



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
RETROFIT NOISE BARRIER WALLS  
HIGHWAY 417 OPERATIONAL IMPROVEMENTS  
PARKDALE AVENUE TO THE RIDEAU CANAL  
OTTAWA, ONTARIO**

**W.P. 4088-07-01**

**Geocres Number: 31G5-268**

**Report to**

**MMM Group Limited**

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

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Appendices A through F include:

- Record of Borehole Sheets
- Laboratory Test Results
- Borehole Locations and Soil Strata Drawings

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) at proposed noise barrier wall locations along Highway 417 between Parkdale Avenue and the Rideau Canal in Ottawa, Ontario. The noise barrier walls are part of the Highway 417 Operational Improvements project.

The purpose of this investigation was to explore the subsurface conditions along the proposed noise barrier alignments and based on the data obtained, to provide borehole location plans, record of borehole sheets, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the proposed noise barriers was developed from the data obtained in the course of the investigation.

Eight proposed noise barrier wall alignments were investigated between Parkdale Avenue and the Rideau Canal. Two of the walls (Bronson Avenue W-NS Ramp, and Lyon Street to Bank Street Eastbound Mainlanes) have previously been addressed in separate reports.

Thurber Engineering Ltd. carried out the investigation as a sub-consultant to MMM Group Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 4009-E-0007.

**2 SITE DESCRIPTION**

Highway 417 is a controlled access divided highway with three to four lanes in both the eastbound and westbound directions. The highway is elevated on a fill embankment and crosses overpass structures at Preston, Rochester, Booth, Bronson, Percy, Kent, Bank, O'Connor, Metcalfe and Elgin Streets within the current project segment.

The lands adjacent to Highway 417 comprise a mix of residential and commercial properties.

The site lies within the Ottawa Valley Clay Plains physiographic region, a clay plains interrupted by ridges of sand and rock. The underlying bedrock consists of three formations, from west to east: interbedded limestone and shale of the Verulam Formation; limestone with shale interbeds of the Lindsay Formation; and dark brown to black shale of the Billings Formation.

### 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for the noise barrier walls were carried out between July 15, 2012 and July 3, 2013 and consisted of drilling and sampling a total of 33 boreholes, designated Boreholes NB-01 to NB-33, located along the alignments of eight proposed noise barrier walls.

A summary of the noise barrier walls proposed at the time of drilling and the corresponding borehole numbers is presented in Table 3.1. The respective appendices, which include Record of Borehole sheets, laboratory test results, and Borehole Locations and Soil Strata Drawings for each wall, are also listed in Table 3.1.

**Table 3.1 – Summary of Proposed Noise Barrier Walls and Corresponding Boreholes**

Proposed Wall Location	Approx. Station	Length (m)	Boreholes	Appendix
CPR to Preston St. Eastbound Mainlanes	26+950 to 27+035	85	NB-01 and NB-02	A
Bronson Avenue W-NS Ramp	27+400 to 27+690	290	NB-03 to NB-05	**
Bronson Ave. to Lyon St. Eastbound Mainlanes	27+810 to 28+400	590	NB-06 to NB-14	B
Lyon St. to Bank St. Eastbound Mainlanes	28+380 to 28+690	310	NB-15 to NB-19	**
Bank St. to Elgin St. Eastbound Mainlanes	28+790 to 29+240	450	NB-20 to NB-25	C
Metcalf Street S-E Ramp	29+210 to 29+365	155	NB-26 to NB-28	D
Percy St. to Lyon St. Westbound Mainlanes	28+170 to 28+300	130	NB-29 to NB-31	E
Bronson Ave. to Percy St. Westbound Mainlanes	27+985 to 28+045	60	NB-32 and NB-33	F

\*\* Presented in a separate report.

Two of the walls (Bronson Avenue W-NS Ramp, and Lyon Street to Bank Street Eastbound Mainlanes) have previously been addressed in separate reports. In addition, one section of wall identified for replacement in the RFP (Bronson Avenue to Lyon Street Eastbound Mainlanes, Appendix B) is not currently planned for replacement. The factual data from that wall alignment is presented for information purposes only.

All boreholes referenced in the current report were advanced to 6.7 m depth with the exception of Boreholes NB-20 and NB-26 which were terminated at depths of 13.1 and 10.1 m, respectively.

The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings included in Appendices A through F. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole sheets.

The borehole locations were marked in the field where possible and utility clearances were obtained prior to commencement of drilling operations. Boreholes were repositioned as necessary to avoid conflicts with utilities.

The boreholes were advanced using hollow stem augers powered by a truck-mounted drill rig. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). In situ vane shear testing was carried out to assess the undrained shear strength of the cohesive deposits.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and bedrock samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm diameter PVC pipe with a slotted screen were installed in selected boreholes to monitor groundwater levels after drilling. The installation details are summarized in Table 3.2.

Where no piezometer was installed, the boreholes were backfilled with a mixture of bentonite and cuttings in general accordance with MOE Regulation 903 as amended, with asphalt patch at surface. Following the final water level readings, the piezometers were decommissioned in general accordance with MOE Regulation 903.

In addition to the boreholes drilled during the current investigation, existing test pit information was reviewed for the east section of wall along the Lyon Street N-W ramp (Report on the Foundation Investigation for the Proposed Queensway Embankment between Stations 358+00 and 415+00, McRostie & Associates Ltd., undated; Geocres No. 31G05-46). The test pit log for Hole No. 78 from the previous investigation is included in Appendix E.

**Table 3.2 – Piezometer Installation and Borehole Completion Details**

Borehole	Tip Position (m)	Installation / Completion Details
	Depth / Elev.	
NB-07	6.1 / 69.7	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, bentonite mixed with cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-09	6.1 / 68.5	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-11	6.1 / 67.1	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt cold patch to surface. Flush-mount casing protector installed at surface.
NB-13	6.1 / 65.7	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-21	6.1 / 66.4	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-23	6.1 / 67.8	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-25	6.1 / 67.0	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-27	6.1 / 66.1	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-29	6.1 / 65.3	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-31	6.1 / 66.6	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.
NB-33	6.1 / 68.2	Sand filter from 6.1 to 4.3 m, bentonite from 4.3 to 3.4 m, cuttings from 3.4 to 0.1 m, then asphalt at surface. Flush-mount casing protector installed at surface.

#### 4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing, where appropriate. The results of this testing program are summarized on the Record of Borehole sheets included in Appendices A to F and plotted on the figures included in Appendices A through F.

## 5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and the Borehole Locations and Soil Strata Drawings included in Appendices A to F. A general description of the stratigraphy at each wall alignment, based on the conditions encountered in the boreholes, is given in the following sections. However, the factual data presented in the borehole logs shall take precedence over these general descriptions and interpretations of the site conditions. It must be recognized that the soil conditions may vary between and beyond the investigated borehole locations.

### 5.1 EBL - CPR to Preston Street, Sta. 26+950 to 27+035 (Appendix A)

Boreholes NB-01 and NB-02 were drilled along the proposed noise barrier wall alignment on the right shoulder of the Highway 417 eastbound lanes. The stratigraphy encountered in the boreholes consisted of an asphalt and concrete pavement over sand fill underlain by silty clay fill.

#### 5.1.1 Asphalt and Concrete

A 125 to 150 mm thick layer of asphalt was encountered at the highway surface in both boreholes. The asphalt was underlain by a 225 mm thick layer of concrete.

#### 5.1.2 Sand Fill

Sand fill was encountered below the concrete in both boreholes. The sand fill was brown in colour and typically contained trace gravel and trace silt. In Borehole NB-02, the fill contained some gravel in the upper 0.4 m, and was mixed with clayey silt in the underlying 0.6 m. The thickness of the sand fill was 2.2 and 5.5 m, with the lower boundary encountered at depths of 2.6 and 5.9 m (Elevation 67.1 and 61.7 m).

SPT N-values recorded in the sand fill ranged from 10 to 25 blows for 0.3 m penetration, indicating a compact relative density. It became loose at the boundary with the underlying clay fill in Borehole NB-01. Moisture contents of the sand fill ranged from 4 to 11%.

Three samples of the sand fill were selected for laboratory grain size analysis. The results of these tests are summarized below. These results are also presented on the corresponding Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A1, Appendix A.

Gravel %	1 to 18
Sand %	62 to 94
Silt & Clay %	5 to 20



### 5.1.3 Silty Clay Fill

Silty clay fill was encountered below the sand fill in both boreholes. The clay fill was brown to dark brown in colour and contained some sand (to sandy) and trace gravel. The boreholes were terminated in the silty clay fill at 6.7 m depth (Elevation 63.0 and 60.9 m).

SPT N-values recorded in the silty clay fill ranged from 4 to 6 blows for 0.3 m penetration in Borehole NB-01, indicating a firm consistency. An N-value of 17 blows for 0.3 m was obtained in Borehole NB-02, indicating a very stiff consistency. Moisture contents ranged from 14 to 31%.

Three samples of the silty clay fill underwent laboratory grain size analysis and two samples underwent Atterberg Limits testing, the results of which are summarized below. These results are presented on the corresponding Record of Borehole sheets included in Appendix A and the lab results are plotted on Figures A2 and A3.

Gravel %	0 to 1
Sand %	13 to 40
Silt %	36 to 45
Clay %	23 to 42
Liquid Limit%	32 to 37
Plastic Index %	17 to 20

The Atterberg Limits results indicate that the silty clay fill is of low to intermediate plasticity with a group symbol of CL to CI.

### 5.1.4 Groundwater

Water was not observed in the open boreholes during or upon completion of drilling.

## 5.2 EBL - Bronson Avenue to Lyon Street, Sta. 27+810 to 28+400 (Appendix B)

Boreholes NB-06 to NB-14 were drilled on the right shoulder of the Highway 417 eastbound lanes along the alignment of a noise barrier wall identified for replacement. Replacement of this wall is not currently planned. The Record of Borehole sheets and a Borehole Location Plan are provided in Appendix B for information purposes only.

## 5.3 EBL - Bank Street to Elgin Street, Sta. 28+790 to 29+240 (Appendix C)

Boreholes NB-20 to NB-25 were drilled along the proposed noise barrier wall alignment on the right shoulder of Highway 417. The stratigraphy encountered in the boreholes generally consisted of asphalt (and concrete in Borehole NB-22) overlying sand fill. Native silty clay or silty sand were encountered below the sand fill in some boreholes.

### 5.3.1 Asphalt and Concrete

A 125 to 225 mm thick layer of asphalt was encountered at the surface in all boreholes. The asphalt was underlain by a 300 mm thick layer of concrete in Borehole NB-22.

### 5.3.2 Sand Fill

Sand fill was encountered below the asphalt and concrete in all boreholes. The sand fill was dark brown to brown in colour and contained trace to some silt and trace to some gravel. Occasional asphalt pieces and a 25 mm thick layer of asphalt were observed in the lower part of the fill in Borehole NB-21.

The sand fill was fully penetrated in four of the six boreholes (NB-20 to NB-22 and NB-25). In these boreholes, the sand fill was 4.8 to 5.9 m thick, with the lower boundary encountered at depths of 4.9 to 6.3 m (Elevations 67.3 to 66.4). The other two boreholes (NB-23 and NB-24) were terminated within the sand fill at a depth of 6.7 m (Elevations 67.2 and 66.9).

SPT N-values recorded in the sand fill ranged from 17 to 76 blows for 0.3 m penetration, indicating a compact to very dense relative density. Typically, N-values ranged from 30 to 76 (dense to very dense). The moisture content of samples of the sand fill ranged from 2% to 12%, typically less than 8%.

Six samples of the sand fill were selected for laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C1, Appendix C.

Gravel %	0 to 18
Sand %	71 to 86
Silt and Clay %	11 to 18

### 5.3.3 Organics

A 0.3 m thick layer of organics with wood fragments was encountered below the sand fill in Borehole NB-20.

### 5.3.4 Silty Sand

Native silty sand was encountered below the sand fill in Boreholes NB-21 and NB-22. The silty sand was brown to grey in colour and contained organics. Both boreholes were terminated within the silty sand at a depth of 6.7 m (Elevations 66.9 and 65.8).

SPT N-values of 49 and 53 blows for 0.3 m penetration were recorded in the native silty sand, indicating a dense to very dense relative density. Moisture contents of 9% and 12% were measured.

#### 5.3.5 Silty Clay

Silty clay was encountered below the organic layer in Borehole NB-20 and directly below the sand fill in Borehole NB-25. The silty clay was described as grey in Borehole NB-20 and brown with sand seams in Borehole NB-25. Boreholes NB-20 and NB-25 were terminated in the silty clay at depths of 13.1 and 6.7 m (Elevations 58.2 and 66.4), respectively.

SPT N-values recorded in the silty clay in Borehole NB-20 ranged from 0 to 4 blows for 0.3 m penetration, indicating a very soft to firm consistency. In situ shear vane testing indicated undrained shear strengths in the order of 30 to 72 kPa (firm to stiff). Moisture contents of the silty clay from this borehole ranged from 51% to 74%.

An SPT N-value of 15 blows for 0.3 m penetration (very stiff) was recorded in the clay in Borehole NB-25. A moisture content of 28% was measured.

Three samples of the silty clay underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figures C2 and C3, Appendix C.

	Silty Clay	Silty Clay (with sand seams)
Gravel %	0	0
Sand %	0	31
Silt %	22 to 27	36
Clay %	73 to 78	33

#### 5.3.6 Water Levels

Water was not observed in the open boreholes during or upon completion of drilling.

Standpipe piezometers were installed in three boreholes to monitor groundwater levels after completion of drilling. Water was not detected in the piezometers on two monitoring occasions, as summarized in Table 5.3.1.

**Table 5.3.1 – Groundwater Depths and Elevations in Piezometers**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
NB-21	15-Jul-2012		Dry	Upon completion
	21-Aug-2012		Dry	In piezometer
	21-Nov-2012		Dry	In piezometer
NB-23	16-Jul-2012		Dry	Upon completion
	21-Aug-2012		Dry	In piezometer
	21-Nov-2012		Dry	In piezometer
NB-25	16-Jul-2012		Dry	Upon completion
	21-Aug-2012		Dry	In piezometer
	21-Nov-2012		Dry	In piezometer

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

#### **5.4 Metcalfe Street S-E Ramp (Appendix D)**

Boreholes NB-26 to NB-28 were drilled along the proposed noise barrier wall alignment on the S-E ramp at Metcalfe Street. The stratigraphy encountered in the boreholes generally consisted of an asphalt and concrete surface underlain by sand fill, overlying silty clay in one borehole.

##### **5.4.1 Asphalt and Concrete**

A 150 to 250 mm thick layer of asphalt was encountered in the boreholes located on the highway shoulder. The asphalt was underlain by a 175 to 450 mm thick layer of concrete.

##### **5.4.2 Sand Fill**

Sand embankment fill was encountered below the concrete in all three boreholes. The sand fill was typically brown and contained trace to some gravel, trace to some silt and occasional cobbles.

Boreholes NB-27 and NB-28 were terminated within the sand fill at a depth of 6.7 m (Elevation 65.4 and 66.1). In Borehole NB-26, the sand fill was 2.7 m thick, with the lower boundary encountered at a depth of 3.0 m (Elevation 66.2).

SPT N-values recorded in the sand fill ranged from 7 blows for 0.3 m penetration to 87 blows for 0.25 m penetration, indicating a variable relative density ranging from loose to very dense. The higher N-values may also reflect the presence of cobbles in the fill.

Moisture contents of samples of the sand fill typically ranged from 6% to 21%.

Four samples of the sand fill underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D1, Appendix D.

Gravel %	3 to 13
Sand %	68 to 89
Silt and Clay %	8 to 22

#### 5.4.3 Silty Clay

Silty clay was encountered below the sand fill in Borehole NB-26. The silty clay was brown in colour, becoming grey with increased depth. Borehole NB-26 was terminated within the silty clay at a depth of 10.1 m (Elevation 59.2).

SPT N-values recorded in the silty clay ranged from 1 to 8 blows for 0.3 m penetration, indicating a very soft to firm consistency. In situ shear vane testing indicated undrained shear strengths in the order of 46 to 72 kPa.

The moisture content of samples of the silty clay ranged from 60% to 76%.

Two samples of the silty clay were selected for laboratory grain size analysis, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D2, Appendix D.

Gravel %	0
Sand %	0 to 1
Silt %	20 to 22
Clay %	78 to 79

One sample also underwent Atterberg Limits testing, the results of which are summarized below. These results indicate that the silty clay exhibits high plasticity with a group symbol of CH. Figure D3, Appendix D plots the result of this testing.

Liquid Limit	60
Plastic Limit	25

#### 5.4.4 Water Levels

Water was not observed in the open boreholes during or upon completion of drilling.

A standpipe piezometer was installed in one of the boreholes to monitor groundwater levels after completion of drilling. Water was not detected in the piezometer on two monitoring occasions, as summarized in Table 5.4.1.

**Table 5.4.1 – Groundwater Depths and Elevations in Piezometer**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
NB-27	19-Jul-2012		Dry	Upon completion
	22-Aug-2012		Dry	In piezometer
	21-Nov-2011		Dry	In piezometer

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

### **5.5 WBL – Percy Street to Lyon Street, Sta. 28+170 to 28+300 (Appendix E)**

Boreholes NB-29 to NB-31 were drilled along the proposed noise barrier wall alignment at this location. The stratigraphy encountered in the boreholes consisted of an asphalt and concrete pavement surface underlain by sand fill. The sand fill was underlain by native silty sand in one borehole.

#### **5.5.1 Asphalt and Concrete**

A 150 to 200 mm thick layer of asphalt was encountered at the highway surface in all three boreholes. A 250 to 350 mm thick layer of concrete was encountered below the asphalt.

#### **5.5.2 Sand Fill**

Sand fill was encountered below the concrete in Boreholes NB-29 to NB-31. The sand fill was brown in colour and contained trace gravel, trace to some silt and occasional cobbles.

Boreholes NB-30 and NB-31 were terminated within the sand fill at a depth of 6.7 m (Elevation 66.0 and 65.4). In Borehole NB-29, the sand fill was 5.6 m thick, with the lower boundary encountered at a depth of 6.2 m (Elevation 65.2).

SPT N-values recorded in the sand fill ranged from 2 to 79 blows for 0.3 m penetration, indicating a variable relative density ranging from very loose to very dense. Typically, the sand fill was compact to dense, becoming loose to very loose with depth.

Moisture contents of the sand fill typically ranged from 7% to 12%. A moisture content of 25% was measured near the base of the fill in Borehole NB-29.

Four samples of the sand fill underwent laboratory grain size analysis, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix E and the grain size distribution curves for these samples are plotted on Figure E1, Appendix E.

Gravel %	2 to 7
Sand %	80 to 85
Silt and Clay %	9 to 17

### 5.5.3 Silty Sand

Native silty sand was encountered below the sand fill in Borehole NB-29. The native silty sand was brown and contained trace gravel and trace topsoil. Borehole NB-29 was terminated within the silty sand at a depth of 6.7 m (Elevation 64.7).

A single SPT N-value of 12 blows for 0.3 m penetration was recorded in the native silty sand, indicating a compact relative density. A moisture content of 15% was measured in one sample.

### 5.5.4 Water Levels

Water levels were recorded in the open boreholes upon completion of drilling. Standpipe piezometers were installed in two of the boreholes to monitor water levels after completion of drilling. The groundwater depths and elevations measured in the piezometers and in the open boreholes upon completion are shown in Table 5.5.2.

**Table 5.5.2 – Groundwater Depths and Elevations**

Borehole	Date	Water Level (m)		Comments
		Depth	Elevation	
NB-29	22-Jul-2012	5.9	65.5	Upon completion
	22-Aug-2012	4.4	67.0	In piezometer
	21-Nov-2012	5.4	66.0	In piezometer
NB-30	22-Jul-2012	5.5	66.6	Upon completion
NB-31	22-Jul-2012	Dry	-	Upon completion
	22-Aug-2012	3.2	69.5	In piezometer
	21-Nov-2012	6.1	66.6	In piezometer

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

### 5.5.5 Test Pit from Previous Investigation

The stratigraphy encountered in the test pit excavated during the previous investigation (Hole No. 78, Geocres No. 31G05-46) consisted of 0.9 m of rubble fill (sand, cinders, brick, wood, etc.) underlain by 0.6 m of silty sand fill, overlying native silt and fine sand encountered at a depth of 1.5 m (Elev. 66.9). The silt and fine sand was 0.9 m thick and underlain by a 0.3 m thick layer of sand with some gravel. Clay was encountered below the sand at 2.7 m depth (Elev. 65.7), and the test pit was terminated in the clay at 3.0 m depth (Elev. 65.4).

Seepage was observed in the test pit at a depth of 2.4 m (Elev. 66.0).

## 5.6 WBL - Bronson Avenue to Percy Street, Sta. 27+985 to 28+045 (Appendix F)

Boreholes NB-32 and NB-33 were drilled along the proposed noise barrier wall alignment at this location. The stratigraphy encountered in the boreholes consisted of an asphalt pavement surface overlying sand fill.

### 5.6.1 Asphalt

A 200 to 250 mm thick asphalt layer was encountered at the surface in both boreholes.

### 5.6.2 Sand Fill

Sand fill was encountered below the asphalt in both boreholes. The sand fill was brown in colour and contained trace gravel, trace to some silt and occasional cobbles. Both boreholes were terminated within the sand fill at a depth of 6.7 m (Elevations 67.6 and 67.2).

SPT N-values recorded in the sand fill ranged from 5 to 50 blows for 0.3 m penetration, indicating a variable relative density ranging from loose to dense. Moisture contents of the sand fill ranged from 3% to 8%.

Four samples of the sand fill underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix F and the grain size distribution curves for these samples are plotted on Figure F1, Appendix F.

Gravel %	1 to 5
Sand %	84 to 91
Silt and Clay %	8 to 11



### 5.6.3 Water Levels

Water was not observed in the open boreholes during or upon completion of drilling.

A standpipe piezometer was installed in one of the boreholes to monitor groundwater levels after completion of drilling. Water was not detected in the piezometer on two monitoring occasions, as summarized in Table 5.6.2.

**Table 5.6.2 – Groundwater Depths and Elevations in Piezometer**

Borehole	Date	Water Level (m)		Comments
		Depth	Elevation	
NB-33	02-Aug-2012	Dry		Upon completion
	22-Aug-2012	Dry		In piezometer
	21-Nov-2012	Dry		In piezometer

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

## 6 MISCELLANEOUS

The borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors from MMM Group determined the co-ordinates and ground surface elevations at the boreholes after completion of the site investigation.

Underground Service Locators Inc. obtained utility clearances on behalf of Thurber for the selected borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a truck-mounted drill rig and conducted the drilling, sampling and in-situ testing operations.

The field investigation was supervised by Ms. Eckie Siu, Mr. Stephane Loranger, and Ms. Gabrielle Marcotte, E.I.T. of Thurber. Overall planning and supervision of the field program was conducted by Ms. Lindsey Blaine, E.I.T.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Interpretation of the data and preparation of the report were carried out by Ms. Lindsey Blaine, E.I.T. and Mr. Murray Anderson, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

### **Thurber Engineering Ltd.**



Murray R. Anderson, P.Eng., M.Eng.  
Senior Foundations Engineer



P.K. Chatterji, P.Eng., Ph.D.  
Review Principal, Designated MTO Contact

## **Appendix A**

**EBL - CPR to Preston Street, Sta. 26+950 to 27+035**

**Boreholes NB-01 and NB-02**

## 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 <sup>(1)</sup> '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  
 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 <sub>L</sub> < 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 <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 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			

# RECORD OF BOREHOLE No NB-01

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 477.6 E 366 482.2 ORIGINATED BY SLL  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2013.07.02 - 2013.07.03 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
69.7	GROUND SURFACE							20	40	60	80	100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
0.0	ASPHALT: (125mm)															
0.1																
69.3	CONCRETE: (225mm)															
0.4	SAND, trace gravel, trace silt Compact Brown Moist (FILL)		1	GS			69									
			1	SS	16											4 88 8 (SI+CL)
			2	SS	16		68									
	becoming Loose		3	SS	6		67									
67.1			4	SS	4											1 40 36 23
2.6	Silty CLAY, sandy to some sand, trace gravel Firm Brown Moist (FILL)						66									
	with sand pockets		5	SS	4		65									
			6	SS	5		64									0 13 45 42
63.0							63									
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY TO 6.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CUTTINGS TO 0.3m, THEN ASPHALT TO SURFACE.															

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## METRIC

[illegible]

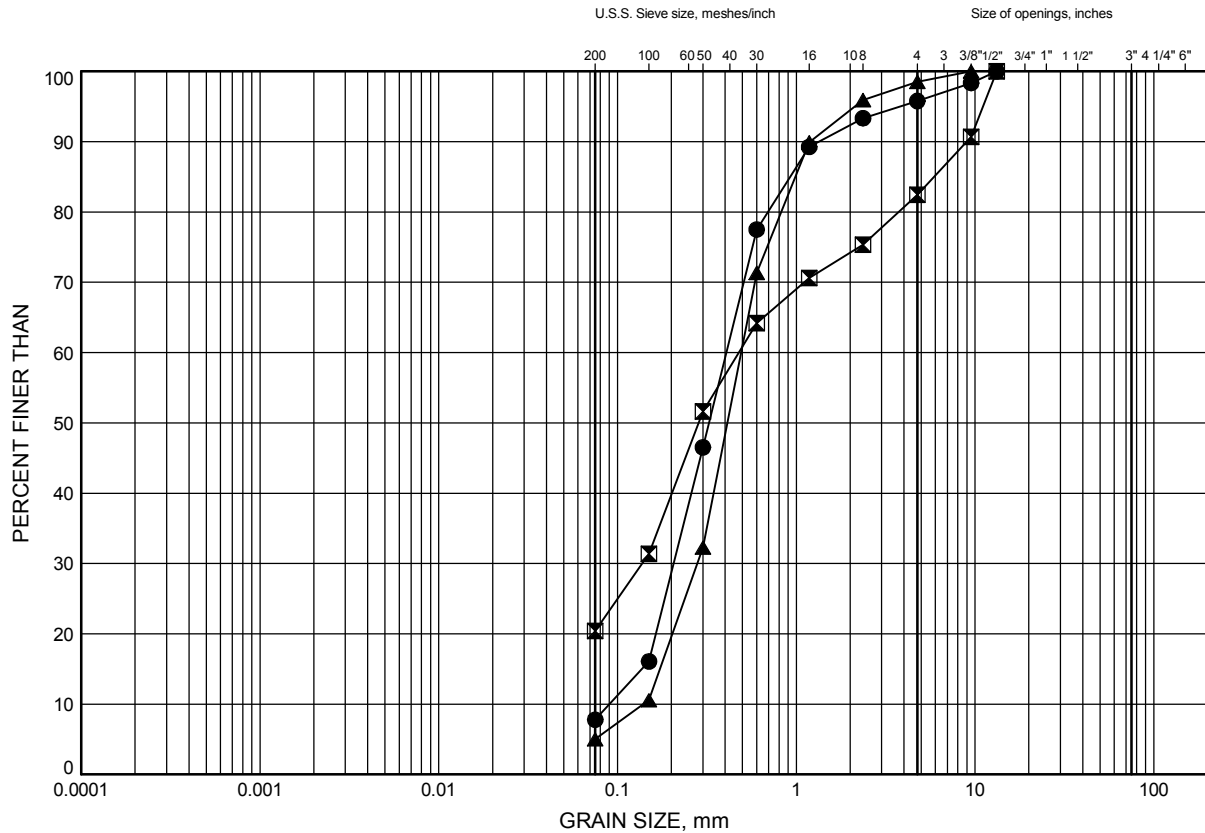
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE A1

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-01	1.07	68.63
⊠	NB-02	0.57	67.03
▲	NB-02	3.35	64.25

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA

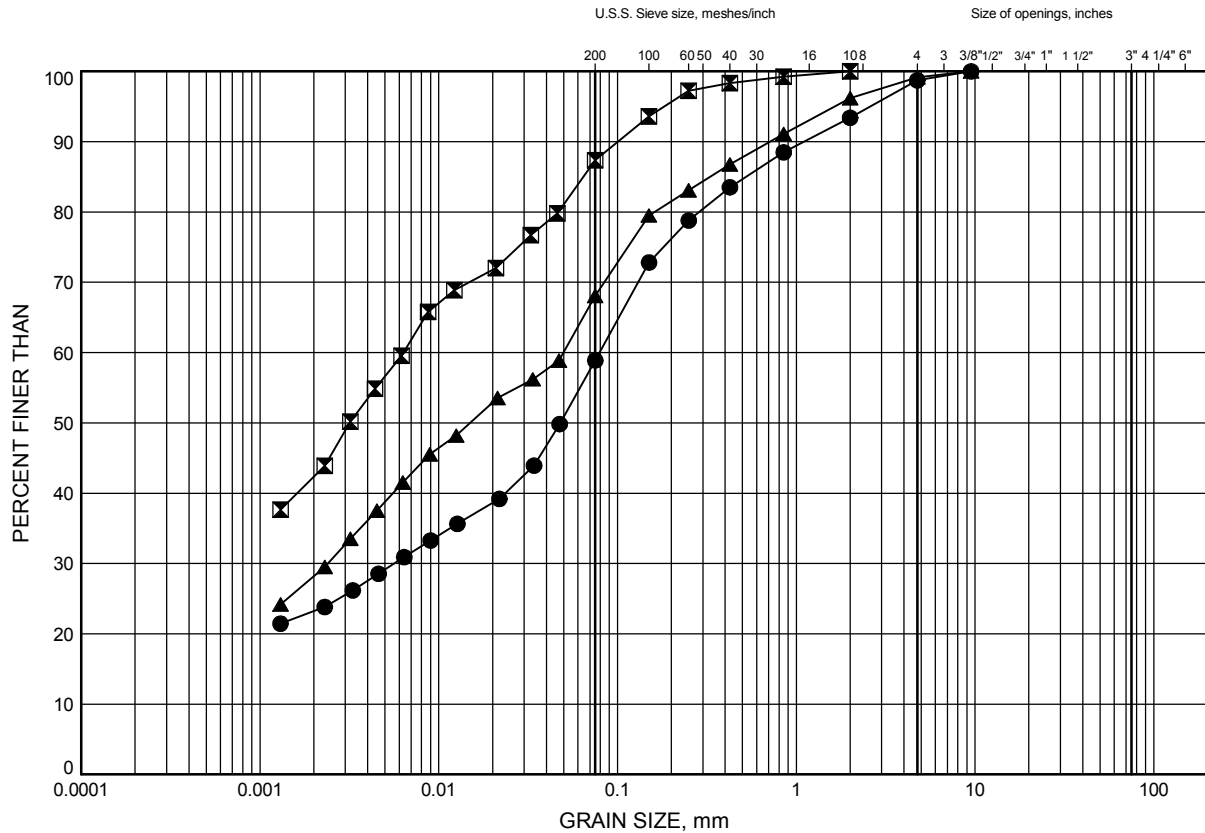


# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE A2

### SILTY CLAY FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-01	3.35	66.35
⊠	NB-01	6.40	63.30
▲	NB-02	6.40	61.20

Date April 2015  
W.P. 4088-07-01



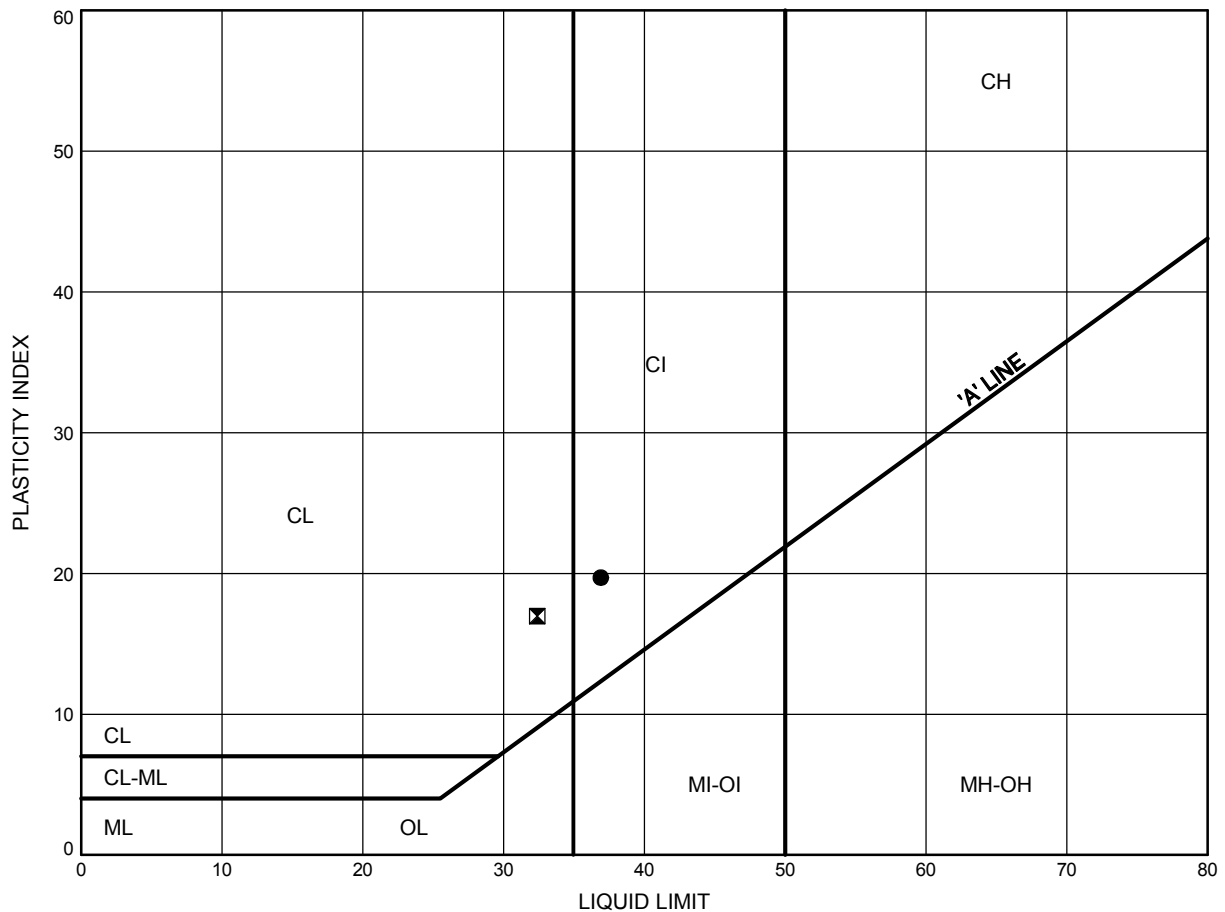
Prep'd MFA  
Chkd. MRA

Highway 417 Ottawa: Noise Barriers

# ATTERBERG LIMITS TEST RESULTS

FIGURE A3

## SILTY CLAY FILL



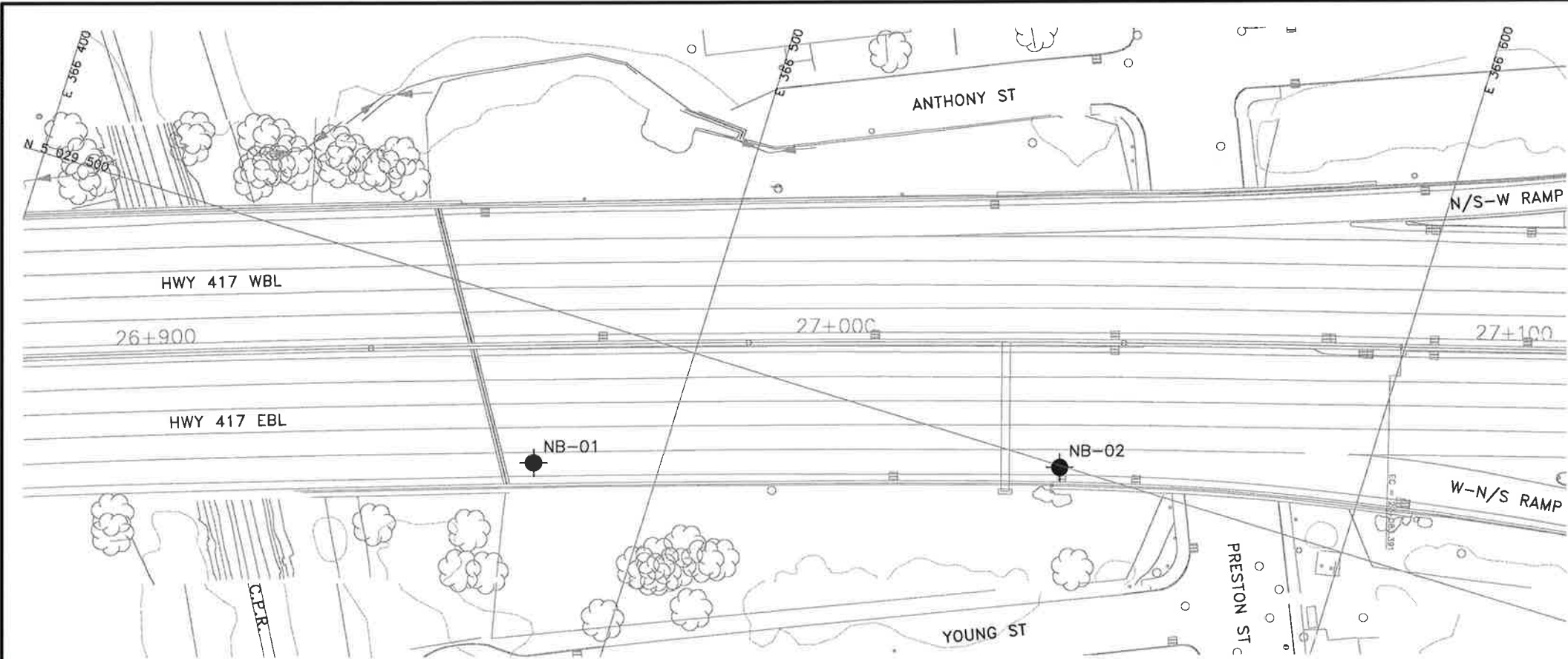
### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-01	6.40	63.30
⊠	NB-02	6.40	61.20

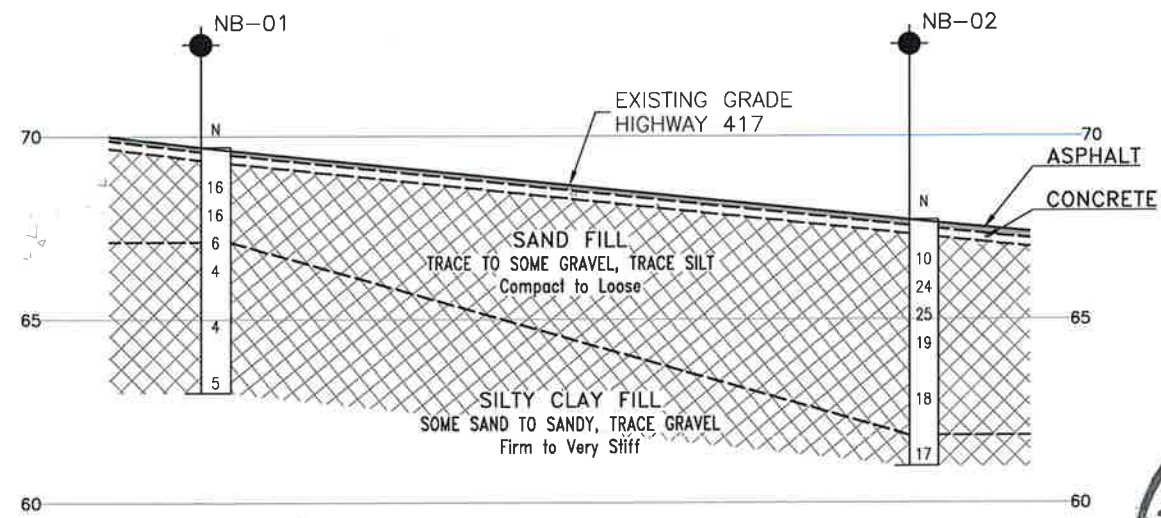
Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA



PLAN  
SCALE 1:800



PROFILE ALONG HWY 417  
H 1:800  
V 1:200

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

CONT No  
WP No 4088-07-01

HIGHWAY 417 EBL  
NOISE BARRIER WALL  
STA. 26+950 TO 27+035  
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
NB-01	69.7	5 029 477.6	366 482.2
NB-02	67.6	5 029 499.7	366 556.5

-NOTES-

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

GEOCRES No. 31G5-268



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	MFA	CHK MRA	SITE
LOAD	DATE	JUN 2016	
STRUCT	DWG	1	

## **Appendix B**

**EBL – Bronson Street to Lyon Street, Sta. 27+810 to 28+400**


**Boreholes NB-06 to NB-14**

# RECORD OF BOREHOLE No NB-06

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 743.2 E 367 301.6 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.17 - 2012.07.17 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>					GR	SA	SI	CL	
76.0	GROUND SURFACE							20	40	60	80	100									
0.0	ASPHALT: (225mm)							20	40	60	80	100									
0.2	SAND, trace to some gravel, trace to some silt Compact to Very Dense Brown Damp (FILL)																				
			1	SS	37																
			2	SS	69																
			3	GS	89																
			4	SS	41																
69.3	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																				
			5	GS	41																
			6	SS	15																
6.7																					

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# RECORD OF BOREHOLE No NB-07

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 772.4 E 367 370.4 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.17 - 2012.07.17 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
75.8	GROUND SURFACE															
0.0	ASPHALT: (225mm)															
0.2	SAND, trace gravel, trace to some silt Dense to Compact Brown Damp (FILL)															
			1	SS	37											
			2	GS	34										7 82 11 (SI+CL)	
			3	SS	36											
			4	GS	33										7 85 8 (SI+CL)	
			5	SS	25											
			6	SS	11											
69.1																
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN 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) 2012.08.21    Dry                69.6 2012.11.21    6.2                69.6															


ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/16/15

# RECORD OF BOREHOLE No NB-08

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 801.3 E 367 434.3 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.17 - 2012.07.17 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				GR	SA	SI	CL
75.2	GROUND SURFACE																		
0.0	ASPHALT: (200mm)																		
0.2	SAND, trace gravel, trace silt Dense to Compact Brown Damp (FILL)																		
			1	SS	40														
			2	SS	42														
			3	GS	25														
			4	SS	10														
			5	SS	32														
			6	SS	27														
68.5																			
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																		

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# RECORD OF BOREHOLE No NB-09

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 829.9 E 367 495.2 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.17 - 2012.07.17 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W P	W	W L			
74.6	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	SAND, trace gravel, trace silt, occasional cobbles Very Dense to Loose Brown Damp to Wet (FILL)		1	SS	43									
			2	SS	72									
			3	SS	18									
			4	SS	7									
			5	SS	46									
			6	SS	50									
68.0	Wet													
67.9	TOPSOIL, clayey													
6.7	Dark Brown Moist													
	END OF BOREHOLE AT 6.7m... BOREHOLE OPEN 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) 2012.08.21 Dry 2012.11.21 Dry													

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# RECORD OF BOREHOLE No NB-10

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 862.6 E 367 563.9 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.18 - 2012.07.18 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20   40   60   80   100	20   40   60	20   40   60	20   40   60	W <sub>P</sub> W      W <sub>L</sub>	GR	SA	SI		CL			
73.9	GROUND SURFACE																			
0.0	ASPHALT: (200mm)																			
0.2	CONCRETE: (250mm)																			
73.5																				
0.5	SAND, trace gravel, trace to some silt, occasional cobbles Very Dense to Dense Brown Damp to Moist (FILL)																			
			1	SS	54		73													
			2	SS	46		72													
			3	GS	33		71											0 90 10 (SI+CL)		
			4	SS	31															
							70													
			5	GS	36		69											7 83 10 (SI+CL)		
			6	SS	41		68													
67.2																				
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																			

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/16/15

# RECORD OF BOREHOLE No NB-11

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 896.2 E 367 630.2 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.18 - 2012.07.18 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      x LAB VANE				WATER CONTENT (%) w <sub>P</sub> w      w <sub>L</sub>				GR	SA	SI	CL	
73.2	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (200mm)							20	40	60	80	100								
0.2	CONCRETE: (200mm)							20	40	60	80	100								
0.4	SAND, trace gravel, trace to some silt Compact to Dense Brown Damp to Moist (FILL)		1	SS	20															
			2	SS	32															
			3	SS	44															
			4	GS	34															
			5	SS	10															
			6	SS	15															
66.5																				
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN 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) 2012.08.21      Dry 2012.11.21      Dry																			

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/16/15

# RECORD OF BOREHOLE No NB-12

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 931.9 E 367 698.3 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.18 - 2012.07.18 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>P</sub>	W	W <sub>L</sub>			GR	SA
72.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (150mm)							20	40	60	80	100						
0.2	CONCRETE: (250mm)							20	40	60	80	100						
72.0								20	40	60	80	100						
0.4	SAND, trace gravel, trace to some silt, occasional cobbles Compact to Very Dense Brown Damp to Moist (FILL)						72											
			1	SS	23													
							71											
			2	GS	20													
			3	SS	56		70											
			4	SS	40		69											
							68											
			5	SS	28													
							67											
66.3																		
6.1	Silty SAND, trace clay, trace gravel, topsoil stained, occasional wood pieces Compact Dark Brown Moist		6	SS	13		66											
65.7																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT TO SURFACE.																	

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# RECORD OF BOREHOLE No NB-13

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 967.0 E 367 763.8 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.18 - 2012.07.18 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
71.8	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (150mm)																	
0.2	CONCRETE: (250mm)																	
71.4																		
0.4	SAND, trace gravel, some silt Dense Brown Damp to Moist (FILL)																	
			1	SS	49		71											
			2	SS	31		70											
			3	GS	50		69											
			4	SS	40													
							68											
	Occasional cobbles		5	SS	37		67											
66.0							66											
5.8	Silty SAND, some clay, trace rootlets Dense Grey Moist		6	SS	40													
65.1																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN 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) 2012.08.21      Dry 2012.11.21      Dry																	

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/16/15

# RECORD OF BOREHOLE No NB-14

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 001.2 E 367 828.7 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.18 - 2012.07.18 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
70.2	GROUND SURFACE							<div><div>20406080100</div><div></div></div>						
0.0	ASPHALT: (150mm)							<div><div>20406080100</div><div></div></div>						
0.2	CONCRETE: (400mm)							<div><div>20406080100</div><div></div></div>						
69.6								<div><div>20406080100</div><div></div></div>						
0.6	SAND, trace to some silt, trace to some gravel, occasional cobbles Very Dense to Compact Brown Damp to Moist (FILL)		1	SS	63									
			2	SS	53									
			3	SS	39									
			4	GS	54									
			5	SS	20									
64.8														
5.4	Silty SAND, trace clay Very Dense Wet													
	No recovery		6	SS	51									
63.5														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND WATER LEVEL AT 5.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.													

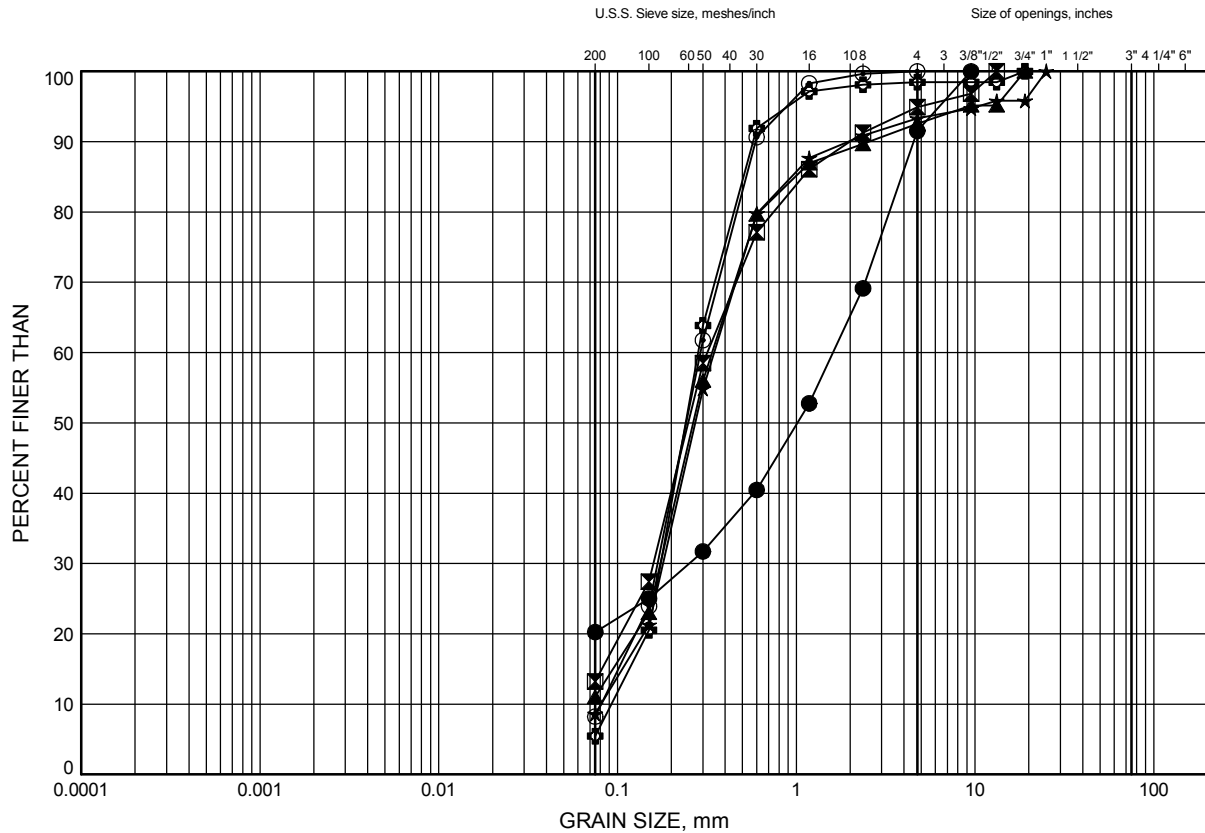
ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/16/15

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE B1

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-06	2.59	73.44
⊠	NB-06	4.88	71.15
▲	NB-07	1.83	73.94
★	NB-07	3.35	72.41
⊙	NB-08	2.59	72.63
⊕	NB-09	3.35	71.27

Date April 2015  
W.P. 4088-07-01



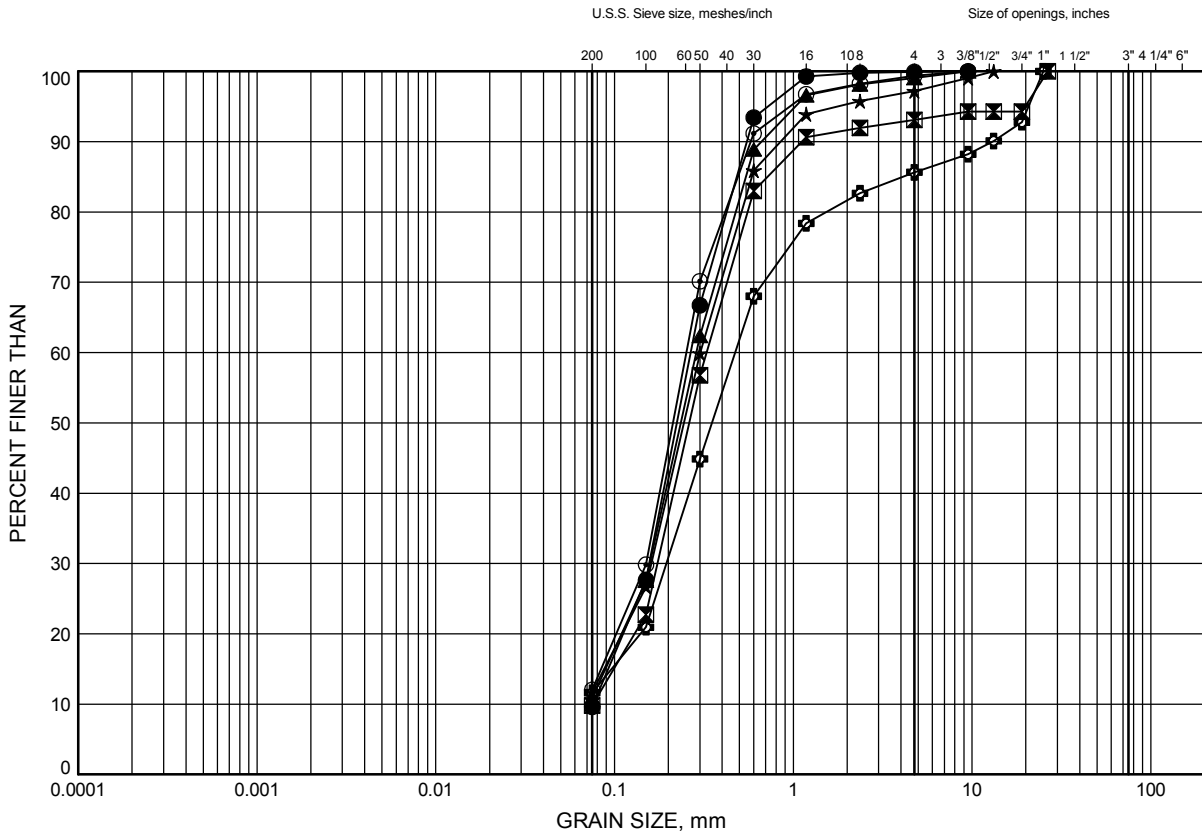
Prep'd MFA  
Chkd. MRA

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE B2

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-10	2.59	71.36
⊠	NB-10	4.88	69.07
▲	NB-11	3.35	69.81
★	NB-12	1.83	70.59
⊙	NB-13	2.59	69.18
⊕	NB-14	3.35	66.82

Date April 2015  
W.P. 4088-07-01



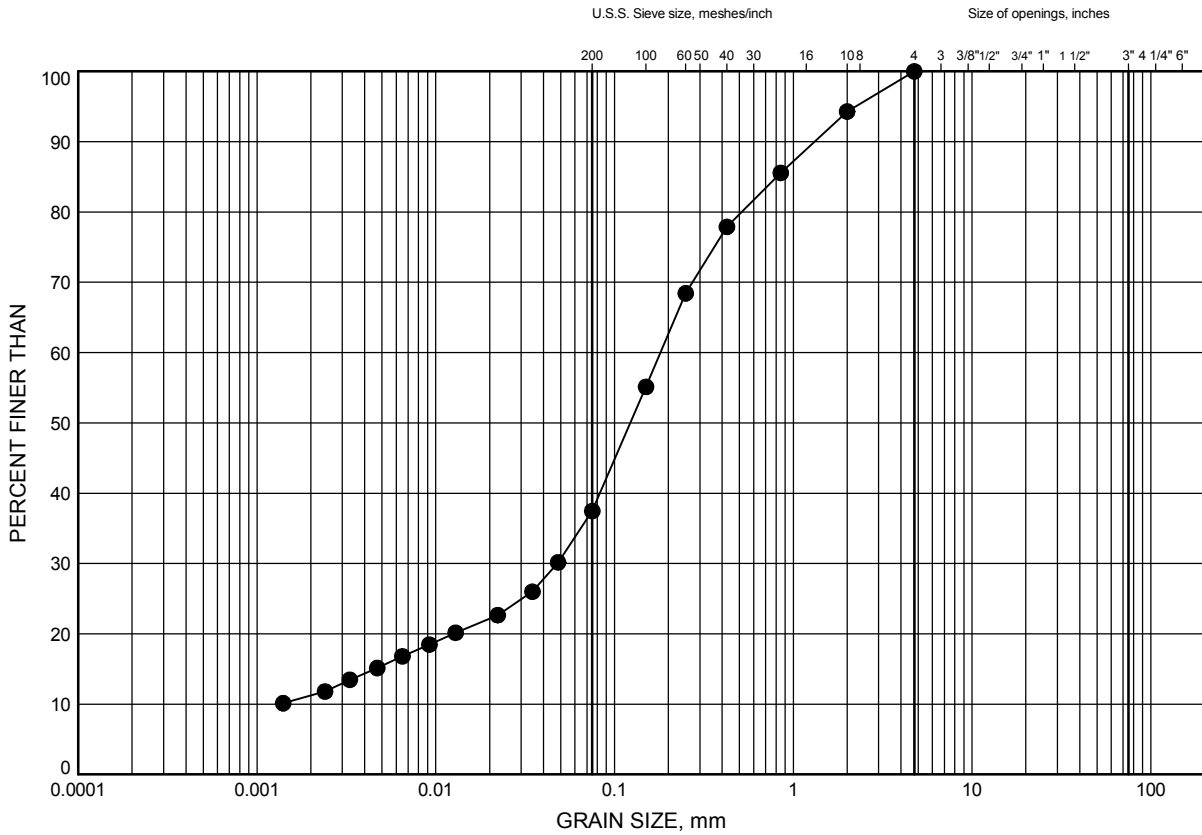
Prep'd MFA  
Chkd. MRA

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE B3

### SILTY SAND



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-13	6.40	65.37

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA

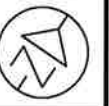


MINISTRY OF TRANSPORTATION, ONTARIO

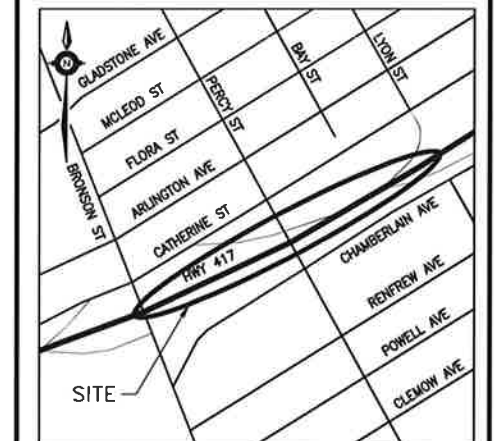
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 4088-07-01

HIGHWAY 417 EBL  
NOISE BARRIER WALL  
STA. 27+810 TO 28+400  
BOREHOLE LOCATIONS PLAN



SHEET



### KEYPLAN

### LEGEND

- Borehole
- ⊕ Borehole and Cone
- 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

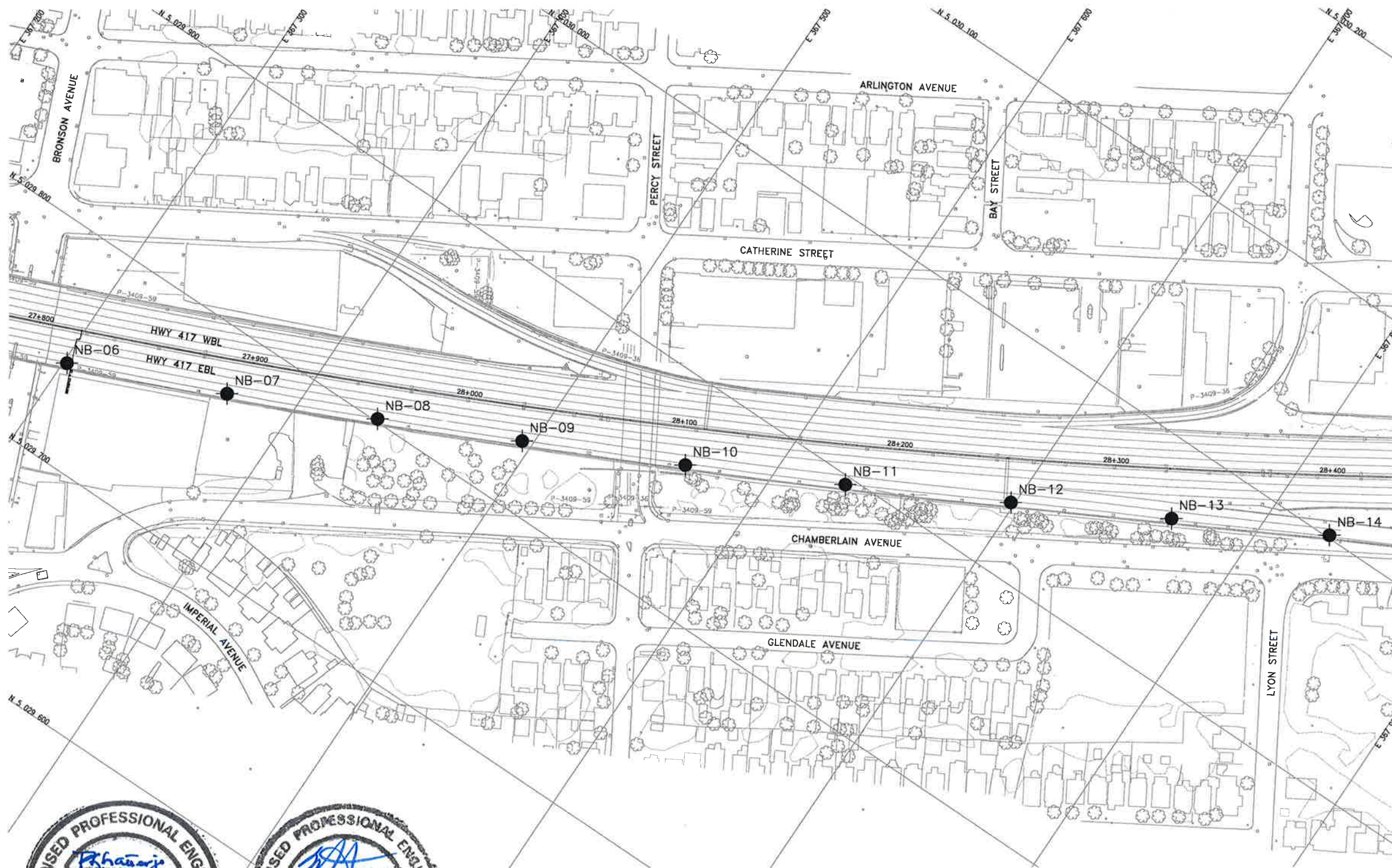
NO	ELEVATION	NORTHING	EASTING
NB-06	76.0	5 029 743.2	367 301.6
NB-07	75.8	5 029 772.4	367 370.4
NB-08	75.2	5 029 801.3	367 434.3
NB-09	74.6	5 029 829.9	367 495.2
NB-10	73.9	5 029 862.6	367 563.9
NB-11	73.2	5 029 896.2	367 630.2
NB-12	72.4	5 029 931.9	367 698.3
NB-13	71.8	5 029 967.0	367 763.8
NB-14	70.2	5 030 001.2	367 828.7

### NOTES

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

GEOCRES No. 31G5-268

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	MFA	CHK MRA	SITE
LOAD			
STRUCT			
DWG			
DATE	JUN 2016		



### PLAN



FILENAME: H:\Drawing\19\351\201\1ed\201-BoreholePlan(NB06-14).dwg  
PLOTDATE: 6/29/2016 1:20 PM

## **Appendix C**

**EBL - Bank Street to Elgin Street, Sta. 28+790 to 29+240**



**Boreholes NB-20 to NB-25**

# RECORD OF BOREHOLE No NB-20

1 OF 2

METRIC

W.P. 4088-07-01 LOCATION N 5 030 265.6 E 368 187.5 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.15 - 2012.07.15 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	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					
71.3	GROUND SURFACE												
0.0	ASPHALT: (125mm)												
0.1	SAND, trace to some silt, trace gravel Dense to Very Dense Brown to Dark Brown Damp (FILL)		1	SS	38								
			2	SS	48								
			3	GS	76								
			4	SS	43								
66.4	Wet		5	SS	10								
4.9	ORGANICS, with wood fragments												
66.1	Black		6	SS	0								
5.2	Silty CLAY Very Soft to Firm Grey Wet												
			7	SS	4								
			8	SS	1								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No NB-20

2 OF 2

METRIC

W.P. 4088-07-01 LOCATION N 5 030 265.6 E 368 187.5 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.15 - 2012.07.15 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT		UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
	Continued From Previous Page							20   40   60   80   100		W <sub>P</sub> W      W <sub>L</sub>			
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					
								20   40   60   80   100		20   40   60			



# RECORD OF BOREHOLE No NB-21

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 308.3 E 368 249.7 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.15 - 2012.07.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	WATER CONTENT (%)		
72.5	GROUND SURFACE													
0.0	ASPHALT: (225mm)													
0.2	SAND, trace gravel, trace to some silt Dense to Very Dense Brown Damp (FILL)													
			1	SS	36									
			2	SS	60									
			3	SS	44									
			4	SS	34									
			5	SS	29									
	Asphalt pieces													
66.4	Layer of asphalt at 6.1m (25mm)													
6.1	Silty SAND, with organics Dense Grey Damp		6	SS	49									
65.8														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE 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) 2012.08.21 Dry 2012.11.21 Dry													

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/17/15

# RECORD OF BOREHOLE No NB-22

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 352.7 E 368 315.3 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.16 - 2012.07.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
73.6	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (125mm)							20	40	60	80	100							
0.1	CONCRETE: (300mm)							20	40	60	80	100							
73.2								20	40	60	80	100							
0.4	SAND, trace gravel, trace to some silt Very Dense Brown Damp (FILL)						73												
		1	SS	72		72													
		2	SS	64		71													
		3	GS	73		70													
		4	SS	63		69													

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 6/28/16

# RECORD OF BOREHOLE No NB-23

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 392.2 E 368 379.9 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.16 - 2012.07.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
73.9	GROUND SURFACE																	
0.0	ASPHALT: (210mm)																	
0.2	SAND, trace to some gravel, trace to some silt Dense to Very Dense Brown Damp to Moist (FILL)																	
			1	SS	43		73											
			2	SS	71		72											
			3	SS	55		71											
			4	SS	74													

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/17/15

# RECORD OF BOREHOLE No NB-24

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 433.3 E 368 448.3 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.16 - 2012.07.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) W <sub>p</sub> W W <sub>L</sub>				
73.6	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	SAND, trace gravel, trace to some silt Dense to Compact Brown Damp to Moist (FILL)															
			1	SS	41											
			2	SS	35											
			3	SS	39											
			4	GS	32											
			5	SS	29											
			6	SS	17											
66.9																
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.															

ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/17/15



# RECORD OF BOREHOLE No NB-25

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 472.7 E 368 517.6 ORIGINATED BY GM/ES  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.16 - 2012.07.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE								
73.1	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	SAND, trace gravel, trace to some silt Very Dense to Dense Brown Damp to Moist (FILL)															
			1	SS	73											
			2	SS	47											
			3	SS	51											
			4	GS	59											
			5	SS	65											
67.0																
6.1	Silty CLAY, with sand seams Very Stiff Brown Moist		6	SS	15											
66.4																
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE 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) 2012.08.21      Dry      - 2012.11.21      Dry      -															

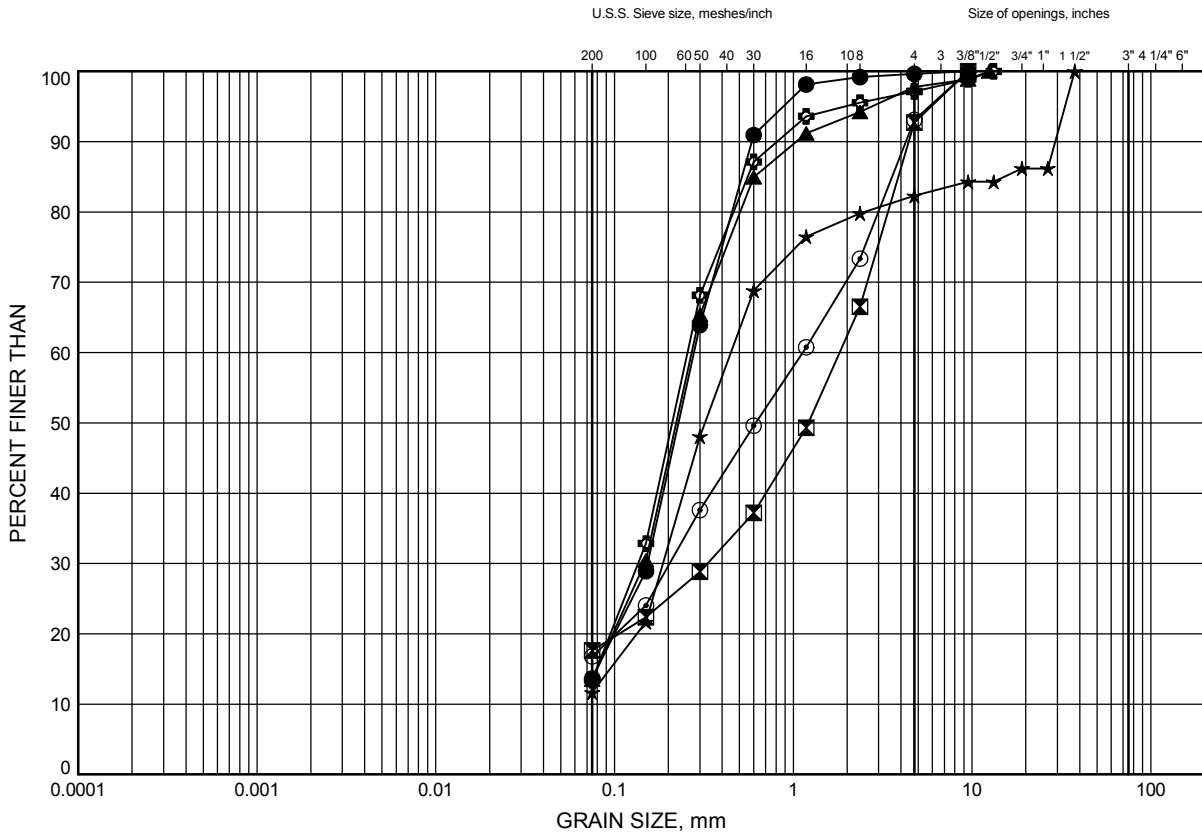
ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/17/15

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE C1

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-20	2.59	68.70
⊠	NB-21	3.35	69.17
▲	NB-22	2.59	71.03
★	NB-23	4.88	69.04
⊙	NB-24	3.35	70.26
⊕	NB-25	3.35	69.79

Date April 2015  
W.P. 4088-07-01

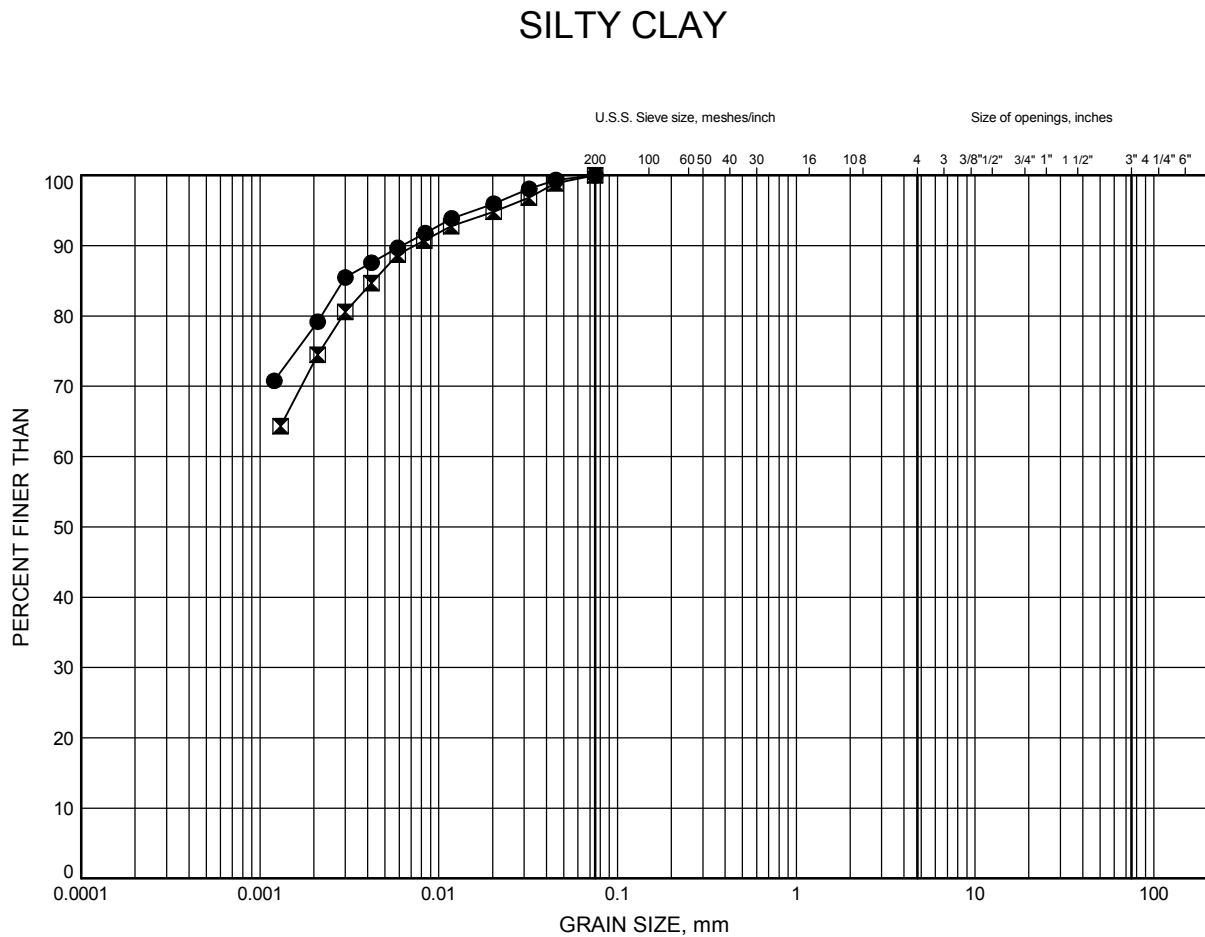


Prep'd MFA  
Chkd. MRA

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE C2



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-20	7.92	63.36
⊠	NB-20	10.97	60.31

Date April 2015  
W.P. 4088-07-01



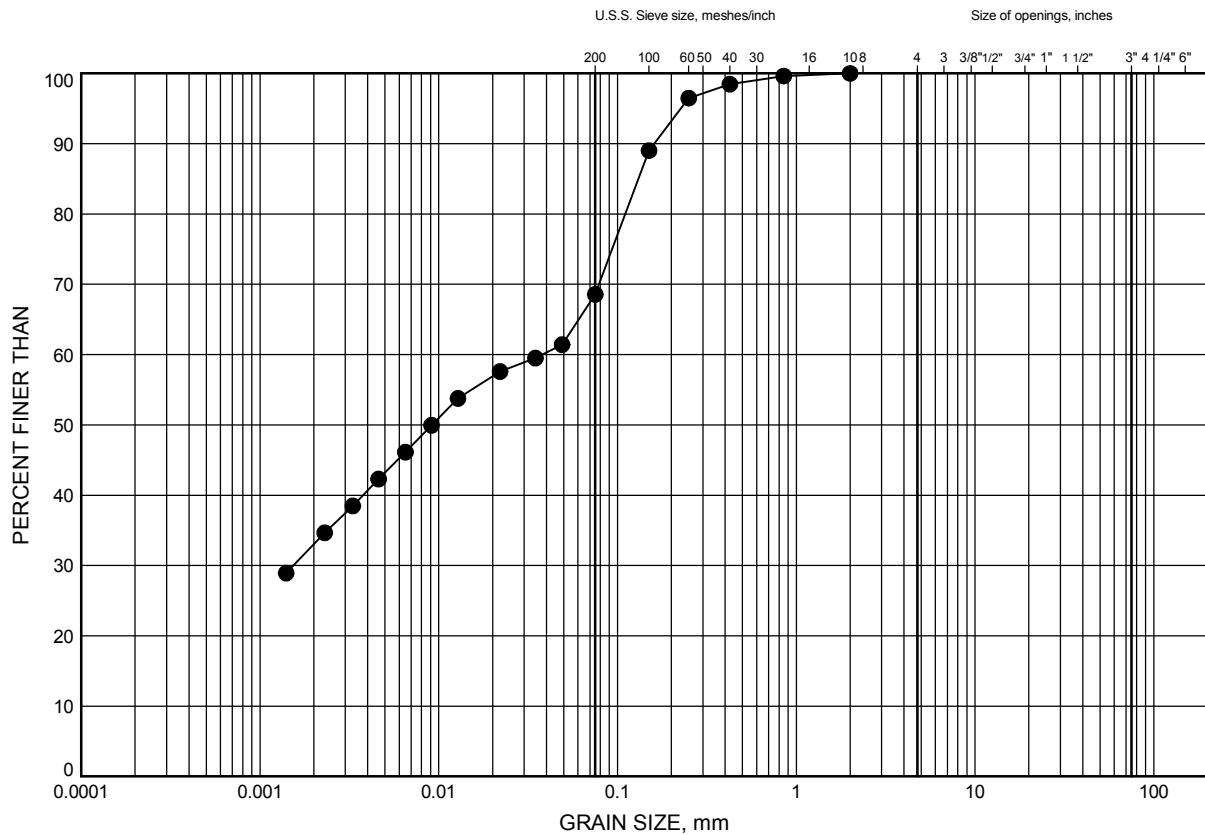
Prep'd MFA  
Chkd. MRA

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE C3

### SILTY CLAY WITH SAND SEAMS



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-25	6.40	66.74

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA



## **Appendix D**

**Metcalf Street S-E Ramp**

**Boreholes NB-26 to NB-28**










# RECORD OF BOREHOLE No NB-26

1 OF 2

METRIC

W.P. 4088-07-01 LOCATION N 5 030 447.7 E 368 512.3 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.19 - 2012.07.19 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20    40    60    80    100	○ UNCONFINED    + FIELD VANE	W <sub>P</sub> W                      W <sub>L</sub>	20    40    60	GR		SA	SI	CL		
69.3	GROUND SURFACE																	
0.0	ASPHALT: (150mm)																	
69.8	CONCRETE: (175mm)																	
0.3	SAND, some gravel, some silt Very Dense to Compact Brown Damp (FILL)		1	GS	98													
	Glass fragments Black		2	SS	18													
			3	SS	16													
66.2	Silty CLAY, trace sand, topsoil stained Firm to Very Soft Brown Moist		4	SS	8													
3.0	Grey		5	SS	4													
			6	SS	1													
			7	SS	1													
			8	SS	2													

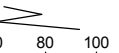
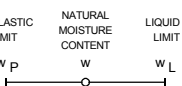
Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT
			NUMBER  TYPE  "N" VALUES			 SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE
						
						WATER CONTENT (%) w                o                L
						kN/m <sup>3</sup>
						GR SA SI CL



# RECORD OF BOREHOLE No NB-27

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 490.8 E 368 573.7 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.19 - 2012.07.19 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20    40    60    80    100	W <sub>P</sub> W                      W <sub>L</sub>	WATER CONTENT (%)					
72.2	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	CONCRETE: (450mm)														
71.5															
0.6	SAND, some silt, trace gravel Very Dense to Compact Brown Damp to Moist (FILL)  Occasional cobbles		1	SS	51										
			2	GS	80										
			3	SS	62										
			4	SS	65										
			5	GS	46										
			6	SS	29										
65.4															
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE 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) 2012.08.22    Dry            - 2012.11.21    Dry            -														

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# RECORD OF BOREHOLE No NB-28

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 030 530.1 E 368 639.5 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.19 - 2012.07.19 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
72.8	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (250mm)							20	40	60	80	100					
0.3	CONCRETE: (350mm)																
72.2	SAND, trace gravel, trace silt, occasional cobbles Loose Brown Damp (FILL)  Very Dense																
0.6																	
			1	SS	8												
			2	SS	9												
			3	SS	7												
			4	GS	47												
			5	SS	87/ 0.250												
			6	SS	78												
66.1																	
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																

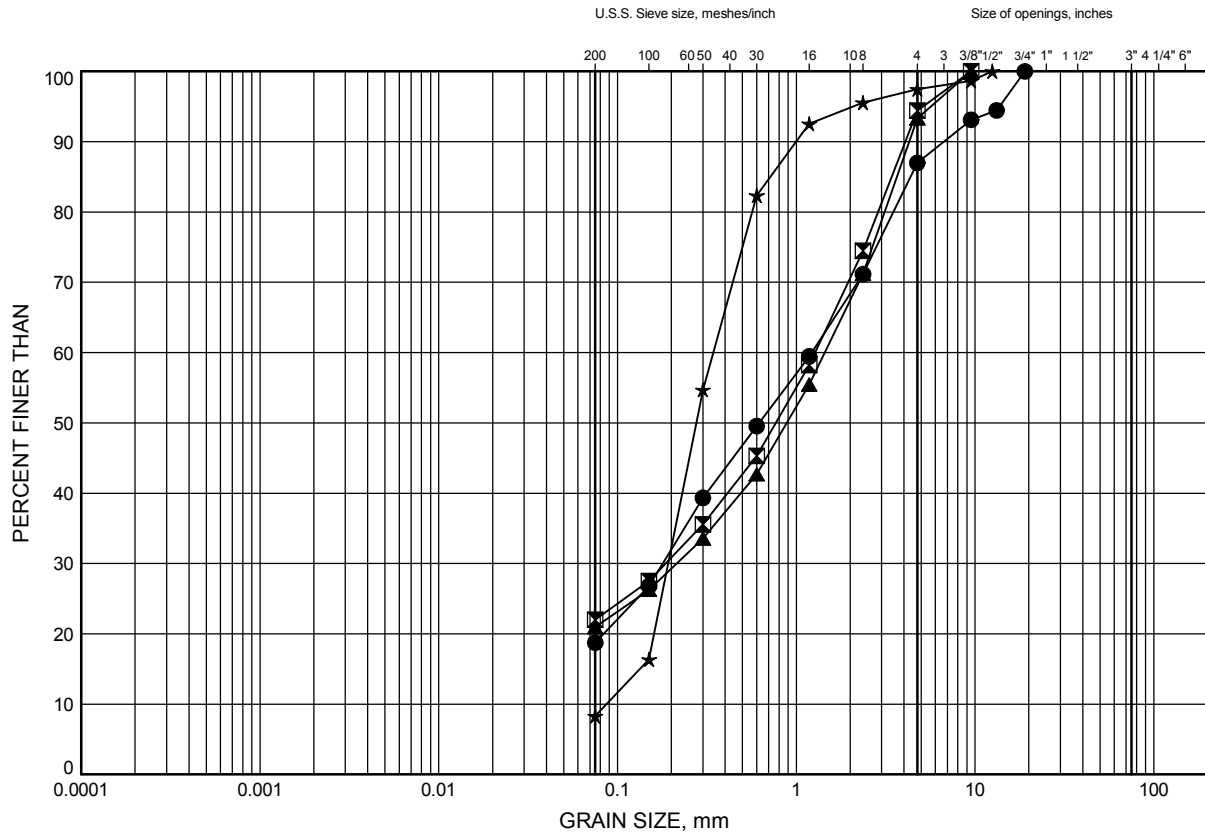
ONTMT4S 1201G.GPJ 2015TEMPLATE(MTO).GDT 4/17/15

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE D1

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-26	1.07	68.22
⊠	NB-27	1.83	70.33
▲	NB-27	4.88	67.28
★	NB-28	3.35	69.48

Date April 2015  
W.P. 4088-07-01

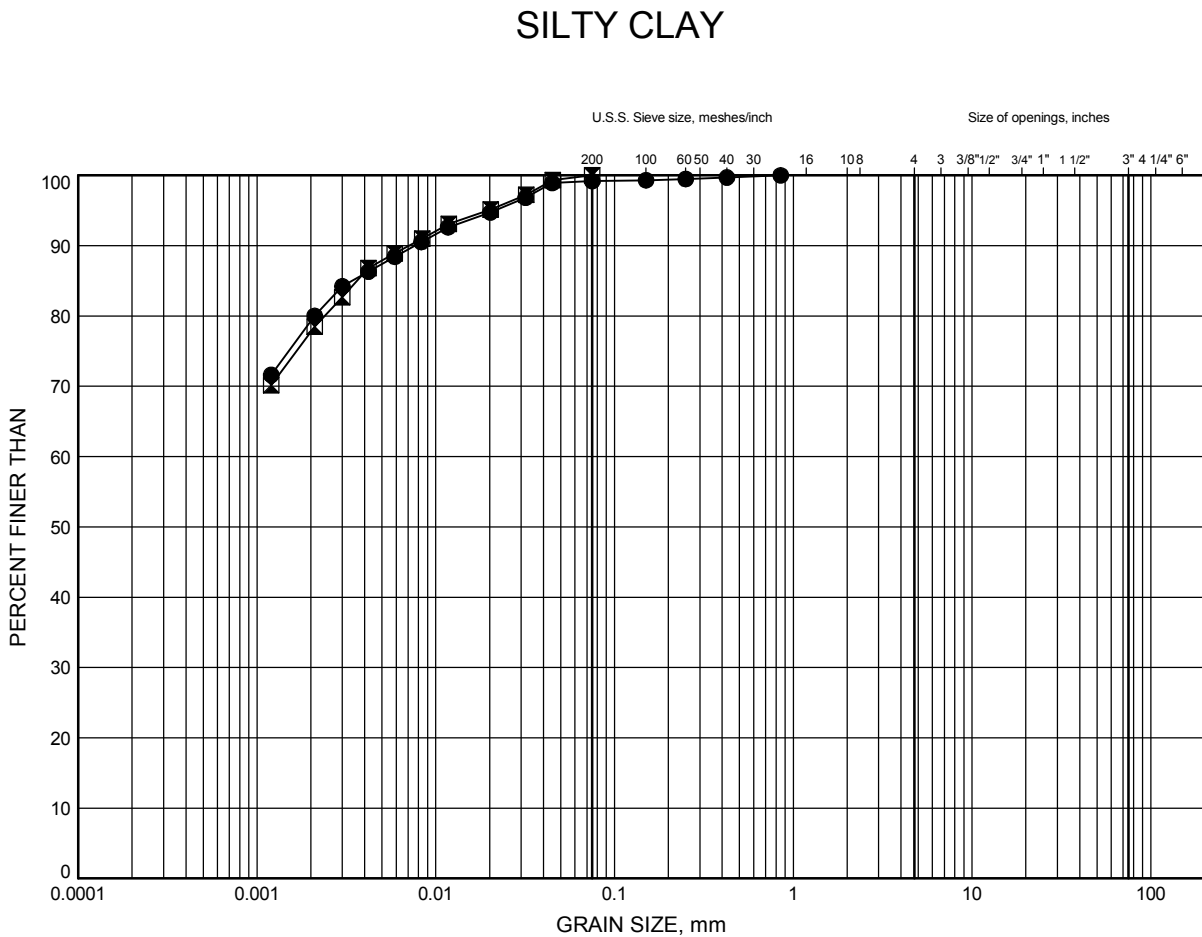


Prep'd MFA  
Chkd. MRA

# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE D2



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-26	4.88	64.41
⊠	NB-26	9.45	59.83

Date April 2015  
W.P. 4088-07-01



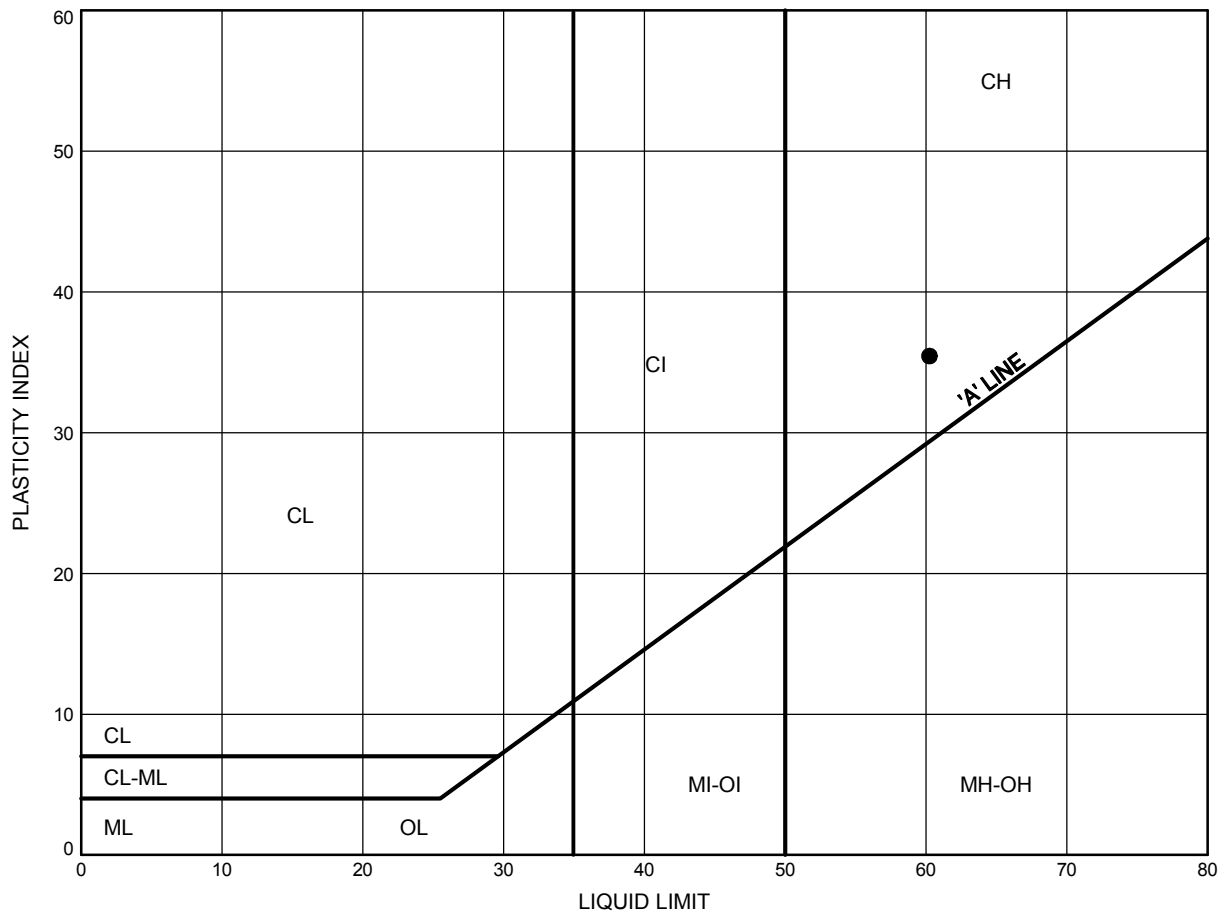
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Chkd. MRA

Highway 417 Ottawa: Noise Barriers

# ATTERBERG LIMITS TEST RESULTS

FIGURE D3

## SILTY CLAY



### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-26	4.88	64.41

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA



## **Appendix E**

**WBL – Percy Street to Lyon Street, Sta. 28+170 to 28+300**

**Boreholes NB-29 to NB-31**

**Hole No. 78 (Geocres No. 31G05-46)**

# RECORD OF BOREHOLE No NB-29

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 991.9 E 367 718.4 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.22 - 2012.07.22 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
71.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (200mm)																	
0.2	CONCRETE: (350mm)																	
70.8																		
0.6	SAND, trace gravel, trace to some silt Dense to Compact Brown Damp to Moist (FILL)		1	SS	32		71											
			2	SS	29		70											
			3	SS	35		69											
			4	GS	22		68											
	Loose		5	SS	4		67											
							66											
65.2	Wet																	
6.2	Silty SAND, trace gravel, trace topsoil Compact Brown Wet		6	SS	12		65											
64.7																		
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 5.9m 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) 2012.08.22      4.4      67.0 2012.11.21      5.4      66.0																	

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# RECORD OF BOREHOLE No NB-30

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 957.2 E 367 664.8 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.22 - 2012.07.22 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>P</sub> W      W <sub>L</sub>							
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%)							
72.1	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (150mm)																			
0.2	CONCRETE: (300mm)		1	GS			72								○					
71.7	SAND, trace gravel, trace to some silt, occasional cobbles Dense to Very Dense Brown Moist to Wet (FILL)														○					
0.4			1	SS	38		71									○			4   85   11 (SI+CL)	
																	○			
			2	SS	37		70										○			
																	○			
			3	SS	35		69										○			
			4	SS	79												○			
	Compact to Loose						68													
			5	GS	22		67									○		7   84   9 (SI+CL)		
							66								○					
65.4	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																			
6.7																				

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# RECORD OF BOREHOLE No NB-31

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 925.8 E 367 607.8 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.22 - 2012.07.22 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
72.7	GROUND SURFACE							20	40	60	80	100				
0.0	ASPHALT: (150mm)							20	40	60	80	100				
0.2	CONCRETE: (250mm)							20	40	60	80	100				
72.3								20	40	60	80	100				
0.4	SAND, trace gravel, trace to some silt Dense to Very Loose Brown Damp to Moist (FILL)							20	40	60	80	100				
			1	SS	35		72									
			2	SS	35		71									
			3	GS	38		70									2 81 17 (SI+CL)
			4	SS	18		69									
							68									
			5	SS	2		67									
							66									
66.0			6	SS	5		66									
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE 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) 2012.08.22      3.2      69.5 2012.11.21      6.1      66.6															

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**McROSTIE & ASSOCIATES LTD.**  
**CONSULTING ENGINEERS**  
**OTTAWA CANADA**

## SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

PERCE TO LYON  
QUERREYAI ENDANGERED

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 224.5'

DATE AUG. 21/61

HOLE NO.

REMARKS SEE PLANT #2

78

DIE WIRTSCHAFTS- UND SOZIALPOLITIK

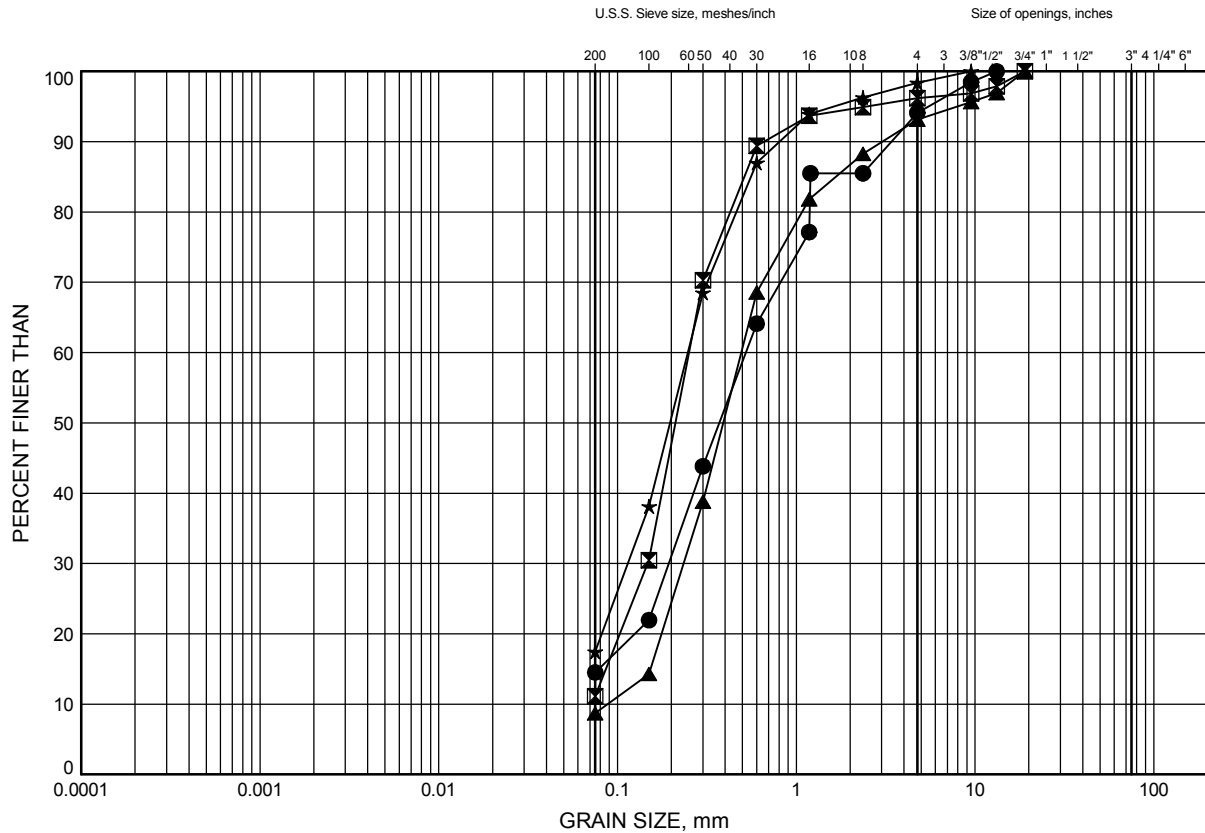
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# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE E1

### SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-29	3.35	68.04
⊠	NB-30	1.07	71.08
▲	NB-30	4.88	67.27
★	NB-31	2.59	70.10

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA

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

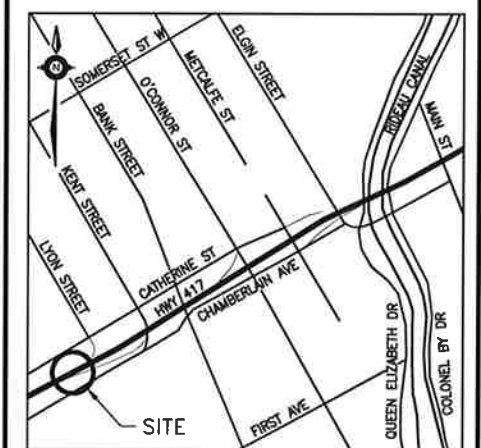
CONT No  
WP No 4088-07-01

HIGHWAY 417 WBL  
NOISE BARRIER WALL  
STA. 28+170 TO 28+300  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








**THURBER** ENGINEERING LTD.



### KEYPLAN

### LEGEND

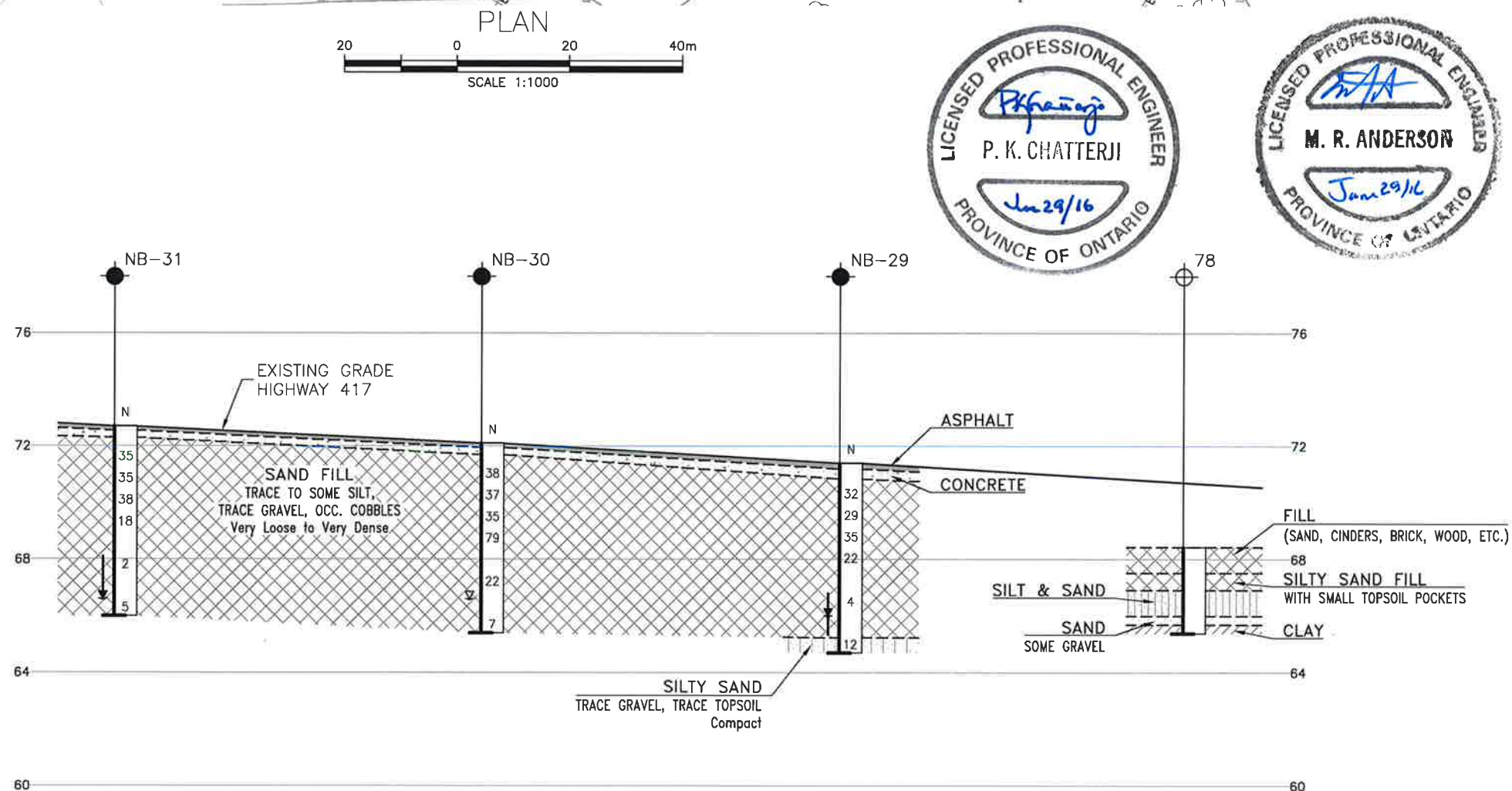
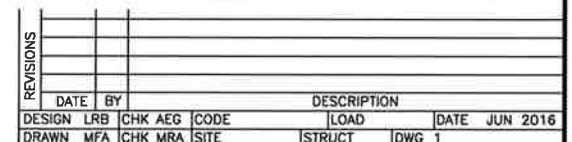
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Test Pit (GEOCRETS 31G05-46)          |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

NO	ELEVATION	NORTHING	EASTING
NB-29	71.4	5 029 991.9	367 718.4
NB-30	72.1	5 029 957.2	367 664.8
NB-31	72.7	5 029 925.8	367 607.8

**-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. 31G5-268**



# PROFILE ALONG HWY 417

Longitudinal section of the bridge showing the profile of the deck and the position of the piers. The scale is H 1:1000 and V 1:200.

FILENAME: H:\Drafting\19\1351\201\ted1201-BoreholePlan&Profile(NB29-31).dwg  
PLOTDATE: 6/29/2016 1:07 PM

## **Appendix F**

**WBL – Bronson Street to Percy Street, Sta. 27+985 to 28+045**

**Boreholes NB-32 and NB-33**

# RECORD OF BOREHOLE No NB-32

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 865.9 E 367 492.9 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.07.22 - 2012.07.22 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									WATER CONTENT (%)	
73.9	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (250mm)							20	40	60	80	100						
73.6																		
0.3	SAND, trace gravel, trace to some silt, occasional cobbles Dense to Compact Brown Damp (FILL)																	
			1	SS	43													
			2	SS	50													
			3	GS	49													
			4	SS	38													
			5	GS	50												5 84 11 (SI+CL)	
			6	SS	19													
67.2																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																	

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# RECORD OF BOREHOLE No NB-33

1 OF 1

METRIC

W.P. 4088-07-01 LOCATION N 5 029 844.4 E 367 451.7 ORIGINATED BY GM  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2012.08.02 - 2012.08.02 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL	
74.3	GROUND SURFACE																			
0.0	ASPHALT: (200mm)																			
0.2	SAND, trace gravel, trace silt Dense to Loose Brown Moist (FILL)						74													
			1	SS	40															
			2	SS	31															
			3	SS	7															
			4	SS	5															
			5	SS	7															
			6	SS	18															
			67.6																	
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE 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) 2012.08.22      Dry 2012.11.21      Dry																			

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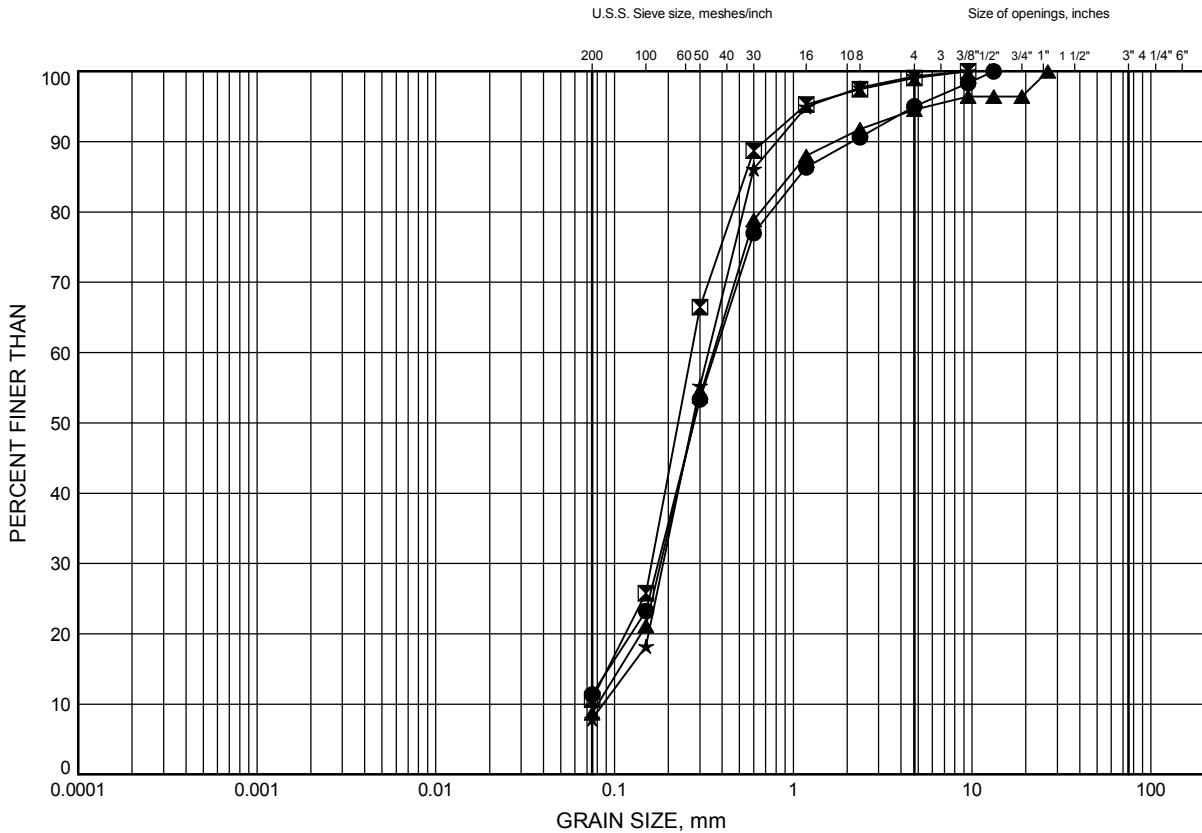


# Highway 417 Ottawa: Noise Barriers

## GRAIN SIZE DISTRIBUTION

FIGURE F1

### SAND FILL



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


### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NB-32	2.59	71.29
⊠	NB-32	4.88	69.00
▲	NB-33	1.83	72.45
★	NB-33	4.88	69.40

Date April 2015  
W.P. 4088-07-01



Prep'd MFA  
Chkd. MRA



SHEET








**THURBER ENGINEERING LTD.**



## KEYPLAN

### LEGEND

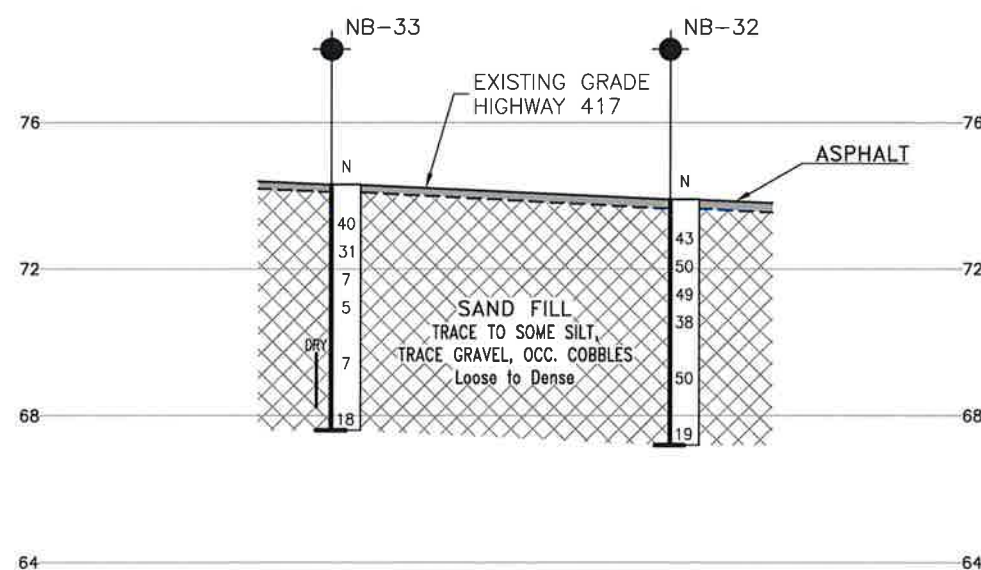
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic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

NO	ELEVATION	NORTHING	EASTING
NB-32	73.9	5 029 865.9	367 492.9
NB-33	74.3	5 029 844.4	367 451.7

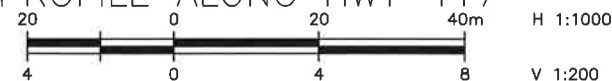
-NOTES-

- 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. 31G5-268**



# PROFILE ALONG HWY 417

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