

**FOUNDATION INVESTIGATION REPORT
LEES AVENUE UNDERPASS REHABILITATION
HIGHWAY 417 EXPANSION FROM NICHOLAS STREET TO VANIER PARKWAY
OTTAWA, ONTARIO**

G.W.P. 4091-07-00, SITE No. 3-225

Geocres Number: 31G5-246

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed rehabilitation of the existing Lees Avenue underpass structure over Highway 417 in the City of Ottawa, Ontario. This investigation included the proposed construction staging area for the superstructure. The structure rehabilitation is part of the Highway 417 Expansion project, from Nicholas Street to Vanier Parkway.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 4009-E-0007.

2 SITE DESCRIPTION

The Lees Avenue Underpass is located at Exit 118 of Highway 417 approximately 2.5km east of Ottawa city centre. The underpass is approximately 800m east of the Rideau Canal and 400m west of the Rideau River. The site is located within an area of mixed land use, with low-rise apartment buildings, residential townhouses, sports fields and open space to the north of Highway 417, and high-rise apartment buildings, institutional centres, a bus station, and open fields to the south.

The existing Lees Avenue underpass is a three span structure with two piers and abutments. The piers are founded on spread footings and the abutments are founded on steel H-piles. The underpass spans a total length of 87 m across Highway 417. The north approach is approximately

7.0 m high and the south approach is approximately 4.5 m high. Photographs in Appendix C show the general layout of the site.

No stability issues were noted on the existing slopes adjacent to the abutments. A shallow erosion channel is present down the slope at the northeast end of the bridge. The existing pavement on the approaches exhibits fatigue cracking. Minor differential settlement appears to have occurred between the approach slabs and adjacent approaches as evidenced by asphalt patching on the concrete sidewalks.

The staging area that would be used for the prefabrication of the superstructure is located north-west of the structure in a grassed area between Robinson Avenue and Lees Avenue.

The site lies within the Ottawa Valley Clay Plains physiographic region, which comprises a clay plain interrupted by ridges of sand or rock. The bedrock consists of the Carlsbad Formation, comprising dark grey shale interbedded with calcareous siltstone and limestone.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out in several stages. Initially between June 27 and June 30, 2011, three boreholes (Boreholes EBH-02, LA-02 and LA-09) were drilled along a potential alternate structure alignment located to the east of the current underpass. Subsequently between August 28 and September 8, 2011, seven boreholes (LE-01 to LE-07) were drilled at the underpass site. Additional rock core was recovered adjacent to Borehole LE-07 (designated Borehole LE-07A) on November 15, 2011. The investigation at the staging area consisted of three boreholes (Boreholes STG-7 to STG-9) and was undertaken between August 10 and August 12, 2011.

Details of the borehole depths and ground elevations are summarised in Table 3.1.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to commencement of drilling operations. A road cut permit was obtained for boreholes drilled on Lees Avenue and City of Ottawa consent was obtained for the boreholes drilled in the proposed staging area off Lees Avenue/ Robinson Avenue.

The drilling was carried out using CME 55 and CME 75 truck-mounted drill rigs. A combination of hollow-stem auger drilling techniques and NQ coring methods was used to advance the boreholes. Overburden samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

A minimum 3.0 m length of bedrock core was recovered from Boreholes LE-02, LE-04, LE-07/7A, LA-02, LA-09, and STG-7 to STG-9. All rock cores were logged, and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Table 3.1 – Borehole Termination Depths and Ground Elevation

Structure Elements	Borehole Number	Ground Elevation	Borehole Termination Elevation	Borehole Termination Depth (m)
South abutment & approach	LE-01	63.0	53.6	9.4
	LE-02	63.7	44.3	19.4
	LE-03	64.2	51.8	12.4
	LA-02	61.1	45.3	15.8
North abutment & approach	LE-04	68.6	46.2	22.4
	LE-05	68.3	58.9	9.4
	LE-06	69.3	53.8	15.5
	LA-09	60.7	46.4	14.3
New proposed pier	LE-07	60.1	47.0	13.1
	LE-07A	60.1	45.8	14.3
	EBH-02	60.1	49.2	10.9
Staging area	STG-7	61.2	48.1	13.1
	STG-8	60.8	45.9	14.9
	STG-9	61.4	47.1	14.3

The drilling and geotechnical 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.

Several of the boreholes were advanced in conjunction with an environmental sampling program being carried out by Ecoplan Limited. The operations were supervised concurrently by a member of Ecoplan's technical staff, and selected soil samples recovered from the boreholes were transported to Ecoplan's laboratory for further examination and environmental testing. Several samples from Boreholes LE-01 and LE-02 and all soil samples recovered from Borehole LE-03 were used for environmental testing and accordingly these samples were not available for geotechnical testing.

Standpipe piezometers consisting of 19 to 25mm diameter PVC pipe with a slotted screen were installed in Boreholes LE-02, LE-05, LE-07 and STG-8. The completion details of the piezometer installations are summarised in Table 3.2. Following the final water level reading, the piezometers will be decommissioned in general accordance with MOE Regulation 903. Upon completion of drilling, boreholes without a piezometer installation were backfilled with a mixture of bentonite holeplug and cuttings then asphalt cold patch to surface.

Table 3.2 – Piezometer Details

Borehole	Tip Position (m)		Completion Details
	Depth	Elev.	
LE-02	17.7	46.0	Sand filter from 17.7 to 14.0 m, bentonite from 14.0 to 13.4m, bentonite/cutting mixture from 13.4 to 0.3m, then asphalt cold patch to surface.
LE-05	8.8	59.5	Sand filter from 8.8 to 5.2m, bentonite from 5.2 to 4.6m, bentonite/cutting mixture from 4.6 to 0.3m, then asphalt cold patch to surface.
LE-07	11.6	48.5	Sand filter from 11.6 to 5.5 m, bentonite from 5.5 to 0.3m, sand backfill from 0.3 to 0.1m, then asphalt cold patch to surface.
STG-8	12.2	48.6	Sand filter from 12.2 to 10.4 m, bentonite/cutting mixture from 10.4 to 0.6m, then bentonite to surface. PVC pipe protrudes 0.9 m above ground surface with 0.5 m diameter protective casing.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and moisture content determinations. Selected samples were also subjected to grain size distribution analyses (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 Appendix A and on the figures presented in Appendix B. Point load tests were conducted on selected portions of the rock cores. The unconfined compressive strength (UCS) values of the rock were assessed from the point load data and these values are reported on the borehole logs.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A and the Borehole Locations and Soil Strata Drawings in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the stratigraphy encountered at this site consists of a pavement structure overlying granular fill, underlain by typically dense to very dense sand, sand and gravel and silty sand till. Shale bedrock was encountered beneath the sand/gravel and till.

More detailed descriptions of the individual strata encountered at the existing underpass site and the staging area are presented below. Information pertaining to the subsurface environmental conditions at the structure site are presented in a separate report by Ecoplans Limited.

5.1 Underpass Site (Boreholes LE-01 to LE-07, EBH-02, LA-02 and LA-09)

5.1.1 Asphalt and Concrete

In boreholes LE-01 to LE-06 drilled on Lees Avenue, a 75 to 130mm of layer of asphalt underlain by 225 to 650 mm of concrete was encountered over sand to sand and gravel fill.

Boreholes LE-07 and EBH-02 were drilled on the median of Highway 417. A 175 to 300mm thick layer of asphalt was encountered over sand fill.

In Borehole LA-09 drilled on Robinson Avenue which runs parallel to Highway 417, the pavement structure consisted of 100mm of asphalt over 200mm of sand and gravel fill.

5.1.2 Sand to Silty Sand Fill

The asphalt and concrete in the structure approaches (Boreholes LE-01 to LE-06) were underlain by sand to silty sand fill. The fill was generally described as brown, fine to coarse grained, with trace silt to silty, and trace to some gravel. Locally in Boreholes LE-03 and LE-05, sand and gravel layers were also encountered.

In Boreholes LE-07 and EBH-02 drilled at the median of Highway 417, the asphalt was underlain by fill consisting of grey to brown sand with some gravel and trace of silt.

Sand fill and silty sand fill were also encountered below the asphalt in Borehole LA-09 drilled on Robinson Street. A concrete obstruction was encountered in the fill at a depth of 1.5 m below ground surface in this borehole.

Borehole LA-02 was drilled in a grass area east of the south abutment and encountered brown to black sand fill. The upper 100mm was identified as topsoil, and possible hydrocarbon impact (coal tar) was noted in a sample from 0.8 to 1.2 m depth (Elev. 60.3 to 59.9).

Details of the fill thickness and elevations are provided in Table 5.1.

SPT ‘N’ values recorded in the fill typically ranged from 30 blows/ 0.3 m penetration to 50 blows with no penetration, indicating a dense to very dense relative density. Locally SPT ‘N’ values of 11 to 28 blows/ 0.3m penetration were recorded in Boreholes LE-02, LE-04, EBH-02, LA-02 and LA-09, indicating a compact condition.

The moisture content of the fill ranged from 3% to 17%.

Grain size distribution analyses were carried out on ten samples of the fill. The results of these tests are plotted on Figures B1 and B2 in Appendix B and summarised below.

Gravel %	3 to 35
Sand %	49 to 84
Silt & Clay %	7 to 46

Occasional cobbles and shale fragments were noted in the fill.

Table 5.1 – Fill Thickness Encountered in Boreholes

Underpass Elements	Borehole Number	Top Boundary of Fill (Elev.)	Base Boundary of Fill (Elev.)	Thickness of Fill (m)
South approach	LE-01	62.7	58.5	4.2
	LE-02	63.0	59.9	3.1
	LE-03	63.4	59.6	3.8
	LA-02	61.1	59.6	1.5
North approach	LE-04	68.2	60.7	7.5
	LE-05	67.8	61.6	6.2
	LE-06	69.0	63.2	5.8
	LA-09	60.6	56.1	4.5
New Pier	LE-07	59.9	58.1	1.8
	EBH-02	59.8	57.8	2.0

5.1.3 Topsoil

A topsoil layer consisting of black silt, some sand was encountered below the fill locally in Borehole LE-04 on the eastern side of the north approach. The organic layer was 0.6 m thick and the depth to base of the layer was 8.5 m (Elev. 60.1). The moisture content of the organic layer was 34%.

5.1.4 Silty Sand to Sand and Gravel

Various interbedded deposits of sand, sand and gravel, and silty sand were encountered in all boreholes except Borehole LE-05. These cohesionless deposits were variously described as brown, light brown, dark brown or grey. In borehole LE-02, a black zone (possible coal tar) was encountered between 4.0 to 4.5 m depth (Elev. 59.7 to 59.2) and a hydrocarbon odour was noted near 7.0 m depth (Elev. 56.7).

The thicknesses of the silty sand to sand and gravel deposits and the elevations at which these materials were encountered are summarised in Table 5.2.

SPT ‘N’ values within the sand/gravel deposits are typically between 35 blows/ 0.3 m penetration and 50 blows/ 0.025 m penetration, indicating a dense to very dense relative density. Locally in borehole LE-02, one SPT ‘N’ value of 23 blows/ 0.3 m penetration was recorded, indicating a compact condition.

Rock coring equipment was required to advance Borehole LE-04 through very dense sand/gravel with possible cobbles below 13.4 m depth.

Moisture contents of the silty sand to sand and gravel varied between 3% and 20%.

Table 5.2 – Sand and Gravel Deposit Thickness Encountered in Boreholes

Underpass Elements	Borehole Number	Top Boundary of Sand/Gravel Deposit (Elev.)	Base Boundary of Sand/Gravel Deposit (Elev.)	Thickness of Sand/Gravel Deposit (m)
South approach	LE-01	58.5	55.3	3.2
	LE-02	59.9	54.6	5.3
	LE-03	59.6	55.0	4.6
	LA-02	56.5	52.0	4.5
North approach	LE-04	56.4	51.9	4.5
	LE-06	61.7	57.1	4.6
	LA-09	56.1	53.8	2.3
		53.1	52.0	1.1
New Pier	LE-07	58.1	49.7	8.4
	EBH-02	57.8	49.2 *	> 8.6

* Borehole was terminated within the sand deposit.

Grain size distribution analyses were carried out on 13 samples of the sand/gravel. The results of these tests are plotted on Figures B3 to B5 in Appendix B and summarised below.

Gravel %	0 to 55
Sand %	29 to 97
Silt & Clay %	2 to 51

5.1.5 Silty Sand Till

Discontinuous layers of silty sand till were encountered below the fill in Boreholes LE-04, LE-05, LE-06 and LA-02, and below the sand deposits in all boreholes except Boreholes LE-05 and EBH-02. The silty sand till was described as brown, grey and dark grey, and locally grades to sandy silt and silt.

The till layer thickness and the elevations at which the till was encountered are summarised in Table 5.3.

SPT 'N' values recorded in the silty sand till typically ranged from 30 blows/ 0.3 m penetration to 50 blows for no penetration, indicating a dense to very dense relative density. The high recorded 'N' values may reflect the presence of cobbles and boulders in the till. Rock coring equipment was required to advance through very dense till with possible cobbles and boulders from 12.5 to 16.2 m in Borehole LE-02 and from 13.7 to 15.2 m in Borehole LE-06.

Table 5.3 – Silty Sand Till Thickness Encountered in Boreholes

Underpass Elements	Borehole Number	Top Boundary of Lower Till (Elev.)	Base Boundary of Lower Till (Elev.)	Thickness of Lower Till (m)
South approach	LE-01	55.3	53.6 *	> 1.7
	LE-02	54.6	47.4	7.2
	LE-03	55.0	51.8 *	> 3.2
	LA-02	59.6 52.0	56.5 48.9	3.1 3.1
North approach	LE-04	60.1	56.4	3.7
		51.9	49.3	2.6
	LE-05	61.6	58.9 *	> 2.7
	LE-06	63.2	61.7	1.5
	LE-06	57.1	53.8 *	> 3.3
New Pier	LE-07	53.8	53.1	0.7
		52.0	49.4	2.6
New Pier	LE-07	49.7	47.9	1.8

* Borehole was terminated within the till layer

Moisture contents of the till ranged from 2% to 25%, typically 8% to 18%.

Grain size distribution analyses were carried out on six samples of the till. The results of these tests are plotted on Figure B6 in Appendix B and summarised below.

Gravel %	3 to 11
Sand %	54 to 70
Silt %	22 to 31
Clay %	3 to 9

Glacial till inherently contains cobbles, boulders and shale slabs.

5.1.6 Shale Bedrock

Bedrock was encountered below the silty sand till and proven by coring in Boreholes LE-02, LE-04, LE-07, LE-07A, LA-02 and LA-09. The depths and elevations at which bedrock was encountered are summarised in Table 5.4. Based on visual identification and geologic mapping, the bedrock belongs to the Carlsbad Formation.

Table 5.4 – Depths and Elevations of Bedrock Surface

Underpass Elements	Borehole	Bedrock Surface	
		Depth (m)	Elevation (m)
South Approach	LE-02	16.3	47.4
	LA-02	12.2	48.9
North Approach	LE-04	19.4	49.3
	LA-09	11.3	49.4
New Pier	LE-07	12.2	47.9
	LE-07A	11.3	48.8

The bedrock was described as grey to dark grey shale. The shale is slightly weathered to fresh with hard thin limestone interbeds throughout. Fractured zones were noted at depths of 13.6 to 14.0 m in Borehole LA-02 and at 11.2 m depth in Borehole LA-09. A clay seam was noted at 13.3 m depth (Elev. 47.8) in Borehole LA-02 and at 12.0 m depth (Elev. 48.1) in Borehole LE-07A. Bituminous seams believed to be naturally occurring were encountered below 14.3 m (Elev. 46.8) in Borehole LA-02 and throughout the rock core in Borehole LE-07A.

Total Core Recovery (TCR) in the bedrock was between 90% and 100%. The RQD values are between 55% and 100%, indicating fair to excellent quality rock. The Fracture Index (FI) of rock, expressed as fractures per 0.3 m of core, ranged from 0 to 7.

The estimated unconfined compressive strength of the shale, interpreted from point load tests conducted on intact rock cores, was between 15 and 28 MPa, indicating a weak to medium strong rock. Limestone interbeds are likely to have higher strengths.

5.1.7 Water Levels

Water was recorded in open Boreholes LE-07A, EBH-02, LA-02 and LA-09 at depths of 2.4 to 5.4 m upon completion of drilling and coring. These water levels represent unstabilized measurements and may reflect the addition of water to the boreholes during coring.

Standpipe piezometers were installed in boreholes LE-02, LE-05 and LE-07. The groundwater depths and elevations measured in the piezometers are summarised in Table 5.5.

The groundwater level is susceptible to seasonal fluctuations. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

Table 5.5 – Ground Water Monitoring Data

Underpass Elements	Borehole	Date	Water Level (m)	
			Depth	Elevation
South Approach	LE-02	01-Sep-11	4.7	59.0
		12-Oct-11	4.7	59.0
North Approach	LE-05	01-Sep-11	8.3	60.0
		12-Oct-11	7.0	61.3
New Pier	LE-07	20-Sep-11	5.0	55.1
		12-Oct-11	5.1	55.0

5.2 Staging Area (Boreholes STG-7, STG-8, STG-9)

5.2.1 Silty Sand Fill

Brown fill was encountered surficially in the boreholes drilled at the staging area. The fill typically consisted of silty sand, locally sandy silt in the upper 0.8 m in Borehole STG-7. A black zone (possible coal tar impact) was encountered between 1.5 and 1.8 m depth (Elev. 59.7 and 59.4) in Borehole STG-7, and a hydrocarbon odour was noted within the sand fill below this depth. Concrete powder and possible concrete debris were encountered near 1.6 m depth in Borehole STG-8.

Details of the fill thickness and upper and lower boundaries are provided in Table 5.6.

Table 5.6 – Fill Thickness Encountered in Boreholes

Location	Borehole Number	Top Boundary of Fill (Elev.)	Base Boundary of Fill (Elev.)	Thickness of Fill (m)
Staging Area	STG-7	61.2	56.6	4.6
	STG-8	60.8	59.0	1.8
	STG-9	61.4	60.6	0.8

SPT ‘N’ values recorded in the fill typically ranged from 17 to 29 blows/ 0.3 m penetration, indicating a compact relative density. An SPT ‘N’ value of 50 blows/ 0.15 m penetration was recorded in Borehole STG-8, indicative of cobbles or concrete rubble within the fill.

Moisture contents of the fill ranged between 3% and 21%.

Grain size distribution analysis was carried out on one sample of the silty sand fill. The results of the test are plotted in Figure B7, Appendix B, and summarised below:

Gravel %	10
Sand %	61
Silt %	26
Clay %	3

5.2.2 Sand

A sand deposit was encountered below the fill in all boreholes. The sand layer was brown to grey, with some silt and trace to some gravel.

The thickness and boundary elevations of the sand layer are summarised in Table 5.7

Table 5.7 – Sand Layer Thickness Encountered in Boreholes

Location	Borehole Number	Top Boundary of Sand Layer (Elev.)	Base Boundary of Sand Layer (Elev.)	Thickness of Sand Layer (m)
Staging Area	STG-7	56.6	53.5	3.1
	STG-8	59.0	54.7	4.3
	STG-9	60.6	54.1	6.5

SPT ‘N’ values recorded in the sand layer ranged from 16 blows/ 0.3 m penetration to 54 blows /0.15 m penetration, indicating a compact to very dense condition. Cobbles and boulders may be present. Moisture contents varied between 3% and 18%.

Grain size distribution analyses were carried out on four samples taken from the sand layer. The results of these tests are presented in Figure B8 in Appendix B and summarised below:

Gravel %	0 to 14
Sand %	74 to 88
Silt & Clay %	11 to 15

5.2.3 Sand and Gravel

A 1.5 m thick layer of sand and gravel was encountered below the sand in Boreholes STG-8 and STG-9. The sand layer was dark grey. The thickness and boundary elevations of this layer are summarised in Table 5.8

Table 5.8 – Sand and Gravel Layer Thickness Encountered in Boreholes

Location	Borehole Number	Top Boundary of Layer (Elev.)	Base Boundary of Layer (Elev.)	Thickness of Layer (m)
Staging Area	STG-8	54.7	53.2	1.5
	STG-9	54.1	52.6	1.5

SPT ‘N’ values of 75 blows/ 0.3 m penetration and 50 blows /0.15 m penetration were recorded in the sand and gravel, indicating a very dense condition. Cobbles and boulders may be present. Moisture contents of 7% and 10% were measured.

The results of a grain size distribution analysis carried out on a sample of the sand and gravel are presented in Figure B9 in Appendix B and summarised below:

Gravel %	47
Sand %	46
Silt & Clay %	7

5.2.4 Silty Sand to Sandy Silt Till

Grey to dark grey silty sand to sandy silt till with some clay, trace of gravel and occasional shale fragments was encountered below the sand/gravel in the boreholes. The till boundary elevations and thicknesses are summarised in Table 5.9.

Table 5.9 – Till Layer Thickness Encountered in Boreholes

Location	Borehole Number	Top Boundary of Till (Elev.)	Base Boundary of Till (Elev.)	Thickness of Till (m)
Staging Area	STG-7	53.5	52.0	1.5
	STG-8	53.2	51.0	2.2
	STG-9	52.6	50.1	2.5

SPT ‘N’ values typically ranged from 47 blows/ 0.3 m penetration to 50 blows/ 0 m penetration, indicating a dense to very dense relative density. In borehole STG-7, an SPT ‘N’ value of 12 blows/ 0.3 m penetration was recorded, indicating a localised compact condition.

Measured moisture contents ranged from 8% to 15%.

Glacial tills inherently contain cobbles, boulders and shale slabs.

5.2.5 Shale Bedrock

Bedrock was encountered below the silty sand till and proven by coring in all boreholes drilled at the staging area. The depths and elevations at which bedrock was encountered are summarised in Table 5.10.

The bedrock comprises grey to black, fresh shale with hard thin limestone interbeds throughout. In boreholes STG-7 and STG-9, highly fractured zones were encountered at depths of 10.0 to 10.2 m and 12.0 to 12.1m, respectively.

Table 5.10 – Depths and Elevations of Bedrock Surface

Location	Borehole	Bedrock Surface	
		Depth (m)	Elevation (m)
Staging Area	STG-7	9.1	52.0
	STG-8	9.8	51.0
	STG-9	11.3	50.1

Total Core Recovery (TCR) in the bedrock was 100%. The RQD values ranged from 90 to 100%, indicating excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 0 to 3.

The estimated unconfined compressive strength of the shale, interpreted from point load tests conducted on intact rock cores, ranged from 18 to 24 MPa, indicating a weak rock strength classification. Limestone interbeds are likely to have higher strengths.

5.2.6 Water Levels

Water was observed in the open boreholes at depths of 3.9 to 8.8 m upon completion of coring. These water levels represent unstabilized measurements and may reflect the addition of water to the boreholes during coring operations.

A standpipe piezometer was installed in Borehole STG-8. The groundwater depths and elevations measured in the piezometer are summarised in Table 5.11.

Table 5.11 – Ground Water Monitoring Data

Location	Borehole	Date	Water Level (m)	
			Depth	Elevation
Staging Area	STG-8	02-Sep-11	7.0	53.8
		20-Sep-11	5.9	54.9
		12-Oct-11	6.2	54.6

The groundwater level is susceptible to seasonal fluctuations. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors from MMM Group provided co-ordinates and the ground surface elevations for the boreholes.

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 truck mounted CME 55 and CME 75 drill rigs and conducted the drilling, sampling and in-situ testing operations.

The field investigation was supervised by Mr. Luke Gilarski, E.I.T., Mr. David Ametrano, E.I.T. and Mr. Ryan Kromer, E.I.T. of Thurber.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall planning and supervision of the field program was conducted by Ms. Lindsey Blaine, E.I.T. Interpretation of the data and preparation of the report were carried out by Ms. Mei Cheong, M.Phil. and Mr. M.R. 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.

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Review Principal



Appendix A

Record of Borehole Sheets

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.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
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 LE-01

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 086.6 E 369 814.6 Lees Avenue - South Approach ORIGINATED BY DA
HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.28 - 2011.08.30 CHECKED BY LRB

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 w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
63.0												
0.0	ASPHALT: (75mm)		1	CORE			63					
0.1												
0.2	CONCRETE: (225mm)											
0.3	SAND, coarse grained, trace to some gravel Very Dense Light Brown Moist (FILL)		2	SS	60		62					
			3	SS	65		61					
60.8												
2.2	Silty SAND, trace gravel Dense Brown Moist to Wet (FILL)		4	SS	38		60					
	No recovery Occasional cobble		5	SS	65/ 0.150							
			6	SS	58		59					
58.5												
4.5	Gravelly SAND, some silt Very Dense Light Brown		7	SS	75		58					
			8	SS	90/ 0.280							
56.9												
6.1	GRAVEL, some sand Very Dense		9	SS	50/ 0.075		57					
	No recovery		10	SS	50/ 0.050		56					
55.3												
7.8	Silty SAND, fine grained Very Dense Brown Wet (TILL)		11	SS	50/ 0.127		55					
							54					
53.6			12	SS	70/ 0.150							
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, THEN											

Continued Next Page

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

RECORD OF BOREHOLE No LE-01

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 086.6 E 369 814.6 Lees Avenue - South Approach ORIGINATED BY DA
HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.28 - 2011.08.30 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT 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		WATER CONTENT (%)				
	Continued From Previous Page ASPHALT TO SURFACE.							20 40 60 80 100	20 40 60					

ONTMT4S 1201A.GPJ 11/10/11

RECORD OF BOREHOLE No LE-02

1 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 100.5 E 369 819.9 Lees Avenue - South Approach ORIGINATED BY DA
HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.28 - 2011.08.30 CHECKED BY LRB

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							
								○ UNCONFINED + FIELD VANE							
						● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)								
						20 40 60 80 100	20 40 60								
63.7			1	AS											
0.0	ASPHALT: (100mm)		2	CORE											
0.1	CONCRETE: (650mm)														
63.0															
0.8	SAND, coarse grained, some silt, trace to some gravel Very Dense to Compact Brown Moist to Wet (FILL)		3	SS	39		63								
	Fine to medium grained, trace silt, trace gravel		4	SS	60		62			○					
			5	SS	55		61			○					
			6	SS	27		60			○					
59.9							59								
3.8	Silty SAND Very Dense to Dense Moist Black (possible coal tar) between 4.0m to 4.5m		7	SS	50/ 0.100										
			8	SS	37					○					
58.4							58			○					
5.3	SAND, some gravel, trace silt, trace clay Compact to Very Dense Dark Brown to Grey Wet Faint hydrocarbon odour		9	SS	23										
			10	SS	41		57			○					
			11	SS	83		56								
	No odour		12	SS	80		55			○					
54.8							54								
9.1	SILT Very Dense Dark Brown Wet (TILL) Faint hydrocarbon odour		13	SS	110/ 0.275										

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity 15-20 (5) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-02

2 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 100.5 E 369 819.9 Lees Avenue - South Approach ORIGINATED BY DA
HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.28 - 2011.08.30 CHECKED BY LRB

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page		14	SS	55/ 0.125										
53.1			15	SS	52/ 0.100		53								
10.7	Silty SAND (probable), fine grained, trace silt, occasional cobbles and boulders Dark Brown Very Dense (Probable TILL)		16	SS	50/ 0.080		52								
	Cored from 12.5m to 16.2m		1	RUN			51								
			2	RUN			50								
			3	RUN			49								
							48								
47.4	clayey silt pocket (150mm) at 16.0m		20	SS	50/ 0.025		47								
16.3	SHALE, slightly weathered, thinly bedded, dark grey, limestone interbeds through out		4	RUN			46								
			5	RUN			45								
44.3															
19.4	END OF BOREHOLE AT 19.4m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.														

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-02

3 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 100.5 E 369 819.9 Lees Avenue - South Approach ORIGINATED BY DA
HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.28 - 2011.08.30 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 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	W _p	W		
Continued From Previous Page																
WATER LEVEL READINGS:																
DATE DEPTH (m) ELEV. (m)																
Sep.01/11 4.7 59.0																
Oct.12/11 4.7 59.0																

ONTMT4S 1201A.GPJ 10/18/11

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-03

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 097.0 E 369 827.6 Lees Avenue - 5m South of Expansion Joint ORIGINATED BY DA
 HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
 DATUM Geodetic DATE 2011.08.30 - 2011.08.31 CHECKED BY LRB

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								WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE						● QUICK TRIAXIAL		× LAB VANE		
64.2							20	40	60	80	100	20	40	60						
0.0	ASPHALT: (100mm)						64													
0.1	CONCRETE: (650mm)																			
63.4																				
0.8	SAND and GRAVEL, trace silt		1	SS	50/															
63.1	Very Dense				0.100															
1.1	Brown						63													
	Wet (FILL)																			
	SAND, fine grained, trace gravel, trace silt		2	SS	103															
	Very Dense						62													
	Brown																			
	(FILL)																			
			3	SS	98															
							61													
			4	SS	61															
			5	SS	78		60													
59.6																				
4.6	Silty SAND, trace to some gravel		6	SS	56		59													
	Very Dense to Dense																			
	Brown																			
			7	SS	81															
							58													
			8	SS	40															
			9	SS	112		57													
			10	SS	86		56													
55.1							55													
9.1	Silty SAND		11	SS	70															
	Very Dense																			
	Dark Grey																			
	(TILL)																			

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-03

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 097.0 E 369 827.6 Lees Avenue - 5m South of Expansion Joint ORIGINATED BY DA
 HWY 417 BOREHOLE TYPE Casing - CME 55 COMPILED BY AN
 DATUM Geodetic DATE 2011.08.30 - 2011.08.31 CHECKED BY LRB

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									
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE																	
	Continued From Previous Page						20	40	60	80	100						
			12	SS	50/ 0.100												
51.8			13	SS	50/ 0.100												
12.4	END OF BOREHOLE AT 12.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, THEN ASPHALT TO SURFACE.																

RECORD OF BOREHOLE No LE-04

1 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 190.3 E 369 832.7 Lees Avenue - North Abutment ORIGINATED BY RK
 HWY 417 BOREHOLE TYPE NW/INQ Casing - CME 72 COMPILED BY AN
 DATUM Geodetic DATE 2011.09.08 - 2011.09.08 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			w _p w w _L				
68.6																
0.0	ASPHALT: (115mm)															
0.1	CONCRETE: (315mm)															
68.2																
0.4	SAND, trace to some gravel, some silt Compact to Dense Brown Moist to Wet (FILL)		1	SS	28		68									
			2	SS	35		67									
			3	SS	46		66									
			4	SS	33		65									
							64									
			5	SS	11		63									
							62									
	No recovery		6	SS	100/ 0.228		61									
							60									
60.7	Silty Orange stains		7	SS	27		59									
7.9	TOPSOIL, silt, some sand Black Moist															
60.1																
8.5	Silty SAND, some gravel Dense Brown Wet (TILL)		8	SS	77/ 0.29											

ONTMT4S 1201A.GPJ 2/15/12

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-04

2 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 180.3 E 369 832.7 Lees Avenue - North Abutment ORIGINATED BY RK
 HWY 417 BOREHOLE TYPE NW/NQ Casing - CME 72 COMPILED BY AN
 DATUM Geodetic DATE 2011.09.08 - 2011.09.08 CHECKED BY LRB

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								WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
	Continued From Previous Page						20 40 60 80 100				20 40 60									
56.4			9	SS	30		58							10 58 28 4						
12.2	SAND and GRAVEL Very Dense Brown Wet Cored from 13.7m to 19.4m Cobble (100mm)		10	SS	50/ 0.08		56													
53.4			11	SS	50/ 0.125		55													
15.2	SAND, some gravel to gravelly Very Dense Brown Moist		12	SS	50/ 0.080		53													
51.9							52													
16.8	Probable Sandy SILT, with gravel Brown Wet (Probable TILL)						51													
49.3							50													
19.4	SHALE, fresh, thinly laminated, horizontally jointed, dark grey						49						FI 4 3							

Continued Next Page

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

RECORD OF BOREHOLE No LE-04

3 OF 3

METRIC

W.P. 4091-07-00 LOCATION N 5 031 190.3 E 369 832.7 Lees Avenue - North Abutment ORIGINATED BY RK
HWY 417 BOREHOLE TYPE NWN/Q Casing - CME 72 COMPILED BY AN
DATUM Geodetic DATE 2011.09.08 - 2011.09.08 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page		1	RUN		48									3	RUN #1 TCR=100% SCR=98% RQD=72% UCS=14.5MPa (Average)
															1	
															2	
			2	RUN		47									1	RUN #2 TCR=100% SCR=100% RQD=100% UCS=16.5MPa (Average)
															1	
															1	
46.2																
22.4	END OF BOREHOLE AT 22.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.5m, SAND TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.															

+³, X³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-05

1 OF 2

METRIC


W.P. 4091-07-00 LOCATION N 5 031 192.8 E 369 823.7 Lees Avenue - 3m North of Expansion Joint ORIGINATED BY DA
HWY 417 BOREHOLE TYPE CME-55 COMPILED BY AN
DATUM Geodetic DATE 2011.08.31 - 2011.08.31 CHECKED BY LRB

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		
68.3	ASPHALT: (130mm)												
0.0	CONCRETE: (325mm)												
0.1													
67.8													
0.5	SAND, fine to coarse grained, some gravel, trace silt Very Dense Moist (FILL)		1	SS	68								
			2	SS	56								
66.0													
2.3	SAND and GRAVEL Brown Wet (FILL)		3	SS	53/ 0.125								
65.2													
3.0	Silty SAND, trace gravel Very Dense Brown Moist (FILL)		4	SS	54								
			5	SS	69								
62.2													
6.1	Silty SAND Dense Brown Moist (FILL)		6	SS	41								
61.6													
6.7	Silty SAND, trace gravel, trace clay Dense Brown to Dark Grey Wet (TILL)		7	SS	42								
			8	SS	53/ 0.100								
58.9													
9.4	END OF BOREHOLE AT 9.4m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.												

Continued Next Page

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

METRIC

ELEV DEPTH	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 (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W _P W W _L	20 40 60		
	Continued From Previous Page											
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100		WATER CONTENT (%) 20 40 60			

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No LE-06

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 210.6 E 369 826.5 Lees Avenue - North Approach ORIGINATED BY DA
 HWY 417 BOREHOLE TYPE CME-55 COMPILED BY AN
 DATUM Geodetic DATE 2011.08.31 - 2011.09.01 CHECKED BY LRB

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		
69.3	ASPHALT: (75mm)												
69.0	CONCRETE: (225mm)												
0.3	SAND, coarse and fine grained, some gravel, some silt Very Dense Dry to Moist (FILL)		1	SS	62								
			2	SS	90/ 0.280								
			3	SS	68								10 73 17 (SI+CL)
			4	SS	72								
			5	SS	100/ 0.250								11 67 22 (SI+CL)
63.2													
6.1	Silty SAND, fine grained, trace gravel Very Dense Brown Moist (TILL)		6	SS	78								8 70 22 (SI+CL)
61.7													
7.6	SAND, fine grained, trace silt, trace to some gravel Very Dense Brown Moist to Wet		7	SS	50/ 0.100								
60.8													
8.5	SAND and GRAVEL, some silt Dense to Very Dense Brown Wet		8	SS	44								55 29 16 (SI+CL)

Continued Next Page

+³ . X³ : Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No LE-07

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 150.0 E 369 819.6 Lees Avenue ORIGINATED BY RK
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.08.26 - 2011.08.26 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			w _p w w _L				
								20 40 60 80 100			20 40 60				
60.1															
0.0	ASPHALT: (175mm)														
0.2	SAND, trace gravel, poorly graded Dense Brown Damp (FILL)		1	SS	30										
			2	SS	38										
58.1															
2.0	SAND and GRAVEL, some silt Very Dense Dark Brown Damp		3	SS	61										
57.1															
3.0	SAND, some gravel, trace silt Dense to Very Dense Damp		4	SS	47										
			5	SS	50/ 0.125										
	Grey Moist to Wet														
54.0															
6.1	SAND and GRAVEL, trace silt, some shale fragments Very Dense Grey Wet		6	SS	94										
53.1															
7.0	SAND, some silt to silty, trace to some gravel Very Dense Grey Wet		7	SS	58										
			8	SS	100/ 0.125										

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-07

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 150.0 E 369 819.6 Lees Avenue ORIGINATED BY RK
HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.08.26 - 2011.08.26 CHECKED BY LRB

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				
Continued From Previous Page								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
49.7												
10.4	Silty SAND, some gravel Very Dense Grey Wet (TILL)		9	SS	100/ 0.125						oo	8 64 25 3
47.9												
12.2	SHALE, slightly weathered to fresh, thinly laminated, horizontally jointed, grey		1	RUN								FI 4 2
47.0												
13.1	END OF BOREHOLE AT 13.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Sep 20/11 5.0 55.1 Oct 12/11 5.1 55.0											

RECORD OF BOREHOLE No LE-07A

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 150.0 E 369 818.6 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.11.15 - 2011.11.15 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 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 (%)					
60.1														
0.0	Overburden sampled and described in Borehole LE-07.						60							
							59							
							58							
							57							
							56							
							55							
							54							
							53							
							52							
							51							

Continued Next Page

+ 3 . X 3 : Numbers refer to
Sensitivity

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15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LE-07A

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 150.0 E 369 818.6 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.11.15 - 2011.11.15 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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page							20 40 60 80 100							
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100							
														</	

RECORD OF BOREHOLE No EBH-02

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 148.1 E 369 844.2 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers - CME-75 COMPILED BY AN
 DATUM Geodetic DATE 2011.06.29 - 2011.06.30 CHECKED BY LRB


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L				WATER CONTENT (%) 20 40 60			
60.1																	
0.0	ASPHALT: (300mm)						60										
59.8																	
0.3	SAND, some gravel, trace silt and clay Dense to Compact Grey to Brown Dry (FILL)		1	SS	47		59									21 67 12 (SI+CL)	
			2	SS	42												
			3	SS	14		58										
57.8																	
2.3	Gravelly SAND, some silt and clay Dense to Very Dense Brown and Grey Dry		4	SS	35		57										
			5	SS	86/ 0.275												
			6	SS	86		56									25 52 23 (SI+CL)	
55.5																	
4.6	SAND, fine grained, trace silt to silty Dense to Very Dense Brown to Grey Moist to Wet		7	SS	92/ 0.275		55										
			8	SS	90/ 0.250		54									1 97 2 (SI+CL)	
			9	SS	84/ 0.250												
			10	SS	50/ 0.125		53										
			11	SS	38		52									0 68 32 (SI+CL)	
			12	SS	50/ 0.100		51										
	Cobbles at 9.8m																

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

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15
10
(%) STRAIN AT FAILURE

METRIC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60		

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						
	Continued From Previous Page							20 40 60 80 100	20 40 60				kN/m ³	GR SA SI CL	
49.2			13	SS	50/		50								
10.9	END OF BOREHOLE AT 10.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND WATER LEVEL AT 5.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG FROM 10.9m TO 0.4m, CONCRETE FROM 0.4m TO 0.3m, THEN ASPHALT PATCH TO SURFACE.				0.025										

ONTMT4S 1201A.GPJ 2/15/12

+³, ×³ Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LA-02

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 106.9 E 369 842.3 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring - CME 75 COMPILED BY AN
 DATUM Geodetic DATE 2011.06.27 - 2011.06.28 CHECKED BY LRB

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		
61.1													
0.0	TOPSOIL: (100mm)												
0.1	SAND , trace silt, trace gravel, occasional rootlets Compact to Very Dense Brown to Black Dry (FILL) Black with hydrocarbon odour (possible coal tar) at 0.8m		1	SS	11		61						
			2	SS	61		60						
59.6													
1.5	Silty SAND , some gravel, trace clay Dense Brown to Grey Dry (TILL)		3	SS	38		59						
			4	SS	31		58						11 54 29 6
			5	SS	44		57						
			6	SS	48		56						13 76 11 (SI+CL)
56.5													
4.6	SAND , trace silt, trace to some gravel Very Dense Grey Dry		7	SS	86		55						
			8	SS	50/ 0.100		54						1 92 7 (SI+CL)
			9	SS	50/ 0.100		53						
			10	SS	50/ 0.125		52						
	Becomes wet		11	SS	98/ 0.250								
			12	SS	50/ 0.100								
			13	SS	50/ 0.100								
52.0													
9.1	Probable Silty SAND Very Dense Grey Wet (Probable TILL)		14	SS	50/ 0.100								

Continued Next Page

+³ × 3³: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100		
Continued From Previous Page														
48.9	Probable Silty SAND Very Dense Grey Wet (Probable TILL)		16	SS	50/	0.025								
12.2	No recovery Probable cobbles and boulders from 10.7m		16	SS	50/	0.00								
48.9	SHALE, fresh, thinly bedded, occasional limestone interbeds, grey		1	RUN										
12.2	Horizontal joints at 12.8m, 13.7m, 13.8m Clay seam at 13.3m Limestone interbeds (between 25mm to 100mm thick) at 12.8m, 12.9m, 13.2m, 13.4m and 13.5m 50mm thick highly broken zone at 13.6m and 14.0m Bituminous seams		2	RUN										
45.3	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 3.9m UPON COMPLETION.													
15.8														

ONTMT4S 1201A.GPJ 2/15/12

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No LA-09

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 175.7 E 369 856.0 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring - CME 75 COMPILED BY AN
 DATUM Geodetic DATE 2011.06.28 - 2011.06.29 CHECKED BY LRB

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 w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
60.7												
0.0	ASPHALT: (100mm)											
60.4												
0.3	SAND and GRAVEL (FILL)		1	SS	58		60					
	SAND, some silt, occasional shale fragments Very Dense to Compact Brown Dry (FILL)		2	SS	23							
	Concrete obstruction at 1.5m		3	SS	50/ 0.00		59					
58.4												
2.3	Silty SAND, some gravel, trace clay Dense to Very Dense Brown Damp (FILL)		4	SS	40		58					16 60 20 4
			5	SS	90							
			6	SS	50/ 0.075		57					
56.1												
4.6	SAND, some silt, some gravel Very Dense Brown to Grey Dry to Wet		7	SS	82/ 0.275		56					20 64 13 3
			8	SS	86/ 0.250		55					
			9	SS	72		54					10 74 16 (SI+CL)
53.8			10	SS	50/ 0.100							
6.9	Silty SAND, trace gravel Very Dense Brown Wet (TILL)						53					0 49 48 3
53.1			11	SS	82							
7.6	SAND and SILT, trace clay Very Dense Grey Wet						52					
52.0			12	SS	50/ 0.125							
8.7	Silty SAND, trace gravel Very Dense Grey Wet (TILL)						51					

Continued Next Page

+ ³ . X ³ : Numbers refer to
Sensitivity

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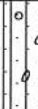

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LA-09

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 175.7 E 369 856.0 Lees Avenue ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring - CME 75 COMPILED BY AN
 DATUM Geodetic DATE 2011.06.28 - 2011.06.29 CHECKED BY LRB

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE															
	Continued From Previous Page							20 40 60 80 100							
49.4	Silty SAND , trace gravel Very Dense Grey Wet (TILL)		13	SS	50/ 0.100		50								
11.3	SHALE , fresh, thinly bedded, grey, occasional limestone interbeds Limestone interbeds (between 25mm to 100mm thick) at 11.3m, 11.6m, 11.8m, 12.0m, 12.2m and 12.3m 50mm highly broken zone at 11.2m Horizontal joints at 11.3m and 11.6m Limestone interbeds (between 25mm to 100mm thick) at 12.8m, 12.9m, 13.3m, 13.4m and 13.5m		1	RUN			49								
			2	RUN			48								
46.4							47								
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE OPEN TO 14.3m AND WATER LEVEL AT 5.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG FROM 14.3m TO 0.2m, THEN ASPHALT PATCH TO SURFACE.														

RECORD OF BOREHOLE No STG-7

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 237.0 E 369 654.0 Lees Avenue Staging Area ORIGINATED BY GA
HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.08.11 - 2011.08.12 CHECKED BY LRB

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 (%)
								UNCONFINED + FIELD VANE					
								QUICK TRIAXIAL × LAB VANE					
61.2							20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L			
0.0	Sandy SILT, trace gravel, occasional rootlets Compact Brown Dry (FILL)		1	SS	21		61						
60.4													
0.8	Silty SAND, trace gravel Compact Brown Dry (FILL) Black (possible coal tar) from 1.5m to 1.8m		2	SS	25		60					10 61 26 3	
			3	SS	19		59						
	Grey, with hydrocarbon odour		4	SS	23		58						
			5	SS	17		57						
56.6													
4.6	SAND, some silt, some gravel Dense to Very Dense Grey Wet		6	SS	32		56						
			7	SS	111		55					14 74 12 (SI+CL)	
53.5													
7.6	Sandy SILT Compact Grey Wet (TILL)		8	SS	12		53						
52.0			9	SS	50/ 0.0		52						
9.1	SHALE, fresh, thinly bedded, grey/black, limestone interbeds through out Augered to 10.0m												

Continued Next Page

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

RECORD OF BOREHOLE No STG-7

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 237.0 E 369 654.0 Lees Avenue Staging Area ORIGINATED BY GA
HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.08.11 - 2011.08.12 CHECKED BY LRB







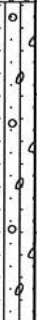


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
								WATER CONTENT (%) W P W W L						
								20	40	60	80	100		
	Highly broken zone (50mm thick) at 10.0m and 10.2m		1	RUN			51						3	RUN #1 TCR=100% SCR=93% RQD=93% UCS=20MPa (Average)
													1	
													0	
							50						0	
													0	
	Vertical joints from 11.5m to 12.1m		2	RUN			49						1	RUN #2 TCR=100% SCR=100% RQD=100% UCS=18MPa (Average)
													1	
													0	
													0	
													0	
48.1														
13.1	END OF BOREHOLE AT 13.1m. BOREHOLE OPEN TO 13.1m AND WATER LEVEL AT 3.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTING AND BENTONITE HOLEPLUG TO SURFACE.													

RECORD OF BOREHOLE No STG-8

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 195.6 E 369 707.7 Lees Avenue Staging Area ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.08.10 - 2011.08.11 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
60.8							20 40 60 80 100			W _P	W	W _L			
0.0	Silty SAND , trace gravel, occasional rootlets Compact to Very Dense Brown Dry (FILL)		1	SS	25										
			2	SS	50/ 0.150										
	Concrete powder, possible rubble zone														
59.0			3	SS	23										
1.8	SAND , some silt, trace gravel Compact to Very Dense Brown Dry														
			4	SS	16										
			5	SS	19										
			6	SS	54/ 0.150										
	Grey														
54.7															
6.1	SAND and GRAVEL , trace silt and clay Very Dense Dark Grey Damp		7	SS	75										
53.2															
7.6	Silty SAND Dense to Very Dense Grey Wet (TILL)		8	SS	47										
			9	SS	64										
51.0															
9.8	SHALE , thinly bedded, grey														

Continued Next Page

+³, x³: Numbers refer to Sensitivity
 20
 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STG-8

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 195.6 E 369 707.7 Lees Avenue Staging Area ORIGINATED BY GA
HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.08.10 - 2011.08.11 CHECKED BY LRB

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								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
						20	40	60	80	100	20	40	60			
Continued From Previous Page																
	Augered to 11.9m		10	SS	50/	0.075										
	Fresh, very thin limestone interbeds through out		1	RUN												
			2	RUN												
45.9																
14.9	END OF BOREHOLE AT 14.9m. BOREHOLE OPEN TO 14.9m AND WATER LEVEL AT 8.8m 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) Sep.02/11 7.0 53.8 Sep.20/11 5.9 54.9 Oct.12/11 6.2 54.6															

RECORD OF BOREHOLE No STG-9

1 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 233.7 E 369 750.1 Lees Avenue Staging Area ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.08.11 - 2011.08.11 CHECKED BY LRB

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		
61.4														
0.0	Silty SAND, some gravel, trace rootlets Compact Brown Dry (FILL)		1	SS	29		61						o	
60.6														
0.8	SAND, some silt, trace gravel Compact to Very Dense Brown to Dark Brown Dry		2	SS	26		60						o	
			3	SS	32		59						o	3 82 15 (SI+CL)
			4	SS	27		58						o	
			5	SS	76		57						o	
			6	SS	112		56						o	
	Moist													
			7	SS	65		55						o	4 85 11 (SI+CL)
54.1														
7.3	SAND and GRAVEL Very Dense Dark Grey Wet		8	SS	50/ 0.150		54						o	
							53							
52.6														
8.8	Silty SAND, some clay, trace gravel, occasional shale fragments Very Dense Dark Grey Wet (TILL)		9	SS	50/ 0.150		52						o	

Continued Next Page

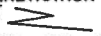
+³, x³: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No STG-9

2 OF 2

METRIC

W.P. 4091-07-00 LOCATION N 5 031 233.7 E 369 750.1 Lees Avenue Staging Area ORIGINATED BY GA
 HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.08.11 - 2011.08.11 CHECKED BY LRB

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						
	Continued From Previous Page						20 40 60 80 100							
							20 40 60 80 100	WATER CONTENT (%) PLASTIC LIMIT (w _p) NATURAL MOISTURE CONTENT (w) LIQUID LIMIT (w _L)						
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
50.1			10	SS	50/ 0.0		51						FI	
11.3	SHALE, thinly bedded, fresh, grey, very thin limestone interbeds through out Highly broken zone from 12.0m to 12.1m		1	RUN			50						1	
													0	
													>3	
							49						0	RUN #1 TCR=100% SCR=95% RQD=90% UCS=24MPa (Average)
													0	
													0	
			2	RUN			48						0	RUN #2 TCR=100% SCR=100% RQD=100% UCS=23MPa (Average)
													0	
47.1														
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE OPEN TO 14.3m AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE HOLEPLUG TO SURFACE.													

+³, X³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

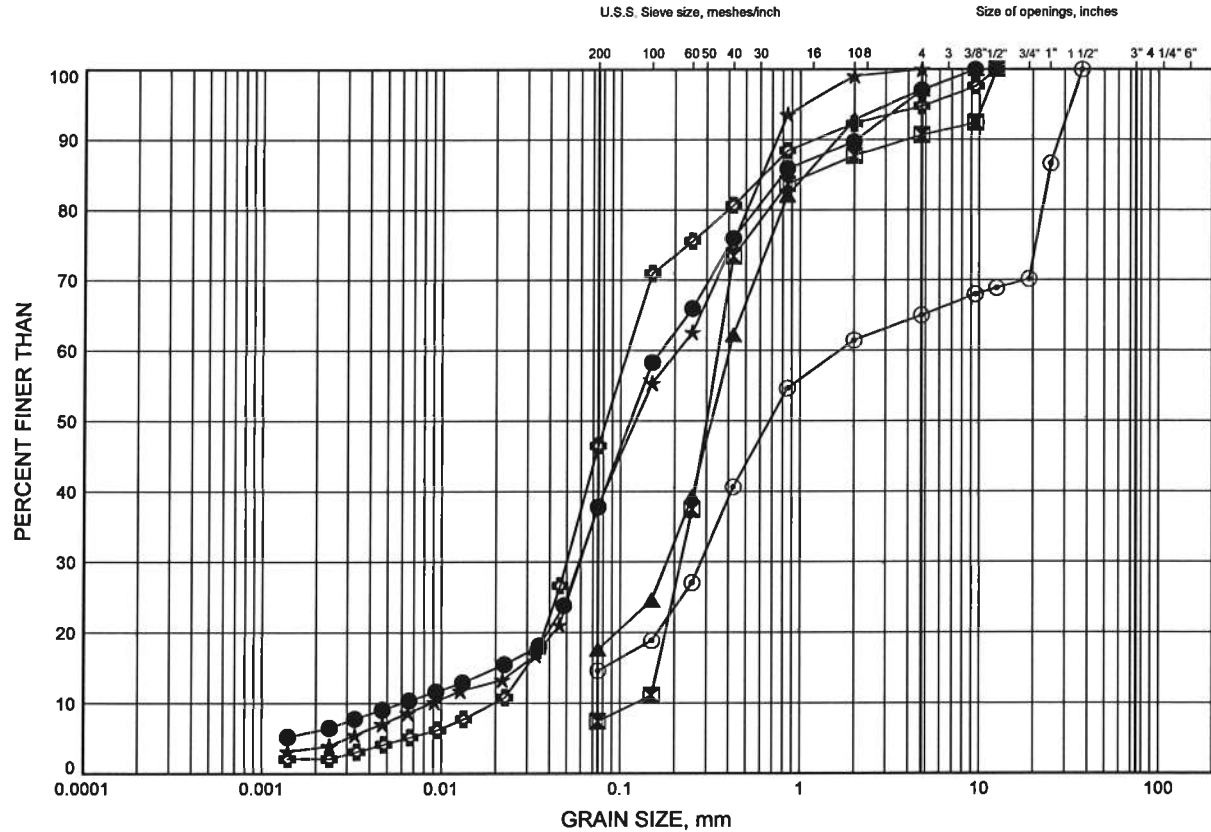
Appendix B

Laboratory Test Results

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B1

SILTY SAND/SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LE-01	2.59	60.45
⊠	LE-02	3.35	60.37
▲	LE-04	3.35	65.27
★	LE-04	7.77	60.85
⊙	LE-05	1.83	66.44
⊕	LE-05	4.85	63.42

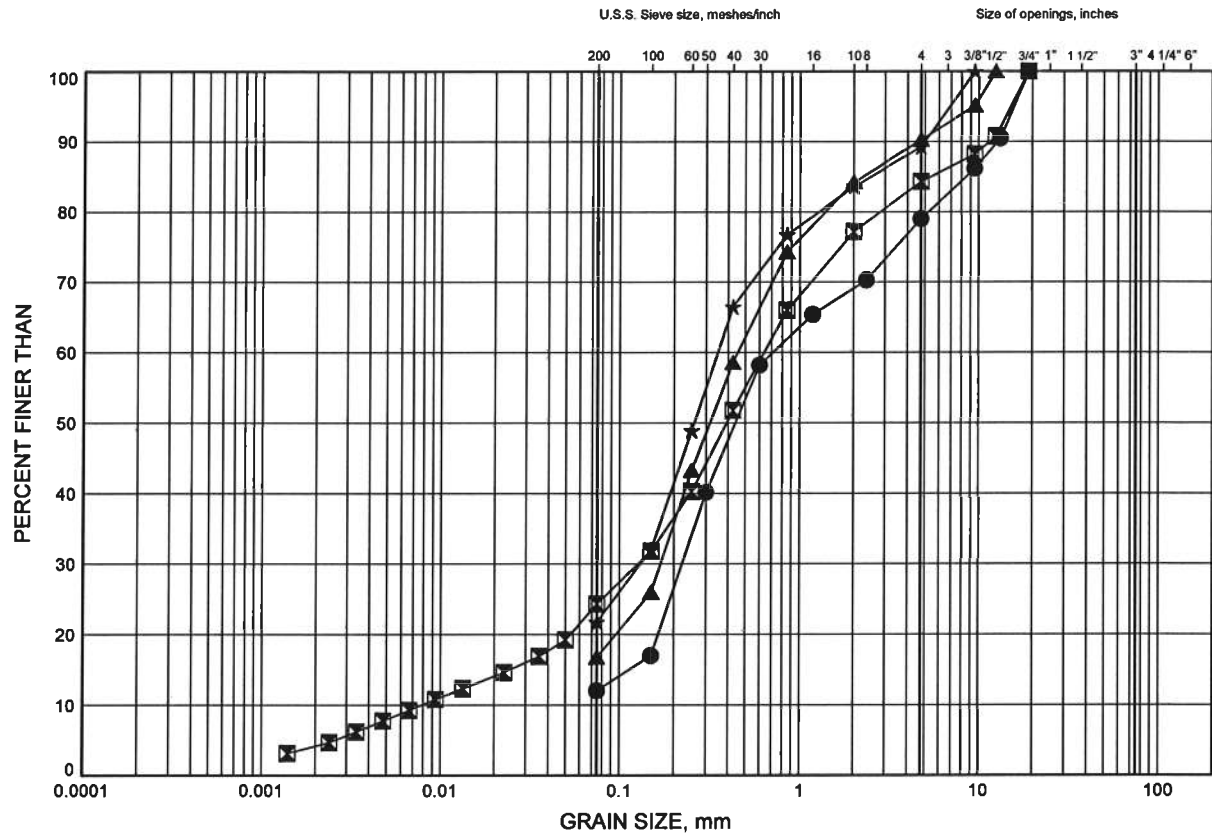


W.P.# .4091-07-00.....
Prepared By .AN.....
Checked By .MC.....

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY SAND/SAND FILL



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

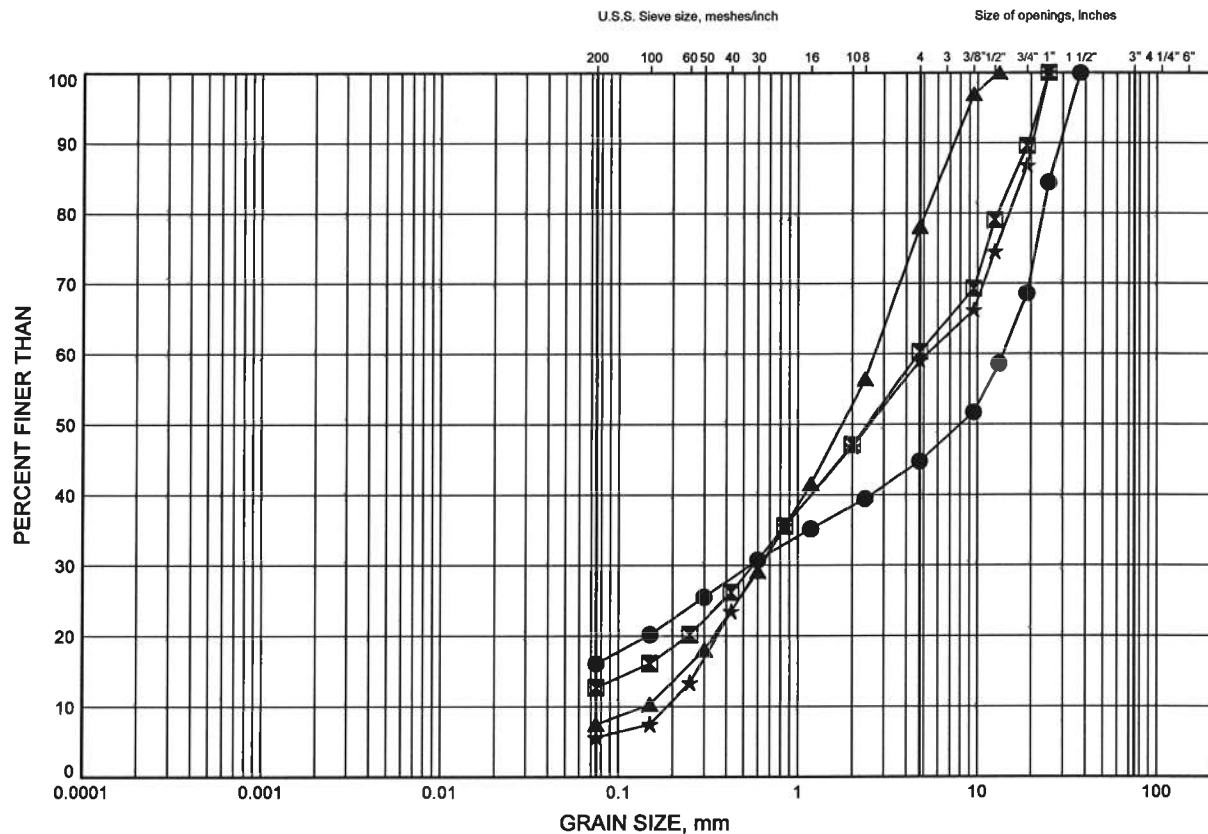
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EBH-02	1.07	59.03
⊠	LA-09	2.59	58.11
▲	LE-06	2.59	66.70
★	LE-06	4.78	64.51

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND and GRAVEL



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

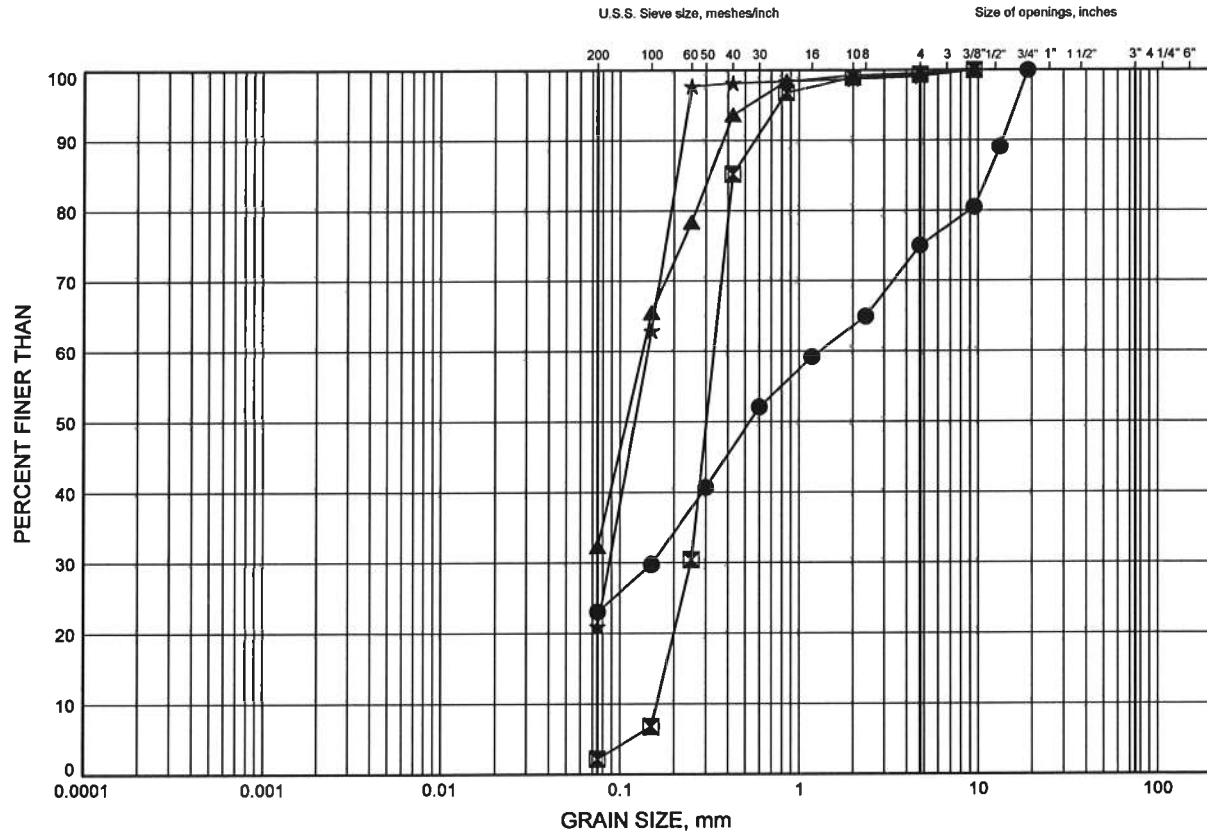
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LE-06	9.45	59.84
⊠	LE-07	2.59	57.51
▲	LE-07	4.88	55.22
★	LE-07	6.40	53.70

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY SAND to SAND and GRAVEL



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

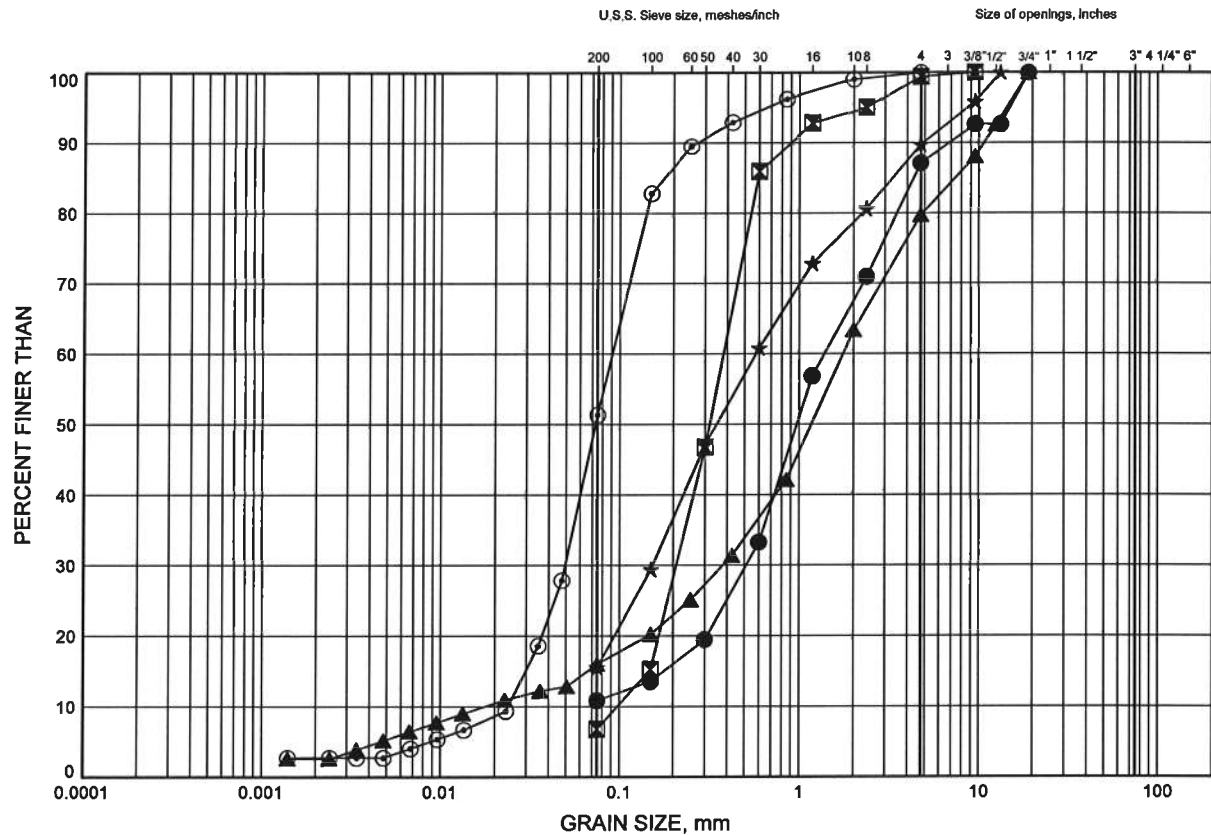
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EBH-02	4.11	55.99
⊠	EBH-02	6.40	53.70
▲	EBH-02	7.92	52.18
★	LE-07	7.85	52.25

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY SAND to GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LA-02	4.88	56.22
⊠	LA-02	7.16	53.94
▲	LA-09	4.88	55.82
★	LA-09	6.40	54.30
⊙	LA-09	7.92	52.77

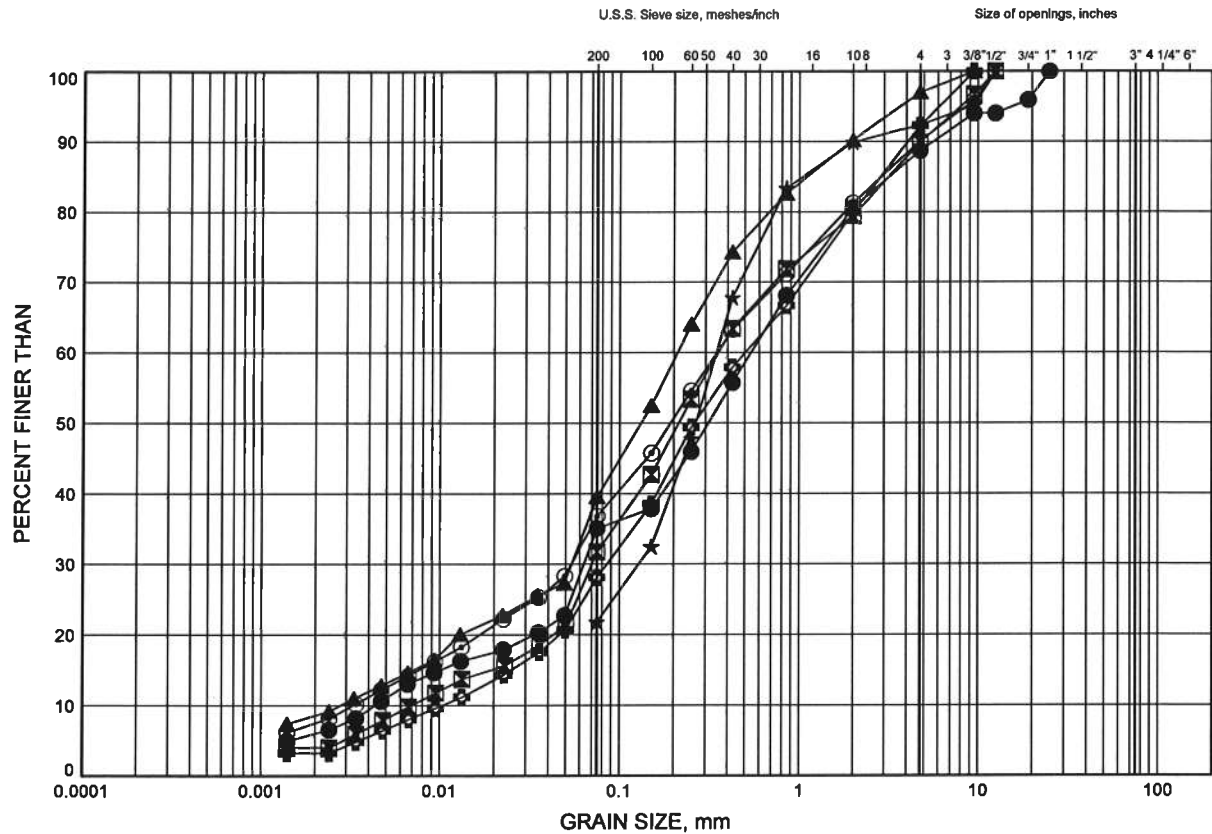


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Prepared By AN
Checked By MC

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B6

SILTY SAND TILL



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

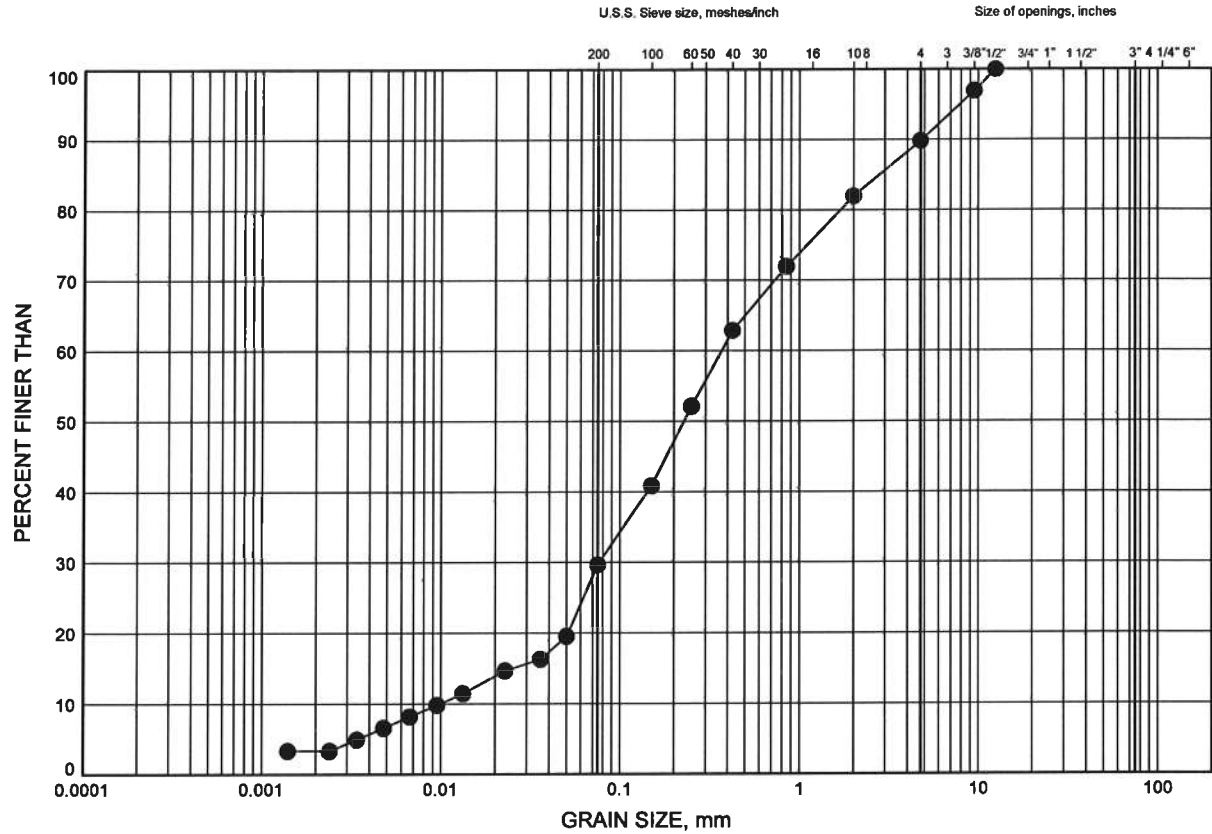
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LA-02	2.59	58.51
⊠	LE-04	10.97	57.65
▲	LE-05	7.92	60.34
★	LE-06	6.38	62.91
⊙	LE-06	12.50	56.79
⊕	LE-07	10.74	49.35

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B7

SILTY SAND FILL STAGING AREA



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	STG-7	1.07	60.09

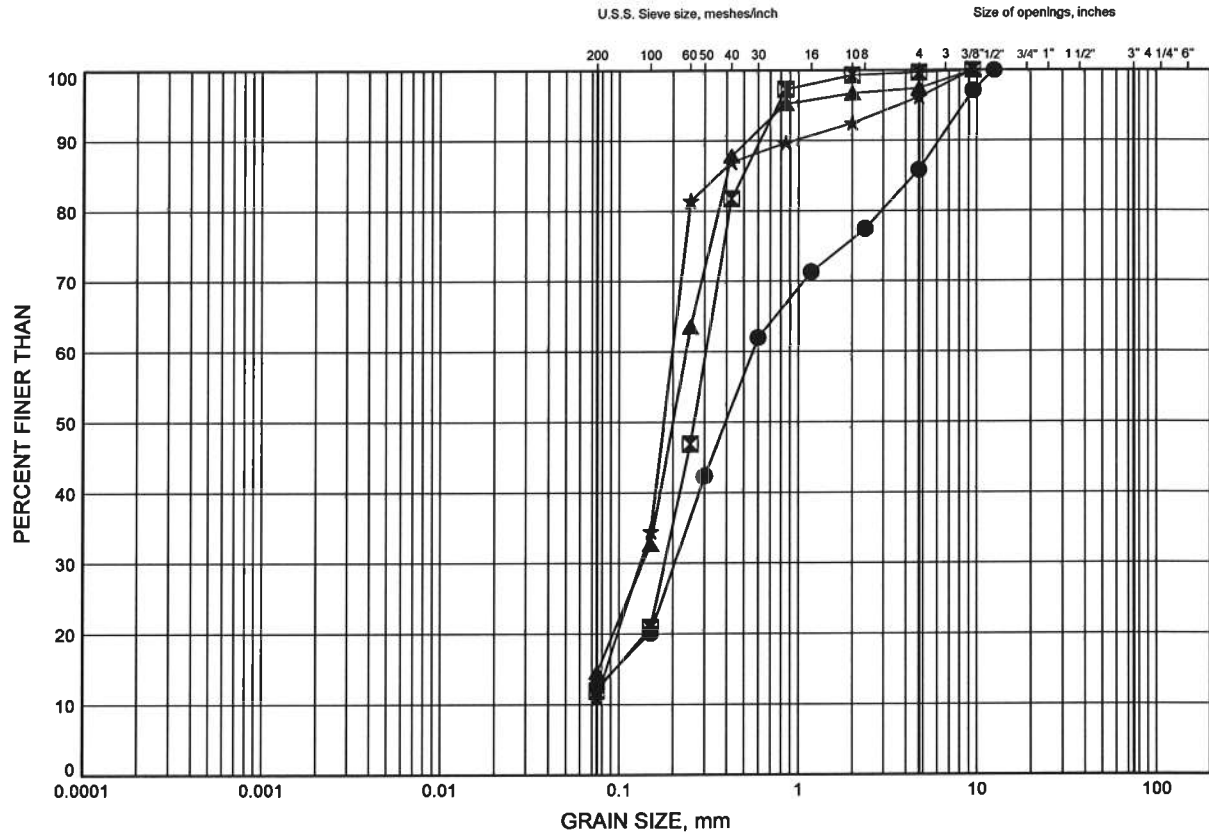


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Prepared By AN.....
Checked By MC.....

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B8

SAND LAYER with Some GRAVEL STAGING AREA



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	STG-7	6.40	54.76
⊠	STG-8	2.59	58.20
▲	STG-9	1.83	59.58
★	STG-9	6.40	55.01

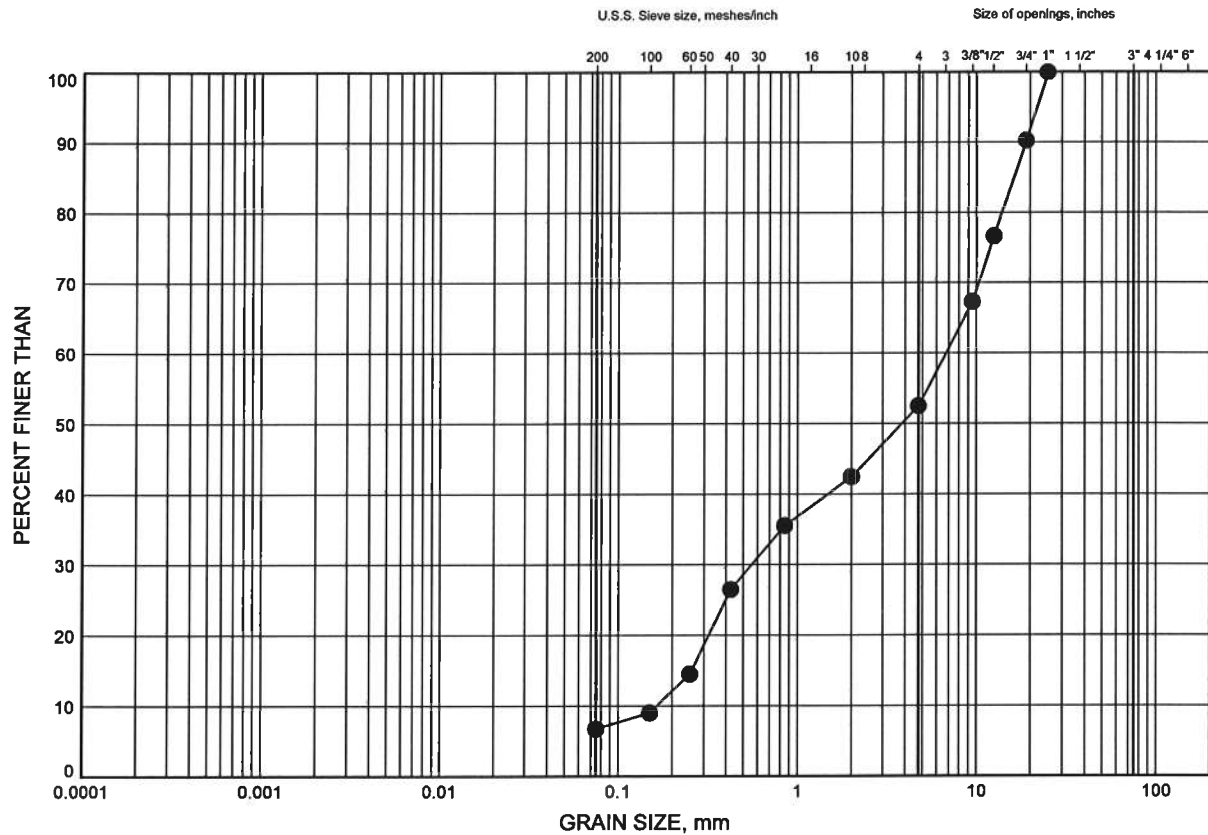


W.P.# 4091-07-00.....
Prepared By .AN.....
Checked By .MC.....

Highway 417 Ottawa: Nicholas to Vanier GRAIN SIZE DISTRIBUTION

FIGURE B9

SAND and GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	STG-8	6.40	54.39



W.P.# 4091-07-00
Prepared By AN
Checked By MC

Appendix C

Site Photographs



Photograph 1: South Abutment of Lees Avenue Underpass



Photograph 2: North Pier of Lees Abutment Underpass



Photograph 3: Lees Avenue Underpass from Robinson Avenue




Photograph 4: East Side of North Approach to Lees Avenue Underpass

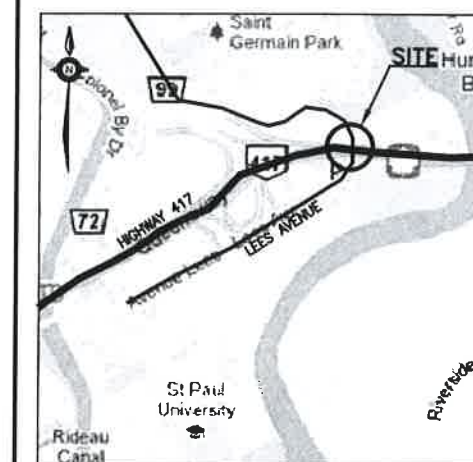
Appendix D

Drawings

Borehole Locations and Soil Strata








SHEET
1



KEYPLAN

LEGEND

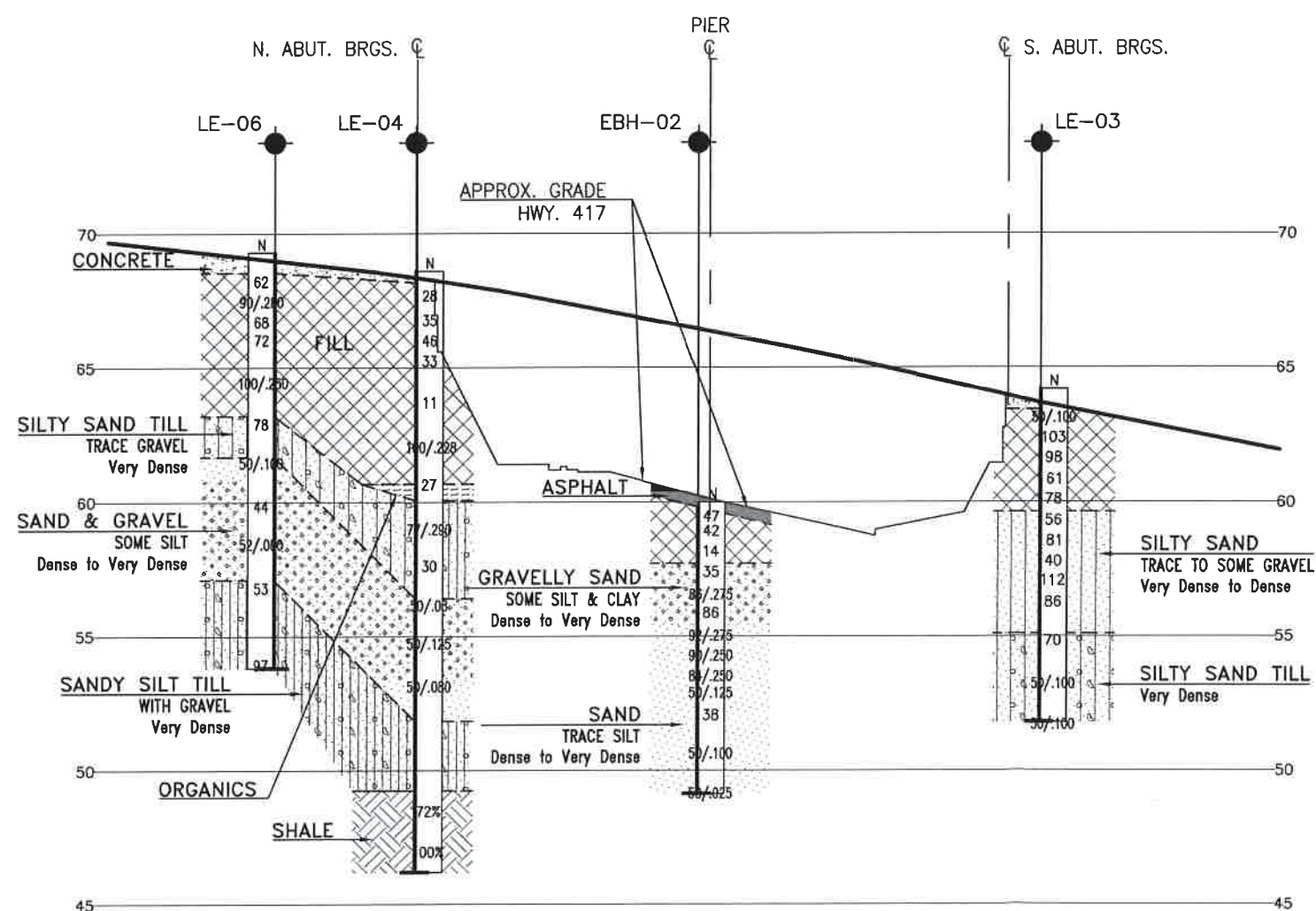
- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation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

NO	ELEVATION	NORTHING	EASTING
LE-01	63.0	5 031 087.0	369 814.6
LE-02	63.7	5 031 101.0	369 819.9
LE-03	64.2	5 031 097.0	369 827.6
LE-04	68.6	5 031 190.0	369 832.7
LE-05	68.3	5 031 193.0	369 823.9
LE-06	69.3	5 031 211.0	369 826.5
LE-07	60.1	5 031 150.0	369 819.7
EBH-02	60.1	5 031 148.0	369 844.2
LA-02	61.1	5 031 107.0	369 842.3
LA-09	60.7	5 031 176.0	369 856.0

-NOTES-

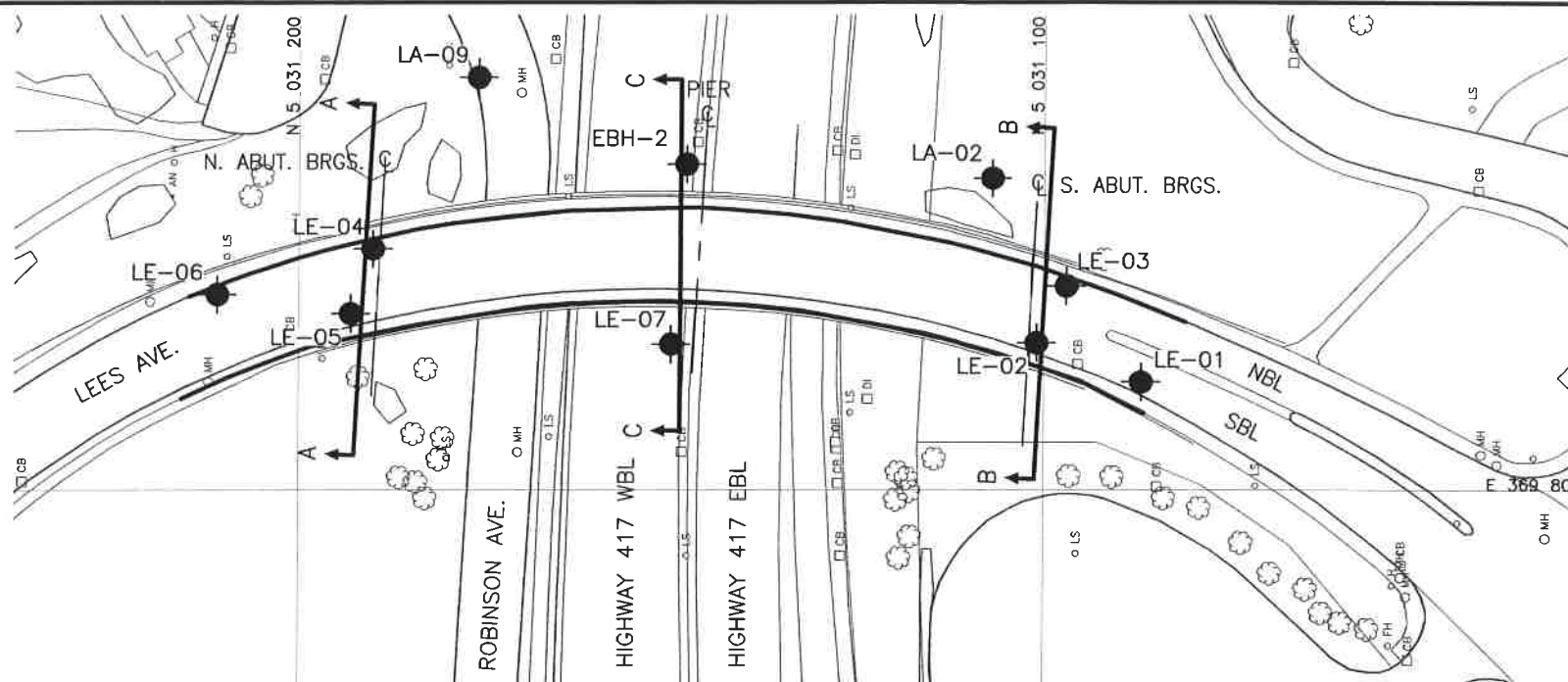
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31G5-246

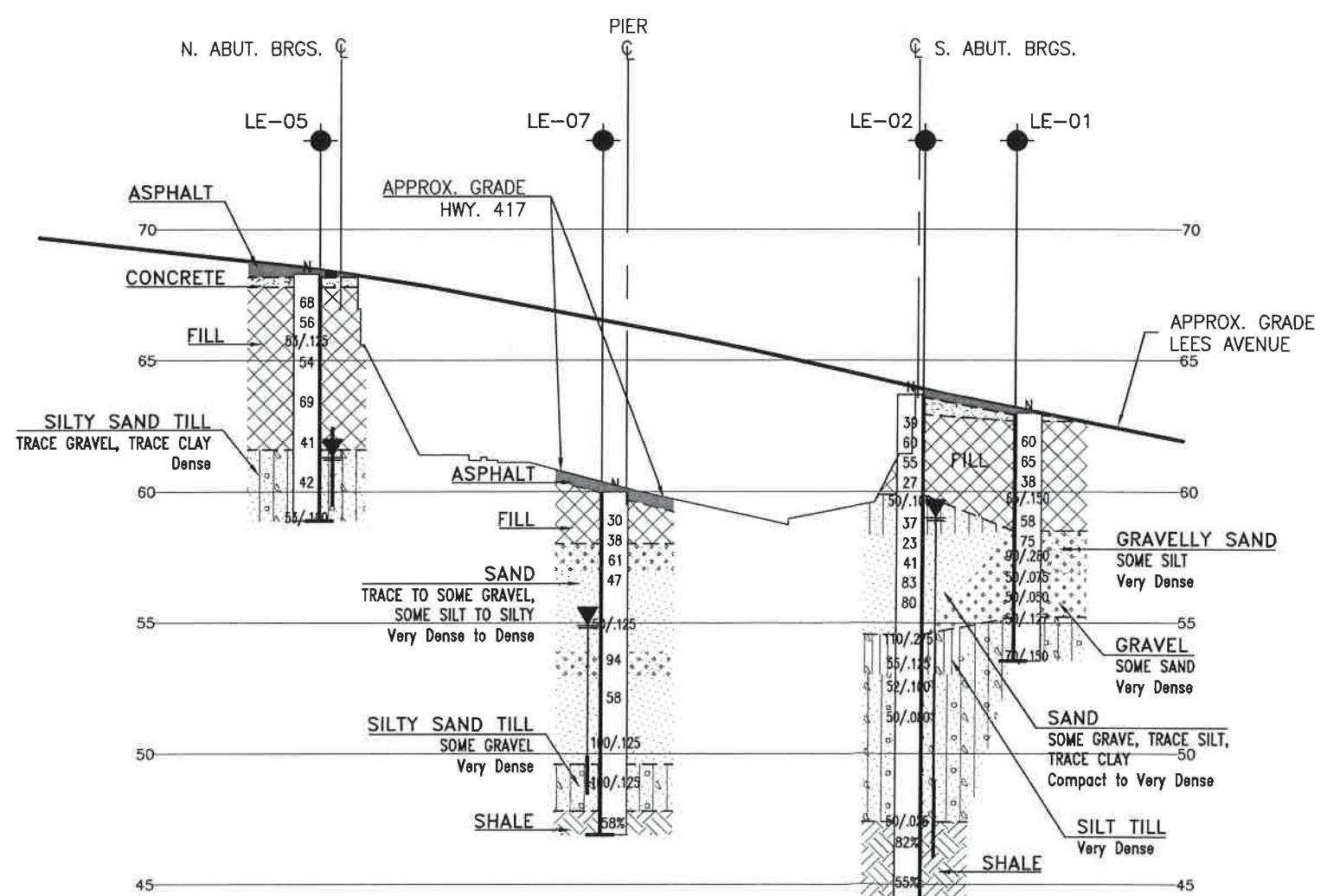


PROFILE ALONG LEES AVE. NBL

[illegible]



PLAN
SCALE 1:1000



PROFILE ALONG LEES AVE. SBL
H 1:1000
V 1:250

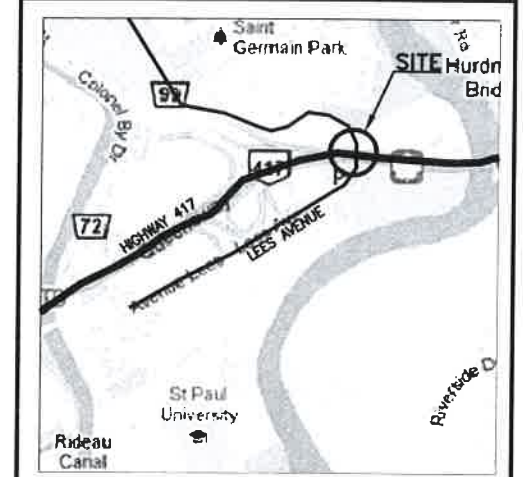
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 4091-07-00

HIGHWAY 417
LEES AVENUE UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN
CORPORATION

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
LE-01	63.0	5 031 087.0	369 814.6
LE-02	63.7	5 031 101.0	369 819.9
LE-03	64.2	5 031 097.0	369 827.6
LE-04	68.6	5 031 190.0	369 832.7
LE-05	68.3	5 031 193.0	369 823.9
LE-06	69.3	5 031 211.0	369 826.5
LE-07	60.1	5 031 150.0	369 819.7
EBH-02	60.1	5 031 148.0	369 844.2
LA-02	61.1	5 031 107.0	369 842.3
LA-09	60.7	5 031 176.0	369 856.0

-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.

GEOCRIS No. 31G5-246



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 4091-07-00



HIGHWAY 417
LEES AVENUE UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

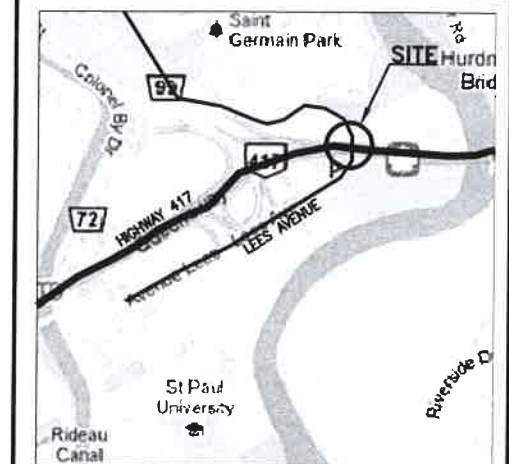
SHEET
3



McCORMICK RANKIN
CORPORATION



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

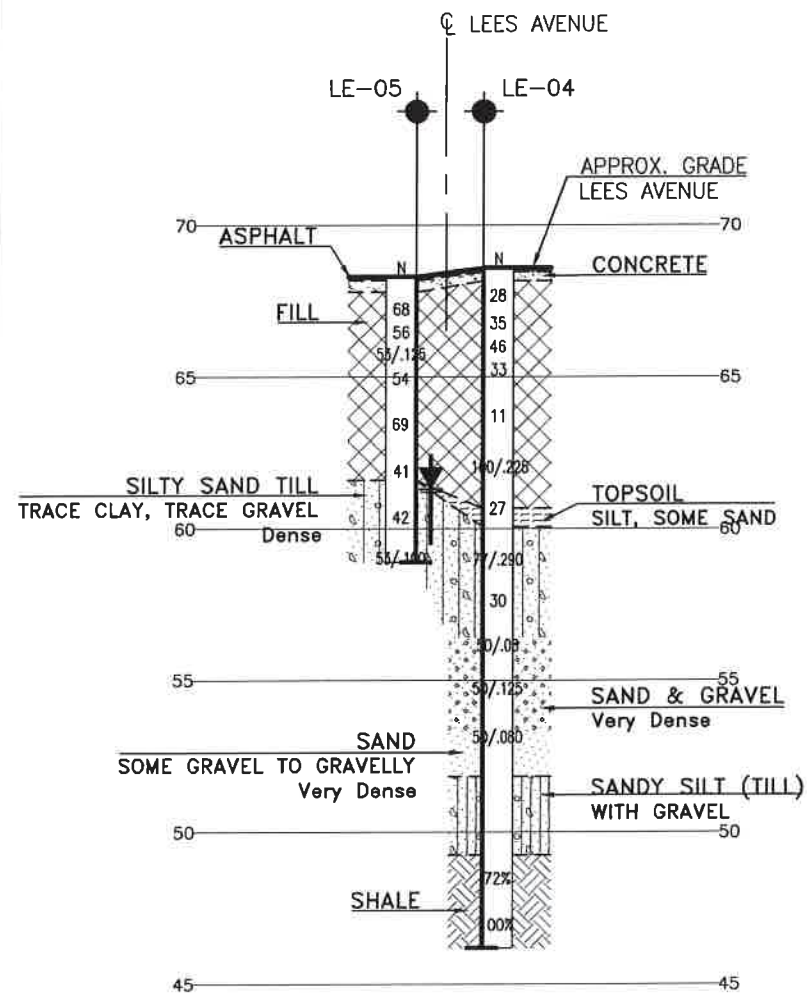
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
LE-01	63.0	5 031 087.0	369 814.6
LE-02	63.7	5 031 101.0	369 819.9
LE-03	64.2	5 031 097.0	369 827.6
LE-04	68.6	5 031 190.0	369 832.7
LE-05	68.3	5 031 193.0	369 823.9
LE-06	69.3	5 031 211.0	369 826.5
LE-07	60.1	5 031 150.0	369 819.7
EBH-02	60.1	5 031 148.0	369 844.2
LA-02	61.1	5 031 107.0	369 842.3
LA-09	60.7	5 031 176.0	369 856.0

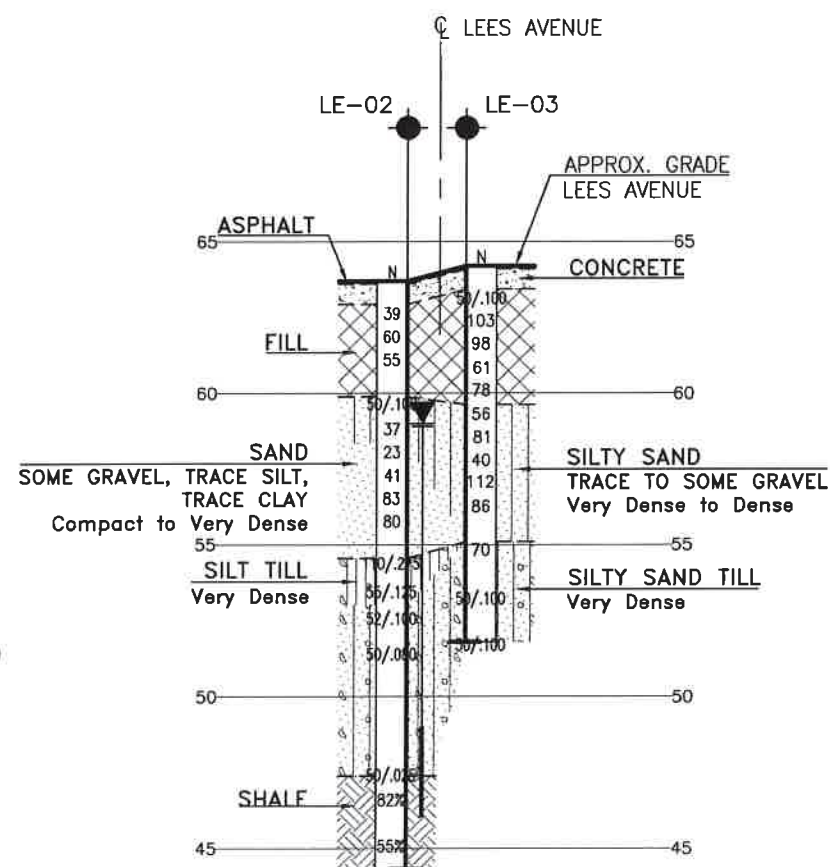
-NOTES-

- 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.

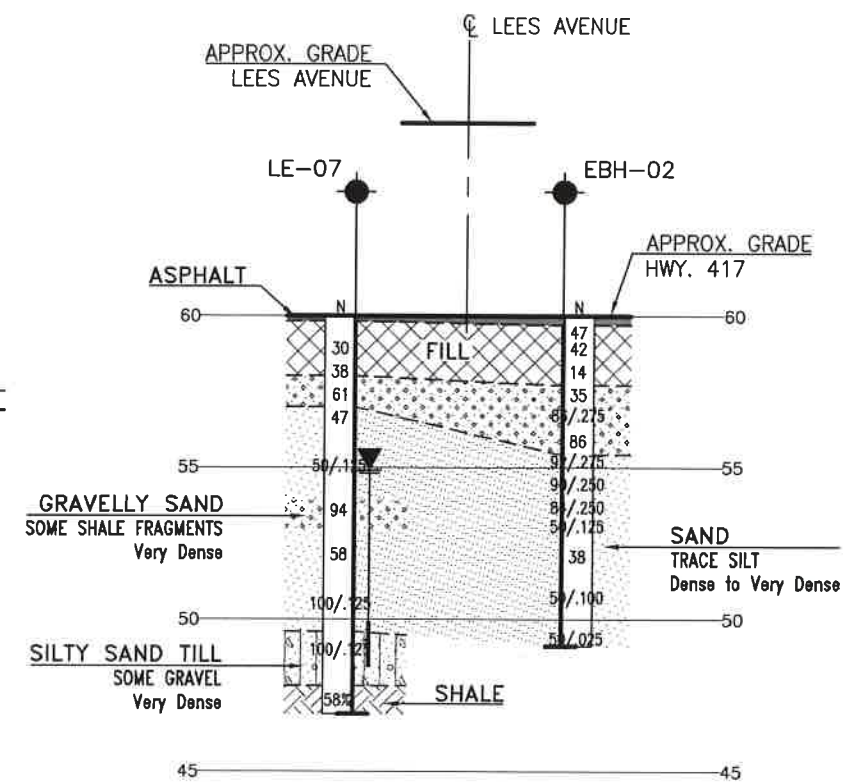
GEOCRES No. 31G5-246



SECTION A-A



SECTION B-B



SECTION C-C

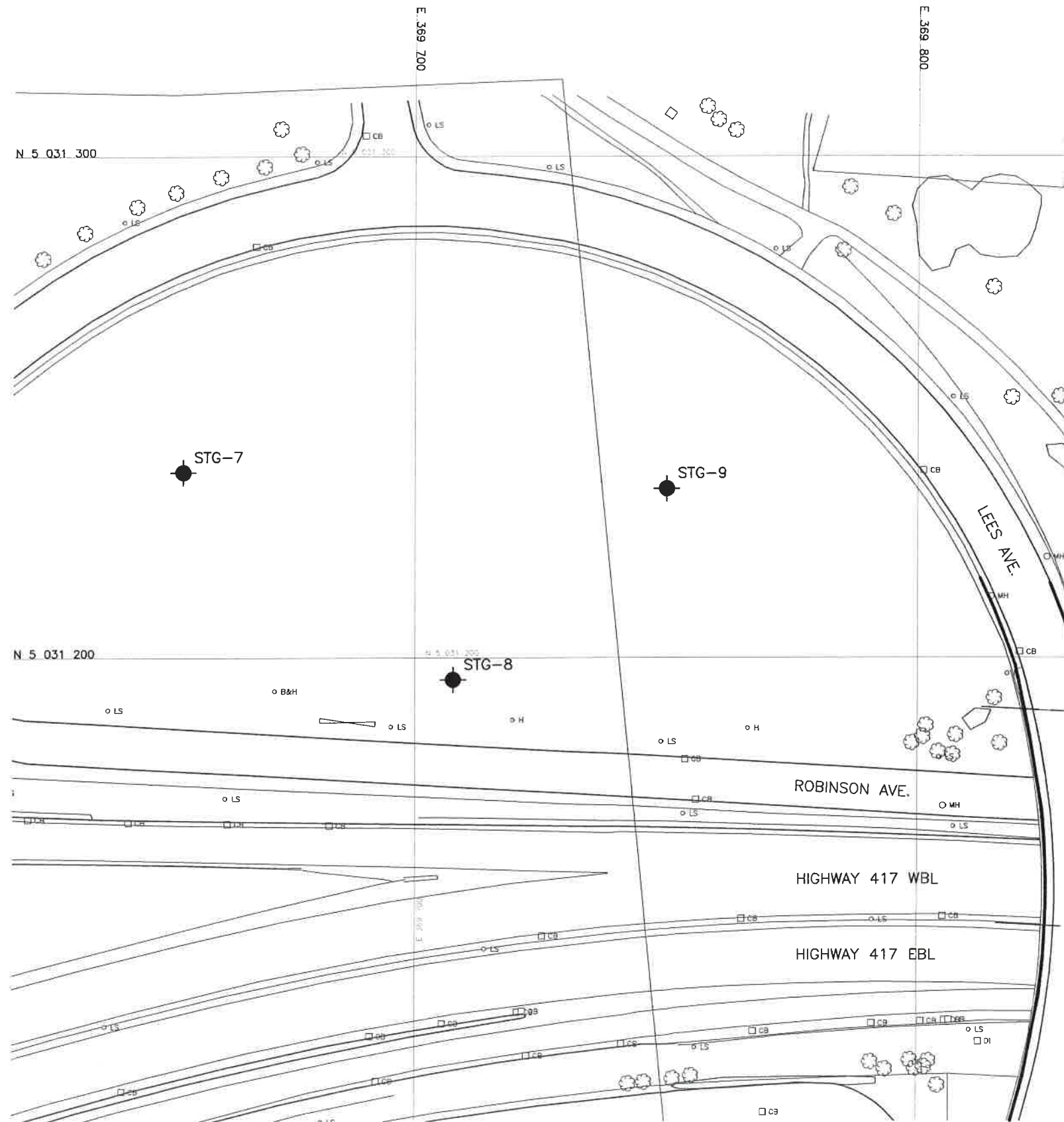


H 1:1000

V 1:250



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MC	CHK	MRA
DRAWN	AN	CHK	SITE
			LOAD
			STRUCT
			DWG 3
			DATE APR. 2012



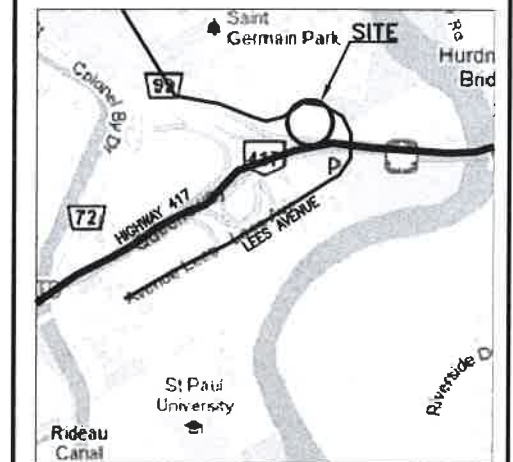
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 4091-07-00

HIGHWAY 417
LEES AVENUE STAGING AREA
BOREHOLE LOCATION PLAN

MRC McCORMICK RANKIN
CORPORATION

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
STG-7	61.2	5 031 237.0	369 654.0
STG-8	60.8	5 031 195.6	369 707.7
STG-9	61.4	5 031 233.7	369 750.1

-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. 31G5-246



DATE	BY	DESCRIPTION
DESIGN	MC	CHK MRA CODE LOAD DATE APR. 2012
DRAWN	AN	CHK SITE STRUCT DWG 1