



Englobe

Soils Materials Environment

**Submitted To AECOM Canada Ltd.
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2
On Behalf of the Ontario Ministry of Transportation**

**Culvert Replacement
Highway 60
Station 18+478 - Twp. of Chaffey
GWP 5333-11-00**

FINAL FOUNDATION INVESTIGATION REPORT

Date: December 7, 2017
Ref. Nº: P-0014193-0-00-100-03-F8

Geocres No. 31E-384



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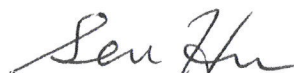
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Final Foundation Investigation Report

Prepared by:


Alexander Tepylo, P. Eng.
Englobe – Project Engineer

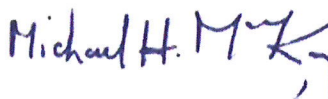




Sen Hu, P. Eng.
Englobe – Senior Geotechnical Engineer
MTO Alternate Designated Contact



Reviewed by:


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

2017-12-07

2-120 Progress Court, North Bay (Ontario) Canada P1A 0C2 - T 705.476.2550 | F 705.476.8882 - WWW.ENGLOBECORP.COM -
NORTHBAY@ENGLOBECORP.COM

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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:

AECOM Canada Ltd.

189 Wyld Street, Suite 103

North Bay, Ontario

P1B 1Z2

Attention: **Mr. Jason Wright, P.Eng**

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1 INTRODUCTION

Englobe Corp. (Englobe) has been retained by AECOM Canada Ltd. (AECOM), on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at an existing centreline culvert site (Latitude/Longitude: 45.358778, -79.139832). The site is located at Station 18+478 in the Township of Chaffey on Highway 60, some 2.8 km west of Two River Lake Road (see Drawing No. 1, Appendix 1).

The foundation investigation for the culvert at this location was requested by email from AECOM dated March 27, 2017, to be carried out in addition to the MTO Terms of Reference for work outlined in Englobe's Proposal Reference No. 2017-P152-053, dated March 30, 2017, under Agreement No. 5013-E-0032: GWP 5333-13-00. The purpose of this investigation was to determine the subsurface conditions to provide baseline information at the culvert site for the Design and Build Contract. 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 1000 mm diameter Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 18+478 in the Township of Chaffey, Ontario. The topography in the area of this site is generally rolling. The existing highway embankment currently supports two undivided lanes of highway, locally running in a south-north direction. The existing highway, at the culvert location, is constructed on an embankment fill containing sand with rock fragments of cobble and boulder sizes, approximately 5.7 m in height above the culvert invert, with centreline Elevation 326.0 m at the culvert location. The existing embankment slopes in the area of the culvert have been generally established at an angle of approximately 2.2H:1V. The culvert at this location is a 1000 mm diameter Corrugated Steel Pipe (CSP) culvert, some 34 m in length. Flow through the culvert is from the east to the west (right to left) (See Enclosure No.5, Appendix 4). A review of the condition of the pavement surface at the culvert location revealed some asphalt cracking; however, in general, the embankment appears to have performed satisfactorily.

Infrastructure at the culvert location consists of overhead wires to the right (north) side of the highway embankment.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The topography on this section of Highway 60 is generally rolling. Layers of earth overlay bedrock. Organic materials were also observed in the region. The conditions at the culvert ends are generally wet and marshy. Within the project area, the 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 October 16th to 18th, 2017, during which time three (3) sampled boreholes were advanced. One (1) borehole was advanced through the embankment and one (1) borehole was advanced adjacent to both the inlet (east) and outlet (west) ends of the culvert, respectively.

The field investigation was carried out using a truck and bombardier mounted CME drilling rig, respectively, 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 drilling was continuously advanced through obstacles and/or cored into bedrock using the wash boring technique and associated diamond drilling, using NQ size coring equipment. 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.

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 2 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 through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface.

The fieldwork for this investigation was under the full time direction of a senior member of the Englobe engineering staff (Jame Lavigne), who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to 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 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-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 (Enclosure Nos. 2 to 4, 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 18+478, TWP. OF CHAFFEY

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, three (3) sampled boreholes were put down at this site, with Borehole No. 1 advanced through the embankment, Borehole No. 2 advanced adjacent to the culvert inlet, and Borehole No. 3 advanced adjacent to the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 were recorded at Elevations 325.9, 321.2, and 321.1 m, respectively.

4.1.1 Pavement Structure

Borehole No. 1 was advanced through the embankment where a pavement structure consisting of 100 mm of asphalt was penetrated, underlain by a base layer of crushed gravel, some 50 mm thick.

4.1.2 Embankment Fill

Underlying the pavement structure at Borehole No. 1, the embankment was found to consist of granular fill consisting of brown sand with gravel to gravelly, trace to some silt. Cobble/boulder size rock pieces were encountered in this fill layer between depths of 0.6 and 2.9 m (Elevations between 328.9 and 323.0 m). Photographs taken along the slopes illustrate the presence of large rock pieces in the embankment (see Enclosure No. 5, Appendix 4). The natural moisture content measured on samples retrieved from this layer was generally in the order of 4 to 16%. Gradation analyses (not including cobble/boulder sizes) were carried out on three (3) samples of this deposit and the testing results indicated 23 to 36% gravel size particles, 52 to 66% sand

size particles, and 10 to 17% silt and clay size particles (Figure No. L-1, Appendix 3). According to results of gradation testing and the criteria for Frost-susceptibility and Erodibility of soils stated in MTO *Pavement Design and Rehabilitation Manual* (2013), the embankment fill is classified as low frost-susceptibility and is non-erodible. Based on SPT 'N' values of 20 to 27 blows per 300 mm penetration (not including N values influenced by rock inclusions), the relative density/compactness of this layer was described as compact. This embankment fill was encountered to a depth of 5.2 m below grade at Borehole No. 1 (Elevation 320.7 m).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
1	325.75	320.7	5.05

4.1.3 Surficial Organic Soils

At ground surface at Borehole Nos. 2 and 3, a layer of organic soils some 150 mm thick was penetrated.

4.1.4 Fill

Underlying the surficial organic soils at Borehole No. 2, a layer of fill described as sand trace gravel trace silt was penetrated. The natural moisture content measured on a sample of this deposit was in the order of 39%. The elevated moisture content is likely due to trace organics in the sample. Based on SPT 'N' values of 0 (sampler advanced solely by the static weight of hammer and rods) blows per 300 mm penetration, the compactness of this layer was described as very loose. This sand fill layer was encountered to a depth of 0.6 m below grade at Borehole No. 2 (Elevation 320.6 m).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
2	321.05	320.6	0.45

4.1.5 Organic Soils

Underlying the fill at Borehole No. 2, a layer of organic soils described as black fibrous peat was penetrated. The natural moisture content measured on samples of this deposit was in the order of 72%. The organic soils were encountered to a depth of 1.2 m below grade (Elevation 320.0 m).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
2	320.6	320.0	0.6

4.1.6 Clayey Silt

Underlying the organic soils at Borehole No. 2, a deposit of grey clayey silt, trace gravel, some sand was penetrated. The natural moisture content measured on samples of this deposit was in the order of 21%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit and the testing results indicated 6% gravel size particles, 11% sand size particles, 61% silt size particles, and 22% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on one (1) sample of this deposit and the test results indicated a Liquid Limit of 23% and a Plastic Limit of 18% (see Figure No. L-5, Appendix 3). Based on the results of the Atterberg Limits testing, this deposit was described as clayey silt (CL-ML). Based on an in-situ undrained shear strength of greater than 100 kPa, the consistency of this deposit was described as very stiff. This deposit was encountered to a depth of 2.1 m below grade at Borehole No. 2 (Elevation 319.1 m).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
2	320.0	319.1	0.9

4.1.7 Sand

Underlying the embankment fill at Borehole No. 1 and underlying the clayey silt at Borehole No. 2, a deposit of grey sand with to some gravel, some silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 9 to 38%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 21% gravel size particles, 59% sand size particles, and 20% silt and clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 5 to 25 blows per 300 mm penetration, the compactness of this deposit was described as loose to compact, generally compact on average. This deposit was encountered to depths of 7.1 and 3.9, m below grade at Borehole Nos. 1 and 2, respectively (Elevations 318.8 and 317.3, respectively).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
1	320.7	318.8	1.9
2	319.1	317.3	1.8

4.1.8 Silty Sand

Underlying the sand deposit at Borehole No. 1 and underlying the surficial organic soils at Borehole No. 3, a deposit of grey silty sand some to trace gravel was encountered. The natural moisture content measured on samples of this deposit was in the order of 11 to 29%. Gradation (sieve) analyses were carried out on two (2) samples of this deposit and the testing results indicated 2 to 13% gravel size particles, 55 to 62% sand size particles, and 32 to 36% silt and clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values of 12 blows per 300 mm penetration to 59 blows per 230 mm penetration, the compactness of this deposit was described as compact to very dense, generally very dense as average. This deposit was encountered to depths of 9.6 and 1.2 m below grade at Borehole Nos. 1 and 3, respectively (Elevations 316.3 and 319.9 m, respectively).

BOREHOLE NO.	ELEVATION AT TOP OF LAYER (m)	ELEVATION AT BOTTOM OF LAYER (m)	THICKNESS OF LAYER (m)
1	318.8	316.3	2.5
3	320.95	319.9	1.05

4.1.9 Bedrock

Underlying the silty sand deposit at Borehole Nos. 1 and 3 and underlying the sands at Borehole No. 2, bedrock was proven by diamond core drilling at Elevations 316.3, 317.3, and 316.9 m, respectively. The bedrock was described as grey gneiss. Based on RQD values of 79 to 98%, the bedrock was described as good to excellent quality. Based on visual review, the bedrock was sound, generally exhibiting negligible weathering. Sampling in the bedrock was terminated at depths of 12.7, 7.0, and 4.2 m below grade at Borehole Nos. 1 to 3, respectively (Elevations 313.2, 314.2, and 316.9 m, respectively). It should be noted that, where encountered, the underlying bedrock surfaces in this area can be very erratic in nature, varying substantially in elevation over short horizontal distances.

BOREHOLE NO.	ELEVATION AT TOP OF BEDROCK (m)
1	316.3
2	317.3
3	316.9

4.2 GROUNDWATER DATA

At the time of this investigation, the surface water was measured at Elevations 321.0 and 320.7 m at the culvert inlet and outlet, respectively.



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 piezometer was installed in Borehole Nos. 1 and 2 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The groundwater levels were measured at Elevations 321.0 and 321.2 m at Borehole Nos. 1 and 2, respectively, and appeared to have stabilized in the period of time during which the field work was carried out. The groundwater level was encountered at Elevation 321.7 m at Borehole No. 3 upon completion of sampling at the borehole.

Notwithstanding the above, the groundwater and surface water levels should be expected to fluctuate seasonally/yearly.

Appendix 1 Key Plan

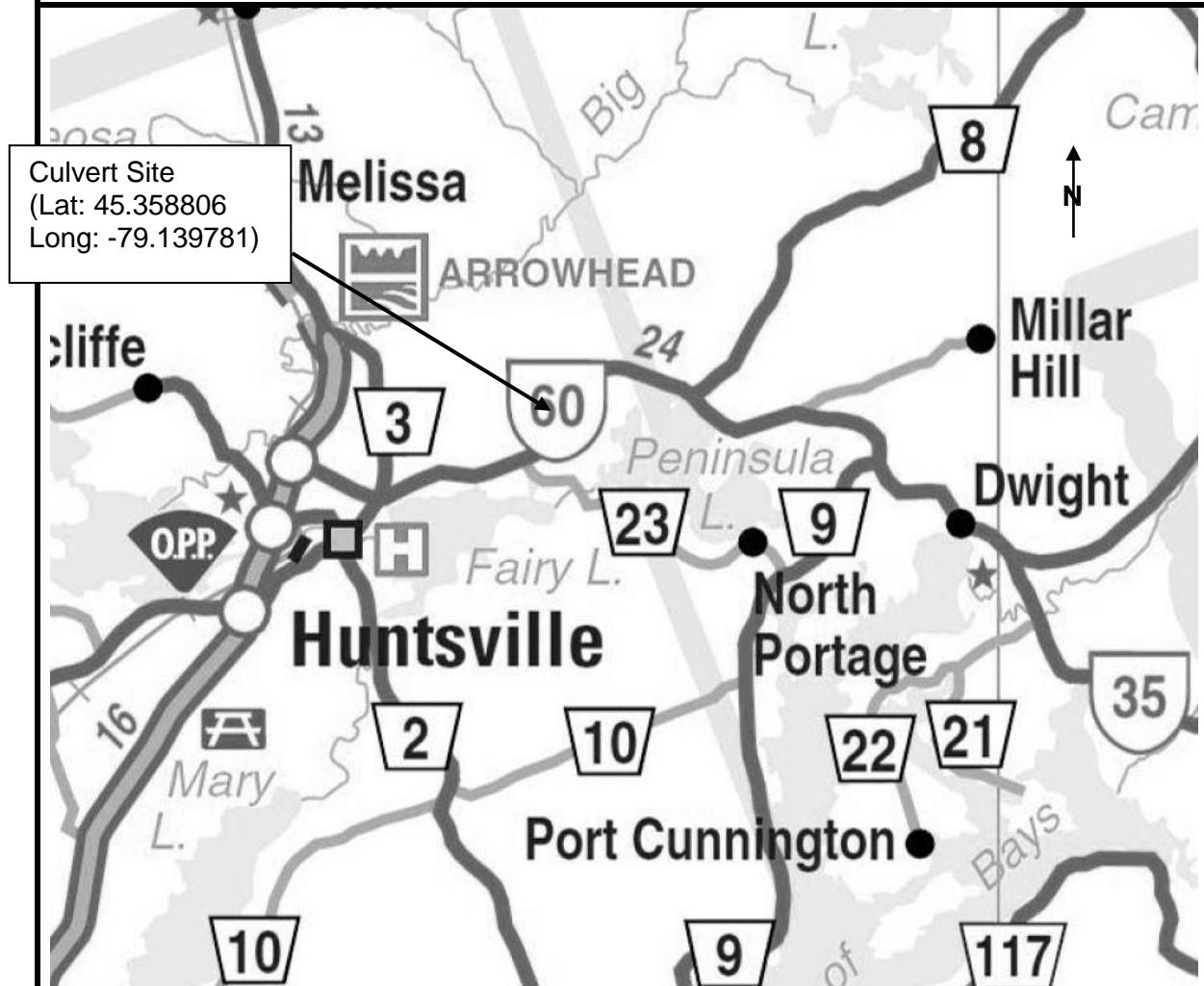
Drawing No. 1

Key Plan

KEY PLAN

Drawing No. 1

NOT TO SCALE



FOUNDATION INVESTIGATION REPORT

GWP 5333-11-00

Highway 60

Culvert 18+478, Twp of Chaffey

Reference No: P-0014193-0-00-100-13-F8

December 2017



Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 4	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-00141930-00-100-03-F8 DATUM Geodetic LOCATION N 5024378.5 E 333025.2 - Twp. of Chaffey, Station 18+477 ORIGINATED BY JL
 PROJECT GWP 5333-11-00, Hwy 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 18 October 2017 TIME
 DATE (Completed) 18 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						
							20 40 60 80 100	20 40 60 80 100	20 40 60					
325.9	Ground Surface													
0.0	100 mm asphalt 50 mm crushed gravel		1	SS	27									24 66 (10)
	EMBANKMENT FILL - sand, with gravel to gravelly, trace to some silt (compact)													
	brown		2	SS	25/75 mm									
	rock fragments of cobble/boulder size encountered at depths between 0.6 and 2.9 m													
	high blow counts due to spoon hitting cobble/boulder size rock auger refusal at depth of 1.8 m, start advancing casing		3	SS	20									36 52 (12)
			4	SS	33/150 mm									
			5	SS	24									
			6	SS	20									
			7	SS	19									23 60 (17)
320.7														
5.2	SAND - some to with gravel, some silt		8	SS	5									
	grey													
	(loose/compact)		9	SS	25									
318.8														
7.1	SILTY SAND - some gravel (very dense)		10	SS	59/230 mm									13 55 (32)
	rock fragment of boulder size encountered at a depth of 8 m													
			11	SS	25/25 mm									
316.3														
9.6	BEDROCK - grey gneiss good to excellent quality Continued Next Page													
COMMENTS							+ 3, X 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 100 kPa		WATER LEVEL RECORDS					
Coordinates based on MTM Zone 10 NAD83 CSRS							Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)			
							1) 18/10/17 4:00:00 PM		4.95		▽		-	
							2)		-		▽		-	
							3)		-		▽		-	
The stratification lines represent approximate boundaries. The transition may be gradual.							○ 3% STRAIN AT FAILURE							

MEL-GEO P-0014193 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 30/11/17

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-00141930-00-100-03-F8 DATUM Geodetic LOCATION N 5024378.5 E 333025.2 - Twp. of Chaffey, Station 18+477 ORIGINATED BY JL
 PROJECT GWP 5333-11-00, Hwy 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 18 October 2017 TIME
 DATE (Completed) 18 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) Continued from Previous Page	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100	W _p	W	W _L
313.2	BEDROCK - grey gneiss good to excellent quality		12	RC	Rec= 100% RQD= 91%												
314			13	RC	Rec= 93% RQD= 79%												
12.7	End of Borehole End of Sampling																

MEL-GEO P-0014193 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 30/11/17

METRIC**RECORD OF BOREHOLE NO. 2**

REFERENCE P-00141930-00-100-03-F8 DATUM Geodetic LOCATION N 5024386.2 E 333042.6 - Twp. of Chaffey, Station 18+489 ORIGINATED BY JL
 PROJECT GWP 5333-11-00, Hwy 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 16 October 2017 TIME
 DATE (Completed) 16 October 2017 (Completed) CHECKED BY AT

SOIL PROFILE		STRATA PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)		NUMBER	TYPE			"N" VALUES	20					
321.2	Ground Surface												
0.0	150 mm organic soils FILL - sand, trace gravel, trace silt		1	SS	WH								
320.6	ORGANIC SOILS - fibrous peat black		2	SS	1								
320.0	CLAYEY SILT - trace gravel, some sand grey (very stiff)		3	SS	25								
319.1	SAND - with gravel, some silt brown (compact)		4	SS	19								
317.3	auger refusal encountered at a depth of 3 m, start advancing casing 200 mm diameter cobble encountered at 3 m depth		5	RC	Rec= 27%								
317.3	BEDROCK - grey gneiss good to excellent quality		6	SS	40/76 mm								
314.2			7	RC	Rec= 100% RQD= 80%								
314.2			8	RC	Rec= 100% RQD= 93%								
7.0	End of Sampling End of Borehole												

COMMENTS		WATER LEVEL RECORDS	
Coordinates based on MTM Zone 10 NAD83 CSRS		Date (dd/mm/yy)/Time	Water Depth (m)
The stratification lines represent approximate boundaries. The transition may be gradual.		1) 16/10/17 5:30:00 PM	0
		2) 16/10/17 5:35:00 PM	0
		3) 18/10/17 9:30:00 AM	0

MEL-GEO P-0014193 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 30/11/17

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. 3**

REFERENCE P-00141930-00-100-03-F8 DATUM Geodetic LOCATION N 5024389.7 E 332995.6 - Twp. of Chaffey, Station 18+480 ORIGINATED BY JL
 PROJECT GWP 5333-11-00, Hwy 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
 CLIENT AECOM DATE (Started) 16 October 2017 TIME
 DATE (Completed) 17 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						
321.1	Ground Surface													
0.0	150 mm organic soils		1	SS	12	 								2 62 (36)
	SILTY SAND - trace gravel													
	grey (compact)													
319.9	high blow counts due to spoon refusal on bedrock		2	SS	34/255 mm									
1.2	Auger Refusal Start Rock Coring													
	BEDROCK - grey gneiss		3	RC	REC= 98% RQD= 86%									
	good to excellent quality													
			4	RC	REC= 98% RQD= 98%									
316.9	End of Sampling End of Borehole													
4.2														

COMMENTS		+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 100 kPa		WATER LEVEL RECORDS	
Coordinates based on MTM Zone 10 NAD83 CSRS		○ 3% STRAIN AT FAILURE		Date (dd/mm/yy)/Time	Water Depth (m)
				1) 17/10/17 3:30:00 PM	0.4
				2)	-
				3)	-
					1.2

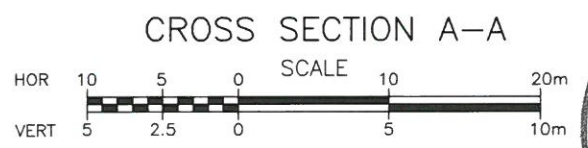
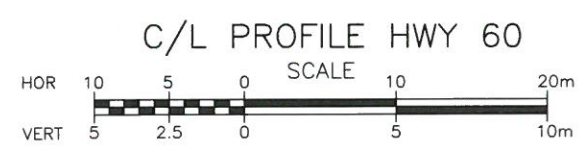
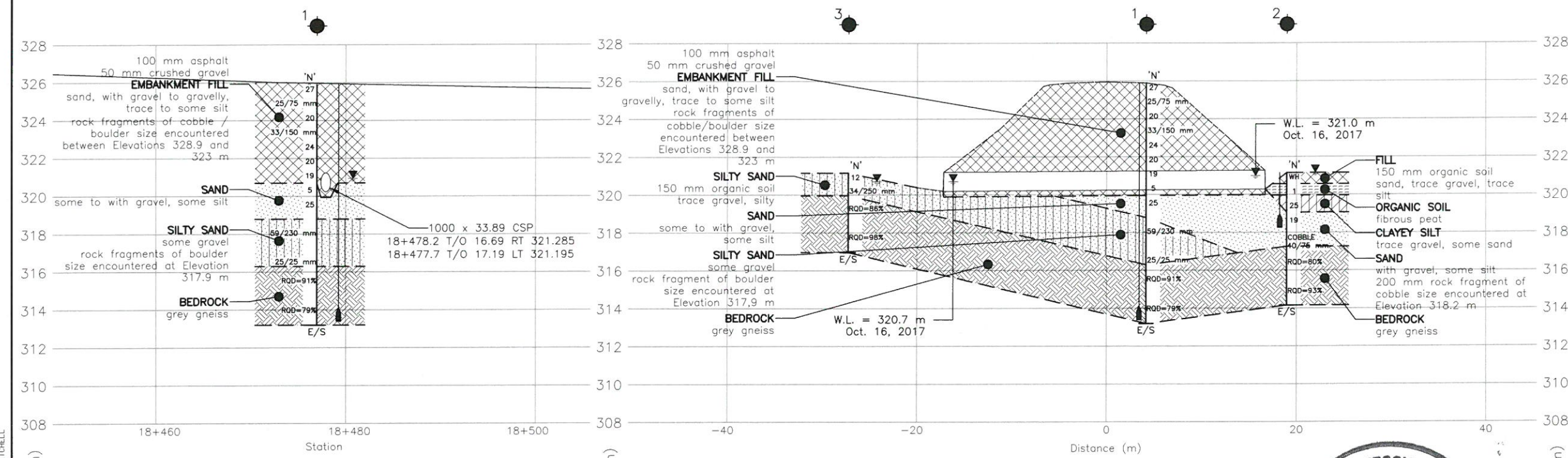
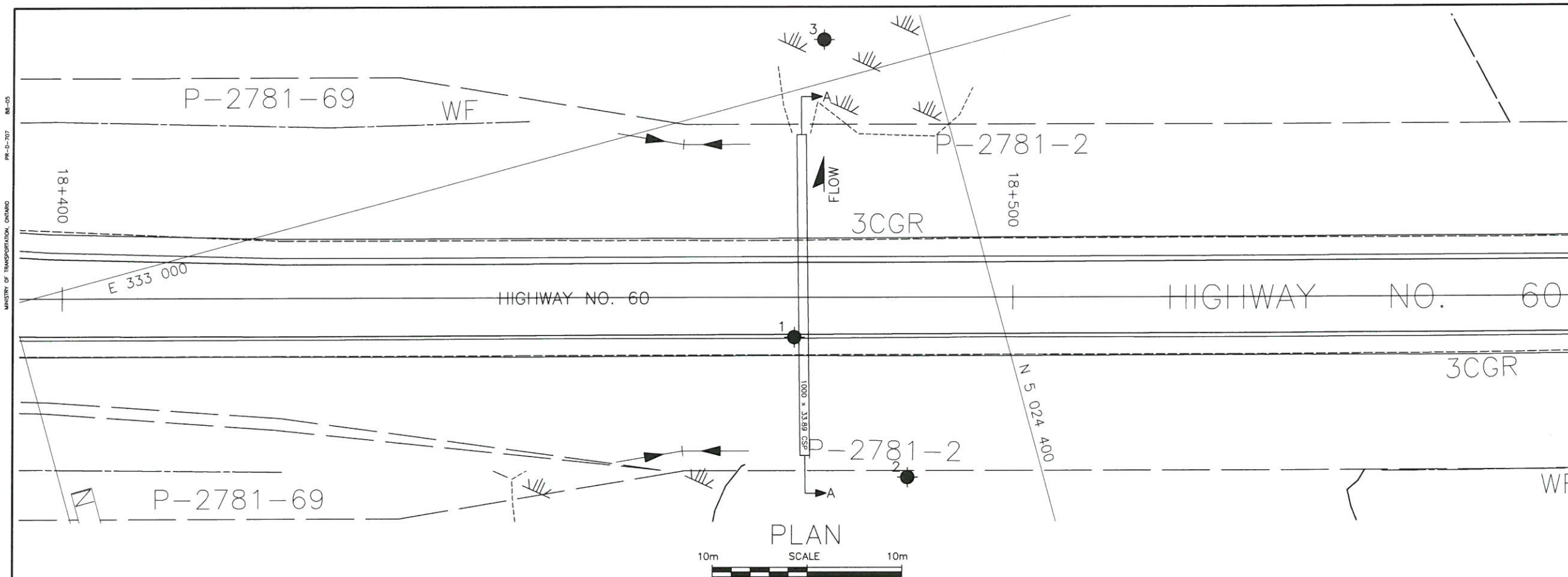
The stratification lines represent approximate boundaries. The transition may be gradual.

MEL-GEO P-0014193 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 30/11/17

Appendix 3 Borehole Plan and Laboratory Data

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

CAD FILE LOCATION AND NAME: I:\2017\12\07\18-480.dwg
MODIFIED: 12/29/2017 4:00:37 PM BY: MITCHELL
DATE PLOTTED: 12/29/2017 4:06:21 PM BY: JUNCAN MITCHELL
CHARGE ORDER: (AECOM) Foundation\4_CAD\VEN-P-0014193-FB - Culvert at Station 18+480.dwg
PAV & FBN, Hwy 60 - 14083 - Change Order



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.

2017-12-07

DISTRICT
CONT. No.
GWP No. 5333-11-00

HWY 60 CULVERT
STA. 18+478, CHAFFEY TWP.

BOREHOLE LOCATIONS
AND SOIL STRATIGRAPHY

DRAWING
2

Borehole

Blows/0.3 m (Std Pen Test, 475 J/blow)

Water Level at Time of Investigation

End of Sampling

Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	325.9	4.2m Rt	5024378.5	333025.2
2	321.2	19.0m Rt	5024386.2	333042.6
3	321.1	27.2m Lt	5024389.7	332995.6

NOTES:

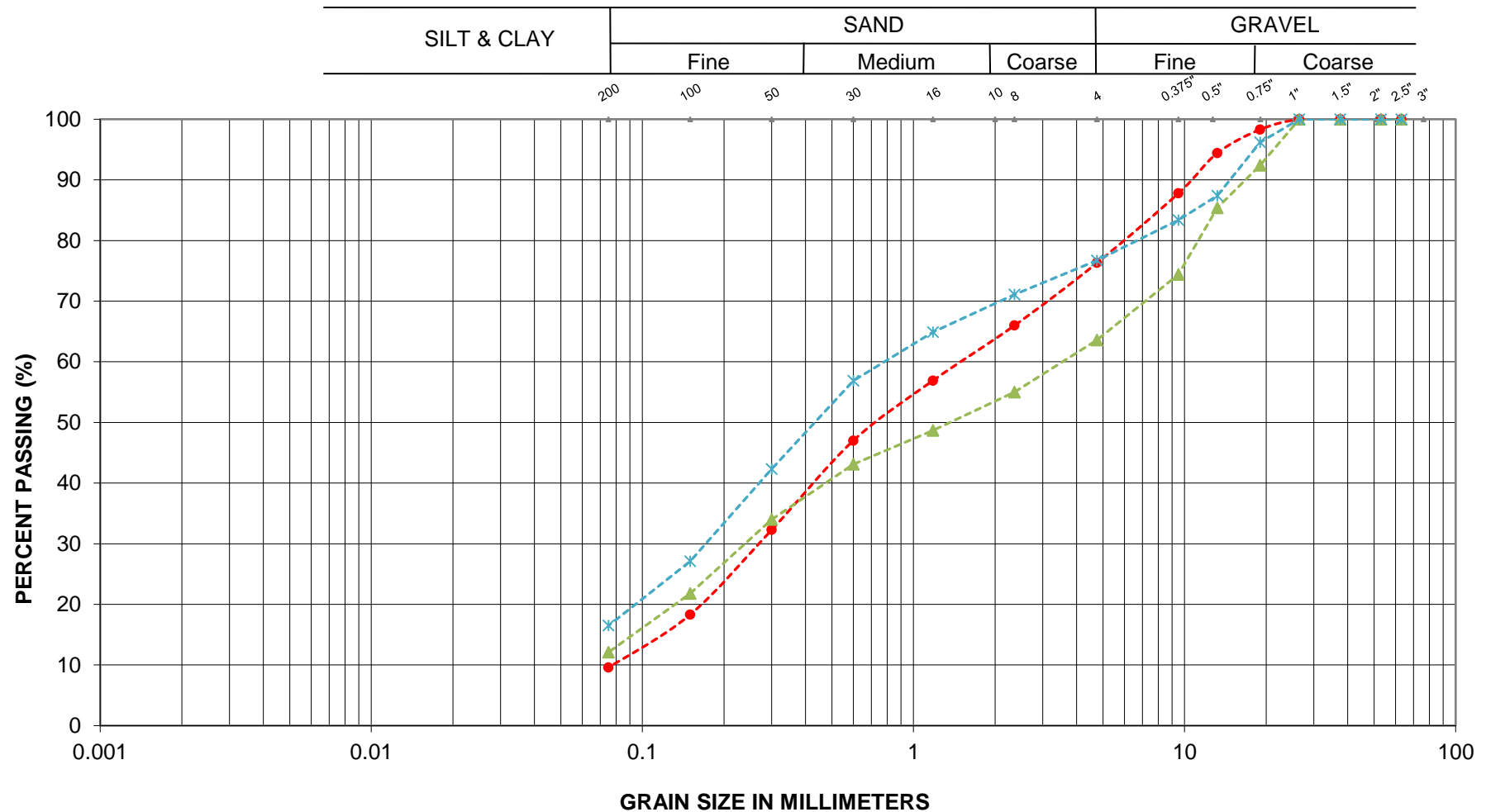
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

Base plan and alignment provided in digital format by AECOM on October 23, 2017

Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCRES No. 31E-384

REVISIONS	NOV/17	DM	DRAFT									
	DEC/17	DM	FINAL									
DESCRIPTION												
DESIGN	AT	CHK	CODE		LOAD				DATE NOV/17			
DRAWN	DM	CHK	SH	SITE	STRUCT	SCHEME		DWG		2		

GRAIN SIZE ANALYSIS

---●--- BH No.: 1 Sa No.: 1 Depth: 0.0 - 0.5 m

---▲--- BH No.: 1 Sa No.: 3 Depth: 1.5 - 2.0 m

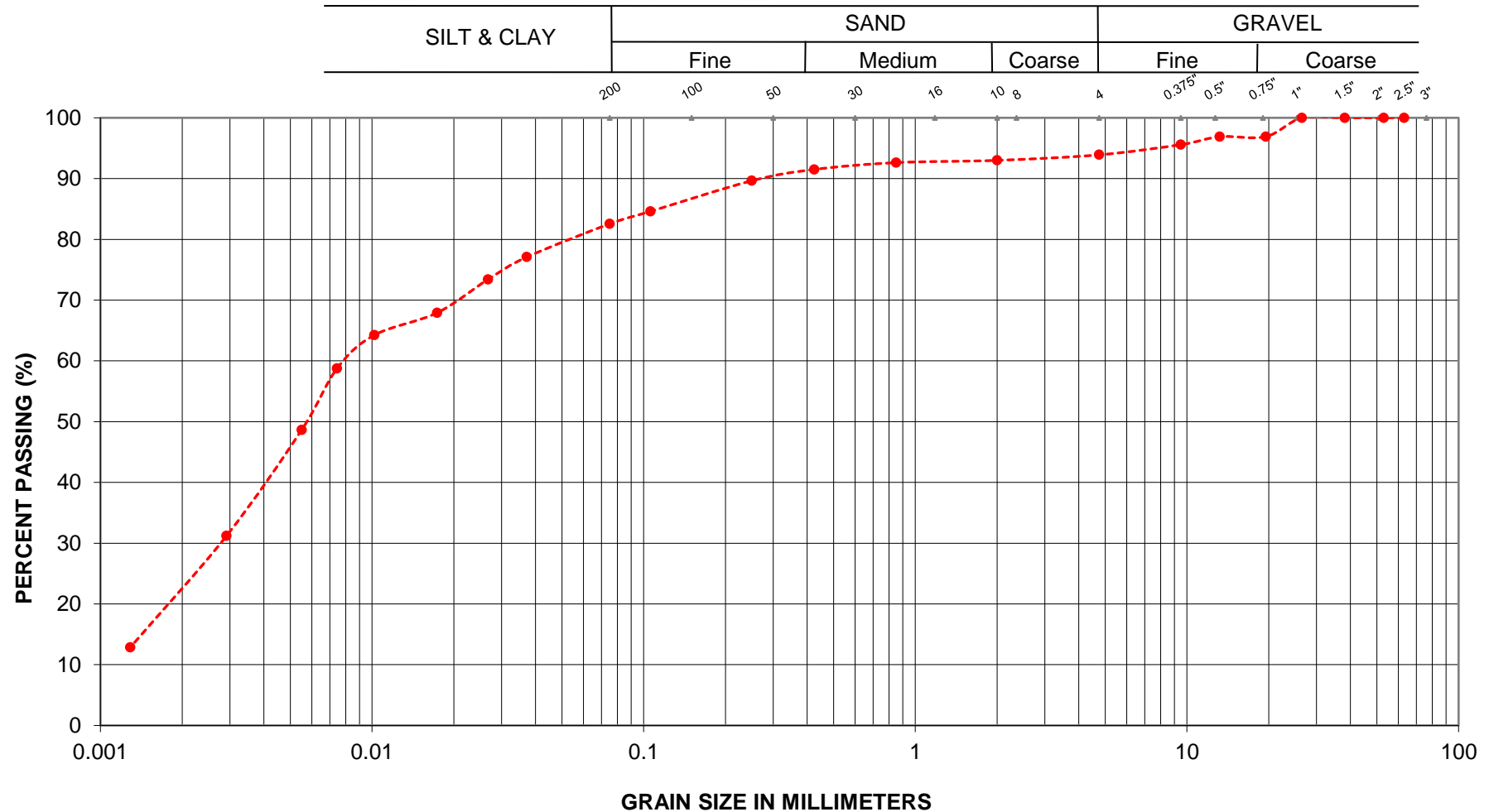
---*--- BH No.: 1 Sa No.: 7 Depth: 4.6 - 5.1 m

EMBANKMENT FILL

LOCATION: Hwy 60, Culvert Station 18+478
TWP of Chaffey

Englobe Corp.

FIGURE L-1

GRAIN SIZE ANALYSIS

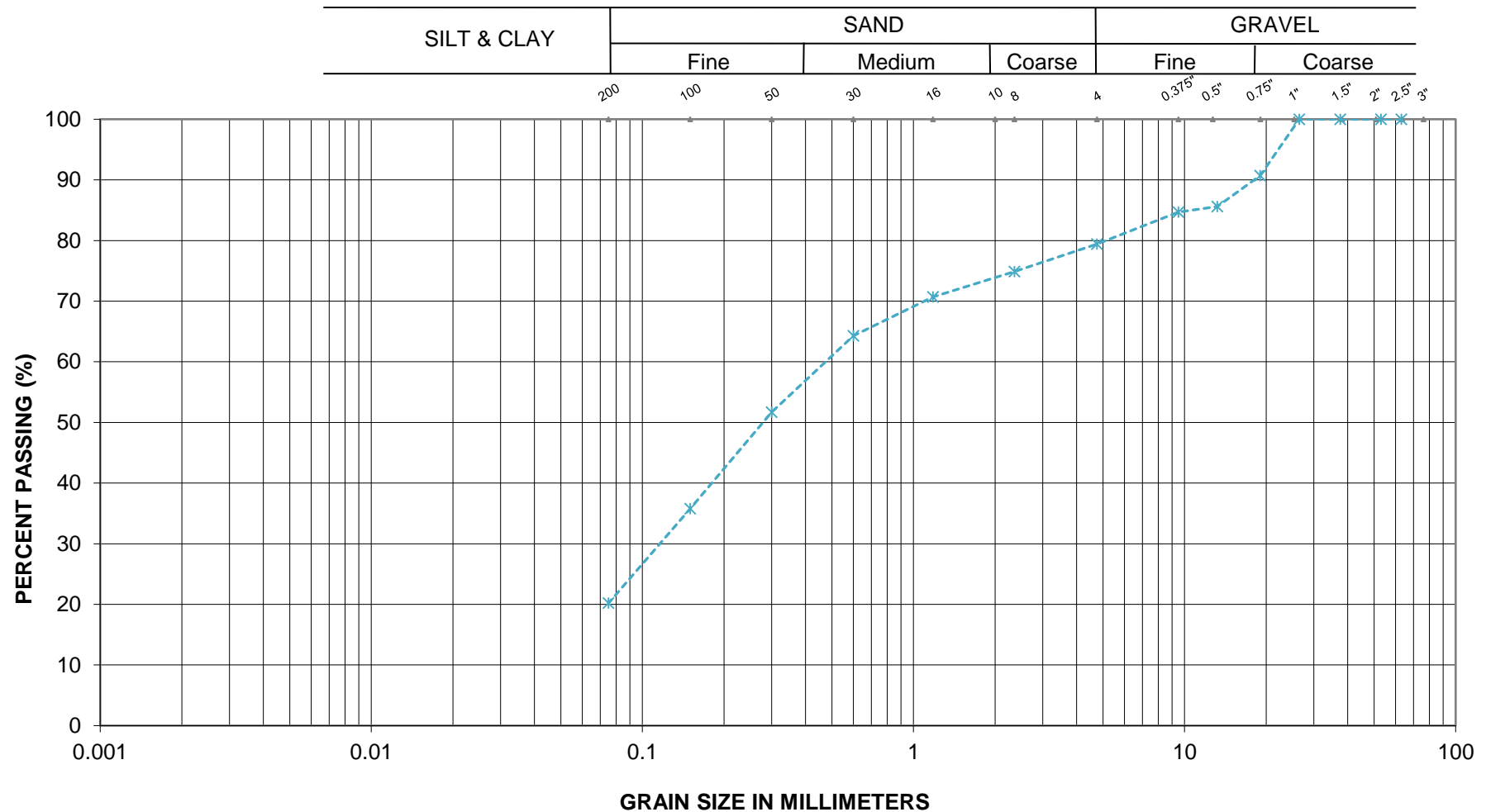
---●--- BH No.: 2 Sa No.: 3 Depth: 1.5 - 2.0 m

CLAYEY SILT

LOCATION: Hwy 60, Culvert Station 18+478
TWP of Chaffey

Englobe Corp.

FIGURE L-2

GRAIN SIZE ANALYSIS

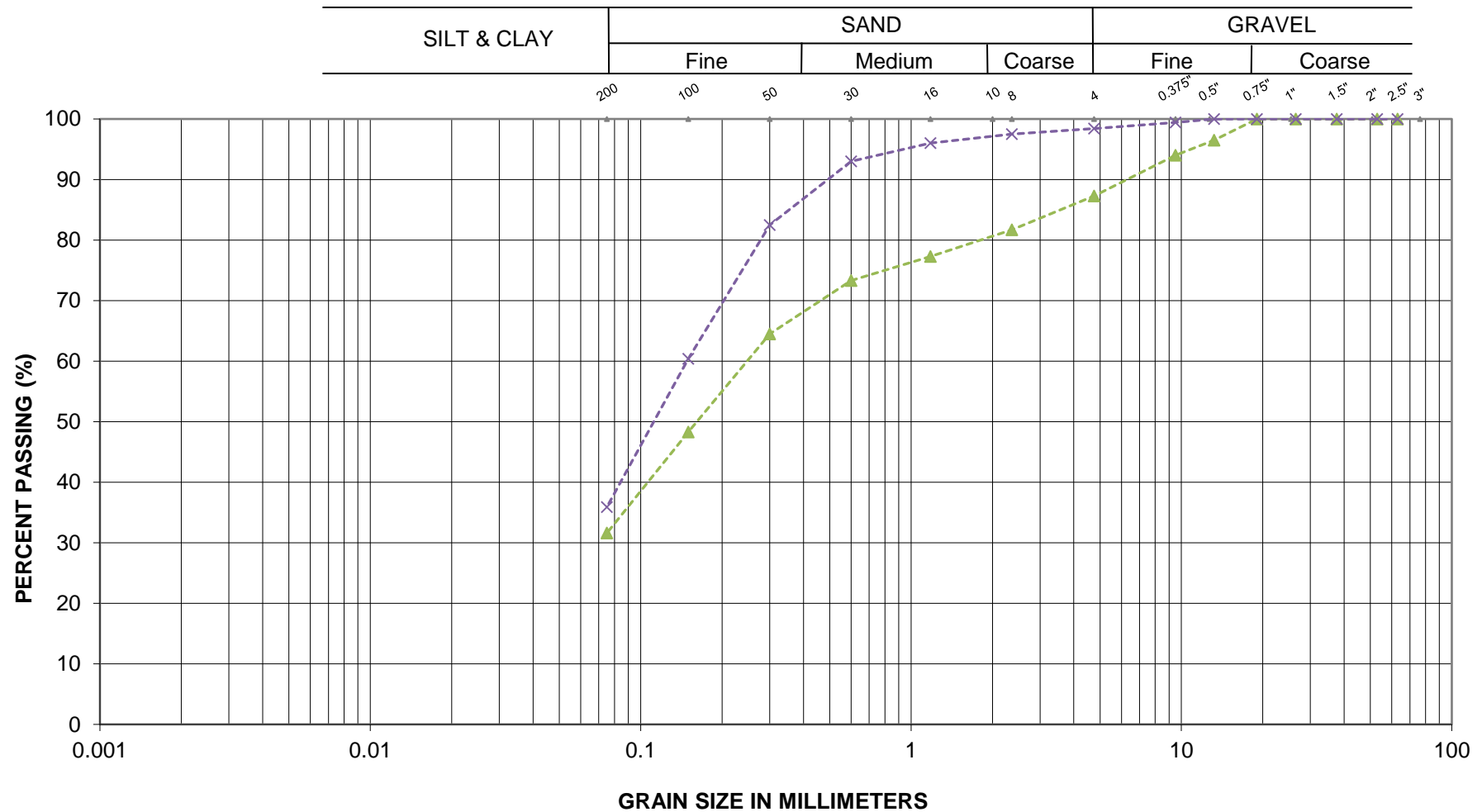
---*--- BH No.: 2 Sa No.: 4 Depth: 2.3 - 2.7 m

SAND

LOCATION: Hwy 60, Culvert Station 18+478
TWP of Chaffey

Englobe Corp.

FIGURE L-3

GRAIN SIZE ANALYSIS

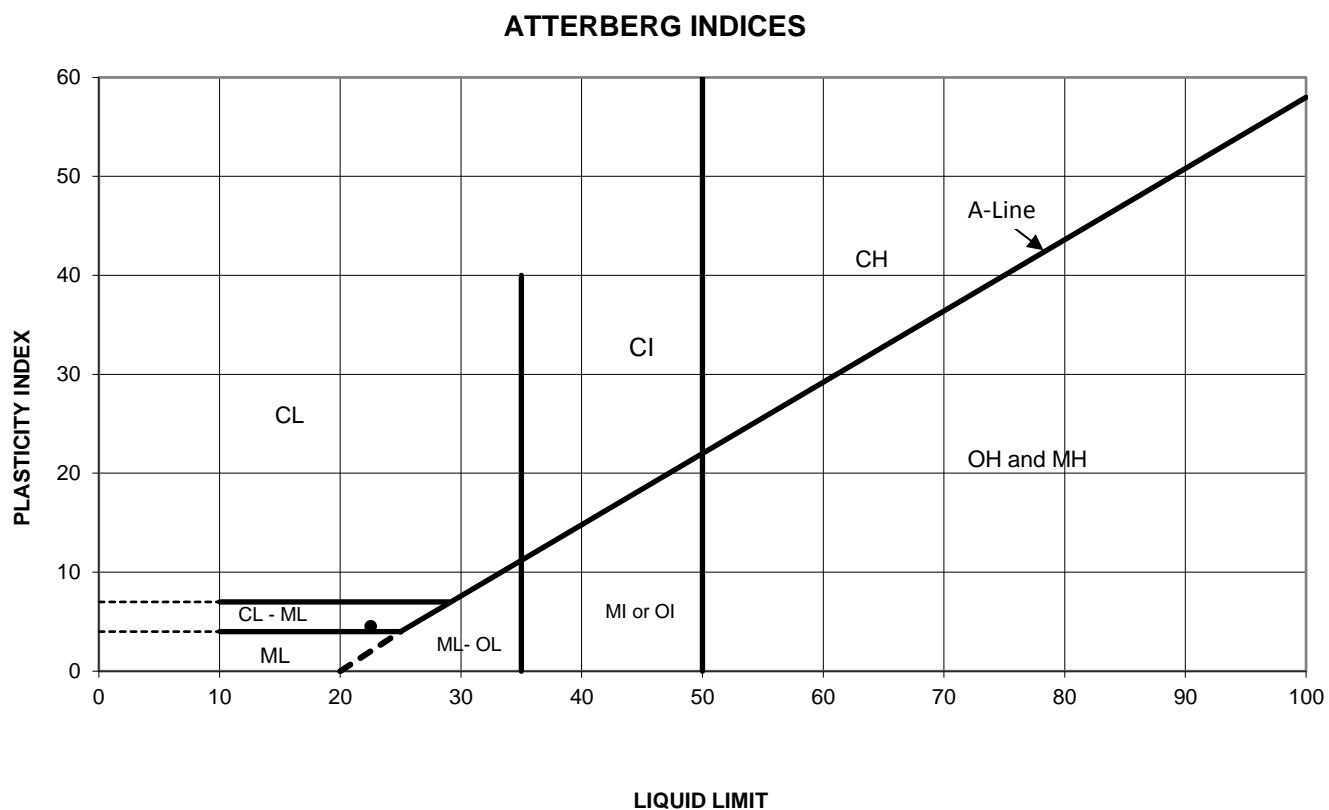
SAND

LOCATION: Hwy 60, Culvert Station 18+478
TWP of Chaffey

Englobe Corp.

FIGURE L-4

FIGURE L-5

[illegible]

Date: Oct-17
Project: Hwy 60
Location: Sta. 18+478, Twp. of Chaffey

Prep'd: DM
Chkd: AT
Ref. No.: P-0014193-0-00-100-03-F8

Englobe Corp.

Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.0	24	66	10		3.9				27			
	2	0.8					3.5				25/75 mm			
	3	1.5	36	52	12		11.0				20			
	4	2.3					9.1				33/150 mm			
	5	3.1					16.3				24			
	6	3.8					15.1				20			
	7	4.6	23	60	17		12.4				19			
	8	5.3					18.2				5			
	9	6.1					38.8				25			
	10	7.6	13	55	32		11.0				59/230 mm			
	11	9.1					12.5				25/25 mm			
	12	9.6												Rec= 100%, RQD= 91%
	13	11.1												Rec= 93%, RQD= 79%
2	1	0.0					39.2				WH			
	2	0.8					71.7				1			
	3	1.5	6	11	61	22	21.2	22.5	18.0	4.5	25			
	4	2.3	21	59	20		11.7				19			
	5	3.1												200 mm diameter cobble
	6	3.8					9.3				40/75 mm			
	7	4.0												Rec= 100%, RQD= 80%
	8	5.51												Rec= 100%, RQD= 93%
3	1	0					29.4				12			
	2	0.76	2	62	36		19.8				34/255 mm			
	3	1.16												Rec= 98%, RQD= 86%
	4	2.6												Rec= 98%, RQD= 98%

Appendix 4 Photo Essay

Enclosure No. 5:

Photo Essay

Embankment at Culvert Location – Looking North

Photo: 1



Culvert Inlet – Looking East

Photo: 2



Project: GWP 5333-11-00 - Hwy 60 – Culvert, Station 18+478, Township of Chaffey

Photos Provided By: Englobe

Date: April 2017

Culvert Outlet – Looking West

Photo: 3



Cobble/Boulder Size Rocks in Embankment, Left Side – Looking North-West

Photo: 4



Project: GWP 5333-11-00 - Hwy 60 – Culvert, Station 18+478, Township of Chaffey

Photos Provided By: Englobe

Date: April 2017

Upstream Conditions – Looking East

Photo: 5



Downstream Conditions – Looking West

Photo: 6



Project: GWP 5333-11-00 - Hwy 60 – Culvert, Station 18+478, Township of Chaffey

Photos Provided By: Englobe

Date: September 2017

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

Photos: 7 and 8



Project: GWP 5333-11-00 - Hwy 60 – Culvert, Station 18+478, Township of Chaffey

Photos Provided By: Englobe

Date: September 2017

Rock Cores – Borehole No. 3 (left)

Photos: 9



Project: GWP 5333-11-00 - Hwy 60 – Culvert, Station 18+478, Township of Chaffey

Photos Provided By: Englobe

Date: September 2017