



Englobe

Soils Materials Environment

**Submitted to Planmac Engineering Inc.
80 North Queen Street, Suite 302, Toronto, Ontario M8Z 2C9
For the Ontario Ministry of Transportation**

**Bridge Rehabilitation
Highway 11
Oro Line 9 Underpass
Site No 30-492
GWP 2197-17-00**

FINAL FOUNDATION INVESTIGATION REPORT

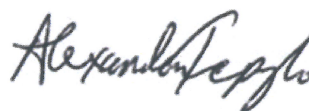
Date: December 7, 2018
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Geocres No. 31D-701

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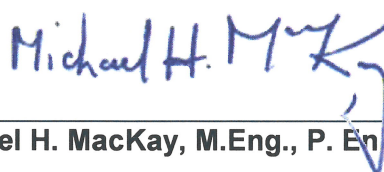
Final Foundation Investigation Report



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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."

Client:

Planmac Engineering Inc.

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Attention: **Mr. Mike Neumann, President, P. Eng.**

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1 INTRODUCTION

Englobe Corp. (Englobe) has been retained by Planmac Engineering Inc. (Planmac), on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at the existing bridge structure described as Oro Line 9 Underpass – Site No. 30-492. The Oro Line 9 Underpass crosses over Highway 11 in the Township of Oro-Medonte, Ontario (see Drawing No. 1, Appendix 1).

The foundation investigation location was specified by the MTO in the Terms of Reference for the work under Assignment No. 2017-E-0004: GWP Nos. 2087-15-00 and 2003-16-00 and its Clarification No. 3, dated May 2017. The terms of reference for the scope of work are outlined in Englobe's Proposal 2017-P152-084, dated May 30, 2017.

The purpose of this investigation was to determine the subsurface conditions in the areas of the bridge approaches to provide the factual information for the Detailed Design of bridge rehabilitation work. Englobe investigated the subsurface conditions at the bridge structure and approaches by drilling boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2 SITE DESCRIPTION

The existing bridge underpass crosses over Highway 11 and is located approximately between Stations 0+011.5 and 0+058.5 on Oro Line 9 in the Township of Oro-Medonte. The existing Oro Line 9 Underpass structure and approach embankments currently support two undivided lanes, locally running in a south-north direction. A visual review of the roadway to the north and the south of the bridge approaches indicates that, in general, the roadway structure is in fair to good condition (see Photo Essay in Appendix 4).

The existing underpass approaches have been constructed on approximately 8.7 m high embankments generally consisting of sand fills. At the bridge location, the existing highway centreline is approximately at Elevation 296.4 m at the north and south expansion joints of the bridge.

Infrastructure at the underpass bridge location consists of municipal drainage and catch basins to the north and south of the underpass bridge.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The topography in the area of this site is generally flat to slightly rolling. Within the project area, the native overburden consists primarily of clayey-silty sands.

Bedrock in the area, based on Ontario Geologic Survey (OGS) MRD-126 [1, see List of References at end of this report], consists of Middle Ordovician limestone, dolostone, shale, arkose, and/or sandstone of the Shadow Lake Formation.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out on October 3, 2017, during which time two (2) sampled boreholes were advanced. One (1) borehole was advanced in the north approach embankment and one (1) borehole was advanced in the south approach embankment.

The field investigation was carried out using a truck 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. All samples taken during this investigation were stored in labeled containers for transport to our North Bay laboratory for visual examination and select laboratory testing. Laboratory testing of select samples included routine geotechnical testing for natural moisture content determination and particle size analyses. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix 2), with a summary of testing results presented on the laboratory sheets in Appendix 3 (Figures Nos. L-1 to L-4 and Table No. L-5).

Groundwater conditions were observed in the open boreholes during the advancement of, and immediately following, completion of the individual boreholes. A 19 mm diameter standpipe was installed in Borehole No. 1 prior to backfilling to allow for further monitoring of the shallow groundwater levels post completion of the field work. The remaining open borehole (Borehole No. 2) was backfilled upon completion with compacted auger cuttings in the same general order that they were removed, and where necessary, bentonite pellet backfill was added to the boreholes to bring them up to grade and sealed in accordance with requirements of Ontario Regulation 903. The pavement surface at each borehole was reinstated with an asphalt cold patch to seal the existing asphalt surface.

The locations of the individual boreholes were determined in the field relative to the existing underpass bridge approaches and offsets relative to the 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 IBW Surveyors. 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 Record of Borehole logs (Enclosure Nos. 2 and 3, Appendix 2) and on Drawing No. 2 (Appendix 3). It must be noted that the stratigraphic delineations presented on the borehole logs and stratigraphic section are the result 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 boreholes and beyond the specific borehole locations, and are shown on the drawings for illustration purposes only.

4.1 ORO LINE 9 UNDERPASS BRIDGE

A plan and profile illustrating the borehole locations and interpreted stratigraphic section is provided on Drawing No. 2, Appendix 3. During the course of the field investigation program, two (2) sampled boreholes were put down at this site, with Borehole No. 1 advanced through the north approach embankment and Borehole No. 2 advanced through the south approach embankment. At the time the subsurface investigation was completed, the ground surface elevation at Boreholes Nos. 1 and 2 was recorded at Elevations 296.3 m.

4.1.1 Pavement Structure

Borehole Nos. 1 and 2 were advanced through the existing roadway approach embankments where a pavement structure consisting of 65 to 115 mm of asphalt was penetrated and underlain by the concrete approach slab which was 265 to 280 mm in thickness. At Borehole No. 1, the concrete approach slab was underlain by a layer of crushed gravel approximately 75 mm thick.

4.1.2 Embankment Fill

4.1.2.1 Gravelly Sand Fill

Underlying the pavement structure at Borehole No. 1, a layer of fill consisting of gravelly sand, trace silt, was penetrated. The natural moisture contents measured on samples retrieved from this layer were generally in the order of 2 to 5%. A gradation (sieve) analysis was carried out on one (1) sample of this layer and the test results indicated 31% gravel size particles, 60% sand size particles, and 9% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 4 to 24 blows per 300 mm penetration, the compactness of this layer was described as very loose to compact, generally compact on average. This layer was encountered to a depth of 2.9 m below grade at Borehole No. 1 (Elevations 293.4 m).

4.1.2.2 Sand Fill

Underlying gravelly sand fill at Borehole No. 1 and the pavement structure at Borehole No. 2, a layer of fill consisting of sand, trace to some gravel, trace to with silt, was penetrated. The natural moisture contents measured on samples retrieved from this layer were generally in the order of 3 to 11%. Gradation (sieve) analyses were carried out on four (4) samples of this layer, and the test results indicated 5 to 16% gravel size particles, 64 to 81% sand size particles, and 9 to 26% silt and clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values ranging from 2 to 50 blows per 300 mm penetration, the compactness of this layer was

described as very loose to dense, generally compact on average. This layer was encountered to a depth of 8.7 m below grade at Borehole Nos. 1 and 2 (Elevation 287.6 m).

4.1.3 Clayey Sand and Silt

Underlying the sand fill layer at Borehole Nos. 1 and 2, a deposit of grey clayey sand and silt, some gravel, was penetrated. The natural moisture content measured on samples of this deposit was in the order of 5 to 10%. Gradation (hydrometer) analyses were carried out two (2) samples of this deposit, and the test results indicated 11 to 15% gravel size particles, 40 to 42% sand size particles, 32 to 34% silt size particles, and 13% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was carried out on two (2) sample of this deposit, and the results indicated a Liquid Limit ranging from 14 to 16% and a Plastic Limit ranging from 10 to 11%, resulting in a Plasticity Index of 4 to 5% (Figure No. L-4, Appendix 3). Based on the results of the gradation analysis and Atterberg Limits testing, this deposit was described as clayey sand and silt (poorly graded sand-clay mixtures). Based on SPT 'N' values of 16 and 91 blows per 300 mm penetration, the compactness of this layer was described as compact to very dense. SPT "N" values of 50 blows for 100 mm penetration and 40 blows for 75 mm penetration were recorded prior to auger refusal at BH Nos. 1 and 2, respectively.

Auger refusal, likely on bedrock (assumed), was encountered in this deposit at depths of 10.9 and 10.7 m below grade at Borehole Nos. 1 and 2, respectively (Elevations 285.4 and 285.6 m, respectively).

4.2 GROUNDWATER DATA

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 19 mm diameter standpipe piezometer was installed in Borehole No. 1 to obtain post borehole completion water level. These levels are recorded on the individual Record of Borehole logs (Appendix 2).

Borehole Nos. 1 and 2 upon completion of drilling.

The groundwater and surface water levels should be expected to fluctuate seasonally/yearly.

4.3 CHEMICAL TESTING

One (1) soil sample recovered from Borehole No. 1 was submitted to AGAT analytical laboratory and tested for corrosivity potential to determine the potential for degradation of concrete in the presence of soluble sulphates used in foundations and buried infrastructure. The results of chemical testing (including PH, water soluble sulphate, chloride, resistivity and electrical conductivity analyses) are tabulated below and included in Appendix 3.

SAMPLE LOCATION	SAMPLE NO.	DEPTH BELOW GRADE (m)	pH	Soluble Sulphate (ppm)	Chloride (ppm)	Resistivity (Ohm.cm)	Electrical Conductivity (mS/cm)
BH 1	2	0.8	8.91	10	12	9620	0.104

5 MISCELLANEOUS

The field investigation was carried out using a truck mounted CME drilling rig owned by Chrisdanat Management Inc. and operated by Englobe Corp. Laboratory testing of select soil samples was undertaken at the North Bay Englobe Laboratory. The fieldwork for this site investigation was under the full time supervision of Jame Lavigne, a senior member of the Englobe engineering staff. The report was written by Alexander Tepylo, P.Eng., and reviewed by Sen Hu, P.Eng. and Michael MacKay, M.Eng., P.Eng.

6 STATEMENT OF LIMITATIONS

Proper subgrade preparation, groundwater control, compaction, etc. are all critical aspects of the bearing capacity of native soils. It must be noted that different aspects of the geotechnical design are based on the assumption that Englobe will be retained during site preparation and construction of the proposed works to ensure that both the geotechnical site characteristics and the construction operations/techniques are consistent with our recommendations. Should Englobe not be involved during the full construction phase, our liability is strictly limited to the factual information contained herein only.

The comments in this report are intended solely for the guidance of the design engineer and address the geotechnical conditions only. The number of boreholes required to determine the localized conditions between boreholes directly affecting construction costs, equipment, scheduling, etc. would in fact be greater than what has been carried out for design purposes. Therefore, contractors bidding on this project or undertaking this work should make their own interpretations of the factual borehole results and carry out further work as they deem necessary to assess the scope of the project.

If, during construction, conditions in the field vary from those assumed at the design stage, an engineer from this office must be notified immediately.

REFERENCES

1. Ontario Geological Survey, 1:250 000 scale bedrock geology of Ontario, Ontario Geological Survey, Miscellaneous Release--Data 126-Revision 1, ISBN 978-1-4435-5704-7 (CD) and ISBN 978-1-4435-5705-4, Ontario Geological Survey, 2011.

Appendix 1 Key Plan

Drawing No. 1

Key Plan

KEY PLAN

Drawing No. 1

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT

GWP 2197-17-00

Highway 11

Oro Line 9 Underpass

Reference No: P-0014012-0-00-100-01-F6

December 2018



Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 and 3	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)	Compactness Condition
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 P-0014012-0-00-100-01-F6 DATUM Geodetic LOCATION N 4928038.8 E 304263.2, Twp. of Oro-Medonte ORIGINATED BY JL
 PROJECT GWP 2197-17-00, Hwy 11, Oro Line 9 Underpass BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT Planmac Engineering Inc. DATE (Started) 03 October 2017 TIME
 DATE (Completed) 03 October 2017 (Completed) CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)											
296.3	Ground Surface																									
0.0	65 mm asphalt 280 mm concrete 75 mm crushed gravel EMBANKMENT FILL - gravelly sand, trace silt (compact/very loose)		1	SS	24									31 60 (9)												
			2	SS	22																					
			3	SS	17																					
			4	SS	4																					
293.4	EMBANKMENT FILL - sand, some gravel, some to with silt grey (very loose/dense)		5	SS	2																					
2.9			6	SS	11																					
			7	SS	25									10 64 (26)												
			8	SS	50																					
			9	SS	37																					
			10	SS	30									16 71 (13)												
287.6	CLAYEY SAND and SILT - some gravel (Poorly graded sand-clay mixtures) grey (very dense)		11	SS	91									15 40 32 13												
8.7																										
	Continued Next Page																									
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 100 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) 03/10/17 11:00:00 AM</td> <td>DRY</td> <td>-</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) 03/10/17 11:00:00 AM	DRY	-	2)	-	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																								
1) 03/10/17 11:00:00 AM	DRY	-																								
2)	-	-																								
3)	-	-																								
The stratification lines represent approximate boundaries. The transition may be gradual.																										

MEL-GEO P-0014012 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 07/12/18

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. 1**

REFERENCE P-0014012-0-00-100-01-F6 DATUM Geodetic LOCATION N 4928038.8 E 304263.2, Twp. of Oro-Medonte ORIGINATED BY JL
 PROJECT GWP 2197-17-00, Hwy 11, Oro Line 9 Underpass BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT Planmac Engineering Inc. DATE (Started) 03 October 2017 TIME
 DATE (Completed) 03 October 2017 (Completed) CHECKED BY AT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
	Continued from Previous Page															
285.4			12	SS	50/100 mm											
10.9	Auger Refusal End of Borehole															

MEL-GEO P-0014012 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 07/12/18

METRIC**RECORD OF BOREHOLE NO. 2**

REFERENCE P-0014012-0-00-100-01-F6 DATUM Geodetic LOCATION N 4927991.7 E 304295.2, Twp. of Oro-Medonte ORIGINATED BY JL
 PROJECT GWP 2197-17-00, Hwy 11, Oro Line 9 Underpass BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT Planmac Engineering Inc. DATE (Started) 03 October 2017 TIME
 DATE (Completed) 03 October 2017 (Completed) CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			
							20	40	60	80	100	20	40	60					
296.3	Ground Surface																		
0.0	115 mm asphalt 265 mm concrete																		
	EMBANKMENT FILL - sand, some to trace gravel, some to trace silt		1	SS	21														
	brown		2	SS	30														
	(loose/dense)																		
			3	SS	28										10 81 (9)				
			4	SS	22														
			5	SS	11														
			6	SS	9										5 78 (17)				
			7	SS	14														
			8	SS	27														
			9	SS	40														
			10	SS	23														
287.6	CLAYEY SAND and SILT - some gravel																		
8.7	(Poorly graded sand-clay mixtures)		11	SS	16										11 42 34 13				
	grey																		
	(compact)																		
	Continued Next Page																		
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 100 kPa ○ 3% STRAIN AT FAILURE			WATER LEVEL RECORDS Date (dd/mm/yy)/Time 1) 03/10/17 3:50:00 PM 2) 3)						Water Depth (m) DRY - -		Cave In (m) 8.7 - -	
The stratification lines represent approximate boundaries. The transition may be gradual.																			

MEL-GEO P-0014012 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 07/12/18

Englobe Corp.

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

METRIC**RECORD OF BOREHOLE NO. 2**

REFERENCE P-0014012-0-00-100-01-F6 DATUM Geodetic LOCATION N 4927991.7 E 304295.2, Twp. of Oro-Medonte ORIGINATED BY JL
 PROJECT GWP 2197-17-00, Hwy 11, Oro Line 9 Underpass BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT Planmac Engineering Inc. DATE (Started) 03 October 2017 TIME
 DATE (Completed) 03 October 2017 (Completed) CHECKED BY AT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W		
	Continued from Previous Page						20	40	60	80	100					
285.6						286										
10.7	Auger Refusal End of Borehole		12	SS	40/75 mm											

MEL-GEO P-0014012 - BOREHOLE LOGS - F6.GPJ MEL-GEO.GDT 07/12/18

Appendix 3 Borehole Plan and Laboratory Data

Drawing No. 2: Borehole Locations and Soil Stratigraphy

Figure Nos. L-1 to L-3: Grain Size Distribution Curves

Figure No. L-4: Atterberg Limits Summary

Table No. L-5: Lab Test Summary Sheet

Analytical Test Results



KEY PLAN
N.T.S.



Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	296.3	1.5 Lt	4928038.8	304263.2
2	296.3	2.2 Rt	4927991.7	304295.2

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.

Coordinates based on MTM Zone 10 NAD83 CSRS

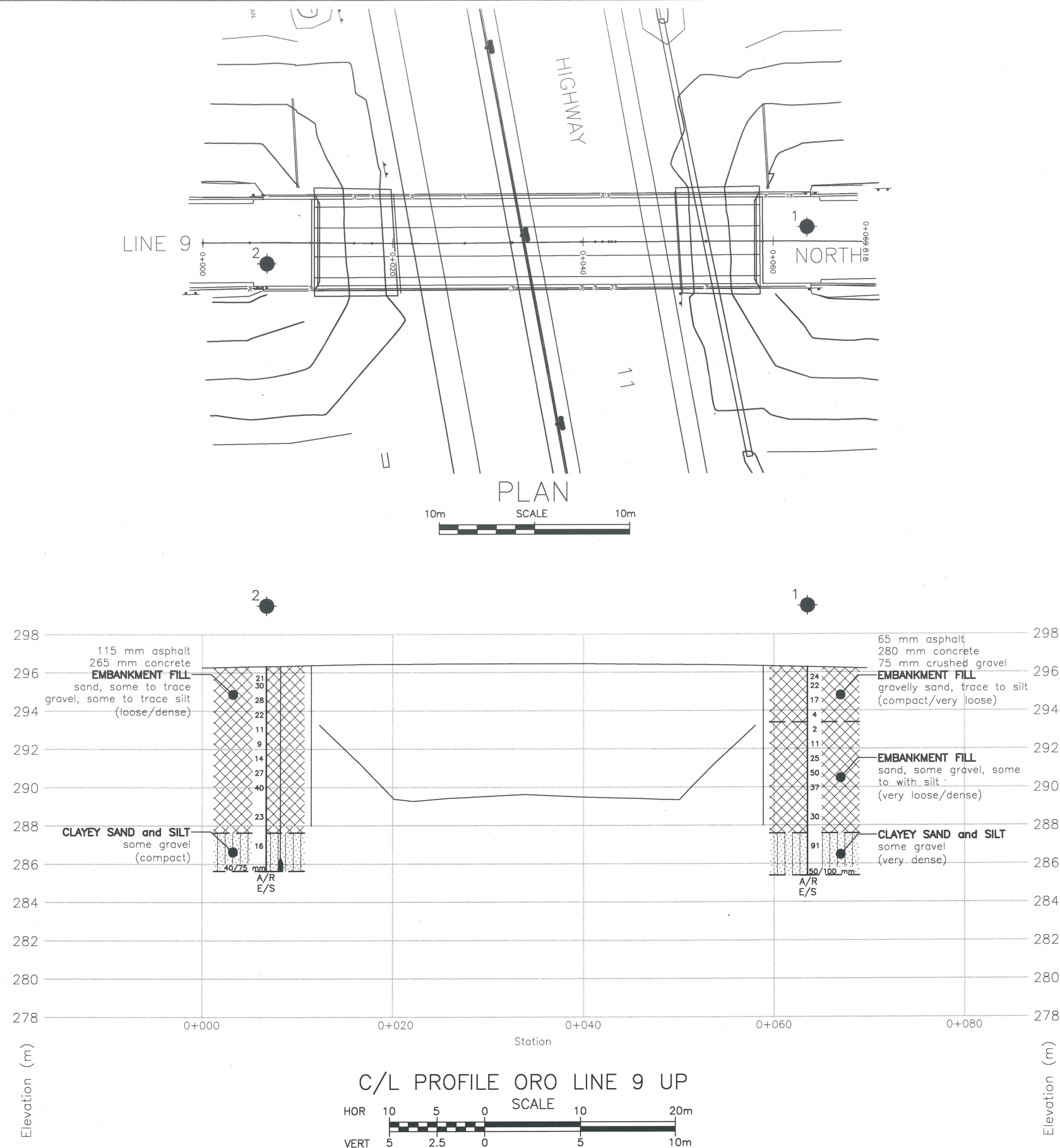
GEOCRES No. 31D-701



2018-12-07

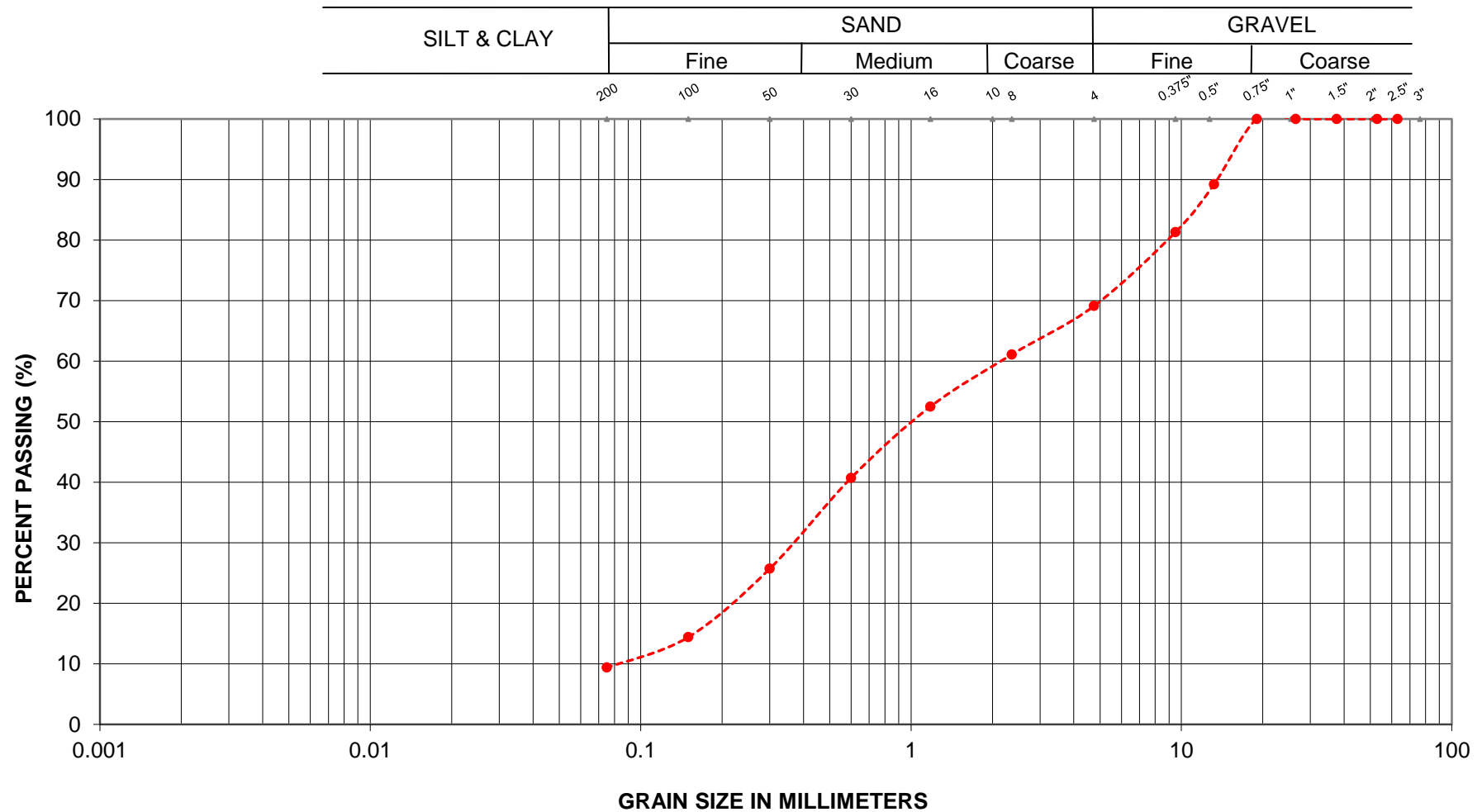


2018-12-07



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	MAR/18		DM	DRAFT				
	DEC/18		DM	FINAL				
DESCRIPTION								
DESIGN	CHK		CODE		LOAD		DATE DEC/18	
DRAWN	DM	CHK	AT	SITE 30-492		STRUCT	SCHFME	DWG 2

GRAIN SIZE ANALYSIS

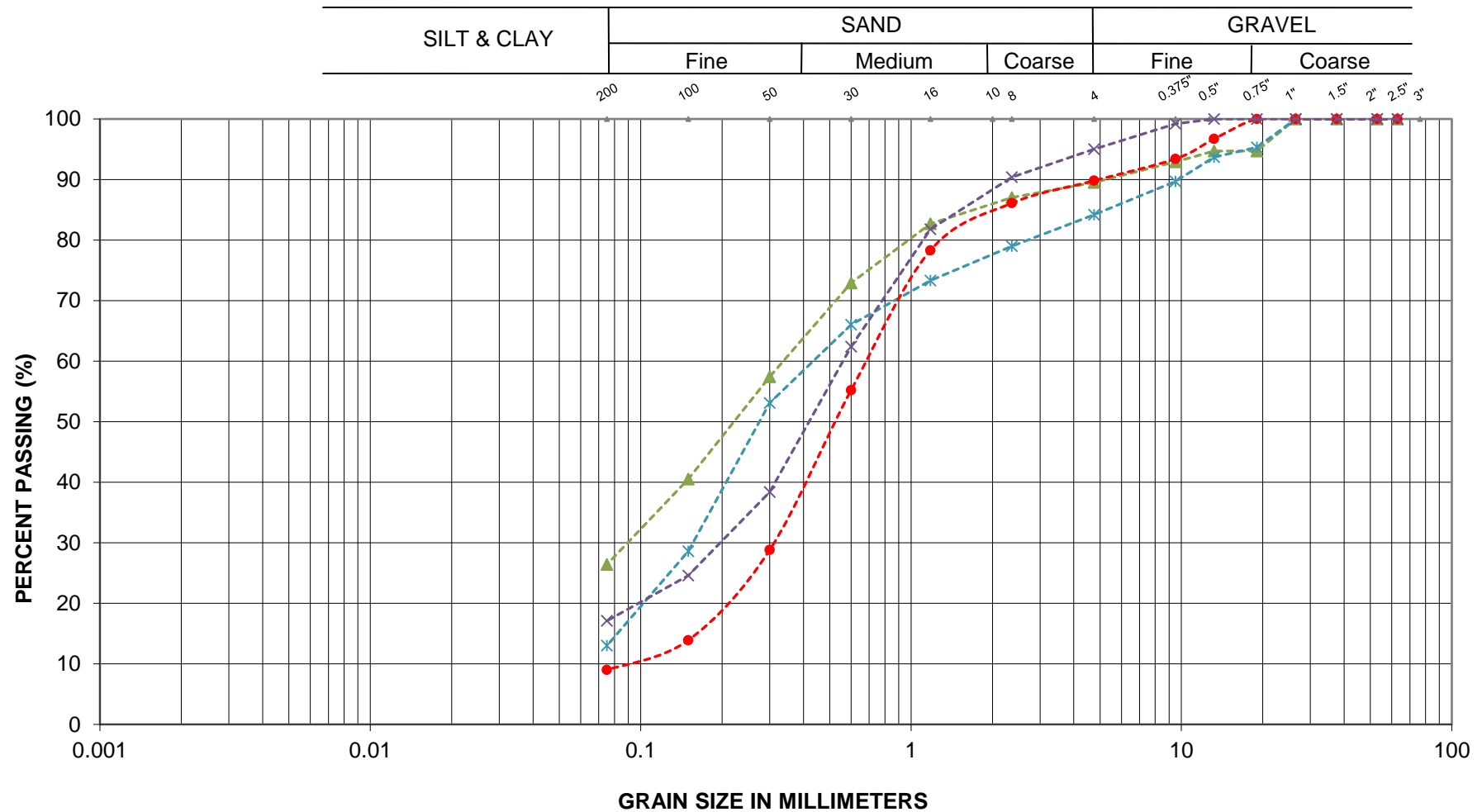
---●--- BH No.: 1 Sa No.: 1 Depth: 0.3 - 0.8 m

EMBANKMENT FILL,
Gravelly Sand

LOCATION: Hwy 11
Oro Line 9 Underpass

Englobe Corp.

FIGURE L-1

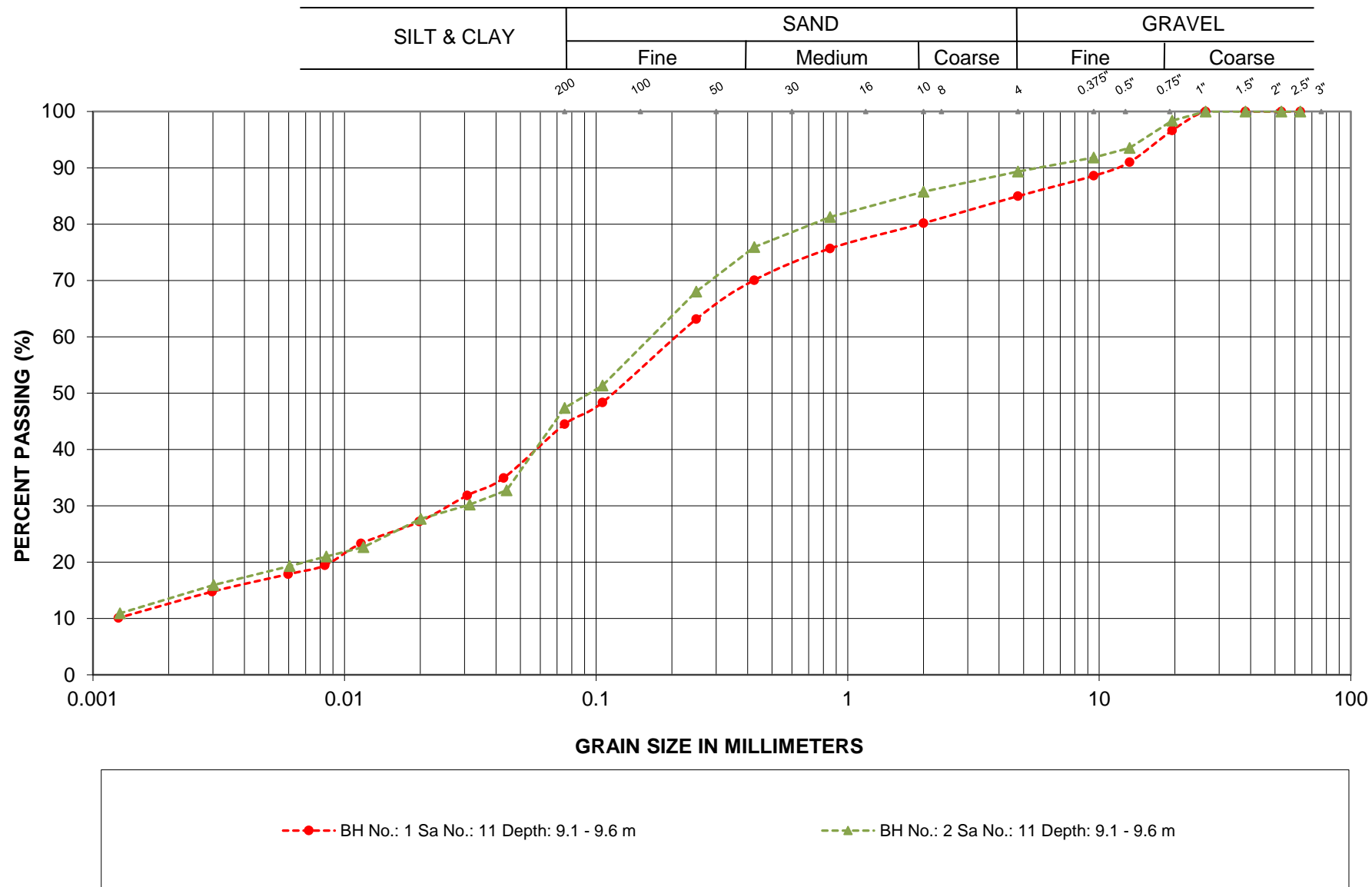
GRAIN SIZE ANALYSIS

EMBANKMENT FILL,
Sand

LOCATION: Hwy 11
Oro Line 9 Underpass

Englobe Corp.

FIGURE L-2

GRAIN SIZE ANALYSIS

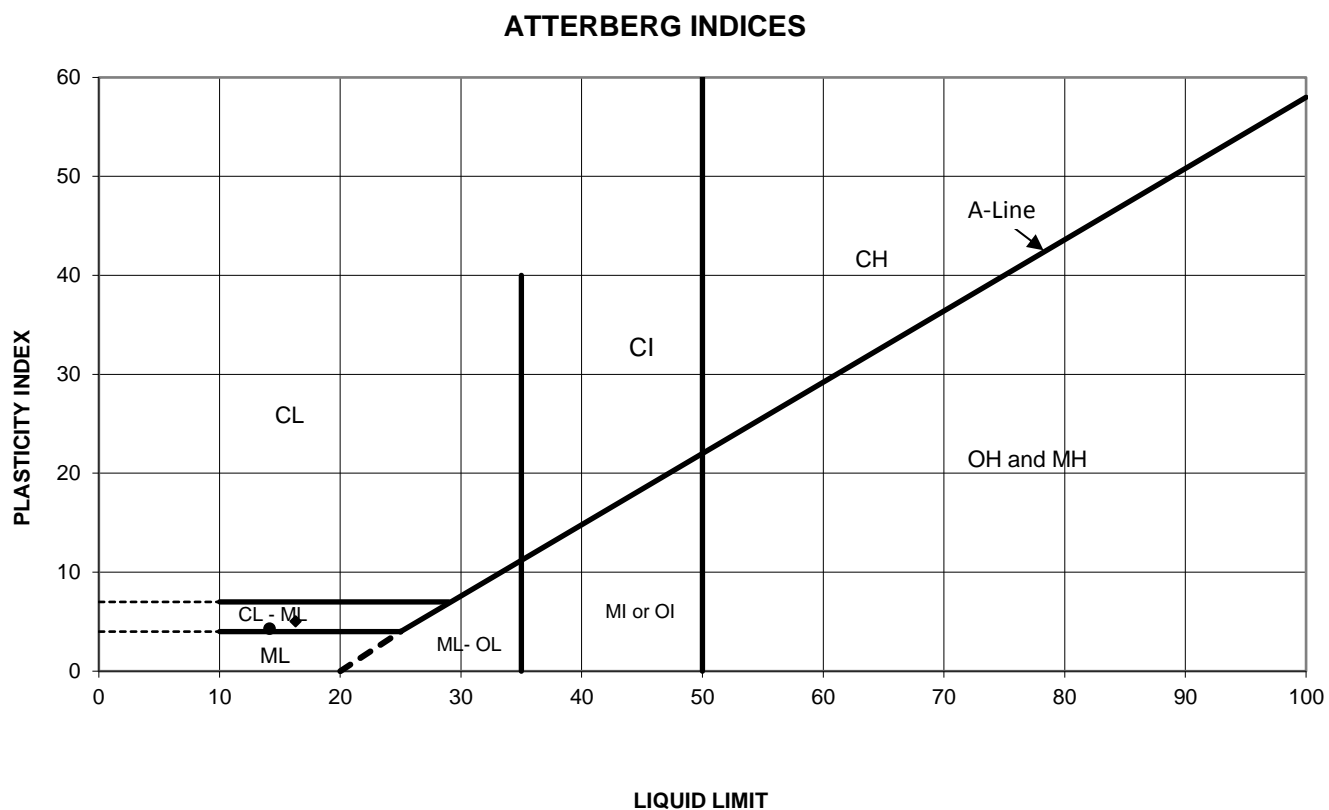
clayey SAND and SILT

LOCATION: Hwy 11
Oro Line 9 Underpass

Englobe Corp.

FIGURE L-3

FIGURE L-4

[illegible]

Date: Nov-17
Project: Hwy 11
Location: Oro Line 9 Underpass

Prep'd: DM
Chkd: AT
Ref. No.: P-0014012-0-00-100-01-F6

Englobe Corp.

Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m ³)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.3	31	60	9		3.2				24			
	2	0.8					2.3				22			
	3	1.5					5.2				17			
	4	2.3					3.5				4			
	5	3.1					9.8				2			
	6	3.8					10.5				11			
	7	4.6	10	64	26		8.4				25			
	8	5.3					4.0				50			
	9	6.1					8.2				37			
	10	7.6	16	71	13		6.1				30			
	11	9.1	15	40	32	13	6.8	14.2	9.9	4.3	91			
	12	10.7					5.4				50/100 mm			
2	1	0.5					5.6				21			
	2	0.8					6.4				30			
	3	1.5	10	81	9		4.3				28			
	4	2.3					3.3				22			
	5	3.1					7.9				11			
	6	3.8	5	78	17		6.4				9			
	7	4.6					6.1				14			
	8	5.3					5.3				27			
	9	6.1					5.9				40			
	10	7.6					10.0				23			
	11	9.1	11	42	34	13	9.8	16.3	11.3	5.0	16			
	12	10.6					7.5				40/75 mm			

CLIENT NAME: ENGLOBE CORP
120 PROGRESS CRT.
NORTH BAY , ON P1A0C2
(705) 476-2550

ATTENTION TO: Victoria Steuernol

PROJECT: P-0014012-0-00-100-01

AGAT WORK ORDER: 17T286462

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Nov 30, 2017

PAGES (INCLUDING COVER): 6

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 17T286462

PROJECT: P-0014012-0-00-100-01

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: ENGLOBE CORP

SAMPLING SITE:

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2017-11-21

DATE REPORTED: 2017-11-30

		SAMPLE DESCRIPTION:		F1-BH1-Sa2	F2-BH2-Sa2	F3-BH1-Sa3	F4-BH2-Sa2	F5-BH2-Sa3	F6-BH1-Sa2	F7-BH1-Sa8	F8-BH1-Sa3
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:									
Parameter	Unit	G / S	RDL	8924749	8924752	8924753	8924754	8924755	8924756	8924757	8924758
Sulfide (S2-)	%		0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.08
Chloride (2:1)	µg/g		2	8	55	190	17	25	12	5	345
Sulphate (2:1)	µg/g		2	4	21	21	7	4	10	7	44
pH (2:1)	pH Units		NA	9.81	9.06	9.80	9.14	8.87	8.91	9.05	9.44
Electrical Conductivity (2:1)	mS/cm		0.005	0.218	0.263	0.557	0.137	0.118	0.104	0.066	0.710
Resistivity (2:1)	ohm.cm		1	4590	3800	1800	7300	8470	9620	15200	1410
Redox Potential (2:1)	mV		5	143	156	118	148	156	158	151	127
		SAMPLE DESCRIPTION:		F9-BH1-Sa2		F10-BH1-Sa5		F11-BH1-Sa3		F12-BH1-Sa4	
		SAMPLE TYPE:		Soil		Soil		Soil		Soil	
		DATE SAMPLED:									
Parameter	Unit	G / S	RDL	8924759	RDL	8924760	RDL	8924761	8924762		
Sulfide (S2-)	%		0.05	<0.05	0.05	0.09	0.05	<0.05	<0.05		
Chloride (2:1)	µg/g		2	166	4	1210	2	175	334		
Sulphate (2:1)	µg/g		2	14	4	19	2	66	30		
pH (2:1)	pH Units		NA	9.62	NA	8.95	NA	9.22	9.33		
Electrical Conductivity (2:1)	mS/cm		0.005	0.435	0.005	1.79	0.005	0.622	0.773		
Resistivity (2:1)	ohm.cm		1	2300	1	559	1	1610	1290		
Redox Potential (2:1)	mV		5	121	5	138	5	123	117		

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8924749-8924759 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

Sampling dates were not mentioned on COC.

8924760 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

Sampling date was not mentioned on COC.

Elevated RDL indicates the degree of sample dilution prior to the analysis for Anions in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

8924761-8924762 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

Sampling dates were not mentioned on COC.

Certified By:

Amanjot Bhela



Quality Assurance

CLIENT NAME: ENGLOBE CORP

PROJECT: P-0014012-0-00-100-01

SAMPLING SITE:

AGAT WORK ORDER: 17T286462

ATTENTION TO: Victoria Steuernal

SAMPLED BY:

Soil Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper

Corrosivity Package

Sulfide (S2-)	8924749	8924749	< 0.05	< 0.05	NA	< 0.05	98%	80%	120%						
Chloride (2:1)	8924749	8924749	8	8	NA	< 2	108%	80%	120%	106%	80%	120%	104%	70%	130%
Sulphate (2:1)	8924749	8924749	4	4	NA	< 2	95%	80%	120%	99%	80%	120%	103%	70%	130%
pH (2:1)	8924749	8924749	9.81	9.79	0.2%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8924749	8924749	0.218	0.209	4.2%	< 0.005	98%	90%	110%	NA			NA		
Redox Potential (2:1)	8924749	8924749	143	143	0.0%	< 5	104%	70%	130%	NA			NA		

Corrosivity Package

Sulfide (S2-)	8924753	8924753	< 0.05	< 0.05	NA	< 0.05	99%	80%	120%						
---------------	---------	---------	--------	--------	----	--------	-----	-----	------	--	--	--	--	--	--

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

Amanjot Bhela



Method Summary

CLIENT NAME: ENGLOBE CORP

PROJECT: P-0014012-0-00-100-01

SAMPLING SITE:

AGAT WORK ORDER: 17T286462

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S ²⁻)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

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AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
web@earth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Englobe Corp
Contact: Victoria Steuermol
Address: 2-120 Progress Court
North Bay, Ontario
Phone: 705 476 2550 Fax: 705 476 8882
Reports to be sent to:
1. Email: alexander.tepylo@englobecorp.com
2. Email: victoria.steuernol@englobecorp.com

Project Information:

Project: P-0014012 0-00-100-08
Site Location:
Sampled By:
AGAT Quote #: PO: A12736

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04 ☐ Sewer Use ☐ Regulation 558
☐ Table Indicate One ☐ Sanitary ☐ CCME
☐ Ind/Com ☐ Storm ☐ Prov. Water Quality Objectives (PWQO)
☐ Res/Park ☐ Agriculture ☐ Other
Soil Texture (Check One) Region Indicate One
☐ Coarse ☐ MISA
☐ Fine

Is this submission for a Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☒ Yes ☐ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Field Filtered - Metals, Hg, CrVI

0. Reg 153

Metals and Inorganics
☐ All Metals ☒ 153 Metals (excl. Hydrides)
☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl ☐ CN
☐ Cr+ ☐ EC ☐ FOC ☐ Hg
☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃+NO₂

Volatiles: ☐ VOC ☐ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs

Sewer Use

Corrosivity Package

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Metals and Inorganics	ORPs	Full Metals Scan	Regulation/Custom Metals	Nutrients	Volatiles	PHCs F1 - F4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use	Corrosivity Package
F1-BH1-Sa2			1	S	Corrosivity Package Test for all:															<input checked="" type="checkbox"/>
F2-BH2-Sa2			1	S	pH, water soluble sulphate,															<input checked="" type="checkbox"/>
F3-BH1-Sa3			1	S	sulphide, chloride, resistivity and															<input checked="" type="checkbox"/>
F4-BH2-Sa2			1	S	electrical conductivity															<input checked="" type="checkbox"/>
F5-BH2-Sa3			1	S																<input checked="" type="checkbox"/>
F6-BH1-Sa2			1	S																<input checked="" type="checkbox"/>
F7-BH1-Sa8			1	S																<input checked="" type="checkbox"/>
F8-BH1-Sa3			1	S																<input checked="" type="checkbox"/>
F9-BH1-Sa2			1	S																<input checked="" type="checkbox"/>
F10-BH1-Sa5			1	S																<input checked="" type="checkbox"/>
F11-BH1-Sa3			1	S																<input checked="" type="checkbox"/>

Samples Relinquished By (Print Name and Sign):

Sonia Clelland

Date

Nov 20/17

Time

7:00

Samples Received By (Print Name and Sign):

Pochei Patel

Date

21/11/17

Time

8:33

Samples Relinquished By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Page 1 of 2

N#:

Appendix 4 Photo Essay

Enclosure No. 4:

Photo Essay

Existing Bridge – Looking South

Photo: 1



Existing Bridge – Looking North

Photo: 2



Project: GWP 2197-17-00 - Hwy 11 – Oro Line 9 Underpass

Photos Provided By: Englobe

Date: October 2017