



October 7, 2016

FOUNDATION INVESTIGATION REPORT

SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER CREEK CULVERTS

SITES 48W-9/C, 48W-188/C AND 48W-12/C

HIGHWAY 17, DISTRICT OF THUNDER BAY

MINISTRY OF TRANSPORTATION, ONTARIO

G.W.P. 6336-14-00 W.P. 6338-14-01, W.P. 6337-14-01 & W.P. 6336-14-01

Submitted to:

Hatch Ltd.
2800 Speakman Drive
Mississauga, ON
L5K 2R7



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REPORT





Table of Contents

PART A – FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
2.1 Sisson Creek Culvert	1
2.2 English River Tributary Culvert	1
2.3 Baker Creek Culvert	2
3.0 INVESTIGATION PROCEDURES	2
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS	3
4.1 Regional Geology	3
4.1.1 Sisson Creek.....	3
4.1.2 English River Tributary	4
4.1.3 Baker Creek	4
4.2 General Overview of Local Subsurface Conditions.....	4
4.3 Sisson Creek Culvert	4
4.4 English River Tributary Culvert	6
4.5 Baker Creek Culvert	8
4.6 Analytical Testing of Creek/Tributary Water Samples.....	9
5.0 CLOSURE.....	9

TABLES

Table 1	Summary Details of Existing Culverts
Table 2	Summary of Analytical Testing of Sisson Creek, English River Tributary and Baker Creek Water Samples

FIGURES

Figure 1	Location Plan
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LIST OF SYMBOLS AND ABBREVIATIONS

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

APPENDICES

Appendix A	Sisson Creek Culvert (Site 48W-9/C)
Drawing A1	Borehole Locations and Soil Strata
Photographs	A1 to A4
Record of Boreholes	SI-1 to SI-4



Figure A1 Grain Size Distribution – Sand
Figure A2 Grain Size Distribution – Silt to Silt and Sand
Figure A3 Grain Size Distribution – Sand to Gravelly Sand

Appendix B English River Tributary Culvert (Site 48W-188/C)
Drawing B1 Borehole Locations and Soil Strata
Photographs B1 to B4
Record of Boreholes ER-1 to ER-4
Record of Drillholes ER-1 and ER-4
Figure B1 Grain Size Distribution – Sand (Fill)
Figure B2 Grain Size Distribution – Silty Sand to Sand
Figure B3 Grain Size Distribution – Gravelly Silty Sand (TILL)
Figure B4 Bedrock Core Photographs

Appendix C Baker Creek Culvert (Site 48W-12/C)
Drawing C1 Borehole Locations and Soil Strata
Photographs C1 to C4
Record of Boreholes BK-1 to BK-4
Figure C1 Grain Size Distribution – Sand
Figure C2 Grain Size Distribution – Silt and Sand to Sand



PART A

**DETAIL FOUNDATION INVESTIGATION REPORT
SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER CREEK CULVERTS
SITES 48W-9/C, 48W-188/C AND 48W-12/C
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Hatch Ltd. (Hatch) on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the rehabilitation of the Sisson Creek Culvert (Site 48W-9/C), English River Tributary Culvert (Site 48W-188/C) and Baker Creek Culvert (Site 48W-12/C) on Highway 17 in the District of Thunder Bay, Ontario. The general locations of the culverts are shown on the Key Plan on Figure 1.

2.0 SITE DESCRIPTION

The existing Sisson Creek, English River Tributary and Baker Creek culvert details (size, length, type, etc.) are summarized in Table 1, following the text of this report.

It should be noted that the orientation (i.e., north, south, east, west) stated in the text of the report is typically referenced to project north and therefore may differ from magnetic north shown on the drawings.

2.1 Sisson Creek Culvert

The Sisson Creek culvert is located on Highway 17 at approximately Sta. 10+959 in the Township of Pyramid, about 66 km east of Highway 599. For the purpose of this report, Highway 17 runs in a west-east direction at the Sisson Creek location with the culvert perpendicular to the highway in north-south orientation.

In general, the topography in the area is relative flat, with low lying grassy/swampy ground bordering the creek on both sides of the highway. Sisson Creek flows from north to south. At the culvert location, the highway grade is at Elevation 465.1 m with the existing culvert inverts at Elevation 462.1 m and 462.0 m at the inlet (north end) and outlet (south end), respectively. The creek water level, as surveyed by Golder on January 25, 2016, was at Elevation 463.4 m at both the inlet and outlet ends of the culverts. Ground surface conditions at the culvert location are shown on Photographs A1 to A4 in Appendix A.

2.2 English River Tributary Culvert

The English River Tributary culvert is located on Highway 17 at approximately Sta. 11+592 in the Township of Trewartha, about 73 km east of Highway 599. For the purpose of this report, Highway 17 runs in a west-east direction at the English River Tributary location with the culvert perpendicular to the highway in north-south orientation.

In general, the topography in the culvert area is relatively flat, with low-lying grassy/swampy ground bordering the tributary on both sides of the highway. The English River Tributary flows from north to south. The highway grade at the culvert location is at Elevation 469.9 m with the existing culvert invert at Elevation 467.0 m and 467.1 m at the inlet (north end) and outlet (south end), respectively. The Tributary ice level, as surveyed by Golder on January 22, 2016, was at Elevation 467.9 m at both the inlet and outlet ends of the culvert. Ground surface conditions at the culvert location are shown on Photographs B1 to B4 in Appendix B.



2.3 Baker Creek Culvert

The Baker Creek culvert is located on Highway 17 at approximately 14+907 in the Township of Trewartha, about 76 km east of Highway 599. For the purpose of this report, Highway 17 runs in a west-east direction at the Baker Creek location with the culvert perpendicular to the highway in north-south orientation.

In general, the topography in the culvert area is relatively flat, with low lying grassy ground bordering the creek on both sides of the highway. Baker Creek flows north to south. The highway grade at the culvert location is at Elevation 469.7 m with the existing culvert invert at Elevation 466.2 m at both the inlet (north end) and outlet (south end). The creek ice level, as surveyed by Golder on January 20, 2016 was at Elevation 467.8 m at the outlet end of the culvert. Ground surface conditions at the culvert location are shown on Photographs C1 to C4 in Appendix C.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the investigation at the Sisson Creek, English River Tributary and Baker Creek culvert sites was carried out between January 19 and 30, 2016, during which period a total of twelve (12) boreholes were advanced at the three culvert sites (4 boreholes at each site). A summary of the boreholes advanced at each culvert site is presented and the locations of the boreholes and culvert sites are shown on Drawings A1, B1 and C1 in Appendices A to C, respectively.

The field investigation was carried out using a track mounted CME 850 drill rig supplied and operated by Cartwright Drilling Ltd. of Thunder Bay, Ontario and a portable tripod drill supplied and operated by Landcore of Sudbury, Ontario. The boreholes were advanced through the overburden using 108 mm inside diameter hollow stem augers and/or HW/NW casing with wash boring techniques. Where bedrock coring was performed, an HQ size core barrel was utilized. In general, soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter split-spoon sampler, performed in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). All open boreholes were backfilled upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The fieldwork was supervised on a full-time basis by a member of Golder's technical staff who: located the boreholes in the field; 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 samples. The soil and bedrock samples were identified in the field, placed in appropriate containers, labelled and transported to our Sudbury Geotechnical Laboratory where the samples and core underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO Laboratory Standards and/or ASTM Standards, as appropriate. Classification testing (water content, grain size distribution and Atterberg limits) was carried out on selected soil samples. Unconfined compressive strength tests were carried out on selected specimens of the recovered bedrock cores.

A sample of the creek/tributary water was obtained during the field investigation at each culvert location, using appropriate sampling protocols and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of parameters.

The as-drilled borehole locations and ground surface elevations were measured and surveyed by members of our technical staff, referenced to the highway centerline and existing culvert and converted into northing/easting coordinates on the plan drawings. The ground surface elevation of the highway centerline at each culvert



location was obtained from the profile drawings provided by MTO (drawings BC322172.dwg, e745172.dwg and e745171.dwg). The MTM NAD83 (Zone 15) northing and easting coordinates, ground surface elevations referenced to Geodetic datum, and borehole depths at each borehole location are presented on the Record of Borehole sheets in Appendices A, B and C and summarized below.

Culvert	Borehole	MTM NAD 83 Coordinates (m)		Ground Surface Elevation (m)	Borehole Depth (m)
		Northing	Easting		
Sisson Creek Culvert (Site 48W-9/C)	SI-1	5 450 504.7	241 789.6	463.6	9.8
	SI-2	5 450 494.3	241 798.6	463.9	9.8
	SI-3	5 450 487.2	241 770.6	463.7	9.1
	SI-4	5 450 477.2	241 780.6	463.9	9.8
English River Tributary Culvert (Site 48W-188/C)	ER-1	5 445 736.4	246 362.4	468.2	7.0*
	ER-2	5 445 732.5	246 373.7	468.3	5.9
	ER-3	5 445 713.0	246 352.5	468.3	6.8
	ER-4	5 445 708.2	246 363.1	468.4	6.1*
Baker Creek Culvert, (Site 48W-12/C)	BK-1	5 444 570.8	249 466.2	468.3	9.8
	BK-2	5 444 568.1	249 477.6	467.8	9.8
	BK-3	5 444 544.0	249 453.2	468.2	9.8
	BK-4	5 444 538.6	249 467.9	468.3	9.8

*Includes 3.1 m and 3.2 m bedrock core at the respective boreholes.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

4.1.1 Sisson Creek

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS)¹ mapping, the subsoils at the Sisson Creek culvert site consists of knobby/hummocky bedrock knobs bordering with organic terrain deposits comprised of peat and outwash plain/valley terrain deposits comprised of sand.

Based on the geological mapping by the Ministry of Northern Development and Mines (MNDM)², the Sisson Creek culvert site is underlain by bedrock of the foliated tonalite suite comprised of foliated to massive tonalite to granodiorite.

¹ Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society. Electronic Mapping, Map 52GSE.

² Ministry of Northern Development and Mines. Bedrock Geology – West Central Sheet, Ontario Geological Survey – Map 2542



4.1.2 English River Tributary

Based on NOEGTS mapping, the subsoils at the English River Tributary culvert site consists knobby/hummocky bedrock knobs bordering with organic terrain deposits comprised of peat.

Based on the geological mapping by the MNDM, the English River Tributary culvert site is underlain by bedrock of the gneissic tonalite suite comprised of foliated to gneissic tonalite to granodiorite with minor supracrustal inclusions.

4.1.3 Baker Creek

Based on NOEGTS mapping, the subsoils at the Baker Creek culvert site consists of organic terrain comprised of peat, bordering knobby/hummocky bedrock knobs and ground moraine deposit consisting sand till.

Based on the geological mapping by the MNDM, the Baker Creek culvert site is underlain by bedrock of the foliated tonalite suite comprised of foliated to massive tonalite to granodiorite.

4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes 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 the laboratory test sheets in Appendices A to C for Sisson Creek, English River Tributary and Baker Creek, respectively. The results of in situ field tests (i.e., SPT 'N'-values) 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 stratigraphic cross-sections on Drawings A1, B1 and C1 are inferred from non-continuous sampling, observations of drilling progress 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.

Detailed descriptions of the subsurface conditions at each investigated culvert crossing are provided in the following sections of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit or stratum.

4.3 Sisson Creek Culvert

A total of four boreholes (Boreholes SI-1 to SI-4) were advanced that the Sisson Creek culvert site. The borehole locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawing A1.

In summary, the subsoil conditions encountered at the site consist of granular fill and peat underlain by deposits of silty sand to sand, silt to silt and sand, a silty clay pocket at one location, and sand to gravelly sand. A more detailed description of the soil deposits and groundwater conditions encountered in the boreholes is presented below.



FOUNDATION REPORT - SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER CREEK CULVERTS

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows)	Laboratory Testing
				Relative Density/Consistency	
Sand (FILL)¹ , trace to some gravel, trace organics; brown; frozen to wet	SI-1 - SI-4	0.7	463.9 – 463.6	n/a	n/a
Peat (Amorphous) ; trace to some silt, trace to some sand; black; wet	SI-2 & SI-4	1.1 & 0.7	463.2	N = 6 ² Loose	w = 54% & 140%
Silty Sand to Sand , trace to some organics; brown to grey; wet	SI-1 - SI-4	0.8 – 1.5	463.0 – 462.1	N = 3 - 12 Very Loose to Compact	w = 22% 1 – MH (Fig. A1)
Silt to Sandy Silt to Silt and Sand³ , trace clay; grey; wet	SI-1 - SI-4	2.2 – 5.0	462.1 – 460.9	N = 6 - 16 Loose to Compact	w = 24% - 28% 6 – MH (Fig. A2) 2 – AL (NP)
Silty Clay , trace to some sand; reddish brown; wet	SI-1	0.8	459.9	N = 4 Soft	w = 39%
Sand to Gravelly Sand , trace to some silt; grey; wet	SI-1 - SI-4	3.5 (fully penetrated in Borehole SI-3) >2.6 to >5.3 (Boreholes SI-1, SI-2 and SI-4 terminated in this deposit)	459.1 – 456.7	N = 1 – 63 ⁴ Very Loose to Very Dense	w = 13% - 23% 3 – M (Fig. A3)

N = SPT 'N'-value; number of blows for 0.3 m of penetration
w = Natural Moisture Content (%)
M = Sieve analysis
MH = Combined Sieve and Hydrometer analysis
AL = Atterberg Limits Test
NP = Non-Plastic Atterberg Limits Test Result

Notes:

- ¹ Cobbles inferred from augers grinding in Borehole SI-4.
- ² An SPT 'N'-value of 15 blows per 0.3 m of penetration was measured in the peat deposit in Borehole SI-2 due to the presence of wood.
- ³ Reddish brown silty clay seams were noted in the silt deposit in Borehole SI-4, similar in composition to the deposit encountered in Borehole SI-1.

Groundwater Conditions

Unstabilized groundwater levels measured in the open boreholes upon completion of drilling are summarized below. The creek water levels at the inlet and outlet were surveyed by Golder at Elevation 463.4 m in January



2016. Groundwater and creek water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Groundwater Level (m)	Groundwater Elevation (m)
SI-1	0.2	463.4
SI-2	0.5	463.4
SI-3	0.3	463.4
SI-4	0.5	463.4

4.4 English River Tributary Culvert

A total of four boreholes (Boreholes ER-1 to ER-4) were advanced at the English River Tributary culvert site. The borehole locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawing B1.

In summary, the subsoil conditions encountered at the site consist of granular fill and/or peat underlain by deposits of silty sand to sand and gravelly silty sand till, further underlain by granitic gneiss bedrock. A more detailed description of the soil deposits, bedrock and groundwater conditions encountered in the boreholes is presented below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows)	Laboratory Testing
				Relative Density	
(FILL) Sand , trace to some silt, trace organics; brown to grey; frozen to wet	ER-4	1.4	468.4	N = 3	w = 25% 1 – M (Fig. B1)
				Very Loose	
Peat (Fibrous), trace sand; black; frozen to wet	ER-1 to ER-4	0.7 – 2.2	468.3 – 467.0	N = 1	w = 124% & 798%
				Very Loose	
Silty Sand to Sand , trace clay, trace to some gravel, trace to some organics; brown to grey; wet	ER-1 to ER-4	1.5 – 4.9	467.6 – 466.0	N = 1 – 30	w = 16% - 29% 6 – M/MH (Fig. B2)
				Very Loose to Compact	
Gravelly Silty Sand (TILL) , trace clay; grey; wet	ER-1 to ER-3	0.2 – 1.4	464.5 – 462.7	N = 36 - 80 ²	w = 14 1 – MH (Fig. B3)
				Dense to Very Dense	

N = SPT 'N'-value; number of blows for 0.3 m of penetration
w = Natural Moisture Content (%)
M = Sieve analysis
MH = Combined Sieve and Hydrometer analysis



Notes:

¹ SPT 'N'-values of 1, 2 and 5 blows per 0.3 m of penetration were noted within the peat deposit; however, these values are indicative of the frozen nature of the material and may not be representative of the relative density of this deposit.

² An SPT 'N'-value of 100 blows for 0.1 m of penetration was measured in Borehole ER-1; however this is due to the proximity of the bedrock surface and not representative of the relative density of this deposit.

Bedrock/Refusal

Bedrock was cored in Boreholes ER-1 and ER-4 and refusal to auger and split-spoon advancement was encountered in Boreholes ER-2 and ER-3. The depth to the confirmed/inferred bedrock surface and bedrock surface elevations are presented below.

Borehole No.	Depth to Bedrock (below ground surface) (m)	Bedrock Surface Elevation (m)	Core Length (m)
ER-1	3.9	464.3	3.1
ER-2	5.9	462.4	auger and split-spoon refusal
ER-3	6.8	461.5	auger and split-spoon refusal
ER-4	2.9	465.5	3.2

The retrieved bedrock core is described as a medium to coarse grained, weakly foliated, pinkish grey, very strong, granitic gneiss as presented in the Record of Drillhole sheets in Appendix B. Photographs of the retrieved bedrock core samples are shown on Figure B4. A more detailed description of the bedrock properties encountered in the boreholes is provided below.

Borehole No.	Total Core Recovery	Rock Quality Designation	Quality Classification Table 3.10 of CFEM 2006 ³	Uniaxial Compressive Strength (MPa)	Strength Classification Table 3.5 of CFEM 2006 ³
ER-1	100%	79% - 100%	Good to Excellent	139	(R5) Very Strong
ER-4	100%	88% - 100%	Good to Excellent	137	(R5) Very Strong

Groundwater Conditions

Unstabilized groundwater levels measured in the open boreholes upon completion of drilling are summarized below. The creek ice levels at the inlet (north end) and outlet (south end) of the culvert were surveyed by Golder

³ Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.



at Elevations 467.9 m in January 2016. The water levels at the inlet and outlet ends of the culvert were surveyed by others at Elevation 468.1 m in October 2014. Groundwater and creek ice/water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Groundwater Level (m)	Groundwater Elevation (m)
ER-1	0.4	467.8
ER-2	0.4	467.9
ER-3	0.4	467.9
ER-4*	Ground Surface	468.4

Note: The groundwater elevation in Borehole ER-4 was obtained after completion of HQ coring any may not be representative of the in-situ groundwater conditions.

4.5 Baker Creek Culvert

A total of four boreholes (Boreholes BK-1 to BK-4) were advanced at the Baker Creek culvert site. The borehole locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawing C1.

In summary, the subsoil conditions encountered at the site consist of peat to sandy peat and organic sand underlain by a deposit of silt and sand to sand. A more detailed description of the soil deposits and groundwater conditions encountered in the boreholes is presented below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows)	Laboratory Testing
				Relative Density or Consistency	
Ice/Snow	BK-1 & BK-2	0.5 & 0.2	468.3 & 467.8	n/a	n/a
Peat to Sandy Peat (Amorphous) , some silt; black to brown; frozen to wet	BK-3 & BK-4	1.4 & 0.7	468.2 & 468.3	N = 2 Very Soft	w = 222%
Organic Sand , trace to some silt, trace gravel, trace wood; dark brown to black; wet	BK-3	0.8	466.8	N = 2 Very Loose	w = 57% 1-M (Fig. C1)
Silt and Sand to Sand¹ , trace clay, trace gravel; brown to grey; wet	BK-1 – BK-4	>7.6 – >9.6 (boreholes terminated in this deposit)	467.8 – 466.0	N = 1 – 20 Very Loose to Compact	w = 19% - 29% 10 – M/MH (Fig. C2)

N = SPT 'N'-value; number of blows for 0.3 m of penetration
w = Natural Moisture Content (%)
M = Sieve analysis
MH = Combined Sieve and Hydrometer analysis



Groundwater Conditions

Unstabilized groundwater levels measured in the open boreholes upon completion of drilling are summarized below. The creek ice level at the outlet (south end) of the culvert was surveyed by Golder in January 2016 at Elevation 467.8 m. The water levels at the inlet and outlet ends of the culvert were surveyed by others at Elevation 468.0 m in October 2014. Groundwater and creek ice/water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Groundwater Level (m)	Groundwater Elevation (m)
BK-1	1.0	467.3
BK-2	0.2	467.6
BK-3	0.6	467.6
BK-4	0.8	467.5

4.6 Analytical Testing of Creek/Tributary Water Samples

The results of an analytical test on a sample of creek/river water taken from the Sisson Creek, English River Tributary and Baker Creek culvert sites are presented in Table 2. The suite of parameters tested include pH, sulphate, chloride, resistivity and conductivity.

5.0 CLOSURE

The drilling program was supervised by Mr. Mathew Riopelle and Mr. Shane Albert under the direction of Mr. Adam Core P.Eng. This report was prepared by Mr. Adam Core, P.Eng. The technical aspects were reviewed by Mr. David Muldowney, P.Eng., and Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant with and Designated MTO Foundations Contact for Golder, carried out a quality control review of the report.



Report Signature Page

GOLDER ASSOCIATES LTD.



Adam Core, P.Eng.
Geotechnical Engineer

David Muldowney, P.Eng.
Geotechnical Engineer



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

KH/AC/DAM/JMAC/kp

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FOUNDATION REPORT - SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER CREEK CULVERTS

Table 1: Summary Details of Existing Culverts

Culvert	Approximate Existing Embankment Height ¹ (m)	Existing Culvert			Approximate Inlet/Outlet Invert Elevation (m)	Boreholes	Reference Appendix
		Type	Height x Span (m)	Length (m)			
Sisson Creek Culvert (Site 48W-9/C)	3.1 (~1 m soil cover)	Cast-in-place Reinforced Concrete Box	3.7 x 1.7	24	462.1 / 462.0	4 Boreholes SI-1 to SI-4	A
English River Tributary Culvert (Site 48W-188/C)	2.9 (~ 0.5 m soil cover)	Cast-in-place Reinforced Concrete Box	3.7 x 1.9	22	467.0 / 467.1	4 Boreholes ER-1 to ER-4	B
Baker Creek Culvert (Site 48W-12/C)	3.5 (~0.6 m soil cover)	Cast-in-place Reinforced Concrete Box	6.1 x 2.5	25	466.2 / 466.2	4 Boreholes BK-1 to BK-4	C

Note: 1. Embankment height is relative to the existing ground surface at the centerline of the roadway and the existing culvert invert.
2. Culvert dimensions and invert elevations are based on the plan and profile drawings provide by MTO (bc322172, e745172 and e755171, respectively).

Prepared by: AC
Checked by: DAM
Reviewed by: JMAC



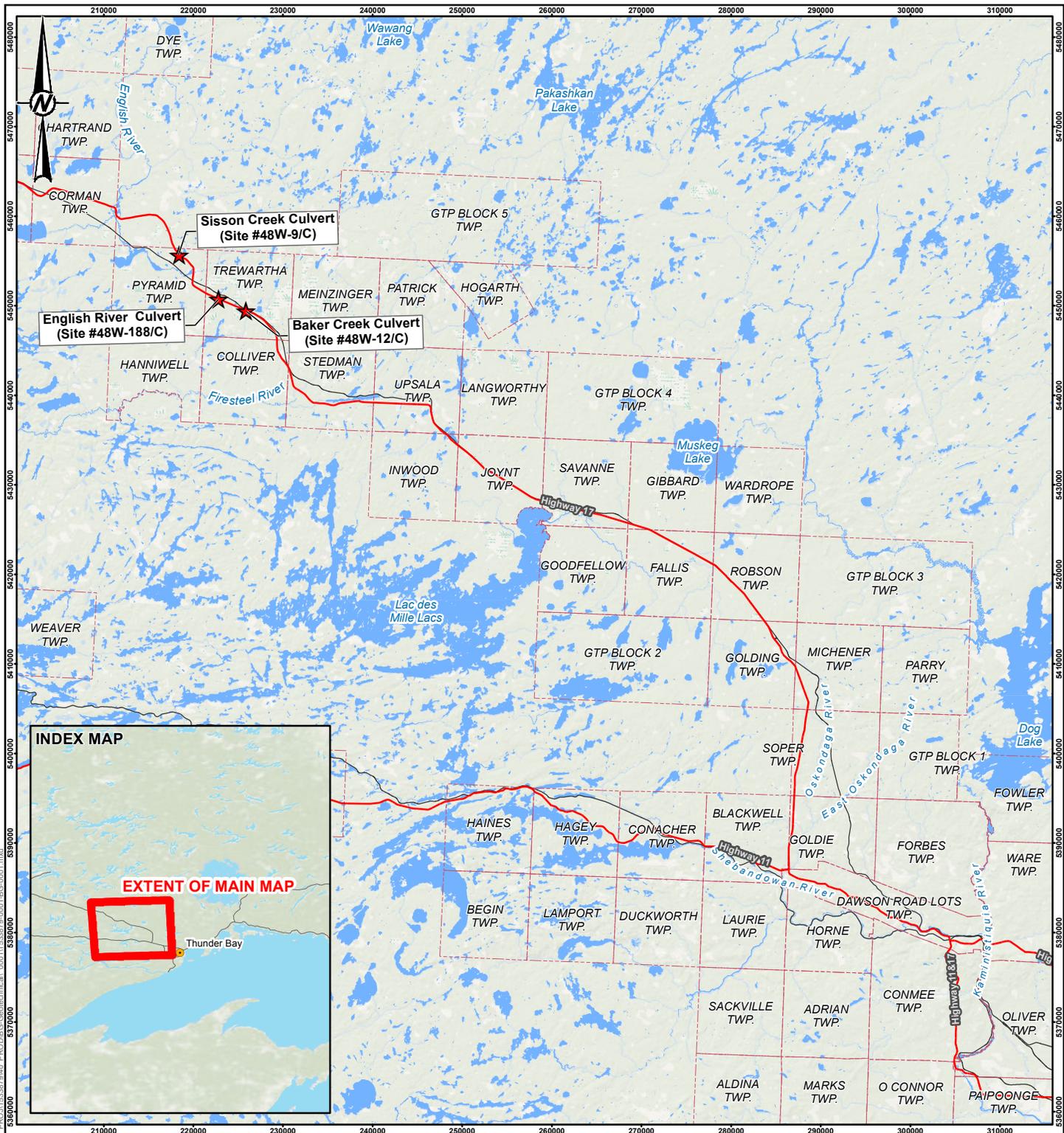
FOUNDATION REPORT - SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER CREEK CULVERTS

Table 2: Summary of Analytical Testing of Sisson Creek, English River Tributary and Baker Creek Water Samples

Culvert	Parameter (Units)				
	Chloride (mg/L)	Sulphate (mg/L)	Conductivity (μ S/cm)	Resistivity (ohm-cm)	pH
Sisson Creek Culvert (Site 48W-9/C)	8.43	1.63	68.7	14600	6.51
English River Tributary Culvert (Site 48W-188/C)	3.20	<0.3	63.8	15700	6.04
Baker Creek Culvert (Site 48W-12/C)	3.45	0.86	68.1	14700	6.54

Note: 1. Samples obtained January 25, 2016.
2. Analytical testing carried out by ALS Environmental

Prepared by: AC
Checked by: DAM
Reviewed by: JMAC



- Legend**
- ★ Site Location
 - Highway
 - Townships
 - Railways
 - Waterbodies



NOTE(S)
 THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING
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 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
 COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

CLIENT
 ONTARIO MINISTRY OF TRANSPORTATION

PROJECT
 SISSON CREEK, ENGLISH RIVER TRIBUTARY AND BAKER
 CREEK CULVERT, REHABILITATIONS

TITLE
LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2016-08-09
DESIGNED	---	
PREPARED	RRD	
REVIEWED	AC	
APPROVED	JMAC	



PROJECT NO.	CONTROL	REV.	FIGURE
1533879	1000	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in



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	(c)	Consolidation (one-dimensional)
σ'	effective stress ($\sigma' = \sigma - u$)	C_c	compression index (normally consolidated range)
σ'_{vo}	initial effective overburden stress	C_r	recompression index (over-consolidated range)
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)	C_s	swelling index
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$	C_α	secondary compression index
τ	shear stress	m_v	coefficient of volume change
u	porewater pressure	C_v	coefficient of consolidation (vertical direction)
E	modulus of deformation	C_h	coefficient of consolidation (horizontal direction)
G	shear modulus of deformation	T_v	time factor (vertical direction)
K	bulk modulus of compressibility	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

$\tau = c' + \sigma' \tan \phi'$
shear strength = (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.

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.



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	



APPENDIX A

Sisson Creek Culvert (Site 48W-9/C)

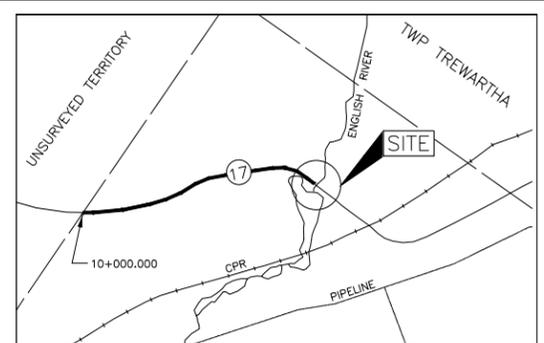
METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 6336-14-00



HIGHWAY 17
 SISSON CREEK CULVERT STA 10+959
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
SI-1	463.6	5450504.7	241789.6
SI-2	463.9	5450494.3	241798.6
SI-3	463.7	5450487.2	241770.6
SI-4	463.9	5450477.2	241780.6

NOTES

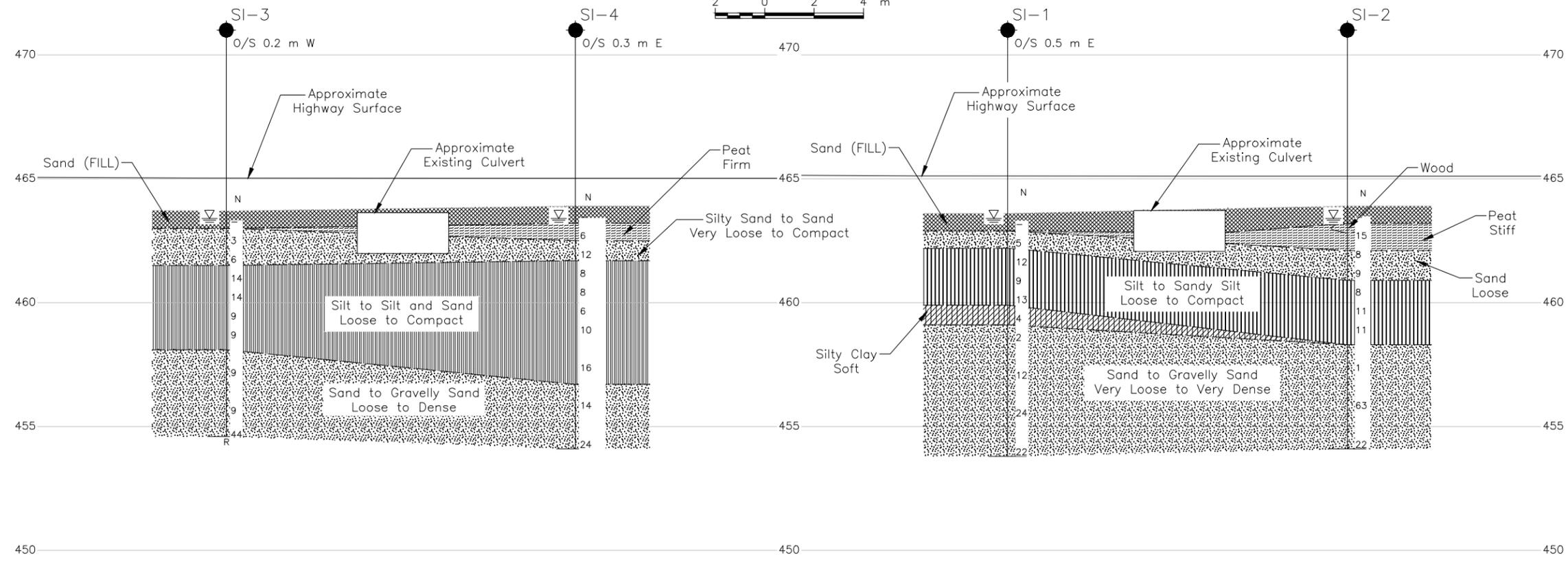
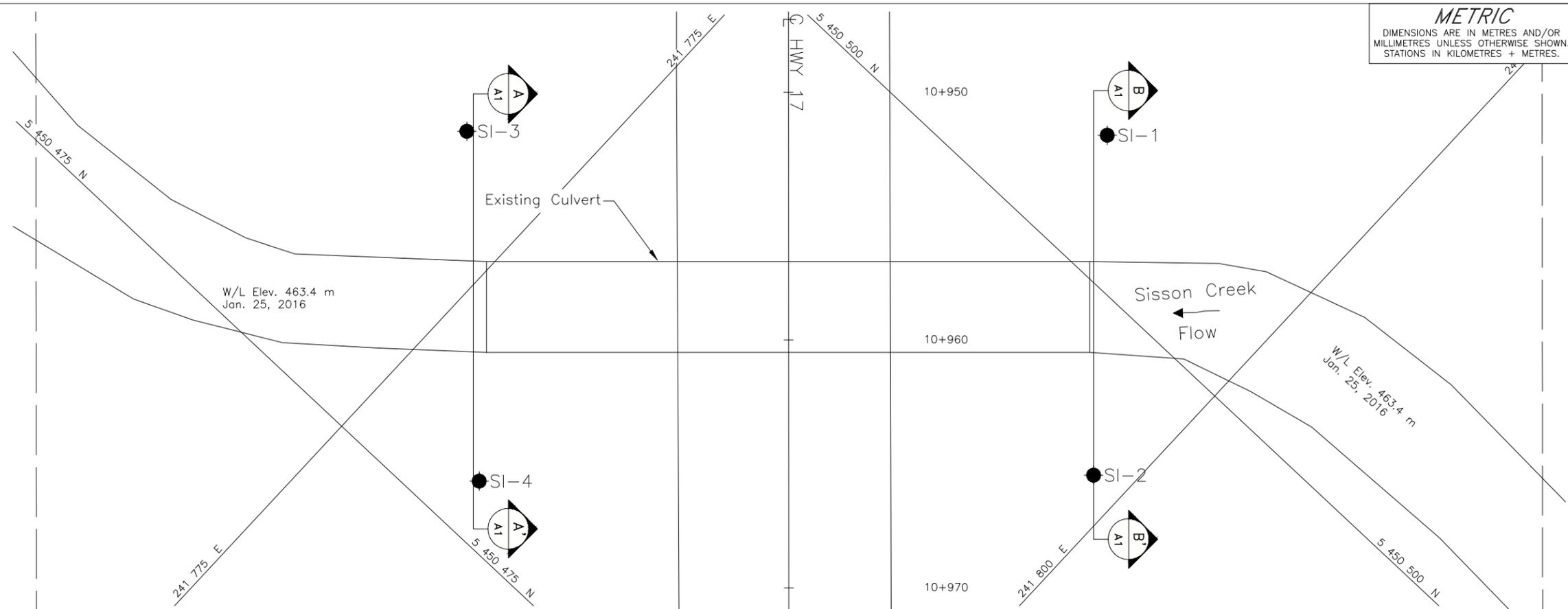
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MTO, drawing file nos. BC322172 received Dec. 11, 2015.



SCALE 1:200 (A-A) CROSS-SECTION AT OUTLET
 VERT. SCALE 1:200 (A1)



SCALE 1:200 (B-B) CROSS-SECTION AT INLET
 VERT. SCALE 1:200 (A1)



NO.	DATE	BY	REVISION

Geocres No. 52G-15

HWY. 17	PROJECT NO. 1533879	DIST. .
SUBM'D. AC	CHKD. .	DATE: 10/7/2016
DRAWN: JJL	CHKD. DAM	APPD. JMAC
		SITE: 48W-9/C
		DWG: A1

PLOT DATE: 10/14/2016 10:51:15 AM
 FILENAME: H:\projects\2015\1533879\HWY 17\11\DWG_30\1533879_Sisson_Creek.dwg



PHOTOGRAPHS

**Photograph A1: Sisson Creek Culvert
Looking West at the Culvert Inlet (North End) (December 2015)**



**Photograph A2: Sisson Creek Culvert
Looking West at the Culvert Outlet (South End) (December 2015)**





PHOTOGRAPHS

**Photograph A3: Sisson Creek Culvert
Looking North at the Culvert Inlet (North End) (December 2015)**



**Photograph A4: Sisson Creek Culvert
Looking South at the Culvert Outlet (South End) (December 2015)**



PROJECT <u>1533879</u>	RECORD OF BOREHOLE No SI-1	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5450504.7; E 241789.6</u>	ORIGINATED BY <u>MR</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>January 24, 2016</u>	CHECKED BY <u>DAM</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT 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	20
463.6	GROUND SURFACE																	
0.0	Sand, trace to some gravel, trace organics (FILL) Brown Wet		1	AS	-	∇												
462.9																		
0.7	SAND, trace to some organics Loose Brown to grey Wet		2	SS	5													
462.1																		
1.5	Sandy SILT Loose to compact Grey Wet		3	SS	12													
			4	SS	9													0 29 69 2
			5	SS	13													
459.9																		
3.7	SILTY CLAY, trace to some sand Soft Reddish brown Wet		6	SS	4													
459.1																		
4.5	SAND to Gravelly SAND, trace silt Very loose to compact Grey Wet Approximately 0.8 to 0.9 m of heave encountered in augers below 4.6 m depth.		7	SS	2													
			8	SS	12													
			9	SS	24													22 77 (1)
			10	SS	22													
453.8	END OF BOREHOLE																	
9.8	Note: 1. Water level at a depth of 0.2 m below ground surface (Elev. 463.4 m) upon completion of drilling.																	

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No SI-2	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5450494.3; E 241798.6</u>	ORIGINATED BY <u>MR</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>January 23 and 24, 2016</u>	CHECKED BY <u>DAM</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									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
463.9	GROUND SURFACE																		
0.0	Sand, some gravel, trace organics (FILL) Brown Frozen*		1	AS	-														
463.2																			
0.7	PEAT (Amorphous) Stiff Black Wet		2	SS	15														
	Wood encountered in upper 0.3 m of Sample 2.																		
462.1			3A	SS	8														
1.8	SAND, some silt, trace organics Loose Grey Wet		3B																
			4	SS	9														
460.9																			
3.0	SILT, trace clay Loose to compact Grey Wet		5	SS	8														
			6	SS	11														
	Reddish brown silty clay seams below 4.6 m depth.		7	SS	11														
458.3																			
5.6	SAND to Gravelly SAND, trace silt Very looseset to very dense Brown to grey Wet		8	SS	1														
	Approximately 0.1 to 0.6 m of heave encountered in augers below 7.6 m depth.		9	SS	63														
454.1																			
9.8	END OF BOREHOLE		10	SS	22														
	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 463.4 m) upon completion of drilling.																		

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

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

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No SI-3	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5450487.2; E 241770.6</u>	ORIGINATED BY <u>MR</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>January 24 and 25, 2016</u>	CHECKED BY <u>DAM</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						
463.7	GROUND SURFACE															
0.0	Sand, trace gravel, trace organics (FILL) Brown Wet		1	AS	-											
463.0																
0.7	SILTY SAND to SAND, trace organics Very loose to loose Grey Wet		2	SS	3											
			3	SS	6											
461.5																
2.2	SILT to SILT and SAND, trace clay Loose to compact Grey Wet		4	SS	14							o			0 42 55 3	
			5	SS	14											
			6	SS	9							o		NP	0 1 95 4	
			7	SS	9											
458.1																
5.6	SAND, trace to some gravel Loose to dense Brown to grey Wet		8	SS	9							o			0 98 (2)	
	Approximately 0.8 m to 0.9 m of heave encountered in augers between 6.1 m and 7.6 m depth.															
	Augers grinding below 7.6 m depth.															
			9	SS	9											
			10	SS	44											
454.6	Spoon bouncing at 9.1 m depth.															
9.1	END OF BOREHOLE SPLIT-SPOON AND AUGER REFUSAL															
	Note: 1. Water level at a depth of 0.3 m below ground surface (Elev. 463.4 m) upon completion of drilling.															

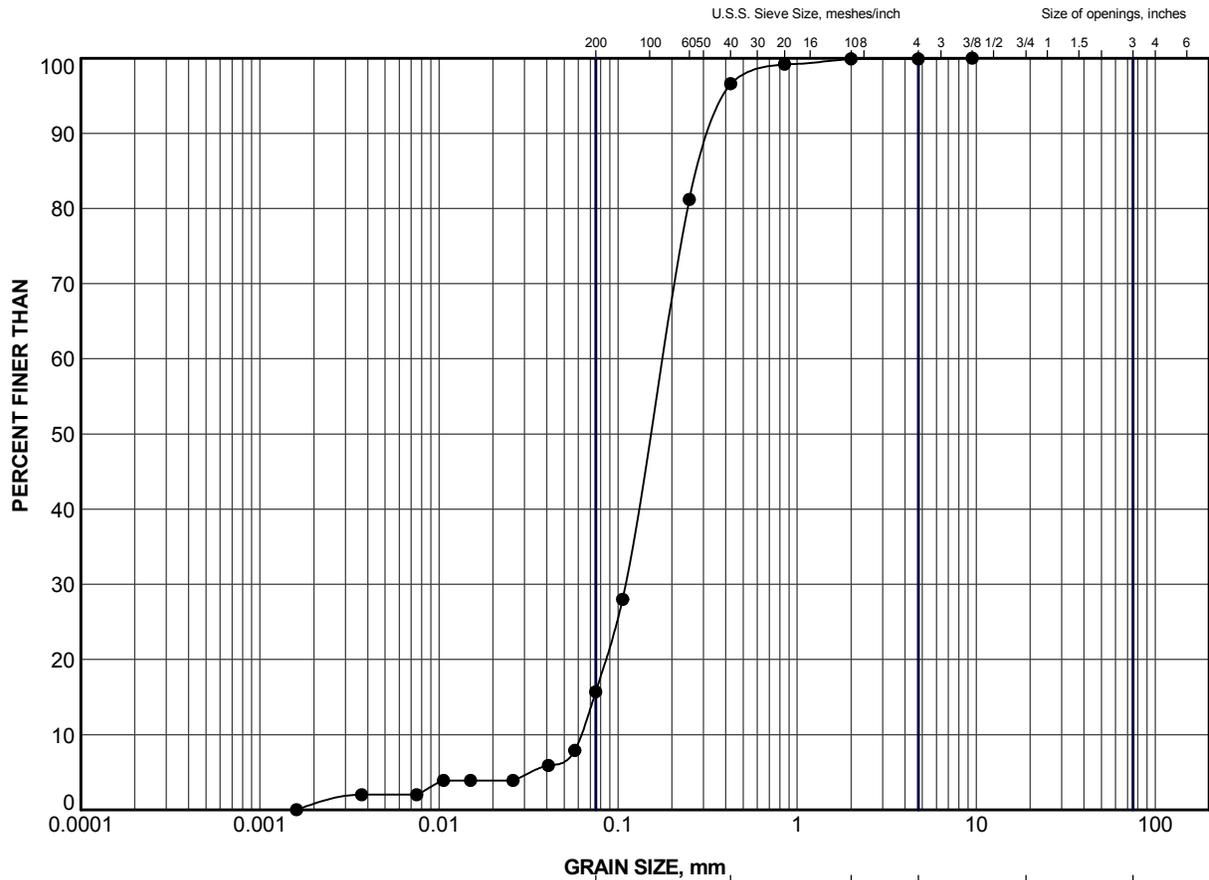
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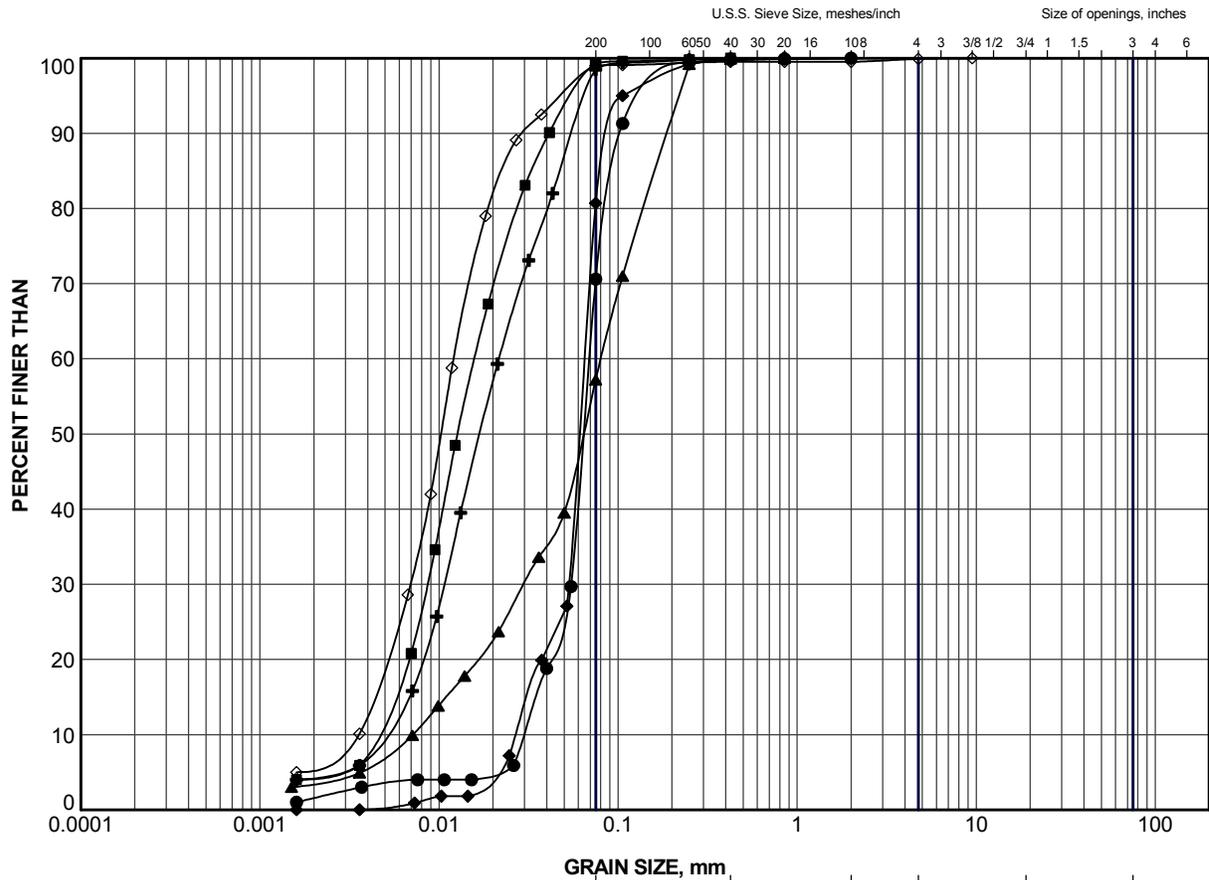
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No SI-4	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5450477.2; E 241780.6</u>	ORIGINATED BY <u>MR</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>January 25, 2016</u>	CHECKED BY <u>DAM</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	20	40	60		GR SA SI CL	
463.9	GROUND SURFACE															
0.0	Sand, trace to some gravel, trace organics (FILL) Brown Frozen		1	AS	-											
463.2	Augers grinding throughout on inferred cobbles. PEAT (Amorphous), trace to some silt, trace to some sand		2	SS	6											
462.5	Firm Black Wet		3	SS	12											
461.7	SILTY SAND Compact Grey Wet		4	SS	8										0 19 81 0	
2.2	SILT, trace to some sand Loose to compact Grey Wet		5	SS	8											
			6	SS	6											
			7	SS	10											
			8	SS	16										0 1 93 6	
456.7	Reddish brown silty clay seams below 6.1 m depth.															
7.2	SAND to Gravelly SAND Compact Grey Wet		9	SS	14											
454.1			10	SS	24											
9.8	END OF BOREHOLE															
	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 463.4 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:





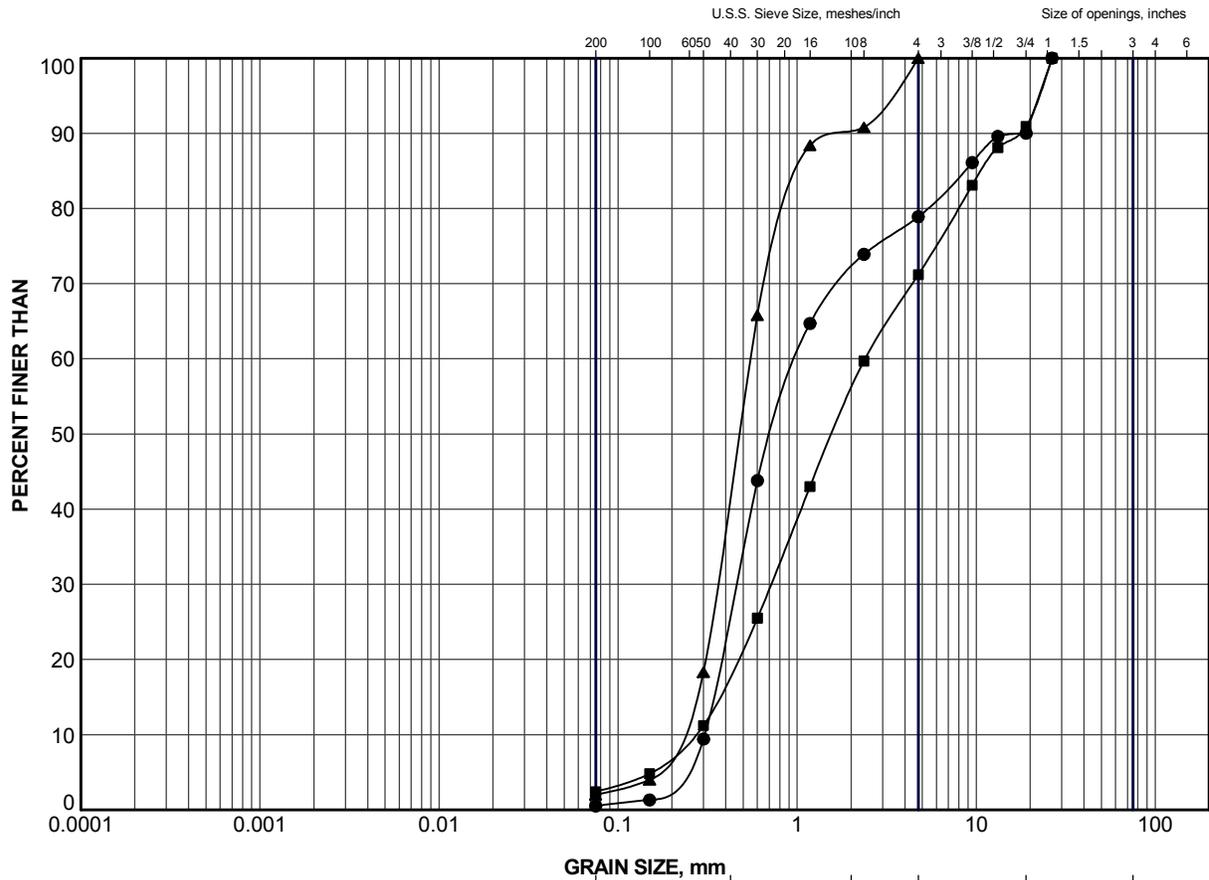
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	SI-1	4	461.0
■	SI-2	6	459.8
▲	SI-3	4	461.1
+	SI-3	6	459.6
◆	SI-4	4	461.3
◇	SI-4	8	457.5

PROJECT HIGHWAY 17 SISSON CREEK CULVERT STA 10+959					
TITLE GRAIN SIZE DISTRIBUTION SILT to SILT and SAND					
PROJECT No.		1533879		FILE No. 1533879.GPJ	
DRAWN	JJL	Jul 2016	SCALE	N/A	REV.
CHECK	DAM	Jul 2016	FIGURE A2		
APPR	JMAC	Jul 2016			





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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	SI-1	9	455.7
■	SI-2	10	454.4
▲	SI-3	8	457.3

PROJECT HIGHWAY 17 SISSON CREEK CULVERT STA 10+959					
TITLE GRAIN SIZE DISTRIBUTION SAND to GRAVELLY SAND					
PROJECT No.		1533879		FILE No.	1533879.GPJ
DRAWN	JJL	Jul 2016	SCALE	N/A	REV.
CHECK	DAM	Jul 2016	FIGURE A3		
APPR	JMAC	Jul 2016			



SUD-MTO GSD (2016) GLDR_LDN.GDT



APPENDIX B

English River Tributary Culvert (Site 48W-188/C)

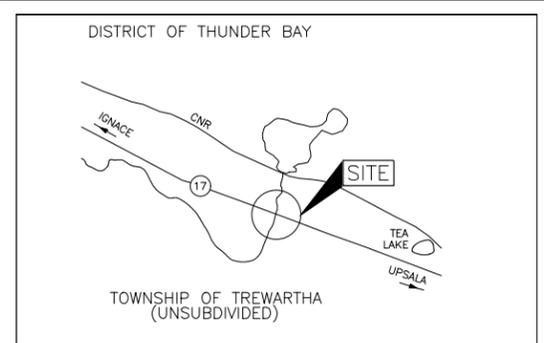
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 6336-14-00

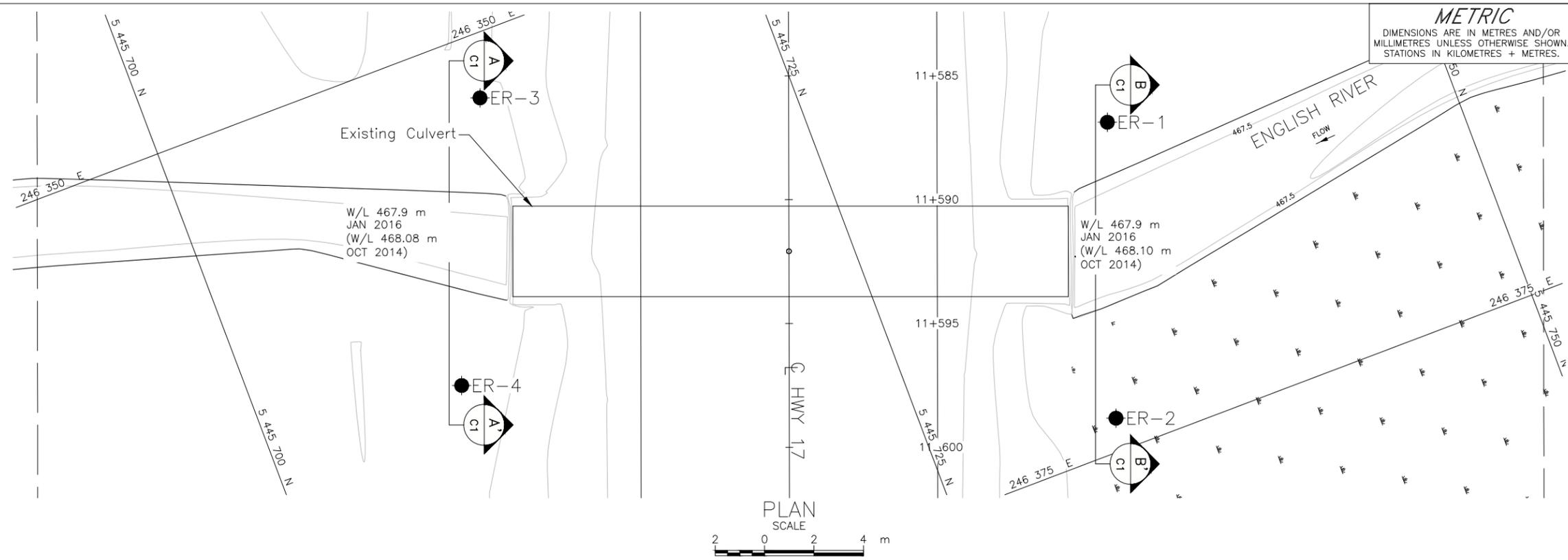


HIGHWAY 17
ENGLISH RIVER TRIBUTARY CULVERT STA 11+592
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN
SCALE 1:2000
1 0 1 2 km



- LEGEND**
- Borehole - Current Investigation
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - 100% Rock Quality Designation (RQD)
 - R Refusal
 - ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
ER-1	468.2	5445736.4	246362.4
ER-2	468.3	5445732.5	246373.7
ER-3	468.3	5445713.0	246352.5
ER-4	468.4	5445708.2	246363.1

NOTES

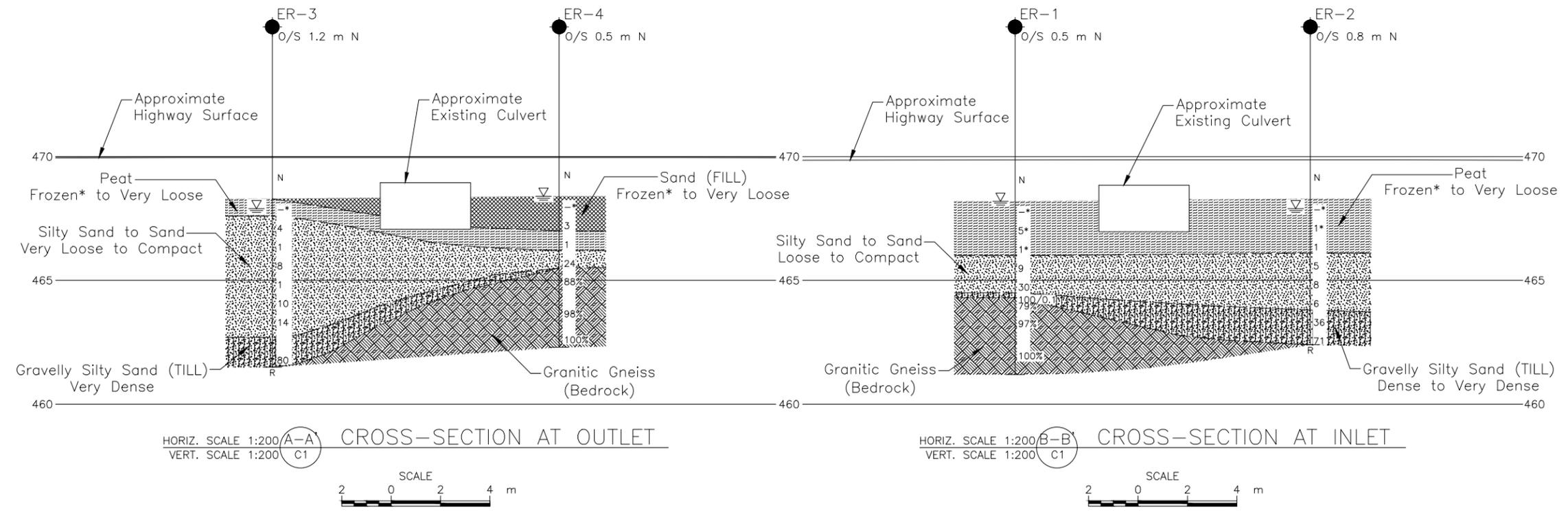
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MTO, drawing file nos. E745172.dwg received Dec. 11, 2015.



NO.	DATE	BY	REVISION

Geocres No. 52G-15

HWY. 17	PROJECT NO. 1533879	DIST. .
SUBM'D. AC	CHKD. .	DATE: 10/7/2016
DRAWN: JJJ	CHKD. DAM	APPD. JMAC
		SITE: 48W-188/C
		DWG. B1



PHOTOGRAPHS

**Photograph B1: English River Culvert
Looking West at the Culvert Inlet (North End) (December 2015)**



**Photograph B2: English River Culvert
Looking East at the Culvert Inlet (North End) (December 2015)**





PHOTOGRAPHS

**Photograph B3: English River Culvert
Looking North at the Culvert Inlet (North End) (December 2015)**



**Photograph B4: English River Culvert
Looking South at the Culvert Outlet (South End) (December 2015)**



PROJECT <u>1533879</u>	RECORD OF BOREHOLE No ER-1	1 OF 2 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5445736.4; E 246362.4</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers, HW Casing, HQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 21, 2016</u>	CHECKED BY <u>DAM</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								
						20 40 60 80 100	20 40 60 80 100	20 40 60								
468.2 0.0	GROUND SURFACE PEAT (Fibrous), trace sand Black Frozen*		1	AS	-*	∇	468									
			2	SS	5*		467									
			3	SS	1*		466									
466.0 2.2	SILTY SAND, trace to some gravel Loose to compact Grey Wet		4	SS	9		466								0 71 (29)	
			5	SS	30		465								12 65 (23)	
464.5 3.9	Gravelly SILTY SAND (TILL) Grey Wet GRANITIC GNEISS (BEDROCK) Bedrock cored from 3.9 m depth to 7.0 m depth. For coring details see Record of Drillhole ER-1.		6	SS	100/0.1		464								RQD = 79%	
			1	RC	REC 100%		464									
			2	RC	REC 100%		463								RQD = 97%	
			3	RC	REC 100%		462								RQD = 100%	
461.2 7.0	END OF BOREHOLE Note: 1. Water level at a depth of 0.4 m below ground surface (Elev. 467.8 m) prior to coring.															

SUD-MTO 001 1533879.GPJ GAL-MASS.GDT 08/08/16 DATA INPUT:

PROJECT: 1533879

RECORD OF DRILLHOLE: ER-1

SHEET 2 OF 2

LOCATION: N 5445736.4 ;E 246362.4

DRILLING DATE: January 21, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 850 Trackmount

DRILLING CONTRACTOR: Cartwright Drilling

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			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w/ ZL CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	10 ⁰				10 ¹	10 ²	
								80000000	80000000			80000000	80000000	80000000	80000000	80000000	80000000	80000000				80000000	80000000	80000000
		TOP OF BEDROCK		464.3																				
4	HW	GRANITIC GNEISS Medium to coarse grained Weakly foliated Pinkish grey Very strong		3.9	1	GREY	100%															UCS = 139 MPa		
5				2	GREY	100%																		
6	CME 850 HQ CORING			3	GREY	100%																		
7		END OF DRILLHOLE		461.2																				
7				7.0																				
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								

SUD-RCK 1533879.GPJ GAL-MISS.GDT 08/08/16 DATA INPUT:

DEPTH SCALE

1 : 60



LOGGED: MR

CHECKED: DAM

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No ER-2	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5445732.5; E 246373.7</u>	ORIGINATED BY <u>MR</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>January 22, 2016</u>	CHECKED BY <u>DAM</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								
						20 40 60 80 100	20 40 60 80 100	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60			
468.3 0.0	GROUND SURFACE PEAT (Fibrous) Very loose Black Frozen* to wet	[Pattern]	1	AS	-	∇	468									
		[Pattern]	2	SS	2*		467									
		[Pattern]	3	SS	1		466									
466.1 2.2	SAND, trace clay, trace to some silt Loose Grey Wet Approximately 0.3 m to 0.8 m of heave encountered below 3.1 m depth.	[Pattern]	4	SS	5		466				○				0 81 18 1	
		[Pattern]	5	SS	8		465									
		[Pattern]	6	SS	6		464				○				0 98 (2)	
463.8 4.5	Gravelly SILTY SAND, trace clay (TILL) Dense to very dense Grey Wet	[Pattern]	7	SS	36		463				○				21 50 27 2	
		[Pattern]	8	SS	71		463									
462.4 5.9	Spoon bouncing at 5.9 m depth. END OF BOREHOLE AUGER AND SPLIT-SPOON REFUSAL Note: 1. Water level at a depth of 0.4 m below ground surface (Elev. 467.9 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL-MISS.GDT 08/08/16 DATA INPUT:

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No ER-3	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5445713.0; E 246352.5</u>	ORIGINATED BY <u>MR</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>January 20 and 21, 2016</u>	CHECKED BY <u>DAM</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						
468.3	GROUND SURFACE															
0.0	PEAT (Fibrous) Black Frozen*		1	AS	-*											
467.6																
0.7	SAND, trace some silt, trace gravel Very loose to compact Grey Wet		2	SS	4											
			3	SS	2							o			2	91 (7)
			4	SS	8											
	Approximately 0.5 m to 1.0 m of heave encountered in augers below 3.1 m depth.															
			5	SS	1											
			6	SS	10											
			7	SS	14							o			0	94 (6)
462.7																
5.6	Gravelly SILTY SAND (TILL) Very dense Grey Wet		8	SS	80											
461.5	Split-spoon attempted at 6.8 m depth. Spoon bouncing.															
6.8	END OF BOREHOLE AUGER AND SPLIT-SPOON REFUSAL Note: 1. Water level at a depth of 0.4 m below ground surface (Elev. 467.9 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

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

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No ER-4	1 OF 2 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5445708.2; E 246363.1</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers, HW Casing, HQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 23, 2016</u>	CHECKED BY <u>DAM</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)	
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20	40	60	80	100						
468.4	GROUND SURFACE																	
0.0	Sand, trace to some silt, trace organics (FILL) Very loose Brown to grey Frozen* to wet		1	AS	-*		468											
			2	SS	3												0 91 (9)	
467.0	PEAT (Fibrous) Very loose Black Wet		3	SS	1		467											
466.2	SILTY SAND, trace organics Compact Brown Wet		4	SS	24		466											
465.5	GRANITIC GNEISS (BEDROCK)																	
2.9	Bedrock cored from 2.9 m depth to 6.1 m depth. For coring details see Record of Drillhole ER-4.		1	RC	REC 100%		465										RQD = 88%	
			2	RC	REC 100%		464											RQD = 98%
			3	RC	REC 100%		463											RQD = 100%
462.3	END OF BOREHOLE																	
6.1	Note: 1. Water level at ground surface (Elev. 468.4 m) upon completion of coring.																	

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

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

PROJECT: 1533879

RECORD OF DRILLHOLE: ER-4

SHEET 2 OF 2

LOCATION: N 5445708.2 ; E 246363.1

DRILLING DATE: January 23, 2016

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 850 Trackmount

DRILLING CONTRACTOR: Cartwright Drilling

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.	NOTES WATER LEVELS INSTRUMENTATION				
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w/ ZL CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²	10 ³
								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.										
		TOP OF BEDROCK		465.5																					
3	HW	GRANITIC GNEISS Medium to coarse grained Pinkish grey Weakly foliated Very strong		2.9	1	GREY	100%																		
4						2	GREY	100%																	
5							3	GREY	100%																
6						462.3																			
6		END OF DRILLHOLE		6.1																					
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									

SUD-RCK 1533879.GPJ GAL-MISS.GDT 08/08/16 DATA INPUT:

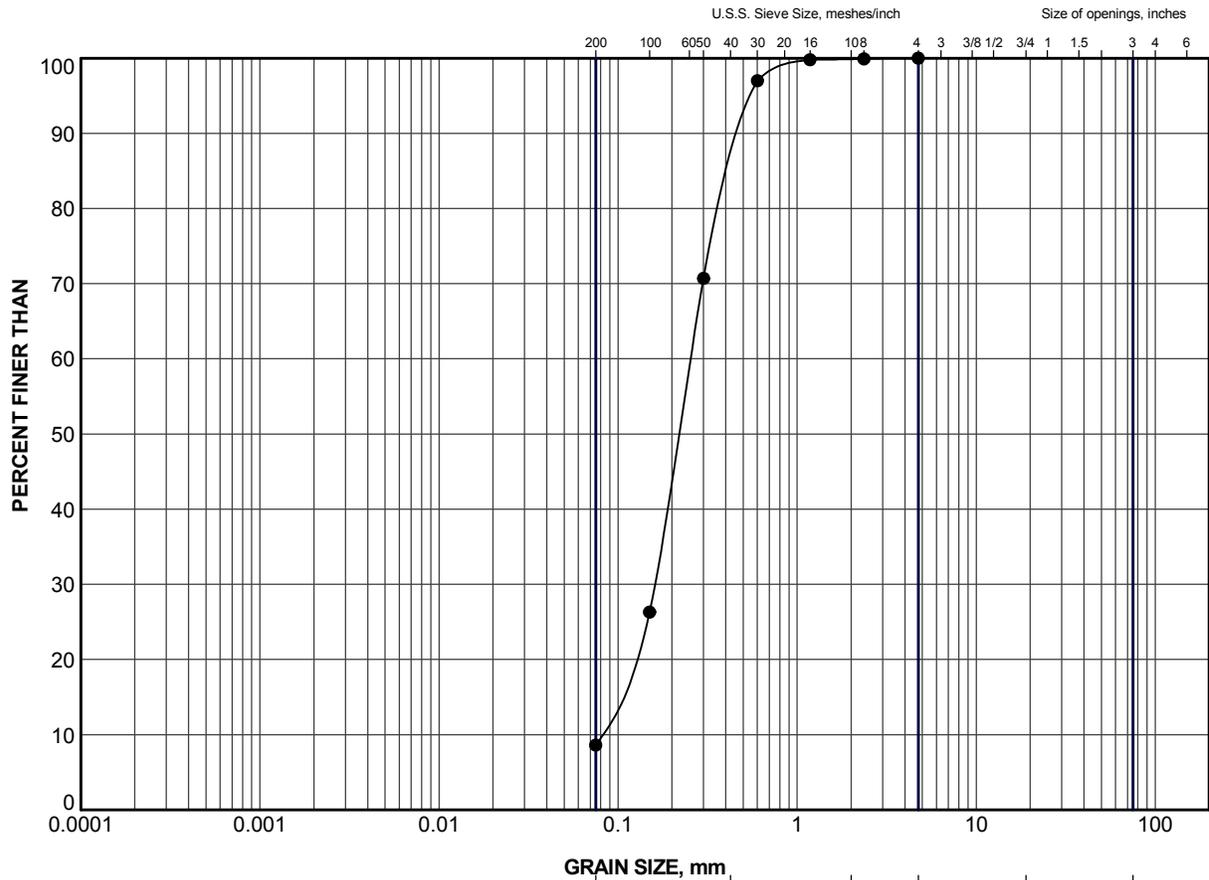
DEPTH SCALE

1 : 60



LOGGED: MR

CHECKED: DAM



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

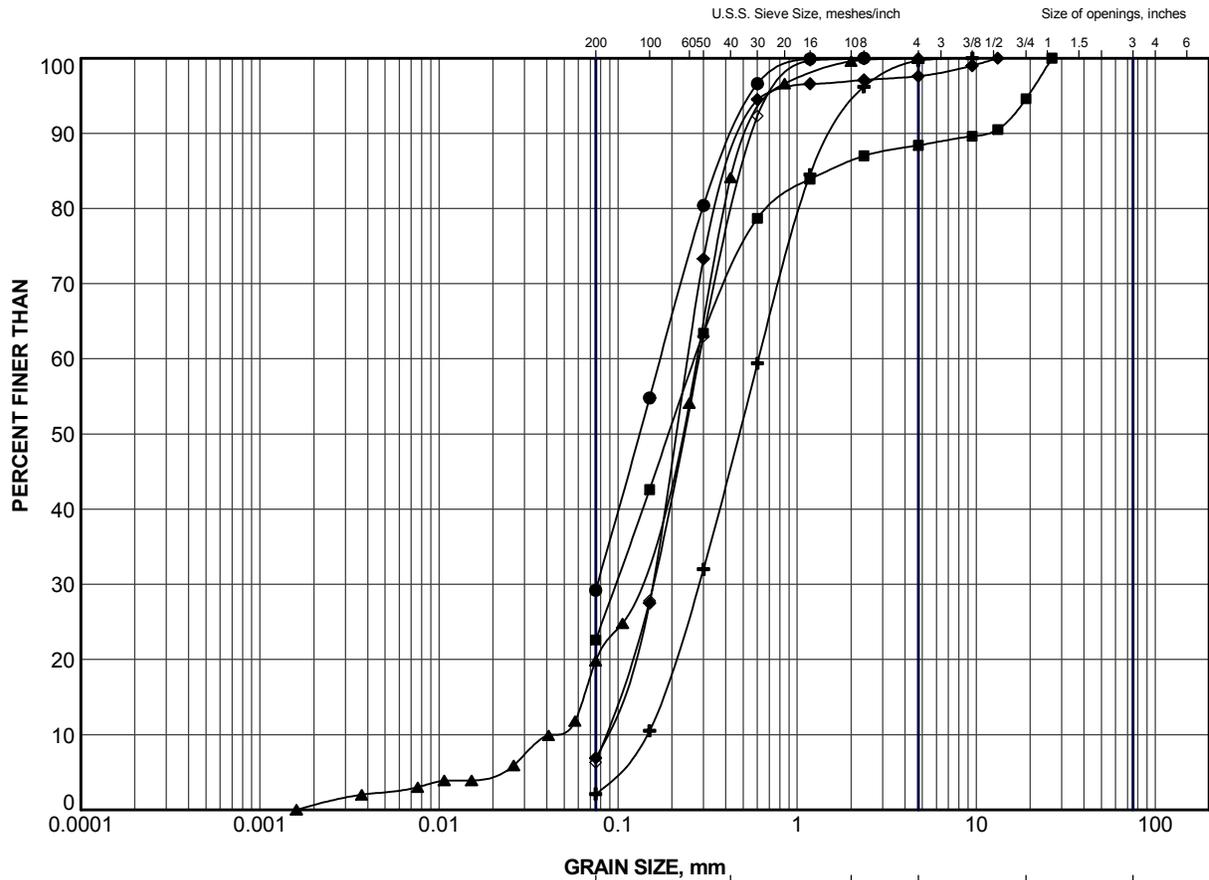
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	ER-4	2	467.3

PROJECT HIGHWAY 17 ENGLISH RIVER TRIBUTARY CULVERT STA 11+592					
TITLE GRAIN SIZE DISTRIBUTION SAND (FILL)					
PROJECT No.		1533879		FILE No.	1533879.GPJ
DRAWN	JJL	Jul 2016	SCALE	N/A	REV.
CHECK	DAM	Jul 2016	FIGURE B1		
APPR	JMAC	Jul 2016			



SUD-MTO GSD (2016) GLDR_LDN.GDT



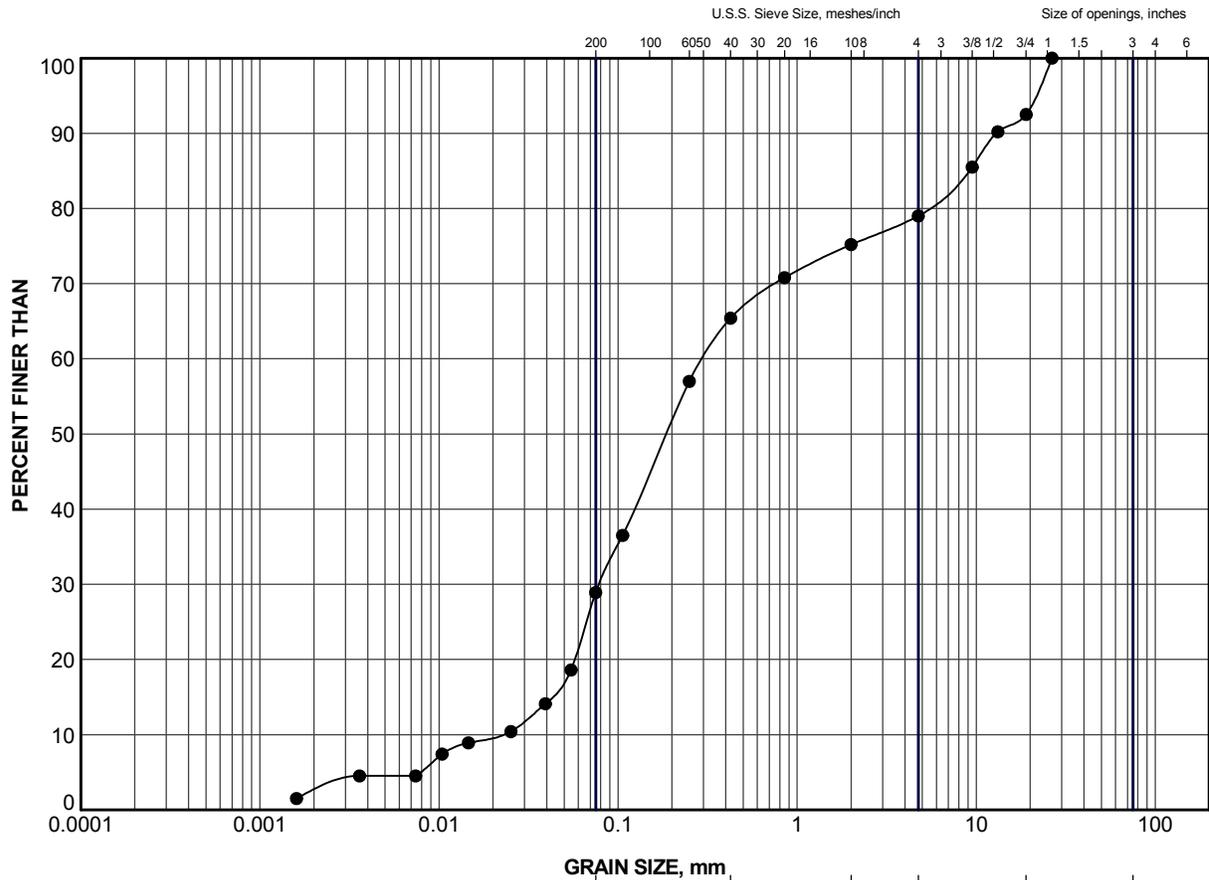
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	ER-1	4	465.6
■	ER-1	5	464.8
▲	ER-2	4	465.7
+	ER-2	6	464.2
◆	ER-3	3	466.5
◇	ER-3	7	463.4

PROJECT					
HIGHWAY 17 ENGLISH RIVER TRIBUTARY CULVERT STA 11+592					
TITLE					
GRAIN SIZE DISTRIBUTION SILTY SAND to SAND					
PROJECT No.		1533879		FILE No.	1533879.GPJ
DRAWN	JJL	Jul 2016	SCALE	N/A	REV.
CHECK	DAM	Jul 2016	FIGURE B2		
APPR	JMAC	Jul 2016			





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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	ER-2	7	463.4

PROJECT					HIGHWAY 17 ENGLISH RIVER TRIBUTARY CULVERT STA 11+592				
TITLE					GRAIN SIZE DISTRIBUTION GRAVELLY SILTY SAND (TILL)				
PROJECT No.		1533879			FILE No.		1533879.GPJ		
DRAWN	JJL	Jul 2016		SCALE	N/A	REV.			
CHECK	DAM	Jul 2016		FIGURE B3					
APPR	JMAC	Jul 2016							



SUD-MTO GSD (2016) GLDR_LDN.GDT



APPENDIX C

Baker Creek Culvert (Site 48W-12/C)

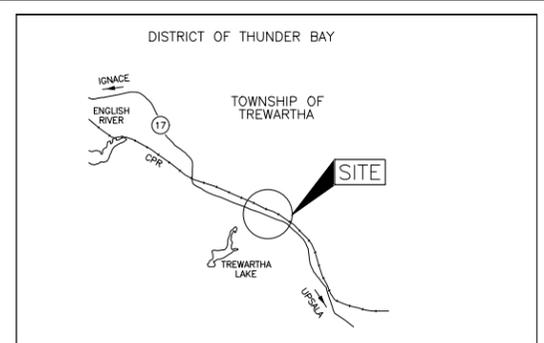
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 6336-14-00

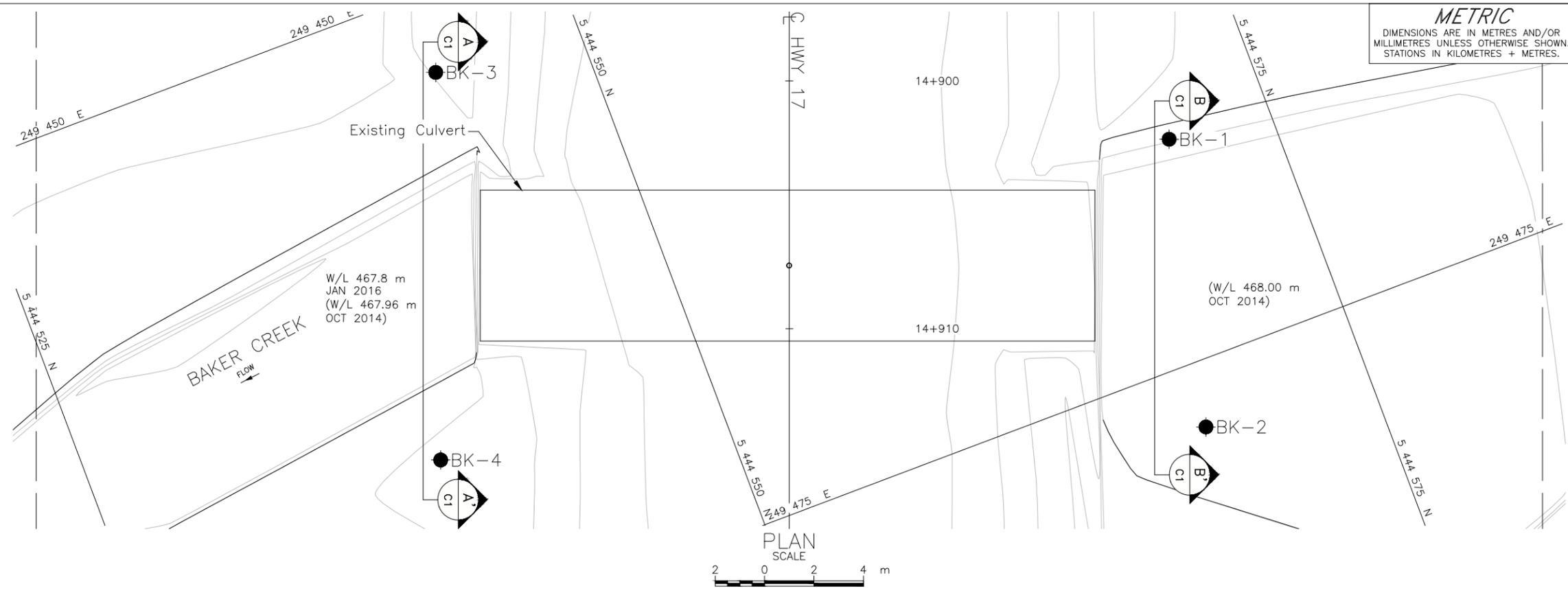


HIGHWAY 17
BAKER CREEK CULVERT STA 14+907
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN
SCALE
0 6 12 km



PLAN SCALE
0 2 4 m

LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BK-1	468.3	5444570.8	249466.2
BK-2	467.8	5444568.1	249477.6
BK-3	468.2	5444544.0	249453.2
BK-4	468.3	5444538.6	249467.9

NOTES

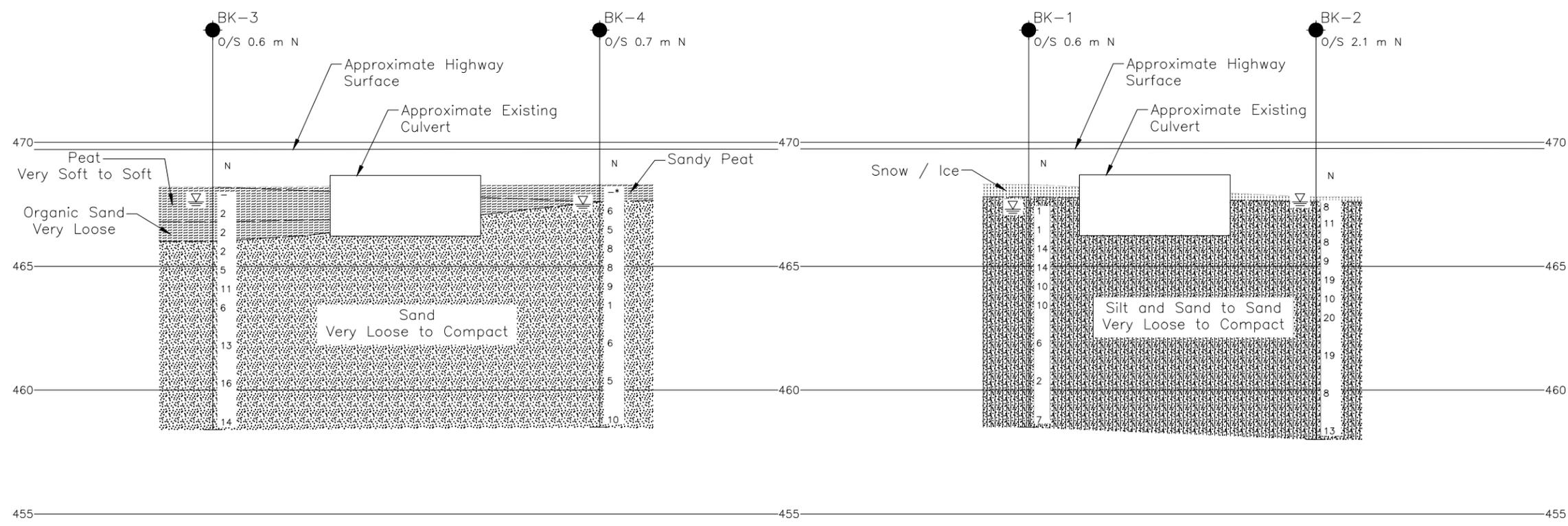
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MTO, drawing file nos. E745171.dwg received Dec. 11, 2015.



HORIZ. SCALE 1:200 (A-A) CROSS-SECTION AT OUTLET
VERT. SCALE 1:200 (C1)

SCALE
0 2 4 m

HORIZ. SCALE 1:200 (B-B) CROSS-SECTION AT INLET
VERT. SCALE 1:200 (C1)

SCALE
0 2 4 m



NO.	DATE	BY	REVISION

Geocres No. 52G-15

HWY. 17	PROJECT NO. 1533879	DIST. .
SUBM'D. AC	CHKD. .	DATE: 10/7/2016
DRAWN: JJJ	CHKD. DAM	APPD. JMAC
		SITE: 48W-12/C
		DWG: C1



PHOTOGRAPHS

**Photograph C1: Baker Creek Culvert
Looking West at the Culvert Inlet (North End) (December 2015)**



**Photograph C2: Baker Creek Culvert
Looking East at the Culvert Outlet (South End) (December 2015)**





PHOTOGRAPHS

**Photograph C3: Baker Creek Culvert
Looking North at Culvert Inlet (North End) (December 2015)**



**Photograph C4: Baker Creek Culvert
Looking South at Culvert Outlet (South End) (December 2015)**



PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-2	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444568.1; E 249477.6</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>HW and NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 28, 2016</u>	CHECKED BY <u>DAM</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	20	40	60	80					
467.8	GROUND SURFACE															
0.0	ICE (200 mm)															
0.2	SILTY SAND to SAND, trace gravel Loose to compact Brown to grey Wet Trace organics in Sample 1.		1	SS	8											
			2	SS	11											
			3	SS	8											0 99 (1)
			4	SS	9											
			5	SS	19											
			6	SS	10											1 86 (13)
			7	SS	20											
			8	SS	19											
	Approximately 0.2 m of heave at 6.1 m depth.		9	SS	8											0 77 (23)
			10	SS	13											
458.0	END OF BOREHOLE															
9.8	Note: 1. Water level at a depth of 0.2 m below ground surface (Elev. 467.6 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

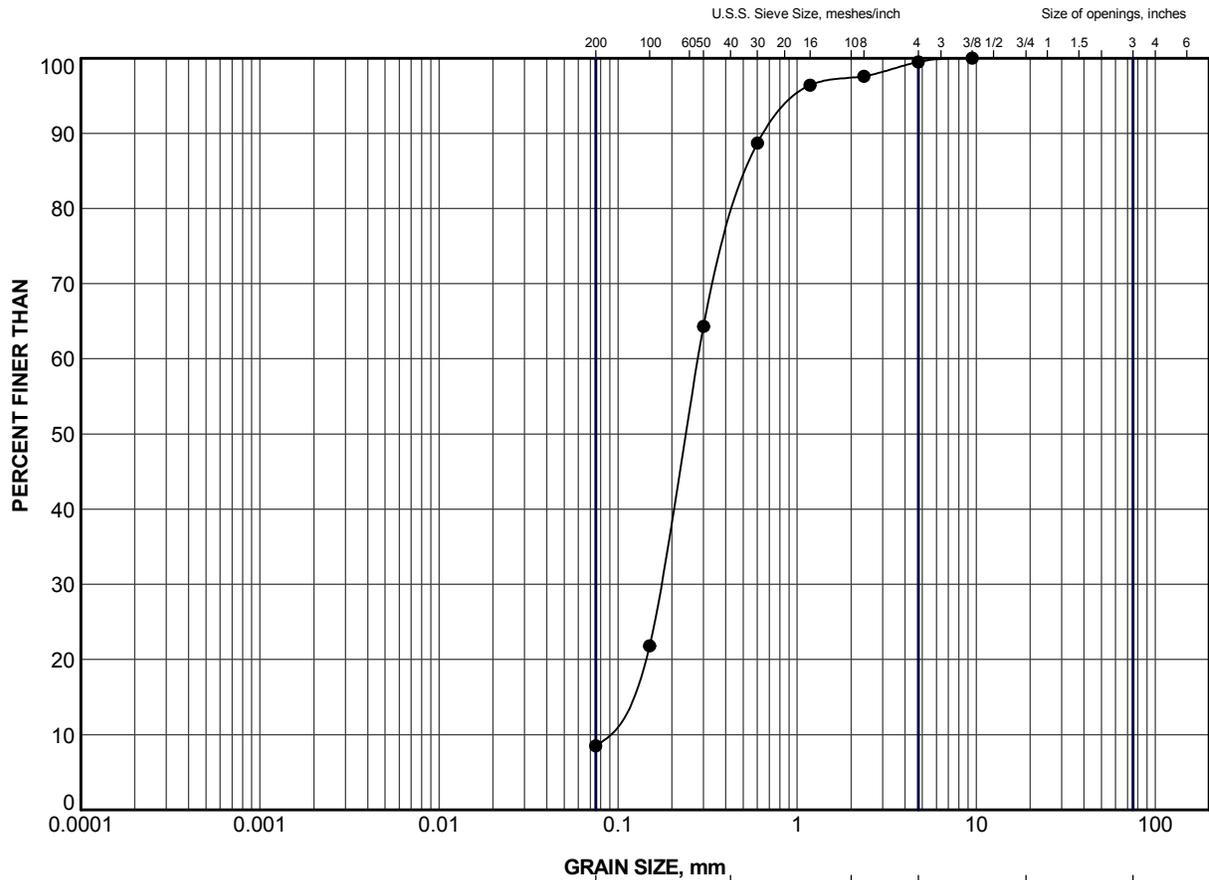
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-3	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444544.0; E 249453.2</u>	ORIGINATED BY <u>MR</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>January 20, 2016</u>	CHECKED BY <u>DAM</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						100	20
468.2 0.0	GROUND SURFACE PEAT (Amorphous) Very soft Black Wet	[Pattern]	1	AS	-	▽												
466.8 1.4	ORGANIC SAND, trace to some silt, trace gravel, trace wood Very loose Dark brown to black Wet	[Pattern]	2	SS	2													
466.0 2.2	SAND, trace to some silt Very loose to compact Grey Wet Approximately 0.6 m to 0.8 m of heave below 3.0 m depth.	[Pattern]	3	SS	2													
		[Pattern]	4	SS	2													
		[Pattern]	5	SS	5													
		[Pattern]	6	SS	11													
		[Pattern]	7	SS	6													
		[Pattern]	8	SS	13													
		[Pattern]	9	SS	16													
		[Pattern]	10	SS	14													
458.4 9.8	END OF BOREHOLE Note: 1. Water level at a depth of 0.6 m below ground surface (Elev. 467.6 m) upon completion of drilling.																	

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

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



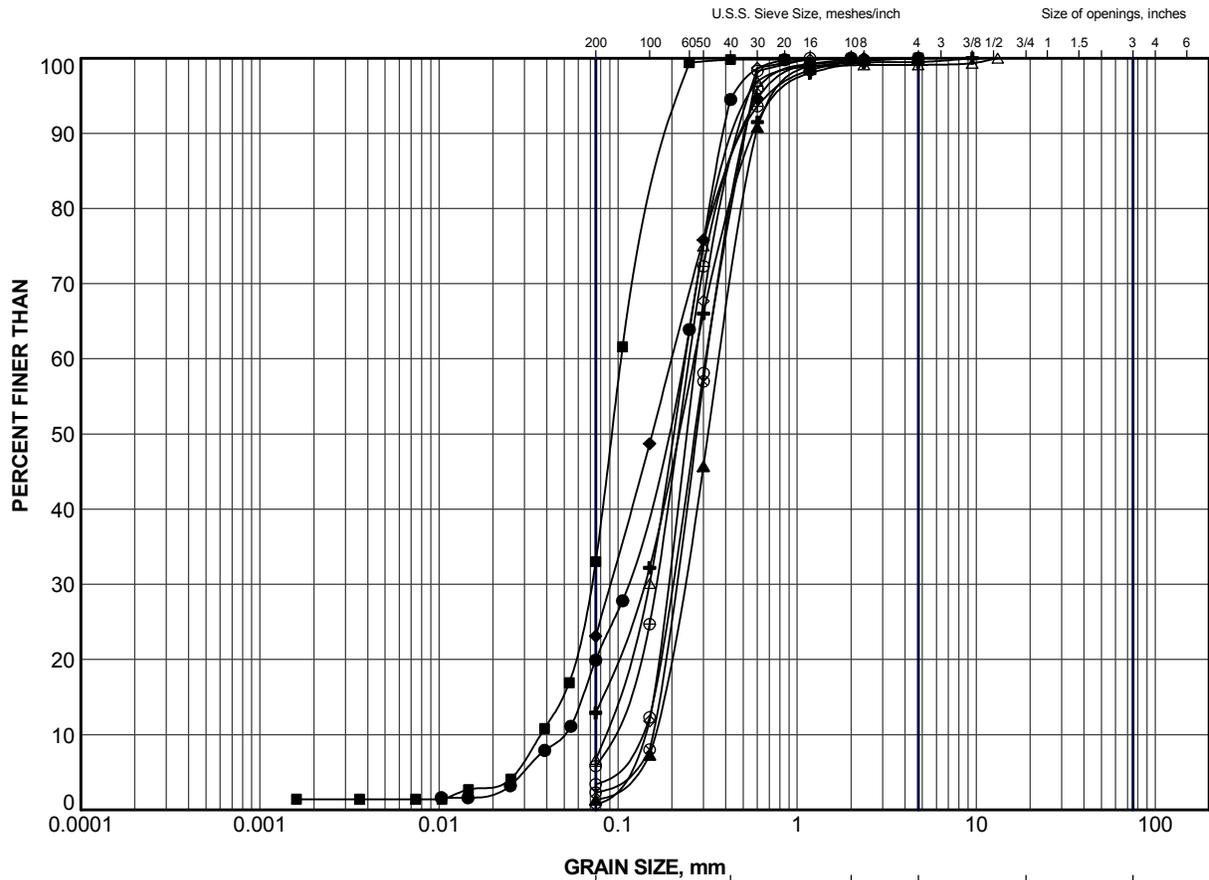
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BK-3	3	466.4

PROJECT					HIGHWAY 17 BAKER CREEK CULVERT STA 14+907				
TITLE					GRAIN SIZE DISTRIBUTION SAND				
PROJECT No.		1533879			FILE No.		1533879.GPJ		
DRAWN	JJL	Aug 2016			SCALE	N/A		REV.	
CHECK	DAM	Aug 2016			FIGURE C1				
APPR	JMAC	Aug 2016							



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BK-1	5	464.2
■	BK-1	9	458.8
▲	BK-2	3	466.0
+	BK-2	6	463.7
◆	BK-2	9	459.9
◇	BK-3	7	463.3
○	BK-3	9	460.3
△	BK-4	2	467.2
⊗	BK-4	5	464.9
⊕	BK-4	9	460.4

PROJECT HIGHWAY 17 BAKER CREEK CULVERT STA 14+907					
TITLE GRAIN SIZE DISTRIBUTION SILT and SAND to SAND					
PROJECT No.		1533879		FILE No.	1533879.GPJ
DRAWN	JJL	Aug 2016	SCALE	N/A	REV.
CHECK	DAM	Aug 2016	FIGURE C2		
APPR	JMAC	Aug 2016			



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At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
33 MacKenzie Street
Sudbury, Ontario, P3C 4Y1
Canada
T: +1 (705) 524 6861

