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 118
Station 23+554 - Twp. of Hindon
GWP 5140-13-00

FINAL FOUNDATION INVESTIGATION REPORT

Date: October 25, 2016
Ref. Nº: 15/03/15019-F6

Geocres No. 31E-366

Englobe

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 23+554 - Twp. of Hindon
GWP 5140-13-00

Final Foundation Investigation Report

Prepared by:

Alexander Tepylo, P. Eng.
Project Engineer

Sen Hu, P. Eng.
Senior Geotechnical Engineer

Reviewed by:

Michael H. MacKay, M.Eng., P. Eng.
Vice President – Expertise
Pavement Technology & Geotechnical Engineering
MTO Designated Contact

TABLE OF CONTENTS

Appendices

Property and Confidentiality

Client:
AECOM Canada Ltd.
189 Wyld Street, Suite 103
North Bay, Ontario
P1B 1Z2
Attention: **Mr. Al Rose**

REVISION AND PUBLICATION REGISTER		
Revision N°	**Date**	**Modification And/Or Publication Details**
00	2016-06-30	DRAFT FIDR Issued
01	2016-10-25	Final FIR 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 23+554 in the Township of Hindon on Highway 118, some 1.5 km west of Brady Lake Road.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0020: GWP 5140-13-00 for Detailed Design. The terms of reference for the scope of work are outlined in Englobe's Proposal P-14-168-R1, dated January 21, 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 1520 mm Corrugated Steel Pipe (CSP) culvert is located on Highway 118 at Station 23+554 in the Township of Hindon, 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 some 4.5 m in height above the culvert invert (at centreline), with centreline Elevation of 365.9 m at the culvert location. At the north and south slope, the maximum height of the embankment is approximately 3.8 m. The existing embankment slopes, in the area of the culvert, have been generally established at inclination angles of approximately 2.1H:1V to 2.3H:1V at the south and north slopes, respectively. The culvert at this location is a 1520 mm diameter Corrugated Steel Pipe (CSP) culvert, some 28.2 m in length. Flow through the culvert is from the south to north (right to left).

There is no other known infrastructure at the culvert location.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The topography on this section of Highway 118 is generally rolling. Layers of earth overlie bedrock. Organic materials were also observed. Within the project area the native overburden consists primarily of sands and silts overlying bedrock.

Bedrock, based on Ontario Geologic Survey (OGS) Map MRD-126, in the area consists of felsic igneous rocks including tonalite, granodiorite, monzonite, granite, syenite and derived gneisses.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between June 4th and September 1s, 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 rigs equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment. The drill equipment is owned by Chrisdamat Management Ltd. and was operated by an Englobe drill crew. 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 D1586). 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. 1 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 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 carried out 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 boreholes 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 23+554, TWP OF HINDON

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 365.9, 365.9, 361.9 and 361.9 m, respectively.

4.1.1 Pavement Structure

Borehole Nos. 1 and 2, was advanced through the embankment and confirmed that the pavement structure consisted of 125 mm asphalt concrete overlying crushed gravel base/subbase approximately 150 to 180 mm thick.

4.1.2 Embankment Fill

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of embankment fill described as brown sand some gravel to sandy gravel, trace silt, was penetrated. Cobble/boulder sized rock pieces were encountered in the embankment fill layer. The natural moisture contents measured for recovered samples from this deposit were generally in the order of 2 to 29%, except at one sample recovered near the bottom of embankment fill at Borehole No.1 where 36% was measured. Gradation (sieve) analyses were carried out on four (4) samples of this deposit, the results of which indicated 14 to 65% gravel size particles, 29 to

75% sand size particles, and 6 to 11% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 4 to 34 blows per 300 mm penetration and 25 blows per 25 mm penetration, the compactness of this deposit was described as loose to very dense, generally compact. This deposit was encountered to a depth of 4.9 m below grade at Borehole Nos. 1 and 2 (Elevation 361.0 m).

4.1.3 Organic Soils

Underlying a surficial layer of water at Borehole Nos. 3 and 4, a layer of black fibrous peat to silty organic soil was penetrated. The natural moisture contents measured on samples of this deposit were in the order of 79 to 92%. This organic soil layer was encountered to approximate depths of 0.8 and 1.1 m below the creek water surface at Borehole Nos. 3 and 4, respectively (Elevations 361.1 and 360.8 m, respectively).

4.1.4 Silt

Underlying the embankment fill at Borehole Nos. 1 and 2, and underlying the organic soils at Borehole Nos. 3 and 4, a deposit of silt, trace gravel, with to trace sand, trace clay was penetrated. The natural moisture contents measured on samples of this deposit were in the order of 16 to 40%. Gradation (hydrometer) analyses were carried out on two (2) sample of this deposit, the results of which indicated 1 to 2% gravel size particles, 9 to 25% sand size particles, 67 to 86% silt size particles, and 3 to 7% clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 5 to 35 blows per 300 mm penetration and 23 blows per 150 mm, this deposit was described as loose to very dense. This deposit was encountered to depths of 5.5, 5.7, 2.1 and 2.1 m below ground surface at Borehole Nos. 1, 2, 3 and 4, respectively (Elevations 360.4, 360.2, 359.8 and 359.8 m, respectively).

4.1.5 Sandy Silt

Underlying the silt at Borehole No. 3, a deposit of sandy silt, trace clay, was penetrated. The natural moisture content measured on samples of this deposit was about 19%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, the results of which indicated 0% gravel size particles, 33% sand size particles, 66% silt size particles and 1% clay size particles (Figure No. L-3, Appendix 3). Based on a SPT 'N' value of 30 blows per 100 mm penetration, this deposit was described as very dense. This deposit was encountered to a depth of 2.9 m below the creek water surface at Borehole No. 3 (Elevation 359.0 m).

4.1.6 Sand and Clayey Silt

Underlying the silt at Borehole No. 4, a deposit of sand and clayey silt, trace gravel, was penetrated. The natural moisture contents measured on samples of this deposit were in the order of 16%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, the results of which indicated 6% gravel size particles, 44% sand size particles, 37% silt size particles and 13% clay size particles (Figure No. L-4, Appendix 3). Atterberg Limits testing was carried out on one (1) sample of this deposit, the results of which indicated a Liquid

Limit of about 20% and a Plastic Limit of 14% (Figure No. L-4, Appendix 3), indicating low degree of plasticity. Based on a SPT 'N' value of 25 blows per 25 mm penetration, this deposit was described as very dense. This deposit was encountered to a depth of 2.5 m below the creek water surface at Borehole No. 4 (Elevation 359.4 m).

4.1.7 Bedrock

Underlying the silts at Borehole Nos. 1 and 2, underlying the sandy silt at Borehole No. 3, and underlying the sand and clayey silt at Borehole No. 4, bedrock was proven by diamond core drilling. The bedrock was described as black gneiss to pink granite. Based on RQD values ranging from 81 to 93% the bedrock was described as good to excellent quality. Based on visual examination, the bedrock generally showed negligible weathering. Sampling in the bedrock was terminated at depths of 8.6 and 9.2 m below grade at Borehole Nos. 1 and 2, and at depths of 6.0 and 5.5 m below the creek water surface at Borehole Nos. 3 and 4, respectively (Elevations 357.3, 356.7, 355.9 and 356.4 m, respectively). Photos of rock cores recovered at Borehole Nos. 3 and 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, the creek surface water level was observed at Elevation 361.9 m on September 1st, 2015 at the culvert location.

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 4 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

The groundwater levels were measured at Elevation 361.9 m at Borehole Nos. 1, 3 and 4 during the site investigation period on September 1st, 2015.

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

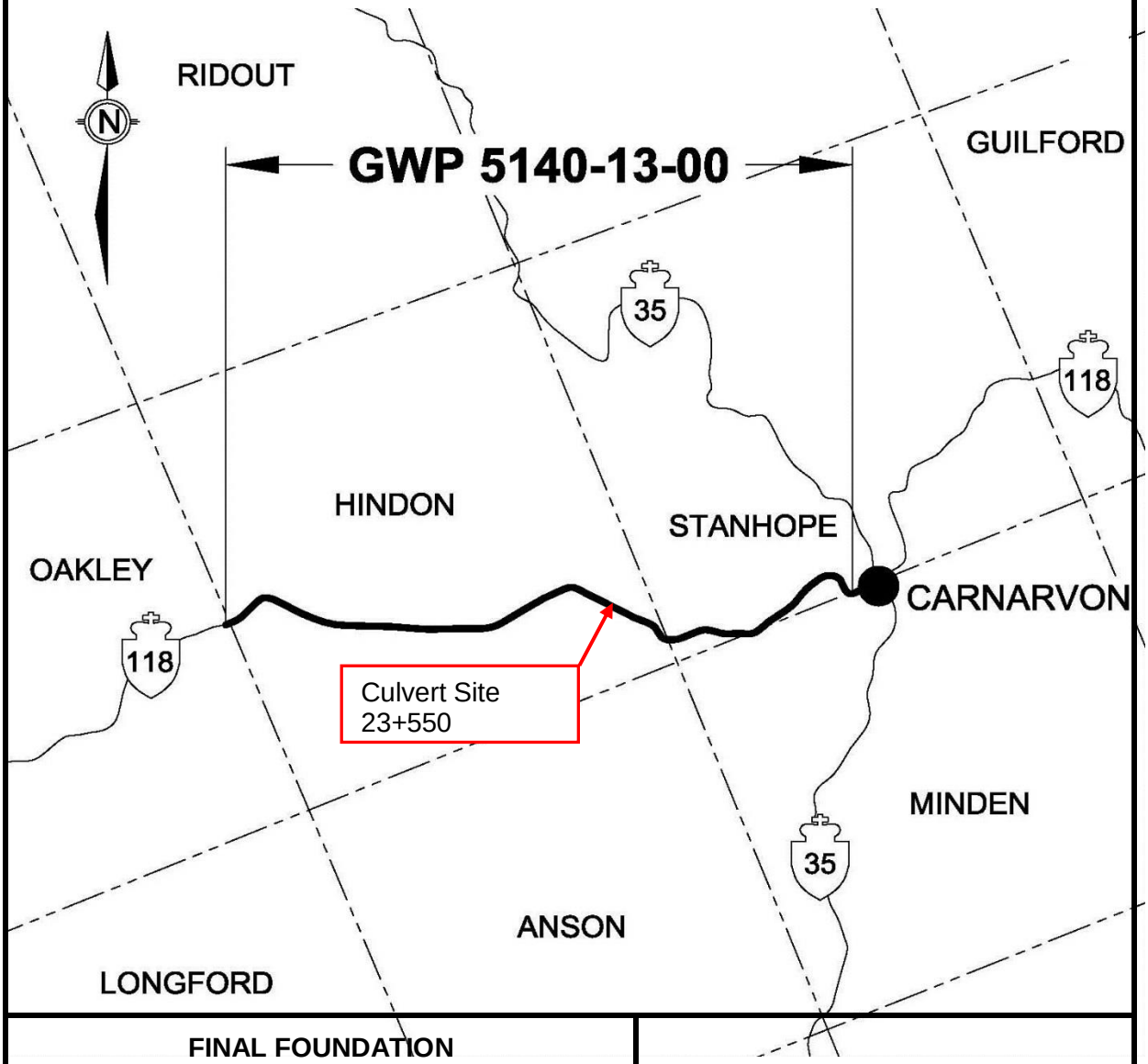
Appendix 1 Key Plan

Drawing No. 1 Key Plan

MACRO KEY PLAN

Drawing No. 1

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT
GWP 5140-13-00
Highway 118

Culvert Station 23+554 - Township of Hindon

Reference No: 15/03/15019-F6 September 2016

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 15/03/15019-F6 DATUM Geodetic LOCATION N 4989124.9 E 359595.0 - Hindon Twp., Station 23+554 ORIGINATED BY JL

PROJECT GWP 5140-13-00, Highway 118 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 4 June 2015 TIME (Completed) 2:40:00 PM CHECKED BY AT

DATE (Completed) 4 June 2015

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	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)
365.9	Ground Surface										
0.0	125 mm Asphalt 180 mm Crushed Gravel FILL- sand with gravel to sandy gravel, trace silt, trace clay cobble sized rock pieces encountered at depths from 2.0 m to 3.0 m brown, moist (very dense/loose)		1	SS	19		365		○		25 65 (10)
			2	SS	25/76 mm				○		
			3	SS	20		364		○		54 37 (9)
			4	SS	27		363		○		
			5	SS	4				○		
			6	SS	6	▽	362		○		
361.0			7A	SS	7				○		
4.9	SILT - trace gravel, some sand, trace clay dark grey to brownish grey		7B	SS			361		○		
360.4			8	SS	23/150 mm				○		
5.5	(loose to very dense) Auger Refual Start Rock Coring Bedrock - black gneiss/thin pink granite good to excellent quality		9	RC	Rec= 98% RQD= 91%		360				
			10	RC	Rec= 97% RQD= 86%		359				
357.3							358				
8.6	End of Sampling End of Borehole										

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) 4/6/15 2:45:00 PM	Dry ▽	-
2) 5/6/15 7:40:00 AM	3.8 ▽	-
3) 1/9/15 3:00:00 PM	4 ▼	-

MEL-GEO 15019 - BOREHOL LOGS - F6.GPJ MEL-GEO.GDT 30/6/16

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

ENCLOSURE NO.:3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 2

Englobe

REFERENCE 15/03/15019-F6 DATUM Geodetic LOCATION N 4989128.5 E 359603.9 - Hindon Twp., Station 23+560 ORIGINATED BY JL

PROJECT GWP 5140-13-00, Highway 118 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 4 June 2015 TIME (Completed) 10:30:00 AM CHECKED BY AT

DATE (Completed) 5 June 2015

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × 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)
365.9	Ground Surface										
0.0	125 mm Asphalt 150 mm Crushed Gravel										
	FILL- sand some gravel to gravel with sand, trace silt		1	SS	20						
			2	SS	25/25mm		365				14 75 (11)
	cobble and boulder sized rock pieces encountered at depths from 0.9 m to 3.8 m										
	brown, moist		3	SS	19		364				
	(loose/very dense)		4	SS	45/152 mm						65 29 (6)
							363				
	loose		5	SS	8						
			6	SS	34		362				
361.0			7A	SS	18						
4.9	SILT - trace sand, trace clay		7B	SS			361				
	grey										
360.2	(compact)										
5.7	Auger Refual Start Rock Coring						360				
	Bedrock - black gneiss/thin pink granite		8	RC	Rec= 96% RQD= 85%						
	good quality						359				
			9	RC	Rec= 98% RQD= 81%		358				
356.7			10	RC	Rec= 100% RQD= 81%		357				
9.2	End of Sampling End of Borehole										

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) 5/6/15 10:30:00 AM	Dry	3.2
2)	-	-
3)	-	-

MEL-GEO 15019 - BOREHOL LOGS - F6.GPJ MEL-GEO.GDT 30/6/16

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

REFERENCE 15/03/15019-F6 DATUM Geodetic LOCATION N 4989145.1 E 359598.4 - Hindon Twp., Station 23+547 ORIGINATED BY JL

PROJECT GWP 5140-13-00, Highway 118 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 1 September 2015 TIME (Completed) 1:15:00 PM CHECKED BY AT

DATE (Completed) 1 September 2015

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
361.9	Water Surface					▽		20 40 60 80 100	20 40 60		
361.7	Water										
0.2	Black silty fibrous peat		1	SS	3						
361.1											
0.8	SILT - with sand trace gravel trace clay wet grey		2	SS	6		361				1 25 67 7
			3	SS	35						
359.8	(loose/dense)						360				
2.1	SANDY SILT - trace clay grey (very dense)		4	SS	30/100 mm						0 33 66 1
359.0							359				
2.9	Auger Refual Start Rock Coring Bedrock - pink granite/black gneiss good to excellent quality		5	RC	Rec= 98% RQD= 83%		358				
			6	RC	Rec= 100% RQD= 93%		357				
355.9							356				
6.0	End of Sampling End of Borehole										

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) 1/9/15 1:15:00 PM	0 ▽	-
2)	- ▽	-
3)	- ▼	-

MEL-GEO 15019 - BOREHOL LOGS - F6.GPJ MEL-GEO.GDT 30/6/16

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 15/03/15019-F6 DATUM Geodetic LOCATION N 4989112.6 E 359591.5 - Hindon Twp., Station 23+557 ORIGINATED BY JL

PROJECT GWP 5140-13-00, Highway 118 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 1 September 2015 TIME (Completed) 4:40:00 PM CHECKED BY AT

DATE (Completed) 1 September 2015

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
361.9	Water Surface										
361.7	Water										
0.2	Black silty organics, trace gravel, trace sand, trace grass rootlets		1	SS	WH						
360.8			2	SS	5		361				
1.1	SILT - trace gravel, trace sand, trace clay brown, wet (loose/dense)		3	SS	35						2 9 86 3
359.8							360				
2.1	SAND and CLAYEY SILT - trace gravel		4	SS	~~25/25 mm~~						6 44 37 13
359.4							359				
2.5	grey (dense/very dense) Auger Refual Start Rock Coring Bedrock - pink granite/black gneiss good to excellent quality		5	RC	Rec= 93% RQD= 82%		358				
356.4			6	RC	Rec= 97% RQD= 91%		357				
5.5	End of Sampling End of Borehole										

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

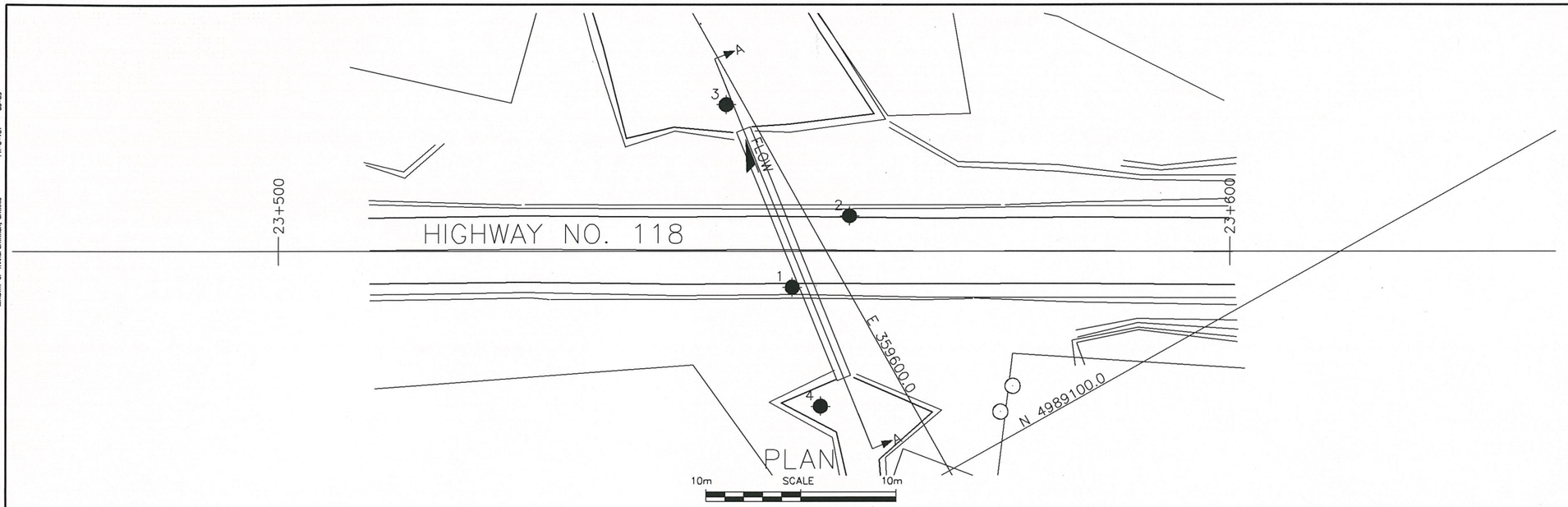
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 1/9/15 4:45:00 PM	0	-
2)	-	-
3)	-	-

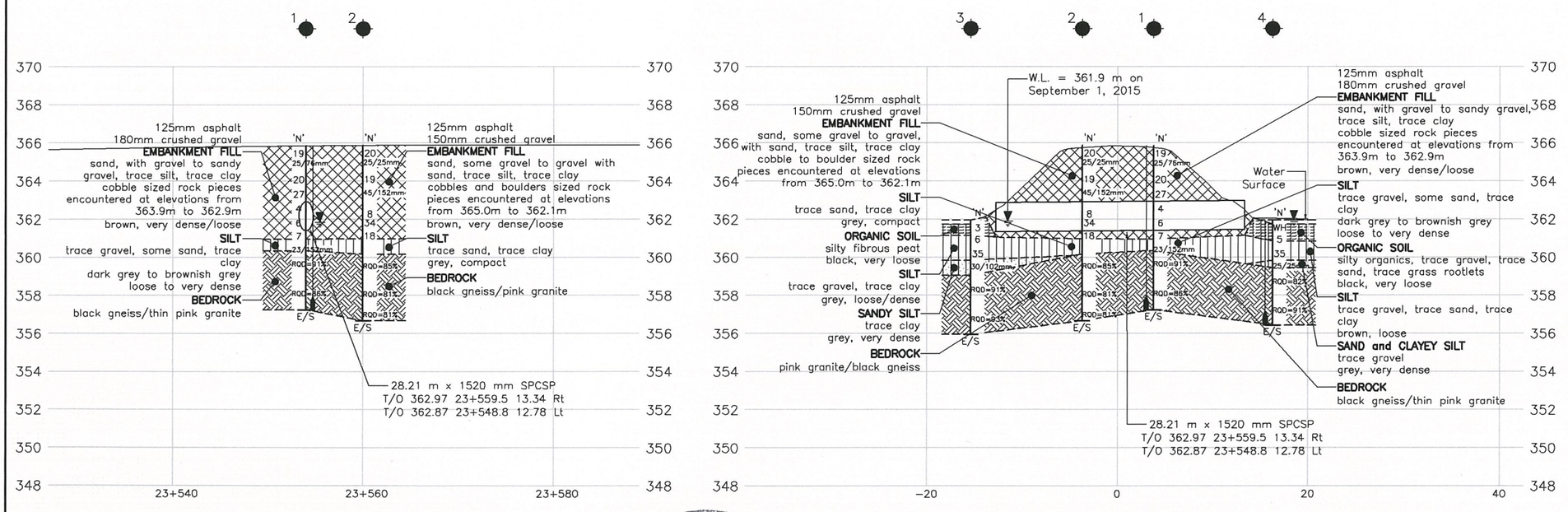
MEL-GEO 15019 - BOREHOL LOGS - F6.GPJ MEL-GEO.GDT 30/6/16

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-4:	Grain Size Distribution Curves
Figure Nos. L-5:	Atterberg Limits
Table No. L-6:	Lab Test Summary Sheet





C/L PROFILE HWY 118

SCALE

HOR 10 5 0 10 20m

VERT 5 2.5 0 5 10m

CROSS SECTION A–A

SCALE

HOR 10 5 0 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
OCT 24/16
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M. H. MacKAY
OCT 24/16
PROVINCE OF ONTARIO

2016-10-27

DISTRICT
CONT. No.
GWP No. 5140-13-00

HWY 118 CULVERT
CULVERT AT STA. 23+554

BOREHOLE LOCATIONS AND SOIL STRATIGRAPHY

DRAWING 2

Englobe

KEY PLAN
N.T.S.

LEGEND

●	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	365.9	3.8m Rt	4989124.9	359595.0
2	365.9	3.7m Lt	4989128.5	359603.9
3	361.9	15.4m Lt	4989145.1	359598.4
4	361.9	16.3m Rt	4989112.6	359591.5

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 February 26, 2016

Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCRES No. 31E-366

REVISIONS			
JUN/16	DM	DRAFT	
SEP/16	DM	FINAL	

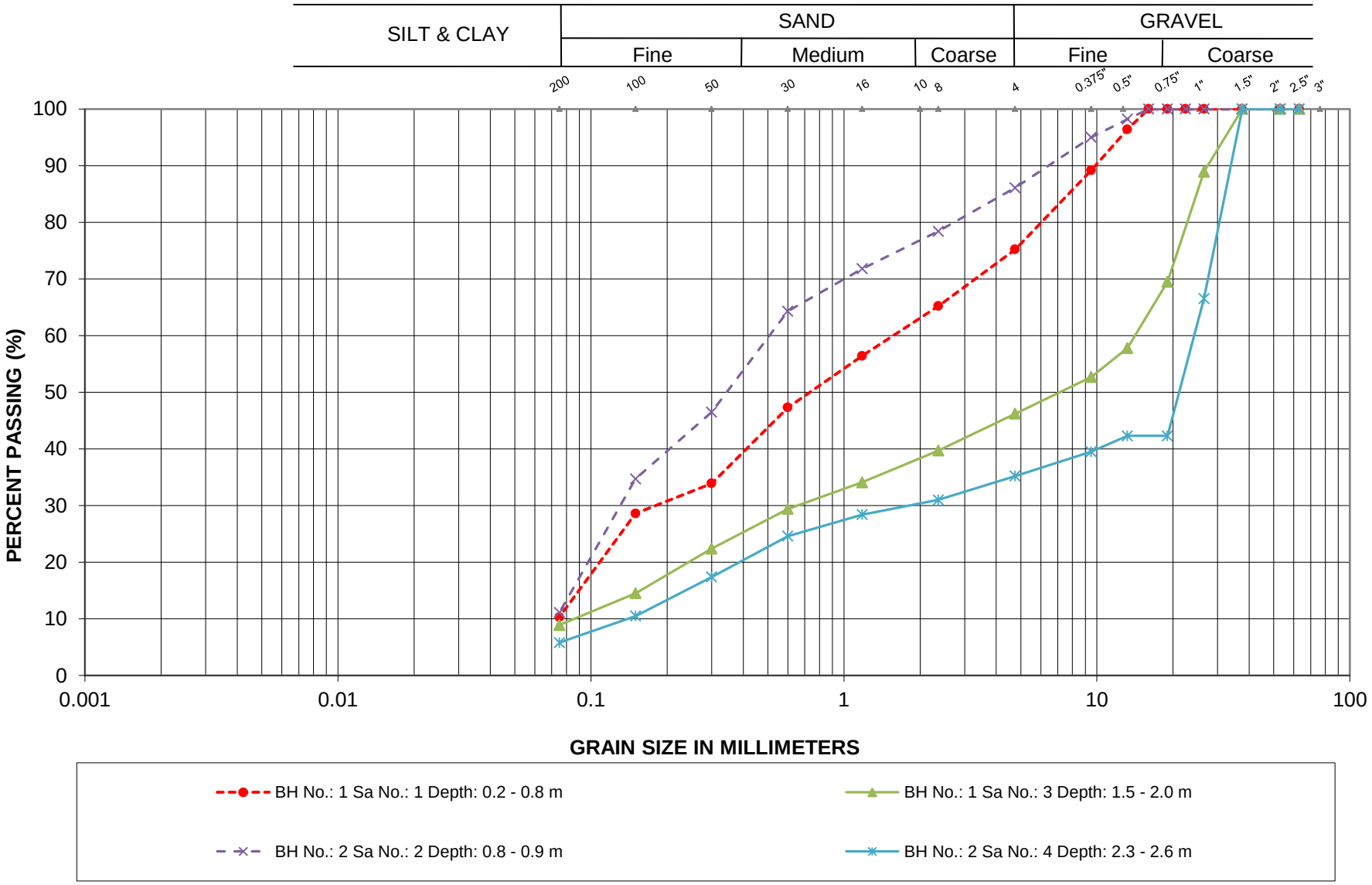
DESCRIPTION					
DESIGN	CHK	CODE	LOAD	DATE SEP/16	
DRAWN DM	CHK SH	SITE	STRUCT	SCHEME	DWG 2

CAD FILE LOCATION AND NAME: G:\2015\15019 - PAV & FDN, Hwy 35 & 118 S014-E-0020 (AECOM)\FOUNDATION\Drawings\F6\15019 F6 - Culvert at Sta. 23+550 (Final 16-09-30).dwg
MODIFIED: 9/30/2016 11:50:20 AM BY: GRASKRY
DATE PLOTTED: 9/30/2016 11:50:50 AM BY: RYAN GRASSER
MINISTRY OF TRANSPORTATION, ONTARIO PR-0-707 88-05

Reference No.: 15/03/15019-F6
Date: June 2016

Englobe

GRAIN SIZE ANALYSIS



LOCATION: Hwy 118 Sta.23+554
TWP. Hindon, Ontario

EMBANKMENT FILL

Englobe Corp.

FIGURE L-1

Reference No.: 15/03/15019-F6
Date: June 2016

GRAIN SIZE ANALYSIS

LOCATION: Hwy 118 Sta.23+554
TWP. Hindon, Ontario

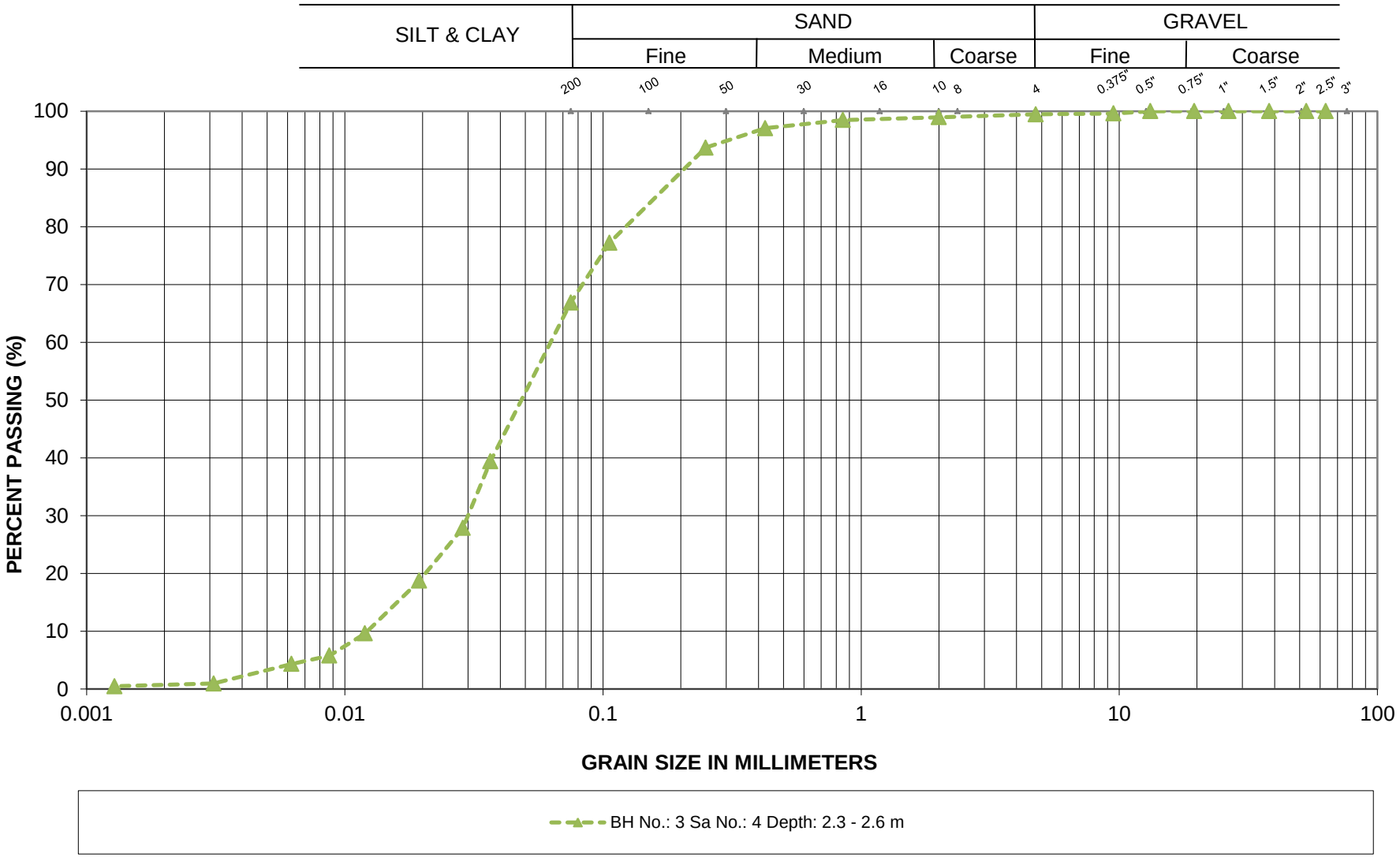
SILT

Englobe Corp.

FIGURE L-2

Reference No.: 15/03/15019-F6
Date: June 2016

GRAIN SIZE ANALYSIS



LOCATION: Hwy 118 Sta.23+554
TWP. Hindon, Ontario

SANDY SILT

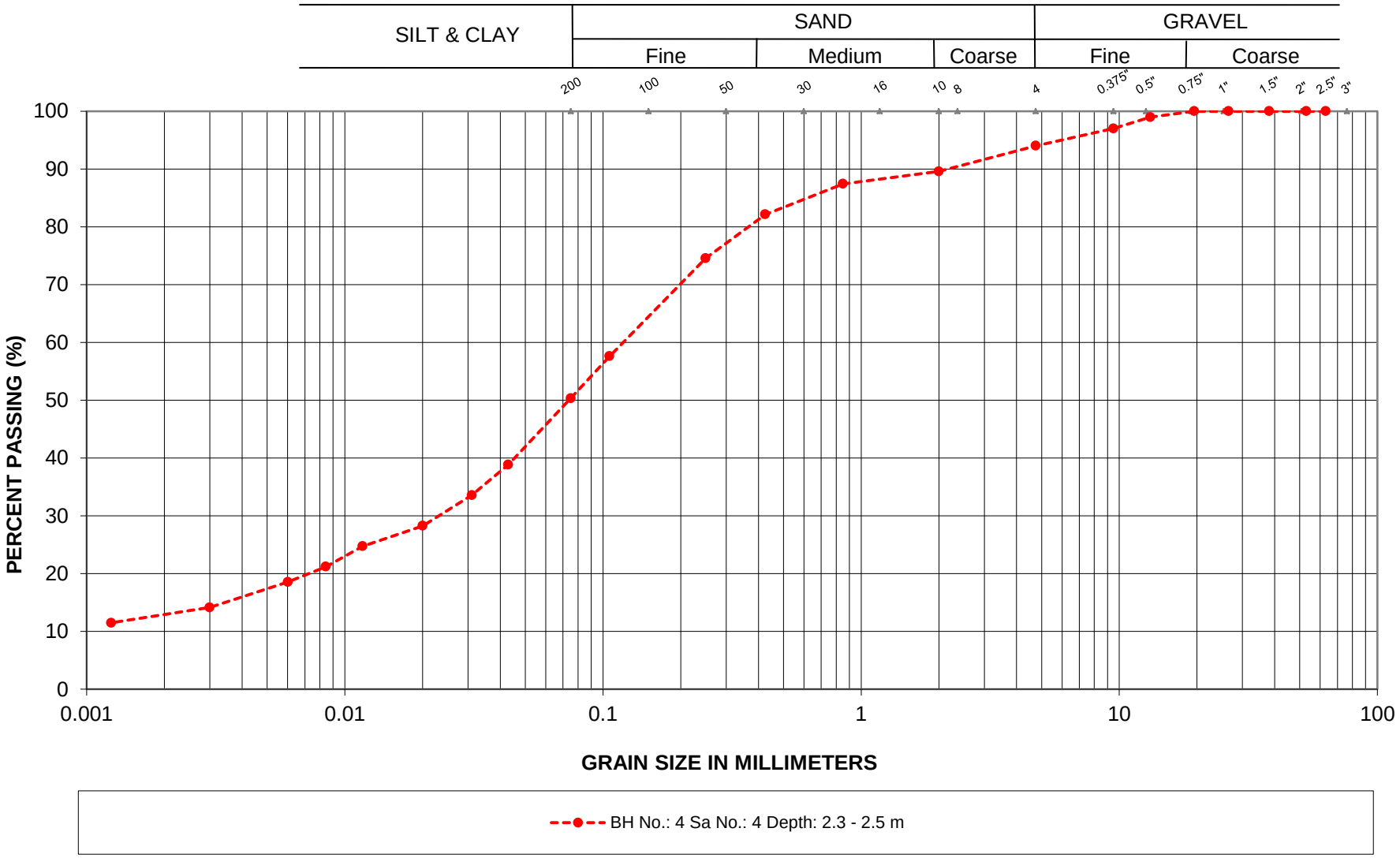
Englobe Corp.

FIGURE L-3

Reference No.: 15/03/15019-F6
Date: June 2016

Englobe

GRAIN SIZE ANALYSIS



LOCATION: Hwy 118 Sta.23+554
TWP. Hindon, Ontario

SAND and CLAYEY SILT

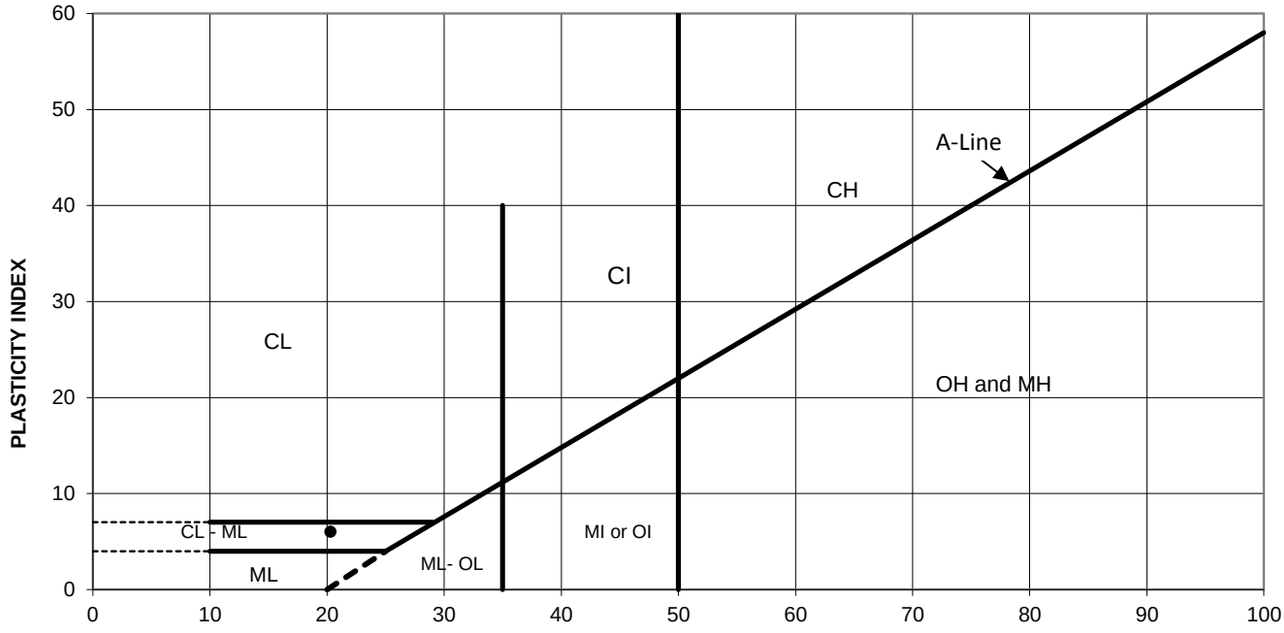
Englobe Corp.

FIGURE L-4

ATTERBERG LIMITS TEST RESULTS

FIGURE L-5

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	4	4	2.4	359.5	20.3	14.3	6.0	16.1

Date: Jun-16
Project: Hwy 118
Location: Sta. 23+554, TWP. of Hindon

Prep'd: AT
Chkd: SH
Ref. No.: 15/03/15019-F6

Englobe Corp.

Reference No.: 15/04/15019-F6
Date: June 2016

Laboratory Tests - Summary Sheet

Englobe

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	0.2	25	65	10		4.1				19			
	2	0.8					3.8				25/76 mm			
	3	1.5	54	37	9		2.3				20			
	4	2.3					2.0				27			
	5	3.1					16.0				4			
	6	3.8					24.0				6			
	7A	4.6					29.3				7			
	7B	4.9					28.2							
	8	5.3					16.0				23/152 mm			
	9	5.5												Rec= 98% RQD= 91%
	10	7.0												Rec= 97% RQD= 86%
2	1	0.2					4.0				20			
	2	0.8	14	75	11		5.8				25/25mm			
	3	1.5					16.3				19			
	4	2.3	14	29	6		5.5				45/152 mm			
	5	3.4					8.9				8			
	6	3.8					13.4				34			
	7A	4.6					35.7				18			
	7B	4.9												
	8	5.7												Rec= 96% RQD= 85%
	9	7.1												Rec= 98% RQD= 81%
	10	8.6												Rec= 100% RQD= 81%

Project: Hwy 118, Culvert Sta. 23+554, Township of Hindon

Table No. L-6
Sheet 1 of 2

Laboratory Tests - Summary Sheet

Englobe

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	0.2					79.0				3			
	2	0.8	1	25	67	7	39.9				6			
	3	1.5					15.5				35			
	4	2.3	0	33	66	1	18.8				30/102 mm			
	5	2.9												Rec= 91% RQD= 83%
	6	4.5												Rec= 100% RQD= 93%
4	1	0.2					92.0				WH			
	2	0.8					26.9				5			
	3	1.5	2	9	86	3	23.2				35			
	4	2.3	6	50	37	13	16.1	20.3	14.3	6.0	25/25 mm			
	5	2.5												Rec= 93% RQD= 82%
	6	4.0												Rec= 97% RQD= 91%

Appendix 4 Photo Essay

Enclosure No. 6: Photo Essay

Embankment at Culvert Location – Looking West	Photo: 1

Embankment at Culvert Location – Looking East	Photo: 2

Project: Hwy 118 – Culvert, Station 23+554, Township of Hindon	Photos Provided By: Englobe Date: June 2015

Culvert Inlet – Looking South	Photo: 3

Culvert Outlet – Looking North	Photo: 4

Project: Hwy 118 – Culvert, Station 23+554, Township of Hindon	Photos Provided By: Englobe Date: September/June 2015

Rock Cores – Borehole No. 3 and 4	Photos: 5 and 6

Project: Hwy 118 – Culvert, Station 23+554, Township of Hindon	Photos Provided By: Englobe Date: June 2016