MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL
FOUNDATION INVESTIGATION AND DESIGN REPORT

CULVERT STATION 18+688 – TWP. of Grenfell
GWP 162-98-00
MEL SITE C

Highway 11, From 0.3 km South of the Highway 11/66 Intersection
Northerly 11.7 km to 3.5 km South of Highway 570

MEL Ref. No.: 09/10/09181C November 15, 2010

Submitted to:

AECOM Canada Ltd.
189 Wyld Street
North Bay, Ontario
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Geocres No. 42A-81

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1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at a culvert located at Station 18+688, Township of Grenfell. GWP 162-98-00 on Highway 11 passes through parts of the Townships of Eby and Grenfell and the location is described as: from 0.3 km South of the Highway 11/66 intersection Northerly 11.7 km to 3.5 km South of Highway 570. This foundation project involves the replacement of a single 1350 mm x 1118 mm CTC in an embankment that is 5.1 m high, above the culvert invert at the centerline.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5008-E-0067. The terms of reference for the scope of work are outlined in MEL's proposal P-09-037, dated May 2009. The purpose of the investigation was to determine the subsurface conditions in the area of the culvert. MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The CTC is located on Highway 11, at Station 18+688, Township of Grenfell. The topography at the site is generally of moderate relief and the direction of flow in the culvert is from west to east. The existing highway embankment, at the culvert location, supports two undivided lanes of highway, running in a north south direction. The existing highway embankment at the culvert location is some 5.1 m higher than the culvert invert at centerline, with the paved surface at elevation 322.9 m and the culvert invert at 317.8 m (See Photos, Appendix D). The embankment slopes at the culvert location are currently 1.6H:1.0V left of centerline and 1.9H:1.0V right of centerline. At the culvert location, a visual review indicated no signs of

embankment instability except for surface slippage above the culvert due to insufficient culvert length on the left. There were no obvious signs of settlement of the pavement structure at the culvert location. The culvert was reported to be in good condition, however the left end was buried due to slope raveling.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the Eastern Sandy Uplands. The topography on this section of Highway 11 is generally rolling. There are exposed bedrock cuts along this section of highway. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area, overburden consists primarily of sand and gravel containing varying amounts of silt and strata of fine grained materials.

Bedrock in the area, as indicated on OGS Map 2440, is of the Early Precambrian Era. At the culvert site the bedrock comprises of Metavolcanics including basaltic and andesitic flows, tuffs and breccias.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out in two stages. Initially six (6) boreholes were advanced during the period of February 24 to 26, 2010 to take advantage of frozen surface conditions. One borehole was advanced at each of the culvert ends, to the east and west of the embankment. Four additional boreholes were advanced to the west of the existing embankment along a proposed detour alignment. The second stage of the investigation was carried out on June 25, 2010, after the thawing of the embankment and consisted of one sampled borehole advanced through the embankment.

The field investigation was carried out using a Bombardier mounted CME drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. Soil samples were obtained 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) at the borehole locations. The SPT method involves advancing a 50 mm diameter 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 the 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 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. 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.

The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on

the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures Nos. L-1 to L-8).

The location of the individual boreholes was determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. C-1 (Appendix C). 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 design purposes only. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. C-1 to C-7, inclusive, were recorded at 318.1, 318.4, 318.8, 319.0, 319.6, 321.0, and 322.8 m, respectively.

4.1 Culvert, Station 18+688, Township of Grenfell – MEL SITE C

A plan and section showing the boring locations and stratigraphic sequences is shown on Figure No. C-1, Appendix C. During the course of the exploration program, seven (7) sampled boreholes were put down at this site, with Borehole Nos. C-1 and C-2, advanced at the east

(outlet) and west (inlet) ends of the existing culvert, respectively, while Borehole No. C-7 was advanced through the embankment at the culvert location. Borehole Nos. C-3 to C-6 inclusive were advanced to the west of the existing embankment, along an estimated detour alignment.

At Boreholes Nos. C-1 to C-6, a surficial layer of grass, surficial organics and topsoil, some 50 to 100 mm in thickness was penetrated.

4.1.1 Fill

Underlying the surficial layer of organics at Borehole No. C-1, a deposit of fill consisting of brown fine to medium sand containing trace gravel trace silt was penetrated. The natural moisture content from samples of this deposit was in the order of 24 to 25%. Based on a single SPT value in this fill deposit of 3 blows per 300 mm penetration, the compactness of this deposit was described as very loose. This deposit was encountered to depth of 1.2 m below ground surface (elevation 316.9 m).

4.1.2 Peat

Underlying the fill deposit at Borehole No. C-1, a deposit of dark brown fibrous peat containing trace wood some sand, some 0.9 m in thickness, was penetrated, and was encountered to elevation 316.0 m. The natural moisture content from a sample of this deposit was in the order of 84%.

4.1.3 Sand

Underlying the peat at Borehole No. C-1, and underlying the surficial organics at Borehole Nos. C-2 to C-6, a deposit of brown fine to medium sand containing trace gravel trace to with silt was penetrated. Trace wood was encountered within the upper portion of this deposit at Borehole

No. C-1. The natural moisture content from samples of this deposit was in the order of 4 to 56%. Gradation analyses were carried out on three samples of this deposit which were retained in the spilt spoon sampler (37 mm inside diameter), the results of which indicated 0 to 5% gravel size particles, 87 to 98% sand sized particles, and 2 to 8% silt and clay size particles (see Figure No. L-1, Appendix C). Based on STP values of 3 to 19, the compactness of this deposit is described as very loose to compact, generally compact. This deposit was encountered to depths of 4.2, 1.5, 1.5, 1.4, and 1.1 m below ground surface (elevations 313.9, 316.9, 317.3, 317.6, and 318.5 m) at Borehole Nos. C-1 to C-5 respectively. At Borehole No. C-6, this sand deposit was encountered for the full depth of the borehole, to auger refusal at a depth of 5.6 m (elevation 315.4 m).

4.1.4 Silty Clay

Underlying the sand deposit at Borehole Nos. C-1 to C-5, a deposit of brown to grey silty clay containing trace to some fine sand was penetrated. The natural moisture content from samples of this deposit was in the order of 21 to 42%. Hydrometer analyses were carried out on four (4) samples of this deposit, the results of which indicated 0% gravel size particles, 2 to 18% sand size particles, 58 to 66% silt size particles, and 21 to 33% clay size particles (see Figure No. L-2, Appendix C). Atterberg Limit testing was carried out on five (5) samples, the results of which indicated a plastic limit of 15 to 20% and a liquid limit of 25 to 35% (see Figure No. L-8, Appendix C), resulting in a USCS classification of CL to CI. Based on two (2) in-situ field vane tests, which returned values of 48 kPa to greater than 100 kPa, this deposit has a consistency of firm to very stiff. This deposit was encountered to depths of 5.6, 3.2, 2.3, 4.0, and 2.0 m below ground surface at Borehole Nos. C-1 to C-5, respectively (elevations 312.5, 315.2, 316.5, 315.0, and 317.6 m, respectively).

4.1.5 Sandy Silt

Underlying the silty clay at Borehole No. C-1, a thin deposit of grey sandy silt was penetrated. The natural moisture content from a sample of this deposit was in the order of 22%. Gradation analysis was carried out on a single sample of this deposit, the results of which indicated 0% gravel size particles, 34% sand size particles, and 66% silt and clay size particles (see Figure No. L-3, Appendix C). Auger refusal was encountered in this deposit at depth of 6.1 m below ground surface (elevation 312.0 m).

4.1.6 Sand

Underlying the silty clay at Boreholes Nos. C-2 to C-5, a deposit of grey fine sand containing trace silt trace gravel was encountered. The natural moisture content from samples of this deposit was in the order of 20 to 56%. Gradation analyses were carried out on four (4) samples of this deposit, the results of which indicated 0 % gravel size particles, 92 to 98% sand size particles, and 2 to 8% silt and clay size particles (see Figure No. L-4, Appendix C). Based on the SPT values of 0 (static weight of hammer) to 27 blows per 300 mm penetration, the compactness of this deposit is described as very loose to compact, generally loose. Auger refusal was encountered in this deposit at Borehole Nos. C-2 to C-5 at depths of 6.9, 6.5, 5.9, and 5.3 m below ground surface, respectively (elevations 311.5, 312.3, 313.1, and 314.3 m, respectively).

4.1.7 Embankment Fill

Borehole No. C-7 was advanced though the right side of the embankment at the culvert location. At this borehole some 100 mm of asphalt overlying some 70 mm of crushed gravel and sand was penetrated at surface. Underlying the crushed gravel and sand a deposit of granular fill consisting of brown fine sand with trace gravel and trace silt was penetrated. The natural

moisture content from samples of this granular fill deposit was in the order of 3 to 20%. Gradation analyses were carried out on four (4) samples of this deposit which was retained in the spilt spoon sampler (37 mm inside diameter), the results of which indicated 0 to 2% gravel size particles, 92 to 96% sand size particles, and 4 to 7% silt and clay size particles (see Figure No. L-5, Appendix C). Based on the SPT values of 18 to 80 the compactness of this deposit was described as compact to very dense, generally very dense. This deposit was encountered to a depth of 5.8 m (elevation 317.0 m).

4.1.8 Silty Clay

Underlying the fill at Borehole No. C-7, a deposit of silty clay with sand was penetrated. The natural moisture content from samples of this deposit was in the order of 26 to 37%. Hydrometer analysis was carried on a single sample of this deposit, the results of which indicated 0% gravel size particles, 22% sand size particles, 46% silt size particles, and 32% clay size particles (Figure No. L-6, Appendix C). Atterberg Limit testing was carried out on one sample of this deposit, the results of which indicated a plastic limit in the order of 15% and a liquid limit in the order of 28% (see Figure No. L-8, Appendix C). Based on a single in-situ field vane test, which returned a value of 40 kPa, this deposit has a consistency of firm. This deposit was encountered to depth of 8.9 m below ground surface (elevation 313.9 m).

4.1.9 Sand

Underlying the silty clay at Borehole No. C-7, a deposit of grey fine to coarse sand trace to some gravel trace silt was penetrated. The natural moisture content from samples of this deposit was in the order of 13 to 26%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 0 to 19% gravel size particles, 77 to 95% sand size particles, and 4 to 5% silt and clay size particles (see Figure No. L-7, Appendix C). Based on

the SPT values of 4 to 49 blows per 300 mm penetration, the compactness of this deposit was described as loose becoming dense with depth. Auger refusal was encountered in this deposit at depth of 13.0 m below ground surface (elevation 309.8 m).

4.2 Groundwater Conditions

Groundwater and cave-in levels in the open boreholes were measured during the advance of the individual borings and upon completion. These levels were recorded on the individual Record of Borehole Log Sheets (Appendix B). The water level was measured at depths of 0.6, 0.7, 0.9, 1.2, 1.2, 3.6, and 4.7 m below ground surface at Boreholes No. C-1 to C-7, respectively (elevations 317.5, 317.7, 317.9, 317.8, 318.4, 317.4 and 318.1 m, respectively). These groundwater levels will fluctuate seasonally.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

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Project Engineer

5.0 DESIGN COMMENTS AND RECOMMENDATIONS

5.1 General

The existing 1350 mm x 1118 mm CTC culvert, located at Station 18+688 in the Township of Grenfell, was originally identified as requiring replacement in the RFP. The preferred method of culvert replacement was to detour the traffic to the west of the existing highway, along the route covered by Borehole Nos. C-2 to C-6. Since carrying out the field program, the culvert inlet has been exposed and inspected by others and was found to be in good condition. As such, a culvert replacement and detour will not be required at this location, however a culvert extension, to the west culvert end, will be constructed. Therefore, discussion for a detour will not be included in this design report, although the borehole logs will be included for factual completeness. The embankment at this location is some 5.1 m in height (elevation 322.9 m) above the culvert invert (elevation 317.8 m). Based on data from this foundation investigation and the geotechnical investigation, which was also carried out by MEL, the embankment supporting the pavement structure has been constructed using granular soils (pavement structure) over granular fill, predominately sands.

The culvert was reported to be in good condition, however the left end was buried. It appears that the embankment has been built to wide and this has resulted in the top of the embankment slope sloughing down, resulting in slope instability, with the loose granular material burying the west end of the culvert (See Photos, Appendix D). As such, that the west end of the culvert will require an extension by 3 m to allow reinstatement of the embankment slope. It is anticipated that the culvert extension will be constructed using either a flexible or a rigid pipe of sufficient capacity to accommodate the flow as per the hydrology report. The decision on the type of culvert to be for the extension used will be made at the construction stage.

5.2 Foundation Consideration

The existing embankment is constructed of granular soil. At the culvert location, a visual review of the pavement structure indicated no obvious signs of settlement at the culvert location. However, slope instability was observed on the west side of the embankment at the culvert location (See Photos, Appendix D). At the west end of the culvert, where the culvert extension is required (Borehole No. C-2), the subgrade at the culvert end/toe of slope embankment fill consisted of competent native compact sands underlain by stiff silty clay, underlain by loose to compact sands with auger refusal at elevation 311.5 m. The founding mineral soils are considered good for culvert support and for a conventional highway embankment foreslope of this height, and bearing resistance and/or embankment stability will not be an issue, as discussed in the following.

5.3 Design Bearing Pressure

Based on the presence of a competent native compact sand subgrade at the location of the culvert extension (west end), the response of the existing embankment, and a founding elevation similar to that of the existing culvert invert at the west end (elevation 318.0), we have determined a factored bearing resistance at ULS of 650 kPa for the native sand. A geotechnical reaction at SLS of 250 kPa reflects settlement considerations of the preloaded zone below the existing culvert, a settlement estimate of less than 25 mm, and the assumption that a stable subgrade is maintained with proper groundwater control during excavation and construction.

5.4 Bedding/Embedment and Subgrade Preparation

The results of this investigation indicate that the native soils at the toe of slope to the west of the inlet (Borehole No. C-2) consist of a stratum of sand, underlain by a thin stratum of stiff silty clay (0.8 to 2.6 m in thickness), underlain by a sand deposit, with auger refusal at depths of 5.3 to

6.9 m below ground surface (elevation 314.3 and 311.5 m). The embankment fill soils consist of granular materials. A review of the condition of the pavement surface, at the culvert location, revealed some longitudinal and transverse asphalt cracking, however no past patching, or settlement was observed, which indicates that the embankment fill has generally performed well, with the exception of the west slope, where sloughing at the top of the embankment had developed at the culvert location due to local steepening of the slope.

The existing culvert will be left in place with an extension connected at the west end. The connection between the existing CTC end and the circular pipe or pipe arch extension should be made tight and permanent at the joint to prevent infiltration of fine backfill. The end segment of the existing CTC is sound.

Embedment material, for flexible pipes, can consist of Granular B Type I placed in accordance with OPSD 802.010. However, if a rigid pipe is used, provide Class B bedding as per OPSD 802.031 with a Granular A bedding material. Cover material can consist of a Granular B Type I placed as per OPSD 802.031. Since the decision on the type of pipe to be used will be made at the construction stage, not at detailed design, specifying Granular A material for cover and embedment material would be prudent considering the minimal quantities involved. The backfill for the culvert extension should consist of a granular B Type I and the foreslope above the extension should be constructed to a 2H:1V.

Lateral earth pressures should be computed in accordance with the Canadian Highway Bridge Design Code (CHBDC). The design parameters are as follows:

	Granular A	**Granular B Type I and Existing Embankment Fill**
Angle of Internal Friction (degrees)	35	30
Unit weight (KN/m^3)	22	20
Active earth pressure (Ka)	0.27	0.33
At-rest earth pressure (Ko)	0.43	0.50

For rigid structures, such as precast concrete units, deflection cannot occur, as such the "at-rest" condition (Ko) applies. For flexible structures, such as CSP culverts, deflection can occur, as such the "active" condition (Ka) applies.

5.5 Excavation and Embankment Reconstruction

All excavations greater than 1.2 m in depth must be sloped or shored in accordance with the Occupational Health and Safety Act Regulations for Construction Projects. Excavation, to cut back the existing foreslope to connect the extension, will penetrate the existing embankment fills, which consist of sands trace gravel trace silt. Temporary open excavations will be stable above the groundwater table at an angle of 1H: 1V, as the embankment soils are considered a Type 3 soil as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.

Bedrock was not encountered within the anticipated depth of excavation, therefore bedrock excavation and/or blasting operations are not anticipated.

The groundwater table was encountered in the borehole at the west end of the culvert at elevation 317.7 m whereas the culvert invert at the west end is at elevation 318.0 m. These water levels will fluctuate seasonally however, it is not anticipated that groundwater control will be a major issue during construction of the extension. If encountered, dewatering in accordance with OPSS 517, must be carried out.

The existing left foreslope is at a 1.6H:1V slope and shows signs of localized sloughing/surface erosion at the slope crest. Once the extension has been installed the forslope should be reconstructed at a standard 2H:1V slope with Granular B Type I material. To prevent erosion top soil and seed should be applied as soon as possible after slope construction.

5.6 Extension Connection

The existing end members of the 1350 mm x 1118 mm CTC are in excellent condition and sound. A metal flange plate connector of width adequate to cover the timber end opening should be lag bolted to the CTC. This flange must be designed to collar the pipe extension securely to the CTC. The connection should be covered with a 2 m wide strip of geotextile centered on the joint between the existing and new culvert extension. Considering the similar permeability characteristics of the embankment fill and bedding material, as well as the size of the culvert, clay seals or cut off walls are not considered necessary.

5.7 Slope Stability During Construction

An open cut excavation may be required around the existing culvert to allow connection of the extension. This temporary slope can be cut back at an angle of 1H:1V, as previously noted. A slope stability analysis on this temporary slope configuration was carried out using the program Slope/W. This analysis established that the stability of a temporary 1H:1V slope, 5.0 m high and

underlain by a compact silt, results in a minimum factor of safety in the order of 1.2 against a circular failure (see Figure No. S-1, Appendix E). This factor or safety would be reduced to approximately 1.1 if the groundwater table rises to the existing grade at the culvert inlet.

As anticipated a shallow slip surface on the slope face has a lower factor of safety. This slope configuration will be temporary and short term, as such, the above factors of safety are considered acceptable for these conditions.

5.8 Construction Consideration

Considering the existing embankment (material composition and limited height), low groundwater table at the site, and underlying native competent bearing stratum (compact silts), it is not anticipated that any major construction issues will be encountered during the construction of this culvert extension.

6.0 CLOSURE

Information provided in this report is valid only at the locations described above. Any assumptions of continuity of soil stratigraphy between boreholes, as shown on the enclosed cross-sections, is intended as an aid for design purposes only and does not constitute a statement of existing conditions for contractual or construction purposes. Field investigation was carried out using a CME drill rig mounted on a Bombardier carrier owned by Chrisdamat Management Ltd. The report was prepared by Mr. J. R. Berghamer, P. Eng and reviewed by the firm's principal and MTO designate Mr. M. A. Merleau, P. Eng.

Details of the investigation, the material analysis and recommendation in this report are considered to be complete. However, should any questions arise, please do not hesitate to contact the undersigned.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng. J. R. Berghamer, P. Eng.
Principal

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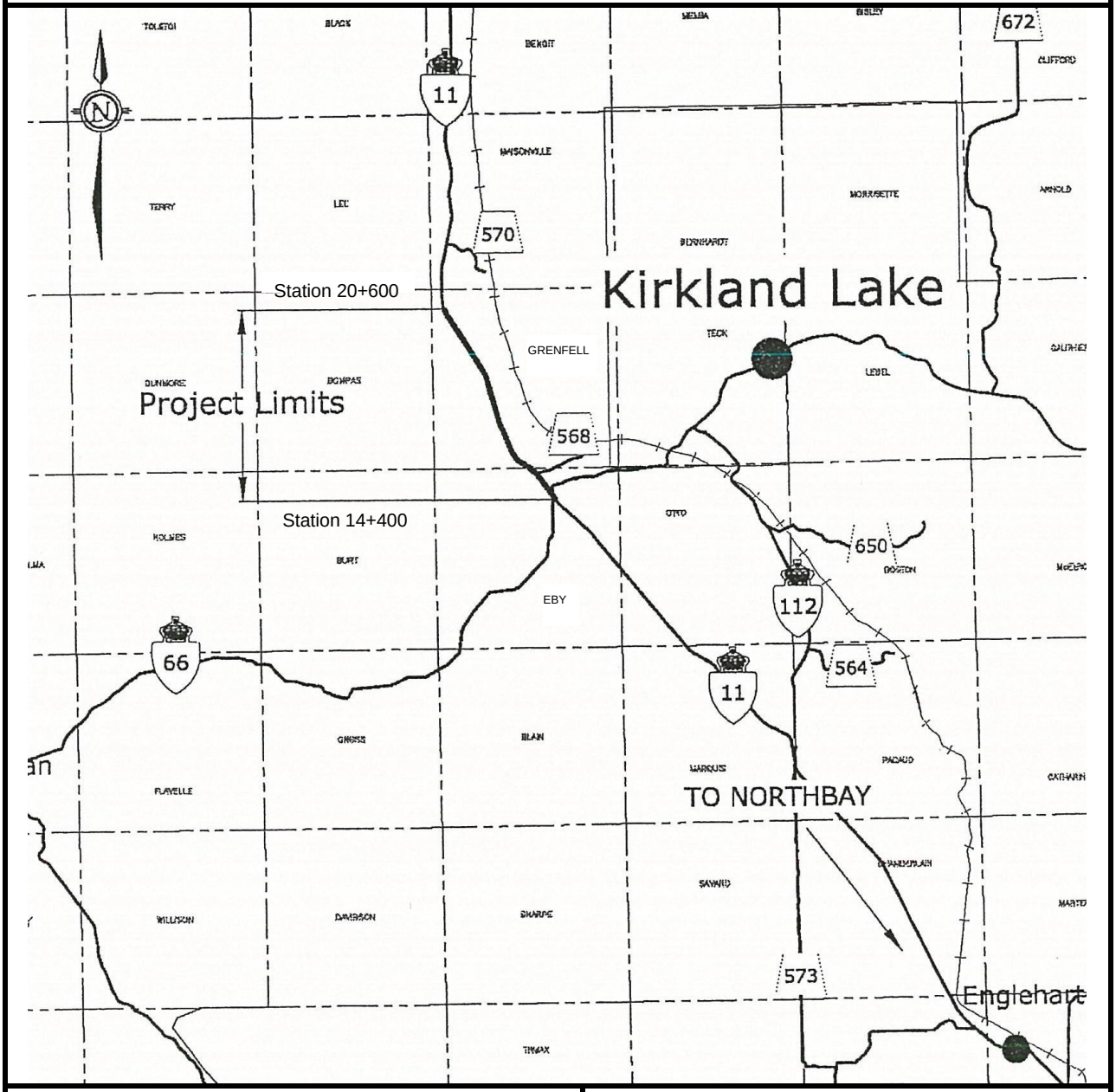
APPENDIX A

Figure No. 1: Key Plan

KEY PLAN

Figure No. 1

NOT TO SCALE



FINAL
FOUNDATION INVESTIGATION AND DESIGN REPORT
GWP 162-98-00

Highway 11, From 0.3 km South of Highway 66, Northerly 11.7 km to 3.5 km South of Highway 570

MEL Ref. No.: 09/10/09181C November 2010

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APPENDIX B

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 8: Record of Borehole Sheets

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
HB Hammer Bouncing
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
WH Sampler Advanced by static weight (weight of hammer and/or rods)
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 90° point cone 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

3. SOIL DESCRIPTION (Cont'd)

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

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%

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.

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-1

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337038.39 E 360400.46 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/24 - 10/2/24 TIME 1:25:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
318.1	Ground Surface						318
0.0	±100 mm Grass/Organics FILL - brown fine to medium sand trace silt trace gravel (very loose)		1	AS	N/A	▽	
316.9			2	SS	3		317
1.2	PEAT - dark brown fibrous peat trace wood some sand		3	SS	WH		
316.0							316
2.1	SAND - brown fine to medium sand trace silt trace gravel trace wood (compact) brown -------- grey		4	SS	12		
			5	SS	15		315
313.9			6	SS	WH		314
4.2	SILTY CLAY - grey silty clay		7	SS	WH		
312.5							313
5.6	SANDY SILT - grey sandy silt						
312.0			8	AS	N/A		312
6.1	Auger Refusal DCPT Refusal End fo Borehole						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

Soil Frozen

+ >100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

83.66

UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	5	87		(8)
	1	96		(3)
	0	34		(66)

COMMENTS
Soil Frozen to a ±0.5 m depth.

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) 10/2/24 1:25:00 PM	0.6 ▽	-
2)	- ▽	-
3)	- ▽	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.:3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-2

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337019.85 E 360370.88 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/25 - 10/2/25 TIME 3:00:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
318.4	Ground Surface						
0.0	±75 mm Top Soil/Organics						
	SAND - brown fine to medium sand trace silt trace gravel		1	AS	N/A	▽	318
	(compact)		2	SS	16	▽	
316.9							317
1.5	SILTY CLAY - grey silty clay trace to some sand		3	SS	23		
	(stiff)						
			4	SS	12		316
315.2							
3.2	SAND - light brown fine sand trace silt		5	SS	15		315
	(loose/compact)		6	SS	5		
			7	SS	3		314
							313
			8	SS	N/A		312
311.5							
6.9	Auger Refusal DCPT Refusal End of Borehole						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

Soil Frozen

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	0	98		(2)
	0	18	61	21
	0	5	65	30
	0	96		(4)

COMMENTS

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

$+^3$, $\times^3$: 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) 10/2/25 3:00:00 PM	0.7 ▽	0.9 ▽
2)	- ▽	-
3)	- ▽	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

MERLEX ENGINEERING LTD.
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ENCLOSURE NO.:4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-3

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337040.80 E 360357.52 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/26 - 10/2/26 TIME 10:25:00 AM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS
318.8	Ground Surface					
0.0	±75 mm Top Soil SAND - brown fine to medium sand trace silt (compact)		1	AS	N/A	
			2	SS	13	▽
317.3						
1.5	SILTY CLAY - light brown silty clay trace fine sand trace organics (stiff)		3	SS	12	
316.5						
2.3	SAND - grey fine to medium sand trace silt (very loose/loose)		4	SS	WH	
			5	SS	3	
			6	SS	9	
			7	SS	2	
312.3			8	SS	27/ 275mm	
6.5	Auger Refusal DCPT Refusal End of Borehole					

ELEVATION SCALE: 318, 317, 316, 315, 314, 313

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
	0	97		(3)

COMMENTS

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

$+^3$, $\times^3$: 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) 10/2/26 10:25:00 AM	0.9 ▽	2.5 ▣
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

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ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-4

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337083.59 E 360331.63 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/26 - 10/2/26 TIME 12:40:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
319.0	Ground Surface										
0.0	±75 mm Organics										
	SAND - brown fine to medium sand trace silt		1	AS	N/A						
	(compact)		2	SS	11	▽	318				
317.6											
1.4	SILTY CLAY - grey silty clay trace fine sand		3	SS	14		317				
	(stiff/firm)		4	SS	15						
			5	SS	2	▽	316	+6			0 2 66 32
315.0											
4.0	SAND - grey fine sand trace silt		6	SS	4		315				0 9 58 33
	(very loose/loose)		7	SS	2		314				
313.1											
5.9	Auger Refusal						313				
313.0											
6.1	DCPT Refusal End of Borehole										

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) 10/2/26 12:40:00 PM	1.2 ▽	3.1 ▼
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

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ENCLOSURE NO.:6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-5

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5336998.55 E 360384.25 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/26 - 10/2/26 TIME 2:50:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
319.6	Ground Surface										
0.0	±75 mm Top Soil/Organics										
	SAND - brown fine sand with silt		1	AS	N/A						
	(compact)										
318.5			2	SS	11	▽					
1.1	SILTY CLAY - brown silty clay trace fine sand										
	(stiff)		3	SS	13						
317.6						▣					
2.0	SAND - brown fine sand trace silt										
	(loose/compact)		4	SS	17						
			5	SS	5						
	brown										
	--------										
	grey		6	SS	1						0 92 (8)
			7	SS	4						0 98 (2)
314.3											
5.3	Auger Refusal DCPT Refusal End of Borehole										

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) 10/2/26 2:50:00 PM	1.2 ▽	2.1 ▣
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

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ENCLOSURE NO.:7 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. C-6

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5336973.93 E 360438.87 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/2/26 - 10/2/26 TIME 4:10:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS
321.0	Ground Surface					
0.0	±50 mm Top Soil					
	SAND - brown fine to coarse sand trace gravel trace silt		1	AS	N/A	
	(loose/compact)		2	SS	15	
			3	SS	7	
			4	SS	4	
			5	SS	6	▽
	brown					
	--------					
	grey		6	SS	7	
			7	SS	17	
315.4						
5.6	Auger Refusal DCPT Refusal End of Borehole					

ELEVATION SCALE: 320, 319, 318, 317, 316

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

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) 10/2/26 4:10:00 PM	3.6 ▽	-
2)	- ▽	-
3)	- ▽	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

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2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.:8 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. C-7

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337027.63 E 360391.88 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/6/25 - 10/6/25 TIME 11:00:00 AM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
322.8	Ground Surface									
0.0	±100 mm Asphalt ±70 mm Crushed Gravel FILL - brown fine sand trace gravel trace silt (compact/very dense)		1	AS	N/A					
			2	SS	43		2	94	(4)	
			3	SS	66					
			4	SS	67		0	96	(4)	
			5	SS	80		0	95	(5)	
			6	SS	19					
			7	SS	18	▽				
			8	SS	35		1	92	(7)	
317.0										
5.8	SILTY CLAY - grey silty clay with sand (stiff/firm)		9	SS	19	▽				
			10	SS	WH		0	22	46	32
313.9										
8.9	SAND - grey fine to coarse sand trace to some gravel trace silt (loose/compact)		11	SS	4					
			12	SS	6		0	95	(5)	
	Continued Next Page									

ELEVATION SCALE: 322, 321, 320, 319, 318, 317, 316, 315, 314, 313, 312, 311

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

------ Approx culvert invert

8

COMMENTS

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

$+^3$, $\times^3$: 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) 10/6/25 11:00:00 AM	4.7 ▽	6.1 ▼
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

METRIC

RECORD OF BOREHOLE NO. C-7

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5337027.63 E 360391.88 - Grenfell Township ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 North - MELSite C BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started/Completed) 10/6/25 - 10/6/25 TIME 11:00:00 AM CHECKED BY MAM

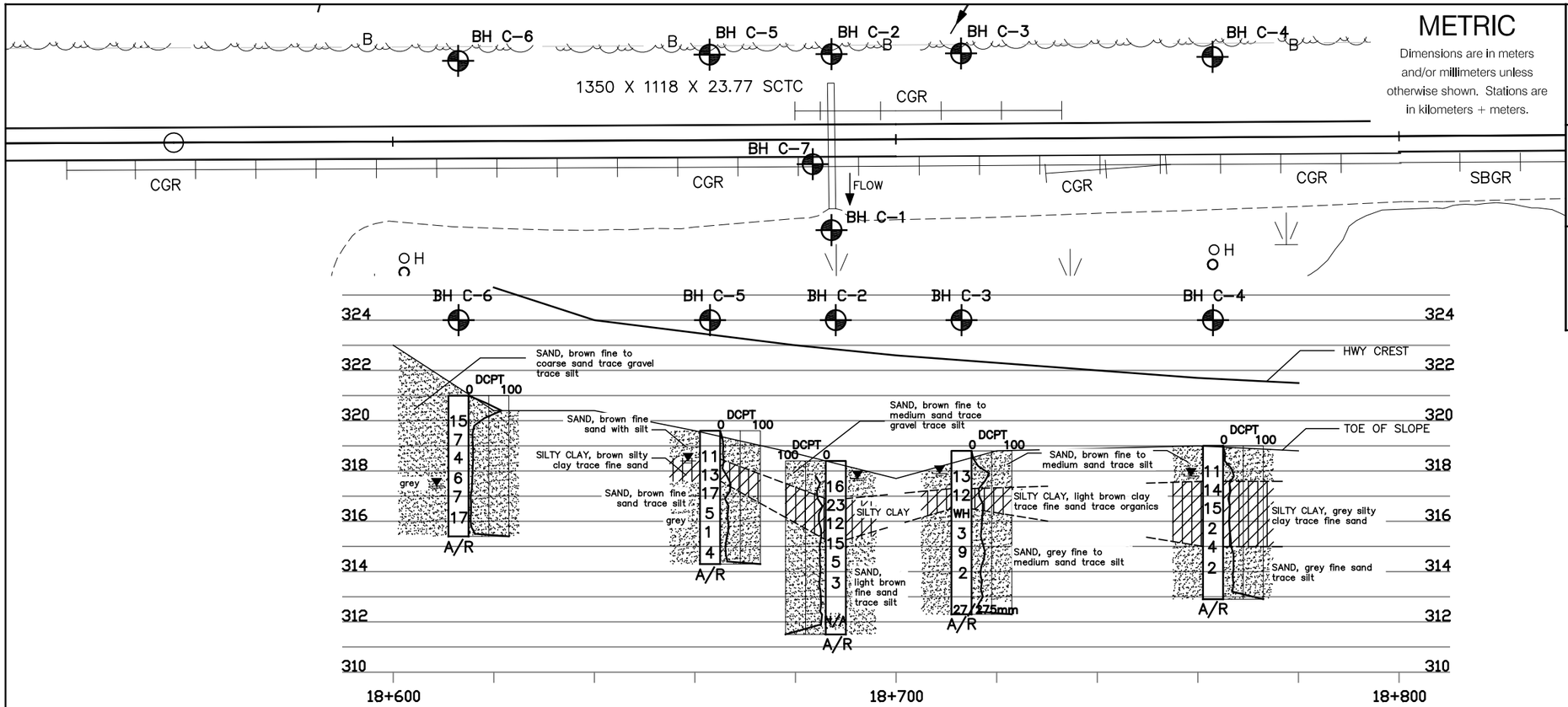
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued from Previous Page										
	SAND - grey fine to coarse sand trace to some gravel trace silt (dense)		13	SS	49		310		o		19 77 (4)
309.8											
13.0	Auger Refusal DCPT Refusal End of Borehole										

MEL-GEO 09181 - SITE C - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/24

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

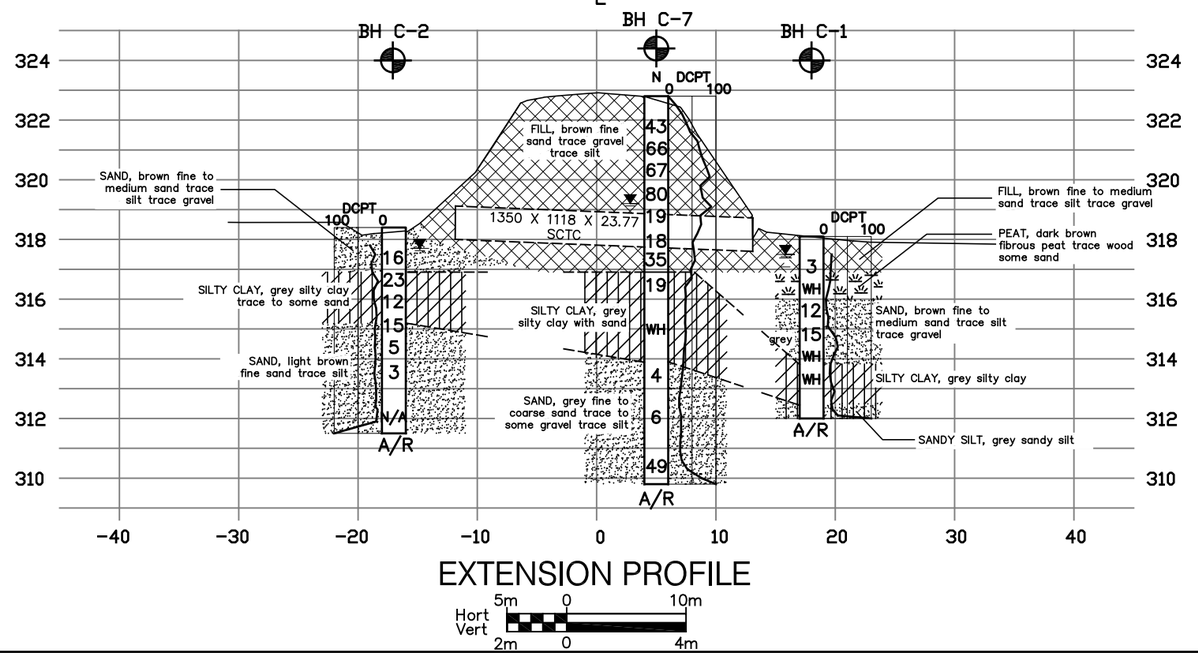
APPENDIX C

Figure No. C-1:	Borehole Locations & Soil Strata
Figure Nos. L-1 to L-7:	Summary Grain Size Analysis Graph
Figure No. L-8:	Plasticity Chart



PLAN & PROFILE

10m 0 20m



EXTENSION PROFILE

Hort 5m 0 10m
Vert 2m 0 4m

Geo Cres No 42A-81

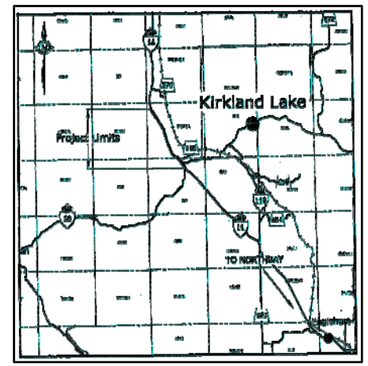
WP No 162-98-00

N

HWY 11 - Township of Grenfell
Sta. 18+688 - MEL SITE C
Culvert Replacement and Possible Detour
BOREHOLE LOCATIONS & SOIL STRATA

Figure C-1

MERLEX ENGINEERING LTD.
Consulting Geotechnical Engineers



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling
- O/S Offset from ℄

Borehole No.	O/S	Co-ordinates Northerly	Co-ordinates Easterly	Elev.
No. C-1	18.0 Rt	5337038.4	360400.5	318.1
No. C-2	17.0 Lt	5337019.7	360370.9	318.4
No. C-3	17.0 Lt	5337040.8	360357.5	318.8
No. C-4	16.0 Lt	5337083.6	360331.6	319.0
No. C-5	17.0 Lt	5336998.6	360384.3	319.6
No. C-6	16.0 Lt	5336954.4	360407.7	321.0
No. C-7	4.9 Rt	5337027.6	360391.9	322.8

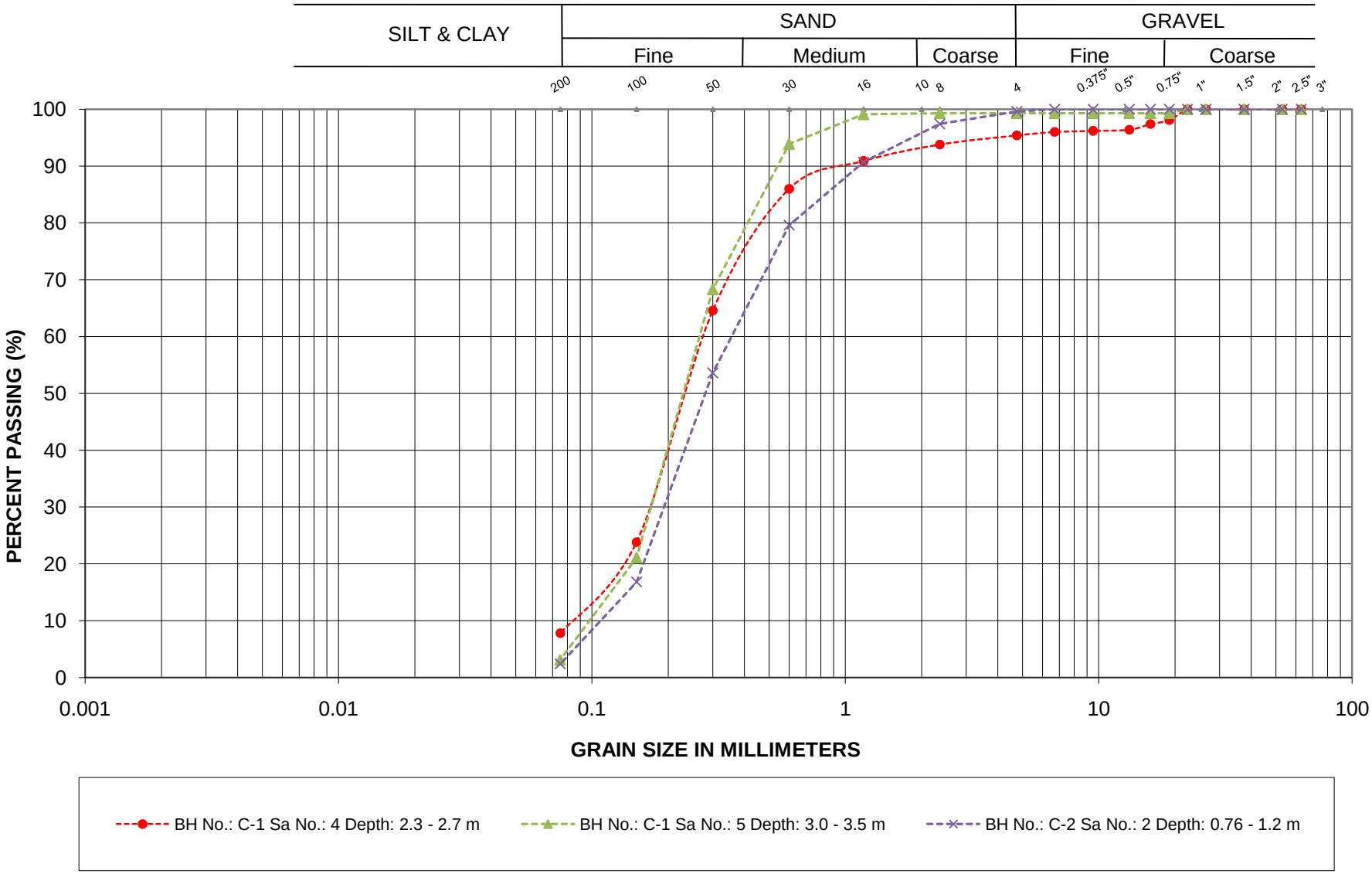
NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

REVISIONS	DATE	BY	DESCRIPTION
	NOV/10	MCM	FINAL

HWY No. 11 – CULVERT REPLACEMENT & POSS. DETOUR – 18+688			REF NO. 09181
SUBM'D			SITE C
DRAWN RG	CHK MAM	DATE SEPTEMBER 2010	FIG C-1

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

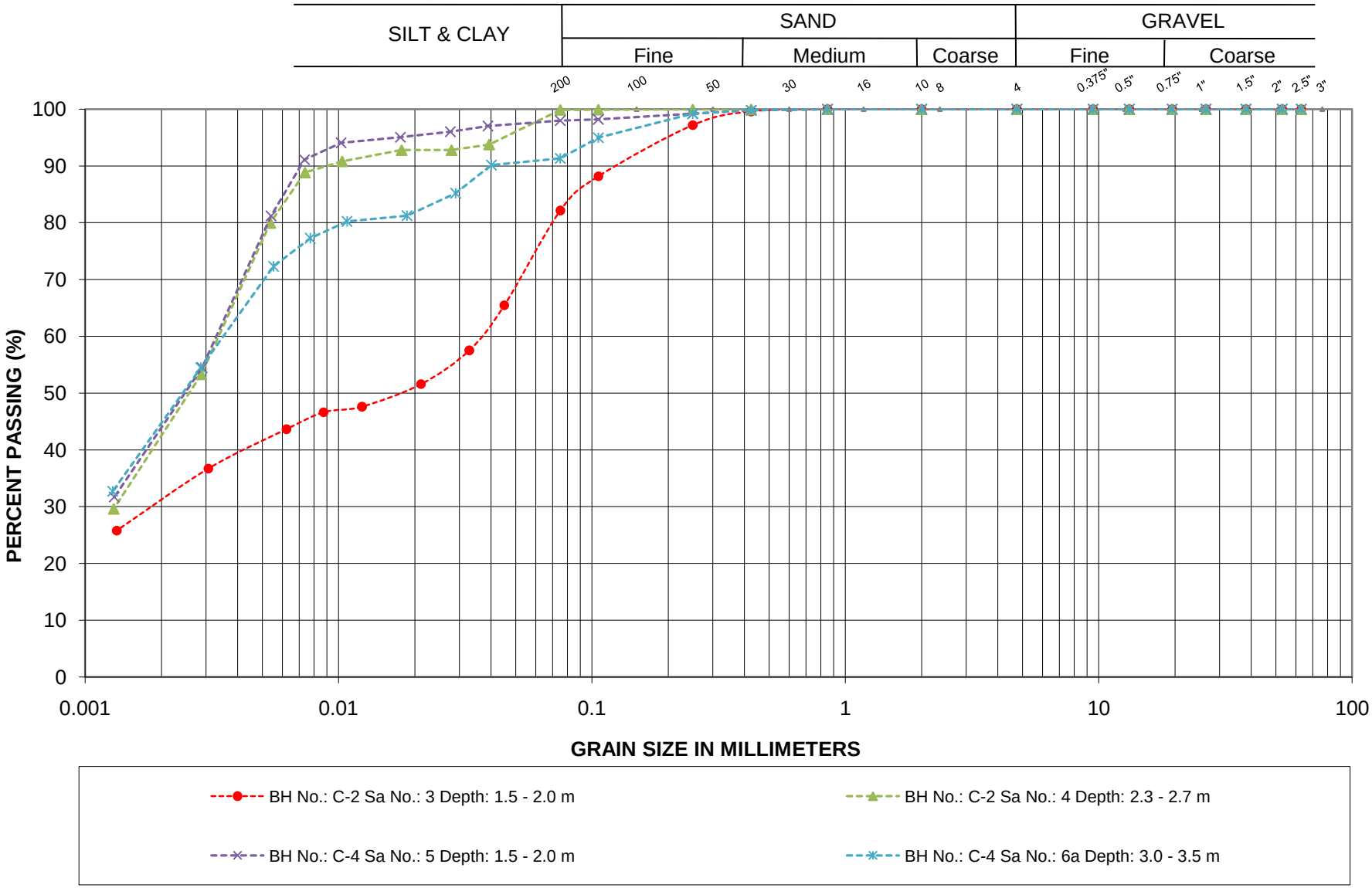
SANDS - Sand, Trace Gravel, Trace Silt

MERLEX ENGINEERING LTD.

FIGURE L-1

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

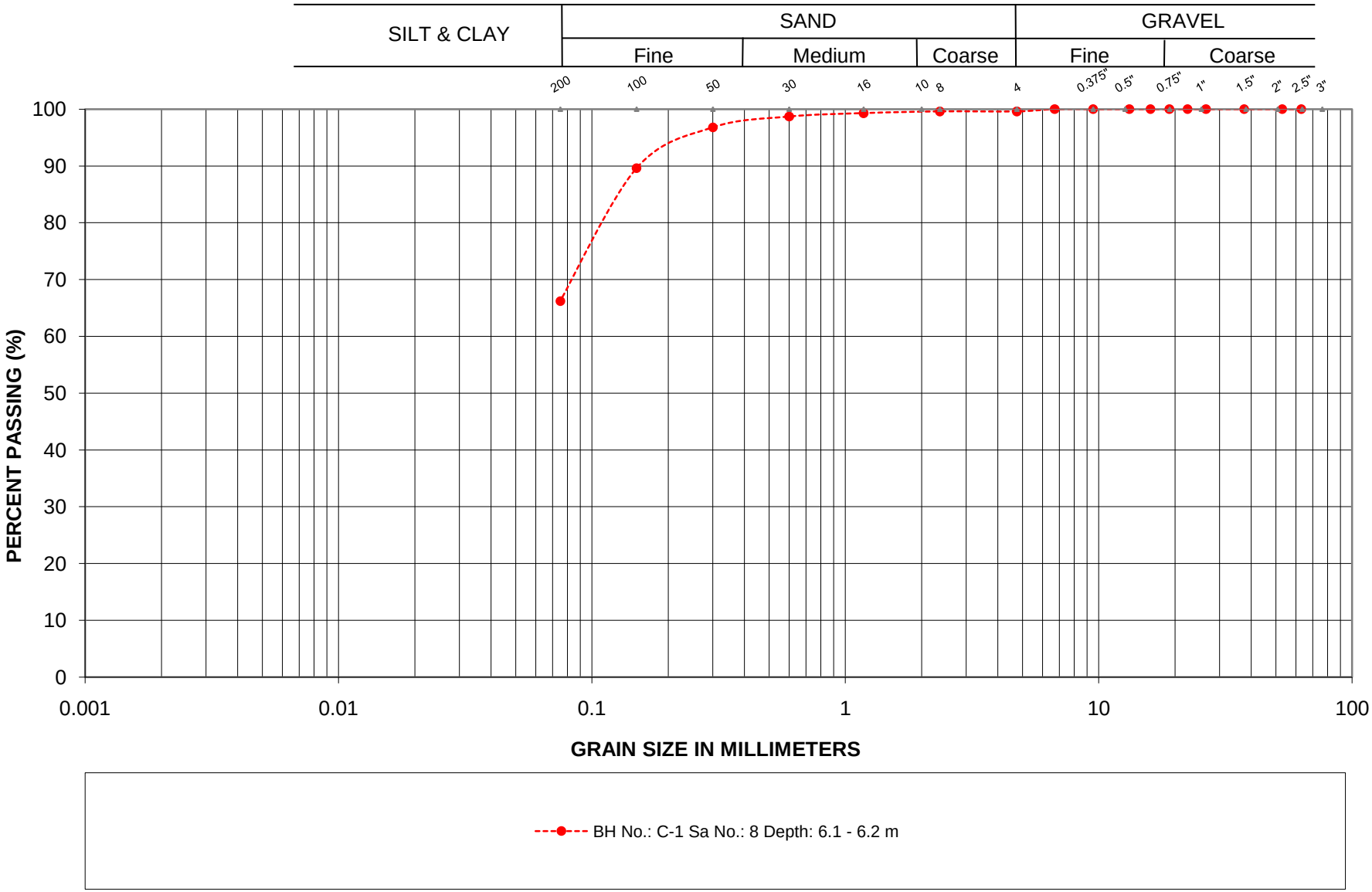
SILTY CLAY - Silty Clay, Trace to Some Sand

MERLEX ENGINEERING LTD.

FIGURE L-2

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

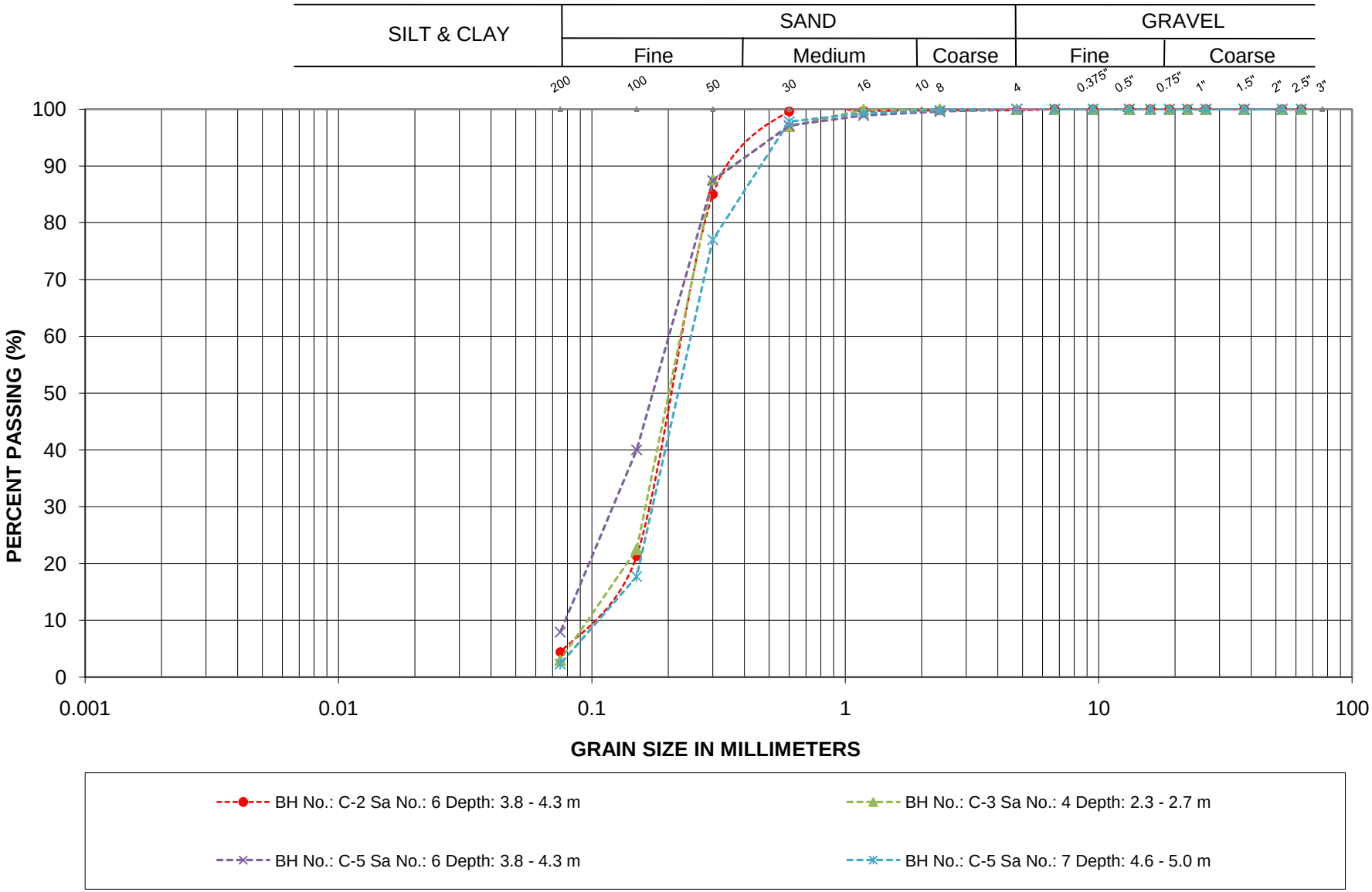
SILTS - Sandy Silt

MERLEX ENGINEERING LTD.

FIGURE L-3

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

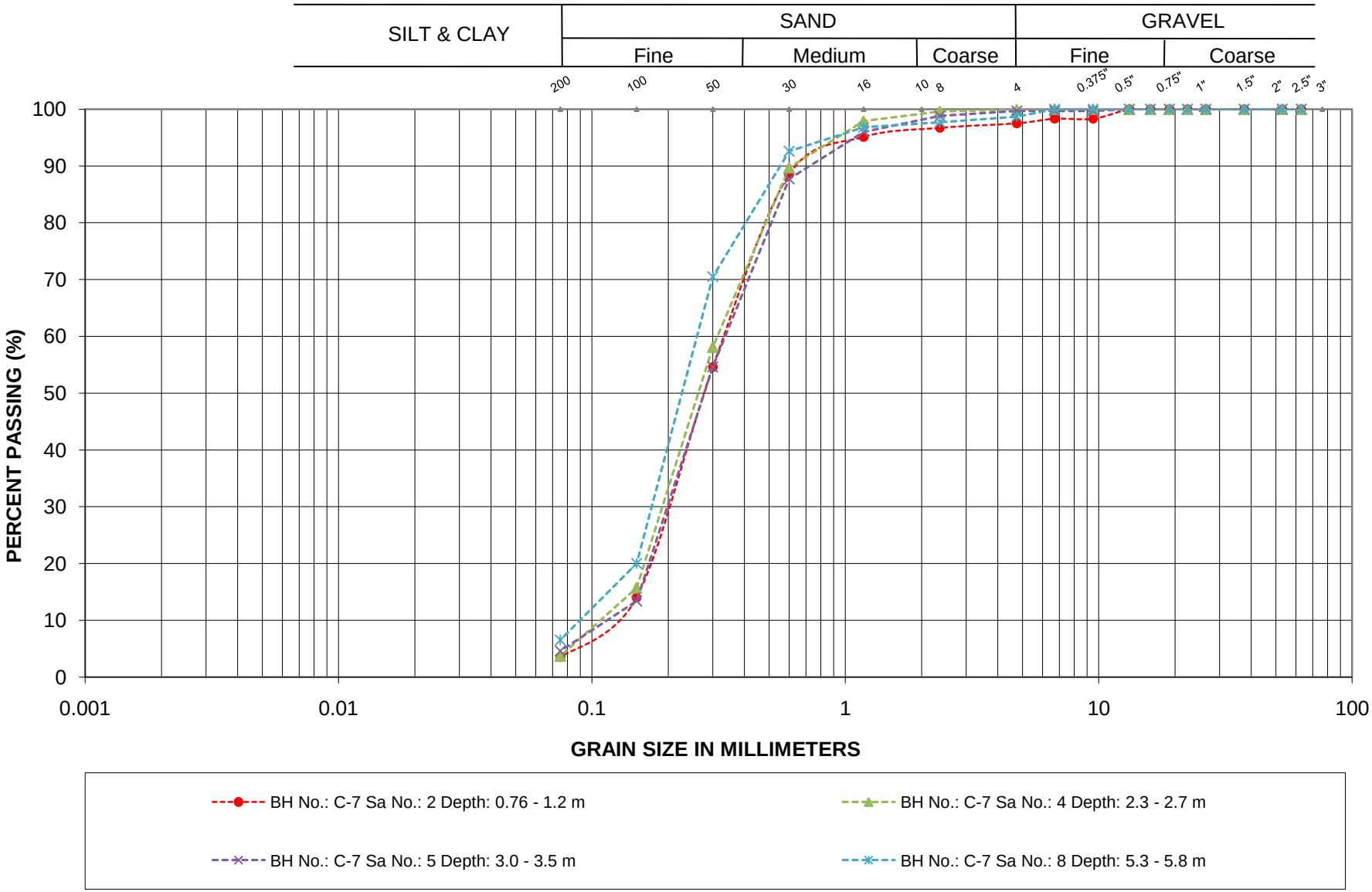
SANDS - Sand, Trace Silt

MERLEX ENGINEERING LTD.

FIGURE L-4

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

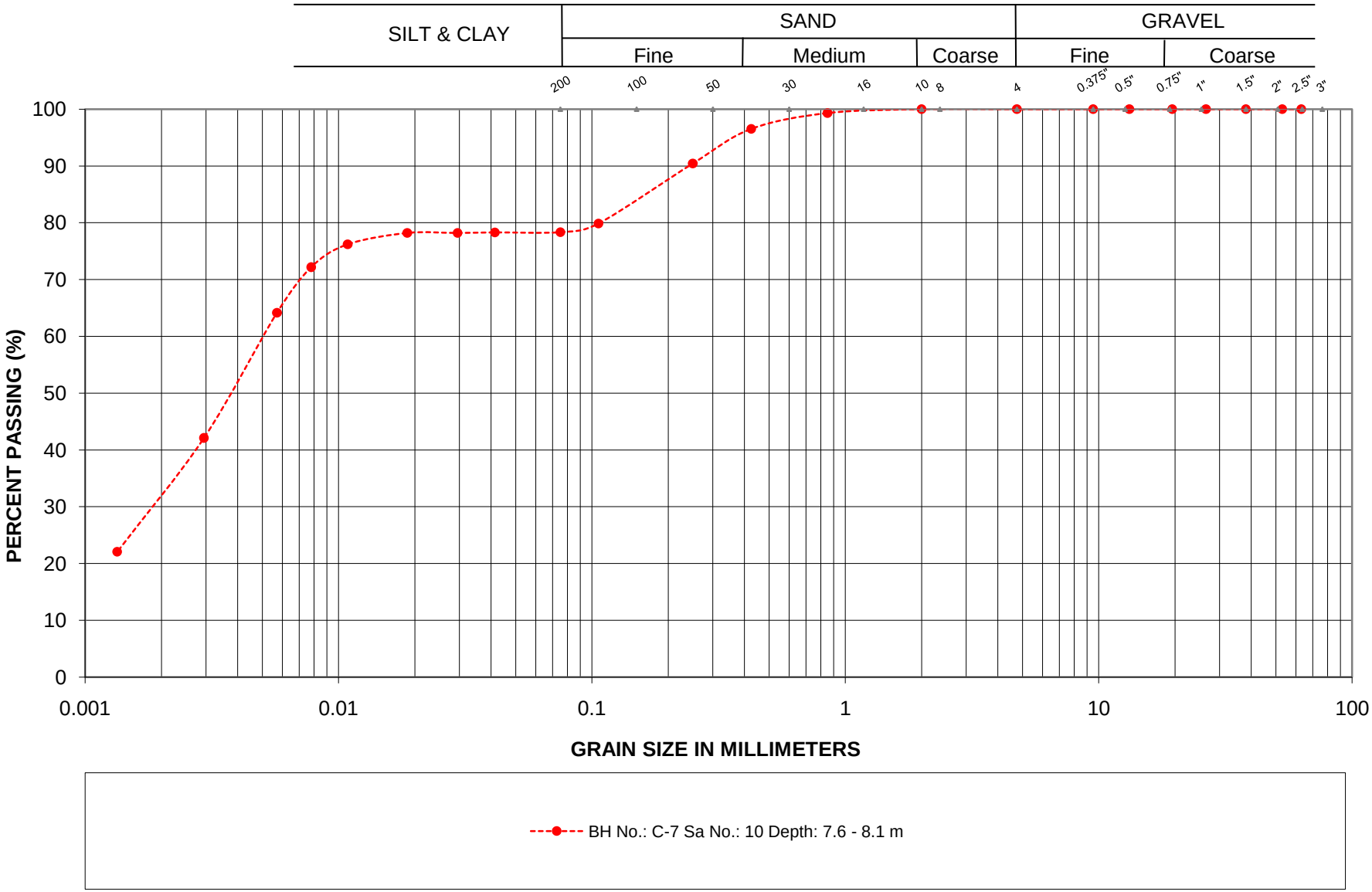
FILL - Sand, Trace Gravel, Trace Silt

MERLEX ENGINEERING LTD.

FIGURE L-5

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

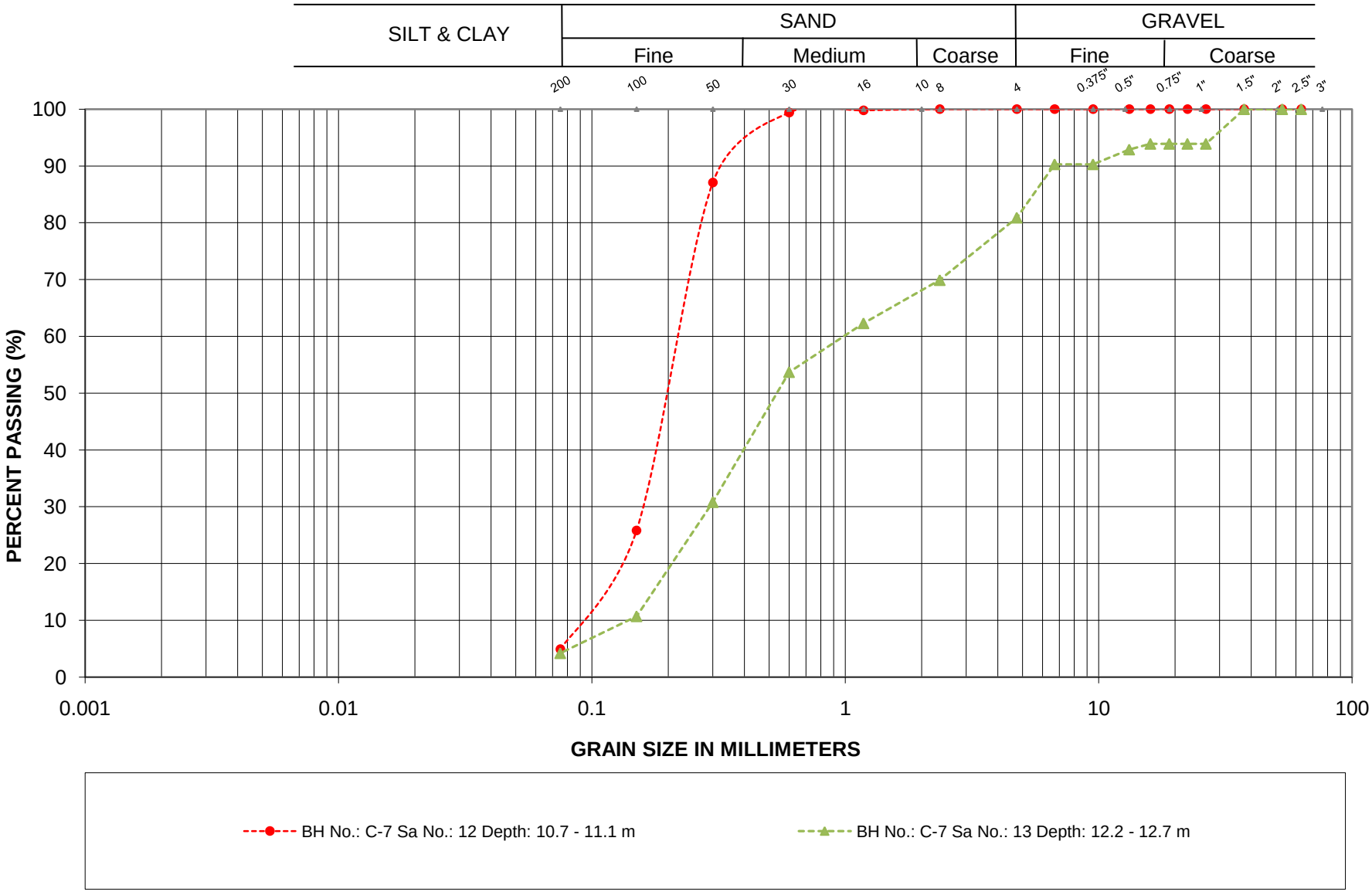
SILTY CLAY - Silty Clay, With Sand

MERLEX ENGINEERING LTD.

FIGURE L-6

Reference No.: 09/10/09181C
Date: November 2010

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site C

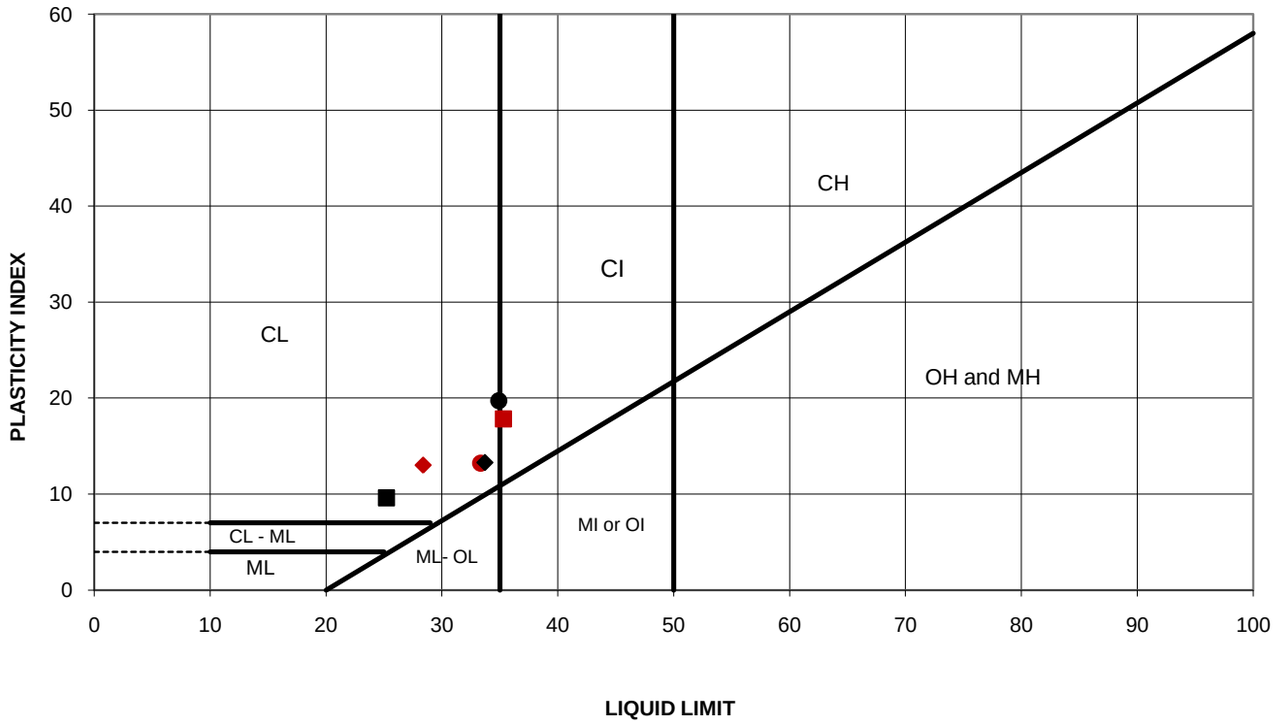
SANDS - Sand, Trace to Some Gravel, Trace Silt

MERLEX ENGINEERING LTD.

FIGURE L-7

ATTERBERG LIMITS TEST RESULTS	FIGURE L- 8

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Plasticity Index	Plastic Limit	Liquid Limit	NMC %
●	C-1	7	4.6	313.5	19.7	15.2	34.9	31.3
■	C-2	3	1.5	316.7	9.6	15.6	25.2	23.2
◆	C-2	4	2.3	315.9	13.3	20.4	33.7	27.2
●	C-4	5	3.0	315.0	13.2	20.1	33.4	29.9
■	C-4	6a	3.8	314.2	17.8	17.5	35.3	42.2
◆	C-7	10	7.6	315.2	13.0	15.4	28.4	25.7

Date: Nov-10
Project: Hwy 11, Grenfell Twp - MEL Site C

Prep'd: AT
Chkd: MAM
Ref. No.: 09/10/09181C

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APPENDIX D

Photos Nos. 1 to 3: Culvert Photos

Location of Culvert Inlet – West Embankment, location of buried culvert end	Photo: 1

West Side of Embankment – Slope instability at culvert inlet, looking south	Photo: 2

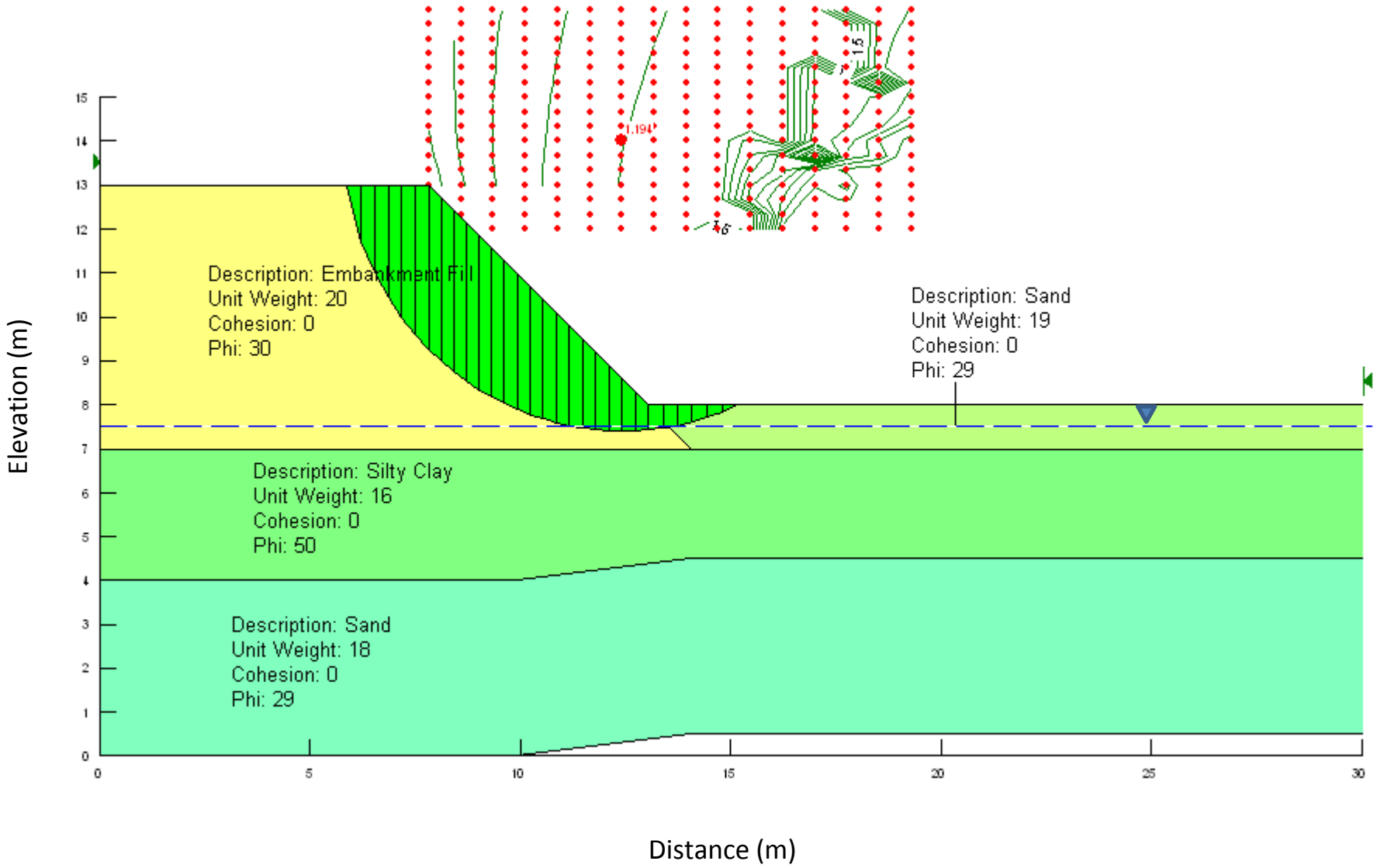
Reference No.: 09/10/09181C Project: Hwy 11 – Township of Grenfell, Culvert Extension Station 18+688, MEL Site C	Originated By: JL Date: September 14, 2010

Culvert Outlet – East Embankment	Photo: 3

Reference No.: 09/10/09181C Project: Hwy 11 – Township of Grenfell, Culvert Extension Station 18+688, MEL Site C	Originated By: JL Date: September 14, 2010

APPENDIX E

Figure No. S-1: Stability Analysis



Stability Analysis
Temporary Open Excavation
1H:1V