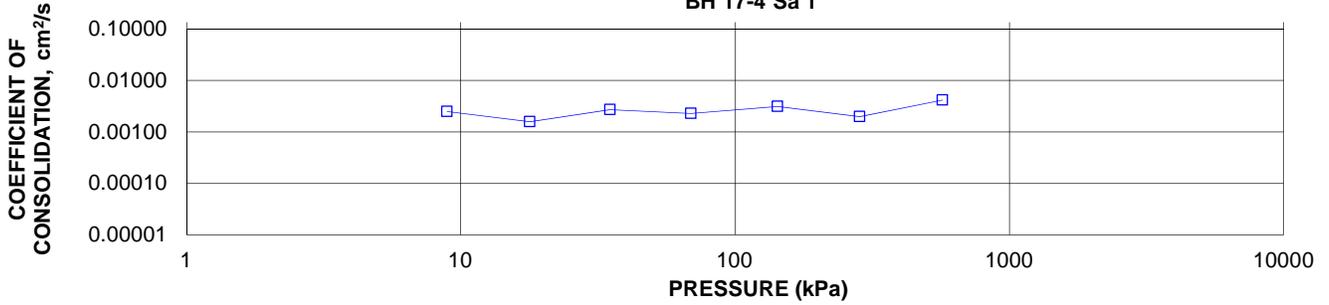
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CONSOLIDATION TEST SUMMARY

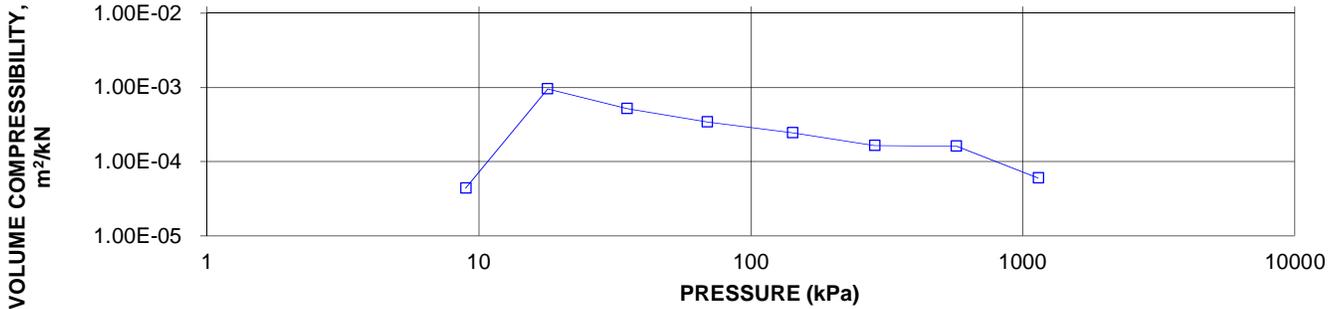
FIGURE D7
Pa. 2 of 4

C17-4

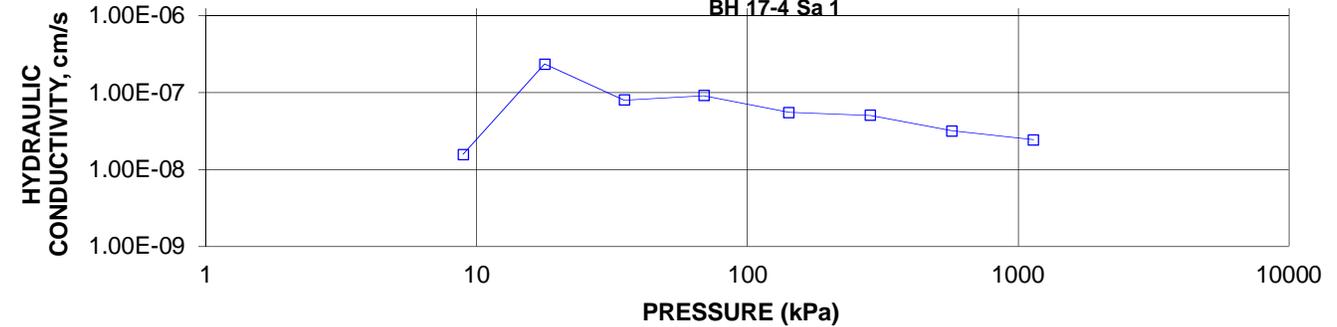
**CONSOLIDATION TEST
CV cm²/s VS PRESSURE (kPa)
BH 17-4 Sa 1**



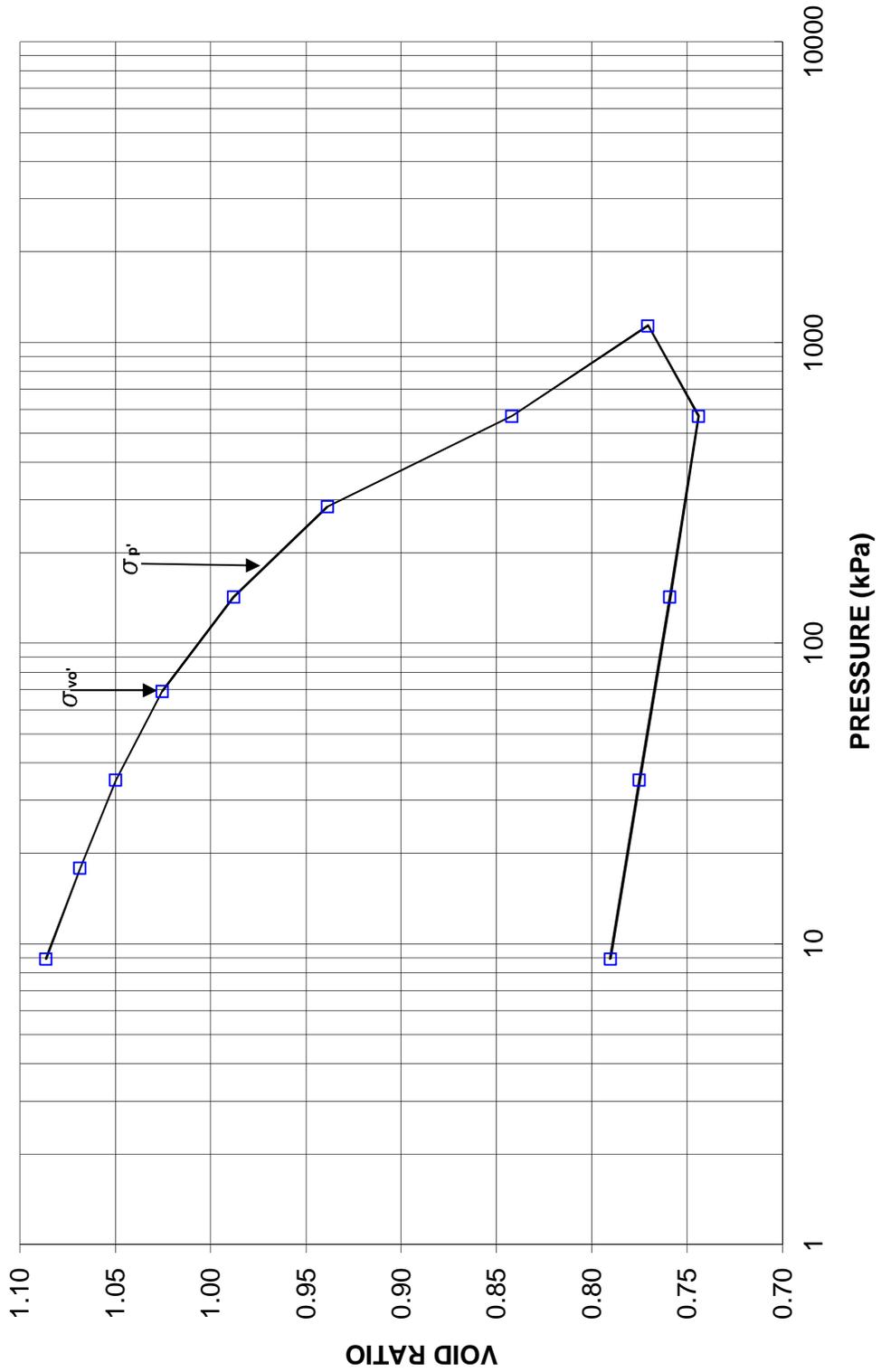
**CONSOLIDATION TEST
MV m²/kN vs PRESSURE (kPa)
BH 17-4 Sa 1**



**CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 17-4 Sa 1**



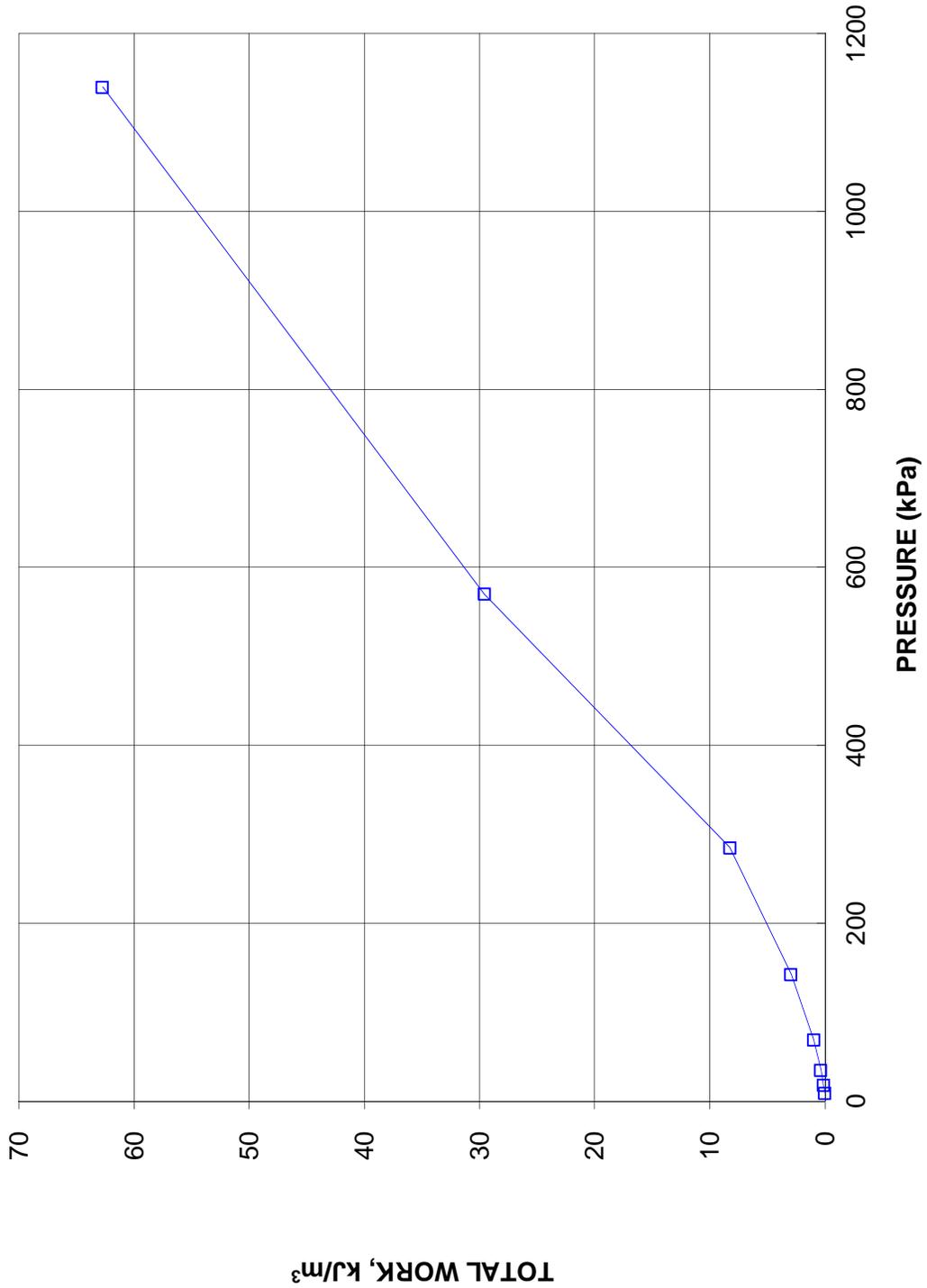
CONSOLIDATION TEST
VOID RATIO VS PRESSURE
BH 17-4 Sa 1

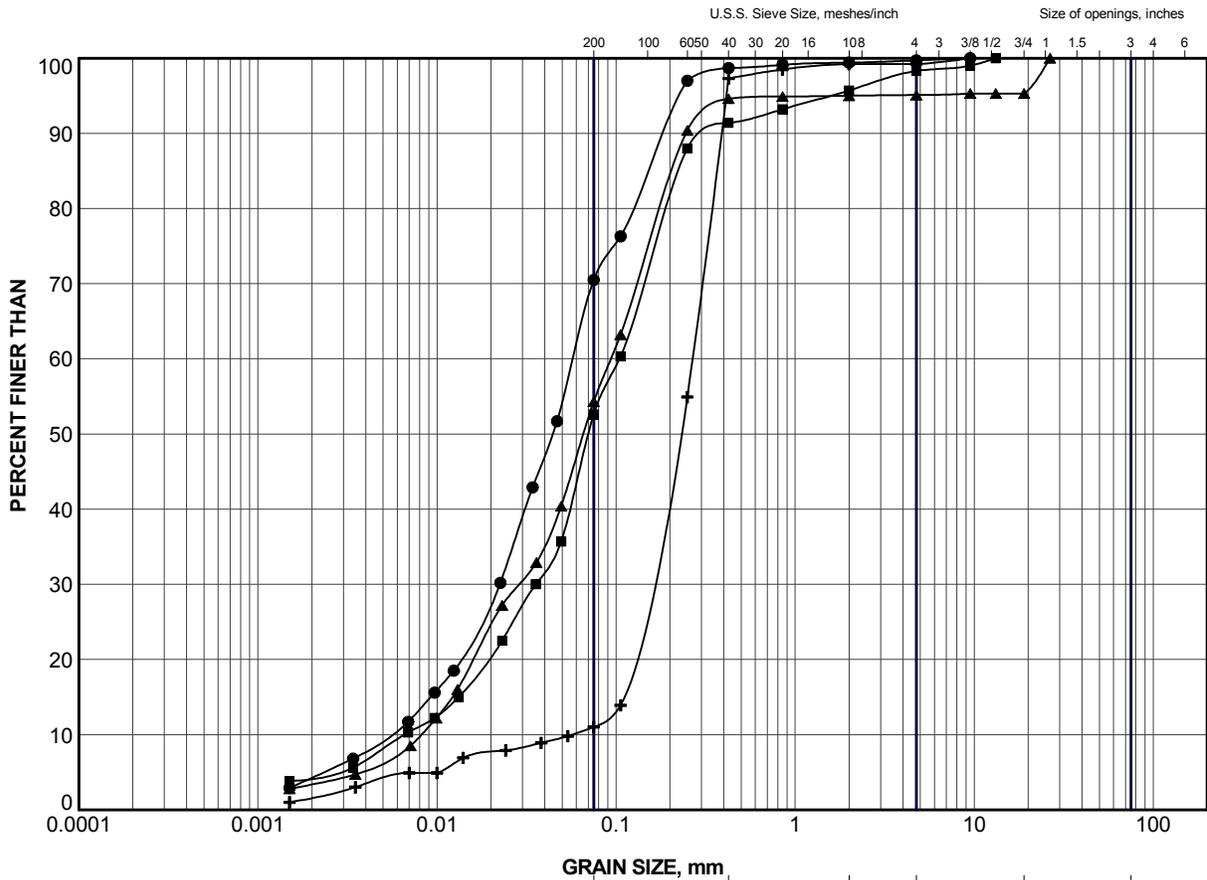


**CONSOLIDATION TEST
TOTAL WORK VS PRESSURE**

FIGURE D7
Pg. 4 of 4

**CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs PRESSURE
BH 17-4 Sa 1**





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

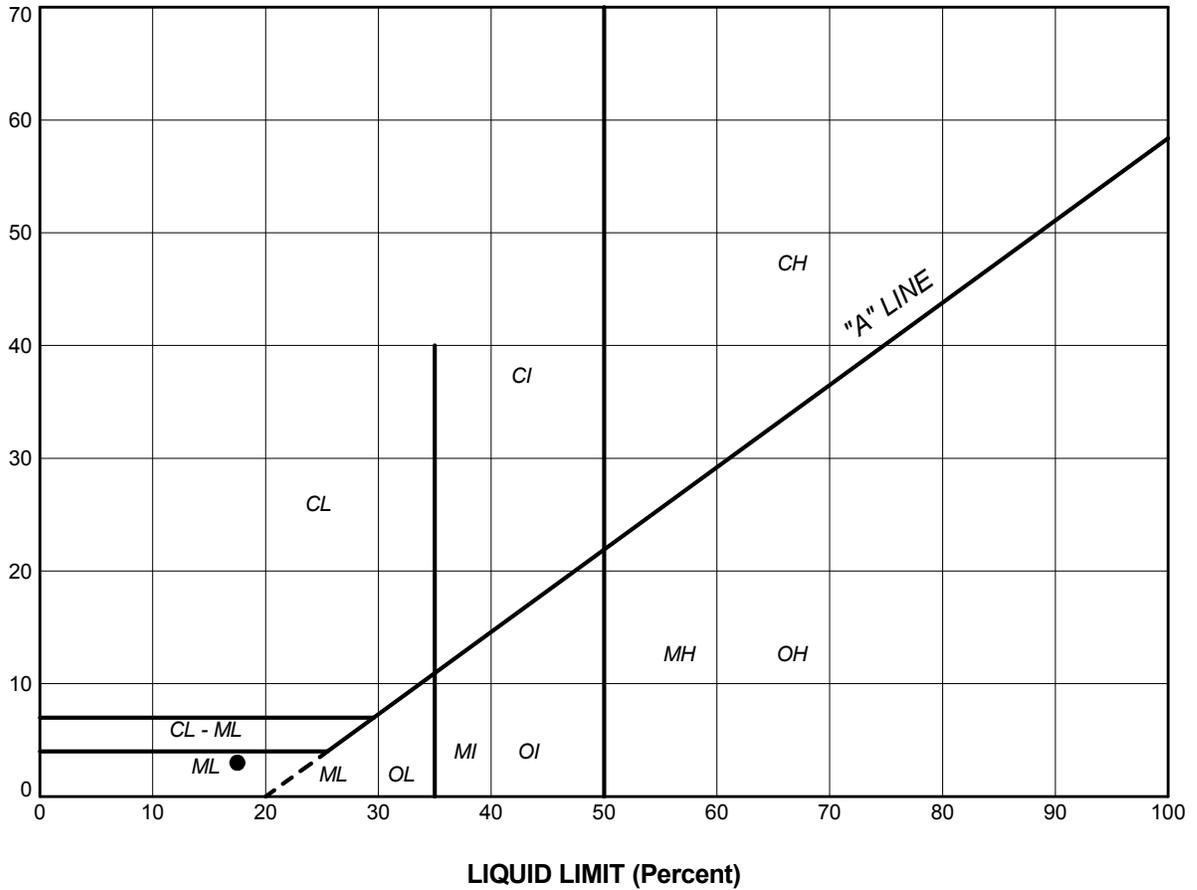
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-3	8	245.6
■	C17-4	7	246.5
▲	C17-6	9B	243.7
+	C17-9	3	255.5

PROJECT						HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE					
TITLE						GRAIN SIZE DISTRIBUTION SANDY SILT to SILT and SAND to SAND					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Sept 2017	SCALE	N/A	REV.	FIGURE D8					
CHECK	SEMP	Sept 2017									
APPR	JMAC	Sept 2017									



PLASTICITY INDEX (Percent)



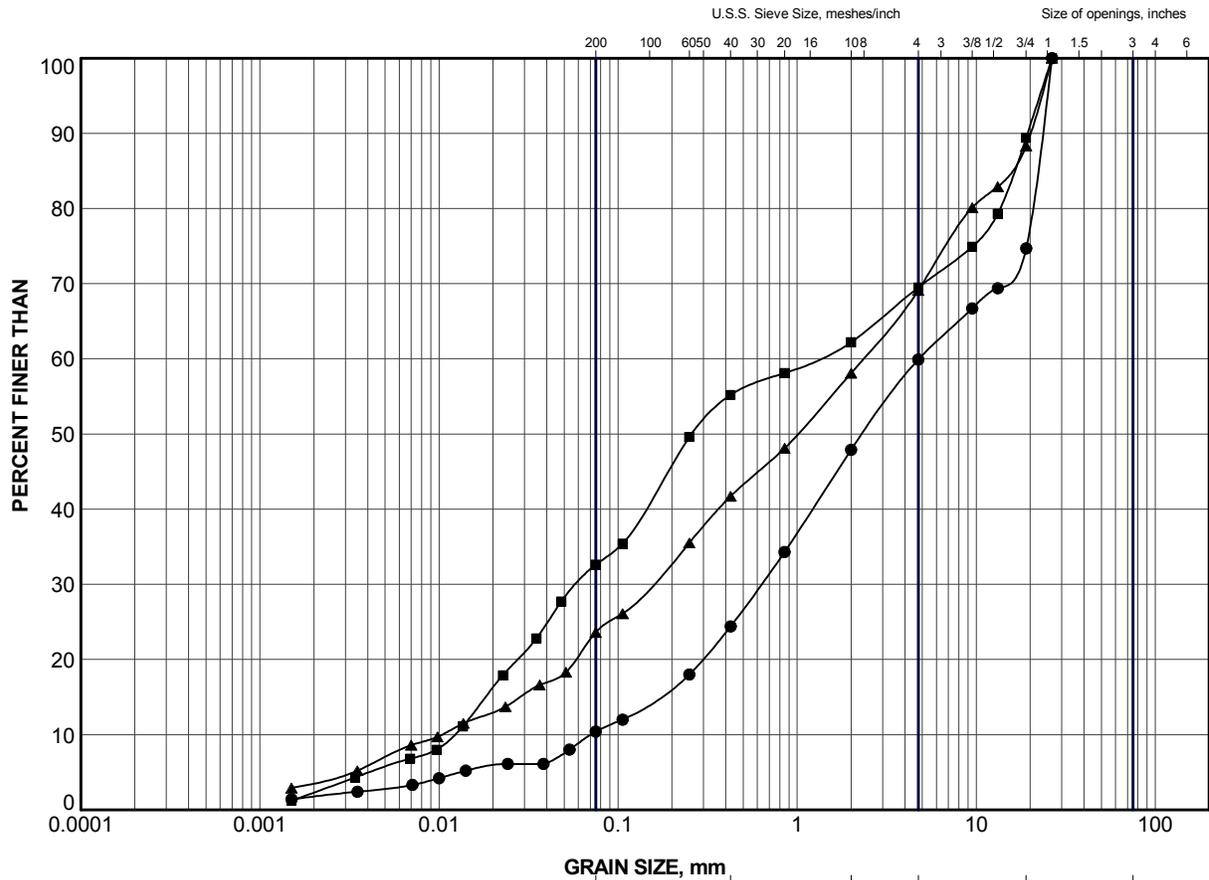
SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C17-9	2	17.5	14.5	3.0

PROJECT					HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE				
TITLE					PLASTICITY CHART SILT				
PROJECT No.		1651997			FILE No.		1651997.GPJ		
DRAWN	TB	Sept 2017			SCALE	N/A		REV.	
CHECK	SEMP	Sept 2017			FIGURE D9				
APPR	JMAC	Sept 2017							
 Golder Associates SUDBURY, ONTARIO									



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-5	14	245.6
■	C17-7	7	255.3
▲	C17-7	8	253.8

PROJECT						HIGHWAY 17 CONISTON CPR OVERHEAD BRIDGE					
TITLE						GRAIN SIZE DISTRIBUTION SILTY SAND and GRAVEL to SAND and GRAVEL (TILL)					
PROJECT No.			1651997			FILE No.			1651997.GPJ		
DRAWN	TB	Sept 2017	SCALE	N/A	REV.	FIGURE D10					
CHECK	SEMP	Sept 2017									
APPR	JMAC	Sept 2017									
 Golder Associates SUDBURY, ONTARIO											

SUD-MTO GSD (2016) GLDR_LDN.GDT

Borehole C17-1



Box 1: 0.0 m – 3.0 m

Borehole C17-2



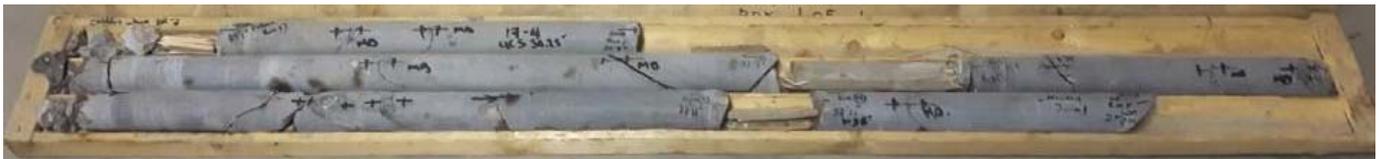
Box 1: 0.0 m – 3.0 m

Borehole C17-3



Box 1: 8.6 m – 11.7 m

Borehole C17-4

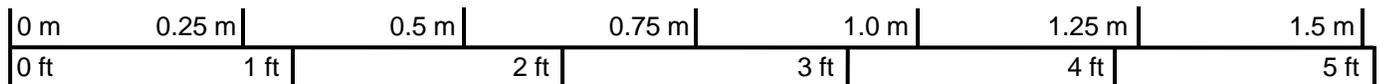


Box 1: 8.9 m – 11.9 m

Borehole C17-7



Box 1: 8.2 m – 9.2 m



Scale

PROJECT					
CPR Overhead on Highway 17 at Coniston Sudbury Area, Ontario					
TITLE					
Bedrock Core Photographs Borehole C17-1, C17-2, C17-3, C17-4, C17-7					
PROJECT No. 1651997			FILE No. ----		
DESIGN	AC	JUN 17	SCALE	NTS	REV.
CADD	--		FIGURE D11		
CHECK	SEMP	JUN 17			
REVIEW	SEMP	JUN 17			



As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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