



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
MOOSE CREEK BRIDGE REPLACEMENT
HIGHWAY 72, KENORA DISTRICT, ONTARIO
W.P. 473-00-01, SITE #41S-16**

Geocres Number: 52K-014

Report to

MMM GROUP LIMITED

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

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed replacement of the Moose Creek Bridge on Highway 72, located south of the Town of Sioux Lookout.

The purpose of the 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, a stratigraphic profile, 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.

Archive drawings consisting of “Plan and Elevation” and “General Details” dated March 3, 1942 and “Gabion Retaining Wall and Pile Cap Reinforcement” dated January 1969 provided by MMM were reviewed during preparation of this report.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The bridge site is located on Highway 72 approximately 500 m south of Fireside Road and 15.5 km south of the Town of Sioux Lookout, Ontario.

The Moose Creek at the Highway 72 crossing flows from west to east, discharging into Abram Lake to the east of the highway. The Moose Creek flows through a long broad marsh, which is approximately 150 m wide at the crossing. The land surrounding the valley is gently undulating and heavily treed.

The existing bridge is a three span structure supported on timber bents. The bridge has a total length of 18.3 m and a width of 10.0 m. Each span is approximately 6 m in length. The archive drawings dated March 3, 1942 indicate that each bent is supported on a single row of eleven timber piles. The deck consists of a reinforced concrete slab supported on a laminated timber deck.

Photographs of the bridge and surrounding area are presented in Appendix C. As evident on the photographs, movement of the abutment foundations and settlement of the approaches has been experienced. Remedial work carried out to address the foundation displacement has included reinforcement (widening) of the timber pile caps, installation of wood shims between the timber piles and pile cap, and reinforcement of the exposed part of selected piles. Loss of ground is also apparent adjacent to the abutments.

The archive drawing dated January 1969 shows that in addition to the wood shims and pile cap reinforcement, gabion retaining walls were to be installed behind the abutments, presumably to prevent loss of material between the piles. Rock or cold mix were also specified to retain the shoulder fill. At present, rock fill and localized asphaltic material are evident at the abutments, however the gabion walls are not visible.

Additional bents of timber piles, cut-off above the creek water level, are also present under the bridge, apparently from a former bridge structure.

The site lies within the physiographical area of Canadian Shield, which is characterized by Pre-Cambrian igneous and metamorphic bedrock typically occurring as rounded knobs and ridges where exposed. According to Canadian Geological Survey (CGS) data, the bedrock at this site generally consists of mafic to intermediate meta-volcanic rocks of the Winnipeg River Subprovince. The bedrock is overlain by a discontinuous cover of Pleistocene sand, silt and gravel (glaciofluvial outwash) overlain by silt and clay (glaciolacustrine deposit).

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at this site were carried out in two stages. Between April 21 and May 3, 2015, a total of four (4) boreholes designated as Boreholes MCB-01, MCB-03, MCB-04 and MCB-06 were drilled from the highway embankment level. Boreholes MCB-01 and MCB-06 were advanced at each bridge approach to depths of 10.1 m and 9.8 m, respectively, and Boreholes MCB-03 and MCB-04 were drilled at the abutments with sampling to depths of 38.7 m and 35.1 m, from which depth dynamic cone penetration testing (DCPT) was performed to 41.7 m and 38.0 m depth.

In addition, twelve hand-augered probeholes were attempted on both sides of the highway embankment at selected locations to investigate the thickness of peat. As the ground within the Moose Creek Valley was still partially frozen, only six (6) probeholes designated as Probehole P1 to P6 were advanced in the swampy area on both sides of the embankment. The probeholes depths varied from 450 mm to 5.5 m depth.

To supplement the existing subsurface information, the second stage of investigation was carried out between July 15 and July 23, 2015, when a total of eighteen (18) boreholes were drilled. The boreholes were distributed within the stretch of the creek valley to the north and south of the existing bridge. Six boreholes were advanced from the highway embankment level, namely Boreholes

MCB-02, MCB-05 and MCB-22 were located to the south of the existing bridge and Boreholes MCB-07, MCB-08 and MBC-21 were located to the north of the bridge. The remaining boreholes were distributed on both sides of the highway embankment in the adjacent swampy area. The boreholes were advanced to depths ranging from 14.3 m to 16.5 m, except for Boreholes MCB-18, MCB-21 and MCB-22, which were terminated at depths ranging from 1.1 m to 6.7 m. In Borehole MCB-20, dynamic cone penetration testing was carried out from 11.3 m to 15.5 m depth.

Boreholes placed on the highway embankment were advanced using a CME 75 track-mounted drill rig in combination with the NW casing/wash boring method. Boreholes located in the swampy area adjacent to the embankment were drilled from the barge using portable tripod drilling equipment.

Soil samples were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear tests were conducted in peat and cohesive soils for determination of undrained shear strengths using MTO Standard “N” size vane and a calibrated torque wrench.

The drilling and sampling operations were supervised on a full time basis by members of Thurber’s technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber’s laboratory for further examination and testing. Undisturbed silty clay samples (Shelby tube samples) were collected from Boreholes MCB-15 and MCB-22 and submitted to TBT Engineering for further laboratory testing.

Groundwater conditions in the open boreholes were observed during the drilling operations. A standpipe piezometer consisting of 19 mm PVC pipe with a slotted screen was installed in Borehole MCB-03. Following the final water level reading, the piezometer was decommissioned in general accordance with MOE Regulation 903.

The ground surface elevations at the borehole and probehole locations were obtained from the drawings provided by MMM. The approximate locations of the boreholes and probeholes are shown on the attached Borehole Locations and Soil Strata Drawing included in Appendix D.

A summary of the drilling program, including borehole and probehole locations, drilling depths, and completion details, is presented in Table 3.1 below.

Table 3.1 –Summary of Drilling Program

Location	Borehole Number	Borehole Depth/Base Elevation (m)	Completion Details
South Approach	MCB-01	10.1 / 349.3	Borehole backfilled with bentonite holeplug and cuttings to 1.0 m, then concrete to surface.
South Embankment	MCB-02	15.8 / 344.0	Borehole backfilled with bentonite holeplug to 1.8 m, concrete to 0.2 m, then asphalt to surface.
South Abutment	MCB-03	41.7 / 317.8	Standpipe piezometer consisting of 19 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen

Location	Borehole Number	Borehole Depth/Base Elevation (m)	Completion Details
			installed.
North Abutment	MCB-04	38.0 / 321.6	Borehole backfilled with bentonite holeplug and cuttings to 1.0 m, then concrete to surface.
South Embankment	MCB-05	15.8 / 343.4	Borehole backfilled with bentonite holeplug to 1.6 m, concrete to 0.2, then asphalt to surface.
North Approach	MCB-06	9.8 / 349.9	Borehole backfilled with bentonite holeplug and cuttings to 0.6 m, then concrete to surface.
North Embankment	MCB-07	15.8 / 343.9	Borehole backfilled with bentonite holeplug to 1.5 m, concrete to 0.2 m, then asphalt to surface.
North Embankment	MCB-08	15.8 / 345.0	Borehole backfilled with bentonite holeplug to 1.5 m, concrete to 0.2 m, then asphalt to surface.
West of South Embankment	MCB-09	15.8 / 342.4	Borehole backfilled with bentonite holeplug to surface.
West of South Embankment	MCB-10	16.5 / 341.1	Borehole backfilled with bentonite holeplug to surface.
West of South Embankment	MCB-11	16.5 / 341.0	Borehole backfilled with bentonite holeplug to surface.
East of South Embankment	MCB-12	15.8 / 342.8	Borehole backfilled with bentonite holeplug to surface.
East of South Embankment	MCB-13	15.8 / 342.4	Borehole backfilled with bentonite holeplug to surface.
East of South Embankment	MCB-14	15.8 / 341.9	Borehole backfilled with bentonite holeplug to surface.
West of North Embankment	MCB-15	15.8 / 341.6	Borehole backfilled with bentonite holeplug to surface.
West of North Embankment	MCB-16	15.8 / 342.5	Borehole backfilled with bentonite holeplug to surface.
West of North Embankment	MCB-17	15.8 / 344.0	Borehole backfilled with bentonite holeplug to surface.
East of North Embankment	MCB-18	1.1 / 355.9	Borehole backfilled with bentonite holeplug to surface.
East of North Embankment	MCB-19	14.3 / 343.4	Borehole backfilled with bentonite holeplug to surface.
East of North Embankment	MCB-20	14.5 / 342.6	Borehole backfilled with bentonite holeplug to surface.
North Embankment	MCB-21	4.3 / 356.5	Borehole backfilled with bentonite holeplug to 1.2 m, concrete to 0.2 m, then asphalt to surface.
South Embankment	MCB-22	6.7 / 352.5	Borehole backfilled with bentonite holeplug to 1.5 m, concrete to 0.2 m, then asphalt to surface.
West of South Embankment	P1	4.0 / 354.1	Borehole backfilled with cuttings to surface.
West of South Embankment	P2	5.2 / 352.6	Borehole backfilled with cuttings to surface.
West of South	P3	5.5 / 352.1	Borehole backfilled with cuttings to surface.

Location	Borehole Number	Borehole Depth/Base Elevation (m)	Completion Details
Embankment			
West of North Embankment	P4	0.5 / 358.8	Borehole backfilled with cuttings to surface.
East of North Embankment	P5	4.6 / 357.1	Borehole backfilled with cuttings to surface.
East of North Embankment	P6	2.9 / 355.1	Borehole backfilled with cuttings to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets included in Appendix A. Grain size analyses and Atterberg Limits tests were conducted on selected samples and the results of this testing program are summarized on the Record of Borehole sheets in Appendix A and are shown on the figures included in Appendix B.

Oedometer tests were performed on selected undisturbed silty clay samples (Shelby tube samples) in the TBT Engineering laboratory. The results of the testing are enclosed in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets and the Summary of Probeholes in Appendix A for details of the encountered soils. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and observations during drilling; therefore they represent transitions between soil types rather than exact geological boundaries. The subsurface conditions may vary between and beyond the borehole locations. The model of the soil stratigraphy is illustrated on the “Borehole Locations and Soil Strata” drawing and soil profiles enclosed in Appendix D.

The subsurface stratigraphy below the existing embankment fill encountered at the site generally consists of a layer of amorphous peat overlying a deposit of silty clay, which in turn is underlain by glaciofluvial deposits comprising of silt/silty sand and transitioning to sand. Bedrock was not encountered during this investigation.

More detailed descriptions of the individual strata are presented below.

5.1 Asphalt

Asphalt pavement was encountered in Boreholes MCB-01 to MCB-08 and MCB-21 drilled from the roadway. The thickness of the asphalt ranged from 75 mm to 225 mm. The greatest thickness of asphalt was noted in Boreholes MCB-03 and MCB-04 located in proximity to

the existing bridge abutments, which may indicate maintenance works (asphalt padding) due to ongoing embankment settlements.

5.2 Fill

Embankment fill was encountered below the asphalt in Boreholes MCB-01 to MCB-08 and MCB-21. A fill material was also found in Borehole MCB-18 drilled near the toe of embankment. The fill thickness where fully penetrated varied from 1.9 m in Borehole MCB-08 to 6.8 m in Borehole MCB-01 with the underside between 2.0 m and 7.0 m depth (Elev. 358.8 and 352.4).

In all roadway boreholes except Boreholes MCB-02 and MCB-03, the upper 0.6 m to 2.2 m of fill consisted of granular material ranging from gravelly sand to sandy gravel forming the road base. Trace to some silt and occasional cobbles were encountered in this fill. The road base was underlain by finer material consisting of sand to sand and silt with localised zones of silt and silty clay to clayey silt. Occasional cobbles were also encountered in this fill. Borehole MCB-18 advanced near the embankment toe encountered 1.1 m of sand fill with some peat content.

In the upper 1.5 to 2.2 m of the fill below the pavement surface, recorded SPT 'N' values ranged from 21 blows for 0.3 m penetration to 50 blows for 0.1 m penetration, indicating a compact to very dense relative density. The higher 'N' values may indicate the presence of cobbles in the fill. Below this level, 'N' values varied from zero (Weight of Rod to Weight of Hammer) to 14 blows for 0.3 m, indicating a very loose to compact condition. Moisture contents of the granular fill typically ranged from 3% to 12%, and the moisture content in the finer fill ranged from 12% to 29%.

The results of grain size analyses conducted on fill samples are provided on the Record of Borehole sheets in Appendix A and are illustrated in Figures B1 to B3 of Appendix B. The results are summarized as follows:

Particles	Gravelly Sand to Sandy Gravel	Sandy Clayey Silt	Silty Sand to Sand and Silt
Gravel	29 to 52%	0%	0 to 14%
Sand	43 to 63%	30%	53 to 76%
Silt & Clay	5 to 20%	-	24%
Silt	-	43%	19 to 39%
Clay	-	27%	5 to 20%

5.3 Peat

A layer of peat was encountered below the embankment fill in all boreholes drilled through the roadway except for Borehole MCB-08. Peat was also encountered from the ground

surface in all boreholes drilled adjacent to the embankment, except for Borehole MCB-18 which was terminated in the fill. The peat was described as dark brown, typically fibrous below the embankment fill and amorphous adjacent to the embankment. Trace shell fragments were observed in the lower zone of the deeper peat areas.

The thickness of the peat beneath the embankment fill ranged from 0.1 m to 3.3 m, with the base of the peat at depths ranging from 2.8 m to 9.0 m depth (Elev. 358.0 to 350.4). The peat in the boreholes drilled beyond the embankment toe extended from the ground surface to depths ranging from 1.1 m to 6.1 m, with the base of the deposit between Elev. 357.0 and Elev. 351.4. The greater thickness of the peat was encountered in the southern part of the site both under the embankment and in the area adjacent to the embankment.

SPT 'N' values obtained in the peat under the embankment fill ranged from 1 to 10 blows per 0.3 m of penetration, indicating a very loose to loose condition. 'N' values recorded in the peat adjacent to the embankment varied from zero (Weight of Rod to Weight of Hammer) to 5 blows per 0.3 m of penetration, indicating a very loose to loose condition.

In areas adjacent to the embankment, undrained shear strengths measured by field vane shear tests (VST) carried out in the peat ranged from 12 kPa to 32 kPa, with typical values between 17 kPa and 22 kPa. In the peat layer beneath the embankment fill, higher undrained shear strengths of 25 kPa to 38 kPa were measured, possibly reflecting consolidation of the peat under the weight of the embankment fill. Two higher values of 70 kPa and 80 kPa recorded in Borehole MCB-05 may indicate the presence of roots in the tested peat zone.

Natural moisture contents of the peat samples collected from the boreholes put down adjacent to the embankment ranged from 51% to 792%, with the lower values obtained in samples collected near the ground surface, and the highest values from the central zone of the deposit. The natural moisture content of peat samples collected from beneath the embankment fill varied between 147% and 430%, which may again reflect consolidation of the peat under the embankment fill.

5.4 Silty Clay

A layer of grey silty clay was encountered below the peat in all boreholes (excluding Borehole MCB-18 terminated in fill). Occasional silt and clayey silt seams and trace to some sand were noted in this deposit, as well as trace of rootlets in the upper zone immediately beneath the peat. Where fully penetrated, the thickness of the layer ranged from 1.4 m to 7.8 m with the lower boundary encountered between 2.7 m and 14.3 m depth (Elev. 344.4 to 356.8). Boreholes MCB-01, MCB-06, MCB-10, MCB-11 and MCB-21 were terminated in the silty clay deposit between 4.3 m and 16.5 m depth (Elev. 356.5 and 341.0), which indicates that the silty clay may extend to greater depths than penetrated in the boreholes.

SPT 'N' values recorded in the silty clay ranged from zero blows (Weight of Rod to Weight of Hammer) to 25 blows per 0.3 m penetration, with typical values from zero to 3 blows per 0.3 m penetration. The higher N values, ranging from 8 to 25 blows per 0.3 m penetration, were generally recorded in the boreholes located close to the south and north boundaries of the valley (Boreholes MCB-09, MCB-12, MCB-16 and MCB-17, where the silty clay layer was relatively thin.

Field vane testing (VST) conducted in the boreholes adjacent to the embankment resulted in undrained shear strengths ranging from 12 kPa to 46 kPa with typical values between 15 kPa and 25 kPa. Similar to the measurements of N-values, higher undrained shear strengths were obtained in the boreholes located at the boundaries of the site. The undrained shear strengths measured in the silty clay encountered below the embankment were somewhat higher and ranged from 17 kPa to 65 kPa with the majority of values ranging from 17 kPa to 45 kPa. One value of 10 kPa was obtained in Borehole MCB-04 in the upper 0.7 m thick zone of silty clay immediately beneath the peat. Based on the SPT and VST data, the consistency of the silty clay varied from very soft to stiff.

The sensitivity of the silty clay, calculated as a ratio of undisturbed strength to remoulded strength, in the majority of the boreholes ranged from 3 to 8, suggesting that the silty clay is normal to sensitive. However, in Borehole MCB-15 and MCB-19, the sensitivity of silty clay was between 5 and 14, indicating sensitive to extra sensitive soil.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figures B4 to B8 of Appendix B. The results are summarized as follows:

Particles	Content in %
Gravel	0 to 12
Sand	0 to 21
Silt	31 to 77
Clay	23 to 69

The results of Atterberg Limits tests conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B15 to B17 of Appendix B. The results indicated that the deposit has plastic limits ranging from 18 to 20% and liquid limits ranging from 32 to 46%. Plasticity indices, the difference between the plastic limit and liquid limit, ranged from 14 to 27%, suggesting low to medium plasticity of the deposit.

Natural moisture contents of the silty clay ranged from 22 to 83% with the typical moisture content values between 35 and 60%.

Oedometer Tests were performed on selected undisturbed samples of silty clay (Shelby tubes samples) collected from Borehole MCB-15 and MCB-22. The testing was performed in the TBT Engineering laboratory. The results of the testing are enclosed in Appendix B and summarized below.

Consolidation Test Results

Borehole	Sample Depth (m)	e_o	C_c	C_r	$p_{e'}$ (kPa)	$p_{o'}$ (kPa)	OCR	c_v m ² /yr
MCB-15	6.1 - 6.7	1.8	0.7	0.07	50	25	2.0	1.6
MCB-22	6.1 - 6.7	1.3	0.3	0.03	80	80	1.0	3.2

5.5 Silt

A layer of grey silt was encountered below the silty clay in 15 of the 22 boreholes, namely in Boreholes MCB-02 to MCB-05, MCB-07 to MCB-09, MCB-12 to MCB-17, MCB-19 and MCB-20. The silt contained trace of gravel, trace to some clay, trace to some sand and occasional silty clay/clayey silt and sand seams. Where fully penetrated in Boreholes MCB-03 and MCB-04, the thickness of the silt was 8.1 m and 9.0 m, and the lower boundary was encountered at depths of 21.5 m and 19.2 m (Elev. 338.0 and 340.4). The remaining boreholes were terminated in the silt at depths ranging from 11.3 m (Elev. 346.8) to 15.8 m (Elev. 341.6).

SPT 'N' values recorded in the silt layer ranged from zero to 25 blows per 0.3 m penetration, indicating a very loose to compact relative density. Natural moisture contents of the silt ranged from 18% to 52%, typically 18% to 30%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figures B9 to B13 of Appendix B. The results are summarized as follows:

Particles	Content in %
Gravel	0 to 7%
Sand	0 to 36%
Silt	61 to 93%
Clay	2 to 24%.

5.6 Silty Sand

A layer of grey silty sand with trace clay and occasional silty clay and sand seams was encountered below the silt deposit in Boreholes MCB-03 and MCB-04. The thickness of silty sand measured in these boreholes was 6.0 m and 7.8 m, and the lower boundary was encountered at 27.5 m and 27.0 m depth (Elev. 332.0 and 332.6).

SPT 'N' values recorded in the silty sand ranged from 7 to 14 blows for 0.3 m penetration, indicating a loose to compact relative density. Measured natural moisture contents ranged from 17 to 22%.

Due to low sample recovery, grain size analyses were not conducted on samples of silty sand.

5.7 Sand

A deposit of sand was encountered below the silty sand in Boreholes MCB-03 and MCB-04. The sand contains trace to some silt, trace clay and occasional silty clay seams. Boreholes MCB-03 and MCB-04 were advanced with sampling 11.2 m and 8.4 m into the sand to depths of 38.7 m and 35.4 m (Elev. 320.8 and 324.2).

SPT 'N' values recorded in the deposit ranged from 10 to 26 blows per 0.3 m penetration, indicating a compact relative density.

Dynamic cone penetration testing conducted below the sampled depths in these boreholes indicated a gradual increase of N values with depth, which may at least partially reflect increasing friction on the cone and drill rods. The tests were terminated at depths of 41.7 m (Elev. 317.8) in Borehole MCB-03 and 38.0 m (Elev. 321.6) in Borehole MCB-04 when N values of 100 blows per 0.3 m of penetration were obtained.

The results of grain size analyses conducted on samples of the sand are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B14 of Appendix B. The results are summarized as follows:

Particles	Content in %
Gravel	0%
Sand	83 to 89%
Silt and Clay	11 to 17%

Measured natural moisture contents ranged from 15% to 20%.

5.8 Water Levels

Water levels in the boreholes were observed during drilling operations and measured upon completion of drilling. However, water was also used during the wash-boring operations to advance boreholes drilled from the highway embankment grade, therefore, the measured water levels on completion of drilling may not reflect prevailing groundwater levels at the site.

A standpipe piezometer was installed in Borehole MCB-03 to monitor groundwater level after drilling. The piezometer was installed in silty sand with the tip at 28.3 m depth.

The water levels measured in the open boreholes upon completion of drilling and in the piezometer are summarized in Table 5.1.

Table 5.1 - Water Level Measurements

Borehole Number	Date	Water Level (m)		Comments
		Depth	Elevation	
MCB-01	May 3, 2015	N/A	N/A	N/A
MCB-02	May 16, 2015	2.3	357.5	Upon completion
MCB-03	May 3, 2015	0.7	358.8	Piezometer
MCB-04	May 3, 2015	0.0	359.6	Water level rose to the road surface upon advancing borehole to 38.0 m depth.
MCB-05	July 17, 2015	1.1	358.1	Upon completion
MCB-06	April 23, 2015	N/A	N/A	N/A
MCB-07	July 17, 2015	1.8	357.9	Upon completion
MCB-08	July 15, 2015	1.2	359.6	Upon completion
MCB-09	July 19, 2015	0.1	358.1	Upon completion
MCB-10	July 18, 2015	0.3	357.3	Upon completion
MCB-11	July 19, 2015	0.0	357.5	Upon completion
MCB-12	July 20, 2015	0.1	358.5	Upon completion
MCB-13	July 20, 2015	0.2	358.0	Upon completion
MCB-14	July 21, 2015	0.0	357.7	Upon completion
MCB-15	July 22, 2015	0.0	357.4	Upon completion
MCB-16	July 23, 2015	0.3	358.0	Upon completion
MCB-17	July 23, 2015	0.5	359.3	Upon completion
MCB-18	July 23, 2015	N/A	N/A	N/A
MCB-19	July 21, 2015	0.2	357.5	Upon completion
MCB-20	July 22, 2015	0.2	357.9	Upon completion
MCB-21	July 17, 2015	0.9	359.9	Upon completion
MCB-22	July 23, 2015	N/A	N/A	N/A

In summary, the groundwater level measured in the piezometer was at Elev. 358.8, and the water levels measured in the open boreholes upon completion of drilling ranged from the ground surface to 0.5 m depth (Elev. 357.3 to 359.3) in the boreholes drilled in the swamp and 0.7 m to 2.3 m depth (Elev. 357.5 to 359.9) in the boreholes drilled through the road embankment.

The following water levels in Moose Creek were indicated in the available documents:

Archive drawing (March 1942) - Elev. 358.0 (1174.6 ft) on October 15, 1941

Preliminary General Arrangement drawing (April 2015) - Elev. 356.7 on November 2011

- Elev. 358.9 High Water Level

Preliminary Profile drawing (MMM) - Elev. 358.8 on May 30, 2014.

The water level in the creek and groundwater levels are subject to precipitation patterns and are expected to fluctuate seasonally. Observations made during drilling operations confirmed that the water level in the Moose Creek can change/rise significantly in a short period of time. Therefore, the water levels at any given time may vary from the levels measured during the foundation field investigation.

6 MISCELLANEOUS

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied the drill rig and conducted the drilling, sampling and in-situ testing operations. Boreholes placed on the highway embankment were advanced using a CME 75 track-mounted drill rig in combination with the NW casing/wash boring method. A portable tripod drill rig was supplied to carry out the drilling, sampling and in-situ testing operations for boreholes located in the swampy area adjacent to the embankment.

The drilling and sampling operations were supervised in the field by Ms. Eckie Siu and Mr. Matthew Whalen, EIT. Mr. Mark Farrant, P.Eng. directed the field operations.

The report was prepared by Ms. Anna Piascik, P.Eng., and reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects.

THURBER ENGINEERING LTD.

Anna Piascik, P.Eng.
Senior Geotechnical Engineer

Murray R. Anderson, P.Eng, M.Eng.
Associate, Senior Foundation Engineer



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



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 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.

EXPLANATION OF ROCK LOGGING TERMS


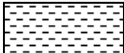



ROCK WEATHERING CLASSIFICATION

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.

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

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

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

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 % 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.

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			

RECORD OF BOREHOLE No MCB-01

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 441.2 E 372 045.8 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.05.03 - 2015.05.03 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
359.4	GROUND SURFACE												
0.0	ASPHALT:(150mm)												
0.2	Gravelly SAND , trace to some silt, trace organics Compact to Very Dense Brown Moist (FILL)		1	SS	69		359						
			2	SS	40								
357.9							358						
1.5	Silty SAND , trace clay, trace gravel, occasional cobbles Compact to Dense Greyish Brown Wet (FILL)		3	SS	88								0 61 34 5
			4	SS	13		357						
356.7													
2.7	Clayey SILT , trace sand, trace gravel, occasional lenses of gravelly sand Stiff Grey to Greyish Brown Moist to Wet (FILL)		5	SS	14		356						
355.6													
3.8	Silty SAND , trace clay, occasional silt lenses Loose to Compact Greyish Brown Wet (FILL)		6	SS	14		355						
							354						
			7	SS	4		353						0 72 23 5
352.4													
7.0	PEAT , fibrous, trace sand Loose Dark Brown Wet		8	SS	5		352						
							351						
350.4	Trace of shell fragments in 300mm zone at 8.7m depth												
9.0	Silty CLAY , trace sand Very Soft Grey Moist		9	SS	0		350						0 0 31 69

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-01

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 441.2 E 372 045.8 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.05.03 - 2015.05.03 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
349.3 10.1	Continued From Previous Page END OF BOREHOLE AT 10.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.0m, THEN CONCRETE TO SURFACE.							20 40 60 80 100	20 40 60				kN/m ³	GR SA SI CL

RECORD OF BOREHOLE No MCB-02

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 381.7 E 372 036.8 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.16 - 2015.07.16 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								WATER CONTENT (%)					
359.8	GROUND SURFACE												
0.0	ASPHALT:(125mm)												
0.1	Silty SAND , some gravel, trace clay, occasional cobbles Compact to Very Dense Brown Moist (FILL)		1	SS	50/ 0.125								
			2	SS	23								
			3	SS	10								
357.7													
2.1	PEAT , fibrous, trace sand Loose Dark Brown Moist to Wet		4	SS	5								
356.7													
3.1	Silty CLAY , some sand, trace rootlets in the upper zone Soft to Firm Grey Wet		5	SS	6								
			6	SS	3								
353.7													
6.1	SILT , trace to some sand, trace clay, occasional clay seam Very Loose to Loose Grey Wet		7	SS	8								
			8	SS	2								
			9	SS	2								

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

RECORD OF BOREHOLE No MCB-02

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 381.7 E 372 036.8 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.07.16 - 2015.07.16 CHECKED BY AMP

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

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RECORD OF BOREHOLE No MCB-03

1 OF 5

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 459.0 E 372 047.9 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.27 - 2015.04.30 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
359.5	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0	ASPHALT:(225mm)							<div><div>20406080100</div><div>WATER CONTENT (%)</div><div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div><div><div>W_P</div><div>W</div><div>W_L</div></div></div>						
0.2	Silty SAND , some gravel, trace clay, occasional cobbles Dense Brown Moist to Wet (FILL)		1	SS	32		359							
			2	SS	50/ 0.100		358							14 56 25 5
357.1														
2.4	Clayey SILT , some sand to sandy, trace gravel Stiff Grey Moist (FILL)		3	SS	12		357							
			4	SS	8		356							0 30 43 27
354.9							355							
4.6	SAND , trace silt, trace gravel Loose Greyish Brown Wet (FILL)		5	SS	4		354							
354.0														
5.5	PEAT , fibrous Very Loose Dark Brown Wet		6	SS	2		353							
	Trace shell fragments, trace wood fragments in 500mm zone at 7.5m depth						352							
351.5														
8.0	Silty CLAY , trace sand, occasional silt lense Soft to Firm Grey Moist to Wet		7	SS	0		351							
							350							0 7 54 39

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-03

3 OF 5

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 459.0 E 372 047.9 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.27 - 2015.04.30 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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Sensitivity 20
15 10 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-03

4 OF 5

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 459.0 E 372 047.9 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.27 - 2015.04.30 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
	Continued From Previous Page													
			18	SS	15		329							
							328							
							327							
							326							
							325							
			19	SS	14		324							
							323							
							322							
			20	SS	26		321							
320.8 38.7	End of sampling at 38.7m. Start DCPT at 38.0m						320							0 89 11 (SI+CL)

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

RECORD OF BOREHOLE No MCB-03

5 OF 5

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 459.0 E 372 047.9 ORIGINATED BY MNW
HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.04.27 - 2015.04.30 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)							
	Continued From Previous Page							20 40 60 80 100								
317.8							319									
41.7	END OF BOREHOLE AT 41.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 03/15 0.7 358.8						318									

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-04

2 OF 4

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 482.1 E 372 042.6 ORIGINATED BY MNW
HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.05.01 - 2015.05.03 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20 40 60 80 100										
349.4								20 40 60 80 100										
10.2	SILT , trace clay, trace to some sand, occasional silty clay and sand seams Very Loose to Compact Grey Wet		9	SS	10		349											
							348											
			10	SS	14		347											
							346											
			11	SS	7		345								0 6 85 9			
							344											
			12	SS	3		343											
							342											
			13	SS	13		341								0 19 75 6			
							340											
340.4																		
19.2	Silty SAND , trace clay, occasional silty clay and sand seams Loose to Compact Grey Wet																	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-04

3 OF 4

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 482.1 E 372 042.6 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.05.01 - 2015.05.03 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W _P W W _L					
	Continued From Previous Page		15	SS	14											
							339									
							338									
							337									
			16	SS	11											
							336									
							335									
							334									
			17	SS	7											
							333									
332.6							332									
27.0	SAND , trace to some silt, trace clay, occasional silty clay seam Compact Grey Moist						331									
			18	SS	12											
							330									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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10
(%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-05

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 412.0 E 372 035.8 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.17 - 2015.07.17 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
359.2	GROUND SURFACE						<div><div>20406080100</div><div>SHEAR STRENGTH kPa</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div> <div><div>20406080100</div><div>WATER CONTENT (%)</div><div>W P W W L</div></div>						
0.0	ASPHALT:(125mm)												
0.1	SAND and GRAVEL, trace silt Very Dense to Dense Brown Moist (FILL)		1	SS	69								37 54 9 (SI+CL)
			2	SS	46								
357.9													
1.3	SAND and SILT, trace gravel, trace clay Loose to Compact Grey Moist (FILL)		3	SS	21								1 53 39 7
			4	SS	12								
			5	SS	7								
355.2													
4.0	PEAT, amorphous, trace sand, trace roots and rootlets Loose to Compact Dark Brown Moist		6	SS	10								
			7	SS	4								
351.9													
7.3	Silty CLAY, trace sand, occasional silt and sand seams Soft to Firm Grey Wet		8	SS	0							0 0 45 55	
			9	SS	5								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-05

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 412.0 E 372 035.8 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.07.17 - 2015.07.17 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
	Continued From Previous Page						20 40 60 80 100												
			10	SS	0														
							4.0 + 2.7 +												
			11	SS	0														
							4.0 + 4.0 +												
			12	SS	1														
344.9																			
14.3	SILT , some clay, trace sand Very Loose Grey Wet																		
							5.0 + 3.0 +												
			13	SS	1														
343.4																			
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 1.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.6m, CONCRETE TO 0.2m, ASPHALT TO SURFACE.																		

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

METRIC

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-06

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 500.0 E 372 044.7 ORIGINATED BY MNW
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.21 - 2015.04.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page																
	BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE HOLEPLUG TO 0.6m, CONCRETE TO SURFACE.																

RECORD OF BOREHOLE No MCB-07

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 528.9 E 372 054.3 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.07.17 - 2015.07.17 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL
359.7	GROUND SURFACE					▽	359												
0.0	ASPHALT:(100mm)																		
0.1	Sandy GRAVEL , trace silt Very Dense Brown Moist (FILL)		1	SS	76									○					52 43 5 (SI+CL)
			2	SS	45									○					
358.4														○					
1.3	SAND , some silt, trace gravel Dense Brown Moist (FILL)																		
358.0			3	SS	30									○					
1.7	Silty SAND , some clay Loose to Compact Grey Moist (FILL)													○					0 57 23 20
			4	SS	11														
			5	SS	9														
355.4																			
4.3	PEAT , amorphous, trace roots, trace sand Loose Dark Brown Wet		6	SS	5														
353.9																			
5.8	Silty CLAY , trace sand, occasional silt layer Soft to Firm Grey Wet		7	SS	4								○						
													○						
			8	SS	3								○				0 0 54 46		
			9	SS	4									○					

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-07

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 528.9 E 372 054.3 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.17 - 2015.07.17 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page						20 40 60 80 100				W P W W L				
349.5							47								
10.2	SILT , trace sand, trace clay Loose to Compact Grey Wet														
		10	SS	10											
		11	SS	5										0 3 91 6	
		12	SS	4											

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

RECORD OF BOREHOLE No MCB-08

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 559.2 E 372 053.3 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.15 - 2015.07.15 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
360.8	GROUND SURFACE							20 40 60 80 100					
0.0 0.1	ASPHALT: (75mm) Gravelly SAND , some silt, occasional asphalt fragments, occasional cobble Very Dense Dark Brown Moist (FILL)		1	SS	50/ 0.100								
359.5			2	SS	85/ 0.275		360						30 50 20 (SI+CL)
1.3	SAND , some silt, trace gravel, trace peat Compact Brown Moist (FILL)		3	SS	13		359						
358.8													
2.0	Silty CLAY , some sand, some gravel, trace peat in the upper 0.5m zone Stiff Grey Moist		4	SS	9		358						
			5	SS	4								12 11 35 42
							357						
356.2													
4.6	SILT , trace to some sand, trace clay Very Loose to Loose Grey Wet		6	SS	7		356						
			7	SS	6		355						
							354						
			8	SS	3		353						0 2 92 6
							352						
			9	SS	3								
							351						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-08

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 559.2 E 372 053.3 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.15 - 2015.07.15 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L				
								20 40 60 80 100	20 40 60							
	Continued From Previous Page															
	SILT , trace to some sand, trace clay Very Loose to Loose Grey Wet		10	SS	3		350						○			
							349									
				11	SS	1		348					○			
				12	SS	0		347					○			
								346								
				13	SS	7							○			
345.0							345									
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 1.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.2m, ASPHALT TO SURFACE.															

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RECORD OF BOREHOLE No MCB-09

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 375.5 E 372 021.0 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.19 - 2015.07.19 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
358.2	GROUND SURFACE							20 40 60 80 100		PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
0.0	PEAT , amorphous, trace roots Loose Dark Brown Wet		1	SS	3			20 40 60 80 100		WATER CONTENT (%)			
			2	SS	5								
355.7													
2.5	Silty CLAY , trace sand Stiff Grey Moist		3	SS	15								
354.3													
3.9	SILT , trace sand, some clay Loose to Compact Grey Wet		4	SS	23								
			5	SS	6								
			6	SS	8								
			7	SS	7								

Continued Next Page

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

RECORD OF BOREHOLE No MCB-09

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 375.5 E 372 021.0 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
DATUM Geodetic DATE 2015.07.19 - 2015.07.19 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
	Continued From Previous Page						20	40	60	80	100	20	40	60					
			8	SS	6									○					
			9	SS	5								○						
345.0																			
13.2	Silty CLAY , some sand Stiff Grey Wet																		
			10	SS	10								○			0 16 45 39			
343.5																			
14.7	SILT , trace sand, trace to some clay Very Loose Grey Wet																		
			11	SS	3									○					
342.4																			
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 0.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		

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

RECORD OF BOREHOLE No MCB-10

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 418.6 E 372 023.0 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.18 - 2015.07.18 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL				
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE													
357.6	GROUND SURFACE							20	40	60	80	100	20	40	60	kN/m ³						
0.0	PEAT , amorphous, trace roots and rootlets Very Loose Dark Brown Wet		1	SS	1																	
			2	SS	3																	
			3	SS	2																	
								2.5														
								2.2														
			4	SS	0																	
								2.0														
								2.7														
			5	SS	0																	
	Becoming fibrous with trace shell fragments, trace clay below 5.1m depth							2.0														
								2.0														
351.5																						
6.1	Silty CLAY , trace sand, occasional silt seams Soft Grey Wet		6	SS	0																	
										3.5												
										4.0												
					7	SS	1															
								3.0														
								3.0														
			8	SS	0																	

Continued Next Page

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

RECORD OF BOREHOLE No MCB-10

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 418.6 E 372 023.0 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
DATUM Geodetic DATE 2015.07.18 - 2015.07.18 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20 40 60 80 100										
341.1 <																		

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

RECORD OF BOREHOLE No MCB-11

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 453.5 E 372 026.3 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.19 - 2015.07.19 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL		
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE												
357.5	GROUND SURFACE							20	40	60	80	100	20	40	60						
0.0	PEAT , amorphous, some sand, trace gravel Loose Dark Brown Wet		1	SS	5																
			2	SS	1																
			3	SS	0																
	Trace shell fragments, trace rootlets below 3.6m depth																				
			4	SS	2																
351.4																					
6.1	Silty CLAY , trace sand, occasional silt seam Soft to Stiff Grey Wet		5	SS	0													0	0	60	40
			6	SS	0													0	0	42	58
			7	SS	0																

Continued Next Page

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

RECORD OF BOREHOLE No MCB-11

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 453.5 E 372 026.3 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.19 - 2015.07.19 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
	Continued From Previous Page							20 40 60 80 100				
	Silty CLAY , trace sand, occasional silt seam Soft to Stiff Grey Wet							○ UNCONFINED + FIELD VANE				GR SA SI CL
									● QUICK TRIAXIAL × LAB VANE			
									20 40 60 80 100			
									PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
									W P W W L			
									WATER CONTENT (%)			
									20 40 60			
			8	SS	1							
			9	SS	1							
			10	SS	0							
			11	SS	2							
341.0												
16.5	END OF BOREHOLE AT 16.5m. WATER LEVEL AT SURFACE UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.											




ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

RECORD OF BOREHOLE No MCB-12

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 370.4 E 372 046.9 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.20 - 2015.07.20 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
358.6	GROUND SURFACE												
0.0	PEAT , amorphous, trace roots Very Loose Dark Brown Wet		1	SS	2		358	2.5 + 2.5 +				156 ○	
357.0							357						
1.6	Silty CLAY , trace sand Firm to Very Stiff Grey Wet to Moist		2	SS	5		356	7.0 +				○	
							355					○	0 6 54 40
354.5			3	SS	25								
4.1	SILT , trace to some sand, some clay Very Loose to Compact Grey Wet to Moist		4	SS	10		354					○	
							353						
			5	SS	7		352					○	
							351						
			6	SS	11		350					○	
							349					○	0 2 88 10

Continued Next Page

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

RECORD OF BOREHOLE No MCB-12

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 370.4 E 372 046.9 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
DATUM Geodetic DATE 2015.07.20 - 2015.07.20 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									20 40 60		
	Continued From Previous Page																		
			8	SS	15		348						○						
							347												
			9	SS	9		346						○						
			10	SS	14		345						○						
							344												
			11	SS	3		343						○			0 13 69 18			
342.8																			
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 0.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

RECORD OF BOREHOLE No MCB-13

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 405.6 E 372 049.0 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.20 - 2015.07.20 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
358.2	GROUND SURFACE						20 40 60 80 100	20 40 60 80 100	20 40 60						
0.0	PEAT , amorphous. trace roots, trace sand Very Loose Dark Brown Wet		1	SS	1										
			2	SS	1										
			3	SS	1										
353.9	Silty CLAY , trace sand Soft to Firm Grey Wet		4	SS	13										
4.3															
			5	SS	2										
			6	SS	0										
			7	SS	0										

Continued Next Page

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

RECORD OF BOREHOLE No MCB-13

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 405.6 E 372 049.0 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.20 - 2015.07.20 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L								
	Continued From Previous Page							20	40	60	80	100		20	40	60				
348.0							348													
10.2	SILT , trace to some sand, some clay to clayey, trace gravel Very Loose to Loose Grey Wet		8	SS	2		347							○						
							346							○					0 10 66 24	
			9	SS	9		345													
			10	SS	6		344							○					7 13 61 19	
							343							○						
342.4			11	SS	9									○						
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 0.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity



20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MCB-14

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 444.9 E 372 055.8 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.21 - 2015.07.21 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
357.7	GROUND SURFACE																	
0.0	PEAT, amorphous, trace to some rootlets Very Loose Dark Brown Wet		1	SS	0													
351.6	Silty CLAY, trace sand, occasional silt seam Soft to Stiff Grey Wet		5	SS	0													
6.1																		

Continued Next Page

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

METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER • CONDITIONS	ELEVATION SCALE
	Continued From Previous Page		NUMBER TYPE "N" VALUES		DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%)
344.4			8 SS 0		347
13.3	SILT, trace sand, some clay, occasional clayey silt seam Compact Grey Wet		9 SS 13		346
			10 SS 24		344
			11 SS 25		343
341.9	END OF BOREHOLE AT 15.8m. WATER LEVEL AT SURFACE UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.				342
15.8					

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-15

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 491.4 E 372 030.5 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.22 - 2015.07.22 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL	
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	W _P W W _L										
357.4	GROUND SURFACE							20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE											
0.0	PEAT, trace sand, trace gravel Very Loose Dark Brown Wet		1	SS	1		357													
			2	SS	0		356	3.0 +												
			3	SS	0	355	2.3 +													

Continued Next Page

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

RECORD OF BOREHOLE No MCB-15

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 491.4 E 372 030.5 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.22 - 2015.07.22 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
	Continued From Previous Page												
345.2													
12.2	SILT , trace sand, trace clay Loose to Compact Grey Wet		7	SS	0								0 0 57 43

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-16

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 525.6 E 372 039.8 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
DATUM Geodetic DATE 2015.07.23 - 2015.07.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L						
	Continued From Previous Page							20	40	60	80	100						
342.5 15.8							348											
			8	SS	16													
			9	SS	12													0 0 92 8
			10	SS	17													
							343									0 4 89 7		
	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																	

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

RECORD OF BOREHOLE No MCB-17

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 570.3 E 372 044.7 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.23 - 2015.07.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
359.8	GROUND SURFACE											
0.0	PEAT, amorphous, trace to some rootlets Very Loose Dark Brown Wet		1	SS	2		359	2.0				
358.7												
1.1	Silty CLAY, trace sand Very Stiff Brown Moist		2	SS	17		358					0 0 76 24
			3	SS	18		357					
356.8												
3.0	SILT, trace sand, trace clay Loose to Compact Grey Wet		4	SS	24		356					
			5	SS	16		355					
							354					
			6	SS	21		353					0 3 89 8
			7	SS	5		352					
							351					
			8	SS	13							
							350					

Continued Next Page

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

RECORD OF BOREHOLE No MCB-17

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 570.3 E 372 044.7 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.23 - 2015.07.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L				
								20 40 60 80 100	20 40 60							
	Continued From Previous Page															
	Becoming sand and silt between 12.0mm and 13.5m depth		9	SS	17		349						○		0 36 61 3	
							348									
							347									
				10	SS	15		346					○			
							345									
				11	SS	18							○			
							344						○		0 11 83 6	
344.0																
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 0.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.															

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RECORD OF BOREHOLE No MCB-18

1 OF 1

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 488.7 E 372 053.5 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Probe with Vane COMPILED BY AN
 DATUM Geodetic DATE 2015.07.23 - 2015.07.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w _p w w _L				
								20	40	60	80	100	20	40	60		
357.0	GROUND SURFACE																
0.0	SAND , some peat, trace gravel Dark Brown/Grey Wet (FILL)		1	GS											○		
355.9			2	GS											○		
1.1	END OF BOREHOLE AT 1.1m.																

RECORD OF BOREHOLE No MCB-19

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 532.0 E 372 070.2 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.21 - 2015.07.21 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE										
357.7	GROUND SURFACE							20	40	60	80	100	20	40	60				
0.0	PEAT , amorphous, trace to some rootlets Very Loose Dark Brown Wet		1	SS	0			2.6											
								2.5											
			2	SS	0														
								2.3											
								2.0											
			3	SS	0														
								2.5											
								2.0											
353.4																			
4.3	Silty CLAY , some sand, becoming sandy Soft to Stiff Grey Moist		4	SS	3														
								5.0											
								4.7											
			5	SS	11														
350.5																			
7.2	Silty CLAY , trace sand Soft to Firm Grey Wet		6	SS	0														
								5.0											
								6.0											
	Occasional silt seam		7	SS	0														

Continued Next Page

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

RECORD OF BOREHOLE No MCB-19

2 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 532.0 E 372 070.2 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.07.21 - 2015.07.21 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page							20	40	60	80	100			
347.0							347								
10.7	SILT , trace sand, trace clay, occasional silty clay seam Compact Grey Wet		8	SS	15										
							346								
			9	SS	5										
							345								
							344								
343.4	Silty clay seam at 14.0m depth		10	SS	10										0 0 67 33
14.3	END OF BOREHOLE AT 14.3m. WATER LEVEL AT 0.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.														

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

RECORD OF BOREHOLE No MCB-20

1 OF 2

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 567.2 E 372 071.3 ORIGINATED BY ES
HWY 72 BOREHOLE TYPE Tripod/DCPT COMPILED BY AN
DATUM Geodetic DATE 2015.07.22 - 2015.07.22 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL			
								20	40	60	80	100	w _P		w	w _L					
358.1	GROUND SURFACE																				
0.0	PEAT , amorphous Very Loose Dark Brown Wet		1	SS	1		358														
357.0								2.7													
1.1	Silty CLAY , some sand, trace peat Soft to Firm Dark Brown/Grey Moist		2	SS	5		357	6.0													
							356														
								3.1													
355.4																					
2.7	SILT , trace to some sand, trace to some clay Very Loose to Compact Grey Wet		3	SS	18		355										0	3	81	16	
							354														
			4	SS	15		353														
							352											0	7	86	7
			5	SS	6																
							351														
			6	SS	1		350														
							349														
			7	SS	6													0	18	77	5

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MCB-21

1 OF 1

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 558.7 E 372 057.8 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.17 - 2015.07.17 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
360.8	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT:(100mm)							20	40	60	80	100								
0.1	SAND and GRAVEL, trace to some silt, occasional cobble Compact to Very Dense Brown Moist (FILL)		1	SS	53												42 50 8 (SI+CL)			
			2	SS	36															
			3	SS	28															
358.5																				
2.3	Silty SAND, trace gravel, trace clay Loose Dark Brown		4	SS	6												7 69 24 (SI+CL)			
358.0	Wet (FILL)																			
2.8	100mm peat layer at 2.7m depth																			
	Silty CLAY, trace to some sand Stiff Dark Grey to Grey Moist		5	SS	6															
356.5																				
4.3	END OF BOREHOLE AT 4.3m. WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, ASPHALT TO SURFACE.																			

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

RECORD OF BOREHOLE No MCB-22

1 OF 1

METRIC

WP# 473-00-01 LOCATION Moose Creek Bridge N 5 542 451.8 E 372 040.5 ORIGINATED BY ES
 HWY 72 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.07.23 - 2015.07.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) w _p w w _L				
359.2 0.0	GROUND SURFACE						359										
	Unsampled borehole advanced to collect shelly tube sample						358										
							357										
							356										
							355										
							354										
			1	SS	TW		353										Oedometer Test
352.5 6.7	END OF BOREHOLE AT 6.7m.																

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 11/6/15

Summary of Subsurface Conditions in Probeholes

Probehole Number	Subsurface Conditions
P1	0 - 3.8 m Peat 3.8 - 4.0 m Silty Clay
P2	0 - 5.0 m Peat 5.0 - 5.2 m Silty Clay
P3	0 - 4.9 m Peat 4.9 - 5.5 m Peat with trace of shell fragments
P4	0 - 150 mm Topsoil 150 - 450 Sand Fill
P5	0 - 3.5 m Peat 3.5 - 4.3 m Peat with trace of shell fragments 4.3 - 4.6 m Silty Clay
P6	0 - 2.6 m Peat 2.6 - 2.9 m Peat with trace of shell fragments 2.9 - 3.0 m Silty Clay

Note: Probehole locations are shown on the Borehole Location and Soil Strata drawing in Appendix D.

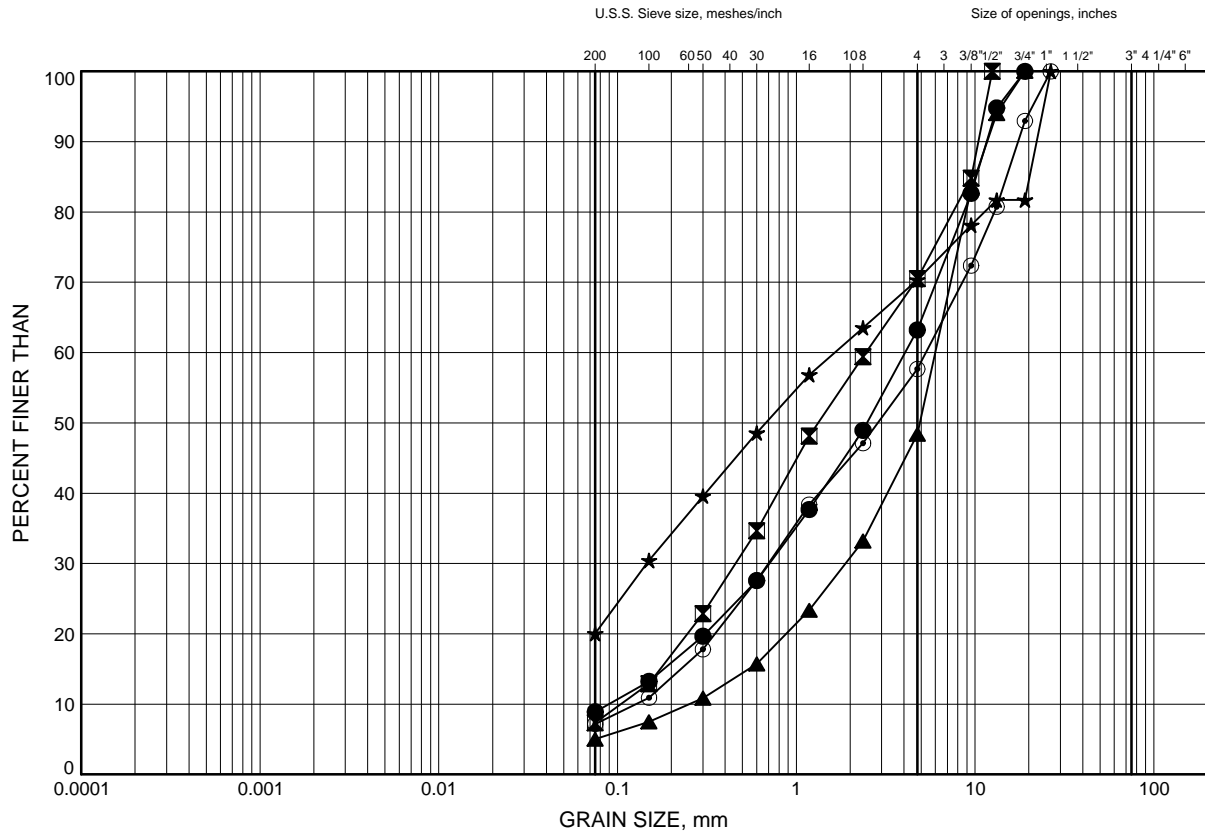
Appendix B

Laboratory Test Results

Moose Creek Bridge GRAIN SIZE DISTRIBUTION

FIGURE B1

GRAVELLY SAND to SANDY GRAVEL (FILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-05	0.35	358.85
⊠	MCB-06	0.38	359.32
▲	MCB-07	0.33	359.37
★	MCB-08	0.98	359.82
⊙	MCB-21	0.41	360.39

Date August 2015
WP# 473-00-01



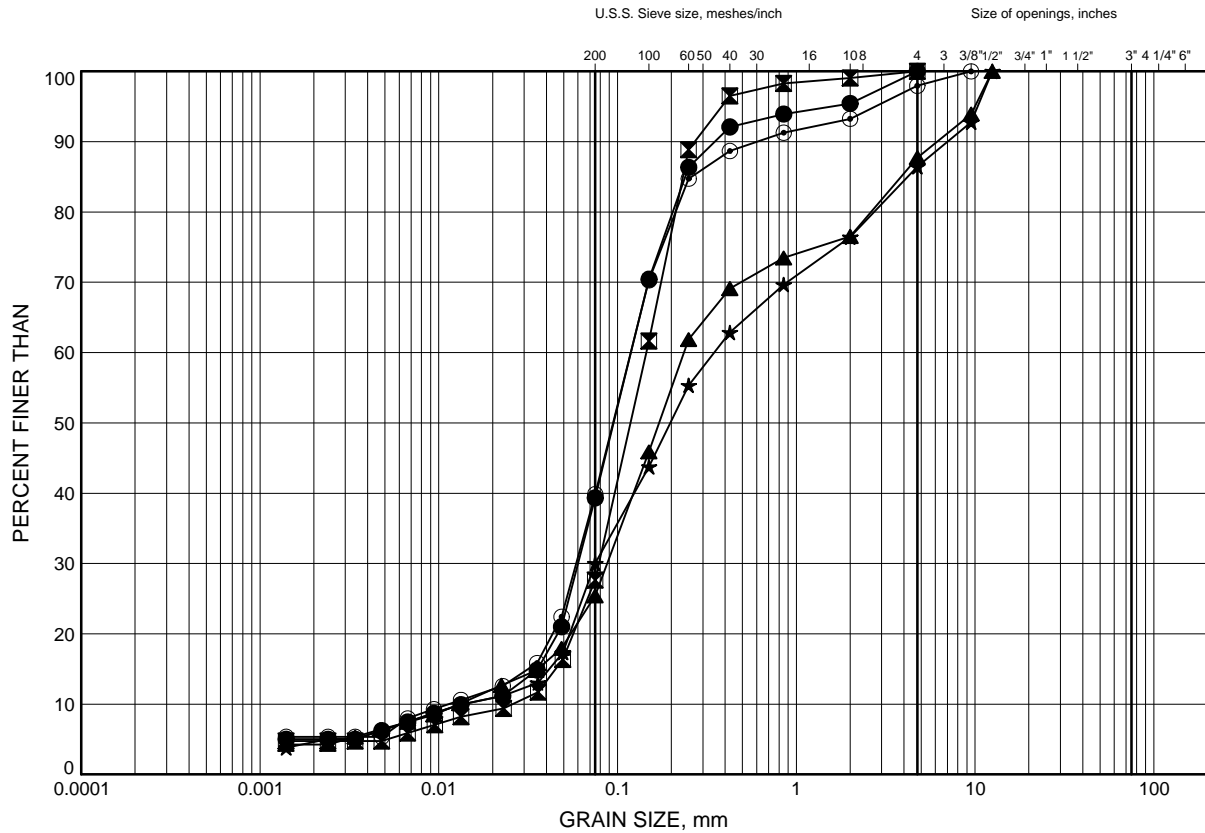
Prep'd AN
Chkd. AMP

Moose Creek 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)
●	MCB-01	1.83	357.57
⊠	MCB-01	6.40	353.00
▲	MCB-02	1.07	358.73
★	MCB-03	1.83	357.67
⊙	MCB-04	1.07	358.53

Date August 2015
 WP# 473-00-01

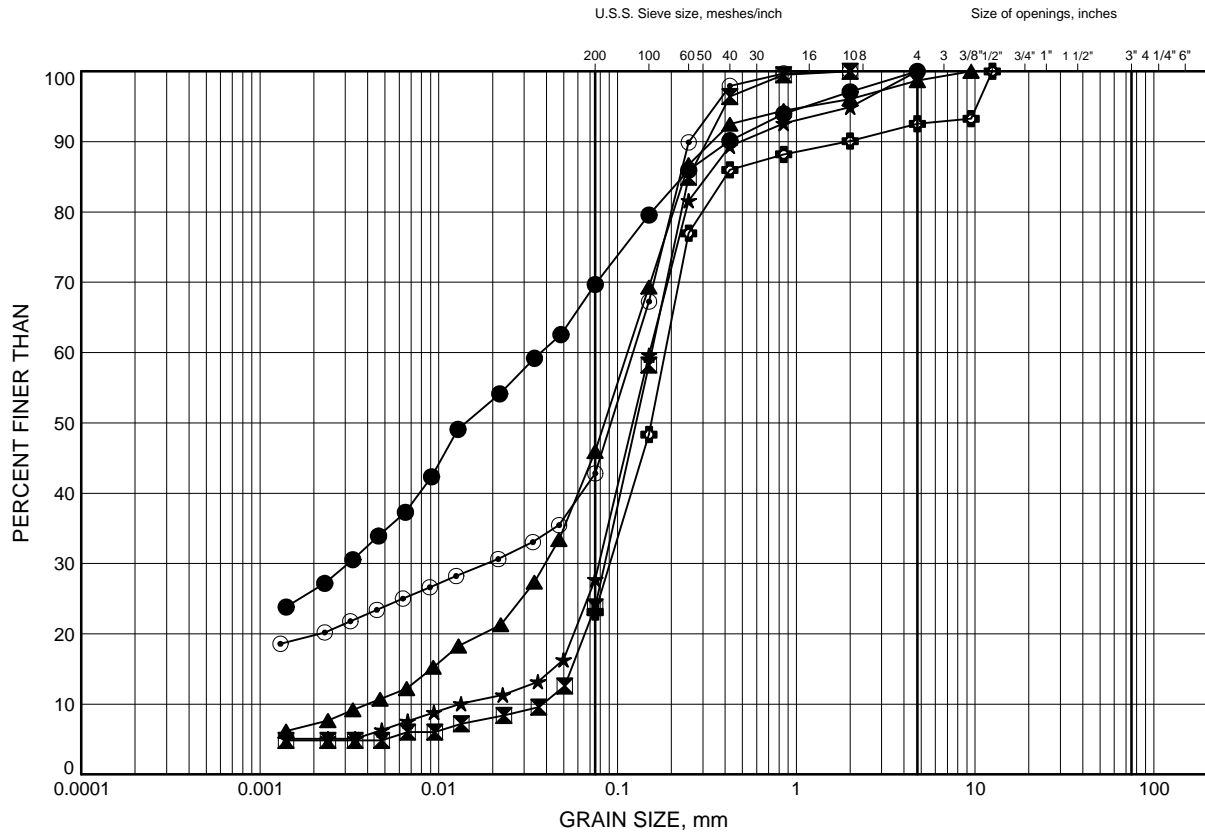


Prep'd AN
 Chkd. AMP

Moose Creek Bridge GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY SAND TO CLAYEY SILT (FILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-03	3.35	356.15
⊠	MCB-04	3.35	356.25
▲	MCB-05	1.83	357.37
★	MCB-06	1.83	357.87
⊙	MCB-07	2.59	357.11
⊕	MCB-21	2.59	358.21

Date November 2015

WP# 473-00-01



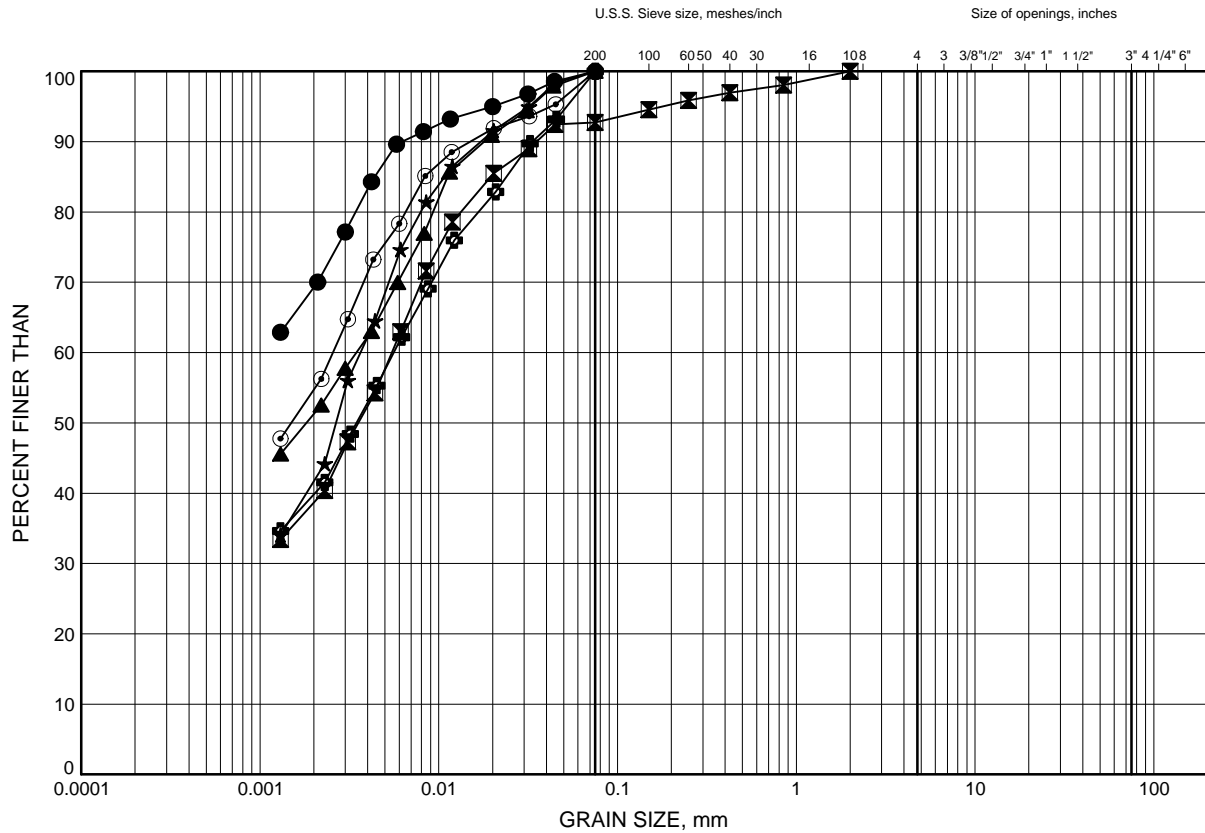
Prep'd AN

Chkd. AMP

Moose Creek Bridge GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-01	9.45	349.95
⊠	MCB-03	9.45	350.05
▲	MCB-03	10.97	348.53
★	MCB-04	9.45	350.15
⊙	MCB-05	7.92	351.28
⊕	MCB-05	14.02	345.18

Date November 2015

WP# 473-00-01



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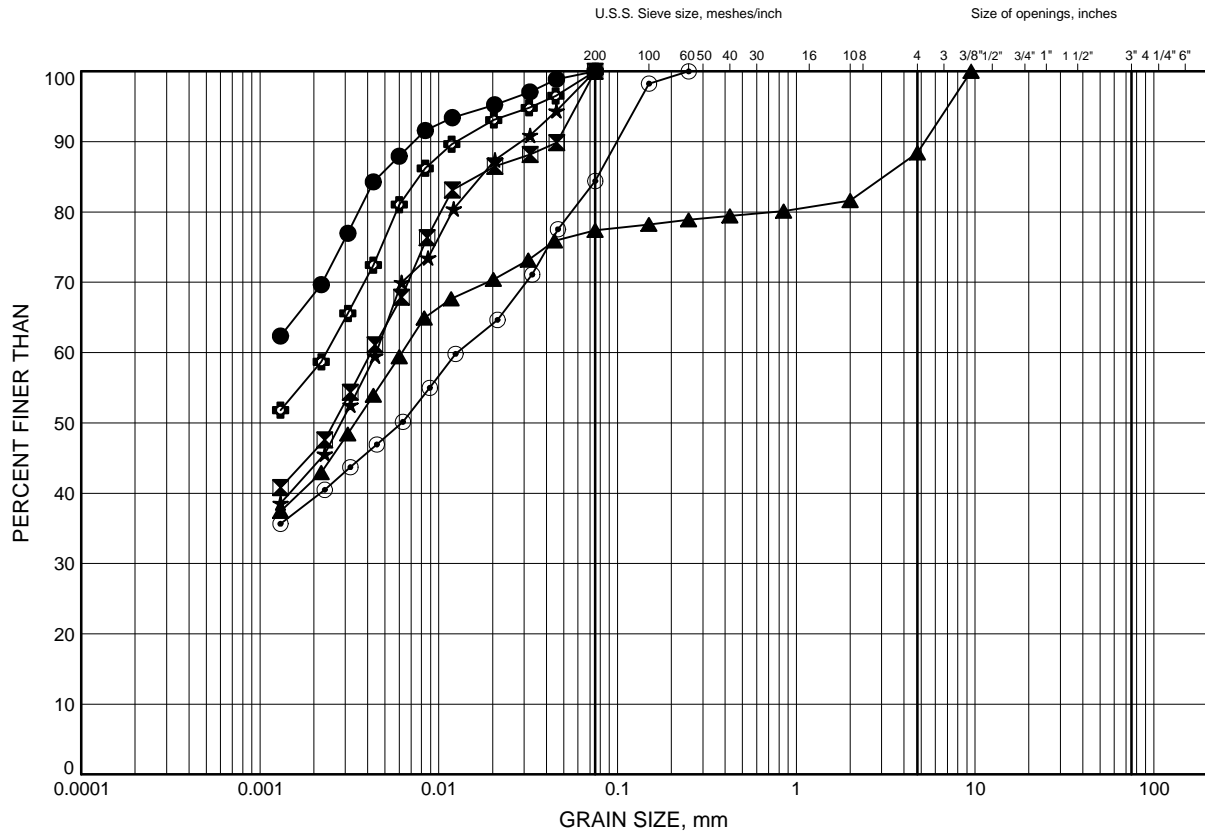
Chkd. AMP

Moose Creek 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)
●	MCB-06	9.45	350.25
⊠	MCB-07	7.92	351.78
▲	MCB-08	3.35	357.45
★	MCB-09	3.35	354.85
⊙	MCB-09	14.02	344.18
⊕	MCB-10	6.40	351.20

Date November 2015

WP# 473-00-01



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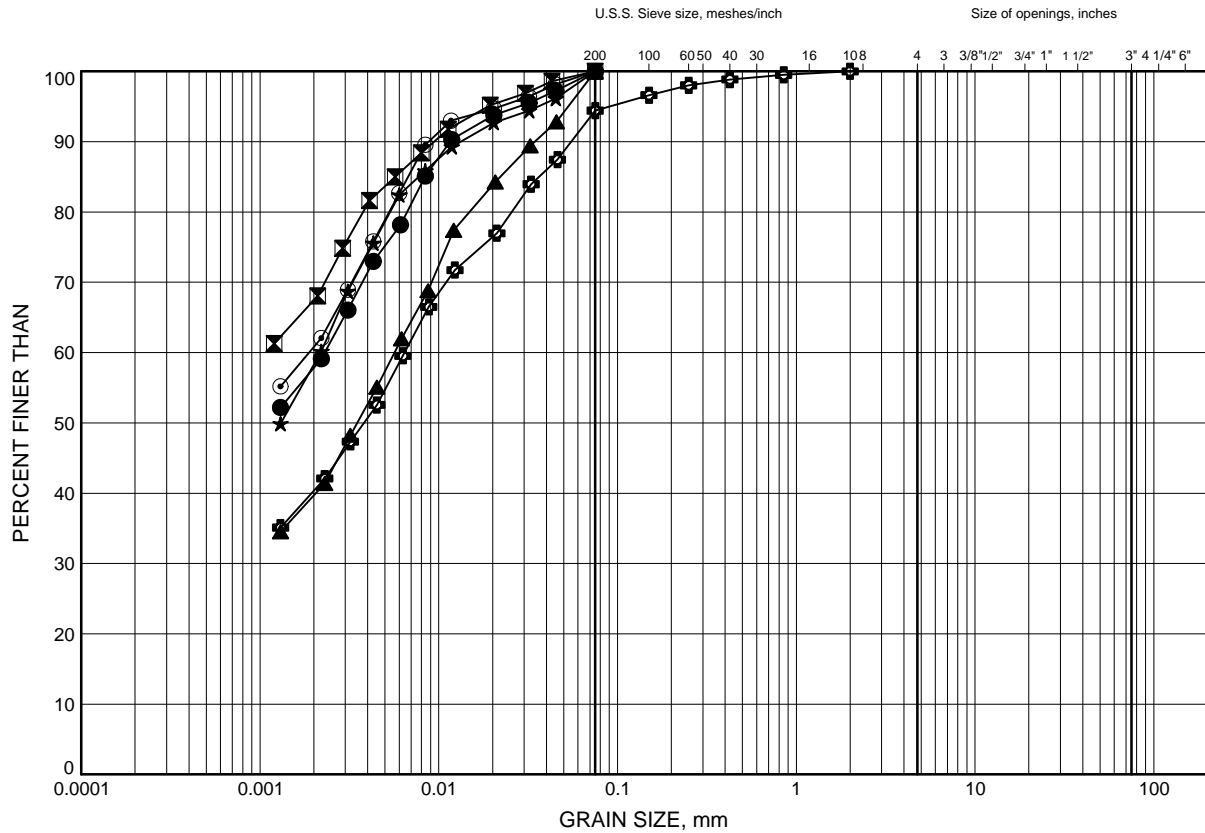
Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B6

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-10	10.97	346.63
⊠	MCB-10	14.02	343.58
▲	MCB-11	6.40	351.10
★	MCB-11	7.92	349.58
⊙	MCB-11	15.54	341.96
⊕	MCB-12	3.35	355.25

Date November 2015

WP# 473-00-01



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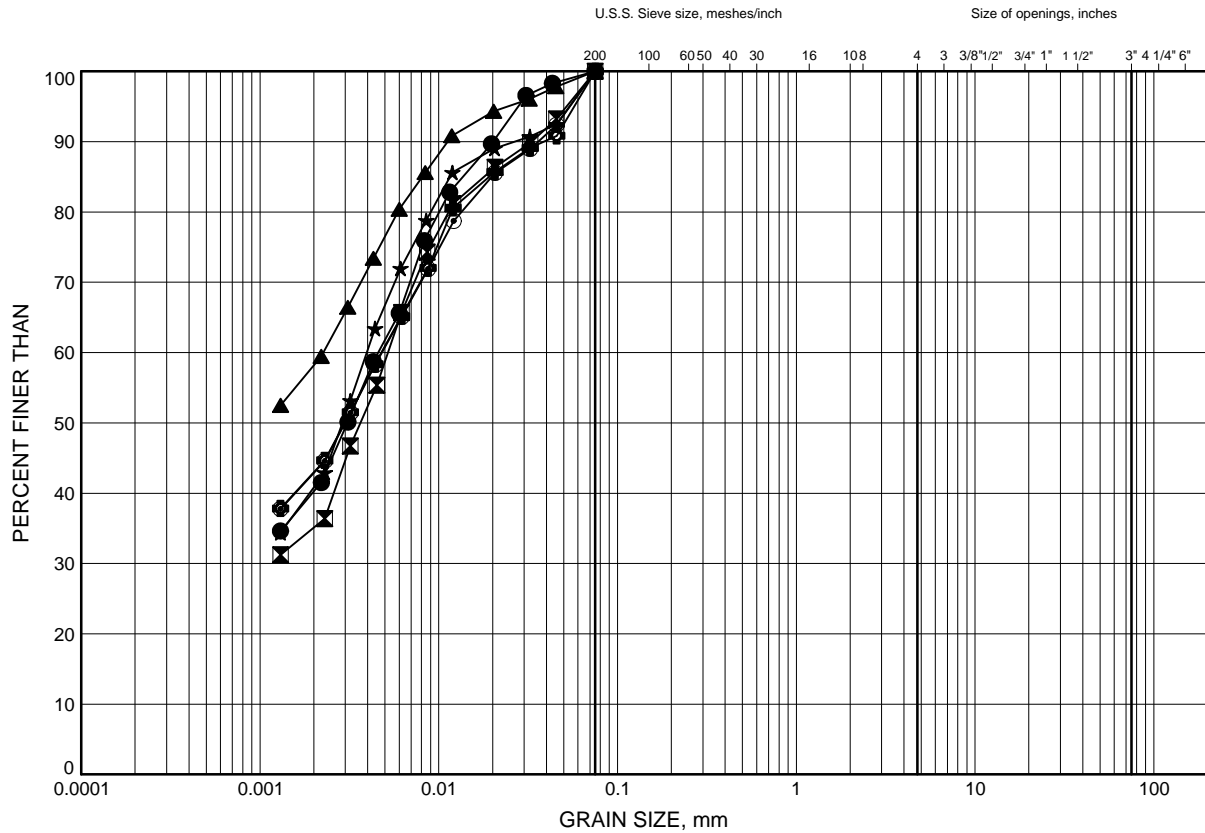
Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B7

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-13	4.88	353.32
⊠	MCB-13	7.92	350.28
▲	MCB-14	7.92	349.78
★	MCB-14	10.97	346.73
⊙	MCB-15	4.88	352.52
⊕	MCB-15	10.97	346.43

Date November 2015

WP# 473-00-01



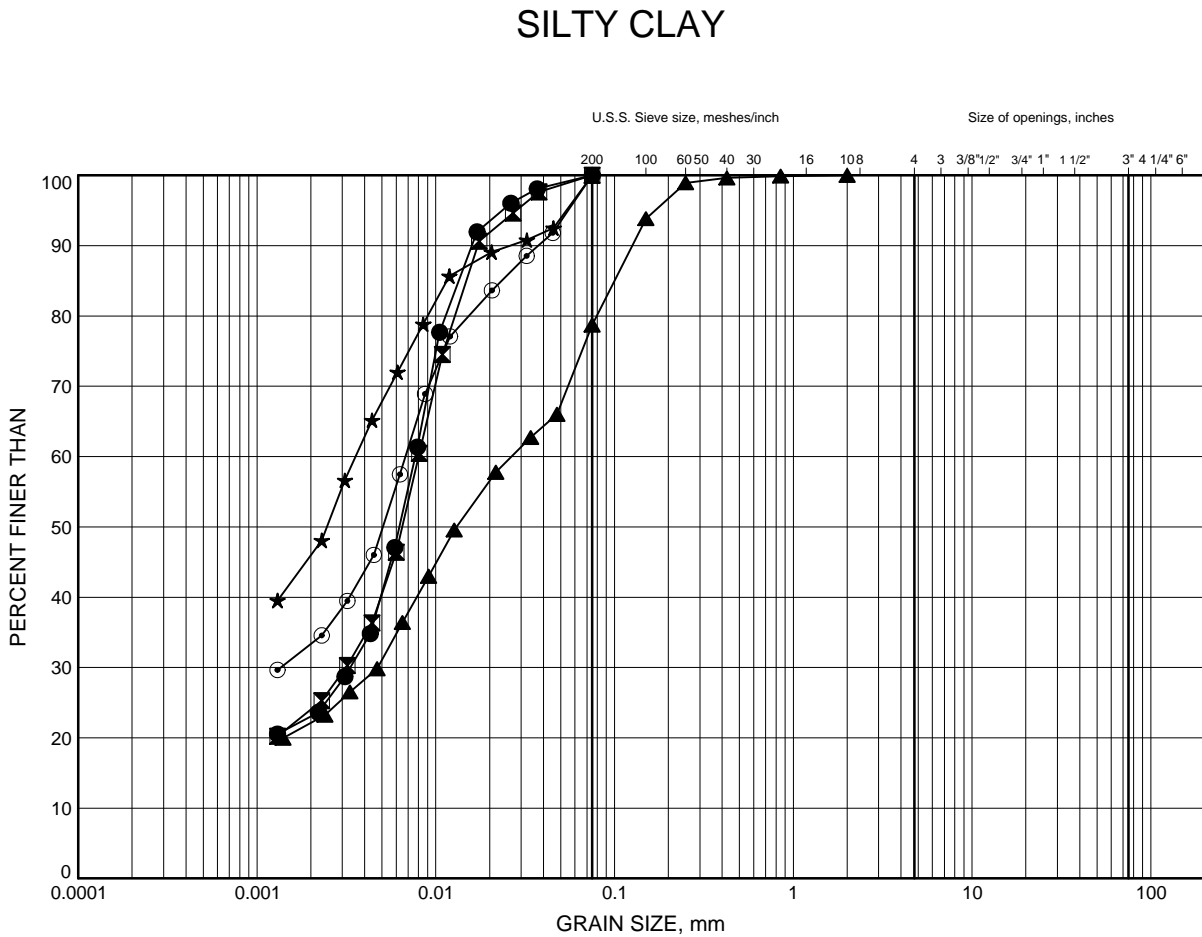
Prep'd AN

Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B8



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-16	6.40	351.90
⊠	MCB-17	1.83	357.97
▲	MCB-19	4.88	352.82
★	MCB-19	7.92	349.78
⊙	MCB-19	14.02	343.68

Date November 2015

WP# 473-00-01



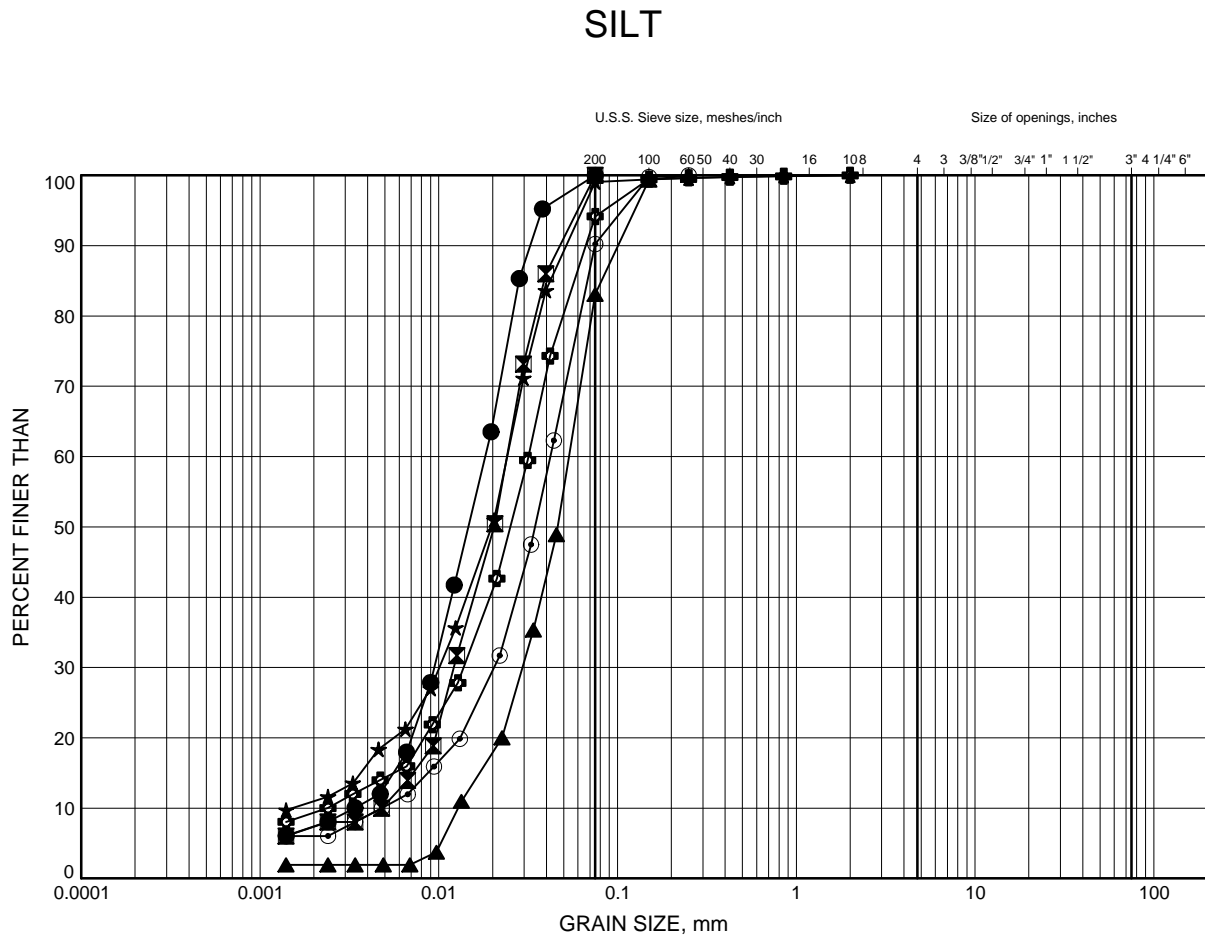
Prep'd AN

Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B9



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-02	6.40	353.40
⊠	MCB-02	10.97	348.83
▲	MCB-02	15.54	344.26
★	MCB-03	14.02	345.48
⊙	MCB-03	20.12	339.38
⊕	MCB-04	14.02	345.58

Date August 2015
WP# 473-00-01

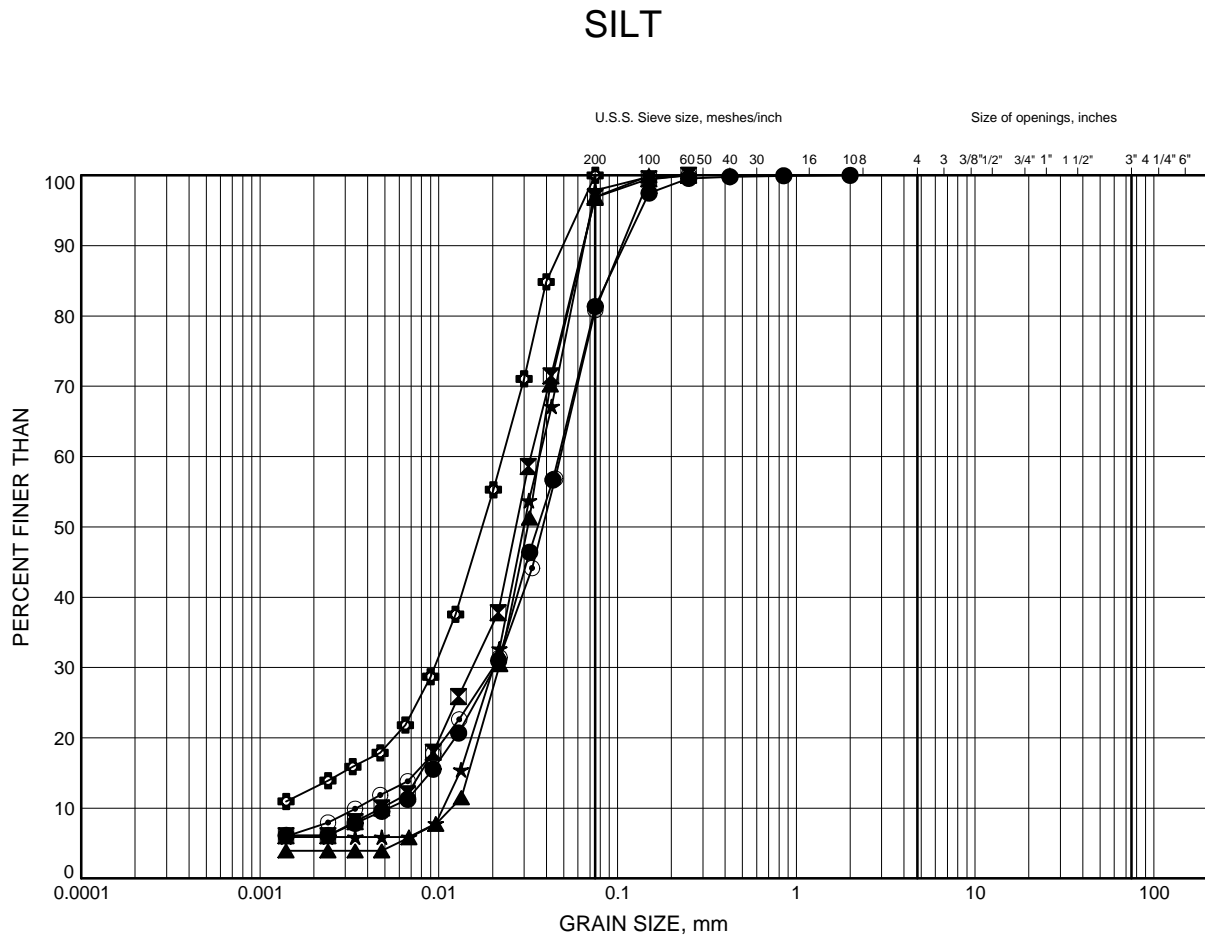


Prep'd AN
Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B10



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-04	18.59	341.01
⊠	MCB-07	12.50	347.20
▲	MCB-07	15.54	344.16
★	MCB-08	7.92	352.88
⊙	MCB-08	12.50	348.30
⊕	MCB-09	7.92	350.28

Date August 2015
 WP# 473-00-01

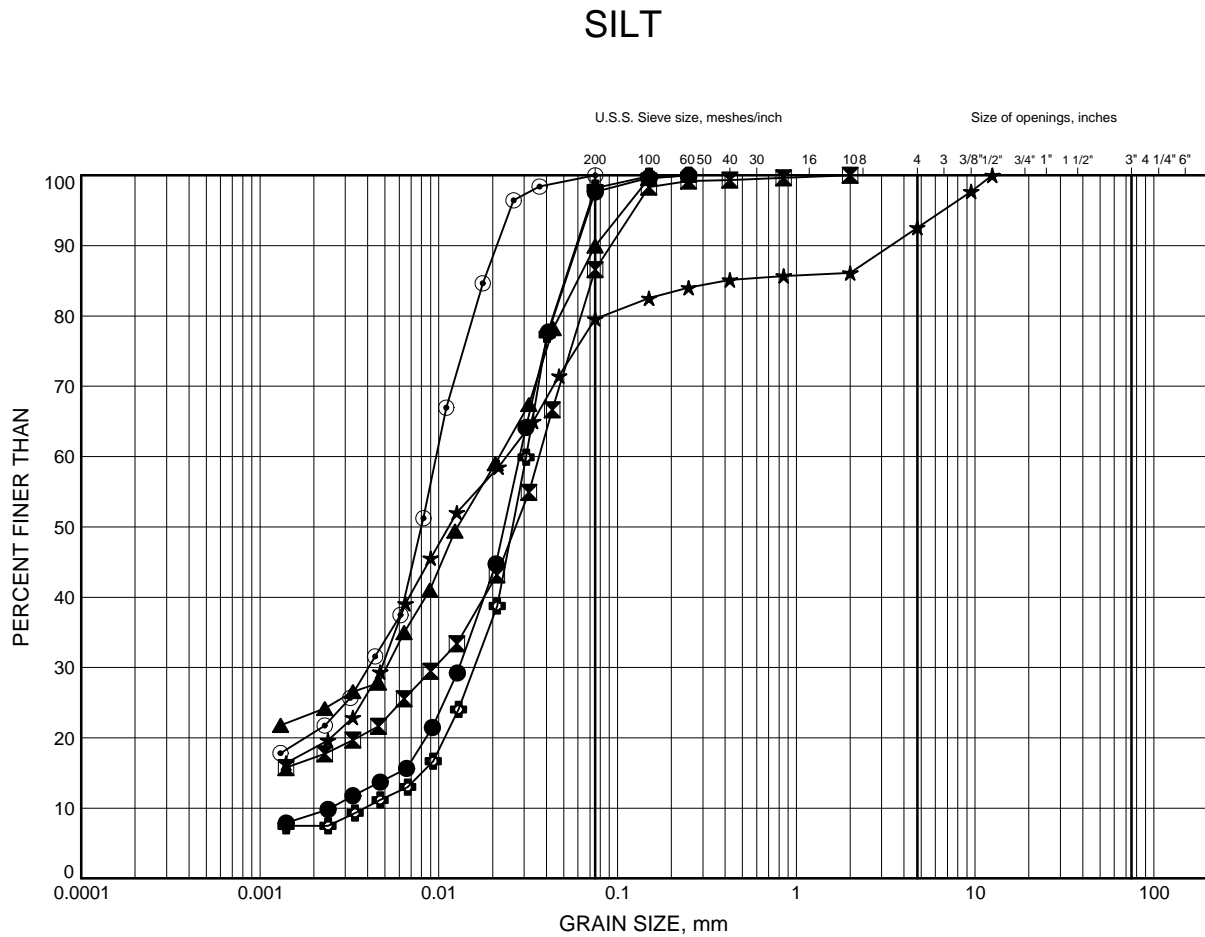


Prep'd AN
 Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B11



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-12	9.45	349.15
⊠	MCB-12	15.54	343.06
▲	MCB-13	12.50	345.70
★	MCB-13	14.02	344.18
⊙	MCB-14	15.54	342.16
⊕	MCB-15	15.54	341.86

Date November 2015

WP# 473-00-01

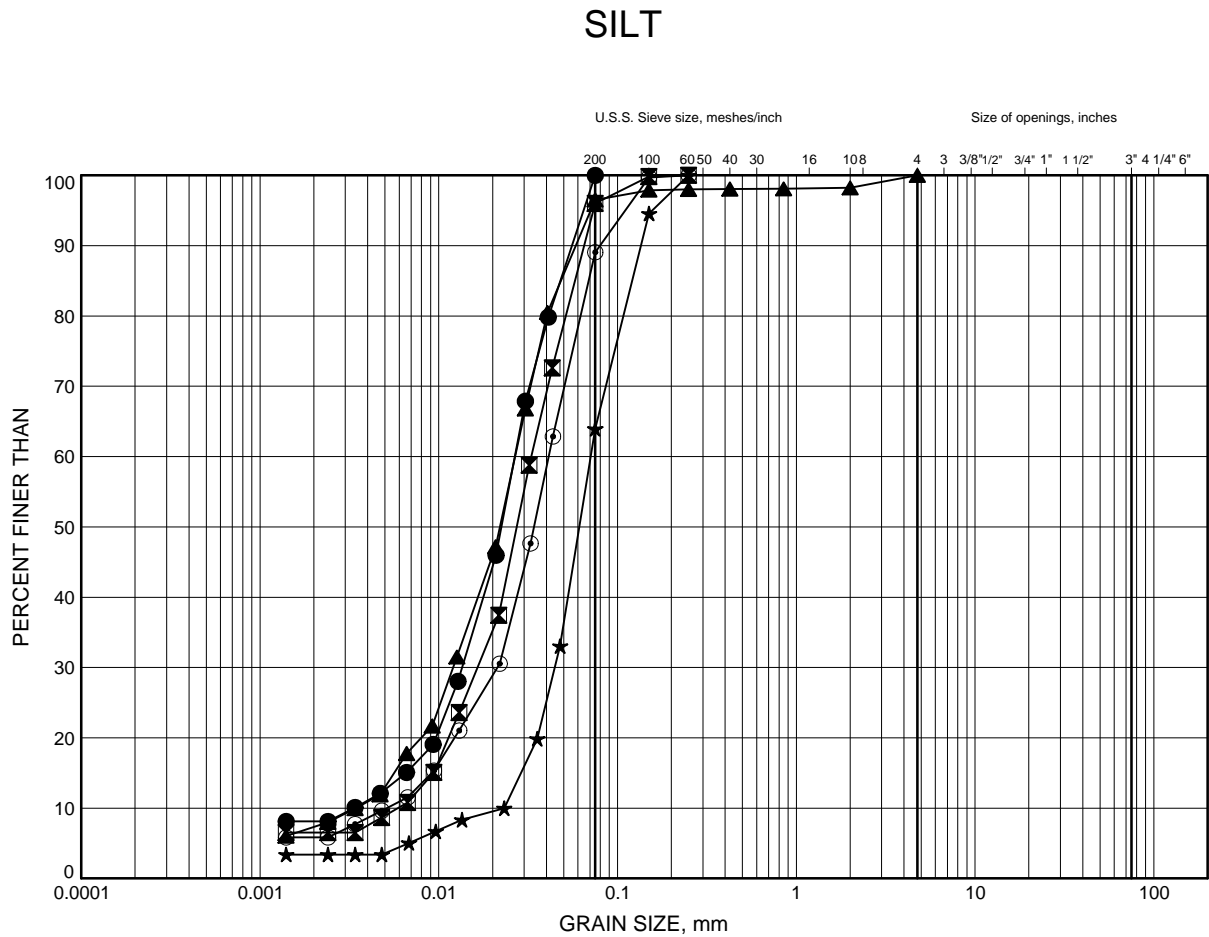


Prep'd AN

Chkd. AMP

Moose Creek Bridge GRAIN SIZE DISTRIBUTION

FIGURE B12



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-16	12.50	345.80
⊠	MCB-16	15.54	342.76
▲	MCB-17	6.40	353.40
★	MCB-17	12.50	347.30
⊙	MCB-17	15.54	344.26

Date August 2015
WP# 473-00-01

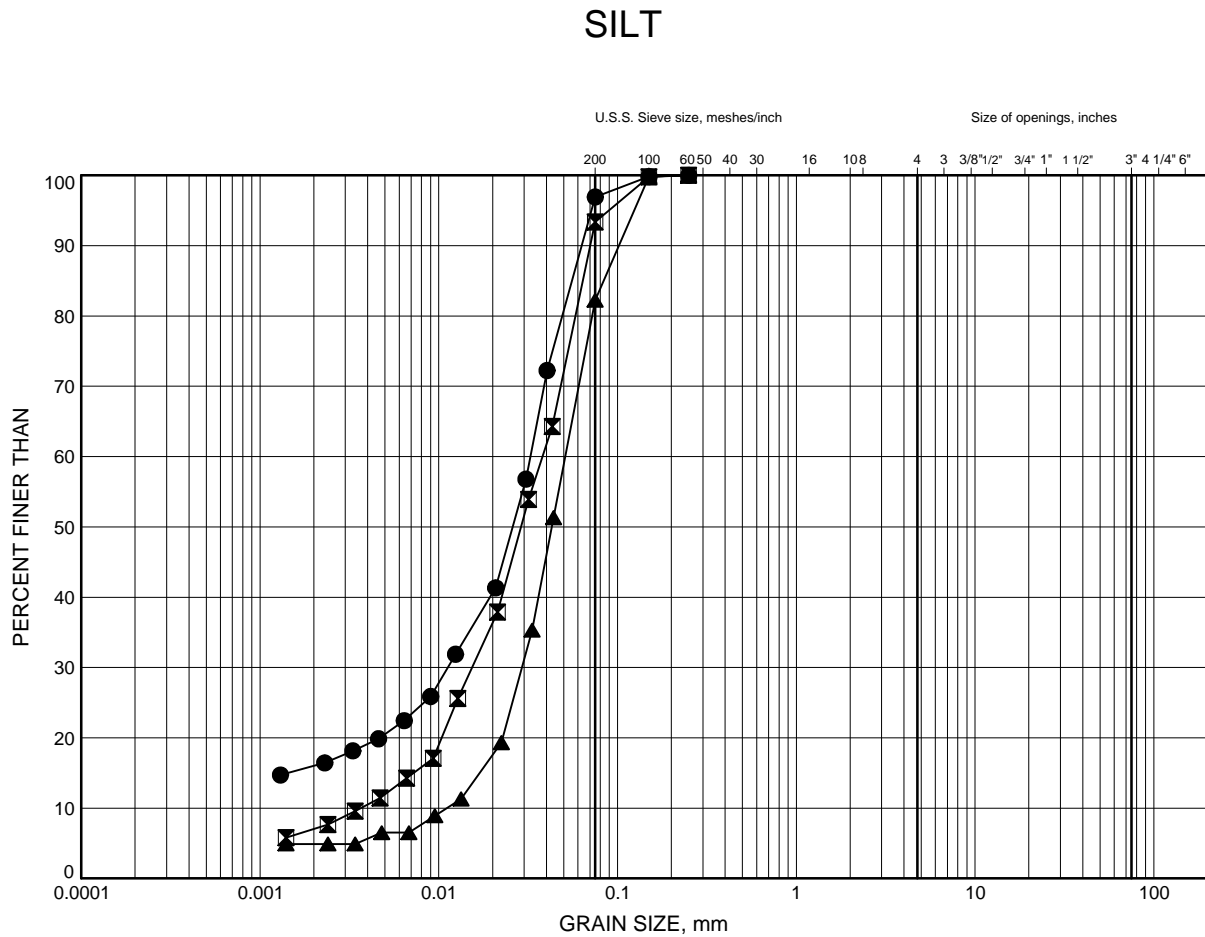


Prep'd AN
Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B13



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-20	3.35	354.75
⊠	MCB-20	6.40	351.70
▲	MCB-20	9.45	348.65

Date August 2015
 WP# 473-00-01

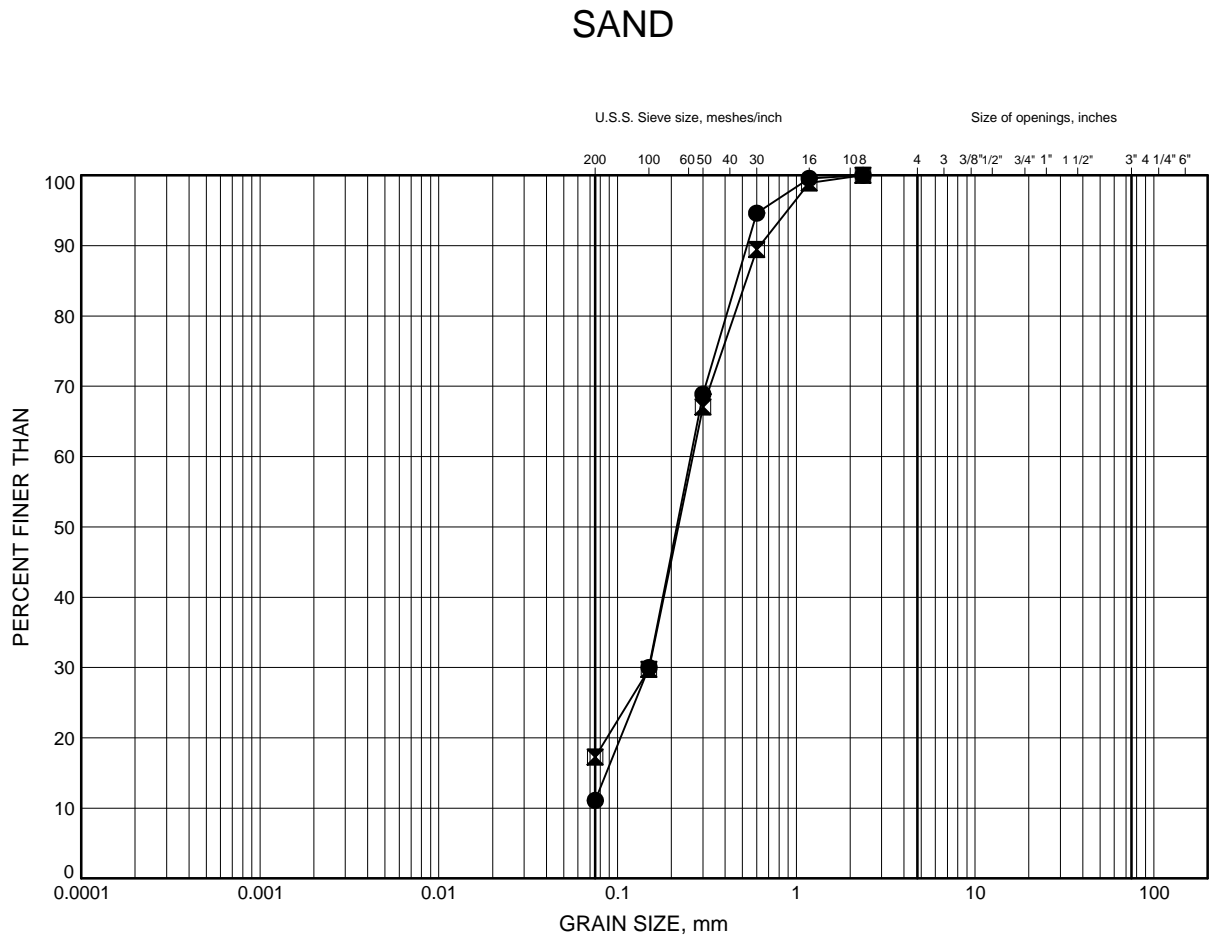


Prep'd AN
 Chkd. AMP

Moose Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B14



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-03	38.40	321.10
⊠	MCB-04	32.00	327.60

Date August 2015
 WP# 473-00-01

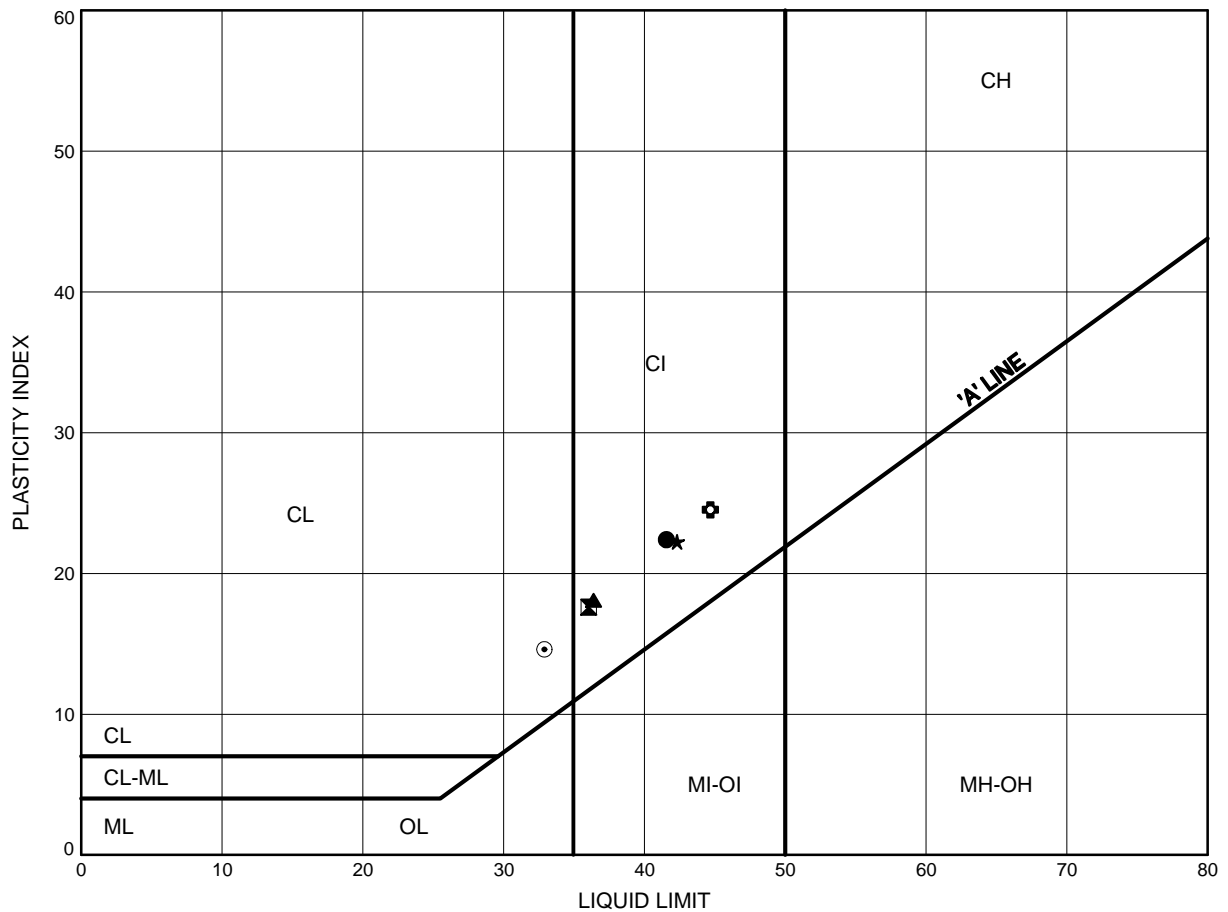


Prep'd AN
 Chkd. AMP

Moose Creek Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B15

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-01	9.45	349.95
⊠	MCB-03	10.97	348.53
▲	MCB-05	7.92	351.28
★	MCB-06	9.45	350.25
⊙	MCB-07	7.92	351.78
⊕	MCB-08	3.35	357.45

Date August 2015
 WP# 473-00-01

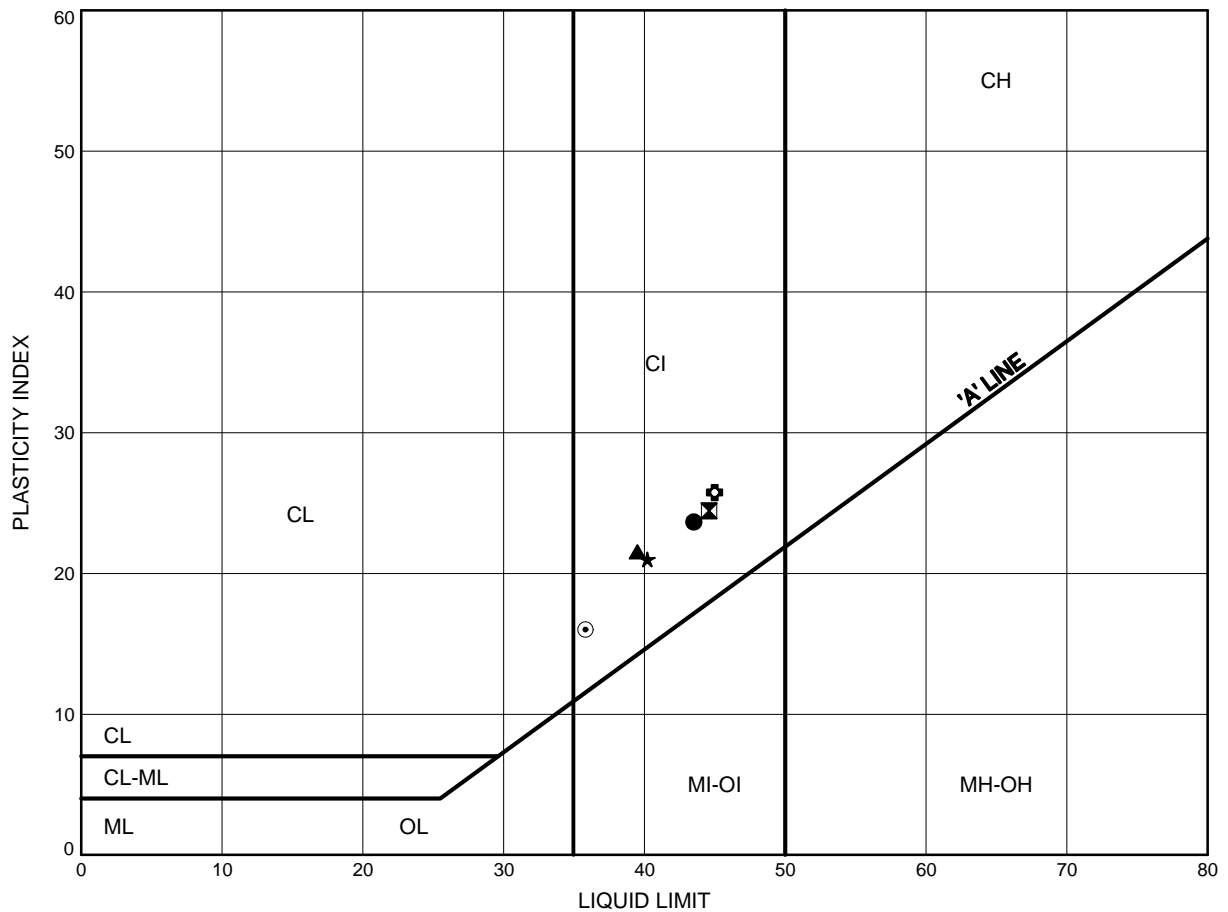


Prep'd AN
 Chkd. AMP

Moose Creek Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B16

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-10	10.97	346.63
⊠	MCB-10	14.02	343.58
▲	MCB-11	7.92	349.58
★	MCB-11	15.54	341.96
⊙	MCB-13	4.88	353.32
⊕	MCB-14	7.92	349.78

Date August 2015
 WP# 473-00-01

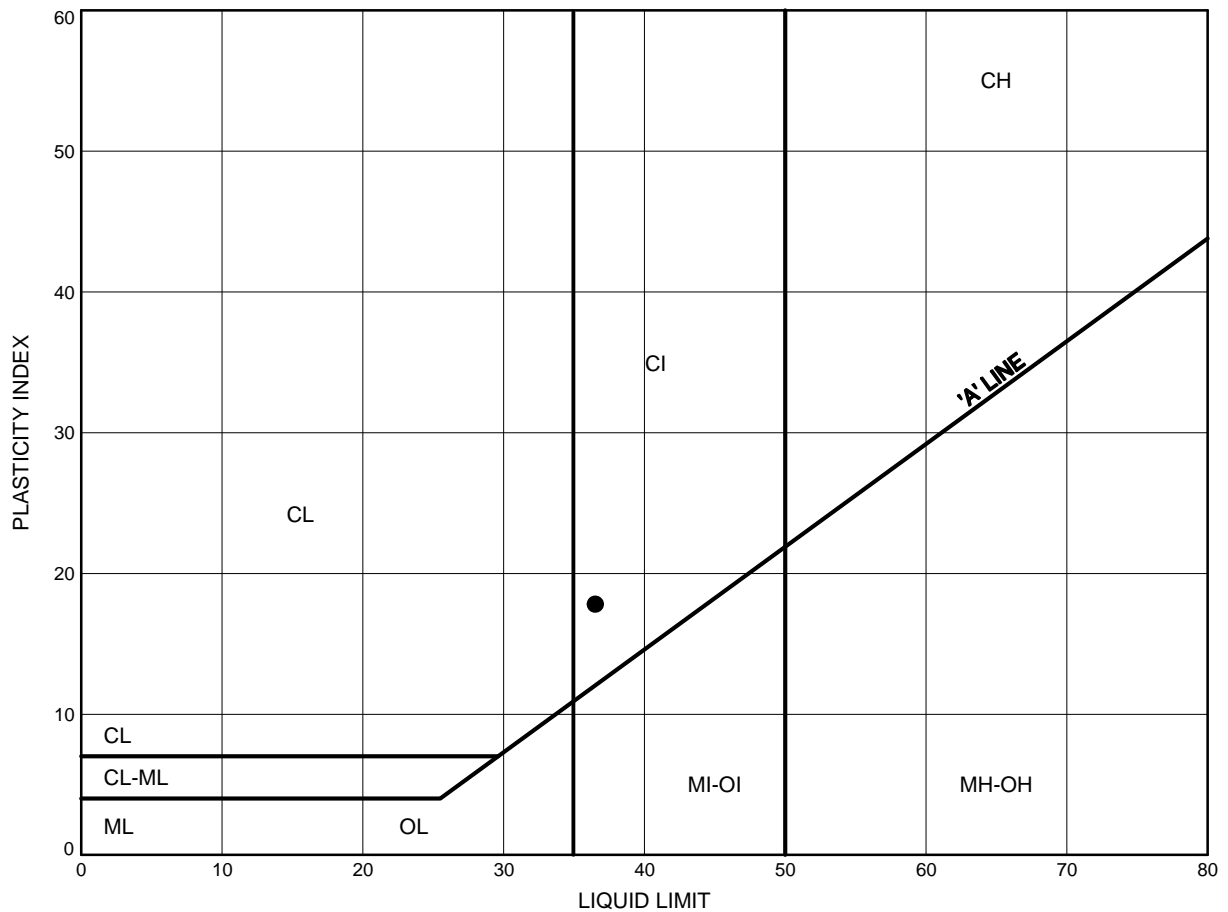


Prep'd AN
 Chkd. AMP

Moose Creek Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B17

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MCB-19	7.92	349.78

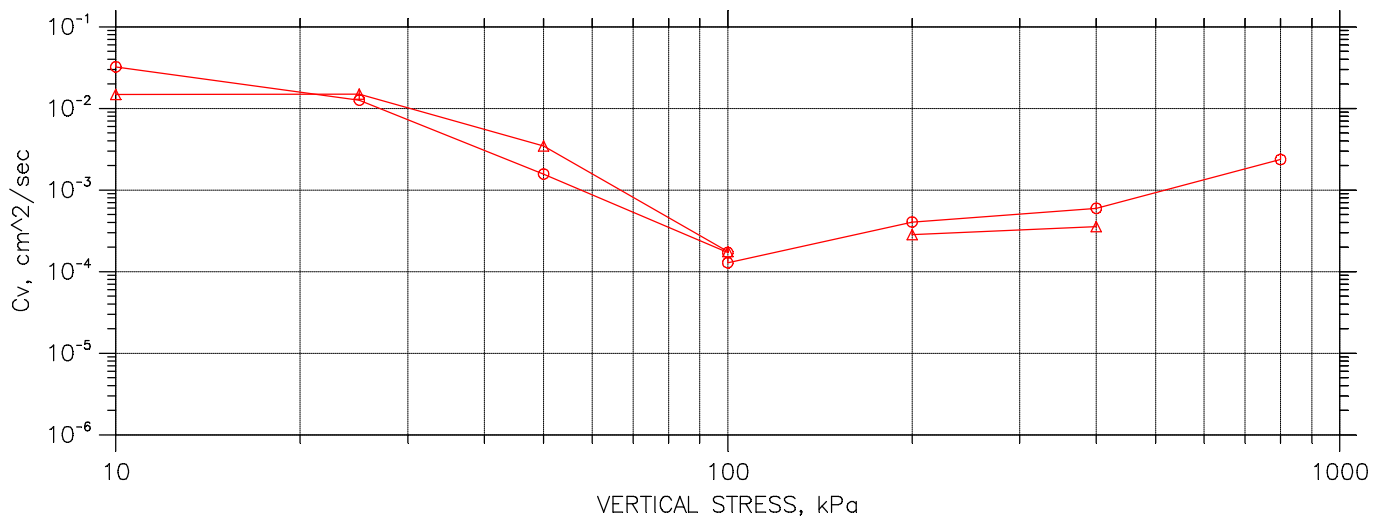
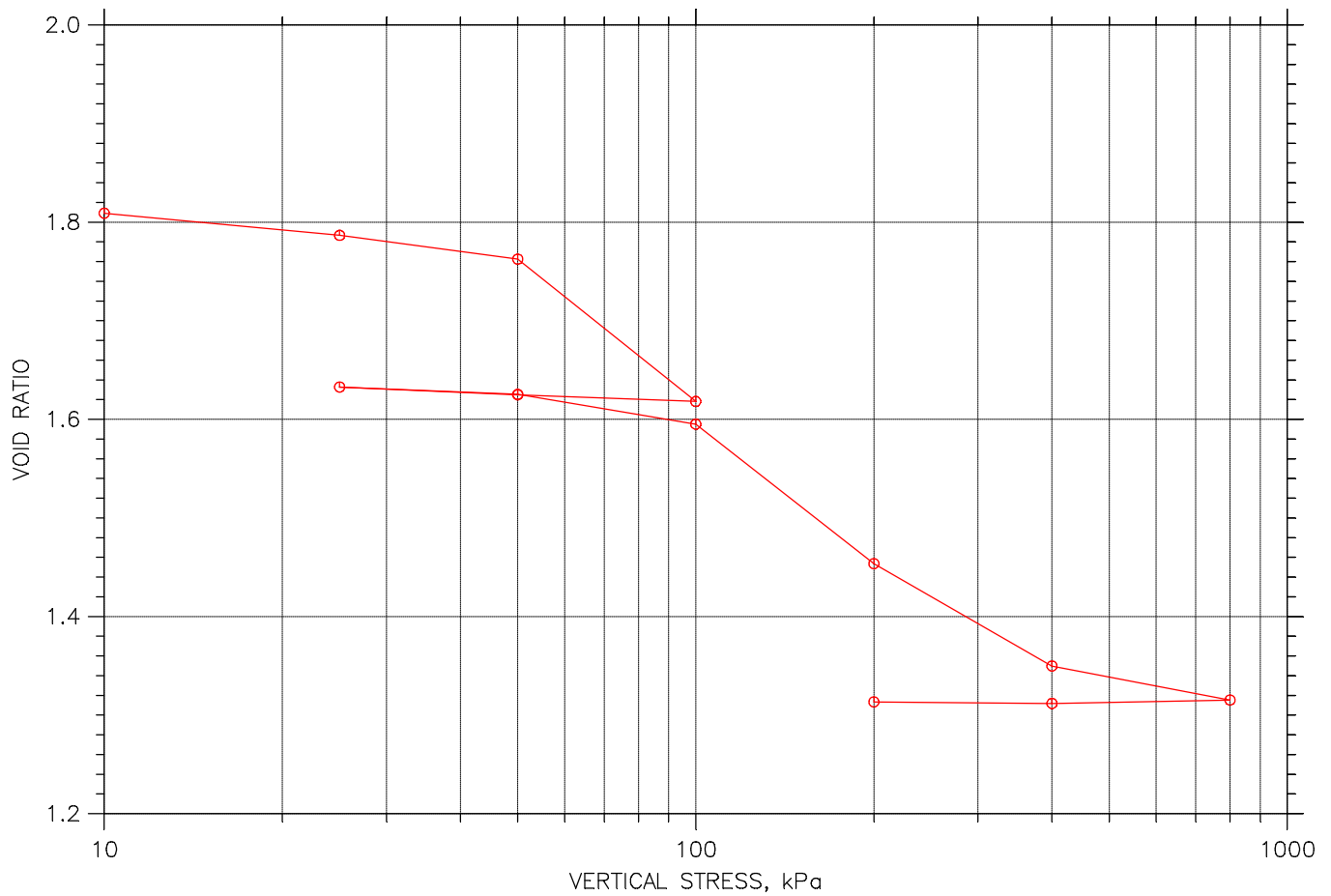
Date August 2015
 WP# 473-00-01




Prep'd AN
 Chkd. AMP

CONSOLIDATION TEST DATA

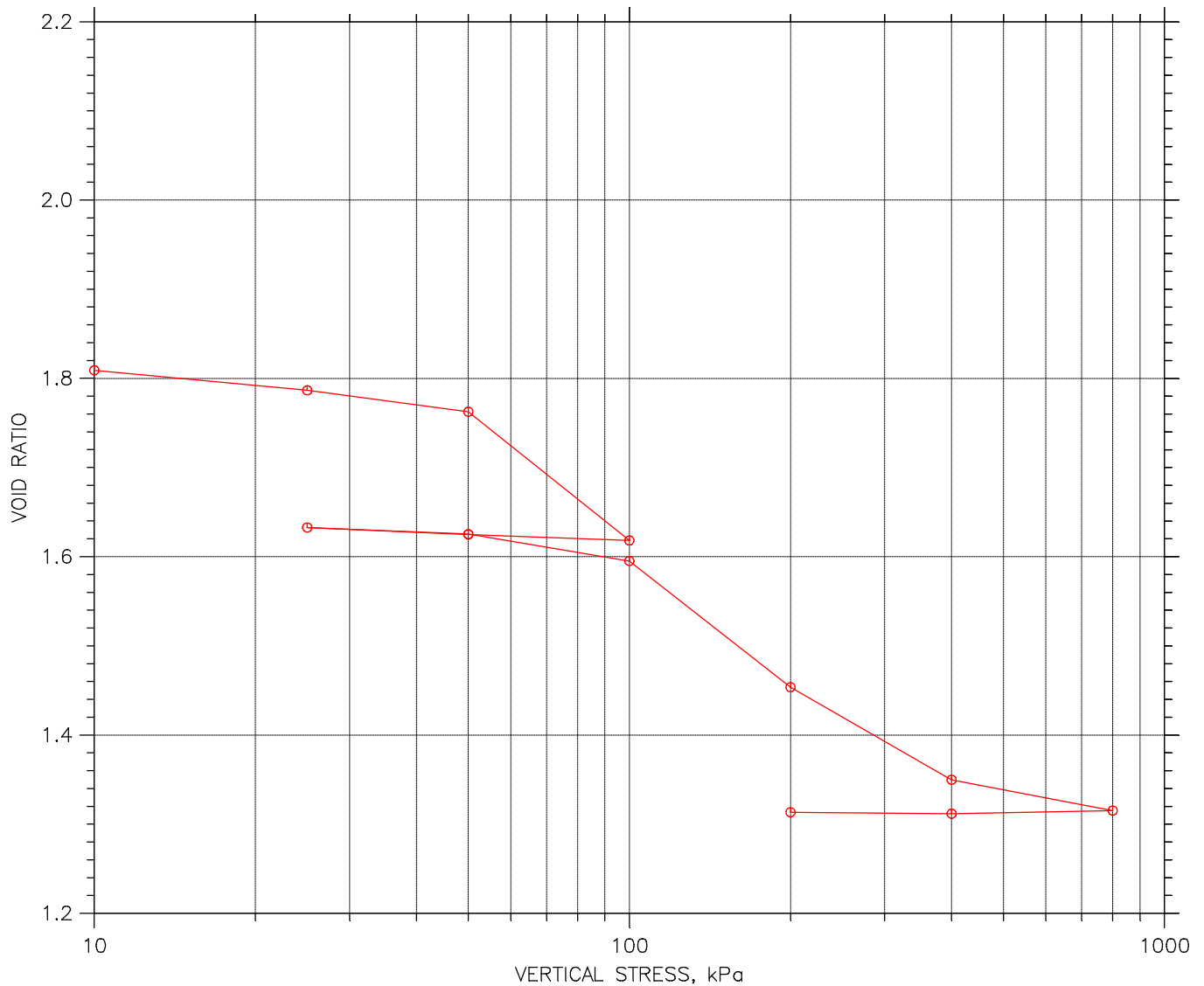
SUMMARY REPORT




	Project: Moose Creek Bridge	Location: Hwy 72 Sioux Lookout	Project No.: 19-1351-197
	Boring No.: MCB-15	Tested By: TF	Checked By: GM
	Sample No.: TW 1	Test Date: Aug 20/15	Depth: 20'-22'
	Test No.: 1	Sample Type: TW	Elevation: 1
	Description: Grey Clay		
	Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT

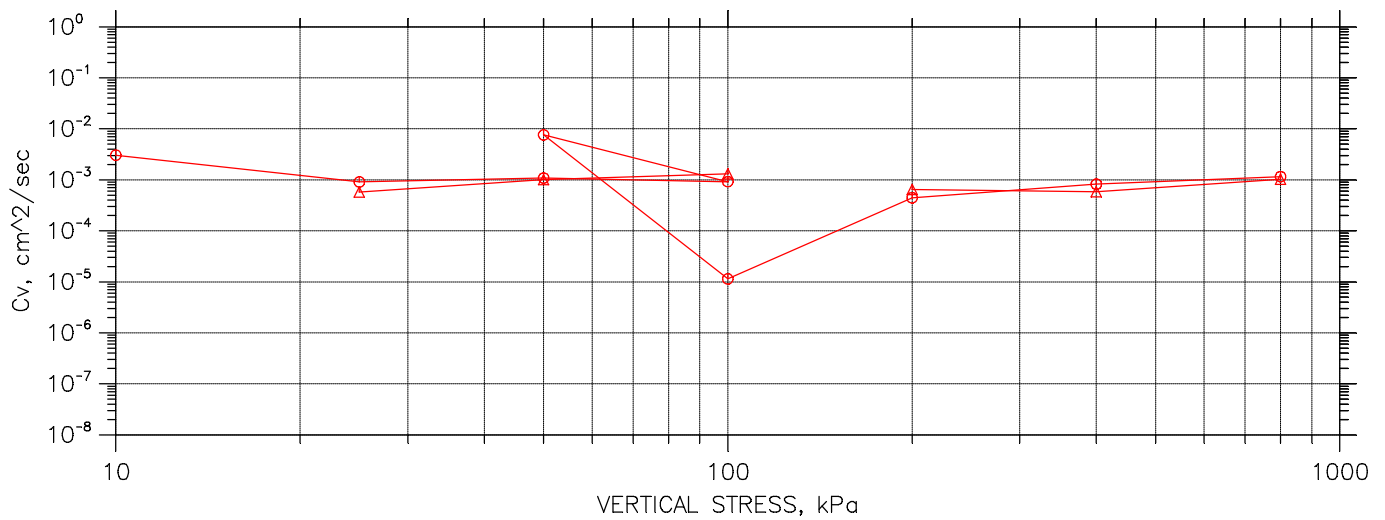
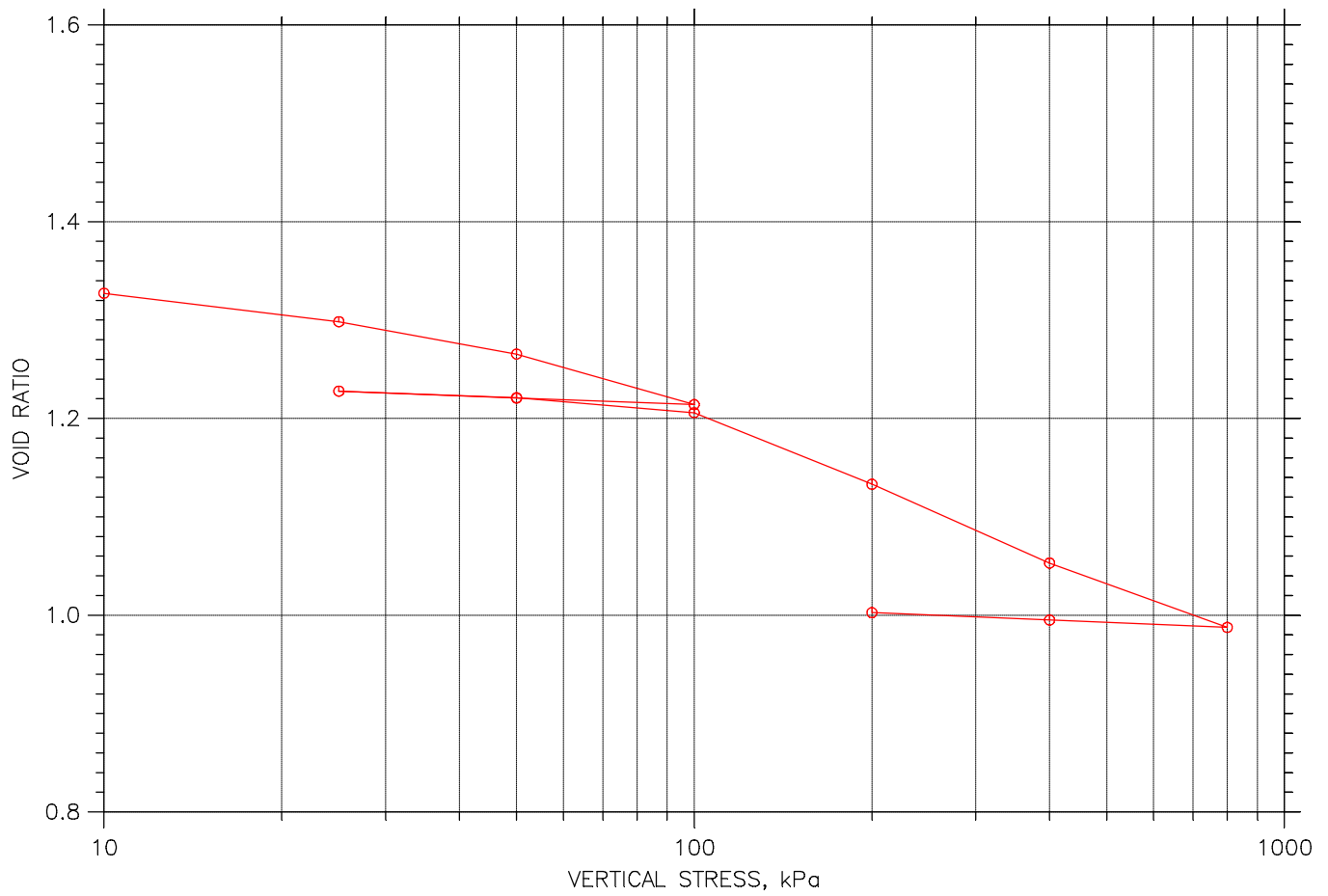



				Before Test	After Test	
Overburden Pressure: 0 kPa				Water Content, %	64.42	37.59
Preconsolidation Pressure: 0 kPa				Dry Unit Weight, N/m^3	9337	11450
Compression Index: 0				Saturation, %	94.73	77.29
Diameter: 50.15 mm		Height: 19.23 mm		Void Ratio	1.84	1.31
LL: 54	PL: 20	PI: 34	GS: 2.70			

	Project: Moose Creek Bridge	Location: Hwy 72 Sioux Lookout	Project No.: 19-1351-197
	Boring No.: MCB-15	Tested By: TF	Checked By: GM
	Sample No.: TW 1	Test Date: Aug 20/15	Depth: 20'-22'
	Test No.: 1	Sample Type: TW	Elevation: 1
	Description: Grey Clay		
	Remarks:		

CONSOLIDATION TEST DATA

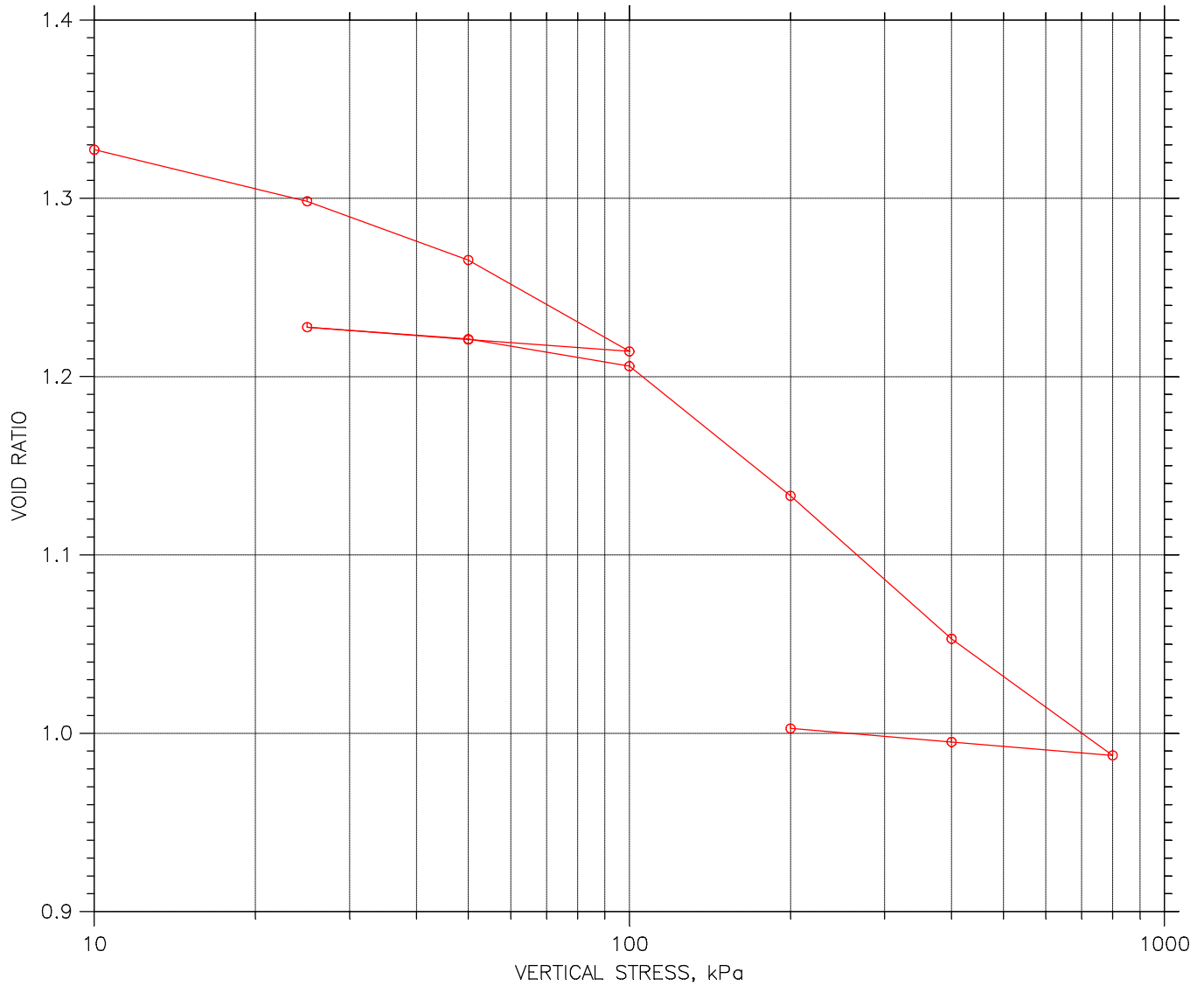
SUMMARY REPORT




	Project: Moose Creek Bridge	Location: Hwy 72 Sioux Lookout	Project No.: 19-1351-197
	Boring No.: MCB-22	Tested By: TF	Checked By: GM
	Sample No.: TW 1	Test Date: Sept 3/15	Depth: 20'-22'
	Test No.: 1	Sample Type: TW	Elevation: 1
	Description: Grey Clay		
	Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 kPa		Water Content, %		52.39	34.26
Preconsolidation Pressure: 0 kPa		Dry Unit Weight, N/m ³		10920	12910
Compression Index: 0		Saturation, %		100.93	90.11
Diameter: 50.15 mm	Height: 18.64 mm		Void Ratio	1.37	1.00
LL: 30	PL: 18	PI: 12	GS: 2.64		

	Project: Moose Creek Bridge	Location: Hwy 72 Sioux Lookout	Project No.: 19-1351-197
	Boring No.: MCB-22	Tested By: TF	Checked By: GM
	Sample No.: TW 1	Test Date: Sept 3/15	Depth: 20'-22'
	Test No.: 1	Sample Type: TW	Elevation: 1
	Description: Grey Clay		
	Remarks:		

Appendix C

Site Photographs



Photo 1 - Highway 72 - Looking North from South Approach



Photo 2 - Looking South at the West Bridge Elevation



Photo 3 – Looking South from North East Corner of North Abutment



Photo 4 - Looking North from South East Corner of North Abutment



Photo 5 - Looking Northeast from South Abutment



Photo 6 - Looking West from North Abutment



Photo 7 - South Abutment Piles – Looking West



Photo 8 - North Abutment Piles – Looking East



Photo 9 - North Abutment –Front Slope and Existing Cut-off Piles



Photo 10 - South Abutment - Front Slope and existing cut-off piles



Photo 11 - Looking South under the Bridge from front slope at North Abutment



Photo 12 - Looking North from SE corner – Noticeable Highway 72 Embankment Sag



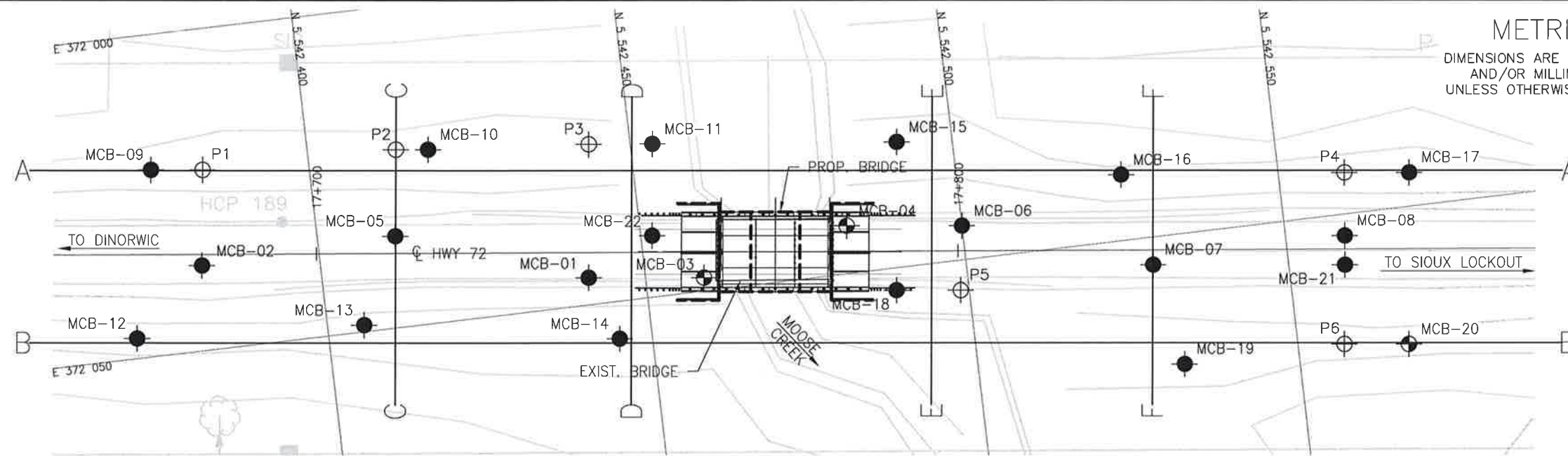
Photo 13 - Looking north along west side of highway embankment; Probehole P3 marked at 20 m distance south of the bridge



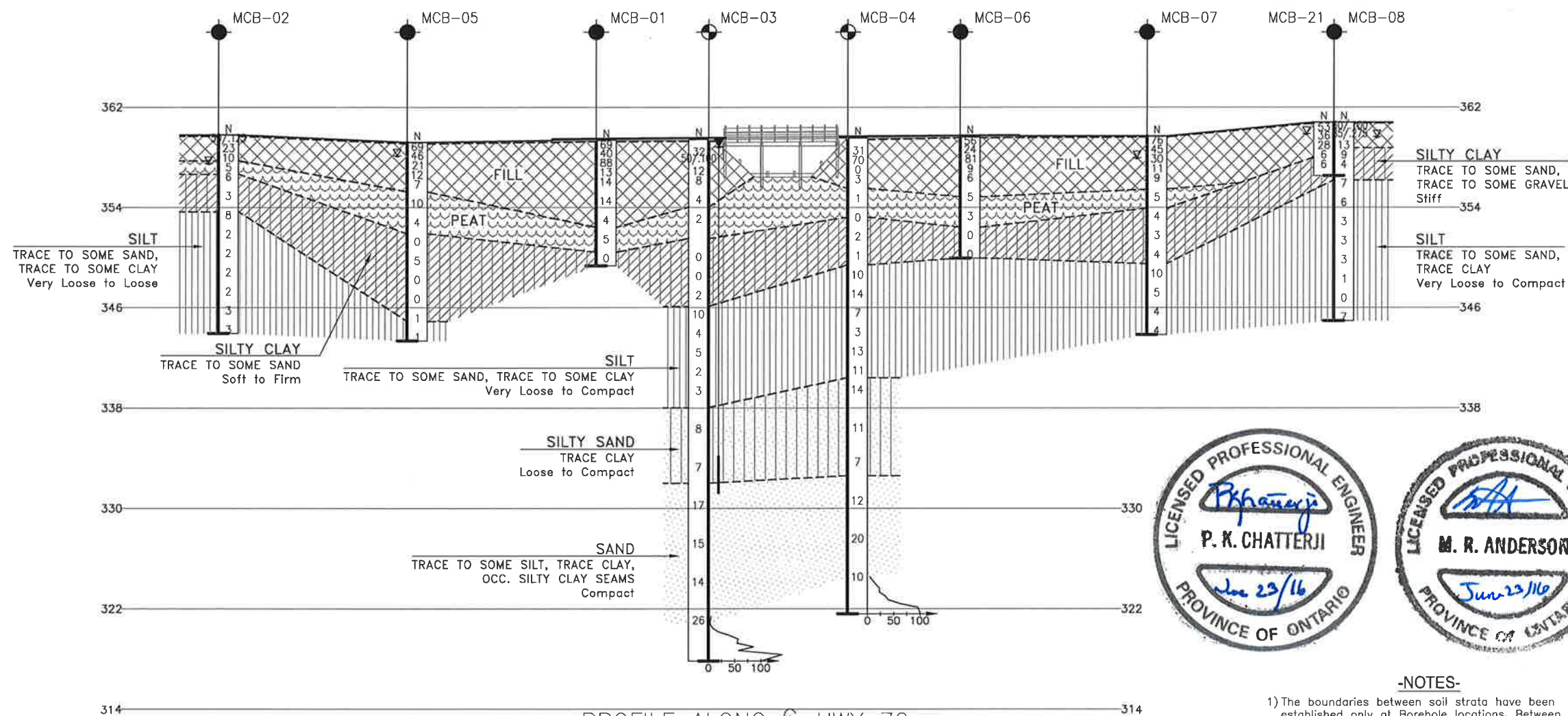
Photo 14 - Looking south along east side of highway embankment; Probehole P5 marked at 20 m distance north of the bridge.

Appendix D

Borehole Locations and Soil Strata Drawings



PLAN
SCALE 1:800



PROFILE ALONG C HWY 72
H 1:800
V 1:400



-NOTES-

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

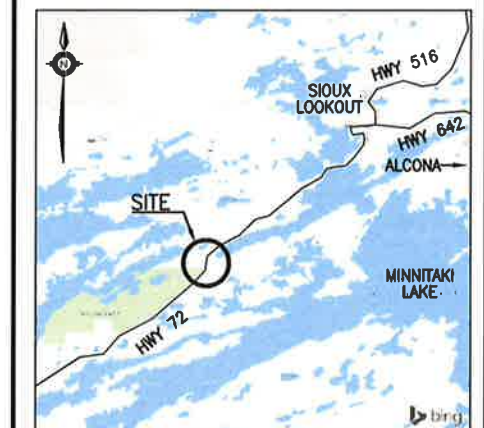
DATE	BY	DESCRIPTION
DESIGN	AMP	CHK PKC CODE
DRAWN	AN	CHK AMP SITE 415-16 STRUCT
DATE	JUN 2016	DWG 2

CONT No
WP No 473-00-01

HIGHWAY 72
MOOSE CREEK
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN
SCALE 1:500,000

LEGEND

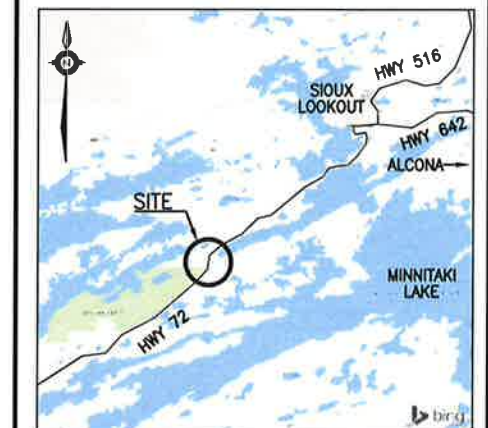
- Borehole
- DCPT (Dynamic Cone Penetration Test)
- Probe (Hand Auger)
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60° Cone, 475J/blow)
- Water Level In Open Borehole
- Water Level In Piezometer
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
MCB-01	359.4	5 542 441.2	372 045.8
MCB-02	359.8	5 542 381.7	372 036.8
MCB-03	359.5	5 542 459.0	372 047.9
MCB-04	359.6	5 542 482.1	372 042.6
MCB-05	359.2	5 542 412.0	372 035.8
MCB-06	359.7	5 542 500.0	372 044.7
MCB-07	359.7	5 542 528.9	372 054.3
MCB-08	360.8	5 542 559.2	372 053.3
MCB-09	358.2	5 542 375.5	372 021.0
MCB-10	357.6	5 542 418.6	372 023.0
MCB-11	357.5	5 542 453.5	372 026.3
MCB-12	358.6	5 542 370.4	372 046.9
MCB-13	358.2	5 542 405.6	372 049.0
MCB-14	357.7	5 542 444.9	372 055.8
MCB-15	357.4	5 542 491.4	372 030.5
MCB-16	358.3	5 542 525.6	372 039.8
MCB-17	359.8	5 542 570.3	372 044.7
MCB-18	357.0	5 542 488.7	372 053.5
MCB-19	357.7	5 542 532.0	372 070.2
MCB-20	358.1	5 542 567.2	372 071.3
MCB-21	360.8	5 542 558.7	372 057.8
MCB-22	359.2	5 542 451.8	372 040.5

GEOCRE No. 52K-014

SHEET
19

HIGHWAY 72
MOOSE CREEK
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

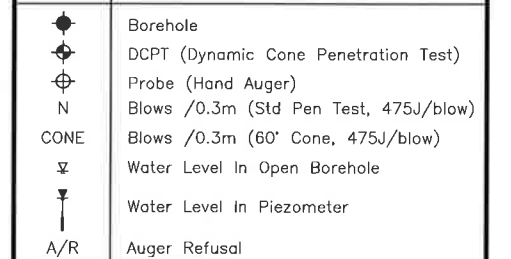


KEYPLAN

5.0 km 0 5.0 km

SCALE 1:500,000

LEGEND

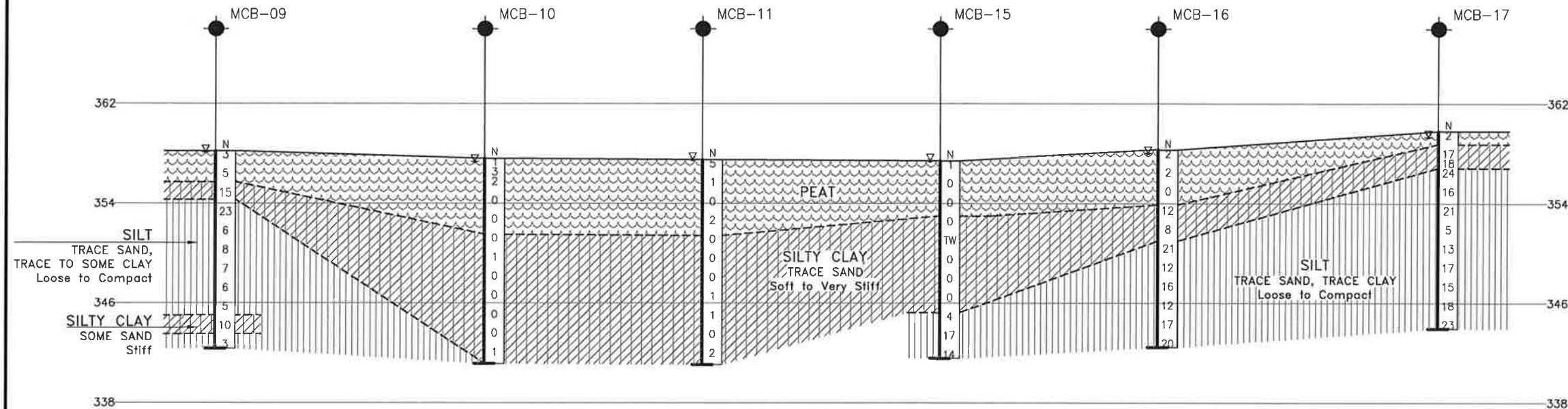


NO	ELEVATION	NORTHING	EASTING
MCB-01	359.4	5 542 441.2	372 045.8
MCB-02	359.8	5 542 381.7	372 036.8
MCB-03	359.5	5 542 459.0	372 047.9
MCB-04	359.6	5 542 482.1	372 042.6
MCB-05	359.2	5 542 412.0	372 035.8
MCB-06	359.7	5 542 500.0	372 044.7
MCB-07	359.7	5 542 528.9	372 054.3
MCB-08	360.8	5 542 559.2	372 053.3
MCB-09	358.2	5 542 375.5	372 021.0
MCB-10	357.6	5 542 418.6	372 023.0
MCB-11	357.5	5 542 453.5	372 026.3
MCB-12	358.6	5 542 370.4	372 046.9
MCB-13	358.2	5 542 405.6	372 049.0
MCB-14	357.7	5 542 444.9	372 055.8
MCB-15	357.4	5 542 491.4	372 030.5
MCB-16	358.3	5 542 525.6	372 039.8
MCB-17	359.8	5 542 570.3	372 044.7
MCB-18	357.0	5 542 488.7	372 053.5
MCB-19	357.7	5 542 532.0	372 070.2
MCB-20	358.1	5 542 567.2	372 071.3
MCB-21	360.8	5 542 558.7	372 057.8
MCB-22	359.2	5 542 451.8	372 040.5

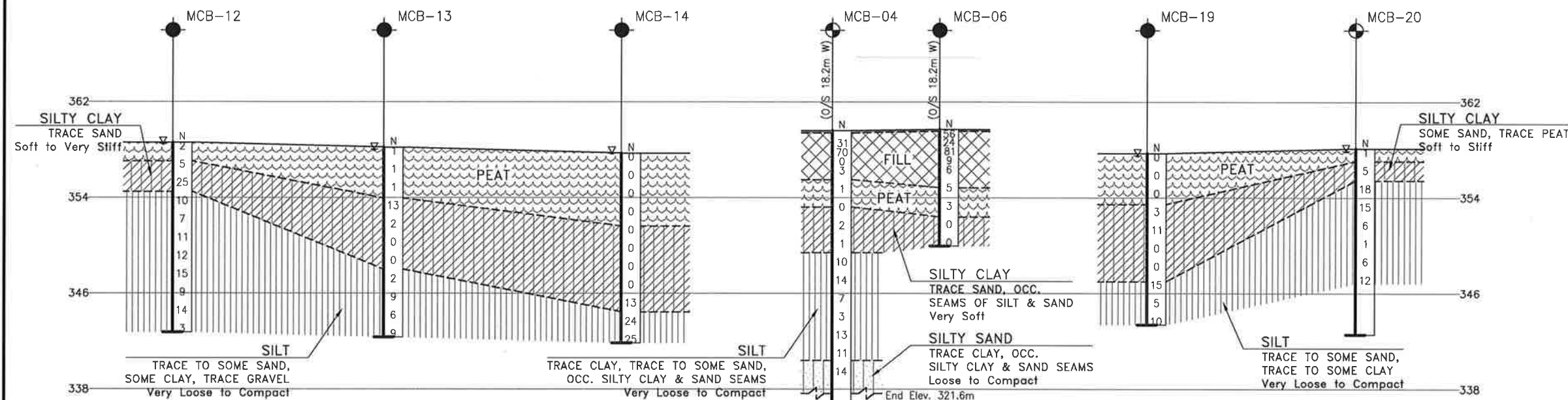
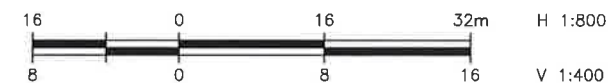
GEOCRES No. 52K-014

-NOTES-

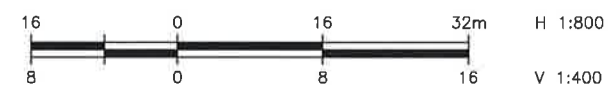
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

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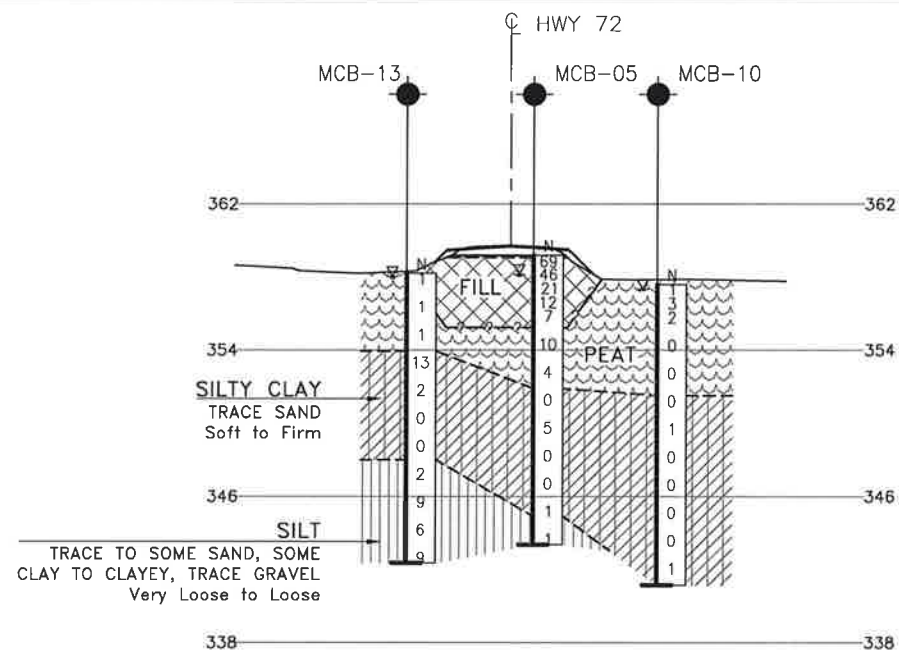
PROFILE ALONG A-A (WEST)



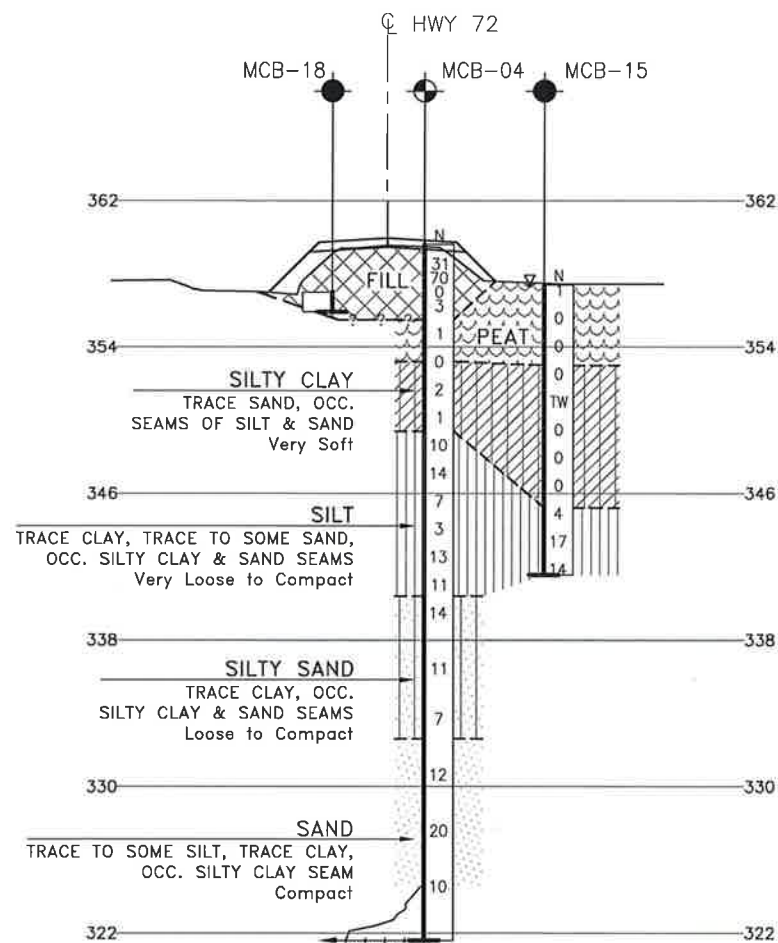
PROFILE ALONG B-B (EAST)



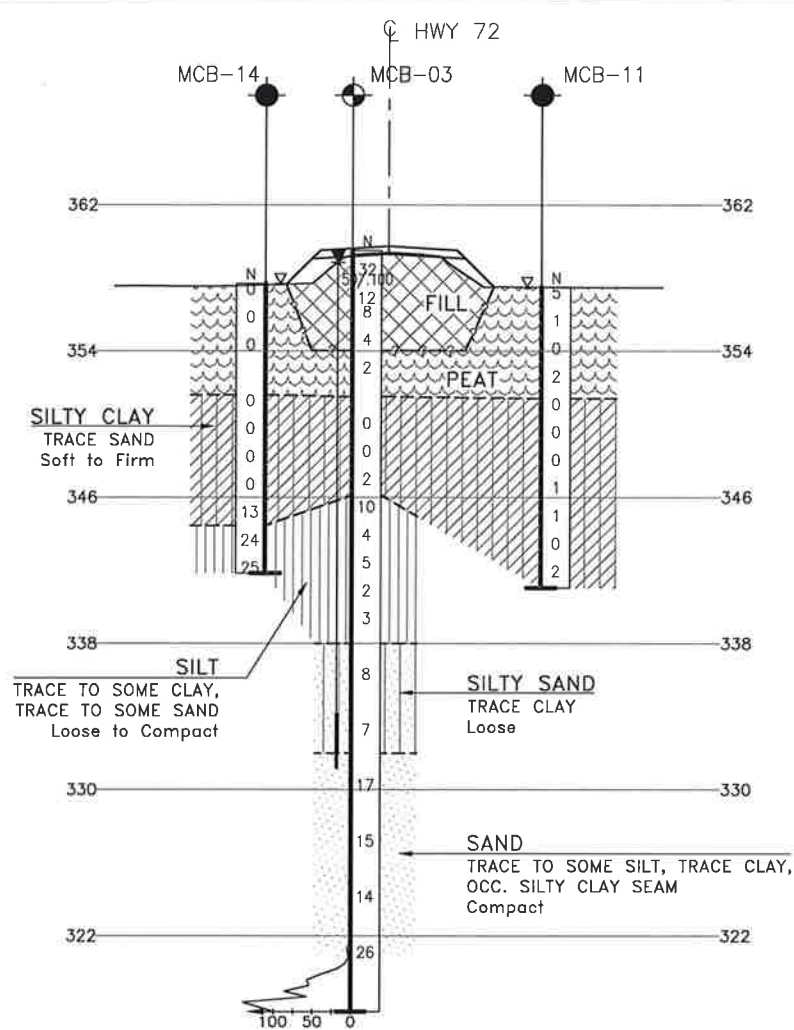
MINISTRY OF TRANSPORTATION, ONTARIO



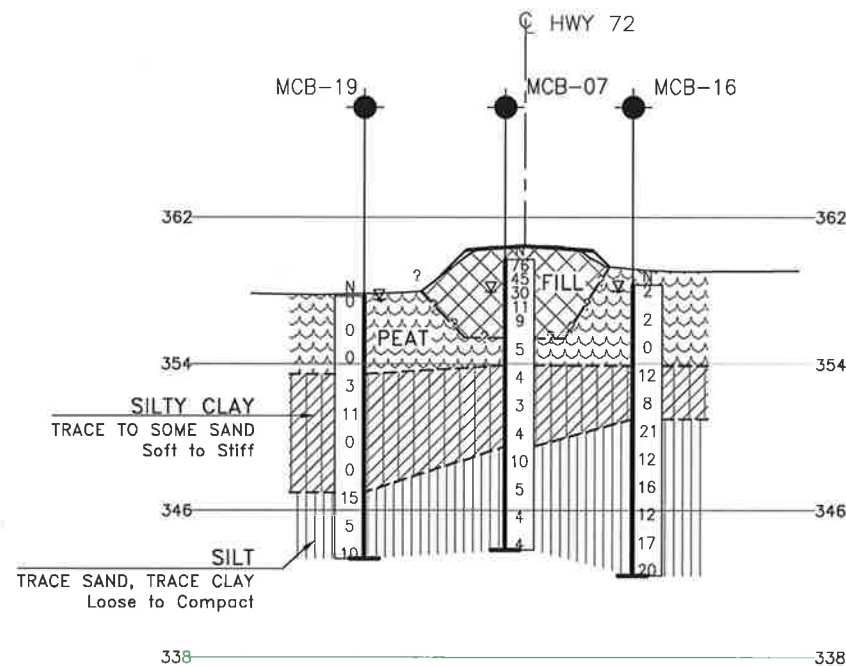
PROFILE ALONG C-C



PROFILE ALONG E-E



PROFILE ALONG D-D



PROFILE ALONG F-F



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

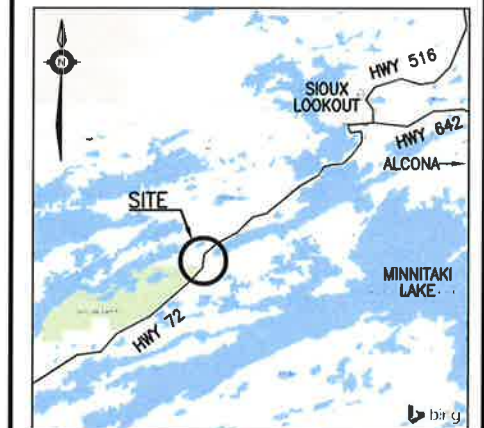
CONT No
WP No 473-00-01

HIGHWAY 72
MOOSE CREEK
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
20

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN
5.0 km 0 5.0 km
SCALE 1:500,000

LEGEND

- Borehole
- DCPT (Dynamic Cone Penetration Test)
- Probe (Hand Auger)
- Blows /0.3m (Std Pen Test, 475J/blow)
- N
- Blows /0.3m (60° Cone, 475J/blow)
- CONE
- Blows /0.3m (60° Cone, 475J/blow)
- Water Level In Open Borehole
- Water Level In Piezometer
- A/R
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
MCB-01	359.4	5 542 441.2	372 045.8
MCB-02	359.8	5 542 381.7	372 036.8
MCB-03	359.5	5 542 459.0	372 047.9
MCB-04	359.6	5 542 482.1	372 042.6
MCB-05	359.2	5 542 412.0	372 035.8
MCB-06	359.7	5 542 500.0	372 044.7
MCB-07	359.7	5 542 528.9	372 054.3
MCB-08	360.8	5 542 559.2	372 053.3
MCB-09	358.2	5 542 375.5	372 021.0
MCB-10	357.6	5 542 418.6	372 023.0
MCB-11	357.5	5 542 453.5	372 026.3
MCB-12	358.6	5 542 370.4	372 046.9
MCB-13	358.2	5 542 405.6	372 049.0
MCB-14	357.7	5 542 444.9	372 055.8
MCB-15	357.4	5 542 491.4	372 030.5
MCB-16	358.3	5 542 525.6	372 039.8
MCB-17	359.8	5 542 570.3	372 044.7
MCB-18	357.0	5 542 488.7	372 053.5
MCB-19	357.7	5 542 532.0	372 070.2
MCB-20	358.1	5 542 567.2	372 071.3
MCB-21	360.8	5 542 558.7	372 057.8
MCB-22	359.2	5 542 451.8	372 040.5

GEOCRE No. 52K-014



-NOTES-

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

REVISIONS	DATE	BY	DESCRIPTION
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SITE	41S-16	STRUCT	DWG 4
LOAD	DATE	JUN 2016	

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