



# Englobe

Soils Materials Environment

**Submitted To AECOM Canada Ltd.  
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2  
On Behalf of the Ontario Ministry of Transportation**

**Culvert Replacement  
Highway 60  
Station 14+219 - Twp. of Canisbay  
GWP 5178-12-00**

## **FINAL FOUNDATION INVESTIGATION REPORT**

Date: May 6, 2016  
Ref. Nº: 15/04/15020-F1

**Geocres No. 31E-354**

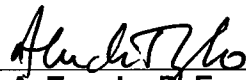


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GWP 5178-12-00

## Final Foundation Investigation Report

Prepared by:

  
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Englobe – Project Engineer




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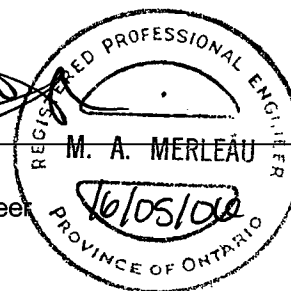
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### Client:

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## 1 INTRODUCTION

Englobe Corp. (Englobe), formerly LVM-Merlex, a Division of Englobe Corp., has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at an existing centerline culvert site. The site is located at Station 14+219 in the Township of Canisbay on Highway 60, some 1.8 km east of Canisbay Lake Road.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0004. The terms of reference for the scope of work are outlined in Englobe's Proposal P-14-199-R2, dated January 15, 2015. The purpose of this investigation was to determine the subsurface conditions in the area of the existing culvert for the contract preparation of the Detailed Design package. Englobe investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

## 2 SITE DESCRIPTION

A 750 mm diameter Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 14+219 in the Township of Canisbay. The topography in the area of this site is generally rolling. The existing highway embankment currently supports two undivided lanes of highway, running in a west-east direction. The existing highway, at the culvert location, is constructed on a sand mixed with rock fill embankment some 3.3 m in height above the culvert invert, with centerline elevation of 457.2 m at the culvert location. At the north slope, the maximum height of embankment fill is some 2.8 m above the culvert invert. The maximum height of embankment fill is some 4 m above the culvert invert at the south slope. The existing embankment slopes, in the area of the culvert, have been generally established at an inclination angle of some 1.8H:1V at the north slope and at an inclination angle of approximately 1H:1.15V at the south slope. The culvert at this location is a 750 mm diameter Corrugated Steel Pipe (CSP) culvert, some 26.9 m in length. Flow through the culvert is from the north to the south (left to right).

Visual observation indicates that the infrastructure at the culvert location consists of overhead wires to the right (south) side of the highway embankment.

### 2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Muskoka Ridges and Pockets. The topography on this section of Highway 60 is generally rolling. Layers of earth overlay bedrock. Organic materials were also observed in the region. Within the project area native overburden consists primarily of sands overlying bedrock.

Bedrock in the area, as indicated on OGS Map MRD-126, bedrock in the area consists of migmatitic rocks and gneisses of undetermined protolith.

### 3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period between June 24<sup>th</sup> and August 17<sup>th</sup>, 2015 during which time four (4) sampled boreholes, were advanced. Two (2) boreholes were advanced through the embankment. A single borehole was advanced at each of the inlet (north) and outlet (south) ends of the culvert, respectively.

The field investigation was carried out using a truck and bombardier mounted CME drilling rig equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment. Soil samples were obtained at the borehole locations at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm. The number of blows per 300 mm penetration was recorded as the “N” value. If refusal to further advancement of the augers was encountered within the proposed depth of borehole, the borehole was advanced further with N size casing equipment. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following, completion of the individual boreholes. A 19 mm diameter standpipe was installed in selected open boreholes prior to backfilling to allow for further monitoring of the shallow groundwater levels. All open boreholes were backfilled upon completion with compacted auger cuttings in the general order they were removed, and where necessary, bentonite pellet backfill was added to the boreholes to bring them up to grade in accordance with requirements of Ontario Regulation 903. At the borehole(s) through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface.

The fieldwork for this investigation was under the full time direction of a senior member of the Englobe engineering staff, Mr. Jame Lavigne, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix 2), with a summary of results presented on the laboratory sheets in Appendix 3 (Figures Nos. L-1 to L-2 and Table No. L-3).

The location of the individual boreholes was determined in the field using highway chainage established by Callon Dietz Inc. (Callon Dietz) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations, using coordinates from MTM Zone 10, NAD 83 CSRS. The borehole elevations are based on coordinating the borehole locations with the Highway survey carried out by Callon Dietz. Elevations contained in this report are referenced to a geodetic datum.

## **4 SUBSURFACE CONDITIONS**

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Records of Borehole Logs (Appendix 2) and on Drawing No. 2 (Appendix 3). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT, plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for illustration purposes only.

### **4.1 CULVERT STATION 14+219, TOWNSHIP OF CANISBAY**

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Drawing No. 2, Appendix 3. During the course of the exploration program, four (4) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced through the embankment, Borehole No. 3 advanced adjacent to the culvert inlet, and Borehole No. 4 advanced adjacent to the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at elevations 457.4, 457.0, 454.7, and 453.3 m, respectively.

#### **4.1.1 Pavement Structure**

Borehole No. 1 was advanced through the embankment where a pavement structure consisting of 51 mm asphalt and 203 mm crushed gravel was penetrated. Borehole No. 2 was advanced through the embankment where a pavement structure consisting of 76 mm asphalt and 76 mm crushed gravel was penetrated.

#### **4.1.2 Embankment Fill**

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of embankment fill consisting of brown sand trace to some gravel, trace to some silt, to gravelly sand, some silt, mixed with rock fill, was penetrated. Gravel to cobble/boulder sized rock pieces were encountered in this fill layer, between elevations 455.2 and 456.6 m. Auger refusal was encountered at Elevations 455.4 and 456 m, respectively, during borehole advancement in the deposit at Borehole Nos. 1 and 2. Below this depth, the boreholes were advanced using N size

coring equipment. The natural moisture content measured on retrieved samples of this deposit was generally in the order of 3 to 16%. Gradation (sieve and hydrometer) analyses were carried out on four (4) samples of this deposit, the results of which indicated 6 to 39% gravel size particles, 44 to 78% sand size particles, and 10 to 17% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 14 to 46 blows per 300 mm penetration and 20 blows per zero mm penetration, the compactness of this deposit was described as compact to very dense, generally compact. This deposit was encountered to a depth of 4.1 and 2.7 m below grade at Borehole No. 1 and 2, respectively (elevations 453.3 and 454.3 m, respectively).

#### 4.1.3 **Topsoil**

At ground surface at Borehole Nos. 3 and 4, a layer of dark brown to black silty topsoil was penetrated. This topsoil layer was encountered to an approximate depth of 0.2 m below ground surface at Borehole Nos. 3 and 4 (elevations 454.5 and 453.1 m, respectively).

#### 4.1.4 **Sands**

Underlying the embankment fill at Borehole Nos. 1 and 2, underlying the topsoil at Borehole Nos. 3 and 4, a deposit of brown to grey sand, trace to with gravel, trace to with silt and clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 2 to 28%. Gradation (sieve) analyses were carried out on three (3) samples of this deposit, the results of which indicated 8 to 21% gravel size particles, 67 to 72% sand size particles, and 7 to 22% silt and clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 8 to 52 blows per 300 mm penetration to 55 blows per 76 mm penetration, this deposit was described as loose to very dense, generally compact. This deposit was encountered to depths of 7.3, 4.3, 0.8, and 1.5 m below grade at Borehole Nos. 1 to 4, respectively (elevations 450.1, 452.7, 453.9, and 451.8 m, respectively).

#### 4.1.5 **Bedrock**

Underlying the above described sands at Borehole Nos. 1 to 4, the bedrock was proven by diamond core drilling. The bedrock was described as black gneiss with pink granite bedrock. Based on RQD values of 68 to 89% the bedrock was described as fair to good quality. Based on visual review, the bedrock generally showed negligible weathering. Sampling in the bedrock was terminated at depths of 10.3, 7.3, 3.8, and 4.6 m below grade at Borehole Nos. 1 to 4, respectively (elevations 447.1, 449.7, 450.9, and 448.7 m, respectively). It should be noted that, when encountered, the underlying bedrock surfaces in this area can be very erratic in nature, varying substantially in elevation over short horizontal distances.

### 4.2 **GROUNDWATER DATA**

At the time of this investigation (June 24<sup>th</sup> to August 17<sup>th</sup>, 2015), surface water was not observed at the culvert.

Measurements of the groundwater and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. A standpipe





was installed in Borehole Nos. 1 and 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The stabilized groundwater levels were measured at elevations 453.3 m and 454.0 m at Borehole Nos. 1 and 3, respectively, during the periods of foundation investigation. The water level reading at elevation 456.4 m measured at Borehole No. 2 had probably not yet stabilized since it was taken upon completion of borehole advancement on June 24, 2015. The groundwater level was measured at elevation 453.1 m at Borehole No. 4 upon completion of borehole advancement on August 17, 2015.

The groundwater and surface water levels will fluctuate seasonally/yearly.

## Appendix 1   Key Plan

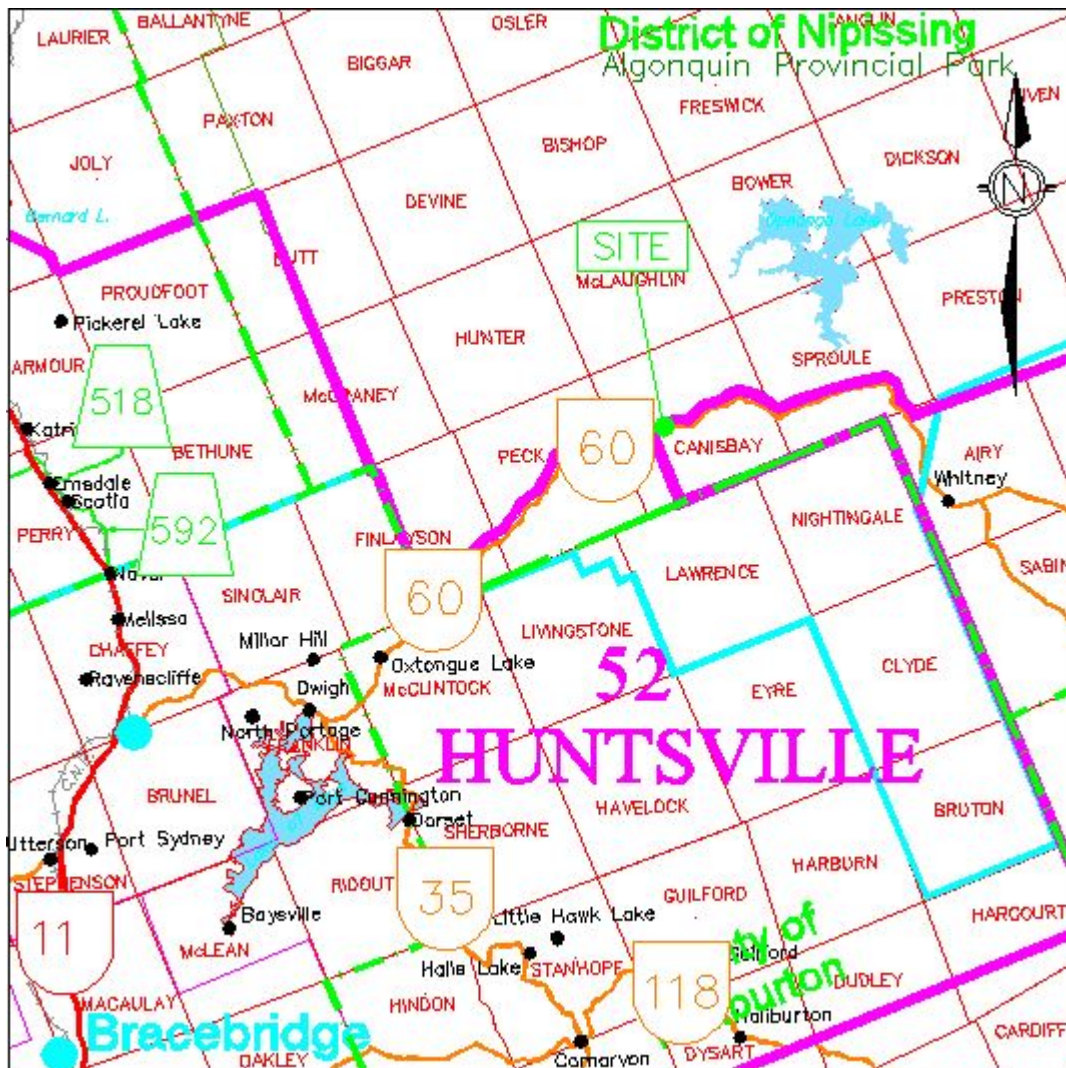
Drawing No. 1

Key Plan

# MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



## FOUNDATION INVESTIGATION REPORT

GWP 5178-12-00

Highway 60

Station 14+219 Culvert

Township of Canisbay



Reference No: 15/04/15020-F1

May 2016

## **Appendix 2   Subsurface Data**

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 5	Record of Borehole Sheet

## LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

### 1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash Sample
WH	Sampler advanced by static weight of hammer and/or rods
Rec	% recovery from individual run of rock core
RQD	Rock quality designation (%)

### 2. PENETRATION RESISTANCE/"N"

#### Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 60° cone attached to AW rod driven by a 63 kg hammer falling 760 mm.

Plotted as —●—●—●—●—

#### Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

### 3. SOIL DESCRIPTION

#### a) Cohesionless Soils:

"N" (blows/0.3 m)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

#### b) Cohesive Soils:

Undrained Shear Strength (kPa)	Consistency
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

### 3. SOIL DESCRIPTION (Cont'd)

#### c) Bedrock:

RQD (%)	Classification
Less than 25	Very poor quality
25 to 50	Poor quality
50 to 75	Fair quality
75 to 90	Good quality
90 to 100	Excellent quality

#### d) Method of Determination of Undrained Shear Strength of Cohesive Soils:

- + 3.2 - Field Vane test in borehole.  
The number denotes the sensitivity to remoulding.
- D - Laboratory Vane Test
- " - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

#### e) Soil Moisture:

Moisture	Described as
Dry	Below optimum moisture content
Moist	Near optimum moisture content
Wet	Above optimum moisture content

### 4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

Terminology for cobbles and boulders is based on auger response and field observations:

Occasional	Obstructions encountered in borehole, however advance is not impeded
Numerous	Obstructions are essentially continuous over drilled length

**SAMPLE DESCRIPTION NOTES:**

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.
2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.
3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.
4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

**METRIC****RECORD OF BOREHOLE NO. 1**

REFERENCE 15/04/15020 DATUM Geodetic LOCATION N 5046866.9 E 376490.3 - Canisbay Twp., Station 14+222.5 ORIGINATED BY JL  
 PROJECT GWP 5178-12-00, Highway 60 - F1 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NW casing COMPILED BY SH  
 CLIENT AECOM DATE (Started) 2015 June 24 TIME   
 DATE (Completed) 2015 June 24 (Completed) 2:30:00 PM CHECKED BY MAM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20					
457.4	Ground Surface												
0.0	51 mm asphalt 203 mm crushed gravel  EMBANKMENT FILL- sand, trace gravel to gravelly, trace to some silt  Rock pieces of gravel to cobble sizes encountered at depths from 0.8 m to 2 m. Auger refusal encountered at depth of 2 m.  gravelly sand, some silt and clay  brown, moist  wet  (compact/dense)		1	SS	17								
			2	SS	23								
			3	SS	46								
			4	SS	31								
			5	SS	10								
453.3			6	SS	22								
4.1	SAND- trace to some gravel, some silt and clay  brown to grey  boulder and cobble encountered at depths of 4.6 m and 5.8 m, respectively  (compact/very dense)		7	SS	17								
			8	SS	34/203m								
			9	SS	52								
450.1													
7.3	Start Bedrock Coring  Bedrock - black gneiss Fair to good quality		10	RC	Rec.=95% RQD=71%								
			11	RC	Rec.=100% RQD=87%								
447.1													
10.3	End of Sampling End of Borehole												

COMMENTS		+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa		WATER LEVEL RECORDS	
Advance borehole with N size casing and coring equipment below 2 m depth		○ 3% STRAIN AT FAILURE		Date (dd/mm/yy)/Time	Water Depth (m)
				1) 15/6/24 2:30:00 PM	3.9
				2) 15/6/24 2:35:00 PM	3.1
				3) 15/6/27 7:50:00 AM	4.1

The stratification lines represent approximate boundaries. The transition may be gradual.

MEL-GEO 15020 - BOREHOLE LOGS - F1.GPJ MEL-GEO.GDT 16/4/27

## METRIC

## RECORD OF BOREHOLE NO. 2



REFERENCE 15/04/15020 DATUM Geodetic LOCATION N 5046862.4 E 376478 - Canisbay Twp., Station 14+212 ORIGINATED BY JL  
 PROJECT GWP 5178-12-00, Highway 60 - F1 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NW casing COMPILED BY SH  
 CLIENT AECOM DATE (Started) 2015 June 24 TIME 6:20:00 PM CHECKED BY MAM  
 DATE (Completed) 2015 June 24

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	20 40 60 80 100	20 40 60					
457.0	Ground Surface													
0.0	76 mm asphalt 76 mm crushed gravel		1	SS	29									12 78 (10)
	EMBANKMENT FILL- sand to gravelly sand, trace to some silt Rock pieces of gravel to cobble sizes encountered at depths from 0.9 m to 1.8 m. Auger refusal encountered at depth of 1 m.		2	SS	20/0mm									
	cobble penetrated at depth of 1.5 m													
	brown, wet		3	SS	14									
	(compact/very dense)		4	SS	30									
454.3	dark brown sand - trace gravel, some silt, trace clay, trace grass rootlets													6 77 15 2
2.7	SAND - trace to some gravel, some silt and clay occasional rock pieces of cobble size encountered		5	SS	13									
	brown to greyish brown		6	SS	55/76mm									
452.7	(compact/very dense)													
4.3	wet Start Bedrock Coring		7	RC	Rec.=95% RQD=79%									
	Bedrock - black gneiss													
	good quality		8	RC	Rec.=100% RQD=87%									
449.7	End of Sampling End of Borehole													
7.3														

COMMENTS

Advance borehole with N size casing and coring equipment below 1 m depth

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity  
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS		
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 15/6/24 6:20:00 PM	0.6	0.8
2)	-	-
3)	-	-

MEL-GEO 15020 - BOREHOLE LOGS - F1.GPJ MEL-GEO.GDT 16/4/27



**METRIC****RECORD OF BOREHOLE NO. 3**

REFERENCE 15/04/15020 DATUM Geodetic LOCATION N 5046875.3 E 376476.7 - Canisbay Twp., Station 14+222 ORIGINATED BY JL  
 PROJECT GWP 5178-12-00, Highway 60 - F1 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers and NW casing COMPILED BY SH  
 CLIENT AECOM DATE (Started) 2015 August 7 TIME 10:30:00 AM DATE (Completed) 2015 August 7 CHECKED BY MAM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20					
454.7	Ground Surface												
454.0	TOPSOIL - silty, with grass rootlets		1	SS	9								21 72 (7)
0.2	Dark brown												
453.9	SAND - with gravel, trace silt brown (compact)		2	SS	25/25mm								
0.8	Auger Refusal Start Bedrock Coring												
	Bedrock - black gneiss with pink granite		3	RC	Rec.=83% RQD=68%								
	Fair to good quality												
			4	RC	Rec.=97% RQD=88%								
450.9	End of Sampling End of Borehole												
3.8													

COMMENTS		WATER LEVEL RECORDS	
Advance borehole with N size casing and coring equipment below 0.8 m depth		Date (dd/mm/yy)/Time	Water Depth (m) Cave In (m)
The stratification lines represent approximate boundaries. The transition may be gradual.		1) 15/8/7 10:30:00 AM	0.1 ▽ - 15
		2) 15/8/17 4:00:00 PM	0.7 ▽ -
		3) - ▽ -	

MEL-GEO 15020 - BOREHOLE LOGS - F1.GPJ MEL-GEO.GDT 16/4/27

**METRIC****RECORD OF BOREHOLE NO. 4**

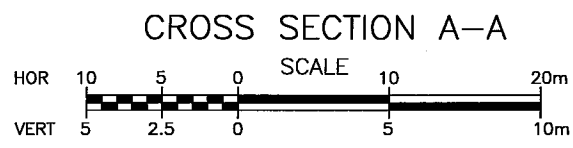
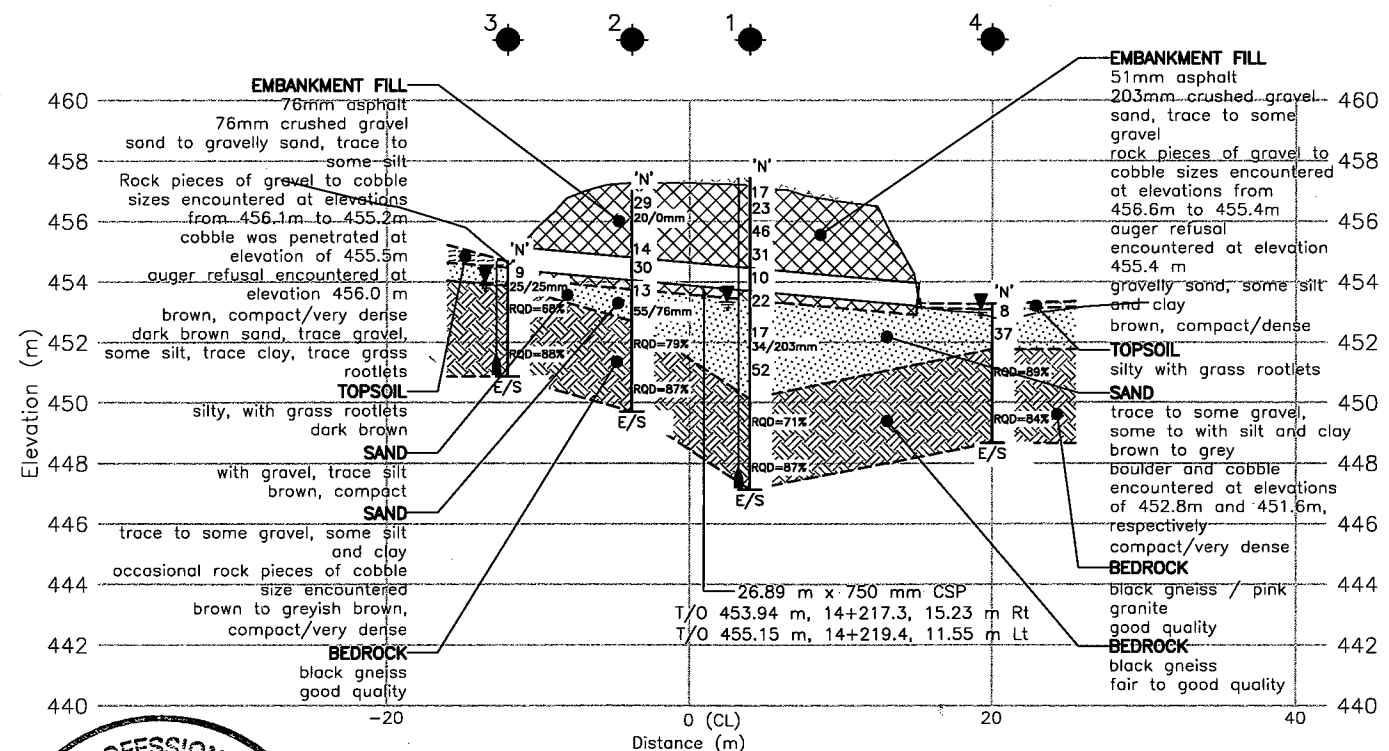
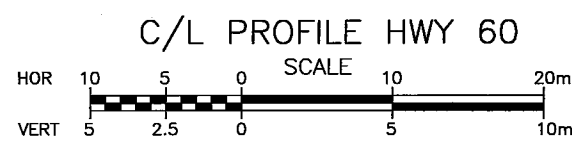
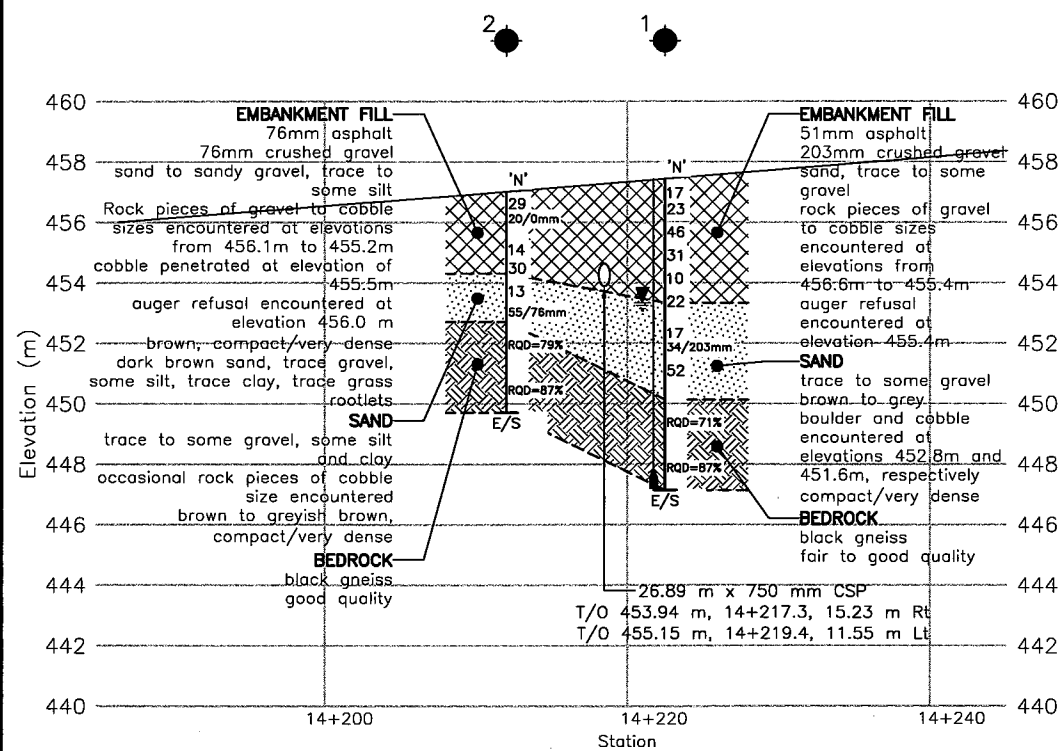
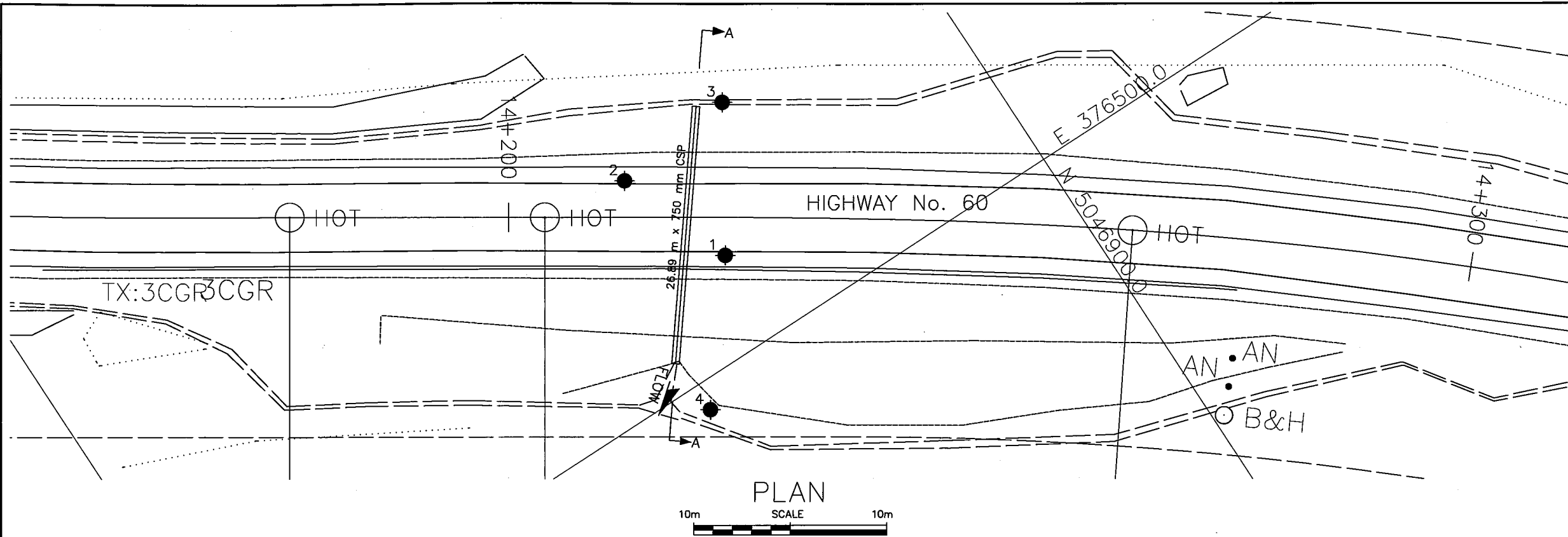
REFERENCE 15/04/15020 DATUM Geodetic LOCATION N 5046856.8 E 376502.8 - Canisbay Twp., Station 14+221 ORIGINATED BY JL  
 PROJECT GWP 5178-12-00, Highway 60 - F1 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers and NW casing COMPILED BY SH  
 CLIENT AECOM DATE (Started) 2015 August 17 TIME 4:10:00 PM CHECKED BY MAM  
 DATE (Completed) 2015 August 17

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100
453.3	Ground Surface													
450.0	TOPSOIL - silty, with grass rootlets		1	SS	8									
0.2	Black SAND - trace gravel, with silt and clay													
	brown (loose/dense)		2	SS	37									
451.8	Auger Refusal													
1.5	Start Bedrock Coring													
	Bedrock - pink granite/black gneiss		3	RC	Rec.=97% RQD=89%									
	Good quality													
			4	RC	Rec.=100% RQD=84%									
448.7	End of Sampling													
4.6	End of Borehole													
COMMENTS						+ 3, $\times$ 3 : Numbers on right refer to Sensitivity		WATER LEVEL RECORDS						
Advance borehole with N size casing and coring equipment below 1.5 m depth						Numbers on left refer to values greater than 120 kPa		Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)		
						○ 3% STRAIN AT FAILURE		1) 15/8/17 4:10:00 PM		0.2		4.6		
								2)		-		-		
								3)		-		-		
The stratification lines represent approximate boundaries. The transition may be gradual.														

MEL-GEO 15020 - BOREHOLE LOGS - F1.GPJ MEL-GEO.GDT 16/4/27

## **Appendix 3      Borehole Plan and Lab Data**

Drawing No. 2:              Borehole Location and Soil Strata  
Figure Nos. L-1 and L-2:   Grain Size Distribution Curves  
Table No. L-3:              Lab Test Summary Sheet



This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

DISTRICT  
CONT. No.  
GWP No. 5178-12-00

HWY 60  
CULVERT AT STA 14+219  
TOWNSHIP OF CANISBAY  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY

KEY PLAN  
N.T.S.

**LEGEND**  
Borehole  
Blows/0.3 m (Std Pen Test, 475 J/blow)  
Water Level at Time of Investigation  
End of Sampling  
Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	457.4	4.0m Rt	5046866.9	376490.3
2	457.0	3.8m Lt	5046882.4	376478.0
3	454.7	12.0m Lt	5046875.3	376476.7
4	453.3	20m Rt	5046856.8	376502.8

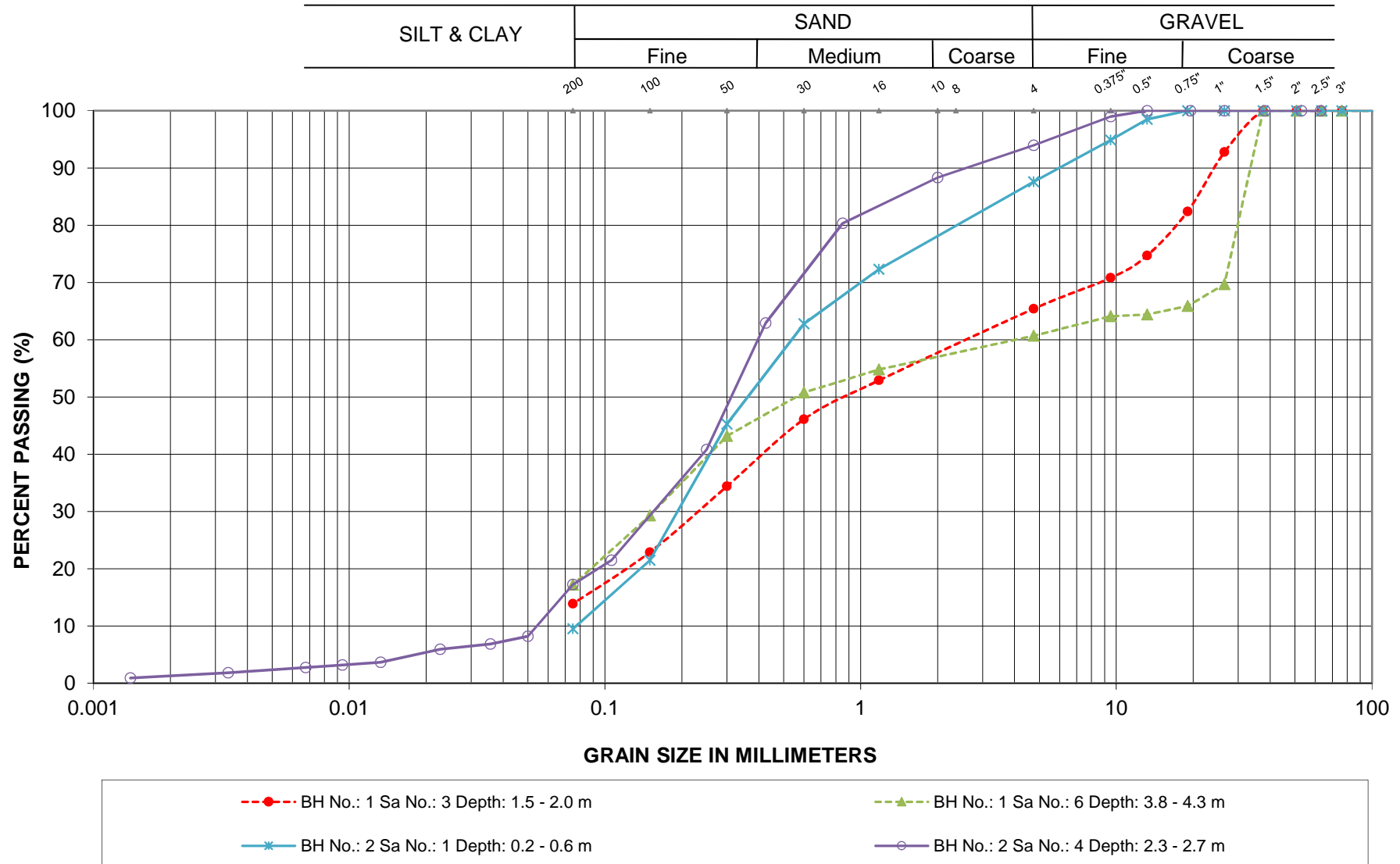
**NOTES:**  
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.  
  
The thickness of fill directly below the culvert has been assumed at 300 mm on the cross section.  
  
Base plan and alignment provided in digital format by Callon Dietz on October 1, 2015  
  
Coordinates based on MTM Zone 10 NAD83 CSRS

**GEOCRES No. 31E-354**

DESIGN	CHK	CODE	LOAD	DATE APR/16
DRAWN DM	CHK SH	SITE	STRUCT	SCHEME

REVISIONS  
DEC/15 DM DRAFT  
APR/16 DM FINAL

DESCRIPTION  
DWG 2

**GRAIN SIZE ANALYSIS**

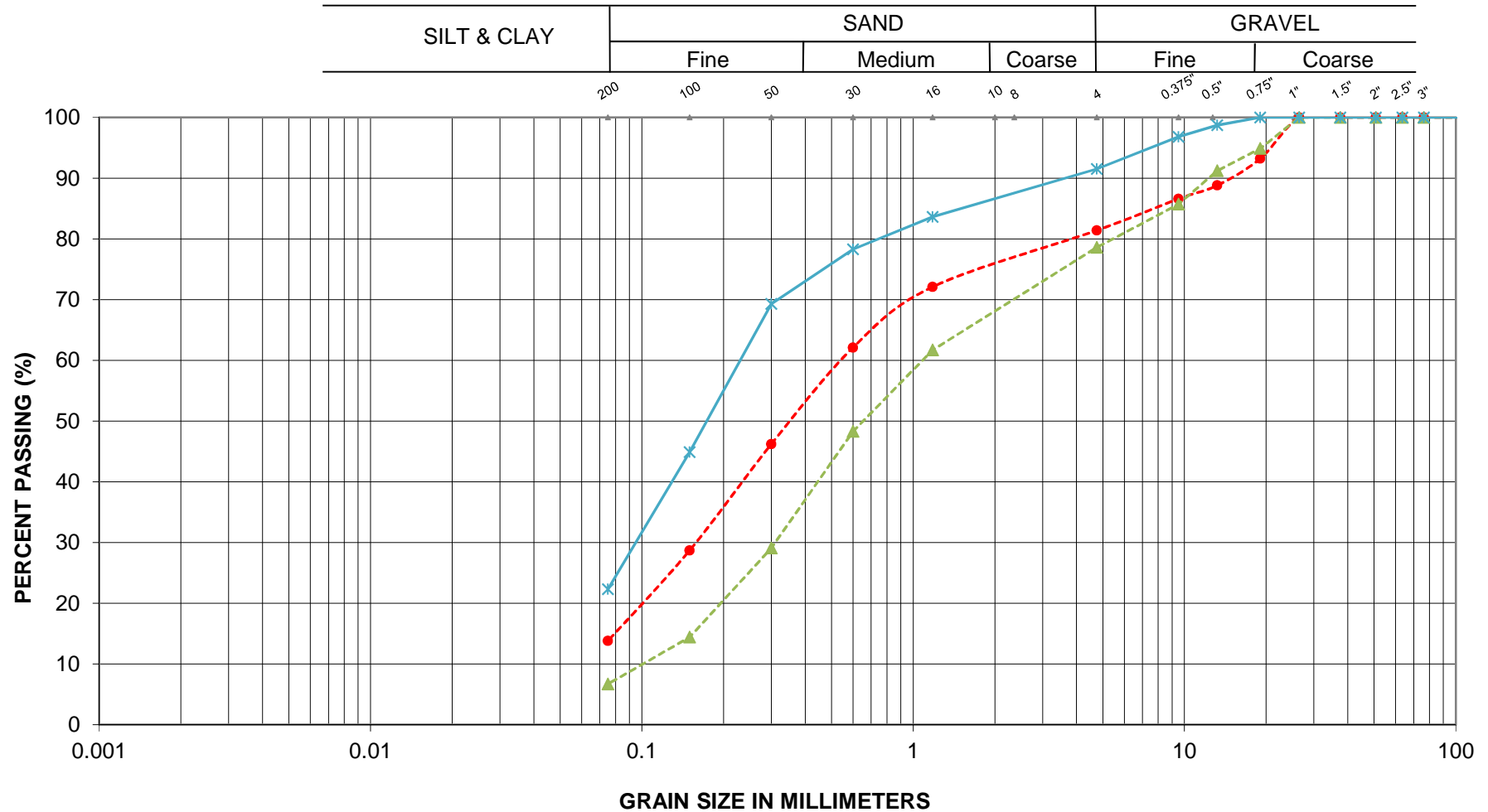
EMBANKMENT FILL

LOCATION: Hwy 60, Culvert Station 14+219  
TWP of Canisbay

Englobe Corp.

FIGURE L-1

## GRAIN SIZE ANALYSIS



SAND

LOCATION: Hwy 60, Culvert Station 14+219  
TWP of Canisbay

Englobe Corp.

FIGURE L-2

## Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.3					3.0				17			
	2	1.0					6.0				23			
	3	1.8	35	51	14		9.0				46			
	4	2.5					13.0				31			
	5	3.3					8.0				10			
	6	4.0	39	44	17		16.0				22			
	7	5.1					20.0				17			
	8	5.6	19	67	14		12.0				34/203mm			
	9	6.3					2.0				52			
	10	7.3												Rec= 95%, RQD= 71%
	11	8.8												Rec= 100%, RQD= 87%
2	1	0.3	12	78	10		4.0				29			
	2	0.8					3.0				20/0mm			
	3	1.9					12.0				14			
	4	2.5	6	77	15	2	16.0				30			Non-plastic
	5	3.3					16.0				13			
	6	3.9					8.0				55/76mm			
	7	4.3												Rec= 95%, RQD= 79%
	8	5.8												Rec= 100%, RQD= 87%
3	1	0.2	21	72	7		21.0				9			
	2	0.8									25/25mm			
	3	0.8												Rec= 83%, RQD= 68%
	4	2.3												Rec= 97%, RQD= 88%
4	1	0.2					28.0				8			
	2	1	8	70	22		15.0				37			
	3	1.5												Rec= 97%, RQD= 89%
	4	3												Rec= 100%, RQD= 84%

## Appendix 4    Photo Essay

Enclosure No. 6:

Photo Essay



Embankment at Culvert Location – Looking East

Photo: 1



Embankment at Culvert Location – Looking West

Photo: 2



Project: Hwy 60 – Culvert, Station 14+219, Township of Canisbay

Photos Provided By: Englobe

Date: June and August 2015

Culvert Outlet – Looking South

Photo: 3



View of Culvert Inlet – Looking above inlet

Photo: 4



Project: Hwy 60 – Culvert, Station 14+219, Township of Canisbay

Photos Provided By: Englobe

Date: June and August 2015



## Rock Cores – Borehole 1 (left) and Borehole 2 (right)

Photos: 5 and 6



Project: Hwy 60 – Culvert, Station 14+219, Township of Canisbay

Photos Provided By: Englobe

Date: June and August 2015

## Rock Cores – Borehole 3 (left) and Borehole 4 (right)

Photos: 7 and 8



Project: Hwy 60 – Culvert, Station 14+219, Township of Canisbay

Photos Provided By: Englobe

Date: June and August 2015



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