



**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 11+814 - 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°: 12/03/12028-F1

**Geocres No. 31M-104**

**LVM | MERLEX**

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## Final Foundation Investigation Report

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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 1.8 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 (SPCSP) culvert is located on Highway 65 at Station 11+814, Township of Dymond. The topography at the site is a low shallow slope valley area to the left and right of the embankment. The existing highway embankment currently supports two undivided lanes of highway, running in an east-west direction. The existing highway, at the culvert location, is constructed on an earth fill embankment some 7.5 m in height, with centerline elevation of 193.9 m at the culvert location. The culvert at this location is a 2.3 m diameter SPCSP culvert, some 61 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.

### 2.2 HISTORICAL INFORMATION

In 1961, a DHO Foundation Report (Geocres No. 31M-009) was prepared for a grade raise and culvert replacement at Station 59+35 in the Township of Dymond (approximately Station 11+810). At that time the report indicates that the embankment was about 4.3 m (14.0') in height, and was to be raised by some 2.4 m (8.0'). This report indicated the embankment

consisted of rock fill. The new culvert was recommended to be a flexible type culvert, installed on a camber, to accommodate settlement. New berms (some 3.1 m (10') in length) were recommended for embankment stability.

### **3 INVESTIGATION PROCEDURES**

The field work for this investigation was carried out during the period of November 5<sup>th</sup> to 16<sup>th</sup>, 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 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-9).

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 11+814 was described as a nail and washer in the east face of Hydro Pole at Station 11+833.6, 22.6 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 11+814, 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 187.9, 193.0, 192.8, 193.3, 192.8, and 187.6 m, respectively.

#### **4.1.1 Pavement Structure**

At surface at Borehole Nos. 2 and 3, a pavement structure consisting of 75 mm of asphalt and 150 mm crushed gravel was penetrated. At surface at Borehole Nos. 4 and 5, a layer of crushed gravel some 100 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 14%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 4 to 30% gravel size particles, 58

to 89% sand size particles, and 7 to 12% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 12 to 26 blows per 300 mm penetration, the compactness of this deposit was described as compact. This deposit was encountered to depths of 1.8, 2.1, 1.1, and 1.4 m below grade at Borehole Nos. 2 to 5, respectively (elevations 191.2, 190.7, 192.2, and 191.4 m, respectively).

#### 4.1.3 Silty Clay Fill

Underlying the granular fill at Borehole No. 2 a deposit of grey silty clay fill was penetrated. Trace asphalt (i.e. a 25 mm thick layer) was encountered in this deposit at elevation 190.5 m. The natural moisture content measured on samples of this fill deposit was in the order of 16 to 32%. This deposit was encountered to a depth of 3.5 m below grade (elevation 189.5 m).

#### 4.1.4 Sand and Clay Fill

Underlying the silty clay fill at Borehole No. 2, and underlying granular fill at Borehole Nos. 3 and 4, a deposit of fill described as grey sand and clay some silt some gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 4 to 30%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 20% gravel size particles, 35% sand size particles, 17% silt size particles, and 28% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on the clay portion of one (1) sample of this deposit, the results of which indicated a Plastic Limit in the order of 18% and a Liquid Limit in the order of 47% (Figure No. L-2, Appendix 4). Based on the results of the Atterberg Limits testing, this deposit was described as a silty clay of medium plasticity (CI). This deposit was encountered to depth of 7.3, 5.1, and 2.1 m below grade at Borehole Nos. 2, 3, and 4, respectively (elevations 185.7, 187.7, and 191.2 m, respectively).

#### 4.1.5 Sand Fill

Underlying the sand and clay fill at BH No. 3, a deposit of sand fill consisting of grey sand trace silt trace gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 18 to 20%. Based on SPT 'N' values of 9 to 20 blows per 300 mm penetration, the compactness of this deposit was described as loose to compact. This deposit was encountered to a depth of 7.3 m below grade (elevation 185.5 m).

#### 4.1.6 Clay Fill

At surface at Borehole Nos. 1 and 6, a deposit of fill described as brown clay with silt was penetrated. Occasional cobbles and boulders were encountered in this deposit. The natural moisture content measured on samples of this deposit was in the order of 37 to 40%. This deposit was encountered to depth of 0.6 and 0.8 m below grade at Borehole Nos. 1 and 6, respectively (elevations 187.3 and 186.8 m, respectively).

#### 4.1.7 Clay

Underlying the clay fill at Borehole Nos. 1 and 6, underlying the sand and clay fill at Borehole Nos. 2 and 4, underlying the sand fill at Borehole No. 3, and underlying the granular fill at



Borehole No. 5, a deposit of grey clay some to with silt was penetrated. Trace organics and wood pieces were encountered in the upper portions of this deposit at Borehole Nos. 1, 2, 3, and 6. The natural moisture content measured on samples of this deposit was in the order of 35 to 63%. Hydrometer analyses were carried out on five (5) samples of this deposit, the results of which indicated 0% gravel size particles, 0 to 2% sand size particles, 12 to 26% silt size particles, and 69 to 88% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was carried out on five (5) samples of this deposit, the results of which indicated a Plastic Limit in the order of 21 to 32% and a Liquid Limit in the order of 52 to 80% (Figure No. L-5, Appendix 4). 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 30 kPa to greater than 100 kPa, the consistency of this deposit was described as firm to very stiff, generally stiff (Figure No. L-6, Appendix 3). This deposit was encountered to depths of 3.8, 10.7, 10.6, 9.1, 7.6, and 3.0 m below grade at Borehole Nos. 1 to 6, respectively, where a transition to a varved clay was observed (elevations 184.1, 182.3, 182.2, 184.2, 185.2, and 184.6 m, respectively).

One (1) one-dimensional oedometer (consolidation) test was carried out on a sample of the clay deposit (Borehole No. 1, Sample 7). The preconsolidation pressure was estimated (using the Casagrande method) to be in the order 85 kPa. The over-consolidation ratio, which is the ratio of the preconsolidation pressure to the existing effective overburden pressure, was in the order of 2.2. 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 slightly overconsolidated, relative to the existing overburden pressure. Results from the consolidation tests are shown on enclosed Figure No. L-7, Appendix 3.

#### 4.1.8 Varved Clay

Underlying the clay at Borehole Nos. 1 to 6, 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 32 to 67%. The natural moisture content measured on a sample of a silty clay varve of this deposit was in the order of 36%. 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, 18 to 40% silt size particles, and 60 to 82% clay size particles (Figure No. L-4, Appendix 3). Atterberg Limits testing was carried out on four (4) 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 52 to 67% (Figure No. L-5, Appendix 4). Based on the results of the Atterberg Limits testing, the clay portion of this deposit was described as a clay of high plasticity (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 20% and a Liquid Limit in the order of 33% (Figure No. L-5, Appendix 4). Based on the results of the Atterberg Limits testing, the clay portion of this deposit was described as a silty clay of low plasticity (CL). Based on in-situ shear strengths of

30 to 56 kPa, the consistency of this deposit was described as firm to stiff (Figure No. L-6, Appendix 3). Sampling was terminated in this deposit at depths of 6.9, 14.5, 13.0, 9.9, 12.9, and 6.9 m below grade at Borehole Nos. 1 to 6, respectively (elevations 181.0, 178.5, 179.8, 183.4, 179.9, and 180.7 m, respectively).

One (1) one-dimensional oedometer (consolidation) test was carried out on a sample of the deposit of the clay with varves (Borehole No. 3, Sample 11). The preconsolidation pressure was estimated (using the Casagrande method) to be in the order 160 kPa. The over-consolidation ratio, which is the ratio of the preconsolidation pressure to the existing effective overburden pressure, was in the order of 1.4. 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 slightly overconsolidated, relative to the existing overburden pressure. Results from the consolidation tests are shown on enclosed Figure No. L-8, Appendix 3.

#### **4.1.9 DCPT**

Dynamic Cone Penetration Tests (DCPT) were advanced at Borehole Nos. 1 and 4. DCPT refusal was encountered at depths of 38.7 and 39.5 m below grade at Borehole Nos. 1 and 4 (elevations 149.2 and 153.8 m, respectively).

#### **4.2 GROUNDWATER DATA**

At the time of this investigation, the water level in the culvert was measured at elevation 187.3 m at the culvert 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.

Standpipes were installed in Borehole Nos. 1, 4, 5, and 6, 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 184.5 to 188.3 m, respectively.

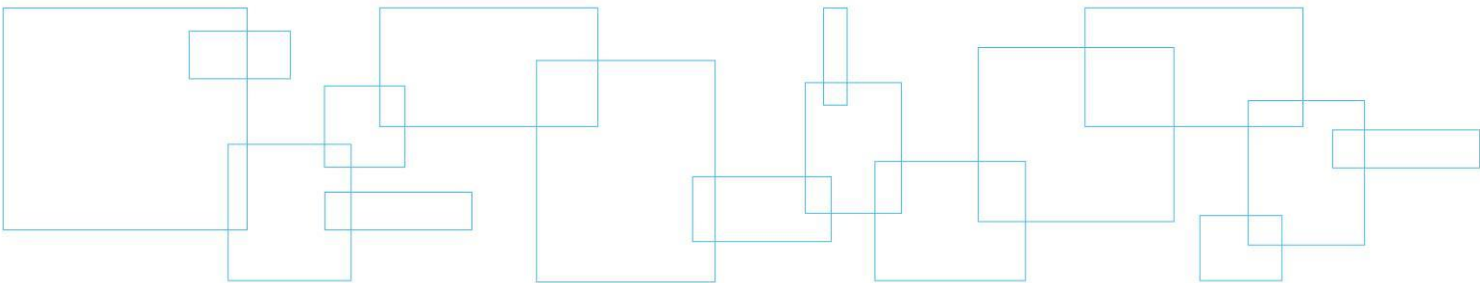
The groundwater and river water levels will fluctuate seasonally/yearly.

The results of the continuous water level monitoring are provided in the following table:

| DATE   | BH NO. 1  |               | BH NO. 4  |               | BH NO. 5  |               | BH NO. 6  |               |
|--------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|
|        | Depth (m) | Elevation (m) | Depth (m) | Elevation (m) | Depth (m) | Elevation (m) | Depth (m) | Elevation (m) |
| Nov 5  | Dry       | -             | -         | -             | -         | -             | -         | -             |
| Nov 6  | 1.5       | 186.4         | -         | -             | -         | -             | -         | -             |
| Nov 7  | 1.0       | 186.9         | -         | -             | -         | -             | 5.2       | 182.4         |
| Nov 8  | 0.8       | 187.1         | -         | -             | -         | -             | 1.8       | 185.8         |
| Nov 9  | 0.8       | 187.1         | Dry       | -             | -         | -             | 1.0       | 186.6         |
| Nov 12 | 0.8       | 187.1         | 8.6       | 185.3         | Dry       | -             | 1.0       | 186.6         |
| Nov 13 | 0.8       | 187.1         | 8.6       | 185.3         | 8.9       | 183.9         | 1.0       | 186.6         |
| Nov 14 | 0.8       | 187.1         | 8.6       | 185.3         | 8.5       | 184.3         | 1.0       | 186.6         |
| Nov 15 | 0.8       | 187.1         | 8.2       | 185.7         | 8.3       | 184.5         | 1.0       | 186.6         |

**Appendix 1    Key Plan**

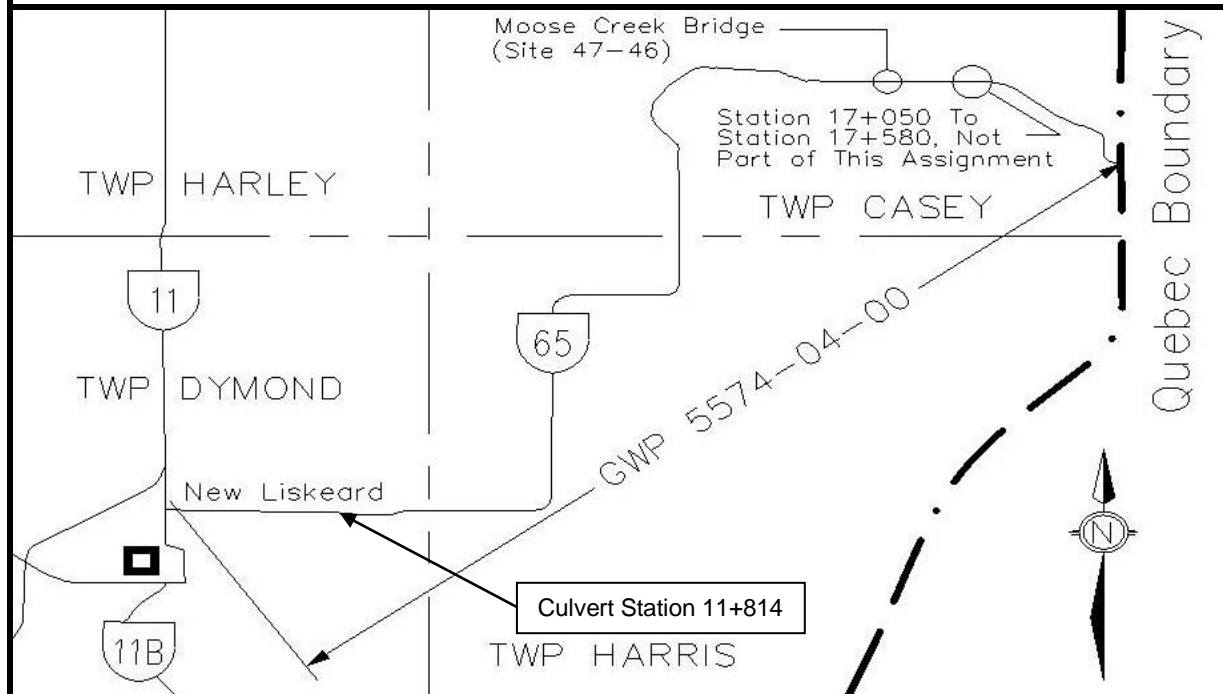
Drawing No. 1                      Key Plan



## KEY PLAN

Drawing No. 1

NOT TO SCALE



**FINAL 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-F1

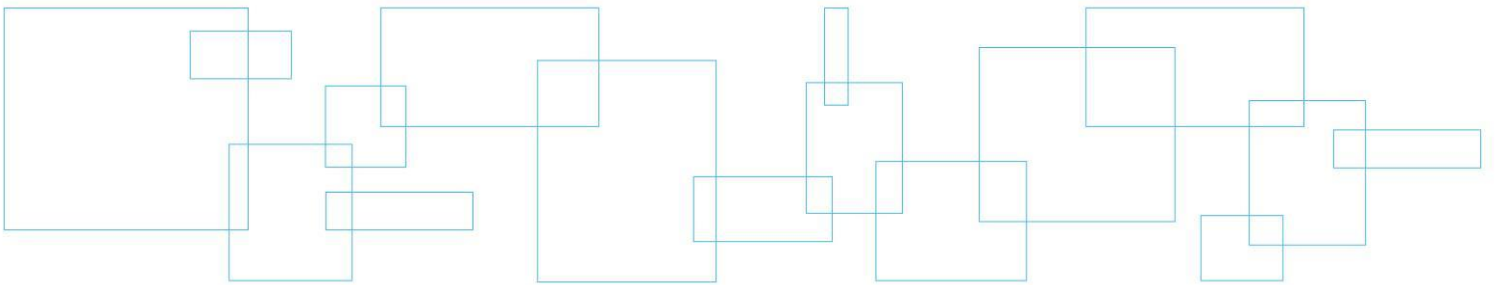
June 2013

**LVM | MERLEX**

## 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-F1             | DATUM            | Geodetic        | LOCATION      | N 5265751.3 E 406421.8 - Dymond Township Station 11+800 | ORIGINATED BY | JL    |
| PROJECT   | GWP 5574-04-00, Highway 65 |                  |                 | BOREHOLE TYPE | Track Mounted CME 45B - Hollow Stem Augers              | COMPILED BY   | AT/RG |
| CLIENT    | AECOM Inc.                 | DATE (Started)   | 5 November 2012 | TIME          |   | CHECKED BY    | MAM   |
|           |                            | DATE (Completed) | 5 November 2012 | (Completed)   | 2:30:00 PM  |               |       |

[illegible]

**METRIC**

## RECORD OF BOREHOLE NO. 1



|           |                            |                  |  |          |   |               |     |
|-----------|----------------------------|------------------|--|----------|---|---------------|-----|
| REFERENCE | 12/03/12028-F1             | DATUM            | Geodetic                                   | LOCATION | N 5265751.3 E 406421.8 - Dymond Township Station 11+800 | ORIGINATED BY | JL  |
| PROJECT   | GWP 5574-04-00, Highway 65 | BOREHOLE TYPE    | Track Mounted CME 45B - Hollow Stem Augers |          | COMPILED BY   | AT/RG         |     |
| CLIENT    | AECOM Inc.                 | DATE (Started)   | 5 November 2012                            | TIME     | (Completed) 2:30:00 PM                                  | CHECKED BY    | MAM |
|           |                            | DATE (Completed) | 5 November 2012                            |          |   |               |     |

| SOIL PROFILE  |                              |             | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT                  |                         |  | PLASTIC LIMIT   NATURAL<br>LIMIT   MOISTURE   LIMIT<br>CONTENT |  |  | UNIT<br>WEIGHT<br>$\gamma$<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR   SA   (SI   CL) |
|---------------|------------------------------|-------------|---------|------|------------|----------------------------|--|-------------------------|--|--|--|--|---|--|
| ELEV<br>DEPTH | DESCRIPTION                  | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                            | SHEAR STRENGTH kPa   |                         |  | W <sub>p</sub> W   W <sub>L</sub><br>WATER CONTENT (%)         |  |  |   |  |
|               |                              |             |         |      |            |                            | ○ UNCONFINED   + FIELD VANE<br>● QUICK TRIAXIAL   × LAB VANE |                         |  |  |  |  |   |  |
|               | Continued from Previous Page |             |         |      |            |                            | ELEVATION SCALE  | 20   40   60   80   100 |  | 20   40   60   |  |  |   |  |
|               |                              |             |         |      |            |                            | 162  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 161  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 160  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 159  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 158  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 157  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 156  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 155  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 154  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 153  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 152  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 151  |                         |  |  |  |  |   |  |
|               |                              |             |         |      |            |                            | 150  |                         |  |  |  |  |   |  |
|               | Continued Next Page          |             |         |      |            |                            |  |                         |  |  |  |  |   |  |

MEL-GEO 12028 - AREA A - BOREHOL LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

**METRIC****RECORD OF BOREHOLE NO. 1**

REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265751.3 E 406421.8 - Dymond Township Station 11+800 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT/RG  
 CLIENT AECOM Inc. DATE (Started) 5 November 2012 TIME   
 DATE (Completed) 5 November 2012 (Completed) 2:30:00 PM CHECKED BY MAM

| SOIL PROFILE  |                                 | SAMPLES     |        |      | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |                    |  |  |  | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA (SI CL) |
|---------------|---------------------------------|-------------|--------|------|-------------------------|-----------------|--|--------------------|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV. DEPTH   | DESCRIPTION                     | STRATA PLOT | NUMBER | TYPE |                         |                 | "N" VALUES                               | SHEAR STRENGTH kPa |  |  |  |                                 |                               |                                |                  |  |
|               | Continued from Previous Page    |             |        |      |                         |                 |  |                    |  |  |  |                                 |                               |                                |                  |  |
| 149.2<br>38.7 | DCPT Refusal<br>End of Borehole |             |        |      |                         |                 |  |                    |  |  |  |                                 |                               |                                |                  |  |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13



## METRIC

## RECORD OF BOREHOLE NO. 2



REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265720.3 E 406431.9 - Dymond Township Station 11+810 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 15 November 2012 TIME 15 November 2012 (Completed) 1:15:00 PM CHECKED BY MAM

| SOIL PROFILE  |  |             | SAMPLES |      |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT<br><br>SHEAR STRENGTH kPa<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL × LAB VANE<br>20 40 60 80 100                       | PLASTIC LIMIT<br>W <sub>p</sub><br>NATURAL MOISTURE CONTENT<br>W<br>LIQUID LIMIT<br>W <sub>L</sub><br>WATER CONTENT (%) | UNIT WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA (SI CL) |
|---------------|--|-------------|---------|------|------------|-------------------------|-----------------|---|---|---------------------------------------|--|
| ELEV DEPTH    | DESCRIPTION  | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                         |                 |   |   |                                       |  |
| 193.0<br>0.0  | Ground Surface<br>± 75 mm Asphalt<br>± 150 mm Crushed Gravel<br><br>FILL - brown sand some silt with gravel<br><br>(loose/compact)                             |             | 1       | SS   | 25         | ▽                       |                 |   |   |                                       | 30 58 (12)   |
|               |  |             | 2       | SS   | 20         |                         | 192             |   |   |                                       |  |
| 191.2<br>1.8  | FILL - grey silty clay trace asphalt<br><br>25 mm asphalt layer  |             | 3       | SS   | 5          |                         | 191             |   |   |                                       |  |
|               |  |             | 4       | SS   | 16         |                         | 190             |   |   |                                       |  |
|               |  |             | 5       | SS   | 14         |                         | 189             |   |   |                                       |  |
| 189.5<br>3.5  | FILL - grey sand and clay with gravel some silt  |             | 6       | SS   | 15         |                         | 188             |   |   |                                       |  |
|               |  |             | 7       | SS   | 22         |                         | 187             |   |   |                                       |  |
|               |  |             | 8       | SS   | 20         |                         | 186             |   |   |                                       |  |
|               |  |             | 9       | SS   | 22         |                         | 185             |   |   |                                       |  |
|               |  |             | 10      | SS   | 26         |                         | 184             |   |   |                                       |  |
| 185.7<br>7.3  | CLAY - grey clay with silt<br>trace organics and wood to a ± 7.9 m depth   |             | 11      | SS   | 12         | 183                     |                 |   |   | 0 0 26 74                             |  |
|               |  |             | 12      | SS   | WH         | 182                     |                 |   |   |                                       |  |
| 182.3<br>10.7 | CLAY - grey clay with silt<br>varved structure<br><br>(±25 mm thick clay layers with ±6 mm thick silty clay varves)<br><br>(firm/stiff)<br>Continued Next Page |             | 13      | TO   | PM         |                         |                 |   |   |                                       |  |
| COMMENTS      |  |             |         |      |            |                         |                 | + 3, × 3 : Numbers on right refer to Sensitivity<br>Numbers on left refer to values greater than 120 kPa<br>○ 3% STRAIN AT FAILURE                                      |   |                                       |  |
|               |  |             |         |      |            |                         |                 | WATER LEVEL RECORDS<br>Date (dd/mm/yy)/Time      Water Depth (m)      Cave In (m)<br>1) 15/11/12 12:43:00 PM      5.1      12.9<br>2)      -      -<br>3)      -      - |   |                                       |  |

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

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13



**METRIC****RECORD OF BOREHOLE NO. 2**

REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265720.3 E 406431.9 - Dymond Township Station 11+810 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 15 November 2012 TIME   
 DATE (Completed) 15 November 2012 (Completed) 1:15:00 PM CHECKED BY MAM

| SOIL PROFILE  |  |             | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT  |  |  | PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT |  |  | UNIT<br>WEIGHT<br><br>$\gamma$<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR   SA   (SI   CL) |
|---------------|--|-------------|---------|------|------------|----------------------------|-----------------|--|--|--|---|--|--|---|--|
| ELEV<br>DEPTH | DESCRIPTION  | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | SHEAR STRENGTH kPa   |  |  | W <sub>p</sub> W                      W <sub>L</sub>    |  |  |   |  |
|               |  |             |         |      |            |                            |                 | ○ UNCONFINED                      + FIELD VANE<br>● QUICK TRIAXIAL                      × LAB VANE |  |  | WATER CONTENT (%)                                       |  |  |   |  |
|               | Continued from Previous Page   |             |         |      |            |                            |                 | 20   40   60   80   100  |  |  |   |  |  |   |  |
|               | CLAY - grey clay with silt<br>varved structure<br><br>(±25 mm thick clay layers with ±6<br>mm thick silty clay varves)<br>(firm/stiff) |             | 14      | SS   | PM         |                            | 180             |  |  |  |   |  |  |   |  |
|               |  |             |         |      |            |                            |                 |  |  |  |   |  |  |   |  |
|               |  |             | 15      | TO   | PM         |                            | 179             |  |  |  |   |  |  |   |  |
| 178.5         |  |             |         |      |            |                            |                 |  |  |  |   |  |  |   |  |
| 14.5          | End of Sampling<br>End of Borehole   |             |         |      |            |                            |                 |  |  |  |   |  |  |   |  |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13





## METRIC

## RECORD OF BOREHOLE NO. 3



REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265712.5 E 406439.0 - Dymond Township Station 11+817 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 15 November 2012 TIME   
 DATE (Completed) 16 November 2012 (Completed) 9:40:00 AM CHECKED BY MAM

| SOIL PROFILE |   |             | SAMPLES |      |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |    |    |    |     | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---|-------------|---------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV. DEPTH  | DESCRIPTION   | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                         |                 | 20                                       | 40 | 60 | 80 | 100 |                                 |                               |                                |                  |                                       |
|              | Continued from Previous Page                                  |             |         |      |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |                                       |
|              | CLAY - grey clay with silt varved structure                   |             | 13      | TO   | PM         |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |                                       |
|              | (±25 mm thick clay layers with ±6 mm thick silty clay varves) |             |         |      |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |                                       |
| 179.8        | (firm)  |             |         |      |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |                                       |
| 13.0         | End of Sampling<br>End of Borehole                            |             |         |      |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |                                       |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13





**METRIC**

## RECORD OF BOREHOLE NO. 4



|           |                            |                |  |                  |   |               |     |
|-----------|----------------------------|----------------|--|------------------|---|---------------|-----|
| REFERENCE | 12/03/12028-F1             | DATUM          | Geodetic                                   | LOCATION         | N 5265712.0 E 406415.9 - Dymond Township Station 11+784 | ORIGINATED BY | JL  |
| PROJECT   | GWP 5574-04-00, Highway 65 | BOREHOLE TYPE  | Truck Mounted CME 45B - Hollow Stem Augers | COMPILED BY      | AT  |               |     |
| CLIENT    | AECOM Inc.                 | DATE (Started) | 9 November 2012                            | TIME (Completed) | 11:00:00 AM   | CHECKED BY    | MAM |

| SOIL PROFILE        |   |             | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |              | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA (SI CL) |                   |                  |            |  |
|---------------------|---|-------------|---------|------|------------|----------------------------|-----------------|---|--------------|---------------------------------|-------------------------------------|--------------------------------|--|--|-------------------|------------------|------------|--|
| ELEV<br>DEPTH       | DESCRIPTION   | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | SHEAR STRENGTH kPa                          |              |                                 |                                     |                                |  |  | WATER CONTENT (%) |                  |            |  |
|                     |   |             |         |      |            |                            |                 | ○ UNCONFINED                                | + FIELD VANE |                                 |                                     |                                |  |  |                   | ● QUICK TRIAXIAL | × LAB VANE |  |
| 193.3               | Ground Surface  |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 0.0                 | ± 100 mm Crushed Gravel   |             | 1       | SS   | 13         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     | FILL - brown sand trace gravel trace silt   |             | 2       | SS   | 12         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 192.2               |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 1.1                 | FILL - grey sand and clay some silt some gravel   |             | 3       | SS   | 20         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 191.2               |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 2.1                 | CLAY - brown to grey clay with silt (very stiff)  |             | 4       | SS   | 5          |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             | 5       | SS   | 5          |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     | brown   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     | grey  |             | 6       | SS   | 2          |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     | (stiff to firm)   |             | 7       | SS   | 2          |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             | 8       | TO   | PM         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
|                     |   |             | 9       | SS   | PM         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 184.2               |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 9.1                 | CLAY - grey clay with silt varved structure (±25 mm thick clay layers with ±6 mm thick silty clay varves) |             | 10      | TO   | PM         |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 183.4               | End of Sampling<br>Continuation of DCPT   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 9.9                 |   |             |         |      |            |                            |                 |   |              |                                 |                                     |                                |  |  |                   |                  |            |  |
| 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

| Date (dd/mm/yy)/Time    | Water Depth (m) | Cave In (m) |
|-------------------------|-----------------|-------------|
| 1) 9/11/12 10:30:00 AM  | DRY             | -           |
| 2) 12/11/12 2:30:00 PM  | 8.6             | -           |
| 3) 15/11/12 12:35:00 PM | 8.2             | -           |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

**METRIC**

## RECORD OF BOREHOLE NO. 4



|           |                            |       |          |                  |   |                  |             |
|-----------|----------------------------|-------|----------|------------------|---|------------------|-------------|
| REFERENCE | 12/03/12028-F1             | DATUM | Geodetic | LOCATION         | N 5265712.0 E 406415.9 - Dymond Township Station 11+784 | ORIGINATED BY    | JL          |
| PROJECT   | GWP 5574-04-00, Highway 65 |       |          | BOREHOLE TYPE    | Truck Mounted CME 45B - Hollow Stem Augers              | COMPILED BY      | AT          |
| CLIENT    | AECOM Inc.                 |       |          | DATE (Started)   | 9 November 2012   | TIME (Completed) | 11:00:00 AM |
|           |                            |       |          | DATE (Completed) |   | CHECKED BY       | MAM         |

| SOIL PROFILE  |                              |             | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |                   | PLASTIC LIMIT      NATURAL<br>LIMIT      MOISTURE<br>CONTENT      LIQUID<br>LIMIT |                |  | UNIT<br>WEIGHT<br><br>γ<br><br>kN/m³ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR SA (SI CL) |
|---------------|------------------------------|-------------|---------|------|------------|----------------------------|---|--|-------------------|---|----------------|--|--------------------------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                  | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                            | ELEVATION SCALE                             | SHEAR STRENGTH kPa   | W <sub>p</sub>    | W   | W <sub>L</sub> |  |                                      |  |
|               |                              |             |         |      |            |                            | 20 40 60 80 100                             | ○ UNCONFINED      + FIELD VANE<br>● QUICK TRIAXIAL      × LAB VANE | WATER CONTENT (%) |   |                |  |                                      |  |
|               | Continued from Previous Page |             |         |      |            |                            | 181   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 180   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 179   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 178   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 177   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 176   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 175   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 174   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 173   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 172   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 171   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 170   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            | 169   |  |                   |   |                |  |                                      |  |
|               |                              |             |         |      |            |                            |   |  |                   |   |                |  |                                      |  |

MEL-GEO 12028 - AREA A - BOREHOL LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

**METRIC**

## RECORD OF BOREHOLE NO. 4



|           |                            |                  |  |                  |   |               |     |
|-----------|----------------------------|------------------|--|------------------|---|---------------|-----|
| REFERENCE | 12/03/12028-F1             | DATUM            | Geodetic                                   | LOCATION         | N 5265712.0 E 406415.9 - Dymond Township Station 11+784 | ORIGINATED BY | JL  |
| PROJECT   | GWP 5574-04-00, Highway 65 | BOREHOLE TYPE    | Truck Mounted CME 45B - Hollow Stem Augers | COMPILED BY      | AT  |               |     |
| CLIENT    | AECOM Inc.                 | DATE (Started)   | 9 November 2012                            | TIME (Completed) | 11:00:00 AM   | CHECKED BY    | MAM |
|           |                            | DATE (Completed) |  |                  |   |               |     |

| SOIL PROFILE                 |             |             | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br><div><div></div><div>20406080100</div></div> | PLASTIC<br>LIMIT<br>w <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>w | LIQUID<br>LIMIT<br>w <sub>L</sub> | UNIT<br>WEIGHT<br>γ<br><br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR SA (SI CL) |
|------------------------------|-------------|-------------|---------|------|------------|----------------------------|-----------------|---|------------------------------------|-------------------------------------|-----------------------------------|--|--|
| ELEV<br>DEPTH                | DESCRIPTION | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 |   |                                    |                                     |                                   |  |  |
| Continued from Previous Page |             |             |         |      |            |                            |                 |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 168             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 167             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 166             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 165             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 164             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 163             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 162             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 161             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 160             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 159             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 158             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 157             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            | 156             |   |                                    |                                     |                                   |  |  |
|                              |             |             |         |      |            |                            |                 |   |                                    |                                     |                                   |  |  |

Continued Next Page

MEL-GEO 12028 - AREA A - BOREHOL LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

**METRIC****RECORD OF BOREHOLE NO. 4**

REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265712.0 E 406415.9 - Dymond Township Station 11+784 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 9 November 2012 TIME (Completed) 11:00:00 AM CHECKED BY MAM  
 DATE (Completed)

| SOIL PROFILE |                                 | SAMPLES     |        |      | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |    | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---------------------------------|-------------|--------|------|-------------------------|-----------------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV. DEPTH  | DESCRIPTION                     | STRATA PLOT | NUMBER | TYPE |                         |                 | "N" VALUES                               | 20 |                                 |                               |                                |                  |                                       |
|              | Continued from Previous Page    |             |        |      |                         |                 |  |    |                                 |                               |                                |                  |                                       |
| 153.8        |                                 |             |        |      |                         | 155             |  |    |                                 |                               |                                |                  |                                       |
| 39.5         | DCPT Refusal<br>End of Borehole |             |        |      |                         | 154             |  |    |                                 |                               |                                |                  |                                       |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13



## METRIC

## RECORD OF BOREHOLE NO. 5



REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265722.3 E 406466.9 - Dymond Township Station 11+845 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 12 November 2012 TIME (Completed) 2:00:00 PM CHECKED BY MAM  
 DATE (Completed) 12 November 2012

| SOIL PROFILE |   |             | SAMPLES |      |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT<br><br>SHEAR STRENGTH kPa<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL × LAB VANE<br>WATER CONTENT (%)<br>20 40 60 80 100 | PLASTIC LIMIT<br>W <sub>p</sub><br>NATURAL MOISTURE CONTENT<br>W<br>LIQUID LIMIT<br>W <sub>L</sub><br>WATER CONTENT (%)<br>20 40 60 | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA (SI CL) |
|--------------|---|-------------|---------|------|------------|-------------------------|-----------------|--|---|------------------|--|
| ELEV DEPTH   | DESCRIPTION   | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                         |                 |  |   |                  |  |
| 192.8<br>0.0 | Ground Surface<br>± 100 mm Crushed Gravel                     |             | 1       | SS   | 16         |                         |                 |  |   |                  |  |
|              | FILL - brown sand trace gravel trace silt                     |             | 2       | SS   | 12         |                         |                 |  |   |                  | 4 89 (7)   |
| 191.4<br>1.4 | CLAY - brown clay some to with silt trace gravel              |             | 3       | SS   | 12         |                         |                 |  |   |                  |  |
|              | (very stiff/firm)   |             | 4       | SS   | 7          |                         |                 |  |   |                  |  |
|              |   |             | 5       | SS   | 6          |                         |                 |  |   |                  | 0 0 12 88  |
|              | brown   |             | 6       | SS   | 4          |                         |                 |  |   |                  |  |
|              | grey  |             | 7       | SS   | 3          |                         |                 |  |   |                  | 0 0 15 85  |
|              |   |             | 8       | TO   | PM         |                         |                 |  |   |                  |  |
| 185.2<br>7.6 | CLAY - grey clay with silt varved structure                   |             | 9       | SS   | PM         |                         |                 |  |   |                  | 0 0 18 82  |
|              | (±25 mm thick clay layers with ±6 mm thick silty clay varves) |             |         |      |            |                         |                 |  |   |                  |  |
|              | (stiff to firm)   |             | 10      | TO   | PM         |                         |                 |  |   |                  |  |
|              |   |             | 11      | SS   | WH         |                         |                 |  |   |                  |  |
|              | Continued Next Page   |             |         |      |            |                         |                 |  |   |                  |  |

COMMENTS  
Borehole extended from 9.9 m to 12.9 m, June 7, 2013.

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

+ 3, × 3 : Numbers on right refer to Sensitivity  
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

| WATER LEVEL RECORDS     |                 |             |
|-------------------------|-----------------|-------------|
| Date (dd/mm/yy)/Time    | Water Depth (m) | Cave In (m) |
| 1) 12/11/12 1:50:00 PM  | DRY             | -           |
| 2) 13/11/12 3:15:00 PM  | 8.9             | -           |
| 3) 15/11/12 12:35:00 PM | 8.3             | -           |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

## METRIC

## RECORD OF BOREHOLE NO. 5



REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265722.3 E 406466.9 - Dymond Township Station 11+845 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 12 November 2012 TIME   
 DATE (Completed) 12 November 2012 (Completed) 2:00:00 PM CHECKED BY MAM

| SOIL PROFILE |                                    | SAMPLES     |        |      | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |    | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA (SI CL) |
|--------------|------------------------------------|-------------|--------|------|-------------------------|-----------------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV DEPTH   | DESCRIPTION                        | STRATA PLOT | NUMBER | TYPE |                         |                 | "N" VALUES                               | 20 |                                 |                               |                                |                  |  |
|              | Continued from Previous Page       |             | 12     | SS   | PM                      |                 |  |    |                                 |                               |                                |                  |  |
| 179.9        |                                    |             |        |      |                         | 180             |  |    |                                 |                               |                                |                  |  |
| 12.9         | End of Sampling<br>End of Borehole |             |        |      |                         |                 |  |    |                                 |                               |                                |                  |  |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13



## METRIC

## RECORD OF BOREHOLE NO. 6



REFERENCE 12/03/12028-F1 DATUM Geodetic LOCATION N 5265686.8 E 406444.0 - Dymond Township Station 11+822 ORIGINATED BY JL  
 PROJECT GWP 5574-04-00, Highway 65 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT  
 CLIENT AECOM Inc. DATE (Started) 6 November 2012 TIME   
 DATE (Completed) 6 November 2012 (Completed) 11:30:00 AM CHECKED BY MAM

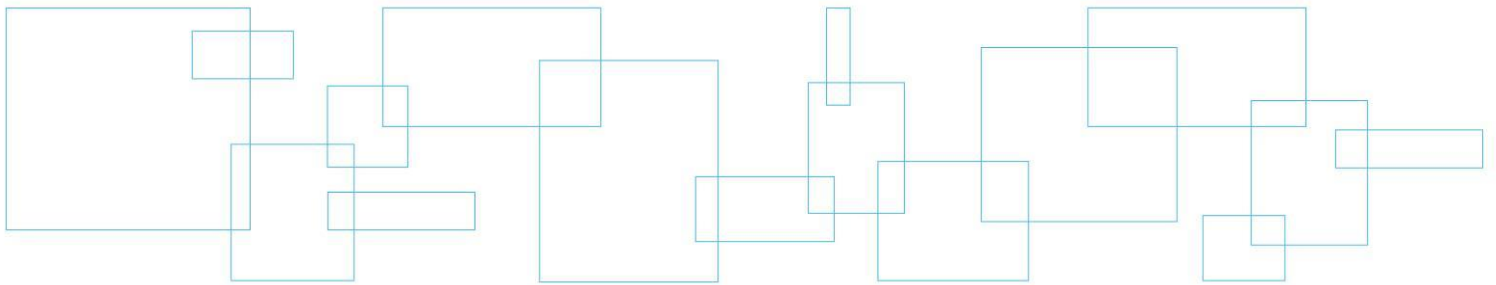
| SOIL PROFILE  |  |             | SAMPLES |      |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT<br><br>SHEAR STRENGTH kPa<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL × LAB VANE<br>20 40 60 80 100<br>WATER CONTENT (%)<br>20 40 60<br>PLASTIC LIMIT (w <sub>p</sub> ) NATURAL MOISTURE CONTENT (w) LIQUID LIMIT (w <sub>L</sub> )   | UNIT WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA (SI CL) |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|---|--|-------------|---------|------|------------|-------------------------|-----------------|---|---------------------------------------|--|----------------------|-----------------|-------------|-----------------------|-----|-------|-----------------------|-----|-----|-------------------------|---|-----|
| ELEV DEPTH  | DESCRIPTION  | STRATA PLOT | NUMBER  | TYPE | "N" VALUES |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 187.6   | Ground Surface   |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 0.0   | FILL - brown clay with silt occasional cobbles/boulders  |             | 1       | SS   | 4          |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 186.8   |  |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 0.8   | CLAY - grey clay some to with silt trace organics to a ± 2.7 m depth   |             | 2       | SS   | 4          |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             | 3       | SS   | 4          |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             | 4       | SS   | 4          |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 184.6   |  |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 3.0   | CLAY - grey clay with silt varved structure<br>(±25 mm thick clay layers with ±6 mm thick silty clay varves)<br>(firm) |             | 5       | SS   | WH         |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             | 6       | SS   | PM         |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             | 7       | SS   | PM         |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             | 8       | TO   | PM         |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 180.7   |  |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 6.9   | End of Sampling<br>End of Borehole   |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| COMMENTS  |  |             |         |      |            |                         |                 | + 3, × 3 : Numbers on right refer to Sensitivity<br>Numbers on left refer to values greater than 120 kPa<br>○ 3% STRAIN AT FAILURE  |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
|   |  |             |         |      |            |                         |                 | WATER LEVEL RECORDS<br><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) 7/11/12 3:05:00 PM</td> <td>5.2</td> <td>▽ - 變</td> </tr> <tr> <td>2) 8/11/12 1:30:00 PM</td> <td>1.8</td> <td>▽ -</td> </tr> <tr> <td>3) 15/11/12 12:35:00 PM</td> <td>1</td> <td>▽ -</td> </tr> </tbody> </table> |                                       |  | Date (dd/mm/yy)/Time | Water Depth (m) | Cave In (m) | 1) 7/11/12 3:05:00 PM | 5.2 | ▽ - 變 | 2) 8/11/12 1:30:00 PM | 1.8 | ▽ - | 3) 15/11/12 12:35:00 PM | 1 | ▽ - |
| Date (dd/mm/yy)/Time  | Water Depth (m)  | Cave In (m) |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 1) 7/11/12 3:05:00 PM   | 5.2  | ▽ - 變       |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 2) 8/11/12 1:30:00 PM   | 1.8  | ▽ -         |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| 3) 15/11/12 12:35:00 PM   | 1  | ▽ -         |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |
| The stratification lines represent approximate boundaries. The transition may be gradual. |  |             |         |      |            |                         |                 |   |                                       |  |                      |                 |             |                       |     |       |                       |     |     |                         |   |     |

MEL-GEO 12028 - AREA A - BOREHOLE LOGS - FINAL.GPJ MEL-GEO.GDT 18/6/13

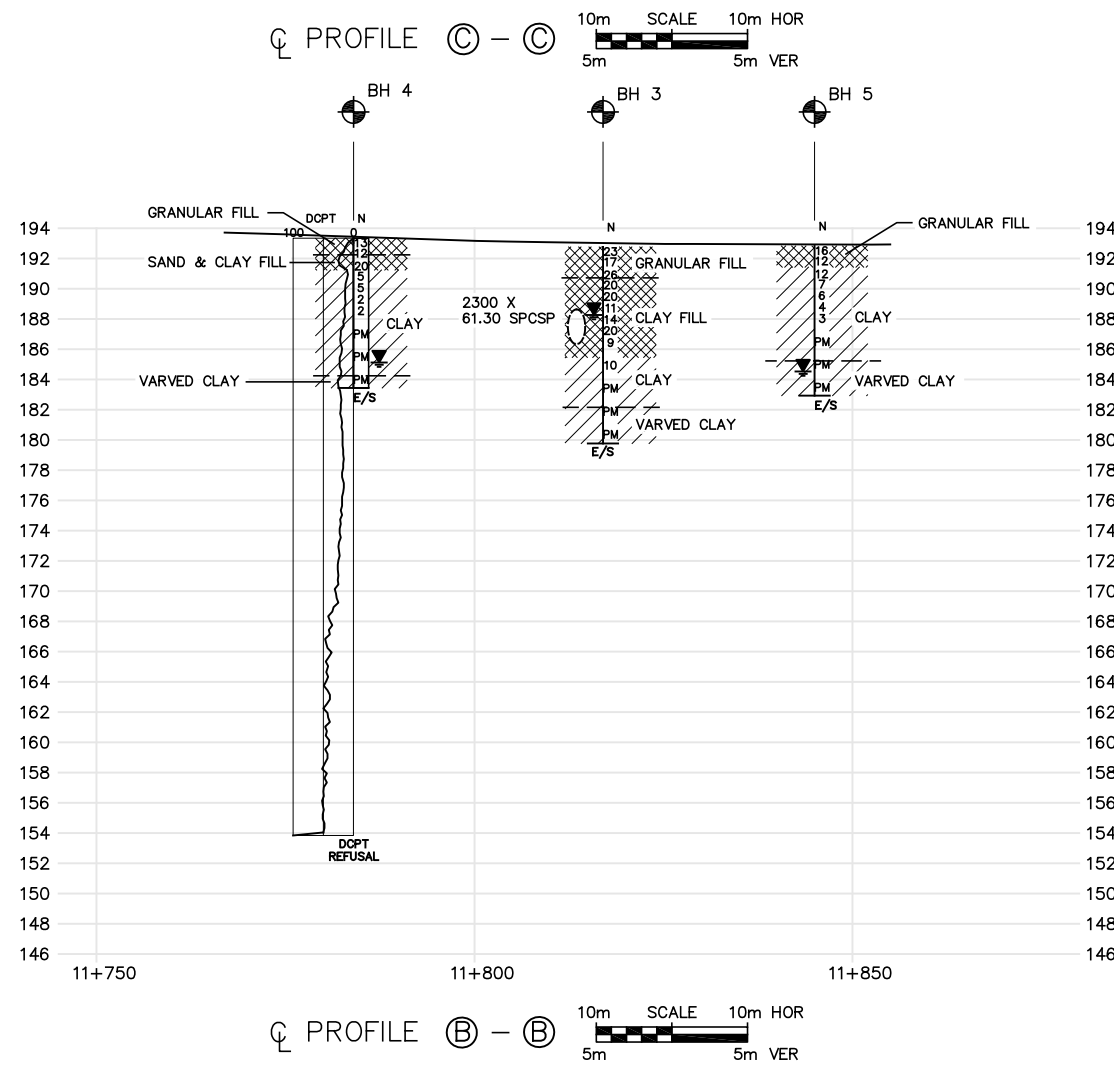
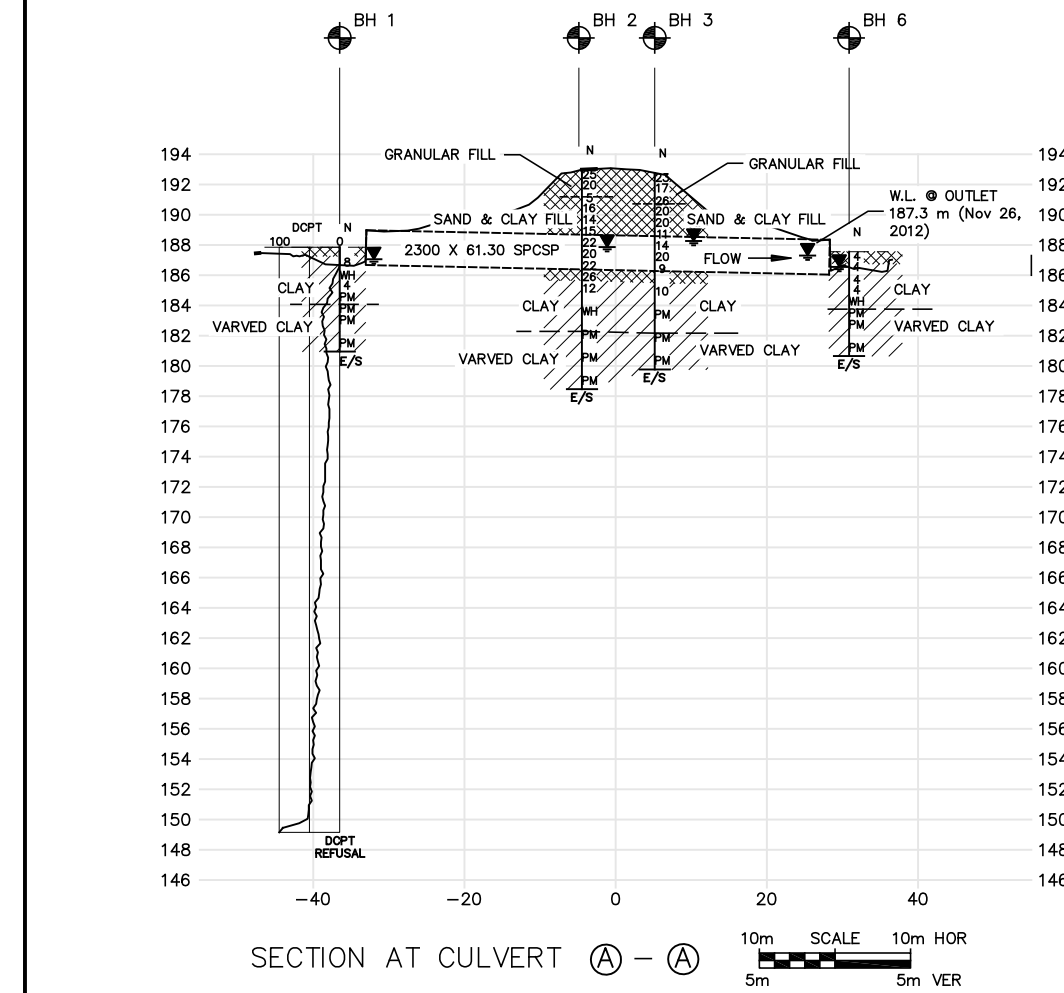
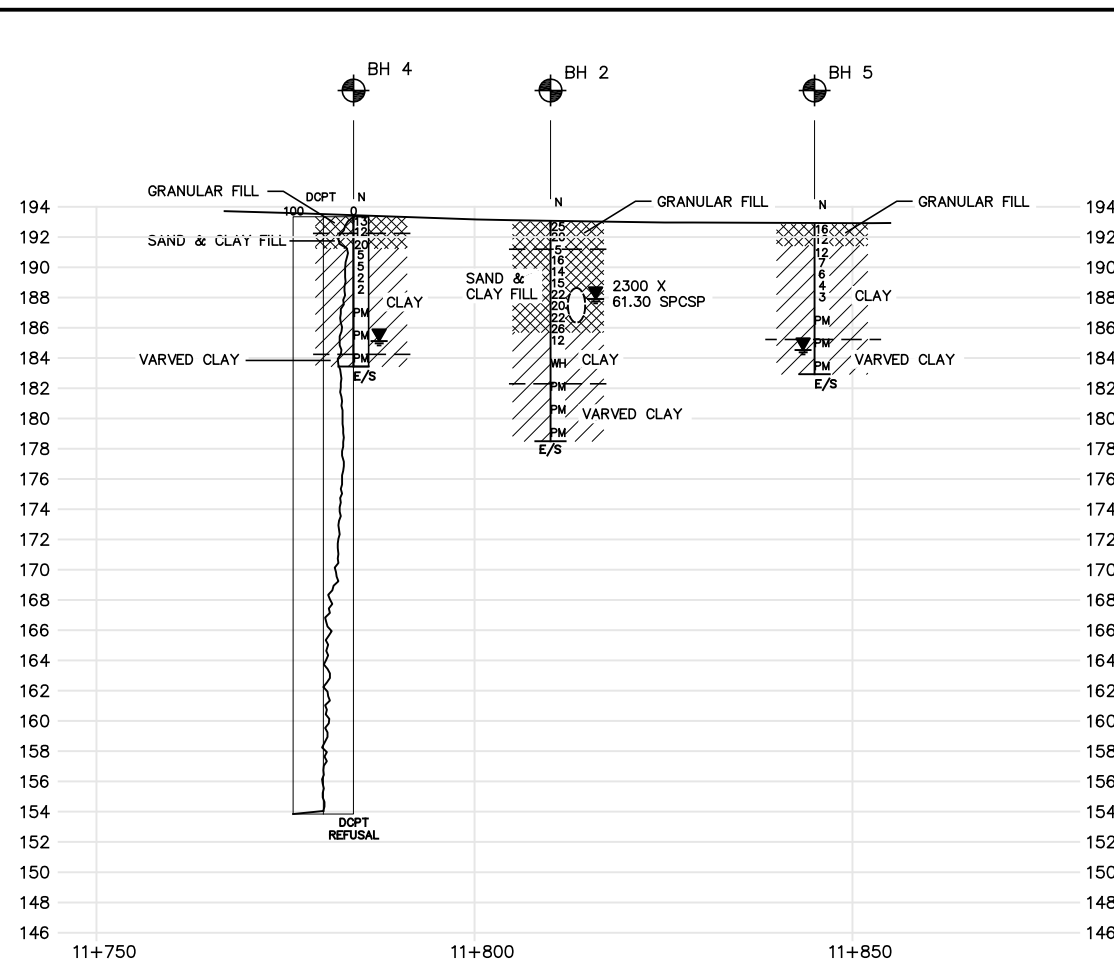
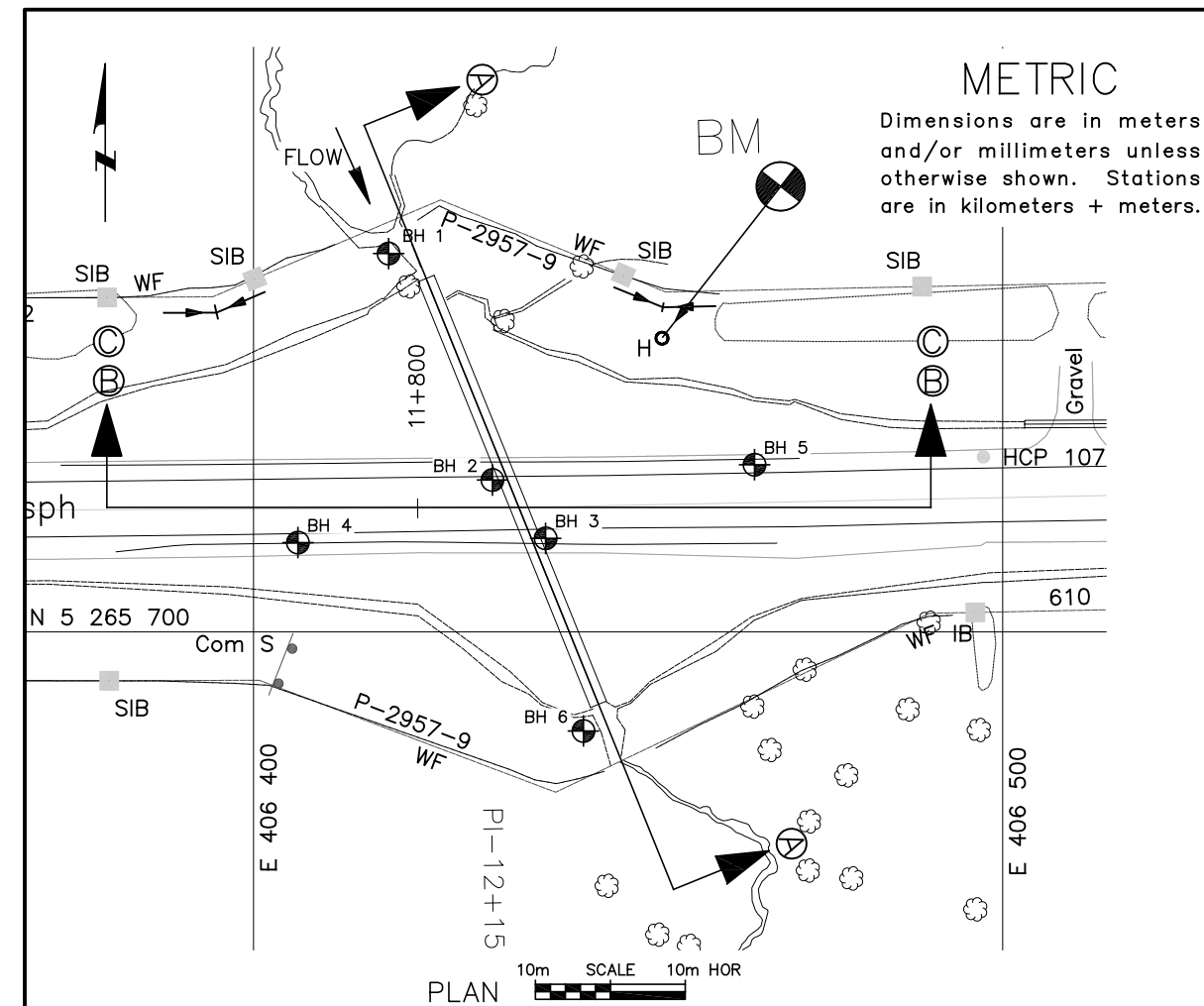


## Appendix 3    Borehole Plan and Lab Data

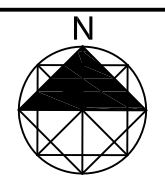
Drawing No. 2:            Borehole Location and Soil Strata  
Figure Nos. L-1 to L-4:    Grain Size Distribution Curves  
Figure No. L-5:            Atterberg Limits Sheet  
Figure No. L-6:            Shear Strength Chart  
Figure Nos. L-7 and L-8:    Consolidation Test Results  
Figure No. L-9:            Lab Test Summary Sheet







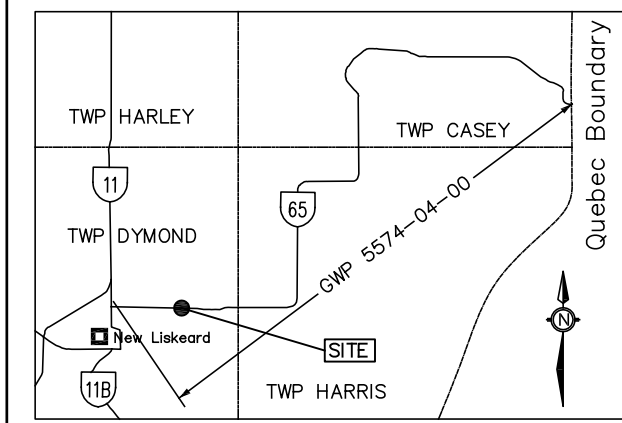
CONT No XXXX-XXXX  
GWP No 5574-04-01



HWY NO. 65  
Township of Dymond  
Culvert at Station 11+814  
BOREHOLE LOCATIONS & SOIL STRATA

Drawing  
2

LVM | MERLEX



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

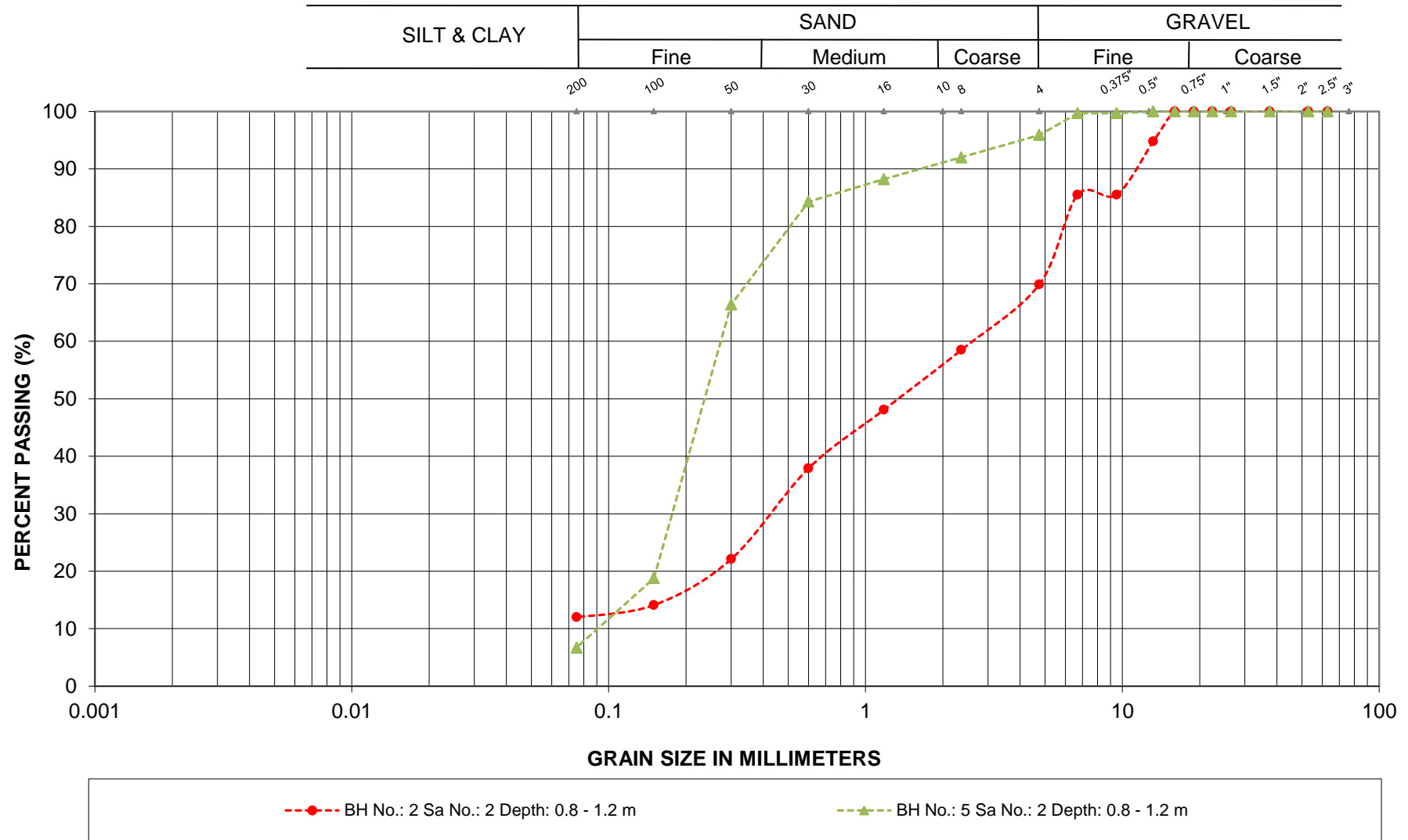
| Borehole No.   | Elev. | O/S     | Co-ordinates |          |
|----------------|-------|---------|--------------|----------|
|                |       |         | Northerly    | Easterly |
| Borehole No. 1 | 187.9 | 34m Lt  | 5265751.3    | 406421.8 |
| Borehole No. 2 | 193.0 | 3.7m Lt | 5265720.3    | 406431.9 |
| Borehole No. 3 | 192.8 | 4.2m Rt | 5265712.5    | 406439.0 |
| Borehole No. 4 | 193.3 | 4.5m Rt | 5265711.9    | 406405.9 |
| Borehole No. 5 | 192.8 | 5.0m Lt | 5265722.3    | 406466.9 |
| Borehole No. 6 | 187.6 | 30m Rt  | 5265686.8    | 406444.0 |

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. 11+814 |          |                | LVM REF 12028-F1 |                    |
| SUBM'D                                       |          | GEOCRE 31M-104 |                  | SITE               |
| DRAWN RG                                     |          | CHK MAM        |                  | DATE December 2013 |
|  |          |                |                  | DWG 2              |

# GRAIN SIZE ANALYSIS



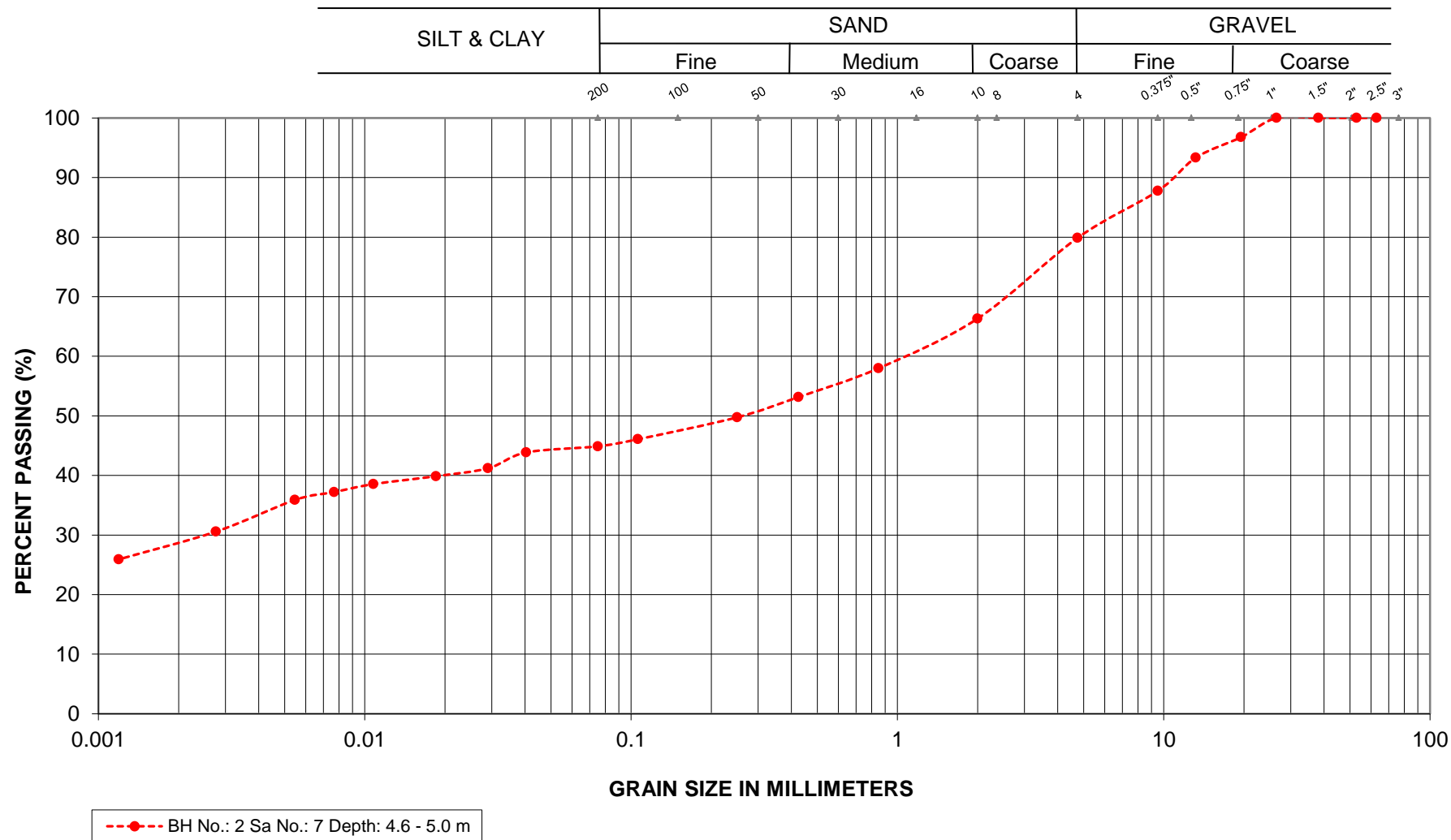
G.W.P.: 5574-04-00  
LOCATION: Hwy 65

GRANULAR FILL

LVM | MERLEX

FIGURE L-1

## GRAIN SIZE ANALYSIS



G.W.P.: 5574-04-00

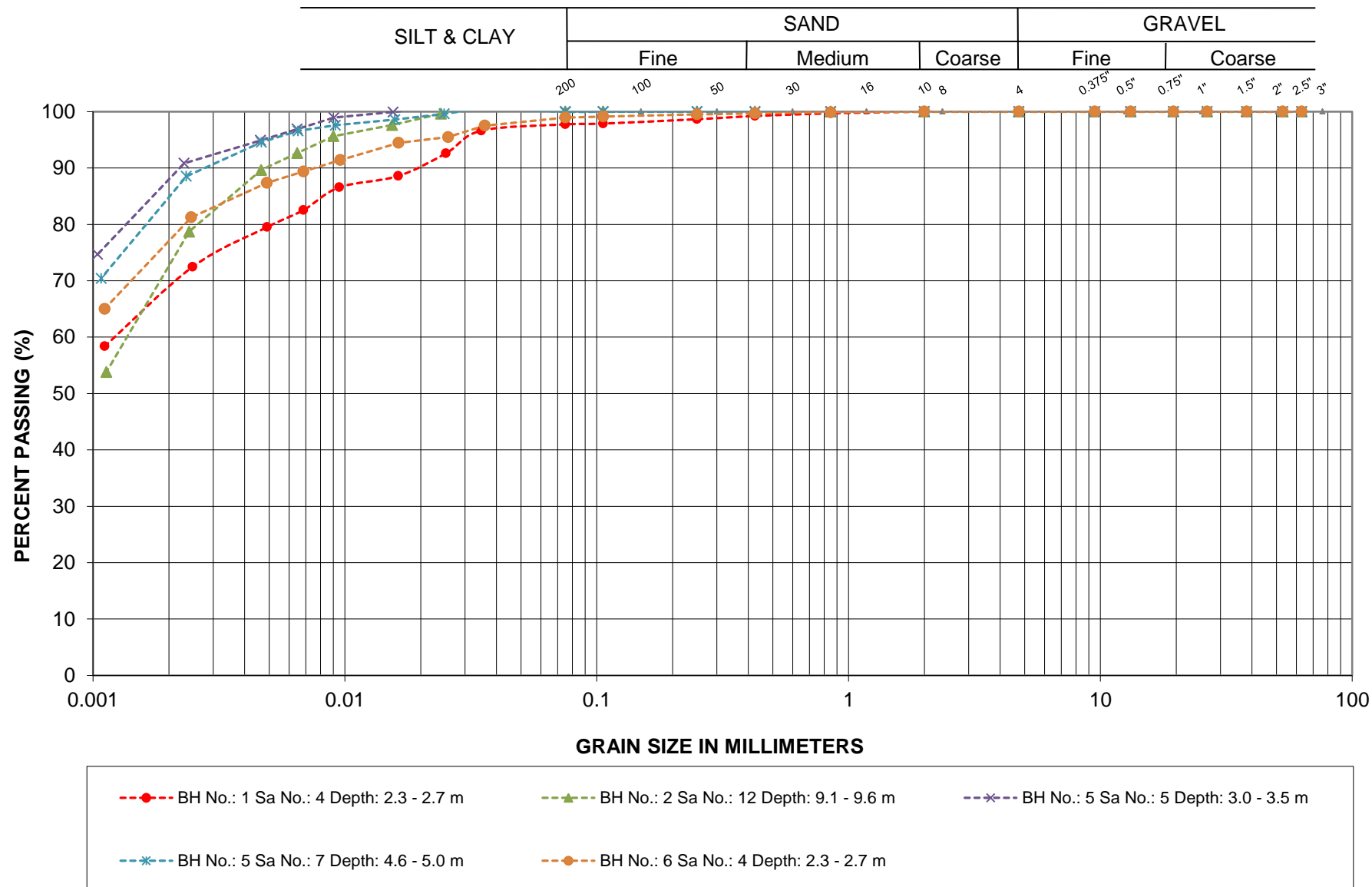
LOCATION: Hwy 65

SAND AND CLAY FILL

LVM | MERLEX

FIGURE L-2

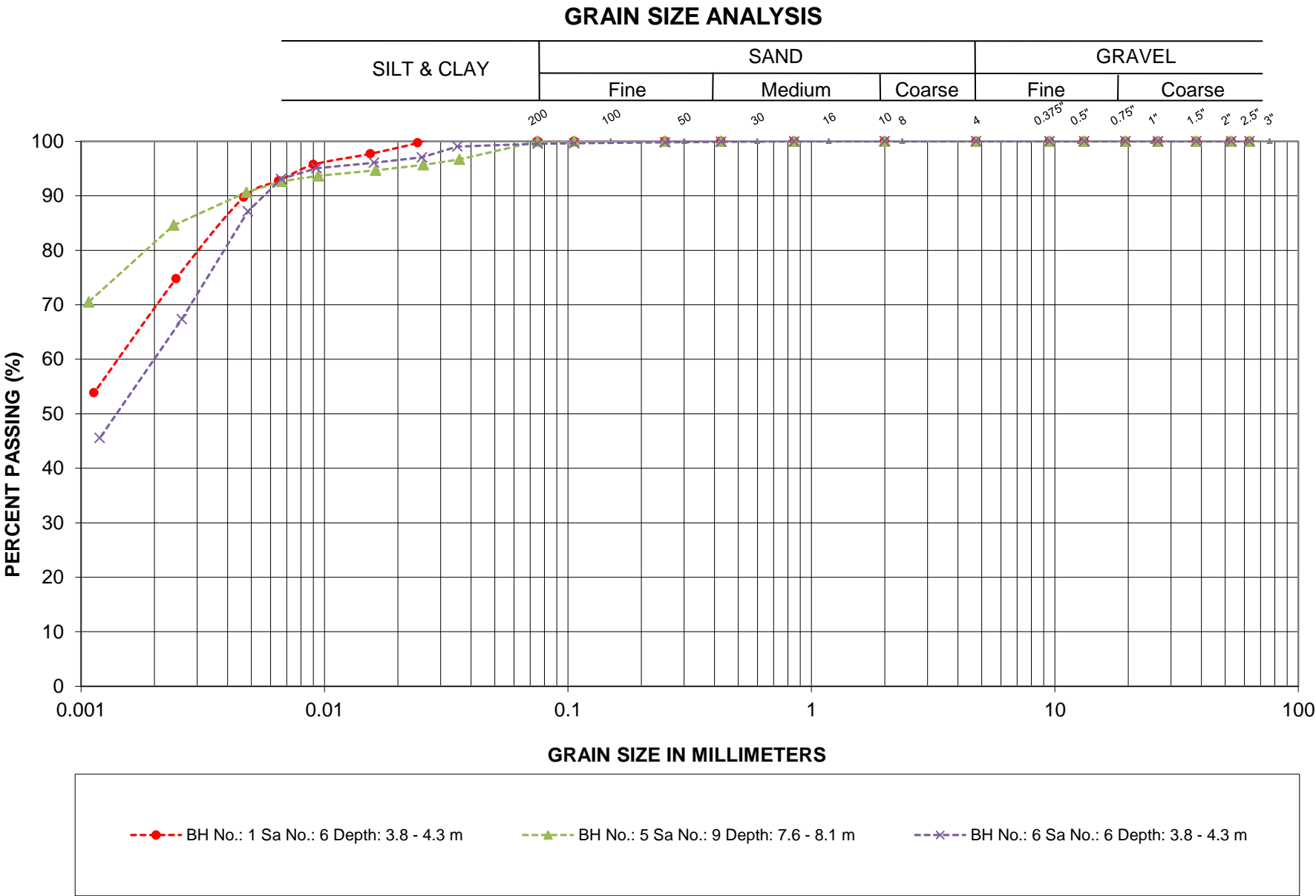
## GRAIN SIZE ANALYSIS



G.W.P.: 5574-04-00

LOCATION: Hwy 65

CLAY



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

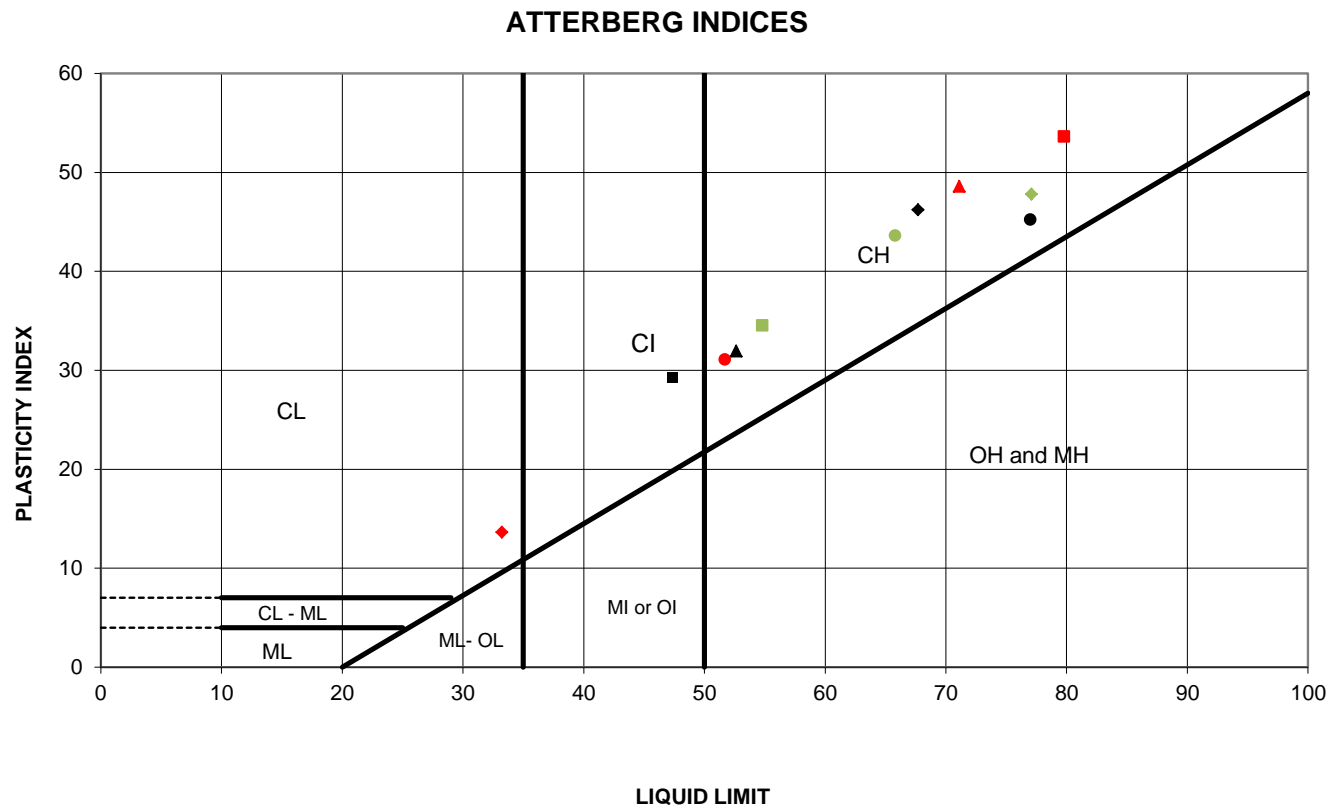
VARVED CLAY

LVM | MERLEX

FIGURE L-4

# ATTERBERG LIMITS TEST RESULTS

FIGURE L-5



| SYMBOL | BH | Sa. No. | Depth(m) | Elev.(m) | Liquid Limit | Plastic Limit | Plasticity Index | NMC % |
|--------|----|---------|----------|----------|--------------|---------------|------------------|-------|
| ●      | 1  | 4       | 2.3      | 185.6    | 77.0         | 31.8          | 45.2             | 43.2  |
| ◆      | 1  | 6       | 3.8      | 184.1    | 67.7         | 21.5          | 46.2             | 62.4  |
| ■      | 2  | 7       | 4.6      | 188.4    | 47.4         | 18.1          | 29.3             | 16.7  |
| ▲      | 2  | 12      | 9.1      | 183.9    | 52.6         | 20.7          | 31.9             | 50.5  |
| ●      | 2  | 14a     | 12.2     | 180.8    | 51.7         | 20.6          | 31.1             | 61.7  |
| ◆      | 2  | 14b     | 12.2     | 180.8    | 33.2         | 19.6          | 13.6             | 36.4  |
| ■      | 5  | 5       | 3.0      | 189.8    | 79.8         | 26.2          | 53.6             | 35.0  |
| ▲      | 5  | 7       | 4.6      | 188.2    | 71.1         | 22.5          | 48.6             | 44.9  |
| ●      | 5  | 9       | 7.6      | 185.2    | 65.8         | 22.2          | 43.6             | 52.3  |
| ◆      | 6  | 4       | 2.3      | 185.3    | 77.1         | 29.3          | 47.8             | 45.6  |
| ■      | 6  | 6       | 3.8      | 183.8    | 54.8         | 20.3          | 34.5             | 51.5  |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |
|        |    |         |          |          |              |               |                  |       |

Date: Jun-13

Project: Hwy 65

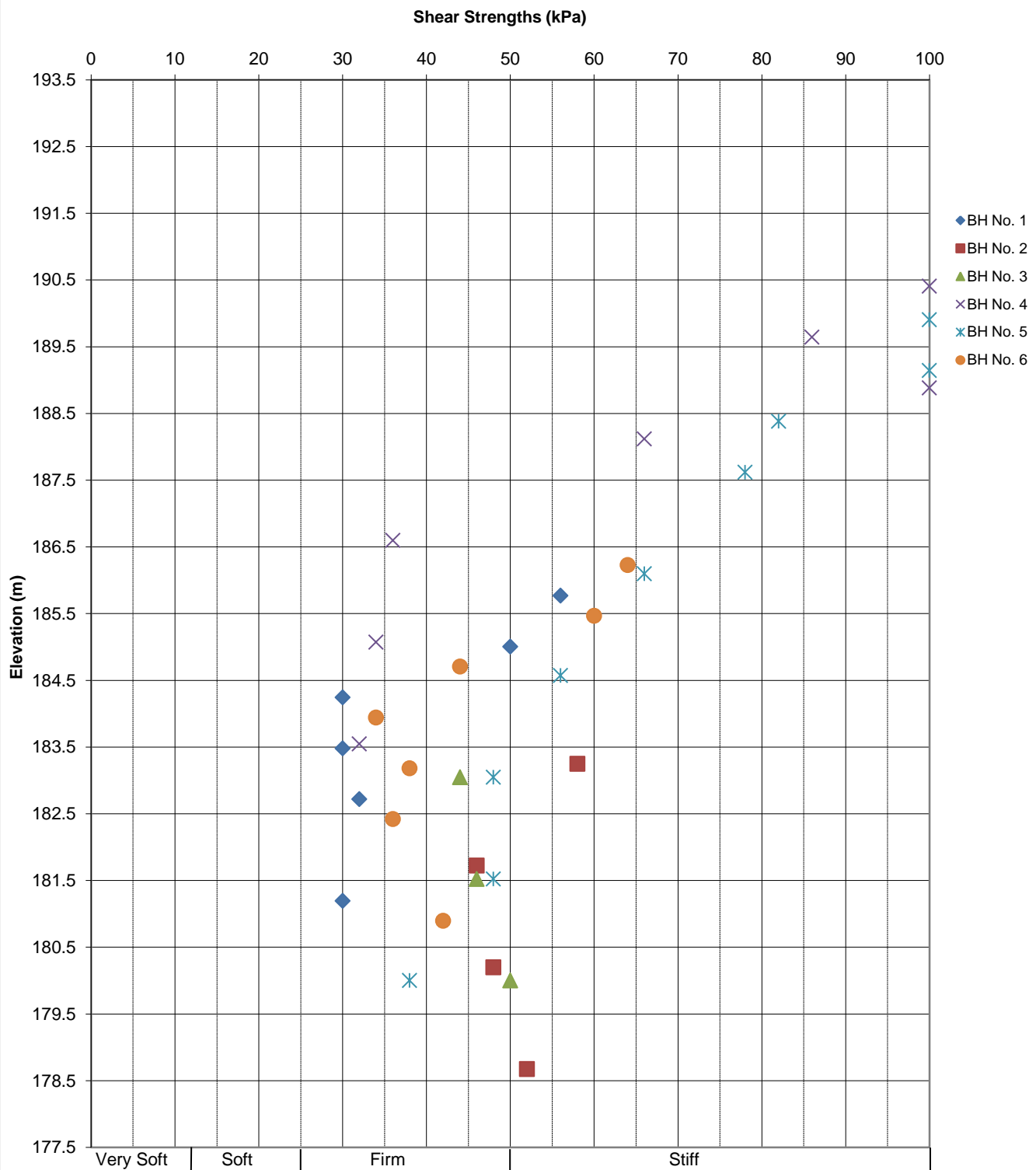
G.W.P: 5574-04-00

Prep'd: AT

Chkd: MAM

Ref. No.: 12/03/12028-F1

## In-Situ Shear Strengths vs. Depth



**CONSOLIDATION TEST SUMMARY****FIGURE L-7a****SAMPLE IDENTIFICATION**

|                 |              |                 |     |
|-----------------|--------------|-----------------|-----|
| Project Number  | 12-1183-0124 | Sample Number   | 7   |
| Borehole Number | 1            | Sample Depth, m | 4.6 |

**TEST CONDITIONS**

|                  |            |                   |    |
|------------------|------------|-------------------|----|
| Test Type        | Standard   | Load Duration, hr | 24 |
| Oedometer Number | 8          |                   |    |
| Date Started     | 12/21/2012 |                   |    |
| Date Completed   | 01/04/2013 |                   |    |

**SAMPLE DIMENSIONS AND PROPERTIES - INITIAL**

|                         |        |                                    |       |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm       | 1.90   | Unit Weight, kN/m <sup>3</sup>     | 16.38 |
| Sample Diameter, cm     | 6.35   | Dry Unit Weight, kN/m <sup>3</sup> | 10.37 |
| Area, cm <sup>2</sup>   | 31.64  | Specific Gravity, measured         | 2.73  |
| Volume, cm <sup>3</sup> | 60.11  | Solids Height, cm                  | 0.736 |
| Water Content, %        | 57.92  | Volume of Solids, cm <sup>3</sup>  | 23.29 |
| Wet Mass, g             | 100.42 | Volume of Voids, cm <sup>3</sup>   | 36.82 |
| Dry Mass, g             | 63.59  | Degree of Saturation, %            | 100.0 |

**TEST COMPUTATIONS**

| Stress<br>kPa | Corr.<br>Height<br>cm | Void<br>Ratio | Average<br>Height<br>cm | t <sub>90</sub><br>sec | cv.<br>cm <sup>2</sup> /s | mv<br>m <sup>2</sup> /kN | k<br>cm/s |
|---------------|-----------------------|---------------|-------------------------|------------------------|---------------------------|--------------------------|-----------|
| 0.00          | 1.900                 | 1.581         | 1.900                   |                        |                           |                          |           |
| 6.45          | 1.882                 | 1.557         | 1.891                   | 772                    | 9.82E-04                  | 1.44E-03                 | 1.38E-07  |
| 11.08         | 1.871                 | 1.542         | 1.877                   | 1848                   | 4.04E-04                  | 1.26E-03                 | 5.00E-08  |
| 21.12         | 1.854                 | 1.518         | 1.863                   | 1127                   | 6.53E-04                  | 9.07E-04                 | 5.80E-08  |
| 40.53         | 1.826                 | 1.480         | 1.840                   | 2089                   | 3.44E-04                  | 7.59E-04                 | 2.56E-08  |
| 79.19         | 1.766                 | 1.398         | 1.796                   | 1042                   | 6.56E-04                  | 8.24E-04                 | 5.30E-08  |
| 156.51        | 1.661                 | 1.256         | 1.713                   | 1215                   | 5.12E-04                  | 7.12E-04                 | 3.57E-08  |
| 311.32        | 1.531                 | 1.080         | 1.596                   | 1162                   | 4.65E-04                  | 4.42E-04                 | 2.01E-08  |
| 620.59        | 1.428                 | 0.940         | 1.480                   | 694                    | 6.69E-04                  | 1.75E-04                 | 1.15E-08  |
| 1239.14       | 1.342                 | 0.823         | 1.385                   | 470                    | 8.65E-04                  | 7.35E-05                 | 6.23E-09  |
| 2478.39       | 1.265                 | 0.719         | 1.304                   | 227                    | 1.59E-03                  | 3.25E-05                 | 5.05E-09  |
| 1239.14       | 1.272                 | 0.727         | 1.269                   |                        |                           |                          |           |
| 311.32        | 1.298                 | 0.763         | 1.285                   |                        |                           |                          |           |
| 79.19         | 1.328                 | 0.804         | 1.313                   |                        |                           |                          |           |
| 21.12         | 1.369                 | 0.860         | 1.349                   |                        |                           |                          |           |
| 6.45          | 1.398                 | 0.899         | 1.384                   |                        |                           |                          |           |

Note:

k calculated using cv based on t<sub>90</sub> values.

Consolidation loading schedule assigned by the client.

Specimen taken 18cm from the top of the tube.

**SAMPLE DIMENSIONS AND PROPERTIES - FINAL**

|                         |       |                                    |       |
|-------------------------|-------|------------------------------------|-------|
| Sample Height, cm       | 1.40  | Unit Weight, kN/m <sup>3</sup>     | 18.87 |
| Sample Diameter, cm     | 6.35  | Dry Unit Weight, kN/m <sup>3</sup> | 14.10 |
| Area, cm <sup>2</sup>   | 31.64 | Specific Gravity, measured         | 2.73  |
| Volume, cm <sup>3</sup> | 44.23 | Solids Height, cm                  | 0.736 |
| Water Content, %        | 33.87 | Volume of Solids, cm <sup>3</sup>  | 23.29 |
| Wet Mass, g             | 85.13 | Volume of Voids, cm <sup>3</sup>   | 20.94 |
| Dry Mass, g             | 63.59 |                                    |       |

Prepared By: LFG

**Golder Associates**Checked By: 

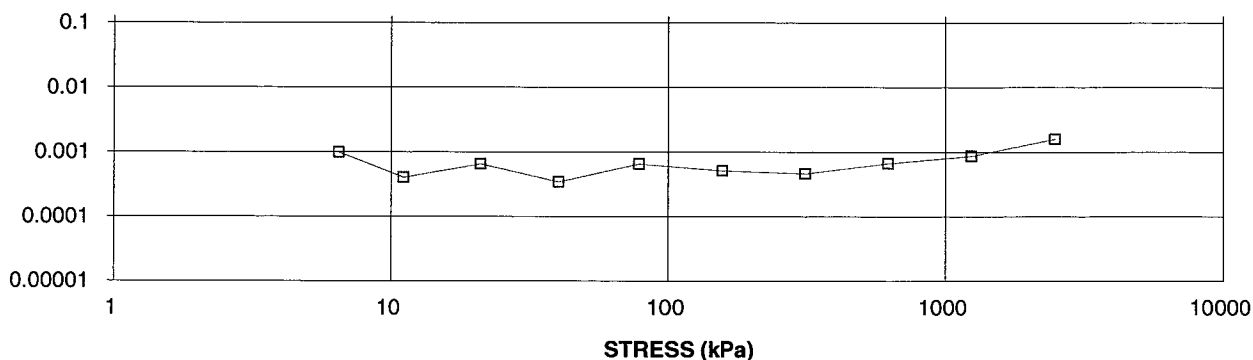


# CONSOLIDATION TEST SUMMARY

FIGURE L-7b

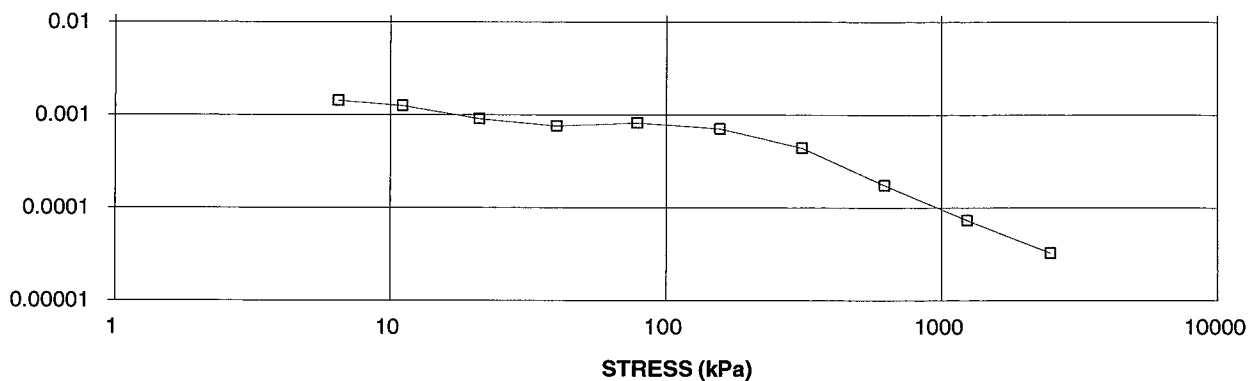
COEFFICIENT OF CONSOLIDATION,  
cm<sup>2</sup>/s

CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS STRESS (kPa)  
BH 1 SA 7



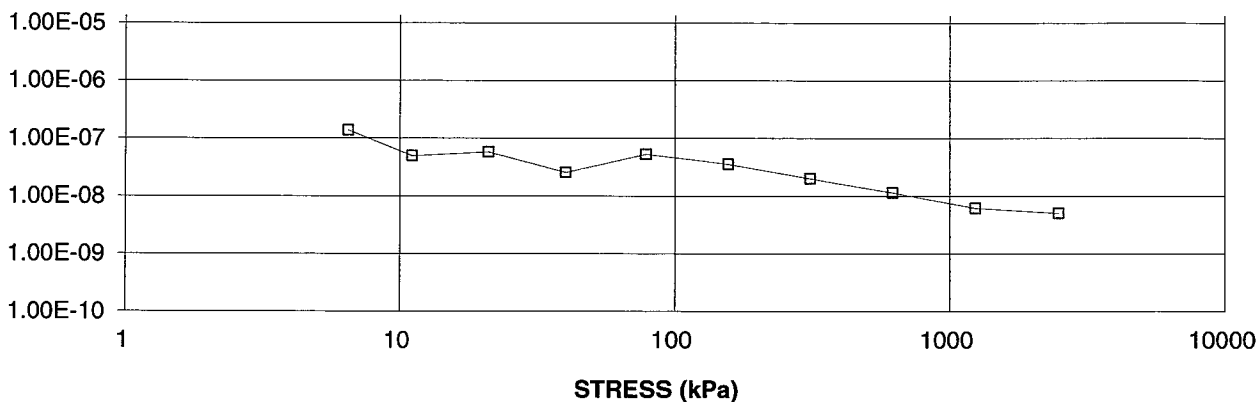
VOLUME COMPRESSIBILITY, m<sup>2</sup>/kN

CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs STRESS (kPa)  
BH 1 SA 7



HYDRAULIC CONDUCTIVITY,  
cm/s

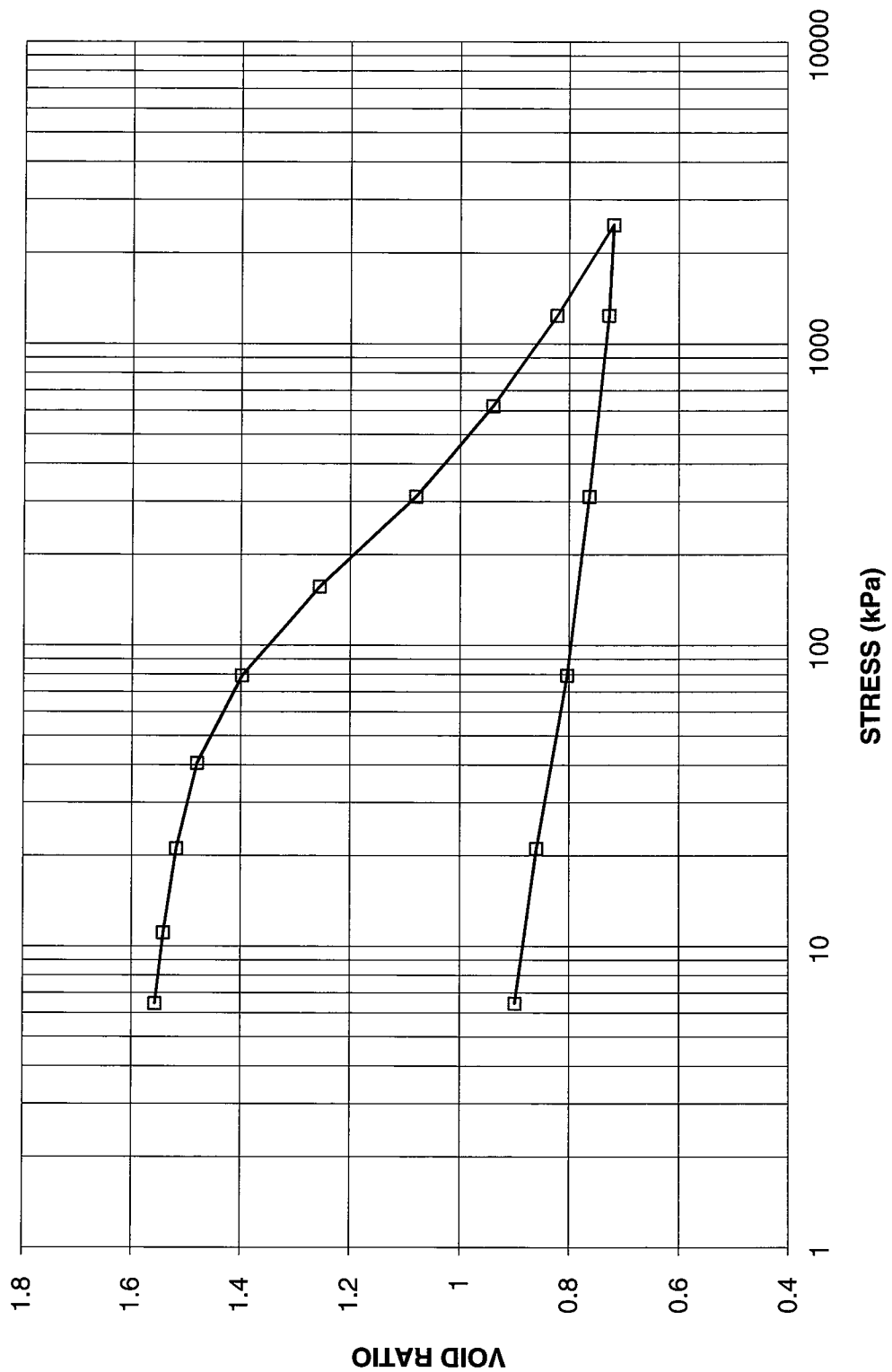
CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs STRESS  
BH 1 SA 7



# CONSOLIDATION TEST VOID RATIO VS LOG STRESS

FIGURE L-7c

CONSOLIDATION TEST  
VOID RATIO vs STRESS  
BH 1 SA 7



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

|                 |              |                 |      |
|-----------------|--------------|-----------------|------|
| Project Number  | 12-1183-0124 | Sample Number   | 11   |
| Borehole Number | 3            | Sample Depth, m | 10.7 |

**TEST CONDITIONS**

|                  |            |                   |    |
|------------------|------------|-------------------|----|
| Test Type        | Standard   | Load Duration, hr | 24 |
| Oedometer Number | 2          |                   |    |
| Date Started     | 12/21/2012 |                   |    |
| Date Completed   | 1/7/2013   |                   |    |

**SAMPLE DIMENSIONS AND PROPERTIES - INITIAL**

|                         |        |                                    |       |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm       | 2.53   | Unit Weight, kN/m <sup>3</sup>     | 16.29 |
| Sample Diameter, cm     | 6.35   | Dry Unit Weight, kN/m <sup>3</sup> | 10.23 |
| Area, cm <sup>2</sup>   | 31.71  | Specific Gravity, measured         | 2.70  |
| Volume, cm <sup>3</sup> | 80.26  | Solids Height, cm                  | 0.978 |
| Water Content, %        | 59.26  | Volume of Solids, cm <sup>3</sup>  | 31.00 |
| Wet Mass, g             | 133.32 | Volume of Voids, cm <sup>3</sup>   | 49.25 |
| Dry Mass, g             | 83.71  | Degree of Saturation, %            | 100.7 |

**TEST COMPUTATIONS**

| Stress<br>kPa | Corr.<br>Height<br>cm | Void<br>Ratio | Average<br>Height<br>cm | t <sub>90</sub><br>sec | cv.<br>cm <sup>2</sup> /s | mv<br>m <sup>2</sup> /kN | k<br>cm/s |
|---------------|-----------------------|---------------|-------------------------|------------------------|---------------------------|--------------------------|-----------|
| 0.00          | 2.531                 | 1.589         | 2.531                   |                        |                           |                          |           |
| 5.87          | 2.524                 | 1.582         | 2.528                   | 746                    | 1.82E-03                  | 4.64E-04                 | 8.26E-08  |
| 10.70         | 2.504                 | 1.561         | 2.514                   | 2233                   | 6.00E-04                  | 1.61E-03                 | 9.48E-08  |
| 20.44         | 2.481                 | 1.537         | 2.493                   | 1815                   | 7.26E-04                  | 9.49E-04                 | 6.75E-08  |
| 39.81         | 2.435                 | 1.490         | 2.458                   | 2160                   | 5.93E-04                  | 9.40E-04                 | 5.46E-08  |
| 78.47         | 2.369                 | 1.422         | 2.402                   | 1852                   | 6.60E-04                  | 6.78E-04                 | 4.38E-08  |
| 155.57        | 2.254                 | 1.305         | 2.311                   | 2693                   | 4.20E-04                  | 5.89E-04                 | 2.43E-08  |
| 310.02        | 2.066                 | 1.113         | 2.160                   | 3985                   | 2.48E-04                  | 4.80E-04                 | 1.17E-08  |
| 618.65        | 1.909                 | 0.953         | 1.988                   | 2018                   | 4.15E-04                  | 2.01E-04                 | 8.16E-09  |
| 1236.18       | 1.781                 | 0.821         | 1.845                   | 1185                   | 6.09E-04                  | 8.22E-05                 | 4.90E-09  |
| 2472.19       | 1.670                 | 0.708         | 1.725                   | 1567                   | 4.03E-04                  | 3.55E-05                 | 1.40E-09  |
| 1236.18       | 1.677                 | 0.715         | 1.673                   |                        |                           |                          |           |
| 310.02        | 1.727                 | 0.766         | 1.702                   |                        |                           |                          |           |
| 78.47         | 1.782                 | 0.822         | 1.754                   |                        |                           |                          |           |
| 20.44         | 1.833                 | 0.875         | 1.807                   |                        |                           |                          |           |
| 5.87          | 1.877                 | 0.920         | 1.855                   |                        |                           |                          |           |

Note:

k calculated using cv based on t<sub>90</sub> values.

Consolidation loading schedule assigned by the client.

Specimen taken 10cm from the bottom of the tube.

**SAMPLE DIMENSIONS AND PROPERTIES - FINAL**

|                         |        |                                    |       |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm       | 1.88   | Unit Weight, kN/m <sup>3</sup>     | 18.74 |
| Sample Diameter, cm     | 6.35   | Dry Unit Weight, kN/m <sup>3</sup> | 13.79 |
| Area, cm <sup>2</sup>   | 31.71  | Specific Gravity, measured         | 2.70  |
| Volume, cm <sup>3</sup> | 59.52  | Solids Height, cm                  | 0.978 |
| Water Content, %        | 35.89  | Volume of Solids, cm <sup>3</sup>  | 31.00 |
| Wet Mass, g             | 113.75 | Volume of Voids, cm <sup>3</sup>   | 28.52 |
| Dry Mass, g             | 83.71  |                                    |       |

Prepared By: LFG

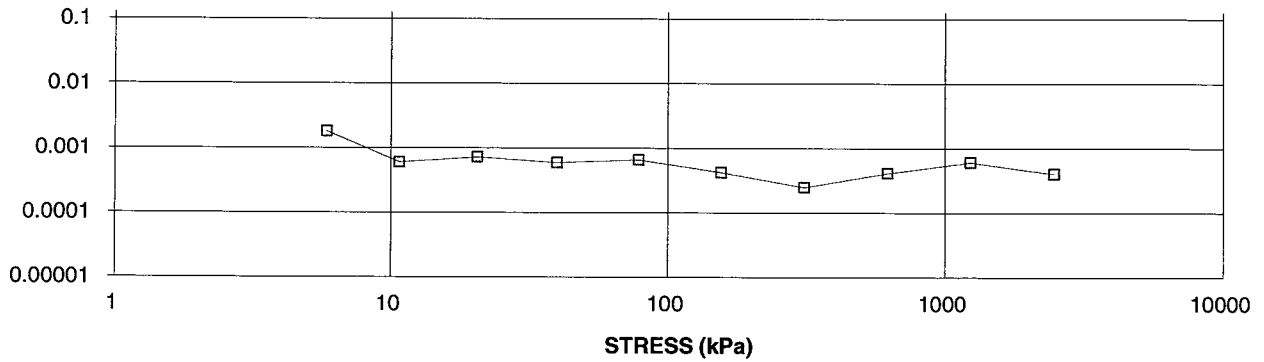
**Golder Associates**Checked By: 

# CONSOLIDATION TEST SUMMARY

FIGURE L-8b

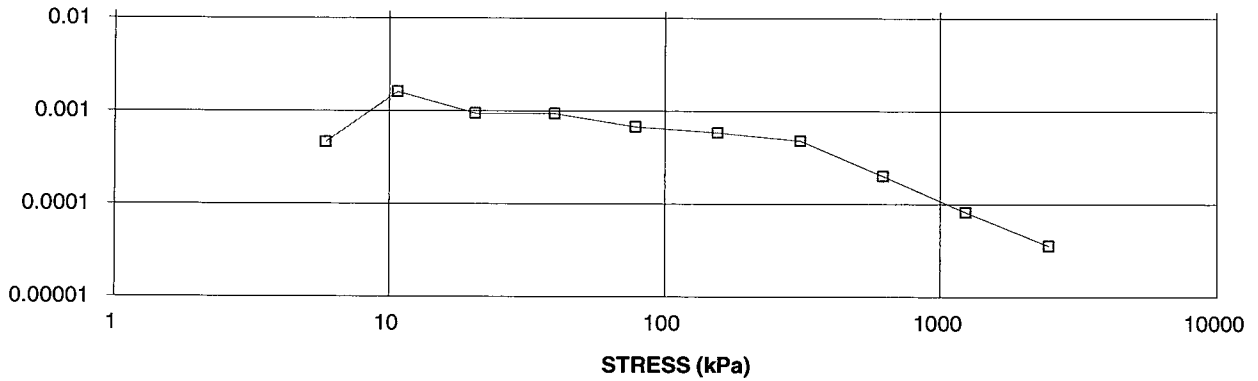
COEFFICIENT OF CONSOLIDATION,  
cm<sup>2</sup>/s

CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS STRESS (kPa)  
BH 3 SA 11



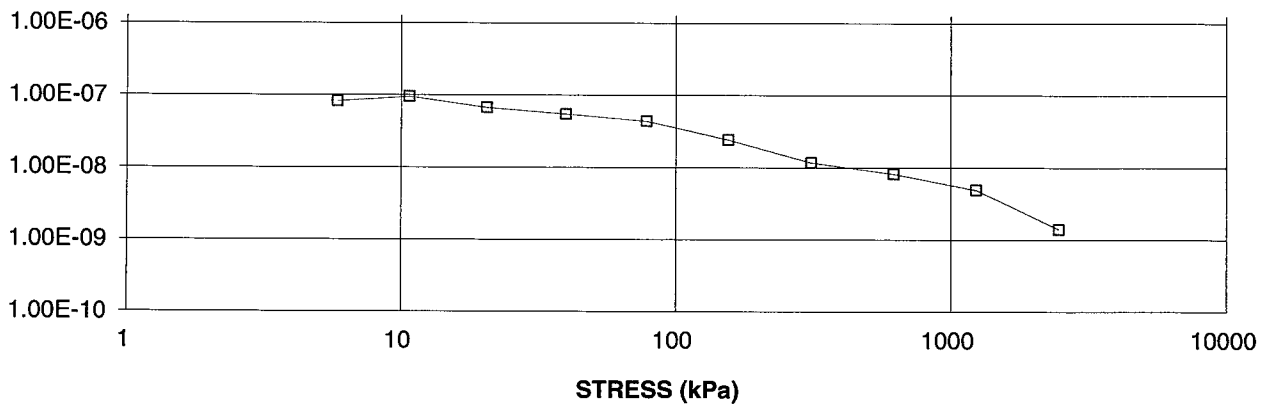
VOLUME COMPRESSIBILITY, m<sup>2</sup>/kN

CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs STRESS (kPa)  
BH 3 SA 11



HYDRAULIC CONDUCTIVITY,  
cm/s

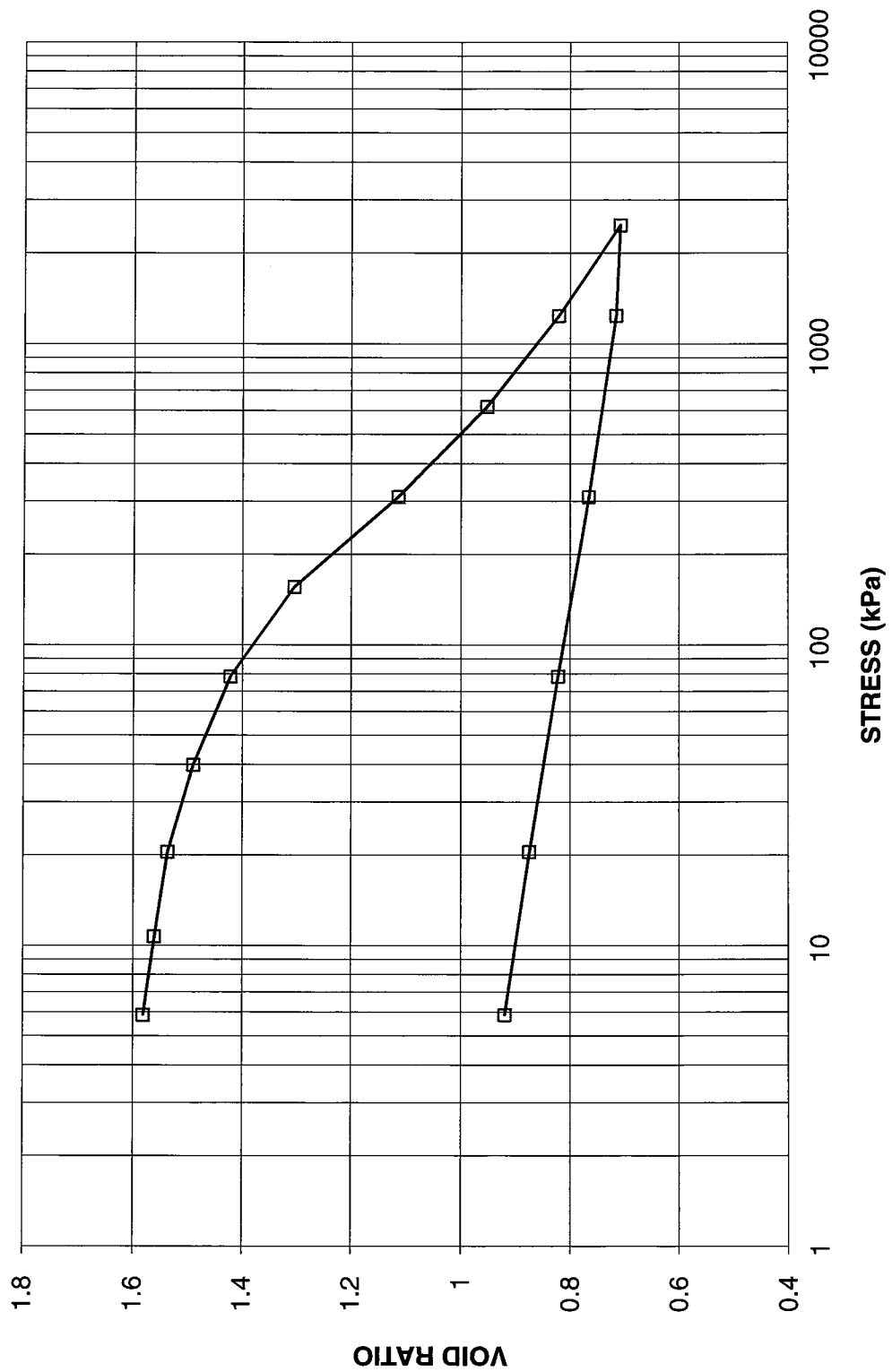
CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs STRESS  
BH 3 SA 11



**CONSOLIDATION TEST  
VOID RATIO VS LOG STRESS**

**FIGURE L-8c**

**CONSOLIDATION TEST  
VOID RATIO vs STRESS  
BH 3 SA 11**



Project No. 12-1183-0124

Prepared By: LFG

**Golder Associates**

Checked By: *[Signature]*

## 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   |                     |               |               |               | 37.4 |                  |        |        | N/A     |      |                     |                    |
|              | 2          | 0.8   |                     |               |               |               | 36.1 |                  |        |        | 8       |      |                     |                    |
|              | 3          | 1.5   |                     |               |               |               | 55.7 |                  |        |        | WH      |      |                     |                    |
|              | 4          | 2.3   | 0                   | 2             | 29            | 69            | 43.2 | 77.0             | 31.8   | 45.2   | 4       | CH   |                     |                    |
|              | 5          | 3.1   |                     |               |               |               | 62.5 |                  |        |        | PM      |      |                     |                    |
|              | 6          | 3.8   | 0                   | 0             | 30            | 70            | 62.4 | 67.7             | 21.5   | 46.2   | PM      | CH   |                     |                    |
|              | 7          | 4.6   |                     |               |               |               | 31.7 |                  |        |        | PM      |      | 16.4                | Consolidation Test |
|              | 8          | 6.1   |                     |               |               |               | 64.8 |                  |        |        | PM      |      |                     |                    |
| 2            | 1          | 0.0   |                     |               |               |               | 4.2  |                  |        |        | 25      |      |                     |                    |
|              | 2          | 0.8   | 30                  | 58            | 12            |               | 6.0  |                  |        |        | 20      |      |                     |                    |
|              | 3          | 1.5   |                     |               |               |               | 32.5 |                  |        |        | 5       |      |                     |                    |
|              | 4          | 2.3   |                     |               |               |               | 15.6 |                  |        |        | 16      |      |                     |                    |
|              | 5          | 3.1   |                     |               |               |               | 24.7 |                  |        |        | 14      |      |                     |                    |
|              | 6          | 3.8   |                     |               |               |               | 26.2 |                  |        |        | 15      |      |                     |                    |
|              | 7          | 4.6   | 20                  | 35            | 17            | 28            | 16.7 | 47.4             | 18.1   | 29.3   | 22      | CI   |                     |                    |
|              | 8          | 5.3   |                     |               |               |               | 25.5 |                  |        |        | 20      |      |                     |                    |
|              | 9          | 6.1   |                     |               |               |               | 20.1 |                  |        |        | 22      |      |                     |                    |
|              | 10         | 6.9   |                     |               |               |               | 27.3 |                  |        |        | 26      |      |                     |                    |
|              | 11         | 7.6   |                     |               |               |               | 49.6 |                  |        |        | 12      |      |                     |                    |
|              | 12         | 9.1   | 0                   | 0             | 26            | 74            | 50.5 | 52.6             | 20.7   | 31.9   | WH      | CH   |                     |                    |
|              | 13         | 10.7  |                     |               |               |               | 38.4 |                  |        |        | PM      |      |                     |                    |
|              | 14a        | 12.2  |                     |               |               |               | 61.7 | 51.7             | 20.6   | 31.1   | PM      | CH   |                     |                    |
|              | 14b        | 12.2  |                     |               |               |               | 36.4 | 33.2             | 19.6   | 13.6   | PM      | CI   |                     |                    |
|              | 15         | 13.7  |                     |               |               |               | 45.8 |                  |        |        | PM      |      |                     |                    |
| 3            | 1          | 0.0   |                     |               |               |               | 5.7  |                  |        |        | 23      |      |                     |                    |
|              | 2          | 0.8   |                     |               |               |               | 3.7  |                  |        |        | 17      |      |                     |                    |
|              | 3          | 1.5   |                     |               |               |               | 8.4  |                  |        |        | 26      |      |                     |                    |

## 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 (%) |         |      |                     |                    |
| 3            | 4          | 2.3   |                     |               |               |               | 7.9  |                  |        |        | 20      |      |                     |                    |
|              | 5          | 3.1   |                     |               |               |               | 26.6 |                  |        |        | 20      |      |                     |                    |
|              | 6          | 3.8   |                     |               |               |               | 29.6 |                  |        |        | 11      |      |                     |                    |
|              | 7          | 4.6   |                     |               |               |               | 30.3 |                  |        |        | 14      |      |                     |                    |
|              | 8          | 5.3   |                     |               |               |               | 17.9 |                  |        |        | 20      |      |                     |                    |
|              | 9          | 6.1   |                     |               |               |               | 19.6 |                  |        |        | 9       |      |                     |                    |
|              | 10         | 7.6   |                     |               |               |               | 37.1 |                  |        |        | 10      |      |                     |                    |
|              | 11         | 9.1   |                     |               |               |               | 62.1 |                  |        |        | PM      |      | 16.3                | Consolidation test |
|              | 12         | 10.7  |                     |               |               |               | 42.1 |                  |        |        | PM      |      |                     |                    |
|              | 13         | 12.2  |                     |               |               |               | 46.1 |                  |        |        | PM      |      |                     |                    |
| 4            | 1          | 0.0   |                     |               |               |               | 5.7  |                  |        |        | 13      |      |                     |                    |
|              | 2          | 0.8   |                     |               |               |               | 12.6 |                  |        |        | 12      |      |                     |                    |
|              | 3          | 1.5   |                     |               |               |               | 10.1 |                  |        |        | 20      |      |                     |                    |
|              | 4          | 2.3   |                     |               |               |               | 40.4 |                  |        |        | 5       |      |                     |                    |
|              | 5          | 3.1   |                     |               |               |               | 45.8 |                  |        |        | 5       |      |                     |                    |
|              | 6          | 3.8   |                     |               |               |               | 48.6 |                  |        |        | 2       |      |                     |                    |
|              | 7          | 4.6   |                     |               |               |               | 51.4 |                  |        |        | 2       |      |                     |                    |
|              | 8          | 6.1   |                     |               |               |               | 56.3 |                  |        |        | PM      |      |                     |                    |
|              | 9          | 7.6   |                     |               |               |               | 61.9 |                  |        |        | PM      |      |                     |                    |
|              | 10         | 9.1   |                     |               |               |               | 65.2 |                  |        |        | PM      |      |                     |                    |
| 5            | 1          | 0.0   |                     |               |               |               | 5.9  |                  |        |        | 16      |      |                     |                    |
|              | 2          | 0.8   | 4                   | 89            |               | 7             | 14.0 |                  |        |        | 12      |      |                     |                    |
|              | 3          | 1.5   |                     |               |               |               | 25.2 |                  |        |        | 12      |      |                     |                    |
|              | 4          | 2.3   |                     |               |               |               | 33.9 |                  |        |        | 7       |      |                     |                    |
|              | 5          | 3.1   | 0                   | 0             | 12            | 88            | 35.0 | 79.8             | 26.2   | 53.6   | 6       | CH   |                     |                    |
|              | 6          | 3.8   |                     |               |               |               | 45.1 |                  |        |        | 4       |      |                     |                    |
|              | 7          | 4.6   | 0                   | 0             | 15            | 85            | 44.9 | 71.1             | 22.5   | 48.6   | 3       | CH   |                     |                    |

## Laboratory Tests - Summary Sheet

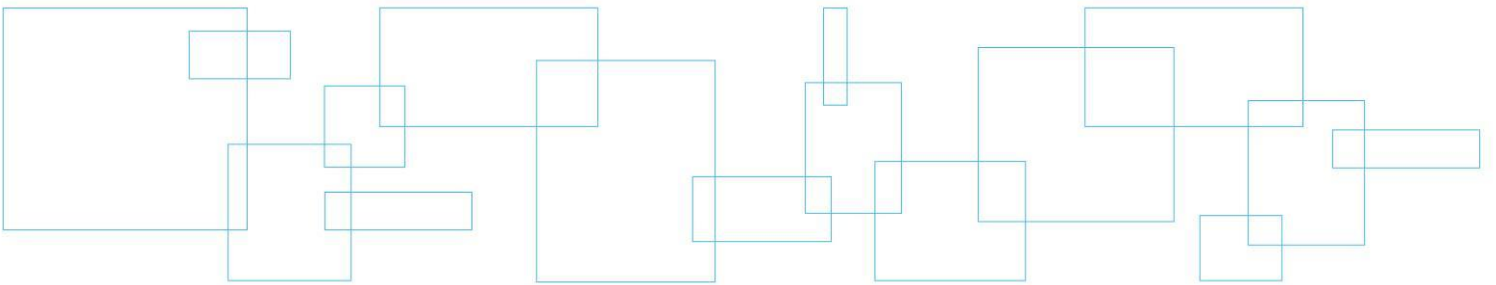
[illegible]



## Appendix 4 Photo Essay

Enclosure No. 8:

Photo Essay



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 North

Photo: 3



View Through Culvert – Looking South

Photo: 4



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

Photos Provided By: LVM

Date: November 2012