



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

**Highway 535 Rehabilitation
Retaining Wall
Twp of Hagar
Intersection of Highway 17 & 535
GWP 5563-04-00**

**Highway 535
From 8.1 km North of Highway 64 (Noelville) Northerly 12.1 km;
And, 0.6 km North of Highway 64 Northerly 1.4 km
District of Sudbury**

FINAL FOUNDATION INVESTIGATION AND DESIGN REPORT

Date: May 7, 2012
Ref. N^o: 11/04/11046-F10

Geocres No. 41I-284

LVM | MERLEX

2-120 PROGRESS COURT, NORTH BAY (ONTARIO) CANADA P1A 0C2 – T 705.476.2550 | F 705.476.8882 –
NORTHBAY@LVM.CA - WWW.LVM.CA

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
2.1 Site Physiography and Surficial Geology	2
3.0 INVESTIGATION PROCEDURES.....	2
4.0 SUBSURFACE CONDITIONS.....	4
4.1 Retaining Wall	4
4.1.1 Surficial Layers	5
4.1.2 Fill	5
4.1.3 Silty Sand.....	5
4.2 Light Pole Base	6
4.2.1 Surficial Layers	7
4.2.2 Fill	7
4.2.3 Silty Sand.....	7
4.3 Groundwater Conditions.....	8
5.0 DESIGN COMMENTS AND RECOMMENDATIONS	9
5.1 General.....	9
5.1.1 Frost Protection	9
5.2 Foundation Considerations	10
5.3 Lateral Earth Pressures.....	11
5.4 Drainage.....	12
5.5 Slope Stability.....	12
5.6 Excavation, Dewatering and Backfill	13
5.7 Construction Concerns	15
6.0 CLOSURE.....	16

APPENDICES

APPENDIX A

Figure No. 1	Key Plan
--------------	----------

APPENDIX B

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 6	Record of Borehole Sheets
Enclosure No. 7	Record of Auger Probe Logs

APPENDIX C

Figure No. 2	Borehole Locations and Soil Strata
Figure Nos. L-1 to L-3	Summary Grain Size Analysis Graph

APPENDIX D

Enclosure No. 8	Photo Essay
-----------------	-------------

APPENDIX E

Figure No. S-1	Slope Stability
----------------	-----------------

1.0 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 for a proposed retaining wall and light pole base. This retaining wall and light pole base are located in the west quadrant of the intersection of Highway 17 and Highway 535, in the Township of Hagar.

The foundation investigation location was specified by AECOM Canada Ltd. in their correspondence dated August 8, 2012, and covered under MTO Agreement No. 5010-E-0015. The terms of reference for the scope of work are outlined in LVM | MERLEX's proposal for additional investigation 11/04/11046, dated August 11, 2011, and in accordance with LVM | MERLEX's original proposal P-10-169, dated December 2010. The purpose of this investigation was to determine the subsurface conditions in the areas of the retaining wall in order to provide design recommendations. LVM | MERLEX investigated the foundation areas by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The field work for this retaining wall foundation investigation was carried out at the intersection of Highways 17 and 535, Township of Hagar. The retaining wall is located some 11.9 to 18 m right of the centerline of Highway 17, between Stations 10+139 and 10+210. The topography at the site slopes from south to north down to the grade of the existing highway (see Photos, Appendix D). The retaining wall will be constructed along an existing slope with an anticipated wall height of some 2 and 3 m. The slope to be retained was recorded at an angle of 2:1 (H:V), at the center of the proposed wall, decreasing (flattening) to 10:1 and 5:1 behind the wall, at the east and west ends of the proposed wall, respectively (see Cross Sections, Figure No. 2, Appendix C).

Infrastructure at this location consists of overhead power and communication wires to the south of the proposed wall.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the North Shore - Sudbury Ridges and Pockets. The topography on this section of Highway 535 is generally rolling. There are a few exposed bedrock ridges. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area, overburden consists primarily of sands.

Bedrock in the area, as indicated on OGS Map 2506, is of the Late to Middle Precambrian Era. At the location of this retaining wall foundation investigation, the bedrock comprises of Metasediments including conglomerate, sandstone, siltstone, chert, and iron formations.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between the dates of November 8th and 11th, 2011, during which five (5) sampled boreholes were advanced. For the purposes of foundation design for the retaining wall, one borehole was advanced at either end of the proposed wall, and one borehole was advanced at the center of the proposed wall. One borehole was also advanced at a proposed light pole location. Shallow refusal was encountered in the borehole at the light pole, as such, a second borehole was advanced at this location. On May 1, 2012, a series of eight (8) auger probes (Auger Probe (AP) Nos. 1 to 8, inclusive) were advanced between the borehole locations along the proposed retaining wall alignment to confirm the absence/presence of bedrock along the alignment of the retaining wall foundation.

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 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 the boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. 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, as well as specific gravity. 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-3).

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.

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. 2 (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 units. 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 Retaining Wall

A plan and profile illustrating the borehole and auger probe locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. Borehole Nos. 1 to 3 were advanced along the orientation of the proposed retaining wall, where as the auger probes were advanced along the wall alignment between the boreholes. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 were recorded at 213.4, 214.3, and 213.5 m, respectively.

4.1.1 Surficial Layers

At surface, at Borehole No. 2, a surficial deposit of black silty sand some 150 mm thick was penetrated. Vegetative cover, including grass and light brush, was encountered at the surface of all boreholes.

4.1.2 Fill

Underlying the surficial silty sand at Borehole No. 2, and at surface at Borehole Nos. 1 and 3, a deposit of fill consisting of brown fine sand some to with silt some to with gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 5 to 18%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 14% gravel size particles, 57% sand size particles, and 29% silt and clay size particles (Figure No. L-1, Appendix C). Based on SPT 'N' values of 8 blows per 300 mm penetration, the compactness of this deposit was described as loose. This deposit was encountered to depths of 0.9, 1.4, and 0.7 m below grade at Borehole Nos. 1 to 3, respectively (elevations 212.5, 212.9, and 212.8 m, respectively).

4.1.3 Silty Sand

Underlying the fill at Borehole Nos. 1 to 3, a deposit of brown to grey silty sand to sand and silt, trace to with gravel was penetrated. Based on drill response during advance of the boreholes and auger probes, this deposit contains cobble and probably small boulder size rock. The natural moisture content measured on samples of this deposit was in the order of 5 to 21%. Gradation analyses were carried out on twelve (12) samples of this deposit, the results of which indicated 6 to 27% gravel size particles, 32 to 55% sand size particles, and 26 to 47% silt and clay size particles (Figure No. L-2, Appendix C). Based on SPT 'N' values of 2 to greater than 100 blows per 300 mm penetration, the compactness of this deposit was described as very loose to very dense, generally very dense. Auger refusal was encountered at depths of 5.3, 5.0,

and 4.8 m below ground surface at Borehole Nos. 1 to 3, respectively (elevations 208.1, 209.3, and 208.7 m, respectively).

Auger probes were advanced along the proposed retaining wall alignment. Auger refusal on cobbles/boulders in the very dense silty sand deposit was encountered at AP Nos. 1, 3, and 7 at depths of 3.1, 2.0, and 2.2 m below grade, respectively. These auger probes were relocated some 0.5 m offset, where they were advanced past the refusal depth to a depth of 4.7 m. At each auger probe location auger advance was achieved to a depth of 4.7 m below grade. The table below provides a summary of the auger probe refusal depths, if encountered.

Auger Probe No.	Auger Probe Depth (m)	Refusal Encountered (Y/N)
1	3.1	Y
1A	4.7	N
2	4.7	N
3	2.0	Y
3A	4.7	N
4	4.7	N
5	4.7	N
6	4.7	N
7	2.2	Y
7A	4.7	N
8	4.7	N

4.2 Light Pole Base

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. Borehole Nos. 4 and 4A were advanced in the area of the proposed light pole base. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 4 and 4A were recorded at 211.4 and 211.8 m, respectively.

4.2.1 Surficial Layers

At surface at Borehole No. 4A, a surficial deposit of sand fill some 150 mm thick was penetrated. Vegetative cover consisting of grass was encountered at both boreholes.

4.2.2 Fill

Underlying the surficial sand fill at Borehole No. 4A, and at surface at Borehole No. 4, a deposit of fill consisting of grey silty sand with gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 14 to 15%. This deposit was encountered to depths of 0.6 and 0.7 m below grade at Borehole Nos. 4 and 4A, respectively (elevations 210.8 and 211.1 m, respectively).

4.2.3 Silty Sand

Underlying the fill at Borehole Nos. 4 and 4A, a deposit of grey sand with silt, with gravel was penetrated. Based on drill response during advance of the boreholes and auger probes, this deposit contains cobble and boulder size rock. The natural moisture content measured on samples of this deposit was in the order of 7 to 8%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 22 to 25% gravel size particles, 47 to 48% sand size particles, and 23 to 28% silt size particles, and 3 to 4% clay size particles (Figure No. L-3, Appendix C). Based on SPT 'N' values greater than 100 blows per 300 mm penetration, the compactness of this deposit was described as very dense. Auger refusal was encountered at depths of 2.1 and 2.6 m below ground surface at Borehole Nos. 4 and 4A, respectively (elevations 209.2 and 209.2 m, respectively).

An unsampled auger probe was advanced some 1 m east of Borehole No. 4A. Auger refusal on the probe was encountered at a depth of 2.6 below grade (elevation 209.2 m).

4.3 Groundwater Conditions

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. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B). Borehole Nos. 1 to 4 were dry at the time of sampling and the boreholes remained dry 1 to 2 days after completion. Surface runoff flooded Borehole No. 4A which was situated in the existing ditch (elevation 211.8 m).

The groundwater levels will fluctuate seasonally.

LVM | MERLEX

M. A. Merleau, P. Eng.
Principal Engineer
MTO Designate

J. R. Berghamer, P. Eng.
Regional Manager

5.0 DESIGN COMMENTS AND RECOMMENDATIONS

5.1 General

A foundation investigation was carried for the proposed retaining wall and light pole base located at the intersection of Highway 17 and Highway 535, in the Township of Hagar. In order to improve sight distance at the intersection, the slope will be cut back and, as such, a retaining wall will be required. Present plans call for the wall to be a reinforced concrete gravity retaining wall. The retaining wall will be some 70 m long, constructed some 18 m right of centerline at Station 10+139 to 11.9 m right of centerline at Station 10+210, and retain some 2.5 m of earth. It is understood that a light pole base is proposed be constructed at Station 10+171 some 11.5 m right of centerline.

5.1.1 Frost Protection

The estimated frost depth penetration for the Hagar area is some 2.0 m below exposed asphalt surfaces and/or for isolated, unheated foundations.

All isolated footings subject to frost penetration and stripped of the natural insulative value of snow cover must have frost protection (permanent and during construction) to the depths noted above.

If a sufficient depth of earth cover cannot be provided for frost protection, equivalent expanded extruded polystyrene (EEP) insulation may be used in conjunction with available soils cover to provide frost protection. If EEP is used for frost protection, precautions must be taken to protect the insulation from accidental spillage of hydrocarbons, solvents or other destructive products.

The founding subgrade must be protected from frost at all times during foundation excavation and construction operations. Concrete cannot be placed against materials with subzero

temperatures. Should freezing temperatures occur during construction, the founding subgrade must be insulated (straw, insulated traps, etc.) against frost until such a time that footings are adequately protected (soil cover, insulation etc.).

5.2 Foundation Considerations

The subsurface conditions at this site generally consist of a relatively thin layer of loose fill overlying very dense silty sands with auger refusal encountered at depths of 4.8 to 5.3 m below grade (elevations 208.1 to 209.3 m) at the borings along the location of the proposed retaining wall.

It is understood that the asphalt boulevard, in front of the retaining wall, will be established at approximately elevation 212.2 m. As such, to provide adequate earth cover for frost protection to the foundation, footings for the retaining wall and light pole base should be established at elevations of approximately 210.2 m for the retaining wall and 209.3 m for the light pole base. At this elevation, the subsurface soils along the length of the proposed retaining wall consist of very dense silty sands which contains cobbles/boulders. These founding materials are acceptable for support of conventional concrete strip and/or spread footings at the depth required for frost protection or higher.

For footings established at the 2 m depth required for frost protection and supported on the undisturbed native very dense silty sands, a factored bearing resistance at ULS of 550 kPa can be used. A geotechnical resistance at SLS of 450 kPa can be used for design, in consideration of less than 25 mm settlement.

Based on this design bearing pressure, and assuming proper subgrade preparation, settlements of the foundation units on soil for the structure will be within the generally accepted tolerance range for this type of structure.

Foundations for the light pole base should be designed and constructed as per OPSS 2200.01. A light pole foundation can be installed by either augering a shallow caisson (drilled shaft) or excavating and installing a sonotube. The lateral resistance of a caisson, based on Brom's Method for a short pile, depends upon the soil unit weight and coefficient of passive earth pressure plus the geometry of the caisson. Provided that backfill to a 760 mm diameter caisson foundation is compacted to 100% Standard Proctor Dry Density the factored lateral capacity of 45 kN can be used for design of a caisson 2.75 m in length.

5.3 Lateral Earth Pressures

Backfill behind retaining walls should be an imported well-graded free draining material (i.e. Granular B Type III) and be compacted to a minimum of 98% SPDD below settlement sensitive areas. Compaction efforts within 1.8 m of the retaining wall should be carried out with hand operated compaction equipment and should not commence until the wall is properly supported. Drainage must be supplied behind the retaining wall with 150 mm geotextile wrapped drains leading to a positive outlet to negate the risk of hydrostatic pressure buildup. The design parameters for the backfill materials are as follows:

Soil Type	Unit Weight (kN/m ³)	Friction Angle (°)	Active Earth Pressure (Ka)	At-rest Earth Pressure (Ko)	Passive Earth Pressure (Kp)
Granular B Type III	20	30	0.33	0.50	3.00
Existing Fill	18	29	0.35	0.52	2.88
Native Silty Sand	19	30	0.33	0.50	3.00

Since gravity retaining walls are rigid, free standing retaining walls, the “active” condition (K_a) should be used in design.

5.4 Drainage

Drainage must be provided for the backfill behind the proposed retaining wall. Properly installed continuous drainage will reduce the risk of hydrostatic pressure buildup.

It is recommended that gravity drainage holes (wall holes) discharging to the exposed wall face be installed along the lower part of the exposed face of the proposed wall, as per OPSS 3120.100 and 3121.150. The perforated subdrain pipe should have a minimum diameter of 150 mm. Bedding and cover material shall consist of Type I, 19 mm Clear Stone. The thickness of the clear stone bedding layer shall be a minimum of 50 mm over earth grade. The clear stone shall be placed so that there is a minimum 150 mm of clear stone on each side of the pipe, and a minimum of 100 mm above the pipe. Geotextile shall be placed to completely surround the clear stone bedding and cover materials. The type of the geotextile shall be a non-woven, Class II geotextile, with a FOS of 50-100 um.

5.5 Slope Stability

Using the program Slope/W, a stability analysis was carried out at Station 10+170 to determine the global stability of the retaining wall. A slope established at 2H:1V was used for the soil behind the retaining wall. The material unit weights and friction angles used in the slope analysis are based on general representative values for soil types, based on lab testing, and field STP 'N' values. The soil parameters used in the slope stability analysis are as follows:

Soil Type	Unit Weight (kN/m ³)	Friction Angle (°)	Cohesion (kPa)
Granular B (Pavement Structure)	20	30	-
Granular B Type III	20	30	-
Existing Fill	18	29	-
Silty Sand	19	30	-
Concrete Retaining Wall	25	45	500

The results of the analysis indicated a factor of safety in the order of 2.00 against failure through the native silty sand subgrade (see Figure No. S-1, Appendix E). As, such the global stability of the finished retaining wall will not be an issue provided it is properly constructed.

5.6 Excavation, Dewatering, and Backfill

Based on the Occupational Health and Safety Act Regulations for Construction Projects, the silty sand fills and upper, loose, silty sands, which extended to a depth of 2.1 m at Borehole No. 3, are considered a Type 3 soil. The very dense silty sands, with gravel and occasional cobbles and boulders, are considered at a minimum a Type 2 soil. 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. Short-term open excavations will be stable above the groundwater table at a temporary angle of 1H:1V, in the Type 3 soils. In the underlying Type 2 soils (i.e. very dense silty sands) the walls are to be sloped back at a 1H:1V to within 1.2 m of the bottom of the excavation.

Bedrock was not encountered within the anticipated depth of excavation, therefore bedrock excavation and/or blasting operations are not anticipated. However, it should be noted that the native soils are in a very dense state of compactness and contains cobbles and boulders. The contractor must be prepared to use equipment of sufficient capacity to excavate these materials.

It should be noted that a long back slope is located to the south of the proposed retaining wall. The excavating contractor must consider the location and topography of this slope, and the presence of a septic tile distribution bed, when assessing the proposed excavation.

At the time of the investigation, the boreholes were dry upon completion, however surface water was encountered entering Borehole No. 4A , which was located in the ditch line. A dry subgrade condition must be maintained at all times during foundation/below grade construction. Therefore, with a founding elevation of around 210.7 m and depending upon the time of year the work is undertaken, groundwater control, in accordance with OPSS 517 and 518, may be required to maintain a stable subgrade during excavation and construction. If necessary, temporary dewatering in soils, similar to those encountered at this site can generally be carried out to a depth of approximately 750 mm to 1.0 m below the prevailing groundwater table using the conventional construction dewatering method of using oversized excavations, installing perimeter drains/ditches leading to a sufficient number of strategically placed filtered sump holes located in the base of the excavation. If greater penetration is required, then a more sophisticated unwatering system must be considered. Ultimately, the method of dewatering and unwatering will be the choice of the contractor however, the importance and benefits of maintaining a dry stable subgrade during excavation and foundation construction cannot be stressed enough.

Gradation analysis was carried out on samples of the existing fill and native silty sands from within the depth of the anticipated excavations to be carried out on this site. None of the samples were found to consistently meet any of the OPSS specifications. Therefore, the excavated material cannot be used for any structural purpose (i.e. backfill etc.). When excavated, if pockets of this material are found to be free of deleterious materials it can remain

on site and used for landscaping purposes only. The removal of any soil from the site must comply with Ontario Regulations.

5.7 Construction Concerns

No major construction concerns are anticipated if carried out in general conformance to that discussed above. However, the contractor must be prepared to excavate the very dense silty sand soils, containing cobble and boulder sizes, during construction of the retaining wall, and installation of the light standard.

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.

LVM | MERLEX

M. A. Merleau, P. Eng.
Principal Engineer
MTO Designate

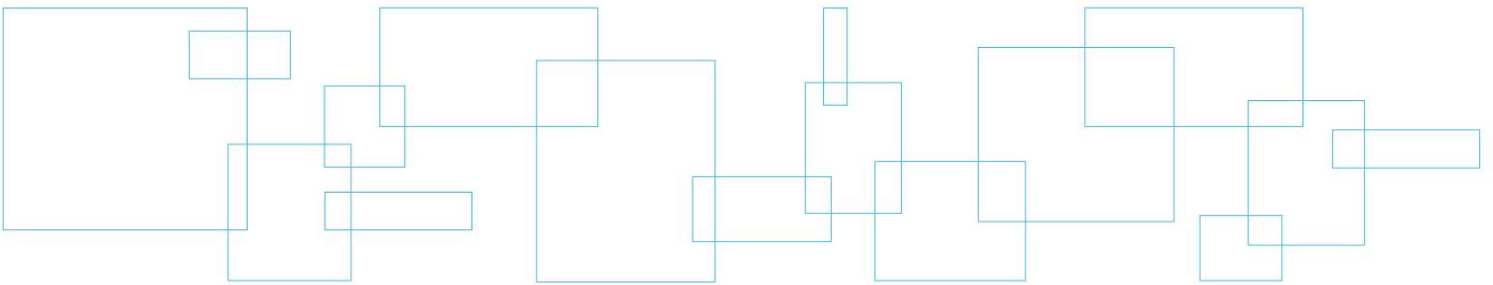
J. R. Berghamer, P. Eng.
Regional Manager

Z:\PROJECT FILES\2011\11046 - PAVE & FDN, Hwy 535 Noelville to Hagar (AECOM)\FOUNDATION\Retaining wall Hwy 535 & 11\Report\FINAL\11046-F10 - FINAL FIDR, Hwy 535 - Retaining Wall.doc

Appendix A

Key Plan

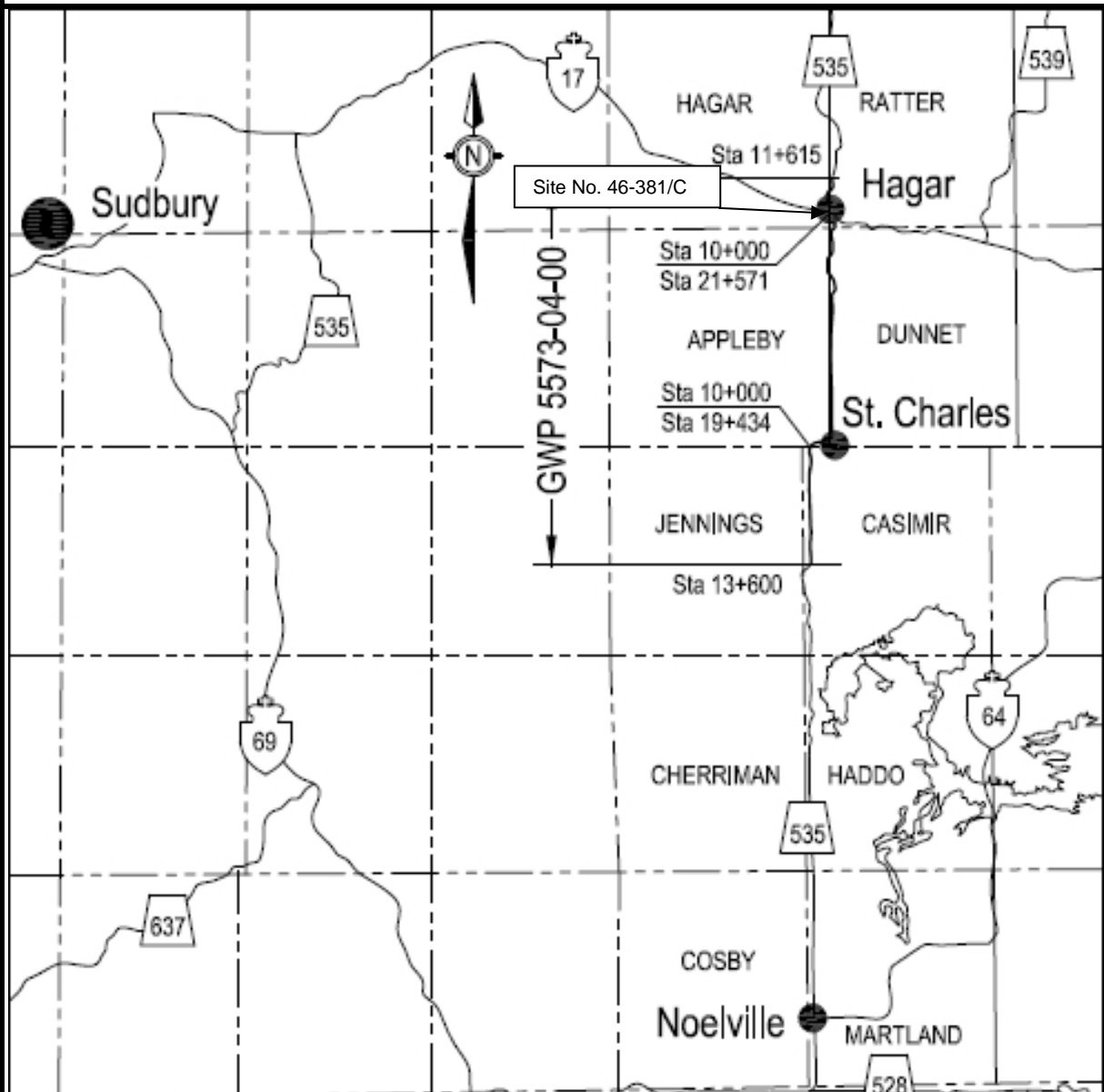
Figure No. 1: Key Plan



KEY PLAN

Figure No. 1

NOT TO SCALE



**FINAL
FOUNDATON INVESTIGATION
AND DESIGN REPORT
GWP 5563-04-00**

Highway 535
From 8.1 km North of Highway 64
(Noelville) Northerly 12.1 km;
And, 0.6 km North of Highway 64
Northerly 1.4 km
District of Sudbury

LVM | MERLEX

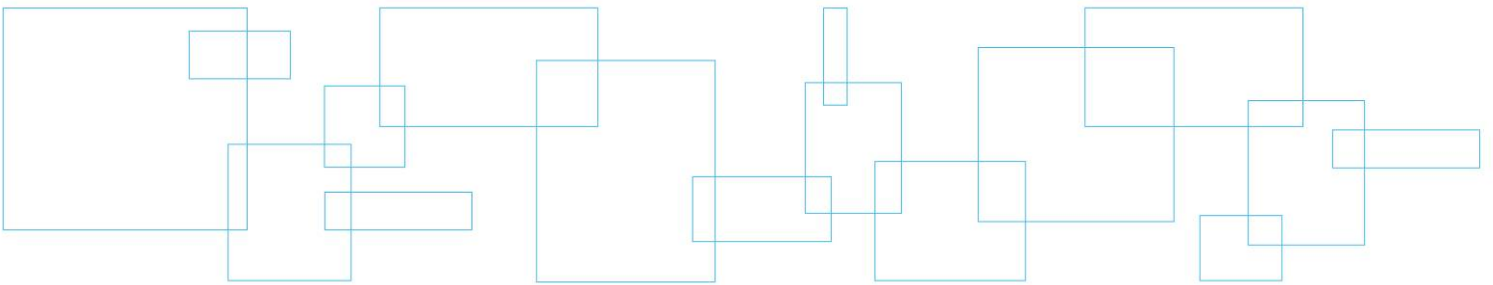
Appendix B

Abbreviations Record of Borehole Sheets

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 6: Record of Borehole Sheets

Enclosure No. 7: Record of Auger Probe Logs



LIST OF ABBREVIATIONS AND 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
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

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

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

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.

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

Accep	Acceptable	Hi	Highly	RSS	Remoulded Shear Strength
Agg	Aggregate	HP	High Plasticity	RF	Rock Fill
Amor	Amorphous	HM	Hot Mix	Sa	Sand
Asph	Asphalt	Ip	Plasticity Index	Sat	Saturated
AP	Auger Probe	L	Loose	SH	Shale
BR	Bedrock	Lt	Light or Left	Sh Rk	Shot Rock
Blk	Black	Liq	Liquid	Si (y)	Silt (y)
Bl	Blue	Lo	Loam	Sl (y)	Slight (ly)
BH	Borehole	Matl	Material	(L,M,H)SFH	Susceptibility to Frost
Bld (y)	Boulder (y)	Max	Maximum		Heave (L – Low, M – Med, H – High)
Blds	Boulders	Med	Medium	SP	Slight Plasticity
Br	Brown	Mod	Moderate	SSM	Select Subgrade Material
CF	Channel Face	Mott	Mottled	St	Sensitivity
Cl	Clay	Mrl	Marl	Stn (y)	Stoney
Co	Coarse	Mul	Mulch	Stks	Streaks
Cob	Cobbles	Num	Numerous	Surf	Surface
Comp	Compact	MDD	Maximum Dry Density	Temp	Temperature
Conc	Concrete	MWD	Maximum Wet Density	TH	Test Hole
Contam	Contaminated	MP	Medium Plasticity	TP	Test Pit
Cr	Crushed	NFP	No Further Progress	Tps	Topsoil
Dk	Dark	NFP (Blds)	No Further Progress (Boulders)	Tr	Trace
Decomp	Decomposed	NMC	Natural Moisture Content	USS	Undisturbed Shear Strength
D	Dense	OCC	Occasional	Unreinf	Unreinforced
D_R	Relative Density	Ora	Orange	Varv	Varved
E	Earth	Org	Organic	VF	Very Fine
Fib	Fibrous	Org M	Organic Matter	WT	Water Table
F	Fine	Ob	Overburden	Weath	Weathered
Fr Wat	Free Water	Pavt	Pavement	W	With
FB	Frost Boil	Pedo	Pedological	w	Field Moisture Content
FH	Frost Heave	Pen Mac	Penetration Macadam	Wd (y)	Wood (y)
Gran	Granular	Psty	Polystyrene	Wopt	Optimum Moisture Content
Gr	Gravel (ly)	Poss	Possible	Wp	Plastic Limit
Grn	Green	PST	Prime & Surface Treated	W_L	Liquid Limit
Gry	Grey	Quant	Quantity	Yel	Yellow
H	Heavy	Reinf	Reinforced		

Example of an Abbreviated Borehole

10+000	On C/L	Station	Offset from Centerline (C/L) (Rt – Right; Lt – Left)
0 - 300	Rooty Peat Fr Wat @ 200	Depth below Grade*	Abbreviated Soil Description Groundwater Data (where encountered) Abbreviated Lab Data (where applicable) - Sample No., Type of Test(s) and Test Results - Relation to Ontario Provincial Standards and Specifications (OPSS) included (i.e. pass or fail; reason) where applicable
300 - 800	Br F Sa Tr Gr Tr Si 20ELS107 NOT Accep Granular 'B' Type I 21% PASSING 75 µm Accep SSM		
800 - 4.0	Gry Si F Sa Tr Gr 20ELS108 w @ 3.6 = 20.0 % % Passing 2.00 mm = 91 425 µm = 80 75 µm = 34		
4.0	NFP Bld or BR		
	LSFH		

* Depths are measured in millimeters from 0 up to 1 meter and in meters for depths equal to greater than 1 meter

METRIC

RECORD OF BOREHOLE NO. 01

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146299.5 E349545.6 - Township of Hagar ORIGINATED BY JL
 PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) November 8, 2011 TIME November 8, 2011
 DATE (Completed) November 8, 2011 (Completed) 12:50:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES																				
213.4 0.0	Ground Surface		1	AS	N/A																				
212.5 0.9	FILL - brown fine sand some silt trace gravel		2	SS	42								6 47 (47)												
211.9 1.5	SILTY SAND - grey fine sand with silt to sand and silt trace to with gravel occasional cobbles and boulders DCPT Refusal (dense/very dense)		3	SS	104/ 225mm								27 32 (41)												
			4	SS	80								18 54 (28)												
			5	SS	>100								15 55 (30)												
			6	SS	58																				
			7	SS	78/ 175mm																				
208.1 5.3	Auger Refusal End of Borehole																								
COMMENTS								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE																	
								WATER LEVEL RECORDS <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) 11/9/11 8:15:00 AM</td> <td>DRY</td> <td>2.98</td> </tr> <tr> <td>2) 11/11/11 8:15:00 AM</td> <td>DRY</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>						Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 11/9/11 8:15:00 AM	DRY	2.98	2) 11/11/11 8:15:00 AM	DRY	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																							
1) 11/9/11 8:15:00 AM	DRY	2.98																							
2) 11/11/11 8:15:00 AM	DRY	-																							
3)	-	-																							

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

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL GPJ MEL-GEO.GDT 5/8/12

LVM | MERLEX

METRIC

RECORD OF BOREHOLE NO. 02

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146294.2 E349581.0 - Township of Hagar ORIGINATED BY JL/RG
 PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) November 9, 2011 TIME
 DATE (Completed) November 11, 2011 (Completed) CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
214.3	Ground Surface												
0.0	150 mm black silty sand		1	AS	N/A								
	FILL - brown sand with silt trace gravel (loose)		2	SS	8								14 57 (29)
212.9													
1.4	SILTY SAND - brown sand with silt trace gravel (loose)		3	SS	9								18 54 (28)
211.9			4	SS	50/75mm								24 46 (30)
2.4	Auger Refusal - Probably Boulder(s) - moved 3.5 m S and 1.2 m E of BH, sampling continued.												
	SILTY SAND - grey fine sand with silt to silty fine sand occasional cobbles and boulders (very dense)		5	SS	75/150mm								25 48 (27)
			6	SS	60/150mm								13 54 (33)
			7	SS	50/125mm								16 52 (32)
209.3													
5.0	Auger Refusal End of Borehole												

WATER LEVEL RECORDS	
Date (dd/mm/yy)/Time	Water Depth (m) / Cave In (m)
1) 11/11/11 1:10:00 PM	DRY 4.8
2)	-
3)	-

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

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL GPJ MEL-GEO.GDT 5/8/12

LVM | MERLEX

METRIC

RECORD OF BOREHOLE NO. 03

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146292.9 E349619.2 - Township of Hagar ORIGINATED BY JL/RG
 PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) November 8, 2011 TIME November 9, 2011 (Completed) 10:00:00 AM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
213.5 0.0	Ground Surface		1	AS	N/A						
212.8 0.7	FILL - brown fine to medium sand with gravel trace silt		2	SS	44						20 43 (37)
211.4 2.1	SILTY SAND - grey/brown silty sand some gravel trace clay occasional cobbles and boulders (loose)		3	SS	2						
211.1 2.4	SILTY SAND - grey fine sand with silt some to with gravel trace clay		4	SS	55/170mm						25 49 23 3
208.7 4.8	DCPT Refusal Occasional cobbles and boulders (very dense)		5	SS	>100						
			6	SS	>100						17 52 27 4
			7	SS	118/175mm						
	Auger Refusal End of Borehole										
COMMENTS								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE			
								WATER LEVEL RECORDS Date (dd/mm/yy)/Time Water Depth (m) Cave In (m) 1) 11/9/11 10:00:00 AM DRY - - 2) - - - 3) - - -			

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

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL GPJ MEL-GEO.GDT 5/8/12

LVM | MERLEX

METRIC**RECORD OF BOREHOLE NO. 04****LVM | MERLEX**

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146303.1 E349581.6 - Township of Hagar ORIGINATED BY RG
 PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) November 9, 2011 TIME
 DATE (Completed) November 9, 2011 (Completed) CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L														
211.4 0.0	Ground Surface		1	AS	N/A																								
210.8 0.6	FILL - grey silty sand with gravel		2	SS	>100																								
	SILTY SAND - grey sand with gravel some silt trace clay occasional cobbles and boulders		3	SS	30/150mm 20/0mm																								
209.3 2.1	Auger Refusal End of Borehole																												
COMMENTS								+ 3, x 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE					WATER LEVEL RECORDS <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) 11/9/11</td> <td>DRY</td> <td>-</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>					Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 11/9/11	DRY	-	2)	-	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																											
1) 11/9/11	DRY	-																											
2)	-	-																											
3)	-	-																											

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

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL GPJ MEL-GEO.GDT 5/8/12

LVM | MERLEX

120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

METRIC

RECORD OF BOREHOLE NO. 04A

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146303.3 E349577.6 - Township of Hagar ORIGINATED BY JL
 PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started) November 11, 2011 TIME (Completed) 11:00:00 AM CHECKED BY MAM
 DATE (Completed) November 11, 2011

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L														
211.8	Ground Surface																												
0.0	150 mm brown sand fill		1	AS	N/A																								
211.1	FILL - grey fine silty sand with gravel																												
0.7	SILTY SAND - grey fine sand with silt with gravel trace clay		2	SS	53/175mm																								
210.7	Auger Refusal - Probably Boulder(s) - moved 0.5 m W of BH, sampling continued.																												
1.1	SILTY SAND - grey fine sand with silt with gravel trace clay occasional cobbles and boulders (very dense)		3	SS	103/275mm																								
209.2	Auger Refusal End of Borehole		4	SS	103/275mm																								
2.6	Advanced Auger Probe 1 m E of Borehole 04A. Auger refusal @ 2.6 m depth.																												
COMMENTS								$+ 3, \times 3$: Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa \bigcirc 3% STRAIN AT FAILURE					WATER LEVEL RECORDS <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 11/11/11 10:55:00 AM</td> <td>0</td> <td>0.9</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>					Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 11/11/11 10:55:00 AM	0	0.9	2)	-	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																											
1) 11/11/11 10:55:00 AM	0	0.9																											
2)	-	-																											
3)	-	-																											

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

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL GPJ MEL-GEO.GDT 5/8/12

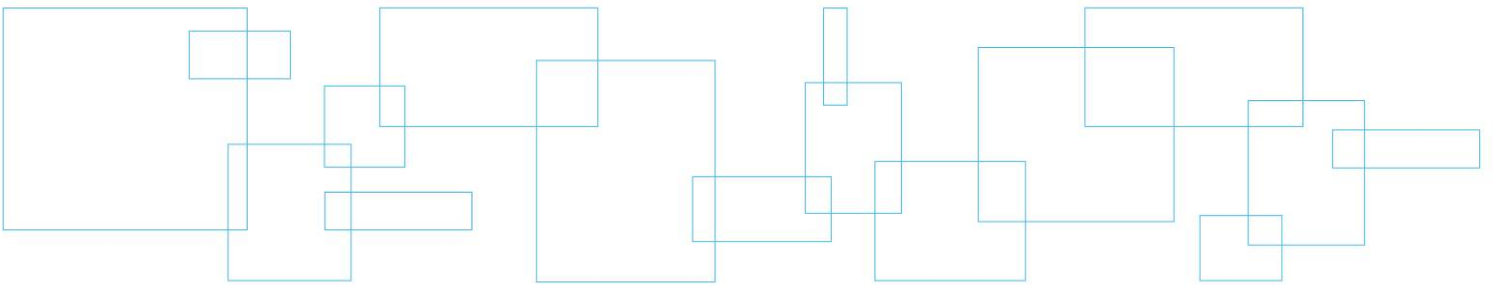
LVM | MERLEX

AP 1.	10+145.3	17.7 Rt C/L	AP 8.	10+203	12.9 Lt C/L
0	- 3.1		0	- 3.0	
3.1		NFP BLD	3.0	- 4.7	very dense material
			4.7	-	E/S
AP 1A.	10+145.3	18.2 Rt C/L			
0	- 4.7				
4.7		E/S			
AP 2.	10+152.5	17.5 Rt C/L			
0	- 2.7				
2.7	- 4.7	very dense material			
4.7	-	E/S			
AP 3.	10+159	17.0 Rt C/L			
0	- 2.0				
2.0		NFP BLD			
AP 3A.	10+159.7	17.5 Rt C/L			
0	- 4.7				
4.7		E/S			
AP 4.	10+166.9	16.6 Rt C/L			
0	- 2.7				
2.7	- 4.7	very dense material			
4.7	-	E/S			
AP 5.	10+181.3	15.4 Lt C/L			
0	- 2.7				
2.7	- 4.7	very dense material			
4.7	-	E/S			
AP 6.	10+188.5	14.7 Lt C/L			
0	- 3.0				
3.0	- 4.7	very dense material			
4.7	-	E/S			
AP 7.	10+195.6	13.8 Lt C/L			
0	- 2.2				
2.2	-	NFP BLD			
AP 7A.	10+195.6	14.3 Lt C/L			
0	- 4.7				
4.7	-	E/S			

Appendix C

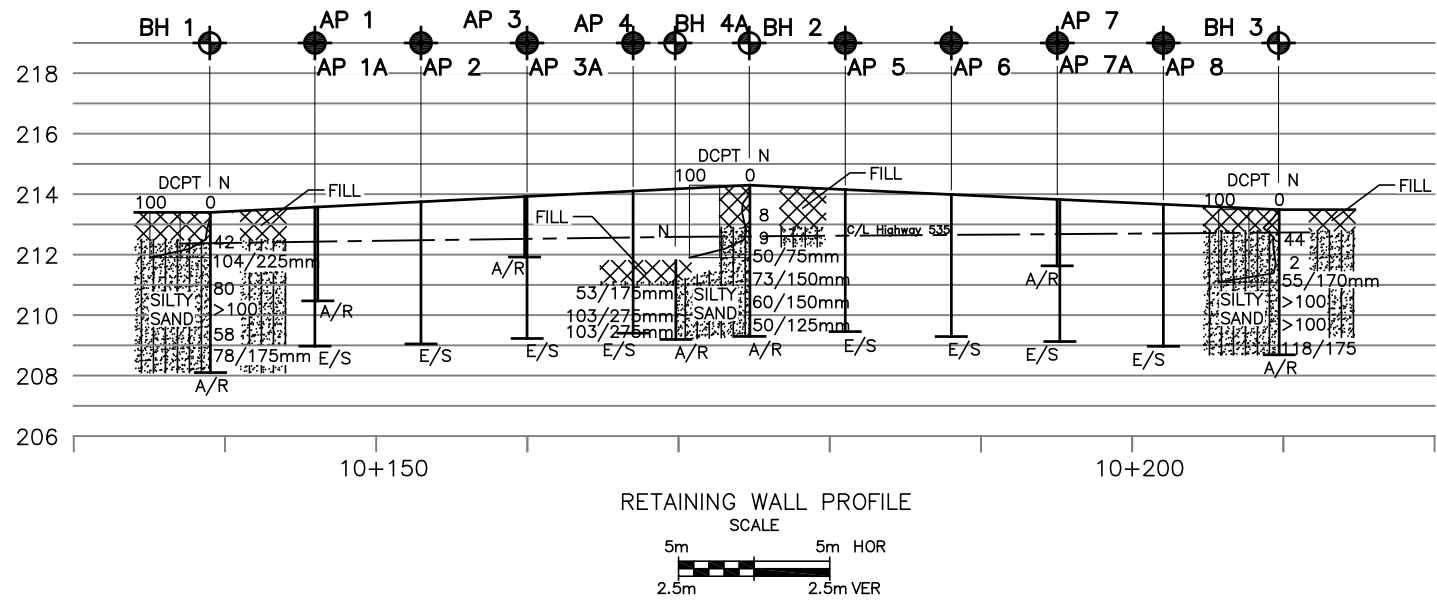
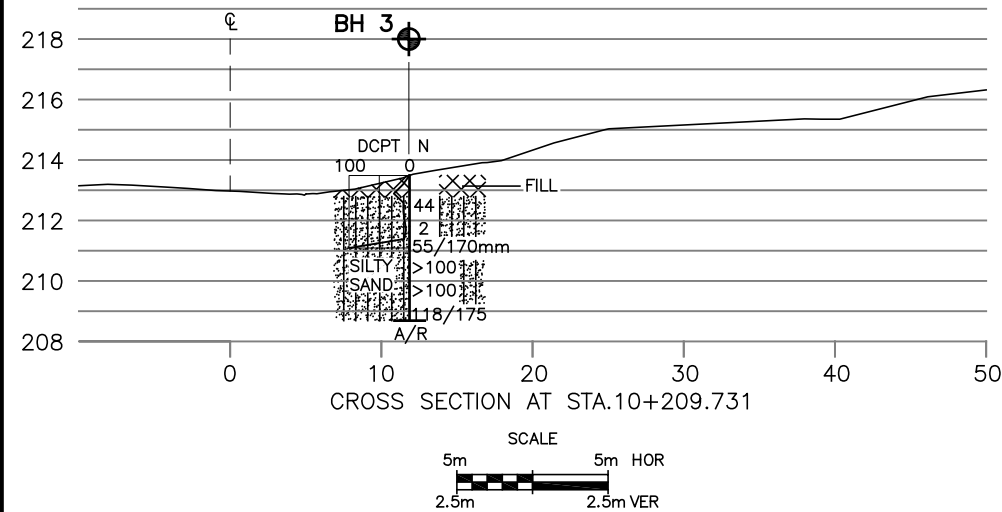
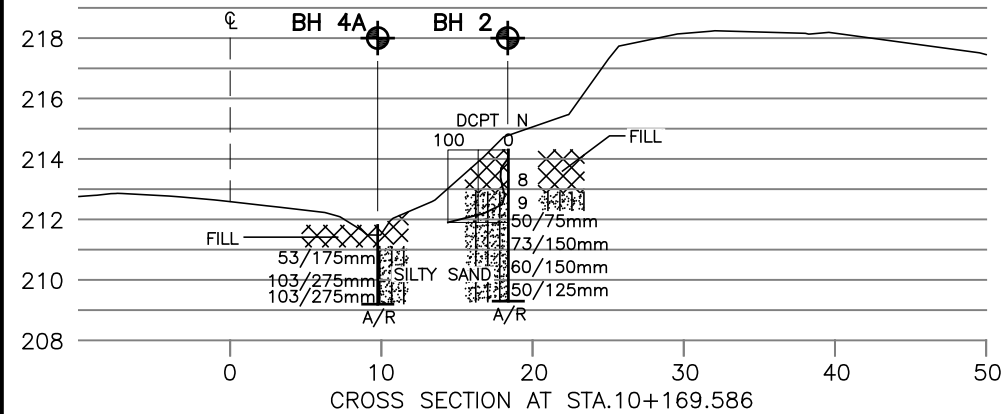
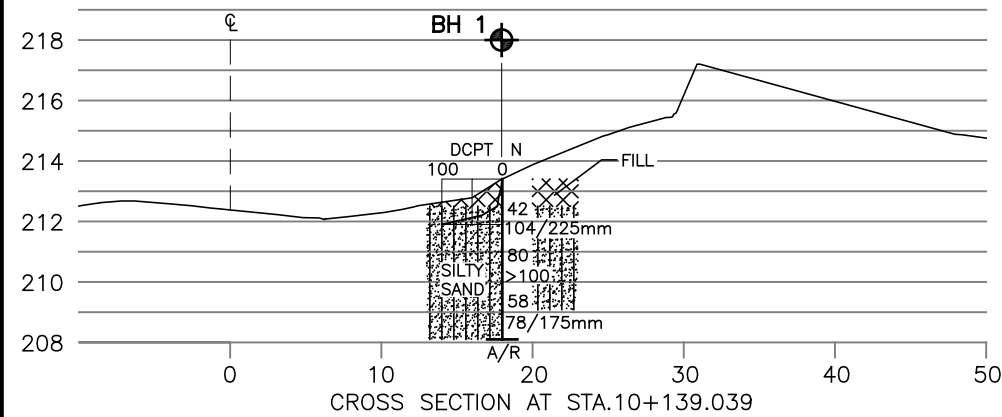
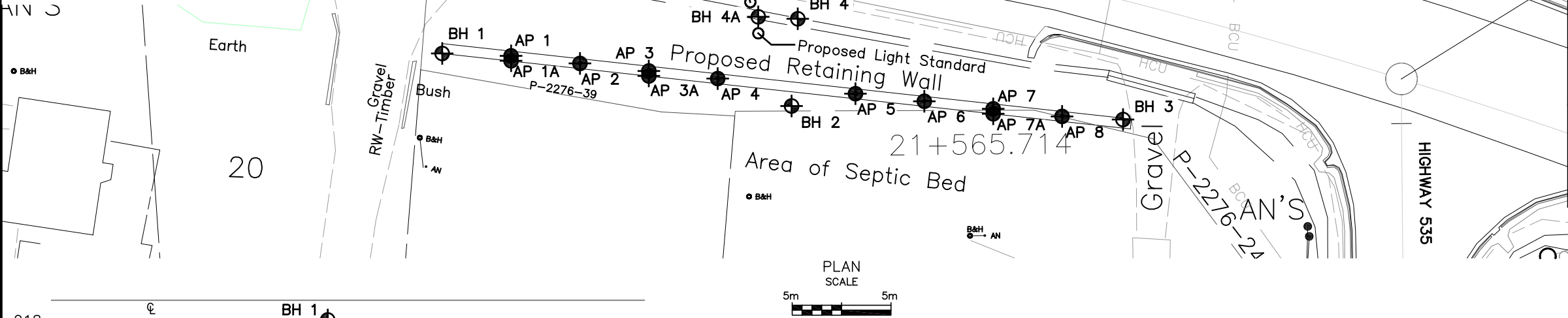
Borehole Location Plan Labwork

Figure No. 2: Borehole Location and Soil Strata
Figure No. L-1 to L-3: Grain Size Analysis Graph

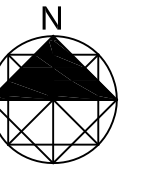


METRIC

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



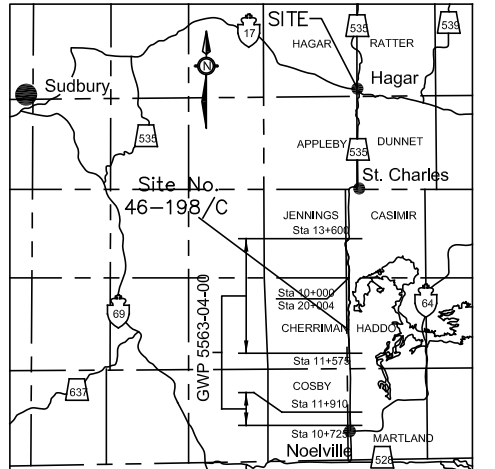
GWP No 5563-04-01
WP No 6257-11-01
GEOCRES No 411-284



HWY NO. 535 – Township of Hagar
Retaining Wall
Intersection of Highway 17 & 535
BOREHOLE LOCATIONS & SOIL STRATA

Figure
2

LIVIM | MERLEX



KEY PLAN – NOT TO SCALE

LEGEND

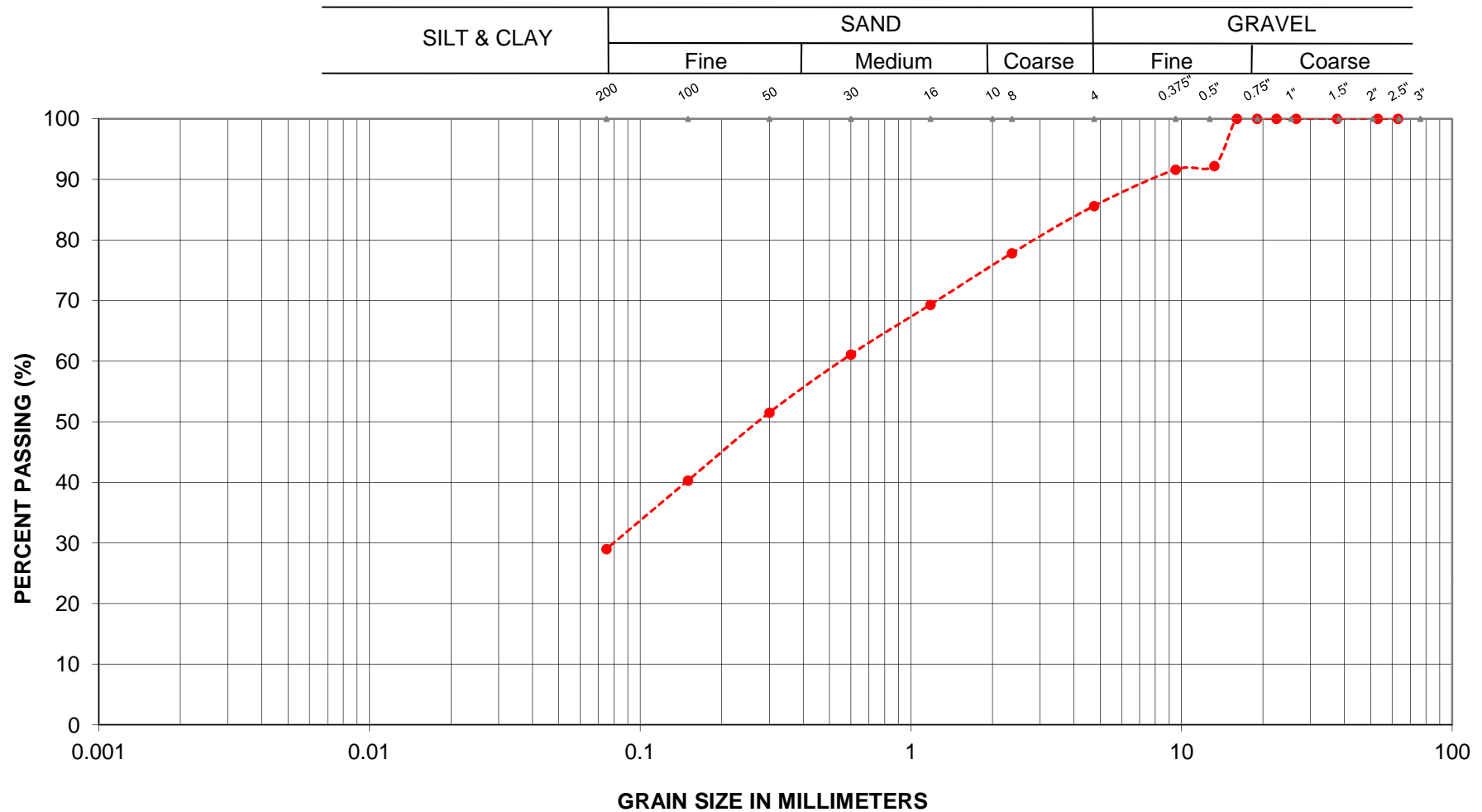
- Auger Probe
- Borehole and DCPT
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- DCPT Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling

Borehole No.	Elev.	O/S	Station	Co-ordinates	
				Northerly	Easterly
Borehole No. 1	213.4	17.9m Rt	10+139	5146299.5	349545.6
Borehole No. 2	213.3	18.3m Rt	10+175	5146294.2	349581.0
Borehole No. 3	213.5	11.8m Lt	10+210	5146292.9	349619.2
Borehole No. 4	211.3	9.1m Lt	10+170	5146303.1	349581.6
Borehole No. 4b	211.8	9.8m Lt	10+166	5146303.3	349577.6

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 purposes only.

REVISIONS	DATE	BY	DESCRIPTION
	May 2012	MCM	Revisions
HWY No. 17/535 – Appleby Twp – Retaining Wall			REF: 11046
SUBM'D			SITE
DRAWN RG			FIG 2

GRAIN SIZE ANALYSIS



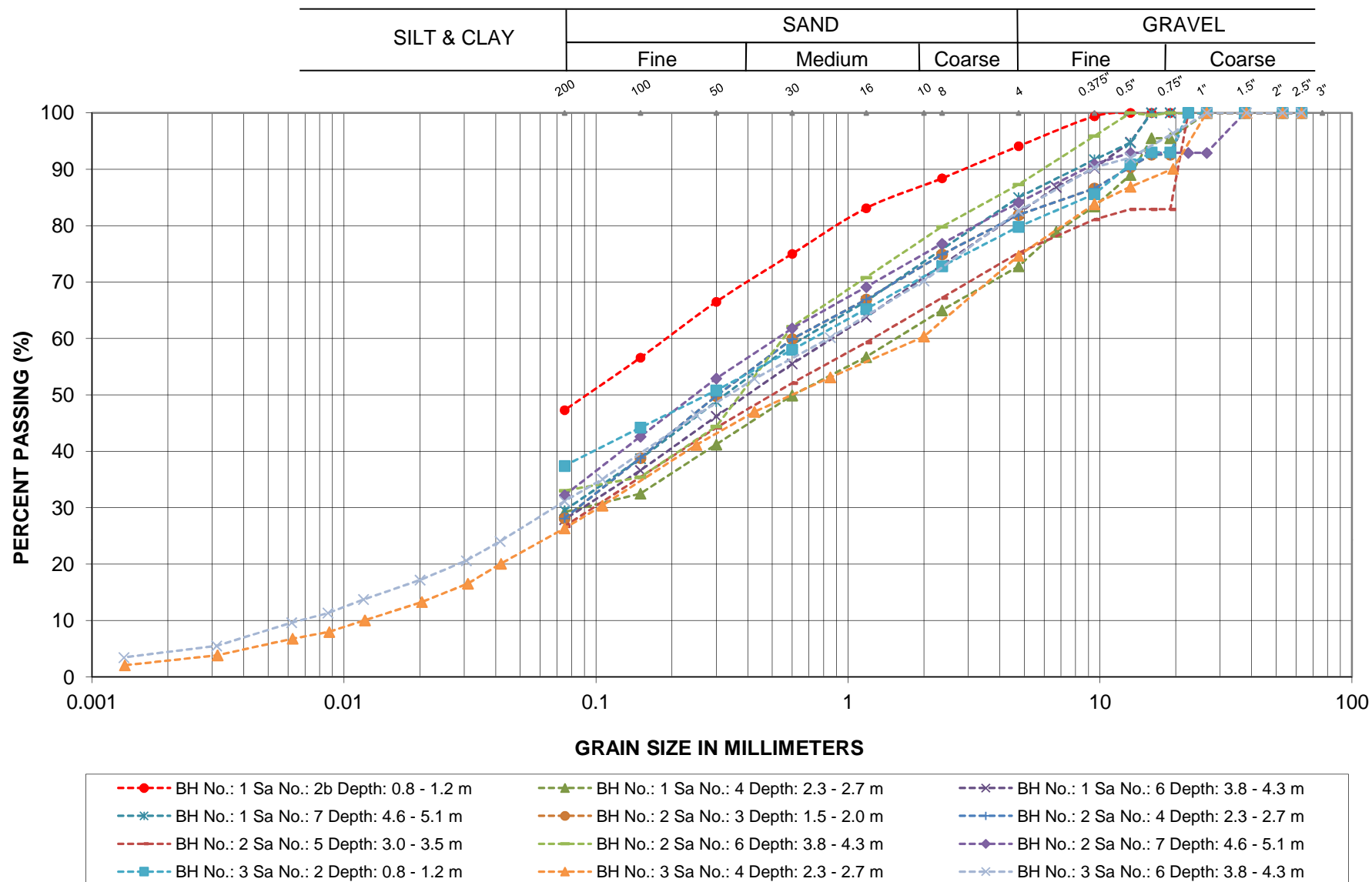
---●--- BH No.: 2 Sa No.: 2 Depth: 0.8 - 1.2 m

G.W.P.: 5563-04-00
LOCATION: Hwy 535

FILL

LVM | MERLEX

FIGURE L-1

GRAIN SIZE ANALYSIS

G.W.P.: 5563-04-00

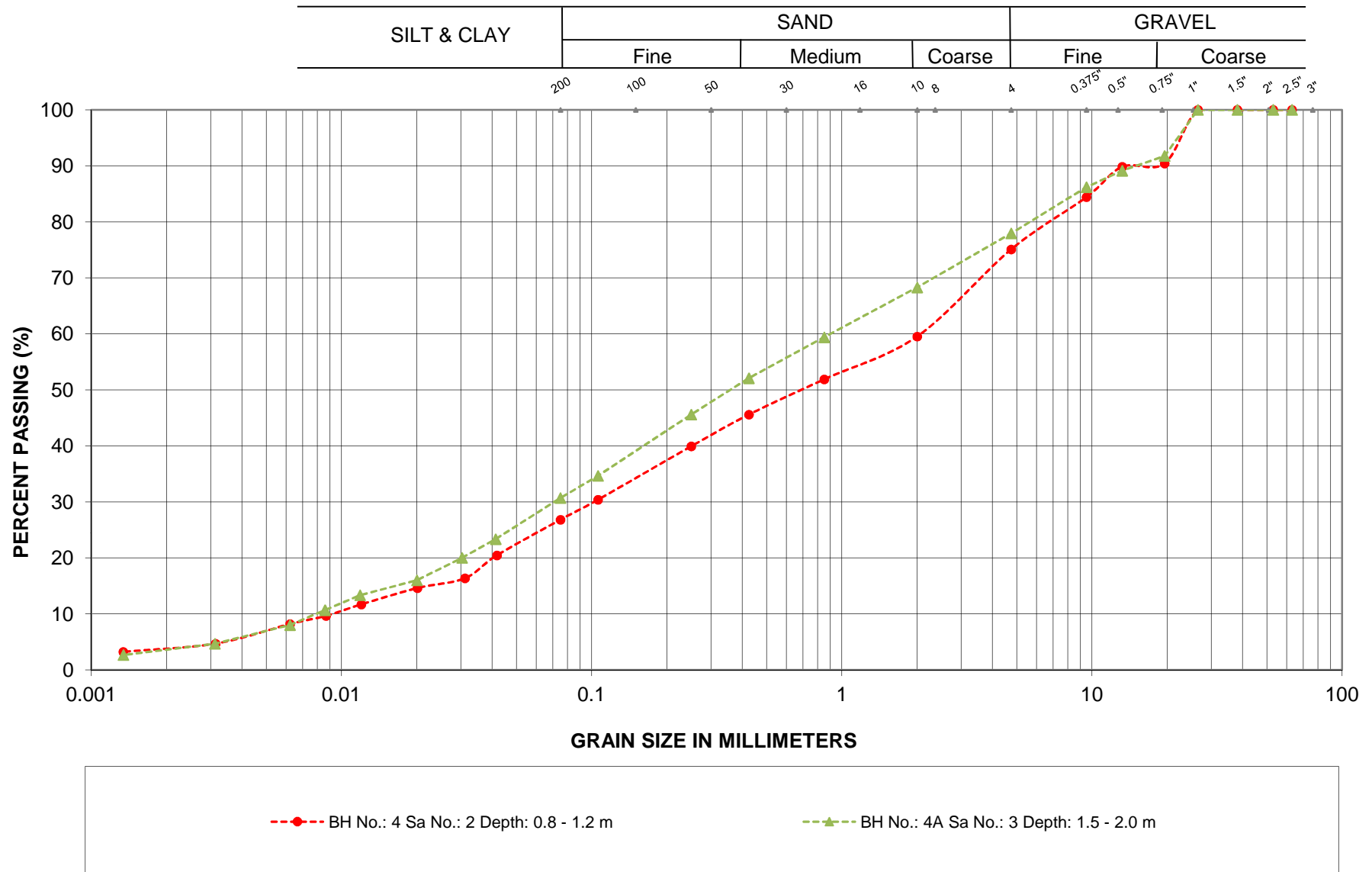
LOCATION: Hwy 535

SILTY SAND

LVM | MERLEX

FIGURE L-2

GRAIN SIZE ANALYSIS



G.W.P.: 5563-04-00
LOCATION: Hwy 535

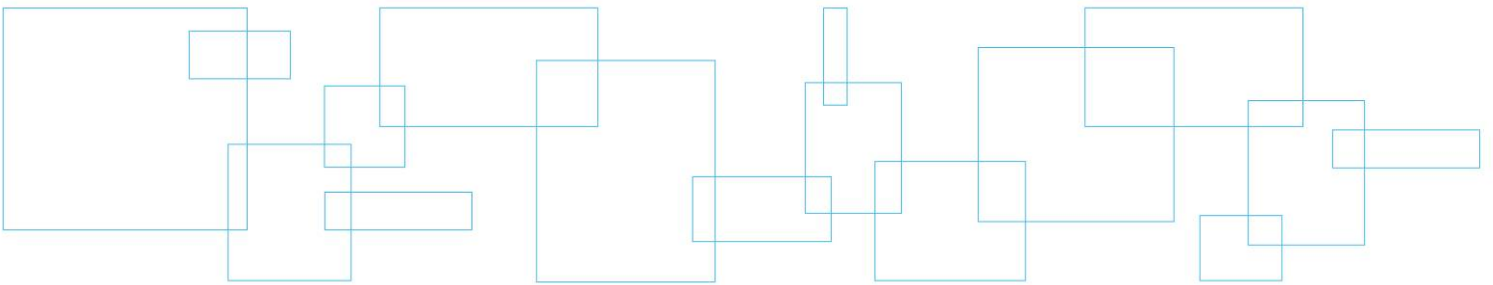
SILTY SAND

LVM | MERLEX

FIGURE L-3

Appendix D Photo Essay

Enclosure No. 8: Photo Essay



Top: Existing slope, and light pole location, looking west
Bottom: Existing slope, looking east

Photo: 1 - 2



Reference Number: 11/04/11046-F10

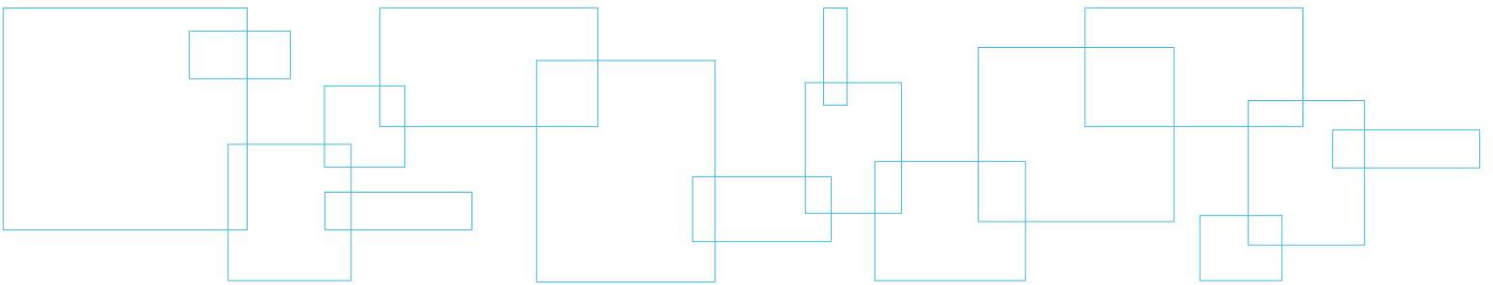
Project: Hwy 535 – Retaining Wall

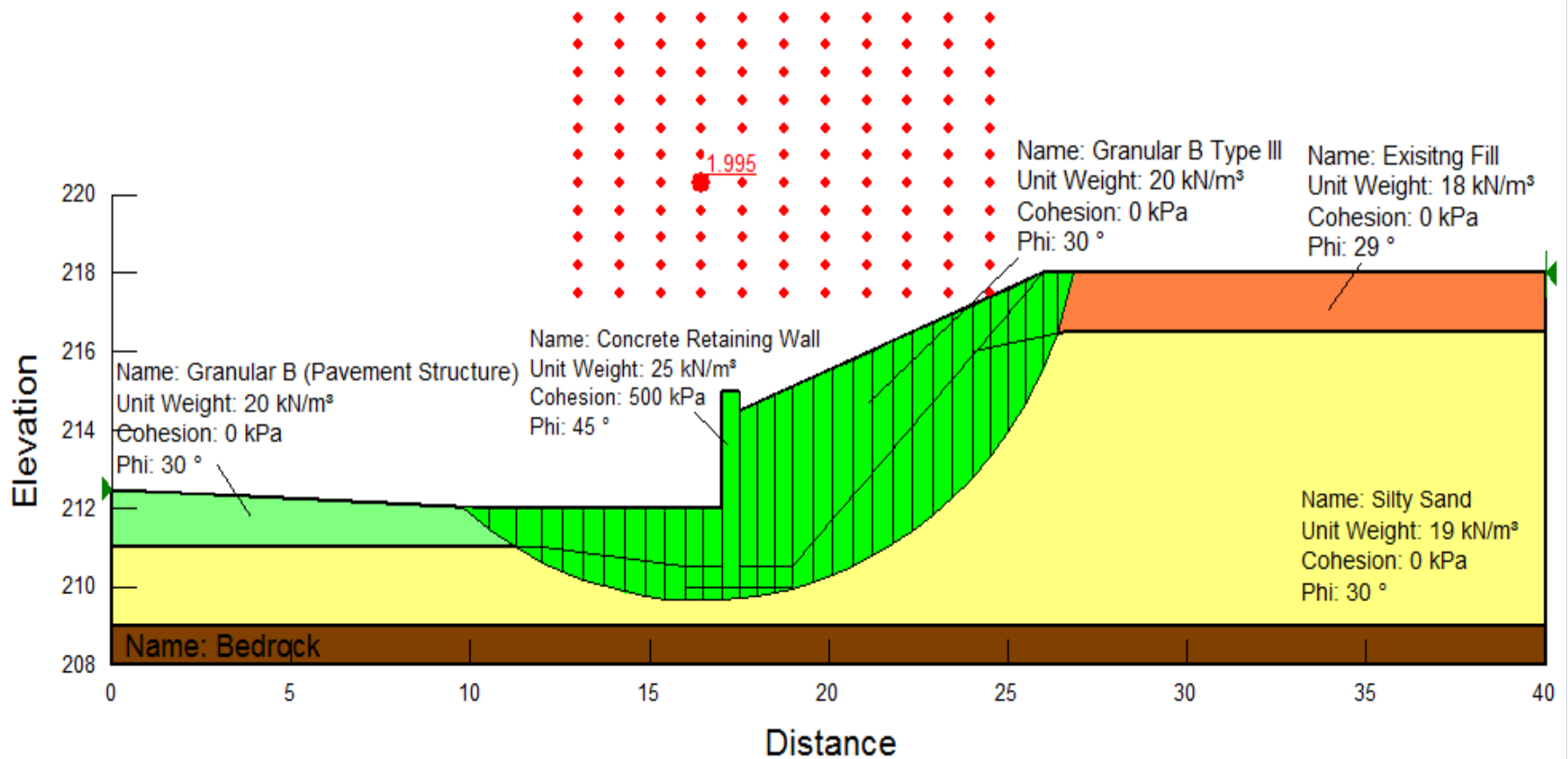
Provided By: LVM | MERLEX

Date: November 2011

Appendix E Design Data

Figure No. S-1: Slope Stability





Stability Analysis
Station 10+170
TWP of Hagar