

**FOUNDATION INVESTIGATION REPORT
HIGH EMBANKMENTS
SCHEEL DRIVE UNDERPASS APPROACHES
WBL MAINLINE SECTION AND
CAMPBELL DRIVE INTERCHANGE
HIGHWAY 17 – 417 FOUR LANING
NEAR ARNPRIOR, ONTARIO
G.W.P. 4067-03-00**

GEOCRES Number: 31F-163

Report to

McCormick Rankin Corporation

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

March 19, 2008
File: 19-1351-125

TABLE OF CONTENTS

PART 1: FACTUAL INFORMATION

| | | |
|-------|---|----|
| 1 | INTRODUCTION | 1 |
| 2 | SITE DESCRIPTION | 2 |
| 3 | SITE INVESTIGATION AND FIELD TESTING | 3 |
| 4 | LABORATORY TESTING | 5 |
| 5 | DESCRIPTION OF SUBSURFACE CONDITIONS | 5 |
| 5.1 | General | 5 |
| 5.2 | Scheel Drive Underpass Approaches | 5 |
| 5.2.1 | Asphalt | 6 |
| 5.2.2 | Topsoil | 6 |
| 5.2.3 | Existing Fill | 6 |
| 5.2.4 | Silty Clay | 7 |
| 5.2.5 | Sand, Silty Sand to Sandy Silt | 8 |
| 5.2.6 | Bedrock | 8 |
| 5.2.7 | Groundwater | 9 |
| 5.3 | Mainline Stations 24+370 to 24+470 (Future Highway 417 WBL) | 10 |
| 5.3.1 | Topsoil and Organics | 11 |
| 5.3.2 | Silty Clay | 11 |
| 5.3.3 | Silty Sand | 13 |
| 5.3.4 | Bedrock | 13 |
| 5.3.5 | Groundwater | 13 |
| 5.4 | Campbell Drive Interchange (Campbell Drive Underpass Approaches, W-N/S Ramp, E-N/S Ramp, N-E Ramp and S-W Ramp) | 14 |
| 5.4.1 | Asphalt | 14 |
| 5.4.2 | Topsoil | 14 |
| 5.4.3 | Existing Fill | 14 |
| 5.4.4 | Silty Clay | 15 |
| 5.4.5 | Silty Sand to Sand Till | 16 |
| 5.4.6 | Bedrock | 17 |
| 5.4.7 | Groundwater | 18 |
| 6 | MISCELLANEOUS | 19 |



Appendices

- Appendix A Scheel Drive Underpass Approaches
 Records of Boreholes, Laboratory Test Results, Drawings
- Appendix B Mainline Stations 24+370 to 24+470 (Highway 417 WBL)
 Records of Boreholes, Laboratory Test Results, Drawings
- Appendix C Campbell Drive Interchange Approaches and Ramps
 Records of Boreholes, Laboratory Test Results, Drawings



**FOUNDATION INVESTIGATION REPORT
HIGH EMBANKMENTS
SCHEEL DRIVE UNDERPASS
WBL MAINLINE SECTION AND
CAMPBELL DRIVE INTERCHANGE
HIGHWAY 17 – 417 FOUR LANING
NEAR ARNPRIOR, ONTARIO
G.W.P. 4067-03-00**

GEOCRES Number: 31F-163

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the high embankment locations at the proposed Scheel Drive Underpass approaches, Campbell Drive Interchange approaches and ramps, and along a section of the proposed WBL Highway 17-417 mainline. This report addresses all identified high embankments of 4.5 m or greater in height, beyond the 20 m zone immediately behind the bridge abutments. Foundation information applicable to the 20m zone are contained in References 1 and 2 noted below.

The purpose of the investigation was to explore the subsurface conditions at the sites and, based on the data obtained, to provide borehole location plans and soil strata drawings, stratigraphic profiles and selected cross-sections, records of boreholes, laboratory test results and a generalized description of the subsurface conditions.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to McCormick Rankin Corporation (MRC), under the Ministry of Transportation Ontario (MTO) Agreement Number 4006-E-0003.

Reference is made to the following documents during the preparation of this report.

- Thurber Engineering Ltd. report titled "Foundation Investigation and Design Report, Scheel Drive Underpass, Highway 17 Twinning, Arnprior to Renfrew, Ontario", G.W.P. 647-92-00, Site No. 29-414, GEOCRES No. 31F-126, File No. 19-3745-0, August 27, 2004 (Reference 1).
- Thurber Engineering Ltd. report titled "Foundation Investigation and Design Report, Campbell Drive Underpass, Highway 17 Twinning, Arnprior to Renfrew, Ontario", G.W.P. 647-92-00,



Site No. 29-415, GEOCREs No. 31F-129, File No. 19-3745-0, September 20, 2004 (Reference 2).

2 SITE DESCRIPTION

All three sites are located in the Township of McNab, County of Renfrew, Ontario. The general site locations are shown on the Borehole Locations and Soil Strata drawings in Appendices A, B and C.

Scheel Drive Underpass Approaches

The site is located just west of the existing intersection between Highway 17 and Scheel Drive (approximate Mainline Station 22+000).

The site is situated in an area of relatively flat terrain characterized by shallow bedrock underlying glacio-lacustrine clays and sandy silt to sand. All four quadrants of the intersection are moderately vegetated with trees and shrubs of various sizes. Local drainage in the area is likely governed by the nearby Dochart Creek, which flows in a southwest-northeast orientation and crosses under the existing Highway 17 at a location some 600 m west of the intersection.

Mainline Stations 24+370 to 24+470 (Future Highway 417 WBL)

The site is located to the west of the existing intersection of Highway 17 and Campbell Drive, approximate mainline Stations 24+370 to 24+470 of the future Highway 417 WBL. The centreline of the future WBL is parallel to and offset about 56m to the north of the existing Highway 17 centreline.

The site is a wet area (surficial ponded water) located just west of a stockpile of rock fill situated within the WBL embankment footprint. The area between the site and the existing highway is moderately vegetated with trees, shrubs and grass. Local surficial drainage appears poor as there is continual presence of ponded water within the site area.

Campbell Drive Interchange

The site area surrounds the existing at-grade intersection of Highway 17 and Campbell Drive (approximate mainline Station 25+950). This location is to the west of the Town of Arnprior.

The terrain at the site is generally flat with open fields on both sides of the existing highway. The land is lightly vegetated with grass, shrubs, and small patches of deciduous and coniferous trees.

General Geology

In general, the three project areas are located within a physiographic region known as the Ottawa Valley Clay Plains. This area is located between the Laurentian upland to the north and west, and the Ottawa lowland to the south and east. Native soil deposits typically consist of glacio-lacustrine clayey silts to silty clays that were deposited when the Champlain Sea inundated the Ottawa – St.



Lawrence lowland. In Renfrew County, there are prominent east-west trending scarps (fault zones), including a major depression geologically known as the “Ottawa-Bonnechere” graben. Bedrock in the site area consists of crystalline limestone of the Ordovician Period that had been subjected to faulting, weathering and erosion.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period of September 4 to 7 and on June 12, 2007, and consisted of drilling and sampling 6 boreholes (07-S01 to 07-S06) at the future Scheel Drive Underpass approaches, 3 boreholes (07-M01 to 07-M03) in the wet section on the WBL mainline, and 19 boreholes (07-C01 to 07-C19) at the Campbell Drive Interchange, for a total of 28 boreholes. The depths of the boreholes ranged from approximately 0.15 m (bedrock at surface) to 6.9 m depths below existing ground surface. All boreholes were advanced to refusal on probable bedrock or boulders. In the vicinities of the proposed bridge approaches at Scheel and Campbell, selected boreholes drilled for the structures (References 1 and 2) are also included as appropriate. A total of 13 shallow pits/holes were put down at locations offset from the WBL centreline to investigate the extent of surficial organic deposits within the wet area. The approximate locations of the boreholes and shallow pits/holes are shown on the Borehole Locations and Soil Strata Drawings in Appendices A to C.

Prior to the start of drilling, the borehole locations were staked in the field and utility clearances were obtained. Minor relocation from the staked/marked locations was necessary at some locations.

Track and truck mounted drill rigs were used to drill and sample the boreholes. The sampled boreholes were advanced by a combination of continuous flight hollow stem and solid stem augers. Soil samples were obtained at selected intervals using a 50 mm outside diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). Thin walled Shelby tubes of 73 mm inside diameter were used to retrieve relatively undisturbed cohesive samples where appropriate. Field vane shear testing using a MTO standard ‘N’ size vane was carried out at selected locations within the cohesive deposits. The shallow pits/holes were manually advanced using a 13 mm diameter hand auger.

Groundwater conditions were observed in the open boreholes throughout the drilling operations and upon completion. Standpipe piezometers were installed in selected boreholes to allow longer term monitoring of the groundwater level. The completion details of all boreholes, including the piezometer installations, are presented in Table 3.1 below.



Table 3.1 – Borehole Completion Details

| Borehole Location | Borehole Depth | Piezometer Tip Depth / Elevation (m) | Completion Details |
|--------------------------|-----------------------|---|---|
| 07-M01 | 4.2 | 4.2 / 117.4 | Sand from 4.2 to 2.1 m, bentonite to 0.3 m, then cuttings to surface |
| 07-M02 | 1.4 | None Installed | Drill cuttings for full depth |
| 07-M03 | 0.9 | None Installed | Drill cuttings for full depth |
| 07-S01 | 6.9 | 6.8 / 113.7 | Sand from 6.8 to 4.8 m, bentonite to 0.3 m, sand from 0.3 to 0.15 m, then cold patch asphalt to surface |
| 07-S02 | 3.0 | None Installed | Drill cuttings to 0.1 m, then cold patch asphalt to surface |
| 07-S03 | 3.0 | None Installed | Drill cuttings for full depth |
| 07-S04 | 2.7 | 2.7 / 122.2 | Sand from 2.7 to 0.9 m, bentonite to 0.3 m, sand from 0.3 to surface |
| 07-S05 | 1.5 | None Installed | Drill cuttings for full depth |
| 07-S06 | 1.1 | None Installed | Drill cuttings for full depth |
| 07-C01 | 3.0 | None Installed | Drill cuttings to 0.1 m, then cold patch asphalt to surface |
| 07-C02 | 2.2 | 2.2 / 111.2 | Sand from 2.2 to 0.4 m, then cold patch asphalt to surface |
| 07-C03 | 5.0 | 5.0 / 109.0 | Sand from 5.0 to 3.0 m, then bentonite to surface |
| 07-C04 | 1.9 | None Installed | Drill cuttings for full depth |
| 07-C05 | 2.6 | None Installed | Drill cuttings for full depth |
| 07-C06 | 4.5 | None Installed | Bentonite to 0.9 m, then drill cuttings to surface |
| 07-C07 | 1.8 | None Installed | Drill cuttings for full depth |
| 07-C08 | 3.7 | None Installed | Bentonite to 0.9 m, then drill cuttings to surface |
| 07-C09 | 3.0 | None Installed | Drill cuttings for full depth |
| 07-C10 | 3.1 | None Installed | Drill cuttings for full depth |
| 07-C11 | 5.2 | None Installed | Bentonite to 0.9 m, then drill cuttings to surface |
| 07-C12 | 6.7 | None Installed | Bentonite to 0.6 m, then drill cuttings to surface |
| 07-C13 | 4.1 | 4.1 / 109.7 | Sand from 4.1 to 2.3 m, then bentonite to surface |
| 07-C14 | 0.9 | None Installed | Drill cuttings for full depth |
| 07-C15 | 2.7 | None Installed | Drill cuttings to 0.1 m, then cold patch asphalt to surface |
| 07-C16 | 0.6 | None Installed | Drill cuttings for full depth |
| 07-C17 | 0.1 | None Installed | Drill cuttings for full depth |



| | | | |
|--------|-----|----------------|--|
| 07-C18 | 2.0 | None Installed | Drill cuttings for full depth |
| 07-C19 | 1.1 | None Installed | Drill cuttings to 0.1 m, then cold patch asphalt to surface |

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the soil samples in labelled and sealed containers which were then transported to Thurber's laboratory for further examination and testing.

4 LABORATORY TESTING

The recovered soil samples were subjected to visual identification and to natural moisture content determination. At least 25% of soil samples were subjected to grain size distribution analysis and Atterberg limits tests where appropriate. The results of this testing are shown on the Record of Borehole sheets and the figures in Appendices A to C. One laboratory oedometer (consolidation) test was carried out on a specimen obtained from a relatively undisturbed, cohesive Shelby tube sample from the swampy area on the future WBL mainline. The results of this testing program are reported on the accompanying figures in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Details of the encountered stratigraphy are presented on the Records of Boreholes, and on the "Borehole Locations and Soil Strata" drawings in Appendices A to C. Summarized descriptions of the stratigraphy at each site are given in the following paragraphs. The factual information at the borehole locations governs any interpretation of site conditions.

For the purpose of reporting, the high embankment areas covered in this report are grouped into several sections as follows:

- Scheel Drive Underpass Approaches
- Mainline Stations 24+370 to 24+470 (Future Highway 417 WBL)
- Campbell Drive Interchange (including Campbell Drive Underpass approaches, W-N/S Ramp, E-N/S Ramp, N-E Ramp and S-W Ramp).

5.2 Scheel Drive Underpass Approaches

Boreholes 07-S01 to 07-S06 were drilled within the footprints of the future approaches. In general, the subsurface conditions in the vicinity of the future Scheel Drive Underpass consist of surficial fill overlying a deposit of silty clay and layers of sand, silty sand to sandy silt.



The site is underlain by limestone bedrock. The groundwater level is either below the top of bedrock, or associated with the sands and silts.

5.2.1 Asphalt

Asphalt of about 25 mm in thickness was encountered on the existing road shoulder in Boreholes 07-S01 and 07-S02.

5.2.2 Topsoil

Topsoil of between 50 mm and 300 mm in thickness was encountered in previous boreholes located at the site (Reference 1). Topsoil thickness may vary between and beyond borehole locations, and this limited data should not be used for topsoil quantity estimates.

5.2.3 Existing Fill

Sand, gravelly sand to sand and gravel fill was encountered at the surface or beneath the asphalt in Boreholes 07-S01 through 07-S06. At these borehole locations, the thickness of this brown coloured fill ranged from 0.2 m to 0.8 m. The base of this road embankment fill varied between Elevations 120.0 and 121.0 m on the north side of the highway, and between Elevations 124.2 and 125.9 m on the south side. Measured SPT 'N' values ranged from 5 blows to 43 blows per 0.3 m penetration indicating loose to dense conditions. The measured moisture contents of samples of the cohesionless fill were typically in the order of 2 to 3%.

Figure A1 in Appendix A shows a grain size distribution curve of a sample of gravelly sand fill. Results of this test are presented on the Record of Borehole sheet in Appendix A and as follows:

| Soil Particles | % |
|-----------------------|----------|
| Gravel | 26 |
| Sand | 67 |
| Silt and Clay | 7 |

Silty clay fill was encountered below the cohesionless fill in Boreholes 07-S02 and 07-S04. At these borehole locations, the thickness of the fill ranged from 0.6 m to 1.4 m. The base of this cohesive fill was at about Elevation 120.5 on the north side of the highway, and at about Elevation 122.7 m on the south side.



Measured SPT 'N' values ranged from 8 blows to 15 blows per 0.3 m penetration indicating a stiff consistency. The measured moisture contents of samples of the cohesive fill were typically in the order of 24%.

5.2.4 Silty Clay

A deposit of silty clay was encountered below the fill in Borehole 07-S01, 07-S02, 07-S03 and 07-S05. This deposit was about 3.8 m thick with a base level at Elevation 116.1 m in Borehole 07-S01. The silty clay was typically brown in colour and was found extending to approximate Elevations 116.1 m to 124.2 m.

Measured SPT 'N' values generally ranged from 4 to 12 blows for 0.3 m penetration. A field vane shear value of about 72 kPa (sensitivity of 2.6) was obtained in Borehole 07-S01. These correlations indicate a typically firm to stiff consistency. The measured moisture contents of samples of the silty clay typically ranged between 30% and 42%.

Figures A2 and A3 in Appendix A show the grain size distribution curves and Atterberg Limits, respectively, of two samples of the silty clay. These test results are summarized as follows:

| Soil Particles | % |
|----------------|----------|
| Gravel | 0 |
| Sand | 1 to 6 |
| Silt | 42 to 53 |
| Clay | 41 to 57 |

| Index Property | % |
|------------------|----------|
| Liquid Limit | 49 to 54 |
| Plastic Limit | 22 to 23 |
| Plasticity Index | 27 to 31 |

The above results show that the silty clay is of medium to high plasticity with a group symbol of CI to CH.



5.2.5 Sand, Silty Sand to Sandy Silt

Layers of sand, silty sand to sandy silt were encountered immediately below the silty clay or existing fill in Boreholes 07-S01, 07-S03, 07-S04 and 07-S06. At these borehole locations, the thickness of this brown and grey layer ranged from 0.4 m to 2.6 m. The base of these layers, inferred to be at the level of auger refusal in the boreholes, ranged from Elevations 113.6 m to 125.5 m in a north to south direction.

Measured SPT 'N' values typically ranged from 4 blows to 15 blows per 0.3 m penetration indicating loose to compact conditions. An occasional 'N' value of 58 recorded in Borehole 07-S6 was due to the probable presence of bedrock, boulder or cobbles near the bottom of the sampling interval. The measured moisture contents of samples of these cohesionless soils were in the order of 10 to 15%.

Figure A4 in Appendix A shows the grain size distribution curves for two samples of the silty sand. These test results are summarized as follows:

| Soil Particles | % |
|----------------|----------|
| Gravel | 3 |
| Sand | 43 to 55 |
| Silt | 31 to 33 |
| Clay | 11 to 21 |

5.2.6 Bedrock

Based on existing subsurface information and geological records, the soils described above are underlain by crystalline limestone bedrock of the Ordovician Period. The bedrock was proven by coring in several boreholes drilled during a previous investigation (Reference 1). The bedrock surface was inferred from refusal to auger penetration in boreholes drilled during this investigation. Inferred (and proven in some previous boreholes) bedrock surface depths and elevations at the borehole locations relevant to the high embankments at this site are summarized in the following table.



**Table 5.1 – Depth and Elevation of Bedrock Surface
Scheel Drive Underpass**

| Borehole Number | Ground Surface Elevation (m) | Inferred Depth to Bedrock (m) | Inferred Top of Bedrock Elevation (m) |
|------------------------|-------------------------------------|--------------------------------------|--|
| North Approach | | | |
| 07-S01 | 120.4 | 6.9 | 113.6 |
| 07-S02 | 121.3 | 3.0 | 118.2 |
| 07-S03 | 121.6 | 3.0 | 118.5 |
| SCH-1 | 121.9 | 2.5 | 119.4 |
| SCH-2 | 121.7 | 3.2* | 118.5* |
| SCH-3 | 121.6 | 1.9 | 119.7 |
| SCH-4 | 122.0 | 2.6 | 119.4 |
| SCH-5 | 121.7 | 4.0 | 117.7 |
| SCH-6 | 121.5 | 2.6* | 118.9* |
| South Approach | | | |
| SCH-12 | 124.2 | 0.6 | 123.6 |
| SCH-13 | 125.1 | 1.3 | 123.8 |
| SCH-14 | 124.0 | 0.6* | 123.4* |
| SCH-15 | 124.7 | 1.1* | 123.6* |
| SCH-16 | 124.1 | 0.6 | 123.5 |
| SCH-17 | 124.1 | 2.2 | 121.9 |
| 07-S04 | 125.0 | 2.7 | 122.2 |
| 07-S05 | 125.7 | 1.5 | 124.2 |
| 07-S06 | 126.6 | 1.1 | 125.5 |

Notes : Rock surface inferred by auger refusal except otherwise noted.

* Rock proven by coring during previous investigation (Reference 1).

The top of bedrock varies across the site with depths below existing ground surface varying from 0.6 m to 6.9 m, or between approximate Elevations 123.8 m and 113.6 m. Based on the borehole information, it appears that the bedrock surface dips in a generally south to north direction along the proposed Scheel Drive alignment. The depth to bedrock also increases in a similar orientation.

5.2.7 Groundwater

Free water was not observed in the boreholes upon completion of drilling, except for Borehole 07-S01 (present investigation) and Borehole SCH-3 (Reference 1) where water levels at 4.6 m and 1 m depths, respectively, were observed in the open hole. A standpipe piezometer was installed in selected boreholes. Measured water levels are presented below.



| Borehole (screen location) | Date of Reading | Water Level Depth (m) | Water Level Elevation (m) |
|---------------------------------------|------------------------|----------------------------------|--------------------------------------|
| 07-S01 (silty sand/silty clay) | September 7, 2007 | 2.0 | 118.4 |
| | October 25, 2007 | 2.0 | 118.4 |
| 07-S04 (fill/silty sand) | September 7, 2007 | Dry | dry |
| | October 25, 2007 | found destroyed | found destroyed |
| Near SCH-5 (silty sand till) | September 7, 2007 | 3.0 | 118.7 |
| | October 25, 2007 | 2.5 | 119.2 |

Based on these water level readings, borehole records and general site observations, the groundwater level is anticipated to be at approximate Elevation 118.5 m to the north of the highway, and below the top of bedrock on the south side.

5.3 Mainline Stations 24+370 to 24+470 (Future Highway 417 WBL)

Boreholes 07-M01 to 07-M03 were drilled within the footprints of the future embankments. In general, the subsurface conditions in this site area consist of topsoil overlying a deposit of silty clay which is occasionally underlain by silty sand. The overburden is underlain by inferred bedrock. The groundwater appears to be associated with the silty sand. A pile of rock fill exists immediately to the north of the section under investigation.

Surface ponded water was present from approximate Stations 24+400 to 24+475 during our site visits prior to the field work. A pile of rock fill exists between approximate Stations 24+460 and 24+560. During our field work, the site was practically dry except for several low lying locations where water was ponded on the underlying silty clay. Several manually excavated holes/pits were advanced in this area to determine the extent of topsoil/organics. Results of these holes/pits are summarized in the following table.

| Location | Stratigraphy |
|--------------------|--|
| 24+460 o/s 5 m Rt | 75 mm Topsoil |
| | 75 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+460 o/s 10 m Rt | 75 mm Topsoil |
| | 75 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+460 o/s 15 m Rt | 60 mm Topsoil |
| | 90 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+460 o/s 20 m Rt | 75 mm Topsoil |
| 24+450 o/s 8 m Rt | 60 mm Topsoil |
| | 65 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+450 o/s 15 m Rt | 60 mm Topsoil |
| | 65 mm Silty Clay, trace to some sand, trace gravel, grey |



| | |
|----------------------|---|
| 24+450 o/s 22 m Rt | 60 mm Topsoil 65 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+437.5 o/s 5 m Rt | 50 mm Topsoil 50 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+437.5 o/s 12 m Rt | 75 mm Topsoil 75 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+437.5 o/s 17 m Rt | 90 mm Topsoil 90 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+437.5 o/s 23 m Rt | 90 mm Topsoil 90 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+425 o/s 10 m Rt | 60 mm Topsoil 60 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+425 o/s 15 m Rt | 60 mm Topsoil 60 mm Silty Clay, trace to some sand, trace gravel, grey |
| 24+460 o/s 20 m Rt | 125 mm Organics Silty Clay |

5.3.1 Topsoil and Organics

Surficial topsoil ranging between 75 and 125 mm was encountered in Boreholes 07-M01, 07-M02 and the shallow holes/pits. Organics up to 125 mm in thickness was present in one of the shallow holes/pits. Topsoil and organics thicknesses may vary between and beyond the borehole locations, and this limited data should not be used for topsoil/organics quantity estimates.

5.3.2 Silty Clay

A deposit of silty clay was encountered below the topsoil or at ground surface in Boreholes 07-M01, 07-M02 and 07-M03. This deposit was about 0.9 m to 1.3 thick in Boreholes 07-M02 and 07-M03, increasing to 3.9 m in Borehole 07-M01. The base level of this deposit ranged between Elevations 120.1 m and 120.4 m at Boreholes 07-M02 and 07-M03, lowering to Elevation 117.7 m at Borehole 07-M01. The silty clay was typically brown in colour, becoming grey below the groundwater level.

Measured SPT 'N' values generally decreased from 9 to 4 blows for 0.3 m penetration with depth. These correlations indicate a typically firm to stiff consistency within the upper, brown zone (crust), becoming firm within the lower, grey zone. The measured moisture contents of samples of the silty clay increased from about 32% to 58% with depth.

Figures B1 and B2 in Appendix B show the grain size distribution curves and Atterberg Limits, respectively, of three samples of the silty clay. These test results are summarized as follows:



| Soil Particles | % |
|----------------|----------|
| Gravel | 0 |
| Sand | 1 to 5 |
| Silt | 47 to 60 |
| Clay | 39 to 51 |

| Index Property | % |
|------------------|----------|
| Liquid Limit | 46 to 54 |
| Plastic Limit | 21 to 26 |
| Plasticity Index | 25 to 31 |

The above results show that the silty clay is of medium to high plasticity with a group symbol of CI to CH.

One laboratory consolidation (oedometer) test was carried out on an undisturbed specimen prepared from a Shelby tube sample obtained in Borehole 07-M01. Inferred parameters from the test are summarized in the following table.

| Borehole and Sample Number | Existing Overburden Pressure p'_0 (kPa) | Pre-consolidation Pressure p'_c (kPa) | Compression Index $C_c/(1 + e_0)$ | Recompression Index $C_r/(1 + e_0)$ | Initial Void Ratio, e_0 | Over-consolidation Ratio (OCR) |
|----------------------------|---|---|-----------------------------------|-------------------------------------|---------------------------|--------------------------------|
| 07-M01 TW1 | 52 | 220 | 0.35 | 0.024 | 1.63 | 4.2 |

The coefficient of consolidation, C_v , value (vertical drainage) for this over-consolidated sample is estimated to be in the order of $40 \text{ m}^2/\text{yr}$, within the range of stresses anticipated to be acting on the foundation soils.

A specific gravity value of 2.75 was measured for the tested specimen. This value corresponds to a unit weight of approximately 17 kN/m^3 .

Detailed results of this oedometer test are included in Appendix B.



5.3.3 Silty Sand

Silty sand was found underlying the silty clay deposit in Borehole 07-M01. This soil contains trace gravel and trace clay. Only about 0.2 m of this soil was contacted before auger refusal was met.

5.3.4 Bedrock

The soils described above are underlain by bedrock inferred by auger refusal. Inferred bedrock surface depths and elevations at the borehole locations are summarized in the following table.

Table 5.3 – Depth and Elevation of Bedrock Surface

| Borehole Number | Ground Surface Elevation (m) | Inferred Depth to Bedrock (m) | Inferred Top of Bedrock Elevation (m) |
|---|-------------------------------------|--------------------------------------|--|
| Mainline Stations 24+370 to 24+470 | | | |
| 07-M1 | 121.7 | 4.2 | 117.4 |
| 07-M2 | 121.8 | 1.4 | 120.4 |
| 07-M3 | 121.0 | 0.9 | 120.1 |

The top of bedrock appears to be relatively flat at shallow depths of 0.9 m to 1.4 m below ground surface, or above Elevation 120 m, between approximate Stations 24+400 and 24+470 (west of the existing rock fill). Between approximate Stations 24+370 and 24+400, the bedrock dips to below Elevation 118 m and the surface topography rises towards the west.

5.3.5 Groundwater

Boreholes 07-M2 and 07-M3 were noted to be dry upon completion of drilling. A standpipe piezometer was installed in Borehole 07-M1 and the measured water level is presented below.

| Borehole (screen location) | Date of Reading | Water Level Depth (m) | Water Level Elevation (m) |
|-----------------------------------|------------------------|------------------------------|----------------------------------|
| 07-M01 (silty clay) | September 7, 2007 | 3.3 | 118.4 |

Based on this information and general site observations, the ponded surface water in this area results from accumulation of surface precipitation in a localized depression. The



groundwater level (as measured in Borehole 07-M1) is likely associated with the silty sand and/or the underlying inferred bedrock. All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

5.4 Campbell Drive Interchange (Campbell Drive Underpass Approaches, W-N/S Ramp, E-N/S Ramp, N-E Ramp and S-W Ramp)

Boreholes 07-C01 to 07-C19 were drilled within the footprints of the future approaches and ramps. In general, the subsurface conditions at this site consist of surficial fill overlying a deposit of silty clay and layers of sand, silty sand to sandy silt. The site is underlain by undulating bedrock. The groundwater level is largely associated with the sands and silts and the lower portion of the silty clay.

5.4.1 Asphalt

Asphalt ranging between 25 mm and 60 mm in thickness was encountered in Boreholes 07-C01, 07-C02, 07-C03, 07-C15 and 07-C19 located on the existing road embankment.

5.4.2 Topsoil

Topsoil was encountered in Boreholes 07-C4 through 07-C11, 07-C13, 07-C14 and 07-C18 with measured thicknesses ranging from 75 mm to 150 mm. Topsoil thickness may vary between and beyond the boreholes, and this limited data should not be used for topsoil/organics quantity estimates.

5.4.3 Existing Fill

Sand and gravel fill was encountered beneath the asphalt or at ground surface in Boreholes 07-C01, 07-C02, 07-C03, 07-C12, 07-C15 and 07-C19. At these borehole locations, the thickness of this brown fill varied between 0.4 m to 0.6 m. The base of this road embankment fill ranged between 0.5 m and 0.7 m, or Elevations 112.4 and 113.7 m. Measured SPT 'N' values ranged from 18 blows to 40 blows per 0.3 m penetration indicating compact to dense conditions. The measured moisture contents of samples of the cohesionless fill were typically in the order of 2 to 3%.

Figure C1 in Appendix C shows the grain size distribution of a sample of this sand and gravel fill. Results of this test are presented on the Record of Borehole sheets in Appendix A and as follows:



| Soil Particles | % |
|----------------|----|
| Gravel | 44 |
| Sand | 44 |
| Silt and Clay | 12 |

Silty clay fill was encountered below the cohesionless fill or topsoil in Boreholes 07-C02, 07-C03 and 07-C13. At these borehole locations, the fill was approximately 0.7 m thick. The base of this cohesive fill ranged between Elevations 112.0 and 113.1 m.

Measured SPT 'N' values ranged from 9 blows to 26 blows per 0.3 m penetration indicating a stiff to very stiff consistency. The measured moisture contents of samples of the cohesive fill varied from 8% to 20%.

5.4.4 Silty Clay

A deposit of silty clay was encountered below the fill in Boreholes 07-C01 through 07-C19, except at the location of Borehole 07-C17 and its immediate surroundings where bedrock was present at ground surface. This deposit ranged in thickness from 0.5 m to 6.1 m. The base of this deposit lied between 0.6 m and 6.7 m, or between Elevations 106.4 m and 113.2 m. The silty clay was typically brown in colour within the upper crust, becoming grey with depth.

Measured SPT 'N' values generally ranged between 15 to 8 blows for 0.3 m penetration with depth. These correlations indicate a typically stiff consistency within the upper, brown zone (crust). 'N' values of 16 blows or 6 to 7 blows indicate the presence of occasional very stiff or firm zones, respectively. The measured moisture contents of samples of the brown silty clay generally ranged from 15% to 39%, with occasional values between 40% and 42%.

Within the lower grey zone, measured SPT 'N' values generally ranged from 4 to 8 blows for 0.3 m penetration. Field vane shear values of 32, 36 and 60 kPa were obtained in Boreholes 07-C12 and 07-C12. These correlations indicate a typically firm consistency with occasional soft or very stiff zones. The measured moisture contents of samples of the grey silty clay typically ranged between 40% and 52%.

Figures C2 to C7 in Appendix C show the grain size distribution curves and Atterberg Limits of samples of the silty clay. These test results are summarized as follows:



| Soil Particles | % |
|----------------|----------|
| Gravel | 0 to 1 |
| Sand | 1 to 17 |
| Silt | 30 to 56 |
| Clay | 26 to 58 |

| Index Property | % |
|------------------|----------|
| Liquid Limit | 45 to 57 |
| Plastic Limit | 14 to 25 |
| Plasticity Index | 16 to 33 |

The above results show that the silty clay is typically of medium to high plasticity with a group symbol of CI to CH, except for Sample 4 in Borehole C-12 where the silty clay is of low plasticity with a group symbol of CL.

5.4.5 Silty Sand to Sand Till

Silty sand to sand till was encountered underlying the silty clay deposit in Boreholes 07-C03 through 07-C11, 07-C15 and 07-C18. Sand was encountered in Boreholes 07-C11 and 07-C18. These cohesionless soils contain trace gravel and occasional clay. At the borehole locations, the thickness of these typically grey soils ranged from 0.1 m to 1.3 m. The base of these layers, inferred to be at the level of auger refusal in the boreholes, ranged from Elevations 107.3 m to 111.9 m.

Where measured, SPT 'N' values ranged from 4 blows per 0.3 m penetration to greater than 50 blows for less than 0.3 m penetration. These layers were typically in a loose to compact state. The higher 'N' values were likely due to the probable presence of bedrock, boulder or cobbles near the bottom of the sampling interval. The measured moisture contents were in the order of 8 to 28%.

Figure C8 in Appendix C shows the grain size distribution curve for a sample of silty sand till. The test results are summarized as follows:



| Soil Particles | % |
|----------------|----|
| Gravel | 5 |
| Sand | 55 |
| Silt | 30 |
| Clay | 10 |

5.4.6 Bedrock

Based on existing subsurface information and geological records, the soils described above are underlain by crystalline limestone bedrock of the Ordovician Period. The bedrock was proven by coring in some boreholes drilled during a previous investigation (Reference 2). The bedrock surface was inferred from refusal to auger penetration in most of the boreholes drilled during this investigation. Inferred (and proven in some previous boreholes) bedrock surface depths and elevations at the borehole locations relevant to the high embankments at this site are summarized in the following table.

**Table 5.4 – Depth and Elevation of Bedrock Surface
Campbell Drive Interchange**

| Borehole Number | Ground Surface Elevation (m) | Inferred Depth to Bedrock (m) | Inferred Top of Bedrock Elevation (m) |
|---------------------------------|------------------------------|-------------------------------|---------------------------------------|
| Underpass North Approach | | | |
| 07-C01 | 112.6 | 3.0 | 109.6 |
| 07-C02 | 112.5 | 2.2 | 110.3 |
| 07-C03 | 112.8 | 5.0 | 107.8 |
| CAM1 | 113.7 | 2.0 | 111.7 |
| CAM2 | 113.3 | 2.2 | 111.1 |
| CAM3 | 113.2 | 4.8* | 108.4* |
| Underpass South Approach | | | |
| CAM6 | 114.3 | 7.6 | 106.7 |
| CAM7 | 113.2 | 4.1* | 109.1* |
| CAM8 | 113.0 | 5.9 | 107.1 |
| 07-C12 | 113.1 | 6.7 | 106.4 |
| 07-C13 | 113.9 | 4.1 | 109.7 |
| 07-C15 | 113.7 | 2.7 | 111.0 |
| 07-C19 | 114.0 | 1.1 | 112.9 |



| | | | |
|-------------------|-------|------|--------|
| E-N/S Ramp | | | |
| 07-C06 | 112.9 | 4.5 | 108.4 |
| 07-C07 | 112.8 | 1.8 | 111.0 |
| 07-C09 | 112.6 | 3.0 | 109.6 |
| 07-C11 | 112.5 | 5.2 | 107.3 |
| S-W Ramp | | | |
| 07-C04 | 113.1 | 1.9 | 111.2 |
| 07-C05 | 112.9 | 2.6 | 110.3 |
| 07-C08 | 112.8 | 3.7 | 109.1 |
| 07-C10 | 112.5 | 3.1 | 109.4 |
| CAM1 | 113.7 | 2.0 | 111.7 |
| CAM2 | 113.3 | 2.2 | 111.1 |
| W-N/S Ramp | | | |
| 07-C16 | 115.0 | 0.6 | 114.4 |
| 07-C17 | 115.9 | 0.0 | 115.9 |
| 07-C18 | 113.8 | 2.0 | 111.9 |
| N-E Ramp | | | |
| 07-C12 | 113.1 | 6.7 | 106.4 |
| 07-C14 | 113.4 | 0.9 | 112.5 |
| 07-C16 | 115.0 | 0.6 | 114.4 |
| CAM7 | 113.2 | 4.1* | 109.1* |
| CAM8 | 113.0 | 5.9 | 107.1 |

Notes : Rock surface inferred by auger refusal except otherwise noted.
 * Rock proven by coring during previous investigation (Reference 2).
 Some boreholes are repeated for completeness.

The top of bedrock undulates across the site with depths below existing ground surface varying from 0 m to 7.6 m, or between approximate Elevations 106.4 m and 115.9 m.

5.4.7 Groundwater

Free water was not observed in most of the boreholes upon completion of drilling, except for Boreholes 07-C03, 07-C06, 07-C08, 07-C09, 07-C10 and 07-C11 (present investigation) where water levels ranging from 1.8 m to 4.3 m depths were observed in the open hole. A standpipe piezometer was installed in five selected boreholes. Measured water levels in these piezometers are presented below.



| Borehole (screen location) | Date of Reading | Water Level Depth (m) | Water Level Elevation (m) |
|--|------------------------|----------------------------------|--------------------------------------|
| 07-C2 (fill/silty clay) | September 5, 2007 | Dry | dry |
| | September 7, 2007 | Dry | Dry |
| | October 25, 2007 | 2.0 | 111.5 |
| 07-C3 (silty clay /sand till) | September 5, 2007 | 4.3 | 109.7 |
| | September 7, 2007 | 2.4 | 111.6 |
| | October 25, 2007 | 2.7 | 111.3 |
| 07-C13 (silty clay) | September 7, 2007 | 2.5 | 111.4 |
| | October 25, 2007 | 2.3 | 111.6 |
| CAM3 (limestone bedrock) | October 22, 2003 | 0.1 | 113.1 |
| | December 18, 2003 | 0.1 | 113.1 |
| | February 4, 2003 | 0.3 | 112.9 |
| | October 25, 2007 | 1.3 | 111.9 |
| CAM7 (sandy silt/ limestone bedrock) | October 22, 2003 | 0.3 | 112.9 |
| | December 18, 2003 | Frozen | Frozen |
| | October 25, 2007 | 1.5 | 111.7 |

Based on these readings, borehole records and general site observations, the stabilized groundwater level is anticipated to be between approximate Elevations 111.3 m to 111.9 m at this site.

6 MISCELLANEOUS

The borehole locations were staked/marked by surveyors from J.D. Barnes Ltd., who surveyed the locations and provided Thurber with the coordinates and geodetic elevations. Thurber obtained utility clearances prior to drilling.

Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario supplied the truck and track mounted drill rigs and conducted the drilling, sampling and in-situ testing operations.

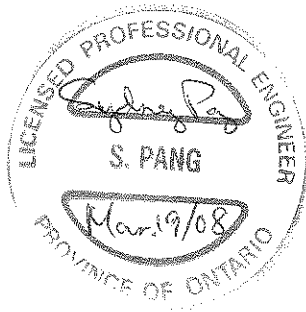
The drilling and sampling operations in the field were supervised on a full time basis by Mr. George Azzopardi of Thurber Engineering Ltd.

Laboratory testing was carried out by Thurber in its MTO-approved Oakville laboratory.

Dr. Sydney Pang, P.Eng. directed the field operations and prepared the report.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.





Engineering Analysis and Report Preparation by:
Sydney Pang, P.Eng.,
Associate, Senior Project Engineer



Alastair E. Gorman, P.Eng.,
Associate, Senior Geotechnical Engineer



Report Reviewed by:
P. K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact



High Embankments
Scheel, Campbell, WBL Mainline, Highway 17-417 Four Laning

Appendix A

**Scheel Drive Underpass Approaches
Records of Boreholes, Laboratory Test Results, Drawings**



SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

| CLASSIFICATION | PARTICLE SIZE | VISUAL IDENTIFICATION |
|----------------|--------------------|---|
| Boulders | Greater than 200mm | same |
| Cobbles | 75 to 200mm | same |
| Gravel | 4.75 to 75mm | 5 to 75mm |
| Sand | 0.075 to 4.75mm | Not visible particles to 5mm |
| Silt | 0.002 to 0.075mm | Non-plastic particles, not visible to the naked eye |
| Clay | Less than 0.002mm | Plastic particles, not visible to the naked eye |

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

| TERMINOLOGY | PROPORTION |
|---------------------------------|---------------|
| Trace or Occasional | Less than 10% |
| Some | 10 to 20% |
| Adjective (e.g. silty or sandy) | 20 to 35% |
| And (e.g. sand and gravel) | 35 to 50% |

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

| DESCRIPTIVE TERM | UNDRAINED SHEAR STRENGTH (kPa) | APPROXIMATE SPT ⁽¹⁾ 'N' VALUE |
|------------------|--------------------------------|--|
| Very Soft | 12 or less | Less than 2 |
| Soft | 12 to 25 | 2 to 4 |
| Firm | 25 to 50 | 4 to 8 |
| Stiff | 50 to 100 | 8 to 15 |
| Very Stiff | 100 to 200 | 15 to 30 |
| Hard | Greater than 200 | Greater than 30 |

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

| DESCRIPTIVE TERM | SPT "N" VALUE |
|------------------|-----------------|
| Very Loose | Less than 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | Greater than 50 |

5. LEGEND FOR RECORDS OF BOREHOLES

| SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE | SS Split Spoon Sample | WS Wash Sample | AS Auger (Grab) Sample |
|---|---|----------------|--|
| | TW Thin Wall Shelby Tube Sample | | TP Thin Wall Piston Sample |
| | PH Sampler Advanced by Hydraulic Pressure | | PM Sampler Advanced by Manual Pressure |
| | WH Sampler Advanced by Self Static Weight | | RC Rock Core |
| | | | SC Soil Core |

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level


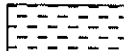



C_{pen} Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

| MAJOR DIVISIONS | | GROUP SYMBOL | TYPICAL DESCRIPTION |
|----------------------|---------------------------------|--------------|--|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | GW | Well-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GP | Poorly-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GM | Silty gravels, gravel-sand-silt mixtures. |
| | | GC | Clayey gravels, gravel-sand-clay mixtures. |
| | SAND AND SANDY SOILS | SW | Well-graded sands or gravelly sands, little or no fines. |
| | | SP | Poorly-graded sands or gravelly sands, little or no fines. |
| | | SM | Silty sands, sand-silt mixtures. |
| | | SC | Clayey sands, sand-clay mixtures. |
| FINE GRAINED SOILS | SILTS AND CLAYS $W_L < 50\%$ | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity. |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. $(W_L < 30\%)$. |
| | | CI | Inorganic clays of medium plasticity, silty clays. $(30\% < W_L < 50\%)$. |
| | | OL | Organic silts and organic silty-clays of low plasticity. |
| | SILTS AND CLAYS $W_L > 50\%$ | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. |
| | | CH | Inorganic clays of high plasticity, fat clays. |
| | | OH | Organic clays of medium to high plasticity, organic silts. |
| HIGHLY ORGANIC SOILS | | Pt | Peat and other highly organic soils. |
| CLAY SHALE | | | |
| SANDSTONE | | | |
| SILTSTONE | | | |
| CLAYSTONE | | | |
| COAL | | | |

EXPLANATION OF ROCK LOGGING TERMS

| ROCK WEATHERING CLASSIFICATION | | SYMBOLS | |
|--------------------------------|---|---|-------------------|
| Fresh (FR) | No visible signs of weathering. | | |
| Fresh Jointed (FJ) | Weathering limited to the surface of major discontinuities. |  | CLAYSTONE |
| Slightly Weathered (SW) | Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material. |  | SILTSTONE |
| Moderately Weathered (MW) | Weathering extends throughout the rock mass, but the rock material is not friable. |  | SANDSTONE |
| Highly Weathered (HW) | Weathering extends throughout the rock mass and the rock is partly friable. |  | COAL |
| Completely Weathered (CW) | Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved. |  | Bedrock (general) |

| DISCONTINUITY SPACING | | STRENGTH CLASSIFICATION | | | |
|-----------------------|-----------------------|-------------------------|---|---------------------|---|
| Bedding | Bedding Plane Spacing | Rock Strength | Approximate Uniaxial Compressive Strength | | Field Estimation of Hardness* |
| | | | (MPa) | (psi) | |
| Very thickly bedded | Greater than 2m | Extremely Strong | Greater than 250 | Greater than 36,000 | Specimen can only be chipped with a geological hammer |
| Thickly bedded | 0.6 to 2m | | | | |
| Medium bedded | 0.2 to 0.6m | Very Strong | 100-250 | 15,000 to 36,000 | Requires many blows of geological hammer to break |
| Thinly bedded | 60mm to 0.2m | | | | |
| Very thinly bedded | 20 to 60mm | Strong | 50-100 | 7,500 to 15,000 | Requires more than one blow of geological hammer to break |
| Laminated | 6 to 20mm | | | | |
| Thinly Laminated | Less than 6mm | Medium Strong | 25.0 to 50.0 | 3,500 to 7,500 | Breaks under single blow of geological hammer. |

| TERMS | | Weak | 5.0 to 25.0 | 750 to 3,500 | Can be peeled by a pocket knife with difficulty |
|-------------------------------------|--|-----------------------|-------------|--------------|--|
| Total Core Recovery: (TCR) | Core recovered as a percentage of total core run length. | Very Weak | 1.0 to 5.0 | 150 to 750 | Can be peeled by a pocket knife, crumbles under firm blows of geological pick. |
| Solid Core Recovery: (SCR) | Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run. | Extremely Weak (Rock) | 0.25 to 1.0 | 35 to 150 | Indented by thumbnail |
| Rock Quality Designation: (RQD) | Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length. | | | | |
| Uniaxial Compressive Strength (UCS) | Axial stress required to break the specimen | | | | |
| Fracture Index: (FI) | Frequency of natural fractures per 0.3m of core run. | | | | |

RECORD OF BOREHOLE No 07-S01

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 319.05 E 308 025.57 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.04 - 2007.09.04 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|---|--|--|------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | |
| 120.4 | ASPHALT (25mm) | | 1 | SS | 14 | | | | | | | | | | |
| 120.0 | SAND and GRAVEL Compact Brown Dry (FILL) | | | | | | | | | | | | | | |
| 117.4 | Silty CLAY Firm to Stiff Brown Dry | | 2 | SS | 7 | | | | | | | | | | 0 6 53 41 |
| | | | 3 | SS | 12 | | | | | | | | | | |
| | | | 4 | SS | 7 | | | | | | | | | | 0 1 42 57 |
| 116.7 | Soft to Firm | | 5 | SS | 4 | | | | | | | | | | |
| 116.1 | | | | | | | | | | | | | | | |
| 113.6 | Silty SAND, some clay, trace gravel Loose Grey Wet | | 6 | SS | 8 | | | | | | | | | | 4 54 31 11 |
| | | | | | | | | | | | | | | | |
| | Very Loose Wet | | 7 | SS | 4 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | END OF BOREHOLE AT 6.9m. AUGER REFUSAL AT 6.9m ON PROBABLE BEDROCK, BOULDERS OR COBBLES. BOREHOLE OPEN TO 6.9m AND WATER LEVEL AT 4.6m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep07/07 2.0 118.4 Oct25/07 2.0 118.4 | | | | | | | | | | | | | | |

+ 3, x 3. Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-S02

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 277.88 E 308 062.04 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.04 - 2007.09.04 CHECKED BY SKP

| 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 | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| 121.3 | ASPHALT:(25mm) | | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | GR SA SI CL |
| 0.2 | SAND and GRAVEL (FILL) | | 1 | SS | 8 | | 121 | | | | | | | | | |
| 120.5 | Silty CLAY, occasional sand, occasional gravel, occasional black oxide staining | | | | | | | | | | | | | | | |
| 0.8 | Stiff Brown Dry (FILL) | | 2 | SS | 8 | | 120 | | | | | | | | | |
| | Silty CLAY Firm to Stiff Brown Dry to Moist | | 3 | SS | 8 | | | | | | | | | | | |
| | occasional iron oxide staining | | 4 | SS | 10 | | 119 | | | | | | | | | |
| 118.2 | | | | | | | | | | | | | | | | |
| 3.0 | END OF BOREHOLE AT 3.0m. AUGER REFUSAL AT 3.0m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 3.0m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT PATCH TO SURFACE. | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-S03

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 240.45 E 308 095.20 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.04 - 2007.09.04 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|-----|--|---|--------------------------------|-----------|--|--|--|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | | | | | | | | | | |
| 121.6 | SAND and GRAVEL Loose Brown Dry (FILL) Silty CLAY Firm to Stiff Brown Dry occasional iron oxide staining Moist SAND, trace silt, trace gravel Compact Brown Moist to Wet | | 1 | SS | 5 | 121 | 20 | 40 | 60 | 80 | 100 | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | 0 2 49 49 | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 121.0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.6 | | | | | | | | | | | | | | | | | | | | | | | | |
| 119.4 | | | 2 | SS | 6 | 120 | 20 | 40 | 60 | 80 | 100 | w _p | w | w _L | | | | | | | | | | |
| 2.2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 118.5 | | | 3 | SS | 8 | 119 | 20 | 40 | 60 | 80 | 100 | w _p | w | w _L | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.0 | END OF BOREHOLE AT 3.0m. AUGER REFUSAL AT 3.0m ON PROBABLE BEDROCK, BOULDERS OR COBBLES. BOREHOLE OPEN TO 3.0m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | 4 | SS | 12 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-S04

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 067.16 E 308 248.69 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.06.12 - 2007.06.12 CHECKED BY SKP

| 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 | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | 20 | 40 | 60 | | | | | | 80 | 100 | 20 | 40 | 60 |
| | | | | | | | | ○ UNCONFINED | + | FIELD VANE | | | | | | ● QUICK TRIAXIAL | × | LAB VANE | | |
| 125.0 | | | | | | | | | | | | | | | | | | | | |
| 0.0 | Gravelly SAND Dense Brown Dry (FILL) | | 1 | SS | 31 | | | | | | | | | | 26 67 7 (SI+CL) | | | | | |
| 124.2 | | | | | | | | | | | | | | | | | | | | |
| 0.8 | Silty CLAY, occasional to trace sand, occasional gravel Stiff Brown Dry to Moist (FILL) | | 2 | SS | 8 | | 124 | | | | | | | | 0 21 33 46 | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 15 | | | | | | | | | | | | | | | |
| 122.7 | | | | | | | 123 | | | | | | | | | | | | | |
| 2.2 | Silty SAND, some clay, trace gravel Compact Brown Dry | | 4 | SS | 15 | | | | | | | | | | 3 43 33 21 | | | | | |
| 122.2 | | | | | | | | | | | | | | | | | | | | |
| 2.7 | END OF BOREHOLE AT 2.7m. AUGER REFUSAL AT 2.7m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 2.7m AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep07/07 dry Oct25/07 destroyed | | | | | | | | | | | | | | | | | | | |

+³ x³ Numbers refer to
Sensitivity



20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-S05

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 030.59 E 308 277.54 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.06.12 - 2007.06.12 CHECKED BY SKP

| 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 kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|---|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 125.7 | | | | | | | | | | | | | | | | | |
| 0.0 | SAND, occasional silt, trace to some gravel Compact Brown Dry (FILL) |  | 1 | SS | 26 | | | | | | | | | | | | |
| 124.9 | | | | | | | | | | | | | | | | | |
| 0.8 | Silty CLAY, occasional rootlets Stiff Brown Dry |  | 2 | SS | 11 | | | | | | | | | | | | |
| 124.2 | | | | | | | | | | | | | | | | | |
| 1.5 | END OF BOREHOLE AT 1.5m. AUGER REFUSAL AT 1.5m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 1.5m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | | |

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-S06

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 003.53 E 308 303.05 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.06.12 - 2007.06.12 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 126.6 | | | | | | | | | | | | | | |
| 0.0 | SAND, trace silt, trace to some gravel Dense Brown Dry (FILL) | | 1 | SS | 43 | | 126 | | | | | | | |
| 125.9 | | | | | | | | | | | | | | |
| 0.7 | Sandy SILT, occasional gravel, occasional rootlets | | 2 | SS | 58 | | | | | | | | | |
| 125.5 | | | | | | | | | | | | | | |
| 1.1 | Very Dense Brown Dry END OF BOREHOLE AT 1.1m. AUGER REFUSAL AT 1.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 1.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | |

+ ³ × ³; Numbers refer to
Sensitivity

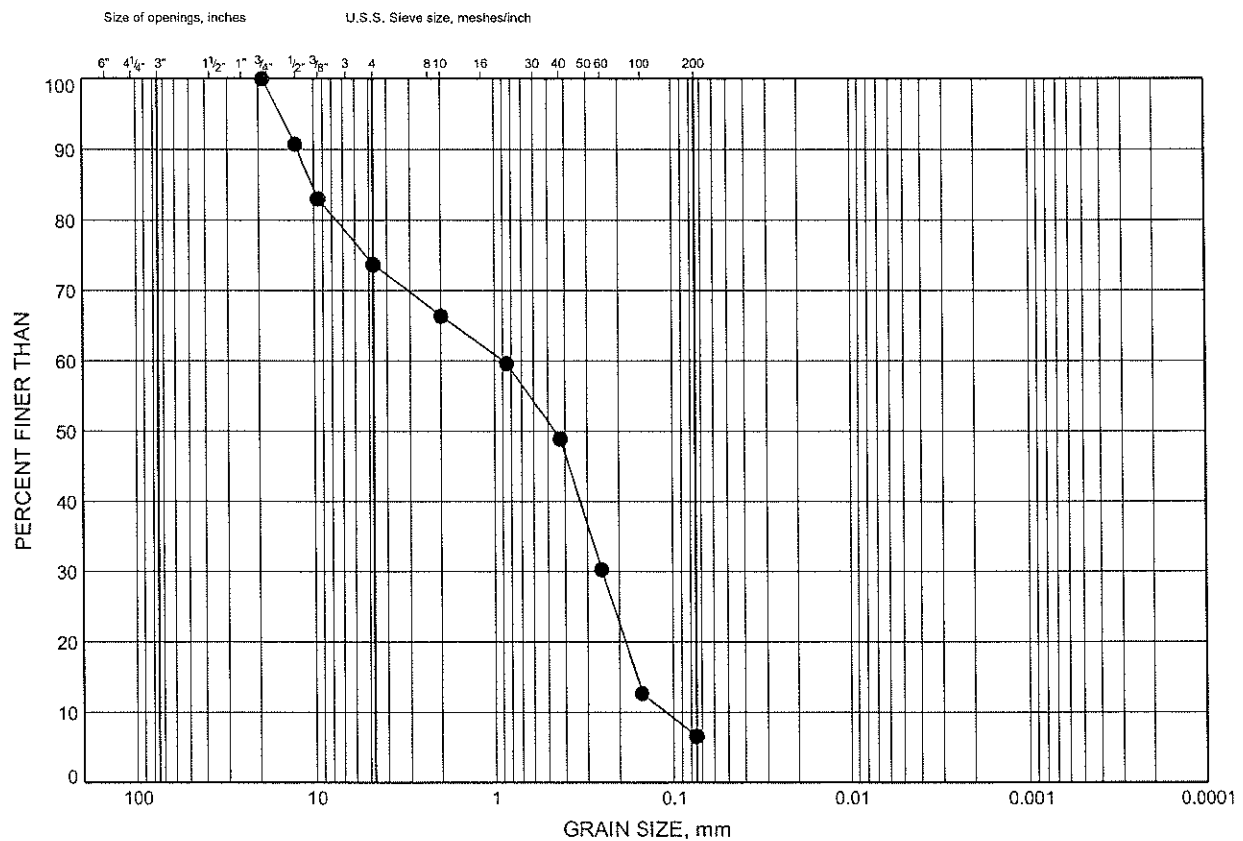
20
15
10
(%) STRAIN AT FAILURE

Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE A1

GRAVELLY SAND FILL



| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-S04 | 0.30 | 124.65 |

Date November 2007

Project 4067-03-00



Prep'd MFA

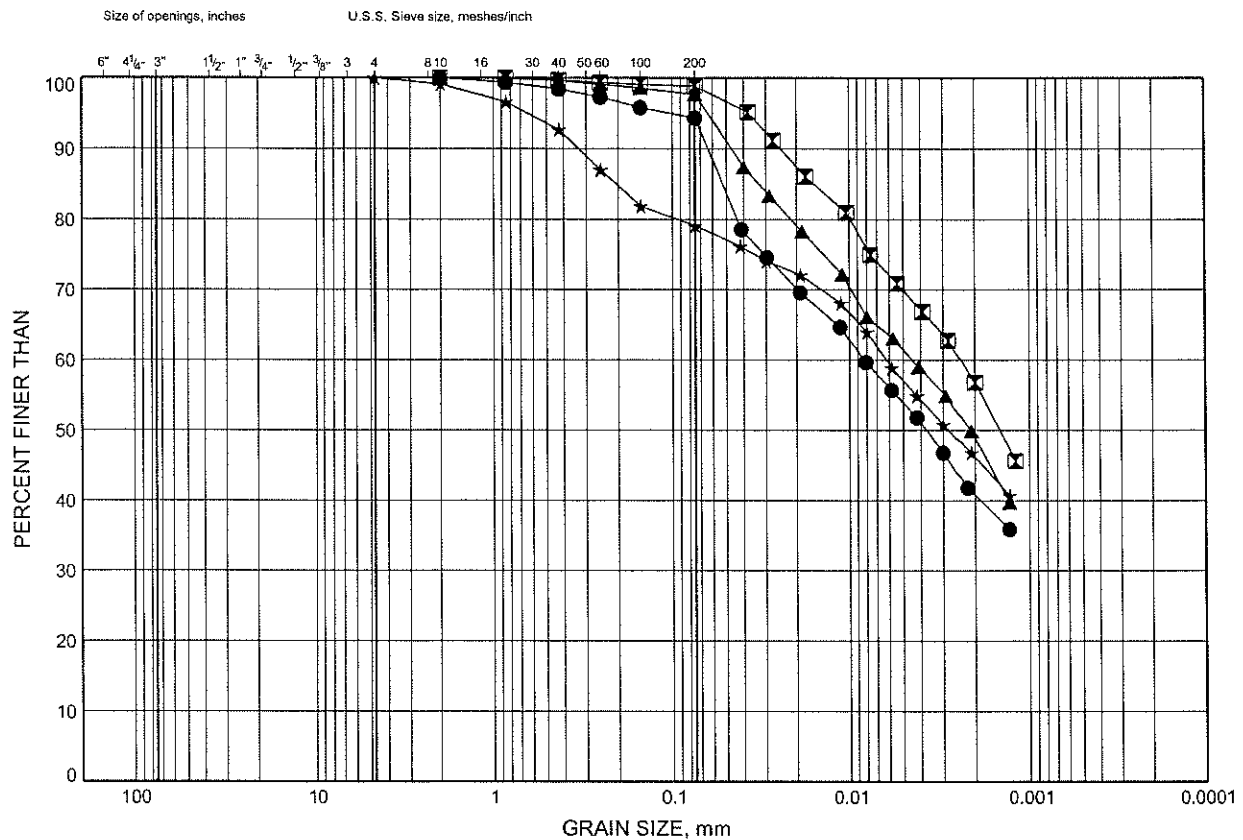
Chkd. SKP

Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE A2

SILTY CLAY



| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
|----------------|--------|------|--------|--------|------|---------------|
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-S01 | 1.07 | 119.34 |
| ⊠ | 07-S01 | 2.59 | 117.82 |
| ▲ | 07-S03 | 1.07 | 120.49 |
| ★ | 07-S04 | 1.07 | 123.88 |

Date November 2007

Project 4067-03-00



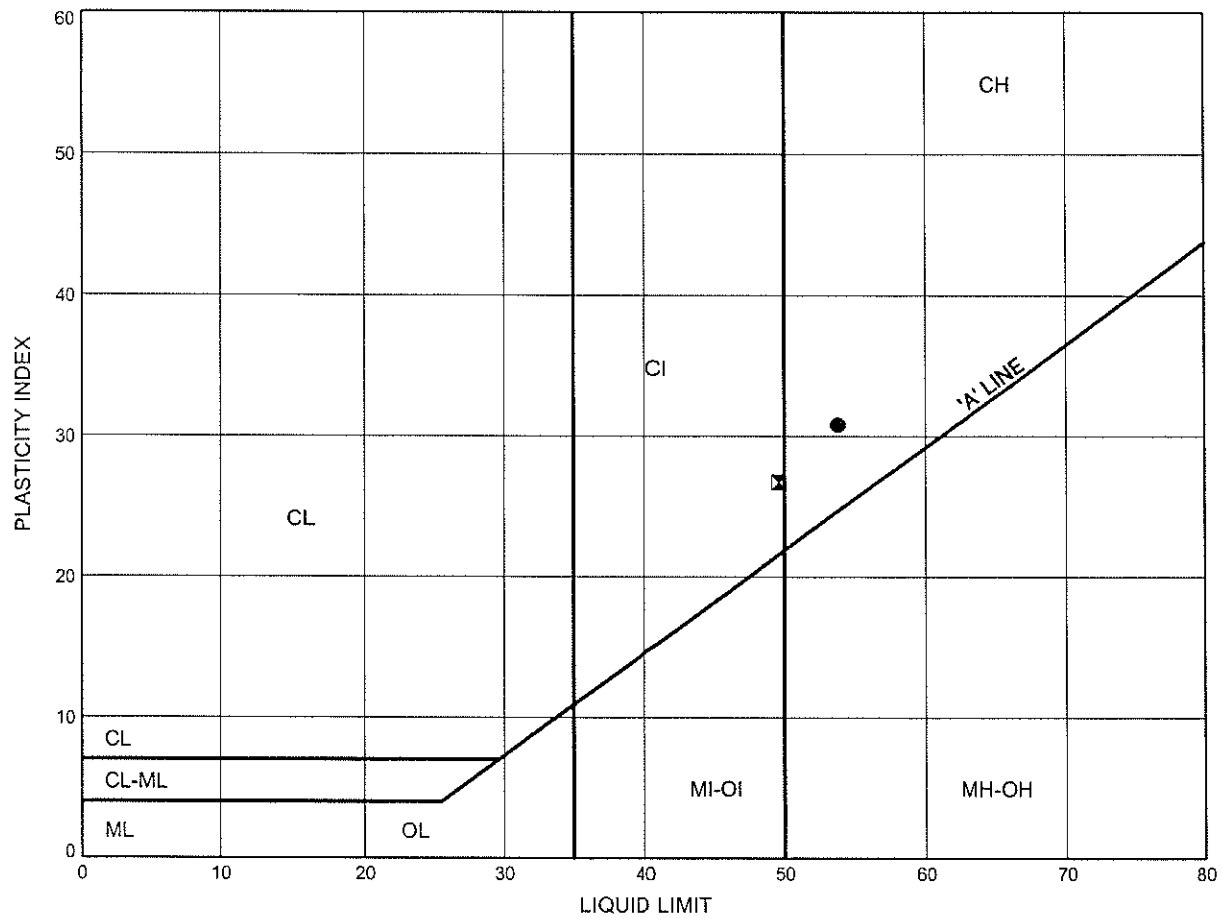
Prep'd MFA

Chkd. SKP

Cornwall Noise Barrier
ATTERBERG LIMITS TEST RESULTS

FIGURE A3

SILTY CLAY



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-S01 | 2.59 | 117.82 |
| ⊠ | 07-S03 | 1.07 | 120.49 |

Date November 2007

Project 4067-03-00



Prep'd MFA

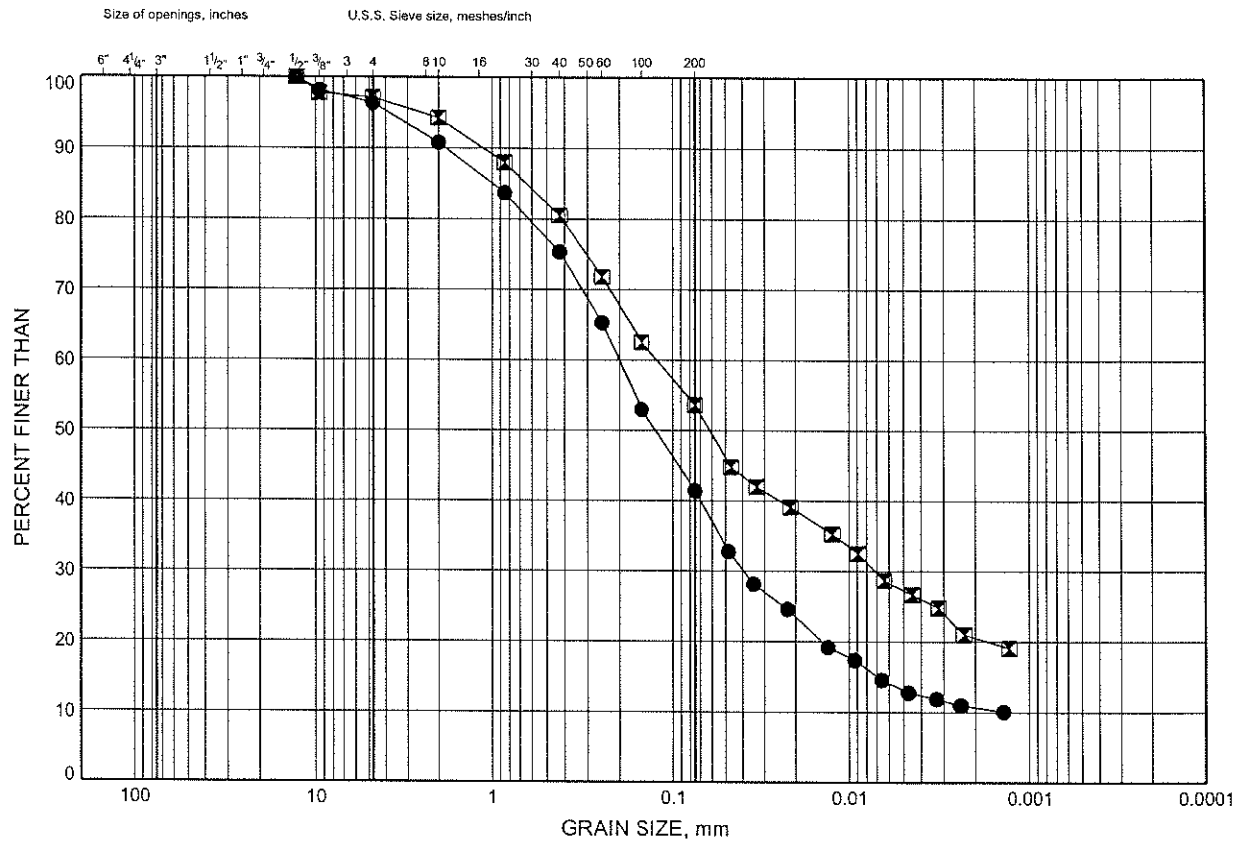
Chkd. SKP

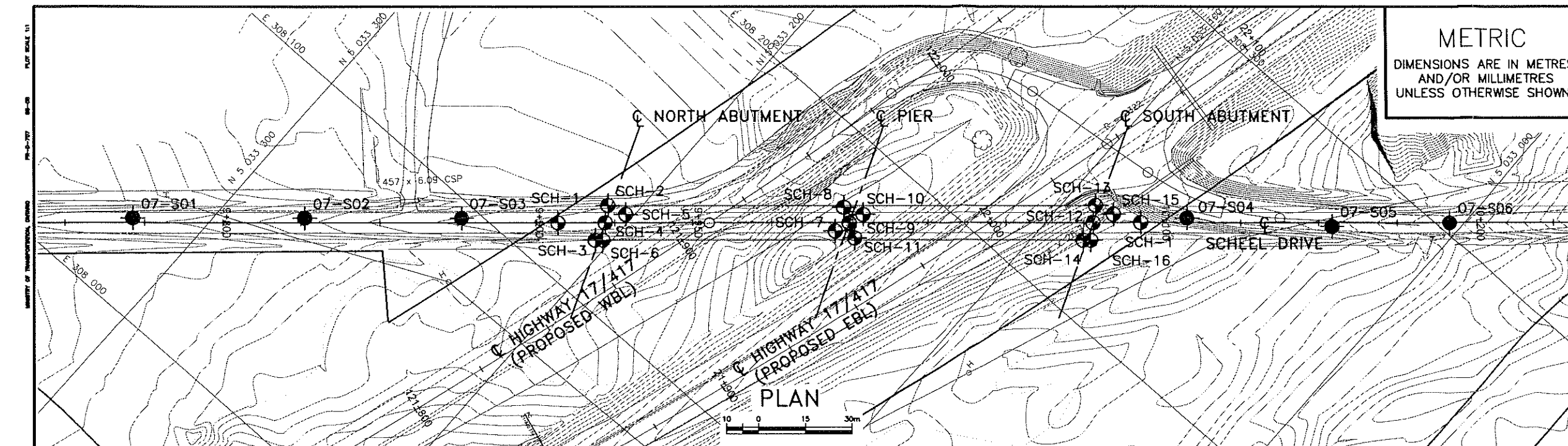
Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE A4

SILTY SAND, SOME CLAY





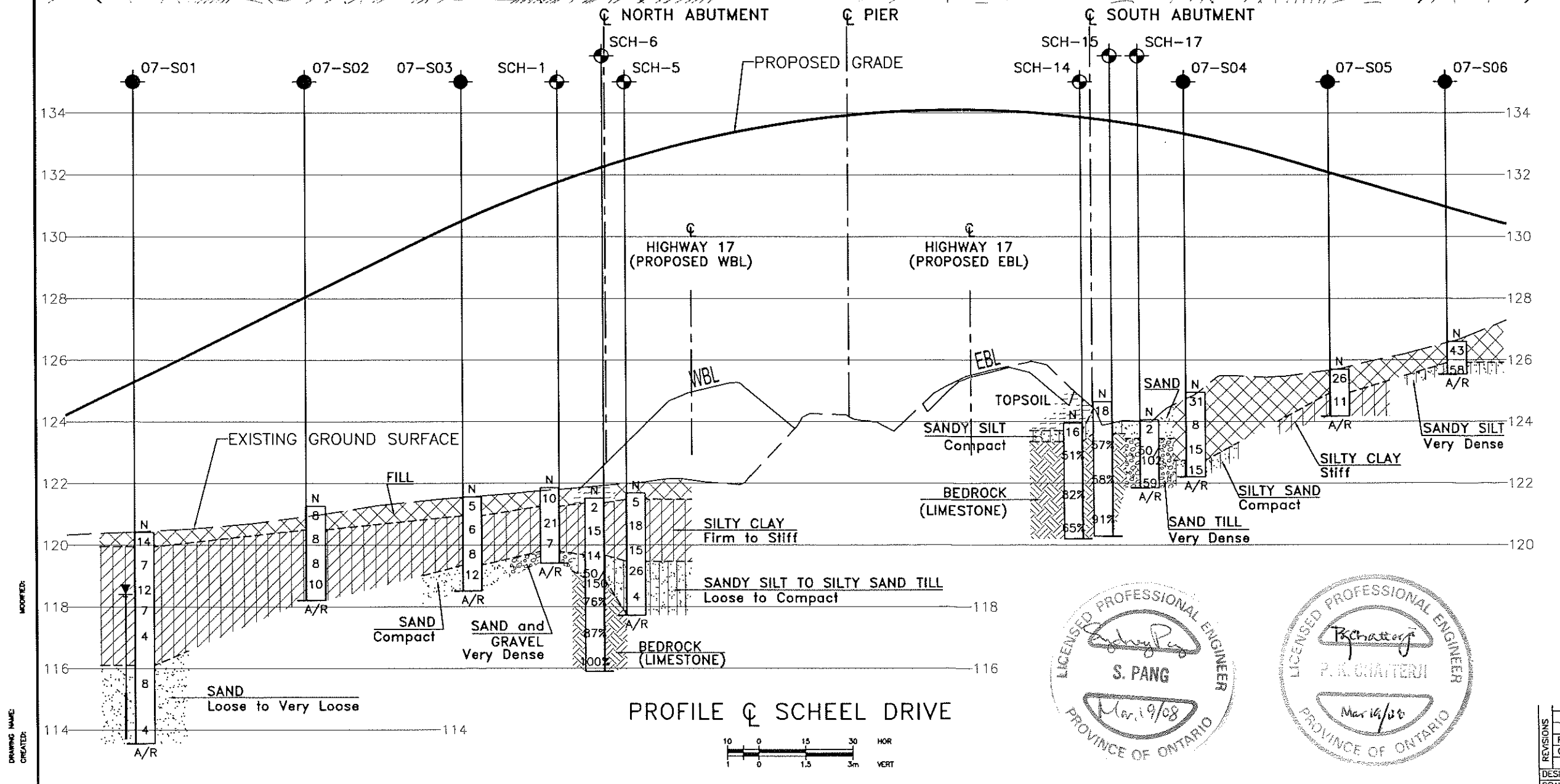
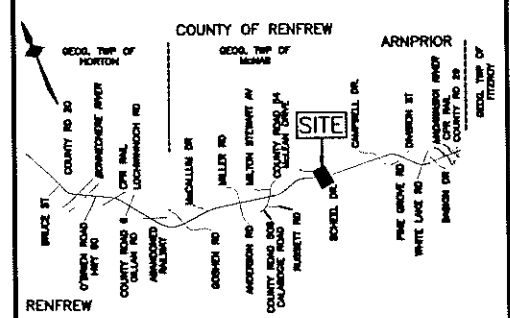
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 17/417
SITE No
GWP No 4067-03-00

SHEET

MCCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

Borehole (Present Investigation, 2007)

Borehole (Previous Investigation, 2004)

Blows /0.3m (Std Pen Test, 475J/blow)

Blows /0.3m (60' Cone, 475J/blow)

Pressure, Hydraulic

Water Level

Head Artesian Water

Piezometer

Rock Quality Designation (RQD)

Auger Refusal

| NO | ELEVATION | NORTHING | EASTING |
|--------|-----------|-------------|-----------|
| SCH-1 | 121.9 | 5 033 216.5 | 308 114.4 |
| SCH-2 | 121.7 | 5 033 208.3 | 308 129.1 |
| SCH-3 | 121.6 | 5 033 204.0 | 308 118.1 |
| SCH-4 | 122.0 | 5 033 205.3 | 308 124.4 |
| SCH-5 | 121.7 | 5 033 202.2 | 308 130.7 |
| SCH-6 | 121.5 | 5 033 202.2 | 308 119.7 |
| SCH-12 | 124.2 | 5 033 088.5 | 308 227.8 |
| SCH-13 | 125.1 | 5 033 091.6 | 308 232.5 |
| SCH-14 | 124.0 | 5 033 087.2 | 308 221.5 |
| SCH-15 | 124.7 | 5 033 085.5 | 308 234.1 |
| SCH-16 | 124.1 | 5 033 085.4 | 308 223.1 |
| SCH-17 | 124.1 | 5 033 077.3 | 308 237.8 |
| 07-S01 | 120.4 | 5 033 319.1 | 308 025.6 |
| 07-S02 | 121.3 | 5 033 277.9 | 308 062.0 |
| 07-S03 | 121.6 | 5 033 240.5 | 308 095.2 |
| 07-S04 | 125.0 | 5 033 067.2 | 308 248.7 |
| 07-S05 | 125.7 | 5 033 030.6 | 307 277.5 |
| 07-S06 | 126.6 | 5 033 003.5 | 308 303.1 |

NOTES

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31F-163

REVISIONS

FEB08 SKP

OCT07 SKP

DATE BY

DESIGN SKP

DRAWN MFA

FINAL

ISSUED AS DRAFT

DESCRIPTION

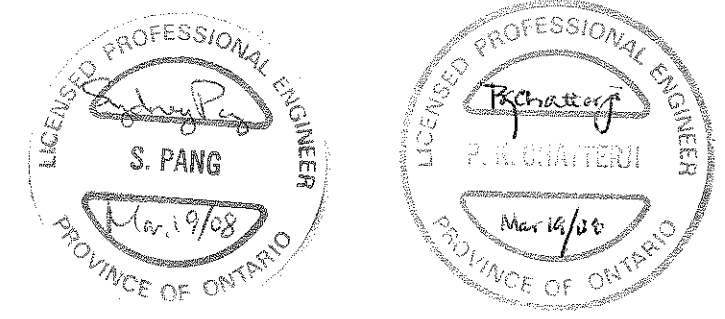
LOAD

STRUCT.

SCHEME

DWG 2

DATE OCT 2007



PROJECT: HWY 17/417
DRAWING: GWP No 4067-03-00
DATE: OCT 2007
DRAWN: MFA
CHECKED: SKP
DESIGNED: SKP
APPROVED: SKP

High Embankments
Scheel, Campbell, WBL Mainline, Highway 17-417 Four Laning

Appendix B

**Mainline Stations 24+270 to 24+470 (Highway 417 WBL)
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 07-M01

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Highway 17/417 WBL N 5 032 964.93 E 310 594.18 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.07 - 2007.09.07 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|-----------|--|-------------|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | W P W W L | WATER CONTENT (%) | GR SA SI CL | | |
| 121.7 | | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (75mm) | | | | | | | | | | | | |
| 0.1 | Silty CLAY, trace sand, occasional gravel, occasional rootlets Stiff to firm Brown Dry | | 1 | SS | 6 | | | | | | | | |
| | | | 2 | SS | 8 | | | | | | | | 0 6 52 42 |
| | becoming Firm to Soft Dry to Moist | | 3 | SS | 4 | | | | | | | | |
| | | | 1 | TW | WH | | | | | | | | 0 1 60 39 |
| | Grey Wet | | 4 | SS | 4 | | | | | | | | 0 1 47 52 |
| 117.7 | | | | | | | | | | | | | |
| 4.0 | Silty SAND, occasional clay, trace gravel Grey Wet | | | | | | | | | | | | |
| 117.4 | | | | | | | | | | | | | |
| 4.2 | END OF BOREHOLE AT 4.2m. AUGER REFUSAL AT 4.2m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 4.2m AND WATER LEVEL AT 3.4m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) | | | | | | | | | | | | Field vane was pushed to 4.1m depth but was unable to turn in the sand. |

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M02

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Highway 17/417 WBL N 5 032 961.24 E 310 644.54 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.07 - 2007.09.07 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------|--------------------------------|-----------------|-------------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 121.8 | | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL:(125mm) | | | | | | | | | | | | | | | | |
| 0.1 | Silty CLAY, trace sand, occasional rootlets Firm Brown Dry to Moist | | 1 | SS | 7 | | 121 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 2 | SS | 7 | | | | | | | | | | | | |
| 120.4 | | | | | | | | | | | | | | | | | |
| 1.4 | END OF BOREHOLE AT 1.4m. AUGER REFUSAL AT 1.4m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 1.4m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. 1. AN AUGER PROBE WAS CARRIED OUT AT A LOCATION SOME 2.5m EAST OF BOREHOLE 07-M2. AUGER REFUSAL AT 0.9m ON PROBABLE BEDROCK, BOULDER OR COBBLES. 2. A SECOND AUGER PROBE WAS CARRIED OUT AT A LOCATION SOME 25m WEST OF BOREHOLE 07-M2. AUGER REFUSAL AT 2.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOTH PROBE HOLES BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-M03

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Highway 17/417 WBL N 5 032 957.66 E 310 687.91 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.07 - 2007.09.07 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 121.0 | | | | | | | | | | | | | | |
| 0.0 | Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry | | 1 | SS | 9 | | | | | | | | | |
| 120.1 | | | 2 | SS | 50/ | | | | | | | | | |
| 0.9 | END OF BOREHOLE AT 0.9m. AUGER REFUSAL AT 0.9m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 0.9m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. 1. AN AUGER PROBE WAS CARRIED OUT AT A LOCATION SOME 2.5m WEST OF BOREHOLE 07-M2. AUGER REFUSAL AT 1.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. 2. A SECOND AUGER PROBE WAS CARRIED OUT AT A LOCATION 5.5m WEST OF BOREHOLE 07-M2. AUGER REFUSAL AT 1.9m ON PROBABLE BEDROCK, BOULDER OR COBBLES. | | | | .150 | | | | | | | | | |

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

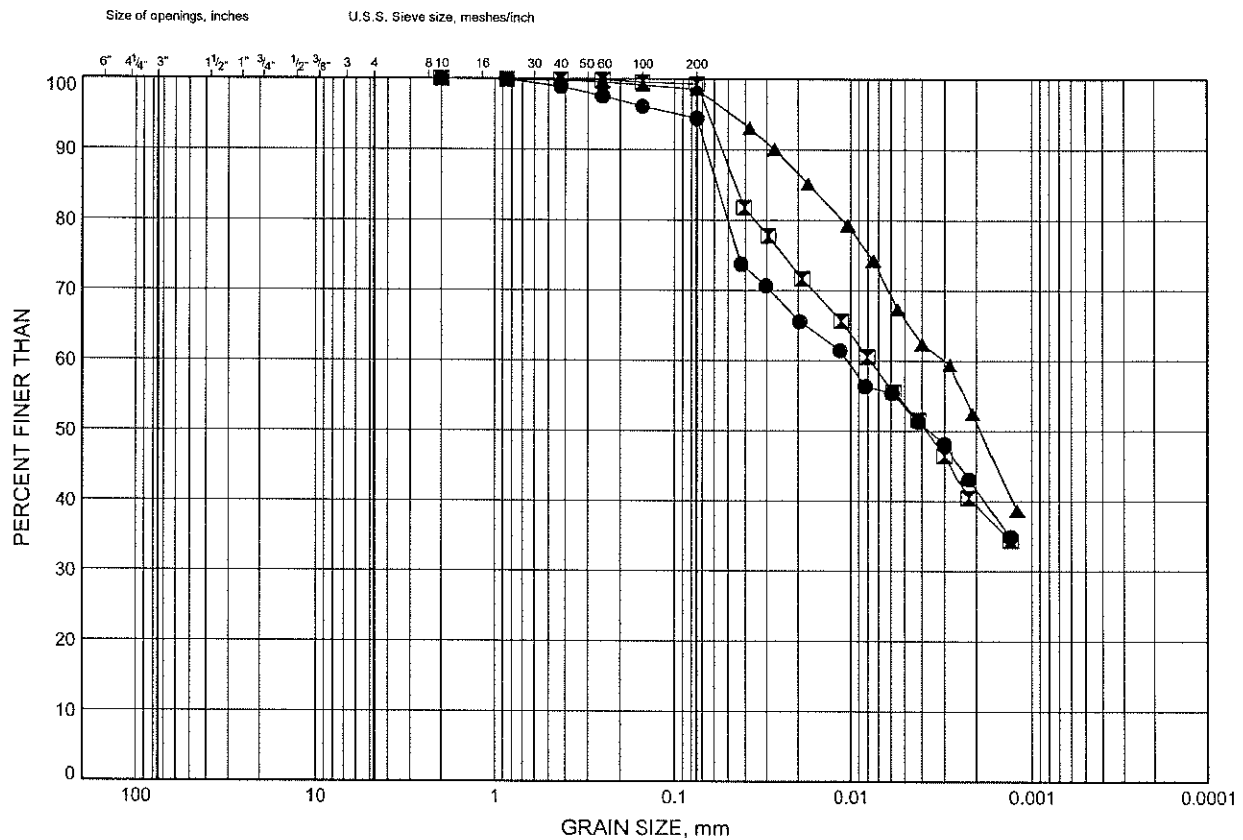
(%) STRAIN AT FAILURE

Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE B1

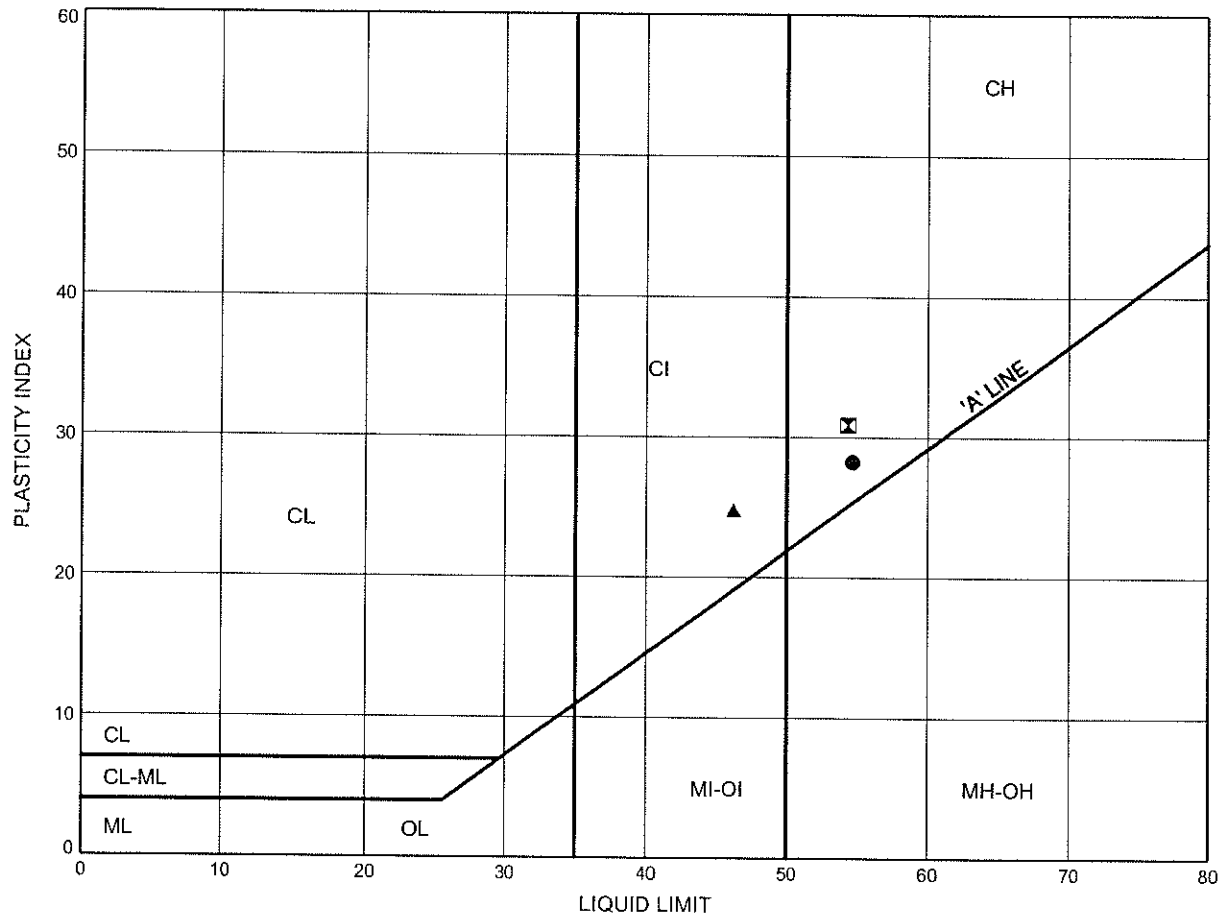
SILTY CLAY



Cornwall Noise Barrier
ATTERBERG LIMITS TEST RESULTS

FIGURE B2

SILTY CLAY



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-M01 | 1.07 | 120.62 |
| ⊠ | 07-M01 | 2.59 | 119.10 |
| ▲ | 07-M01 | 3.35 | 118.34 |

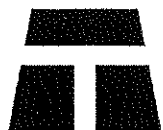


Date November 2007

Project 4067-03-00

Prep'd MFA

Chkd. SKP



Consolidation Test Report

CLIENT: McCormick Rankin Corporation

FILE NUMBER: 18-45-1/19-1351-125

PROJECT: Hwy 417/17 Arnprior

REPORT DATE: 31-Oct-07

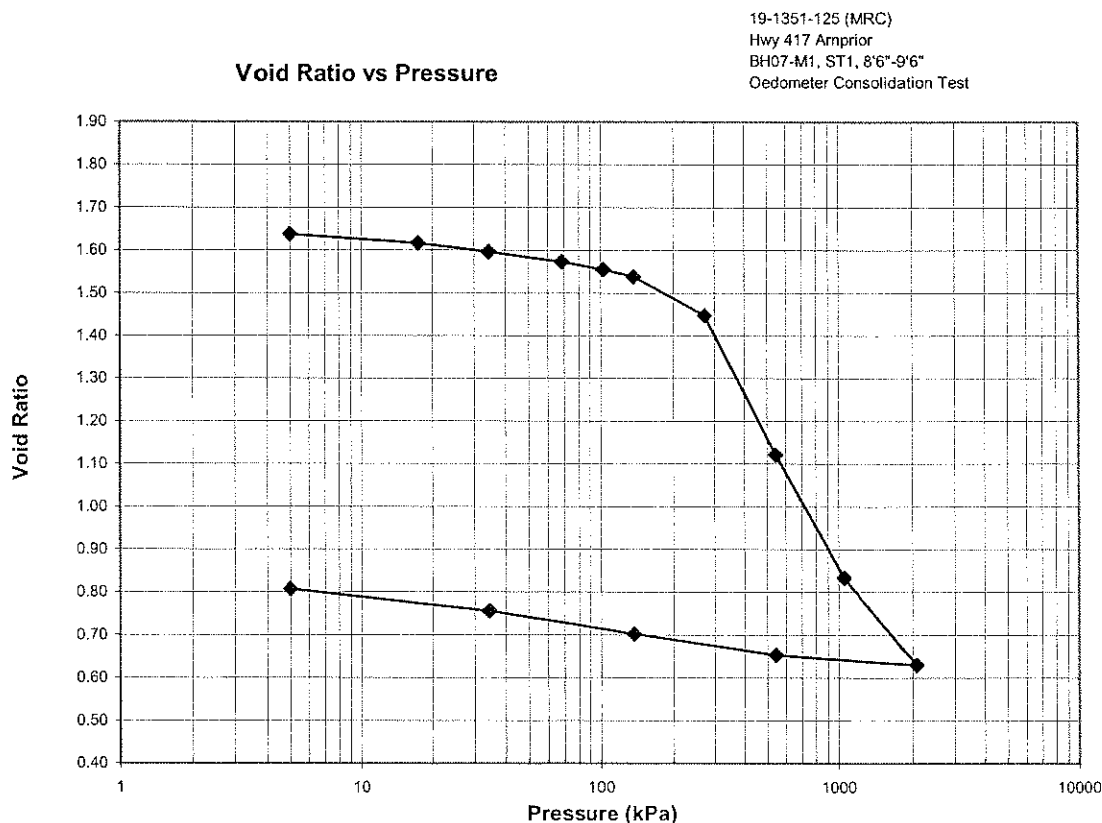
TEST DATES: October 11, 2007 - October 24, 2007

SAMPLE: BH07-M1, ST1, 8'6"-9'6"
Silty Clay, grey, plastic, (CH), Lab Vane: 20 kPa (Soft)
Grain Size: 40% Clay & 60 % Silt

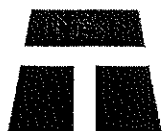
PROCEDURE: Tested in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

| | <u>Start of Test</u> | <u>End of Test</u> |
|--------------------------------|----------------------|--------------------|
| Wet Dens. (kg/m ³) | 1662.5 | 2046.6 |
| Dry Dens. (kg/m ³) | 1040.2 | 1506.3 |
| Moisture Cont. (%) | 59.8 | 35.9 |
| Void Ratio | 1.644 | 0.826 |
| Saturation (%) | 100.0 | |

Note: A Specific Gravity of 2.75 was assumed for the void ratio and saturation calculations



TEST DONE BY: WM/EA
REVIEWED BY: JPL



Consolidation Test Report

Hwy 417/17 Arnprior
18-45-1/19-1351-125

BH07-M1, ST1, 8'6"-9'6"

TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer

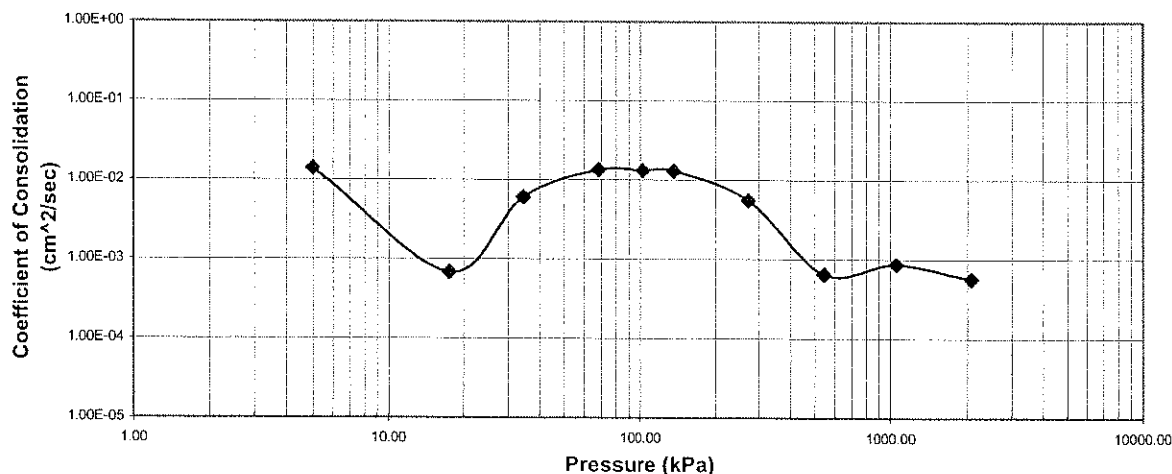
LOADING: A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied and the duration of each load step was 24 hrs.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

| Pressure (kPa) | Corr. Hgt (mm) | Avg. Hgt. (mm) | T90 (min) | Cv (cm ² /sec) | Void Ratio | mv (m ² /kN) | k (cm/s) |
|-------------------|-------------------|-------------------|--------------|------------------------------|---------------|----------------------------|-------------|
| 0.00 | 19.850 | 19.850 | | | 1.644 | | |
| 5.00 | 19.801 | 19.826 | 1.00 | 1.39E-02 | 1.637 | 6.27E-04 | 8.53E-07 |
| 17.50 | 19.646 | 19.723 | 20.25 | 6.79E-04 | 1.617 | 4.45E-04 | 2.96E-08 |
| 34.46 | 19.496 | 19.571 | 2.25 | 6.01E-03 | 1.597 | 2.65E-04 | 1.56E-07 |
| 68.42 | 19.317 | 19.406 | 1.00 | 1.33E-02 | 1.573 | 1.99E-04 | 2.60E-07 |
| 102.82 | 19.181 | 19.249 | 1.00 | 1.31E-02 | 1.555 | 1.80E-04 | 2.31E-07 |
| 136.78 | 19.060 | 19.120 | 1.00 | 1.29E-02 | 1.538 | 2.53E-04 | 3.21E-07 |
| 273.12 | 18.374 | 18.717 | 2.25 | 5.50E-03 | 1.447 | 4.53E-04 | 2.44E-07 |
| 545.39 | 15.924 | 17.149 | 16.00 | 6.49E-04 | 1.121 | 2.13E-04 | 1.35E-08 |
| 1057.63 | 13.763 | 14.844 | 9.00 | 8.65E-04 | 0.833 | 7.51E-05 | 6.36E-09 |
| 2080.12 | 12.240 | 13.002 | 10.56 | 5.66E-04 | 0.630 | 5.68E-06 | 3.15E-10 |
| 545.39 | 12.413 | 13.088 | | | 0.653 | | |
| 136.78 | 12.781 | 12.597 | | | 0.702 | | |
| 34.46 | 13.183 | 12.982 | | | 0.756 | | |
| 5.00 | 13.571 | 13.377 | | | 0.807 | | |

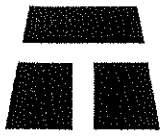
Coefficient of Consolidation vs Pressure

19-1351-125 (MRC)
Hwy 417 Arnprior
BH07-M1, ST1, 8'6"-9'6"
Oedometer Consolidation Test



Notes: Cv and k calculated using t_{90} values

TEST DONE BY: WM/EA
REVIEWED BY: JPL



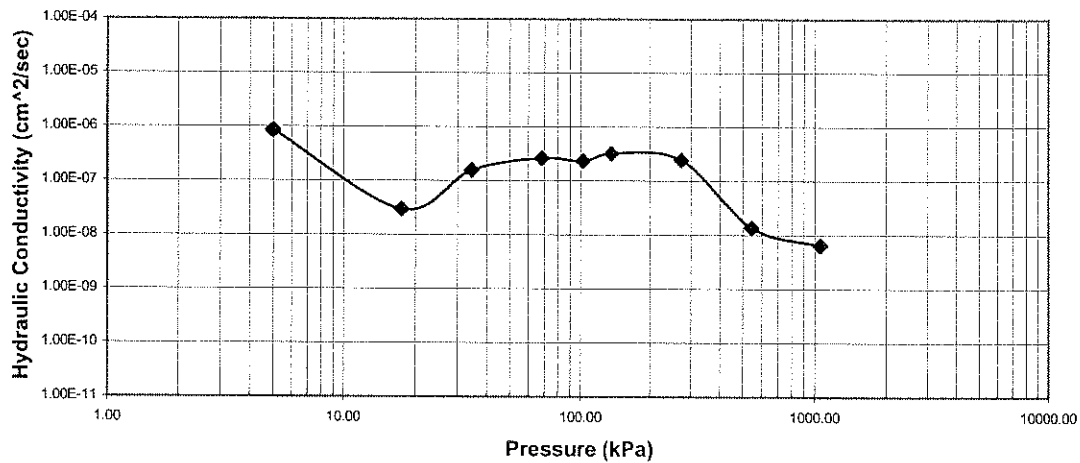
Consolidation Test Report

Hwy 417/17 Arnprior
18-45-1/19-1351-125

BH07-M1, ST1, 8'6"-9'6"

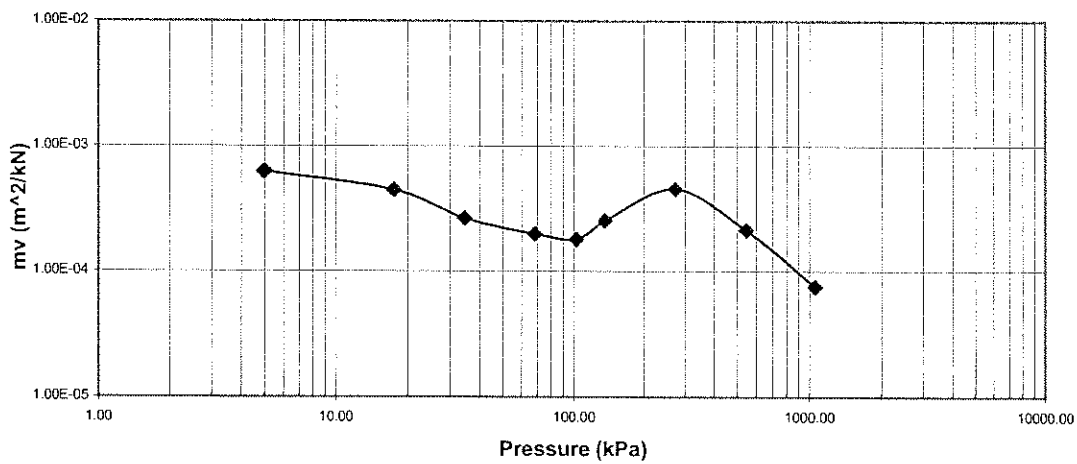
Hydraulic Conductivity vs Pressure

19-1351-125 (MRC)
Hwy 417 Arnprior
BH07-M1, ST1, 8'6"-9'6"
Oedometer Consolidation Test

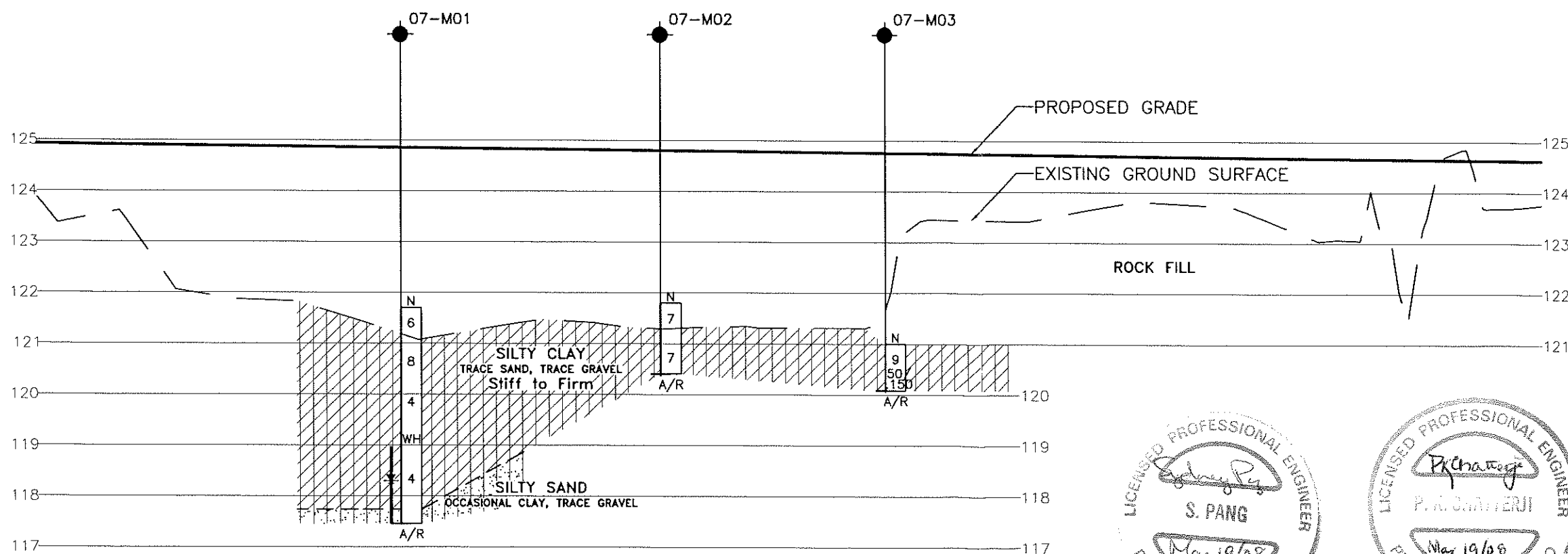
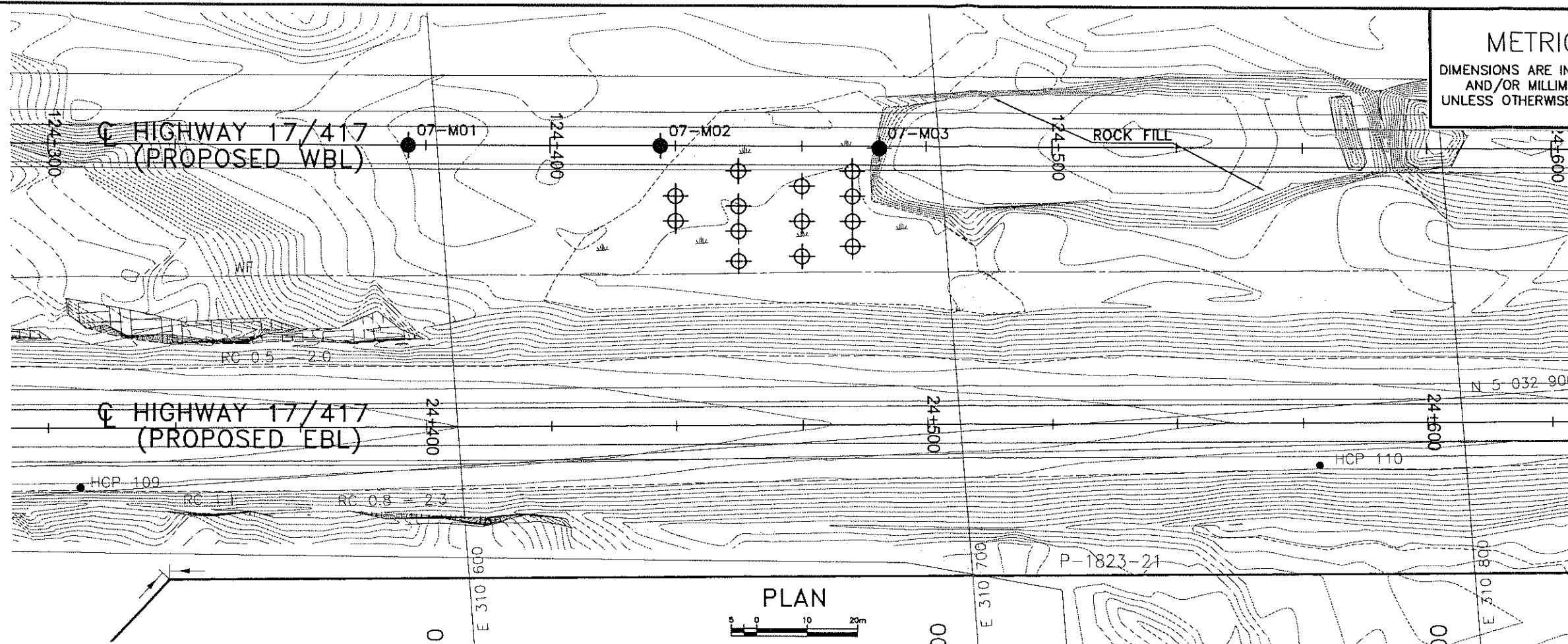


mv vs Pressure

19-1351-125 (MRC)
Hwy 417 Arnprior
BH07-M1, ST1, 8'6"-9'6"
Oedometer Consolidation Test



TEST DONE BY: WM/EA
REVIEWED BY: JPL



PROFILE @ HIGHWAY 17/417 WBL

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

| |
|-------------------|
| HWY 17/417 |
| SITE No |
| GWP No 4067-03-00 |

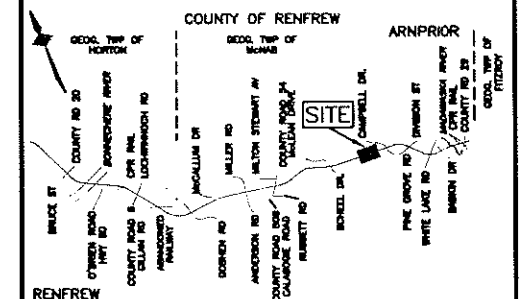
WBL MAINLINE STATIONS 124+300 TO
124+600
HIGHWAY 17/417 TWINNING
BOREHOLE LOCATIONS AND SOIL STRATA



**McCORMICK RANKIN
CORPORATION**









THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

- | | |
|---|--|
|  | Borehole (Present Investigation, 2007) |
|  | Borehole (Previous Investigation, 2004) |
|  | Hand Augered Pit (Present Investigation, 2007) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

| NO | ELEVATION | NORTHING | EASTING |
|--------|-----------|--------------|------------|
| 07-M01 | 121.7 | 5 032 964.93 | 310 594.18 |
| 07-M02 | 121.8 | 5 032 961.24 | 310 644.54 |
| 07-M03 | 121.0 | 5 032 957.66 | 310 687.91 |

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31F-163

[illegible]

PLOTDATE: Feb 15, 2008 - 1:23pm

Appendix C

Campbell Drive Interchange Approaches and Ramps Records of Boreholes, Laboratory Test Results, Drawings



RECORD OF BOREHOLE No 07-C01

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 954.19 E 312 049.51 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|-------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | |
| | | | | | | | | 20 40 60 80 100 | | | | | 20 40 60 | | |
| 112.6 | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT:(60mm) | | | | | | | | | | | | | | |
| 0.1 | SAND and GRAVEL occasional asphalt fragments Compact Brown Dry (FILL) | | 1 | SS | 21 | | | | | | | | | | |
| 111.9 | | | | | | | 112 | | | | | | | | |
| 0.7 | Silty CLAY, occasional sand Stiff to Firm Brown Dry to Moist (CL) | | 2 | SS | 11 | | | | | | | | | | |
| | | | | | | | 111 | | | | | | | | |
| | | | 3 | SS | 4 | | | | | | | 0 1 44 55 | | | |
| | | | | | | | | | | | | | | | |
| | | | 4 | SS | 8 | | 110 | | | | | | | | |
| 109.6 | | | | | | | | | | | | | | | |
| 3.0 | END OF BOREHOLE AT 3.0m. AUGER REFUSAL AT 3.0m ON PROBABLE BEDROCK, BOULDER AND COBBLES. BOREHOLE OPEN AND DRY TO 3.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT PATCH TO SURFACE. | | | | | | | | | | | | | | |

+³ ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C02

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 917.35 E 312 080.30 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|--|--|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | WATER CONTENT (%) |
| | | | | | | | | 20 40 60 80 100 | | | | | | | |
| 112.5 | | | | | | | | | | | | | | | |
| 0.0 0.1 | ASPHALT:(60mm) | | | | | | | | | | | | | | |
| | SAND and GRAVEL Dense Brown Dry (FILL) | | 1 | SS | 40 | | 112 | | | | | | | | |
| 111.8 0.7 | | | | | | | | | | | | | | | |
| | Silty CLAY, occasional gravel, occasional sand Stiff Brown Dry (FILL) | | 2 | SS | 10 | | 111 | | | | | | | | |
| 111.1 1.4 | | | | | | | | | | | | | | | |
| | Silty CLAY, occasional sand Firm to Stiff Brown Dry | | 3 | SS | 8 | | | | | | | | | | |
| 110.3 2.2 | | | | | | | | | | | | | | | |
| | END OF BOREHOLE AT 2.2m. AUGER REFUSAL AT 2.2m ON PROBABLE BEDROCK, BOULDER AND COBBLES. BOREHOLE OPEN AND DRY TO 2.2m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sept 5/07 dry - Sept 7/07 dry - Oct 25/07 2.0 111.5 | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-C03

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 886.87 E 312 110.50 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|-----------------|-----------------|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 112.8 | ASPHALT (60mm) | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | |
| 0.1 | SAND and GRAVEL, limestone fragments, occasional silt | | 1 | SS | 38 | | | | | | | | 44 44 12 (SI+CL) |
| 112.1 | Dense | | | | | | | | | | | | |
| 0.7 | Brown Dry (FILL) | | 2 | SS | 9 | | | | | | | | |
| 111.4 | Silty CLAY, occasional sand, occasional gravel | | | | | | | | | | | | |
| 1.4 | Stiff Dark Brown to Brown Dry (FILL) | | 3 | SS | 7 | | | | | | | | 0 3 46 51 |
| | Silty CLAY, occasional sand Firm to stiff Brown Dry | | 4 | SS | 10 | | | | | | | | |
| | occasional gravel | | 5 | SS | 11 | | | | | | | | 0 10 49 41 |
| 108.8 | | | | | | | | | | | | | |
| 4.0 | SAND, some gravel, some silt Dense Grey Wet (TILL) | | 6 | SS | 50/150 | | | | | | | | |
| 107.8 | | | | | | | | | | | | | |
| 5.0 | END OF BOREHOLE AT 5.0m. AUGER REFUSAL AT 5.0m ON PROBABLE BEDROCK, BOULDER AND COBBLES. BOREHOLE OPEN TO 5.0m AND WATER LEVEL AT 4.3m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sept 5/07 4.3 109.7 Sept 7/07 2.4 111.6 Oct 25/07 2.7 111.3 | | | | | | | | | | | | |

+ 3, x 3, Numbers refer to 20 15 10 5 10 (%) STRAIN AT FAILURE
 Sensitivity

RECORD OF BOREHOLE No 07-C04

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 931.34 E 312 109.75 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|--|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 113.1 | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (150mm) | | | | | | 113 | | | | | | | |
| 0.2 | Silty CLAY, occasional sand, occasional rootlets Stiff to Firm Brown Dry | | 1 | SS | 12 | | | | | | | | | |
| | | | 2 | SS | 7 | | 112 | | | | | | | 0 2 40 58 |
| 111.7 | | | | | | | | | | | | | | |
| 1.4 | SAND, some silt, trace gravel Compact Brown | | 3 | SS | 58/ | | | | | | | | | |
| 111.2 | Wet (TILL) | | | | 225 | | | | | | | | | |
| 1.9 | END OF BOREHOLE AT 1.9m. AUGER REFUSAL AT 1.9m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN AND DRY TO 1.9m BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | |

+ 3 . x 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C05

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 977.41 E 312 119.31 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|--|--|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | WATER CONTENT (%) |
| | | | | | | | | 20 40 60 80 100 | | | | | | | |
| 112.9 | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | |
| 0.1 | TOPSOIL: (100mm) | | | | | | | | | | | | | | |
| | Silty CLAY, occasional sand, occasional rootlets Stiff to Firm Brown Dry | | 1 | SS | 10 | | | | | | | | | | |
| | | | 2 | SS | 7 | | 112 | | | | | | | | |
| | Firm to Soft Grey Moist | | 3 | SS | 4 | | 111 | | | | | | | | |
| 110.7 | | | | | | | | | | | | | | | |
| 2.2 | Silty SAND, trace gravel, occasional iron oxide staining | | 4 | SS | 6/ | | | | | | | | | | |
| 110.3 | Loose Brown Moist to Wet (TILL) | | | | | | | | | | | | | | |
| 2.6 | END OF BOREHOLE AT 2.6m. BOREHOLE OPEN AND DRY TO 2.6m. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-C06

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 981.14 E 312 091.90 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|------------|-----|---|--|--|--|--|-----------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | | | | | | | | UNCONFINED | | FIELD VANE | | | | | | | |
| 112.9 | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 0.0 | TOPSOIL: (150mm) | | | | | | | | | | | | | | | | |
| 0.2 | Silty CLAY, occasional sand, occasional rootlets, occasional iron oxide staining Stiff Brown Dry to Moist | | 1 | SS | 11 | | | | | | | | | | | | 0 7 56 37 |
| | | | 2 | SS | 14 | | | | | | | | | | | | |
| | Firm to Soft Brown to Grey | | 3 | SS | 6 | | | | | | | | | | | | 0 1 49 50 |
| | | | 4 | SS | 4 | | | | | | | | | | | | 0 1 42 57 |
| | | | 5 | SS | 6 | | | | | | | | | | | | |
| 108.9 | | | | | | | | | | | | | | | | | |
| 4.0 | Silty SAND, trace gravel Brown (TILL) | | | | | | | | | | | | | | | | |
| 108.4 | | | | | | | | | | | | | | | | | |
| 4.5 | END OF BOREHOLE AT 4.5m. AUGER REFUSAL AT 4.5m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 4.5m AND WATER LEVEL AT 3.0m UPON COMPLETION . BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, THEN CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-C07

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 033 013.33 E 312 130.37 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| 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 Y kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 112.8 | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 0.0 | TOPSOIL: (150mm) | | | | | | | | | | | | | | | | |
| 0.2 | Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry to Moist | | 1 | SS | 11 | | 112 | | | | | | | | | | |
| | | | 2 | SS | 10 | | | | | | | | | | | | |
| 111.0 | | | 3 | SS | 56/ | | | | | | | | | | | | |
| 111.8 | Silty SAND Brown (TILL) | | | | 150 | | 111 | | | | | | | | | | |
| 1.8 | END OF BOREHOLE AT 1.8m. BOREHOLE OPEN AND DRY TO 1.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | | |

+ 3, x 3: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C08

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 033 010.25 E 312 156.90 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| 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 | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | | | | | | |
| 112.7 | | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | GR SA SI CL | |
| 0.0 | TOPSOIL: (100mm) | | | | | | | | | | | | | | | |
| 0.1 | Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry | | 1 | SS | 9 | | | | | | | | ○ | | | |
| | | | 2 | SS | 13 | | | | | | | | ┌─○─┐ | | 0 1 47 52 | |
| | Grey Moist | | 3 | SS | 8 | | | | | | | | ○ | | | |
| | Firm | | 4 | SS | 5 | | | | | | | | ┌─○─┐ | | 0 2 48 50 | |
| 109.7 | | | | | | | | | | | | | | | | |
| 3.0 | Silty SAND, trace gravel Brown (TILL) | | 1 | ST | PH | | | | | | | | | | | |
| 109.0 | | | | | | | | | | | | | | | | |
| 3.7 | END OF BOREHOLE AT 3.7m. BOREHOLE OPEN TO 3.7m AND WATER LEVEL AT 2.7m UPON COMPLETION . BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, THEN CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | |

+ ³ . x ³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C09

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 033 029.57 E 312 177.03 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|-----------------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 112.6 0.0 | TOPSOIL: (100mm) | | | | | | | | | | | | | |
| 0.1 | Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry | | 1 | SS | 14 | | | | | | | | | |
| | | | 2 | SS | 12 | | | | | | | | | |
| | Firm Grey | | 3 | SS | 6 | | | | | | | | | |
| | Moist | | 4 | SS | 8 | | | | | | | | | |
| 109.7 109.8 3.0 | SAND, some gravel, occasional silt Grey (TILL) | | | | | | | | | | | | | |
| | END OF BOREHOLE AT 3.0m. BOREHOLE OPEN TO 3.0m AND WATER LEVEL AT 2.4m UPON COMPLETION . BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | |

+ ³ , x ³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C10

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 033 011.35 E 312 200.92 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | |
| 112.5 | | | | | | | | 20 40 60 80 100 | | | | |
| 0.0 | | | | | | | | 20 40 60 80 100 | | | | |
| 0.1 | TOPSOIL: (100mm) | | | | | | | 20 40 60 80 100 | | | | |
| | Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry | | 1 | SS | 12 | | 112 | | | | | |
| | | | 2 | SS | 14 | | 111 | | | | | |
| | Firm Dry to Moist | | 3 | SS | 6 | | 110 | | | | | |
| 109.8 | | | | | | | | | | | | |
| 2.7 | SAND, some silt, occasional gravel | | | | | | | | | | | |
| 109.4 | Very Dense Brown | | 4 | SS | 50 | | | | | | | Vane was pushed to 2.6m but was unable to turn |
| 3.1 | Wet (TILL) | | | | .075 | | | | | | | |
| | END OF BOREHOLE AT 3.1m. BOREHOLE OPEN TO 3.1m AND WATER LEVEL AT 1.8m UPON COMPLETION . BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | |

+ 3, X 3: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C11

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 033 018.93 E 312 225.23 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|------------------|--------------------------------|-----------------|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | | |
| 112.5 | | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (75mm) | | | | | | | | | | | | |
| 0.1 | Silty CLAY, occasional sand, occasional rootlets Very Stiff Brown Dry Stiff | | 1 | SS | 15 | | 112 | | | | | | |
| | | | 2 | SS | 13 | | 111 | | | | | | 0 1 42 57 |
| | Firm Brown to Grey Dry to Moist | | 3 | SS | 7 | | 110 | | | | | | |
| | Grey Moist to Wet | | 4 | SS | 6 | | 109 | | | | | | 0 1 45 54 |
| | Wet | | 5 | SS | 5 | | 108 | | | | | | 0 3 47 50 |
| 107.9 | | | | | | | | | | | | | |
| 4.6 | SAND, trace clay, some gravel Loose Grey Wet | | 6 | SS | 4 | | | | | | | | |
| 107.3 | | | | | | | | | | | | | |
| 5.2 | END OF BOREHOLE AT 5.2m. BOREHOLE OPEN TO 5.2m AND WATER LEVEL AT 3.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, THEN CUTTINGS TO SURFACE. | | | | | | | | | | | | |

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C12

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 763.51 E 312 212.36 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|-----------------|-----------------|---|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 113.1 0.0 | SAND and GRAVEL, occasional silt Compact Brown Dry (FILL) | | 1 | SS | 18 | | 113 | | | | | | |
| 112.4 0.6 | Silty CLAY, occasional to trace sand, occasional gravel Stiff Brown Dry | | 2 | SS | 10 | | 112 | | | | | | 0 14 40 46 |
| | | | 3 | SS | 14 | | 111 | | | | | | |
| | | | 4 | SS | 10 | | 110 | | | | | | |
| | Firm Grey Moist | | 5 | SS | 6 | | 109 | | | | | | 0 2 54 44 |
| | | | | | | | 108 | | | | | | 1 17 56 26 |
| | Wet | | 6 | SS | 4 | | 107 | | | | | | |
| | becoming sandy, occasional gravel | | 1 | TW | PH | | | | | | | | |
| 106.4 6.7 | END OF BOREHOLE AT 6.7m, SHELBY TUBE SAMPLER REFUSAL AT 6.7m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 6.7m AND DRY UPON COMPLETION . BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, THEN CUTTINGS TO SURFACE. | | | | | | | | | | | | |

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C13

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 759.49 E 312 246.63 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT Y kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|----------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|--|--|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | |
| 113.9 | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (100mm) | | | | | | | | | | | | | |
| 0.1 | Silty CLAY, trace to some sand, trace gravel, occasional rootlets Very Stiff Brown Dry (FILL) | | 1 | SS | 26 | | | | | | | | | |
| 113.1 | | | | | | | | | | | | | | |
| 0.8 | Silty CLAY, occasional sand, occasional rootlets Very Stiff to Stiff Dark Brown Dry becoming Brown | | 2 | SS | 16 | | 113 | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 3 | SS | 15 | | 112 | | | | | | 0 3 55 42 | |
| | Moist | | | | | | | | | | | | | |
| | | | 4 | SS | 13 | | 111 | | | | | | | |
| | Stiff to Firm Grey | | | | | | | | | | | | | |
| | | | 5 | SS | 8 | | 110 | | | | | | | |
| 109.7 | | | | | | | | | | | | | | |
| 4.1 | END OF BOREHOLE AT 4.1m. AUGER REFUSAL AT 4.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 4.1m AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sept 07/07 2.5 111.4 Oct 25/07 2.3 111.6 | | | | | | | | | | | | | |


+ 3, X 3: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C14

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 718.16 E 312 233.68 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.07 - 2007.09.07 CHECKED BY SKP

| 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 | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 113.4 | | | | | | | | | | | | | | | | | |
| 0.9 0.1 | TOPSOIL: (75mm) Silty CLAY, occasional sand, occasional rootlets Stiff Brown Dry |  | 1 | SS | 13 | | 113 | | | | | | | | | | |
| 112.5 0.9 | END OF BOREHOLE AT 0.9m, AUGER REFUSAL ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 0.9m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. AN AUGER PROBE WAS CARRIED OUT AT A LOCATION SOME 2.5m SOUTH OF BOREHOLE 07-C14. AUGER REFUSAL AT 1.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. | | 2 | SS | 50/ .100 | | | | | | | | | | | | |

+ 3 x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C15

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 728.00 E 312 268.55 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| 113.7 | | | | | | | | 20 40 60 80 100 | | | | | | |
| 0.0 | ASPHALT:(50mm) | | | | | | | | | | | | | |
| 113.2 | SAND and GRAVEL, occasional silt Compact Brown | | 1 | SS | 26 | | | | | | | | | |
| 0.5 | Dry (FILL) | | | | | | | | | | | | | |
| 112.4 | Silty CLAY, some sand, occasional gravel Stiff Brown | | 2 | SS | 12 | | 113 | | | | | | | |
| 1.4 | Dry | | | | | | | | | | | | | |
| | Silty SAND, trace gravel Compact Mottled Brown/Grey Damp (TILL) | | 3 | SS | 10 | | 112 | | | | | | | 5 55 30 10 |
| 111.0 | | | 4 | SS | 57 | | | | | | | | | |
| 2.7 | END OF BOREHOLE AT 2.7m, AUGER REFUSAL AT 2.7m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 2.7m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT PATCH TO SURFACE. | | | | | | | | | | | | | |

+³, ×³: Numbers refer to
Sensitivity

20
15
10


(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C16

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 675.09 E 312 221.75 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | | | |
|---------------|---|---|---------|------|------------|----------------------------|-----------------|---|--------------------|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|-------------------------|--|-------------------|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | | |
| 115.0 | Silty CLAY, occasional to trace sand, occasional gravel, trace rootlets Stiff Brown Dry END OF BOREHOLE AT 0.6m. AUGER REFUSAL AT 0.6m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 0.6m AND DRY UPON COMPLETION. BEDROCK WAS PRESENT AT GROUND SURFACE AT TWO LOCATIONS, 2m AND 4m EAST OF BOREHOLE 07-C16. |  | 1 | SS | 15 | | 115 | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | | | | | | | |
| 114.4 | | | | | | | | | | | | | | | | | | | | | | |
| 0.6 | | | | | | | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 07-C17

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 664.09 E 312 239.50 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.06 - 2007.09.06 CHECKED BY SKP



| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|--------------------|----|----|-----|------------------|--------------------------------|-----------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | |
| 115.9 0.0 | AUGER REFUSAL AT 0.15m ON BEDROCK. BEDROCK WAS PRESENT AT GROUND SURFACE AT THREE LOCATIONS, 2.5m, 5.0m AND 8.0m EAST OF BOREHOLE 07-C17 | | | | | | | | | | | | | | | |
| | | | | | | 115 | | | | | | | | | | |

RECORD OF BOREHOLE No 07-C18

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 691.83 E 312 268.08 ORIGINATED BY GA
HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007.09.07 - 2007.09.07 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT Y kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|---|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| 113.8 | | | | | | | | 20 40 60 80 100 | | | | | | |
| 0.0 0.1 | TOPSOIL: (75mm) Silty CLAY, occasional sand, occasional rootlets, occasional wood fibres Stiff Brown Dry |  | 1 | SS | 13 | | | | | | | | | |
| | | | 2 | SS | 14 | | 113 | | | | | | | 1 33 43 23 |
| 112.3 | | | | | | | | | | | | | | |
| 1.5 | SAND, fine to medium grained Compact Brown Dry |  | 3 | SS | 26 | | 112 | | | | | | | |
| 111.9 2.0 | END OF BOREHOLE AT 2.0m. AUGER REFUSAL ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 2.0m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE. | | | | | | | | | | | | | |

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-C19

1 OF 1

METRIC

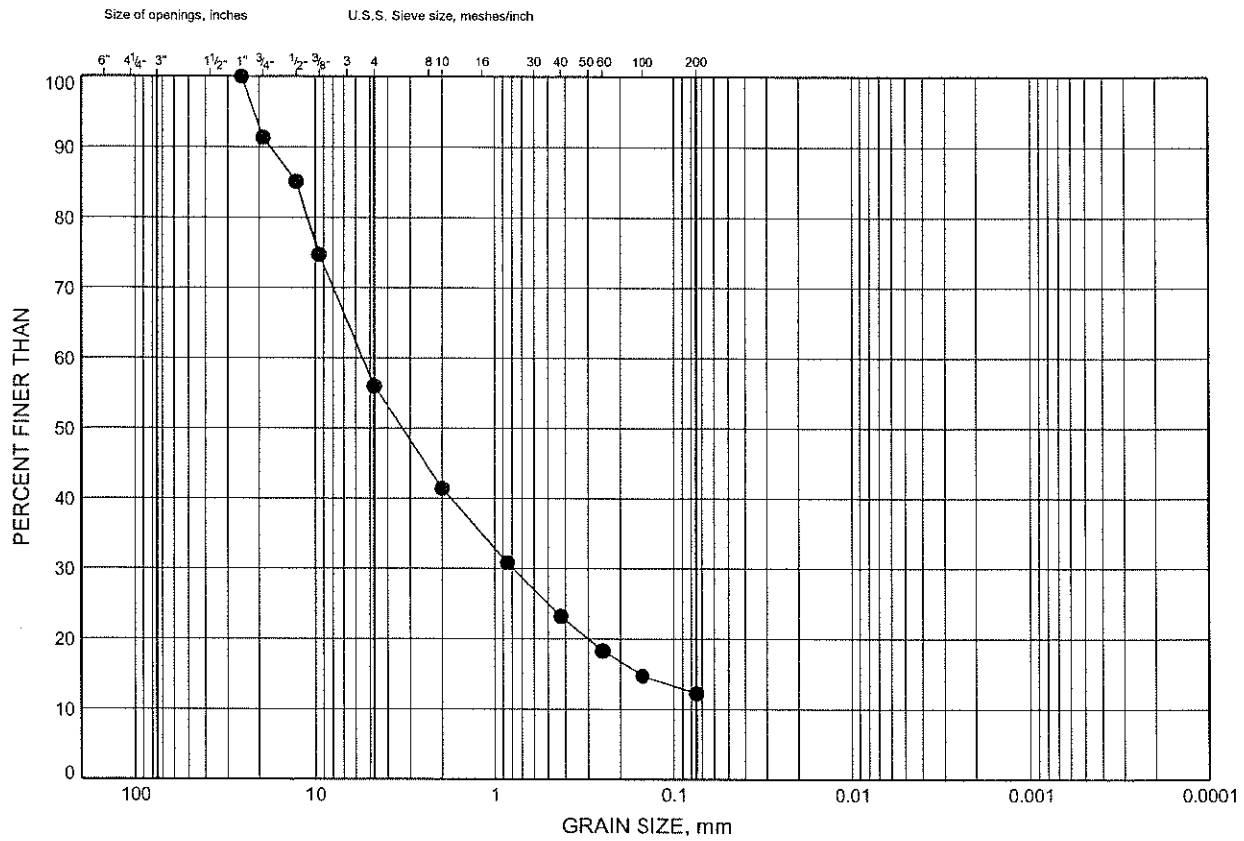
G.W.P. 4067-03-00 LOCATION Campbell Drive N 5 032 689.11 E 312 306.51 ORIGINATED BY GA
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.09.05 - 2007.09.05 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|------------------------------------|-------------------------------------|-----------------------------------|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | PLASTIC LIMIT W _P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | | |
| 114.0 | | | | | | | | | | | | | | |
| 0.8 | ASPHALT:(25mm) | | 1 | SS | 34 | | 114 | | | | | | | |
| 113.4 | SAND AND GRAVEL occasional to trace silt Dense Brown | | | | | | | | | | | | | |
| 0.6 | Dry (FILL) | | 2 | SS | 50/ | | | | | | | | | |
| 112.9 | | | | | | | 113 | | | | | | | |
| 1.1 | Silty CLAY, some sand, occasional gravel Firm Brown Dry | | | | 150 | | | | | | | | | |
| | END OF BOREHOLE AT 1.1m. AUGER REFUSAL AT 1.1m ON PROBABLE BEDROCK, BOULDER OR COBBLES. BOREHOLE OPEN TO 1.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT PATCH SURFACE. | | | | | | | | | | | | | |

Cornwall Noise Barrier GRAIN SIZE DISTRIBUTION

FIGURE C1

SAND AND GRAVEL FILL



| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C03 | 0.38 | 113.57 |

Date November 2007

Project 4067-03-00



Prep'd MFA

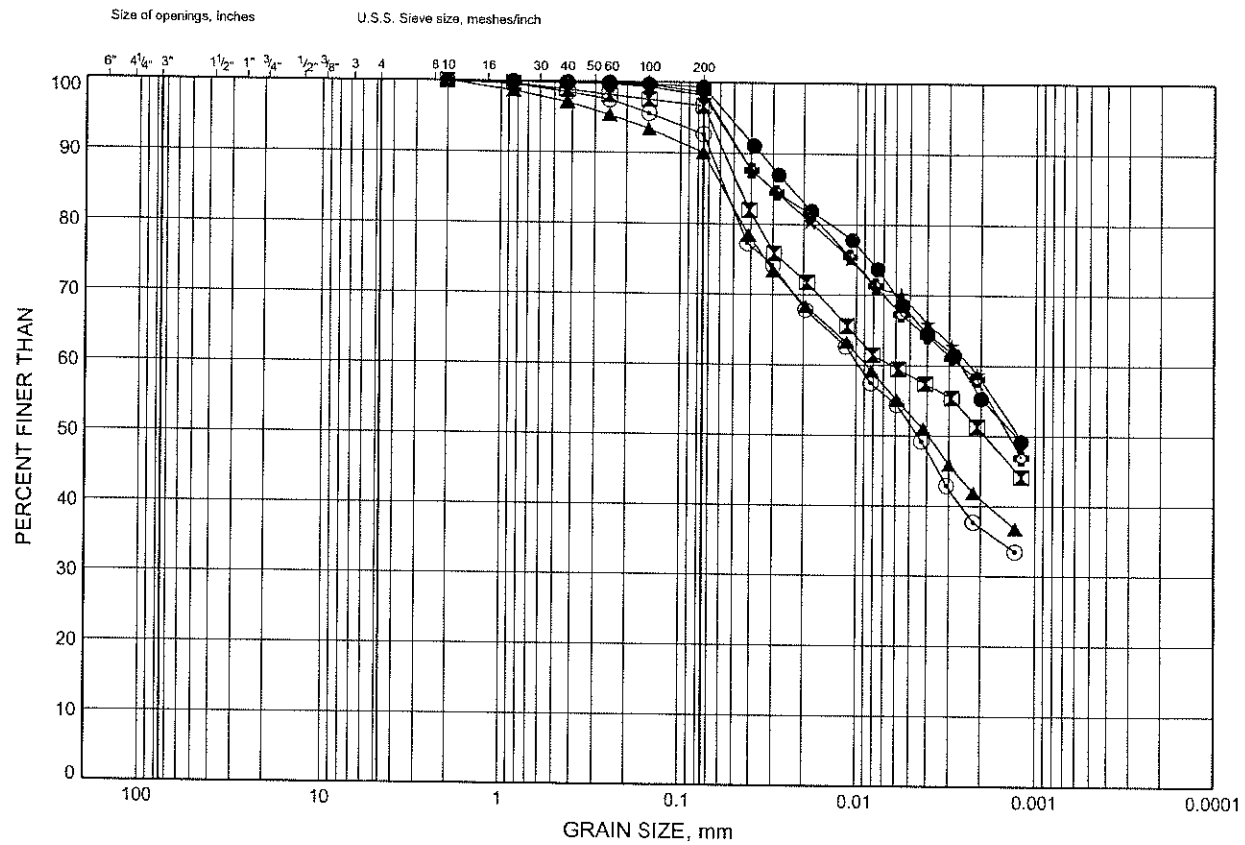
Chkd. SKP

Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE C2

SILTY CLAY

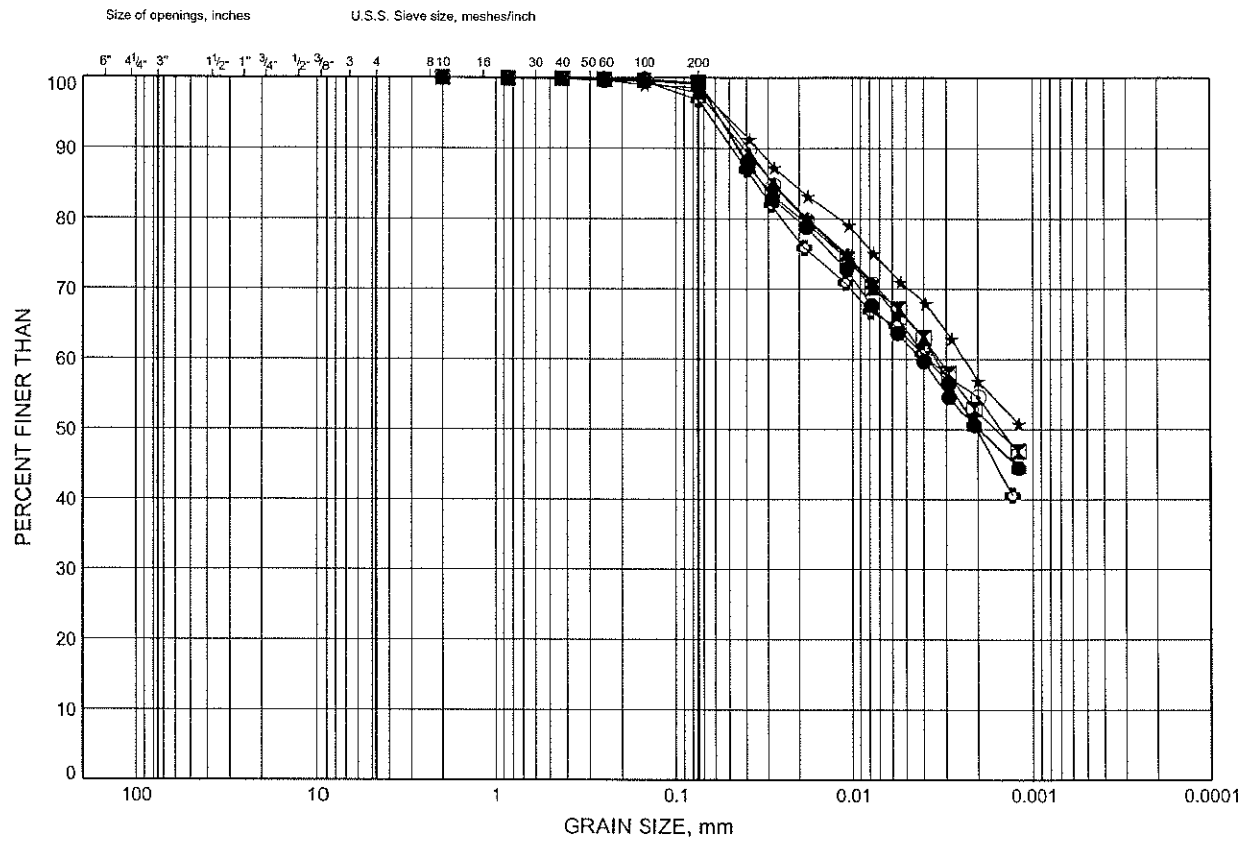


Cornwall Noise Barrier

GRAIN SIZE DISTRIBUTION

FIGURE C3

SILTY CLAY



| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
|----------------|--------|------|--------|--------|------|---------------|
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C06 | 1.83 | 111.07 |
| ⊠ | 07-C08 | 1.07 | 111.63 |
| ▲ | 07-C08 | 2.59 | 110.11 |
| ★ | 07-C11 | 1.07 | 111.43 |
| ⊙ | 07-C11 | 2.59 | 109.91 |
| ⊛ | 07-C11 | 3.35 | 109.15 |

Date November 2007

Project 4067-03-00



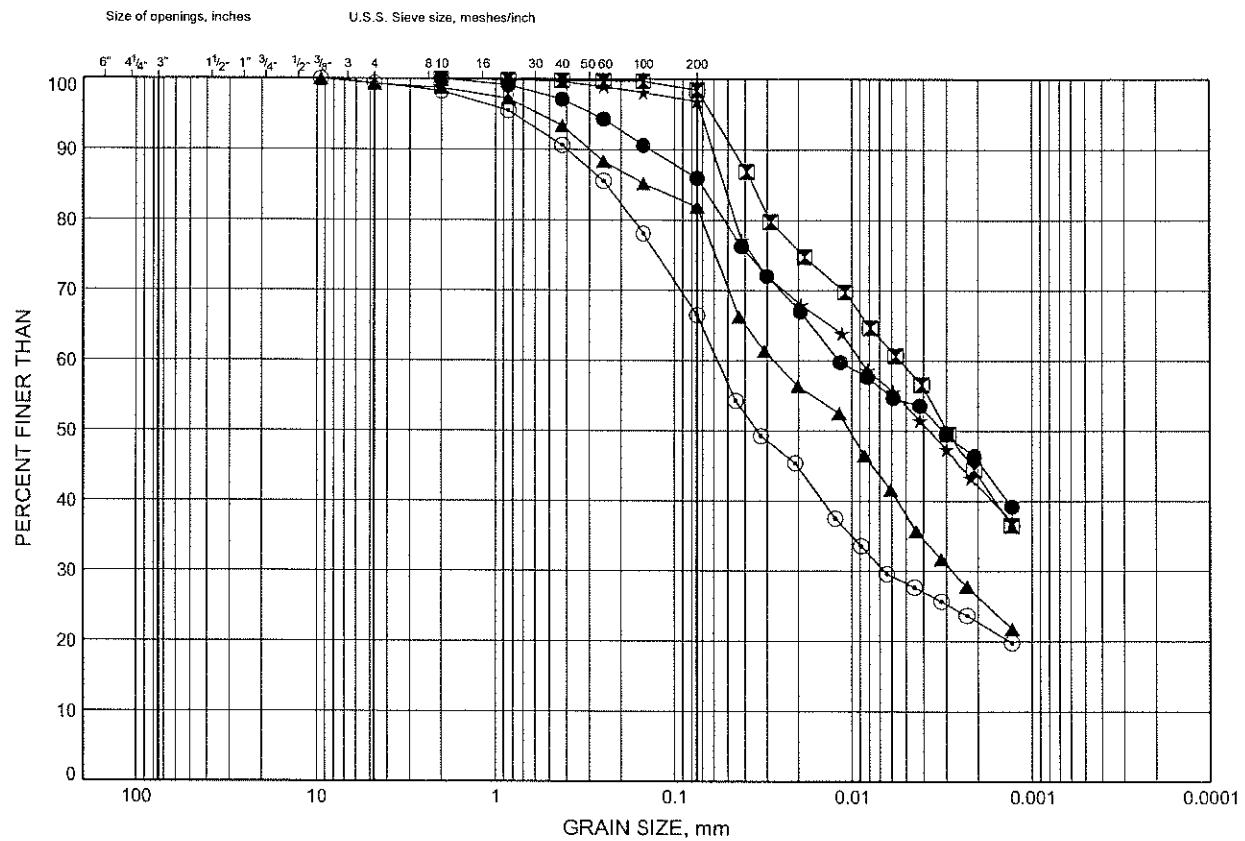
Prep'd MFA

Chkd. SKP

Cornwall Noise Barrier GRAIN SIZE DISTRIBUTION

FIGURE C4

SILTY CLAY



| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
|----------------|--------|------|--------|--------|------|---------------|
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C12 | 1.07 | 111.98 |
| ⊠ | 07-C12 | 3.35 | 109.70 |
| ▲ | 07-C12 | 4.88 | 108.17 |
| ★ | 07-C13 | 1.83 | 112.03 |
| ⊙ | 07-C18 | 1.07 | 112.77 |

Date November 2007

Project 4067-03-00



Prep'd MFA

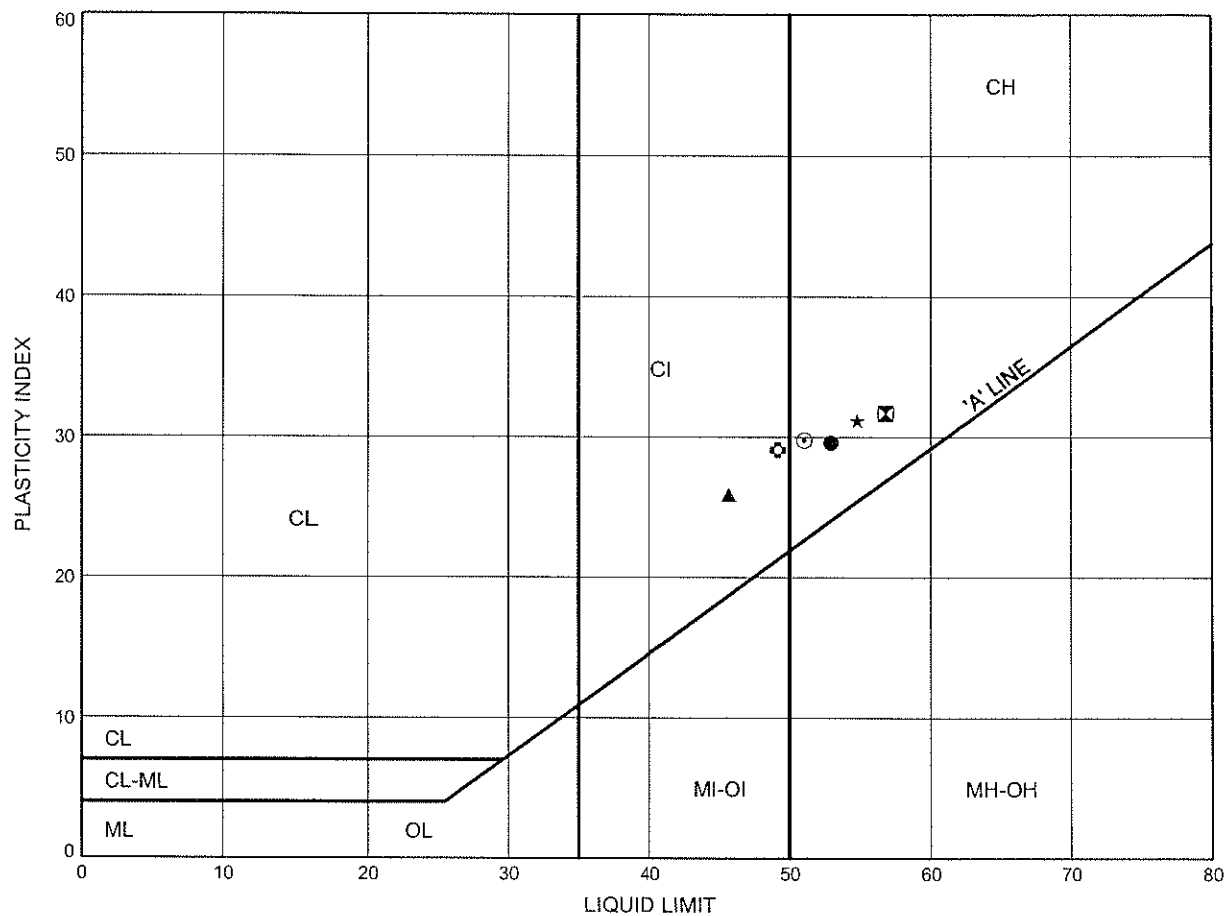
Chkd. SKP

Cornwall Noise Barrier

ATTERBERG LIMITS TEST RESULTS

FIGURE C5

SILTY CLAY



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C01 | 1.83 | 111.80 |
| ⊠ | 07-C03 | 1.83 | 112.12 |
| ▲ | 07-C03 | 3.35 | 110.60 |
| ★ | 07-C04 | 1.07 | 112.03 |
| ⊙ | 07-C06 | 1.83 | 111.07 |
| ⊛ | 07-C06 | 2.59 | 110.31 |

Date November 2007

Project 4067-03-00



Prep'd MFA

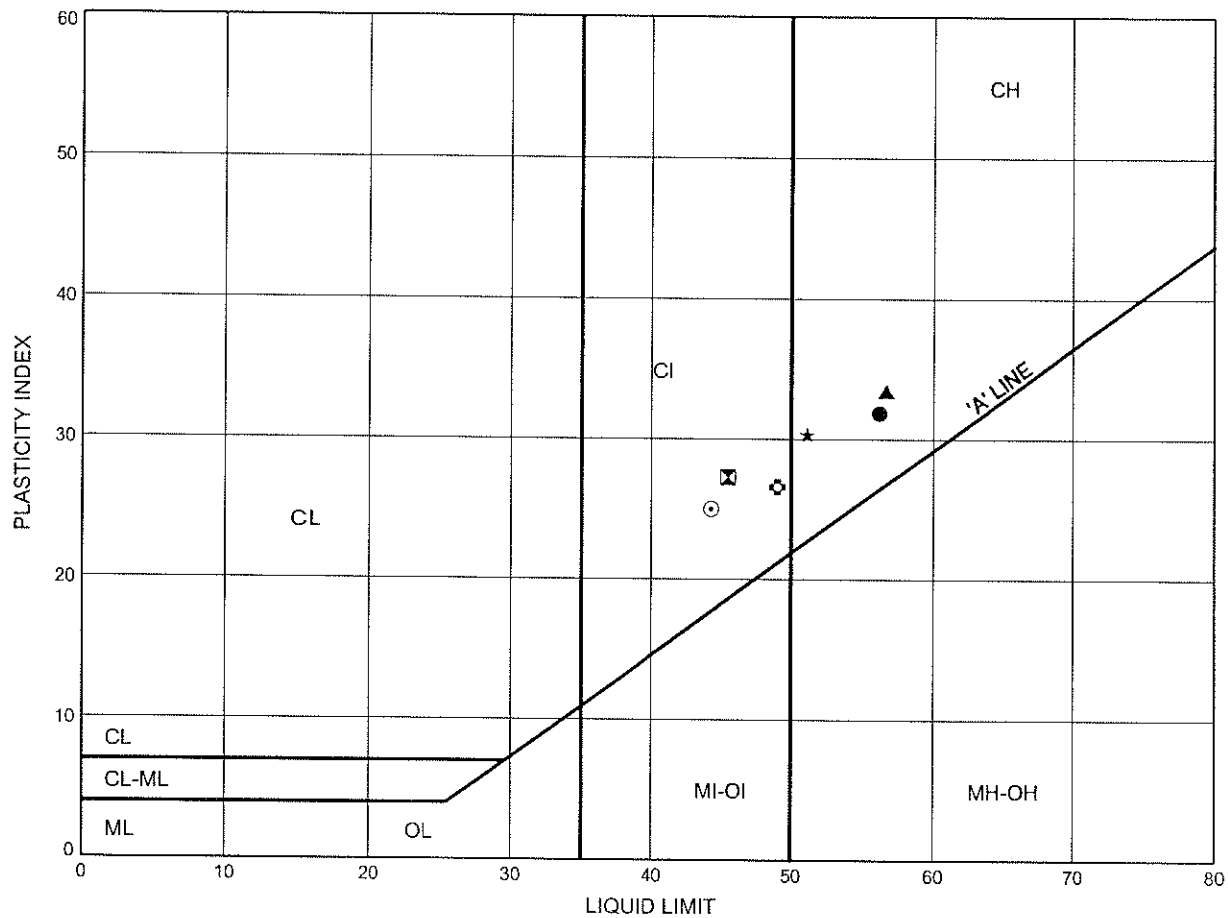
Chkd. SKP

Cornwall Noise Barrier

ATTERBERG LIMITS TEST RESULTS

FIGURE C6

SILTY CLAY



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C08 | 1.07 | 111.63 |
| ⊠ | 07-C08 | 2.59 | 110.11 |
| ▲ | 07-C11 | 1.07 | 111.43 |
| ★ | 07-C11 | 2.59 | 109.91 |
| ⊙ | 07-C11 | 3.35 | 109.15 |
| ⊛ | 07-C12 | 3.35 | 109.70 |

Date November 2007

Project 4067-03-00



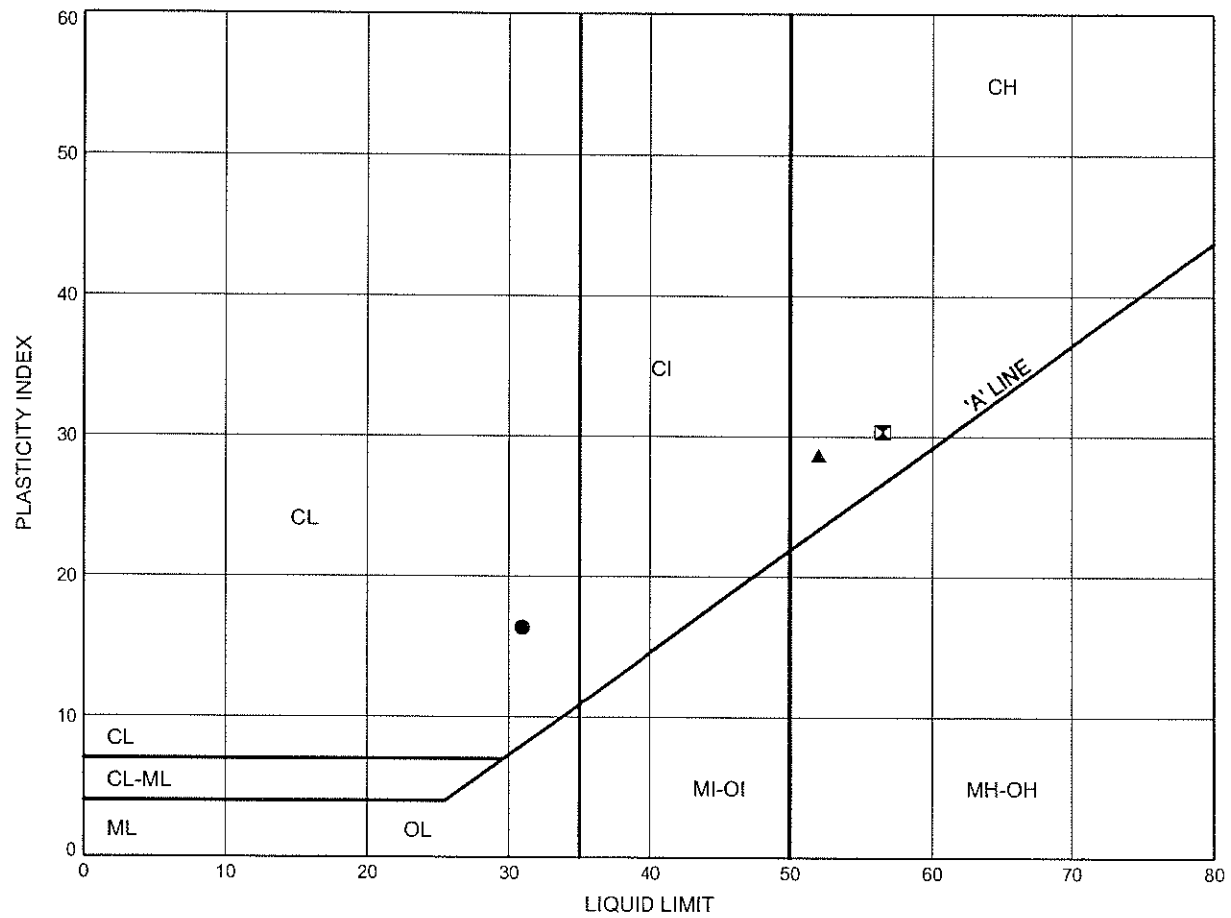
Prep'd MFA

Chkd. SKP

Cornwall Noise Barrier
ATTERBERG LIMITS TEST RESULTS

FIGURE C7

SILTY CLAY



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C12 | 4.88 | 108.17 |
| ⊠ | 07-C13 | 1.83 | 112.03 |
| ▲ | 07-C13 | 3.35 | 110.51 |

THURBALT 1125.GPJ 11/6/07

Date November 2007

Project 4067-03-00



Prep'd MFA

Chkd. SKP

FIGURE C8

Size of openings, inches

U.S.S. Sieve size, meshes/inch

PERCENT FINER THAN

GRAIN SIZE, mm

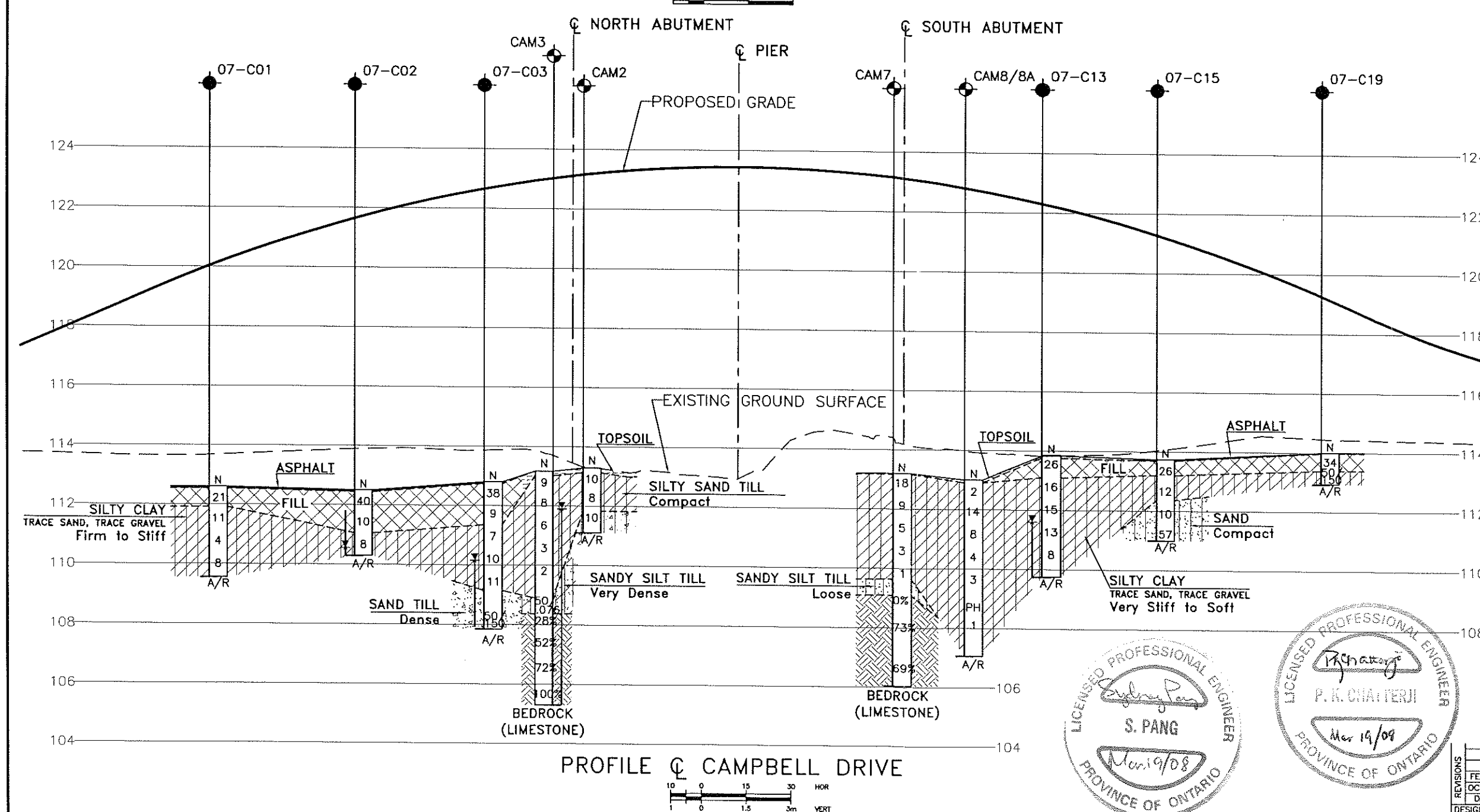
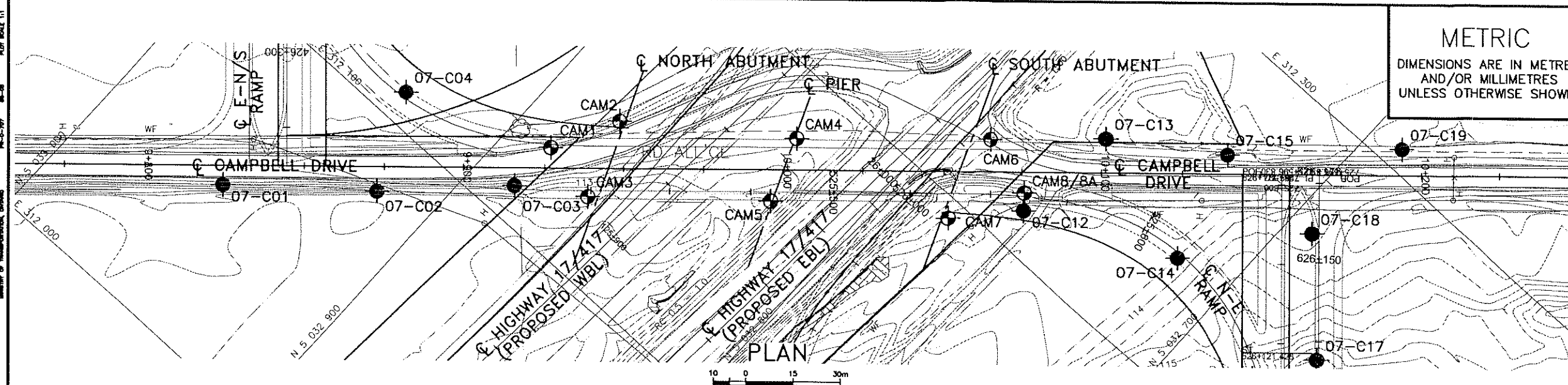
| Grain Size (mm) | Percent Finer (%) |
|-----------------|-------------------|
| 10 | 100 |
| 4.75 | 95 |
| 2.0 | 88 |
| 0.85 | 77 |
| 0.425 | 66 |
| 0.25 | 58 |
| 0.15 | 50 |
| 0.075 | 40 |
| 0.0425 | 31 |
| 0.025 | 28 |
| 0.015 | 25 |
| 0.0075 | 20 |
| 0.00425 | 18 |
| 0.0025 | 15 |
| 0.0015 | 12 |
| 0.00075 | 11 |
| 0.000425 | 10 |
| 0.00025 | 9 |

| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 07-C15 | 1.83 | 111.91 |



Chkd. SKP



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 17/417
SITE No
GWP No 4067-03-00



CAMPBELL DRIVE INTERCHANGE
CAMPBELL DRIVE
HIGHWAY 17/417 TWINUING
BOREHOLE LOCATIONS AND SOIL STRATA

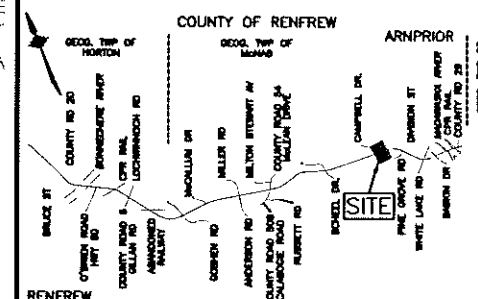
SHEET



McCORMICK RANKIN
CORPORATION







THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

- | | |
|---|---|
|  | Borehole (Present Investigation, 2007) |
|  | Borehole (Previous Investigation, 2004) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
| | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

| NO | ELEVATION | NORTHING | EASTING |
|--------|-----------|-------------|-----------|
| 07-C01 | 112.6 | 5 032 954.2 | 312 049.5 |
| 07-C02 | 112.5 | 5 032 917.4 | 312 080.3 |
| 07-C03 | 112.8 | 5 032 886.9 | 312 110.5 |
| 07-C04 | 113.1 | 5 032 931.3 | 312 109.8 |
| 07-C12 | 113.1 | 5 032 763.5 | 312 212.4 |
| 07-C13 | 113.9 | 5 032 759.5 | 312 246.6 |
| 07-C14 | 113.4 | 5 032 718.2 | 312 233.7 |
| 07-C15 | 113.7 | 5 032 728.0 | 312 268.6 |
| 07-C18 | 113.8 | 5 032 691.8 | 312 268.1 |
| 07-C19 | 114.0 | 5 032 689.1 | 312 306.5 |
| CAM1 | 113.7 | 5 032 886.5 | 312 127.0 |
| CAM2 | 113.3 | 5 032 875.9 | 312 147.9 |
| CAM3 | 113.2 | 5 032 867.6 | 312 123.4 |
| CAM4 | 113.3 | 5 032 831.3 | 312 181.1 |
| CAM5 | 112.7 | 5 032 824.3 | 312 160.9 |
| CAM6 | 114.3 | 5 032 786.5 | 312 221.7 |
| CAM7 | 113.2 | 5 032 779.7 | 312 194.3 |
| CAM8 | 113.0 | 5 032 767.1 | 312 216.7 |

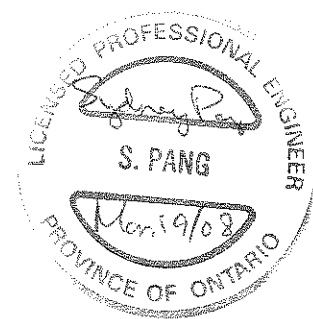
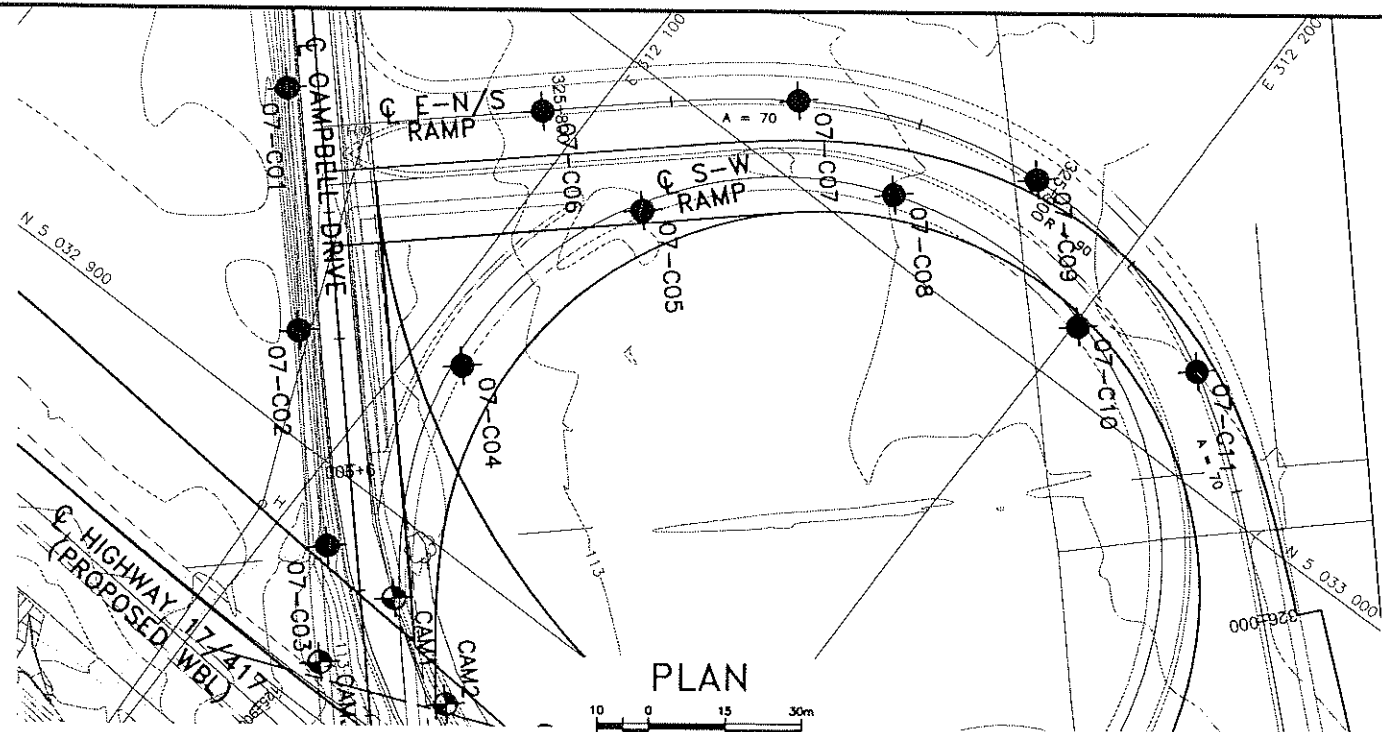
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31F-163

[illegible]

DATE: 11/11/08
DRAWING NAME: CAMPBELL DRIVE INTERCHANGE
CREATED: 11/11/08



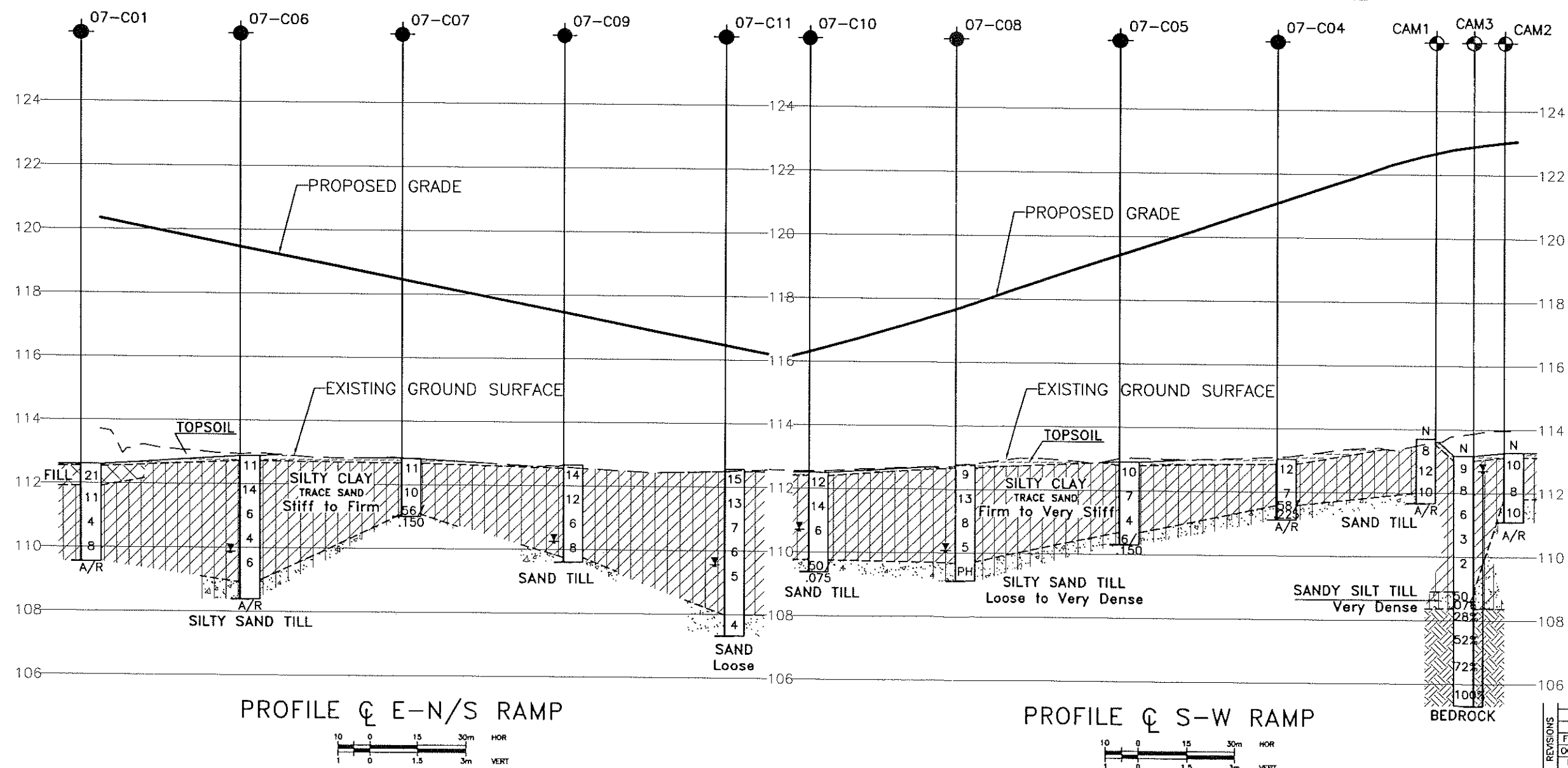
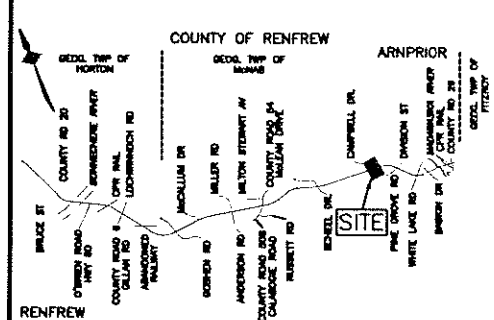
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 17/417
SITE No
GWP No 4067-03-00

CAMPBELL DRIVE INTERCHANGE
E-N/S AND S-W RAMP
HIGHWAY 17/417 TWINNING
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN CORPORATION

SHEET



| LEGEND | | | |
|--------|---|--|--|
| ● | Borehole (Present Investigation, 2007) | | |
| ○ | Borehole (Previous Investigation, 2004) | | |
| N | Blows /0.3m (Std Pen Test, 475J/blow) | | |
| CONE | Blows /0.3m (60° Cone, 475J/blow) | | |
| PH | Pressure, Hydraulic | | |
| W | Water Level | | |
| H | Head Artesian Water | | |
| P | Piezometer | | |
| 90% | Rock Quality Designation (RQD) | | |
| A/R | Auger Refusal | | |

| NO | ELEVATION | NORTHING | EASTING |
|--------|-----------|-------------|-----------|
| 07-C01 | 112.6 | 5 032 954.2 | 312 049.5 |
| 07-C02 | 112.5 | 5 032 917.4 | 312 080.3 |
| 07-C03 | 112.8 | 5 032 886.9 | 312 110.5 |
| 07-C04 | 113.1 | 5 032 931.3 | 312 109.8 |
| 07-C05 | 112.9 | 5 032 977.4 | 312 119.3 |
| 07-C06 | 112.9 | 5 032 981.1 | 312 091.9 |
| 07-C07 | 112.8 | 5 033 013.3 | 312 130.4 |
| 07-C08 | 112.7 | 5 033 010.3 | 312 156.9 |
| 07-C09 | 112.6 | 5 033 029.6 | 312 177.0 |
| 07-C10 | 112.5 | 5 033 011.4 | 312 200.9 |
| 07-C11 | 112.5 | 5 033 018.9 | 312 225.2 |
| CAM1 | 113.7 | 5 032 886.5 | 312 127.0 |
| CAM2 | 113.3 | 5 032 875.9 | 312 147.9 |
| CAM3 | 113.2 | 5 032 867.6 | 312 123.4 |

NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

| | | | |
|----------------------|----------|-----|-----------------|
| GEOCRETS No. 31F-163 | | | |
| REVISIONS | DATE | BY | DESCRIPTION |
| FEB08 | SKP | | FINAL |
| OCT07 | SKP | | ISSUED AS DRAFT |
| DESIGN | SKP | CHK | SKP |
| DRAWN | MFA | CHK | PKC |
| LOAD | | | |
| STRUCT. | | | |
| SCHEME | | | |
| DATE | OCT 2007 | | |
| DATE | | | |

FILENAME: C:\V08 FILES\18\1331\125\1125-plan\profile(campbell).dwg
PLOTDATE: Feb 15, 2008 - 1:25pm

