FOUNDATION INVESTIGATION AND DESIGN REPORT
COVENTRY PEDESTRIAN OVERPASS
MULTI-USE PATHWAY CONNECTION
COVENTRY ROAD – TRAIN STATION
OTTAWA, ONTARIO

Report to

McCormick Rankin Corporation

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

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TABLE OF CONTENTS

PART 1 FACTUAL INFORMATION

PART 2 ENGINEERING DISCUSSION AND RECOMMENDATIONS

Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
Appendix C	List of SPs and OPSS, and Suggested Text for Selected NSSPs
Appendix D	Borehole Locations and Soil Strata Drawings

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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 Coventry Pedestrian Overpass which is to span across Highway 417. The proposed bridge is located approximately 300 m east of Vanier Parkway, Ottawa, Ontario. The pedestrian bridge will serve as a connection for Coventry Road and the Baseball Stadium (north of Highway 417) to the Ottawa Train Station (south of Highway 417) as part of Ottawa's multi-use pathway system.

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, record of borehole sheets, 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.

2 SITE DESCRIPTION

The site of the proposed Coventry Pedestrian Overpass is located between Vanier Parkway and Belfast Road, approximately 300 m east of Vanier Parkway, at Highway 417 in the City of Ottawa. The investigation site extends north and south of Highway 417 between Coventry Road and Tremblay Road. The proposed bridge site is located approximately 750 m east of the Rideau River and is located within a landscaped area of sparse trees and shrubs.

The current concept for the bridge indicates the pedestrian overpass will consist of four spans of varying length, crossing over the main lanes of Highway 417, two ramps (E-N/S and S-E Ramps at Vanier Parkway) and Tremblay Road at the south end. The total length of the pedestrian bridge will be approximately 170 m. The north abutment and ramps will be located adjacent to the parking lot of the Baseball Stadium and the south abutment will be located on the train station lands south of Tremblay Road. The piers will be located in the median of Highway 417, in the gore area between the main westbound lanes of Highway 417 and the E-N/S Ramp, and between the S-E Ramp and Tremblay Road.

Access ramps are proposed for both ends of the pedestrian bridge. Two access ramps are proposed for the north end of the bridge, one ramp going east and the second ramp heading west. These ramps will be roughly 100 m in length. A stairs and a switchback ramp heading west of the alignment are proposed for the south end of the bridge.

Two large diameter watermains (1050mm and 1200mm) belonging to the City of Ottawa are present between the S-E Ramp and Tremblay Road. Currently a bridge pier is planned at this location. A previous concept called for the overpass to end at this location, with the south abutment and south access ramp located between the two mains.

The site lies within the Ottawa Valley Clay Plains physiographic region, a clay plains 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 two stages. Initially during the period of November 8 to 24, 2011, a total of ten boreholes (identified as CPB-01 to CPB-10) were drilled and sampled in the area of the north abutment, north and median piers, and the former south abutment location between the S-E Ramp and Tremblay Road. Subsequently between February 14 and 16, 2012, four additional boreholes (CPB-11 to CPB-14) were drilled and sampled at the proposed revised location of the south abutment south of Tremblay Road.

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

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

The borehole locations were marked in the field by MRC and utility clearances were obtained prior to commencement of drilling operations. An Encroachment Permit was obtained for boreholes located within the MTO corridor, and City of Ottawa consent was obtained for the boreholes drilled in the stadium parking lot. A National Capital Commission (NCC) Land Access Permit was obtained by MRC for the boreholes located on the lands of the Ottawa Train Station.

A truck-mounted CME 75 drill rig was used to drill the boreholes located in the stadium parking lot (CPB-01, 02, 08, 09, and 10) and the borehole located in the Highway 417 median (CPB-04). A track-mounted CME 75 drill rig was used to drill the boreholes located in the gore area of Highway 417 (CPB-03), the grass area between the S-E Ramp and Tremblay Road (CPB-05 to 07), and one borehole located in the grass area south of Tremblay Road (CPB-11). A track-mounted CME 850 drill rig was used to drill the three remaining boreholes (CPB-12 to CPB-14).

Table 3.1 – Borehole Termination Depths and Ground Elevation

Structure Element	Borehole	Ground Elevation (m)	BH Termination Depth (m)	BH Termination Elevation (m)
North Abutment	CPB-01	62.5	19.6	42.9
	CPB-2	62.3	18.0	44.3
North Pier	CPB-03	60.7	16.5	44.2
Median Pier	CPB-04	60.0	15.0	45.0
South Pier	CPB-05	59.9	14.5	45.4
South Pier (Ramp)	CPB-06	60.5	8.8	51.7
	CPB-07	60.8	7.6	53.2
North Ramps	CPB-08	62.0	10.3	51.7
	CPB-09	61.5	11.3	50.2
	CPB-10	60.7	10.0	50.7
South Abutment	CPB-11	62.1	15.1	47.0
	CPB-12	61.5	9.0	52.5
South Ramp and Stairs	CPB-13	61.8	9.4	52.4
	CPB-14	63.2	11.0	52.2

A combination of hollow-stem auger drilling techniques and NQ coring methods were 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 3.0 to 11.0 m length of rock core was recovered from all boreholes. 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.

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.

Standpipe piezometers, consisting of 19mm diameter PVC pipe with slotted screen, were installed in seven of the boreholes at this site. The installation details of the piezometers are summarised in Table 3.2. Upon completion of drilling, boreholes without a piezometer installation were backfilled with a mixture of bentonite holeplug and cuttings to a depth of approximately 0.15 m below ground level and then asphalt cold patch to surface, where appropriate. Following the final water level reading, the piezometers will be decommissioned in general accordance with MOE Regulation 903.

Table 3.2 – Piezometer Installation Details

Borehole	Piezometer Tip		Installation Details
	Depth (m)	Elevation (m)	
CPB-01	19.2	43.3	Sand filter from 19.2 to 14.6 m, bentonite holeplug from 14.6 to 8.5 m, then bentonite and cuttings mixture to surface. Flushmount casing installed.
CPB-03	16.5	44.2	Sand filter from 16.5 to 14.6 m, bentonite holeplug from 14.6 m to ground surface. PVC pipe sticks up 1.2 m above ground surface.
CPB-05	14.5	45.4	Sand filter from 14.5 to 12.5 m, bentonite holeplug from 12.5 m to ground surface. PVC pipe sticks up 0.9 m above ground surface.
CPB-07	4.6	56.2	Bentonite from 7.6 to 4.6 m. Sand filter from 4.6 to 2.7 m, bentonite holeplug and cuttings from 2.7 m to ground surface. PVC pipe sticks up 1.5 m above ground surface.
CPB-08	10.3	51.7	Sand filter from 10.3 to 6.1 m, bentonite from 6.1 m to ground surface. Flushmount casing installed.
CPB-11	15.1	47.0	Sand filter from 15.1 to 12.6 m, bentonite from 12.6 to 0.5 m, then cuttings from 0.5 m to ground surface. PVC pipe sticks up 0.8 m above ground surface.
CPB-13	6.2	55.6	Bentonite from 9.4 to 6.2 m. Sand filter from 6.2 to 3.9 m, bentonite holeplug from 3.9 to 0.3 m, then cuttings from 0.3 m to ground surface. PVC pipe sticks up 0.8 m above ground surface.

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 cores were assessed from the point load data and these values are reported on the borehole logs (as average UCS value per run).

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 based on the conditions encountered in the boreholes is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

The stratigraphy encountered at the site of the proposed pedestrian bridge generally consists of topsoil in landscaped areas or asphalt over sand and gravel fill in pavement areas, overlying fill consisting of silty sand, sand and/or clayey silt and sand, underlain by native silty sand till then shale at depth. A layer of silty clay was encountered locally in Borehole CPB-01, below the sand and gravel fill. A layer of sandy silt was encountered locally in Boreholes CPB-03 and CPB-13, below the fill.

More detailed descriptions of the individual strata encountered along the proposed bridge alignment are presented below.

5.1 Asphalt

Asphalt was encountered at the ground surface in six of the ten boreholes drilled for this investigation (Boreholes CPB-01, CPB-02, CPB-04, CPB-08, CPB-09, and CPB-10). Boreholes CPB-01, CPB-02, and CPB-08 to CPB-10 were drilled in the parking lot of the Baseball Stadium and Borehole CPB-04 was drilled on the left shoulder of the westbound lanes of Highway 417. The asphalt was 100 mm thick in all six boreholes.

5.2 Topsoil

Dark brown topsoil containing rootlets was encountered at the surface in eight boreholes (CPB-03, CPB-05 to CPB-07, and CPB-11 to CPB-14). The thickness of the topsoil ranged from 100 mm to 300 mm. The topsoil was thickest at the location of Borehole CPB-03, which was drilled in the gore area between the main westbound lanes of Highway 417 and the E-N/S Ramp to Vanier Parkway.

5.3 Sand and Gravel Fill

Sand and gravel fill was encountered below the asphalt in the boreholes drilled in the baseball stadium parking lot (Boreholes CPB-01, CPB-02, CPB-08, CPB-09, and CPB-10) and in the borehole drilled in the median of Highway 417 (Borehole CPB-04). The sand and gravel fill is generally brown and contains trace to some silt and clay.

The thickness of the sand and gravel fill ranged from 1.0 m to 2.9 m in the boreholes drilled in the baseball stadium parking lot and was 0.5 m in Borehole CPB-04. The lower boundary of the sand and gravel fill was encountered at depths of 0.6 m to 3.0 m (Elevation. 61.4 to 59.3)

SPT 'N' values recorded in the sand and gravel fill generally ranged from 7 to 30 blows for 0.3 m penetration, indicating a loose to compact relative density. A SPT 'N' value of 45 blows for 0.3 m penetration was recorded in the sand and gravel fill in Borehole CPB-09, indicating a dense condition.

The moisture content of samples of the sand and gravel fill ranged from 2 to 10%.

A grain size distribution analysis was carried out on one sample of sand and gravel fill from the baseball stadium parking lot. The results of this test are plotted on Figure B1 of Appendix B, and are summarized below:

Gravel%	45
Sand%	32
Silt and Clay %	23

5.4 Silty Sand Fill

Silty sand fill was encountered below the topsoil in Boreholes CPB-03 and CPB-05 to CPB-07, below the sand and gravel fill in Borehole CPB-04, and below clayey silt and sand fill in Borehole CPB-12. The silty sand fill was brown to grey in colour and contained trace to some clay and trace to some gravel.

The thickness of the silty sand fill ranged from 0.6 m to 3.1 m, with the lower boundary encountered at depths of 1.2 to 4.3 m (Elevations 59.5 to 57.2).

SPT 'N' values recorded in the silty sand fill generally ranged from 11 to 30 blows for 0.3 m penetration, indicating a compact relative density. Locally, SPT 'N' values of 48 blows for 0.3 m penetration and 50 blows for 0.15 m penetration were also recorded in the silty sand fill, indicating dense to very dense zones or obstructions within the fill. In Borehole CPB-12, an SPT 'N' value of 5 blows for 0.3 m penetration was recorded at 2.5 to 3.0 m depth, indicating a loose condition.

The moisture content of samples of the silty sand fill ranged from 6 to 23%.

Selected samples of the silty sand fill underwent laboratory grain size distribution analyses, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are plotted on Figure B2 of Appendix B.

Gravel%	6 to 17
Sand%	36 to 60
Silt%	23 to 36
Clay%	8 to 15

5.5 Clayey Silt and Sand Fill

A zone of clayey silt and sand fill was encountered in Borehole CBP-07 below the silty sand fill, in Borehole CPB-12 below the topsoil, and in Borehole CPB-13 below sand fill. The clayey silt and sand was brown to grey and contained trace gravel.

The thickness of the clayey silt and sand fill ranged from 1.1 m to 1.8 m, with the lower boundary encountered at depths of 1.2 m to 3.0 m (Elevations 60.3 to 58.4).

SPT ‘N’ values of 10 and 17 blows for 0.3 m penetration were recorded in the clayey fill in Boreholes CPB-07 and CPB-12, indicating a stiff to very stiff consistency. In Borehole CPB-13, SPT ‘N’ values of 2 to 4 blows for 0.3 m penetration were recorded, indicating a soft consistency. Moisture contents of 14% to 31% were measured.

Three samples of the clayey silt and sand fill were selected for grain size distribution analysis. The grain size distribution curves for these samples are plotted on Figure B3, Appendix B and the results are summarized as follows:

Gravel%	1 to 2
Sand%	33 to 41
Silt%	21 to 33
Clay%	25 to 39

5.6 Sand Fill

Sand fill was encountered below the topsoil in Boreholes CPB-11, CPB-13, and CPB-14, located in the train station lands. In general, the sand fill was brown to grey and contained some gravel to gravelly. Below depths of 1.8 and 3.0 m (Elev. 60.3 and 60.2 m) in Boreholes CPB-12 and CPB-14 respectively, the sand fill was mixed with coarse ballast material and was grey to black.

The thickness of the sand fill ranged from 1.1 to 5.7 m, with the lower boundary encountered at depths of 1.2 to 5.8 m (Elev. 60.6 to 57.4).

SPT ‘N’ values recorded in the sand fill generally ranged from 18 to 90 blows for 0.3 m penetration, indicating a compact to very dense condition. An ‘SPT’ N value of 7 blows for 0.3 m penetration, indicating a loose relative density, was recorded above 1.2 m depth in Borehole CPB-13.

The moisture content of samples of the sand fill ranged from 4 to 29%.

Two samples of the sand fill underwent laboratory grain size analysis testing. The results of these tests are presented on the Record of Borehole sheets included in Appendix A and on the grain size distribution curves plotted on Figure B4, Appendix B. The results are summarized as follows:

Gravel%	20 to 22
Sand%	50 to 67
Silt and Clay%	13 to 28

5.7 Silty Clay

Dark brown to dark grey silty clay containing some sand and trace gravel was encountered locally in Borehole CPB-01, below the sand and gravel fill. The thickness of the silty clay layer was 2.6 m. The lower boundary of the silty clay layer was encountered at a depth of 3.7 m (Elevation 58.8).

SPT 'N' values of 8 and 12 blows for 0.3 m penetration were recorded in the silty clay layer. These SPT 'N' values indicate the silty clay has a stiff consistency.

The moisture content of samples of the silty clay ranged from 13 to 22%.

One sample of the silty clay underwent laboratory grain size distribution analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curve for this sample is plotted on Figure B5, Appendix B and the results of the Atterberg Limits tests are plotted on Figure B11, Appendix B.

Gravel%	1
Sand%	19
Silt%	30
Clay%	51
Liquid Limit %	33
Plastic Limit %	19
Plasticity Index %	14

The results of the Atterberg Limits tests indicate that the silty clay is of low plasticity with a group symbol of CL.

5.8 Sandy Silt

A thin layer of sandy silt containing trace to some clay and trace gravel was encountered below the fill in Boreholes CPB-03 and CPB-13 at depths of 1.8 and 3.0 m, respectively. The sandy silt layer was 0.9 and 1.2 m thick, with a lower boundary at depths of 2.7 and 4.2 m (Elevation 58.0 and 57.6).

SPT 'N' values recorded in the sandy silt in Borehole CPB-03 were 82 blows for 0.3 m penetration and 50 blows for 0.15 m penetration, indicating a very dense relative density.

In Borehole CPB-13, an SPT ‘N’ value of 6 blows for 0.3 m penetration was recorded, indicating a loose relative density.

The moisture content of samples of the sandy silt ranged from 16% to 20%.

Two samples of the sandy silt underwent laboratory grain size distribution analysis. The results of these tests are summarized on the Record of Borehole sheets in Appendix A and the grain size distribution curve is plotted on Figure B6, Appendix B. The results are as follows:

Gravel%	0 to 8
Sand%	21 to 38
Silt%	47 to 63
Clay%	7 to 16

5.9 Clayey Silt and Sand

A thin layer of clayey silt and sand was encountered locally in Borehole CPB-10 below the sand and gravel fill. The clayey silt and sand is brown to dark brown and contains trace gravel. This layer was 0.7 m thick, with the lower boundary of the layer encountered at a depth of 1.8 m (Elevation 58.9).

A SPT ‘N’ value of 4 blows for 0.3 m penetration was recorded in this clayey silt and sand layer, indicating a firm consistency.

A moisture content of 27% was measured from a sample of the clayey silt and sand.

One sample of the clayey silt and sand underwent laboratory grain size distribution analysis, the results of which are summarized below. The grain size distribution curve for this sample is plotted on Figure B7 of Appendix B.

Gravel%	3
Sand%	33
Silt%	34
Clay%	30

5.10 Silty Sand Till

Silty sand till was encountered in all of the boreholes advanced for this investigation. In Borehole CPB-05, the till consists of silt and sand rather than silty sand. The upper boundary of the native till was encountered at depths of 1.2 to 5.8 m. The thickness and elevation of the upper and lower boundary of the silty sand till in each borehole are presented in Table 5.1.

Table 5.1 – Thickness and Boundary Elevations of Silty Sand Till

Foundation Element	Borehole	Elevation of Upper Boundary (m)	Elevation of Lower Boundary (m)	Thickness (m)
North Abutment	CPB-01	58.8	53.9	4.9
	CPB-02	59.3	54.7	4.6
North Ramps	CPB-08	60.2	55.5	4.7
	CPB-09	60.1	53.8	6.3
	CPB-10	58.9	54.6	4.3
North Pier	CPB-03	58.0	54.3	3.7
Median Pier	CPB-04	58.8	55.1	3.7
South Pier	CPB-05*	57.5	55.6	1.9
South Pier (Ramp)	CPB-06	57.5	54.7	2.8
	CPB-07	58.4	56.2	2.2
South Abutment	CPB-11	57.7	56.5	1.2
	CPB-12	57.2	55.9	1.3
South Ramp and Stairs	CPB-13	57.6	55.7	1.9
	CPB-14	57.4	55.8	1.6

* Silt and Sand Till

SPT ‘N’ values recorded in the silty sand till varied widely, generally ranging from 4 to 39 blows for 0.3 m penetration, indicating a loose to dense relative density. Higher SPT ‘N’ values of 50 blows for 0.075 m penetration and 61 blows for 0.3 m penetration were recorded in Borehole CPB-06, indicating a very dense condition. In Boreholes CPB-03, CPB-04, CPB-08 and CPB-09, SPT split spoon refusal occurred at the interface of the till and bedrock, measuring high SPT ‘N’ values ranging from 74 blows for 0.225 m penetration to 50 blows for 0.075 m penetration.

Moisture contents of samples of the silty sand till generally ranged from 6% to 19%. A higher moisture content (37%) was measured in Borehole CPB-07 near the interface with the overlying silty clay.

Grain size distribution analyses were carried out on selected samples of the silty sand till, the results of which are summarized below. These results are also presented on the

Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are plotted on Figures B8 to B10 of Appendix B.

Gravel%	1 to 19
Sand%	39 o 51
Silt%	21 to 48
Clay%	10 to 21

A sample of the silty sand till contained sufficient clay to allow for Atterberg Limits testing. The results of one Atterberg Limits test are summarized below. These results are plotted on Figure B12, Appendix B. These results indicate that the silty sand till is slightly to low plastic at some locations and depths.

Liquid Limit %	17
Plastic Limit %	12
Plasticity Index %	5

Glacial till inherently contains cobbles and boulders.

5.11 Shale Bedrock

Dark grey, slightly weathered to fresh, laminated shale was proven by coring in all fourteen boreholes drilled at this site. The shale was observed to have thin hard limestone interbeds throughout. In the boreholes located at the proposed abutment and pier locations (CPB-01 to CPB-05 and CPB-11), 9.5 m to 11.0 m of bedrock was cored. In the other boreholes (CPB-06 to CPB-10 and CPB-12 to CPB-14), the boreholes were advanced 3.0 m to 3.9 m into bedrock.

The depths and elevations at which bedrock was encountered in each borehole are summarized in Table 5.2.

Total Core Recovery (TCR) in the bedrock was typically between 90% and 100%, indicating good core recovery. Lower TCR values between 25% and 67% were observed in five core runs of rock collected from near the bedrock surface. The Rock Quality Designation (RQD) values typically ranged from 75% to 100%, indicating a good to excellent rock quality. Lower RQD values of 0% to 53% (very poor to fair quality) were recorded in the upper 1.1 to 2.4 m of rock core from Boreholes CPB-01, 02, 08, 09 and 10, as well as two other runs in Borehole CPB-01.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10, typically less than 4. A FI of 25 was noted in Borehole CPB-11 at a depth of 12.5 m.

Table 5.2 – Depths and Elevations of Bedrock Surface

Structure Element	Borehole	Bedrock Surface	
		Depth (m)	Elevation (m)
North Abutment	CPB-01	8.6	53.9
	CPB-02	7.8	54.5
North Ramps	CPB-08	6.5	55.5
	CPB-09	7.7	53.8
	CPB-10	6.1	54.6
North Pier	CPB-03	6.4	54.3
Median Pier	CPB-04	4.9	55.1
South Pier	CPB-05	4.3	55.6
South Pier (Ramp)	CPB-06	5.8	54.7
	CPB-07	4.6	56.2
South Abutment	CPB-11	5.6	56.5
	CPB-12	5.6	55.9
South Ramp and Stairs	CPB-13	6.1	55.7
	CPB-14	7.4	55.8

The average unconfined compression strength (UCS) of the shale with limestone interbeds, interpreted from point load tests conducted on intact cores, typically ranged from 11 MPa to 49 MPa, which indicates a weak to medium strong rock. Higher UCS values of 100 MPa and 64 MPa were measured in Borehole CPB-02 Run 1 and Run 2.

5.12 Water Levels

Water levels were observed in most boreholes during the drilling operations or upon completion of drilling. Standpipe piezometers were installed in seven of the boreholes to monitor groundwater levels. Five piezometers were installed in the bedrock and two piezometers were installed above the bedrock in the silty sand till. The water levels measured during drilling and in the piezometers are summarized in Table 5.3.

It should be noted that groundwater levels are 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 5.3 – Groundwater Depths and Elevations

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
CPB-01	24-Nov-2011 29-Dec-2011	4.1 5.7	58.4 56.8	During drilling In piezometer
CPB-02	23-Nov-2011	4.6	57.7	During drilling
CPB-03	10-Nov-2011 29-Dec-2011 16-Feb-2012	3.6 3.4 4.2	57.1 57.3 56.5	Upon completion* In piezometer In piezometer
CPB-04	13-Nov-2011	4.9	55.1	Upon completion*
CPB-05	11-Nov-2011 29-Dec-2011 16-Feb-2012	4.5 2.7 2.9	55.4 57.2 57.0	Upon completion* In piezometer In piezometer
CPB-06	10-Nov-2011	4.3	56.2	Upon completion*
CPB-07	11-Nov-2011 29-Dec-2011 16-Feb-2012	4.6 2.0 3.2	56.2 58.8 57.6	Upon completion* In piezometer In piezometer
CPB-08	29-Dec-2011	5.0	57.0	In piezometer
CPB-09	22-Nov-2011	2.7	58.8	During drilling
CPB-11	16-Feb-2012 15-Mar-2012	5.4 1.1	56.7 61.0	In piezometer In piezometer
CPB-13	16-Feb-2012 15-Mar-2012	2.7 0.8	59.1 61.0	In piezometer In piezometer

* Unstabilized level; water was added to the borehole during coring operations.

6 MISCELLANEOUS

Borehole locations were selected and established in the field by McCormick Rankin Corporation (MRC). Surveyors from MRC provided co-ordinates and the ground surface elevations at the proposed borehole locations. Where boreholes could not be drilled at the proposed location, measurements were made in the field to establish the as drilled co-ordinates and elevations.

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

The field investigation was supervised by Mr. George Azzopardi, Mr. Stephane Loranger, C.E.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. Lindsey Blaine, E.I.T and Ms. Mei Cheong, M.Phil.

The report was reviewed by Mr. M.R Anderson, P.Eng. and 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

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Apr 20/12
PROVINCE OF ONTARIO

P.K. Chatterji, P.Eng., Ph.D.
Review Principal

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Apr 20/12
PROVINCE OF ONTARIO

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents geotechnical design recommendations to assist the design team to select and design a suitable foundation system for the proposed Coventry Pedestrian Overpass.

The proposed pedestrian bridge will be a four span structure crossing over Highway 417, the E-N/S and S-E Ramps of the Vanier Parkway interchange, and Tremblay Road. The north end of the bridge will be located adjacent to a stadium parking lot to the north of the E-N/S Ramp and the south end will be located on the train station lands south of Tremblay Road. The piers will be located in the median of Highway 417, in the gore area between Highway 417 WBL and the E-N/S Ramp, and between the S-E Ramp and Tremblay Road. The total length of the bridge will be approximately 170 m.

Access to the pedestrian bridge will be provided by ramps at both ends. At the north end, access ramps supported on piers will extend both east and west from the bridge. The configuration at the south end will consist of a stairs and a switchback ramp extending west at the top and then east to grade level.

A previous concept called for the overpass to end between the S-E Ramp and Tremblay Road. At this location, two large diameter watermains are present: a 1050mm diameter watermain with a crown level at 2 m depth (Elev. 57.0); and a 1200mm diameter main at a depth of approximately 5.4 m (Elev. 56.6). Currently a bridge pier is planned at this location.

The discussion and recommendations presented in this report are based on the information provided by MRC and on the factual data obtained in the course of the investigation.

8 STRUCTURE FOUNDATIONS

The site is generally underlain by fill consisting of sand and gravel, silty sand, sand and/or clayey silt and sand overlying variable loose to dense silty sand till. The fill extended to depths of 1.2 to 5.8 m at the borehole locations. Shale bedrock was encountered below the till at depths of 4.3 to 8.6 m (Elev. 53.9 to 56.5).

Foundations for the new pedestrian bridge and ramps must be designed to support the bridge superstructure and meet the seismic requirements of the CHBDC including resistance to any potential uplift and/or rocking effects. Initial consideration was given to the following foundation types:

- Spread footings on native soil
- Caissons socketed into bedrock
- Steel H-piles on bedrock, and
- Drilled micropiles.

The geotechnical resistance available in the near-surface native soils at this site are variable and generally insufficient to carry the bridge loads. The use of spread footings is therefore not recommended and this foundation option has not been developed further.

The use of micropiles extended into bedrock is considered feasible. However, micropiles are typically more costly than conventional deep foundations, will provide little lateral support for the bridge structure, and are considered unlikely to be the preferred foundation option. Additional comments on micropiles can be provided if this option is to be advanced.

Recommendations for design of caisson foundations socketed into bedrock and steel H-pile foundations are presented below.

8.1 Caissons

The proposed pedestrian bridge and ramps may be founded on caissons (drilled shafts) socketed into the shale bedrock. The caissons will provide resistance to both axial foundation loads and seismic uplift. Caissons socketed into bedrock to develop uplift resistance should be extended at least 3 m below the bedrock surface.

The factored axial geotechnical resistances at ULS recommended for typical caisson designs socketed 3 m and 5 m into shale bedrock, are provided in Table 8.1. These values include the geotechnical resistance factors of 0.4 and 0.3 specified in the CHBDC for axial compression and uplift, respectively.

Table 8.1- Axial Geotechnical Resistance of Caissons

Socket Length in Shale (m)	Caisson Diameter (m)	Factored Axial Resistance at ULS (kN)	Factored Uplift Resistance at ULS (kN)
3	0.9	3,000	1,500
	1.2	4,500	2,000
	1.5	6,300	2,500
5	0.9	4,000	2,500
	1.2	6,000	3,300
	1.5	8,000	4,200

The SLS condition will not govern for caissons founded in bedrock.

Temporary steel liners must be used to support the sides of the caisson shaft through the overburden. The liners should be sealed into the bedrock to exclude groundwater and permit construction in the dry. Caissons should be backfilled with concrete within 8 hours of excavation to minimize softening of the shale bedrock.

The Contractor’s caisson drilling equipment must be able to penetrate dense till deposits and shale bedrock with frequent hard limestone layers to prepare the rock sockets. Suggested wording for an NSSP on caisson installation is provided in Appendix C.

8.2 Steel H-Piles

8.2.1 Pile Design

Steel H-piles are considered suitable to support the proposed bridge and access ramps. In general, the H-piles should be driven to refusal in the bedrock, or alternatively placed in sockets extended below the bedrock surface to provide uplift resistance. To minimize the potential for vibrations and damage to the existing watermains at the south pier of the bridge, driving of piles is not recommended at this location and piles should be installed in predrilled holes.

For HP 310x110 steel H-piles placed in rock sockets, a factored axial geotechnical resistance at ULS of 2,000 kN is recommended. This value includes a geotechnical resistance factor of 0.4 as per the CHBDC. The SLS condition will not govern for piles founded in bedrock.

The structural resistance of the pile must be checked by the structural designer.

Piles socketed into bedrock to develop uplift resistance should be extended at least 3 m below the bedrock surface. Piles socketed in shale should be installed by drilling or coring to the required depth, inserting the pile, then backfilling around the pile with concrete.

The uplift resistance provided per pile socket should be based on a factored sidewall resistance at ULS of 200 kPa between socket concrete and weathered shale sidewall. For a 610 mm diameter socket required to install an H-pile, the factored axial resistance (in uplift) at ULS would be 1,150 kN for a 3m long socket and 1,900 kN for a 5 m long socket (all values include a geotechnical resistance factor of 0.3 as per the CHBDC).

Downdrag on the piles is not considered to be an issue at this site.

8.2.2 Pile Installation

Pile installation must be in accordance with OPSS 903.

For piles driven to bedrock, the appropriate pile driving note is “Piles to be driven to bedrock.” The tips of all driven piles must be fitted with cast steel, H-section rock points from an approved manufacturer such as Titus Steel (Standard H-point), APF Hard Bite or approved equivalent.

For piles set in rock sockets, an appropriate pile installation note for the foundation drawing is “Piles to be placed in bedrock. Suitability of bedrock to be confirmed by Geotechnical Engineer during construction of predrilled hole.” An NSSP will be required for installation of piles in rock sockets. Suggested wording is provided in Appendix C.

Construction of the predrilled holes will require use of a steel liner advanced to the bedrock surface to support the sidewalls, minimize groundwater inflow, and enable machine-cleaning of the socket base. Installation procedures that deal with potential instability due to the presence of a high groundwater table and cohesionless soil deposits must be employed.

Sockets and auger holes containing piles should be backfilled with concrete within 8 hours of excavation to minimise softening of the shale bedrock by groundwater.

The Contractor must be prepared to drive piles or drill through very dense till deposits containing cobbles, boulders and shale slabs. Further, drilling equipment that can penetrate shale bedrock with hard limestone layers must be employed to prepare rock sockets.

8.3 Lateral Resistance of Piles and Caissons

If driven piles are employed, resistance to lateral loads may be provided using batter piles. The lateral resistance will be developed by the horizontal component of the axial load in the pile driven to bedrock.

Resistance to lateral loads may also be provided by the passive resistance developed on the face of vertical piles or caissons within the native silty sand till and localized clay/silt deposits. For vertical piles and caissons, the lateral resistance may be calculated using a value for the coefficient of horizontal subgrade reaction (k_s) and ultimate lateral resistance (p_{ult}) as follows:

k_s = $n_h \, . \, z / D$ (kN/m^3)

p_{ult} = $3 \, . \, \gamma \, . \, z \, . \, K_p$ (kPa)

where z = depth of embedment of pile/caisson in metres

D = pile/caisson width in metres

n_h = 3,000 kN/m^3 for variable loose/dense till or sand fill

= 1,000 kN/m^3 for fill and sandy silt in BH CPB-13

γ = unit weight = 11 kN/m^3 below water table

K_p = passive earth pressure coefficient = 3.1 recommended

In rock, the lateral resistance may be calculated as follows:

k_s = $67 \, s_u / D$ (kN/m^3)

p_{ult} = $9 \, s_u$ (kPa) at and below a depth of 3D (m) reducing to zero at ground surface

where D = pile/caisson width in metres

s_u = undrained shear strength (kPa). At this site, undrained shear strength of the bedrock is taken as 1,000 kPa

The above equations and recommended parameters may be used to analyse the interaction between a pile and the surrounding rock. The lateral pressures obtained from the analysis should not exceed the ultimate lateral resistance.

The spring constant, K, for analysis may be obtained by the expression, $K = k_s{*}L{*}D$ (kN/m), where k_s is the coefficient of horizontal subgrade reaction (kN/m^3), D is the pile width (m) and L is the length (m) of the pile segment or element used in the analysis.

The ultimate lateral resistance on any one segment of pile, P_{ult}, may be obtained from the expression, $P_{ult} = p_{ult}{*}L{*}D$. This represents the ultimate load at which the soil/rock fails and will not support any additional load at greater displacements. As per the CHBDC, a resistance factor of 0.5 must be applied to the computed horizontal resistance; this factor is not included in the noted value.

The modulus of subgrade reaction may have to be reduced, based on the pile/ caisson spacing. The reduction factors to be used for a pile/ caisson group oriented perpendicular or parallel to the direction of loading are provided in Table 8.2. Intermediate values may be obtained by linear interpolation.

Table 8.2 - Subgrade Reaction Reduction Factors for Pile/Caisson Spacing

Condition	Pile Spacing, Centre to Centre*	Reduction Factor
Pile group oriented ***perpendicular*** to direction of loading	4D	1.0
	1D	0.5
Pile group oriented ***parallel*** to direction of loading	8D	1.0
	6D	0.7
	4D	0.4
	3D	0.25

* where D is the width of pile/caisson augerhole

8.4 Recommended Foundation Type

From a geotechnical perspective, the recommended foundation system for the bridge and access ramp structures is caissons socketed into bedrock. H-piles placed in bedrock sockets may also be considered.

8.5 Frost Cover

The design depth of frost penetration at this site is 1.8 m. It is recommended that the underside of all pile caps be provided with a minimum of 1.8 m of earth cover.

9 WALL BACKFILL AND LATERAL EARTH PRESURES

Backfill to abutment or retaining walls, if required, should be in accordance with OPSS 902. Granular backfill should be placed to the extents shown in OPSD 3121.150 and 3101.150. The design of the wall must include a subdrain as shown in OPSD 3190.100.

All granular material should meet the specifications of OPSS 1010 as amended by Special Provision 110S13. Compaction equipment to be used adjacent to retaining structures should be restricted in accordance with OPSS 501.

Earth pressures acting on the structure may be assumed to be triangular and to be governed by the characteristics of the abutment backfill. For a fully drained condition, the pressures should be computed in accordance with the CHBDC but generally are given by the expression:

$$p_h = K (\gamma h + q)$$

where:

p_h = horizontal pressure on the wall at depth h (kPa)
K = earth pressure coefficient (see Table 9.1)
γ = unit weight of retained soil (see Table 9.1)
h = depth below top of fill where pressure is computed (m)
q = value of any surcharge (kPa)

Earth pressure coefficients for backfill to the wall are dependent on the material used as backfill. Typical values are shown in Table 9.1.

Table 9.1 – Earth Pressure Coefficients (K)

Condition	**Earth Pressure Coefficient (K)**					
	OPSS Granular A or Granular B Type II $\phi = 35^\circ, \gamma = 22.8\ \mathrm{kN/m^3}$		**OPSS Granular B Type I** $\phi = 32^\circ, \gamma = 21.2\ \mathrm{kN/m^3}$		**Existing Fill and Native Soil** $\phi = 30^\circ, \gamma = 21.0\ \mathrm{kN/m^3}$	
	Horizontal Surface Behind Wall	**Sloping Backfill (2H:1V)**	**Horizontal Surface Behind Wall**	**Sloping Backfill (2H:1V)**	**Horizontal Surface Behind Wall**	**Sloping Backfill (2H:1V)**
Active (Unrestrained Wall)	0.27	0.38	0.31	0.46	0.33	0.54
At Rest (Restrained Wall)	0.43	-	0.47	-	0.50	-
Passive	3.7	-	3.3	-	3.0	-

In conventional design, the use of a material with a high friction angle and low active pressure coefficient (e.g. Granular A, Granular B Type II) might be preferred as it results in lower earth pressures acting on the wall.

The factors in Table 9.1 are “ultimate” values and require certain movements for the respective conditions to be mobilized. The values to use in design can be estimated from Figure C6.16 in the Commentary to the Canadian Highway Bridge Design Code.

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be added. The magnitude should be 12 kPa at the top of fill and decreasing to 0 kPa at a depth of 2.0 m for Granular B Type I or 1.7 m for Granular A or Granular B Type II.

10 EXCAVATION AND GROUNDWATER CONTROL

Excavation for foundation construction on the site is expected to be limited to the existing pavement materials and sand and gravel or silty sand fill, as well as native soils primarily comprising silty sand till.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the existing fill and native soils within the probable depth of excavation at this site may be classed as Type 3 soils above the water table and Type 4 soils below the water table.

The excavation and backfilling for foundations must be carried out in accordance with OPSS 902.

The variable fills and silty sand till potentially contain cobbles, boulders, shale slabs or other obstructions. The equipment supplied by Contractor must be capable of advancing through and removing these materials.

In general, excavation is expected to be maintained above the groundwater level. The Contractor should be prepared to pump from sumps to remove any seepage water or surface water collecting in an excavation. Application for an MOE Permit to Take Water (PTTW) is advisable in the event that pumping volumes exceed 50,000 L/day.

Use of a steel liner is recommended to advance caissons or pile sockets to the bedrock surface to support the sidewalls, minimize groundwater inflow, and enable machine-cleaning of the socket base. Installation procedures that deal with potential instability due to the presence of groundwater and cohesionless soil deposits must be employed.

11 ROADWAY PROTECTION

Roadway protection should be supplied in accordance with OPSS 539 and designed for Performance Level 2. The protection systems should be designed by a licensed Professional Engineer experienced in design of shoring with consideration of adjacent traffic loads and any sloping retained surfaces.

Roadway protection along Highway 417 at the median pier will be required. Use of sheet piles or a soldier pile and lagging system with driven H-piles is considered feasible. Depending upon the required depth of embedment, H-piles may require socketing into the shale bedrock.

If shoring is required for foundation construction at the south end of the bridge, piles should be installed in predrilled holes to minimize the potential for damage to the existing watermains.

The parameters provided for the existing fill and native soils in Table 9.1 are recommended for design of the roadway protection system. The shoring design must take into account any surcharge loads such as roadway traffic. Material and equipment should not be stockpiled adjacent to the excavation.

It is the responsibility of the Contractor to design the roadway protection system and any dewatering system required.

12 SEISMIC CONSIDERATIONS

The following seismic parameters should be used for design/ assessment of the existing underpass:

• Velocity Related Seismic Zone	2
• Zonal Velocity Ratio	0.1
• Acceleration Related Seismic Zone	4
• Zonal Acceleration Ratio	0.2
• Peak Horizontal Acceleration	0.16g

The soil profile type at this site has been classified as Type I. Therefore, according to Table 4.4.6.1 of the CHBDC, a Site Coefficient "S" (ground motion amplification factor) of 1.0 should be used in seismic design.

In accordance with Clause 4.6.4 of the CHBDC, retaining structures should be designed using earth pressure coefficients that incorporate the effects of earthquake loading. The seismic component of the earth pressure distribution is additional to the static earth pressure distribution and may be taken as an inverted triangle with the maximum pressure at the top of the wall and the minimum pressure at the toe. The total (static plus seismic) pressure distribution for earthquake loading is therefore as follows:

$$p_{he} = K (\gamma h + q) + \Delta K_E \gamma (H - h)$$

where:

p_{he} = horizontal pressure on the wall at depth h (kPa)
K = earth pressure coefficient (see Table 9.1)
ΔK_E = seismic earth pressure coefficient (see Table 12.1)
γ = unit weight of retained soil (see Table 12.1)
h = depth below top of fill where pressure is computed (m)
H = height of wall (m)
q = value of any surcharge (kPa)

The seismic earth pressure parameters (ΔK_E) recommended for determining the seismic component are presented in Table 12.1.

Table 12.1 – Earth Pressure Coefficients for Earthquake Loading

Condition	**Seismic Earth Pressure Coefficient (ΔK_E)**				
	OPSS Granular A or OPSS Granular B Type II $\phi = 35°, \gamma = 22.8\ kN/m^3$		**OPSS Granular B Type I** $\phi = 32°, \gamma = 21.2\ kN/m^3$		**Fill and Native Silty Sand Till** $\phi = 30°$ $\gamma = 21\ kN/m^3$
	Horizontal Surface Behind Wall	**Sloping Surface Behind Wall (2H:1V)**	**Horizontal Surface Behind Wall**	**Sloping Surface Behind Wall (2H:1V)**	**Horizontal Surface Behind Wall**
Active (ΔK_{AE})*	0.07	0.22	0.07	0.23	0.08
At Rest (ΔK_{OE})**	0.21	-	0.21	-	0.21

* After Mononobe and Okabe, passive case assumes a horizontal surface in front of the wall.
** After Woods

The foundation soils at the site are not in danger of liquefaction under earthquake loading.

13 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to the following:

- The fill and silty sand till at the site may contain cobbles, boulders and shale slabs. In addition, the shale bedrock underlying the till contains hard limestone layers. Equipment selected to excavate the fill/till or install augered caisson/piles must be capable of penetrating these materials.
- Sockets and auger holes containing piles should be backfilled with concrete within 8 hours of excavation to minimize deterioration of the till and shale bedrock by groundwater.
- Use of a steel liner is recommended to advance pile sockets to the bedrock surface to support the sidewalls, minimize groundwater inflow, and enable machine-cleaning of the socket base.
- The foundations and temporary shoring (if required) for the south pier are in close proximity to two existing large diameter watermains. Construction in the vicinity of the watermains must include precautions to avoid damage to these pipes. In this regard:
  - Driving of piles is not recommended at this location.
  - Any excavation in the area must not undermine the existing watermains.
  - No net surcharge (ie., foundation loads, embankments, stockpiles) should be applied over the watermains unless detailed analysis indicates that the pipes are capable of supporting the additional loads without damage.
  - The watermain pipes should be monitored for vibration during foundation and substructure construction. Minimum clearance constraints, requirements for monitoring during construction, and permissible construction vibration limits should be specified by the Owner (City of Ottawa).

14 CLOSURE

Engineering analysis and preparation of the report were carried out by Ms. M.T. 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.

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

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Ap. 20/12
PROVINCE OF ONTARIO

P.K. Chatterji, P.Eng., Ph.D.
Review Principal

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Apr 20/12
PROVINCE OF ONTARIO

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over . . . .)

INTERPRETATION OF THE REPORT *(continued . . . .)*

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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

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

SYMBOLS

▨	CLAYSTONE
┅	SILTSTONE
░	SANDSTONE
■	COAL
▩	Bedrock (general)

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

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.

STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength**		**Field Estimation of Hardness***
	(MPa)	**(psi)**	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
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

THURBER

Ministry of Transportation
Ontario

THURBER

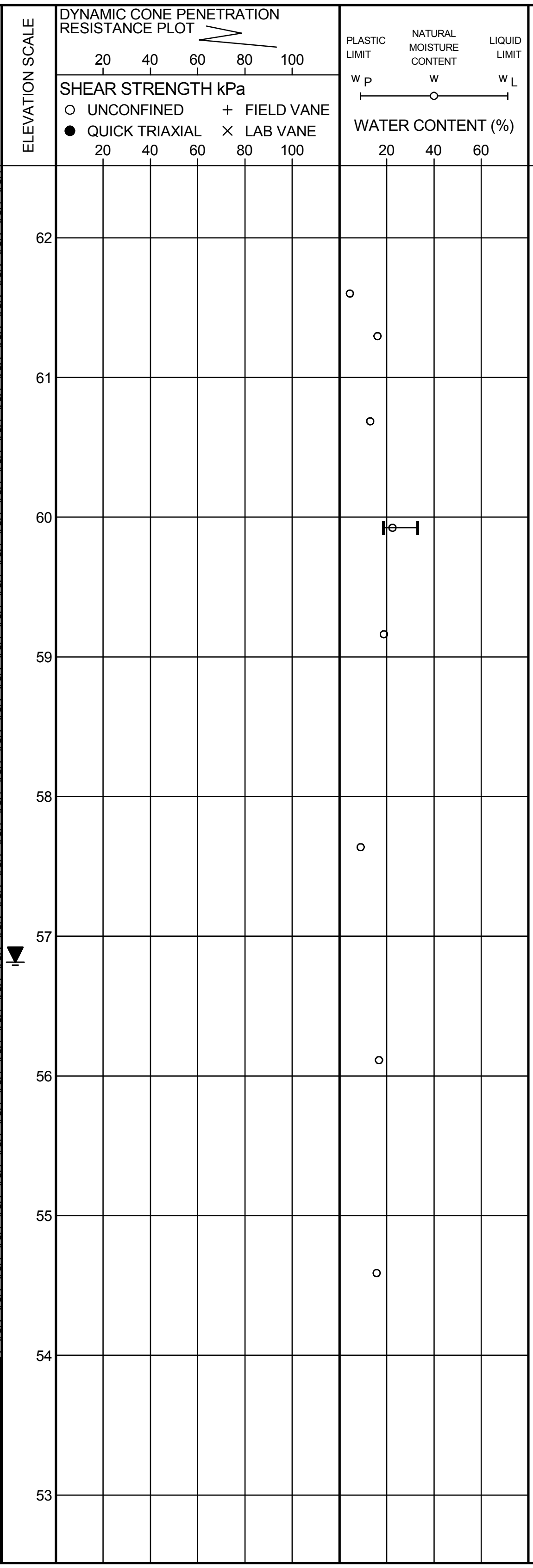
RECORD OF BOREHOLE No CPB-01

1 OF 3

METRIC

G.W.P.	19-1351-212	LOCATION	N 5 031 402.7 E 371 038.3	ORIGINATED BY	RK
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2011.11.24 - 2011.11.24	CHECKED BY	LRB

ELEV DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
62.5					
0.0	**ASPHALT:** (100mm)				
0.1	**SAND** and **GRAVEL** Compact Brown Moist (FILL)	1	SS	16	
61.4 1.1	Silty **CLAY**, some sand, trace gravel, occasional sandy layers Stiff Dark Brown to Dark Grey Moist Sandy gravel layer at 1.5m	2	SS	8	
		3	SS	12	1 19 30 51
		4	SS	8	
58.8 3.7	Silty **SAND**, some gravel, some clay Loose to Compact Dark Grey Moist to Wet (TILL)				Water at 4.1m
		5	SS	6	
		6	SS	15	14 48 25 13
	Augers grinding at 7.3m	7	SS	29	
53.9 8.6	**SHALE**, fresh, dark grey, thinly laminated, occasional horizontal joints, occasional limestone interbeds (up to 30mm thick)	1	RUN		RUN 1# TCR=43%, SCR=18%, RQD=7%



UNIT WEIGHT γ kN/m³

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+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1212.GPJ 4/19/12

Ministry of Transportation
Ontario

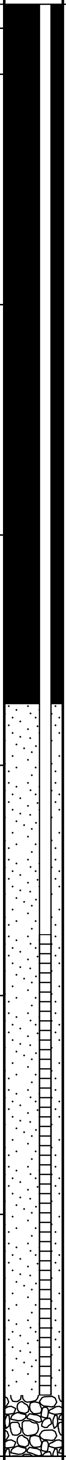
RECORD OF BOREHOLE No CPB-01

2 OF 3

METRIC

G.W.P.	19-1351-212	LOCATION	N 5 031 402.7 E 371 038.3	ORIGINATED BY	RK
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2011.11.24 - 2011.11.24	CHECKED BY	LRB

SOIL PROFILE — Continued From Previous Page



ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	FI	REMARKS & GRAIN SIZE DISTRIBUTION (%)
		2	RUN			6	RUN 2# TCR=67%, SCR=42%, RQD=33%
	Mechanical breaks at 10.8m, 11.2m, 11.3m, 11.8m	3	RUN		52 51	1 0 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=100%
		4	RUN		50	3 3 4 6 5	RUN 4# TCR=95%, SCR=57%, RQD=32%
	Vertical joint from 13.6m to 15.0m Rubble zone (100mm) at 15.0m	5	RUN		49 48	2 2 2 2 1	RUN 5# TCR=97%, SCR=7%, RQD=0%
		6	RUN		47	0 2 4 2 4	RUN 6# TCR=100%, SCR=75%, RQD=70%
	More frequent limestone interbeds (up to 40mm thick)	7	RUN		46 45	0 0 0 0 2	RUN 7# TCR=100%, SCR=93%, RQD=93%
42.9		8	RUN		44 43	0 0 0 0 0	RUN 8# TCR=98%, SCR=98%, RQD=98%
19.6	END OF BOREHOLE AT 19.6m. Piezometer installation consists of						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE — 20 40 60 80 100
PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 20 40 60
UNIT WEIGHT γ kN/m³
GR SA SI CL

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-01

3 OF 3

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 402.7 E 371 038.3
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.24 - 2011.11.24
CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION Continued From Previous Page	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2011.12.29 5.7 56.8 2012.02.16 Snow and Ice on Surface										

+³, ×³: Numbers refer to Sensitivity

15 ⊕ 5 (20 above, 10 below) (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-02

1 OF 2

METRIC

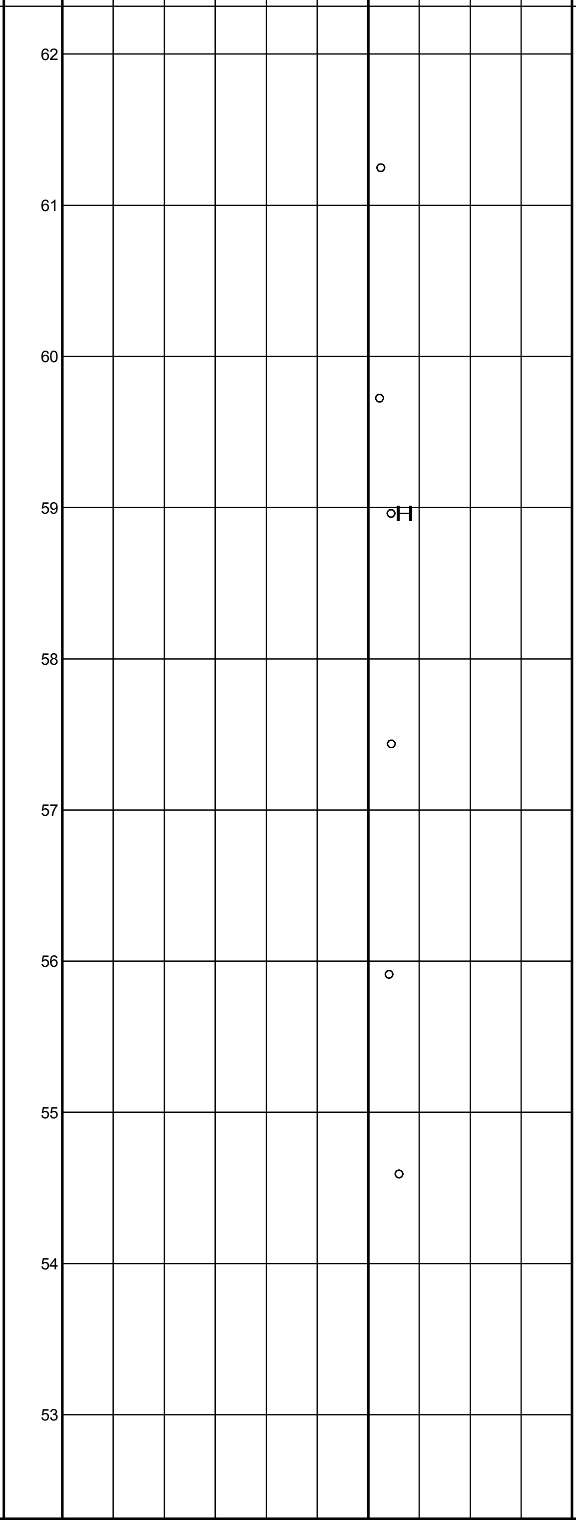
G.W.P. 19-1351-212
LOCATION N 5 031 389.1 E 371 039.6
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.23 - 2011.11.23
CHECKED BY LRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES				GR	SA	SI	CL
62.3											
0.0	**ASPHALT:** (100mm)										
0.1	**SAND** and **GRAVEL**, some silt and clay Compact to Loose Brown Moist (FILL)	1	SS	20				45	32	23 (SI+CL)	
	No recovery	2	SS	7							
		3	SS	14							
59.3 3.0	Silty **SAND**, some clay, trace gravel Loose to Compact Brown to Dark Grey Moist to Wet (TILL) Augers grinding at 3.7m	4	SS	14				9	47	32	12
					∇		Water at 4.6m				
		5	SS	4							
		6	SS	12							
54.7 7.6	**SAND** and **GRAVEL** Dark Brown Wet						RUN 1# TCR=53%, SCR=28%, RQD=0%				
54.5 7.8	**SHALE**, fresh, dark grey, thinly laminated, jointed, occasional limestone interbeds	1	RUN			FI 3					
	Rubble zone (25mm) at 9.1m	2	RUN			2 5 1	RUN 2# TCR=100%, SCR=87%, RQD=83%				

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

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

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60



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+3, ×3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-02 2 OF 2 METRIC

G.W.P.	19-1351-212	LOCATION	N 5 031 389.1 E 371 039.6	ORIGINATED BY	RK
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2011.11.23 - 2011.11.23	CHECKED BY	LRB

SOIL PROFILE: ELEV / DEPTH; DESCRIPTION; STRAT PLOT
SAMPLES: NUMBER; TYPE; "N" VALUES
GROUND WATER CONDITIONS
ELEVATION SCALE
DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100
PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L
WATER CONTENT (%): 20 40 60
UNIT WEIGHT γ kN/m³
REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Continued From Previous Page

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	ELEVATION SCALE	UNIT WEIGHT column	REMARKS
	Mechanical breaks at 10.3m Limestone interbeds 10mm to 50mm thick	3	RUN	52 51	0 1 0 1 1	RUN 3# TCR=95%, SCR=85%, RQD=85%
		4	RUN	50	1 2 0 2 0	RUN 4# TCR=100%, SCR=93%, RQD=90%
		5	RUN	49 48	2 0 2 0 2	RUN 5# TCR=98%, SCR=95%, RQD=90%
	Frequent limestone interbeds	6	RUN	47	1 2 5 4 0	RUN 6# TCR=100%, SCR=75%, RQD=60%
44.3		7	RUN	46 45	2 0 1 1 2 0	RUN 7# TCR=98%, SCR=98%, RQD=98%
18.0	END OF BOREHOLE AT 18.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.					

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-03

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 354.5 E 371 058.3
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.09.11 - 2011.10.11
CHECKED BY LRB

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
60.7	
0.0	**TOPSOIL**, rootlets Dark Brown
60.4 0.3	Silty **SAND**, some gravel, trace clay Compact to Very Dense Dark Brown Damp (FILL)
58.9 1.8	Sandy **SILT**, some clay, trace gravel Very Dense to Compact Brown Dry
58.0 2.7	Silty **SAND**, some gravel, some clay Compact to Very Dense Dark Brown to Grey Damp (TILL) No recovery Poor recovery
54.3 6.4	**SHALE**, fresh, thinly bedded, grey, very thin limestone interbeds throughout, occasional hydrocarbon interbeds, occasional mechanical breaks Highly broken zone (125mm) at 6.5m Highly broken zone (200mm) at 7.6m Limestone interbed (50mm) at 8.9m

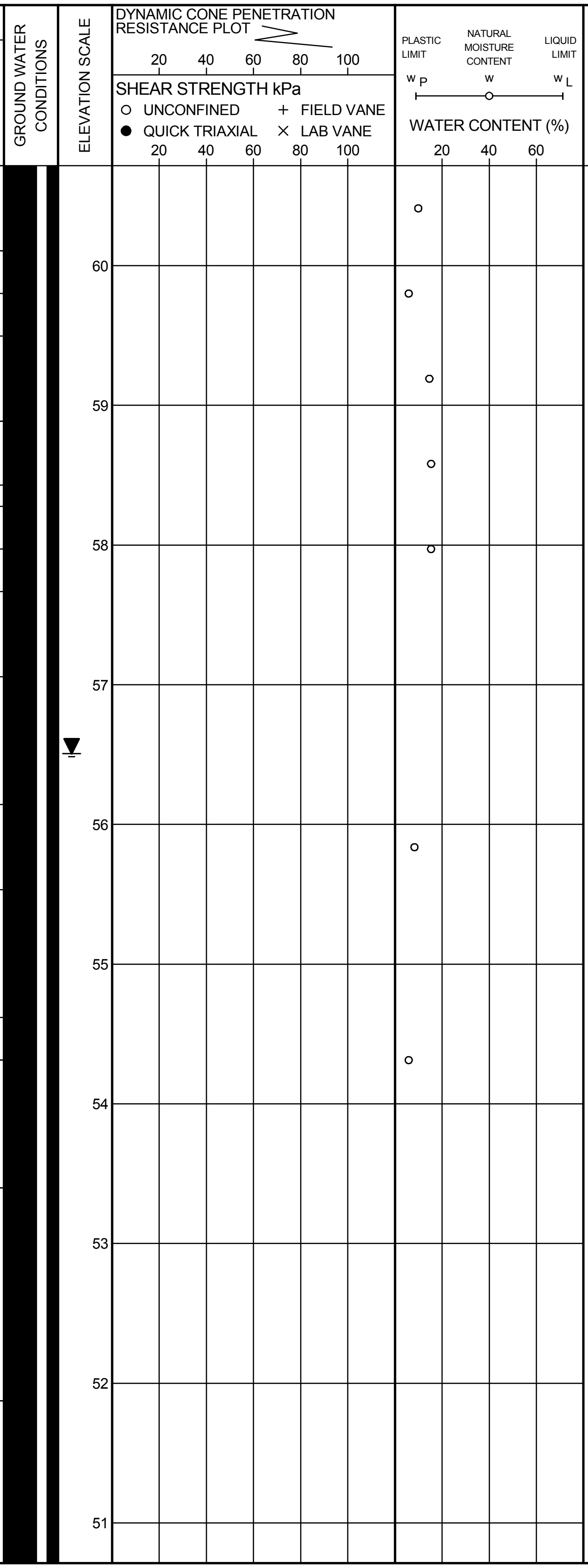
Continued Next Page

SAMPLES

NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
1	SS	11				
2	SS	50/ 0.150				
3	SS	30	14	52	26	8
4	SS	82	0	21	63	16
5	SS	50/ 0.150				
6	SS	28				
7	SS	38	12	46	31	12
8	SS	50/ 0.150				
1	RUN					
2	RUN					
3	RUN					

FI: >5, 0, 0, 2, >5, 0, 0, 0, 0, 0, 0, 0

REMARKS
RUN 1# TCR=100%, SCR=86%, RQD=83%
RUN 2# TCR=100%, SCR=87%, RQD=83%
RUN 3# TCR=100%, SCR=100%, RQD=100%



UNIT WEIGHT γ kN/m³

+³, ×³: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

ONTMT4S 1212.GPJ 4/19/12

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-03

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 354.5 E 371 058.3
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.09.11 - 2011.10.11
CHECKED BY LRB

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
										0	
										0	RUN 4# TCR=100%, SCR=100%, RQD=100%
	Limestone interbeds (50mm) at 10.6m						50			0	
			4	RUN						0	
										0	
	Limestone interbeds at 11.9m, 12.1m, 12.5m, 12.7m, 12.8m, 13.0m, 13.1m, 13.2m						49			0	
										0	RUN 5# TCR=100%, SCR=100%, RQD=100%
										0	
			5	RUN			48			0	
										0	
										0	
										0	RUN 6# TCR=100%, SCR=100%, RQD=100%
							47			0	
			6	RUN						0	
										0	
	Limestone interbed at 13.4m, 15.3m						46			0	
										0	RUN 7# TCR=100%, SCR=100%, RQD=100%
										0	
			7	RUN			45			0	
										0	
44.2										0	
16.5	END OF BOREHOLE AT 16.5m. BOREHOLE OPEN TO 16.5m AND WATER LEVEL AT 3.6m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2011.12.29 3.4 57.3 2012.02.16 4.2 56.5										

ONTMT4S 1212.GPJ 4/19/12

$+^3, \times^3$: Numbers refer to Sensitivity

20
15-⊕-5 (%) STRAIN AT FAILURE
10

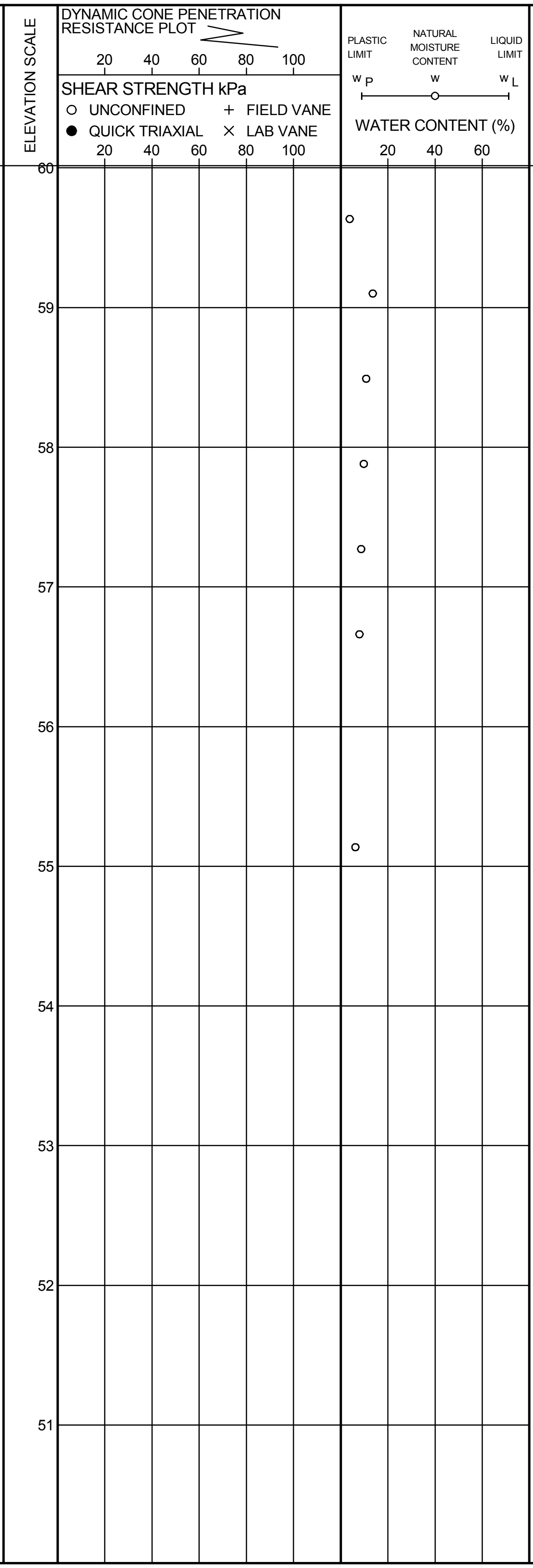
RECORD OF BOREHOLE No CPB-04

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 334.1 E 371 070.5
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.13 - 2011.11.13
CHECKED BY LRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m 3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			GR SA SI CL
60.0 0.0	**ASPHALT:** (100mm)						
0.1	**SAND** and **GRAVEL**, trace silt Compact Brown Dry (FILL)	1	SS	14			
59.4 0.6	Silty **SAND**, some clay, trace gravel Compact Grey Damp (FILL)	2	SS	12			7 49 32 12
58.8 1.2	Silty **SAND**, some clay, some gravel Compact Grey Damp (TILL)	3	SS	22			
		4	SS	12			11 45 34 10
		5	SS	7			
		6	SS	14			
	Residual soil, some shale fragments, clayey	7	SS	72/ 0.175	▽	FI	
55.1 4.9	**SHALE**, fresh, thinly bedded, limestone interbeds throughout, occasional mechanical breaks Highly broken zone (150mm) at 4.9m Limestone interbeds at 5.2m, 5.4m, 5.5m, 5.6m, 5.7m, 5.9m, 6.0m, 6.2m, 6.3m Occasional black hydrocarbon banding	1	RUN			>3 0 0 0 0	RUN 1# TCR=100%, SCR=90%, RQD=90%
	Limestone interbed at 6.8m, 7.0m, 7.3m, 7.8m	2	RUN			0 0 0 0 0	RUN 2# TCR=100%, SCR=100%, RQD=100%
	Limestone interbeds (<25mm) at 8.0m, 8.2m, 8.4m, 8.5m, 8.6m, 9.0m to 9.2m	3	RUN			0 0 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=100%
	Limestone interbeds (<25mm) at 9.5m, 9.6m, 9.8m, 9.9m, 10.0m, 10.1m, 10.4m, 10.6m, 10.8m					0 0 0	RUN 4# RQD=100% TCR=100%, SCR=100%,



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+ 3, × 3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-04

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 334.1 E 371 070.5
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.13 - 2011.11.13
CHECKED BY LRB

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page					50		
		4	RUN				0 0 0	
	Limestone interbed at 11.0m, 11.2m, 11.4m, 11.5m, 12.0m, 12.1m, 12.3m					49	0 0	RUN 5# TCR=100%, SCR=100%, RQD=100%
		5	RUN			48	0 0 0	
	Limestone interbed at 12.7m, 12.8m, 13.1m, 13.3m, 13.5m, 13.7m					47	0 0	RUN 6# TCR=100%, SCR=100%, RQD=100%
		6	RUN				0 0 0	
	Limestone interbeds (<25mm) at 14.2m, 14.3m, 14.5m, 14.6m, 14.8m	7	RUN			46	0 0 0	RUN 7# TCR=100%, SCR=100%, RQD=100%
45.0 15.0	END OF BOREHOLE AT 15.0m. BOREHOLE OPEN TO 15.0m AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS FROM 15.0m TO 0.3m, CONCRETE FROM 0.3m TO 0.15m, THEN ASPHALT TO SURFACE.					45	0	

$+^3, \times^3$: Numbers refer to Sensitivity

20 / 15 / 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-05

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 291.4 E 371 096.2
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.11 - 2011.12.11
CHECKED BY LRB

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
59.9	
0.0	**TOPSOIL:** (125mm)
0.1	Silty **SAND**, some clay, trace to some gravel, occasional rootlets Compact Brown Damp (FILL)
57.5 / 2.4	**SILT** and **SAND**, some clay, trace gravel Compact to Dense Grey Damp (TILL)
55.6 / 4.3	**SHALE**, fresh, thinly bedded, grey, occasional limestone interbeds Highly broken zone (150mm) at 4.6m Limestone interbeds (<25mm) at 4.7m, 5.0m, 5.2m, 5.3m, 5.5m, 5.7m Limestone interbed at 7.1m Limestone interbed at 7.6m, 7.8m, 7.9m, 8.1m, 8.4m, 9.0m, 9.1m Limestone interbeds (<25mm) at 9.4m, 9.7m, 9.9m, 10.1m, 10.3m, 10.5m

Continued Next Page

SAMPLES

NUMBER	TYPE	"N" VALUES	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	REMARKS
1	SS	11		
2	SS	20	10 47 28 15	
3	SS	18		
4	SS	50/ 0.150		
5	SS	11		
6	SS	39	1 39 48 12	
1	RUN			RUN 1# TCR=100%, SCR=90%, RQD=90%
2	RUN			RUN 2# TCR=100%, SCR=100%, RQD=100%
3	RUN			RUN 3# TCR=100%, SCR=100%, RQD=100%
4	RUN			RUN 4# TCR=100%, SCR=100%, RQD=100%

GROUND WATER CONDITIONS: water level at approx. elevation 57.0 ▼

ELEVATION SCALE: 59, 58, 57, 56, 55, 54, 53, 52, 51, 50

UNIT WEIGHT γ kN/m³

FI
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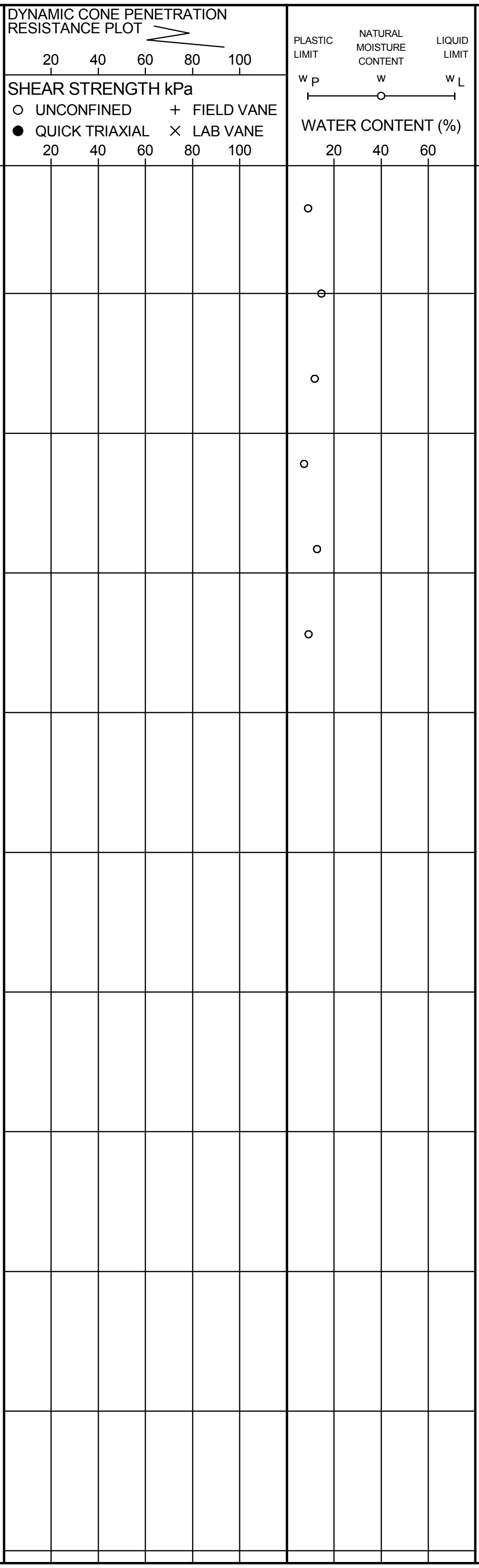


+ ³, × ³: Numbers refer to Sensitivity

20 / 15 / 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-05

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 291.4 E 371 096.2
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.11 - 2011.12.11
CHECKED BY LRB

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L | WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page								
								0 0	
	Limestone interbeds (<25mm) at 10.6m, 10.7m, 10.9m, 11.1m, 11.3m, 11.5m, 11.7m		5	RUN			49 48	0 0 0 0 0	RUN 5# TCR=100%, SCR=100%, RQD=100%
	Limestone interbed at 12.2m, 12.3m, 12.5m, 12.7m, 13.2m, 13.3m, 13.4m		6	RUN			47	0 0 0 0 0	RUN 6# TCR=100%, SCR=100%, RQD=100%
45.4	Limestone interbed at 13.7m, 13.8m, 13.9m, 14.0m, 14.1m		7	RUN			46	0 0 0	RUN 7# TCR=100%, SCR=100%, RQD=100%
14.5	END OF BOREHOLE AT 14.5m. BOREHOLE OPEN TO 14.5m AND WATER LEVEL AT 4.5m 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)
2011.12.29	2.7	57.2
2012.02.16	2.9	57.0

ONTMT4S 1212.GPJ 4/19/12

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 – 5 / 10 (%) STRAIN AT FAILURE

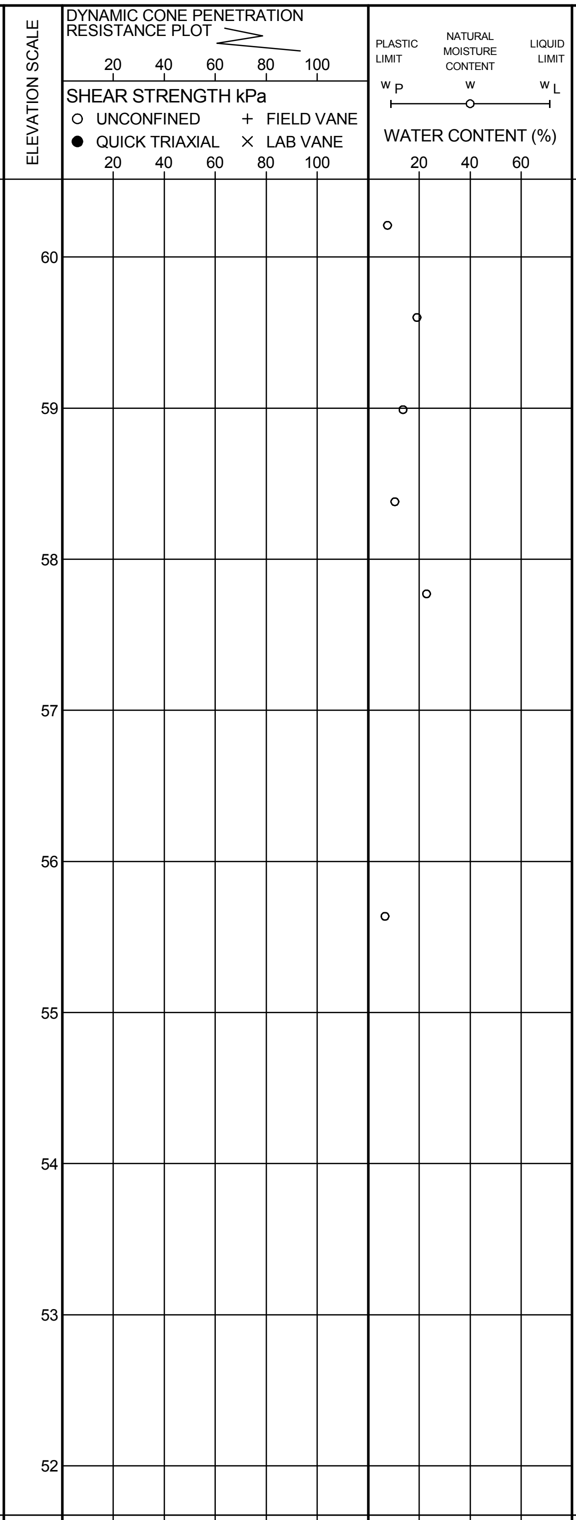
Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-06

1 OF 1 **METRIC**

G.W.P.	19-1351-212	LOCATION	N 5 031 280.8 E 371 071.1	ORIGINATED BY	GA
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2011.10.11 - 2011.10.11	CHECKED BY	LRB



ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
60.5										
0.0	**TOPSOIL:** (100mm)									
0.1	Silty **SAND**, trace to some gravel, some clay, occasional rootlets Compact to Dense Brown Dry (FILL)	1	SS	11						
		2	SS	21			7	59	23	10
		3	SS	27			17	36	36	11
	Occasional wood fibres Grey Damp	4	SS	48						
		5	SS	28						
57.5 3.0	Silty **SAND**, some clay, some gravel Very Dense Brown to Grey Dry (TILL)	6	SS	50/ 0.075						
					▽					
		7	SS	61			16	45	28	11
54.7 5.8	**SHALE**, fresh, thinly bedded, grey, occasional limestone interbeds					FI 0 0	RUN 1# TCR=100%, SCR=100%, RQD=100%			
	Limestone interbeds (<25mm) at 6.3m, 6.5m, 6.6m, 6.8m, 7.2m	1	RUN			0 0 0				
	Occasional black hydrocarbon banding					0 0	RUN 2# TCR=100%, SCR=100%, RQD=100%			
	Limestone interbeds (<25mm) at 7.4m, 8.1m, 8.3m, 8.5m, 8.7m	2	RUN			0 0 0				
51.7 8.8	END OF BOREHOLE AT 8.8m. BOREHOLE OPEN TO 8.8m AND WATER LEVEL AT 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTNGS TO SURFACE.									

+ 3, × 3 : Numbers refer to Sensitivity

20 15 ⊕ 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CPB-07

1 OF 1

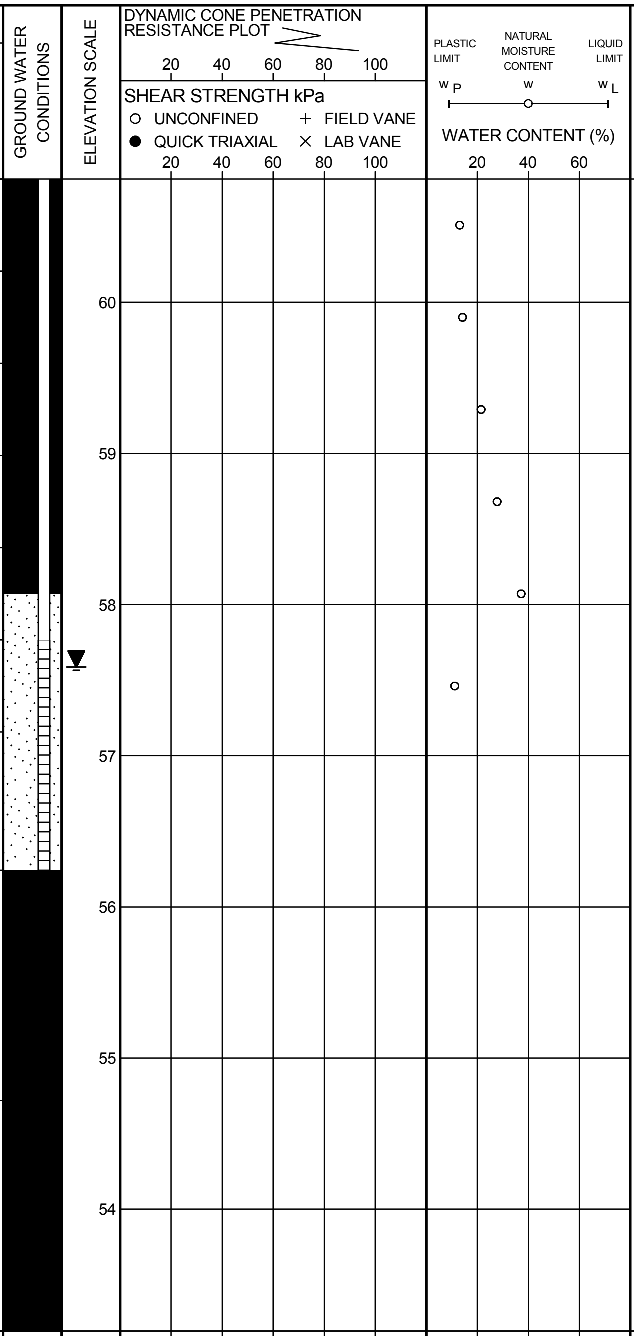
METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 307.9 E 371 130.7
ORIGINATED BY GA
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.11 - 2011.11.11
CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m 3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
60.8						
0.0	**TOPSOIL:** (150mm)					
0.2	Silty **SAND**, trace clay, trace gravel Compact Brown Damp (FILL)	1	SS	13		
		2	SS	20		
59.5 1.3	Clayey **SILT** and **SAND**, trace gravel Very Stiff Brown Damp (FILL)	3	SS	17		1 33 27 39
		4	SS	16		
58.4 2.4	Silty **SAND**, some clay, trace gravel Compact Dark Brown to Grey Damp (TILL)	5	SS	14		4 41 34 21
		6	SS	16		
					FI	
56.2 4.6	**SHALE**, fresh, thinly bedded, grey, occasional limestone interbeds Highly broken zone (150mm) at 5.1m Horizontal joint at 4.7m, 4.8m, 5.6m Limestone interbeds (<25mm) at 4.6m, 4.7m, 5.7m, 5.9m	1	RUN		2 0 5 1 0	RUN 1# TCR=100%, SCR=100%, RQD=80%
	Limestone interbeds (<25mm) at 6.1m, 6.2m, 6.8m, 6.9m, 7.0m, 7.1m, 7.6m Black hydrocarbon banding	2	RUN		0 0 0 0 0	RUN 2# TCR=100%, SCR=100%, RQD=100%
53.2 7.6	END OF BOREHOLE AT 7.6m. BOREHOLE OPEN TO 7.6m AND WATER LEVEL AT 4.6m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.					

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
2011.12.29	2.0	58.8
2012.02.16	3.2	57.6



+ 3 , × 3 : Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

ONTMT4S 1212.GPJ 4/19/12

Ministry of Transportation
Ontario

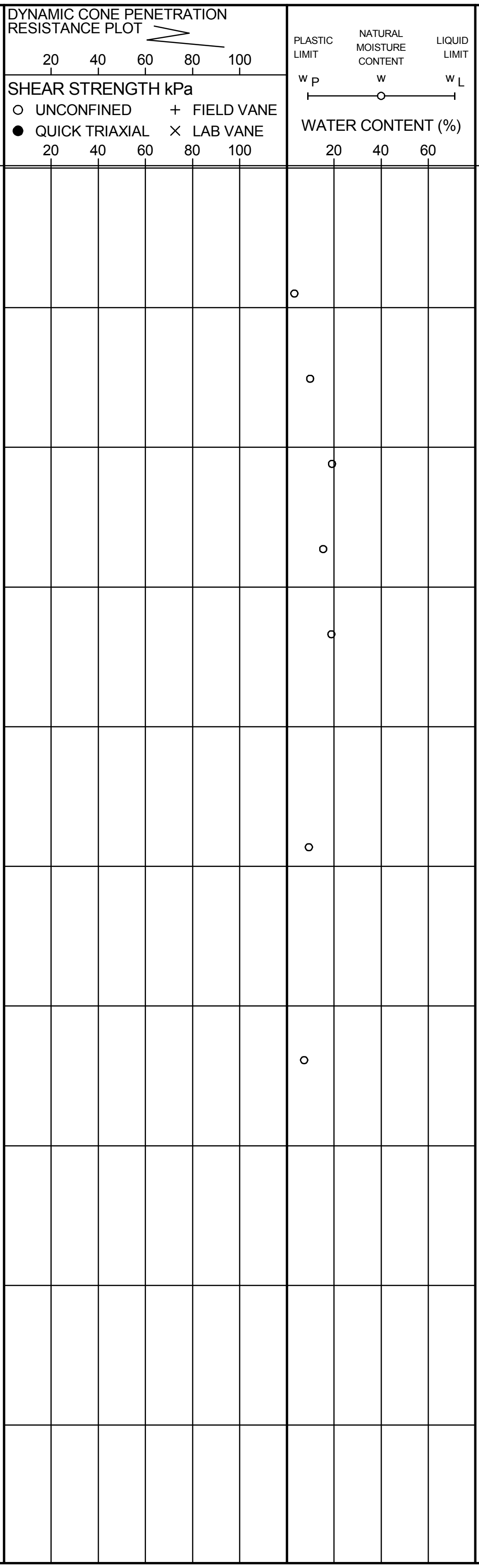
RECORD OF BOREHOLE No CPB-08

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 403.4 E 370 988.5
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.23 - 2011.11.23
CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
62.0					62		
0.0	**ASPHALT:** (100mm)						
0.1	**SAND** and **GRAVEL**, some silt and clay Compact Grey to brown Damp to Moist (FILL)	1	SS	22	61		
	Some clayey silt Augers grinding	2	SS	30			
60.2 / 1.8	Silty **SAND**, some clay, some gravel Loose to Compact Brown Moist (TILL)	3	SS	8	60		12 42 31 15
		4	SS	16	59		
	Poor recovery	5	SS	10			
	Augers grinding				58		
	Dark Grey	6	SS	18	57		11 51 25 13
					56		
	Residual soil, some shale fragments, clayey	7	SS	74/ 0.225			
55.5 / 6.5	**SHALE**, fresh, dark grey, thinly laminated, jointed, occasional limestone interbeds	1	RUN		55		RUN 1# TCR=31%, SCR=0%, RQD=0%
		2	RUN		54	FI 2 >10 >10 4	RUN 2# TCR=100%, SCR=27%, RQD=25%
		3	RUN		53	>5 0 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=97%



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+³, ×³: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-08

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 403.4 E 370 988.5
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.23 - 2011.11.23
CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION Continued From Previous Page	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
							52				
51.7 10.3	END OF BOREHOLE AT 10.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2011.12.29 5.0 57.0									0	

ONTMT4S 1212.GPJ 4/19/12

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 / 5 / 10 (%) STRAIN AT FAILURE

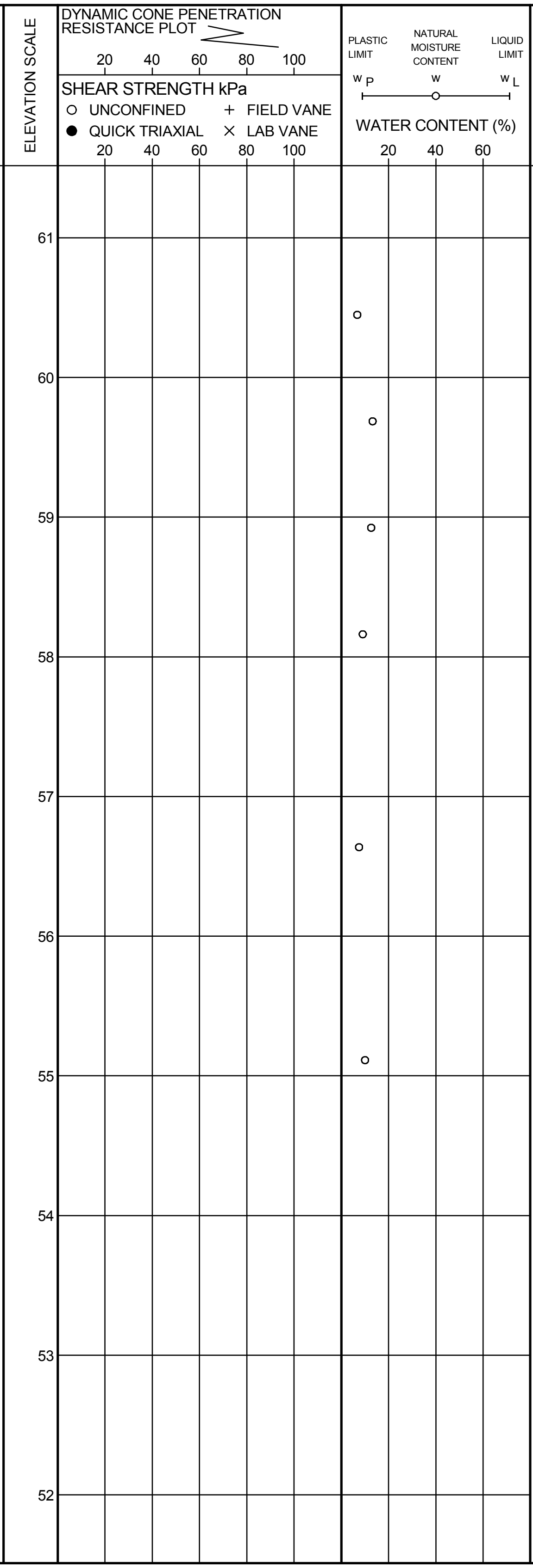
RECORD OF BOREHOLE No CPB-09

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 393.7 E 371 079.5
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.22 - 2011.11.22
CHECKED BY LRB

SOIL PROFILE		SAMPLES				UNIT WEIGHT γ kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS		GR	SA	SI	CL
61.5										
0.0	**ASPHALT:** (100mm)									
0.1	**SAND** and **GRAVEL**, some silt Dense Brown Damp	1	SS	45						
60.1 1.4	Silty **SAND**, some clay, some gravel Loose to Compact Dark Brown Moist to Wet (TILL)	2	SS	6						
		3	SS	5	∇		15	47	27	12
							Water at 2.7m			
		4	SS	8						
		5	SS	7						
	Augers grinding									
	Dark Grey	6	SS	24			19	45	21	14
	Shale fragments	7	SS	50/ 0.075		FI				
53.8 7.7	**SHALE**, fresh, dark grey, thinly laminated, horizontally jointed	1	RUN			8 5 2 3	RUN 1# TCR=100%, SCR=51%, RQD=35%			
		2	RUN			4 0 0 0	RUN 2# TCR=97%, SCR=90%, RQD=85%			



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+3, ×3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-09

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 393.7 E 371 079.5
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.22 - 2011.11.22
CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION Continued From Previous Page	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
		▨								1	
		▨					51			0	RUN 3# TCR=100%, SCR=97%, RQD=89%
		▨	3	RUN						1	
50.2		▨								0	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.5m, SAND TO 0.15m THEN COLD PATCH TO SURFACE.										

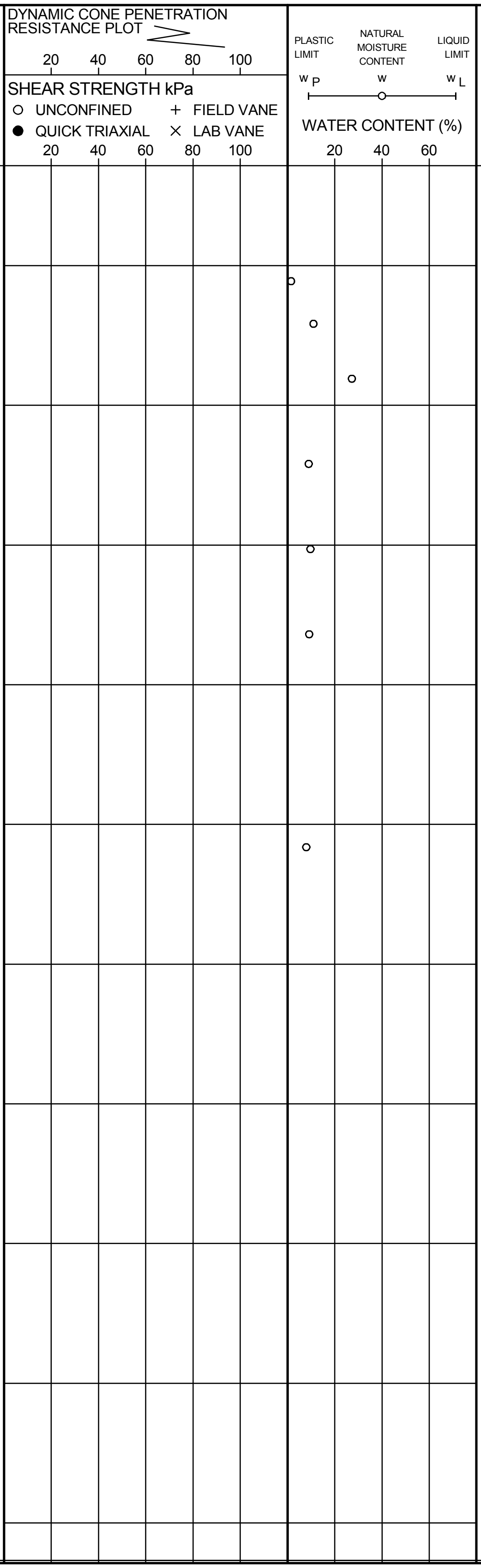
+ 3, × 3: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-10 1 OF 2 METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 399.7 E 371 119.3
ORIGINATED BY RK
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2011.11.22 - 2011.11.22
CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
60.7						
0.0	**ASPHALT:** (100mm)					
0.1	**SAND** and **GRAVEL** Compact Dark Brown Moist (FILL)	1	SS	10		
59.6 1.1	Clayey **SILT** and **SAND**, trace gravel Firm to Soft Brown to Dark Brown Moist	2	SS	4		3 33 34 30
58.9 1.8	Silty **SAND**, some clay, some gravel Loose to Compact Dark Brown Moist (TILL)	3	SS	10		
		4	SS	9		
	Poor recovery	5	SS	5		
		6	SS	11		14 49 22 15
54.6 6.1	**SHALE**, fresh, dark grey, thinly laminated, occasional limestone interbeds Vertical joint from 6.5m to 7.3m	1	RUN		FI	RUN 1# TCR=25%, SCR=0%, RQD=0%
		2	RUN		6 7 >5	RUN 2# TCR=100%, SCR=0%, RQD=0%
	Rubble zone (75mm) at 7.3m	3	RUN		0 6 3	RUN 3# TCR=100%, SCR=57%, RQD=53%
		4	RUN		1 1 1 1 0	RUN 4# TCR=100%, SCR=100%, RQD=95%
50.7						



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+ ³, × ³: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPB-10

2 OF 2

METRIC

G.W.P. 19-1351-212	LOCATION N 5 031 399.7 E 371 119.3	ORIGINATED BY RK
HWY 417	BOREHOLE TYPE Hollow Stem Augers/NQ Coring	COMPILED BY AN
DATUM Geodetic	DATE 2011.11.22 - 2011.11.22	CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
10.0	END OF BOREHOLE AT 10.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.5m, SAND TO 0.15m, THEN COLD PATCH TO SURFACE.										

$+^3, \times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\underset{10}{\oplus}} 5$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CPB-11

1 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 248.5 E 371 126.0
ORIGINATED BY SLL
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2012.02.14 - 2012.02.14
CHECKED BY LRB

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
62.1					62		
0.0	**TOPSOIL:** (100mm)						
0.1	**SAND**, some gravel to gravelly, some silt and clay Compact Brown Moist (FILL)	1	SS	18	61		
		2	SS	22			20 67 13 (SI+CL)
60.3 1.8	**SAND**, mixed with ballast, trace gravel, trace to some clay Dense to Compact Grey Moist (FILL)	3	SS	47	60		
		4	SS	20			
		5	SS	28	59		
					58		
57.7 4.4	Silty **SAND**, some clay, trace gravel Compact Grey Moist (TILL)	6	SS	12	57		5 42 40 13
56.5 5.6	**SHALE**, fresh, grey, occasional limestone interbeds Sub-vertical joint (100mm) at 6.1m					FI	
		1	RUN		56	4 3 2	RUN 1# TCR=100%, SCR=100%, RQD=75%
		2	RUN		55 54	3 1 2 1 1	RUN 2# TCR=100%, SCR=100%, RQD=95%
		3	RUN		53	0 0 1 2 1	RUN 3# TCR=100%, SCR=100%, RQD=98%

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-11 2 OF 2 METRIC

G.W.P.	19-1351-212	LOCATION	N 5 031 248.5 E 371 126.0	ORIGINATED BY	SLL
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2012.02.14 - 2012.02.14	CHECKED BY	LRB

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page				52	2	RUN 4# TCR=100%, SCR=98%, RQD=88%
						3	
	100mm limestone interbed at 10.4m	4	RUN			3	
	Clay seam (25mm) at 10.9m 70mm limestone layer interbed at 11.0m				51	3	
						1	
						1	RUN 5# TCR=80%, SCR=80%, RQD=73%
						2	
	Rubble zone (300mm) at 12.5m	5	RUN		50	4	
						25	
						1	
	Vertical joint (100mm) at 12.9m				49	4	RUN 6# TCR=100%, SCR=100%, RQD=93%
	Clay seam (25mm) at 13.2m					1	
		6	RUN			0	
					48	1	
						2	
						1	RUN 7# TCR=100%, SCR=100%, RQD=100%
47.0		7	RUN			2	
15.1	END OF BOREHOLE AT 15.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.1m slotted screen.						

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
2012.02.16	5.4	56.7
2012.03.15	1.1	61.0

+3, ×3: Numbers refer to Sensitivity

20
15 ⊕ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CPB-12

1 OF 1 **METRIC**

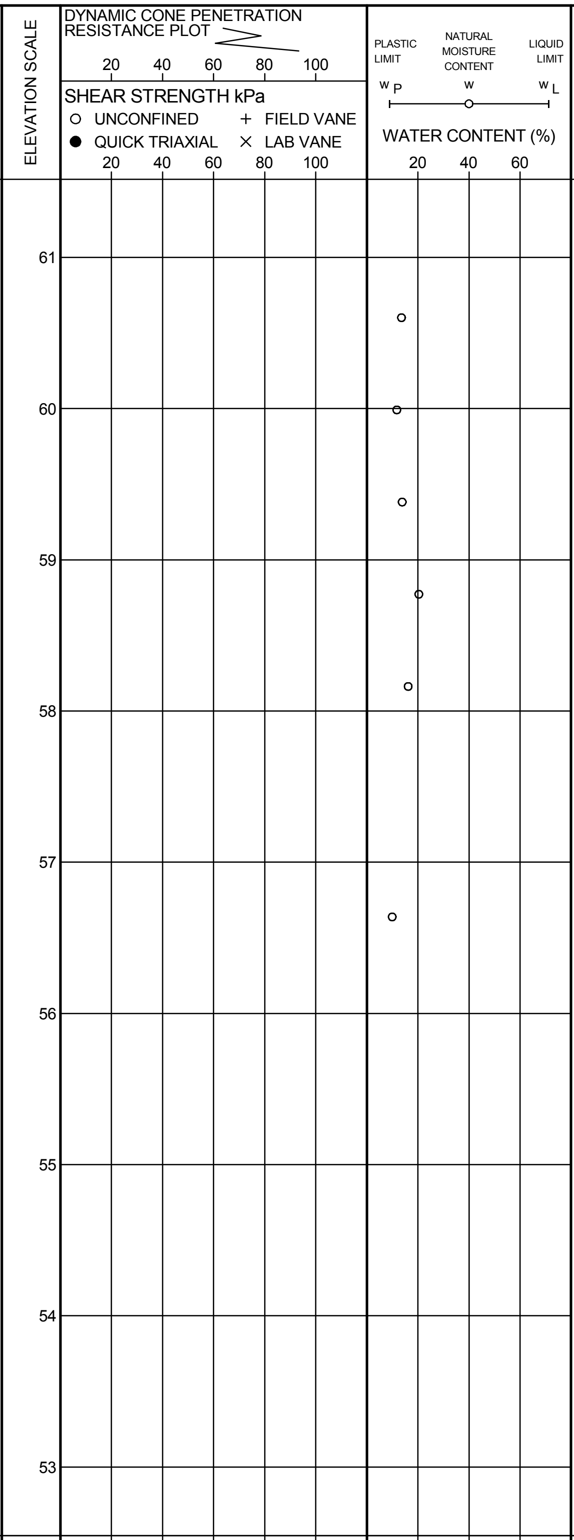
G.W.P. 19-1351-212	LOCATION N 5 031 237.8 E 371 107.9	ORIGINATED BY SLL
HWY 417	BOREHOLE TYPE Hollow Stem Augers/NQ Coring	COMPILED BY AN
DATUM Geodetic	DATE 2012.02.15 - 2012.02.15	CHECKED BY LRB

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
61.5	
0.0	**TOPSOIL:** (100mm)
0.1	Clayey **SILT** and **SAND**, trace gravel Stiff Brown Moist (FILL)
60.3 1.2	Silty **SAND**, some clay, trace gravel Compact to Loose Dark Brown Moist (FILL) Occasional clay inclusions
57.2 4.3	Silty **SAND**, some clay, trace gravel Compact Grey Moist (TILL)
55.9 5.6	**SHALE**, fresh, grey, occasional thin limestone interbeds
52.5 9.0	END OF BOREHOLE AT 9.0m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m THEN CUTTINGS TO SURFACE.

SAMPLES

NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
1	SS	10		1	41	33	25
2	SS	22					
3	SS	23					
4	SS	5		6	52	29	13
5	SS	24					
6	SS	20		2	46	40	11
1	RUN		FI 7 2	RUN 1# TCR=100%, SCR=100%, RQD=68%			
2	RUN		2 0 1 5 2	RUN 2# TCR=100%, SCR=100%, RQD=80%			
3	RUN		1 1 2	RUN 3# TCR=100%, SCR=100%, RQD=100%			



+ 3, × 3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

ONTMT4S 1212.GPJ 4/19/12

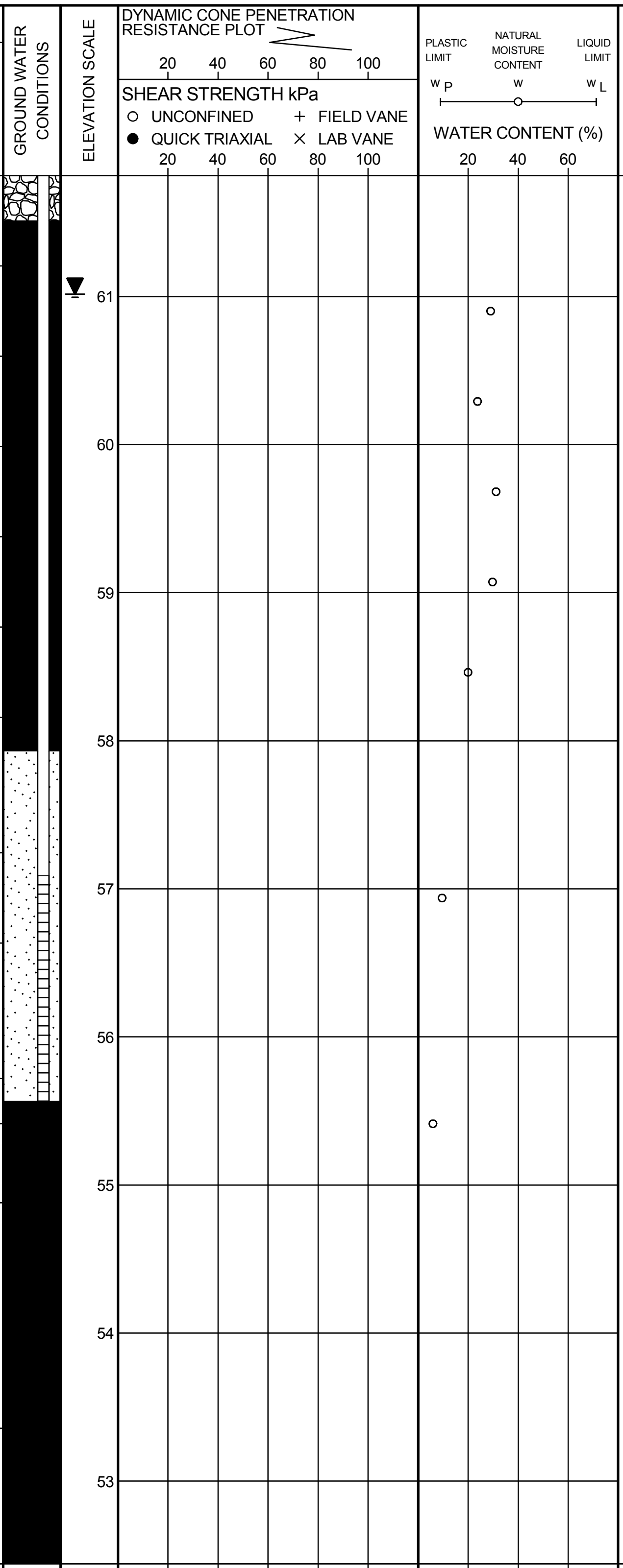
Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CPB-13

1 OF 2 **METRIC**

G.W.P.	19-1351-212	LOCATION	N 5 031 219.9 E 371 090.7	ORIGINATED BY	SLL
HWY	417	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring	COMPILED BY	AN
DATUM	Geodetic	DATE	2012.02.15 - 2012.02.15	CHECKED BY	LRB

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
61.8 0.0	**TOPSOIL:** (100mm)					
0.1	**SAND**, some gravel, some clay, trace silt Loose Brown Moist (FILL)	1	SS	7		
60.6 1.2	Clayey **SILT** and **SAND**, trace gravel Firm to Soft Brown to Grey (FILL)	2	SS	4		2 39 21 38
		3	SS	4		
		4	SS	2		
58.8 3.0	Sandy **SILT**, trace gravel, trace clay Loose Grey Wet	5	SS	6		8 38 46 7
57.6 4.2	Silty **SAND**, some clay, trace gravel Compact Grey Moist to Wet (TILL)	6	SS	21		
55.7 6.1	**SHALE**, very weathered, grey, with occasional limestone interbeds	7	SS	50/ 0.150	FI	
		1	RUN		3 1	RUN 1# TCR=100%, SCR=100%, RQD=81%
		2	RUN		3 0 0 1	RUN 2# TCR=100%, SCR=100%, RQD=95%
		3	RUN		0 2 6 2	RUN 3# TCR=90%, SCR=90%, RQD=68%
52.4 9.4	END OF BOREHOLE AT 9.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.					



Continued Next Page

+3, ×3: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-13 2 OF 2 METRIC

G.W.P. 19-1351-212 LOCATION N 5 031 219.9 E 371 090.7 ORIGINATED BY SLL
HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2012.02.15 - 2012.02.15 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION Continued From Previous Page	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	WATER LEVEL READINGS:										

DATE	DEPTH (m)	ELEV. (m)
2012.02.16	2.7	59.1
2012.03.15	0.8	61.0

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

$\overset{20}{15 \oplus 5}_{10}$ (%) STRAIN AT FAILURE

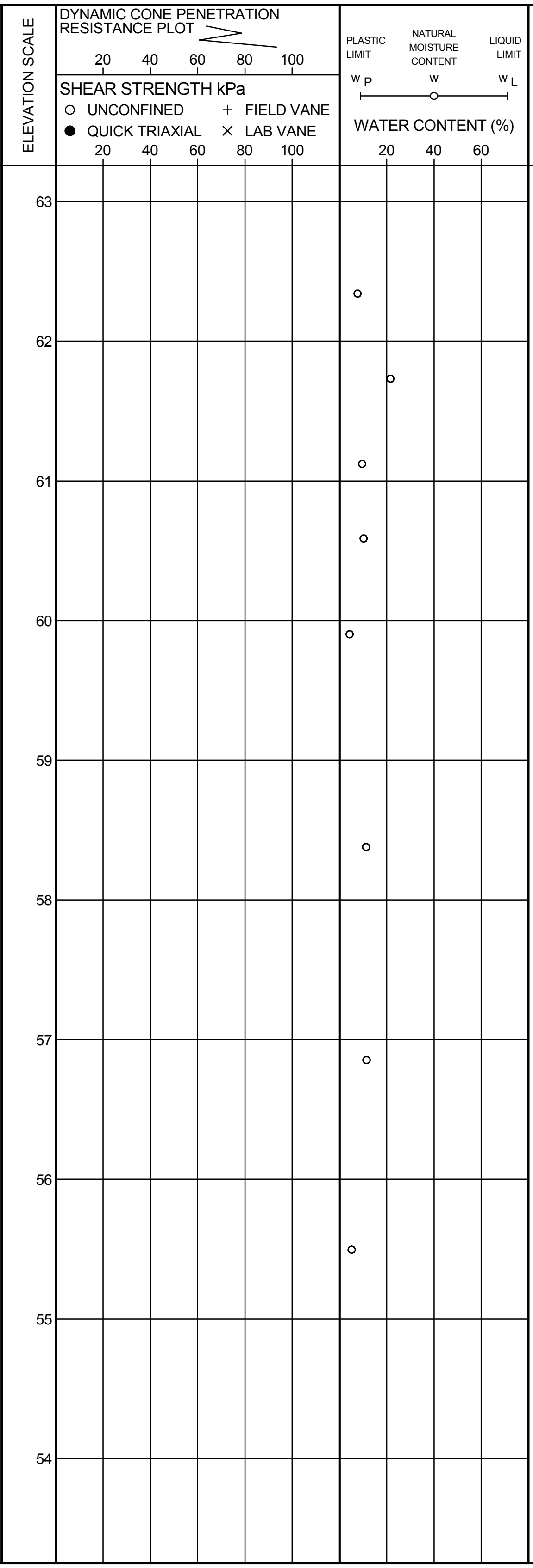
Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CPB-14

1 OF 2 **METRIC**

G.W.P. 19-1351-212	LOCATION N 5 031 236.7 E 371 133.0	ORIGINATED BY SLL
HWY 417	BOREHOLE TYPE Hollow Stem Augers/NQ Coring	COMPILED BY AN
DATUM Geodetic	DATE 2012.02.15 - 2012.02.15	CHECKED BY LRB

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
63.2						
0.0	**TOPSOIL:** (125mm)					
0.1	**SAND**, some gravel to gravelly, some silt, trace clay Dense Brown/Grey Moist (FILL)	1	SS	34		
		2	SS	31		
	Very Dense	3	SS	52		22 50 22 6
		4	SS	90		
60.2 3.0	**SAND**, mixed with ballast, some gravel Very Dense to Dense Dark Grey to Black Moist to Wet (FILL)	5	SS	56		
		6	SS	33		
57.4 5.8	Silty **SAND**, trace clay, trace gravel Compact Grey Moist to Wet (TILL)	7	SS	19		
55.8 7.4	**SHALE**, highly weathered to fresh, grey, with thin limestone interbeds (25mm thick) through out, occasional clay seams	8	SS	50/ 0.125	FI	
		1	RUN		2 0 2	RUN 1# TCR=100%, SCR=100%, RQD=100%
		2	RUN		1 2 0 1	RUN 2# TCR=100%, SCR=100%, RQD=90%



Continued Next Page

+ ³, × ³ : Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CPB-14

2 OF 2

METRIC

G.W.P. 19-1351-212
LOCATION N 5 031 236.7 E 371 133.0
ORIGINATED BY SLL
HWY 417
BOREHOLE TYPE Hollow Stem Augers/NQ Coring
COMPILED BY AN
DATUM Geodetic
DATE 2012.02.15 - 2012.02.15
CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION Continued From Previous Page	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
		▨					53			1	
52.2		▨	3	RUN						0 0	RUN 3# TCR=100%, SCR=100%, RQD=100%
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m, THEN CUTTINGS TO SURFACE.										

$+^3, \times^3$: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

Appendix B

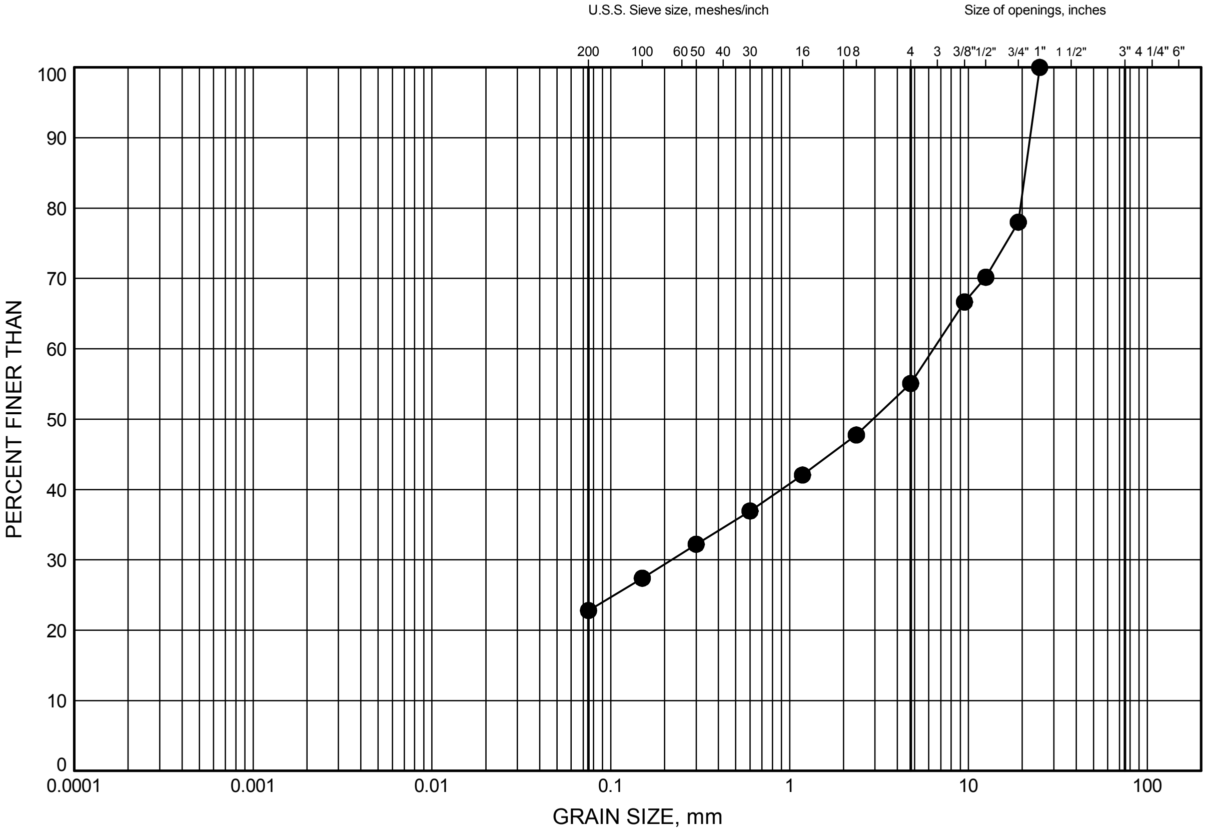
Laboratory Test Results

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-02	1.07	61.23

W.P.# 19-1351-212
Prepared By AN
Checked By LRB

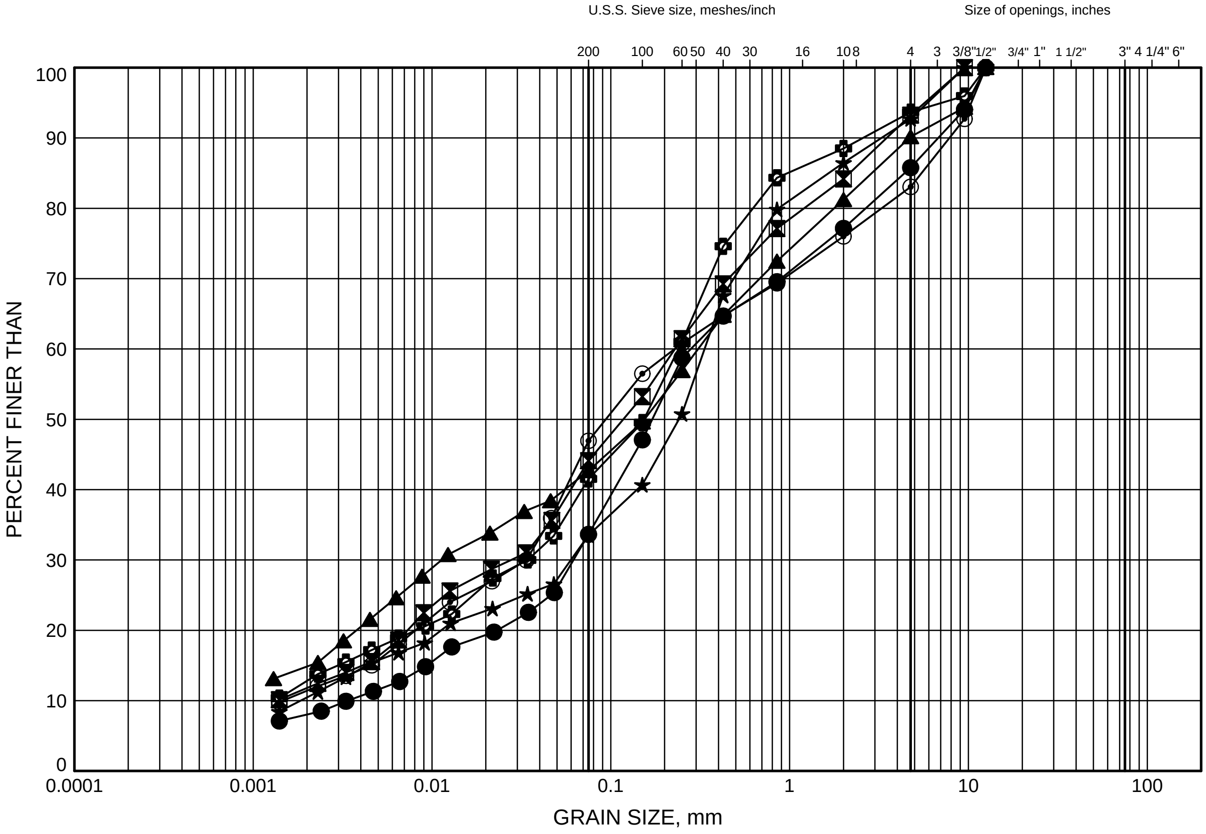
THURBER

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-03	1.52	59.18
⧗	CPB-04	0.91	59.08
▲	CPB-05	0.91	58.98
★	CPB-06	0.91	59.58
⊙	CPB-06	1.52	58.98
✿	CPB-12	2.74	58.76

W.P.# 19-1351-212
Prepared By AN
Checked By LRB

THURBER

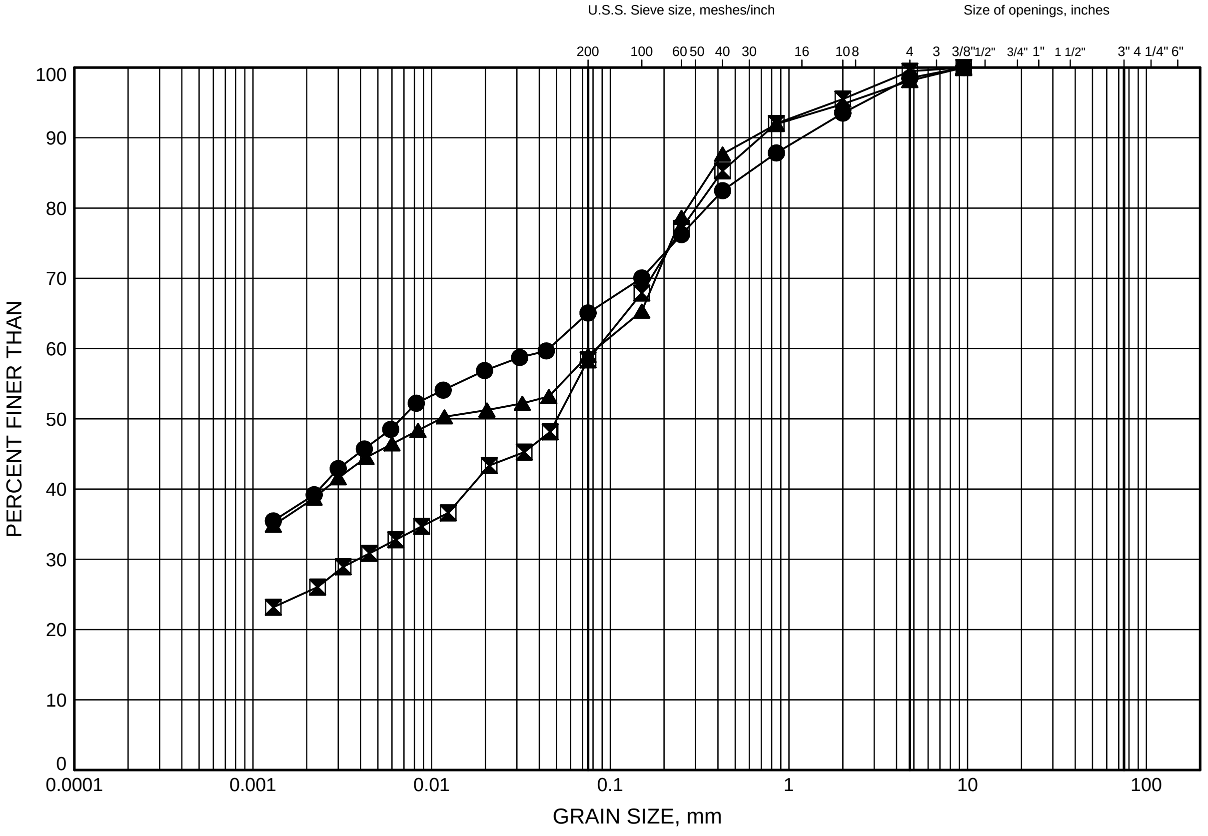
GRAIN SIZE DISTRIBUTION - THURBER 1212.GPJ 4/19/12

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B3

CLAYEY SILT & SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-07	1.52	59.28
☒	CPB-12	0.91	60.59
▲	CPB-13	1.52	60.28

W.P.# 19-1351-212

Prepared By AN

Checked By LRB

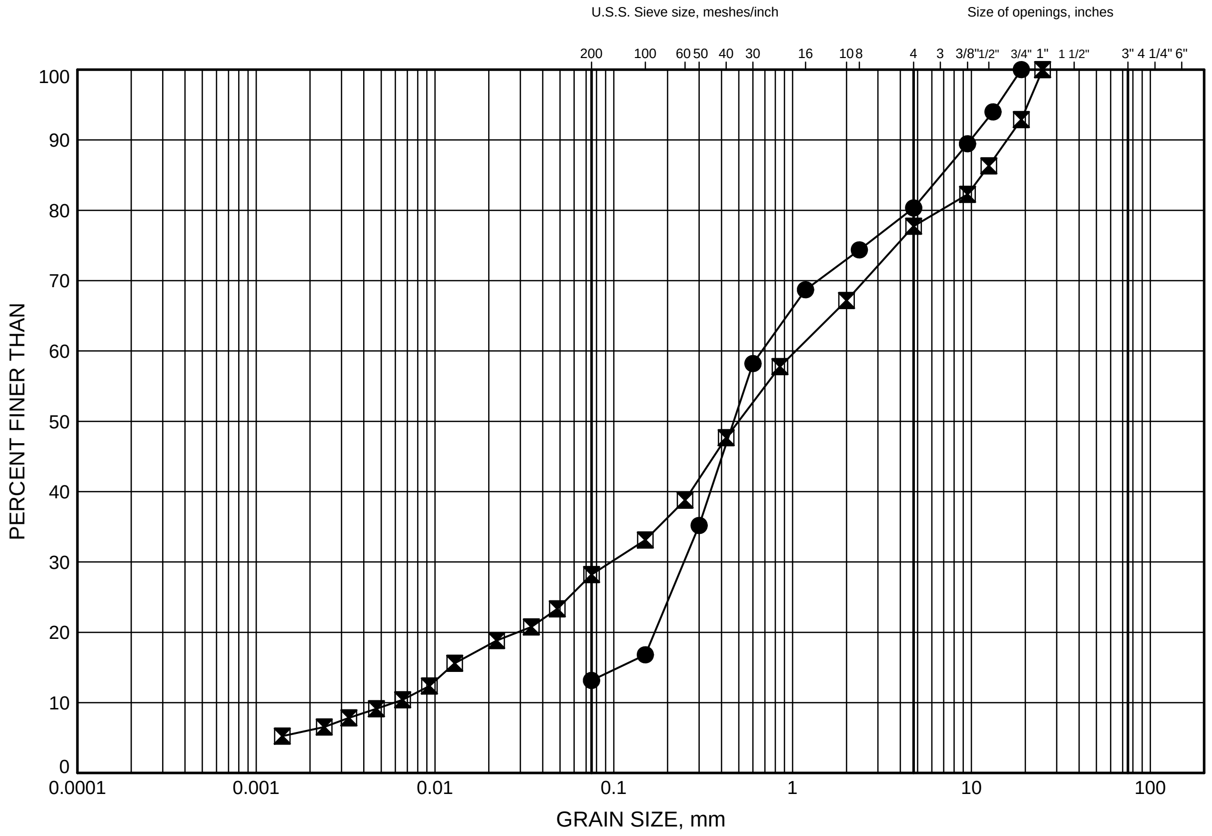
THURBER

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-11	1.52	60.58
☒	CPB-14	2.13	61.11

THURBER

W.P.# 19-1351-212

Prepared By AN

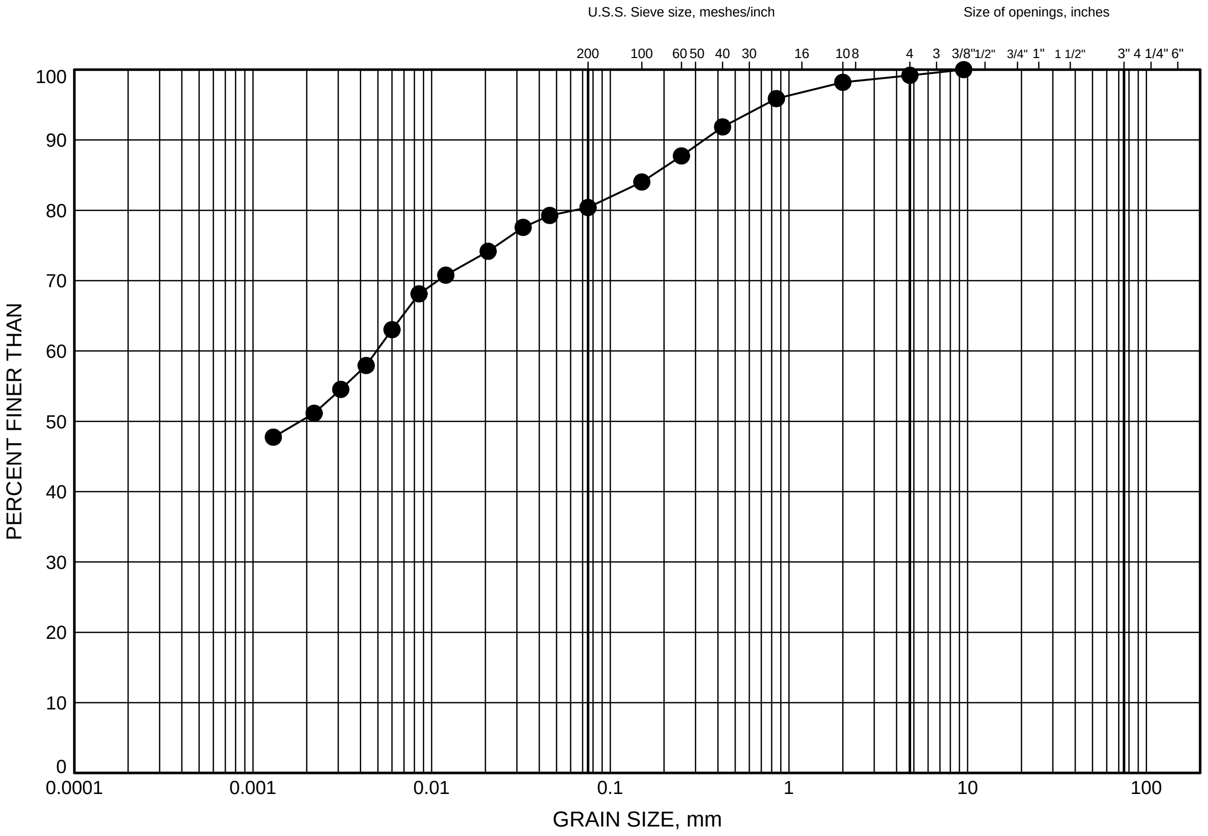
Checked By LRB

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-01	2.59	59.91

W.P.# 19-1351-212

Prepared By AN

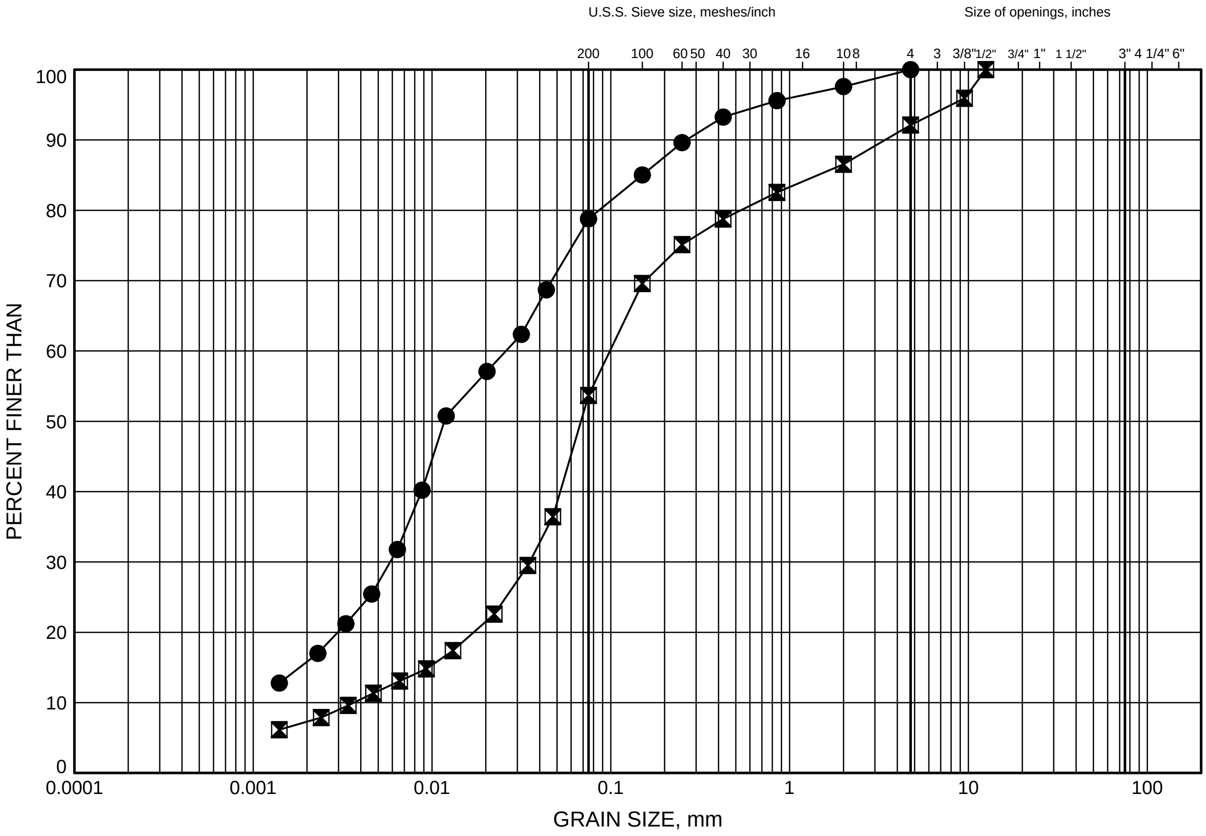
Checked By LRB

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B6

SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-03	2.44	58.26
☒	CPB-13	3.35	58.45

GRAIN SIZE DISTRIBUTION - THURBER 1212.GPJ 4/19/12

W.P.# 19-1351-212

Prepared By AN

Checked By LRB

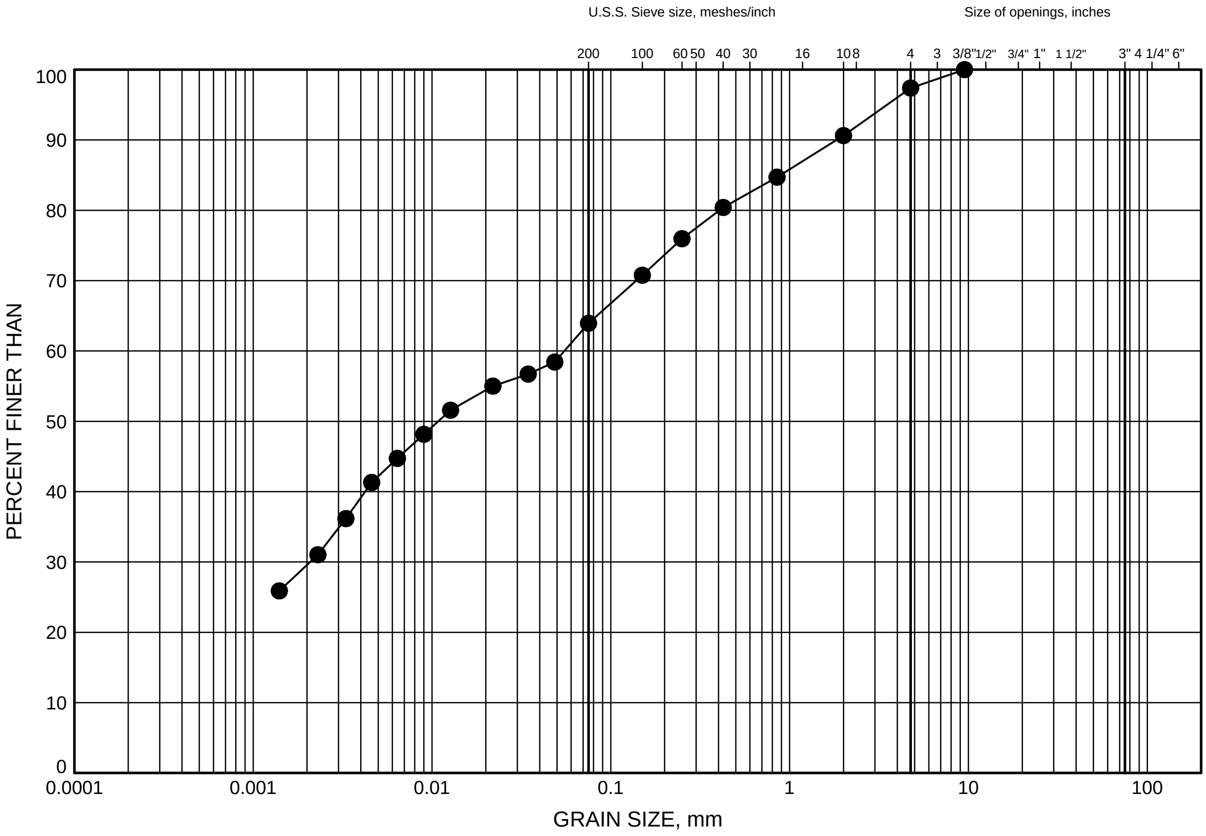
THURBER

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B7

CLAYEY SILT & SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-10	1.52	59.18

W.P.# 19-1351-212

Prepared By AN

Checked By LRB

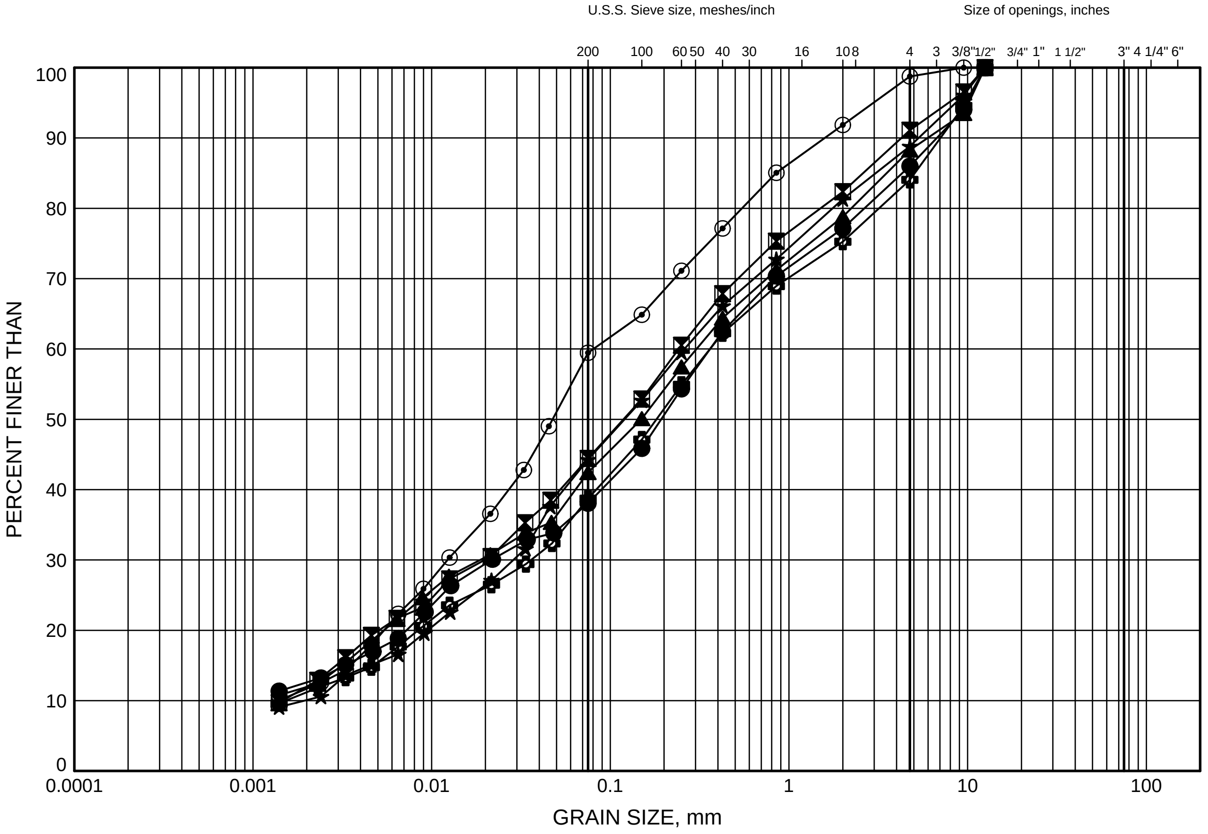
THURBER

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B8

SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-01	6.40	56.10
⧗	CPB-02	3.35	58.95
▲	CPB-03	4.88	55.82
★	CPB-04	2.13	57.87
⊙	CPB-05	3.35	56.55
✿	CPB-06	4.88	55.62

W.P.# 19-1351-212
Prepared By AN
Checked By LRB

THURBER

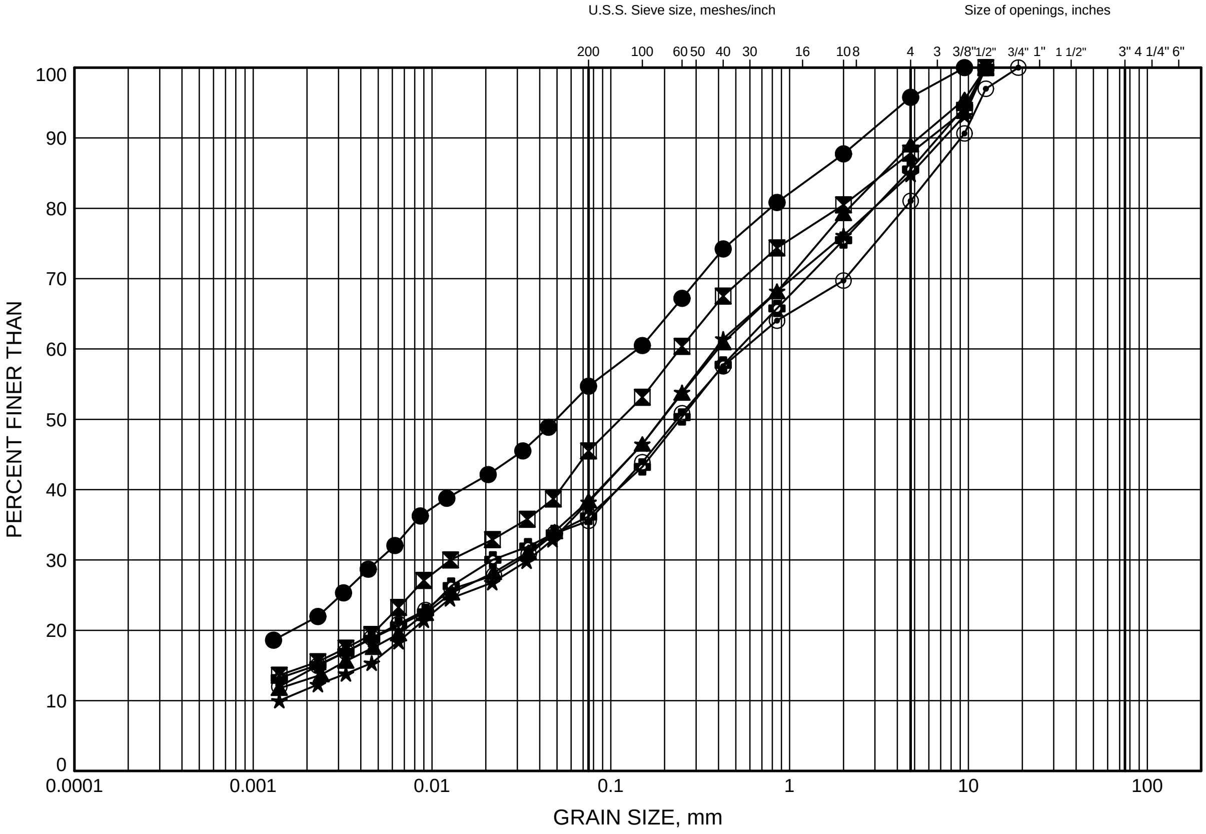
GRAIN SIZE DISTRIBUTION - THURBER 1212.GPJ 4/19/12

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B9

SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-07	2.74	58.06
⧗	CPB-08	2.13	59.87
▲	CPB-08	4.88	57.12
★	CPB-09	2.59	58.91
⊙	CPB-09	6.40	55.10
✿	CPB-10	4.88	55.82

W.P.# 19-1351-212
Prepared By AN
Checked By LRB

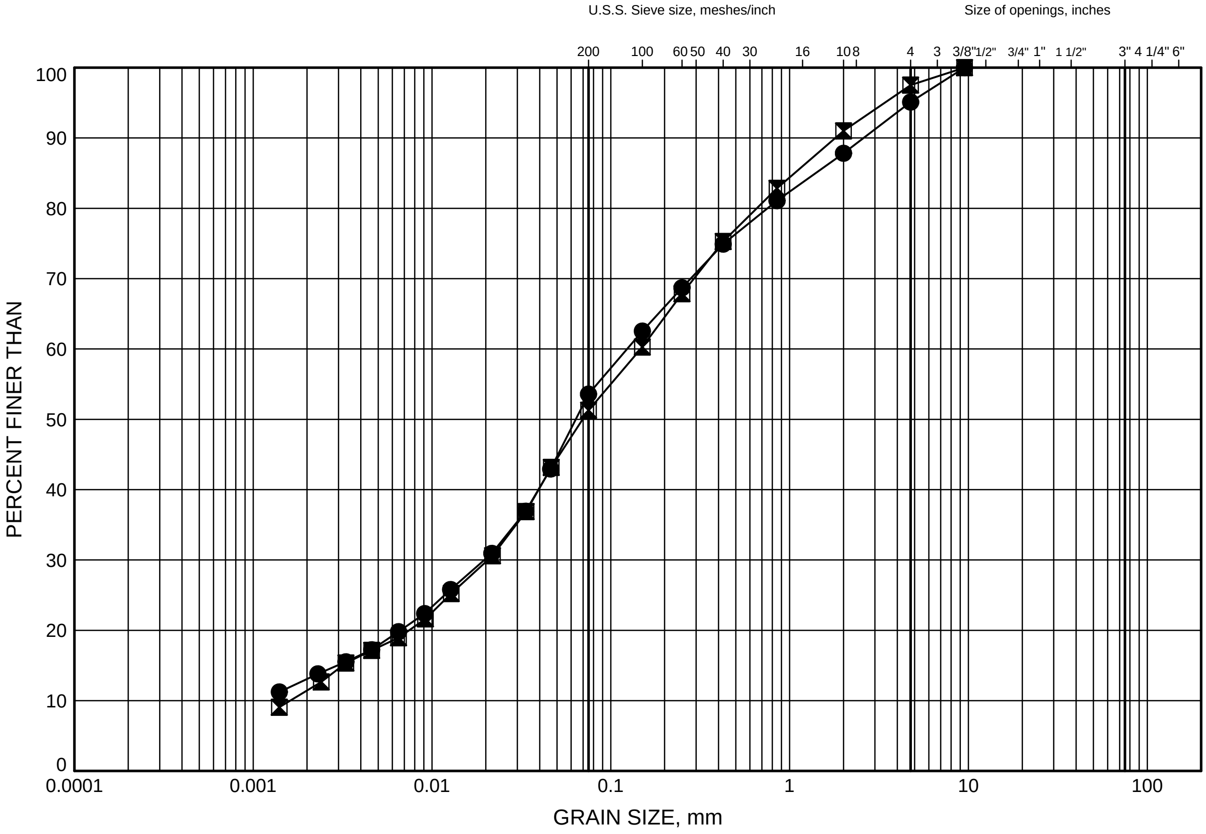
GRAIN SIZE DISTRIBUTION - THURBER 1212.GPJ 4/19/12

Coventry Pedestrian Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B10

SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPB-11	4.88	57.22
⧗	CPB-12	4.88	56.62

W.P.# 19-1351-212

Prepared By AN

Checked By LRB

THURBER

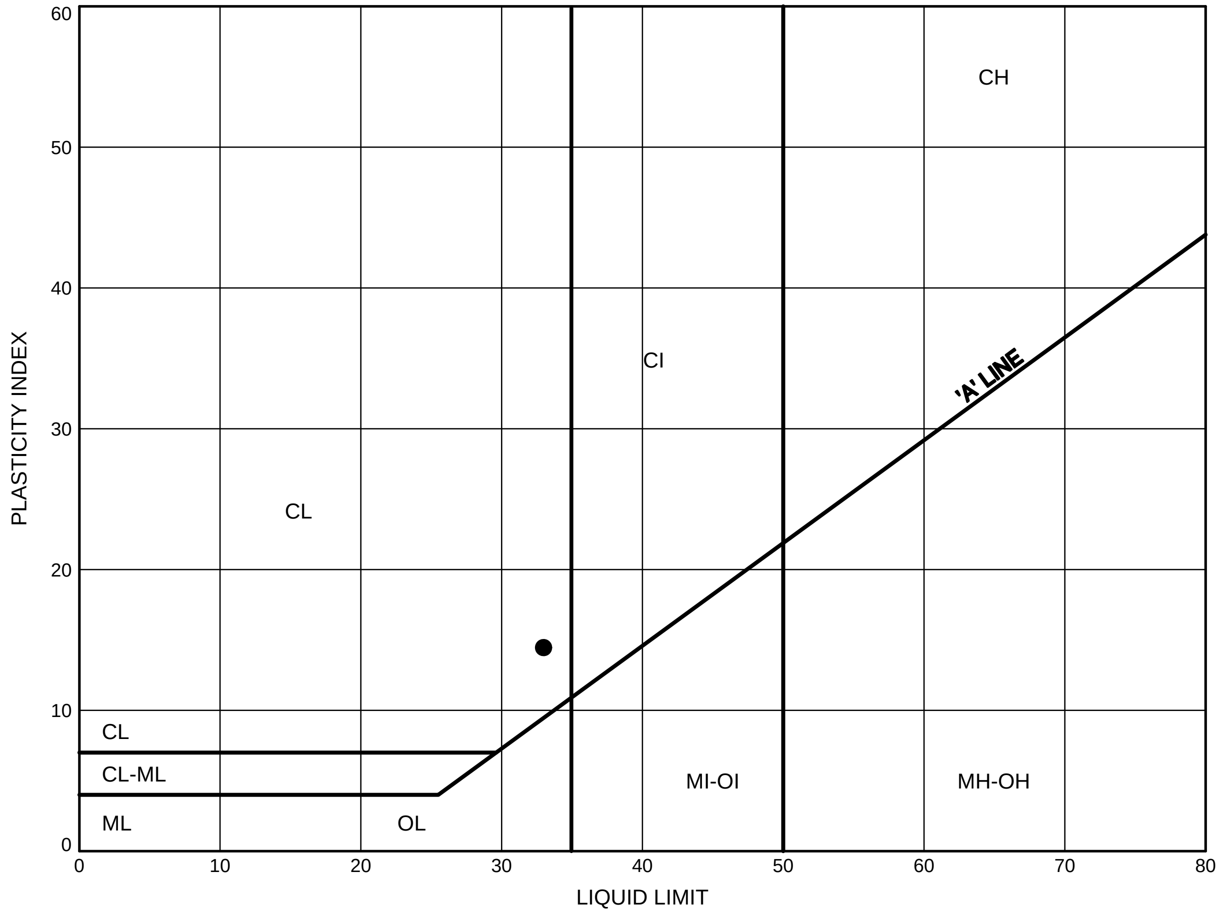
GRAIN SIZE DISTRIBUTION - THURBER 1212.GPJ 4/19/12

Coventry Pedestrian Bridge

ATTERBERG LIMITS TEST RESULTS

FIGURE B11

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CPB-01	2.59	59.91

Date April 2012

Project 19-1351-212

THURBER

Prep'd AN

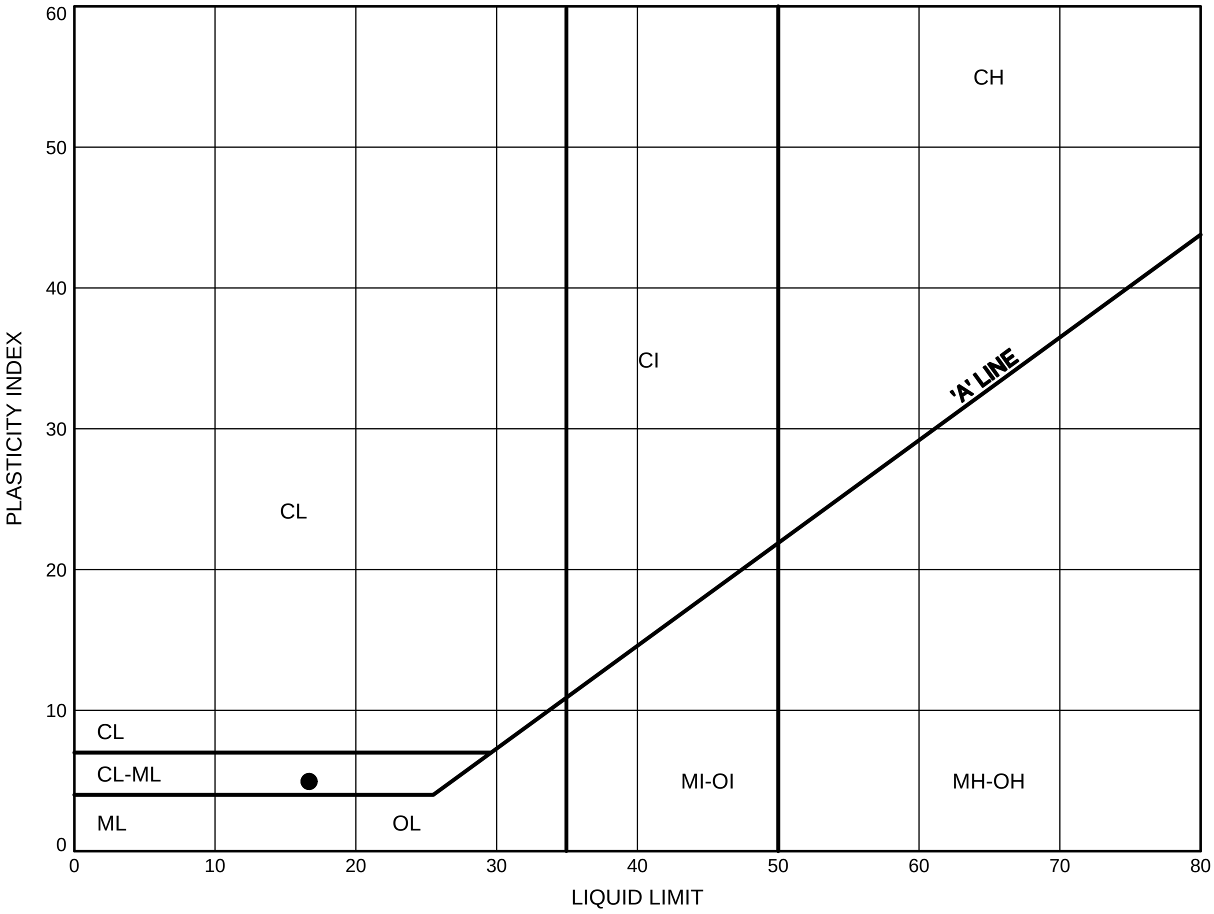
Chkd. LRB

Coventry Pedestrian Bridge

ATTERBERG LIMITS TEST RESULTS

FIGURE B12

SILTY SAND TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CPB-02	3.35	58.95

THURBALT 1212.GPJ 4/19/12

Date April 2012

Project 19-1351-212

THURBER

Prep'd AN

Chkd. LRB

Appendix C

List of SPs and OPSS, and Suggested Text for Selected NSSPs

1. List of Special Provisions and OPSS Documents Referenced in this Report

- OPSS 501
- OPSS 539
- OPSS 902
- OPSS 903
- OPSS 1010
- OPSD 3101.150
- OPSD 3121.150
- OPSD 3190.100
- Special Provision 110S13

2. Suggested Text for NSSP on Caisson Installation

The soils on site consist of fill and silty sand till which may contain cobbles, boulders and shale slabs. Further, the till is underlain by shale bedrock containing hard limestone layers. These materials will potentially have an impact on the installation of caissons, such as:

- impeding the advance of the caissons resulting in lower production and faster wear of drilling bits.
- requiring alternate equipment or procedures in cases where obstructions in the fill/till or thick layers of hard limestone in the bedrock are encountered.
- affecting the alignment of the caissons during advancement.

The Contractor is further advised that non-cohesive soils and high groundwater levels are present on site. Non-cohesive soil is susceptible to disturbance under conditions of unbalanced hydrostatic head.

The Contractor is responsible for constructing the caisson excavation and rock socket without disturbing the sides or base of the excavation, and for cleaning of the socket base. The construction method is the responsibility of the Contractor, but consideration could be given to temporary liners, mud drilling and tremie concrete techniques where conditions warrant.

3. Suggested Text for NSSP on Rock Sockets

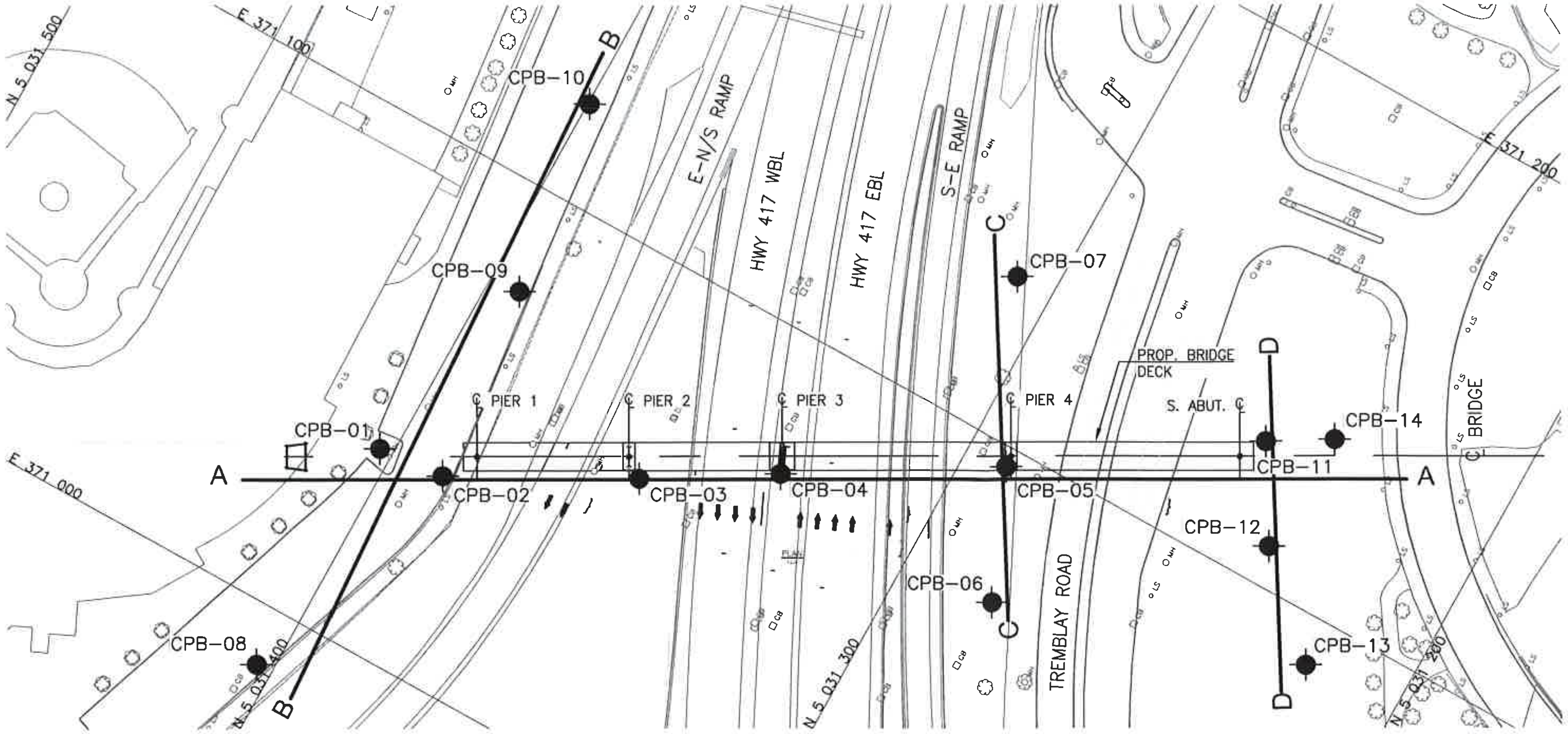
Pile installation shall be in accordance with OPSS 903 and the following:

- Foundation piles are to be installed to the specified socket depth in shale bedrock by drilling or coring to the required depth, cleaning of the socket base, inserting the pile complete with bottom pin or plate, and backfilling the socket around the pile with concrete, all as shown on the contract drawings.
- The Contractor is advised that non-cohesive soils and high groundwater levels are present on site. Non-cohesive soil is susceptible to disturbance under conditions of unbalanced hydrostatic head.
- The Contractor is responsible for constructing the excavation and rock socket for socketed pile installation without disturbing the sides or base of the excavation. The construction method is the responsibility of the Contractor, but consideration could be given to temporary liners and tremie concrete techniques where conditions warrant.

Appendix D

Borehole Locations and Soil Strata Drawings

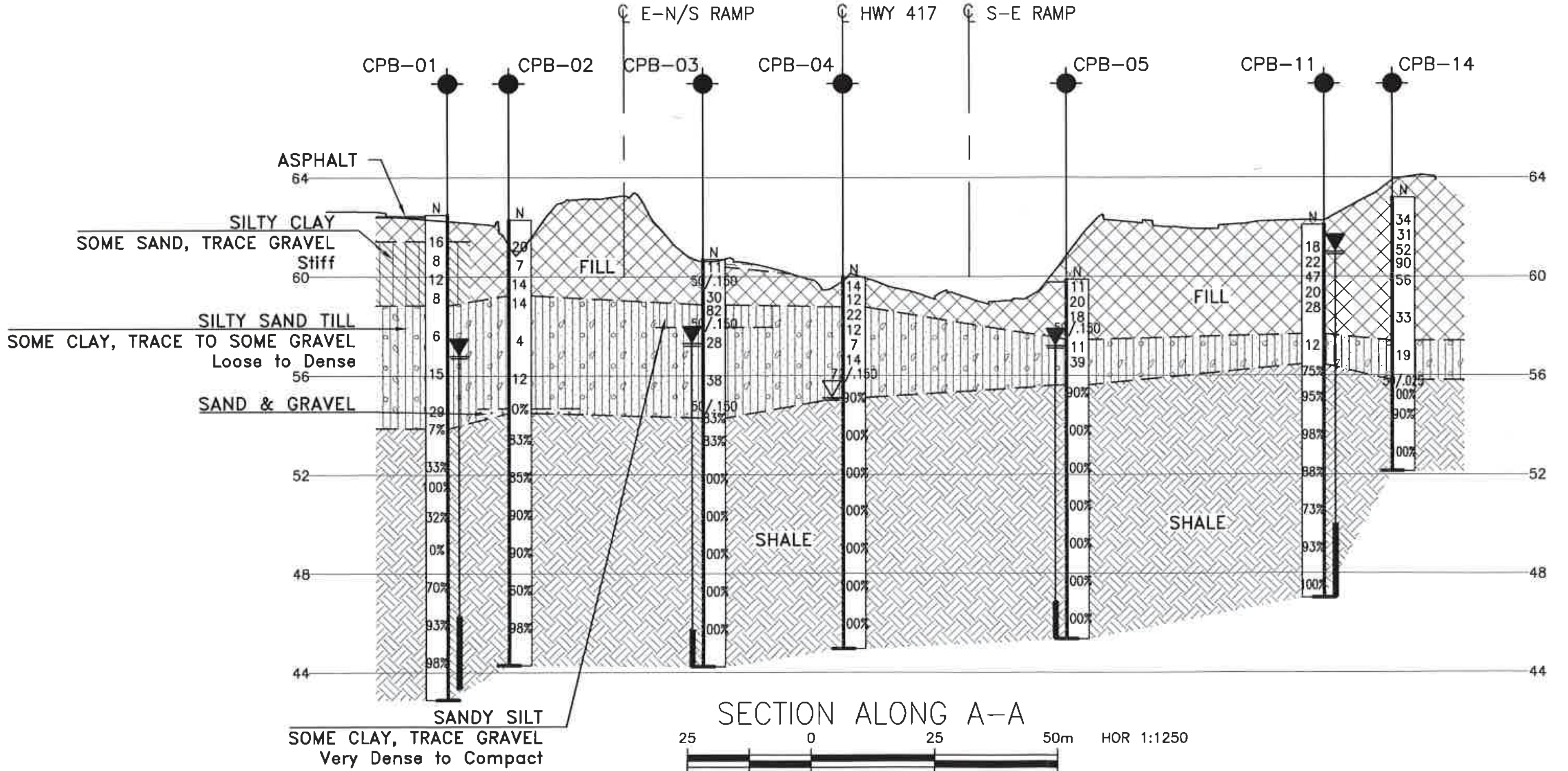
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

25 0 25 50m

SCALE 1:1250



SECTION ALONG A-A

25 0 25 50m HOR 1:1250

5 0 5 10m VER 1:250

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

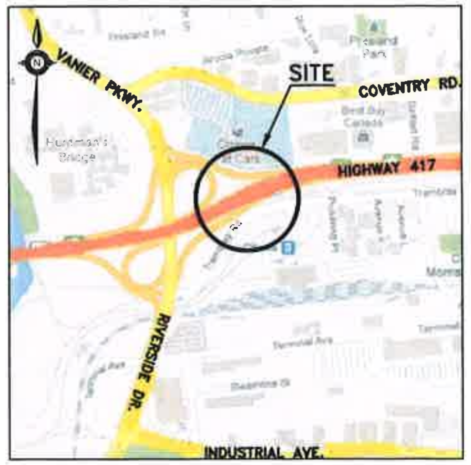
CONT No
WP No

SHEET

COVENTRY PEDESTRIAN
OVERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

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
CPB-01	62.5	5 031 402.7	371 038.3
CPB-02	62.3	5 031 389.1	371 039.6
CPB-03	60.7	5 031 354.5	371 058.3
CPB-04	60.0	5 031 334.1	371 070.5
CPB-05	59.9	5 031 291.4	371 096.2
CPB-06	60.5	5 031 280.8	371 071.1
CPB-07	60.8	5 031 307.9	371 130.7
CPB-08	62.0	5 031 403.4	370 988.5
CPB-09	61.5	5 031 393.7	371 079.5
CPB-10	60.7	5 031 399.7	371 119.3
CPB-11	62.1	5 031 248.5	371 126.0
CPB-12	61.5	5 031 237.8	371 107.9
CPB-13	61.8	5 031 219.9	371 090.7
CPB-14	63.2	5 031 236.7	371 133.0

-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.

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Apr 23/12
PROVINCE OF ONTARIO

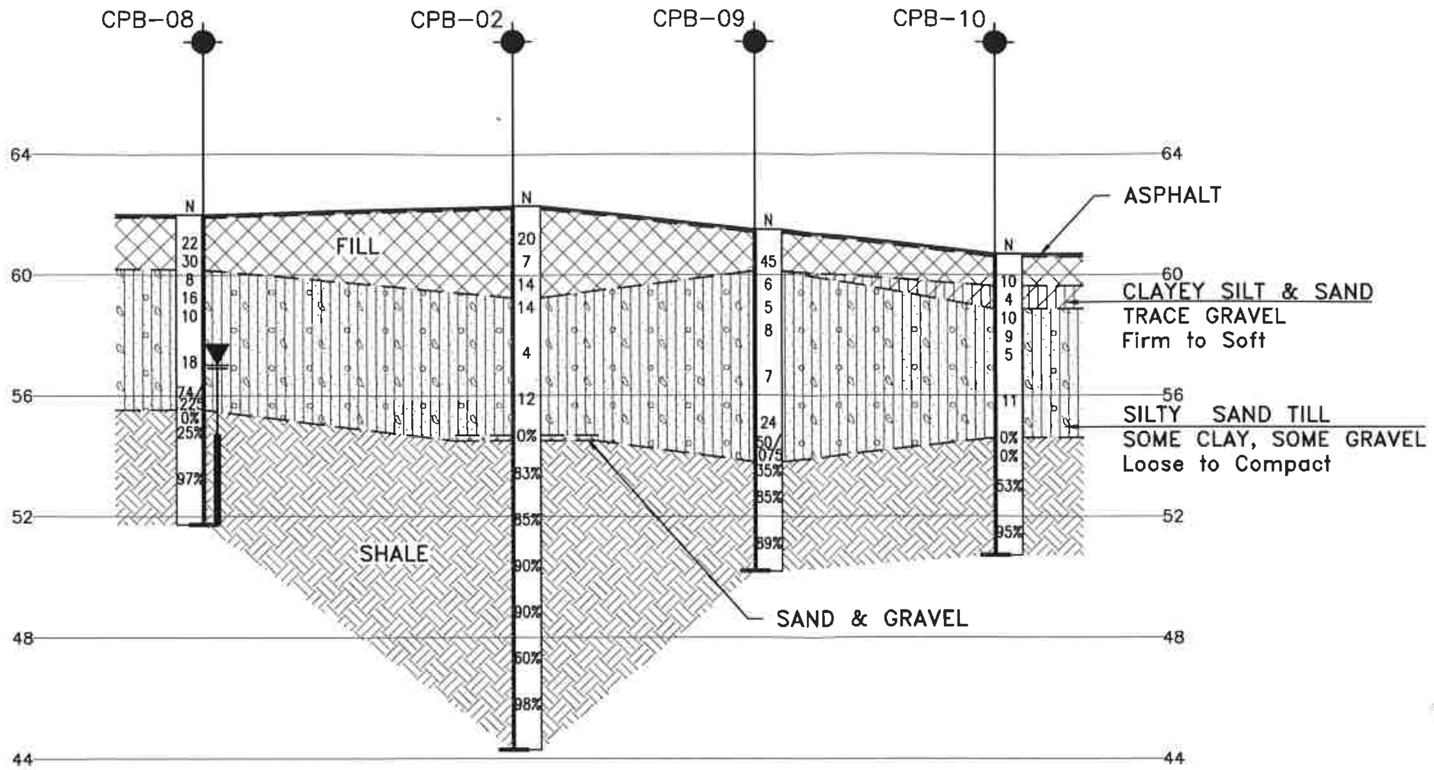
LICENSED PROFESSIONAL ENGINEER
Pchatterji
CHATTERJI
Apr 20/12

REVISIONS	DATE	BY	DESCRIPTION

DESIGN LRB	CHK LRB	CODE	LOAD	DATE APR. 2012
DRAWN AN	CHK	SITE	STRUCT	DWG 1

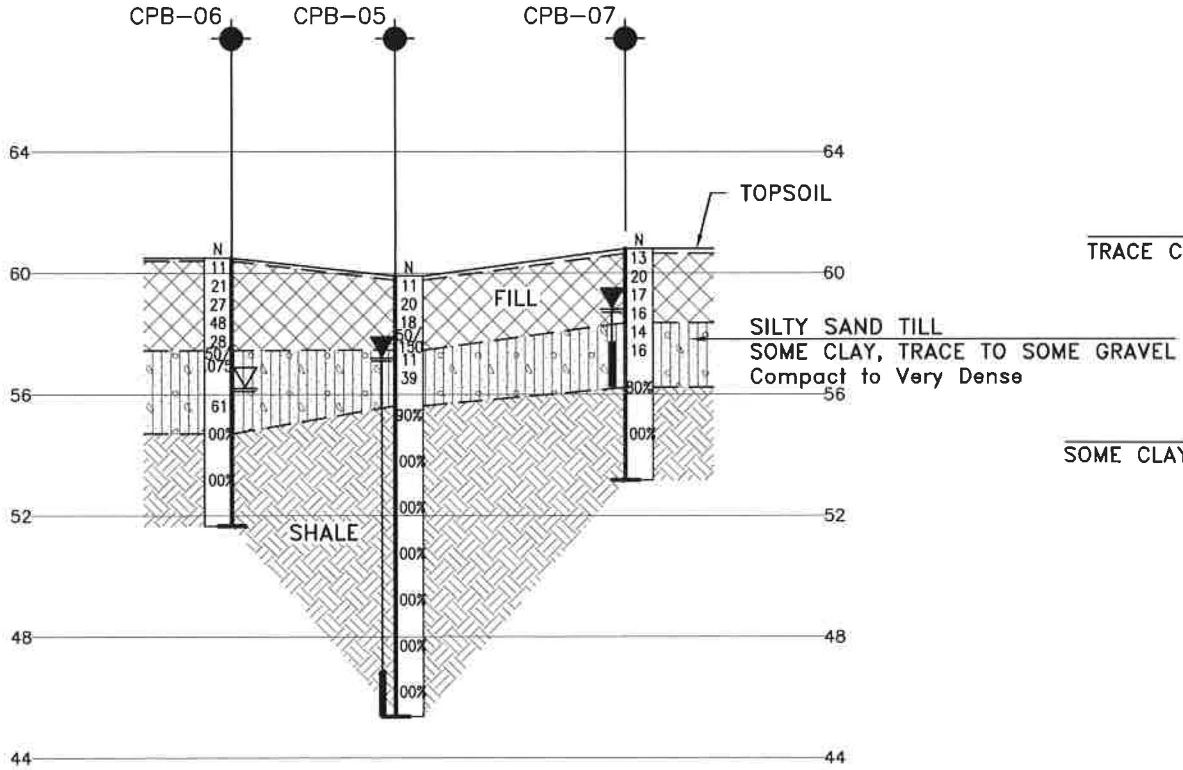
FILENAME: H:\Drafting\19\1351\212\ted1212-BoreholePlan&Profile(Revise).dwg
PLOTDATE: 4/20/2012 10:00 AM

MINISTRY OF TRANSPORTATION, ONTARIO



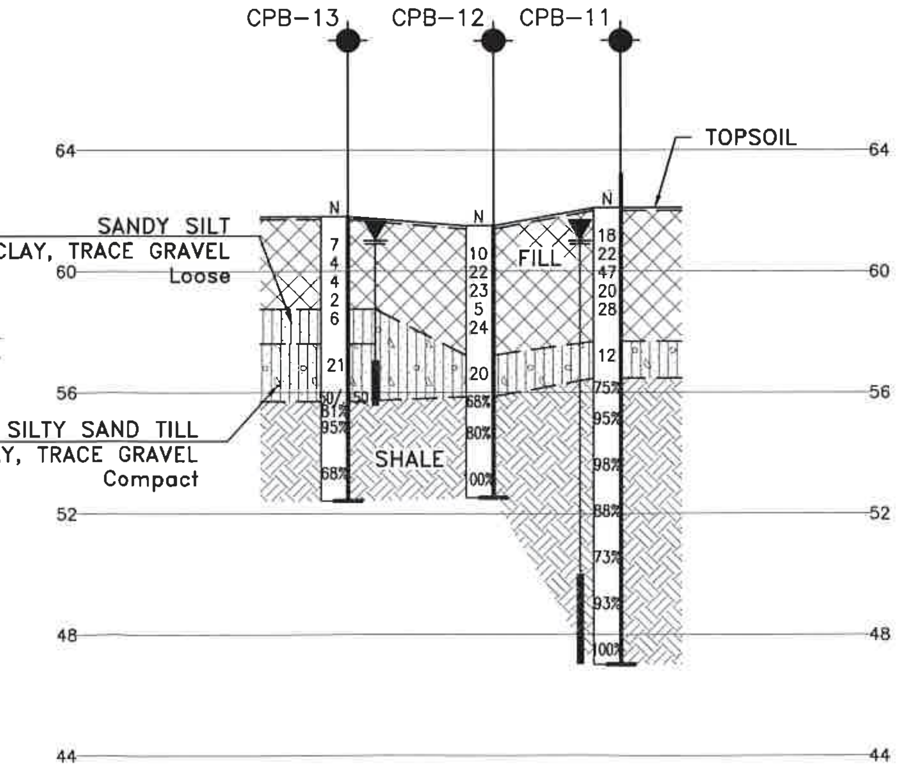
SECTION ALONG B-B

25 0 25 50m HOR 1:1250
5 0 5 10m VER 1:250



SECTION ALONG C-C

25 0 25 50m HOR 1:1250
5 0 5 10m VER 1:250



SECTION ALONG D-D

25 0 25 50m HOR 1:1250
5 0 5 10m VER 1:250

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Apr 20/12
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Apr 20/12
PROVINCE OF ONTARIO

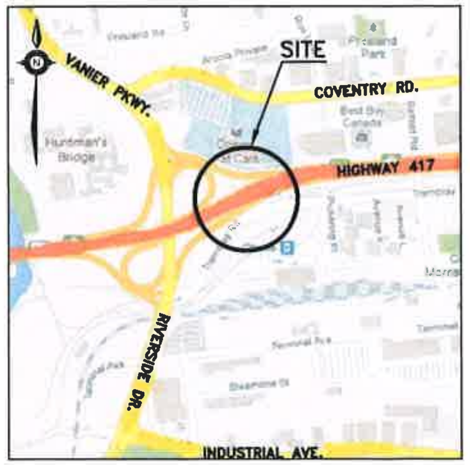
CONT No
WP No

COVENTRY ROAD
PEDESTRIAN BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

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
CPB-01	62.5	5 031 402.7	371 038.3
CPB-02	62.3	5 031 389.1	371 039.6
CPB-03	60.7	5 031 354.5	371 058.3
CPB-04	60.0	5 031 334.1	371 070.5
CPB-05	59.9	5 031 291.4	371 096.2
CPB-06	60.5	5 031 280.8	371 071.1
CPB-07	60.8	5 031 307.9	371 130.7
CPB-08	62.0	5 031 403.4	370 988.5
CPB-09	61.5	5 031 393.7	371 079.5
CPB-10	60.7	5 031 399.7	371 119.3
CPB-11	62.1	5 031 248.5	371 126.0
CPB-12	61.5	5 031 237.8	371 107.9
CPB-13	61.8	5 031 219.9	371 090.7
CPB-14	63.2	5 031 236.7	371 133.0

-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.

REVISIONS

DATE	BY	DESCRIPTION

DESIGN LRB	CHK LRB	CODE	LOAD	DATE APR. 2012
DRAWN AN	CHK	SITE	STRUCT	DWG 2

FILENAME: H:\Drafting\19\1351\212\ted1212-BoreholePlan&Profile(Revise).dwg
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