



**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 – Whiskey Jack Culvert
Highway 66
Station 14+791 - Twp. of Cairo
Site No. 47-001
GWP 364-00-00
WP 5290-07-01**

FINAL FOUNDATION INVESTIGATION REPORT

Date: May 21, 2014
Ref. N^o: 13/05/13073-F3

Geocres No. 41P-56

LVM | MERLEX

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Final Foundation Investigation Report

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

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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North Bay, Ontario

P1B 1Z2

Attention: **Mr. Al Rose**

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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 triple centerline culvert site. The site is located at Whiskey Jack Creek on Highway 66, some 0.3 km East of Highway 65, in the Township of Cairo, Site No. 47-001.

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 triple 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

The triple Corrugated Steel Pipe (CSP) culverts are located on Highway 66 at Stations 14+788, 14+791, and 14+794, Township of Cairo. The topography at the site is a low wetland 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 317.2 m at the culvert location. The existing embankment slopes have been established between angles of 1.6H:1V to 2H:1V. The culverts at this location are 2.0 m diameter Corrugated Steel Pipe (CSP) culverts, some 17 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 to the left (north) side of the highway embankment.

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 materials were also observed. Within the project area native overburden consists primarily of sands and gravels overlying bedrock.

Bedrock in the area, as indicated on OGS Map 2506, is of the Early Precambrian Mafic Metavolcanics, which consists of basaltic and andesitic flows, tuffs, and breccias.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period of October 2nd to 17th, 2013 during which time six (6) sampled boreholes, were advanced. Two (2) boreholes were

advanced through the embankment at the location of the triple culverts, and two boreholes were advanced at each of the inlet (north) and outlet (south) ends of the culverts.

The field investigation was carried out using a truck mounted CME drilling rig equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment. In order to advance sampled boreholes at the inlet and outlet of the culverts, a mobile B-24 “fly-in” drill rig mounted on a raft was employed equipped with NW casing, NQ coring equipment, and conventional split spoon 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. When shallow refusal was encountered, NQ size diamond coring equipment was used to determine the nature of shallow refusal. 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 19 mm diameter standpipe was installed in Borehole No. 1, prior to backfilling, to allow for further monitoring of the shallow groundwater levels. All other 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 Ontario Regulation 903. 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. Upon completion of the fieldwork program the standpipe in Borehole No. 1 was decommissioned in accordance with Ontario Reg. 903.

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-4).

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 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 14+791, TWP OF CAIRO

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, six (6) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced through the embankment, Borehole Nos. 3 and 4 advanced at the culvert inlet, and Borehole Nos. 5 and 6 advanced at the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 and 2 were recorded at elevation 317.1 m. The elevations of the creek water surface at Borehole Nos. 3 to 6, inclusive, were recorded at elevation 314.8 m.

4.1.1 Pavement Structure

Borehole Nos. 1 and 2 were advanced from the shoulders where a pavement structure consisting of 50 mm asphalt and 150 mm crushed gravel was penetrated.

4.1.2 Granular Fill

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of granular fill consisting of brown sand trace silt some to with gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 2 to 4%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 9% gravel size particles, 85% sand size particles, and 6% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 31 to 54 blows per 300 mm penetration, the compactness of this deposit was described as dense to very dense. This deposit was encountered to depths of 1.4 and 2.1 m below grade at Borehole Nos. 1 and 2, respectively (elevations 315.7 and 315.0 m, respectively).

4.1.3 Sands and Gravels

At the creek bottom at Borehole Nos. 4, 5, and 6, a deposit of gravel and sand described as grey sand and gravel to gravel with sand trace silt was penetrated. Decomposed wood pieces were encountered in this deposit at varying depths. The natural moisture content measured on

samples of this deposit was in the order of 12 to 381%. The elevated moisture contents are due to the wood pieces (organic soils) in the deposit. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 47 and 69% gravel size particles, 30 and 52% sand size particles, and 1% silt and clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 2 to 15 blows per 300 mm penetration, this deposit was described as very loose to compact. This deposit was encountered to a depth of 3.1 m below creek water surface at Borehole No. 4 (elevation 311.7 m), where bedrock was encountered. This deposit was encountered to depths of 2.5 and 2.0 m below creek water surface at Borehole Nos. 5 and 6, respectively (elevations 312.3 and 312.8 m, respectively).

4.1.4 Sands

Underlying the granular fill at Borehole Nos. 1 and 2, at the creek bottom at Borehole No. 3, and underlying the gravel and sand at Borehole Nos. 5 and 6, a stratum of grey sand some gravel to gravelly trace silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 3 to 25%. Gradation analyses were carried out on six (6) samples of this deposit, the results of which indicated 9 to 33% gravel size particles, 62 to 90% sand size particles, and 1 to 5% silt and clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 5 to 61 blows per 300 mm penetration, this deposit was described as loose to very dense, generally compact. This deposit was encountered to a depth of 2.0 m below creek water surface at Borehole No. 3 (elevation 312.8 m), where bedrock was encountered. Sampling was terminated in this deposit at a depth of 8.7 m below creek water surface at Borehole Nos. 5 and 6 (elevations 307.0 m). Auger refusal was encountered in this deposit at depths of 8.6 and 11.0 m below grade at Borehole Nos. 1 and 2, respectively (elevations 308.5 and 306.1 m).

4.1.5 Bedrock

Underlying the sands at Borehole No. 3 and underlying the sand and gravel at Borehole No. 4, bedrock was proven by diamond core drilling. The bedrock was described as black basaltic bedrock. Based on RQD values of 25 to 97% the bedrock was described as poor to excellent quality, generally fair quality. Sampling in the bedrock was terminated at depths of 5.3 and 5.6 m below creek water surface at Borehole Nos. 3 and 4, respectively (elevations 309.5 and 309.2 m, respectively). It should be noted that, when encountered, the underlying bedrock surfaces in this area are very erratic in nature, varying substantially in elevation over short horizontal distances.

4.2 GROUNDWATER DATA

At the time of this investigation, the creek water level in the culvert was measured at elevation 314.8 m at the inlet and outlet.

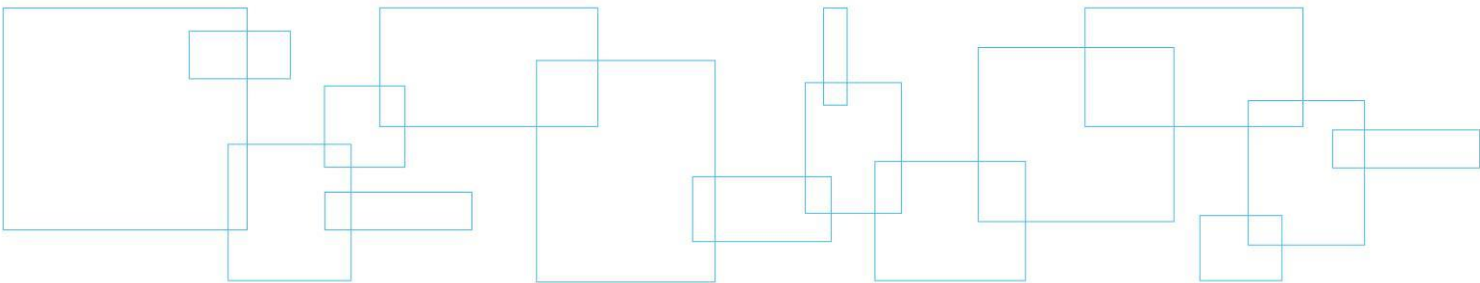
Measurements of the groundwater table and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. A standpipe was installed in Borehole No. 1 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

The water levels were measured between elevations 315.2 to 315.3 m below grade at Borehole Nos. 1 and 2, respectively. The standpipe in Borehole No. 1 was decommissioned in accordance with Ontario Reg. 903 on the last day work was carried out at this site.

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

Appendix 1 Key Plan

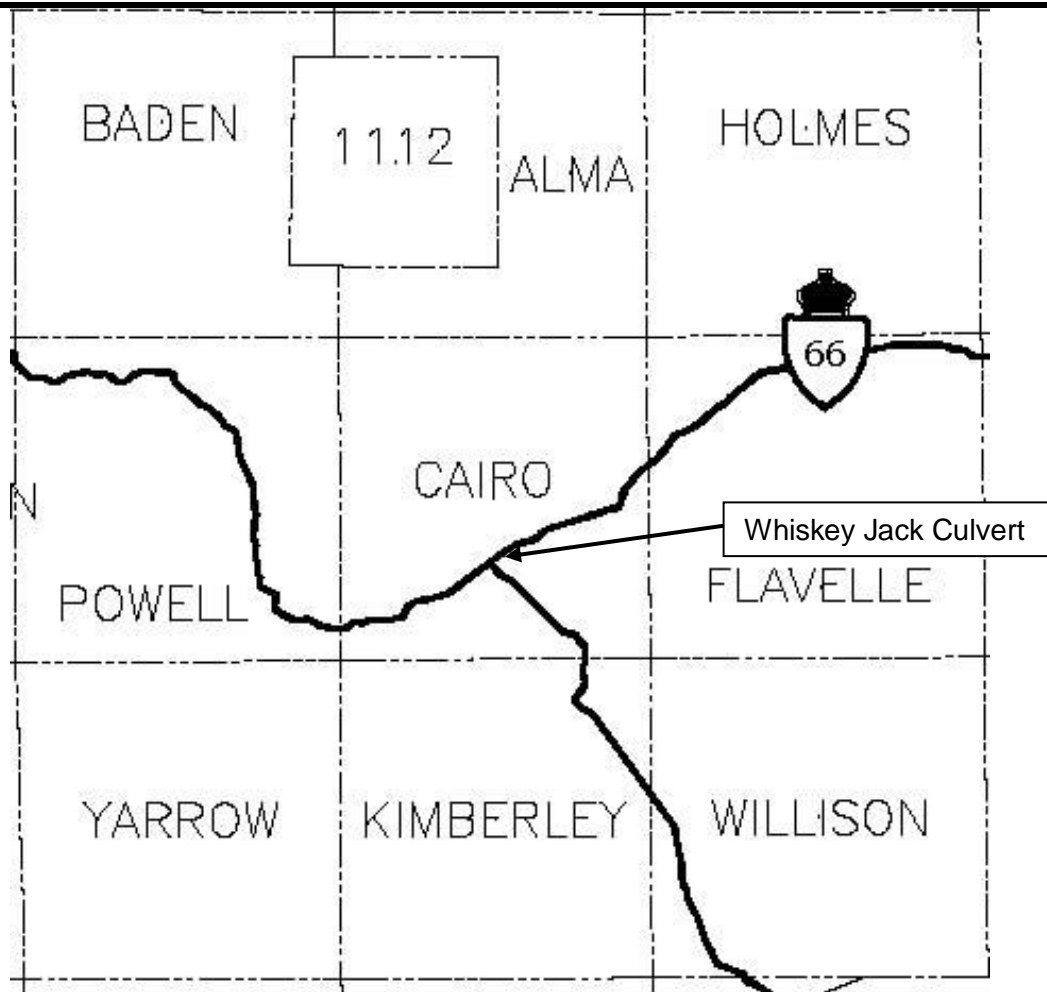
Drawing No. 1 Key Plan



KEY PLAN

Drawing No. 1

NOT TO SCALE



**FINAL
FOUNDATION INVESTIGATION REPORT**

GWP 364-00-00

Highway 66

Whiskey Jack Creek Culvert

LVM | MERLEX

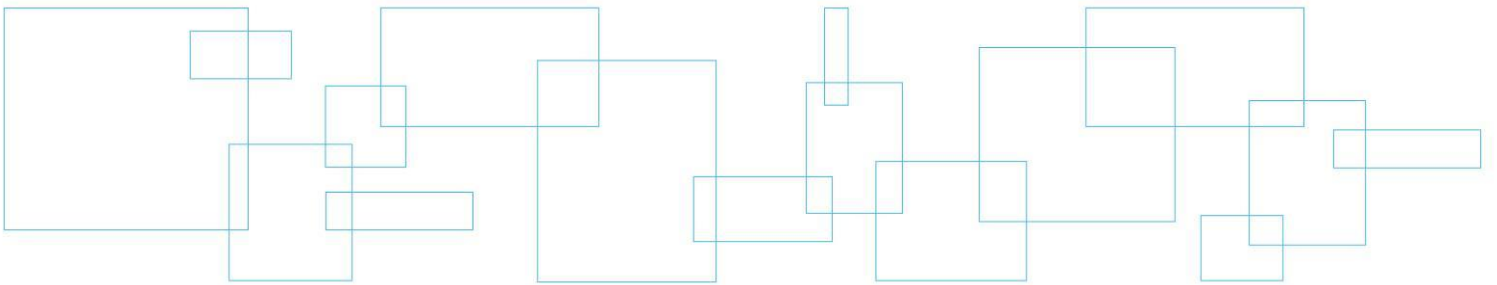
Reference No: 13/05/13073-F3

May 2014

Appendix 2 Subsurface Data

Enclosure No. 1
Enclosure Nos. 2 to 7

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. 01



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313213.4 E 335043.5 - Cairo Township - Station 14+784, 2.2 m R ORIGINATED BY JL

PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) 2013 October 2 TIME

DATE (Completed) 2013 October 2 (Completed) 2:45:00 PM CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES														
317.1	Asphalt Surface																		
0.0	± 50 mm Asphalt ± 150 mm Crushed Gravel		1	AS	N/A														
	FILL - sand trace silt some to with gravel		2	SS	31														
	brown, dry																		
	(dense)																		
315.7	SAND some gravel to gravelly trace silt		3	SS	17								23 73 (4)						
1.4	brown, dry																		
	(loose/very dense)		4	SS	13								23 72 (5)						
	moist/wet																		
			5	SS	18														
	grey		6	SS	16								33 62 (5)						
			7	SS	9								20 76 (4)						
			8	SS	5														
			9	SS	61														
308.5	Auger Refusal End of Borehole																		
8.6																			
COMMENTS The stratification lines represent approximate boundaries. The transition may be gradual.								WATER LEVEL RECORDS											
								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa						Date (yy/mm/dd)/Time					
								○ 3% STRAIN AT FAILURE						Water Depth (m)					
														Cave In (m)					
								1) 13/10/2 2:45:00 PM						1.9		2.2			
								2) 13/10/18 8:00:00 AM						2.4		-			
								3)						-		-			

MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26



METRIC

RECORD OF BOREHOLE NO. 02



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313221.3 E 335053.8 - Cairo Township - Station 14+797, 2.2 m Lt ORIGINATED BY JL
 PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 2013 October 2 TIME
 DATE (Completed) 2013 October 2 (Completed) 5:30:00 PM CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)														
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES																				
317.1	Asphalt Surface		1	AS	N/A	▽ ■	317				9 85 (6)														
0.0	± 50 mm Asphalt ± 150 mm Crushed Gravel FILL - sand trace silt trace to some gravel brown, dry (dense/very dense)		2	SS	54		316																		
			3	SS	39																				
315.0	SAND trace silt some to with gravel brown, wet (loose/compact)	4	SS	11	315																				
2.1		5	SS	8	314																				
		6	SS	4	313																				
		7	SS	4	312																				
		8	SS	8	311																				
		9	SS	12	310																				
		10	SS	6	309																				
					308																				
Continued Next Page																									
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 <table border="1"> <thead> <tr> <th>Date (yy/mm/dd)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 13/10/2 5:30:00 PM</td> <td>1.8</td> <td>2.1</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)	1) 13/10/2 5:30:00 PM	1.8	2.1	2)	-	-	3)	-	-
							Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)																
							1) 13/10/2 5:30:00 PM	1.8	2.1																
							2)	-	-																
3)	-	-																							

MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26



METRIC

RECORD OF BOREHOLE NO. 02



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313221.3 E 335053.8 - Cairo Township - Station 14+797, 2.2 m Lt ORIGINATED BY JL
 PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 2013 October 2 TIME
 DATE (Completed) 2013 October 2 (Completed) 5:30:00 PM CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w_p	w	w_L		
	Continued from Previous Page																
306.1	SAND trace silt some to with gravel grey, wet (loose/compact)		11	SS	8/150mm 50/50mm												
11.0	Auger Refusal End of Borehole																

MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26



METRIC

RECORD OF BOREHOLE NO. 03



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313223.4 E 335042.1 - Cairo Township - Station 14+789, 11.4 m ORIGINATED BY JL
 PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Raft Mounted B-24 - NW Casing & NQ Core COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 2013 October 15 TIME
 DATE (Completed) 2013 October 16 (Completed) 11:45:00 AM CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W		
314.8	Water Surface															
0.0	Water															
313.6	SAND trace silt with gravel brown, wet		1	SS	32											
312.8	BEDROCK - black basaltic rock (poor quality)		2	SS-50/25mm												
2.0	(fair quality)		3	RC	Rec=100% RQD=25%											
			4	RC	Rec=100% RQD=70%											
			5	RC	Rec=100% RQD=73%											
309.5	End of Borehole															
5.3																

COMMENTS	+ 3, x 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)
The stratification lines represent approximate boundaries. The transition may be gradual.		1) 13/10/16	0	▽ - 變
		2)	-	▽ -
		3)	-	▽ -

MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26



METRIC

RECORD OF BOREHOLE NO. 04



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313229.7 E 335048.7 - Cairo Township - Station 14+798, 12.0 m ORIGINATED BY JL
 PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Raft Mounted B-24 - NW Casing & NQ Core COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 2013 October 16 TIME
 DATE (Completed) 2013 October 16 (Completed) 6:15:00 PM CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
314.8	Water Surface															
0.0	Water															
313.9	SAND AND GRAVEL trace silt grey (very loose/loose)		1	SS	8											
	decomposed wood pieces encountered at depth		2	SS	2											
311.7			3	SS	HW/300mm 25/0mm											
3.1	BEDROCK - black basaltic rock (good quality)		4	RC	Rec=100% RQD=78%											
	(excellent quality)		5	RC	Rec=100% RQD=97%											
309.2																
5.6	End of Borehole															
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 (yy/mm/dd)/Time		Water Depth (m)		Cave In (m)	
The stratification lines represent approximate boundaries. The transition may be gradual.											1) 13/10/16		0		-	
											2)		-		-	
											3)		-		-	

MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26



METRIC

RECORD OF BOREHOLE NO. 05



REFERENCE 13/0513073-F3 DATUM Geodetic LOCATION N 5313209.6 E 335062.7 - Cairo Township - Station 14+797, 12.4 m ORIGINATED BY JL
 PROJECT GWP 364-00-00, Hwy 66 - Whiskey Jack Culvert BOREHOLE TYPE Raft Mounted B-24 - NW Casing & NQ Core COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 2013 October 17 TIME
 DATE (Completed) 2013 October 17 (Completed) CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p		
314.8	Water Surface														
0.0	Water														
313.9	GRAVEL AND SAND trace silt and decomposed wood pieces		1	SS	3									128	
0.9	grey, wet (loose/compact)														
312.3	SAND trace silt trace to with gravel		2	SS	15										69 30 (1)
2.5	grey, wet (compact)														
			3	SS	14										
			4	SS	16										9 90 (1)
			5	SS	11										
			6	SS	13										
			7	SS	15										23 76 (1)
307.0	End of Sampling End of Borehole														
7.8															

COMMENTS		WATER LEVEL RECORDS	
+ 3, x 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE		Date (yy/mm/dd)/Time	Water Depth (m) Cave In (m)
		1) 13/10/17	0 - -
		2)	- - -
		3)	- - -

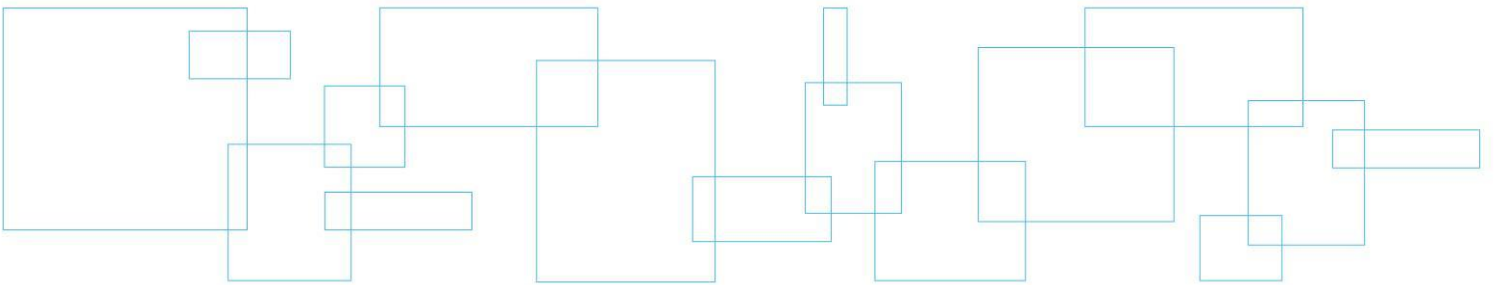
The stratification lines represent approximate boundaries. The transition may be gradual.

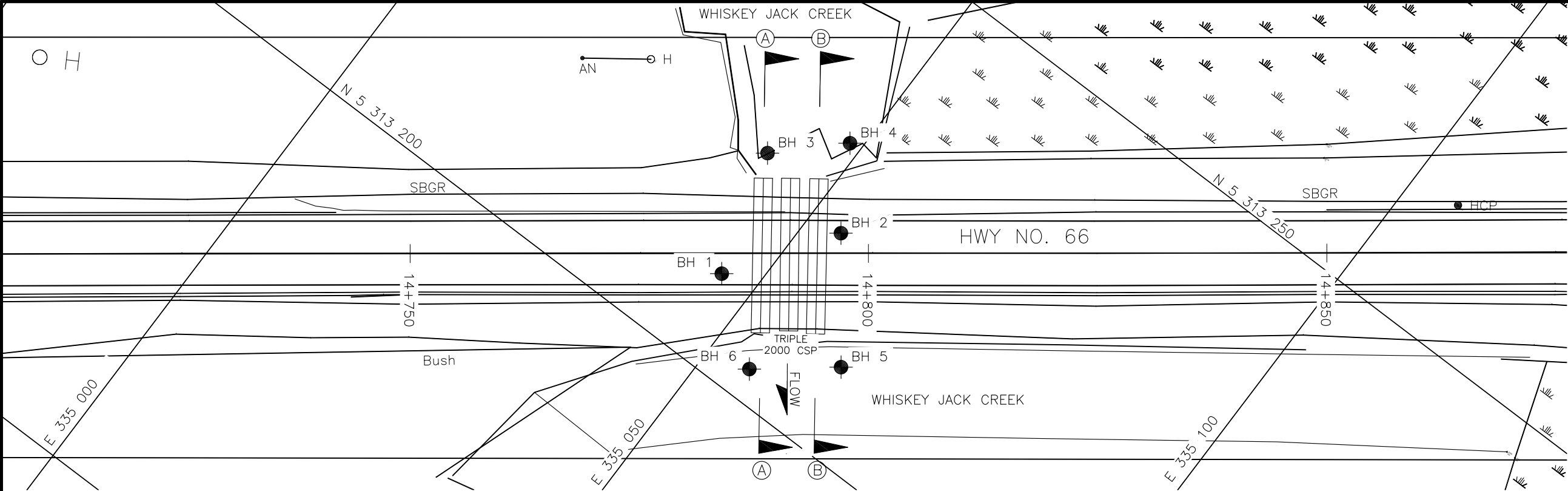
MEL-GEO 13073-F3 - BOREHOLE LOGS - WHISKEY JACK CULVERT.GPJ MEL-GEO.GDT 14/5/26

L|V|M

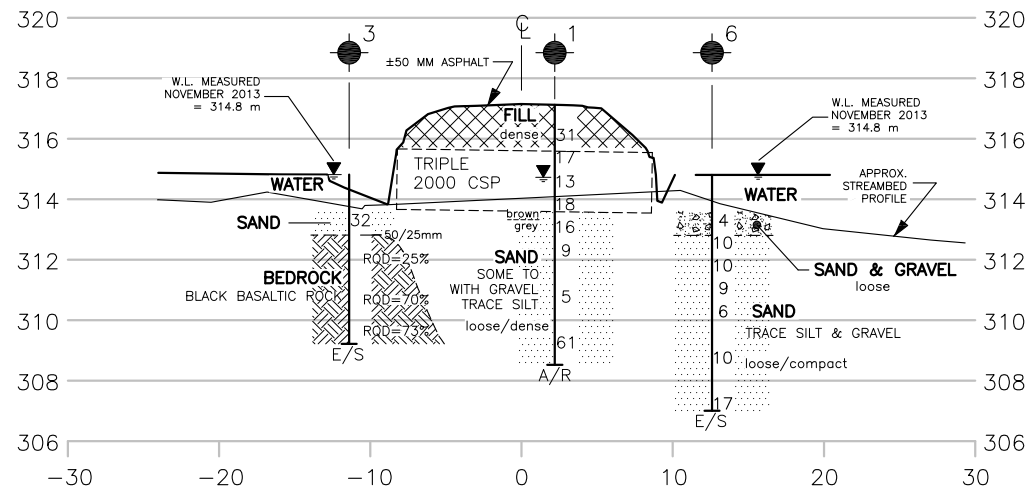
Appendix 3 Borehole Plan and Lab Data

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

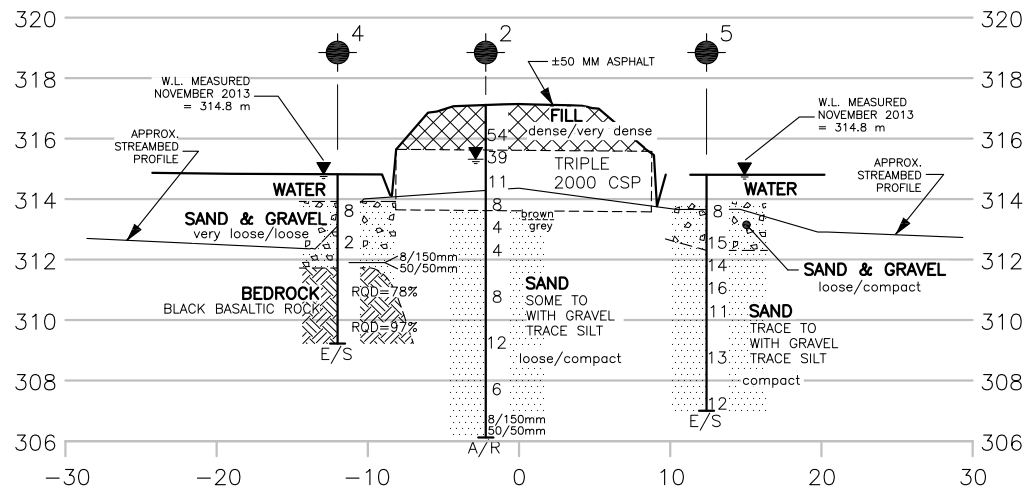




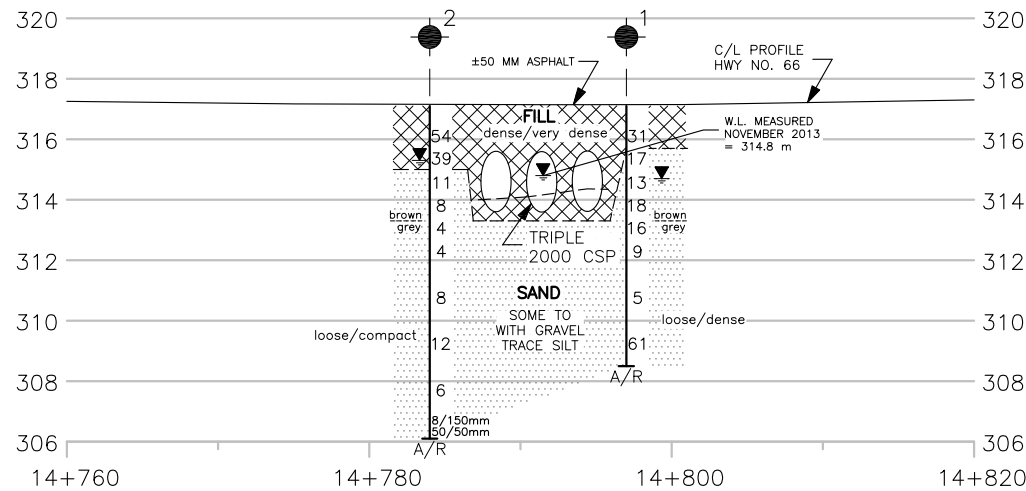
PLAN
5m SCALE 5m



CROSS SECTION (A) - (A)
5m SCALE 5m HOR 2.5m VER



CROSS SECTION (B) - (B)
5m SCALE 5m HOR 2.5m VER



C/L PROFILE
5m SCALE 5m HOR 2.5m VER

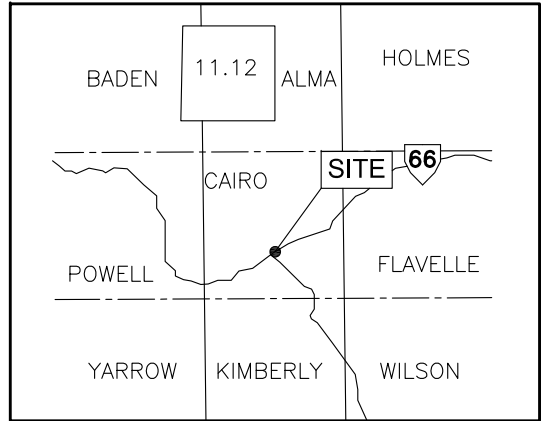
CONT. No.
XXXX-XXXX

GWP. No.
364-00-00

N

DRAWING
2

HWY 66
WHISKEY JACK CULVERT (SITE 47-001)
CAIRO TOWNSHIP
BOREHOLE LOCATIONS & SOIL STRATA



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole
- 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
- E/S End of Sampling

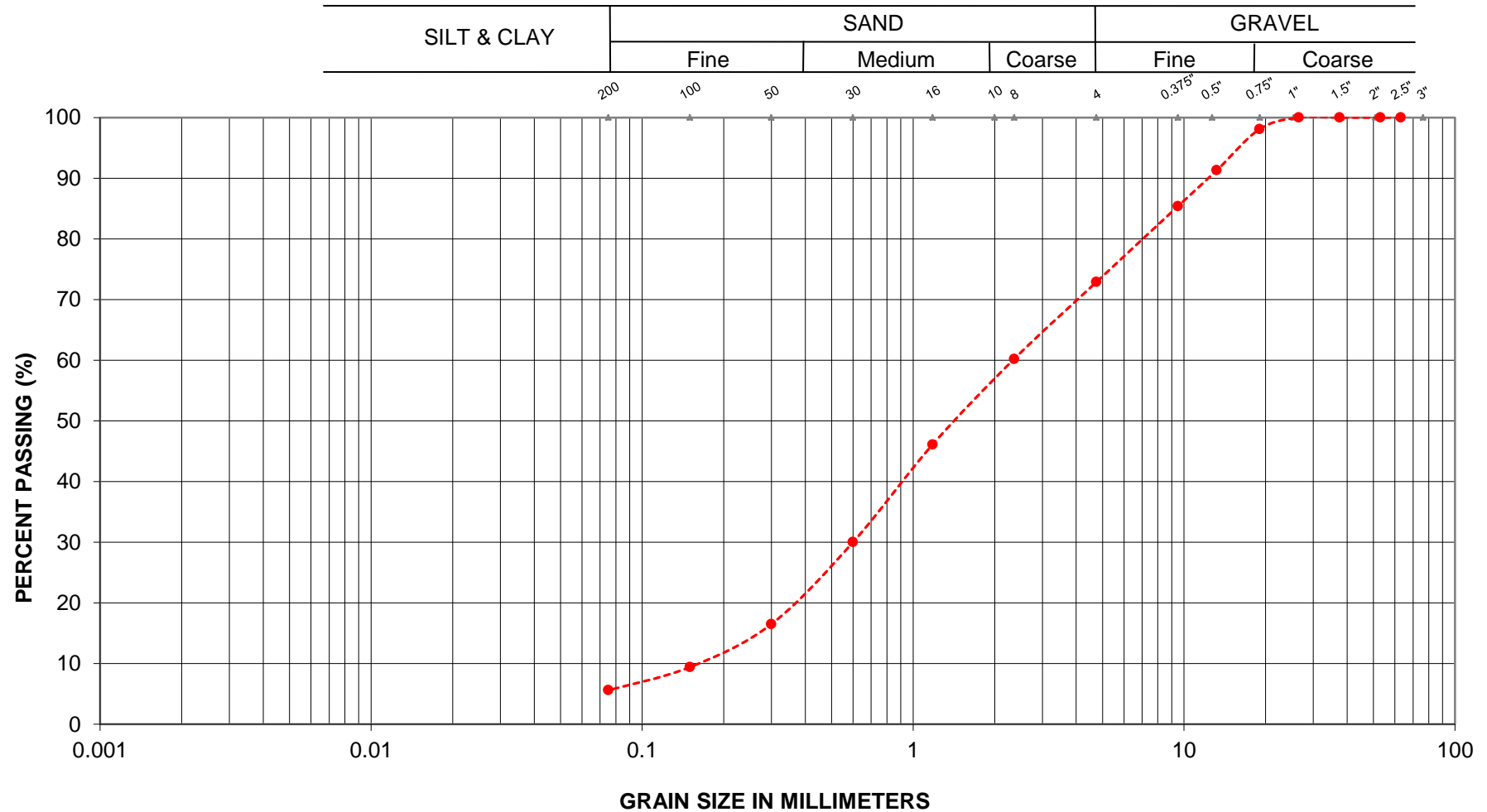
Borehole No.	Elev.	O/S	Co-ordinates	
			Northerly	Easterly
Borehole No. 1	317.1	2.2 m Rt	5313213.4	335043.5
Borehole No. 2	317.1	2.2 m Lt	5313221.3	335053.8
Borehole No. 3	314.8	11.4 m Lt	5313223.4	335042.1
Borehole No. 4	314.8	12.0 m Lt	5313229.7	335048.7
Borehole No. 5	314.8	12.4 m Rt	5313209.6	335062.7
Borehole No. 6	314.8	12.6 m Rt	5313203.4	335054.8

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
	MAY 2014	IK	REVISION 1
HWY NO. 66 - CAIRO TOWNSHIP			
GEOCRES NO.: 41P-56			
L V M REF. NO.: 13/05/13073-F3			
DRAWN: RG		CHECKED: AT	DATE: JANUARY 2014

GRAIN SIZE ANALYSIS



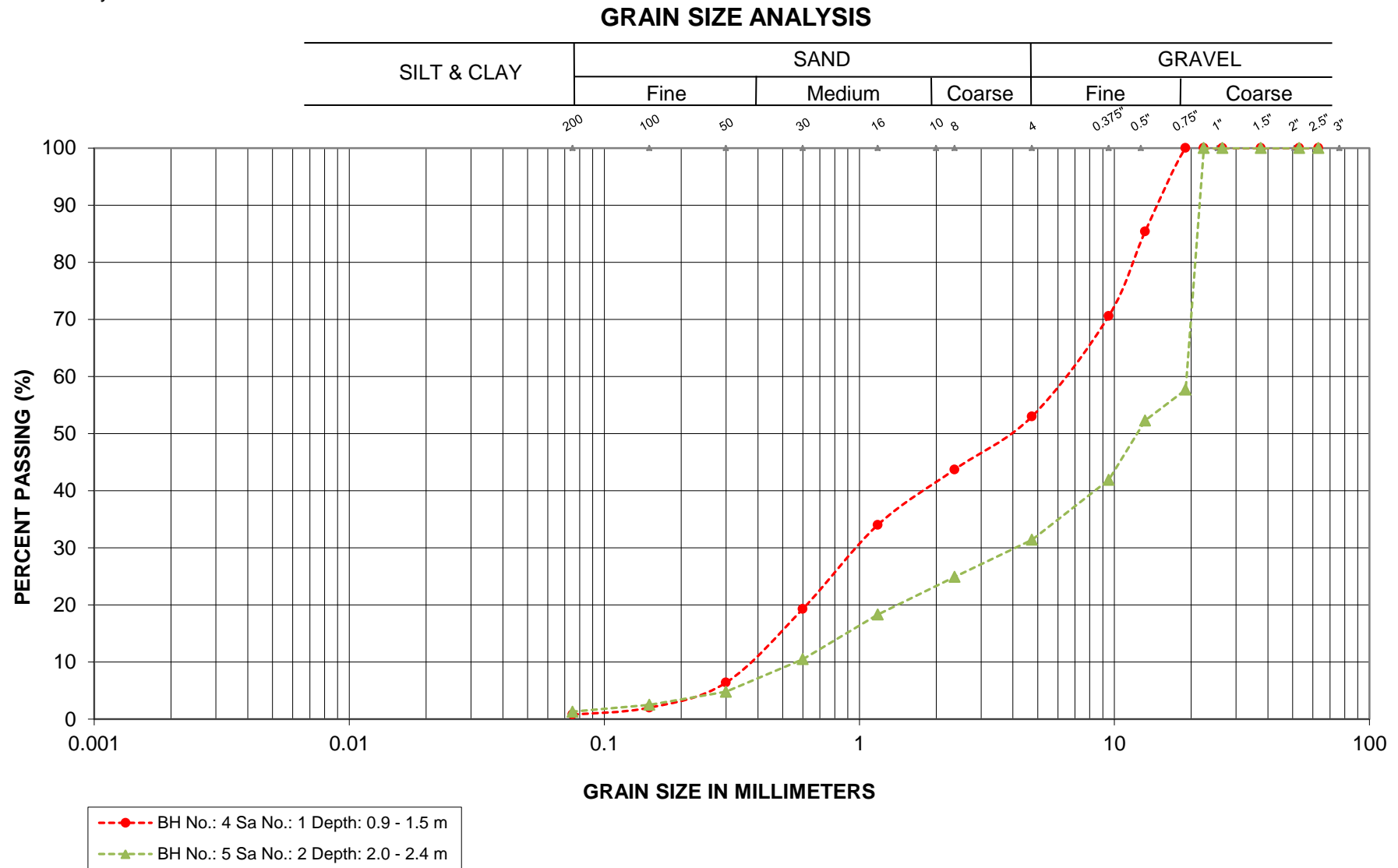
---●--- BH No.: 2 Sa No.: 1 Depth: 0.0 - 0.8 m

G.W.P.: 364-00-00
LOCATION: Hwy 65, Whiskey Jack Creek

EMBANKMENT FILL

LVM | MERLEX

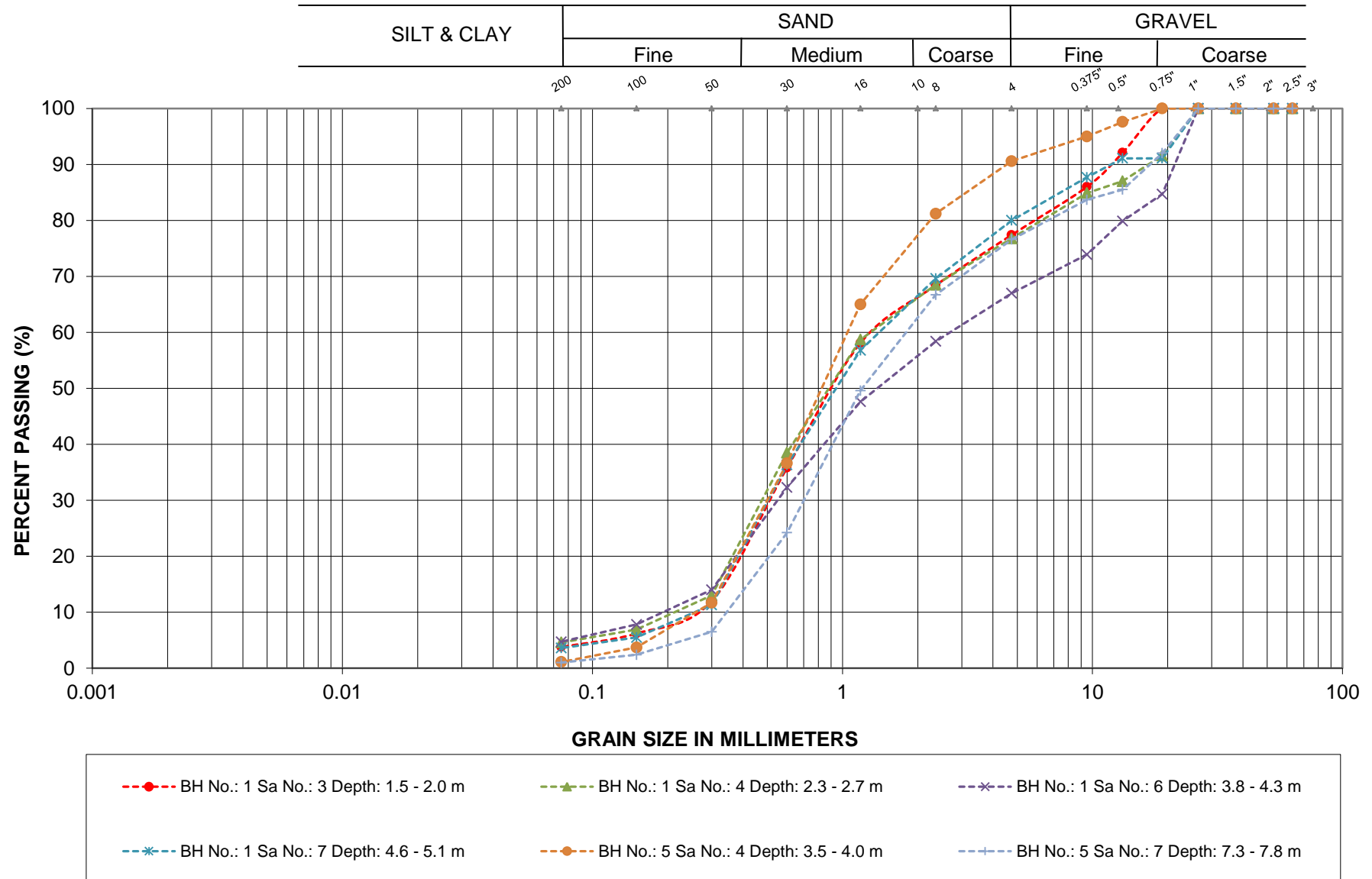
FIGURE L-1



G.W.P.: 364-00-00
LOCATION: Hwy 65, Whiskey Jack Creek

SAND AND GRAVEL

GRAIN SIZE ANALYSIS



G.W.P.: 364-00-00
LOCATION: Hwy 65, Whiskey Jack Creek

SAND

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					2.3				N/A			
	2	0.8					3.8				31			
	3	1.5	23	73	4		3.4				17			
	4	2.3	23	72	5		14.2				13			
	5	3.1					10.1				18			
	6	3.8	33	62	5		14.2				16			
	7	4.6	20	76	4		20.8				9			
	8	6.1					20.6				5			
	9	7.6					11.3				61			
2	1	0.0	9	85	6		3.6				N/A			
	2	0.8					3.3				54			
	3	1.5					3.0				39			
	4	2.3					13.2				11			
	5	3.1					18.3				8			
	6	3.8					18.6				4			
	7	4.6					23.2				4			
	8	6.1					15.6				8			
	9	7.6					22.7				12			
	10	9.1					16.6				6			
	11	10.7					16.5				8/150mm			
3	1	1.2					19.4				32			
	2	2									50/25mm			
	3	2.0												Rec= 100% RQD= 25%
	4	3.5												Rec= 100% RQD= 70%
	5	4.7												Rec= 100% RQD= 73%

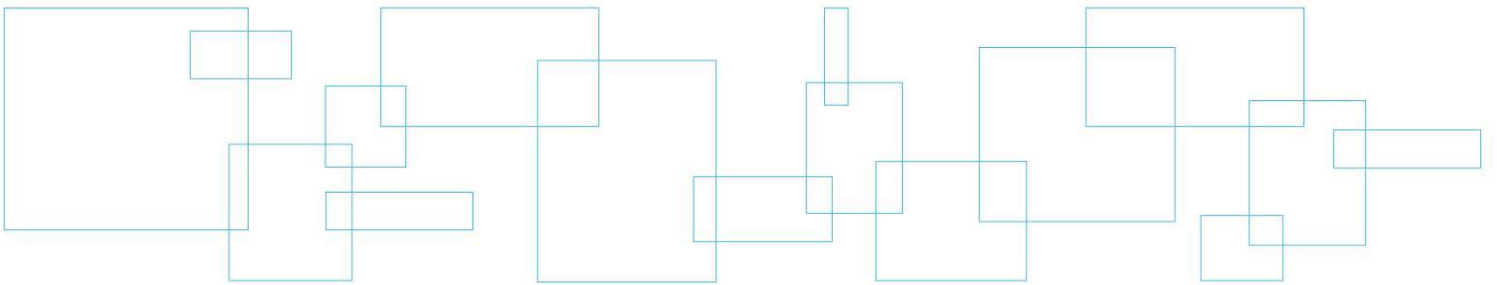
Laboratory Tests - Summary Sheet

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 (%)				
4	1	0.9	47	52	1		18.3				8			
	2	2.0					34.0				2			
	3	2.7					381.0							
	4	3.1												Rec= 100% RQD= 78%
	5	4.4												Rec= 100% RQD= 97%
5	1	0.9					128.0				3			
	2	2.0	69	30	1		12.6				15			
	3	2.7					15.4				14			
	4	3.5	9	90	1		24.7				16			
	5	4.3					23.7				11			
	6	5.8					20.9				13			
	7	7.3	23	76	1		17.9				15			
6	1	1.2					39.68				4			
	2	2					4.94				10			
	3	2.74					18.74				10			
	4	3.51					15.64				9			
	5	4.27					8.3				6			
	6	5.8					13.28				10			
	7	7.32					9.23				17			

Appendix 4 Photo Essay

Enclosure No. 8:

Photo Essay



Existing Embankment, North Side – Looking West

Photo: 1



Existing Embankment, South Side – Looking East

Photo: 2



Project: Hwy 66 – Stations 14+791, Twp of Cairo

Photos Provided By: LVM

Date: October 2013

Culvert Inlet – Looking South East

Photo: 3



Culvert Outlet, Center and East Culverts – Looking South

Photo: 4



Project: Hwy 66 – Stations 14+791, Twp of Cairo

Photos Provided By: LVM

Date: July 2013