LVM Merlex

Geotechnical, Materials and Environmental Engineering

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 11+540 – Township of Sinclair
GWP 5333-11-00

FINAL PRELIMNARY FOUNDATION INVESTIGATION REPORT

Date: April 22, 2015
Ref. №: 14/07/14083-F4

Geocres No. 31E-350

Submitted To AECOM Canada Ltd.
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Highway 60
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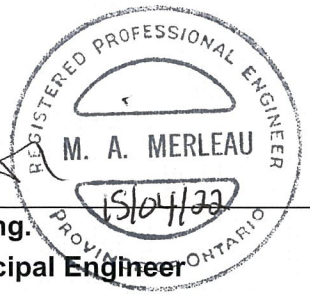
Final Preliminary Foundation Investigation Report

Prepared by:

Sen Hu, P. Eng.
LVM-Merlex – Senior Geotechnical Engineer



Reviewed by:

M.A. Merleau, P. Eng.
LVM-Merlex – Principal Engineer
MTO Designate

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Property and Confidentiality

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

REVISION AND PUBLICATION REGISTER		
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1 hard copy	File

1 INTRODUCTION

LVM-Melex, 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 preliminary foundation investigation at an existing centerline culvert site. The site is located at Station 11+540 in the Township of Sinclair on Highway 60, some 1.3 km east of the intersection between Highway 60 and Harp Lake Road.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5013-E-0032: GWP 5333-11-00 for Design-Build. The terms of reference for the scope of work are outlined in LVM-Merlex's Proposal P-14-051 dated May, 2014. The purpose of this investigation was to determine the subsurface conditions in the area of the existing culvert. LVM-Merlex investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2 SITE DESCRIPTION

The Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 11+540 in the Township of Sinclair. The topography of this site is located in a valley area. The existing highway embankment currently supports two undivided lanes of highway, running in an east-west direction. The existing highway, at the culvert location, is constructed of a granular fill, mixed with rockfill, embankment some 8 m to 10.5 m in height, with centerline elevation of 298.8 m at the culvert location. The existing embankment slopes in the area of the culvert have been built between angles of approximately 1.85H:1V on the south side to 1.6H:1V to 3.6H:1V on the north side. The culvert at this location is a 1520 mm diameter Corrugated Steel Pipe (CSP) culvert, some 53 m in length. The flow through the culvert is from north to south (left to right).

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Muskoka Ridges and Pockets. The topography on this section of Highway 60 is generally rolling. Significant layers of earth overlay the bedrock. Organic materials were also observed. Within the project area native overburden primarily consists of sands overlying the bedrock.

Bedrock in the area consists of the migmatitic rocks and gneisses of undetermined protolith.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period between August 18th and November 7th, 2014 during which time three (3) sampled boreholes were advanced. One (1) borehole was advanced through the embankment at the location of the culvert, and a single borehole was advanced at each of the inlet (east) and outlet (west) ends of the culverts.

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. Soil samples were obtained at the borehole locations at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm. The number of blows per 300 mm penetration was recorded as the "N" value. When cohesive deposits were encountered, the in-situ strength was measured using an "N" size field vane, vane collar, and calibrated torque meter. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following, completion of the individual boreholes. A single 19 mm diameter standpipe was installed in selected open boreholes prior to backfilling to allow for post borehole completion monitoring of the shallow groundwater levels. All open boreholes were backfilled upon completion with compacted auger cuttings in the general order they were removed, and where necessary, bentonite pellet backfill was added to the boreholes to bring them up to grade in accordance with requirements of Ontario Regulation 903. At the borehole through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface.

The fieldwork for this investigation was under the full time direction of a senior member of the LVM-Merlex engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix 2), with a summary of results presented on the laboratory sheets in Appendix 3 (Figures Nos. L-1 to L-3 and Table No. L-4).

The location of the individual boreholes was determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum. The borehole elevations are based on a survey carried out by others.

4 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Records of Borehole Logs (Appendix 2) and on Drawing No. 2 (Appendix 3). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the

results of non-continuous sampling, response to drilling progress, the results of SPT, plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for illustration purposes only.

4.1 CULVERT STATION 11+540, TWP OF SINCLAIR

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 at the culvert inlet, Borehole No. 3 advanced through the embankment, and Borehole No. 2 advanced at the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 inclusive were recorded at elevations 290.7 m, 289.1 m, and 298.8 m, respectively.

4.1.1 Pavement Structure

Borehole No. 3 was advanced through the embankment where a pavement structure consisting of 40 mm asphalt and 270 mm crushed gravel was penetrated. In addition, a separate 50 mm thick layer of asphalt was encountered at depth of 1.8 m below ground surface at the location of Borehole No.3.

4.1.2 Granular Fill

Underlying the pavement structure at Borehole No.3, a layer of fill consisting of brown sand trace to with gravel, trace to some silt, trace clay, and occasional cobble was penetrated. The natural moisture content measured on samples of this deposit was in the order of 3% to 17%. Gradation analyses were carried out on four (4) samples of this deposit, the results of which indicated 1% to 26% gravel size particles, 58% to 77% sand size particles, 12% to 26% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT ‘N’ values of 11 to 35 blows per 30 mm penetration, the compactness of this deposit was described as compact to dense. This deposit was encountered to a depth of 10.2 m below grade at Borehole No. 3 (elevation 288.6 m).

4.1.3 Organic Soils

Below ground surface at Borehole No. 1, a layer of organic silty sand was penetrated. The natural moisture content measured on one (1) sample of this layer was some 49%. This organic soil layer was encountered to an approximate depth of 0.7 m below ground surface at Borehole No. 1 (elevation 290 m).

4.1.4 Sand

Underlying the granular fill at Borehole No.3 and the organic silty sand deposit at Borehole No. 1, a deposit of grey sand some to with gravel, some silt and clay, and occasional cobble was penetrated. The sand deposit was encountered at the ground surface at Borehole No. 2. The

natural moisture content measured on samples of this deposit was in the order of 8% to 32%. Gradation analysis was carried out on three (3) samples of this deposit, the results of which indicated 17% to 30% gravel size particles, 46% to 68% sand size particles, and 15% to 25% silt and clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 3 to 61 blows per 300 mm penetration, the compactness state of this deposit was described as very loose to very dense, generally compact. This deposit was encountered to depths of 2.0 m, 0.7 m and 13.3 m below grade at Borehole Nos. 1 to 3, respectively (elevations 288.7 m, 288.4 m and 285.6 m, respectively).

4.1.5 Sand and Gravel

Underlying the sand at Borehole No. 2, a deposit of brown sand and gravel trace silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 17% to 18%. The gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 40% gravel size particles, 51% sand size particles, and 9% silt and clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 48 and 47 blows per 300 mm penetration, the compactness state of this deposit was described as dense state. This deposit was encountered to a depth of 2 m below grade at Borehole No. 1 (elevation 288.7 m).

4.1.6 Bedrock

Underlying the above described sand and gravel deposit at Borehole No. 2 and sands at Borehole Nos. 1 and 3, bedrock was proven by diamond core drilling. The bedrock was described as greyish gneiss. Based on values of Rock Quality Designation (RQD) ranging from 53% to 96%, the bedrock was described as fair to excellent quality. Sampling in the bedrock was terminated at depths of 5 m, 5.5 m, and 16.3 m below grade at Borehole Nos. 1 to 3, respectively (elevations 285.7 m, 283.6 m, and 282.5 m, respectively). It should be noted that, when encountered, the underlying bedrock surfaces in this area can be very erratic in nature, varying substantially in elevation over short horizontal distances.

4.2 GROUNDWATER DATA

At the time of the investigation period (November 5 to November 7th, 2014), the creek water levels were measured at elevations some 290.1 m at the inlet area and 288.4 m at the outlet area.

Measurements of the groundwater table and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. Standpipes were respectively installed in Borehole Nos. 1 and 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

The groundwater levels were measured at elevations 290.7 m and 290.2 m at Borehole Nos. 1 and 3, respectively.

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

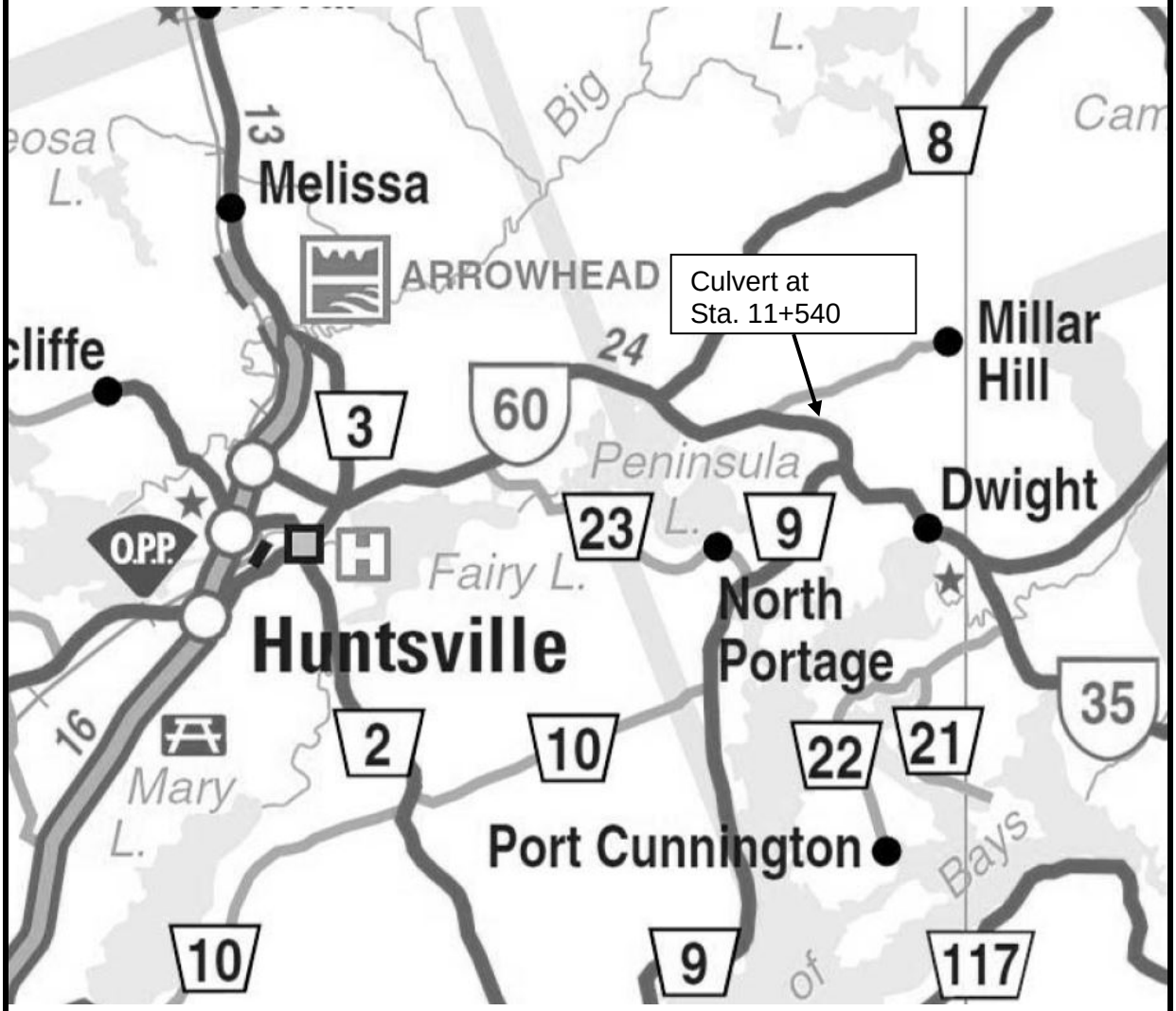
Appendix 1 Key Plan

Drawing No. 1 Key Plan

MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



FINAL PRELIMINARY
FOUNDATION INVESTIGATION
AND DESIGN REPORT
GWP 5333-11-00

Highway 60

Station 11+540 Culvert

Township of Sinclair

Reference No: 14/07/14083-F4

April 2015

LVM Merlex

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)	*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) Cohesive Soils:

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

LVM Merlex

REFERENCE 14/07/14083 DATUM Geodetic LOCATION N 5024782.9 E 335957.9 - Sinclair Twp., Station 11+538 ORIGINATED BY JL

PROJECT GWP 5333-11-00, Highway 60 - F4 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2014 November 07 TIME (Completed) 12:10:00 PM CHECKED BY MAM

DATE (Completed) 2014 November 07

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
290.7	Ground Surface										
0.0	Organic silty sand trace gravel occasional grasslets dark brown (very loose)		1	SS	1						
290.0							290				
0.7	SAND some gravel some silt and clay occasional cobble (compact/dense) grey		2	SS	11						
			3	SS	38		289				17 68 (15)
288.7											
2.0	Auger Refual Start to rock coring BEDROCK - grey gneiss fair quality		4	RC	Rec= 100% RQD= 53%		288				
			5	RC	Rec= 100% RQD= 73%		287				
							286				
285.7											
5.0	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 (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 14/11/07 12:00:00 PM	0	3.35
2) 14/11/07 12:10:10 PM	0	-
3)	-	-

MEL-GEO 14083 - BOREHOL LOGS - F4.GPJ MEL-GEO.GDT 15/01/19

LVM-Merlex, a Division of EnGlobe Corp.
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

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

METRIC

RECORD OF BOREHOLE NO. 2

LVM Merlex

REFERENCE 14/07/14083 DATUM Geodetic LOCATION N 5024755.5 E 335911.0 - Sinclair Twp., Station 11+532 ORIGINATED BY JL

PROJECT GWP 5333-11-00, Highway 60 - F4 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) November 6, 2014 TIME (Completed) 12:00:00 PM CHECKED BY MAM

DATE (Completed) November 6, 2014

ELEV / DEPTH	DESCRIPTION	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)
289.1	Ground Surface										
0.0	SAND with gravel some silt and clay occasional grass rootlets dark brown (very loose)		1	SS	3		289				30 46 (24)
288.4											
0.7	SAND and GRAVEL trace silt and clay rock fragments of cobble size encountered (dense) brown		2	SS	48		288				40 51 (9)
			3	SS	47						
286.9							287				
2.2	Auger Refual Start to rock coring BEDROCK - grey gneiss good quality		4	RC	Rec= 100% RQD= 82%		286				
			5	RC	Rec= 100% RQD= 78%		285				
			6	RC	Rec= 100% RQD= 75%		284				
283.6											
5.5	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)		-	-
2)		-	-
3)		-	-

MEL-GEO 14083 - BOREHOL LOGS - F4.GPJ MEL-GEO.GDT 4/21/15

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ENCLOSURE NO.:4 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 3

LVM Merlex

REFERENCE 14/07/14083 DATUM Geodetic LOCATION N 5024767.4 E 335927.7 - Sinclair Twp., Station 11+532.4 ORIGINATED BY TB

PROJECT GWP 5333-11-00, Highway 60 - F4 BOREHOLE TYPE Truck Mounted CME 75 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2014 August 18 TIME (Completed) 9:30:00 PM CHECKED BY MAM

DATE (Completed) 2014 August 18

ELEV / DEPTH	DESCRIPTION	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 (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
298.8	Ground Surface										
0.0	40 mm Asphalt 270 mm Crushed Gravel FILL - sand trace to with gravel trace to some silt trace clay		1	SS	20		298				
			2	SS	21						26 62 (12)
	50 mm Asphalt encountered at depth of 1.8 m dark greyish trace organic encountered at depth of 3 m		3	SS	24		297				
	brown to grey		4	SS	35		296				
			5A	SS	35						9 73 (17)
			5B	SS			295				
	cobble / rockfill encounted at depths from 4.6 m to 5.2 m		6	SS	20		294				
			7	SS	18						16 58 19 7
			8	SS	12		293				
			9	SS	11		292				
			10A	SS	16						
			10B	SS			291				1 77 (22)
	seam of silt encountered at depth of 9.1 m		11	SS	5	▽	290				
	gravel and sand encountered at depths from 9.9 m to 10.2 m (compact/very dense)		12	SS	5		289				
288.6			13A	SS	66						
10.2	SAND with gravel some silt and clay grey		13B	SS			288				
	(dense/very dense)		14	SS	31						25 50 (25)
			15	SS	61		287				
	Continued Next Page						286				

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 (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 14/08/26 10:30:00 AM	8.56 ▽	-
2)	- ▽	-
3)	- ▽	-

MEL-GEO 14083 - BOREHOL LOGS - F4.GPJ MEL-GEO.GDT 15/01/19

LVM-Merlex, a Division of EnGlobe Corp.
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 14/07/14083 DATUM Geodetic LOCATION N 5024767.4 E 335927.7 - Sinclair Twp., Station 11+532.4 ORIGINATED BY TB

PROJECT GWP 5333-11-00, Highway 60 - F4 BOREHOLE TYPE Truck Mounted CME 75 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 2014 August 18 TIME (Completed) 9:30:00 PM CHECKED BY MAM

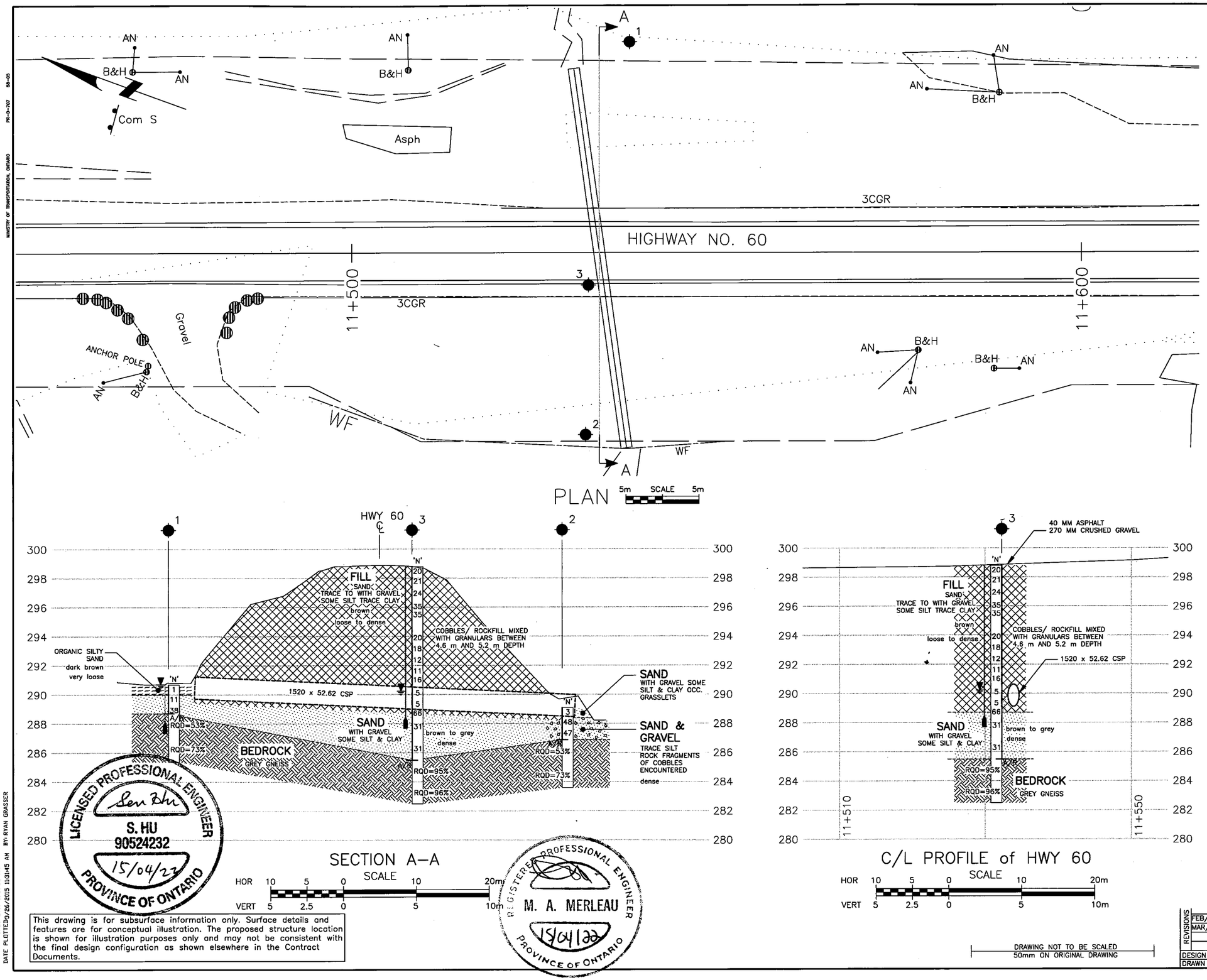
DATE (Completed) 2014 August 18

ELEV / DEPTH	DESCRIPTION	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)
285.6	Continued from Previous Page										
13.3	Auger Refual Start to rock coring										
	BEDROCK - grey gneiss excellent quality		16	RC	Rec= 100% RQD= 95%		285				
			17	RC	Rec= 96% RQD= 96%		284				
282.5							283				
16.3	End of Sampling End of Borehole										

LVM-Merlex, a Division of EnGlobe Corp.
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

Appendix 3 Borehole Plan and Laboratory Data

Drawing No. 2: Borehole Location and Soil Strata
Figure Nos. L-1 to L-3: Grain Size Distribution Curves
Table No. L-4: Laboratory Test Summary Sheet



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

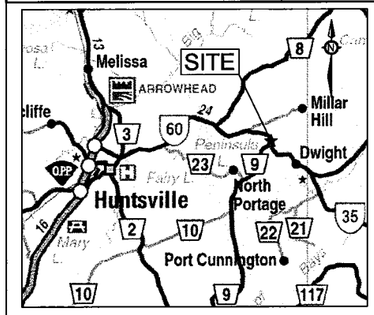
HWY 60
CULVERT AT STATION 11+534
SINCLAIR TOWNSHIP

BOREHOLE LOCATIONS
AND SOIL STRATA

DRAWING 2

LVM Merlex

METRIC



KEY PLAN
N.T.S.

LEGEND

	Borehole
	Borehole w/ Dynamic Cone Penetration Test
N	Blows/0.3 m (Std Pen Test, 475 J/blow)
DCPT	Blows/0.3 m (60° Cone, 475 J/blow)
	Water Level at Time of Investigation
A/R	Auger Refusal at Elevation
E/S	End of Sampling
	Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	290.7	29.0m Lt	5024782.9	345957.9
2	289.1	25.0m Rt	5024755.5	345911.0
3	298.8	4.5m Rt	5024767.4	345927.7

NOTES:

1. 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.

2. Base plan and alignment provided in digital format by exp. on October 22, 2014.

GEOCRES No. 31E-350

LICENSED PROFESSIONAL ENGINEER
S. HU
90524232
15/04/22
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M. A. MERLEAU
15/04/22
PROVINCE OF ONTARIO

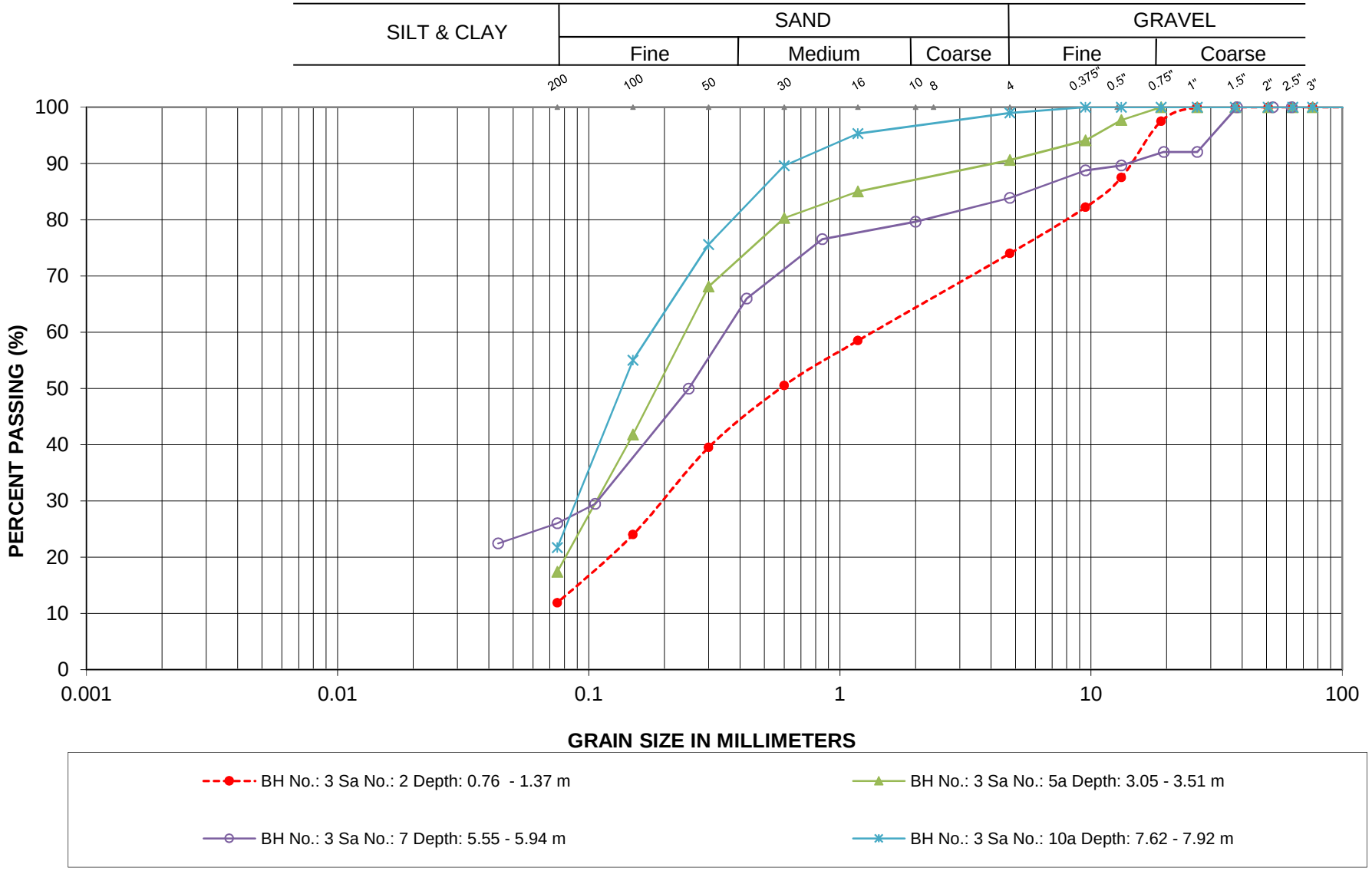
This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

REVISIONS			
FEB/15	RG	DRAFT	
MAR/15	RG	FINAL	
		DESCRIPTION	

DESIGN	CHK	CODE	LOAD	DATE MAR/15
DRAWN RG	CHK SH	SITE	STRUCT	SCHEME	DWG 2

Reference No.: 14/08/114083-F4
Date: April, 2015

GRAIN SIZE ANALYSIS



SAND FILL

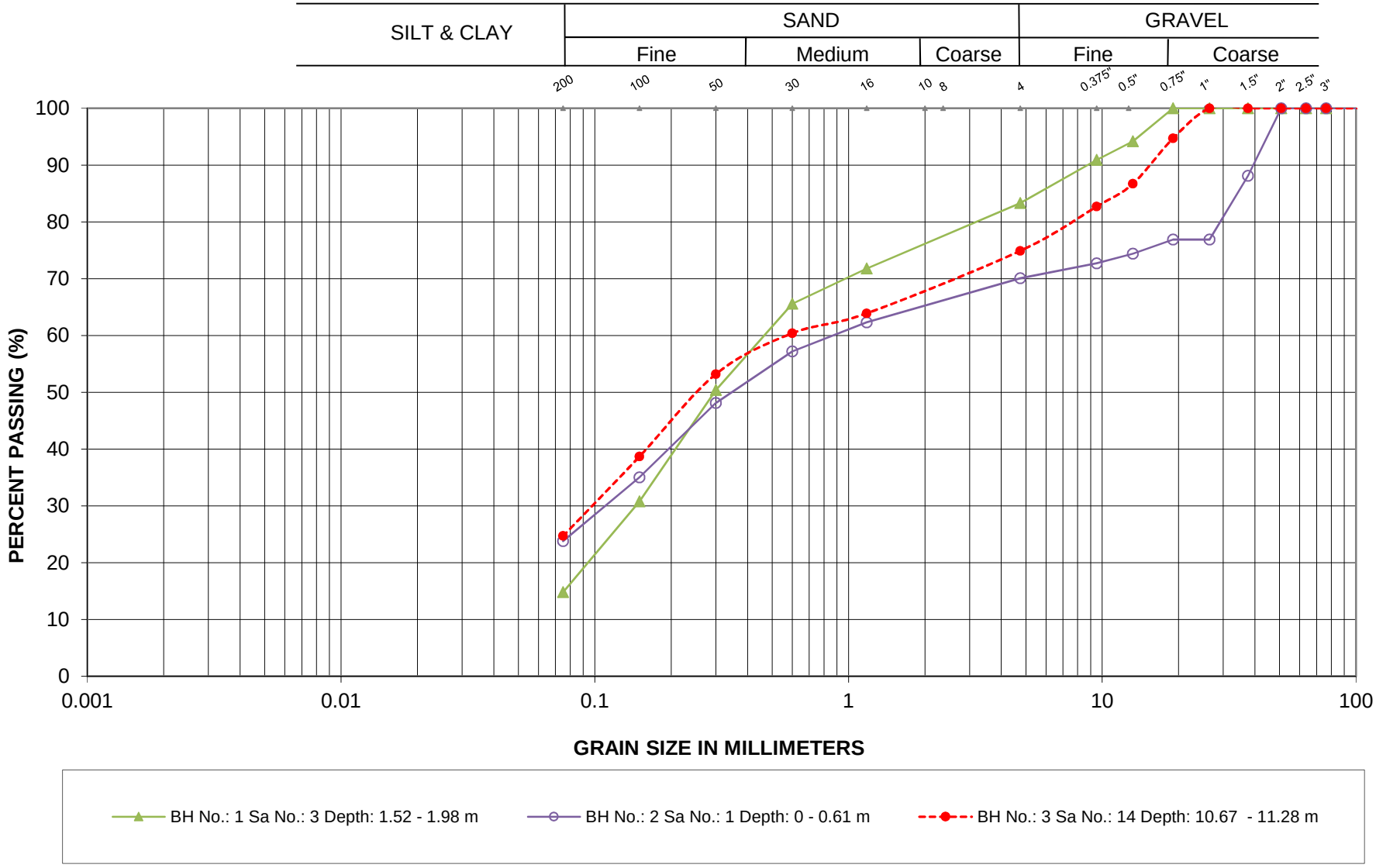
LOCATION: Hwy 60 Sta. 11+540 Culvert
TWP Sinclair, Ontario

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-1

Reference No.: 14/08/114083-F4
Date: April, 2015

GRAIN SIZE ANALYSIS



SAND

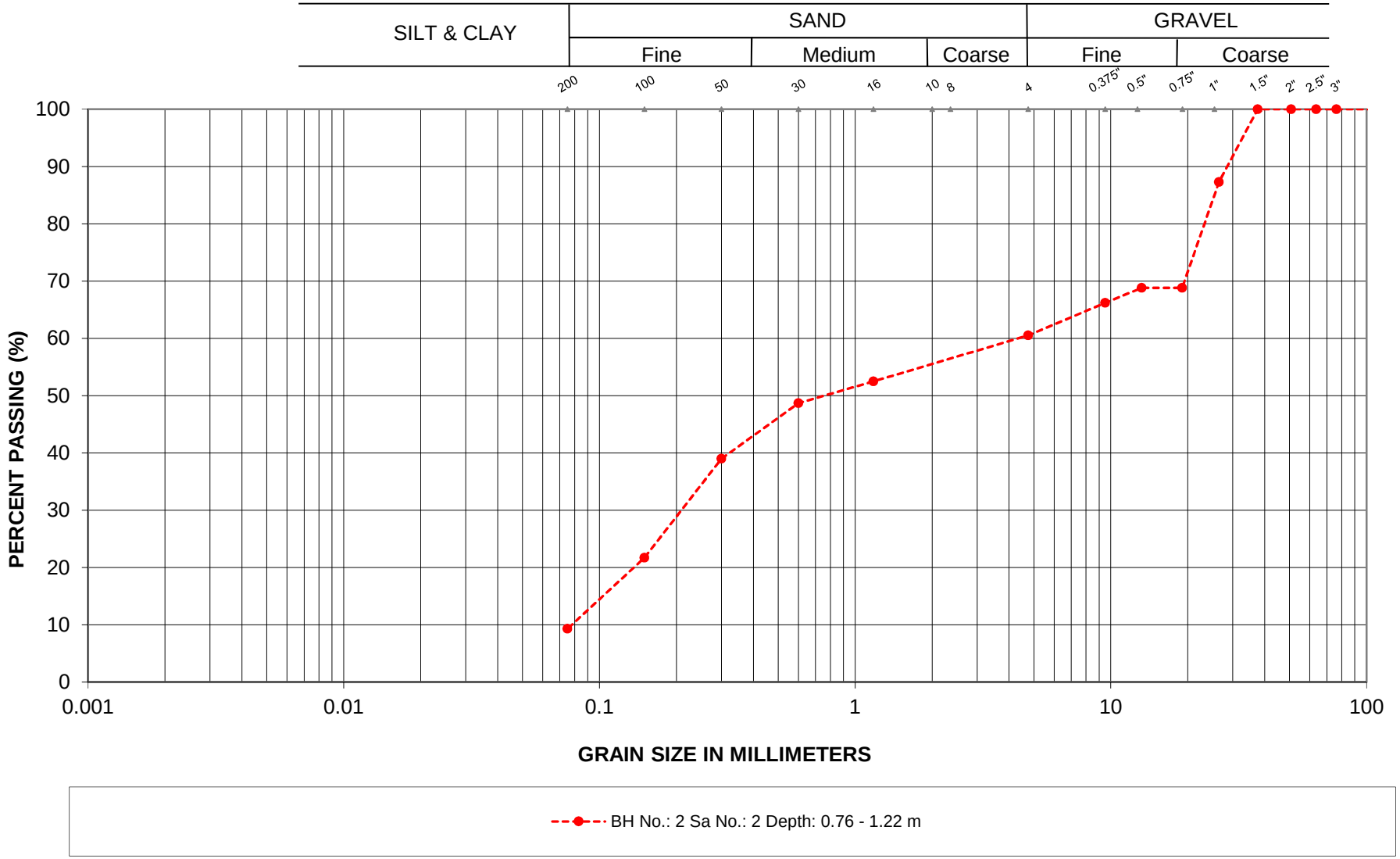
LOCATION: Hwy 60 Sta. 11+540 Culvert
TWP Sinclair, Ontario

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-2

Reference No.: 14/08/114083-F4
Date: April, 2015

GRAIN SIZE ANALYSIS



SAND and GRAVEL

LOCATION: Hwy 60 Sta. 11+540 Culvert
TWP Sinclair, Ontario

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-3

Reference No.: 14/07/14083-F4

Date: April, 2015

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	0.3					48.5				1			
	2	1.0					32.2				11			
	3	1.8	17	68	15		14.4				38			
2	1	0.3	30	46	24		17.5				3			
	2	1.0	40	51	9		17.7				48			
	3	1.8					17.2				47			
3	1	0.3					5.1				20			
	2	1.1	26	62	12		9.0				21			
	3	1.8					7.6				24			
	4	2.6					11.0				35			
	5a	3.3	9	73	17		12.2				35			
	5b	3.6					3.4							
	6	4.9					13.7				20			
	7	5.6	16	58	19	7	11.4				18			
	8	6.4					11.5				12			
	9	7.2					12.7				11			
	10a	7.8	1	77	22		10.3				16			
	10b	8.0					16.7							
	11	8.7					14.1				5			
	12	9.5					20.0				5			
	13a	10.1					8.0				66			
	13b	10.4					8.7							
	14	10.98	25	50	25		9.22				31			
	15	12.5					16.42				61			

Project: Hwy 60, Culvert Sta. 11+540, Township of Sinclair

Table No. L-4

Appendix 4 Photo Essay

Enclosure No. 5: Photo Essay

Embankment at Culvert Location – Looking East	Photo: 1

Culvert Outlet Location – Looking East	Photo: 2

Project: Hwy 60 – Culvert 11+540	Photos Provided By: LVM Date: August 2014

Culvert Outlet Location – Looking East	Photo: 3

Culvert Outlet – Looking North	Photo: 4

Project: Hwy 60 – Culvert 13+035	Photos Provided By: LVM Date: August 2014