



# 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 11  
Station 21+918 – Township of Idington  
GWP 163-98-00**

## **FINAL FOUNDATION INVESTIGATION REPORT**

Date: February 23, 2016  
Ref. N<sup>o</sup>: 15/05/15059-F6

**Geocres No. 42G-59**

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GWP 163-98-00

## Final Foundation Investigation Report

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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."

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Attention: **Mr. Al Rose**

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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 culvert site. The site is located on Highway 11 at Station 21+918 in the Township of Idington, some 4.0 km east of the intersection between Highway 11 and Belanger Road.

The foundation investigation location was specified by the MTO in Change Order Number 2 for the work under Agreement No. 5014-E-0001: GWP 163-98-00. The terms of reference for the scope of work are outlined in Englobe's Proposal 15/05/15059-A2 dated July 17, 2015. The purpose of this investigation was to determine the subsurface conditions in the area of the existing culvert for the detailed design of the culvert replacement. 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

The Corrugated Steel Pipe (CSP) culvert is located on Highway 11 at Station 21+918 in the Township of Idington. The topography of this site is generally flat. 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 supported on an embankment of granular fill overlying silty clay fill embankment some 5.0 m in height, with centerline elevation of 231.8 m at the culvert location. The existing embankment slopes in the area of the culverts have been built at angles ranging between approximately 1.8H:1V (right side) to 2.4H:1V (left side). The culvert at this location has been described as a 0.9 m diameter Corrugated Steel Pipe (CSP) culvert, some 29 m long. The flow through the culvert is from the south to the north (right to left).

Infrastructure at this site consists of overhead and underground communication lines running parallel to the highway embankment. An Ontario Northland Rail Line runs adjacent to the south of the highway embankment.

### 2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Cochrane Clay Plain. The topography on this section of Highway 11 is generally flat. Significant layers of earth overlay the bedrock. Within the project area native overburden primarily consists of silty clay till to silt till deposits.

Bedrock in the area, as indicated on OGS Map 2506, is of the Early Precambrian felsic igneous and metamorphic rocks consisting of granitic, metasedimentary, and minor metavolcanic migmatite.

### 3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between the period of July 23<sup>rd</sup> and 27<sup>th</sup>, 2015 during which time four (4) sampled boreholes were advanced. Two (2) boreholes were advanced through the embankment at the location of the culvert, and one (1) borehole was advanced at each of the inlet (south) and outlet (north) ends of the culvert.

The field investigation was carried out using 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. When cohesive deposits were encountered, the in-situ strength was measured using an “N” size field vane, vane collar, and calibrated torque meter. 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 single 19 mm diameter standpipe was installed in selected open boreholes prior to backfilling to allow for post borehole completion 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 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, 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-5 and Table No. L-6).

The location of the individual boreholes was determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in

this report are referenced to a geodetic datum. The borehole elevations are based on a survey carried out by others.

## **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 21+918, TWP OF IDINGTON**

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 adjacent to the culvert, Borehole No. 3 advanced in the area adjacent to the culvert outlet, and Borehole No. 4 advanced adjacent the culvert inlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4, inclusive, were recorded at elevations 231.7, 231.7, 227.2, and 227.4 m, respectively.

#### **4.1.1 Pavement Structure**

Borehole No. 1 and 2 were advanced through the embankment shoulder where a layer of crushed gravel some 203 to 305 mm thick was penetrated.

#### **4.1.2 Granular Fill**

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of fill consisting of brown sand trace to some gravel, trace to some silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 3 to 5%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 1 to 17% gravel size particles, 73 to 86% sand size particles, and 10 to 13% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 18 to 29 blows per 300 mm penetration, the compactness of this deposit was described as compact. This fill layer was encountered to depths of 0.9 and 1.4 m below grade at Borehole Nos. 1 and 2, respectively (elevations 230.8 and 230.3 m, respectively).

#### **4.1.3 Silty Clay Fills**

Underlying the granular fill at Borehole Nos. 1 and 2, a layer of fills consisting of silty clay, trace to some gravel, trace to with sand, was penetrated. The natural moisture content measured on

samples of this deposit was in the order of 11 to 18%. Gradation (hydrometer) analyses were carried out on two (2) samples of this deposit, the results of which indicated 3 to 5% gravel size particles, 23% sand size particles, 42 to 47% silt size particles, and 27 to 30% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on two (2) samples of this deposit, indicating a Plastic Limit in the order of 14 to 15% and a Liquid Limit in the order of 24 to 25%, indicating a clay of low plasticity (Figure No. L-5, Appendix 3). Based on SPT 'N' values ranging from 5 to 17 blows per 300 mm penetration of greater than 100 kPa, the consistency of this deposit was described as firm to very stiff. This fill layer was encountered to depths of 4.1 and 4.0 m below grade at Borehole Nos. 1 and 2, respectively (elevations 227.6 and 227.7 m, respectively).

#### 4.1.4 **Organic Soils**

Underlying the silty clay fills at Borehole Nos. 1 and 2, and at ground surface Borehole Nos. 3 and 4, a layer of silty organic soils, including fibrous peat, trace decayed wood, was penetrated. This organic soil layer was encountered to depths of 4.3, 4.7, 0.3, and 0.4 m below ground surface at Borehole Nos. 1 to 4, respectively (elevations 227.4, 227.0, 226.9, and 227.0 m, respectively).

#### 4.1.5 **Tills**

Underlying the organic soils at Borehole No. 1 to 4, deposits of native tills were encountered. Sampling was terminated in the till deposits at a depth of 9.8 m below grade at Borehole Nos. 1 to 4 (elevations 221.9, 221.9, 217.4, and 217.6 m). The till deposit consisted of interbedded layers of till ranging from silty clay tills to silt tills, and have been described as follows.

##### 4.1.5.1 **Silty Clay Till**

The silty clay portion of the till deposit was described as silty clay, trace to some gravel, with sand. The natural moisture content measured on samples of the silty clay portions of the deposit was in the order of 10 to 30%. Gradation (hydrometer) analyses was carried out on five (5) single sample of this deposit, the results of which indicated 2 to 13% gravel size particles, 19 to 33% sand size particles, 46 to 50% silt size particles, and 18 to 32% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was carried out on five (5) sample of this deposit, the results of which indicated a Plastic Limit in the order of 13 to 16% and a Liquid Limit in the order of 23 to 26% (Figure No. L-5, Appendix 3). The consistency of this deposit was described as very stiff.

##### 4.1.5.2 **Silt Till**

The silt portion of the till deposit was described as silt, trace to with gravel, with sand to sandy, trace to some. The natural moisture content measured on samples of this deposit was in the order of 12 to 18%. Gradation (hydrometer) analyses were carried out on five (5) sample of this deposit, the results of which indicated 3 to 26% gravel size particles, 16 to 41% sand size particles, 42 to 66% silt size particles, and 3 to 12% clay size particles (Figure No. L-4,



Appendix 3). Atterberg Limits testing was attempted on five (5) samples of this deposit. The results generally indicated a non-plastic material, however, the result of one test indicated a Plastic Limit in the order of 15% and a Liquid Limit in the order of 18% (Figure No. L-5, Appendix 3). Based on STP 'N' values of 20 to 72 blows per 300 mm penetration, the compactness of this deposit was described as compact to very dense.

## 4.2 GROUNDWATER DATA

During the period of investigation (July 27<sup>th</sup>, 2015), the creek water levels were measured at an elevation of some 227.0 m at the culvert outlet.

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.

Standpipes were installed in Borehole Nos. 1 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 225.5, 219.7, and 227.4 m at Borehole Nos. 2, 3, and 4, respectively. The water level encountered at Borehole Nos. 2 and 3, likely had not stabilized at the time of recording.

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

## Appendix 1   Key Plan

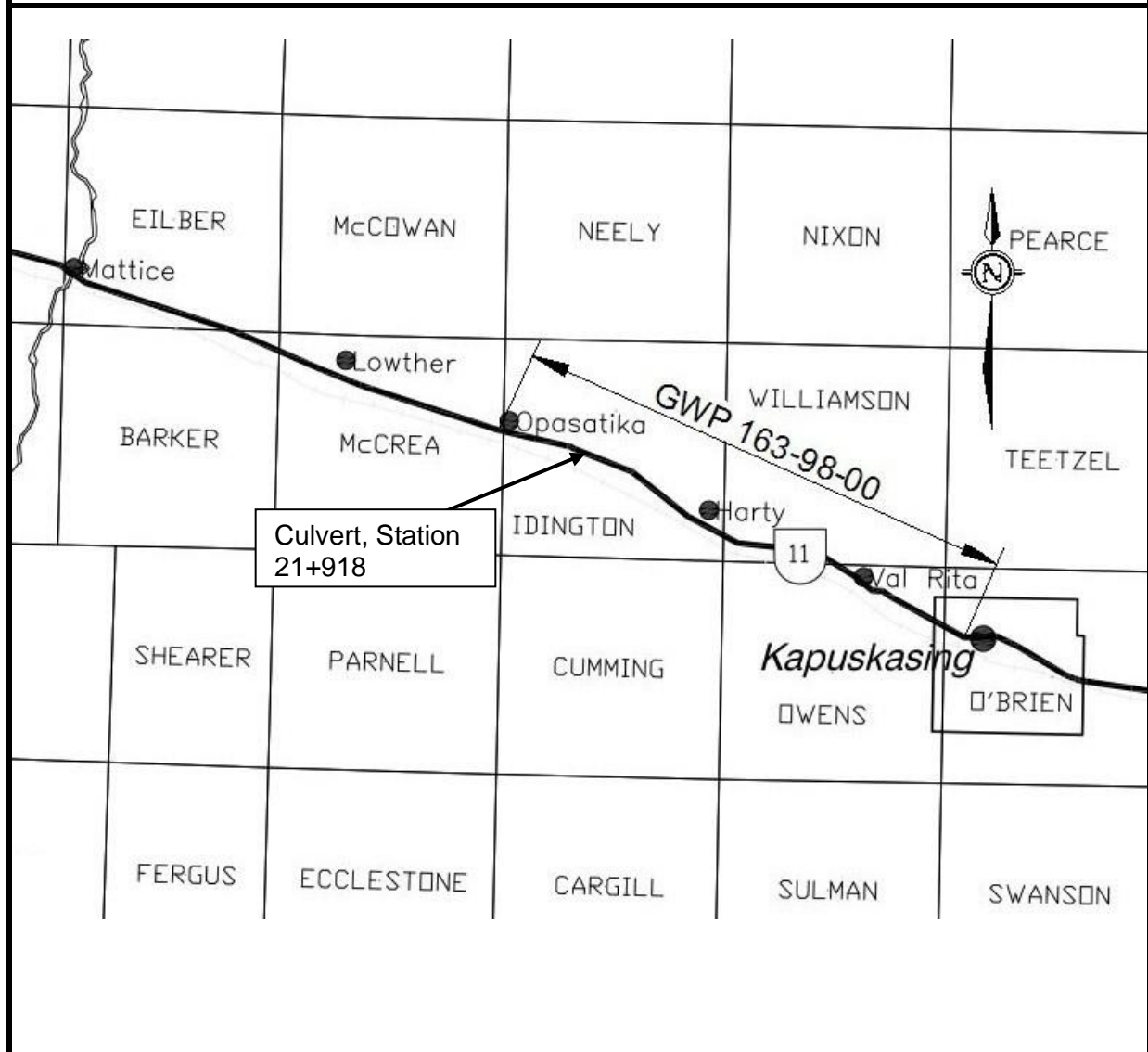
Drawing No. 1

Key Plan

# MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



## FOUNDATION INVESTIGATION REPORT

**GWP 163-98-00**

Highway 11

Station 21+918 Culvert

Township of Idington



Reference No: 15/05/15059-F6

February 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 15/05/15059-F6 DATUM Geodetic LOCATION N 5484681.8 E 397125.7 - Idington Twp., Station 21+919.5 ORIGINATED BY JL  
 PROJECT GWP 163-98-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH  
 CLIENT AECOM DATE (Started) 23 July 2015 TIME 9:50:00 AM DATE (Completed) 23 July 2015 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	SHEAR STRENGTH kPa					
231.7	Ground Surface												
0.0	305 mm Crushed Gravel GRANULAR FILL- sand, some gravel, trace silt brown, moist (compact)		1	SS	25								17 73 (10)
230.8	SILTY CLAY FILL - silty clay, trace gravel, trace to with sand		2	SS	17								
0.9	brown												
	Moist		3	SS	7								
	(very stiff/stiff)		4	SS	7								3 23 47 27
			5	SS	7								
	grey		6	SS	9								
227.6	trace black decayed wood												
227.4	ORGANIC SOIL - silty organics, trace decayed wood black		7	SS	10								13 33 46 18
4.3	CLAY TILL - silty clay, trace to some gravel, with sand		8	SS	39								
	Brown to grey		9	SS	31								2 22 48 28
	(stiff/very stiff)		10	SS	26								
			11	SS	29								
221.9	End of Sampling												
9.8	End of Borehole												

COMMENTS		WATER LEVEL RECORDS	
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	Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
	1) 23/7/15 9:50:00 AM	DRY	-
	2) 27/7/15 10:30:00 AM	2.3	-
	3) 28/7/15 6:45:00 AM	2.3	-

MEL-GEO 15059 - F6 BOREHOLE LOGS - 15-10-27.GPJ MEL-GEO.GDT 23/2/16

## METRIC

## RECORD OF BOREHOLE NO. 2



REFERENCE 15/05/15059-F6 DATUM Geodetic LOCATION N 5484688.7 E 397127.2 - Idington Twp., Station 21+916.7 ORIGINATED BY JL  
 PROJECT GWP 163-98-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH  
 CLIENT AECOM DATE (Started) 23 July 2015 TIME (Completed) 12:15:00 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	SHEAR STRENGTH kPa					
231.7	Ground Surface												
0.0	203 mm Crushed Gravel GRANULAR FILL- sand, trace to some gravel, some silt brown, moist (compact)		1	SS	29								
230.3			2	SS	18								1 86 (13)
1.4	SILTY CLAY FILL - brown silty clay, trace gravel, trace to with sand, trace organics Moist (very stiff/stiff)		3	SS	8								5 23 42 30
			4	SS	8								
			5	SS	6								
227.7			6	SS	5								
4.0	ORGANIC SOIL - fibrous peat Moist Black												
227.0			7	SS	12								
4.7	CLAY TILL - silty clay, trace gravel, some to with sand Brown to grey (very stiff/hard)		8	SS	35								3 20 50 27
			9	SS	17								
224.6													
7.1	SILT TILL - with sand, with gravel, trace clay Grey (very dense)		10	SS	72								26 29 42 3 NP
223.1													
8.6	CLAY TILL - silty clay, trace to some gravel, some sand Grey (very stiff)		11	SS	28								
221.9													
9.8	End of Sampling End of Borehole												

COMMENTS		WATER LEVEL RECORDS	
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	Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
	1) 23/7/15 12:15:00 PM	6.2	6.7
	2) 28/7/15	-	-
	3)	-	-

MEL-GEO 15059 - F6 BOREHOLE LOGS - 15-10-27.GPJ MEL-GEO.GDT 23/2/16



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

REFERENCE 15/05/15059-F6 DATUM Geodetic LOCATION N 5484705.2 E 397143.3 - Idington Twp., Station 21+920 ORIGINATED BY JL  
 PROJECT GWP 163-98-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH  
 CLIENT AECOM DATE (Started) 27 July 2015 TIME   
 DATE (Completed) 27 July 2015 (Completed) 9:40:00 AM 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	SHEAR STRENGTH kPa						WATER CONTENT (%)											
227.2	Ground Surface																								
0.0	ORGANIC SOIL - fibrous peat and organics black		1	SS	4																				
226.9	CLAY TILL - silty clay, trace gravel, some sand																								
0.3	Grey (very stiff)		2	SS	18																				
			3	SS	17																				
			4	SS	22																				
224.3	SILT TILL - sandy silt, trace gravel, trace clay																								
2.9	compact		5	SS	25																				
223.5	CLAY TILL - silty clay, trace gravel, some sand																								
3.7	(compact)		6	SS	50/76mm																				
			7	SS	21																				
221.6	SILT TILL - trace gravel, some sand																								
5.6	Grey (compact)		8	SS	20																				
220.1	CLAY TILL - silty clay, trace gravel, trace to some sand																								
7.1	Grey (very stiff)		9	SS	30																				
			10	SS	23																				
217.4	End of Sampling																								
9.8	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 <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 27/7/15 9:40:00 AM</td> <td>7.5</td> <td>8</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>					Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 27/7/15 9:40:00 AM	7.5	8	2)	-	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																							
1) 27/7/15 9:40:00 AM	7.5	8																							
2)	-	-																							
3)	-	-																							

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

**EnGlobe Corp.**

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

MEL-GEO 15059 - F6 BOREHOLE LOGS - 15-10-27.GPJ MEL-GEO.GDT 23/2/16

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

REFERENCE 15/05/15059-F6 DATUM Geodetic LOCATION N 5484673.4 E 397114.0 - Idington Twp., Station 21+915 ORIGINATED BY JL  
 PROJECT GWP 163-98-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH  
 CLIENT AECOM DATE (Started) 27 July 2015 TIME   
 DATE (Completed) 27 July 2015 (Completed) 1:10:00 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	SHEAR STRENGTH kPa					
227.4	Ground Surface												
0.0	ORGANIC SOIL - silty organics Dark brown		1	SS	WH								
227.0													
0.4	CLAY TILL - silty clay, trace gravel, some sand  Grey  (very stiff)		2	SS	34								
			3	SS	37								
			4	SS	26								
			5	SS	36								
223.7													
3.7	SILT TILL - trace gravel, with sand, trace clay		6	SS	27								
223.0													
4.4	Grey (compact) CLAY TILL - silty clay, some gravel, some sand  Grey  (very stiff/hard)		7	SS	23								
			8	SS	22								
			9	SS	33								
218.8													
8.6	SILT TILL - sandy, some gravel, trace clay  Grey  (compact)		10	SS	25								
217.6													
9.8	End of Sampling End of Borehole												

COMMENTS		WATER LEVEL RECORDS	
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	Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
	1) 27/7/15 1:15:00 PM	8.2	▽ -
	2) 28/7/15 6:50:00 AM	0	▽ -
	3)	-	▽ -

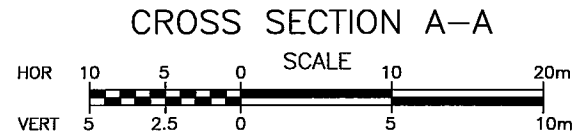
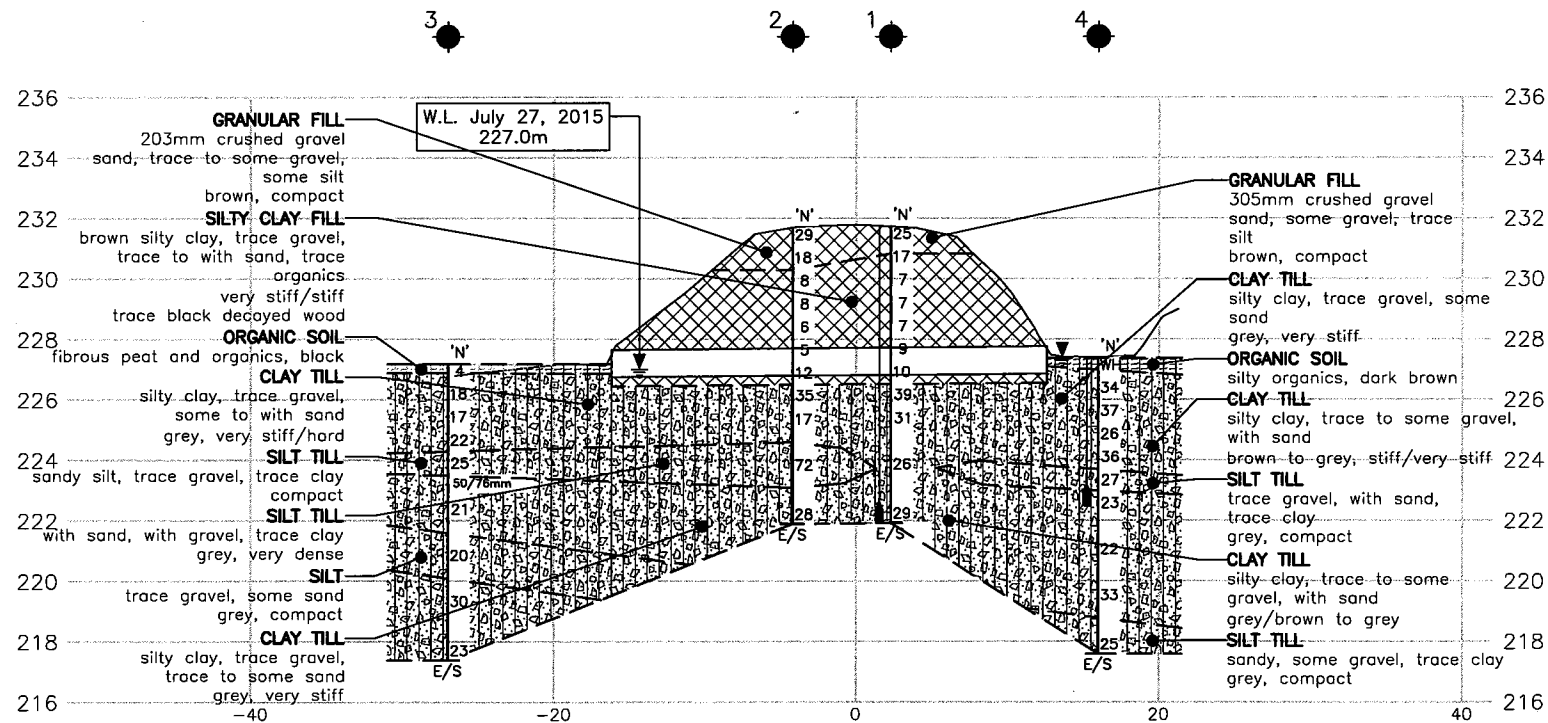
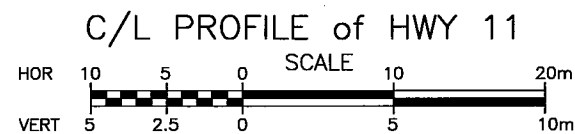
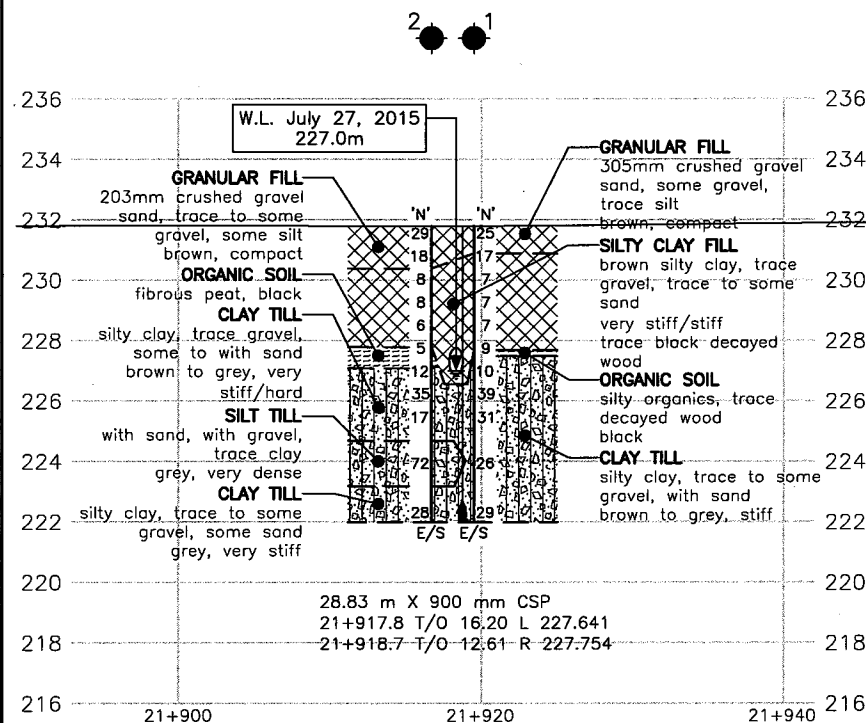
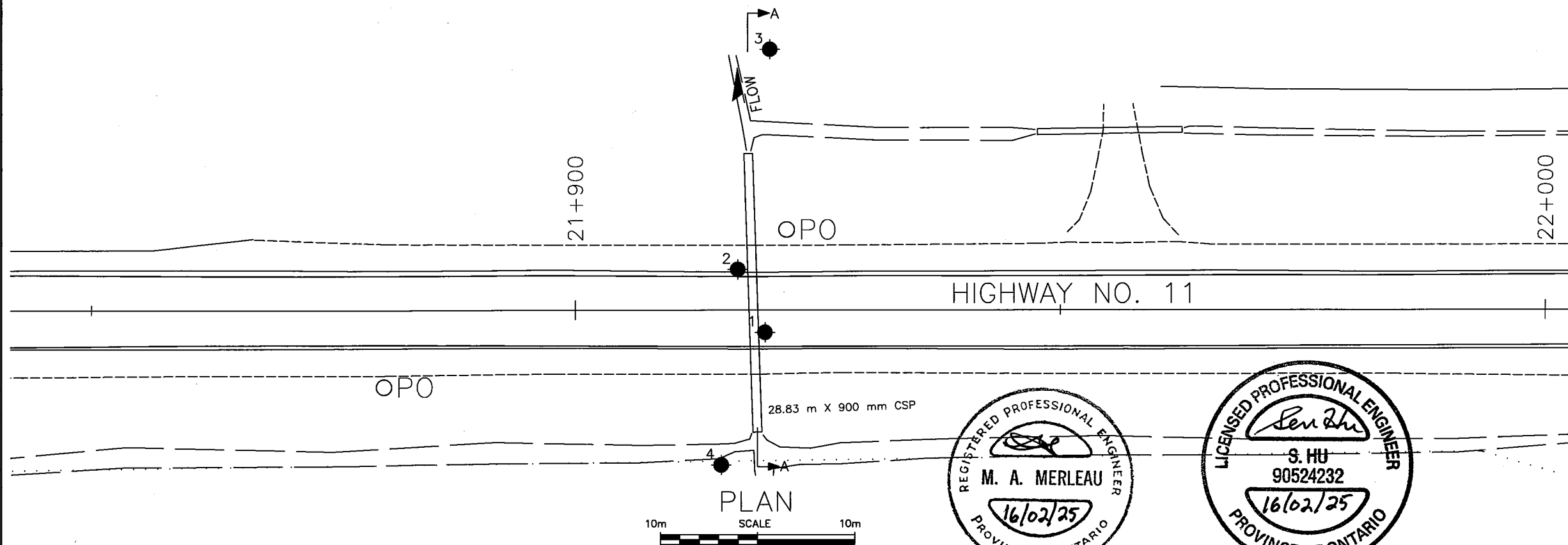
MEL-GEO 15059 - F6 BOREHOLE LOGS - 15-10-27.GPJ MEL-GEO.GDT 23/2/16

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

Drawing No. 2:            Borehole Location and Soil Strata  
Figure Nos. L-1 to L-4:    Grain Size Distribution Curves  
Figure No. L-5:                    Atterberg Limits  
Table No. L-6:            Laboratory Test Summary Sheet

CAD FILE LOCATION AND NAME: C:\2015\15059 - PAV & FDN, Hwy 11 - 163-98-00 & 5145-05-00 (ACCOM)\FOUNDATIONS\Drawings\15059 - F6 - Solomon Culvert.dwg  
MODIFIED: 2/23/2016 10:45:31 AM BY: MITCH  
DATE PLOTTED: 2/23/2016 10:49:06 AM BY: DUNCAN MITCHELL

MINISTRY OF TRANSPORTATION, ONTARIO  
PR-5-707  
18-03



DISTRICT  
CONT. No.  
GWP No. 163-98-00

HWY 11 CULVERT  
STA. 21+918

BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY

DRAWING  
2

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	231.7	2.3m Rt	5484681.8	397125.7
2	231.7	4.2m Lt	5484688.7	397127.2
3	227.2	27.0m Lt	5484705.2	397143.3
4	227.4	16.0m Rt	5484673.4	397114.0

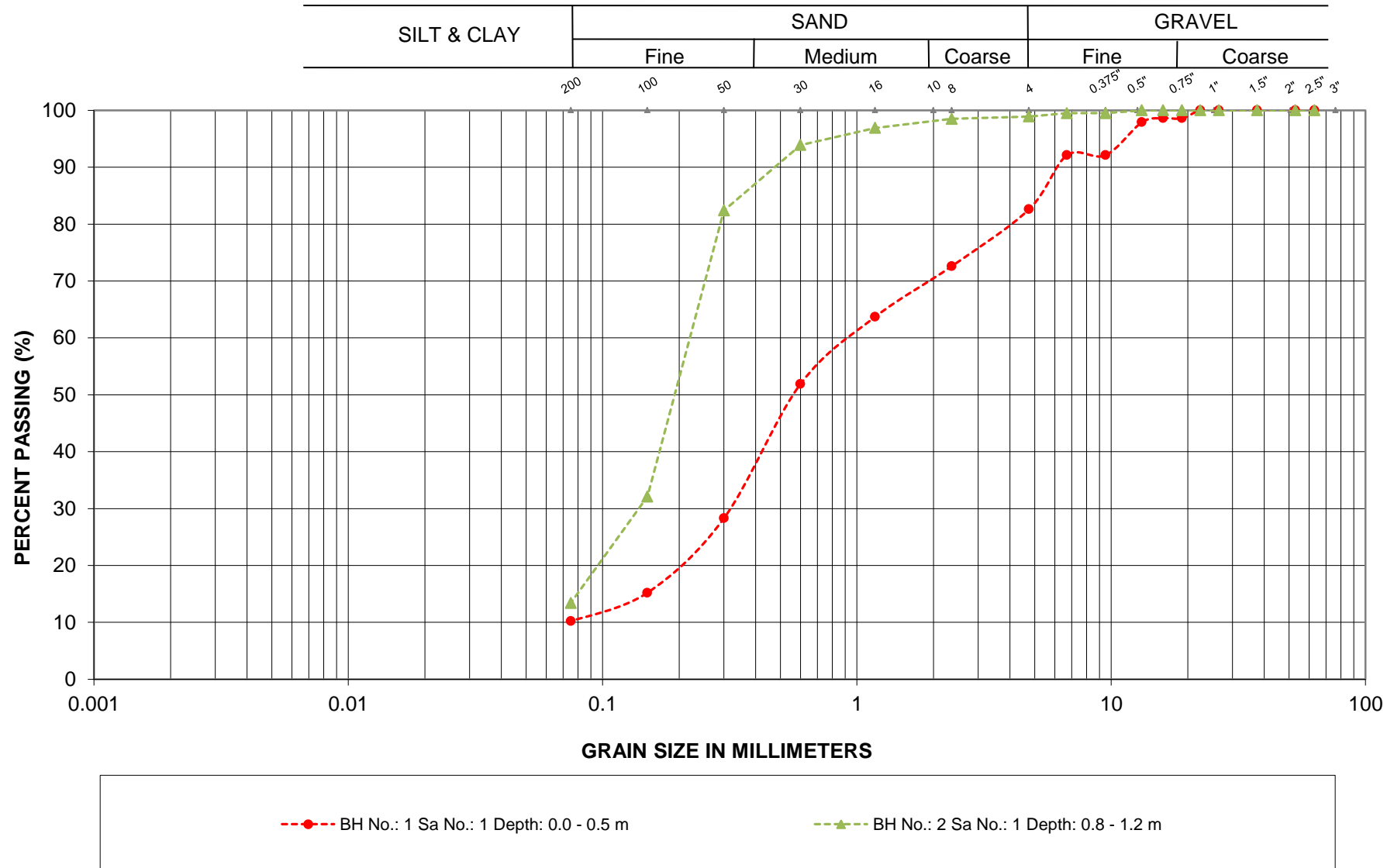
NOTES:  
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.  
  
Base plan and alignment provided in digital format by Callon Dietz on August 4, 2015  
  
Coordinates based on MTM Zone 13 NAD83 CSRS

GEOCREs No. 42G-59

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.

REVISIONS	NOV/15		DM		DRAFT				
	FEB/16		DM		FINAL				
DESCRIPTION									
DESIGN		CHK		CODE		LOAD		DATE FEB/16	
DRAWN	DM	CHK	SH	SITE		STRUCT		SCHEME	DWG 2

## GRAIN SIZE ANALYSIS



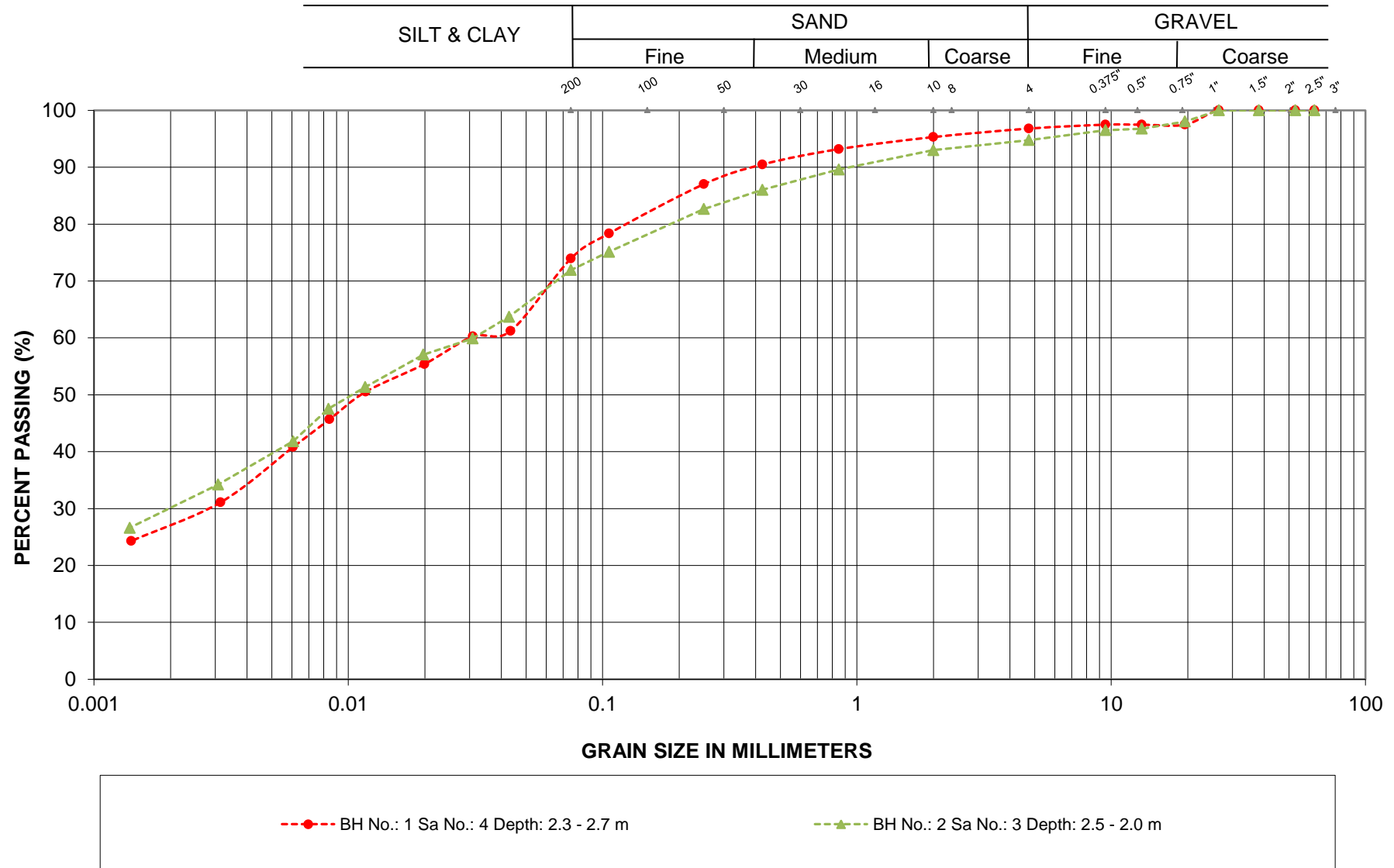
GRANULAR FILL

LOCATION: Hwy 11, Culvert Station 21+910  
TWP of Idington

Englobe Corp.

FIGURE L-1

## GRAIN SIZE ANALYSIS

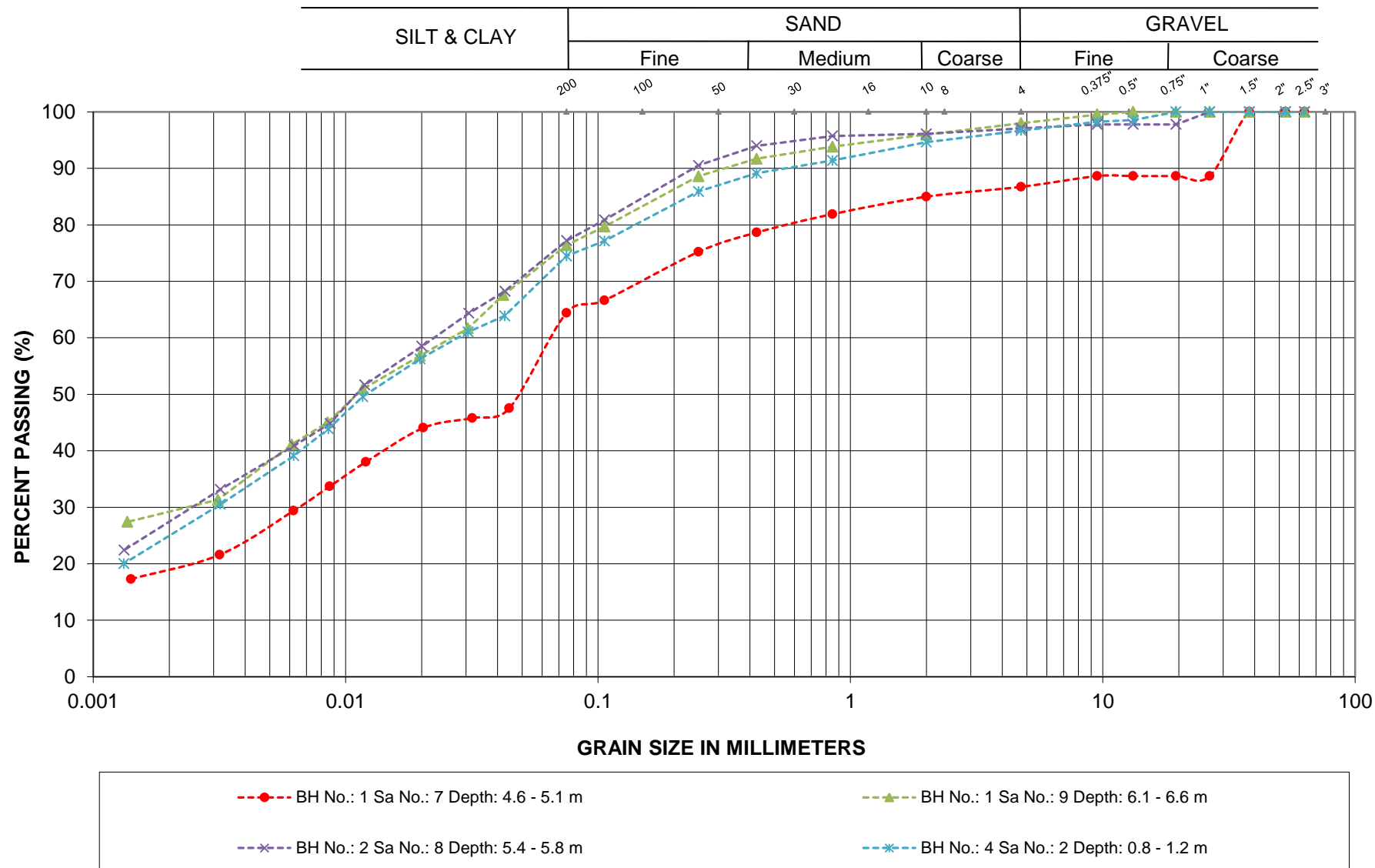


SILTY CLAY FILL

LOCATION: Hwy 11, Culvert Station 21+910  
TWP of Idington

Englobe Corp.

FIGURE L-2

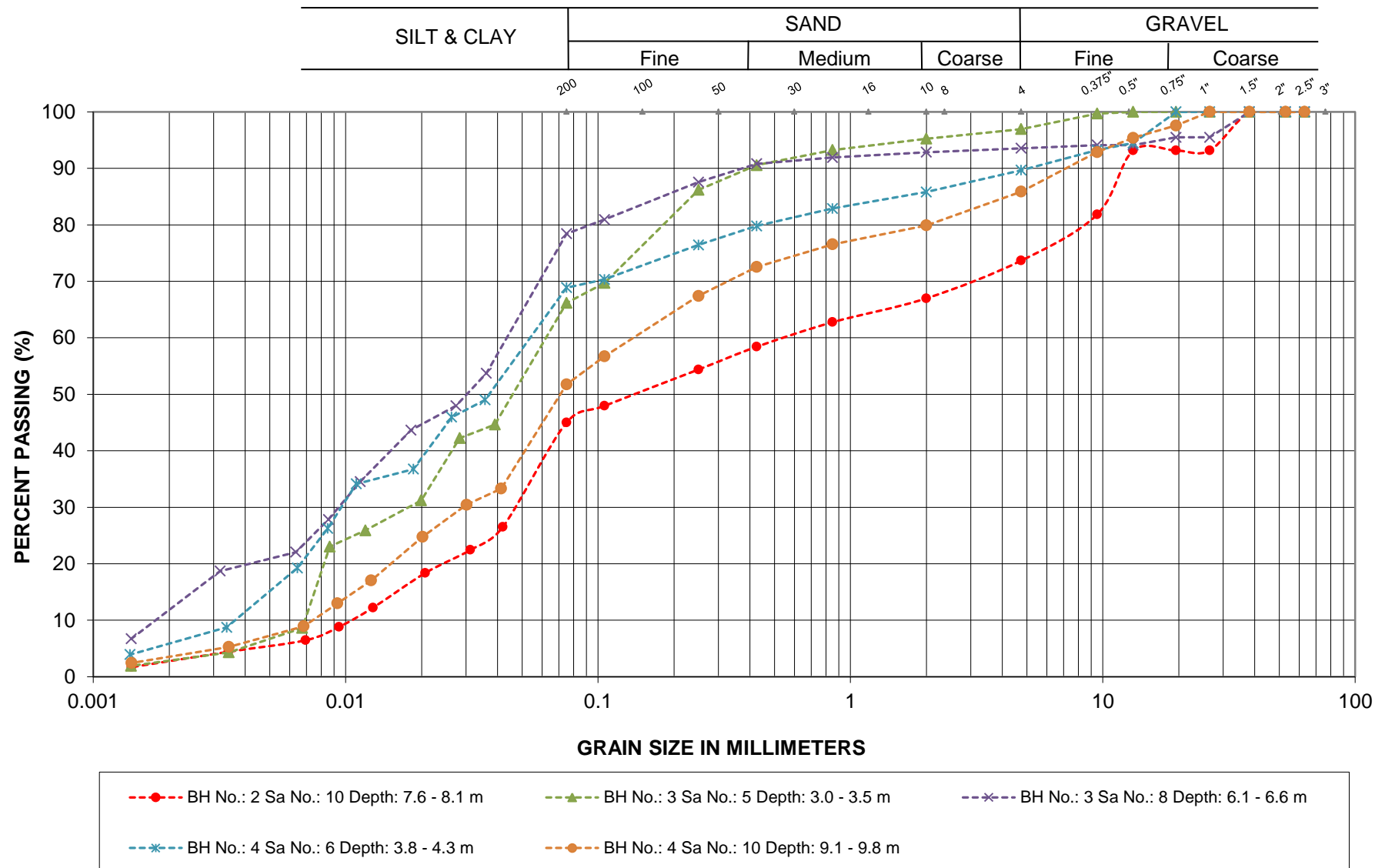
**GRAIN SIZE ANALYSIS**

SILTY CLAY TILL

LOCATION: Hwy 11, Culvert Station 21+910  
TWP of Idington

Englobe Corp.

FIGURE L-3

**GRAIN SIZE ANALYSIS**

SILT TILL

LOCATION: Hwy 11, Culvert Station 21+910  
TWP of Idington

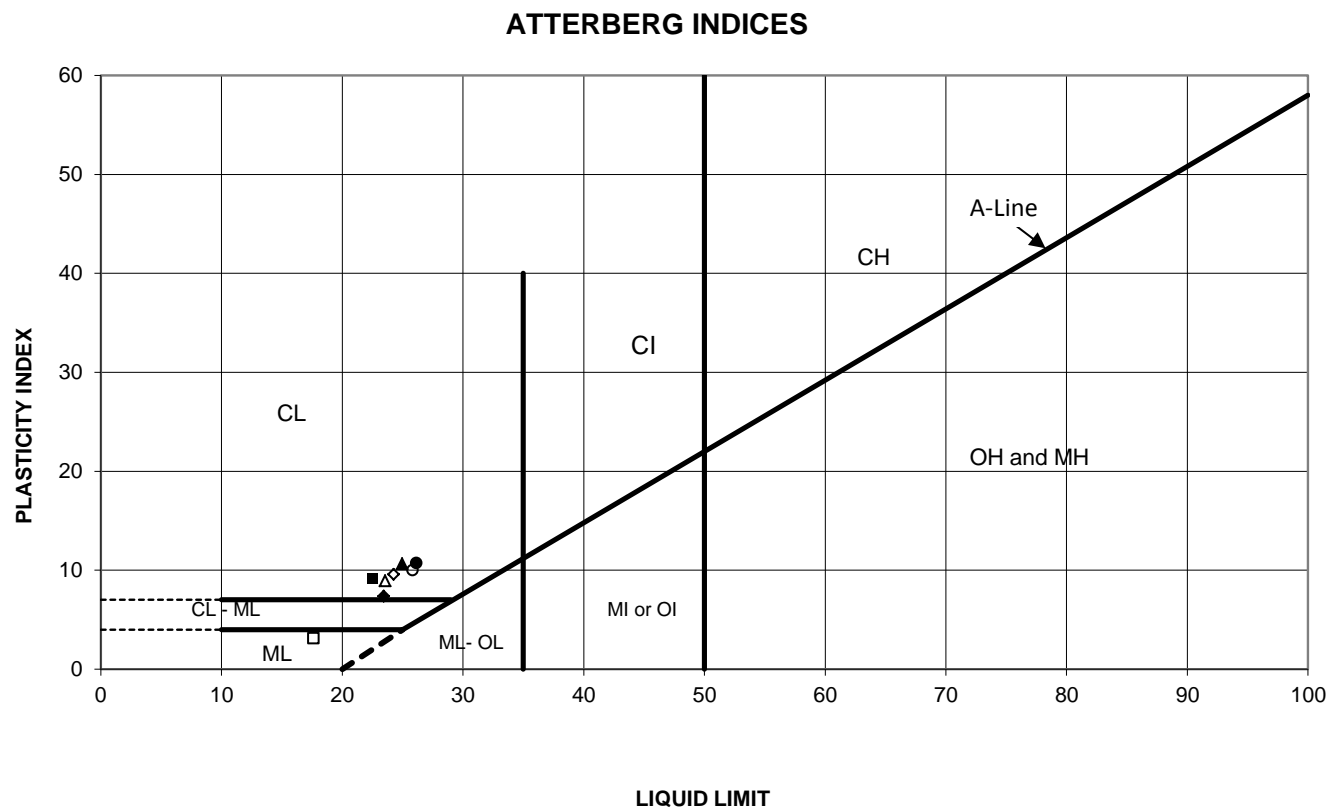
Englobe Corp.

FIGURE L-4



# ATTERBERG LIMITS TEST RESULTS

FIGURE L-5



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	4*	2.5	229.2	26.1	15.4	10.7	13.0
◆	1	7	4.8	226.9	23.4	16.1	7.4	13.0
■	1	9	6.3	225.4	22.5	13.4	9.1	10.7
▲	2	3*	1.8	229.9	25.0	14.3	10.6	12.0
○	2	8	5.6	226.1	25.8	15.9	10.0	10.0
◇	3	2	1.0	226.2	24.3	14.7	9.6	10.2
□	3	8	6.3	220.9	17.6	14.5	3.1	13.4
△	4	2	1.0	226.4	23.6	14.6	8.9	10.1

\*note test on silty clay fill

Date: Sep-15  
 Project: Hwy 11, T  
 Location: Sta. 21+910, TWP. of Idington

Prep'd: AT  
 Chkd: MAM  
 Ref. No.: 15/05/15059-F6

Englobe Corp.

## 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	17	73	10		3.3				25			
	2	0.8					11.1				17			
	3	1.5					14.0				7			
	4	2.3	3	23	47	27	13.0	24.1	15.4	8.7	7			
	5	3.1					17.9				7			
	6	3.8					15.2				9			
	7	4.6	13	23	46	18	13.0	23.4	16.1	7.4	10			
	8	5.3					10.7				39			
	9	6.1	2	22	48	28	10.7	22.5	13.4	9.1	31			
	10	7.6					10.7				26			
	11	9.2					9.5				29			
2	1	0.0					4.9				29			
	2	0.8	1	86	13		3.6				18			
	3	1.5	5	23	42	30	12.0	25.0	14.3	10.6	8			
	4	2.3					14.6				8			
	5	3.1					16.1				6			
	6	3.8					21.1				5			
	7	4.6					11.3				12			
	8	5.3	3	20	50	27	10.0	25.8	15.9	10.0	35			
	9	6.1					23.9				17			
	10	7.6	26	29	42	3	11.7				72			Non-Plastic (NP)
	11	9.2					11.2				28			

## 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 (%)				
3	1	0.0					13.4				4			
	2	0.8	2	20	46	32	10.2	24.3	14.7	9.6	18			
	3	1.5					11.1				17			
	4	2.3					30.6				22			
	5	3.1	3	31	63	3	17.9				25			Non-Plastic (NP)
	6	3.8					10.2				50/76mm			
	7	4.6					10.8				21			
	8	6.1	6	16	65	13	13.4	17.6	14.5	3.1	20			
	9	7.6					17.8				30			
	10	9.2					14.5				23			
4	1	0.0					30.2				WH			
	2	0.8	3	22	50	25	10.1	23.6	14.6	8.9	34			
	3	1.5					10.6				37			
	4	2.3					23.5				26			
	5	3.1					24.2				36			
	6	3.8	10	21	63	6	14.2				27			Non-Plastic (NP)
	7	4.6					11.2				23			
	8	6.1					10.7				22			
	9	7.6					13.2				33			
	10	9.2	14	34	48	4	12.3				25			Non-Plastic (NP)

## Appendix 4    Photo Essay

Enclosure No. 6:

Photo Essay

Existing Embankment – Looking East along south ditch, Note ONR embankment

Photo: 1



Looking North, towards culvert outlet

Photo: 2



Project: Hwy 11 – Culvert, Station 21+918, Township of Idington

Photos Provided By:Englobe

Date: July 2015



Looking South, towards culvert inlet. Note culvert shown is in the ONR embankment.

Photo: 3



Culvert Inlet – Looking North

Photo: 4



Project: Hwy 11 – Culvert, Station 21+918, Township of Idington

Photos Provided By: Englobe

Date: July 2015