



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

**Highway 631 Rehabilitation – GWP 548-00-00  
Culvert Replacement – Culvert No. 80  
Station 10+977 - Twp. of Cooper**

## **FINAL FOUNDATION INVESTIGATION REPORT**

Date: March 11, 2014  
Ref. N°: 13/03/13042-F3

**Geocres No. 42C-30**

**LVM | MERLEX**



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## **Final Foundation Investigation Report**

Prepared by:

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Test results mentioned herein are only valid for the sample(s) stated in this report.

LVM inc.'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.

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P1B 1Z2

Attention: **Mr. Al Rose**

REVISION AND PUBLICATION REGISTER		
Revision N°	Date	Modification And/Or Publication Details
00	2014-01-17	DRAFT Report Issued
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REPORT DISTRIBUTION	
5 hard copies and 1 electronic copy	MTO Project Manager
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## 1 INTRODUCTION

LVM | MERLEX has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation for the proposed replacement of existing triple culverts under GWP 548-00-00. This culvert replacement is located on Highway 631, some 18.6 km north of the Junction with Hwy 17, in the Township of Cooper.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5011-E-0040. The terms of reference for the scope of work are outlined in LVM | MERLEX's Proposal P-12-140, dated September, 2012. The purpose of this investigation was to determine the subsurface conditions in the area of the culverts in order to provide design recommendations. 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 triple cell Asphalt Coated Corrugated Steel Pipe (ACCSP) culverts are located at Station 10+977, Township of Cooper. The topography at the site is a low wet land area with organic terrain to the south (right) of the embankment. The existing highway embankment currently supports two undivided lanes of highway, locally running in a west to east direction. Highway 631 is designated as a south to north highway however, at the culvert location the highway runs predominately in a west to east direction. As such, for the purposes of this report, the highway has been described as oriented in a west to east direction.

The existing highway, at the culvert location, is constructed on an embankment typically consisting of granular fill, some 3.5 m deep. The embankment projects some 1.8 m above surrounding grade, with centerline elevation of 412.4 m at the culvert location. The culverts at this location are identified as triple ACCSP culverts. Each cell is 1.2 m diameter and some 19 m in length. Flow through the culverts, at this location, is from south to north (right to left) (see Photo Essay, Appendix 4).

No above ground infrastructure was observed at this culvert location at the time of this investigation.

### 2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Long Lake Rocky and Limy Drift Uplands. The topography on this section of Highway 631 is generally slightly rolling. There are exposed bedrock ridges. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area overburden consists primarily of sands containing varying amounts of silts and gravel.

Bedrock in the area, as indicated on OGS Map 2506, is of the Early Precambrian period. In the area of this culvert foundation investigation, the bedrock comprises of granitic rocks, syenite, pegmatite, and unsubdivided migmatite.

### 3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period of July 19<sup>th</sup> and 20<sup>th</sup>, 2013 during which time three (3) sampled boreholes was advanced. For the purposes of foundation design for the culvert replacement, one borehole were advanced at the outlet of the culverts, one (1) borehole was advanced through the embankment in the area of the culverts, and one boreholes was advanced at the inlet of the culverts.

The field investigation was carried out using a Bombardier mounted CME drill rig equipped with hollow stem augers, standard augers, 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 mounted in a trip (automatic) hammer. 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. When shallow refusal was encountered at the culvert boreholes, NQ size diamond coring equipment was used to determine the nature of shallow refusal.

Groundwater conditions in the open boreholes were observed during the advancement of, and immediately following, completion of the individual boreholes. 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. At the borehole(s) through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface.

The field work for this investigation was under the full time direction of a senior member of our 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, Atterberg Limits testing, as well as specific gravity testing. 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 C (Figures Nos. L-1 to L-3).

The location of the individual boreholes were 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.

## 4 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record 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 and Dynamic Cone Penetration Test (DCPT), plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of a 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 CULVERTS STATION 10+977, TWP OF COOPER

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. 2 advanced through the embankment, and Borehole Nos. 1 and 3 advanced at the culvert ends. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 were recorded at 410.8, 412.3, and 411.2 m, respectively.

#### 4.1.1 Fill

At surface at Borehole No. 2, a layer of embankment fill consisting of brown sand trace to some silt trace gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 5 to 19%, indicating a dry to wet moisture condition, relative to optimum moisture content. Gradation analyses were carried out on two (2) samples of this layer, the results of which indicated 1 to 2% gravel size particles, 81 to 82% sand size particles, and 16 to 18% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 6 to 29 blows per 300 mm penetration, the compactness of this layer was described as loose to compact, typically compact. The fill layer was encountered to a depth of 3.5 m below grade (elevation 408.8 m).

#### 4.1.2 Peat

At surface, at Borehole Nos. 1 and 3, a deposit of black to dark brown fine fibrous peat was penetrated. Wood pieces were encountered in this deposit at Borehole No. 1, and rootlets were encountered in this deposit at Borehole No. 3. The natural moisture content measured on samples of this deposit was in the order of 48 to 224%. Several in-situ shear strength tests taken in the peat stratum returned values ranging between 20 to 60 kPa. This deposit was encountered to depths of 2.3 and 1.1 m below grade at Borehole Nos. 1 and 3, respectively (elevations 408.5 and 410.1 m, respectively).

#### 4.1.3 Silt

Underlying the fill at Borehole No. 2, and underlying the peat deposit at Borehole Nos. 1 and 3, a deposit of grey silt trace to some sand trace clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 14 to 25%, indicating a moist to wet moisture condition, relative to optimum moisture content. Hydrometer analyses were carried out on six (6) samples of this deposit, the results of which indicated 0% gravel size particles, 0 to 4% sand size particles, 92 to 94% silt size particles, and 4 to 7% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was undertaken on samples of this deposit, the results of which indicated this deposit is non-plastic (NP). A gradation analysis was carried out on one sample of this deposit, the results of which indicated 0% gravel size particles, 13% sand size particles, and 87% silt and clay size particles (see Figure No. L-2, Appendix 3). Based on SPT 'N' values of 9 to 21 blows per 300 mm penetration, the compactness of this deposit was described as loose to compact, generally compact. Sampling was terminated in this deposit at depths of 9.6, 12.6, and 9.6 m below grade at Borehole Nos. 1, 2, and 3, respectively (elevations 401.2, 399.7, and 401.6 m, respectively).

## 4.2 GROUNDWATER DATA

The water level at the culvert inlet and outlet was measured at elevations of 410.6 m at the time of this investigation.

Measurements of the groundwater level and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B). The water levels in Borehole Nos. 1, 2, and 3 were measured at elevations 410.6, 410.5, and 410.7 m, respectively.

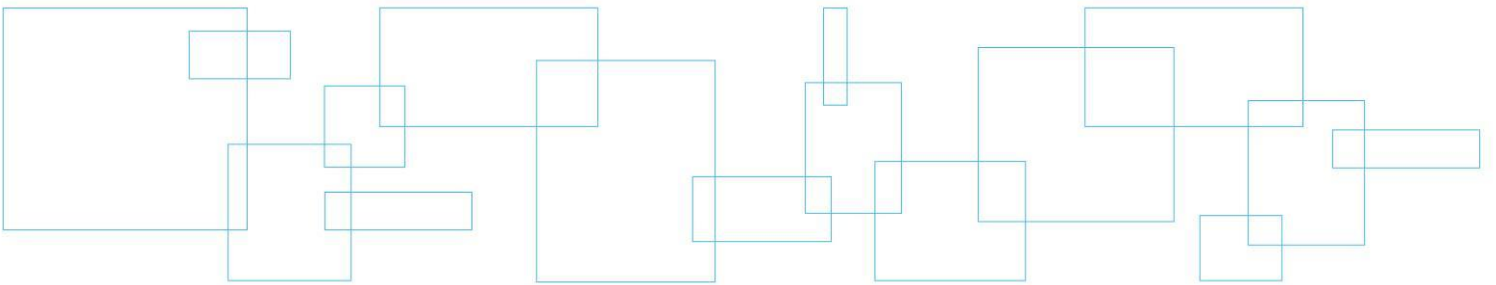
The groundwater and surface water levels will fluctuate seasonally/yearly.



## Appendix 1    Key Plan

Drawing No. 1

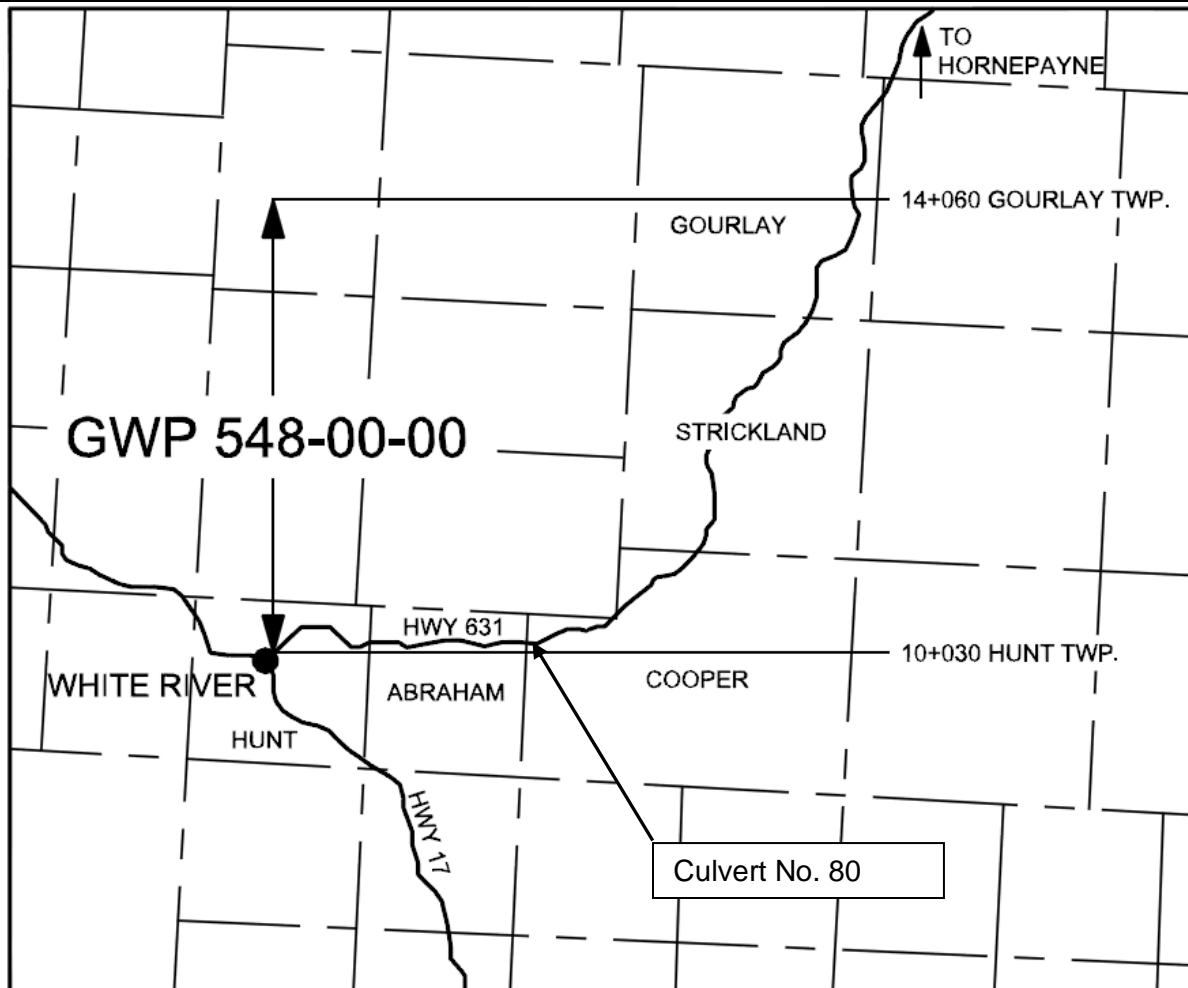
Key Plan



# KEY PLAN

Drawing No. 1

NOT TO SCALE



**FINAL**  
**FOUNDATION INVESTIGATION REPORT**  
**GWP 548-00-00**  
Highway 631  
Culvert No. 80

**LVM | MERLEX**

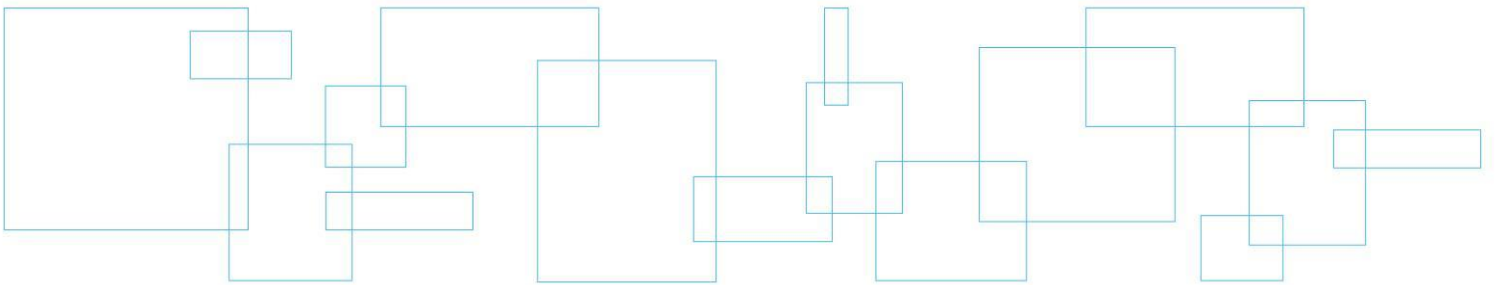
Reference No: 13/03/13042-F3

March 2014

## Appendix 2    Subsurface Data

Enclosure No. 1  
Enclosure Nos. 2 to 4

List of Abbreviations and Symbols  
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
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.

## METRIC

## RECORD OF BOREHOLE NO. 1



REFERENCE 13/03/13042-F3 DATUM Geodetic LOCATION N 5386536.2 E 227633.7 - Cooper Township, Culvert No. 80 ORIGINATED BY JL

PROJECT GWP 548-00-00, Highway 631 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM DATE (Started) 2013 July 19 TIME  CHECKED BY MAM

DATE (Completed) 2013 July 19 (Completed)

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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40					
410.8	Ground Surface													
0.0	PEAT - fibrous peat with wood pieces black to dark brown		1	SS	1								117	
			2	SS	5								144	
			3	SS	WH								224	
408.5	SILT - trace sand grey, wet (compact)		4	SS	13									
2.3			5	SS	11									
			6	SS	14									
			7	SS	18									
			8	SS	18									
			9	SS	12									
			10	SS	12									
401.2	End of Sampling End of Borehole													
9.6														
COMMENTS								$+3, \times 3$ : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa $\bigcirc$ 3% STRAIN AT FAILURE		WATER LEVEL RECORDS				
								Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)		
								1) 13/7/19 3:20:00 PM		1.8		2.7		
								2) 13/7/19 5:35:00 PM		0.5		2.7		
								3) 13/7/20 11:00:00 AM		0.2		2.4		

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

MEL-GEO 13042 - BOREHOLE LOGS - SITE C.GPJ MEL-GEO.GDT 14/3/11

**METRIC**

**L|V|M**



REFERENCE	13/03/13042-F3	DATUM	Geodetic	LOCATION	N 5386547.4 E 227640.8 - Cooper Township - Culvert No. 80	ORIGINATED BY	JL
PROJECT	GWP 548-00-00, Highway 631			BOREHOLE TYPE	Truck Mounted CME 45B - Hollow Stem Augers	COMPILED BY	AT
CLIENT	AECOM			DATE (Started)	2013 July 20	TIME (Completed)	
				DATE (Completed)	2013 July 20	CHECKED BY	MAM

[illegible]



## METRIC

## RECORD OF BOREHOLE NO. 3



REFERENCE 13/03/13042-F3 DATUM Geodetic LOCATION N 5386259.9 E 227632.7 - Cooper Township - Culvert No. 80 ORIGINATED BY JL

PROJECT GWP 548-00-00, Highway 631 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM DATE (Started) 2013 July 19 TIME  CHECKED BY MAM

DATE (Completed) 2013 July 19 (Completed)

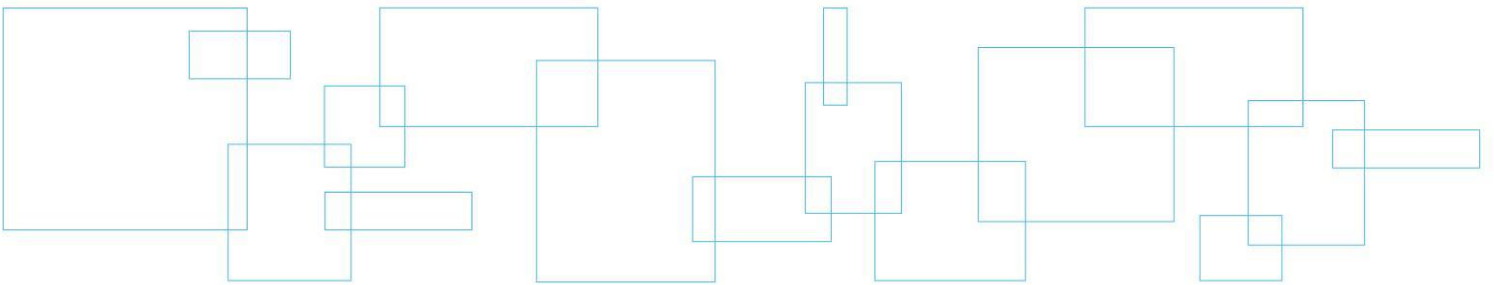
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40					
411.2	Ground Surface													
0.0	PEAT - fibrous peat trace rootlets black		1	SS	2		411							
410.1			2	SS	12		410							0 13 (87)
1.1	SILT - trace to some sand trace clay grey, wet (loose/compact)		3	SS	21		409							
			4	SS	11		408							0 4 92 4 NP
			5	SS	11		407							
			6	SS	9		406							
			7	SS	15		405							0 1 92 7 NP
			8	SS	15		404							
			9	SS	16		403							
			10	SS	15		402							
401.6	End of Sampling End of Borehole													
9.6														
COMMENTS								+ 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) 13/7/19 5:35:00 PM		2.4		3.2		
								2) 13/7/20 11:05:00 AM		0.5		1.1		
								3)		-		-		

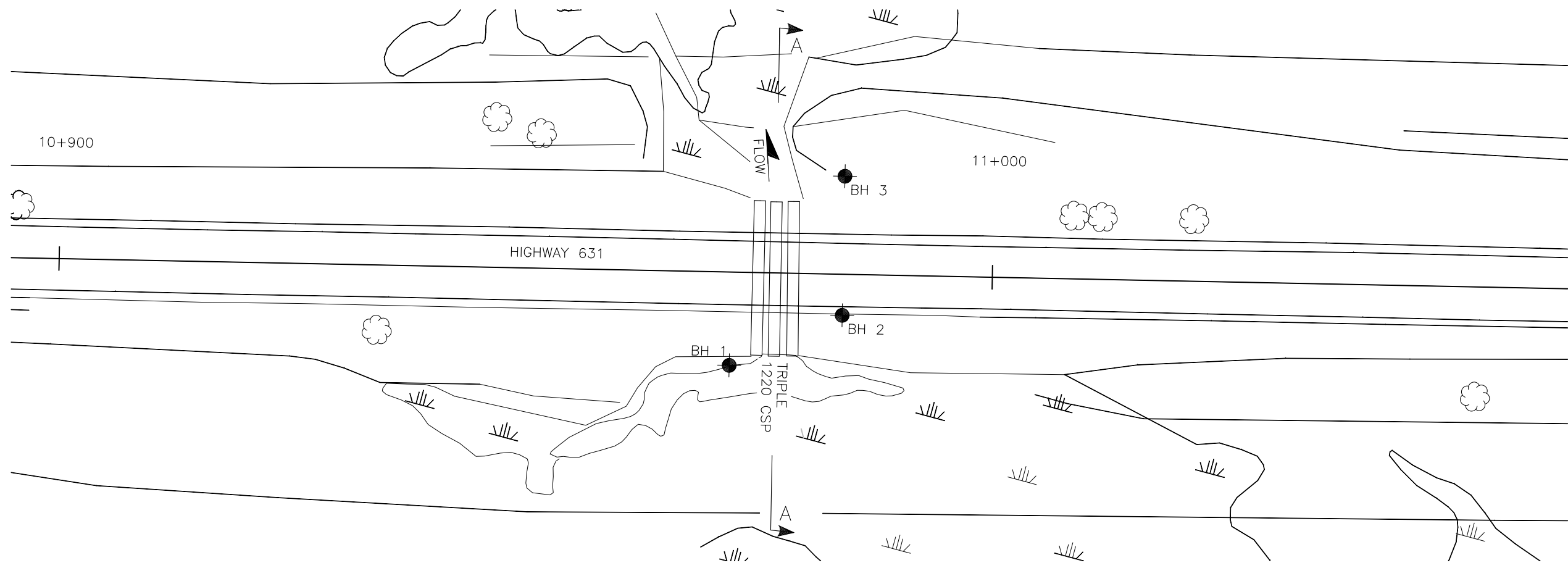
The stratification lines represent approximate boundaries. The transition may be gradual.

MEL-GEO 13042 - BOREHOLE LOGS - SITE C.GPJ MEL-GEO.GDT 14/3/11

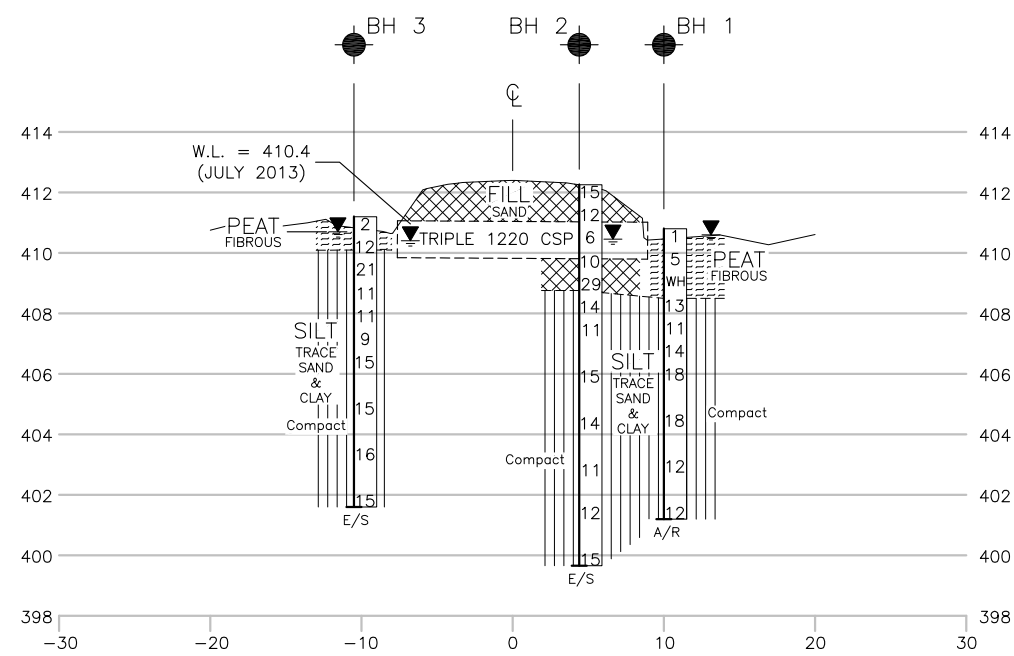
## Appendix 3    Borehole Plan and Lab Data

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





PLAN  
5m SCALE 5m HOR



CROSS SECTION A – A

5m SCALE 5m HOR  
2.5m 2.5m VER

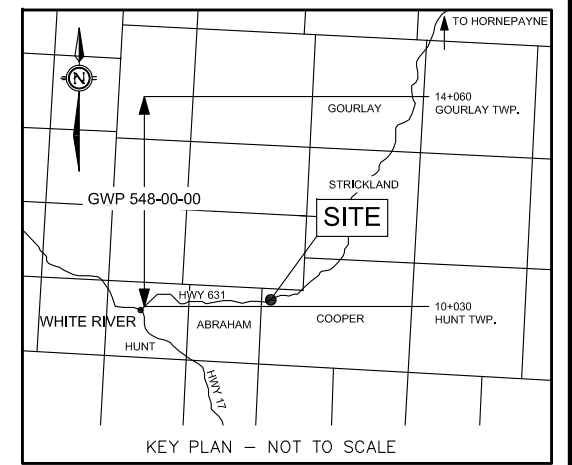
CONT. No.  
XXXX-XXXX

GWP. No.  
548-00-00

N

DRAWING  
2

HWY 631  
CULVERT #80  
STA. 10+977 – COOPER TOWNSHIP  
BOREHOLE LOCATIONS & SOIL STRATA



LEGEND

- Borehole
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- CONE 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

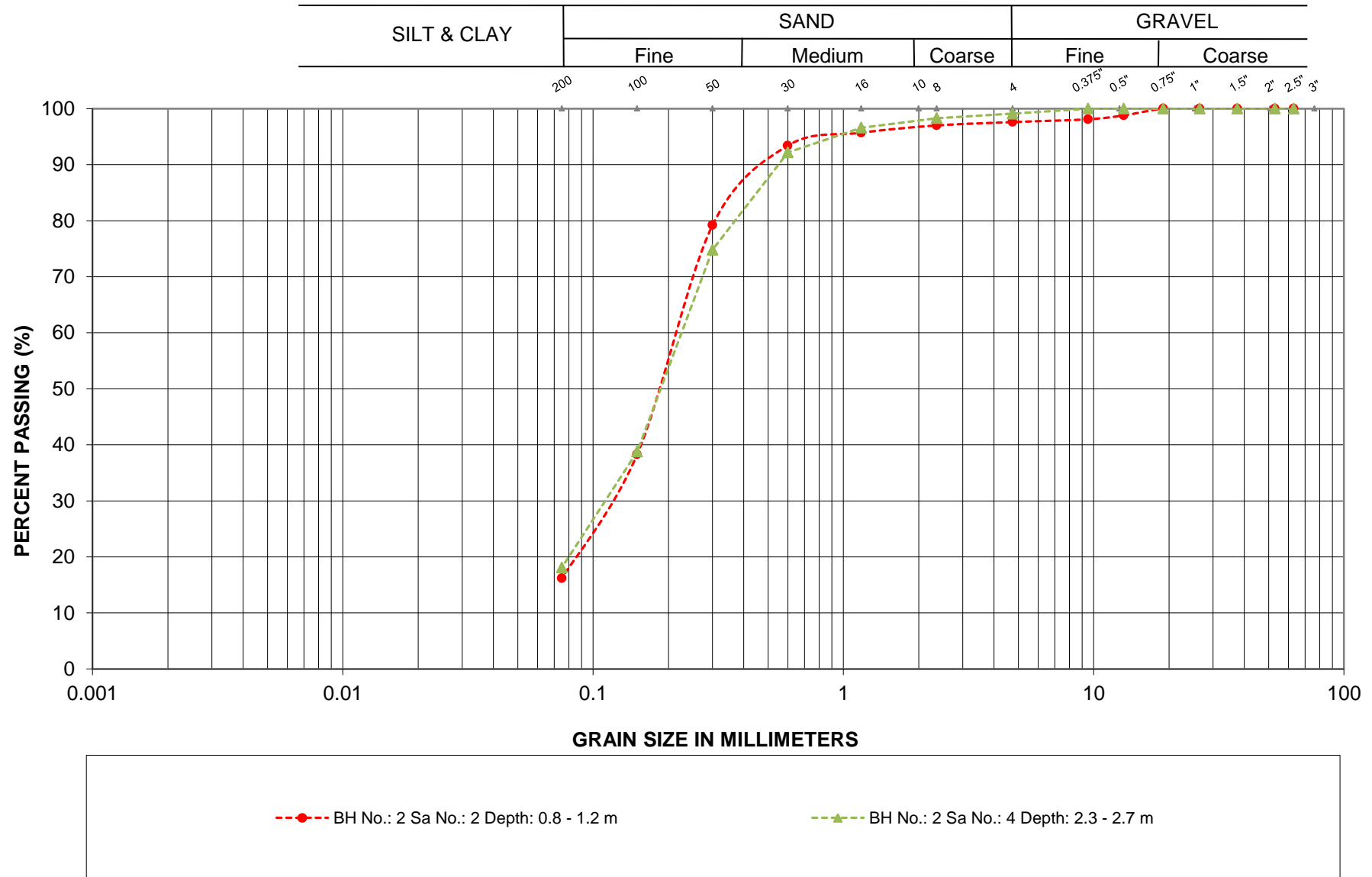
Borehole No.	Elev.	O/S	Co-ordinates	
			Northerly	Easterly
Borehole No. 1	410.8	10.0 m Rt	5386536.2	227633.7
Borehole No. 2	412.3	4.4 m Rt	5386547.4	227640.8
Borehole No. 3	411.2	10.5 m Lt	5386259.9	227632.7

NOTE 1: 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.

NOTE 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.

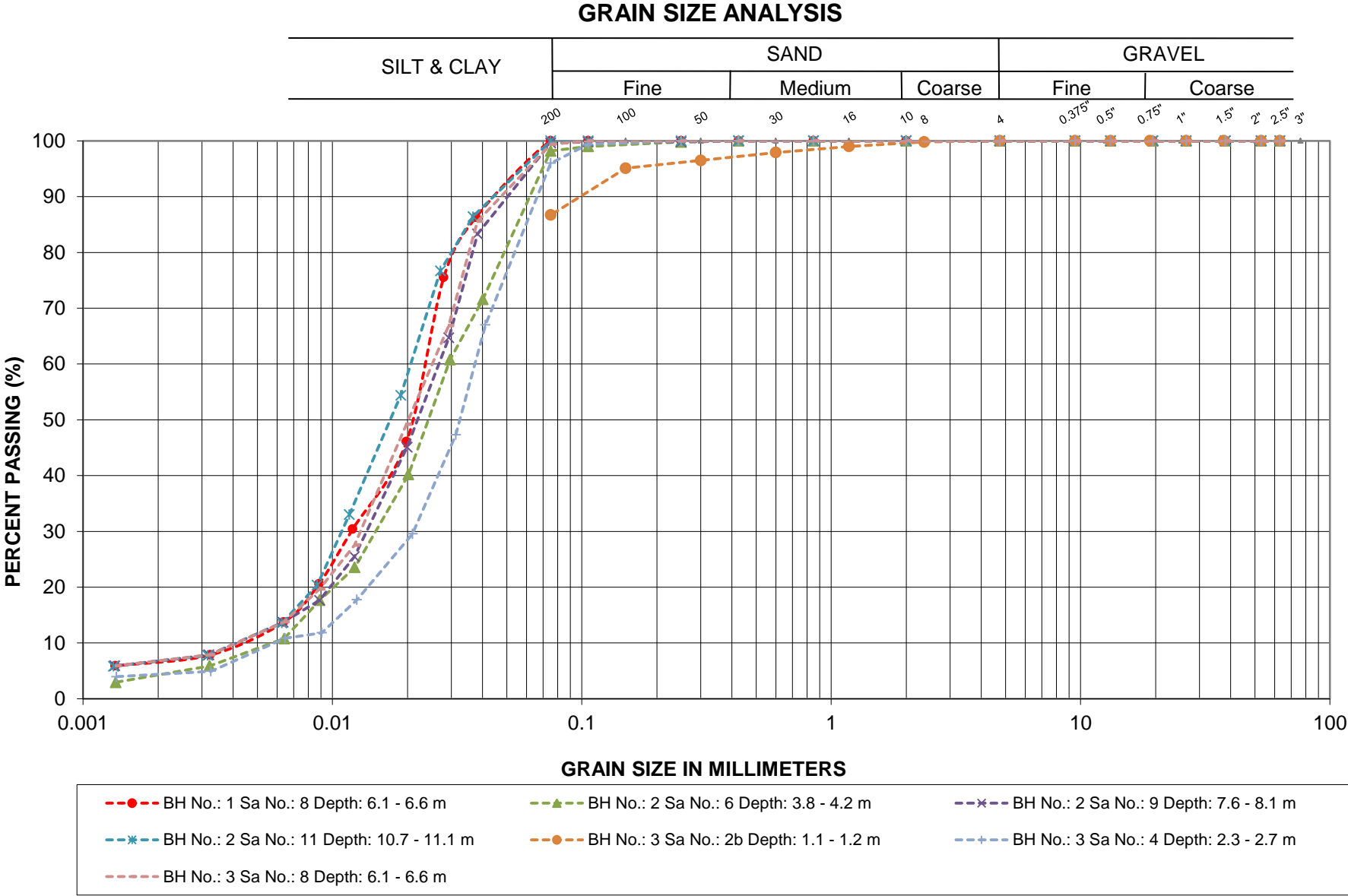
REVISIONS	DATE	BY	DESCRIPTION
	FEB 2014	RG	Revisions for Final, Add GEOCREs #
HWY NO. 631 – COOPER TOWNSHIP			
GEOCREs NO.: 42C-30			
L V M REFERENCE NO.: 13/13/13042			
DRAWN: RG		CHECKED: AT	DATE: DECEMBER 2013

# GRAIN SIZE ANALYSIS



G.W.P.: 548-00-00  
LOCATION: Hwy 631, Culvert No. 80

EMBANKMENT FILL



G.W.P.: 548-00-00  
LOCATION: Hwy 631, Culvert No. 80

SILT

## 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					116.9				1			
	2	0.8					144.0				5			
	3	1.5					223.7				WH			
	4	2.3					22.1				13			
	5	3.1					20.6				11			
	6	3.8					25.5				14			
	7	4.6					24.2				18			
	8	6.1	0	0	93	7	21.9				18			Non-Plastic
	9	7.6					16.1				12			
	10	9.1					19.7				12			
2	1	0.0					5.1				15			
	2	0.8	2	82	16		9.9				12			
	3	1.5					19.1				6			
	4	2.3	1	81	18		17.1				10			
	5	3.1					14.8				29			
	6	3.8	0	2	94	4	15.6				14			Non-Plastic
	7	4.6					14.0				11			
	8	6.1					15.2				15			
	9	7.6	0	0	93	7	17.3				14			Non-Plastic
	10	9.1					16.6				11			
	11	10.7	0	0	93	7	24.1				12			Non-Plastic
	12	12.19					15.7				15			
3	1	0.0					69.8				2			
	2a	0.8					48.2				12			
	2b	1.0	0	13	87		18.1				12			

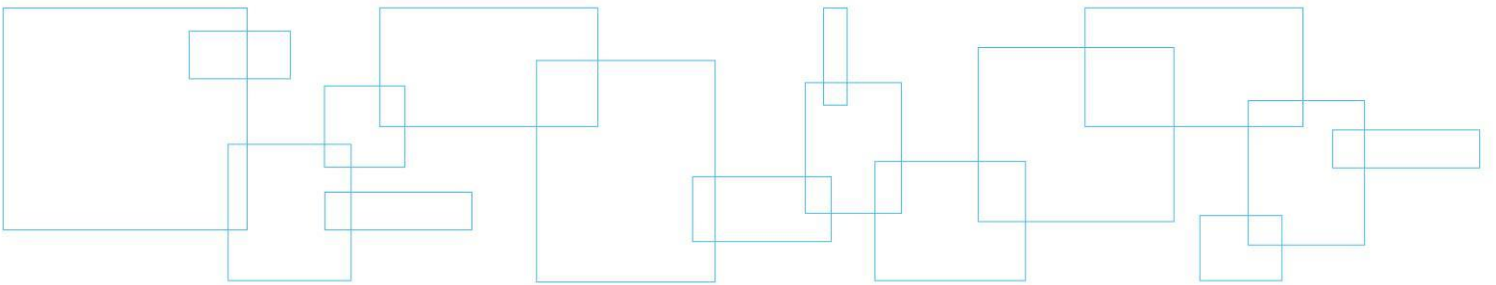
## Laboratory Tests - Summary Sheet

[illegible]

## Appendix 4    Photo Essay

Enclosure No. 5:

Photo Essay





Left Side of Existing Embankment, Drilling Borehole No. 3 – Looking East

Photo: 1



Culvert Inlet – Looking North

Photo: 2



Project: Hwy 631 – Culvert No. 80

Photos Provided By: LVM

Date: June 2013

Culvert Outlet – Looking East

Photo: 3



Project: Hwy 631 – Culvert No. 80

Photos Provided By: LVM

Date: June 2013