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 118
Station 22+510 - Twp. of Dysart
GWP 5466-04-00

FINAL FOUNDATION INVESTIGATION REPORT

Date: February 3, 2017
Ref. Nº: 15/04/15020-F16 – R2

Geocres No. 31E-357

Englobe

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Highway 118
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Final Foundation Investigation Report

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2017-02-03

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Appendices

Property and Confidentiality

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:
AECOM Canada Ltd.
189 Wyld Street, Suite 103
North Bay, Ontario
P1B 1Z2
Attention: **Mr. Jason Wright, P. Eng.**

REVISION AND PUBLICATION REGISTER		
Revision N°	**Date**	**Modification And/Or Publication Details**
00	2016-01-06	DRAFT FIDR Issued
01	2016-05-06	FINAL FIR Issued
02	2016-07-08	FINAL FIR Revision 1 Issued
03	2017-02-03	FINAL FIR Revision 2 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 centerline culvert site. The site is located at Station 22+510 in the Township of Dysart on Highway 118, some 310 m east of Burke's 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.

After submission of the Final Foundation Investigation and Design Report (FIDR), Revision 1, on July 8, 2016, Englobe was requested in December 2016 to provide additional comments on potential trenchless technology options for installation of the replacement culvert in consideration of the existing traffic conditions on Highway 118; therefore the Final FIDR has been revised to include possible trenchless construction options for the culvert installation at the site.

2 SITE DESCRIPTION

A Corrugated Steel Pipe (CSP) culvert is located on Highway 118 at Station 22+510 in the Township of Dysart, 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 granular mixed with rock fill embankment some 4.8 m in height (at centerline), with centerline elevation of 377.8 m at the culvert location. At the north slope, the maximum height of the embankment is some 5.8 m. At the south slope, the maximum height of the embankment is some 3.5 m. The existing embankment slopes, in the area of the culvert, have been generally established at an angle of approximately 1.3H:1V at the north slope and at an angle of approximately 2.2H:1V at the south slope. The culvert at this location is a 480 mm diameter Corrugated Steel Pipe (CSP) culvert, some 27.5 m in length. Flow through the culvert is from the south to the north (right to left).

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 118 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, based on Ontario Geologic Survey (OGS) Map MRD-126, consists of migmatitic rocks and gneisses of undetermined protolith.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period of May 13th to August 19th, 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 (south) and outlet (north) 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 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 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-5 and Table No. L-6).

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 22+510, TOWNSHIP OF DYSART

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 378.1, 377.8, 374.9, and 370.1 m, respectively.

4.1.1 Pavement Structure

At Borehole No. 1, was advanced through the embankment where a pavement structure consisting of 125 mm crushed gravel was penetrated. At Borehole No. 2, a layer of asphalt some 50 mm thick was penetrated.

4.1.2 Embankment Fill

Underlying the crushed gravel and asphalt at Borehole Nos. 1 and 2, respectively, a layer of fill consisting of brown sand some gravel to gravelly, trace silt, mixed with rock fill, was penetrated. Cobble and boulder size rock fill were encountered at depths between 1.2 to 4.9 m below ground surface (Elevations 376.6 to 372.9 m). The natural moisture content measured on retrieved samples of this deposit was generally in the order of 2 to 12%. Gradation (sieve) analyses were carried out on three (3) samples of this deposit, the results of which indicated 33 to 34% gravel size particles, 53 to 59% sand size particles, and 8 to 9% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 5 to 22 blows per 300 mm penetration, the compactness/relative density of the granular portion of the deposit was described as loose to compact. This deposit was encountered to depths of 2.6 and 5.6 m below grade at Borehole Nos. 1 and 2, respectively (Elevations 375.5 and 372.2 m, respectively).

4.1.3 Organic Soils

At ground surface at Borehole Nos. 3 and 4, a layer of black silty organic soils was penetrated. This organic soil layer was encountered to approximate depths of 0.2 and 0.1 m below ground surface at Borehole Nos. 3 and 4, respectively (Elevations 374.7 and 370.0 m, respectively).

4.1.4 Sandy Silt

Underlying the granular fill at Borehole No. 1, and underlying the organic soil at Borehole No. 4, a deposit of sandy silt, trace gravel, trace clay was penetrated. Trace grass and rootlets were encountered in this deposit. The natural moisture content measured on samples of this deposit was in the order of 34 to 39%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results of testing indicated 10% gravel size particles, 33% sand size particles, 55% silt size particles, and 2% clay size particles (Figure No. L-2, Appendix 3). Based on a SPT 'N' value of 2 to 14 blows per 300 mm penetration, the compactness/relative density of this deposit was described as very loose to compact. This deposit was encountered to depths of 3.7 and 0.5 m below ground surface at Borehole Nos. 1 and 4, respectively (Elevations 374.4 and 369.6 m).

4.1.5 Silty Sand

Underlying the organic soils at Borehole No. 3, a deposit of silty sand, trace gravel was penetrated. Trace grass and rootlets were encountered in this deposit. The natural moisture content measured on samples of this deposit was in the order of 10 to 19%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results of testing indicated 2% gravel size particles, 61% sand size particles, 37% silt size particles, and 0% clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 9 to 34 blows per 300 mm penetration, the compactness/relative density of this deposit was described as loose to dense. This deposit was encountered to a depth of 2.3 m below ground surface at Borehole No. 3 (Elevation 372.6 m).

4.1.6 Sands

Underlying the sandy silt at Borehole Nos. 1 and 4, and underlying the fill at Borehole No. 2, a deposit of brown to grey sand trace to some gravel, some to with silt, trace clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 12 to 18%. Gradation (sieve) analyses were carried out on three (3) samples of this deposit, and the results of testing indicated 12 to 18% gravel size particles, 58 to 63% sand size particles, and 19 to 30% silt and clay size particles (Figure No. L-4, Appendix 3). Gradation (hydrometer) analyses were carried out on four (4) samples of this deposit, the results of which indicated 2 to 19% gravel size particles, 67 to 87% sand size particles, 10 to 24% silt size particles, and 0 to 3% clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values of 13 to 43 blows per 300 mm penetration, the compactness/relative density of this deposit was described as compact to dense, generally compact. This deposit was encountered to depths of 6.1, 9.1, and 3.7 m below grade at Borehole Nos. 1, 2, and 4, respectively (Elevations 372.0, 368.7, and 366.4 m, respectively).

4.1.7 Gravelly Sands

Underlying the sand at Borehole No. 1, a deposit of grey to brown gravelly sand, some silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 9%. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, and the results of testing indicated 38% gravel size particles, 46% sand size particles, and 16% silt and clay size particles (Figure No. L-5, Appendix 3). This deposit was encountered to a depth of 6.4 m below grade at Borehole No. 1 (Elevation 371.7 m).

4.1.8 Bedrock

Underlying the gravelly sands at Borehole No. 1, underlying the sands at Borehole Nos. 2 and 4, and underlying the silty sands at Borehole No. 3, bedrock was proven by diamond core drilling. The bedrock was described as black gneiss bedrock. Based on RQD values of 40 to 89% the bedrock was described as poor to good quality. Based on visual review, the bedrock generally showed negligible weathering. Sampling in the bedrock was terminated at depths of 9.6, 12.2, 5.7, and 6.7 m below grade at Borehole Nos. 1 to 4, respectively (Elevations 368.5, 365.6, 369.2, and 363.4 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 (May 13th and 14th, and August 18th to 19th, 2015), surface water was not observed at 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. 1 and 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

The water levels were measured at Elevations 372.6, 371.7, 371.3, and 368.9 m at Borehole Nos. 1 to 4, respectively.

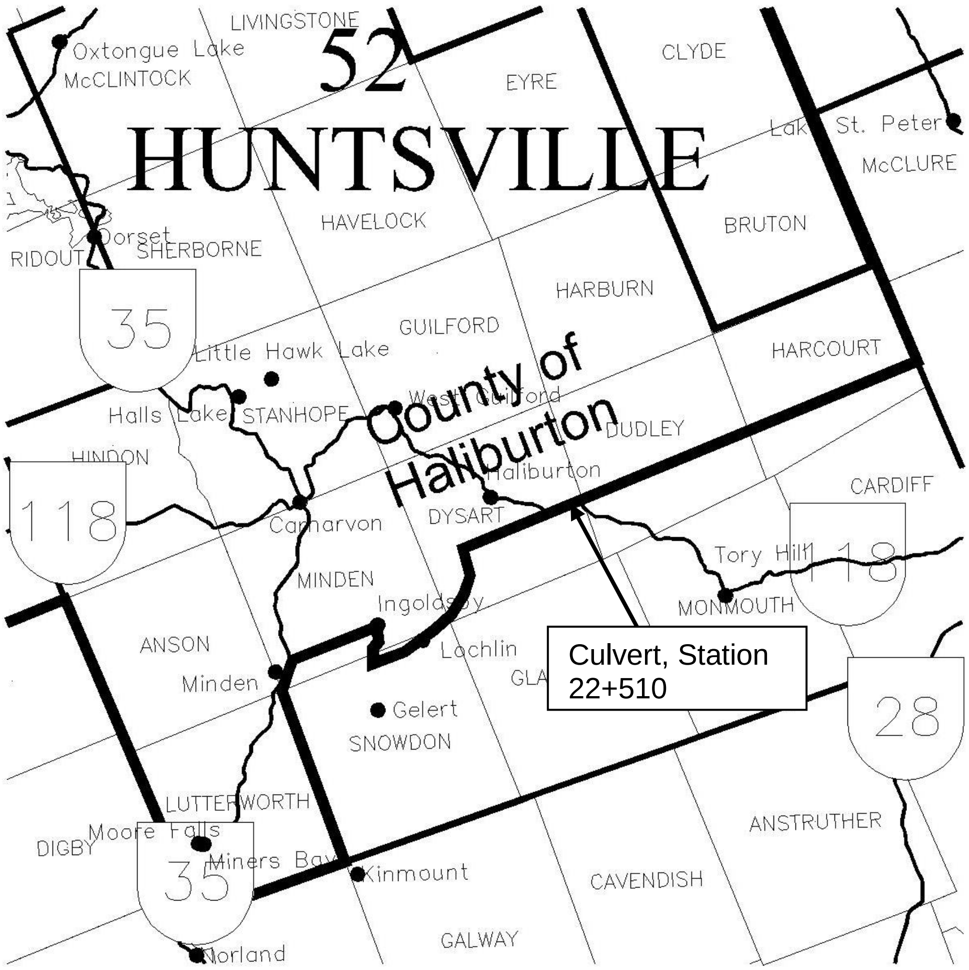
The groundwater and surface water levels will fluctuate seasonally/yearly.

Appendix 1 Key Plan

Drawing No. 1	Key Plan

MACRO KEY PLAN **Drawing No.1**

NOT TO SCALE



FOUNDATION INVESTIGATION REPORT
GWP 5466-04-00
Highway 118

Station 22+510 Culvert

Township of Dysart

Reference No: 15/04/15020-F16 February 2017

Englobe

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.

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 1

Englobe

REFERENCE 15/04/15020-F16 DATUM Geodetic LOCATION N 4989026.8 E 386951.0 - Dysart Twp., Station 22+500 ORIGINATED BY JL

PROJECT GWP 5466-04-00, Highway 118 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2015 May 13 DATE (Completed) 2015 May 13 TIME (Completed) 3:45:00 PM CHECKED BY MAM

ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
378.1	Ground Surface				
0.0	125 mm Crushed Gravel EMBANKMENT FILL- sand, some gravel to gravelly , trace silt Cobble/boulder size rock fill encountered between depths from 1.6 m to 2.3 m brown, moist (loose/compact) trace organic material encounted at depth of 2.6 m	1	SS	17	33 59 (8)
		2	SS	22	
		3	SS	30/51mm	
375.5 2.6	sandy SILT - trace gravel, trace clay (compact)	4	SS	5	
		5	SS	14	10 33 55 2
374.4 3.7	SAND - some gravel, some silt, trace clay brown (compact)	6	SS	19	18 63 (19)
		7	SS	23	19 67 14 0
372.0 6.1	gravelly SAND - some silt grey to brown	8	SS	43/152mm	38 46 (16)
371.7 6.4	Auger Refual Start Rock Coring Bedrock - black gneiss Poor to fair quality	9	RC	Rec= 97% RQD= 40%	
		10	RC	Rec= 100% RQD= 66%	
368.5 9.6	End of Sampling End of Borehole				

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
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 (%) 20 40 60
UNIT WEIGHT γ kN/m³

COMMENTS

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) 15/5/14 2:45:00 PM	3.5	-
2) 15/8/19 4:30:00 PM	5.5	-
3) 16/8/15	5.9	-

MEL-GEO 15020 - BOREHOL LOGS - F16.GPJ MEL-GEO.GDT 17/1/23

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

Englobe

REFERENCE 15/04/15020-F16	DATUM Geodetic	LOCATION N 4989024.8 E 386965.4 - Dysart Twp., Station 22+511.5	ORIGINATED BY JL
PROJECT GWP 5466-04-00, Highway 118		BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers	COMPILED BY SH
CLIENT AECOM		DATE (Started) 2015 May 14; DATE (Completed) 2015 May 14; TIME (Completed) 12:00:00 PM	CHECKED BY MAM

Legend: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); 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 (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	GR	SA	SI	CL
377.8	Ground Surface								
0.0	50 mm Asphalt EMBANKMENT FILL- sand, some gravel to gravelly, trace silt Cobble/boulder size rock fill encountered between depths of 1.2 m to 4.9 m	1	SS	20					
		2	SS	13					
	brown, moist	3	SS	13		39	53	(8)	
	(loose/compact)	4	SS	13					
		5	SS	6		34	57	(9)	
		6	SS	11					
	300 mm diameter boulder encounted at depths from 4.9 m to 5.2 m	7	SS	25/0mm					
372.2	(very dense/dense)								
5.6	SAND - trace to some gravel, with silt, trace clay grey to brown (compact/dense)	8	SS	43	▽ (water level)	6	67	23	4
					Cave in				
		9	SS	27		16	61	(23)	
368.7									
9.1	Auger Refual Start Rock Coring Bedrock - black gneiss Fair to good quality	10	RC	Rec= 92% RQD= 74%					
		11	RC	Rec= 95% RQD= 89%					
365.6									
12.2	End of Sampling End of Borehole								

Elevation scale: 377, 376, 375, 374, 373, 372, 371, 370, 369, 368, 367, 366

COMMENTS

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

$+^3$, $\times^3$: 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)	15/5/14 2:40:00 PM	6.1	7.1
2)		-	-
3)		-	-

MEL-GEO 15020 - BOREHOL LOGS - F16.GPJ MEL-GEO.GDT 17/1/23

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

ENCLOSURE NO.:4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 3

Englobe

REFERENCE 15/04/15020-F16 DATUM Geodetic LOCATION N 4989013.2 E 386952.8 - Dysart Twp., Station 22+510.5 ORIGINATED BY JL

PROJECT GWP 5466-04-00, Highway 118 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2015 August 18 DATE (Completed) 2015 August 18 TIME (Completed) 12:05:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
374.9	Ground Surface						
374.7 / 0.0	ORGANIC SOIL - silty, black						
0.2	silty SAND - trace gravel, trace grass, rootlets, brown to grey (loose/dense) wet	1	SS	9			
		2	SS	34			2 61 37 0
		3	SS	50/279 mm			
372.6 / 2.3	Auger Refual, Start Rock Coring. Bedrock - black gneiss. Fair to good quality	4	RC	Rec= 85% RQD= 66%			
		5	RC	Rec= 95% RQD= 76%			
369.2 / 5.7	End of Sampling. End of Borehole						

Chart scales: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; 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 (%) 20 40 60; UNIT WEIGHT γ kN/m³; ELEVATION SCALE 374, 373, 372, 371, 370.

COMMENTS

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) 15/8/18 12:10:00 PM	1.2	-
2) 15/8/19 4:30:00 PM	3.6	-
3) 16/8/15	5.7	-

MEL-GEO 15020 - BOREHOL LOGS - F16.GPJ MEL-GEO.GDT 17/1/23

Englobe Corp.

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

ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 4

Englobe

REFERENCE 15/04/15020-F16 DATUM Geodetic LOCATION N 4989035.2 E 386974.0 - Dysart Twp., Station 22+510 ORIGINATED BY JL

PROJECT GWP 5466-04-00, Highway 118 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2015 August 19 DATE (Completed) 2015 August 19 TIME (Completed) 4:30:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
370.1	Ground Surface								
370.0 / 0.1	ORGANIC SOIL - silty, black	1	SS	2		370			
369.6 / 0.5	sandy SILT - trace gravel, trace grass, rootlets, brown (very loose)								
	SAND - trace to some gravel, with silt, trace clay, trace rootlets, decayed wood, grey to brown (compact) wet	2	SS	16	▽	369			
		3	SS	23					2 69 29 0
		4	SS	15		368			2 87 10 1
		5	SS	13		367			12 58 (30)
366.4 / 3.7	Auger Refual, Start Rock Coring, Bedrock - black gneiss, Good quality	6	RC	Rec= 98% RQD= 83%		366			
		7	RC	Rec= 97% RQD= 78%		365, 364			
363.4 / 6.7	End of Sampling, End of Borehole								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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 (%) 20 40 60

COMMENTS

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)	15/8/19 4:30:00 PM	1.2	-
2)		-	-
3)		-	-

MEL-GEO 15020 - BOREHOL LOGS - F16.GPJ MEL-GEO.GDT 17/1/23

Englobe Corp.

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

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

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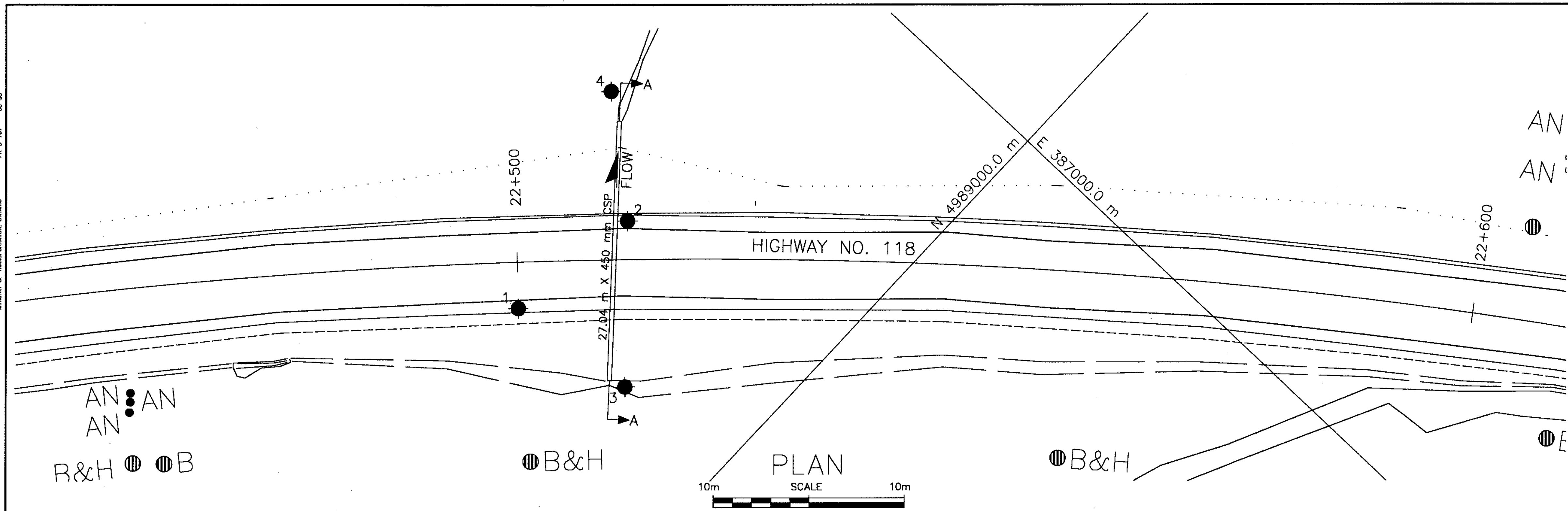
DISTRICT
CONT. No.
GWP No. 5466-04-00

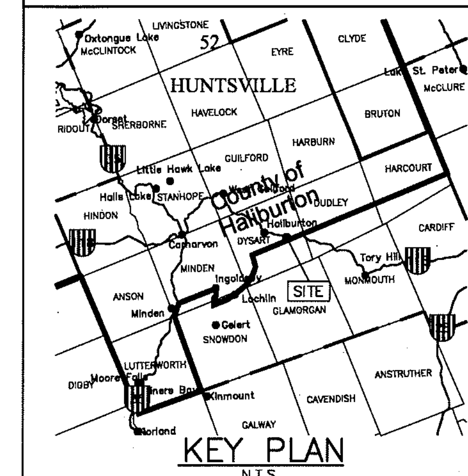
HWY 118
CULVERT AT STN: 22+510
TOWNSHIP OF DYSART

BOREHOLE LOCATIONS
AND SOIL STRATIGRAPHY

SHEET 2

Englobe

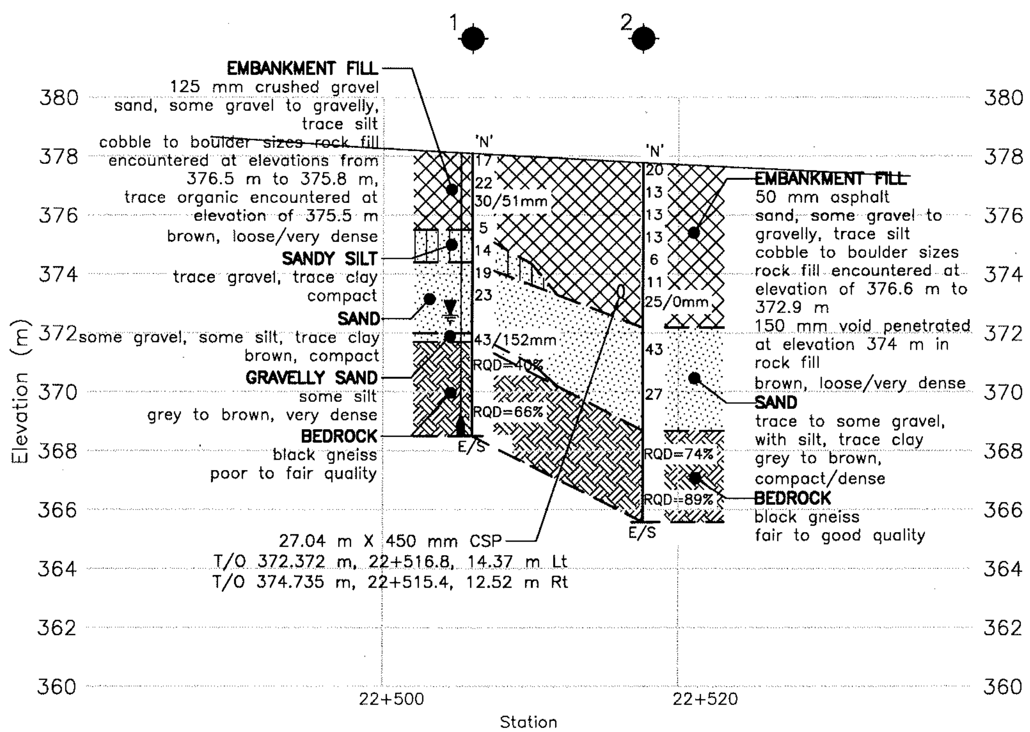




LEGEND

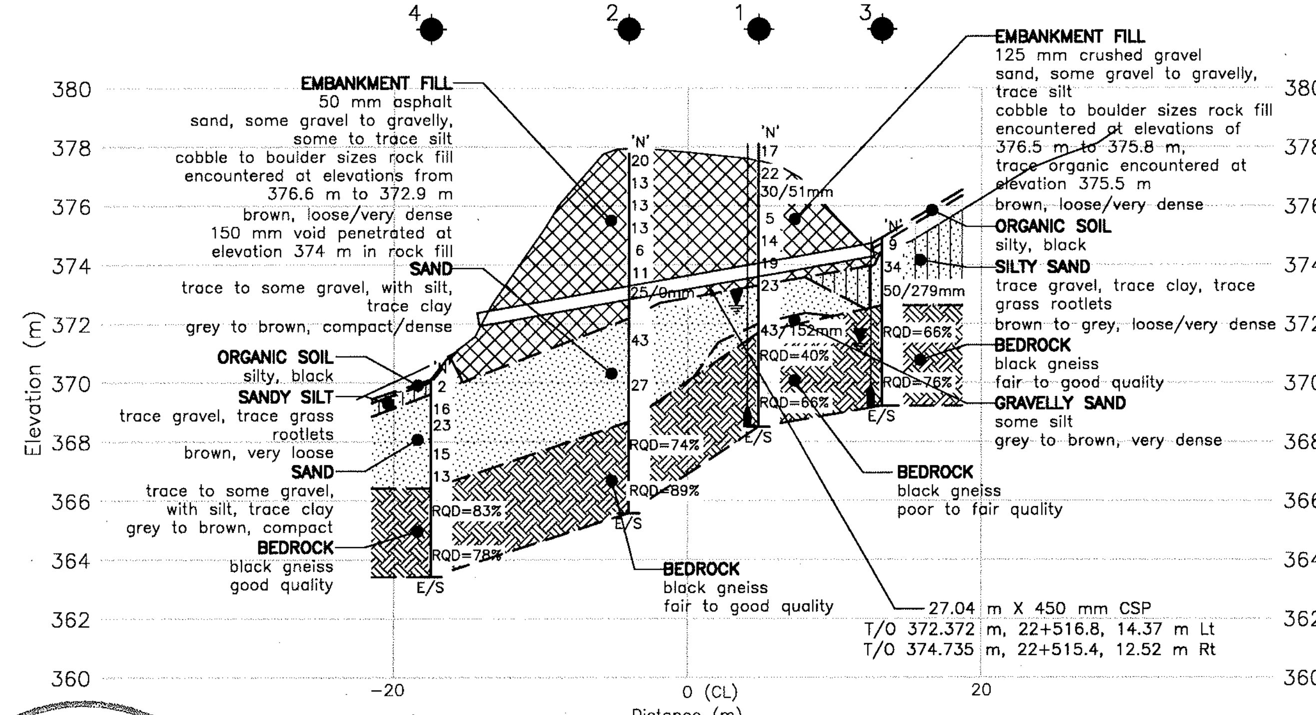
Symbol	Description
●	Borehole
N	Blows/0.3 m (Std Pen Test, 475 J/blow)
▼	Water Level at Time of Investigation
E/S	End of Sampling
	Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	378.1	4.8m Rt	4989026.8	386951.0
2	377.8	4.0m Lt	4989024.8	386965.4
3	374.9	13.2m Rt	4989013.2	386952.8
4	370.1	17.5m Lt	4989035.2	386974.0



C/L PROFILE HWY 118

HOR 10 5 0 SCALE 10 20m
VERT 5 2.5 0 5 10m



CROSS SECTION A–A

HOR 10 5 0 SCALE 10 20m
VERT 5 2.5 0 5 10m

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.

LICENSED PROFESSIONAL ENGINEER
S. HU
90524232
2017-02-03
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M. H. MacKAY
PROVINCE OF ONTARIO

2017-02-03

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 August 4, 2015

Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCRES No. 31E-357

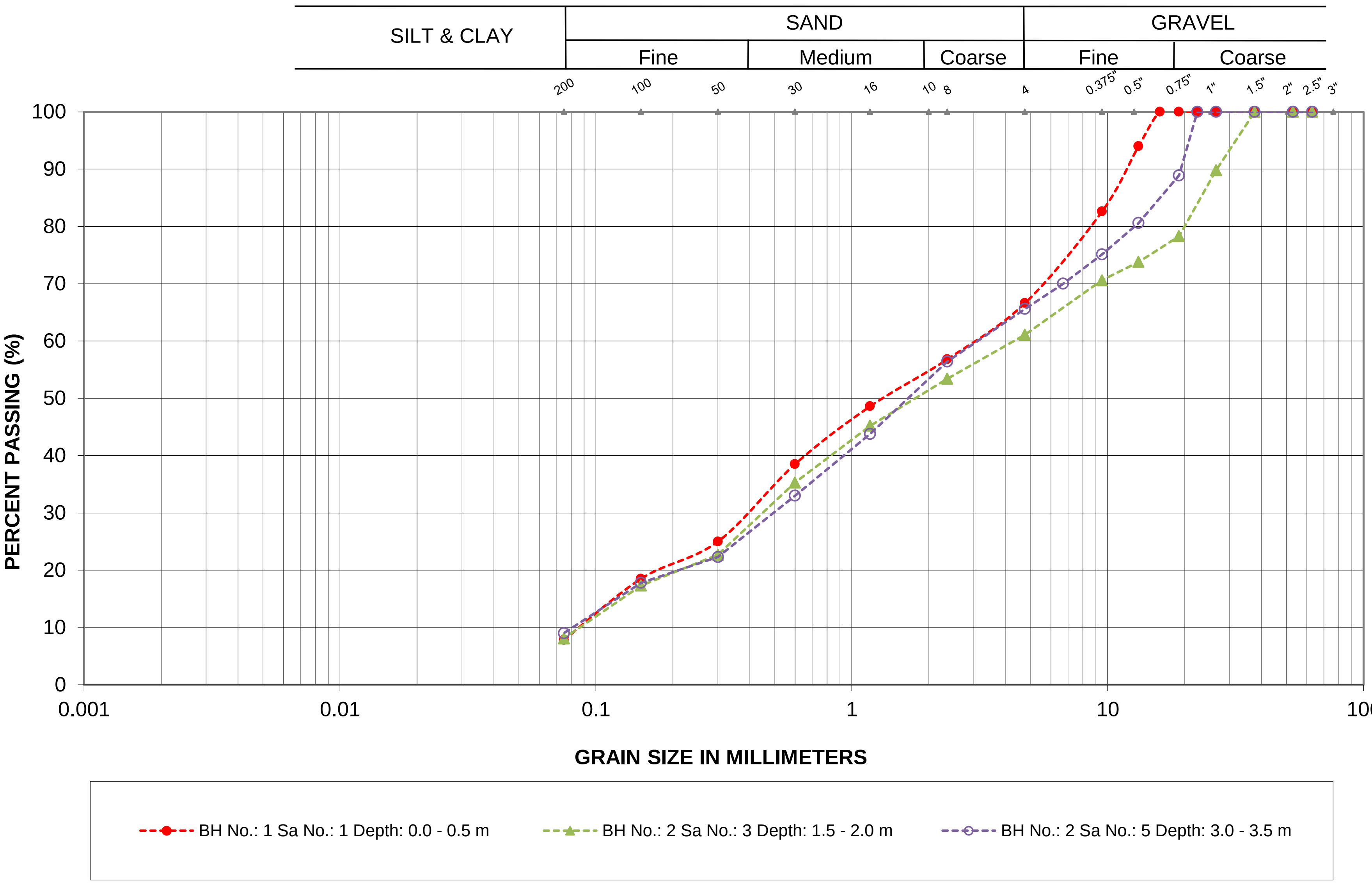
REVISIONS		DESCRIPTION
JAN/16	DM	DRAFT
APR/16	DM	FINAL
FEB/17	DM	FINAL R2

DESIGN	CHK	CODE	LOAD	DATE FEB/17
DRAWN DM	CHK SH	SITE	STRUCT	SCHEME	DWG 2

CAD FILE LOCATION AND NAME: C:\2015\15020 - PAV & FDN, Hwy 60 & 118, 5014-E-0004 (AECOM)\FOUNDATION\Drawings\F16\15020 - 22+510 - Revised Chainage (17-01-23).dwg
MODIFIED: 2/3/2017 1:59:21 PM BY: GRASRY
DATE PLOTTED: 2/3/2017 2:02:04 PM BY: RYAN GRASSER

Reference No.: 15/04/15020-F16
Date: November 2015

GRAIN SIZE ANALYSIS



EMBANKMENT FILL

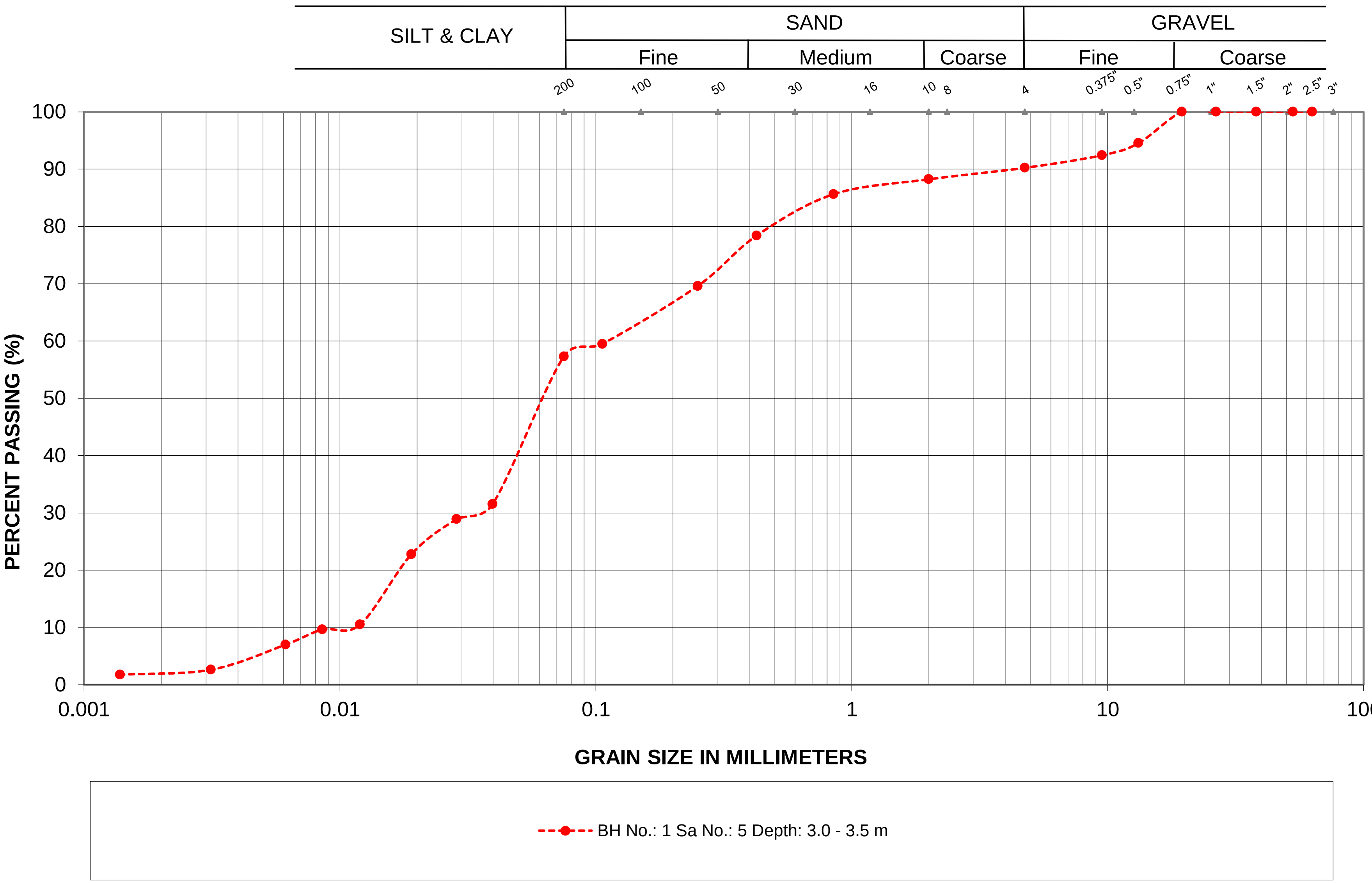
LOCATION: Hwy 118, Station 22+510
TWP of Dysart

Englobe Corp.

FIGURE L-1

Reference No.: 15/04/15020-F16
Date: November 2015

GRAIN SIZE ANALYSIS



SANDY SILT

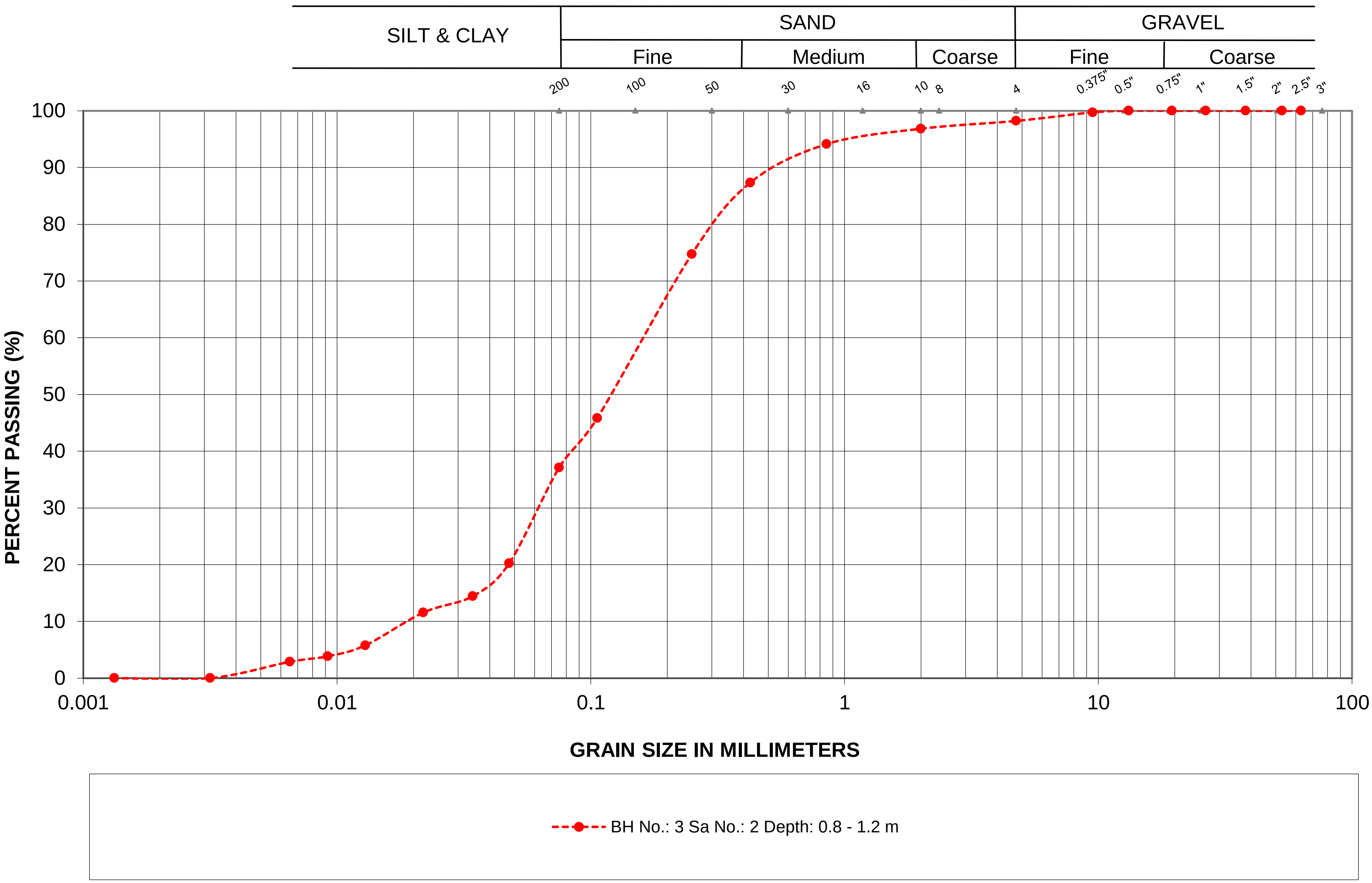
LOCATION: Hwy 118, Station 22+510
TWP of Dysart

Englobe Corp.

FIGURE L-2

Reference No.: 15/04/15020-F16
Date: November 2015

GRAIN SIZE ANALYSIS



SILTY SAND

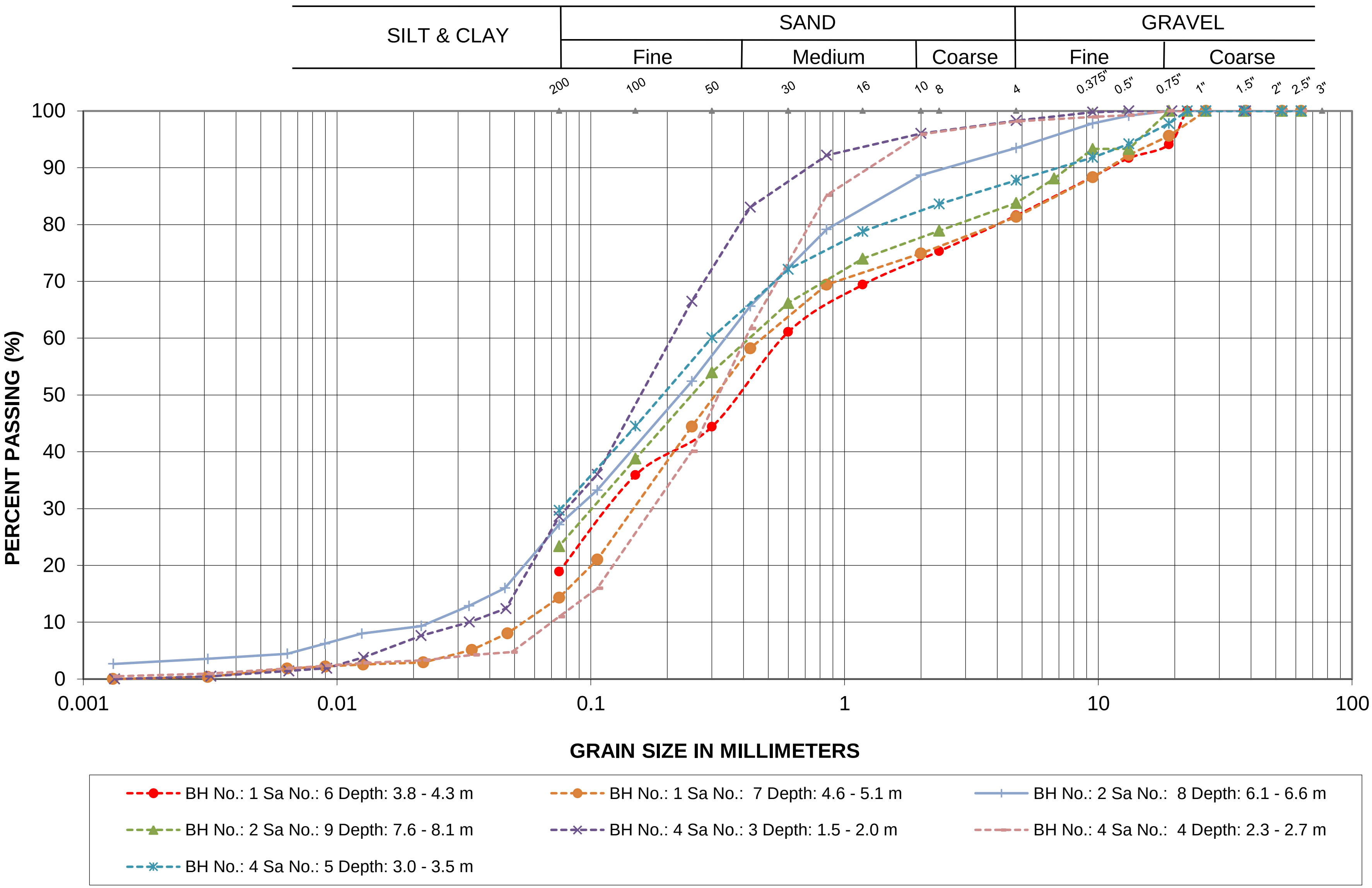
LOCATION: Hwy 118, Station 22+510
TWP of Dysart

Englobe Corp.

FIGURE L-3

Reference No.: 15/04/15020-F16
Date: November 2015

GRAIN SIZE ANALYSIS



SAND

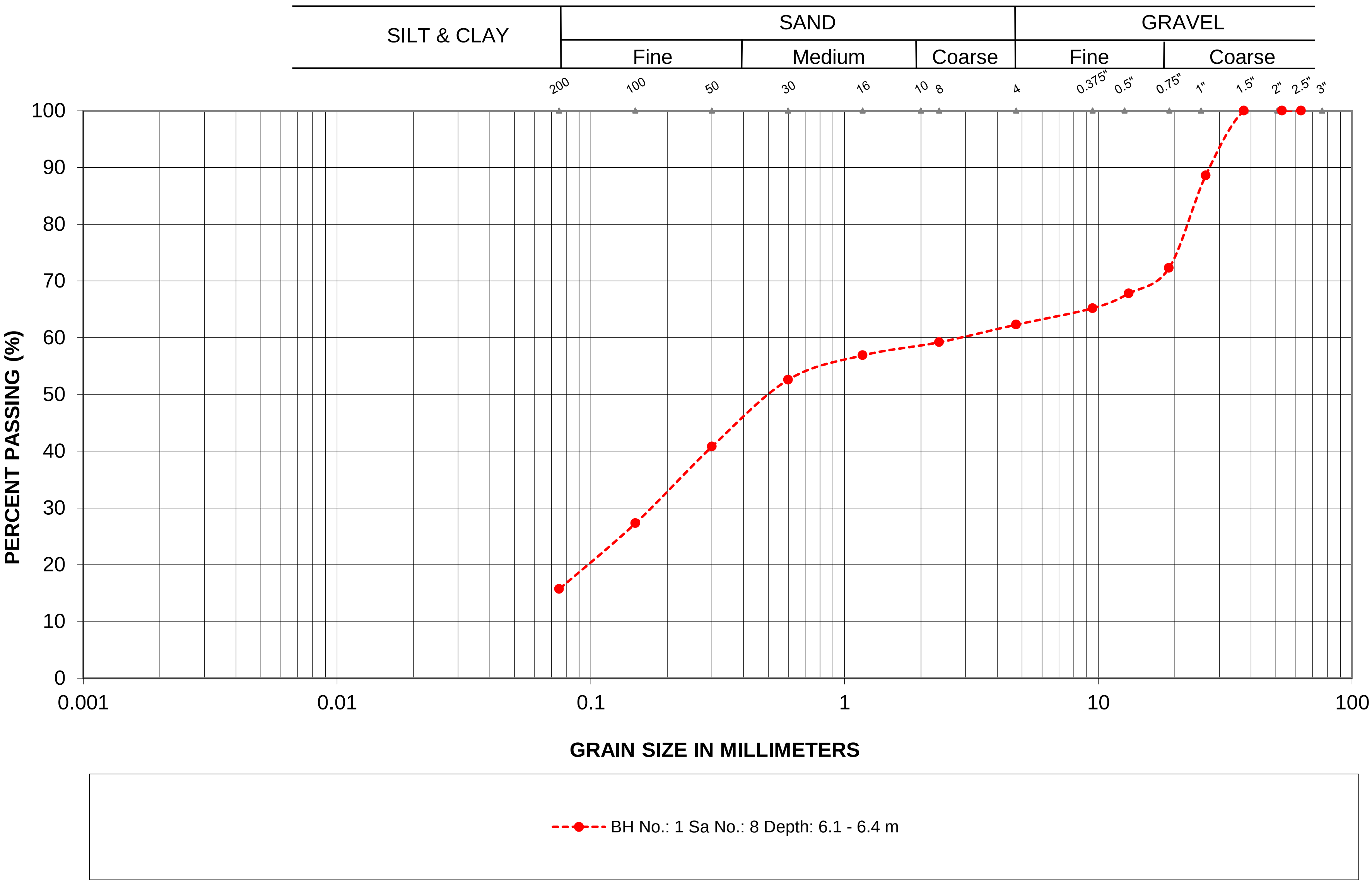
LOCATION: Hwy 118, Station 22+510
TWP of Dysart

Englobe Corp.

FIGURE L-4

Reference No.: 15/04/15020-F16
Date: November 2015

GRAIN SIZE ANALYSIS



GRAVELLY SAND

LOCATION: Hwy 118, Station 22+510
TWP of Dysart

Englobe Corp.

FIGURE L-5

Laboratory Tests - Summary Sheet

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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	33	59	8		4.6				17			
	2	0.8					5.5				22			
	3	1.5									30/51mm			
	4	2.3					12.0				5			
	5	3.1	10	33	55	2	38.6				14			Non-Plastic (NP)
	6	3.8	18	63	19		12.8				19			
	7	4.6					12.6				23			
	8	6.1	38	46	16		8.9				43/152mm			
	9	6.4												Rec= 97%, RQD= 40%
	10	7.9												Rec= 100%, RQD= 66%
2	1	0.0					2.9				20			
	2	0.8					4.6				13			
	3	1.5	39	53	8		4.1				13			
	4	2.3					6.2				13			
	5	3.1	34	57	9		4.6				6			
	6	3.8									11			
	7	4.6					2.4				25/0mm			
	8	6.1					12.1				43			
	9	7.6	16	61	23		11.6				27			
	10	9.1												Rec= 92%, RQD= 74%
	11	10.7												Rec= 95%, RQD= 89%

Laboratory Tests - Summary Sheet

Englobe

Borehole No.	Sample No.	Depth	Grain Size Analysis: Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)	NMC	Atterberg Limits: LL (%)	PL (%)	IP (%)	SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
3	1	0.0					19.4				9			
	2	0.8	2	61	37	0	10.4				34			
	3	1.5					12.5				50/279 mm			
	4	2.3												Rec= 85%, RQD= 66%
	5	4.1												Rec= 95%, RQD= 76%
4	1	0.0					33.5				2			
	2	0.8					14.2				16			
	3	1.9	2	69	29	0	18.3				23			
	4	2.3					17.1				15			
	5	3.1	12	58	30		16.0				13			
	6	3.7												Rec= 98%, RQD= 83%
	7	5.2												Rec= 97%, RQD= 78%

Appendix 4 Photo Essay

Enclosure No. 6: Photo Essay

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Embankment at Culvert Location – Looking West, south side of embankment	Photo: 1

Embankment at Culvert Location – Looking East, north side of embankment	Photo: 2

Project: Hwy 118 – Culvert, Station 22+510, Township of Dysart	Photos Provided By: Englobe Date: August 2015

Culvert Inlet – Looking South	Photo: 3

View of Embankment at Culvert Outlet – Looking North	Photo: 4

Project: Hwy 118 – Culvert, Station 22+510, Township of Dysart	Photos Provided By: Englobe Date: August 2015

Rock Cores – Borehole 2 (left) and Borehole 3 (right)	Photos: 5 and 6
	
Project: Hwy 118 – Culvert, Station 22+510, Township of Dysart	Photos Provided By: Englobe Date: August 2015

Rock Cores – Borehole 4	Photos: 7

Project: Hwy 118 – Culvert, Station 22+510, Township of Dysart	Photos Provided By: Englobe Date: August 2015