



**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 – Sutton Creek Culvert
Stations 20+440 and 20+448 - Twp. of Harris
Site No. 47-291
GWP 5358-11-00**

Highway 65

FINAL FOUNDATION INVESTIGATION REPORT

Date: December 06, 2013
Ref. N°: 13/05/13073-F1

Geocres No. 31M-105

LVM | MERLEX

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Final Foundation Investigation Report

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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.

189 Wyld Street, Suite 103

North Bay, Ontario

P1B 1Z2

Attention: **Mr. Al Rose**

REVISION AND PUBLICATION REGISTER		
Revision N°	Date	Modification And/Or Publication Details
00	2013-09-10	DRAFT FIDR Issued
01	2013-12-06	Final FIDR/FIR Issued

REPORT DISTRIBUTION	
5 hard copies and 1 electronic copy	MTO Project Manager
1 hard copy and 1 electronic copy	MTO Pavements and Foundations Section, Foundations Group
1 hard copy	File

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 at an existing twin centerline culvert site. The site is located at Sutton Creek on Highway 65, some 11.2 km East of Highway 11, in the Township of Harris, Site No. 47-291.

The foundation investigation location was specified by the MTO in the Terms of Reference for extra work under Agreement No. 5012-E-0025. The terms of reference for the scope of work are outlined in LVM | MERLEX's Proposal P-13-022, dated February, 2013. The purpose of this investigation was to determine the subsurface conditions in the area of the twin culverts. 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

These twin Structural Plate Corrugated Steel Pipe Arch (SPCSPA) culverts are located on Highway 65 at Stations 20+440 and 20+448, Township of Harris. The topography at the site is a low shallow slope valley area to the left and right of the embankment. 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 on an earth fill embankment some 3.5 m in height, with centerline elevation of 182.1 m at the culvert location. The existing embankment slopes have been established at an average angle of 2H:1V. The culverts at this location are 4.5x2.7 m Structural Plate Corrugated Steel Pipe Arch (SPCSPA) culverts, some 22.6 m in length. Flow through the culvert is from north to south (left to right) (see Photo Essay, Appendix 4).

Infrastructure at the culvert location consists of overhead wires on the left and right (north and south) sides of the highway.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Temiskaming Clay Plain. The topography on this section of Highway 65 is generally flat. Significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area native overburden consists primarily of a deep deposit of clays.

Bedrock in the area, as indicated on OGS Map 2506, is of the Ordovician period. At the location of this culvert foundation investigation, the bedrock comprises of limestone, sandy limestone, and sandstone. Bedrock was not encountered within the 16 m depth of the boreholes.

3 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of June 11th to 19th, 2013 during which time four (4) sampled boreholes, were advanced. Two (2) boreholes were advanced through the embankment at the location of the twin culverts, and one borehole was advanced at each the inlet (north) and outlet (south) ends of the culverts.

The field investigation was carried out using both a Bombardier and a truck mounted CME drilling 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.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following, completion of the individual boreholes. Standpipes were installed in select open boreholes prior to backfilling. 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, particle size analysis, Atterberg Limits determination, 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 3 (Figures Nos. L-1 to L-6).

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. The borehole elevations are based on a survey carried out by exp. Services. The elevations are derived from the Geodetic Benchmark

011982U080 described as the Brass Tablet set in the concrete foundation of a livestock barn at Station 13+167.2, 60.7 m right of centerline.

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 STATIONS 20+440 AND 20+448, TWP OF HARRIS

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Drawing No. 2, Appendix 3. During the course of the exploration program, four (4) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced at the culvert ends (inlet (left/north) and outlet (right/south), respectively), and Borehole Nos. 3 and 4 advanced through the embankment. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at 180.1, 180.6, 182.1, and 182.1 m, respectively.

4.1.1 Pavement Structure

Borehole Nos. 3 and 4 were advanced from the shoulder where a pavement granular base structure, consisting of 175 to 300 mm of crushed gravel, was penetrated.

4.1.2 Granular Fill

Underlying the pavement structure at Borehole Nos. 3 and 4, a layer of granular fill consisting of brown sand trace to some silt, and varying gravel content was penetrated. The natural moisture content measured on samples of this deposit was in the order of 4 to 11%. Gradation analyses were carried out on three (3) samples of this deposit, the results of which indicated 16 to 37% gravel size particles, 55 to 69% sand size particles, and 8 to 15% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 7 to 21 blows per 300 mm penetration, the compactness of this deposit was described as loose to compact, generally compact. This deposit was encountered to depths of 2.1 and 3.7 m below grade at Borehole Nos. 3 and 4, respectively (elevations 180.0, and 178.4 m, respectively).

4.1.3 Clay

Underlying a surficial layer of silty organics some, 300 mm thick, at Borehole Nos. 1 and 2, and underlying the fill at Borehole Nos. 3 and 4, a deposit of grey silty clay was penetrated. The silt content generally decreases with depth in this deposit. The natural moisture content measured

on samples of this deposit was in the order of 24 to 75%, generally increasing with depth. Hydrometer analyses were carried out on eleven (11) samples of this deposit, the results of which indicated 0% gravel size particles, 0% sand size particles, 15 to 66% silt size particles, and 33 to 85% clay size particles (Figure Nos. L-2 and L-3, Appendix 3). Atterberg Limits testing was carried out on the eleven (11) samples of this deposit, the results of which indicated a Plastic Limit in the order of 20 to 25% and a Liquid Limit in the order of 36 to 78% (Figure No. L-4, Appendix 4). Based on the results of the Atterberg Limits testing, this deposit was described as a clay of medium to high plasticity (CI-CH). The plasticity of the clay deposit generally increased with depth. Based on in-situ shear strengths of greater than 100 kPa down to 20 kPa, the consistency of this deposit was described as very stiff to soft, generally firm (Figure No. L-5, Appendix 3). The stiff to very stiff clay was generally encountered above elevation 177 m, and is associated with the desiccation of the upper portion of the clay deposit. Sampling was terminated in this deposit at a depth of 8.4 m below grade at Borehole Nos. 1 and 2, and at a depth of 16.0 m below grade at Borehole Nos. 3 and 4 (elevations 171.7, 172.2, 166.1, and 166.1 m, respectively).

4.2 GROUNDWATER DATA

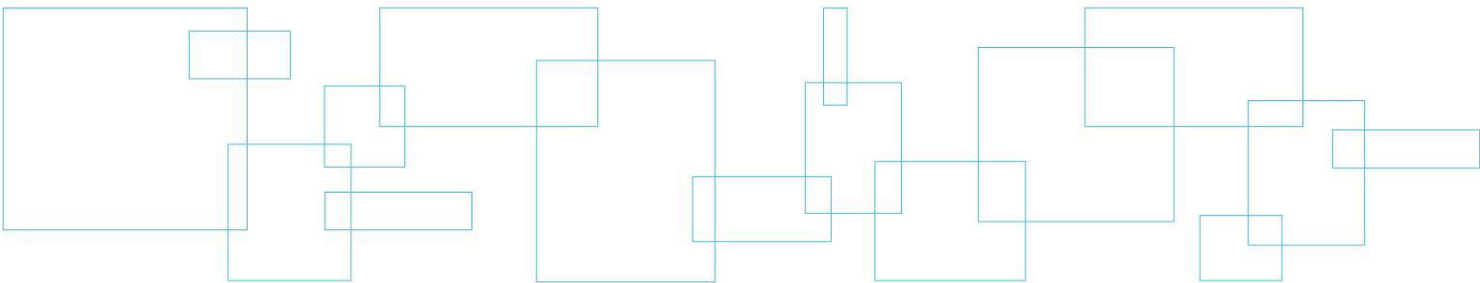
At the time of this investigation, the water level in the culvert was measured at elevation 179.3 m at the inlet and outlet. The flow through the culvert was negligible at the time of the investigation, see Photo Essay, Appendix 4.

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 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 water levels measured in the piezometers at Borehole Nos. 1 and 3 were measured between elevations 178.3 and 178.2 m some 29 and 21 hours post completion of the boreholes, respectively.

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

Appendix 1 Key Plan

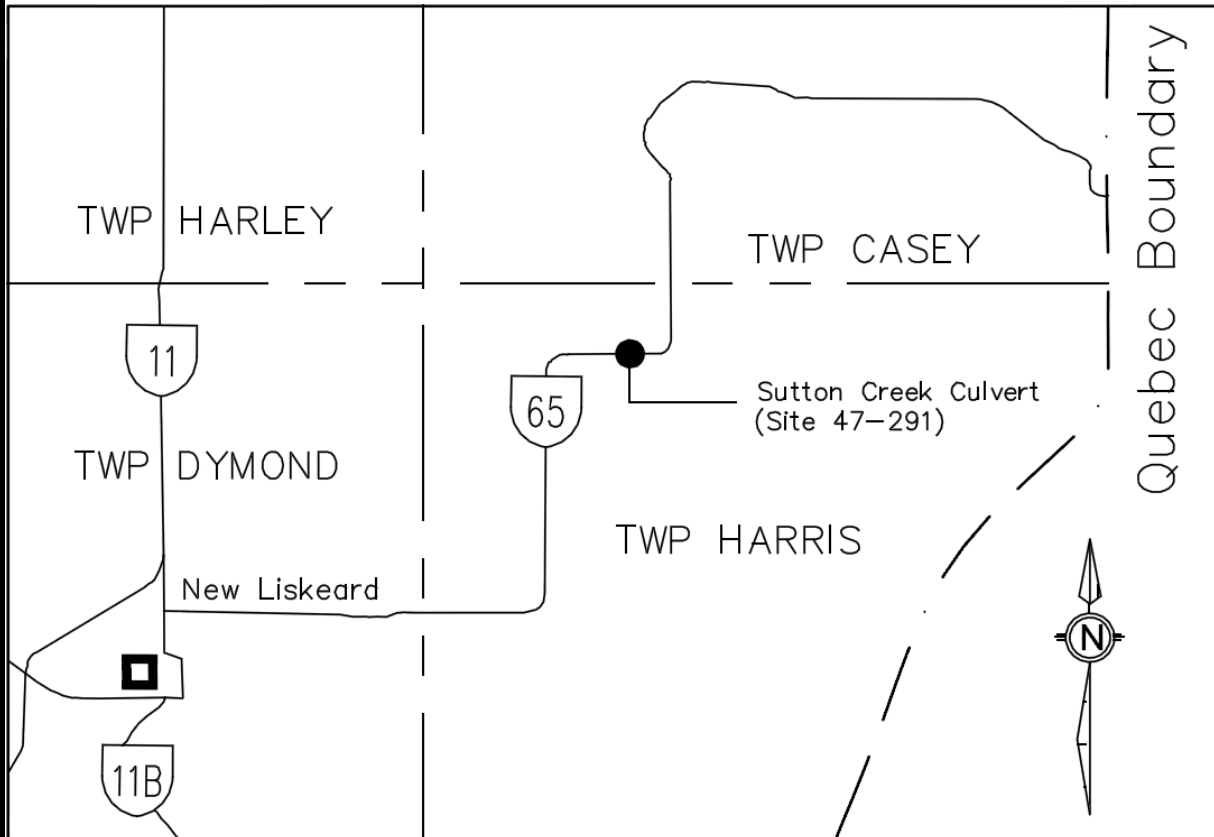
Drawing No. 1 Key Plan



KEY PLAN

Drawing No. 1

NOT TO SCALE



FINAL
FOUNDATION INVESTIGATION REPORT
GWP 5358-11-00
Highway 65
Sutton Creek

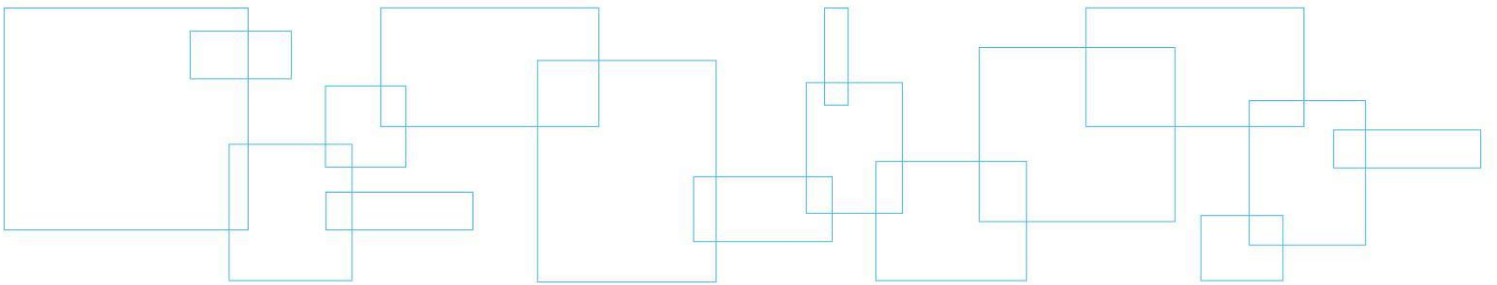
LVM | MERLEX

Reference No: 13/05/13073-F1

December 2013

Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 5	Record of Borehole Sheet



LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash Sample

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) *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.

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/or boulders frequency is an estimate based on drill response and field observations:

Occasional	Obstructions encountered in borehole, however advance is not severely impeded
Numerous	Obstructions appear essentially continuous over drilled length

5. LABORATORY TESTS

P	Standard Proctor Test
A	Atterberg Limit Test
GS	Grain Size Analysis
H	Hydrometer Analysis
C	Consolidation

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 13/05/13073-F1 DATUM Geodetic LOCATION N5270687.9 E410399.1 - Harris Township Station 20+432 ORIGINATED BY JL

PROJECT GWP 5358-11-00, Highway 65 - Sutton Creek BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) 2013 June 11 TIME CHECKED BY MAM

DATE (Completed) 2013 June 11 (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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40					
180.1	Ground Surface													
0.0	300 mm silty organics		1	SS	9									
	SILTY CLAY - grey silty clay		2	SS	8									
	(very stiff)													
			3	SS	9									
	(stiff)		4	SS	4									
			5	SS	WH									
	(firm)		6	SS	PM									
			7	SS	PM									
			8	SS	PM									
			9	SS	WH									
171.7	End of Sampling													
8.4	End of Borehole													
COMMENTS								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa			WATER LEVEL RECORDS			
In-situ shear tests at Borehole Nos. 2 to 4 indicate that shear strengths exceed 100 kPa where N values are 6 or greater.								○ 3% STRAIN AT FAILURE			Date (dd/mm/yy)/Time			
The stratification lines represent approximate boundaries. The transition may be gradual.											Water Depth (m)			
											Cave In (m)			
											1) 13/6/11 1:30:00 PM			
											2) 13/6/11 4:00:00 PM			
											3) 13/6/12 6:30:00 AM			

MEL-GEO 13073-F1 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 13/9/5



METRIC

RECORD OF BOREHOLE NO. 2



REFERENCE 13/05/13073-F1 DATUM Geodetic LOCATION N5270660.7 E410429.0 - Harris Township Station 20+461 ORIGINATED BY JL

PROJECT GWP 5358-11-00, Highway 65 - Sutton Creek BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) 2013 June 11 TIME (Completed) CHECKED BY MAM

DATE (Completed) 2013 June 11

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	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80
180.6	Ground Surface															
0.0	300 mm silty organics		1	SS	9											137.5
	SILTY CLAY - grey silty clay															
	(very stiff)		2	SS	6											
			3	SS	8											
	(stiff)		4	SS	7											
			5	SS	WH											
			6	SS	WH											
	(firm)															
			7	SS	WH											
			8	SS	PM											
			9	SS	PM											
172.2	End of Sampling															
8.4	End of Borehole															
COMMENTS								+ 3, × 3 : Numbers on right refer to Sensitivity		WATER LEVEL RECORDS						
In-situ shear tests at Borehole Nos. 2 to 4 indicate that shear strengths exceed 100 kPa where N values are 6 or greater.								Numbers on left refer to values greater than 120 kPa		Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)		
								○ 3% STRAIN AT FAILURE		1) 13/6/11 4:05:00 PM		7		7.3		
										2) 13/6/12 6:30:00 AM		2.1		3.5		
										3)		-		-		
The stratification lines represent approximate boundaries. The transition may be gradual.																

MEL-GEO 13073-F1 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 13/9/5



METRIC**RECORD OF BOREHOLE NO. 3**

REFERENCE 13/05/13073-F1 DATUM Geodetic LOCATION N5270678.5 E510418.3 - Harris Township Station 20+451 ORIGINATED BY JL

PROJECT GWP 5358-11-00, Highway 65 - Sutton Creek BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) 2013 June 18 TIME CHECKED BY MAM

DATE (Completed) 2013 June 18 (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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40					
182.1 0.0	Ground Surface													
	± 175 mm Crushed Gravel		1	SS	17									37 55 (8)
	FILL - brown gravelly sand trace silt													
	(loose/compact)		2	SS	16									
			3	SS	7									
180.0 2.1	SILTY CLAY - grey silty clay trace organics at interface		4	SS	5									0 0 64 36
	(very stiff)		5	SS	6									
	(stiff)		6	SS	5									0 0 66 34
	(firm)		7	SS	WH									
			8	SS	PM									0 0 49 51
			9	SS	PM									
			10	SS	PM									
	Continued Next Page													

COMMENTS		WATER LEVEL RECORDS	
In-situ shear tests at Borehole Nos. 2 to 4 indicate that shear strengths exceed 100 kPa where N values are 6 or greater.		Date (dd/mm/yy)/Time	Water Depth (m)
The stratification lines represent approximate boundaries. The transition may be gradual.		1) 13/6/18 1:00:00 PM	8.3
		2) 13/6/19 7:00:00 AM	4.2
		3) 13/6/19 10:40:00 AM	3.9

MEL-GEO 13073-F1 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 13/9/5

METRIC**RECORD OF BOREHOLE NO. 3**

REFERENCE 13/05/13073-F1 DATUM Geodetic LOCATION N5270678.5 E510418.3 - Harris Township Station 20+451 ORIGINATED BY JL

PROJECT GWP 5358-11-00, Highway 65 - Sutton Creek BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) 2013 June 18 TIME CHECKED BY MAM

DATE (Completed) 2013 June 18 (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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								UNCONFINED		FIELD VANE		QUICK TRIAXIAL						LAB VANE		
	Continued from Previous Page																			
	SILTY CLAY - grey silty clay (soft)		11	SS	WH											0 0 21 79				
			12	SS	WH															
	(firm)																			
			13	SS	WH											0 0 15 85				
			14	SS	WH															
166.1																				
16.0	End of Sampling End of Borehole																			

MEL-GEO 13073-F1 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 13/9/5

METRIC

RECORD OF BOREHOLE NO. 4



REFERENCE 13/05/13073-F1 DATUM Geodetic LOCATION N5270669.3 E410402.6 - Harris Township Station 20+435 ORIGINATED BY JL

PROJECT GWP 5358-11-00, Highway 65 - Sutton Creek BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) 2013 June 19 TIME CHECKED BY MAM

DATE (Completed) 2013 June 19 (Completed) 11:50:00 AM

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	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40					
182.1 0.0	Ground Surface													
	± 300 mm Crushed Gravel		1	SS	14									
	FILL - brown sand trace to some silt some gravel													
	(loose/compact)		2	SS	9									19 68 (13)
			3	SS	13									
			4	SS	21									16 69 (15)
			5	SS	13									
178.4 3.7	SILTY CLAY - grey silty clay trace organics at interface (very stiff)		6	SS	7									
	(firm)		7	SS	3									0 0 51 49
			8	SS	WH									
			9	SS	PM									0 0 35 65
			10	SS	PM									
	Continued Next Page													
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa		WATER LEVEL RECORDS					
In-situ shear tests at Borehole Nos. 2 to 4 indicate that shear strengths exceed 100 kPa where N values are 6 or greater.							○ 3% STRAIN AT FAILURE		Date (dd/mm/yy)/Time		Water Depth (m)		Cave In (m)	
									1)		-		-	
									2)		-		-	
									3)		-		-	
The stratification lines represent approximate boundaries. The transition may be gradual.														

MEL-GEO 13073-F1 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 13/9/5

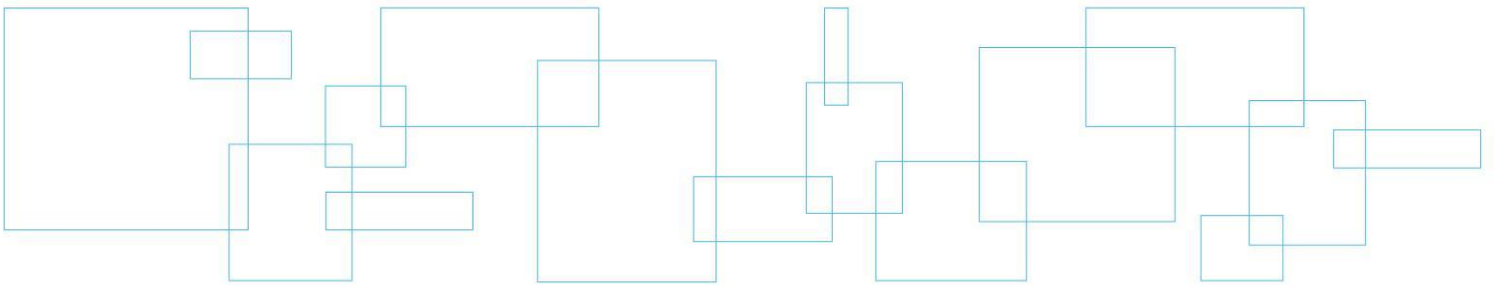
METRIC

REFERENCE	13/05/13073-F1	DATUM	Geodetic	LOCATION	N5270669.3 E410402.6 - Harris Township Station 20+435	ORIGINATED BY	JL
PROJECT	GWP 5358-11-00, Highway 65 - Sutton Creek	BOREHOLE TYPE	Truck Mounted CME 45B - Hollow Stem Augers	COMPILED BY	AT		
CLIENT	AECOM Inc.	DATE (Started)	2013 June 19	TIME (Completed)	11:50:00 AM	CHECKED BY	MAM
		DATE (Completed)	2013 June 19				

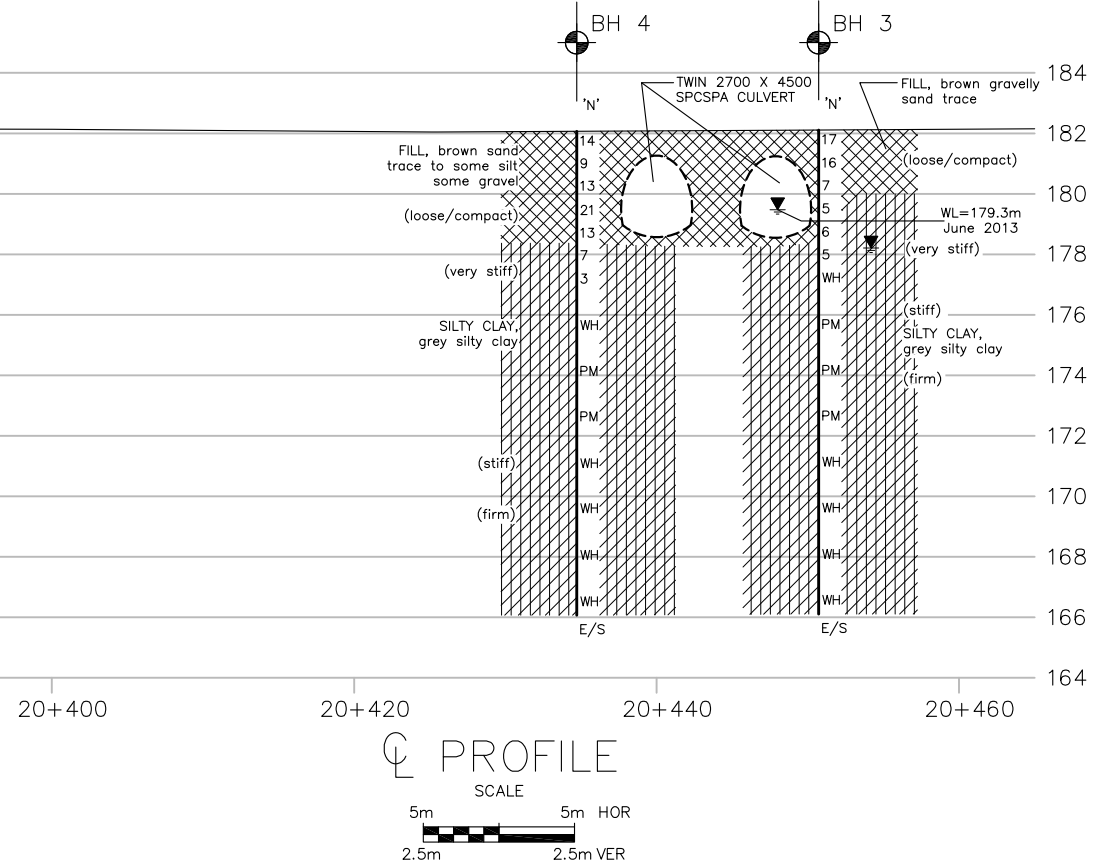
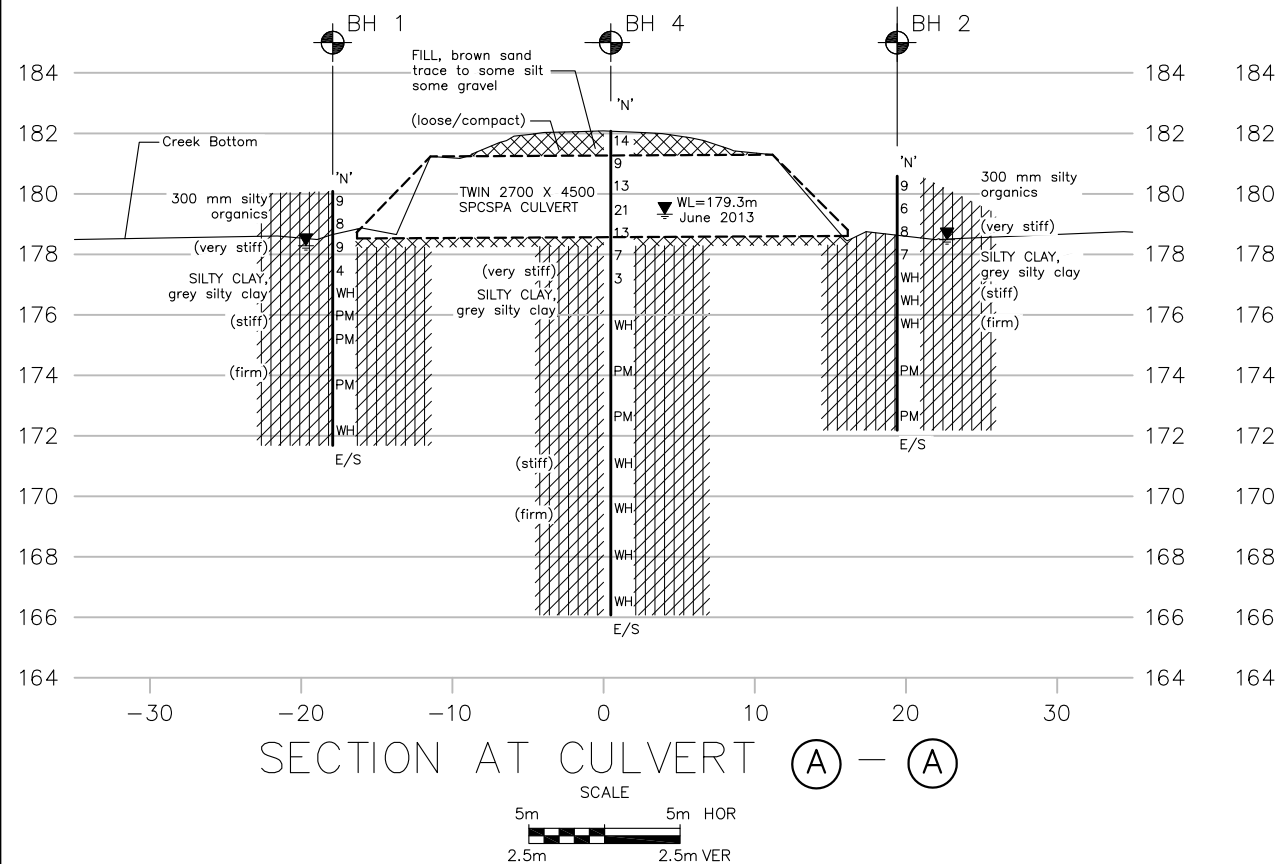
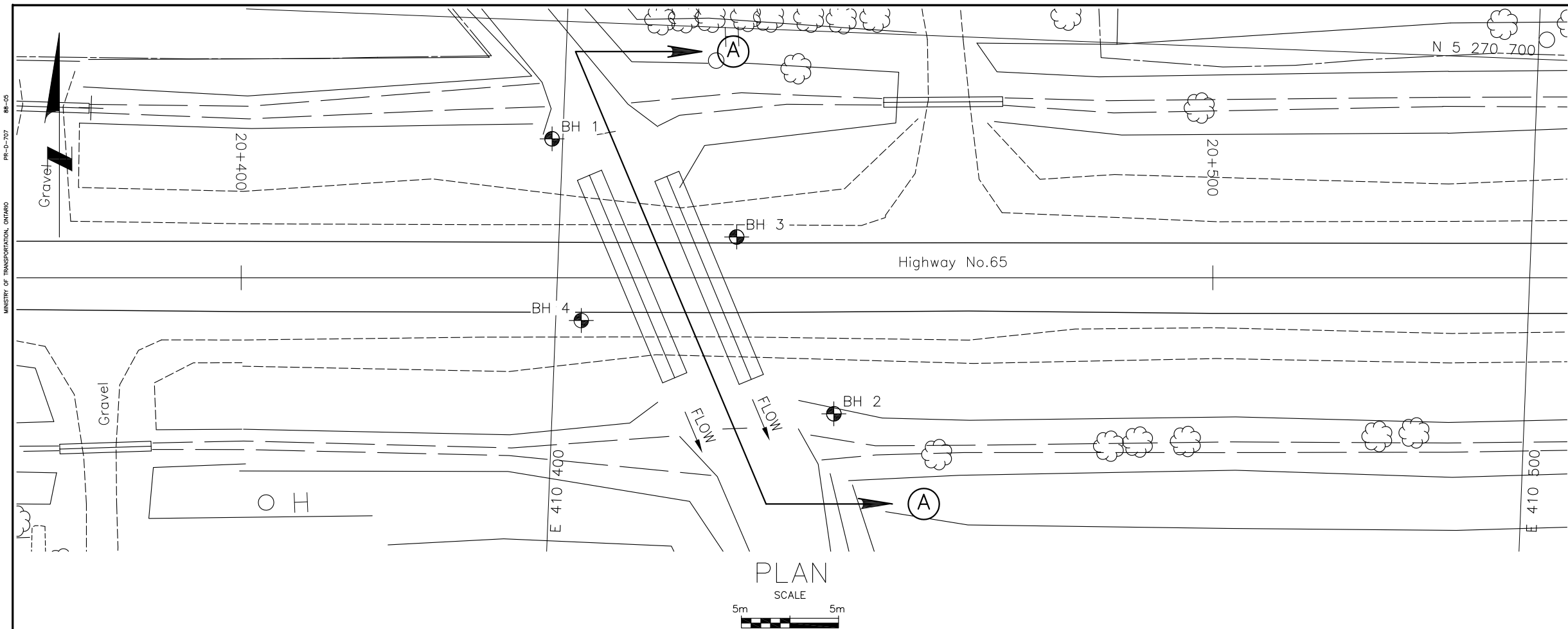
[illegible]

Appendix 3 Borehole Plan and Lab Data

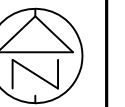
Drawing No. 2: Borehole Location and Soil Strata
Figure Nos. L-1 and L-3: Grain Size Distribution Curves
Figure Nos. L-4: Atterberg Limits Sheet
Figure No. L-5: Shear Strength Chart
Figure No. L-6: Lab Test Summary Sheet



CAD FILE LOCATION AND NAME: \\2013\\13073 - PAVE & FDN, Hwy 65 Various Locations (AECOM)\\FOUNDATIONS\\1-Sutton Creek GWP 5358-11-00\\Report\\FINAL Appendix 3\\13073-F1 - Borehole Location Plan - Sutton Creek Culvert.dwg
MODIFIED: 09/19/2013 2:31:08 PM BY: MERLWA
DATE PLOTTED: 12/12/2013 4:09:23 PM BY: RYAN GRASSER



DISTRICT
CONT. No.
WP No. 5358-11-00



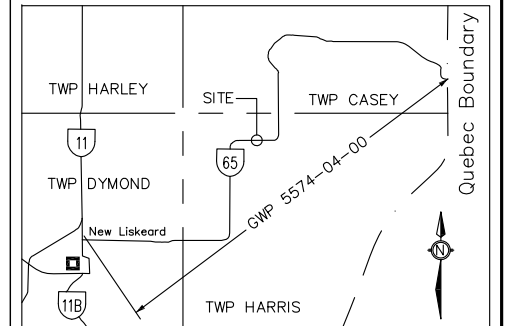
HWY 65
SUTTON CREEK CULVERT
SITE NO. 47-291

SHEET

BOREHOLE LOCATIONS
AND SOIL STRATA

LVM

METRIC



KEY PLAN
N.T.S.

LEGEND



Borehole

N

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

DCPT

Blows/0.3 m (60° Cone, 475 J/blow)

WL

Water Level at Time of Investigation

A/R

Auger Refusal at Elevation

E/S

End of Sampling

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	180.1	14.3m Lt	5270687.9	410399.1
2	180.6	14.0m Rt	5270660.7	410429.0
3	182.1	4.2m Lt	5270678.5	410418.3
4	182.1	4.4m Rt	5270669.3	410402.6

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.

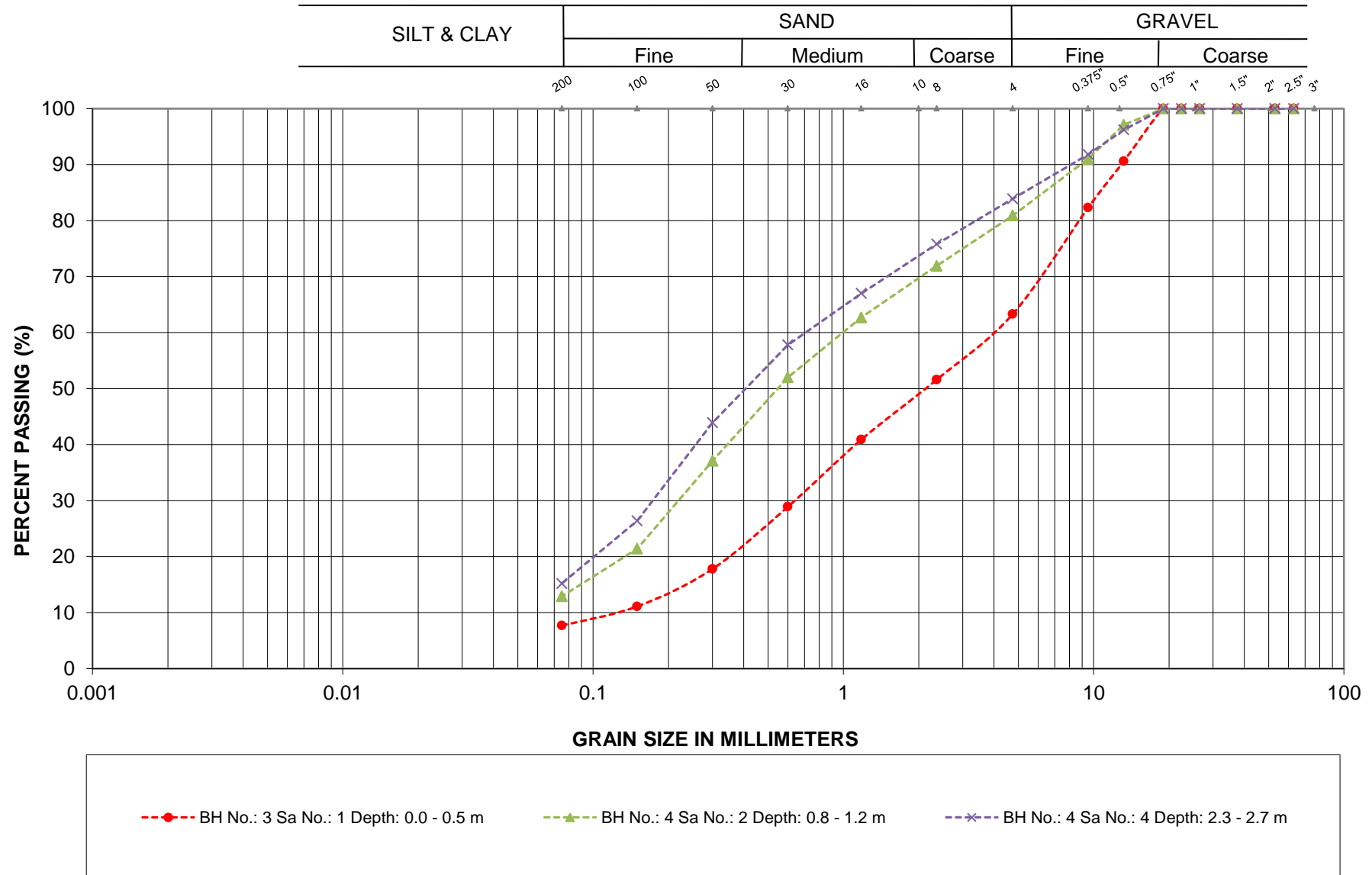
GEOCRES No. 31M-105

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.

DRAWING NOT TO BE SCALED
50mm ON ORIGINAL DRAWING

REVISIONS					DESCRIPTION				
NO.	DATE	BY	CHK	APP	DESIGN	CHK	CODE	LOAD	DATE
1					DESIGN	CHK	SITE	47-291	SEP/13
2					DRAWN	MCM	CHK	AT	DWG

GRAIN SIZE ANALYSIS



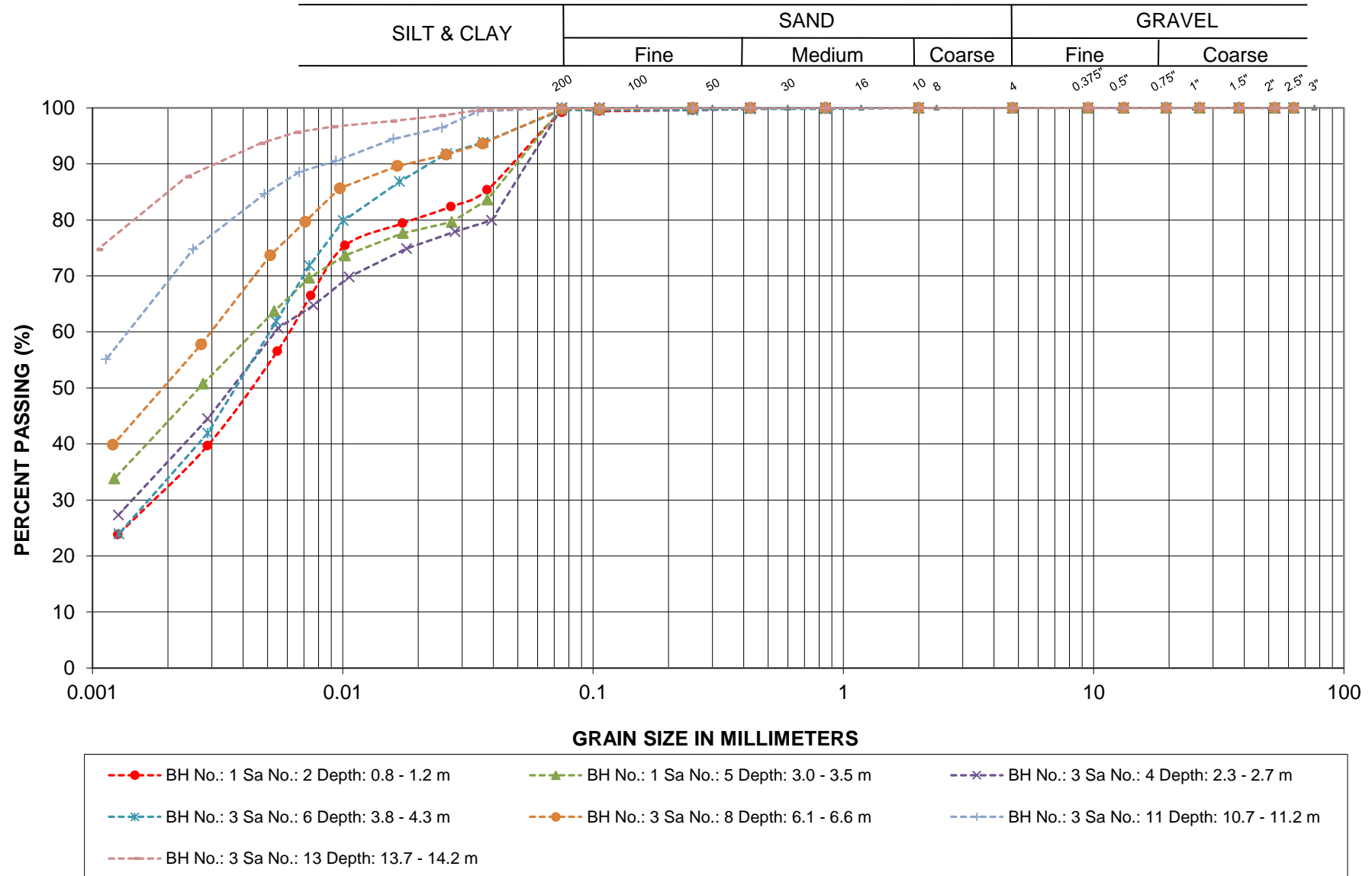
G.W.P.: 5358-11-00
LOCATION: Hwy 65, Sutton Creek

EMBANKMENT FILL

LVM | MERLEX

FIGURE L-1

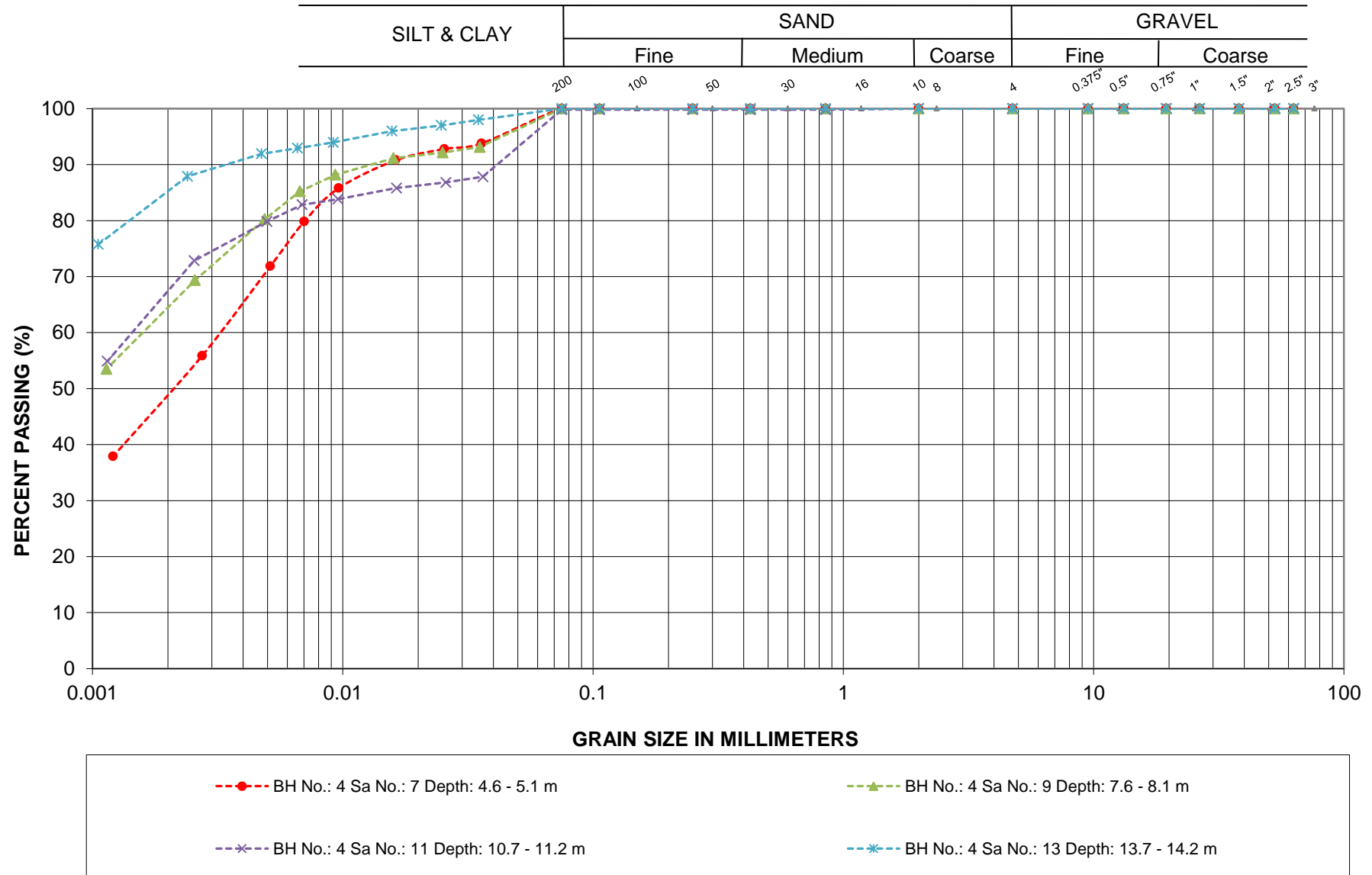
GRAIN SIZE ANALYSIS



G.W.P.: 5358-11-00
LOCATION: Hwy 65, Sutton Creek

SILTY CLAY

GRAIN SIZE ANALYSIS

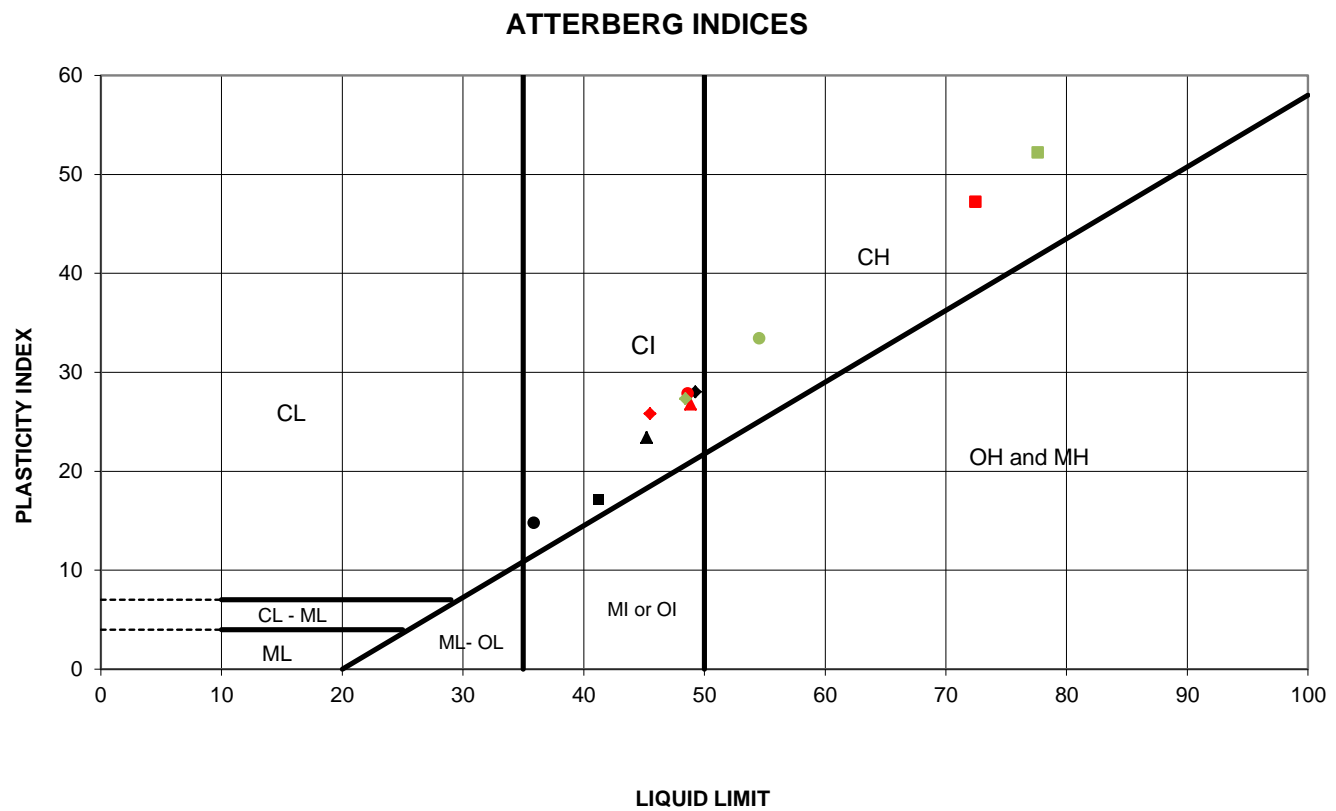


G.W.P.: 5358-11-00
LOCATION: Hwy 65, Sutton Creek

SILTY CLAY

ATTERBERG LIMITS TEST RESULTS

FIGURE L-4

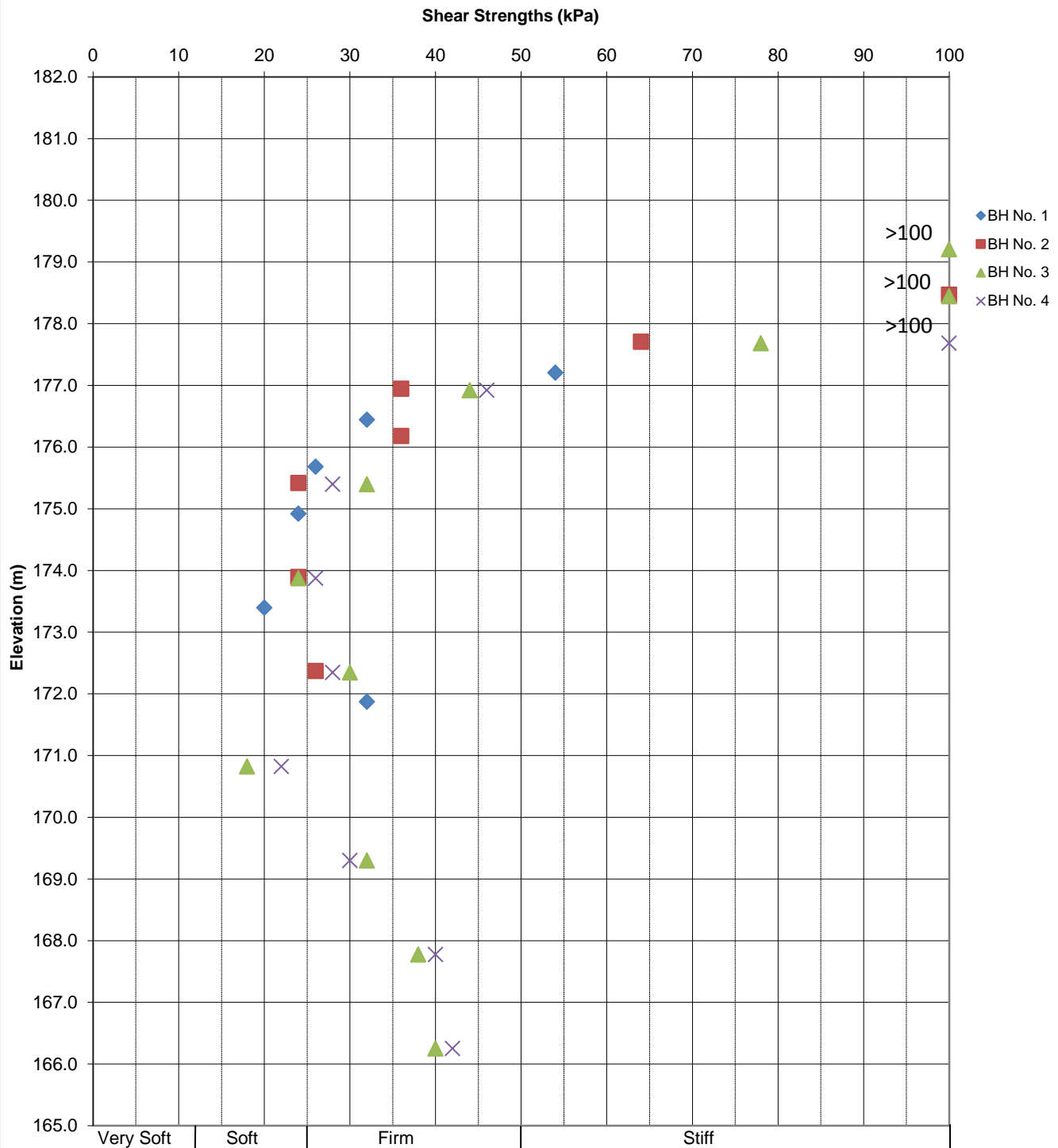


SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	2	0.8	179.3	35.9	21.1	14.8	25.2
◆	1	5	3.0	177.1	49.3	21.2	28.0	44.4
■	3	4	2.3	179.8	41.2	24.2	17.1	24.2
▲	3	6	3.8	178.3	45.2	21.8	23.4	31.0
●	3	8	6.1	176.0	48.6	20.8	27.8	46.0
◆	3	11	10.7	171.4	45.5	19.7	25.8	45.2
■	3	13	13.7	168.4	72.5	25.3	47.2	70.1
▲	4	7	4.6	177.5	48.9	22.1	26.8	36.3
●	4	9	7.6	174.5	54.6	21.1	33.4	50.6
◆	4	11	10.7	171.4	48.4	21.1	27.3	46.6
■	4	13	13.7	168.4	77.6	25.4	52.2	74.1

Date: Dec-13
 Project: Hwy 65, Sutton Creek
 G.W.P: 5358-11-00

Prep'd: AT
 Chkd: MAM
 Ref. No.: 13/05/13073-F1

In-Situ Shear Strengths vs. Depth



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					28.0				9			
	2	0.8	0	1	66	33	25.2	35.9	21.1	14.8	8			
	3	1.5					27.3				9			
	4	2.3					37.9				4			
	5	3.1	0	0	56	44	44.4	49.3	21.2	28.0	WH			
	6	3.8					53.3				PM			
	7	4.6					52.5				PM			
	8	6.1					57.4				PM			
	9	7.6					27.2				WH			
2	1	3.8					137.5				9			
	2	4.6					22.2				6			
	3	6.1					26.8				8			
	4	0.0					29.0				7			
	5	0.8					36.9				WH			
	6	1.5					43.0				WH			
	7	2.3					46.8				WH			
	8	3.1					56.5				PM			
	9	3.8					52.2				PM			
3	1	4.6	37	55	8		3.8				17			
	2	6.1									16			
	3	7.6					7.7				7			
	4	0.0	9	8	49	34	24.2	41.1	24.2	17.0	5			
	5	0.76					25.7				6			
	6	1.52	0	0	66	34	31.0	45.2	21.8	23.4	5			
	7	0.0					36.9				WH			
	8	0.8	0	0	49	51	46.0	48.6	20.8	27.8	PM			
	9	0.0					53.2				PM			

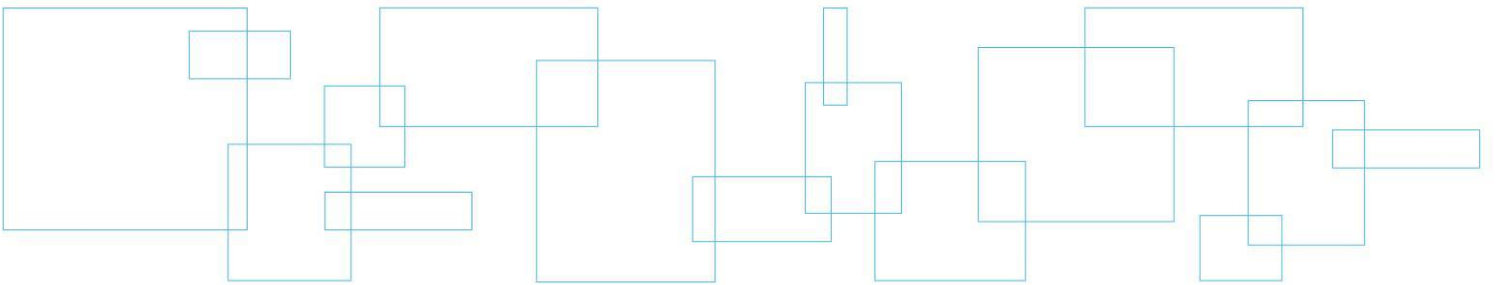
Laboratory Tests - Summary Sheet

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Appendix 4 Photo Essay

Enclosure No. 6:

Photo Essay



Existing Embankment – Looking East

Photo: 1



Culvert Outlet – Looking South

Photo: 2



Project: Hwy 65 – Stations 20+440 and 20+448, Twp of Harris

Photos Provided By: LVM

Date: June 2013

Culvert Outlet – Looking West

Photo: 3



Culvert Inlet – Looking North

Photo: 4



Project: Hwy 65 – Stations 20+440 and 20+448, Twp of Harris

Photos Provided By: LVM

Date: June 2013

Culvert Inlet – Looking East

Photo: 5



Culvert Inlet (East Barrel) – Looking South

Photo: 6



Project: Hwy 65 – Stations 20+440 and 20+448, Twp of Harris

Photos Provided By: LVM

Date: June 2013