



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 21+072 - Twp. of Sproule
GWP 5264-13-00**

FINAL FOUNDATION INVESTIGATION REPORT

Date: November 2, 2016
Ref. N°: 15/04/15020-F6

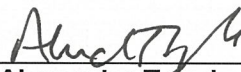
Geocres No. 31E-375

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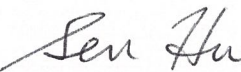
Final Foundation Investigation Report

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2016-11-02

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Test results mentioned herein are only valid for the sample(s) stated in this report.

Englobe's subcontractors who may have accomplished work either on site or in laboratory are duly qualified as stated in our Quality Manual's procurement procedure. Should you require any further information, please contact your Project Manager."

Client:

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Attention: **Mr. Jason Wright**

REVISION AND PUBLICATION REGISTER		
Revision N°	Date	Modification And/Or Publication Details
00	2016-07-25	DRAFT FIDR Issued
01	2016-11-02	Final FIDR Issued

REPORT DISTRIBUTION	
5 hard copies and 1 electronic copy	MTO Project Manager
1 hard copy and 1 electronic copy	MTO Pavement and Foundations Section, Foundation Group
1 hard copy	File

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 centreline culvert site. The site is located at Station 21+072 in the Township of Sproule on Highway 60, about 700 m east of Opeongo Lake Road.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0004: GWP 5264-13-00 for Detailed Design. 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 Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 21+072 in the Township of Sproule, Ontario. 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 fill embankment approximately 5.2 m in height above the culvert invert (at centreline), with centreline at Elevation 436.1 m at the culvert location. At the north slope, the maximum height of the embankment is approximately 5.7 m. At the south slope, the maximum height of embankment fill is approximately 4.8 m above the culvert invert. The existing embankment slopes in the area of the culvert have been generally established at an angle of approximately 2H:1V at the north and south slopes. The culvert at this location is a 750 mm diameter Corrugated Steel Pipe (CSP) culvert, some 30 m in length. Flow through the culvert is from the south to the north (right to left).

Observed infrastructure at the culvert location includes overhead wires to the north of the highway embankment.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The topography on this section of Highway 60 is generally rolling. Layers of earth overlie bedrock. Organic materials were also observed in the region. Within the project area, the native overburden consists primarily of tills overlying bedrock.

Bedrock, based on Ontario Geologic Survey (OGS) Map MRD-126, in the area consists of magmatic rocks and gneisses.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out on September 5th, 15th and 16th, 2015 and March 21st and 22nd, 2016 during which time four (4) sampled boreholes, were advanced. Two (2) boreholes were advanced through the embankment, and one (1) borehole was advanced adjacent to each inlet (south) and outlet (north) end of the culvert, respectively (total of two (2) inlet and outlet boreholes).

The field investigation was carried out using a truck and a bombardier mounted CME drilling rigs 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 advance of the augers was encountered within the proposed depth of borehole, the boring was advanced through diamond drilling using NQ size coring 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 Borehole Nos. 2 and 4 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 same general order in which 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 boreholes 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 (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 the Englobe North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in the 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-5 and Table No. L-6).

The location of the individual borehole was determined in the field using highway chainage established by Callon Dietz Inc. (Callon Dietz) and offsets relative to highway centreline. 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 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 the 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 21+072, TWP OF SPROULE

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 outlet, and Borehole No. 4 advanced adjacent to the culvert inlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at Elevations 435.8, 436.4, 429.6, and 432.4 m, respectively.

4.1.1 Pavement Structure

Borehole Nos. 1 and 2, were advanced through the embankment. Borehole Nos. 1 and 2 confirmed the pavement structure consisted of 50 mm asphalt concrete overlying a layer of crushed gravel base/subbase approximately 100 to 175 mm thick.

4.1.2 Embankment Fill

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of embankment fill described as of brown sand, with to some gravel, with to some silt, trace clay was penetrated. Cobble/boulder sized rock pieces were encountered in the embankment fill layer. The natural moisture content measured for recovered samples from this deposit ranged from 1 to 6%. Gradation (sieve) analyses were carried out on three (3) samples of this deposit, the results of which indicated 13 to 28% gravel size particles, 58 to 71% sand size particles, and 14 to 25% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 8 to 27

blows per 300 mm penetration and 50 blows per 76 mm penetration, the relative density/compactness of this deposit was described as loose to very dense, but generally compact on average. This embankment fill was encountered to depths of 3.2 and 3.7 m below grade at Borehole Nos. 1 and 2, respectively (Elevations 432.6 and 432.7 m, respectively).

4.1.3 Sand Fill

Underlying the embankment fill at Borehole Nos. 1 and 2, a layer of fill described as of brown sand, with to trace gravel, with to some silt, trace clay was penetrated. Cobble/boulder sized rock pieces were encountered in the embankment fill layer. The natural moisture content measured for recovered samples from this deposit ranged from 9 to 23%. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, and the results indicated 21% gravel size particles, 73% sand size particles, and 6% silt and clay size particles (Figure No. L-2, Appendix 3). A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 12% gravel size particles, 60% sand size particles, 26% silt size particles, and 2% clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 6 to 36 blows per 300 mm penetration and 27 blows per 178 mm penetration, the relative density/compactness of this deposit was described as loose to very dense, but generally compact on average. This embankment fill was encountered to depths of 5.2 and 5.9 m below grade at Borehole Nos. 1 and 2, respectively (Elevations 430.6 and 430.5 m, respectively).

4.1.4 Organic Soils

At surface at Borehole No. 3, a layer of fine fibrous organic soil (topsoil) was encountered. The organic soil (topsoil) was encountered to a depth of 0.3 m below grade at Borehole No. 3 (Elevation 429.3 m).

4.1.5 Upper Sand

At surface at Borehole No. 4 and underlying the organic soil at Borehole No. 3, an upper deposit of sand, with to trace gravel, some silt, trace clay was penetrated. The natural moisture content measured on samples of this deposit ranged from about 22 to 25%. Organics, wood pieces, and grass rootlets were encountered in this deposit. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, and the results indicated 21% gravel size particles, 58% sand size particles, and 21% silt and clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 8 blows per 300 mm penetration and 20 blows per 25 mm penetration, the relative density/compactness of this deposit was described as loose to very dense. This deposit was encountered to depths of 1.4 and 0.6 m below grade at Borehole Nos. 3 and 4, respectively (Elevations 428.2 and 431.8 m, respectively).

4.1.6 Silty Sand

Underlying the sand fill at Borehole Nos. 1 and 2, and underlying the upper sand deposit at Borehole No. 3 and 4, a deposit of silty sand, with to trace gravel, trace clay was penetrated. The natural moisture content measured for recovered samples from this deposit ranged from

about 9 to 13%. Gradation (hydrometer) analyses were carried out on five (5) samples of this deposit, and the results indicated 8 to 22% gravel size particles, 43 to 58% sand size particles, 30 to 39% silt size particles, and 1 to 4% clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values of 27 to 55 blows per 300 mm penetration and 50 blows per 152 mm penetration, the relative density/compactness of this deposit was described as compact to very dense, but generally compact on average. This embankment fill was encountered to depths of 7.1, 7.6, 3.3, and 1.4 m below grade at Borehole Nos. 1 to 4, respectively (Elevations 428.7, 428.8, 426.3 and 431.0 m, respectively).

4.1.7 Lower Sand

Underlying the silty sands at Borehole Nos. 1 and 4, a lower deposit of sand, with to trace gravel, with some silt, trace clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 7 to 13%. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, and the results indicated 30% gravel size particles, 56% sand size particles, and 14% silt and clay size particles (Figure No. L-6, Appendix 3). Additional gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 9% gravel size particles, 60% sand size particles, 27% silt size particles, and 4% clay size particles (Figure No. L-5, Appendix 3). Based on SPT 'N' values of 8 to 42 blows per 300 mm penetration, the relative density/compactness of this deposit was described as loose to dense, but generally compact on average. This deposit was encountered to depths of 8.4 and 3.6 m below grade at Borehole Nos. 1 and 4, respectively (Elevations 427.4 and 428.8 m, respectively).

4.1.8 Bedrock

Underlying the lower sand deposit at Borehole Nos. 1 and 4, and underlying the silty sand deposit at Borehole Nos. 2 and 3, bedrock was proven by diamond core drilling. The bedrock was described as black gneiss. Based on RQD values of 23 to 95%, the bedrock was described as very poor to excellent quality, but is considered to be generally good quality on average. Based on visual review, the bedrock generally showed negligible weathering. Sampling in the bedrock was terminated at depths of 11.5, 10.5, 6.3, and 6.7 m below grade at Borehole Nos. 1 to 4, respectively (Elevations 424.3, 425.9, 423.3, and 425.7 m, respectively). Photos of rock cores recovered at Borehole Nos. 1 to 4 are shown in Enclosure No. 6, Appendix 4. 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 surface water was not observed within the culvert.

Measurements of the groundwater table 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. 2 and 4 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The groundwater levels were measured at Elevations 431.6 and 431.6 m at Borehole Nos. 2 and 4 during the site investigation period, respectively. The groundwater level was encountered at Elevation 429.6 m at Borehole No. 3 upon completion of sampling at the boreholes.

The groundwater was measured at Elevations 431.1 and 432.1 m at Borehole No. 2 and 4, respectively, at the time of decommissioning on August 16, 2016.

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

Appendix 1 Key Plan

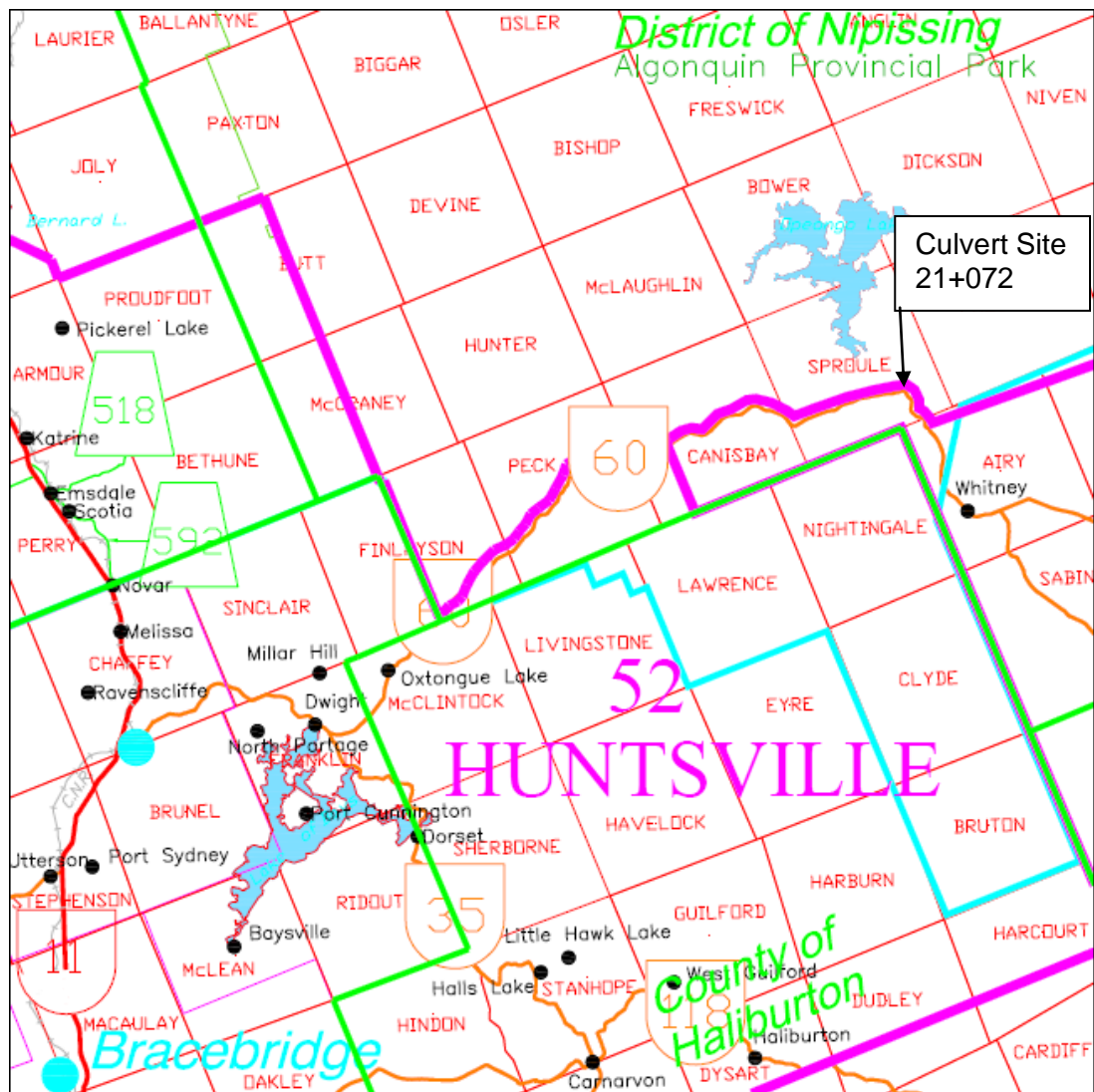
Drawing No. 1

Key Plan

MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



FOUNDATION INVESTIGATION REPORT

GWP 5264-13-00

Highway 60

Station 21+072 Culvert

Township of Sproule



Reference No: 15/04/15020-F6

November 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-F6 DATUM Geodetic LOCATION N 5051170.2 E 397067.9 - Sproule Twp., Station 21+066 ORIGINATED BY JL
 PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 2015 September 8 TIME
 DATE (Completed) 2015 September 15 (Completed) CHECKED BY SH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)		
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
435.8	Ground Surface												
0.0	50 mm Asphalt 175 mm Crushed Gravel EMBANKMENT FILL - sand, with to some gravel, with to some silt, trace clay brown (compact/ very dense) start advance with casing using wash boring at depth of 0.8 m due to auger refusal 10 mm to 40 mm gravel sized rock fragments encountered at depths from 0.8 m to 2.7 m		1	SS	11								
			2	SS	50/76 mm						28 58 (14)		
			3	SS	16								
			4	SS	16								
432.6													
3.2	FILL - sand, some to trace gravel, with silt, trace clay brown to grey, wet (loose/very dense) 150 mm cobble sized rock piece encountered at depth of 3.4 m		5	SS	6						12 60 26 2		
			6	SS	7								
			7	SS	27/178 mm								
430.6													
5.2	silty SAND - trace gravel, trace clay brown to grey 100 mm cobble sized rock piece encountered at depth of 5.6 m (very dense)		8	SS	50/152 mm						9 48 39 4		
			9	SS	55								
428.7													
7.1	SAND - with gravel, some silt brown to grey (dense)		10	SS	42						30 56 (14)		
427.4													
8.4	Start Rock Coring BEDROCK - black gneiss good to excellent quality		11	RC	REC= 98% RQD= 83%								
			12	RC	REC= 100% RQD= 93%								
424.3													
11.5	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 ○ 3% STRAIN AT FAILURE					
The stratification lines represent approximate boundaries. The transition may be gradual.								WATER LEVEL RECORDS					
								Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)	
								1) 15/9/15		DRY		-	

MEL-GEO 15020 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 16/11/2

Englobe Corp.

120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@englobecorp.com

METRIC

RECORD OF BOREHOLE NO. 2



REFERENCE 15/04/15020-F6 DATUM Geodetic LOCATION N 5051179.0 E 397079.4 - Sproule Twp., Station 21+078 ORIGINATED BY JL
 PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 2015 September 16 TIME 2015 September 16 (Completed) CHECKED BY SH

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 (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	
436.4	Ground Surface													
0.0	50 mm Asphalt 100 mm Crushed Gravel EMBANKMENT FILL - sand, with to some gravel, with to some silt brown, damp (loose/very dense) start advance with casing using wash boring at depth of 0.8 m due to auger refusal cobble/boulder sized rock pieces encountered at depths from 0.8 m to 3.0 m		1	SS	27									13 71 (16)
			2	SS	12									
			3	SS	8									
			4	SS	25/25 mm									
			5	SS	28									25 50 (25)
432.7	FILL - sand, with gravel, some silt, trace clay brown, wet (compact/loose)		6	SS	13									
			7	SS	6									21 73 (6)
			8	SS	36									
430.5	silty SAND - some to trace gravel, trace clay brown to grey, wet (very dense)		9	SS	54									13 53 31 3
428.8	Start Rock Coring BEDROCK - black gneiss fair to excellent quality		10	RC	Rec= 100% ROD= 72%									
			11	RC	REC= 100% ROD= 95%									
425.9	End of Sampling End of Borehole													
10.5														
COMMENTS								+ 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) 15/9/16		4.8		▽		
								2) 16/8/16		5.3		▽		
								3)				▽		

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

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MEL-GEO 15020 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 16/11/2

METRIC**RECORD OF BOREHOLE NO. 3**

REFERENCE 15/04/15020-F6 DATUM Geodetic LOCATION N 5051194.0 E 397077.5 - Sproule Twp., Station 21+077 ORIGINATED BY JL
 PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 2016 March 21 TIME
 DATE (Completed) 2016 March 22 (Completed) CHECKED BY SH

SOIL PROFILE		STRATA 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 (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)		NUMBER	TYPE			"N" VALUES	20					
429.6	Ground Surface												
0.0	black fine fibrous organic soil		1	SS	22/152 mm								
429.3													
0.3	SAND - with gravel, some silt some grass rootlets, decayed wood, trace organics		2	SS	20/25 mm								21 58 (21)
428.2	black to dark brown (very dense)												
1.4	silty SAND - some to trace gravel, trace clay, trace organics		3	SS	58								8 53 35 4
	dark brown, wet (very dense/dense)		4	SS	32								
426.3			5	SS	25/76 mm								11 58 30 1
3.3	Auger Refusal Start Rock Coring		6	RC	REC= 98% RQD= 82%								
	BEDROCK - black gneiss with thin pink granite												
	very poor to good quality		7	RC	REC= 98% RQD= 23%								
423.3													
6.3	End of Sampling End of Borehole												

WATER LEVEL RECORDS	
Date (dd/mm/yy)/Time	Water Depth (m) / Cave In (m)
1) 16/3/22 12:30:00 PM	0 1
2)	- -
3)	- -

COMMENTS

+ 3, × 3 : Numbers on right refer to Sensitivity
 Numbers on left refer to values greater than 120 kPa
 ○ 3% STRAIN AT FAILURE

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

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MEL-GEO 15020 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 16/11/2

METRIC**RECORD OF BOREHOLE NO. 4**

REFERENCE 15/04/15020-F6 DATUM Geodetic LOCATION N 5051162.1 E 397072.4 - Sproule Twp., Station 21+070 ORIGINATED BY JL
 PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 2016 March 22 TIME
 DATE (Completed) 2016 March 22 (Completed) CHECKED BY SH

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p W W _L					
						20	40	60	80	100	20	40	60			
432.4	Ground Surface															
0.0	SAND - with to trace gravel, some silt, trace clay		1	SS	8											
431.8	some grass rootlets, trace organics brown (loose/ compact)															
0.6	silty SAND - with gravel, trace clay		2	SS	27											
431.0	brown to grey															
1.4	(compact)															
	SAND - trace gravel, with silt, trace clay		3	SS	17											
	grey															
	(compact/loose)		4	SS	10											
			5	SS	8											
428.8	Auger Refusal															
3.6	Start Rock Coring															
	BEDROCK - black gneiss		6	RC	REC= 98% RQD= 79%											
	good quality															
			7	RC	REC= 98% RQD= 83%											
425.7	End of Sampling															
6.7	End of Borehole															
COMMENTS						+ 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) 16/3/23 10:55:00 AM 0.8 ▽ - 變										
						2) 16/8/16 0.3 ▽ - 變										
						3) - ▽ - 變										

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

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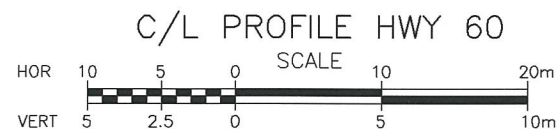
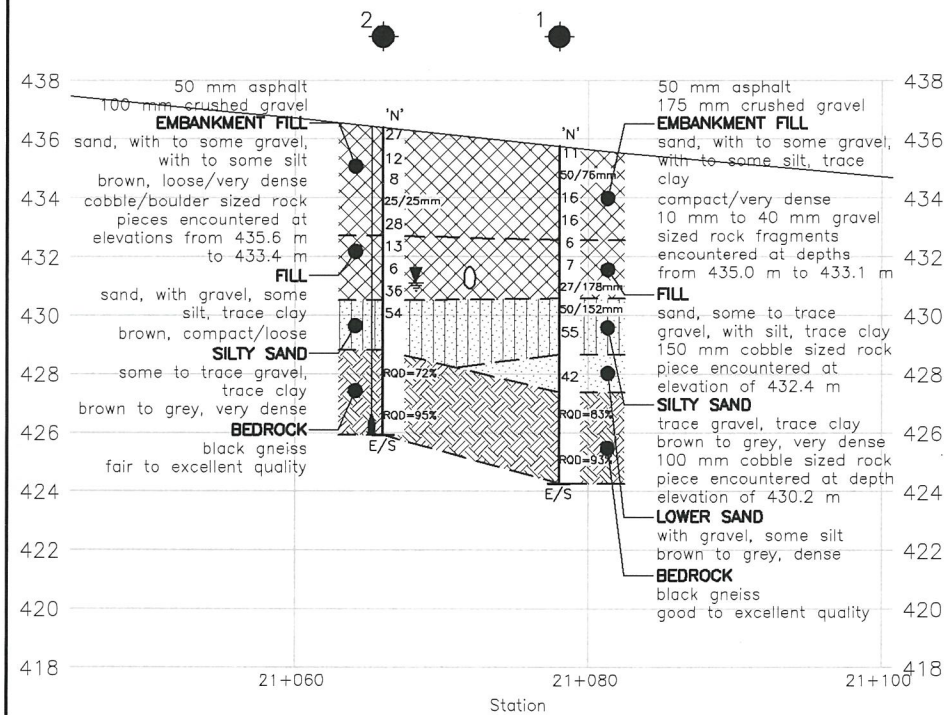
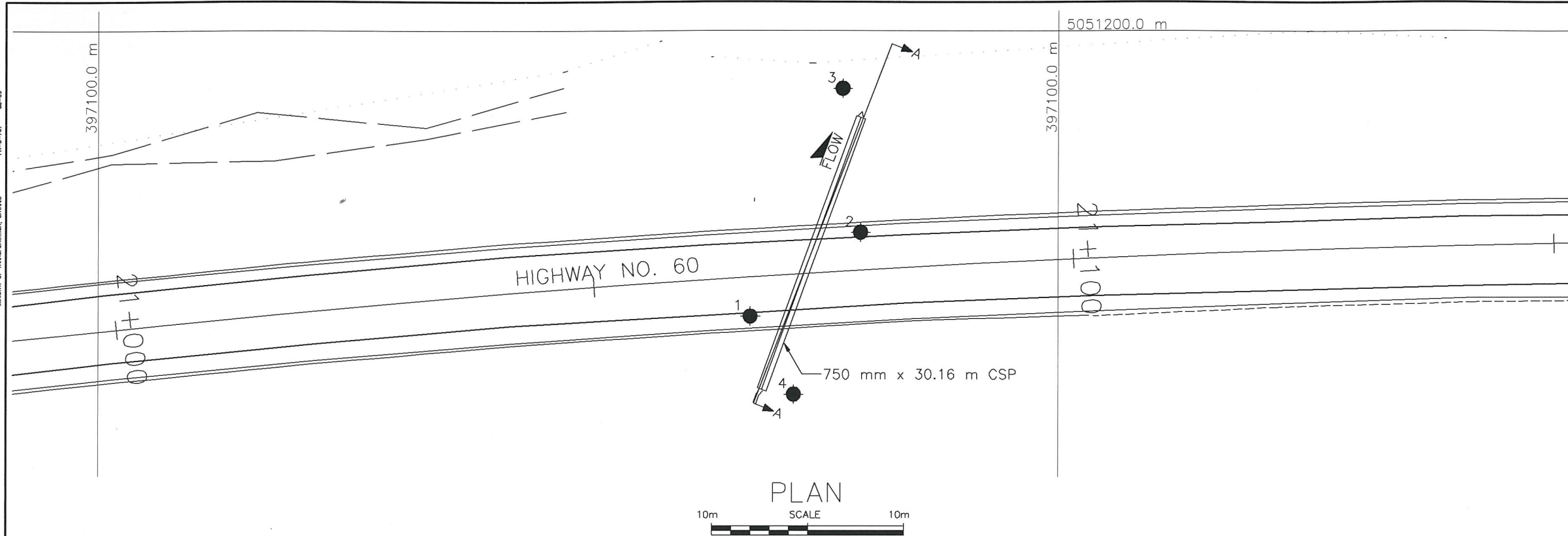
MEL-GEO 15020 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 16/11/2

Appendix 3 Borehole Plan and Lab Data

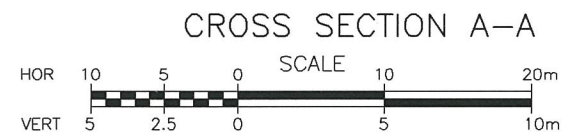
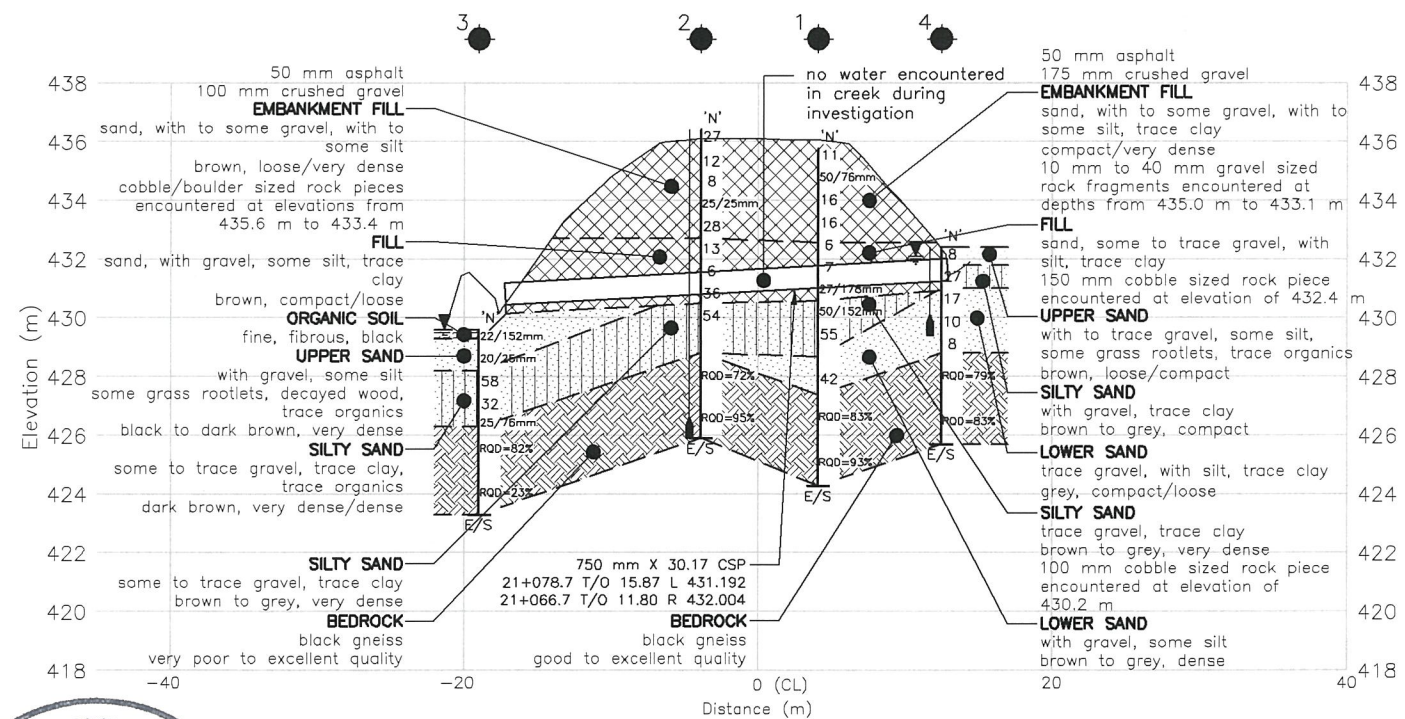
Drawing No. 2: Borehole Location and Soil Strata
Figure Nos. L-1 to L-5: Grain Size Distribution Curves
Table No. L-6: Lab Test Summary Sheet

CAD FILE LOCATION AND NAME: G:\2015\15020 - PAV & FDR, Hwy 60 & 118, 5014-E-004 (ACCOM)\FOUNDATION\Drawings\F6 - 21+067.dwg
MODIFIED: 11/2/2016 1:13:54 PM BY: MITCHIE
DATE PLOTTED: 11/2/2016 1:14:38 PM BY: DUNCAN MITCHELL

MINISTRY OF TRANSPORTATION, ONTARIO
PR-0-707
BB-05



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.



2016-11-02

DISTRICT
CONT. No.
GWP No. 5264-13-00

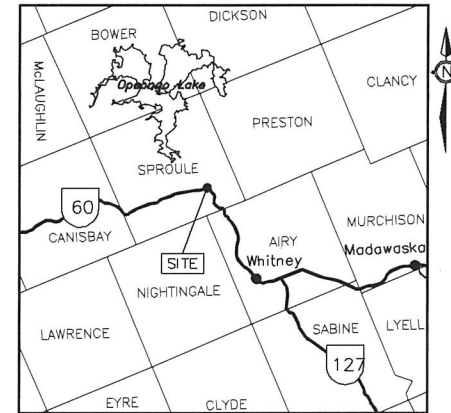
HWY 60 CULVERT
STA. 21+072

BOREHOLE LOCATIONS
AND SOIL STRATIGRAPHY



DRAWING

2



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	435.8	4.1 Rt	5051170.2	397067.9
2	436.4	3.9 Lt	5051179.0	397079.4
3	429.6	19 Lt	5051194.0	397077.5
4	432.4	12.5 Rt	5051162.1	397072.4

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.

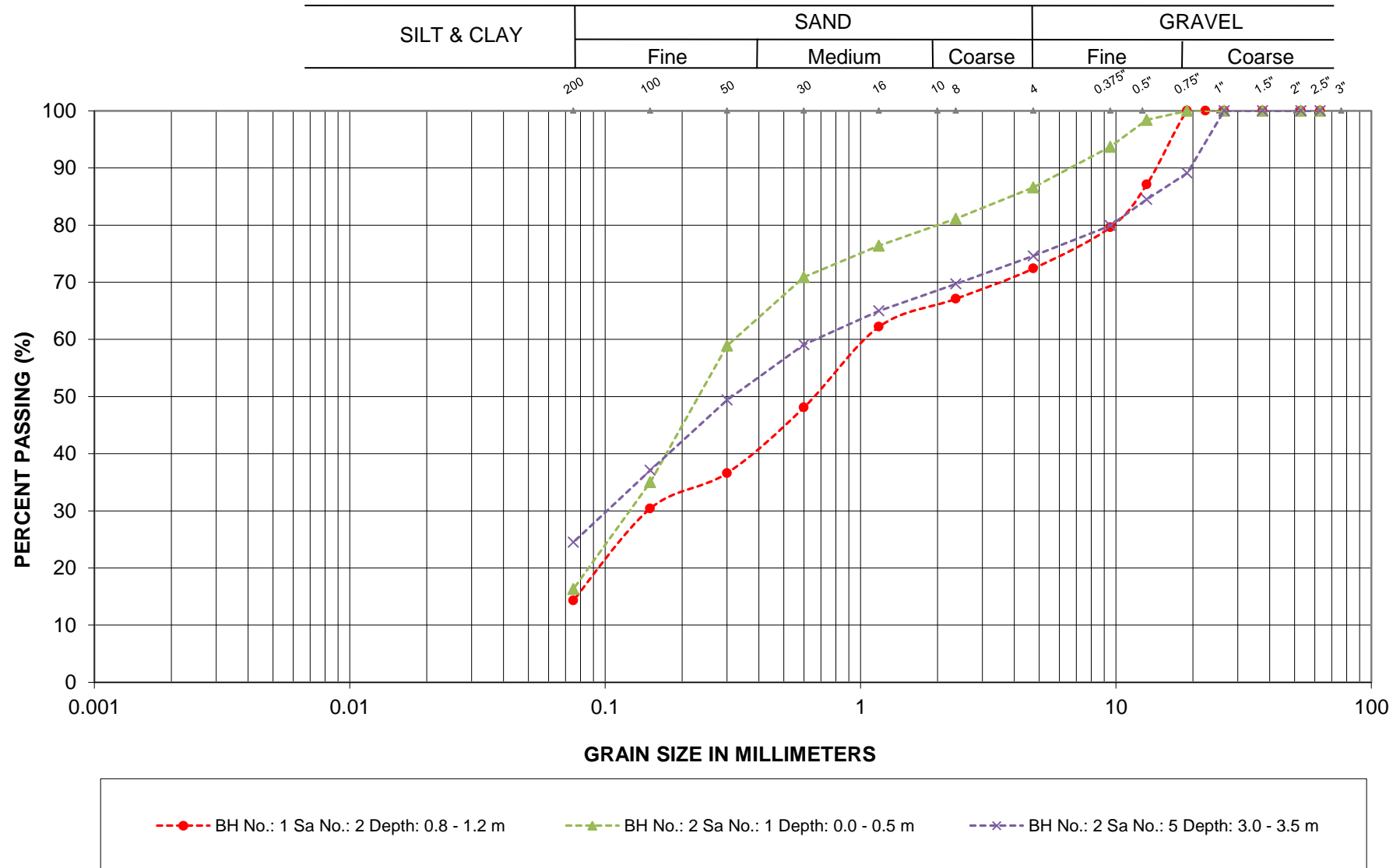
Base plan and alignment provided in digital format by Callon Dietz on July 6, 2016

Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCREs No. 31E-375

REVISIONS	JUL/16	DM	DRAFT				
	NOV/16	DM	FINAL				
DESCRIPTION							
DESIGN	CHK		CODE		LOAD		DATE NOV/16
DRAWN	DM	CHK SH	SITE	STRUCT	SCHEME	DWG	2

GRAIN SIZE ANALYSIS



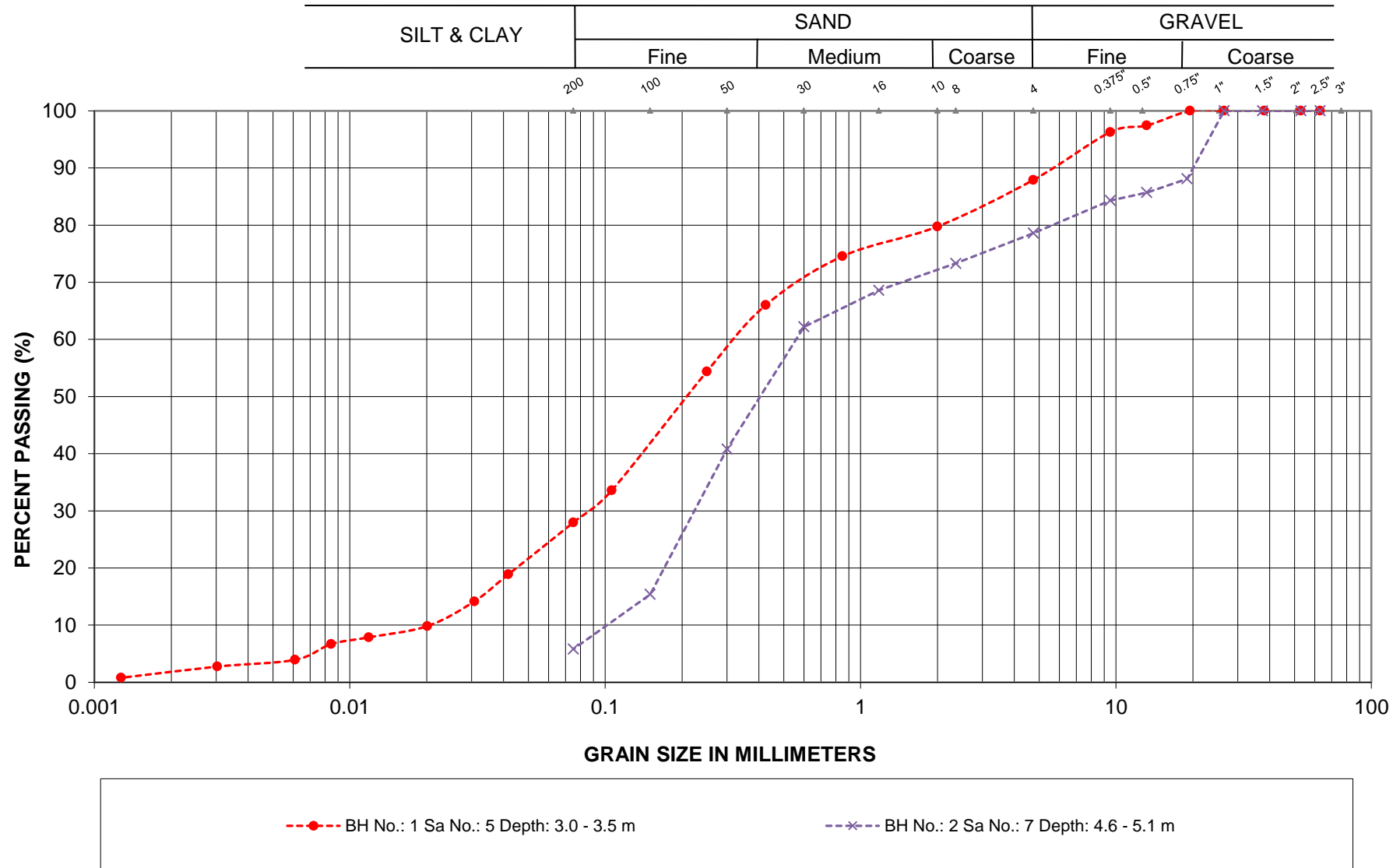
EMBANKMENT FILL

LOCATION: Hwy 60, Station 21+072
TWP of Sproule

Englobe Corp.

FIGURE L-1

GRAIN SIZE ANALYSIS



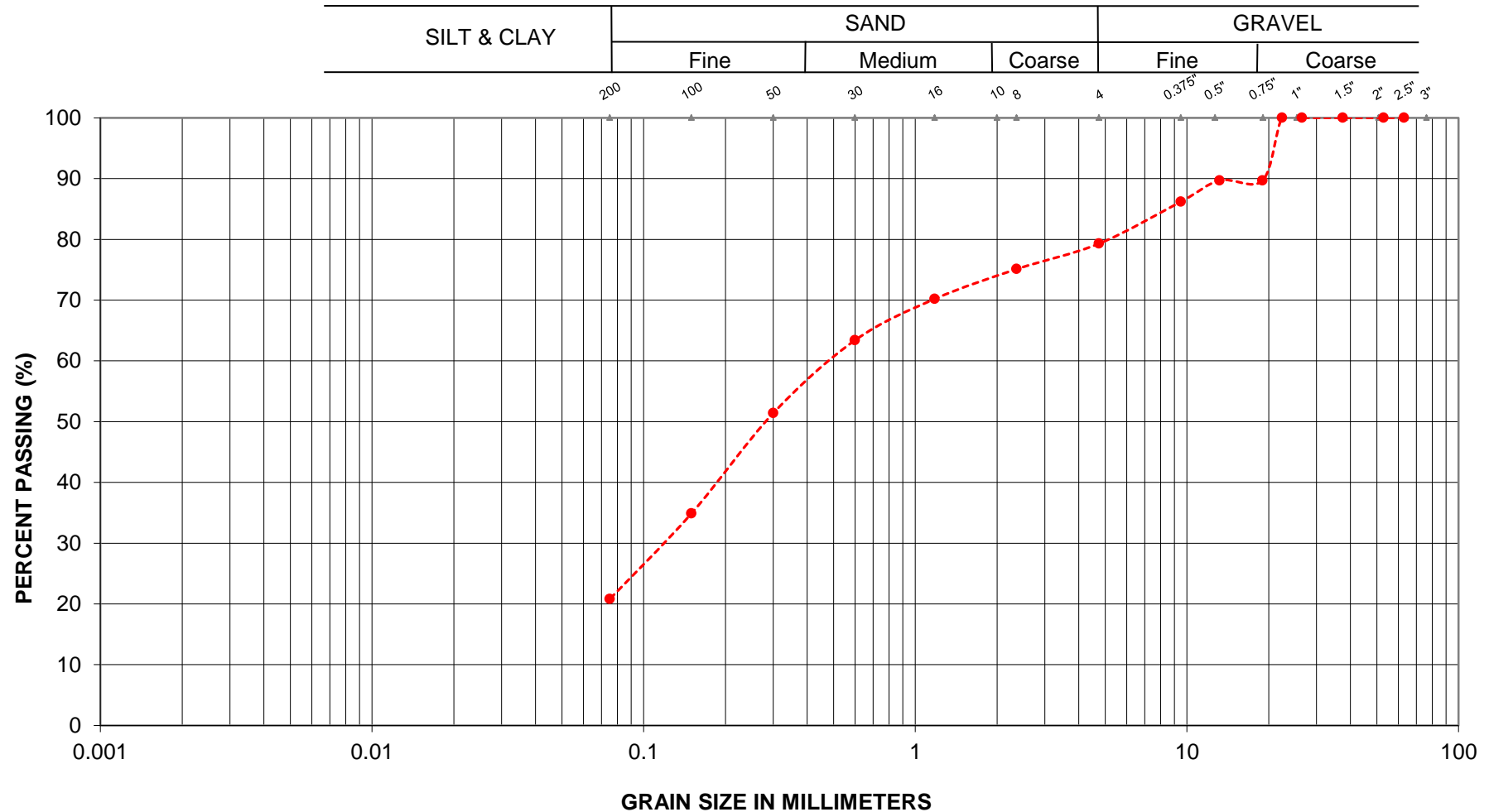
SAND FILL

LOCATION: Hwy 60, Station 21+072
TWP of Sproule

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FIGURE L-2

GRAIN SIZE ANALYSIS



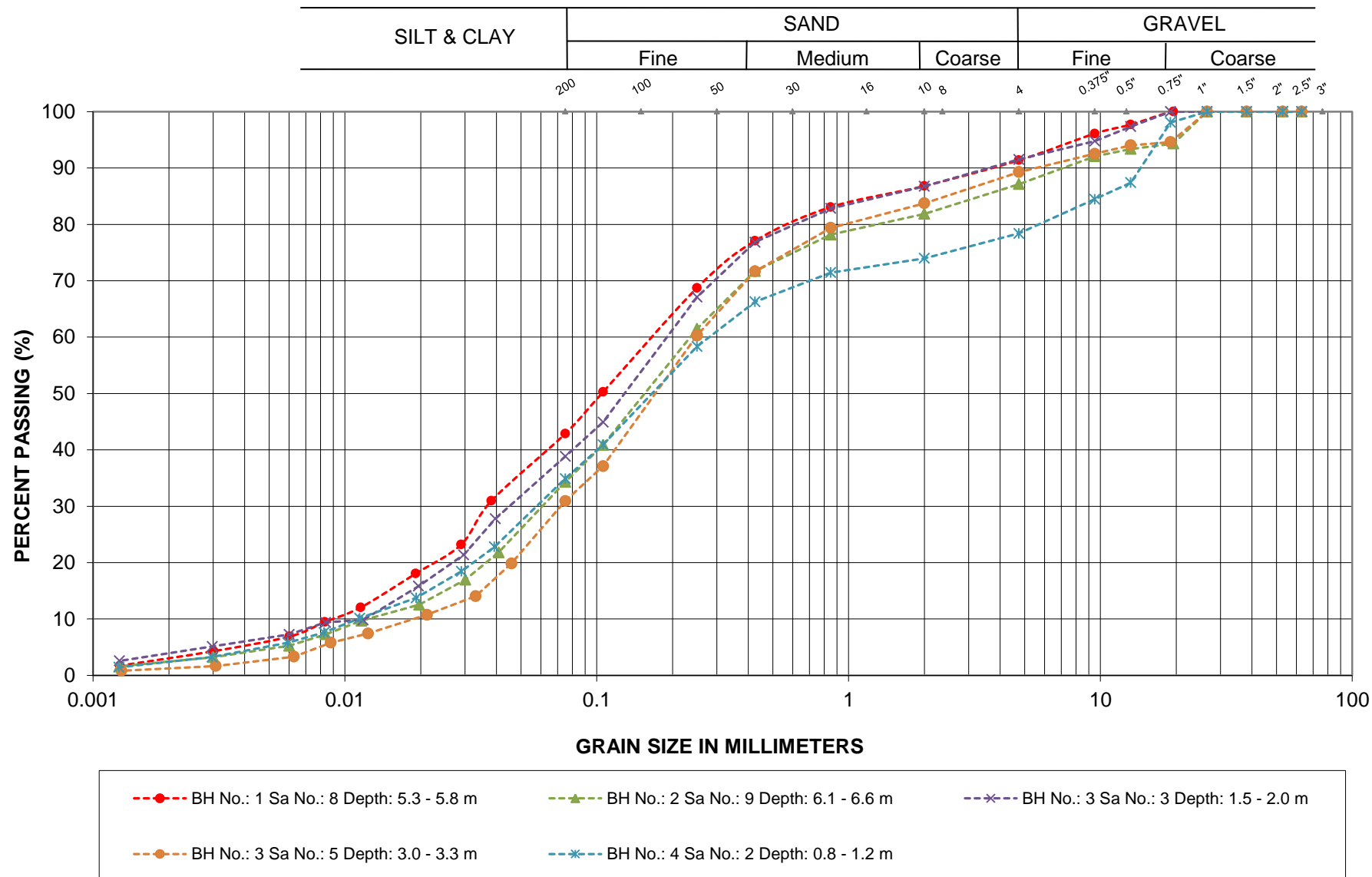
---●--- BH No.: 3 Sa No.: 2 Depth: 0.8 - 1.2 m

UPPER SAND

LOCATION: Hwy 60, Station 21+072
TWP of Sproule

Englobe Corp.

FIGURE L-3

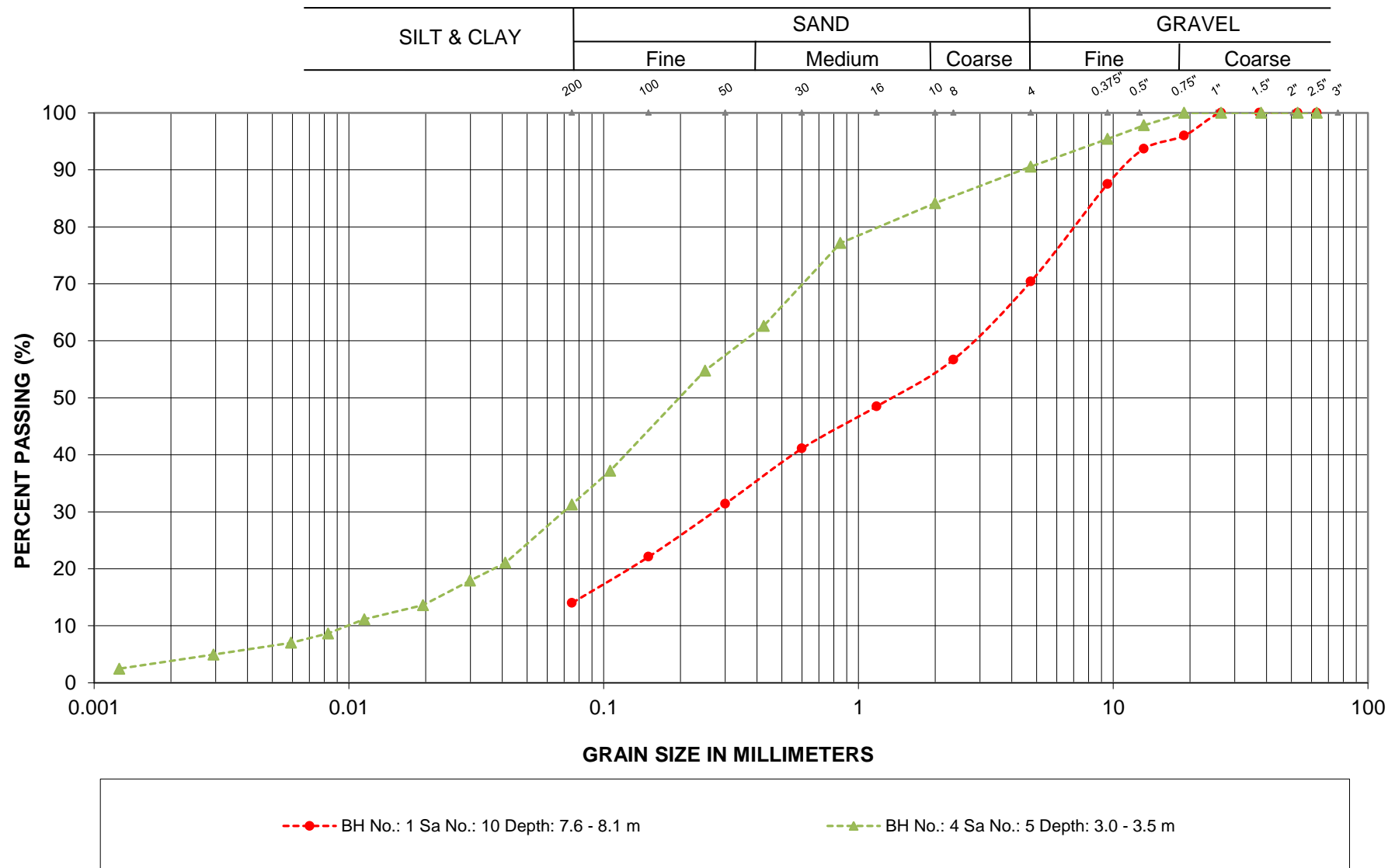
GRAIN SIZE ANALYSIS

SILTY SAND

LOCATION: Hwy 60, Station 21+072
TWP of Sproule

Englobe Corp.

FIGURE L-4

GRAIN SIZE ANALYSIS

LOWER SAND

LOCATION: Hwy 60, Station 21+072
TWP of Sproule

Englobe Corp.

FIGURE L-5

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	0.0					6.0				11			
	2	0.8	28	58	14		6.4				50/76 mm			
	3	1.5					1.1				16			
	4	2.3					0.4				16			
	5	3.1	12	60	26	2	14.1				6			
	6	3.8					11.3				7			
	7	4.6					11.2				27/178 mm			
	8	5.3	9	48	39	4	10.3				50/152 mm			
	9	6.1					8.9				55			
	10	7.6	30	56	14		6.7				42			
	11	8.4												Rec= 98%, RQD= 83%
	12	9.9												Rec= 100%, RQD= 93%
2	1	0.0	13	71	16		5.8				27			
	2	0.8									12			
	3	1.5									8			
	4	2.3									25/25 mm			
	5	3.1	25	50	25		10.5				28			
	6	3.8					23.2				13			
	7	4.6	21	73	6		15.9				6			
	8	5.3					9.2				36			
	9	6.1	13	53	31	3	9.6				54			
	10	7.6												Rec= 100%, RQD= 72%
	11	9.1												Rec= 100%, RQD= 95%

Table No. L-6
Sheet 2 of 2

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 21+072, Township of Sproule

Photos Provided By: Englobe

Date: September 2015

Culvert Outlet – Looking South

Photo: 3



Project: Hwy 60 – Culvert, Station 21+072, Township of Sproule

Photos Provided By: Englobe

Date: March 2016

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

Photos: 4 and 5



Project: Hwy 60 – Culvert, Station 21+072, Township of Sproule

Photos Provided By: Englobe

Date: July 2016

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

Photos: 6 and 7



Project: Hwy 60 – Culvert, Station 21+072, Township of Sproule

Photos Provided By: Englobe

Date: July 2016