



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

**Highway 65 Rehabilitation
Culvert Replacement
Station 12+548 - Twp. of Dymond
GWP 5574-04-00**

**Highway 65
From 0.1 km East of Armstrong Street, Easterly 22.5 km to the Ontario/Quebec
Boundary**

FINAL FOUNDATION INVESTIGATION REPORT

Date: June 19, 2013
Ref. N^o: 12/03/12028-F2

Geocres No. 31M-103

LVM | MERLEX

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Culvert Replacement
Station 12+548 - Twp. of Dymond
GWP 5574-04-00**

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**

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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 at an existing centerline culvert site. The site is located on Highway 65, some 2.6 km East of Highway 11, in the Township of Dymond.

The foundation investigation location was specified by the MTO in the Terms of Reference for extra work under Agreement No. 5010-E-0028. The terms of reference for the scope of work are outlined in LVM | MERLEX's Proposal P-11-023, dated August, 2012. The purpose of this investigation was to determine the subsurface conditions in the area of the culvert. LVM | MERLEX investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2 SITE DESCRIPTION

The foundation investigation for this Structural Plate Corrugated Steel Pipe (CSP) culvert is located on Highway 65 at Station 12+548, Township of Dymond. The topography at the site is a predominately flat with a creek 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 a granular and earth fill embankment some 10.8 m in height, with centerline elevation of 197.5 m at the culvert location. The culvert at this location is a 2.3 m diameter SPCSP culvert, some 77.9 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 (north) side 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 Middle/Late Silurian. At the location of this culvert foundation investigation, the bedrock comprises of dolostone, limestone, sandstone, and shale.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period of October 31st to November 14th, 2012 during which time six (6) sampled boreholes and DCPTs, were advanced.

Four (4) boreholes were advanced through the embankment up and down chainage from the culvert, and one borehole was advanced at each the inlet and outlet ends of the culvert.

The field investigation was carried out using 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. At select boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. 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. Consolidation testing was also carried out on two samples of the native silty clay deposit. 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-10).

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 benchmark used at the culvert at Station 12+548 was described as a nail and washer in the southeast face of Hydro Pole at Station 12+631.3, 18.8 m

left of centerline (see Drawing No. 2, Appendix 3). 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 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 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 12+548, TWP OF DYMOND

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Figure 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 6 advanced at the culvert ends (left and right, respectively), and Borehole Nos. 2 to 5 advanced through the embankment. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 6 were recorded at 191.3, 197.3, 197.6, 196.9, 198.3, and 189.4 m, respectively.

4.1.1 Pavement Structure

At surface at Borehole Nos. 2 and 3, a pavement structure consisting of 50 to 100 mm of asphalt and 100 mm crushed gravel was penetrated. At surface at Borehole Nos. 4 and 5, a layer of crushed gravel some 150 mm thick was penetrated.

4.1.2 Granular Fill

Underlying the pavement structure at Borehole Nos. 2 to 5, a deposit of granular fill consisting of brown sand trace silt trace gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 4 to 23%. Gradation analyses were carried out on three (3) samples of this deposit, the results of which indicated 6 to 30% gravel size particles, 58 to 88% sand size particles, and 6 to 13% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 8 to 47 blows per 300 mm penetration, the compactness of this deposit was described as loose to dense, generally compact. This deposit was encountered to depths of 5.5, 4.1, 1.4, and 1.7 m below grade at Borehole Nos. 2 to 5, respectively (elevations 191.8, 193.5, 195.5, and 196.6 m, respectively).

4.1.3 Clay Fill

Underlying the granular fill at Borehole Nos. 2 and 3, and at surface at Borehole No. 6, a deposit of fill described as brown to grey clay with silt trace to some sand was penetrated. The natural moisture content measured on samples of this deposit was in the order of 20 to 55%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 0% gravel size particles, 0 to 14% sand size particles, 29 to 32% silt size particles, and 57 to 68% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on two (2) samples of this deposit, the results of which indicated a Plastic Limit in the order of 24 to 25% and a Liquid Limit in the order of 70 to 75% (Figure No. L-6, Appendix 3). Based on the results of the Atterberg Limits testing, this deposit was described as a clay of high plasticity (CH). This deposit was encountered to depths of 7.3, 9.4, and 3.0 m below grade at Borehole Nos. 2, 3 and 6, respectively (elevations 190.0, 188.2, and 186.0 m, respectively).

4.1.4 Sand and Clay Fill

At surface at Borehole No. 1, and underlying the clay fill at Borehole Nos. 2 and 3, a deposit of fill described as grey sand and clay some silt some gravel was penetrated. Trace organics and wood pieces were encountered in this deposit at Borehole No. 1. Occasional cobbles were encountered in this deposit at Borehole No. 1. The natural moisture content measured on samples of this deposit was in the order of 17 to 56%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 15% gravel size particles, 35% sand size particles, 17% silt size particles, and 33% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was carried out on one (1) sample of this deposit, the results of which indicated a Plastic Limit in the order of 26% and a Liquid Limit in the order of 70% (Figure No. L-6, Appendix 3). Based on the results of the Atterberg Limits testing, this deposit was described as a clay of high plasticity (CH). This deposit was encountered to depths of 9.0 and 10.8 m below grade at Borehole Nos. 2 and 3, respectively (elevations 188.3 and 186.8 m, respectively).

4.1.5 Clay

Underlying the sand and clay fill at Borehole Nos. 1 and 2, underlying the granular fill at Borehole Nos. 4 and 5, and underlying the clay fill at Borehole No. 6, a deposit of grey clay some to with silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 26 to 67%. Hydrometer analyses were carried out on three (3) samples of this deposit, the results of which indicated 0% gravel size particles, 0% sand size particles, 15 to 49% silt size particles, and 51 to 85% clay size particles (Figure No. L-4, Appendix 3). Atterberg Limits testing was carried out on three (3) samples of this deposit, the results of which indicated a Plastic Limit in the order of 20 to 24% and a Liquid Limit in the order of 66 to 77% (Figure No. L-6, Appendix 3). Based on the results of the Atterberg Limits testing, this deposit was described as a clay of high plasticity (CH). Based on in-situ shear strengths of 40 to greater than 100 kPa, the consistency of this deposit was described as firm to very stiff, generally stiff (Figure No. L-7, Appendix 3). This deposit was encountered to depths of 5.5,

10.4, 7.3, 7.3, and 4.6 m below grade at Borehole Nos. 1, 2, 4, 5, and 6, respectively, where a transition to a varved clay was observed (elevations 185.8, 186.9, 189.6, 191.0, and 184.8 m, respectively).

4.1.6 Varved Clay

Underlying the clay at Borehole Nos. 1, 2, 4, 5, and 6, and underlying the sand and clay fill at Borehole No. 3, a deposit of grey clay some to with silt was penetrated. Silty clay varves were encountered in this deposit. This deposit consisted of clay layers some 25 mm thick interbedded with silty clay varves some 6 mm thick. The natural moisture content measured on samples of this deposit was in the order of 38 to 69%. Hydrometer analyses were carried out on four (4) samples of this deposit, the results of which indicated 0% gravel size particles, 0% sand size particles, 34 to 39% silt size particles, and 61 to 66% clay size particles (Figure No. L-5, Appendix 3). Atterberg Limits testing was carried out on five (5) samples of the clay portion of this deposit, the results of which indicated a Plastic Limit in the order of 20 to 22% and a Liquid Limit in the order of 48 to 56% (Figure No. L-6, Appendix 3). Based on the results of the Atterberg Limits testing, the clay portion of this deposit was described as a clay of medium to high plasticity (CI to CH). Atterberg Limits testing was carried out on one (1) sample of the silty clay portion of this deposit, the results of which indicated a Plastic Limit in the order of 21% and a Liquid Limit in the order of 36% (Figure No. L-6, Appendix 3). Based on the results of the Atterberg Limits testing, the silty clay portion of this deposit was described as a silty clay of medium plasticity (CI). Based on in-situ shear strengths of 38 to 76 kPa, the consistency of this deposit was described as firm to stiff (Figure No. L-7, Appendix 3). Sampling was terminated in this deposit at depths of 9.9, 20.6, 20.6, 19.1, 19.1, and 8.4 m below grade at Borehole Nos. 1 to 6, respectively (elevations 181.4, 176.7, 177.0, 177.8, 179.2, and 181.0 m, respectively).

Two (2) one-dimensional oedometer (consolidation) tests were carried out on a sample of the deposit of the clay with varves (Borehole No. 1, Sample 8 and Borehole No. 2, Sample 12). The preconsolidation pressure was estimated (using the Casagrande method) to be in the order 170 kPa. The over-consolidation ratio, which is the ratio of the preconsolidation pressure to the existing effective overburden pressure, was in the order of 1.2 to 3.1. Based on the results of the oedometer (consolidation) tests, vane shear strength data, and the relationship of the moisture content to liquid limit, this deposit is considered to be overconsolidated, relative to the existing overburden pressure. Under the existing embankment, this deposit is considered to be slightly overconsolidated. Results from the consolidation tests are shown on enclosed Figure Nos. L-8 and L-9, Appendix 3.

Dynamic Cone Penetration Tests (DCPT) were advanced at Borehole Nos. 1, 3 and 6. DCPT refusal was encountered at depth of 29.5, 31.7, and 24.8 m below grade at Borehole Nos. 1 and 4 (elevations 161.8, 165.9, and 164.6 m, respectively).

4.2 GROUNDWATER DATA

The water level in the culvert was measured at elevations 189.3 and 188.5 m at the culvert inlet and outlet, respectively, at the time of this investigation.

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.

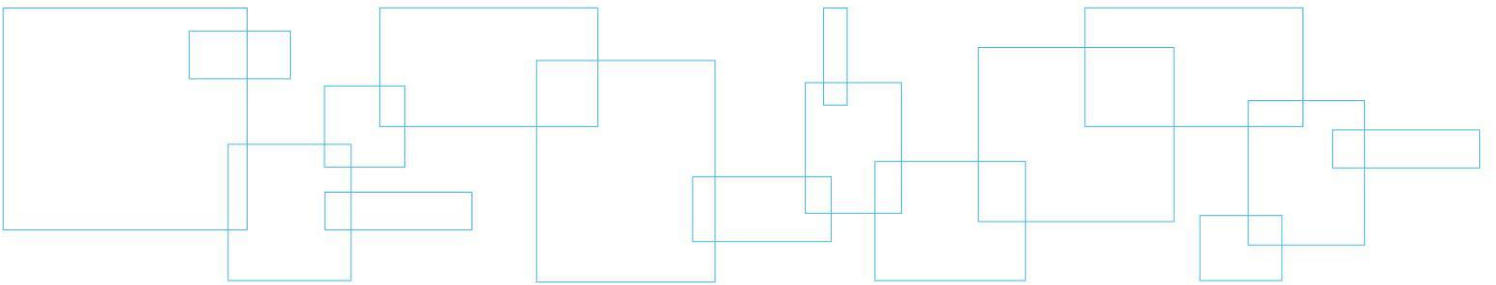
Standpipes were installed in Borehole Nos. 1, 3, 4, and 5, to obtain post completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B). The water levels in Borehole Nos. 1 to 6 were measured between elevations 185.1 to 195.1 m.

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

Appendix 1 Key Plan

Drawing No. 1

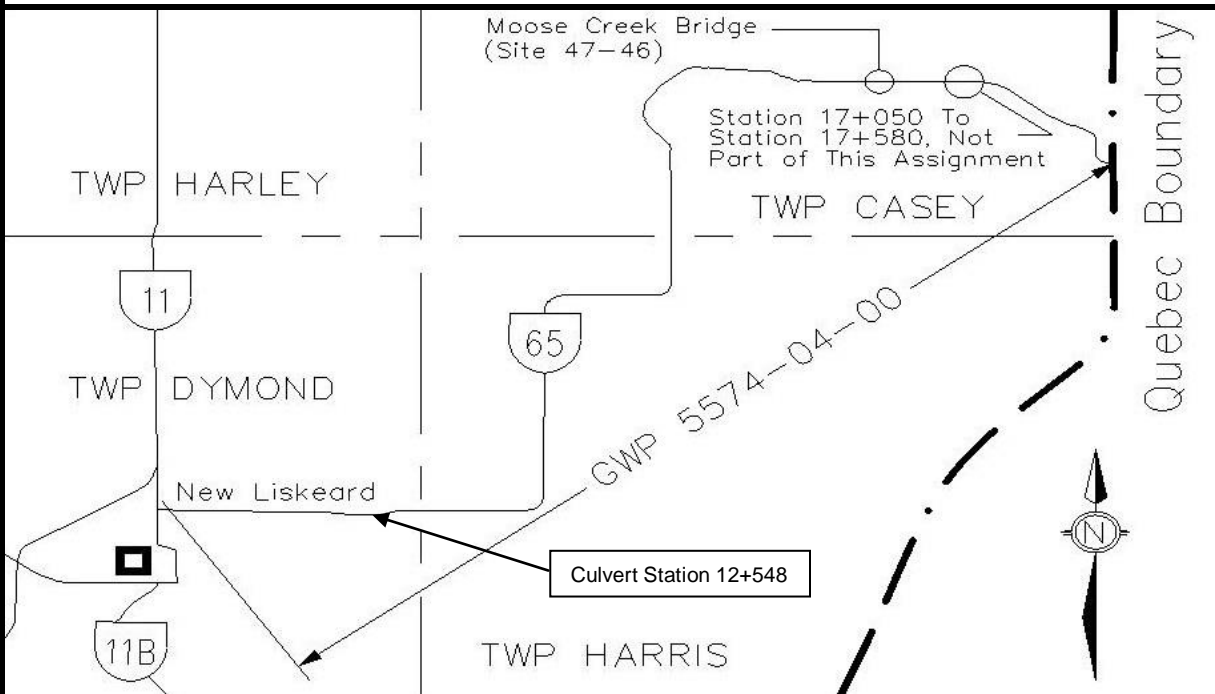
Key Plan



KEY PLAN

Drawing No. 1

NOT TO SCALE



**DRAFT FOUNDATION
INVESTIGATION REPORT
GWP 5574-04-00**

Highway 65

From 0.1 km East of Armstrong Street
Easterly 22.5 km To the
Ontario/Québec Boundary

MEL Ref. No.: 12/08/12028-F2

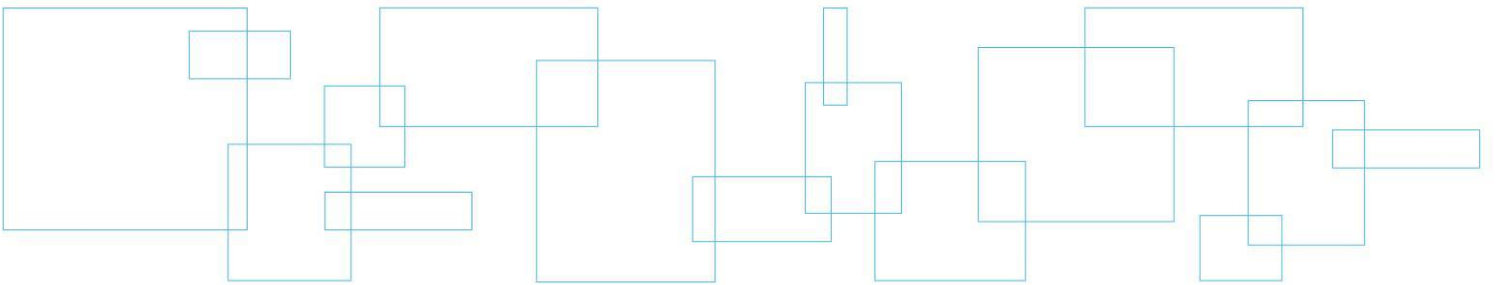
June 2013

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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

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 12/03/12028-F2 DATUM Geodetic LOCATION N 5262714.4 E 407164.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 1 November 2012 TIME
 DATE (Completed) 1 November 2012 (Completed) 5:25:00 PM CHECKED BY MAM

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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
191.3 0.0	Ground Surface		1	AS	N/A		191						
	FILL - brown and grey sand and clay some gravel some silt occasional cobbles trace organics and wood		2	SS	9		190						
			3	SS	25		189						15 35 17 33
			4	SS	7		188						
188.4 2.9	CLAY - grey clay with silt (firm)		5	SS	8		187						
			6	SS	WH		186						0 0 36 64
			7	TO	PM		185						
185.8 5.5	CLAY - grey clay with silt varved structure (±25 mm thick clay layers with ±6 mm thick silty clay varves) (firm/stiff)		8	TO	PM		184						
			9	TO	PM		183						
			10	SS	PM		182						0 0 39 61
181.4 9.9	End of Sampling Continuation of DCPT						181						
							180						
Continued Next Page													
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 ○ 3% STRAIN AT FAILURE					
								Date (dd/mm/yy)/Time					
								Water Depth (m)					
								Cave In (m)					
								1) 1/11/12 5:10:00 PM 1.7 9.14					
								2) 2/11/12 8:30:00 AM 1.2 -					
								3) 15/11/12 12:20:00 PM 1.2 -					

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC**RECORD OF BOREHOLE NO. 1**

REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5262714.4 E 407164.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 1 November 2012 TIME
 DATE (Completed) 1 November 2012 (Completed) 5:25:00 PM CHECKED BY MAM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE						
	Continued from Previous Page									
						179				
						178				
						177				
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						167				
	Continued Next Page									

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13

METRIC**RECORD OF BOREHOLE NO. 1**

REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5262714.4 E 407164.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 1 November 2012 TIME
 DATE (Completed) 1 November 2012 (Completed) 5:25:00 PM CHECKED BY MAM

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 (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued from Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
161.8						166							
29.5	DCPT Refusal End of Borehole					165							
						164							
						163							
						162							

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 2



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265687.3 E 407171.4 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 14 November 2012 TIME (Completed) 5:00:00 PM CHECKED BY MAM
 DATE (Completed) 14 November 2012

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 WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
197.3	Asphalt Surface										
0.0	± 50 mm Asphalt ± 100 mm Crushed Gravel FILL - brown sand with gravel some silt (loose/dense)		1	SS	37		197				
			2	SS	28		196				
			3	SS	37		195				23 64 (13)
			4	SS	31		194				
			5	SS	29		193				
			6	SS	20		192				
	trace asphalt in sample		7	SS	8		191				30 58 (12)
191.8	FILL - brown clay with silt		8	SS	7		190				
5.5							189				
190.0	± 75 mm asphalt layer at 7.6 m depth FILL - grey sand and clay some gravel some silt		9	SS	50/100mm		188				
7.3			10	SS	14		187				
188.3	CLAY - grey silty clay		11	SS	14		186				0 0 49 51
9.0											
186.9	CLAY - grey clay with silt varved structure (±25 mm thick clay layers with ±6 mm thick silty clay varves)		12	TO	PM					16.7	
10.4											
	Continued Next Page										
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 1) 14/11/12 4:40:00 PM 2) 3)				
							Water Depth (m) 4.8 - -				
							Cave In (m) 13.1 - -				

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

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 3



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265679.3 E 407163.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Bombadier Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 13 November 2012 TIME 13 November 2012 (Completed) 4:40:00 PM CHECKED BY MAM

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								
197.6 0.0	Asphalt Surface ± 100 mm Asphalt ± 100 mm Crushed Gravel FILL - brown sand with gravel some silt (compact/dense)		1	SS	47								
			2	SS	35								
			3	SS	16/150 mm 15/75 mm								
			4	SS	26								
			5	SS	13								
193.5 4.1	FILL - grey clay with silt (very stiff)		6	SS	7								
			7	SS	8								
			8	SS	16								
			9	SS	11								
			10	SS	11								
188.2 9.4	FILL - grey sand and clay with gravel with silt		11	SS	87/200 mm								
			12	SS	21								
186.8 10.8	CLAY - grey clay with silt varved structure (±25 mm thick clay layers with ±6 mm thick silty clay varves)		13	SS	5								
Continued Next Page													

COMMENTS		WATER LEVEL RECORDS		
The stratification lines represent approximate boundaries. The transition may be gradual. + 3, x 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE		Date (dd/mm/yy)Time	Water Depth (m)	Cave In (m)
		1) 13/11/12 4:15:00 PM	5.9	16.8
		2) 14/11/12 2:45:00 PM	2.5	-
		3) 15/11/12 12:20:00 PM	2.5	-

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 3



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265679.3 E 407163.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Bombardier Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 13 November 2012 TIME
 DATE (Completed) 13 November 2012 (Completed) 4:40:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued from Previous Page											
	CLAY - grey clay with silt varved structure		14	TO	PM		185	3				
	(±25 mm thick clay layers with ±6 mm thick silty clay varves)		15	SS	PM		184	3				
	(stiff)		16	TO	PM		183	3				
			17	SS	WH		182	3				
			18	TO	WH		181	3				
			19	SS	WH		180	3				
177.0 20.6	End of Sampling Continuation of DCPT						179	3				
	Continued Next Page						178	3				
							177	3				
							176					
							175					
							174					
							173					

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC**RECORD OF BOREHOLE NO. 3**

REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265679.3 E 407163.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Bombadier Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 13 November 2012 TIME
 DATE (Completed) 13 November 2012 (Completed) 4:40:00 PM CHECKED BY MAM

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					
	Continued from Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
						172							
						171							
						170							
						169							
						168							
						167							
165.9						166							
31.7	DCPT Refusal End of Borehole												

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 4



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265679.3 E 407138.0 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 8 November 2012 TIME
 DATE (Completed) 8 November 2012 (Completed) 4:20:00 PM CHECKED BY MAM

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)												
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES																		
196.9 0.0	Ground Surface ± 150 mm Crushed Gravel		1	SS	24																		
	FILL - brown sand trace gravel trace silt		2	SS	12																		
195.5 1.4	CLAY - brown clay some to with silt (stiff/very stiff) brown grey		3	SS	8																		
			4	SS	2																		
			5	SS	2																		
			6	SS	2																		
			7	SS	4																		
			8	SS	PM																		
			9	SS	PM																		
			10	TO	PM																		
189.6 7.3	CLAY - grey clay with silt varved structure (±25 mm thick clay layers with ±6 mm thick silty clay varves)		11	SS	PM																		
Continued Next Page																							
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 <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 8/11/12 4:10:00 PM</td> <td>DRY</td> <td>-</td> </tr> <tr> <td>2) 9/11/12 9:50:00 AM</td> <td>16.5</td> <td>-</td> </tr> <tr> <td>3) 15/11/12 2:25:00 PM</td> <td>11.8</td> <td>-</td> </tr> </tbody> </table>					Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 8/11/12 4:10:00 PM	DRY	-	2) 9/11/12 9:50:00 AM	16.5	-	3) 15/11/12 2:25:00 PM	11.8	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																					
1) 8/11/12 4:10:00 PM	DRY	-																					
2) 9/11/12 9:50:00 AM	16.5	-																					
3) 15/11/12 2:25:00 PM	11.8	-																					

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

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 4



REFERENCE	12/03/12028-F2	DATUM	Geodetic	LOCATION	N 5265679.3 E 407138.0 - Dymond Township	ORIGINATED BY	JL
PROJECT	GWP 5574-04-00, Highway 65	BOREHOLE TYPE	Truck Mounted CME 45 - Hollow Stem Augers	COMPILED BY	RG		
CLIENT	AECOM Inc.	DATE (Started)	8 November 2012	TIME (Completed)	4:20:00 PM	CHECKED BY	MAM
		DATE (Completed)	8 November 2012				

[illegible]

METRIC

RECORD OF BOREHOLE NO. 5



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265679.4 E 407198.1 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Bombadier Mounted CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 7 November 2012 TIME
 DATE (Completed) 7 November 2012 (Completed) 4:40:00 PM CHECKED BY MAM

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	● QUICK TRIAXIAL	+ FIELD VANE							× LAB VANE			
Continued from Previous Page								20	40	60	80	100	20	40	60	kN/m ³	GR	SA	(SI	CL)
179.2 19.1	CLAY - grey clay with silt varved structure 																			

MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



METRIC

RECORD OF BOREHOLE NO. 6



REFERENCE 12/03/12028-F2 DATUM Geodetic LOCATION N 5265642.9 E 407163.8 - Dymond Township ORIGINATED BY JL
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) 31 October 2012 TIME
 DATE (Completed) 31 October 2012 (Completed) 6:15:00 PM CHECKED BY MAM

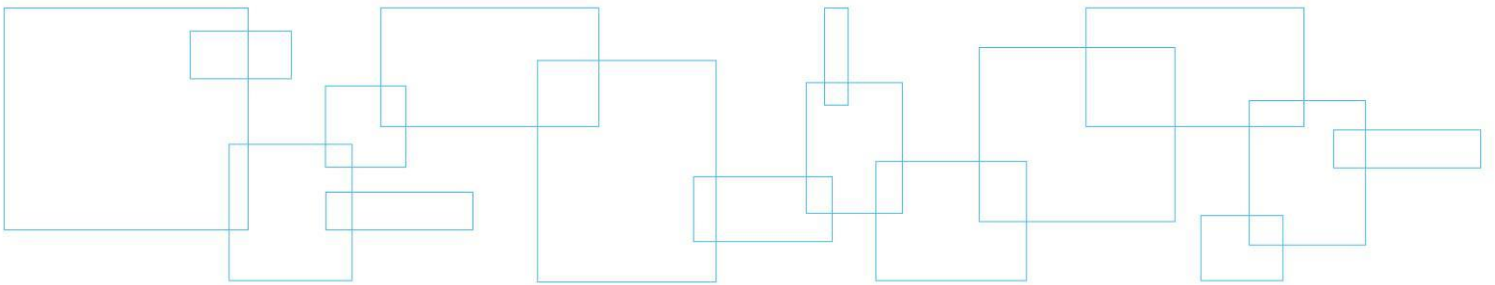
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES												
189.4 0.0	Ground Surface ± 50 mm Grass		1	AS	N/A												
	FILL - brown clay with silt trace to some sand		2	SS	18												
			3	SS	11												
			4	SS	5												
186.4 3.0	CLAY - grey clay with silt some sand		5	SS	5												
	(firm)		6	SS	PM												
184.8 4.6	CLAY - grey clay with silt varved structure		7	SS	PM												
	(±25 mm thick clay layers with ±6 mm thick silty clay varves)																
	(stiff)		8	SS	PM												
			9	SS	PM												
181.0 8.4	End of Sampling Continuation of DCPT																
Continued Next Page																	
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 <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 31/10/12 6:00:00 PM</td> <td>1.3</td> <td>7</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>						Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 31/10/12 6:00:00 PM
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)															
1) 31/10/12 6:00:00 PM	1.3	7															
2)	-	-															
3)	-	-															
The stratification lines represent approximate boundaries. The transition may be gradual.																	

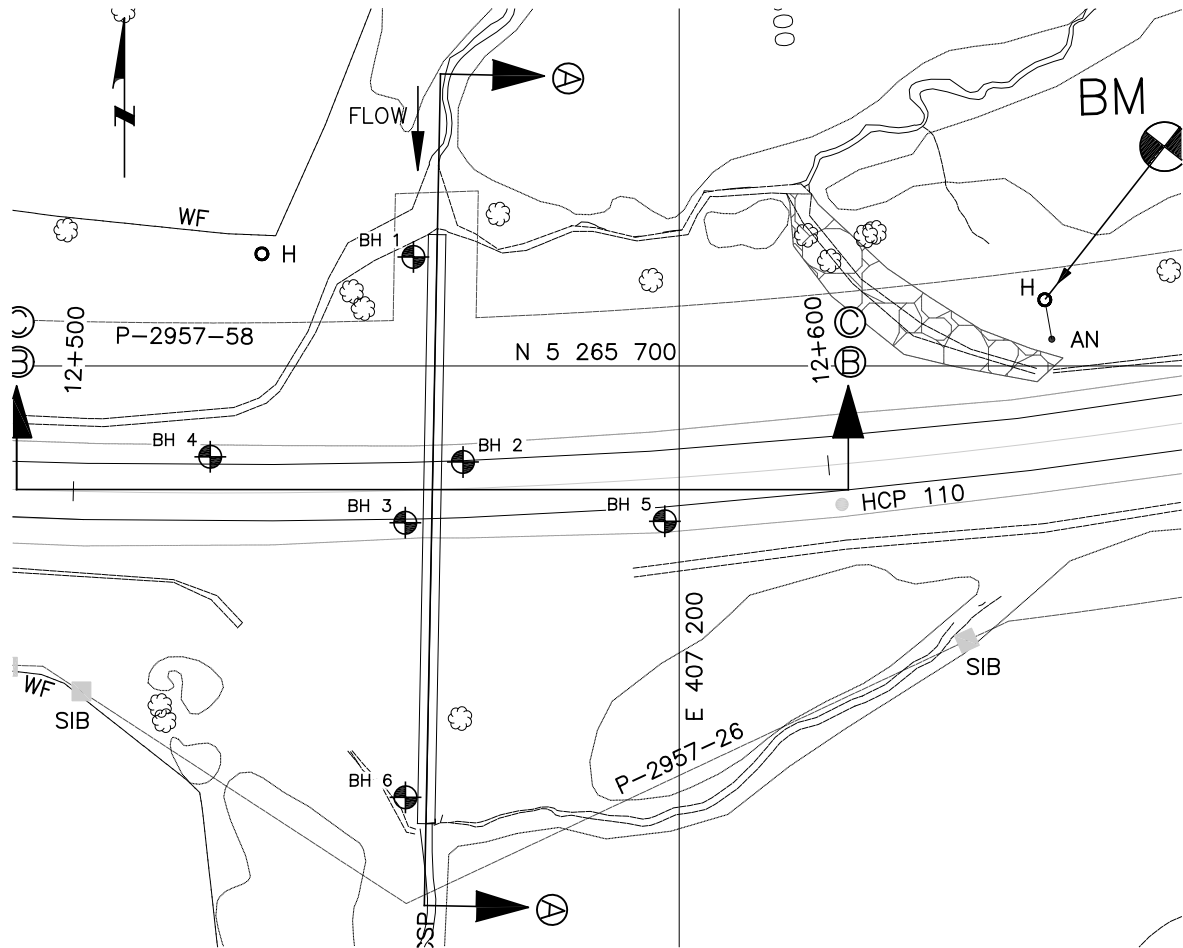
MEL-GEO 12028 - BOREHOLE LOGS - STA. 12+540 - FINAL.GPJ MEL-GEO.GDT 18/6/13



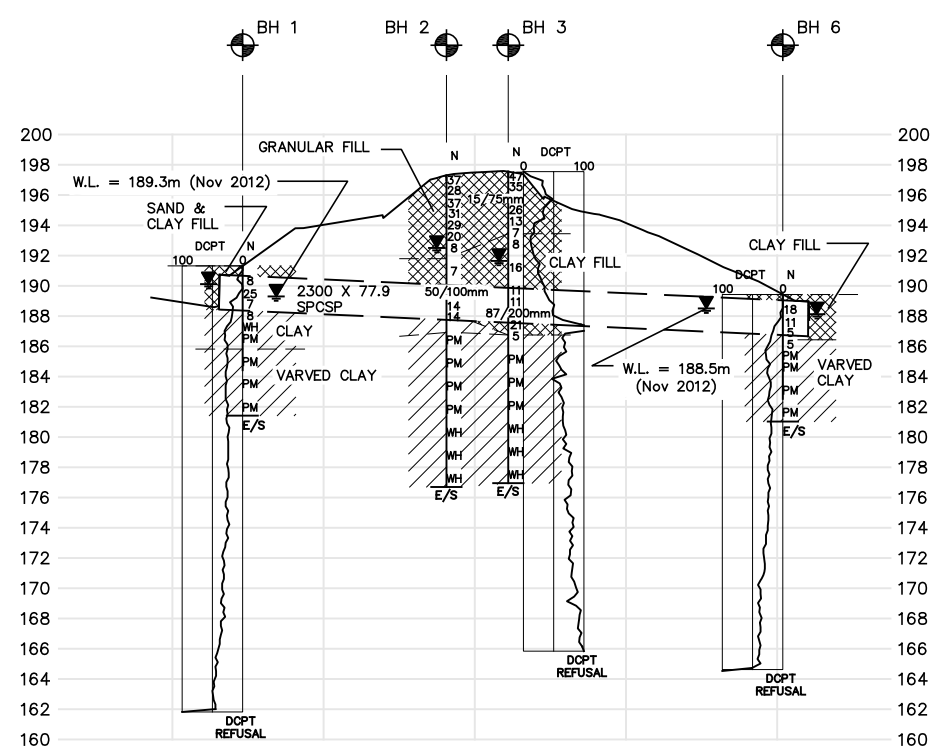
Appendix 3 Borehole Plan and Lab Data

Drawing No. 2:	Borehole Location and Soil Strata
Figure Nos. L-1 to L-5:	Grain Size Distribution Curves
Figure No. L-6:	Atterberg Limits Sheet
Figure No. L-7:	Shear Strength Chart
Figure No. L-8 and L-9:	Consolidation Test Results
Figure No. L-10:	Lab Test Summary Sheet

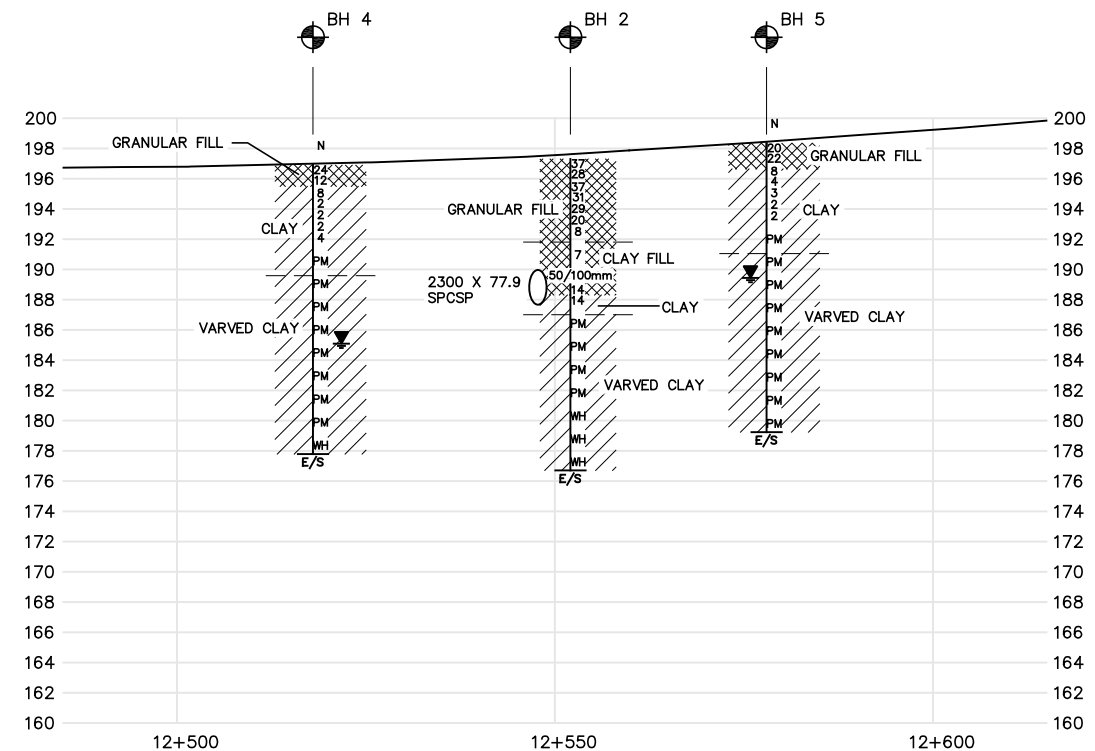




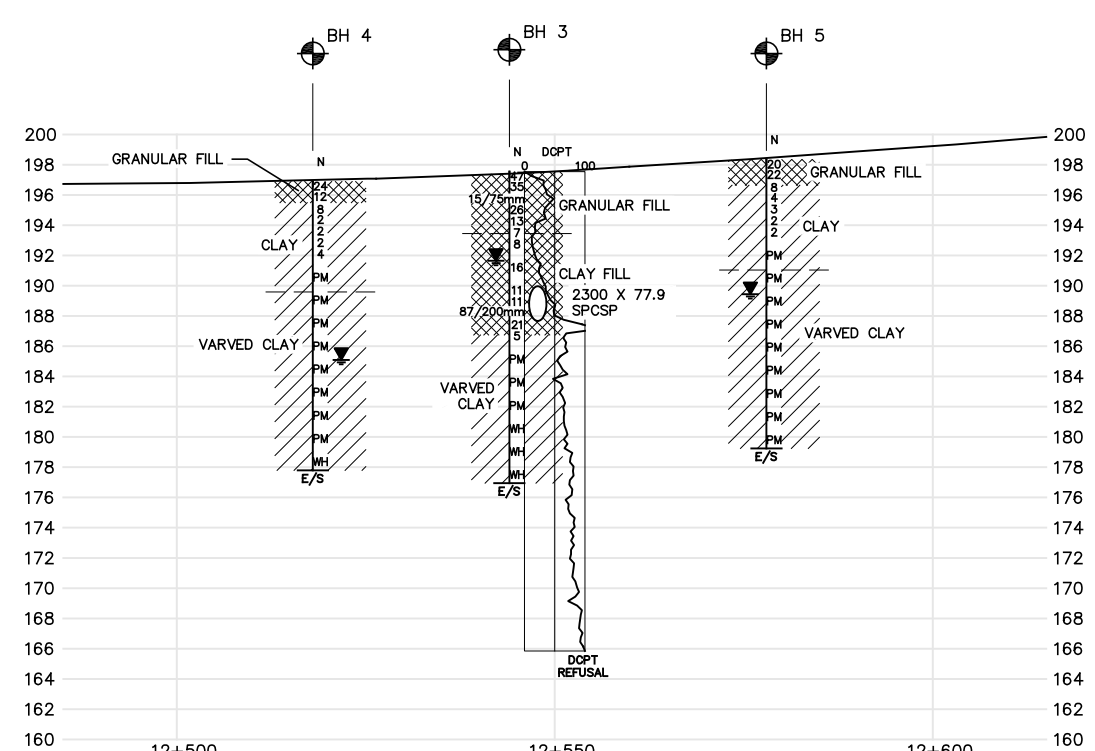
PLAN 10m SCALE 10m



SECTION AT CULVERT (A) - (A) 10m SCALE 10m HOR 5m 5m VER



PROFILE (B) - (B) 10m SCALE 10m HOR 5m 5m VER



PROFILE (C) - (C) 10m SCALE 10m HOR 5m 5m VER

METRIC

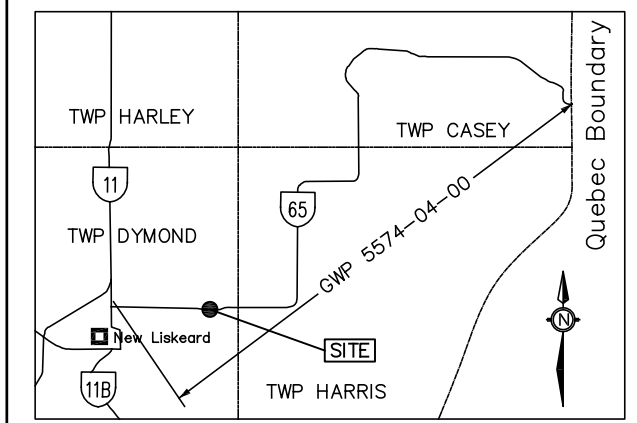
Dimensions are in meters and/or millimeters unless otherwise shown. Stations are in kilometers + meters.

CONT No XXXX-XXXX
GWP No 5574-04-00

HWY NO. 65
Township of Dymond
Culvert at Station 12+548
BOREHOLE LOCATIONS & SOIL STRATA

Drawing
2

LVM | MERLEX



KEY PLAN - NOT TO SCALE
LEGEND

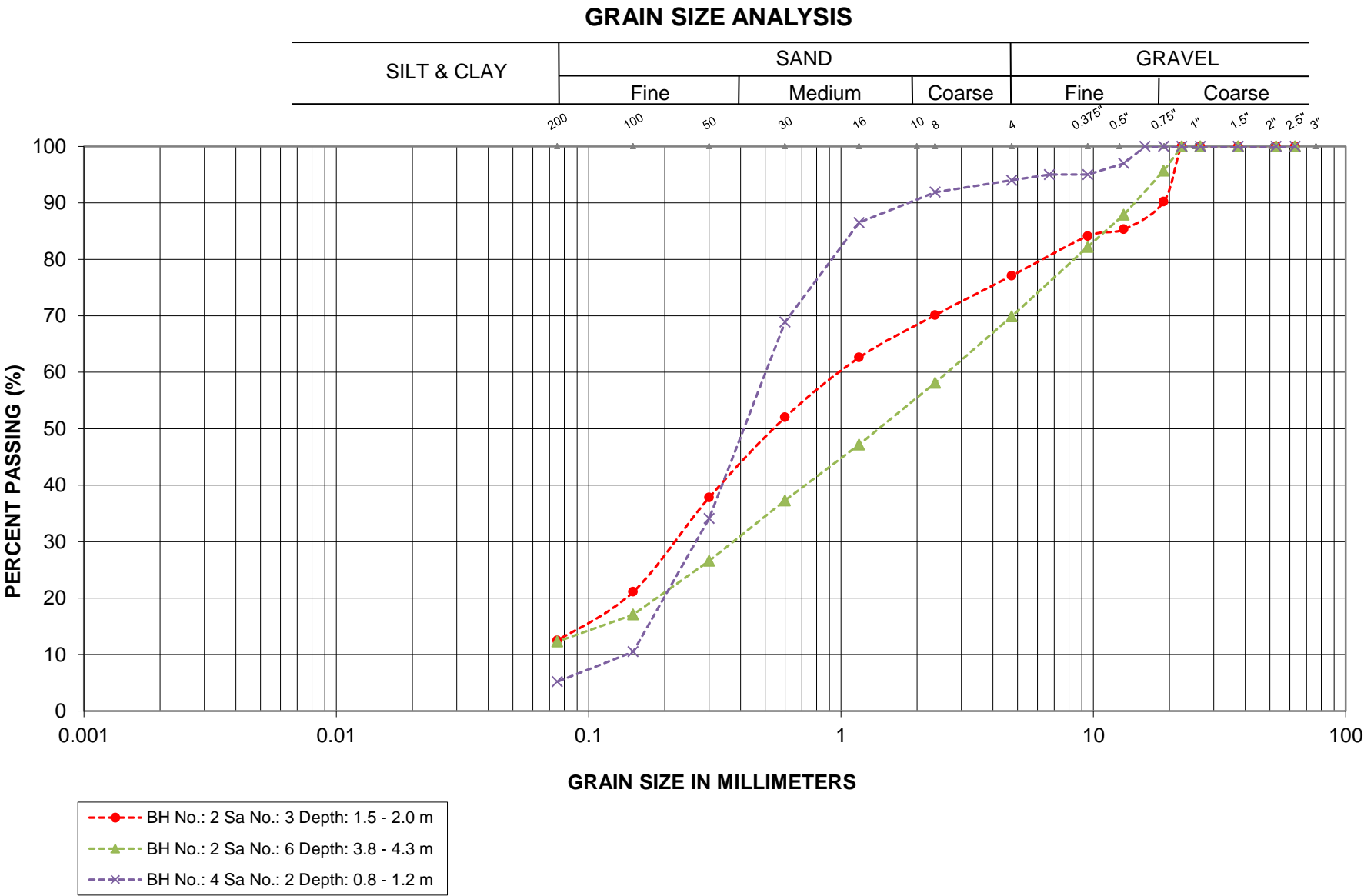
- Borehole
- Dynamic Cone Penetration Test (DCPT)
- Borehole and DCPT
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- DCPT Blows/0.3 m (60' Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling

Borehole No.	Elev.	O/S	Co-ordinates	
			Northerly	Easterly
Borehole No. 1	191.3	31m Lt	5265714.4	407164.8
Borehole No. 2	197.3	3.7m Lt	5265687.3	407171.4
Borehole No. 3	197.6	4.1m Rt	5265679.3	407163.8
Borehole No. 4	196.9	4.7m Lt	5265688.0	407138.0
Borehole No. 5	198.3	5.3m Rt	5265679.4	407198.1
Borehole No. 6	189.4	42m Rt	5265642.9	407163.8

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	
	Jan 2013	RG	DRAFT	
	Apr 2013	RG	FINAL	
HWY No. 65 - Dymond Twp - Cvt at Sta. 12+548			LVM REF 12028-F2	
SUBM'D		GEOCRE 31M-103	SITE	
DRAWN RG		CHK MAM	DATE December 2013	DWG 2



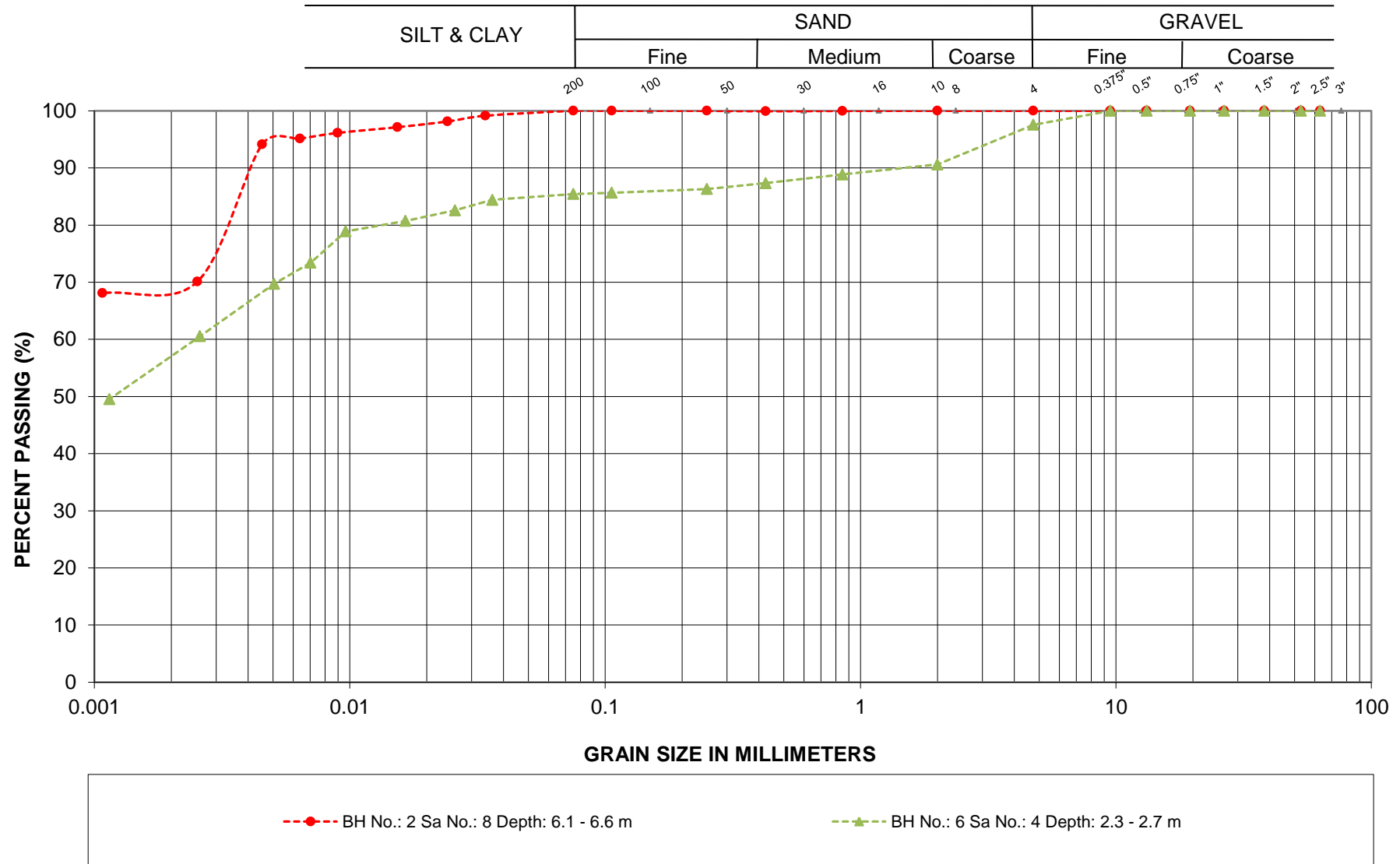
G.W.P.: 5574-04-00
LOCATION: Hwy 65

GRANULAR FILL

LVM | MERLEX

FIGURE L-1

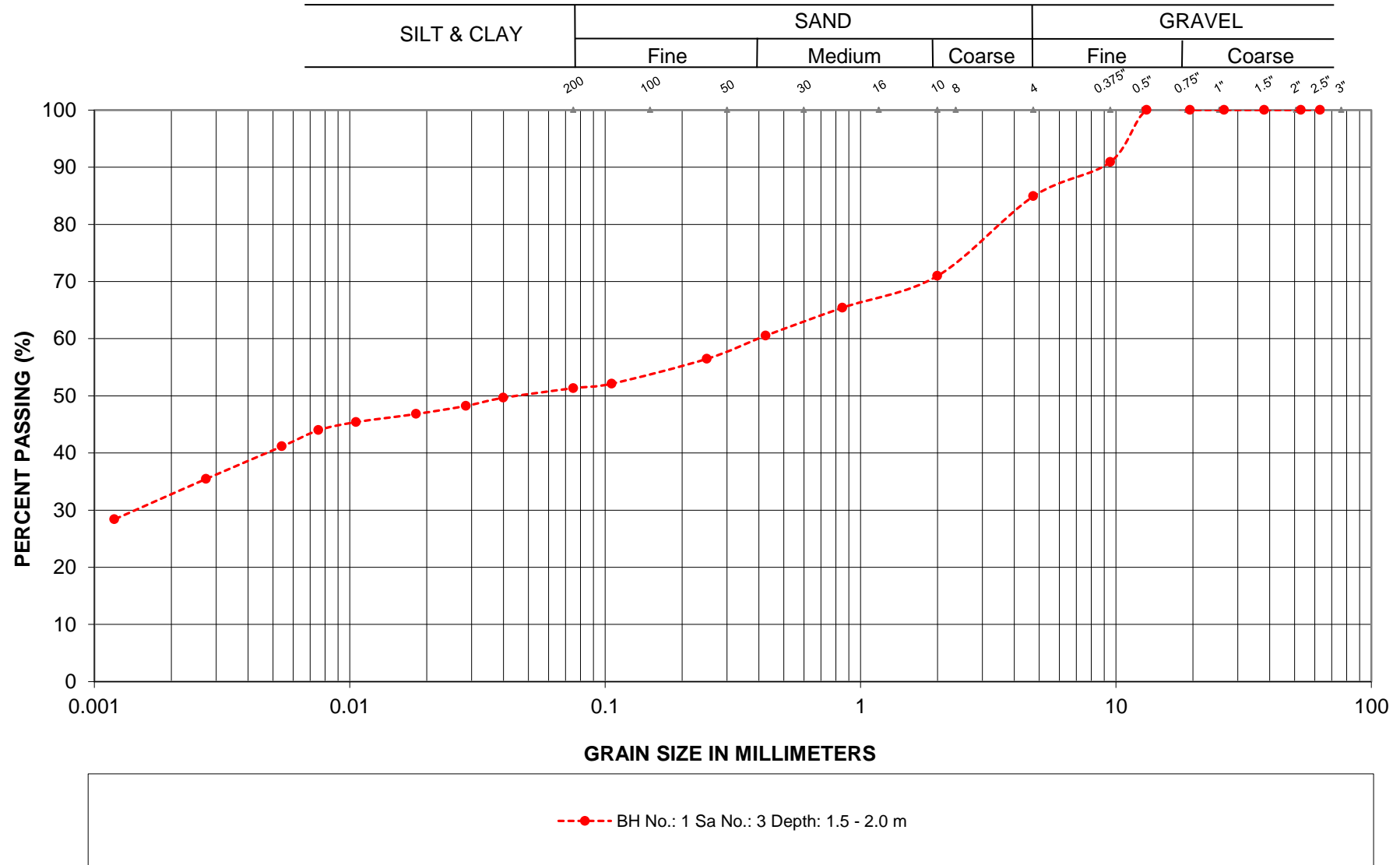
GRAIN SIZE ANALYSIS



G.W.P.: 5574-04-00
LOCATION: Hwy 65

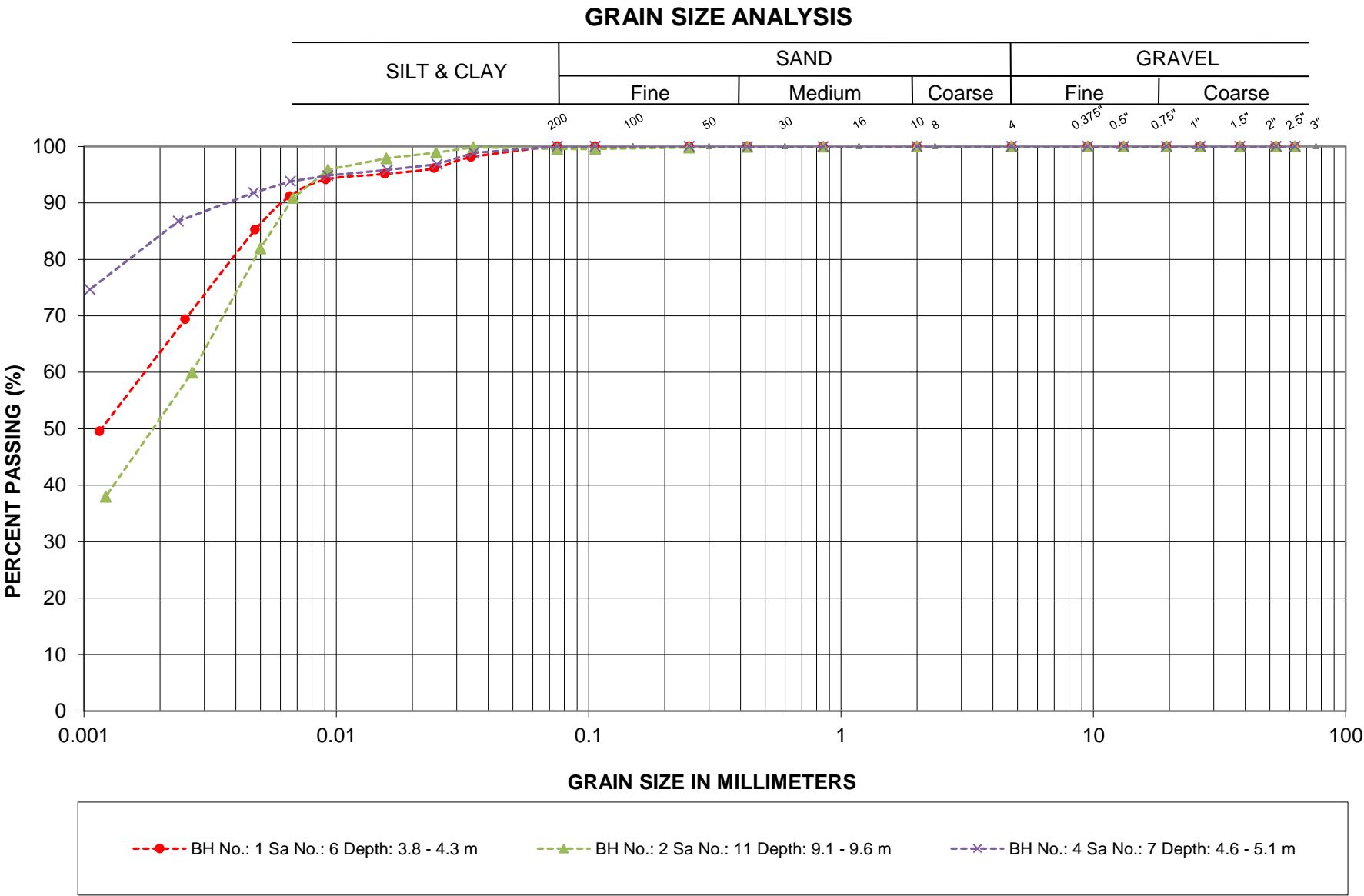
CLAY FILL

GRAIN SIZE ANALYSIS



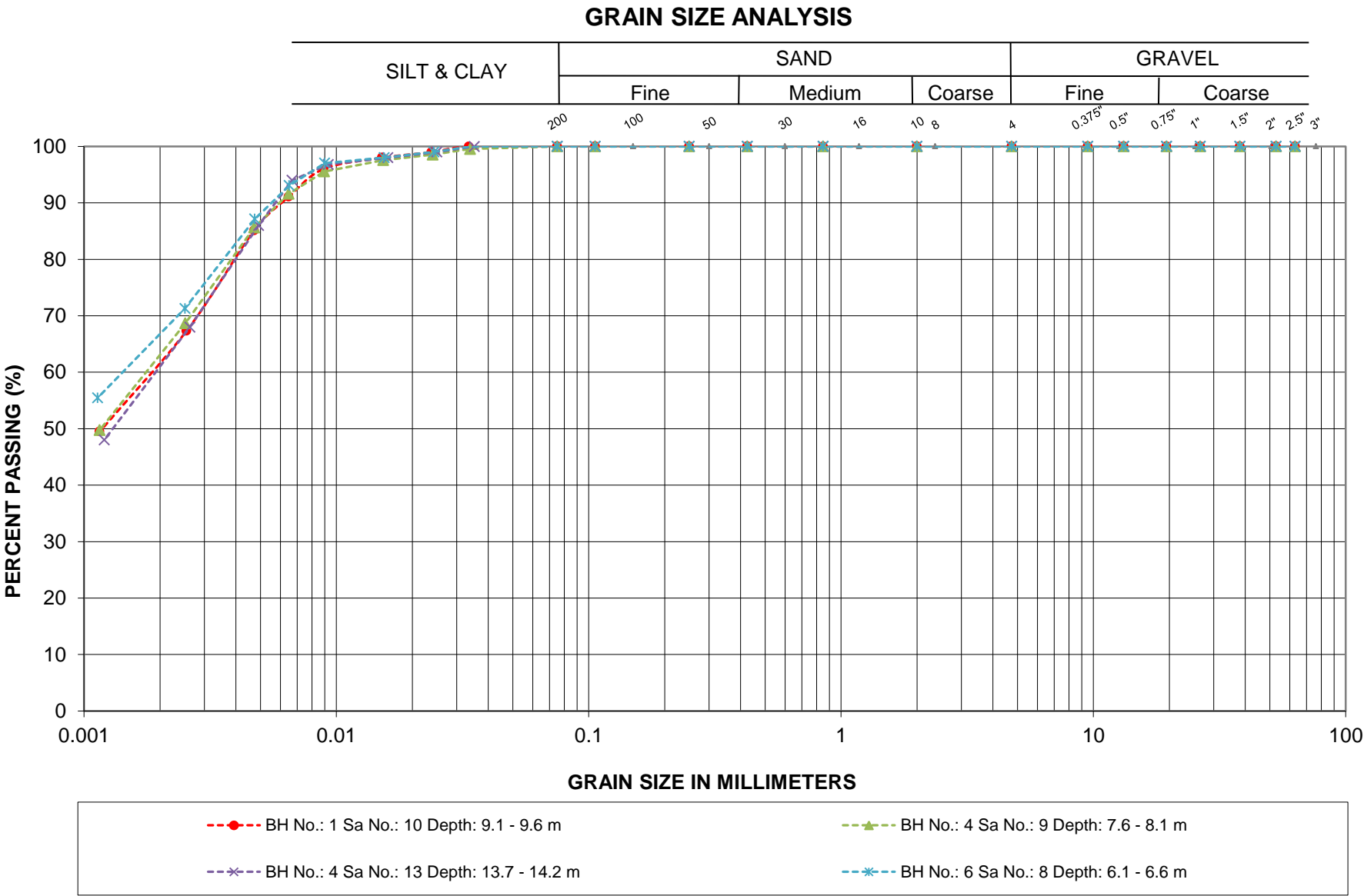
G.W.P.: 5574-04-00
LOCATION: Hwy 65

SAND AND CLAY FILL



G.W.P.: 5574-04-00
LOCATION: Hwy 65

CLAY



G.W.P.: 5574-04-00
LOCATION: Hwy 65

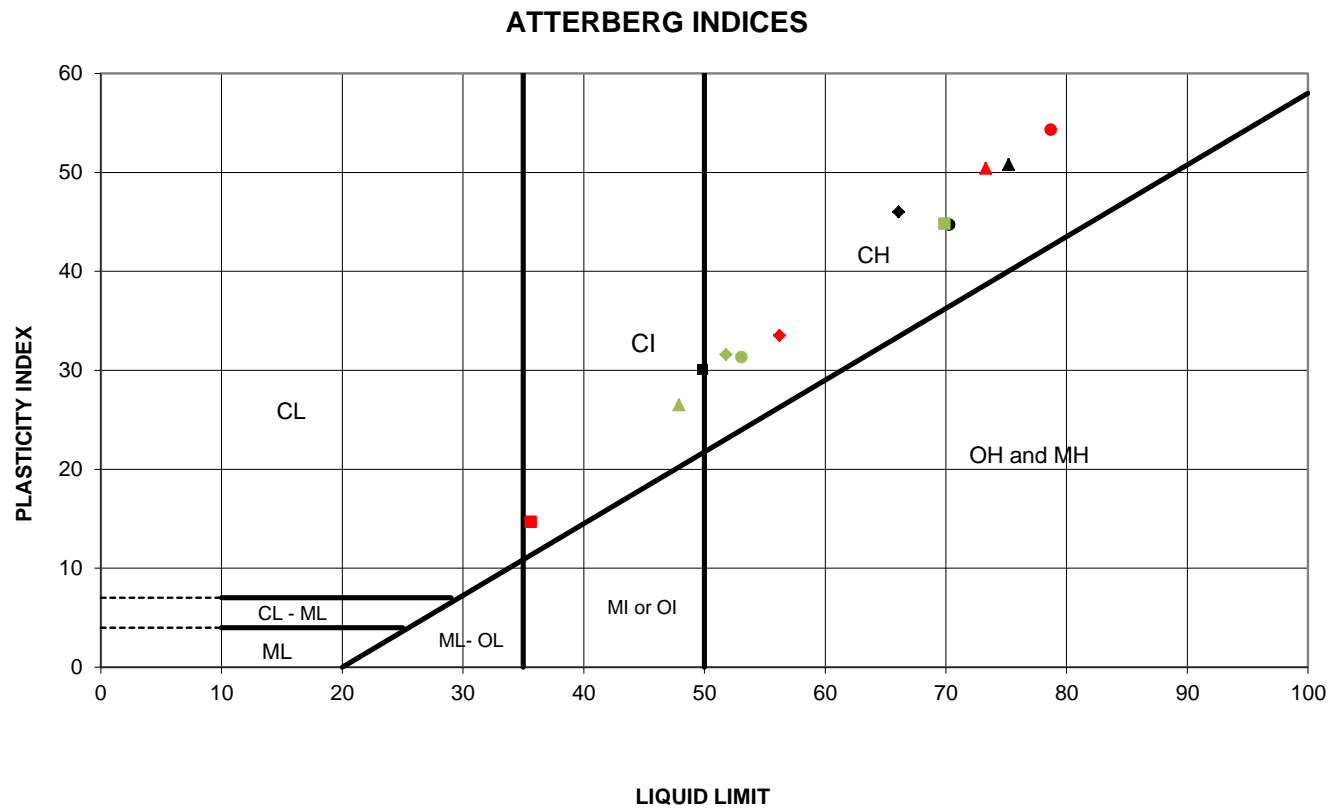
VARVED CLAY

LVM | MERLEX

FIGURE L-5

ATTERBERG LIMITS TEST RESULTS

FIGURE L-6

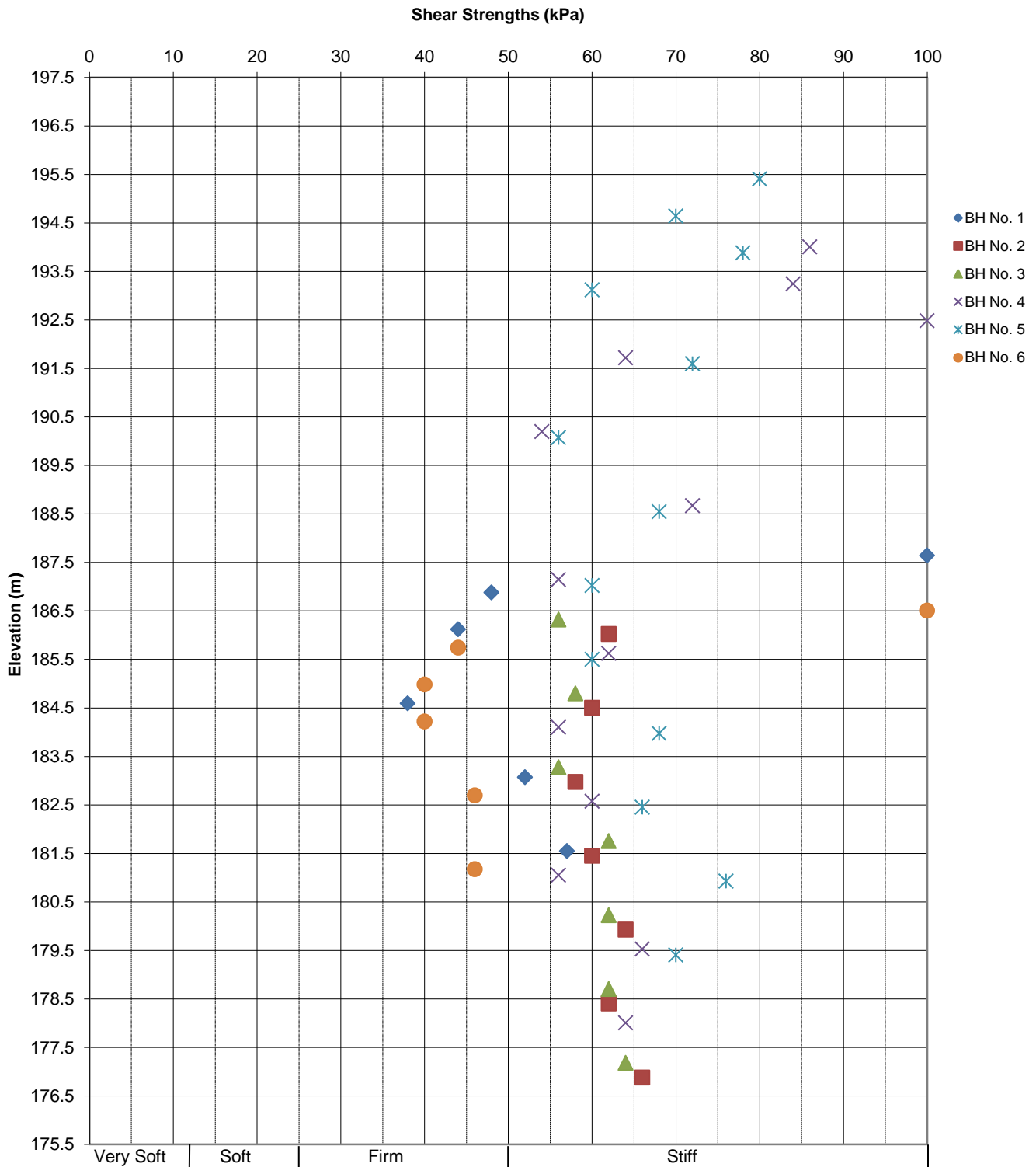


SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	3	1.5	189.8	70.3	25.6	44.7	24.7
◆	1	6	3.8	187.5	66.1	20.1	46.0	57.8
■	1	10	9.1	182.2	49.9	19.9	30.0	51.1
▲	2	8	6.1	191.2	75.2	24.4	50.8	44.4
●	2	11	9.1	188.2	78.7	24.4	54.3	26.2
◆	2	15a	15.2	182.1	56.2	22.7	33.5	64.8
■	2	15b	15.2	182.1	35.6	20.9	14.7	
▲	4	7	4.6	192.3	73.3	22.9	50.4	51.0
●	4	9	7.6	189.3	53.1	21.8	31.3	44.6
◆	4	13	13.7	183.2	51.8	20.2	31.6	46.3
■	6	4	2.3	187.1	69.9	25.1	44.8	32.7
▲	6	8	6.1	183.3	47.9	21.4	26.5	59.3

Date: Jun-13
 Project: Hwy 65
 G.W.P: 5574-04-00

Prep'd: AT
 Chkd: MAM
 Ref. No.: 12/03/12028-F2

In-Situ Shear Strengths vs. Depth



CONSOLIDATION TEST SUMMARY**FIGURE L-8a****SAMPLE IDENTIFICATION**

Project Number	12-1183-0124	Sample Number	8
Borehole Number	1	Sample Depth, m	6.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	4		
Date Started	12/29/2012		
Date Completed	01/14/2013		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.53	Unit Weight, kN/m ³	15.96
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	9.71
Area, cm ²	31.71	Specific Gravity, measured	2.73
Volume, cm ³	80.22	Solids Height, cm	0.918
Water Content, %	64.35	Volume of Solids, cm ³	29.10
Wet Mass, g	130.56	Volume of Voids, cm ³	51.13
Dry Mass, g	79.44	Degree of Saturation, %	100.0

TEST COMPUTATIONS

Stress	Corr. Height	Void Ratio	Average Height	t ₉₀	cv.	mv	k
kPa	cm		cm	sec	cm ² /s	m ² /kN	cm/s
0.00	2.530	1.757	2.530				
6.24	2.527	1.754	2.529	60	2.26E-02	1.77E-04	3.93E-07
10.93	2.524	1.750	2.525	173	7.82E-03	3.12E-04	2.39E-07
20.62	2.517	1.743	2.520	214	6.29E-03	2.73E-04	1.69E-07
40.03	2.506	1.731	2.511	290	4.61E-03	2.20E-04	9.94E-08
78.68	2.485	1.708	2.496	304	4.34E-03	2.14E-04	9.10E-08
155.78	2.445	1.664	2.465	406	3.17E-03	2.07E-04	6.44E-08
310.20	2.122	1.312	2.283	7760	1.42E-04	8.27E-04	1.15E-08
618.36	1.873	1.041	1.997	2241	3.77E-04	3.19E-04	1.18E-08
1235.42	1.716	0.869	1.794	1042	6.55E-04	1.01E-04	6.48E-09
2470.82	1.588	0.731	1.652	540	1.07E-03	4.07E-05	4.27E-09
1235.42	1.599	0.743	1.594				
310.20	1.648	0.796	1.624				
78.68	1.711	0.864	1.679				
20.62	1.766	0.924	1.738				
6.24	1.796	0.957	1.781				

Note:

k calculated using cv based on t₉₀ values.

Consolidation loading schedule assigned by the client.

Specimen taken 8cm from the bottom of the tube.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.80	Unit Weight, kN/m ³	19.09
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	13.68
Area, cm ²	31.71	Specific Gravity, measured	2.73
Volume, cm ³	56.96	Solids Height, cm	0.918
Water Content, %	39.60	Volume of Solids, cm ³	29.10
Wet Mass, g	110.90	Volume of Voids, cm ³	27.86
Dry Mass, g	79.44		

Prepared By: LFG

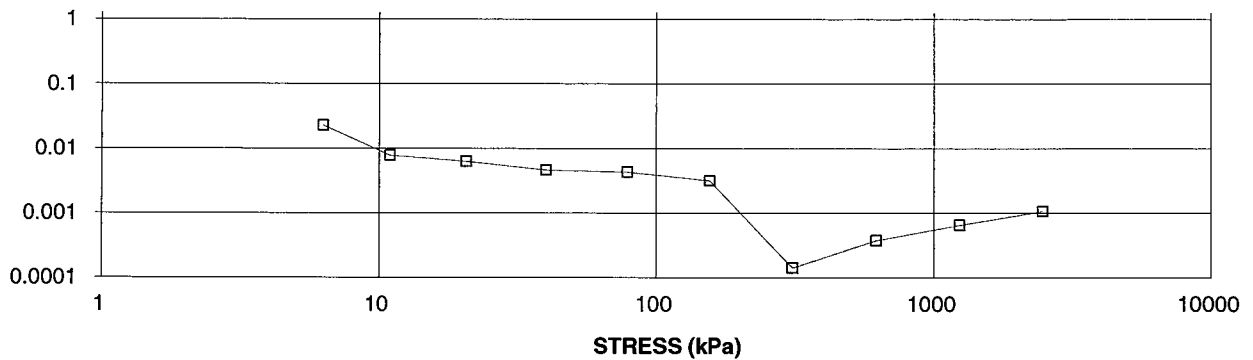
Golder AssociatesChecked By: 

CONSOLIDATION TEST SUMMARY

FIGURE L-8b

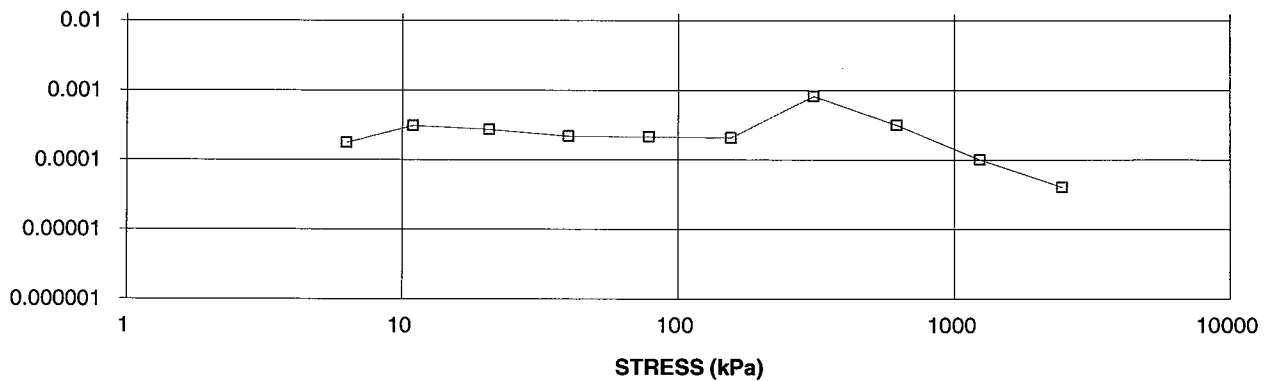
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH 1 SA 8



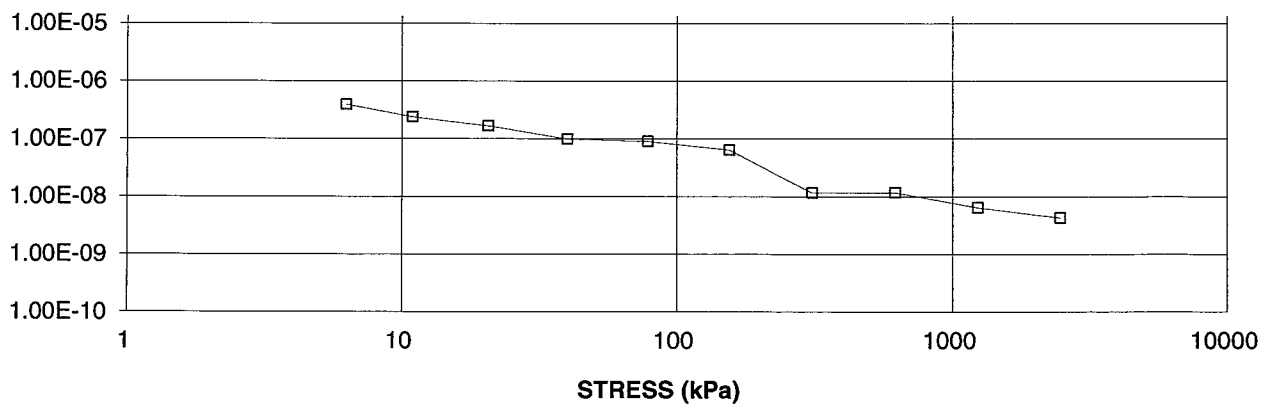
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH 1 SA 8



HYDRAULIC CONDUCTIVITY,
cm/s

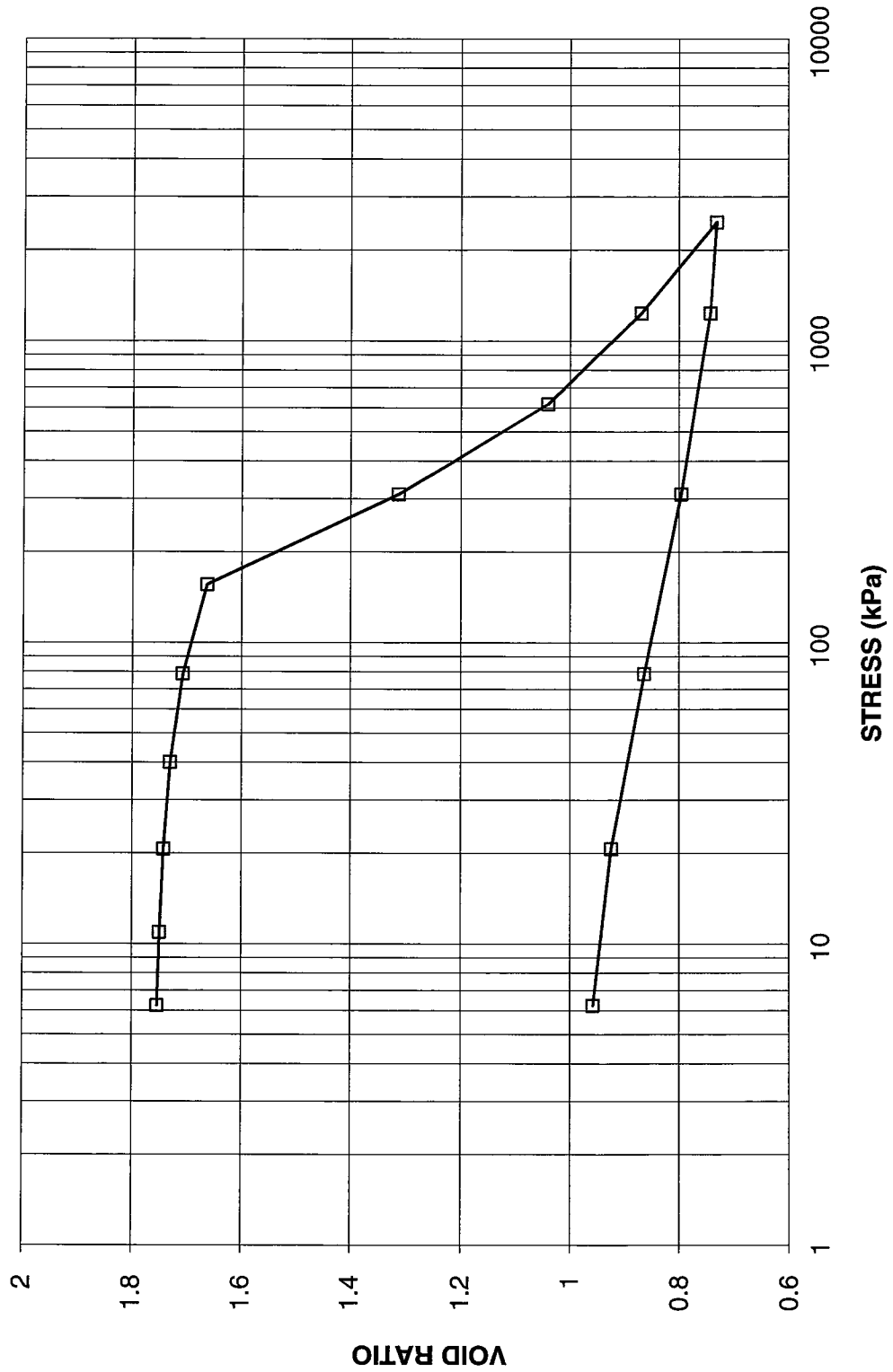
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 1 SA 8



CONSOLIDATION TEST VOID RATIO VS LOG STRESS

FIGURE L-8c

CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 1 SA 8



CONSOLIDATION TEST SUMMARY**FIGURE L-9a****SAMPLE IDENTIFICATION**

Project Number	12-1183-0124	Sample Number	12
Borehole Number	2	Sample Depth, m	12.2

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	3		
Date Started	1/02/2013		
Date Completed	1/17/2013		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.53	Unit Weight, kN/m ³	16.72
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	10.82
Area, cm ²	31.68	Specific Gravity, measured	2.75
Volume, cm ³	80.28	Solids Height, cm	1.016
Water Content, %	54.55	Volume of Solids, cm ³	32.20
Wet Mass, g	136.84	Volume of Voids, cm ³	48.08
Dry Mass, g	88.54	Degree of Saturation, %	100.5

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	2.534	1.493	2.534				
6.00	2.520	1.480	2.527	560	2.42E-03	9.14E-04	2.17E-07
10.63	2.513	1.472	2.516	240	5.59E-03	6.22E-04	3.41E-07
20.45	2.501	1.461	2.507	577	2.31E-03	4.86E-04	1.10E-07
40.04	2.479	1.440	2.490	445	2.95E-03	4.29E-04	1.24E-07
78.65	2.447	1.407	2.463	602	2.14E-03	3.36E-04	7.04E-08
155.88	2.390	1.351	2.418	960	1.29E-03	2.91E-04	3.69E-08
310.08	2.199	1.164	2.294	4920	2.27E-04	4.88E-04	1.08E-08
618.96	1.994	0.962	2.097	1852	5.03E-04	2.62E-04	1.29E-08
1237.37	1.864	0.834	1.929	735	1.07E-03	8.31E-05	8.74E-09
2473.83	1.752	0.724	1.808	487	1.42E-03	3.57E-05	4.98E-09
1237.37	1.757	0.729	1.754				
310.08	1.801	0.772	1.779				
78.65	1.847	0.817	1.824				
20.45	1.885	0.855	1.866				
6.00	1.930	0.899	1.908				

Note:

k calculated using cv based on t₉₀ values.

Consolidation loading schedule assigned by the client.

Specimen taken 16cm from the bottom of the tube.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.93	Unit Weight, kN/m ³	18.99
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	14.20
Area, cm ²	31.68	Specific Gravity, measured	2.75
Volume, cm ³	61.15	Solids Height, cm	1.016
Water Content, %	33.76	Volume of Solids, cm ³	32.20
Wet Mass, g	118.43	Volume of Voids, cm ³	28.95
Dry Mass, g	88.54		

Prepared By: LFG

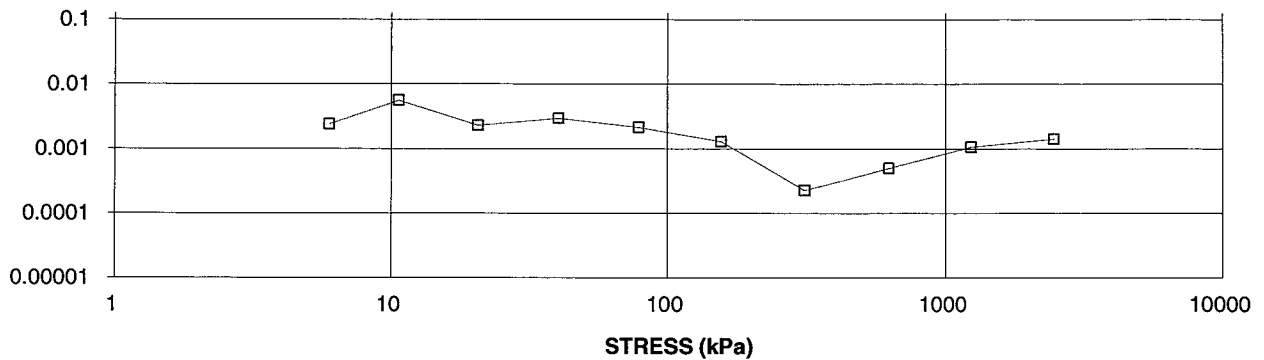
Golder AssociatesChecked By: 

CONSOLIDATION TEST SUMMARY

FIGURE L-9b

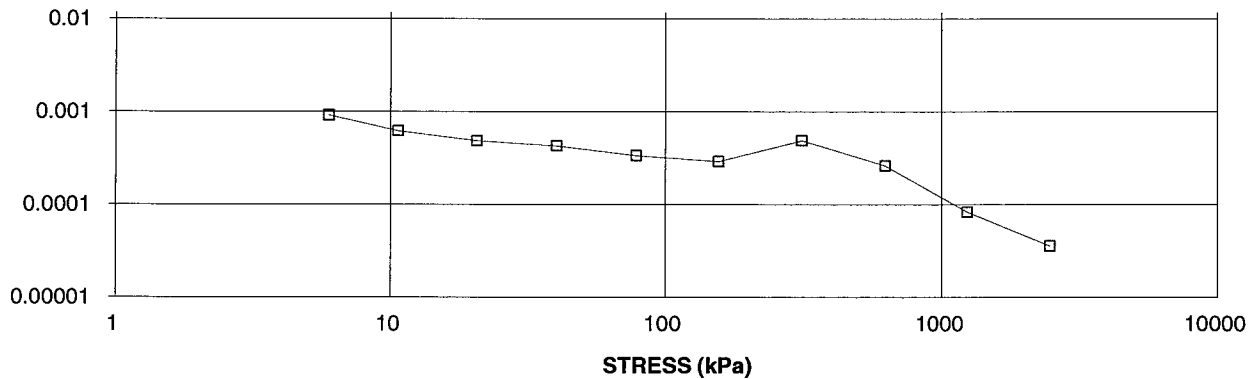
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH 2 SA 12



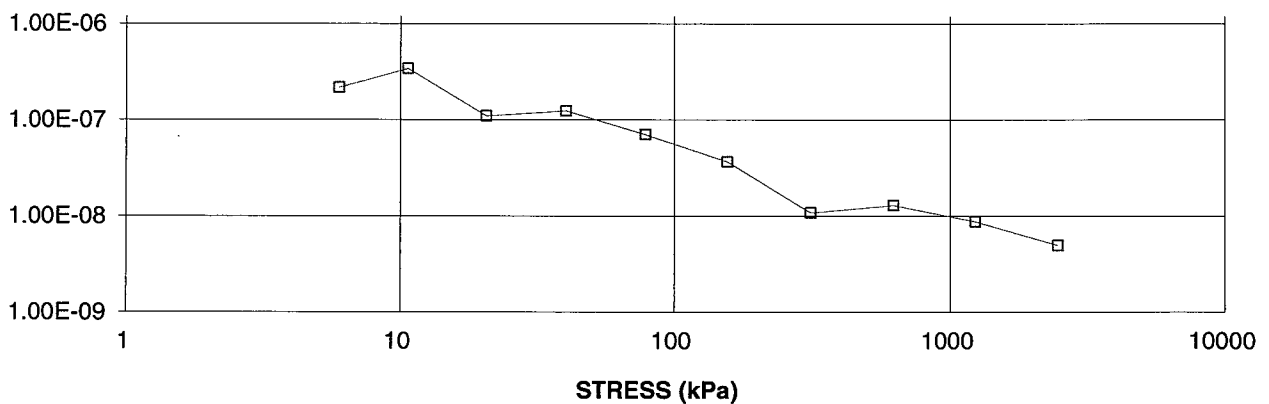
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH 2 SA 12



HYDRAULIC CONDUCTIVITY,
cm/s

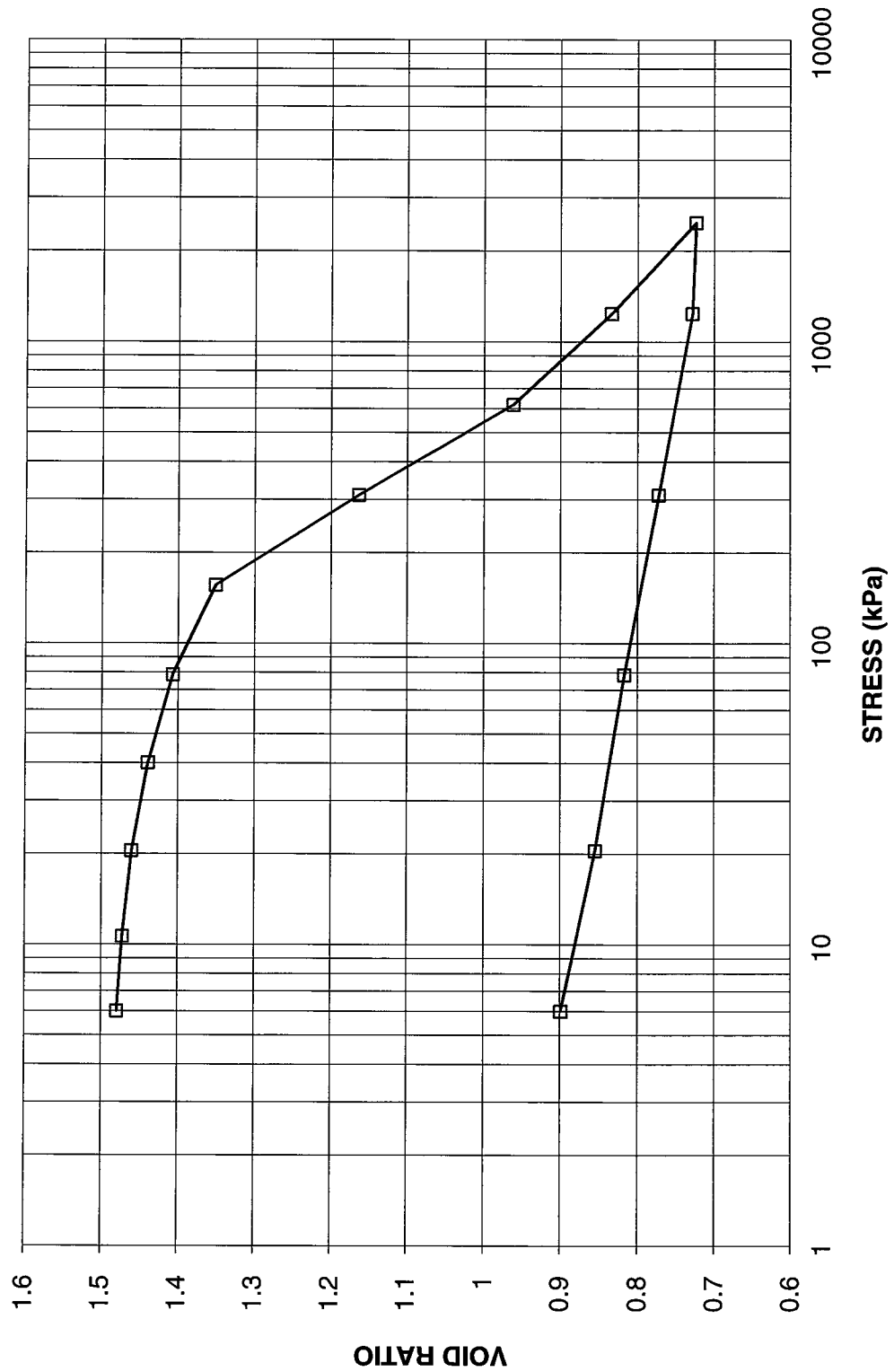
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 2 SA 12



CONSOLIDATION TEST VOID RATIO VS LOG STRESS

FIGURE L-9c

CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 2 SA 12



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					55.8				N/A			
	2	0.8					19.4				9			
	3	1.5	15	35	17	33	24.7	70.3	25.6	44.7	25	CH		
	4	2.3					54.1				7			
	5	3.1					34.7				8			
	6	3.8	0	0	36	64	57.8	66.1	20.1	46.0	WH	CH		
	7	4.6					67.0				PM			
	8	6.1					43.5				PM		16.0	Consolidation Test
	9	7.6					57.0				PM			
	10	9.1	0	0	39	61	51.1	49.9	19.9	30.0	PM	CI		
2	1	0.0					4.7				37			
	2	0.8					4.9				28			
	3	1.5	23	64	13		4.9				37			
	4	2.3					7.7				31			
	5	3.1					23.2				29			
	6	3.8	30	58	12		8.9				20			
	7	4.6					10.3				8			
	8	6.1	0	0	32	68	44.4	75.2	24.4	50.8	7	CH		
	9	7.6					29.9				50/100mm			
	10	8.4					31.6				14			
	11	9.1	0	0	49	51	26.2	78.7	24.4	54.3	14	CH		
	12	10.7					69.2				PM		16.7	Consolidation Test
	13	12.2					51.9				PM			
	14	13.7					51.0				PM			
	15a	15.2					64.8	56.2	22.7	33.5	PM	CH		
	15b	15.2						35.6	20.9	14.7	PM	CI		
	16	16.8					37.5				WH			

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 (%)				
2	17	18.3					56.2				WH			
	18	19.8					53.4				WH			
3	1	0.0					4.4				47			
	2	0.8					4.3				35			
	3	1.5					5.3				16/150 mm			
	4	2.3					11.3				26			
	5	3.1					16.5				13			
	6a	3.8					11.8				7			
	6b	3.8					35.4				7			
	7	4.6					26.6				8			
	8	6.1					34.9				16			
	9	7.6					32.8				11			
	10	8.4					37.8				11			
	11	9.1					33.2				87/200 mm			
	12	9.9					17.9				21			
	13	10.7					47.5				5			
	14	12.2					49.4				PM			
	15	13.7					64.0				PM			
	16	15.2					49.1				PM			
	17	16.8					42.5				WH			
	18	18.3					61.9				WH			
	19	19.8					52.5				WH			
4	1	0.0					4.7				24			
	2	0.8	6	88		6	5.5				12			
	3	1.5					29.9				8			
	4	2.3					53.6				2			
	5	3.1					49.4				2			

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	6	3.8					50.3				2			
	7	4.6	0.0	0.0	15.0	85.0	51.0	73.3	22.9	50.4	4	CH		
	8	6.1					52.8				PM			
	9	7.6	0.0	0.0	36.0	64.0	44.6	53.1	21.8	31.3	PM	CH		
	10	9.1					54.2				PM			
	11	10.7					49.3				PM			
	12	12.2					42.2				PM			
	13	13.7	0.0	0.0	28.0	72.0	46.3	51.8	20.2	31.6	PM	CH		
	14	15.2					56.8				PM			
	15	16.8					44.3				PM			
	16	18.3					42.8				WH			
5	1	0.0					4.4				20			
	2	0.8					5.1				22			
	3	1.5					29.4				8			
	4	2.3					50.0				4			
	5	3.1					49.2				3			
	6	3.8					50.8				2			
	7	4.6					50.6				2			
	8	6.1					63.3				PM			
	9	7.6					47.9				PM			
	10	9.1					58.4				PM			
	11	10.7					45.9				PM			
	12	12.2					41.4				PM			
	13	13.7					45.4				PM			
	14	15.2					49.5				PM			
	15	16.8					51.7				PM			
	16	18.3					42.1				PM			

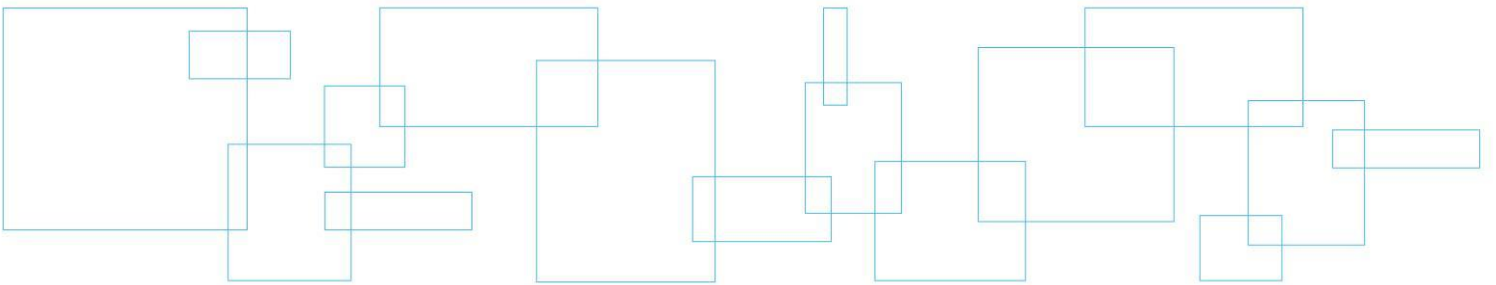
Laboratory Tests - Summary Sheet

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Appendix 4 Photo Essay

Enclosure No. 8:

Photo Essay



Location of Culvert Inlet – Looking North

Photo: 1



Culvert Inlet – Looking East

Photo: 2



Project: Hwy 65 – Station 11+814, Twp of Dymond

Photos Provided By: LVM

Date: November 2012

Culvert Outlet – Looking South

Photo: 3



View Through Culvert – Looking South

Photo: 4



Project: Hwy 65 – Station 12+542, Twp of Dymond

Photos Provided By: LVM

Date: November 2012