

**FOUNDATION INVESTIGATION REPORT
DETAIL DESIGN
MINDEMOYA LAKE BRIDGE AND DAM REPLACEMENT
HIGHWAY 542, MANITOULIN ISLAND
G.W.P. 5460-04-00, SITE 49-023**

Geocres Number: 41G-8

Report to

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PART A: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed replacement of the bridge and dam located on Highway 542 at the south end of Mindemoya Lake. The existing structure consists of a combined dam and bridge at the outlet of Mindemoya Lake to Mindemoya River.

A preliminary foundation investigation was carried out for this project by Thurber in August 2006, and the factual data from that investigation has been incorporated into the current assignment.

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, borehole logs, stratigraphic profile and a written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and construction of the foundations and approach embankments for the proposed replacement bridge and dam.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 5004-E-0056.

2 SITE DESCRIPTION

The bridge and dam site lies at the south end of Mindemoya Lake on Highway 542, approximately 6 km west of the Town of Mindemoya on Manitoulin Island. It lies in the Township of Central Manitoulin, District of Manitoulin.

The general site area is located within the physiographic region referred to as Manitoulin Island. The island is part of the Niagara cuesta, the rim of a large dolomitic saucer underlying the Michigan basin. It is characterized by a dolostone bedrock plain, gradually rising out of Lake Huron along the south side of the island and terminating in successive step cliffs along the centre and north sides of the island.

Mindemoya Lake and the study site itself are located within a broad lowland between areas of bedrock plain, formed by infilling of a north-south trending bedrock channel with stratified deposits of clay, sand and silt during submergence of the island by glacial Lake Algonquin.

Highway 542 forms the south boundary of Mindemoya Lake, with the roadway embankment constructed approximately 1 to 2 m above adjacent grade to create an earth dam. The lake is relatively shallow upstream of the structure (approximately 0.5 m) and the downstream river was approximately 0.3 m deep at the time of the investigation. Vegetation in the ditches along the downstream side of the dam indicates wet conditions and probable seepage through the dam.

Photographs of the site are provided in Appendix C. The existing outlet structure at Mindemoya River consists of an integrated stop log control structure and concrete deck bridge. The existing bridge deck has a span of 6.1 m and width of 6.0 m. The lands to the south of Highway 542 comprise relatively flat farmland. Brush and trees have reclaimed much of the property west of Mindemoya River.

3 SITE INVESTIGATION AND FIELD TESTING

Thurber carried out site investigation and field testing for the detailed design phase of this project during the period July 12 to August 10, 2007. The fieldwork for the preliminary investigation was carried out from August 21 to 27, 2006. In total, 27 boreholes were drilled and sampled at the locations of the proposed bridge, dam control structure, approaches and embankments.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D. The locations and depths of the boreholes were as follows:

Table 3.1 – Borehole Details

Location	Study Phase	Number of Boreholes	Borehole Numbers	Depth of Boreholes (m)
Proposed Bridge Abutments	Detail	4	07-M6, 07-M7, 07-M14, 07-M15	30.2 to 37.2
Proposed Control Structure	Preliminary	3	06-M1, 06-M3, 06-M4	35.1 to 37.7
	Detail	3	07-M1, 07-M3, 07-M4	34.7 to 35.1
Structure Approaches	Detail	4	07-M2, 07-M5, 07-M11, 07-M12	15.8 to 20.4
Existing and Proposed Embankments	Preliminary	9	06-M7 to 06-M15	13.0 to 33.4
	Detail	4	07-M8, 07-M9, 07-M10, 07-M13	15.7 to 15.8

The borehole depths in Table 3.1 include recovery of an approximate 3 m length of rock core at four locations.

Thurber positioned the boreholes in the field relative to the centreline of Highway 542 and the existing bridge structure. The coordinates and ground surface elevations at the boreholes were subsequently established by MRC. The coordinates and elevations of the boreholes are given on the Borehole Locations and Soil Strata Drawing and on the individual Record of Borehole Sheets in Appendix A.

A layer of rock fill surrounded by silt fence was placed in Mindemoya Lake and on the east bank of Mindemoya River to form platforms for drilling of boreholes 06-M01, 07-M1, 07-M7 and 07-M15. The rock fill was removed following completion of drilling.

A combination of hollow stem auger and rotary drilling techniques was used to advance the boreholes. Samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests (SPT). Where soft to firm cohesive soils were encountered, the undrained shear strength was evaluated using the MTO shear vane, and thin wall tube samples were recovered. The boreholes were supplemented by dynamic cone penetration testing. Bedrock cores were recovered using NQ coring equipment.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the soil and groundwater conditions encountered in the boreholes, and collected, labelled and arranged for transport of the samples to Thurber's laboratory.

Standpipe piezometers and monitoring wells were installed in and adjacent to selected boreholes to monitor groundwater levels and conduct field permeability testing. The completion details of the piezometers and wells are presented in Table C1 of Appendix C.

The boreholes without piezometers were grouted upon completion, and the piezometers and monitoring wells were subsequently decommissioned in accordance with the abandonment requirements of MOE Reg. 903.

Field permeability (slug) testing was carried out in six monitoring wells installed in or adjacent to boreholes 07-M3, 07-M4 and 07-M6. The tests were carried out in general accordance with ASTM D 4044-96. The results are presented in Appendix C.

4 LABORATORY TESTING

All recovered soil samples were subjected to visual identification and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A.

Selected samples were subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing. A thin wall tube sample of silty clay from borehole 07-M1 was selected for one-dimensional consolidation testing. The results are shown on the Record of Borehole sheets in Appendix A and on the charts in Appendix B.

The rock core descriptions were confirmed in the laboratory and Point Load Tests were conducted to assess the compressive strength of the rock.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix A and to the Borehole Locations and Soil Strata Drawings in Appendix D. An overall description of the stratigraphy based on the conditions encountered in the boreholes is given in the following paragraphs. However, the factual data presented in the borehole logs takes precedence over this general description and interpretation of the site conditions.

The soil stratigraphy encountered at this site generally consists of existing road embankment fill and/or relatively thin layers of topsoil, sand or silt, overlying a layer of soft to stiff silty clay, underlain by a silt stratum and a thick deposit of sand. The sand overlies bedrock.

More detailed descriptions of the individual strata are presented below.

It is noted that a 0.6 to 1.2 m thick layer of rockfill was placed to form a drilling platform at boreholes 06-M1, 07-M1, 07-M7 and 07-M15. In the description below, depths at these locations are referenced to the top of the rockfill, which has since been removed.

5.2 Proposed Bridge Location

Boreholes 07-M6, 07-M7, 07-M14 and 07-M15 were drilled at the proposed bridge abutments. Boreholes 07-M11 and 07-M12 were drilled at the approaches.

5.2.1 Topsoil

A 150 to 275 mm thick layer of topsoil was encountered surficially at the west abutment and both approaches. Topsoil was not encountered in the boreholes at the east abutment situated within the riverbank. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.2.2 Upper Silt and Sand Layers

Layers of silt and sand were encountered below the topsoil at the west abutment and both approaches. These deposits comprised sand, trace silt, to silt, trace sand, and contained trace rootlets, topsoil, wood fibres, and locally shells. The colour varied between dark brown, brown and grey.

SPT N-values obtained in these deposits ranged from 4 to 13 blows/0.3 m, indicating a loose to compact condition.

The natural moisture content of recovered samples ranged from 19 to 39%, with one sample at 4%.

The total thickness of the sand/silt layers was 1.1 to 1.2 m, with the base at 1.4 m depth (elevation 195.4 to 195.6 m).

5.2.3 Silty Clay

A layer of silty clay was encountered below the sand/silt at the west abutment and approaches, and immediately below the rockfill drilling platform at the east abutment.

Based on SPT values of 2 to 15 blows/0.3 m, the consistency of the clay is soft to stiff. The undrained shear strength of the clay, assessed by in situ vane testing, ranged from 36 to 80 kPa (firm to stiff).

The natural moisture content of the silty clay ranged from 21 to 36%.

The results of laboratory tests carried out on five samples were as follows:

Gravel %	0
Sand %	0 to 1
Silt %	65 to 76
Clay %	23 to 34
Liquid Limit	29 to 38
Plastic Limit	17 to 20

The results of these tests indicate that the silty clay is a CL to CI soil (low to medium plasticity).

The grain size distribution curves for the samples tested are shown in Figures 07-B3 and 07-B4, Appendix B. The Atterberg Limits are plotted on Figures 07-B15 and 07-B16.

The clay layer ranged in thickness from 1.4 to 4.7 m. The depth to the base of the clay layer ranged from 2.2 to 6.1 m (elevation 190.9 to 193.9 m).

5.2.4 Silt

The clay was underlain by a layer of silt at all borehole locations. The silt contained trace to some clay, trace sand and was described as grey and wet. The bottom 3.2 m of this unit, below 8.4 m depth, at the north end of the east abutment (BH07-M7) was described as clayey silt to silty clay.

SPT N-values obtained in the silt ranged from 4 to 33 blows/0.3 m, indicating a loose to dense condition.

The natural moisture content of recovered samples ranged from 17 to 28%.

The results of laboratory tests carried out on eight samples were as follows:

Gravel %	0 to 1
Sand %	0 to 5
Silt %	77 to 85
Clay %	13 to 23

The grain size distribution curves for the samples tested are shown in Figures 07-B6 to 07-B8, Appendix B.

The silt unit ranged in thickness from 4.5 to 9.4 m. The depth to the base of the silt ranged from 9.1 to 11.9 m (elevation 183.6 to 187.7 m).

5.2.5 Sand

Sand was encountered below the silt unit in all boreholes. The sand varied from trace silt content to silty, and contained trace gravel and occasional silt inclusions. It was described as grey and wet.

SPT N-values obtained in the sand typically ranged from 20 to 49 blows/0.3 m, indicating a compact to dense condition. Isolated values of 10 and 56 blows/0.3 m were also obtained.

The natural moisture content of recovered samples ranged from 14 to 29%.

The results of laboratory tests carried out on eleven samples were as follows:

Gravel %	0 to 3
Sand %	59 to 95
Silt & Clay %	4 to 41

The grain size distribution curves for the samples tested are shown in Figures 07-B10 to 07-B12, Appendix B. The percentage of silt and clay size particles in two samples (37 and 41%) may reflect the presence of silt inclusions in the samples tested.

The sand extended to auger refusal or top of bedrock at depths of 30.2 to 34.1 m (elevation 162.9 to 165.0 m), indicating a deposit thickness of 18.6 to 23.7 m. The approach boreholes were terminated in sand at 15.8 m depth.

5.2.6 Bedrock and/or Refusal

Auger refusal was encountered on bedrock, probable bedrock, and a possible boulder at the depths and elevations listed in Table 5.1.

Table 5.1 – Depth to Bedrock and/or Refusal

Location	Borehole	Bedrock and/or Refusal		Comment
		Depth (m)	Elevation (m)	
West Abutment North End	07-M6	34.1	162.9	Bedrock proven by coring
West Abutment South End	07-M14	33.8	163.0	Probable bedrock
East Abutment North End	07-M7	30.2	165.0	Probable boulder above the bedrock surface
East Abutment South End	07-M15	32.0	163.4	Bedrock proven by coring

The bedrock recovered in the core samples consists of dolostone. The rock is described as fresh, thinly bedded, and brown to grey.

The core recovery was 100%. The measured RQD values in the full core runs ranged from 90 to 100%, indicating an excellent quality rock. The Fracture Index was 0 except for a single value of 3 fractures in the top 0.3 m of one core.

Based on Point Load Testing, the unconfined compressive strength of the bedrock was estimated to range from about 125 to 155 MPa. Based on these strength values and the classification system given in the Canadian Foundation Engineering Manual, the rock is classified as very strong.

5.2.7 Groundwater

The initial and final groundwater depths and elevations measured in the boreholes and piezometers are shown in Table 5.2.

Table 5.2 – Groundwater Depths and Elevations

Location	Borehole	Tip Depth (m)	Date	Water Level (m)	
				Depth	Elevation
West Approach	07-M11	15.2	18-Jul-07	2.0	194.8
			20-Jul-07	2.0	194.8
			17-Aug-07	2.1	194.7
			28-Aug-07	2.3	194.5
West Abutment North End	07-M6	7.6	18-Jul-07	2.3	194.7
			20-Jul-07	2.0	195.0
			17-Aug-07	2.2	194.8
			28-Aug-07	2.6	194.4
	12.5	18-Jul-07	1.9	195.1	
		20-Jul-07	1.8	195.2	
		17-Aug-07	1.9	195.1	
		28-Aug-07	2.4	194.6	
West Abutment South End	07-M14	7.6	18-Jul-07	2.1	194.7
			20-Jul-07	2.1	194.7
			17-Aug-07	2.0	194.8
			28-Aug-07	1.8	195.0
East Abutment North End	07-M7	7.6	20-Jul-07	1.4	193.8
			17-Aug-07	0.7	194.5
			28-Aug-07	1.0	194.2
East Abutment South End	07-M15	16.8	17-Aug-07	0.6	194.8
			28-Aug-07	1.4	194.0

The above water levels reflect the piezometric head at the level of the piezometer tips at the time of the investigation. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.3 Proposed Control Structure Location

Boreholes 06-M1, 06-M3, 06-M4, 07-M1, 07-M3 and 07-M4 were drilled at the proposed control structure. Boreholes 07-M2 and 07-M5 were drilled at the approaches.

5.3.1 Pavement and Existing Embankment Fill

A 25 to 50 mm thick layer of asphalt, appearing to comprise surface treatment, was encountered in the five boreholes drilled through the existing Highway 542 pavement.

The existing embankment fill consists primarily of sand. The sand contains variable amounts of silt (trace silt to silty), gravel (trace gravel to gravelly), organics, wood fibres, and cobbles and boulders. It is described as moist becoming wet with depth, and brown, locally dark brown and grey.

SPT N-values obtained in the fill ranged from 3 blows/0.3 m to 50 blows/0.15 m penetration, indicating a very loose to very dense condition. The wide variation in recorded N-values may reflect hydraulic disturbance as well as the presence of cobbles and boulders in the fill.

The natural moisture content of recovered samples ranged from 2 to 39%.

The results of laboratory tests carried out on two samples were as follows:

Gravel %	1 to 15
Sand %	56 to 70
Silt & Clay %	15 to 43

The grain size distribution curves for the samples tested are shown in Figures B1 and 07-B1, Appendix B.

The depth to the base of the fill ranged from 1.8 to 4.0 m (elevation 194.0 to 196.1 m).

5.3.2 Upper Silt and Sand Layers

A sand layer was encountered below the rockfill pad placed in the lake. The sand contained trace organics, wood fibres, and shells, and was described as grey and wet. SPT N-values of 2 to 9 blows/0.3 m indicate a loose to very loose condition. Moisture contents of 19 to 56% were measured in the recovered samples.

The lakebed sand layer was 1.2 and 1.7 m thick. The base of this layer was at elevation 194.6 and 194.9 m.

A 0.4 m thick layer of sandy silt was encountered below the embankment fill at the east approach. This layer was described as loose, wet and grey. A moisture content of 18% was measured in one sample. The base of this layer was at elevation 195.7 m.

5.3.3 Silty Clay

A layer of silty clay was encountered below the embankment fill, sand and silt at all locations. The clay was described as grey and moist to wet.

Based on SPT values of 2 to 14 blows/0.3 m, the consistency of the clay is soft to stiff. The undrained shear strength of the clay, assessed by in situ vane testing, ranged from 32 to 64 kPa (firm to stiff).

The natural moisture content of the silty clay ranged from 21 to 38%.

The results of laboratory tests carried out on nine samples were as follows:

Gravel %	0 to 1
Sand %	0 to 6
Silt %	56 to 76
Clay %	23 to 43
Liquid Limit	18 to 35
Plastic Limit	7 to 20

The results of these tests indicate that the silty clay is a CL to CI soil (low to medium plasticity).

The grain size distribution curves for the samples tested are shown in Figures B3, 07-B2 and 07-B3, Appendix B. The Atterberg Limits are plotted on Figures B13 and 07-B14.

The results of consolidation testing conducted on a sample of the silty clay are included in Appendix B and summarized below.

Borehole	Depth (m)	w _o (%)	γ (kN/m ³)	e _o	P _o ' (kPa)	P _c ' (kPa)	OCR	C _c	C _r
07-M1	3.0-3.6	31	18.9	0.86	30	200	6.7	0.29	0.04

The clay layer ranged in thickness from 2.1 to 4.9 m. The depth to the base of the clay layer ranged from 6.0 to 7.3 m (elevation 190.3 to 192.0 m).

5.3.4 Silt

The clay was underlain by silt at all borehole locations. The silt contained trace to some clay, trace to some sand and was described as grey and wet.

SPT N-values obtained in the silt typically ranged from 1 to 29 blows/0.3 m, indicating a very loose to compact condition. Four values of 33 to 61 blows/0.3 m were obtained, indicating localized dense to very dense zones.

The natural moisture content of recovered samples ranged from 16 to 32%.

The results of laboratory tests carried out on nine samples were as follows:

Gravel %	0
Sand %	1 to 6
Silt %	82 to 90
Clay %	6 to 15

The grain size distribution curves for the samples tested are shown in Figures B6, 07-B5 and 07-B6, Appendix B.

The silt unit ranged in thickness from 4.9 to 8.8 m. The depth to the base of the silt ranged from 11.7 to 14.8 m (elevation 183.1 to 186.2 m).

5.3.5 Sand

Sand was encountered below the silt unit in all boreholes. The sand contained trace to some silt and occasional gravel and cobbles. It was described as brown to grey and wet.

SPT N-values obtained in the sand ranged from 8 blows/0.3 m to 100 blows/.125 m penetration, indicating a loose to very dense condition. An isolated value of 1 blow per 0.3 m probably resulted from hydraulic disturbance.

The natural moisture content of recovered samples ranged from 14 to 26%.

The results of laboratory tests carried out on twelve samples were as follows:

Gravel %	0
Sand %	80 to 97
Silt & Clay %	3 to 20

The grain size distribution curves for the samples tested are shown in Figures B9, B10, 07-B9 and 07-B10, Appendix B. The results of three additional samples from this unit, not included in the percentages listed above, indicate the presence of sand and silt layers and occasional gravel or cobbles within the sand.

The sand typically extended to auger refusal at depths of 34.7 to 35.2 m (elevation 162.6 to 163.2 m), indicating a deposit thickness of 21.8 to 23.2 m. However, the sand was interrupted by a silty clay layer at one location (BH07-M3) and was underlain by silt at 27.4 m depth (elevation 169.5 m) at another location (BH06-M1). The approach boreholes were terminated in sand at 20.4 m depth.

5.3.6 Localized Silt, Silt Till and Silty Clay Layers

At the northwest corner of the proposed structure location (BH06-M1), the sand was underlain by silt overlying silt till. The silt contained some sand and was described as grey a wet. SPT N-values of 18 and 24 blows/0.3 m obtained in the silt indicate a compact condition. Moisture contents of 17 and 21% were measured in two recovered samples. The base of this layer was at elevation 163.2 m.

The underlying silt till contained some sand and gravel and occasional limestone fragments. An N-value of 52 blows/0.3 m indicates a very dense condition. A moisture content of 11% was measured in this deposit. The till extended to auger refusal at 34.6 m depth (elevation 162.3 m).

A 5.2 m thick layer of silty clay was encountered within the sand at the west side of the structure location (BH07-M3) between depths of 27.6 and 32.8 m (elevation 170.4 and 165.2 m). This layer was hard (N-values of 30 blows/0.3 m and 66 blows/0.275 m). Natural moisture contents of 26 and 12% were measured.

5.3.7 Bedrock and/or Refusal

Auger refusal was encountered on bedrock and probable bedrock at the depths and elevations listed in Table 5.3.

Table 5.3 – Depth to Bedrock and/or Refusal

Location	Borehole	Bedrock and/or Refusal		Comment
		Depth (m)	Elevation (m)	
Northwest Corner	06-M1	34.6	162.3	Bedrock proven by coring
West Central Side	07-M3	34.8	163.2	Probable bedrock
Southwest Corner	06-M3	35.1	163.0	Probable bedrock
Northeast Corner	07-M1	34.7	162.6	Probable bedrock
East Central Side	07-M4	35.1	162.9	Probable bedrock
Southeast Corner	06-M4	35.2	162.8	Bedrock proven by coring

The bedrock recovered in the core samples consists of dolostone. The rock is described as fresh, thinly to medium bedded, and light brown to grey or dark brown. The core recovery was 100% in three core runs and 78% in the initial run in borehole 06-M04 where cobbles or very weathered rock was encountered in the first 275 mm of core. The measured RQD values in the full core runs ranged from 98 to 100%, indicating an excellent quality rock. The Fracture Index was generally 0 to 1, with single values of 2 and 4 fractures/0.3 m.

Based on Point Load Testing, the unconfined compressive strength of the bedrock was estimated to range from about 122 to 169 MPa. Based on these strength values and the classification system given in the Canadian Foundation Engineering Manual, the rock is classified as very strong.

5.3.8 Groundwater

The initial and final groundwater depths and elevations measured in the boreholes and piezometers are shown in Table 5.4.

Table 5.4 – Groundwater Depths and Elevations

Location	Borehole	Tip Depth (m)	Date	Water Level (m)	
				Depth	Elevation
West Central Side	07-M3	2.3	17-Aug-07	1.3	196.7
			29-Aug-07	1.3	196.7
		4.6	17-Aug-07	1.3	196.7
			28-Aug-07	1.3	196.7
7.6	17-Aug-07	2.5	195.5		
	28-Aug-07	2.2	195.8		
Southwest Corner	06-M3	35.1	27-Aug-06	3.5	194.6
			31-Aug-06	3.6	194.5
East Central Side	07-M4	2.2	17-Aug-07	1.2	196.8
			29-Aug-07	1.3	196.7
Southeast Corner	06-M4	37.7	27-Aug-06	3.3	194.7
			31-Aug-06	3.5	194.5
			18-Jul-07	3.2	194.8

The above water levels reflect the piezometric head at the level of the piezometer tips at the time of the investigation. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. The groundwater levels will fluctuate in conjunction with the water level in the lake, which was near elevation 197 m at the time of the fieldwork.

5.4 Existing and Proposed Embankments

Boreholes 06-M7 to 06-M15, 07-M8 to 07-M10, and 07-M13 were drilled along the existing and proposed embankments.

5.4.1 Pavement and Existing Embankment Fill

A 25 mm thick layer of asphalt, appearing to comprise surface treatment, was encountered in two boreholes drilled through the existing Highway 542 alignment.

The existing embankment fill encountered in the embankment boreholes consists of sand, sand and gravel, and silty sand. The fill contains organics, wood fibres, and cobbles and boulders. It is described as moist and brown, locally dark brown.

SPT N-values obtained in the fill typically ranged from 2 to 21 blows/0.3 m, indicating a very loose to compact condition. Two values of 40 blows/0.3 m and 50 blows/0.125 m penetration were obtained in gravel and rock fragments, respectively.

The natural moisture content of recovered samples ranged from 2 to 22%, with one sample at 45%.

The results of laboratory tests carried out on two samples were as follows:

Gravel %	5 to 22
Sand %	67 to 80
Silt & Clay %	11 to 15

The grain size distribution curves for the samples tested are shown in Figure B1, Appendix B.

The depth to the base of the fill ranged from 0.9 to 2.3 m (elevation 195.5 to 197.0 m).

5.4.2 Topsoil and Peat

A topsoil layer was encountered surficially at five locations along the new embankment location. The topsoil layer was 50 to 500 mm thick. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

A peat layer was encountered surficially at one location (BH07-M8) and below existing embankment fill at another location (BH06-M8) west of the bridge. The surficial and buried peat layers were 300 and 100 mm thick, respectively, with a base elevation of 196.0 m. Moisture contents of 60 and 65% were measured in the peat.

A peat layer was also encountered within the upper silt unit near the west limit of new embankment (BH06-M7). The buried peat layer was 0.9 m thick, extending from 4.3 to 5.2 m depth (elevation 193.5 to 192.6 m). A moisture content of 198% was measured in one sample from this layer.

5.4.3 Upper Silt and Sand Layers

Layers of silt, sandy silt, silty sand and sand were encountered below the fill, peat and topsoil at all but two locations (BH06-M15 and 07-M13). These deposits were typically described as moist to wet and grey, locally brown to dark brown.

SPT N-values obtained in the silt and sand deposits ranged from 1 to 8 blows/0.3 m, indicating a loose to very loose condition.

The natural moisture content of recovered samples ranged from 17 to 39%.

The results of laboratory tests carried out on three samples were as follows:

Gravel %	0
Sand %	5 to 36
Silt %	59 to 87
Clay %	5 to 10

The grain size distribution curves for the samples tested are shown in Figure B2, Appendix B.

The total thickness of the sand/silt layers was 0.1 to 2.8 m, with the base at 0.8 to 4.3 m depth (elevation 193.4 to 195.6 m). At one location at the west end of the study area (BH06-M7), the silt deposit was encountered between 2.3 and 6.1 m depth (elevation 195.5 to 191.7 m) but contains a peat layer between 4.3 and 5.2 m depth.

5.4.4 Silty Clay

A layer of silty clay was encountered below the embankment fill, topsoil, sand and silt at all locations. The clay was described as grey and moist to wet.

Based on SPT values of 0 to 16 blows/0.3 m, the consistency of the clay is very soft to very stiff. The undrained shear strength of the clay, assessed by two in situ vane tests, was 56 and 60 kPa (stiff).

The natural moisture content of the silty clay ranged from 19 to 38%.

The results of laboratory tests carried out on 15 samples were as follows:

Gravel %	0
Sand %	0 to 1
Silt %	53 to 79
Clay %	21 to 46
Liquid Limit	18 to 37 (typically 32 to 36)
Plastic Limit	7 to 21 (typically 17 to 21)

The results of these tests indicate that the silty clay is a CL to CI soil (low to medium plasticity).

The grain size distribution curves for the samples tested are shown in Figures B3 to B5, 07-B3 and 07-B4, Appendix B. The Atterberg Limits are plotted on Figures B13 to B15, 07-B15 and 07-B16.

The clay layer generally ranged in thickness from 1.5 to 4.2 m, increasing to 7.9 m at the east limit of investigation (BH06-M15). The depth to the base of the clay layer ranged from 3.5 to 9.4 m (elevation 188.4 to 193.2 m).

5.4.5 Silt

The clay was underlain by silt at all borehole locations. The silt contained trace to some clay, trace to some sand and was described as grey and wet.

SPT N-values obtained in the silt typically ranged from 1 to 26 blows/0.3 m, indicating a very loose to compact condition.

The natural moisture content of recovered samples ranged from 17 to 30%, typically 17 to 23%.

The results of laboratory tests carried out on 15 samples were as follows:

Gravel %	0
Sand %	1 to 16
Silt %	73 to 91
Clay %	8 to 14

The grain size distribution curves for the samples tested are shown in Figures B6 to B8 and Figures 07-B6 to 07-B8, Appendix B.

The silt unit ranged in thickness from 3.6 to 12.2 m. The depth to the base of the silt ranged from 7.6 to 17.8 m (elevation 180.1 to 189.3 m). One borehole (BH06-M14) was terminated in the silt at 20.1 m depth (elevation 177.6 m).

5.4.6 Sand

Sand was encountered below the silt unit in all but four boreholes (BH06-M7, 06-M14, 06-M15 and 07-M13). The sand contained trace to some silt and occasional gravel and cobbles. It was described as grey and wet.

SPT N-values obtained in the sand ranged from 10 to 42 blows/0.3 m, indicating a compact to dense condition. Values of 74 and 120 blows/0.3 m (very dense) were obtained on single occasions. An isolated value of 2 blows per 0.3 m probably resulted from hydraulic disturbance.

The natural moisture content of recovered samples ranged from 15 to 26%.

The results of laboratory tests carried out on twelve samples were as follows:

Gravel %	0
Sand %	62 to 96
Silt & Clay %	4 to 38

The grain size distribution curves for the samples tested are shown in Figures B10, B11, 07-B10 and 07-B11, Appendix B. The results from one sample, not included in the percentages listed above, indicate the presence of sand and silt layers within the sand.

The sand extended to auger refusal at depths of 33.4 and 32.6 m (elevation 163.2 and 164.1 m) in two boreholes, indicating a deposit thickness of 22.7 and 16.4 m. The remaining boreholes were terminated in the sand at 15.7 to 20.4 m depth.

5.4.7 Localized Clayey Silt, and Silty Clay to Clayey Silt Till

At two locations (BH06-M7 and 07-M13), the non-cohesive silt was underlain by clayey silt. The silt contained trace sand (2 to 4%) and 19 to 23% clay in three samples tested (Figures B6 and 07-B8). SPT N-values of 8 to 18 blows/0.3 m obtained in the clayey silt indicate a stiff to very stiff consistency. Moisture contents of 19 to 30% were measured. The base of this layer was not encountered within the exploration depths of 20.1 and 15.8 m (elevation 177.7 and 180.7 m).

A deposit of till-like silty clay to clayey silt was encountered below the silty clay layer at the east limit of the study area (BH06-M15). This unit was firm to hard, with N-values of 4 and 39 blows/0.3 m recorded. A grain size distribution curve is included in Figure B5. Auger refusal was encountered in this deposit at 13.0 m depth (elevation 184.8 m).

5.4.8 Bedrock and/or Refusal

Auger refusal was encountered on probable bedrock or boulders at the depths and elevations listed in Table 5.5.

Table 5.5 – Depth to Bedrock and/or Refusal

Location	Borehole	Bedrock and/or Refusal		Comment
		Depth (m)	Elevation (m)	
West Embankment	06-M10	33.4	163.2	Probable bedrock
East Embankment	06-M13	32.6	164.1	Probable bedrock
East Embankment	06-M15	13.0	184.8	Probable boulder, possible bedrock

5.4.9 Groundwater

The initial and final groundwater depths and elevations measured in the boreholes and piezometers are shown in Table 5.6.

Table 5.6 – Groundwater Depths and Elevations

Location	Borehole	Tip Depth (m)	Date	Water Level (m)	
				Depth	Elevation
West Embankment	06-M9	20.1	27-Aug-06	3.1	194.6
			31-Aug-06	3.1	194.6
West Embankment	06-M10	32.0	26-Aug-06	2.1	194.5
			27-Aug-06	1.9	194.7
			31-Aug-06	2.1	194.5
			18-Jul-07	1.7	194.9
			20-Jul-07	1.7	194.9
East Embankment	06-M13	32.6	28-Aug-07	1.9	194.7
			27-Aug-06	2.9	193.8
			31-Aug-06	2.9	193.8
			18-Jul-07	1.8	194.9
			20-Jul-07	1.8	194.9
East Embankment	06-M14	20.1	28-Aug-07	1.8	194.9
			27-Aug-06	3.0	194.7
			31-Aug-06	2.8	194.9
			18-Jul-07	1.6	196.1
			20-Jul-07	1.6	196.1

The above water levels reflect the piezometric head at the level of the piezometer tips at the time of the investigation. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. The groundwater levels will fluctuate in conjunction with the water level in the lake, which was near elevation 197 m at the time of the fieldwork.

Artesian pressure to 1.5 m above the ground surface was encountered while drilling at about 25 m depth in borehole 06-M10. The pressure dissipated during continued drilling. Slight artesian pressure was also noted near 9 m depth in borehole 06-M13.

5.5 Field Permeability Testing

Field permeability (slug) testing was carried out in six monitoring wells installed in or adjacent to the existing dam embankment to evaluate the in situ hydraulic conductivity of the embankment and foundation soils. The results of these tests are presented in Appendix C and summarized in Table 5.7. For comparison, the average hydraulic conductivity of the various deposits was also estimated based on Hazen's formula and the grain size distribution curves.

Table 5.7 – Results of Hydraulic Conductivity Tests

Material Type	Monitoring Well	Estimated Hydraulic Conductivity (cm/s)	
		In Situ Test	Hazen's Formula
Embankment Fill	07-M3-2	3×10^{-4}	10^{-3}
	07-M4-2	4×10^{-4}	10^{-3}
Silty Clay	07-M3-5	7×10^{-6}	10^{-6}
	07-M3-8	1×10^{-5}	10^{-6}
Silt	07-M6-8	2×10^{-5}	10^{-5}
Sand	07-M6-12	1×10^{-4}	10^{-2}

The discrepancy in predicted and measured hydraulic conductivity may be attributed to variations in properties within the same deposits, inherent inaccuracies in the test method, and installation of the well infiltration zone (sand filter) partially within two different stratigraphic units.

6 MISCELLANEOUS

McCormick Rankin Corporation determined the co-ordinates and ground elevations at the boreholes following completion of the site investigation.

George Downing Estate Drilling Ltd. supplied and operated the drilling and sampling equipment. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. George Azzopardi and Mr. Stephane Loranger of Thurber.

Supervision of the field program, interpretation of the field data, and preparation of the report was performed by Mr. Murray Anderson, P.Eng. The report was reviewed by Mr. Alastair Gorman, P.Eng., and by Dr. P.K. Chatterji, Ph.D., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.
Murray R. Anderson, P.Eng., M.Eng.
Senior Geotechnical Engineer



Alastair E. Gorman, P.Eng., M.Sc.
Project Manager



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

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

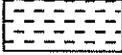
 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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.

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>		
Fresh (FR)	No visible signs of weathering.			
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE	
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE	
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE	
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL	
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)	
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>		
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa) (psi)	Field Estimation of Hardness*
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250 Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m			
Medium bedded	0.2 to 0.6m	Very Strong	100-250 15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m			
Very thinly bedded	20 to 60mm	Strong	50-100 7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm			
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0 3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0 750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0 150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0 35 to 150	Indented by thumbnail
<u>TERMS</u>				
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.			
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.			
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.			
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen			
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.			

RECORD OF BOREHOLE No 07-M01

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.66 E9181.24 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-07-17 - 2007-07-17 CHECKED BY MRA

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							
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL
197.3 0.0	Rockfill Platform ROCKFILL (drilling platform)														
196.1 1.2	SAND , fine to coarse grained, trace to some silt, with organics, trace shells, trace wood fibres Loose Grey Wet		1	SS	9										
194.9 2.4	Silty CLAY , trace sand Firm to soft Grey Wet		2	SS	5										
			1	TW											0 1 56 43
			3	SS	4										0 1 76 23
			4	SS	4										
190.3 7.0	SILT , trace to some clay, trace sand Compact to dense Grey Wet		5	SS	11										
			6	SS	12										0 3 82 15

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

RECORD OF BOREHOLE No 07-M01

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.66 E9181.24 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-07-17 - 2007-07-17 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
	Continued From Previous Page		7	SS	29									
			8	SS	33									
185.1														
12.2	SAND, fine to medium grained, trace silt Compact to dense Grey Wet occasional gravel at 13.7 to 14.4m		9	SS	21									0 97 3 (SI+CL)
			10	SS	22									
			11	SS	31									
			12	SS	36									

ONTMT4S 5195.GPJ 11/2/07

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

RECORD OF BOREHOLE No 07-M01

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.86 E9181.24 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-07-17 - 2007-07-17 CHECKED BY MRA

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	NUMBER	TYPE	"N" VALUES			20	40	60					
Continued From Previous Page														
		13	SS	26		177								
		14	SS	35		176								
		15	SS	42		175								0 97 3 (SI+CL)
						174								
						173								
						172								
						171								
						170								
						169								
						168								

ONTMT4S 5198.GPJ 11/2/07

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

RECORD OF BOREHOLE No 07-M01

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.66 E9181.24 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-07-17 - 2007-07-17 CHECKED BY MRA

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					
162.6	Continued From Previous Page occasional gravel at 29.9 to 31.1m		16	SS	32									
	cobble or large gravel at 34.1m													
34.7	END OF BOREHOLE AT 34.7m. AUGER REFUSAL AT 34.7m ON PROBABLE BEDROCK. BOREHOLE OPEN TO 34.7m AND WATER LEVEL AT 0.9m. BOREHOLE BACKFILLED WITH BENTONITE TO 1.2m AND ROCKFILL TO SURFACE.													

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+³ . X³ : Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M02

1 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9872.33 E9152.51 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-09-08 - 2007-09-08 CHECKED BY MRA

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						
197.9	Ground Surface													
0.0	Gravelly SAND Brown Moist (FILL)	[Hatched Strat Plot]												
197.3														
0.6	COBBLES AND BOULDERS in a sand matrix (FILL)													
195.9														
2.0	SAND, trace to some silt, trace wood fragments and seashells Very loose Brown Wet (FILL)			1	SS	3								
194.8														
3.1	Silty CLAY, trace sand, occasional limestone fragment Stiff to soft Grey Moist to wet	[Hatched Strat Plot]	2	SS	14								0 6 57 37	
194														
	Boulder (200mm)		3	SS	41								Sampler striking boulder. Switched to NW Casing and tricone to penetrate.	
191.8														
6.1	SILT, trace to some clay, trace sand Very loose to compact Grey Wet	[Hatched Strat Plot]	4	SS	2									
191														
			5	SS	17									
190														
189														
188			6	SS	7								0 1 88 11	

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

RECORD OF BOREHOLE No 07-M02

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9872.33 E9152.51 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-08-09 - 2007-08-09 CHECKED BY MRA

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			T _N VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	
	Continued From Previous Page		12	SS	28									
177.5 20.4	END OF BOREHOLE AT 20.4m. BOREHOLE GROUTED WITH BENTONITE TO 0.15m THEN ASPHALT PATCH TO SURFACE.													

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

RECORD OF BOREHOLE No 07-M03

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9868.79 E9166.69 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-10-08 - 2007-10-08 CHECKED BY MRA

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		
198.0	Road Surface										
0.0	ASPHALT: (40mm)										
197.2	Gravelly SAND, some silt Brown Moist (FILL)										
0.8	COBBLES and BOULDERS in a sand matrix (FILL)										
196.6	SAND, some silt to silty, with wood fragments Loose Brown Wet (FILL)		1	SS	8						1 56 42 1
1.4			2	SS	9						
195.0	Silty CLAY, trace sand, trace gravel Stiff to soft Grey Wet		3	SS	10						
3.0			4	SS	5						1 3 63 33
			5	SS	4						
			1	TW							
			6	SS	2						
190.7	SILT, some clay, trace sand, with clay seams Loose to compact Grey Wet		7	SS	7						
7.3			8	SS	8						0 4 85 11

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Continued Next Page

+³. ×³: Numbers refer to Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M03

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam NS868.79 E9166.69 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-08-10 - 2007-08-10 CHECKED BY MRA

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 X LAB VANE					PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W
Continued From Previous Page														
185.8 12.2	SAND, trace silt Very Dense Grey Wet		9	SS	18		188							
								187						
					10	SS	50/ .125		186					
					11	SS	50/ .125		185					
					12	SS	56		184					
							183							
							182							
							181							
							180							
			13	SS	53		179							

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Continued Next Page

+³. X³: Numbers refer to Sensitivity $\frac{20}{15 \oplus 5}{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M03

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9868.79 E9166.69 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-08-10 - 2007-08-10 CHECKED BY MRA

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								
						20	40	60	80	100	20	40	60	KN/m ³	GR SA SI CL	
	Continued From Previous Page															
			14	SS	47											
			15	SS	76											
170.4 27.6	Silty CLAY, trace sand, with sand seams Hard Grey Moist		16	SS	30										0 9 63 28	

ONTMT4S 5198.GPJ 11/2/07

Continued Next Page

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

RECORD OF BOREHOLE No 07-M03

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9868.79 E9166.69 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2007-10-08 - 2007-10-08 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40						60
	Continued From Previous Page														
165.2			17	SS	66/ 275										
32.8	SAND, trace to some silt, trace gravel, trace limestone fragments Very Dense Grey Wet		18	SS	50/ .100										
163.2															
34.8	END OF BOREHOLE AT 34.8m. AUGER REFUSAL AT 34.8m ON PROBABLE BEDROCK BOREHOLE GROUTED WITH BENTONITE TO 0.15m, THEN ASPHALT PATCH TO SURFACE. INSTALLED MONITORING WELLS 07-M3-2, 07-M3-5 AND 07-M3-8 IN SEPARATE HOLES. REFER TO SKETCH FOR DETAILS. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) MW 07-M3-2 2007-08-17 1.29 196.74 2007-08-29 1.34 196.69 MW 07-M3-5 2007-08-17 1.35 196.68 2007-08-28 1.26 196.77 MW 07-M3-8 2007-08-17 2.49 195.54 2007-08-28 2.22 195.81														

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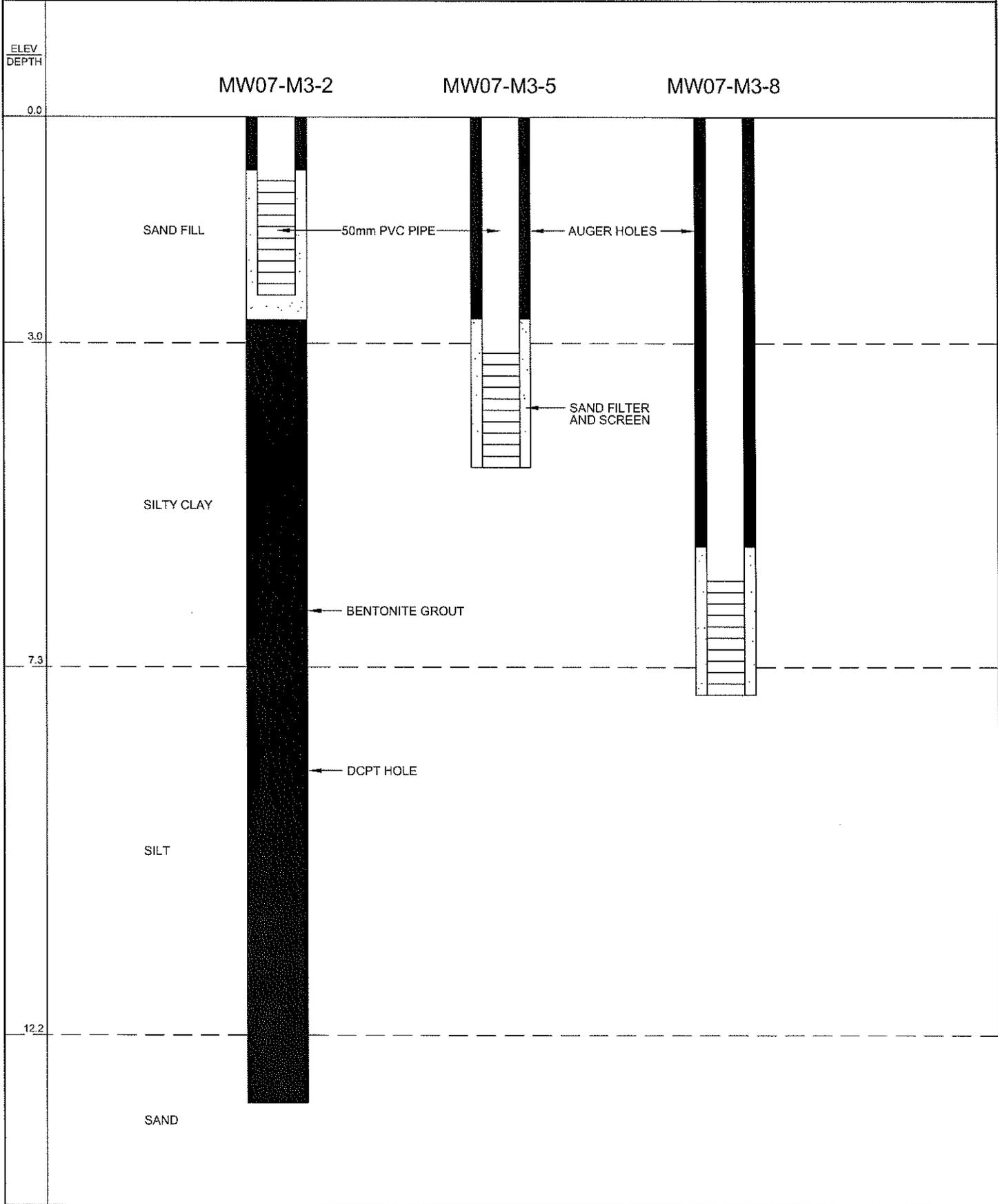
+³, x³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

MONITORING WELL DETAIL No 07-M03

1 OF 1

METRIC

G.W.P. 5460-04-00	LOCATION Mindemoya Lake Bridge and Dam N9868.79 E9168.89	ORIGINATED BY SLL
HWY 542	BOREHOLE TYPE Hollow Stem Augers/NW Casing	COMPILED BY WM
DATUM Geodetic	DATE 2007-08-10 - 2007-08-10	CHECKED BY MRA



RECORD OF BOREHOLE No 07-M04

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.32 E9181.62 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-08-08 - 2007-10-08 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	20
198.0	Road Surface																	
198.0	ASPHALT: (25mm)	[Cross-hatched]	1	AS														
	Gravelly SAND, some silt, occasional cobbles Very Dense Brown Moist (FILL)	[Dotted]	1	SS	50/150													
	with wood fragments Grey Wet	[Diagonal lines]	2	SS	48													
195.6	Silty CLAY, trace sand Firm to stiff Grey Moist to wet	[Horizontal lines]	3	SS	4													
			4	SS	13													
			5	SS	5													
			1	TW														
			6	SS	2													
190.7	SILT, trace to some clay, trace sand Loose to compact Grey Wet	[Vertical lines]	7	SS	19													
			8	SS	5													

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M04

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9876.32 E9181.62 ORIGINATED BY SLL
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-08-08 - 2007-10-08 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued From Previous Page					20 40 60 80 100							
162.9	occasional cobbles		17	SS	100/ .175								
			18	SS	100/ .125								
35.1	END OF BOREHOLE AT 35.1m. AUGER REFUSAL AT 35.1m ON PROBABLE BEDROCK. BOREHOLE BACKFILLED WITH BENTONITE TO 0.15m, THEN ASPHALT PATCH TO SURFACE. INSTALLED MONITORING WELL 07-M4-2 IN DCPT HOLE. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2007-08-17 1.23 196.77 2007-08-29 1.32 196.68												

ONTMT4S 5-198-MINDEMOYA.GPJ 15/11/07

+³, X³: Numbers refer to Sensitivity
 20
 15
 10
 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 07-M05

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9867.95 E9195.58 ORIGINATED BY SLI
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-08-09 - 07/0/90/7 CHECKED BY MRA

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	20	40	60	80						100	W _p	W
	Continued From Previous Page		15	SS	28														
177.5 20.4	END OF BOREHOLE AT 20.4m. BOREHOLE GROUTED WITH BENTONITE TO 0.15m, THEN ASPHALT PATCH TO SURFACE.	[Pattern]				177													10 0 90 (SI+CL)

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+ 3 . X 3 . Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M06

2 OF 5

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9857.86 E9158.58 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-16 - 2007-07-17 CHECKED BY MRA

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							
Continued From Previous Page															
	Dense		10	SS	32										
185.4															
11.6	SAND, fine to medium grained, trace silt Dense to compact Grey Wet		11	SS	44									0 92 8 (SI+CL)	
	Silty from 14.6 to 16.2m		12	SS	40										
	trace gravel at 15.5m		13	SS	30										
			14	SS	24										
	trace gravel at 19.2m														
			15	SS	38										

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Continued Next Page

+³, X³: Numbers refer to Sensitivity
 20
 15 10 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M06

3 OF 5

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9857.86 E9158.58 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-16 - 2007-07-17 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page													
			16	SS	34									0 93 7 (SI+CL)
			17	SS	42									
	trace gravel at 26.8 to 27.7m													
			18	SS	32									

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M06

4 OF 5

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9857.86 E9158.58 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-16 - 2007-07-17 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L				
								WATER CONTENT (%) 20 40 60						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
	Continued From Previous Page clay seam at 29.9m						167							
			19	SS	31		166							
							165							
							164							
162.9	34.1		1	RUN			163					FI 3	RUN 1# TCR=100%, SCR=87%, RQD=90%, UCS=125MPa	
			2	RUN			162					0		
							161					0	RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=127MPa	
							160					0		
159.8	37.2													
	END OF BOREHOLE AT 37.2m. BOREHOLE OPEN TO 37.2m AND WATER LEVEL AT 3.7m ON COMPLETION. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. INSTALLED MONITORING WELL 07-6-8 IN SEPARATE AUGER HOLE. REFER TO SKETCH. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) MW 07-6-8 2007-07-18 2.25 194.73 2007-07-20 2.00 194.98 2007-08-17 2.21 194.77 2007-08-28 2.56 194.42 MW 07-6-12 2007-07-18 1.89 195.09 2007-07-20 1.81 195.17													

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M06

5 OF 5

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9857.86 E9158.58 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-16 - 2007-07-17 CHECKED BY MRA

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y 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					
	Continued From Previous Page																	
	2007-08-17 1.92 195.06																	
	2007-08-28 2.36 194.62																	

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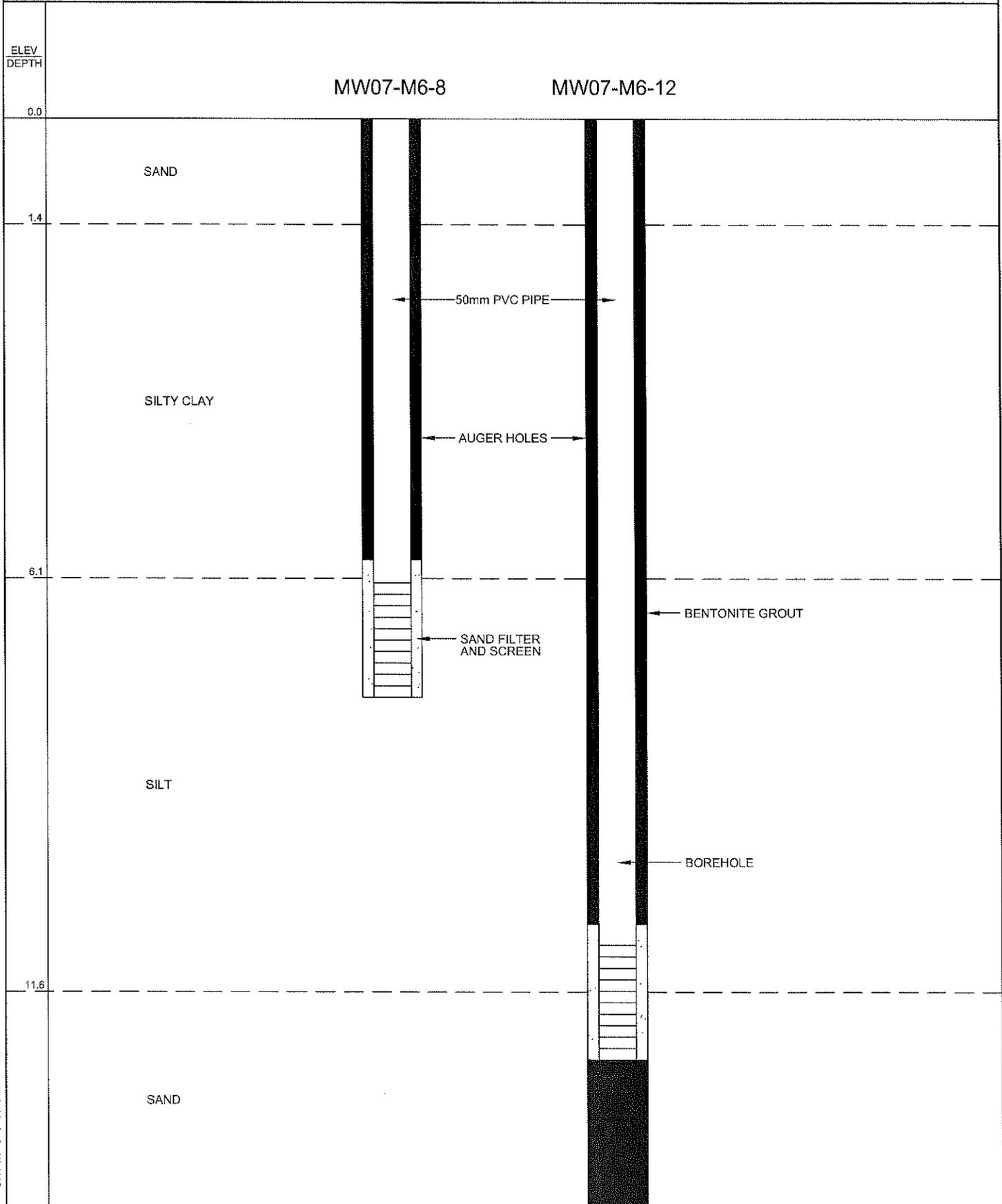
+³ . X³ : Numbers refer to Sensitivity 20
15
10 5 (%) STRAIN AT FAILURE

MONITORING WELL DETAIL No 07-M06

1 OF 1

METRIC

G.W.P. 5460-04-00	LOCATION Mindemoya Lake Bridge and Dam N9857.86 E9158.58	ORIGINATED BY GA
HWY 542	BOREHOLE TYPE Hollow Stem Augers/NQ Coring	COMPILED BY WM
DATUM Geodetic	DATE 2007-07-16 - 2007-07-17	CHECKED BY MRA



RECORD OF BOREHOLE No 07-M07

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9853.87 E9181.08 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-18 - 2007-07-19 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
195.2	Ground Surface															
0.0	ROCKFILL (drilling platform)															
194.4	Silty CLAY Firm to soft Grey Wet		1	SS	6											
					2	SS	2									0 0 70 30
193.0	SILT, trace clay to clayey, trace sand Loose to compact Grey Wet		3	SS	4											
					4	SS	8									
					5	SS	16									
			6	SS	8									0 2 83 15		
			7	SS	12											
186.8	Clayey SILT to silty CLAY, trace sand Stiff Grey Wet		8	SS	11											
8.4																

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M07

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9853.87 E9181.08 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-18 - 2007-07-19 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
Continued From Previous Page																
183.6			9	SS	10											0 0 77 23
11.6	SAND, fine to medium grained, trace to some silt, trace gravel, occasional silt inclusions Compact to dense Grey Wet		10	SS	32											
			11	SS	36											
			12	SS	27											
			13	SS	23											3 82 15 (SI+CL)
			14	SS	28											

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M07

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9853.87 E9181.08 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-18 - 2007-07-19 CHECKED BY MRA

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					
Continued From Previous Page							20 40 60 80 100						
			15	SS	36								
			16	SS	36								
			17	SS	44								

ONTMT4S 5198.GPJ 11/2/07

Continued Next Page

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

RECORD OF BOREHOLE No 07-M07

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9853.87 E9181.08 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-18 - 2007-07-19 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
	Continued From Previous Page																	
165.0																		
30.2	END OF BOREHOLE AT 30.2m. AUGER REFUSAL AT 30.2m ON POSSIBLE BOULDER OR BEDROCK. BOREHOLE OPEN TO 30.2m AND WATER LEVEL AT 0.9m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2007-07-20 1.37 193.86 2007-08-17 0.68 194.55 2007-08-28 1.02 194.21					165												

ONTMT4S 5195.GPJ 11/2/07

RECORD OF BOREHOLE No 07-M08

1 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9893.23 E8995.38 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-13 - 2007-07-13 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40						60	80	100	20
196.3	Ground Surface																	
0.0	PEAT																	
196.0	Dark brown		1	SS	6													
0.3	SILT , trace sand, trace rootlets Loose Grey Damp to wet		2	SS	6													
194.8																		
1.5	Silty CLAY Stiff to firm Grey Moist to wet		3	SS	13													0 0 56 44
			4	SS	14													
			5	SS	5													
192.3																		
4.0	SILT , trace clay, trace to some sand, occasional clay seams Compact to loose Grey Wet		6	SS	12													
			7	SS	26													0 12 79 9
			8	SS	18													
			9	SS	14													

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Continued Next Page

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

RECORD OF BOREHOLE No 07-M08

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9893.23 E8995.38 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-13 - 2007-07-13 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
Continued From Previous Page														
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE														
20 40 60 80 100 20 40 60 80 100														
182.9			10	SS	8									
182.9			11	SS	3									0 7 85 8
13.4	SAND, fine grained, trace silt Compact to very dense Grey Wet		12	SS	18									
180.6			13	SS	74									
15.7	END OF BOREHOLE AT 15.7m. BOREHOLE OPEN TO 15.2m AND WATER LEVEL AT 1.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 5198.GPJ 11/2/07

RECORD OF BOREHOLE No 07-M09

1 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9877.56 E9042.05 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-13 - 2007-07-13 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
196.4	Ground Surface														
0.0	TOPSOIL: (150mm)														
0.2	Sandy SILT, occasional rootlets Loose Brown Moist		1	SS	8										
195.6															
0.8	Silty CLAY, trace sand Stiff to firm Grey Moist to wet		2	SS	9										
			3	SS	11										
			4	SS	8									0 1 59 40	
192.9			5	SS	4										
3.5	SILT, trace to some clay, trace sand Loose to compact Grey Wet														
			6	SS	15										
			7	SS	13										
			8	SS	8									0 1 86 13	
			9	SS	17										

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Continued Next Page

+³ × 3³ Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M09

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9877.56 E9042.05 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-13 - 2007-07-13 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60			
	Continued From Previous Page															
184.2			10	SS	10											
12.2	SAND, fine to medium grained, trace to some silt Compact to dense Grey Wet		11	SS	42											0 92 8 (SI+CL)
			12	SS	20											
180.6			13	SS	32											0 87 13 (SI+CL)
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															

ONTMT4S 5198.GPJ 11/2/07

+³.x³; Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M10

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9863.56 E9084.88 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-13 - 2007-07-14 CHECKED BY MRA

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													
	occasional silt inclusions		10	SS	26									
			11	SS	17									
			12	SS	15									
181.1			13	SS	34									0 62 38 (SH+CL)
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.2m AND WATER LEVEL AT 2.3m ON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 6196.GPJ 11/2/07

+³, X³: Numbers refer to Sensitivity

20
15
10
5
0

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M11

1 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9849.13 E9136.60 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-15 - 2007-07-15 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
196.8	Ground Surface															
0.0	TOPSOIL: (200mm)															
0.2	SAND, trace silt, mixed with topsoil, occasional rootlets, shells and wood fibres Loose to compact Brown to grey Moist to wet		1	SS	10											
			2	SS	9											
195.4	Silty CLAY, trace sand Stiff Grey Moist to wet		3	SS	12											
1.4			4	SS	13											
			5	SS	8											
			6	SS	11											
			7	SS	27											
192.2	SILT, trace to some clay, trace sand Compact to dense Grey Wet		8	SS	33											
4.6			9	SS	10											
			10	SS	10											
187.7	SAND, fine to medium grained, trace silt Compact to dense Grey Wet		11	SS	10											
9.1			12	SS	10											

ONTM14S 5198-MINDEMOYA.GPJ 08/11/8

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M11

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9849.13 E9136.60 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-15 - 2007-07-15 CHECKED BY MRA

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							
						20	40	60	80	100	20	40	60	KN/m ³	GR SA SI CL
	Continued From Previous Page														
			10	SS	40										
			11	SS	21										0 94 6 (SI+CL)
			12	SS	49										
			13	SS	33										
181.0															
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.2m AND WATER LEVEL AT 1.7m ON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2007-07-18 1.97 194.82 2007-07-20 1.96 194.83 2007-08-17 2.09 194.70 2007-08-28 2.31 194.48														

ONTMT4S 5196.GPJ 11/2/07

RECORD OF BOREHOLE No 07-M12

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9839.73 E9198.99 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-12 - 2007-07-12 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40
	Continued From Previous Page																		
165.0			10	SS	6														
11.9	SAND, fine to medium grained, trace to some silt Compact to dense Grey Wet		11	SS	20														
			12	SS	42														
			13	SS	36														
181.1																			
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 3.0m ON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																		

ONTMT4S 5198.GPJ 11/2/07

+³, X³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M13

1 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9833.74 E9246.39 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-12-07 - 2007-12-07 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40						60	80	100	20
196.5	Ground Surface																	
0.0	TOPSOIL: (150mm)																	
0.2	Silty CLAY , trace sand, occasional rootlets Very stiff to firm Brown to grey Moist to wet		1	SS	11													
			2	SS	16													
			3	SS	11													
			4	SS	11													
			5	SS	7													0 1 68 31
192.8	SILT , trace to some clay, trace sand Compact Grey Wet																	
3.7			6	SS	13													
			7	SS	23													
			8	SS	14													0 4 84 12
187.8	Clayey SILT , trace sand Stiff to very stiff Grey																	
8.7			9	SS	16													0 4 73 23

ONTMT4S 5198-MINDEMOYA.GPJ 08/11/8

Continued Next Page

+³, X³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M13

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9833.74 E9246.39 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-12 - 2007-07-12 CHECKED BY MRA

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						
Continued From Previous Page						20	40	60	80	100	20	40	60	
180.7			10	SS	8									
			11	SS	12									
			12	SS	18									0 3 78 19
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 2.7m ON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.		13	S	14									

ONTMT4S 5195.GPJ 11/2/07

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

RECORD OF BOREHOLE No 07-M14

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9844.84 E9154.49 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-15 - 2007-07-15 CHECKED BY MRA

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			T ⁿ VALUES	20	40	60	80						100	W _p
	Continued From Previous Page																	
	gravelly seam at 20.7m					176												
			16	SS	34	174												
	occasional large gravel at 22.9 to 24.4m					173												
			17	SS	29	171												
	occasional gravel at 25.9 to 27.4m					170												
			18	SS	33	168												0 63 37 (SI+CL)
						167												

Continued Next Page

+³ × 3³ Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 5198.GPJ 11/2/07

RECORD OF BOREHOLE No 07-M14

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9844.84 E9154.49 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-07-15 - 2007-07-15 CHECKED BY MRA

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								
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
Continued From Previous Page	clay seam at 29.9m															
166																
165			19	SS	34											
164																
163.0																
33.8	END OF BOREHOLE AT 33.8m. AUGER REFUSAL AT 33.8m ON PROBABLE BEDROCK. BOREHOLE OPEN TO 33.8m AND WATER LEVEL AT 3.4m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2007-07-18 2.08 194.72 2007-07-20 2.08 194.72 2007-08-17 2.01 194.79 2007-08-28 1.83 194.97															

ONTMT4S 5198.GPJ 11/2/07

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

RECORD OF BOREHOLE No 07-M15

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9841.29 E9181.37 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-19 - 2007-07-20 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	20 40 60					
195.4 0.0	Rockfill Platform	[Cross-hatched]													
194.2 1.2	ROCKFILL (drilling platform)	[Cross-hatched]													
192.4 3.0	Silty CLAY Firm Grey Wet	[Diagonal lines]	1	SS	5										
			2	SS	4										
	SILT, trace sand, trace to some clay Loose to compact Grey Wet	[Vertical lines]	3	SS	4									0 1 83 16	
			4	SS	12										
			5	SS	11										
			6	SS	9										
			7	SS	8									1 5 81 13	

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Continued Next Page

+³, X³: Numbers refer to Sensitivity
 20
 15 ⊕ 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M15

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9841.29 E9181.37 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-19 - 2007-07-20 CHECKED BY MRA

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			"N" VALUES	20					
	Continued From Previous Page												
184.4	Compact		8	SS	15								
11.0	SAND, fine to medium grained, trace to some silt, occasional silt inclusions Compact to dense Grey Wet		9	SS	32								0 75 25 (SI+CL)
			10	SS	25								
			11	SS	40								
	occasional gravel at 15.2 to 15.9m		12	SS	37								0 95 5 (SI+CL)
			13	SS	27								

ONTMT4S 5198.GPJ 11/2/07

Continued Next Page

+³ × 3³: Numbers refer to Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-M15

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9841.29 E9181.37 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM
 DATUM Geodetic DATE 2007-07-19 - 2007-07-20 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20 40 60 80 100 20 40 60 80 100				20 40 60 20 40 60						
	Continued From Previous Page															
163.4							165									
	cobble (100mm)						164									
32.0							163									
	Grey to brown, fresh, thinly bedded, strong to very strong DOLOSTONE		1	RUN			162									
			2	RUN			161									
160.3																
35.1																
	END OF BOREHOLE AT 35.1m. BOREHOLE OPEN TO 35.1m AND WATER LEVEL AT 1.1m ON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2007-08-17 0.57 194.78 2007-08-28 1.35 194.00															

ONTMT-45 5198-MINDEMOYA.GPJ 15/11/07

+³ ×³: Numbers refer to
Sensitivity

20
15-0-5
10 (%) STRAIN AT FAILURE

**Record of Borehole Sheets
from Preliminary Investigation**

RECORD OF BOREHOLE No 06-M01

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9878.4 E9169.6 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

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			20	40	60					
196.9	Rockfill Platform														
0.0	ROCK FILL (drilling platform)														
196.3	SAND, occasional wood fibres Very Loose Grey Wet		1	SS	2										
0.6			2	SS	2										
194.6	Silty CLAY, trace sand Firm to Soft Grey Wet (CL-ML)		3	SS	7										
2.3			4	SS	2										0 1 61 38
			5	SS	2										
			6	SS	2										
190.8	SILT, trace sand Very Loose to Compact Grey Wet (ML-NP)		7	SS	10										0 3 90 7
6.1			8	SS	12										

ONTMT4S 5198-MINDEMOYA.GPJ 08/17/18

Continued Next Page

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

RECORD OF BOREHOLE No 06-M03

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9865.0 E9166.1 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-24 - 2006-08-24 CHECKED BY MA

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		
198.1	Road Surface											
0.0	ASPHALT: (25 mm)	[Cross-hatched]	1	GS								
	SAND, some gravel, some silt, occasional wood and rock fragments, trace organics Compact to Dense Brown Moist (FILL)	[Cross-hatched]	1	SS	29							
	Loose	[Cross-hatched]	2	SS	38							
195.4			3	SS	5							
2.7	Silty CLAY, trace sand Soft Grey Wet	[Diagonal lines]	4	SS	3							
		[Diagonal lines]	5	SS	2							0 1 74 25
192.0			6	SS	1							
6.1	SILT, some sand Very Loose to Loose Grey Wet	[Vertical lines]	7	SS	8							0 1 89 10
		[Vertical lines]	8	SS	3							

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Continued Next Page

+³ X³: Numbers refer to Sensitivity
 20
 15 10 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M03

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9865.0 E9166.1 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-24 - 2006-08-24 CHECKED BY MA

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						
	Continued From Previous Page													
186.2			9	SS	3									
11.9	SAND , fine to medium grained, trace silt Dense to Compact Grey Wet		10	SS	30									
			11	SS	39									0 92 8 (SI+CL)
			12	SS	25									
			13	SS	15									

Continued Next Page

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

RECORD OF BOREHOLE No 06-M03

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9865.0 E9166.1 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-24 - 2006-08-24 CHECKED BY MA

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								
	Continued From Previous Page											
	Continued from previous page		14	SS	15							
			15	SS	22							0 92 8 (SI+CL)
	Occasional silt layer		16	SS	27							
	some silt, trace gravel, occasional limestone fragments											

ONTM14S 5198.GPJ 11/2/07

Continued Next Page

+³ · X³: Numbers refer to Sensitivity
 20
 15 10 5 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M03

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9865.0 E9166.1 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-24 - 2006-08-24 CHECKED BY MA

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	20	40	60					
	Continued From Previous Page														
	Continued from previous page		17	SS	25										16 65 19 (SI+CL)
			18	SS	44										
163.0															
35.1	END OF BOREHOLE AT 35.10 m. AUGER REFUSAL AT 35.10m ON PROBABLE BEDROCK. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-27 3.46 194.6 2006-08-31 3.56 194.5														

ON1MT4S 5198.GPJ 11/2/07

RECORD OF BOREHOLE No 06-M04

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9863.6 E9180.7 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-22 - 2006-08-23 CHECKED BY MA

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		
198.0	Road Surface											
0.8	ASPHALT: (25 mm)		1	GS								
	SAND, some gravel, some silt Compact Brown Moist (FILL)		1	SS	11							15 70 15 (SI+CL)
196.6												
1.4	SAND, some silt to silty, trace gravel, trace organics, occasional wood fragments Compact to Loose Dark Brown Moist to Wet (FILL)		2	SS	28							
			3	SS	14							
			4	SS	5							
194.0												
4.0	Silty CLAY, trace sand Soft Grey		5	SS	2							0 2 67 31
191.9												
6.1	SILT, trace sand, trace clay Grey Wet		6	SS	2							
			7	SS	10							
			8	SS	2							

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Continued Next Page

+³, X³: Numbers refer to Sensitivity
 20
 15 10 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M04

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9863.6 E9180.7 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-22 - 2006-08-23 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		WATER CONTENT (%)			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page												
	Continued from previous page	9	SS	6									0 2 89 9
		10	SS	3									
184.9													
13.1	SAND, fine to medium grained, trace to some silt Loose to Compact Brown Wet	11	SS	1									
		12	SS	12									0 92 8 (SH+CL)
		13	SS	18									
	with layers of reddish brown sand and silt from 17.4m to 18.9m	14	SS	8									0 49 47 4
		15	SS	12									

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M04

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9863.6 E9180.7 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-22 - 2006-08-23 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	Wp	W	Wl	WATER CONTENT (%)		
	Continued From Previous Page												
	Continued from previous page												
	Grey	16	SS	17									
		17	SS	13									
		18	SS	28									
		19	SS	16									

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M04

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9863.6 E9180.7 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-22 - 2006-08-23 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			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					W _P	W		
							20 40 60 80 100					20 40 60				
							○ UNCONFINED + FIELD VANE									
							● QUICK TRIAXIAL X LAB VANE									
							20 40 60 80 100					20 40 60				
	Continued From Previous Page															
	Continued from previous page		20	SS	34											0 80 20 (SH+CL)
	with cobbles		21	SS	38											
162.8	Possible cobbles or weathered rock.															
35.2	Dark brown, fresh, thinly bedded, very strong, DOLOSTONE		1	RUN												Run #1 -no recovery in top 275mm; probable cobbles or weathered rock TCR=78% SCR=78% RQD=78% UCS=122MPa Run #2 TCR=100% SCR=100% RQD=98% UCS=151MPa
160.3	END OF BOREHOLE AT 37.7 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		2	RUN												
37.7	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-27 3.31 194.7 2006-08-31 3.55 194.5 2007-07-18 3.25 194.8															

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+³. X³: Numbers refer to Sensitivity 20 15 10 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 06-M07

2 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9963.0 E8870.2 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)			
						20	40	60	80	100	20	40	60	
	Continued From Previous Page													
	Continued from previous page		10	SS	9									
						187								
			11	SS	23									0 1 91 8
						186								
			12	SS	14									
						185								
						184								
			13	SS	20									
						183								
						182								
181.3						181								0 2 77 21
16.5	Clayey SILT, trace sand Stiff Grey Wet		14	SS	14									
						180								
						179								
			15	SS	10									
						178								

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M07

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9963.0 E8870.2 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
177.7	Continued From Previous Page	<input checked="" type="checkbox"/>													
20.1	END OF SAMPLED BOREHOLE AT 20.12 m.														
171.3															
26.5	END OF DCPT AT 26.52 m. BOREHOLE BACKFILLED WITH BENTONITE AND PATCHED WITH ASPHALT AT SURFACE.														

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

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RECORD OF BOREHOLE No 06-M08

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9923.5 E8961.3 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

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
198.0	Shoulder Surface													
0.0	SAND and GRAVEL , trace silt, trace organics Dense to Loose Brown Moist (FILL)		1	SS	40									
			2	SS	5									
196.1			3	SS	4									
196.8	PEAT													
2.0	SILT , trace sand, trace clay Loose to Very Loose Grey Moist		4	SS	2									
			5	SS	4									0 8 82 10
193.7			6	SS	4									
4.3	Silty CLAY Firm to Very Soft Grey Moist to Wet		7	SS	1									0 1 53 46
			8	SS	4									
189.5			9	SS	5									
8.5	SILT , trace clay, trace sand Loose to Very Loose Grey Wet													

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M08

2 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9923.5 E8961.3 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

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						
						20	40	60	80	100	20	40	60	GR SA SI CL
	Continued From Previous Page													
	Continued from previous page		10	SS	1									
			11	SS	1									
			12	SS	1									0 7 82 11
			13	SS	1									
			14	SS	2									
180.2														
17.8	SAND, fine grained, trace silt Compact Grey Wet													
			15	SS	21									0 91 9

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M08

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9923.5 E8961.3 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

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 (SIFCD)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100	20	40	60		
177.9	Continued From Previous Page														
20.1	END OF SAMPLED BOREHOLE AT 20.12 m.														

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Continued Next Page

+³, X³; Numbers refer to Sensitivity 20 15 10 5 0 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 06-M08

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9923.5 E8961.3 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-27 - 2006-08-27 CHECKED BY MA

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						
	Continued From Previous Page									
166.6 31.4	END OF DCPT AT 31.39 m. BOREHOLE BACKFILLED WITH BENTONITE AND PATCHED WITH ASPHALT AT SURFACE.									

ONTMT4S 5195.GPJ 11/2/07

RECORD OF BOREHOLE No 06-M09

1 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9914.2 E9012.9 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-26 - 2006-08-26 CHECKED BY MA

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						
						20	40	60	80	100	20	40	60	GR SA SI CL
197.7	Shoulder Surface													
0.0	SAND, some gravel, some silt, trace organics Compact Brown Moist (FILL)	[Cross-hatched pattern]	1	SS	16									
			2	SS	12									
196.2	SILT, trace sand, trace clay Loose to Very Loose Grey Moist to Wet	[Vertical lines pattern]	3	SS	6									
1.5			4	SS	3									
			5	SS	1									
193.4	Silty CLAY, trace sand Soft Grey Wet	[Diagonal lines pattern]	6	SS	2									
4.3			7	SS	1									
			8	SS	1									
189.2	SILT, trace sand, trace clay Compact Grey Wet	[Vertical lines pattern]	9	SS	11									
8.5														

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M09

2 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9914.2 E9012.9 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-26 - 2006-08-26 CHECKED BY MA

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					
	Continued From Previous Page												
	Continued from previous page		10	SS	10								
			11	SS	24								0 2 88 10
183.9			12	SS	17								
13.8	SAND, fine grained, some silt Compact Grey Wet		13	SS	25								
			14	SS	15								0 81 19 (SI+CL)
			15	SS	23								

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M09

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9914.2 E9012.9 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-26 - 2006-08-26 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
177.6	Continued From Previous Page															
20.1	END OF BOREHOLE AT 20.12 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-27 3.08 194.7 2006-08-31 3.10 194.6					177										

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RECORD OF BOREHOLE No 06-M10

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9886.0 E9051.4 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-23 - 2006-08-24 CHECKED BY MA

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					
	Continued From Previous Page														
	Continued from previous page		18	SS	33										0 72 28 (SI+CL)
	occasional limestone fragments														
163.2			19	SS	140										
33.4	AUGER REFUSAL AT 33.38 m ON PROBABLE BEDROCK OR BOULDERS. WATER LEVEL AT 3.05 m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. END OF BOREHOLE AT 33.38 m. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-26 2.10 194.5 2006-08-27 1.89 194.7 2006-08-31 2.10 194.5 2007-07-18 1.73 194.9 2007-07-20 1.70 194.9 2007-08-28 1.88 194.7														

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RECORD OF BOREHOLE No 06-M11

1 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9874.6 E9107.3 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-23 - 2006-08-23 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40						60	80	100	20	40	60
197.9	Road Surface																			
197.0	ASPHALT: (25 mm) SAND, trace gravel, trace silt Compact Brown Dry (FILL)		1	SS	20															
197.0	Sandy SILT, trace organics, occasional wood fibres Loose to Very Loose Dark Brown to Grey Moist to Wet		2	SS	6															
			3	SS	7														0 36 59 5	
			4	SS	1															
			5	SS	2															
194.9	Silty CLAY, trace sand Very Soft Grey Wet		6	SS	2															
192.4			7	SS	10															
192.4	SILT, some sand, trace clay Compact to Very Loose Grey Wet		8	SS	3															
188.8			9	SS	22														0 16 73 11	
188.8	SAND, fine grained, trace to some silt Compact Grey Wet																			

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M11

2 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9874.6 E9107.3 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-23 - 2006-08-23 CHECKED BY MA

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	NUMBER	TYPE	"N" VALUES			20	40	60					
	Continued From Previous Page													
	Continued from previous page													
		10	SS	15		187								
						186								
		11	SS	22		185								
						184								
		12	SS	22		183								
						182								
		13	SS	28		181								0 84 16 (SI+CL)
						180								
	fine to medium grained Dense	14	SS	30		179								
						178								

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M11

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9874.6 E9107.3 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-23 - 2006-08-23 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued From Previous Page						20 40 60 80 100						
177.5			15	SS	35								
20.4	END OF BOREHOLE AT 20.42 m. BOREHOLE OPEN TO 19.81 m AND WATER LEVEL AT 5.18 m. BOREHOLE BACKFILLED WITH BENTONITE AND PATCHED WITH ASPHALT AT SURFACE.					177							

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+³, X³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M12

2 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9866.0 E9239.5 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-26 - 2006-08-26 CHECKED BY MA

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	NUMBER	TYPE	"N" VALUES			20	40	60					
	Continued From Previous Page													
	Continued from previous page	10	SS	10										0 4 82 14
		11	SS	6										
		12	SS	11										
		13	SS	2										0 1 86 13
		14	SS	16										
180.1 17.7	SAND , fine to medium grained Compact Grey Wet													
		15	SS	15										

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Continued Next Page

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

RECORD OF BOREHOLE No 06-M13

1 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9847.6 E9296.2 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-26 CHECKED BY MA

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					
196.7	Ground Surface												
0.0	TOPSOIL Dark Brown		1	SS	7								
196.2													
0.5	Silty SAND , fine grained Loose Grey Damp		2	SS	8								
195.2													
1.5	Silty CLAY Stiff Grey Wet		3	SS	11								
			4	SS	8								
			5	SS	8							0 0 64 36	
			6	SS	2								
191.2	SOFT												
5.5	SILT , trace sand, trace clay Very Loose to Loose Grey Wet		7	SS	1								
			8	SS	2							0 2 90 8	
			9	SS	2								Slight artesian pressure

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity $\frac{20}{15-5} = 2$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M13

3 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9847.6 E9296.2 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-26 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	
	Continued From Previous Page Continued from previous page													
			16	SS	24									
			17	SS	23									0 71 29 (SI+CL)
	compact to dense		18	SS	33									

ONTMT4S 5198.GPJ 11/2/07

Continued Next Page

+³. X³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M13

4 OF 4

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9847.6 E9296.2 ORIGINATED BY GA
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-26 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
	Continued From Previous Page					20 40 60 80 100	20 40 60							
	Continued from previous page		19	SS	29	166								
164.1						165								
32.6	END OF BOREHOLE AT 32.61 m. AUGER REFUSAL AT 32.61 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 32.61 m AND WATER LEVEL AT 3.51 m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-27 2.93 193.7 2006-08-31 2.89 193.8 2007-07-18 1.84 194.9 2007-07-20 1.78 195.0 2007-08-28 1.76 195.0													

ONTM14S 5195.GPJ 11/2/07

RECORD OF BOREHOLE No 06-M14

2 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9854.2 E9342.9 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-25 CHECKED BY MA

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						
Continued From Previous Page														
	Continued from previous page		10	SS	3									
						187								
			11	SS	4									0 10 83 7
						186								
			12	SS	3									
						185								
			13	SS	1									
						184								
						183								
			14	SS	1									
						182								
						181								
						180								
						179								
	occasional cobbles		15	SS	1									
						178								

ONTMT4S 5198.GPJ 11/2007

Continued Next Page

+³, X³: Numbers refer to Sensitivity
 20
 15
 10
 5
 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-M14

3 OF 3

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9854.2 E9342.9 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-25 CHECKED BY MA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100	W _p	W	W _L		
177.6	Continued From Previous Page														
20.1	END OF BOREHOLE AT 20.12 m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2006-08-27 3.01 194.7 2006-08-31 2.83 194.9 2007-07-18 1.63 196.1 2007-07-20 1.58 196.2 2007-08-28 1.83 196.0														
						177									

ONTMT4S 5198.GPJ 11/2/07

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

RECORD OF BOREHOLE No 06-M15

2 OF 2

METRIC

G.W.P. 5460-04-00 LOCATION Mindemoya Lake Bridge and Dam N9865.5 E9443.1 ORIGINATED BY KH
 HWY 542 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY WM
 DATUM Geodetic DATE 2006-08-25 - 2006-08-25 CHECKED BY MA

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						
	Continued From Previous Page													
	Grey Wet (TILL-LIKE)		10	SS	4								0 24 52 24	
	Hard occasional limestone fragments		11	SS	39									
184.8 13.0	END OF BOREHOLE AT 12.95 m. AUGER REFUSAL AT 12.95 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE BACKFILLED WITH BENTONITE.													

ONTMT4S 5196.GPJ 11/2/07

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

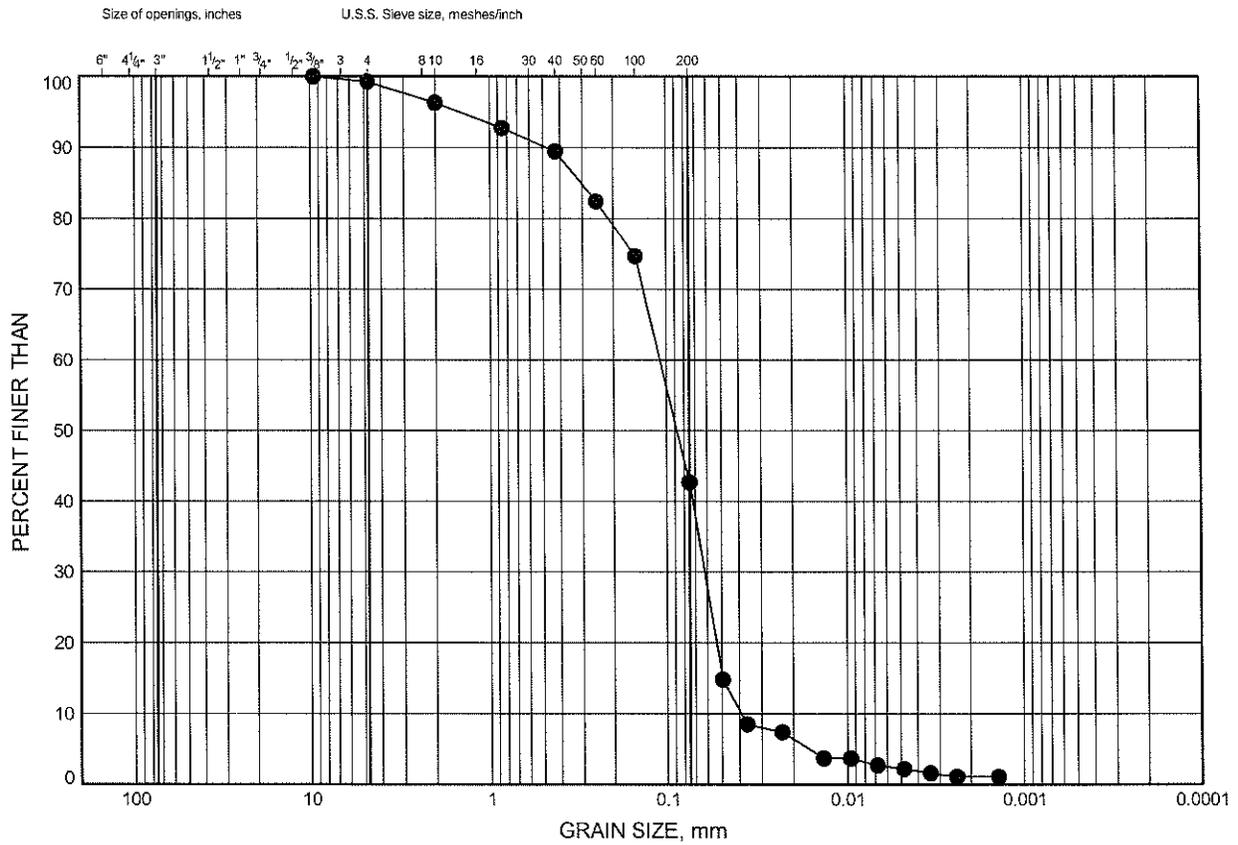
Appendix B

Laboratory Test Results

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B1

FILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M03	1.83	196.17

Date November 2007
 Project 5460-04-00

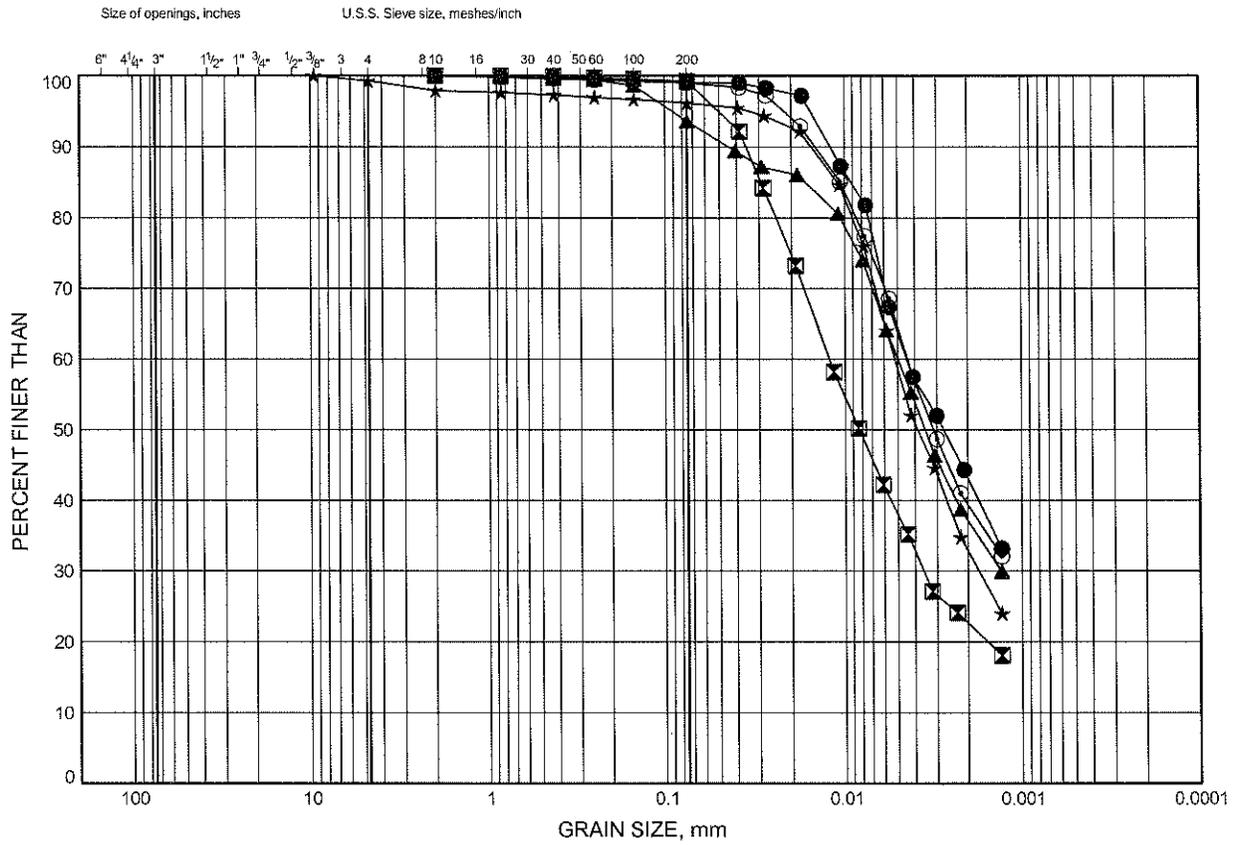


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B2

SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M1	3.33	193.97
⊠	07-M1	4.88	192.42
▲	07-M2	3.33	194.57
★	07-M3	4.11	193.89
⊙	07-M4	4.11	193.89

THURBGSD 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



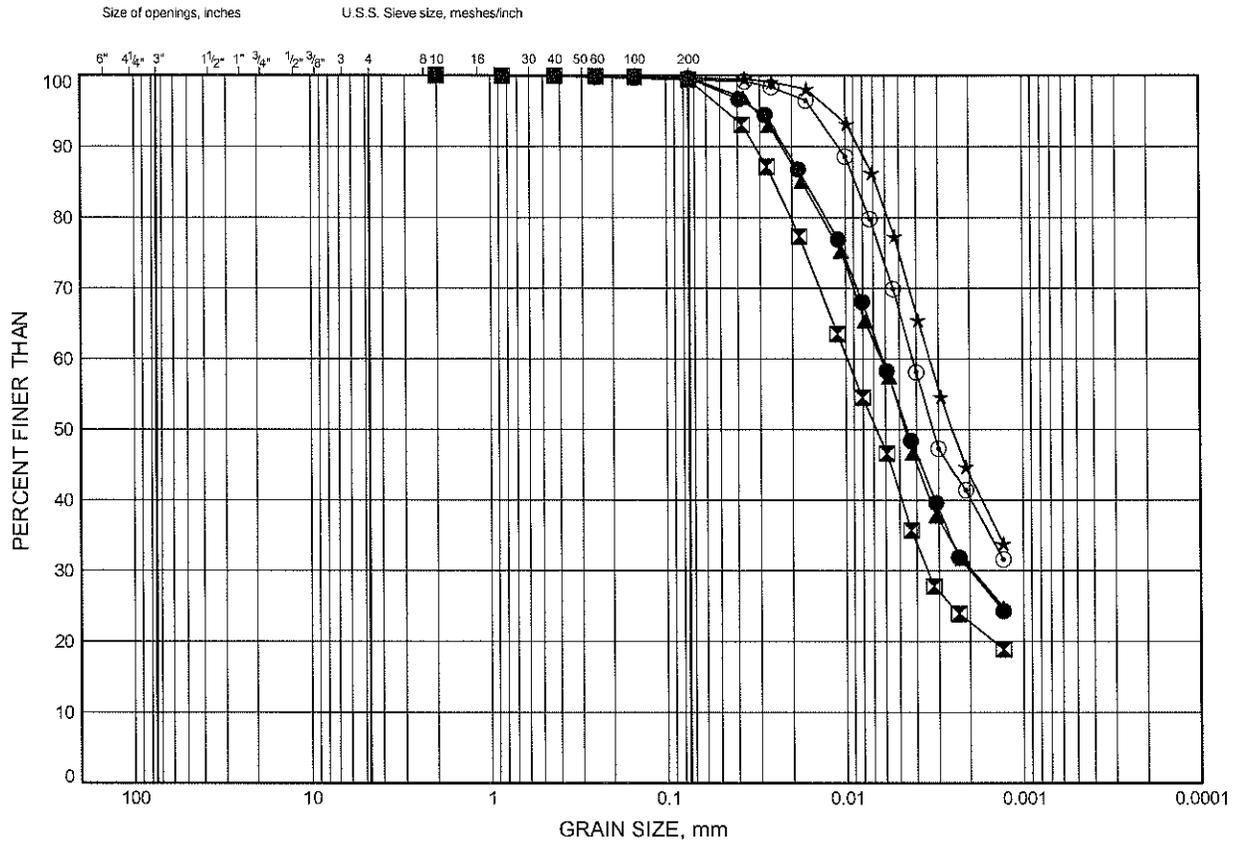
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B3

SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M5	4.88	193.02
⊠	07-M6	3.35	193.65
▲	07-M7	1.83	193.37
★	07-M8	1.83	194.47
⊙	07-M9	2.59	193.81

THURBGSD 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



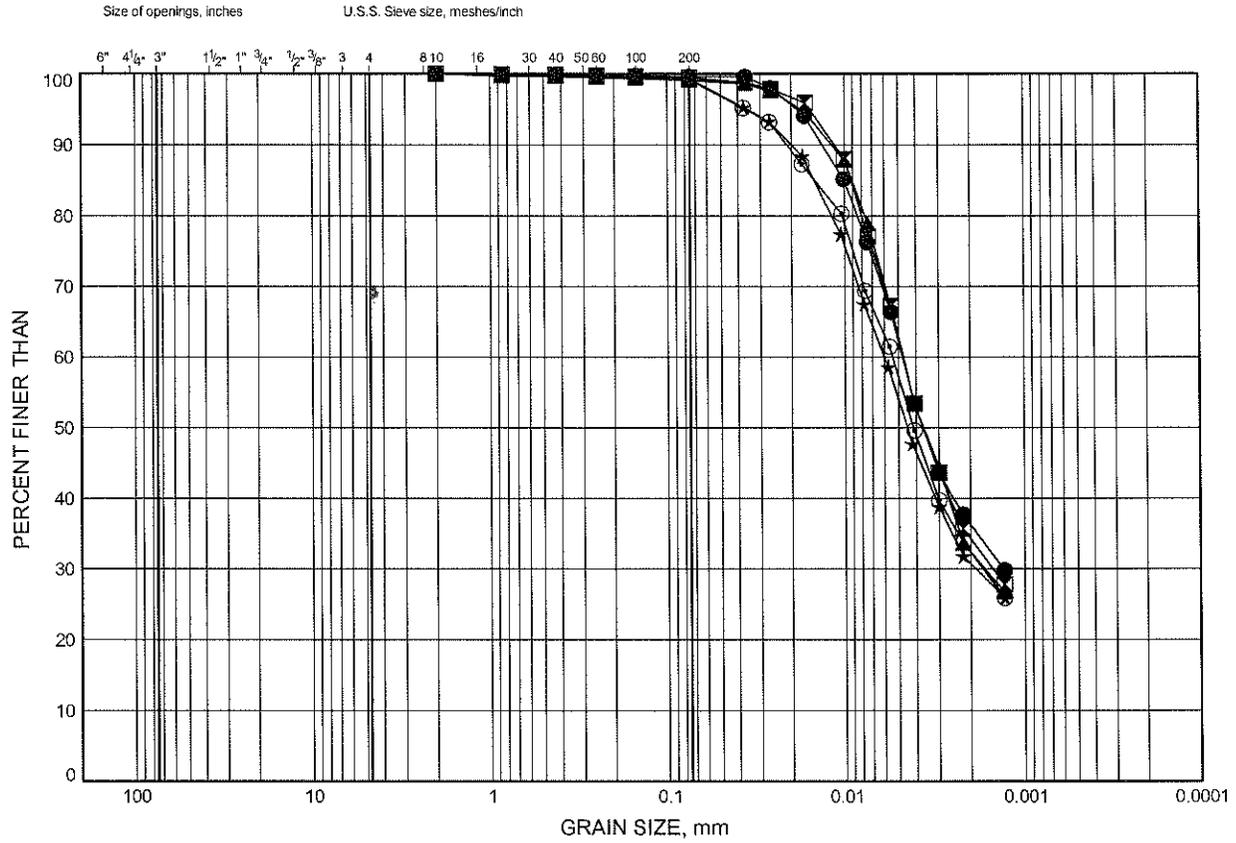
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B4

SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M10	2.59	194.31
⊠	07-M11	2.59	194.21
▲	07-M12	2.59	194.31
★	07-M13	3.35	193.15
⊙	07-M14	2.59	194.21

THURBGSD 5198.GPJ 10/22/07

Date October 2007
 Project 5460-04-00

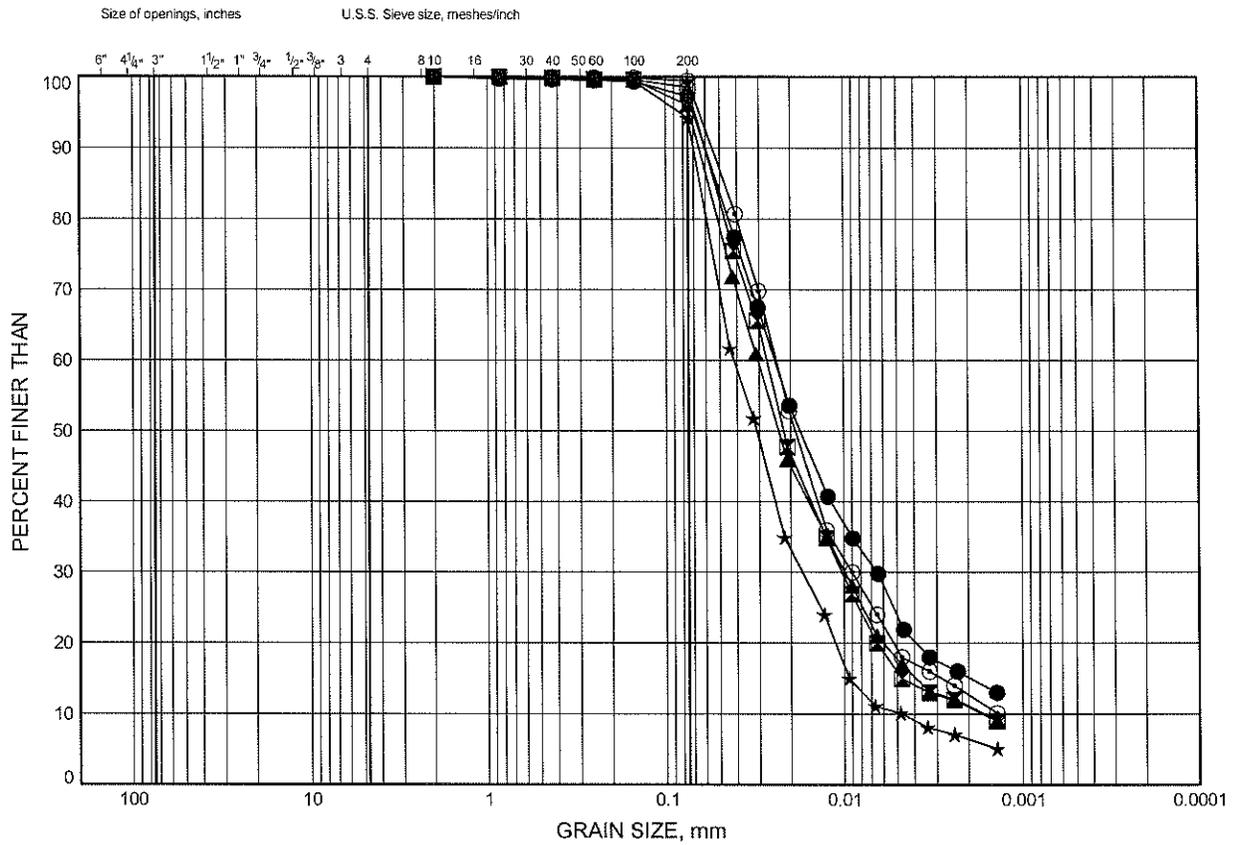


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B5

SILT TO CLAYEY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M1	8.53	188.77
⊠	07-M2	9.45	188.45
▲	07-M3	9.45	188.55
★	07-M4	10.97	187.03
⊙	07-M5	9.45	188.45

THURBCSD 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



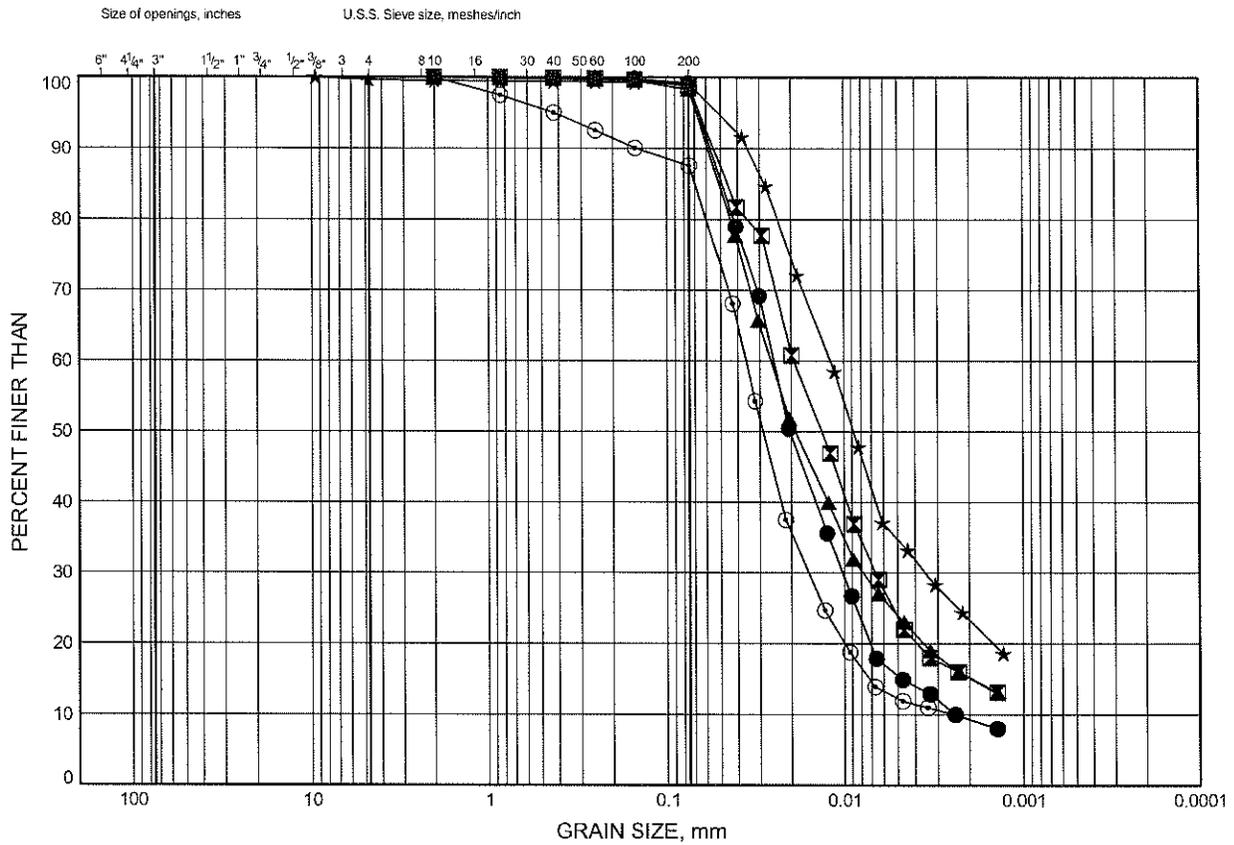
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B6

SILT TO CLAYEY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M5	14.02	183.88
⊠	07-M6	8.84	188.16
▲	07-M7	6.40	188.80
★	07-M7	10.36	184.84
⊙	07-M8	6.40	189.90

THURBGSD \$198.GPJ 10/22/07

Date October 2007
 Project 5460-04-00

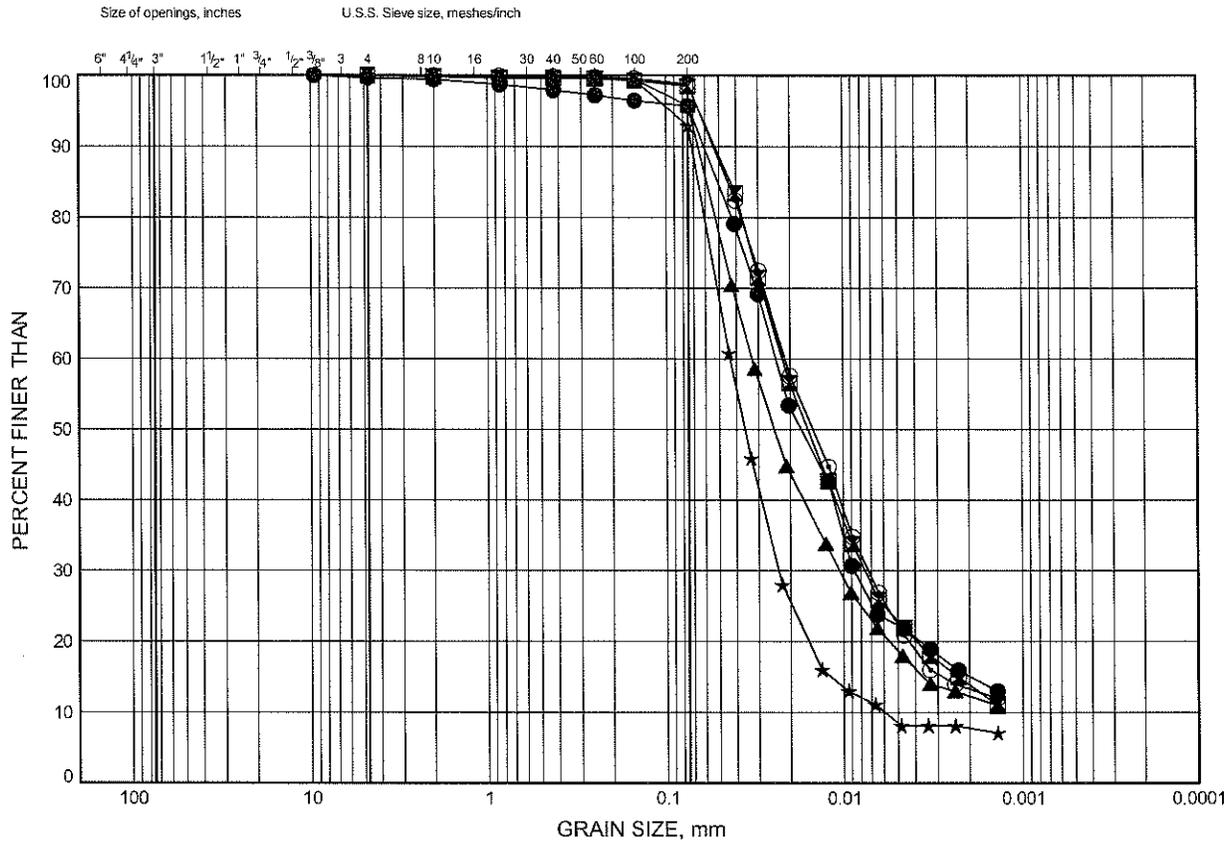


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B7

SILT TO CLAYEY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M11	6.40	190.40
⊠	07-M12	4.88	192.02
▲	07-M13	7.92	188.58
★	07-M8	12.50	183.80
⊙	07-M9	7.92	188.48

THURBGS05D 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



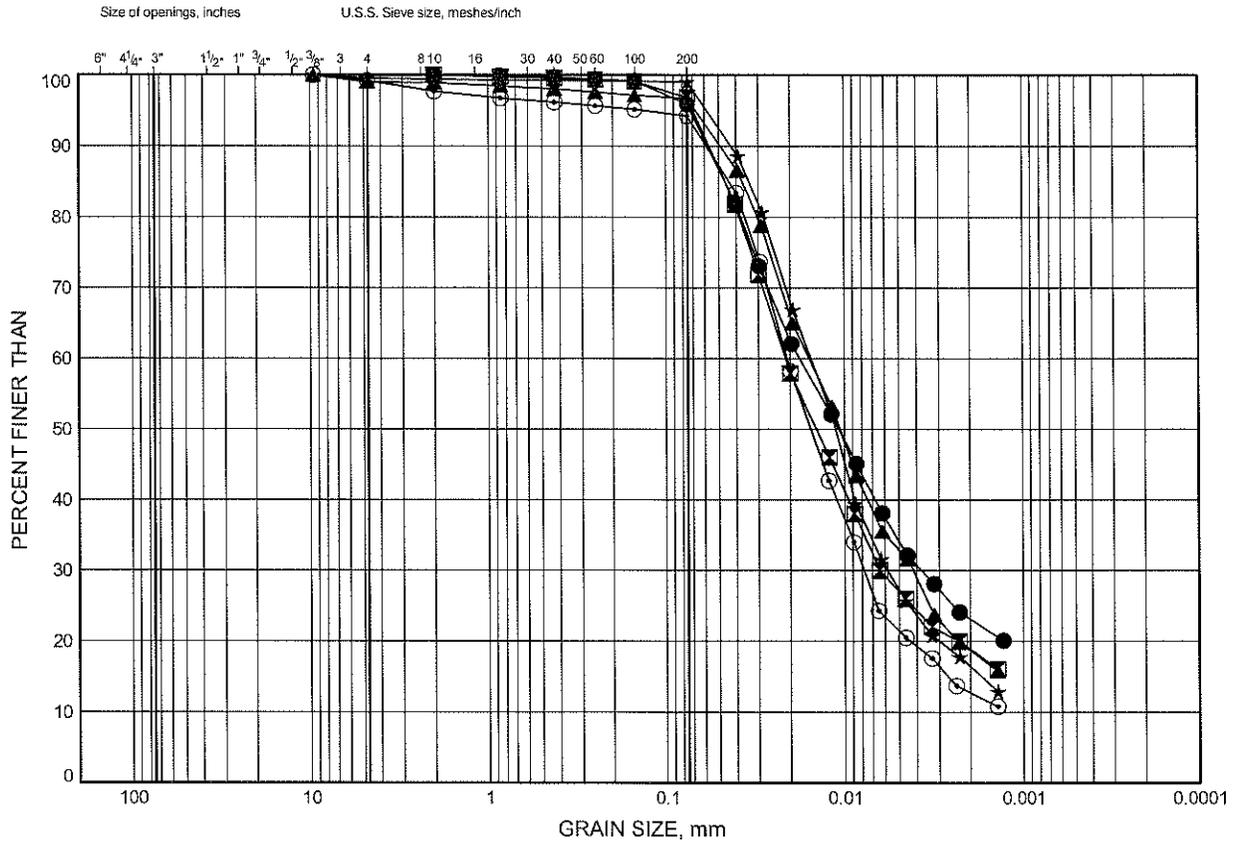
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B8

SILT TO CLAYEY SILT



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M13	9.45	187.05
⊠	07-M13	14.02	182.48
▲	07-M14	6.40	190.40
★	07-M15	3.35	192.05
⊙	07-M15	8.84	186.56

THURBGSD 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



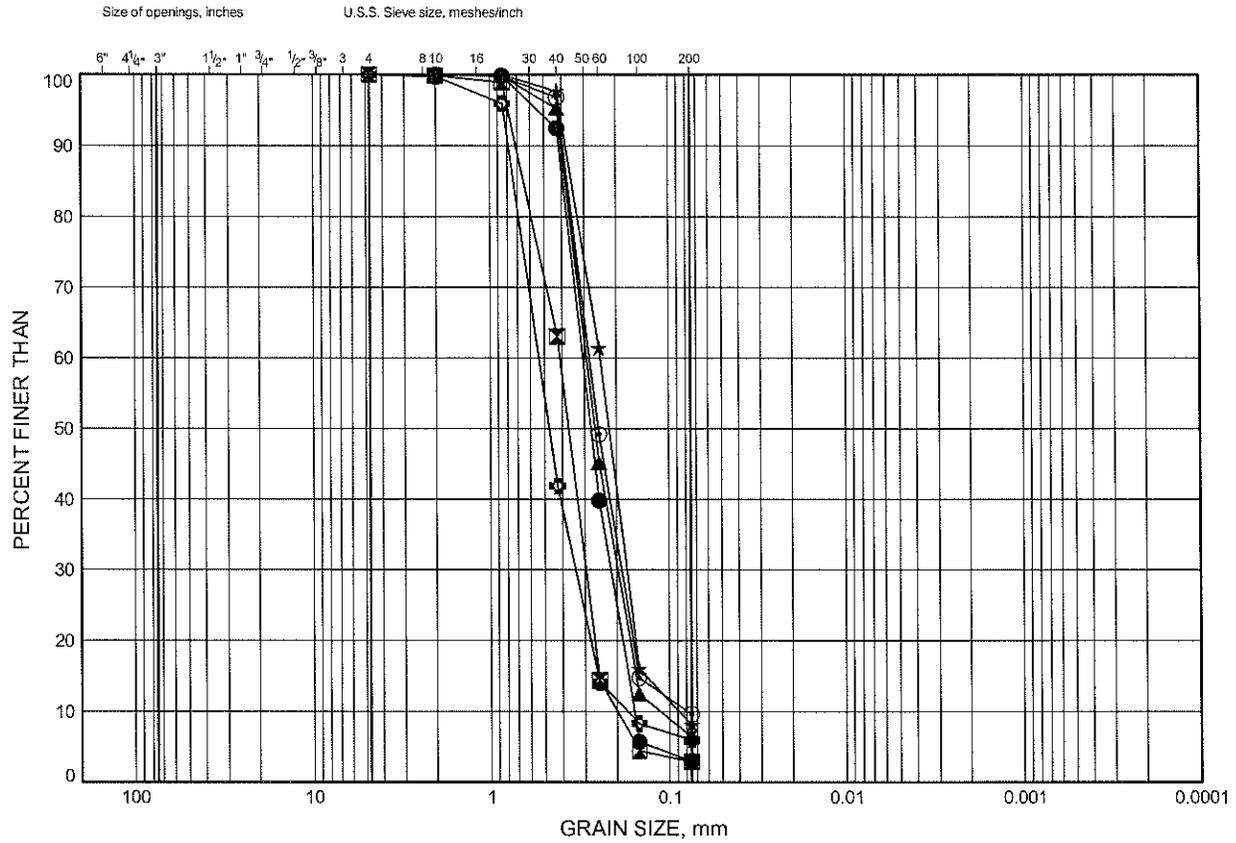
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B9

SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M1	13.11	184.19
⊠	07-M1	28.35	168.95
▲	07-M2	14.02	183.88
★	07-M3	15.54	182.46
⊙	07-M4	15.54	182.46
⊕	07-M4	27.74	170.26

THURBGSD 5198.GPJ 10/22/07

Date October 2007

Project 5460-04-00



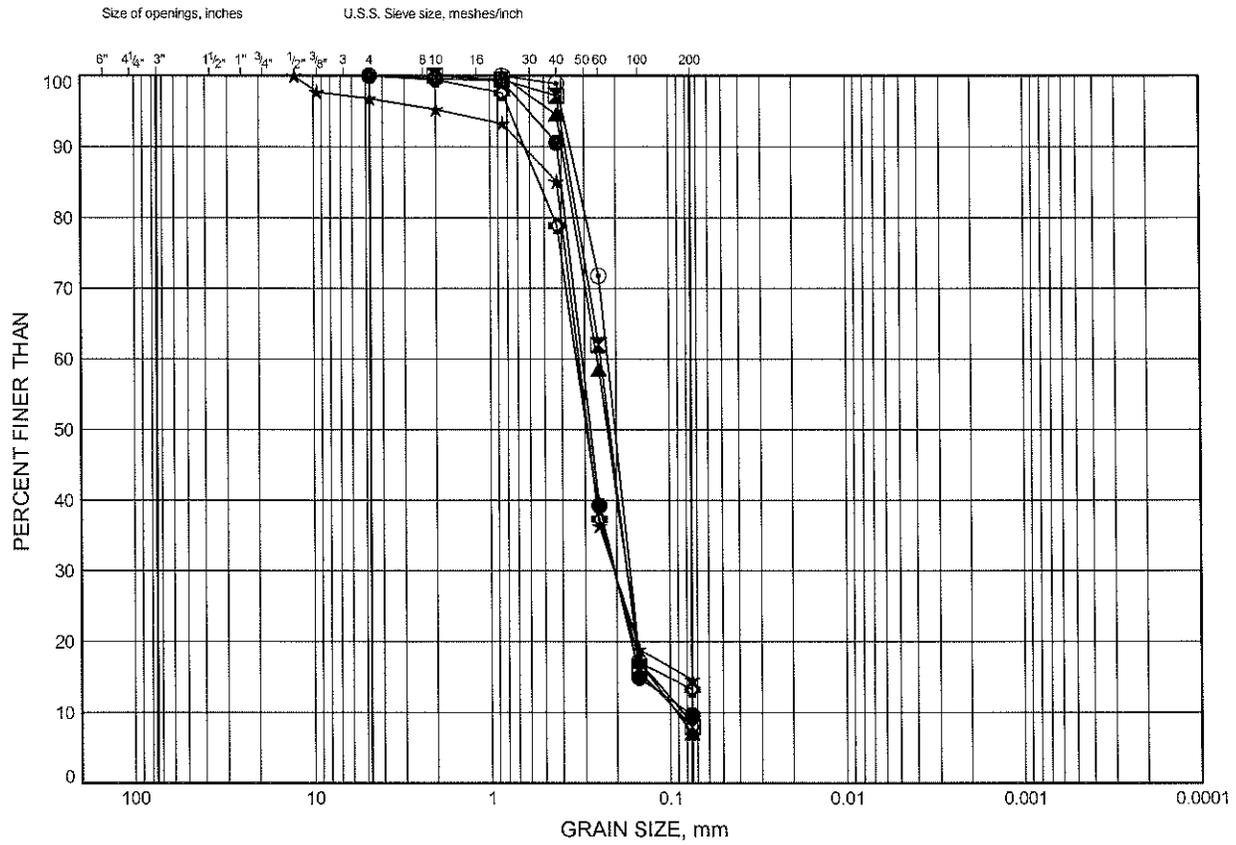
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B10

SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M5	20.12	177.78
⊠	07-M6	11.89	185.11
▲	07-M6	22.56	174.44
★	07-M7	16.46	178.74
⊙	07-M9	12.50	183.90
⊞	07-M9	15.54	180.86

THURBGSD 5198.GPJ 10/22/07

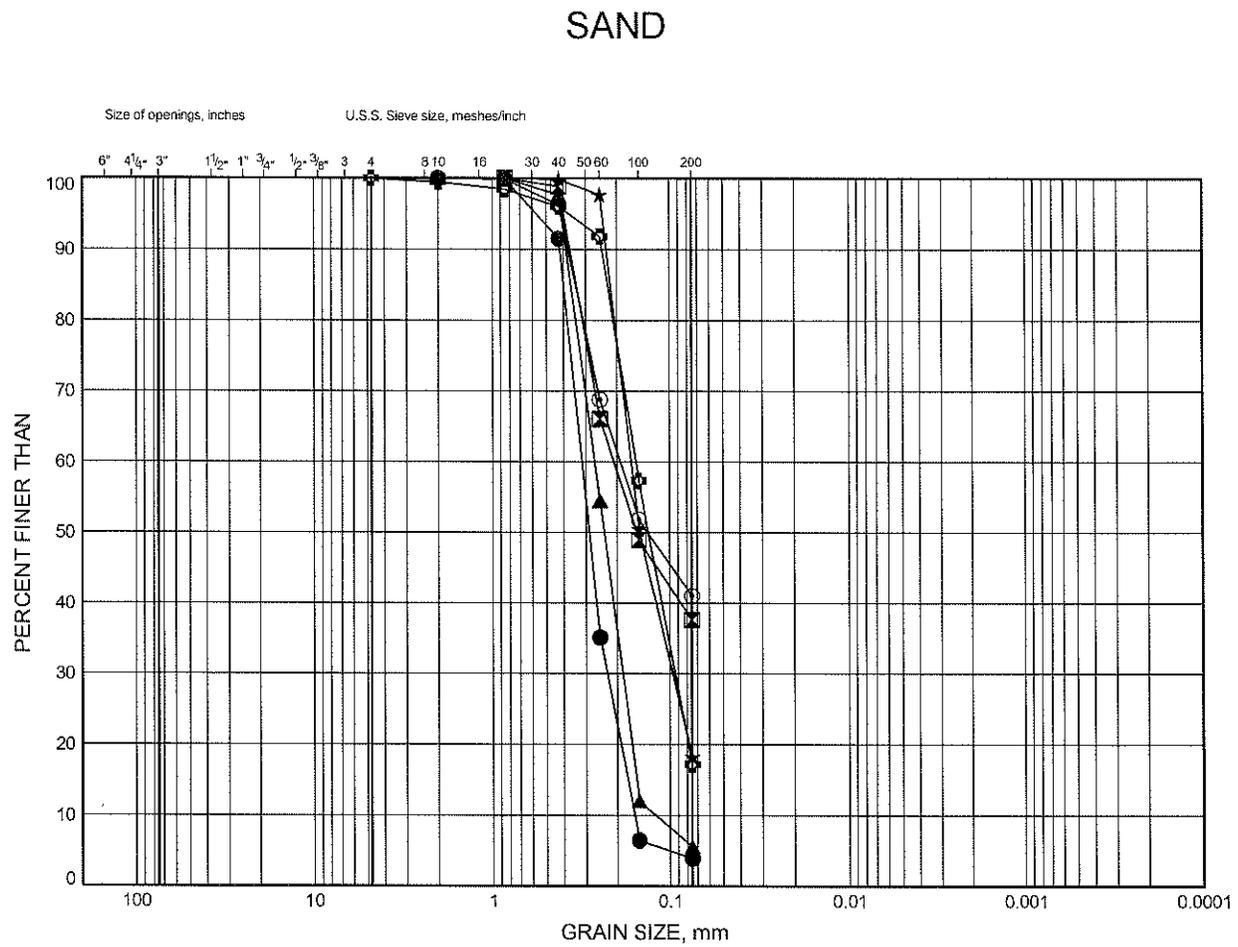
Date October 2007
 Project 5460-04-00



Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
GRAIN SIZE DISTRIBUTION

FIGURE 07-B11



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M10	9.45	187.45
⊠	07-M10	15.54	181.36
▲	07-M11	12.50	184.30
★	07-M12	14.02	182.88
⊙	07-M14	11.89	184.91
⊕	07-M14	16.46	180.34

THURBGSD 5198.GPJ 10/22/07

Date October 2007
 Project 5460-04-00

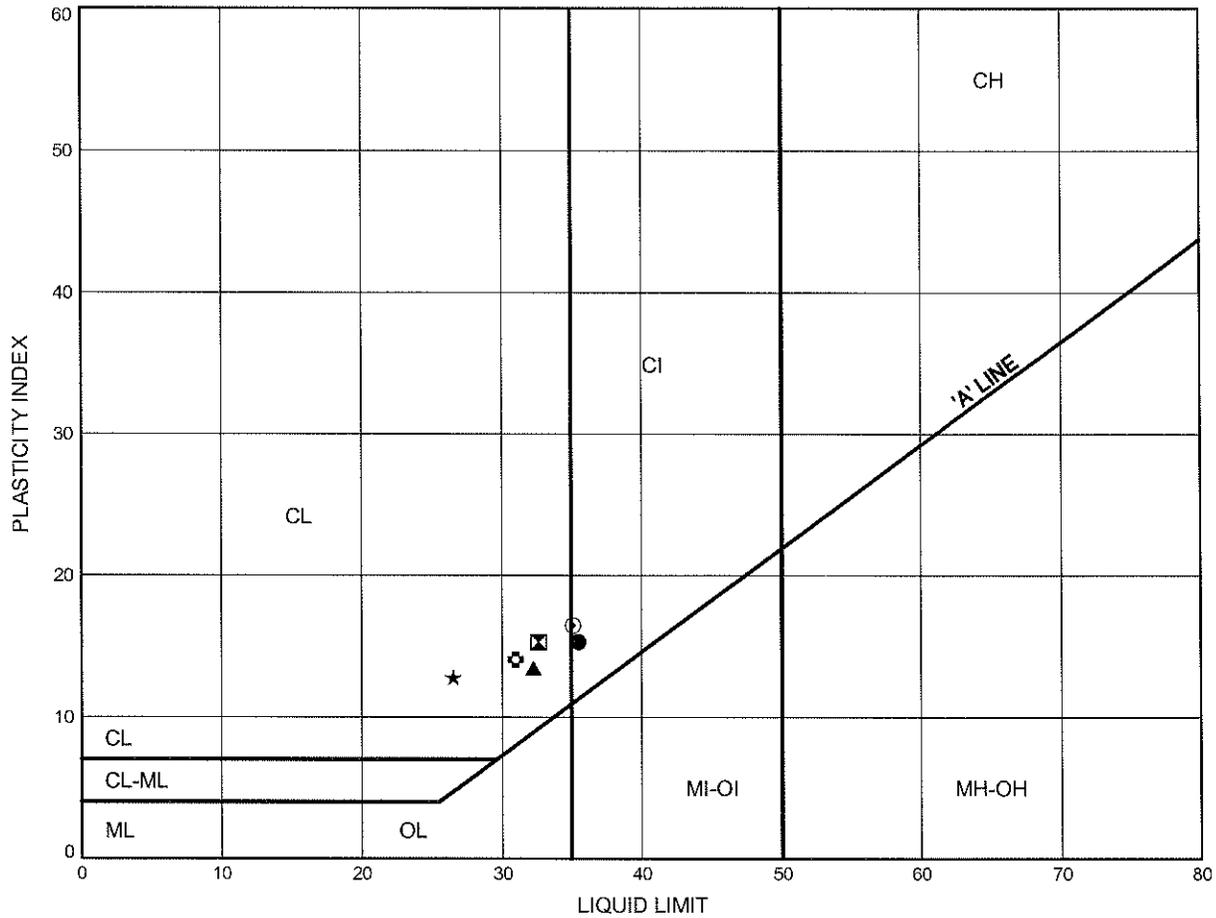


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
ATTERBERG LIMITS TEST RESULTS

FIGURE 07-B14

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M01	3.33	193.97
⊠	07-M02	3.33	194.57
▲	07-M03	4.11	193.89
★	07-M03	27.81	170.19
⊙	07-M04	4.11	193.89
⊛	07-M05	4.88	193.02

THURBALT 5198.GPJ 11/2/07

Date November 2007

Project 5460-04-00



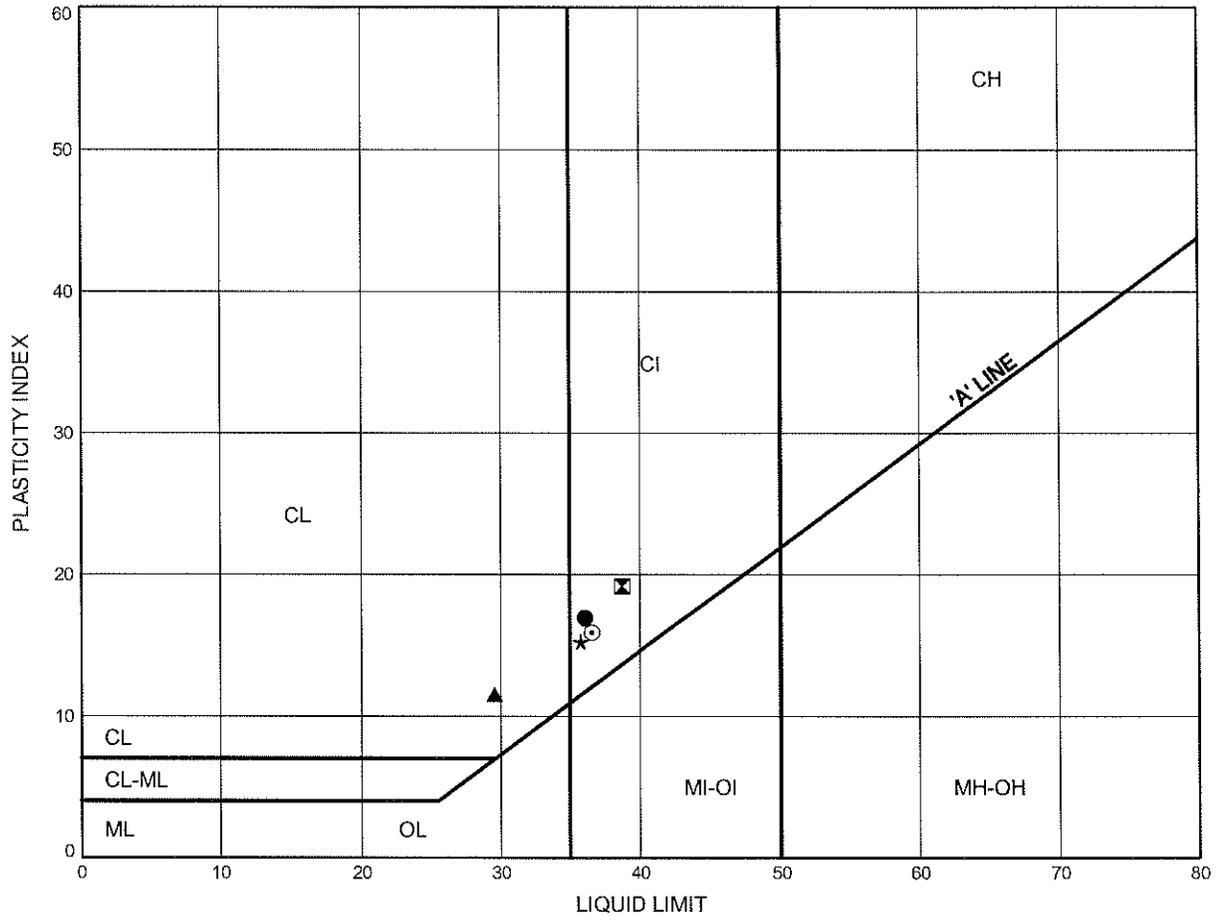
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
ATTERBERG LIMITS TEST RESULTS

FIGURE 07-B15

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M10	2.59	194.31
⊠	07-M11	2.59	194.21
▲	07-M7	1.83	193.37
★	07-M8	1.83	194.47
⊙	07-M9	2.59	193.81

THURBALT 5198.GPJ 10/22/07

Date October 2007
 Project 5460-04-00

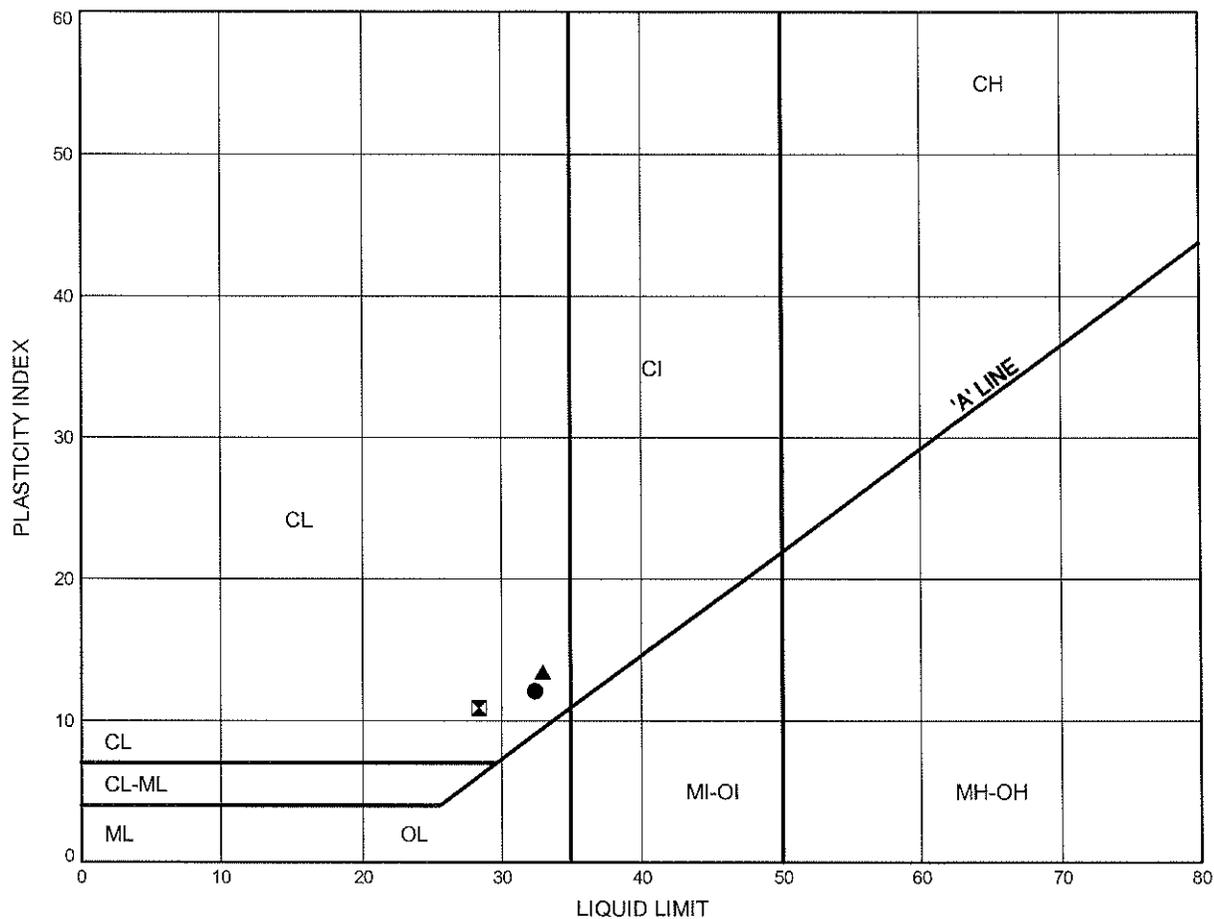


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam Replacement
ATTERBERG LIMITS TEST RESULTS

FIGURE 07-B16

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-M12	2.59	194.31
⊠	07-M13	3.35	193.15
▲	07-M14	2.59	194.21

THURBALT 5198.GPJ 10/22/07

Date October 2007
 Project 5460-04-00



Prep'd MFA
 Chkd. MRA

Consolidation Test Report

CLIENT: **McCormick Rankin Corporation**

FILE NUMBER: 18-45-1 / 19-1351-98

PROJECT: **Mindemoya Bridge and Dam Replacement**

REPORT DATE: 11-Oct-07

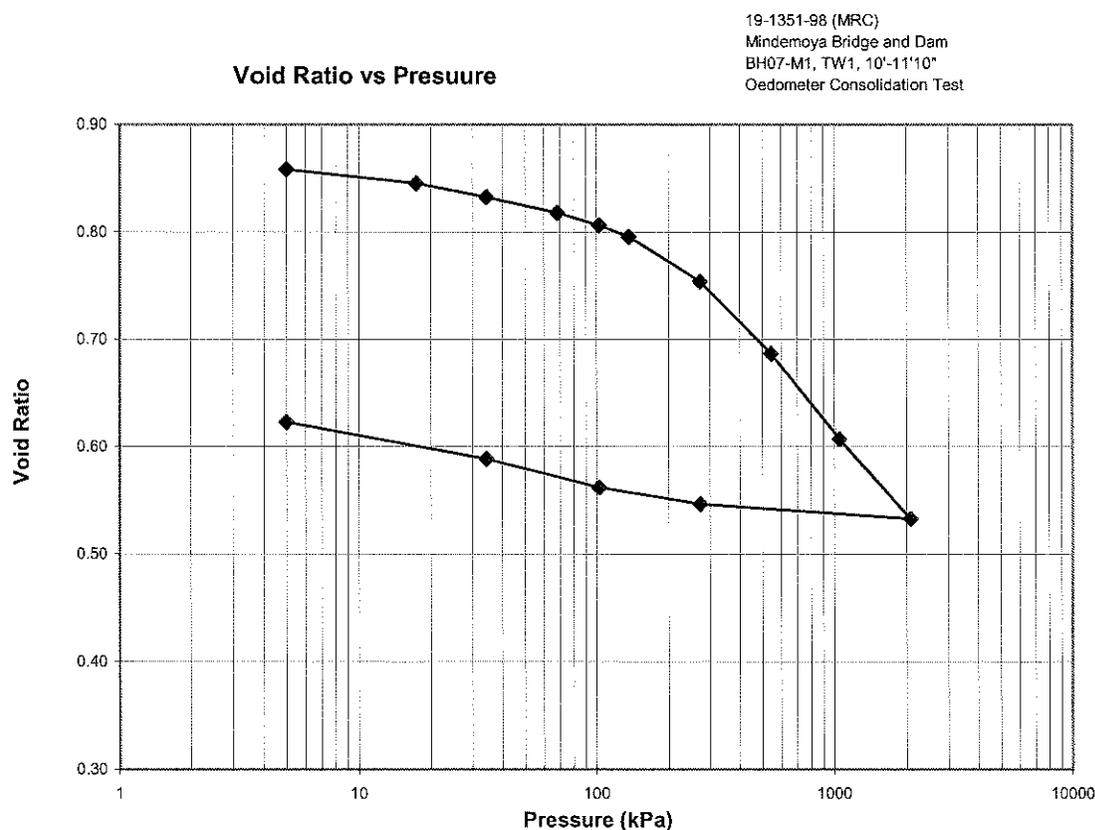
TEST DATES: September 20, 2007 - October 3, 2007

SAMPLE: BH07-M1, TW1, 10'-11'10"
 Silty Clay, grey, plastic, (CI), Lab Vane: 20 - 37 kPa (Soft)
 Grain Size: 43% Clay & 56 % Silt

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

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	1931.9	2119.6
Dry Dens. (kg/m ³)	1480.7	1681.7
Moisture Cont. (%)	30.5	26.0
Void Ratio	0.857	0.635
Saturation (%)	97.8	

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



TEST DONE BY: WM/EA
 REVIEWED BY: JPL

Consolidation Test Report

Mindemoya Bridge and Dam Replacement
 18-45-1 / 19-1351-98

BH07-M1, TW1, 10'-11'10"

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

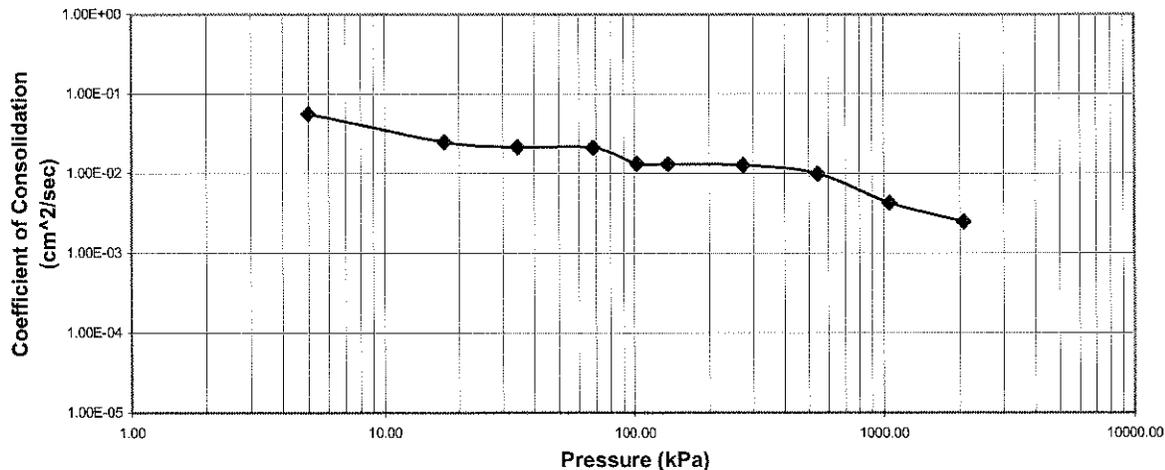
LOADING: A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied and the duration of each load step was 24 hrs.

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

Pressure (kPa)	Corr. Hgt (mm)	Avg. Hgt. (mm)	T90 (min)	Cv (cm ² /sec)	Void Ratio	mv (m ² /kN)	k (cm/s)
0.00	19.850	19.850			0.857		
5.00	19.858	19.854	0.25	5.57E-02	0.858	5.50E-04	3.00E-06
17.50	19.722	19.790	0.56	2.47E-02	0.845	4.04E-04	9.78E-07
34.46	19.586	19.654	0.64	2.13E-02	0.833	2.31E-04	4.82E-07
68.42	19.430	19.508	0.64	2.10E-02	0.818	1.82E-04	3.74E-07
102.82	19.306	19.368	1.00	1.33E-02	0.806	1.70E-04	2.21E-07
136.78	19.192	19.249	1.00	1.31E-02	0.796	1.65E-04	2.12E-07
273.12	18.745	18.968	1.00	1.27E-02	0.754	1.33E-04	1.66E-07
545.39	18.025	18.385	1.21	9.87E-03	0.687	8.38E-05	8.10E-08
1057.63	17.173	17.599	2.56	4.27E-03	0.607	3.90E-05	1.63E-08
2080.12	16.381	16.777	4.00	2.49E-03	0.533	4.04E-06	9.85E-10
273.12	16.526	16.850			0.546		
102.82	16.694	16.610			0.562		
34.46	16.975	16.835			0.588		
5.00	17.341	17.158			0.623		

Coefficient of Consolidation vs Pressure

19-1351-98 (MRC)
 Mindemoya Bridge and Dam
 BH07-M1, TW1, 10'-11'10"
 Oedometer Consolidation Test



Notes: Cv and k calculated using t₉₀ values

TEST DONE BY: WM/EA
 REVIEWED BY: JPL

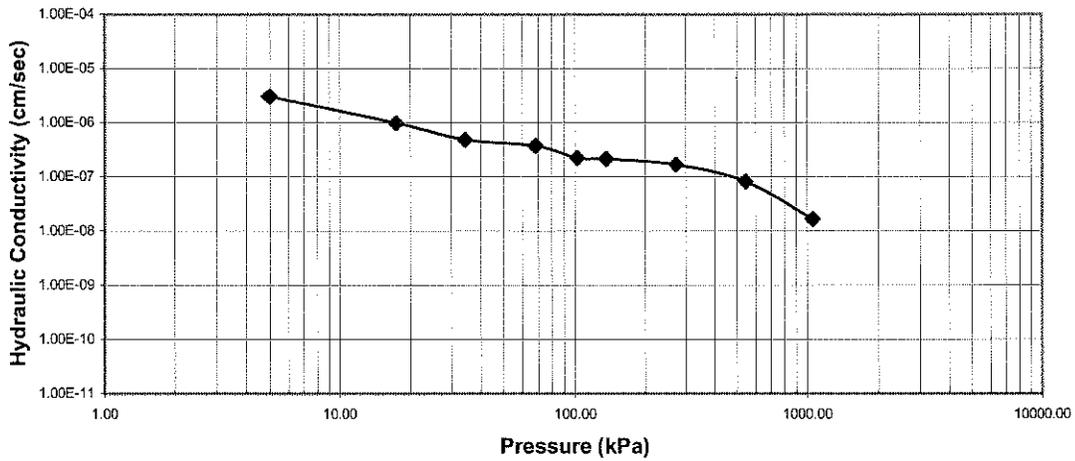
Consolidation Test Report

Mindemoya Bridge and Dam Replacement
 18-45-1 / 19-1351-98

BH07-M1, TW1, 10'-11'10"

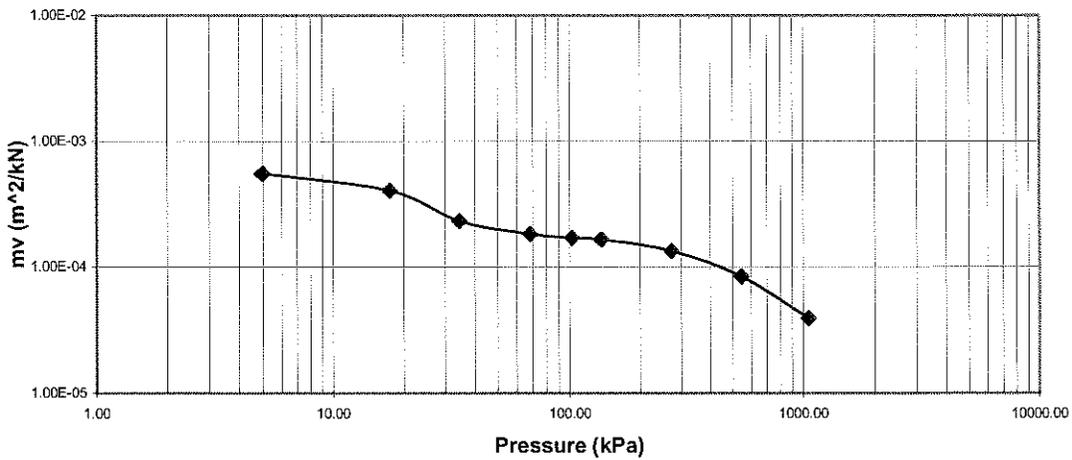
Hydraulic Conductivity vs Pressure

19-1351-98 (MRC)
 Mindemoya Bridge and Dam
 BH07-M1, TW1, 10'-11'10"
 Oedometer Consolidation Test



mv vs Pressure

19-1351-98 (MRC)
 Mindemoya Bridge and Dam
 BH07-M1, TW1, 10'-11'10"
 Oedometer Consolidation Test



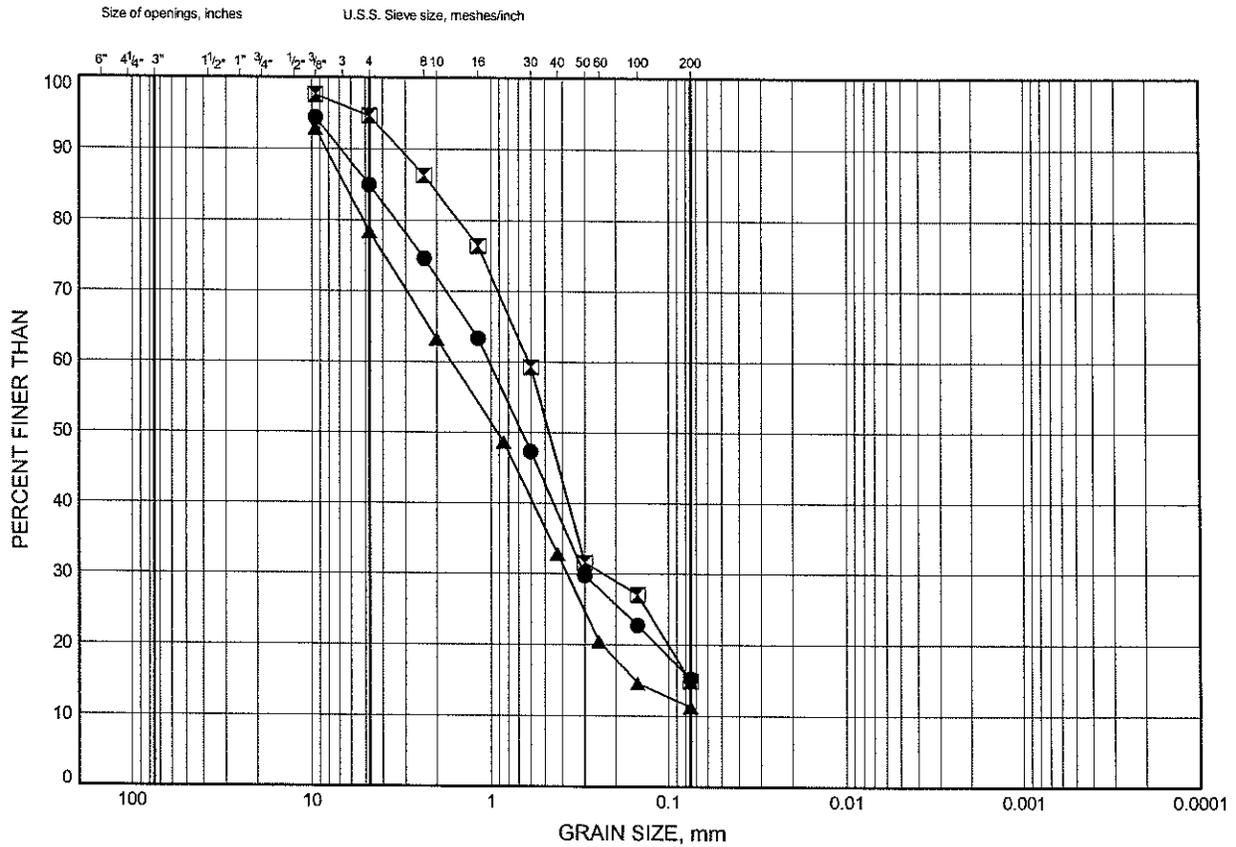
TEST DONE BY: WM/EA
 REVIEWED BY: JPL

**Laboratory Test Results
from Preliminary Investigation**

Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND FILL



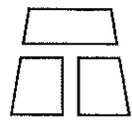
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY FINE GRAINED
	GRAVEL		SAND			

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M04	1.07	196.93
⊠	06-M09	1.07	196.63
▲	06-M14	0.30	197.39

THURBGSD 5198.GPJ 05/12/06

Date December 2006

Project 5460-04-00



THURBER

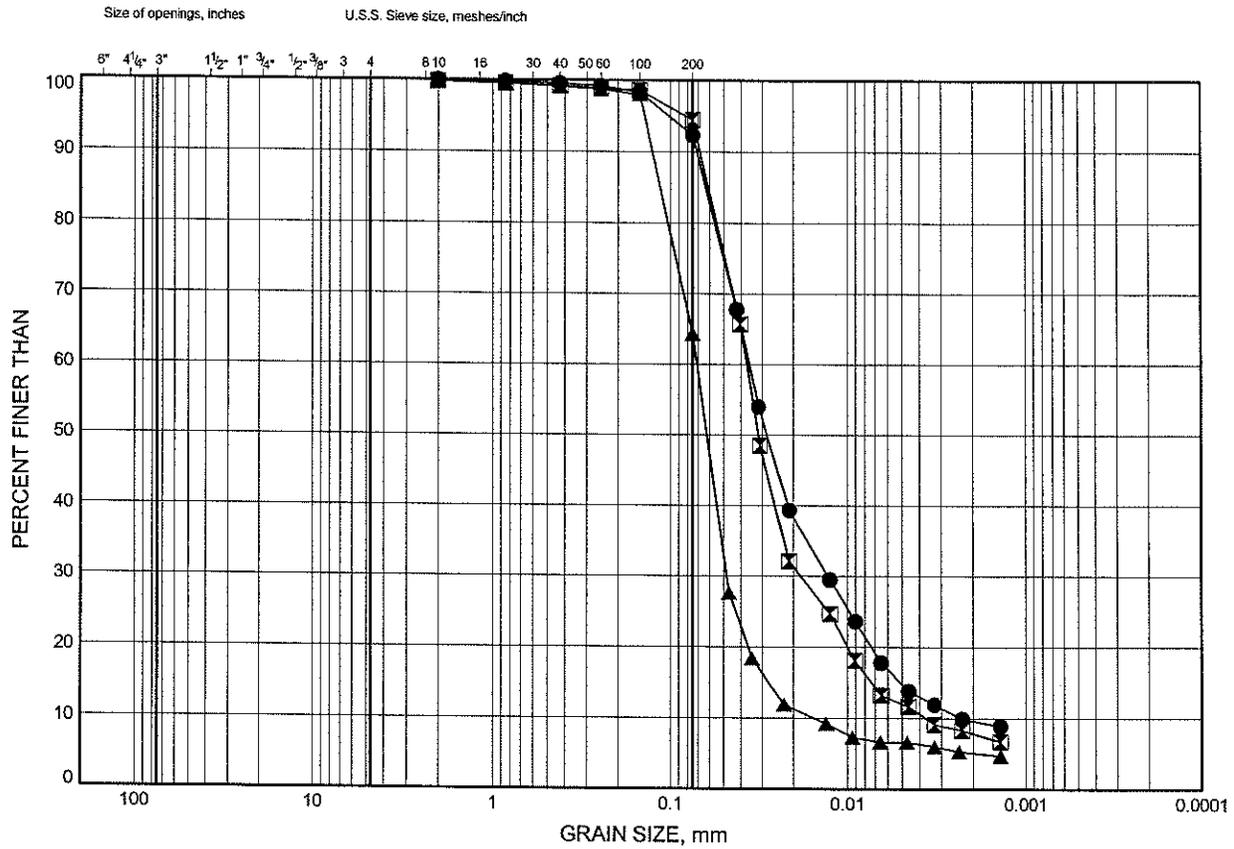
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B2

SURFICIAL SILT TO SANDY SILT



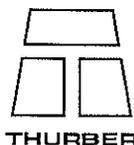
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY FINE GRAINED
	GRAVEL		SAND			

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M08	3.35	194.65
☒	06-M09	2.59	195.11
▲	06-M11	1.83	196.07

THURBGSD 5198.GPJ 05/12/06

Date December 2006

Project 5460-04-00



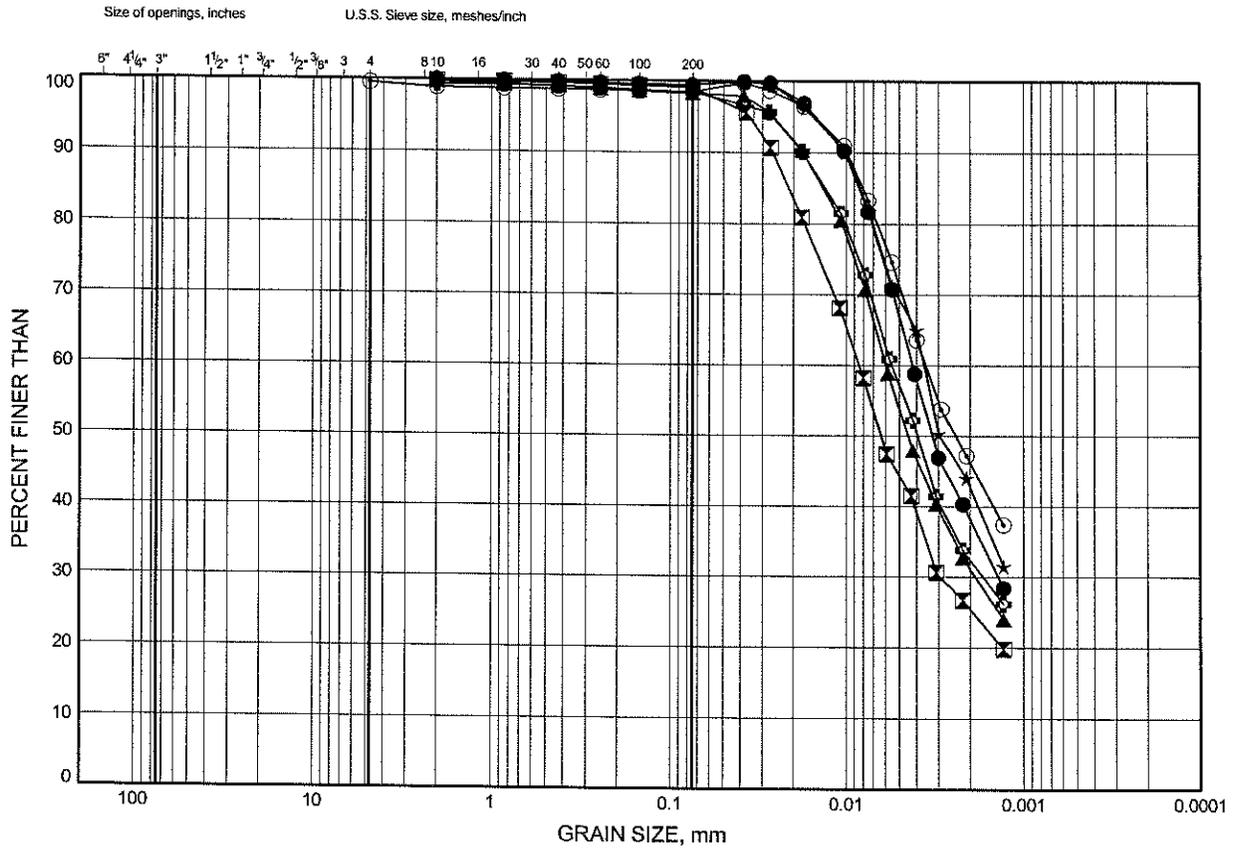
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY



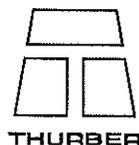
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY FINE GRAINED
	GRAVEL		SAND			

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M01	3.35	193.55
⊠	06-M03	4.88	193.22
▲	06-M04	4.88	193.12
★	06-M07	7.62	190.18
⊙	06-M08	6.10	191.91
⊛	06-M09	7.62	190.08

THURBGSD 5:198.GPJ 05/12/06

Date December 2006

Project 5460-04-00



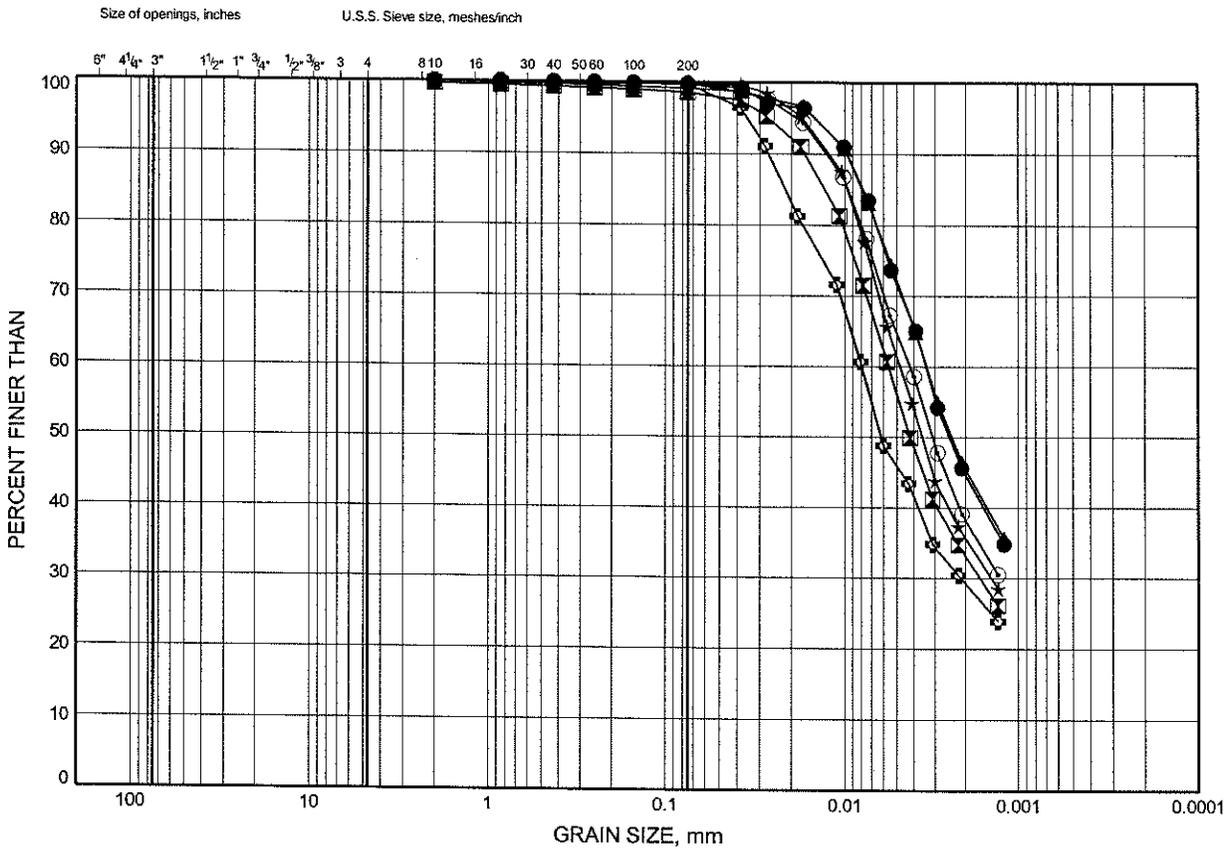
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY

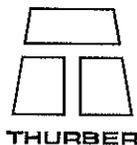


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M10	3.35	193.25
⊠	06-M11	4.88	193.02
▲	06-M12	3.35	194.45
★	06-M13	3.35	193.35
⊙	06-M14	3.35	194.35
⊕	06-M14	7.62	190.08

Date December 2006

Project 5460-04-00



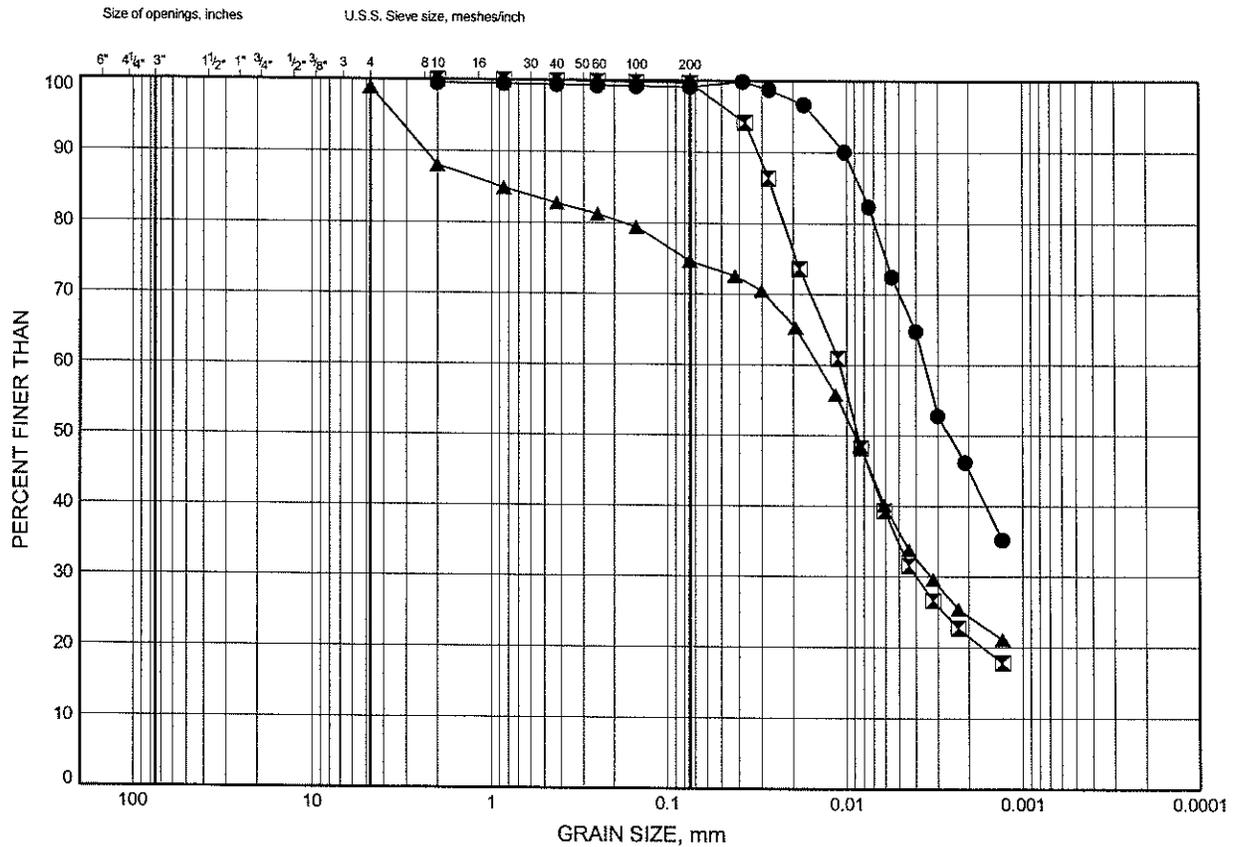
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam GRAIN SIZE DISTRIBUTION

FIGURE B5

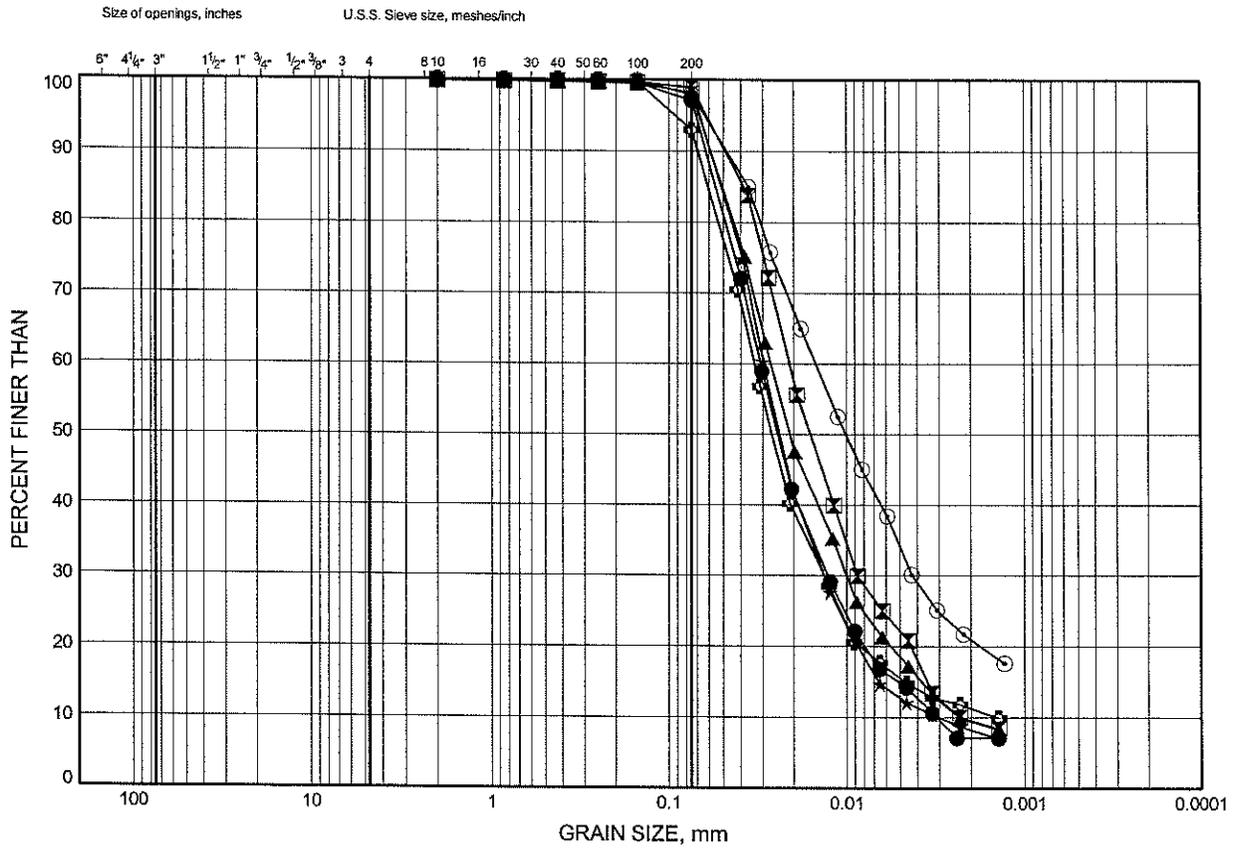
SILTY CLAY



Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B6

SILT

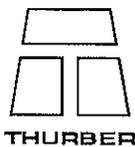


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY FINE GRAINED
	GRAVEL		SAND			

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M01	7.92	188.98
⊠	06-M03	7.62	190.48
▲	06-M04	10.97	187.03
★	06-M07	12.19	185.61
⊙	06-M07	16.76	181.04
⊛	06-M08	13.72	184.29

THURBGSD 5198.GPJ 05/12/06

Date December 2006
Project 5460-04-00

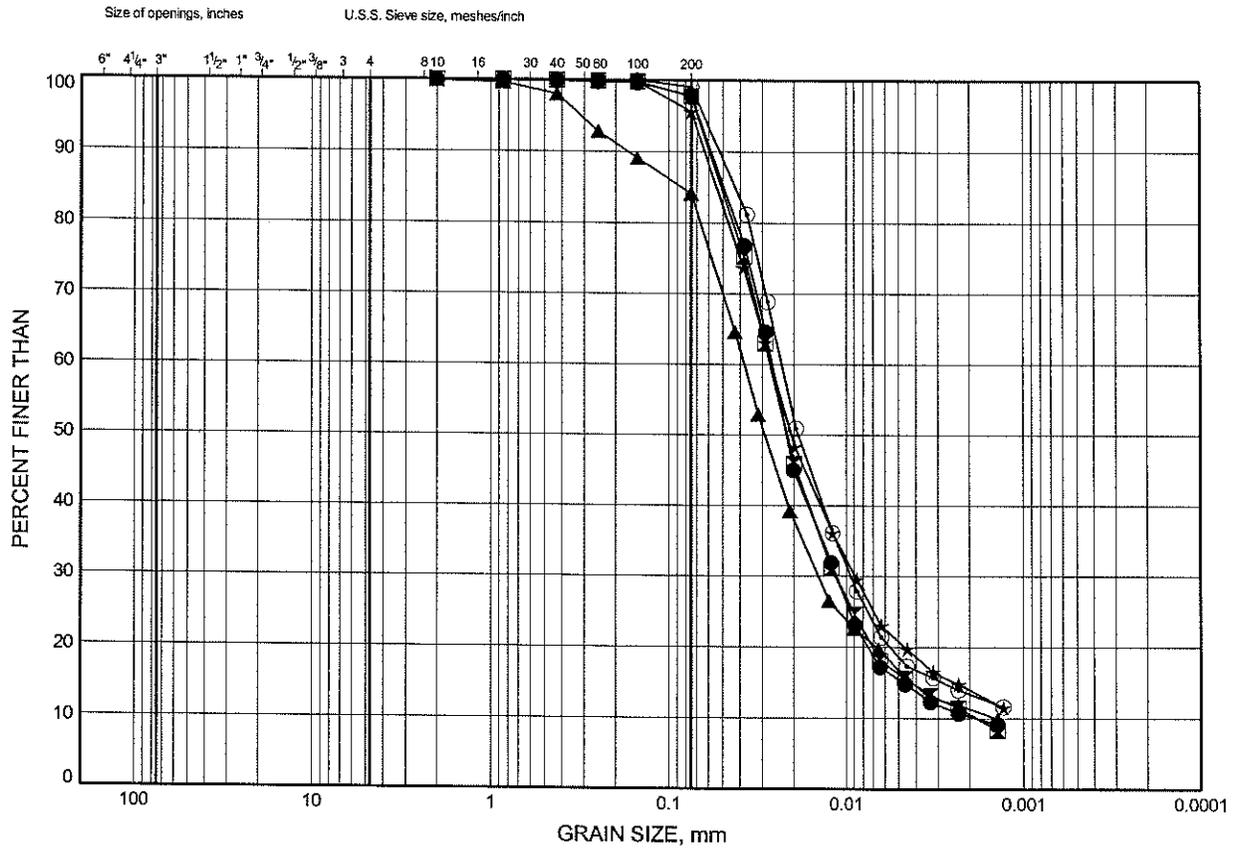


Prep'd MFA
Chkd. MRA

Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B7

SILT

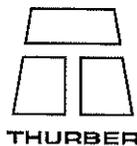


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY FINE GRAINED
	GRAVEL		SAND			

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M09	12.19	185.51
■	06-M10	7.92	188.67
▲	06-M11	7.92	189.98
★	06-M12	10.67	187.13
⊙	06-M12	15.24	182.56

THURBGSD 5198.GPJ 05/12/06

Date December 2006
 Project 5460-04-00

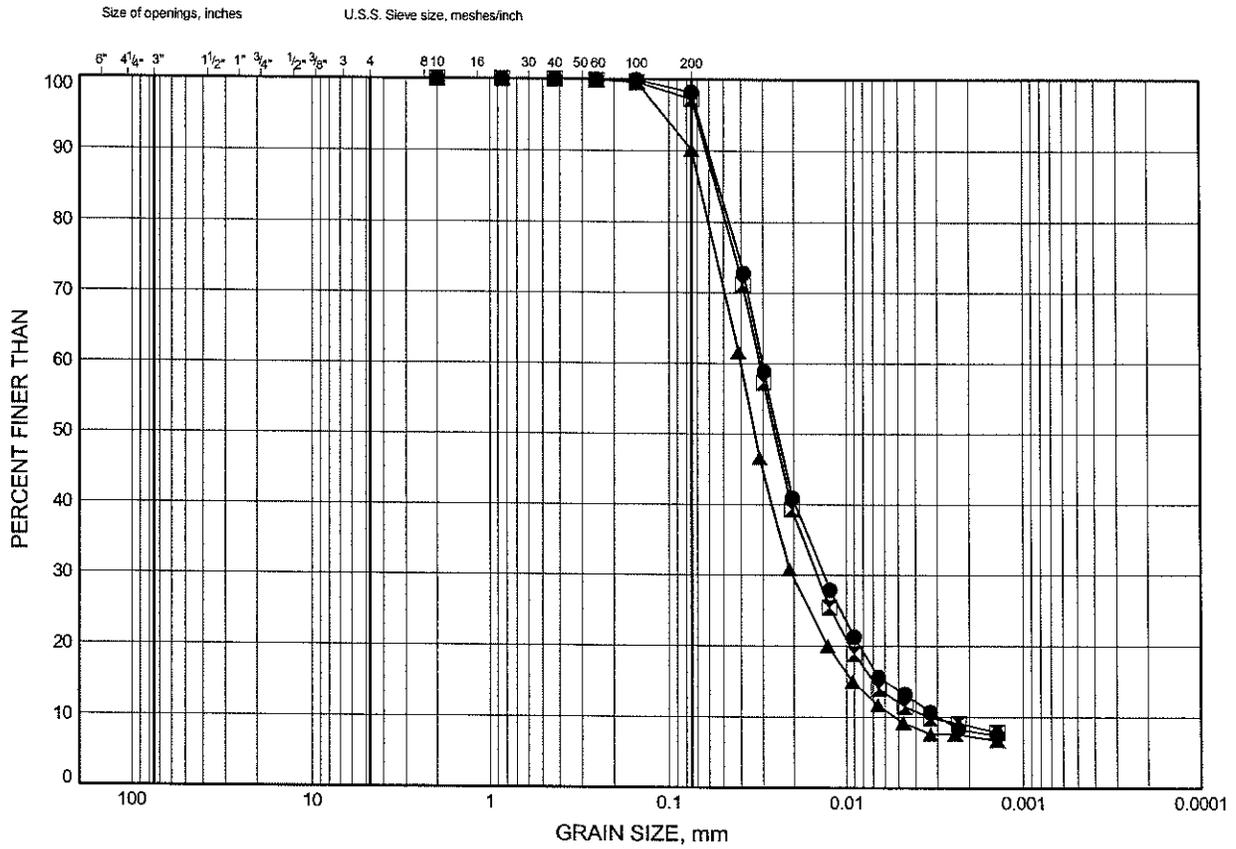


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam GRAIN SIZE DISTRIBUTION

FIGURE B8

SILT



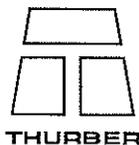
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M13	7.32	189.38
⊠	06-M13	13.41	183.29
▲	06-M14	12.19	185.51

THURBGSD 5198.GPJ 05/12/06

Date December 2006

Project 5460-04-00

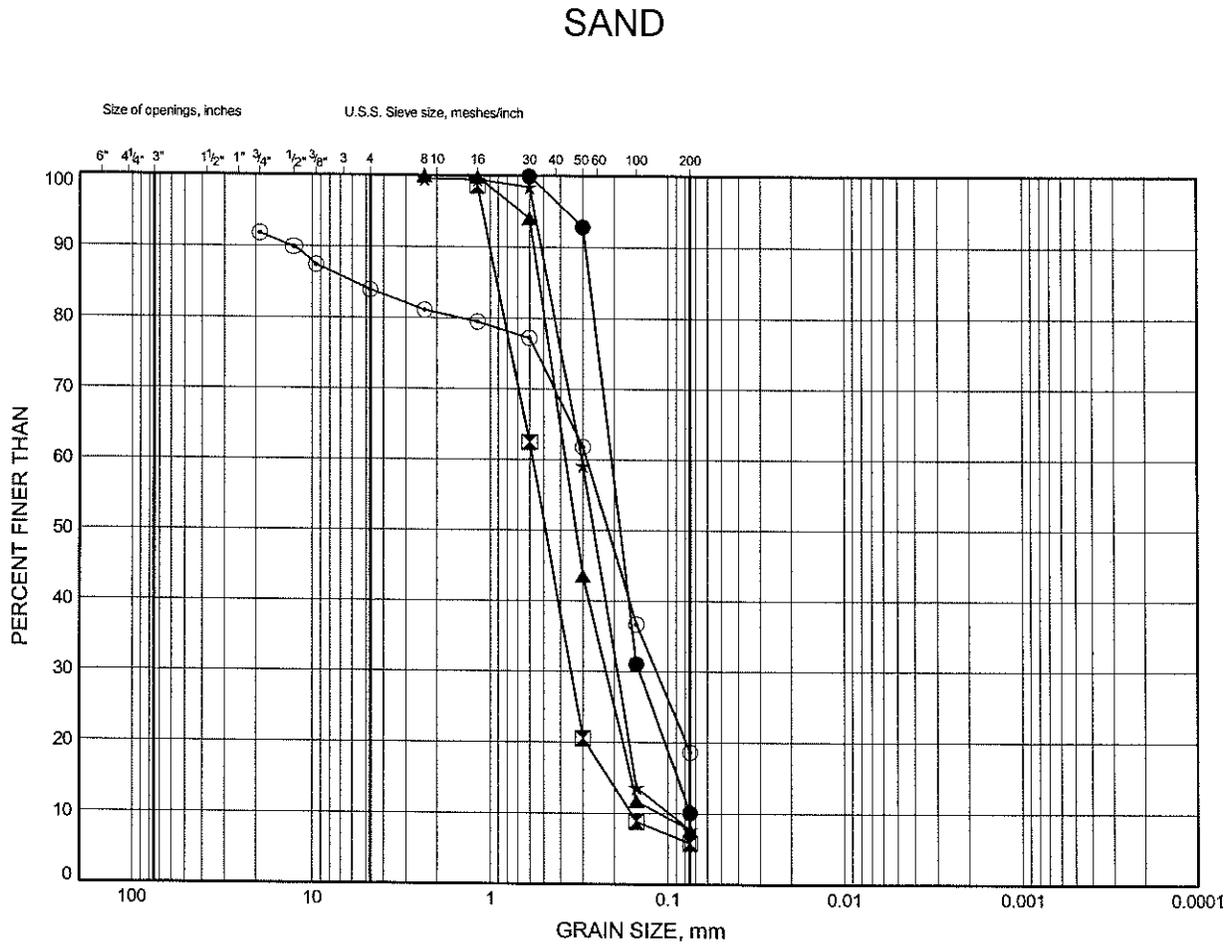


Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam GRAIN SIZE DISTRIBUTION

FIGURE B9

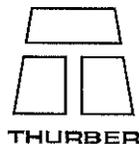


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M01	14.02	182.88
☒	06-M01	21.64	175.26
▲	06-M03	13.72	184.38
★	06-M03	24.38	173.71
⊙	06-M03	30.48	167.62

THURBGSD 5198.GPJ 05/12/06

Date December 2006
Project 5460-04-00

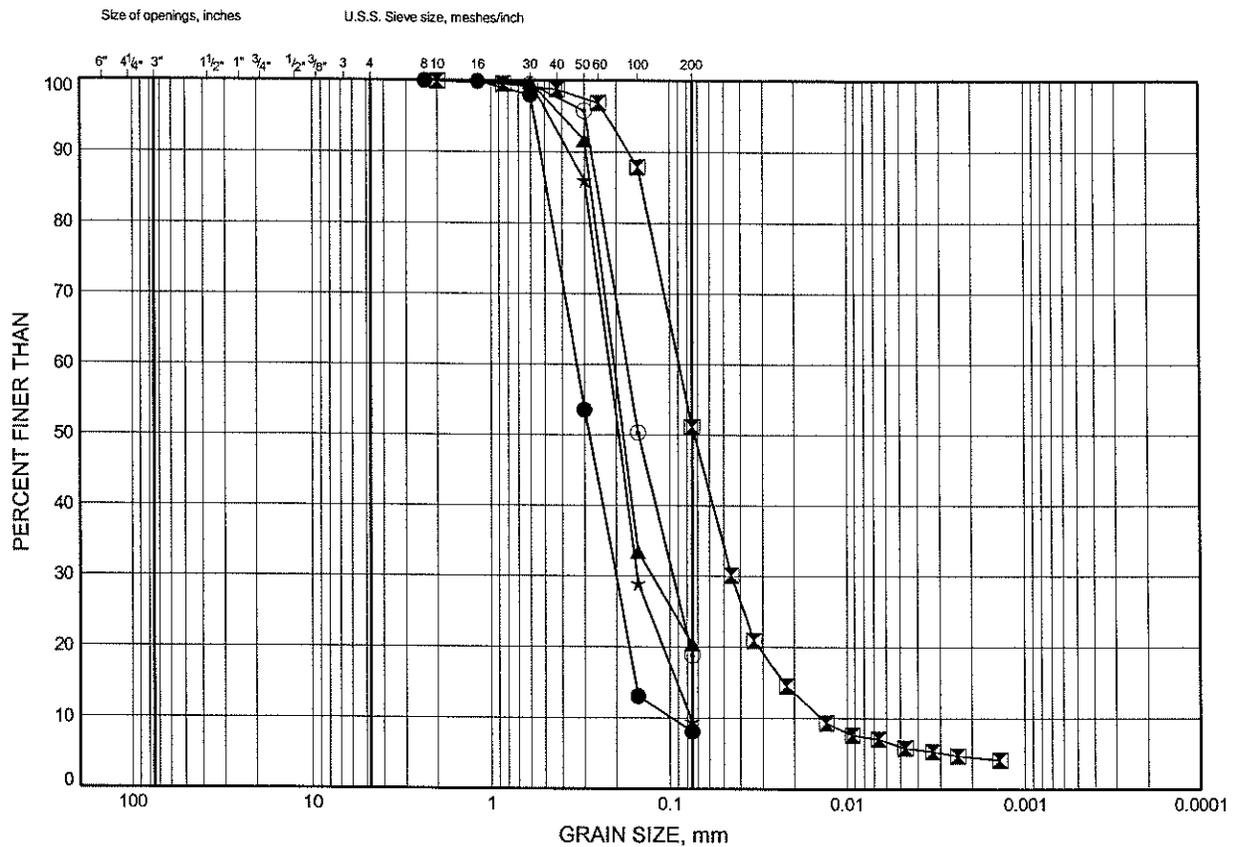


Prep'd MFA
Chkd. MRA

Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B10

SAND TO SAND AND SILT

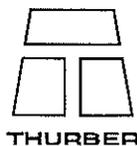


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M04	15.24	182.76
⊠	06-M04	18.29	179.71
▲	06-M04	30.48	167.52
★	06-M08	19.81	178.19
⊙	06-M09	16.76	180.94

THURBERGSD 5198.GPJ 05/12/06

Date December 2006
 Project 5460-04-00

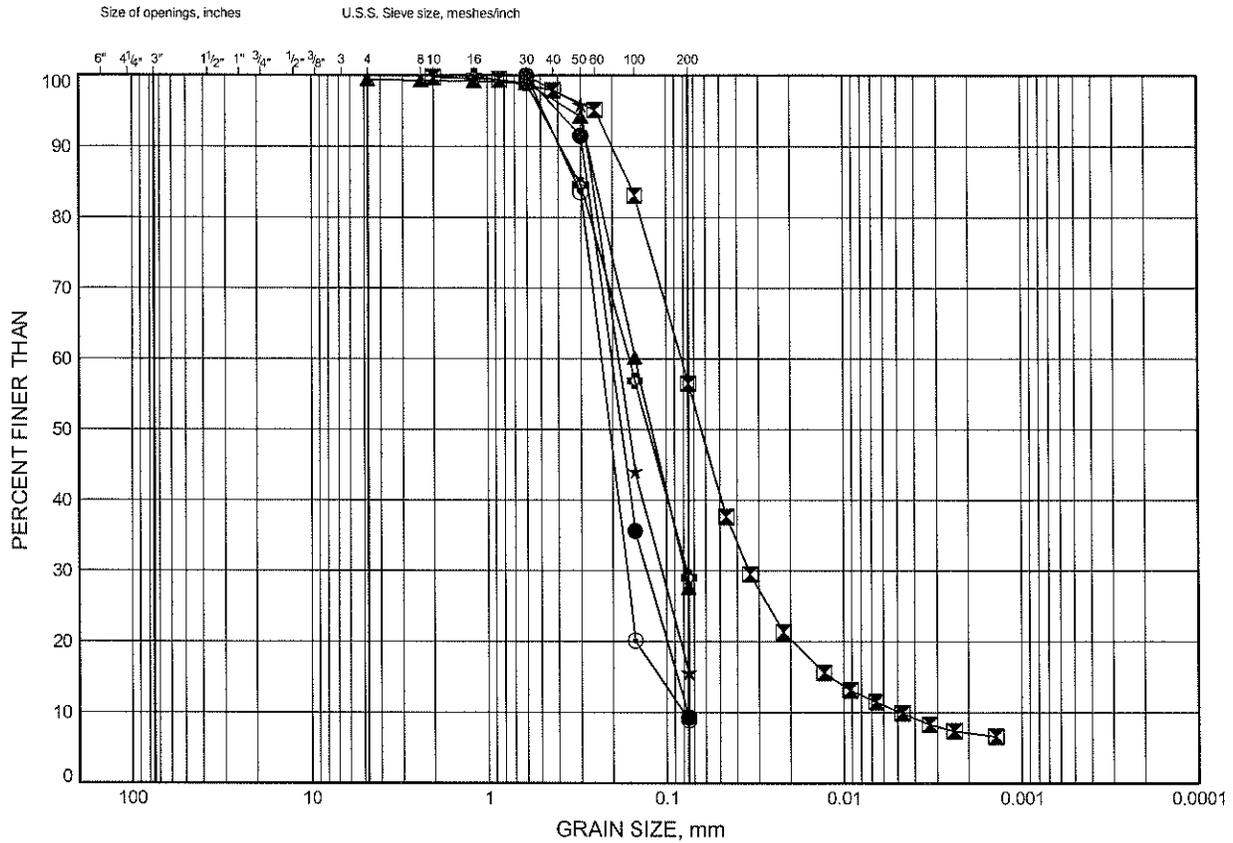


Prep'd MFA
 Chkd. MRA

Beatty Creek Bridge Replacement
GRAIN SIZE DISTRIBUTION

FIGURE B11

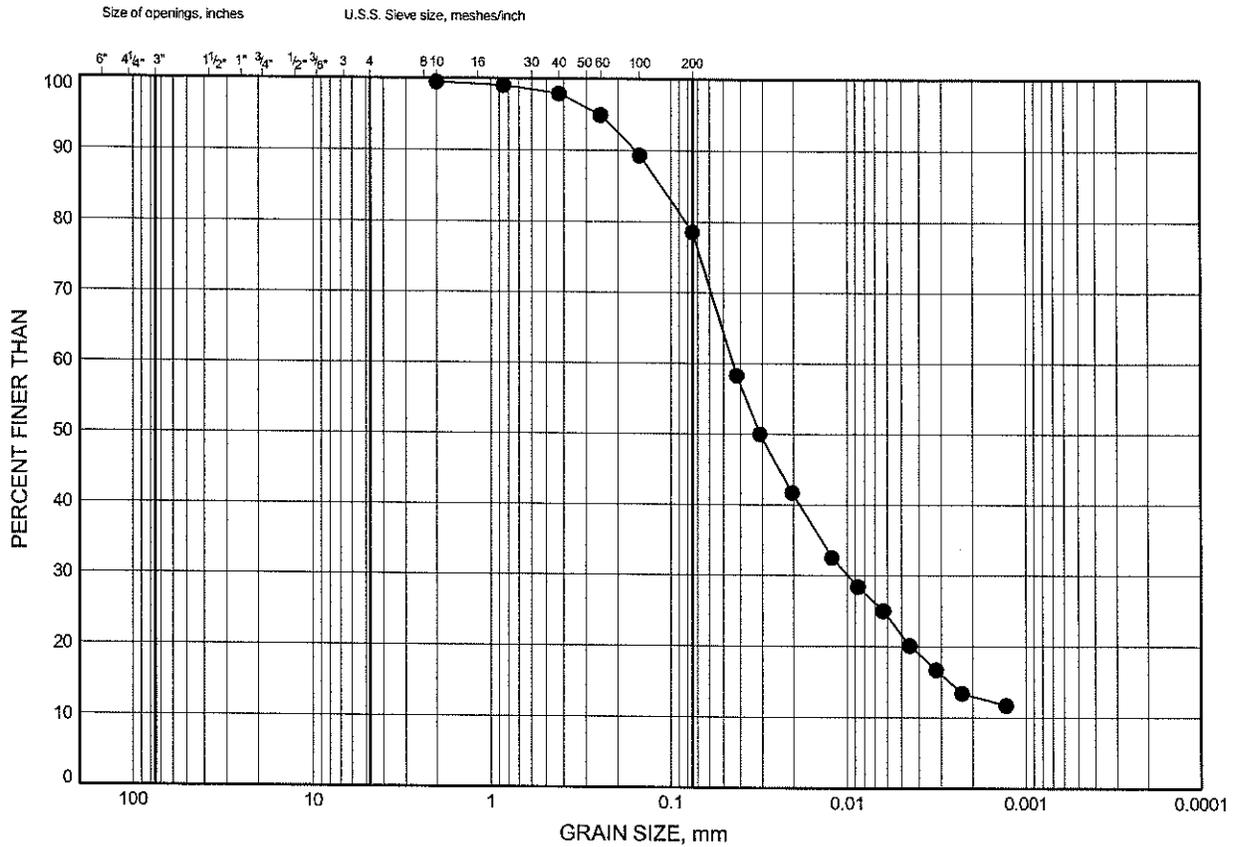
SAND TO SAND AND SILT



Mindemoya Lake Bridge and Dam
GRAIN SIZE DISTRIBUTION

FIGURE B12

LOWER SILT

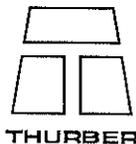


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M01	27.74	169.16

THURBGSD 5198.GPJ 05/12/06

Date December 2006
 Project 5460-04-00

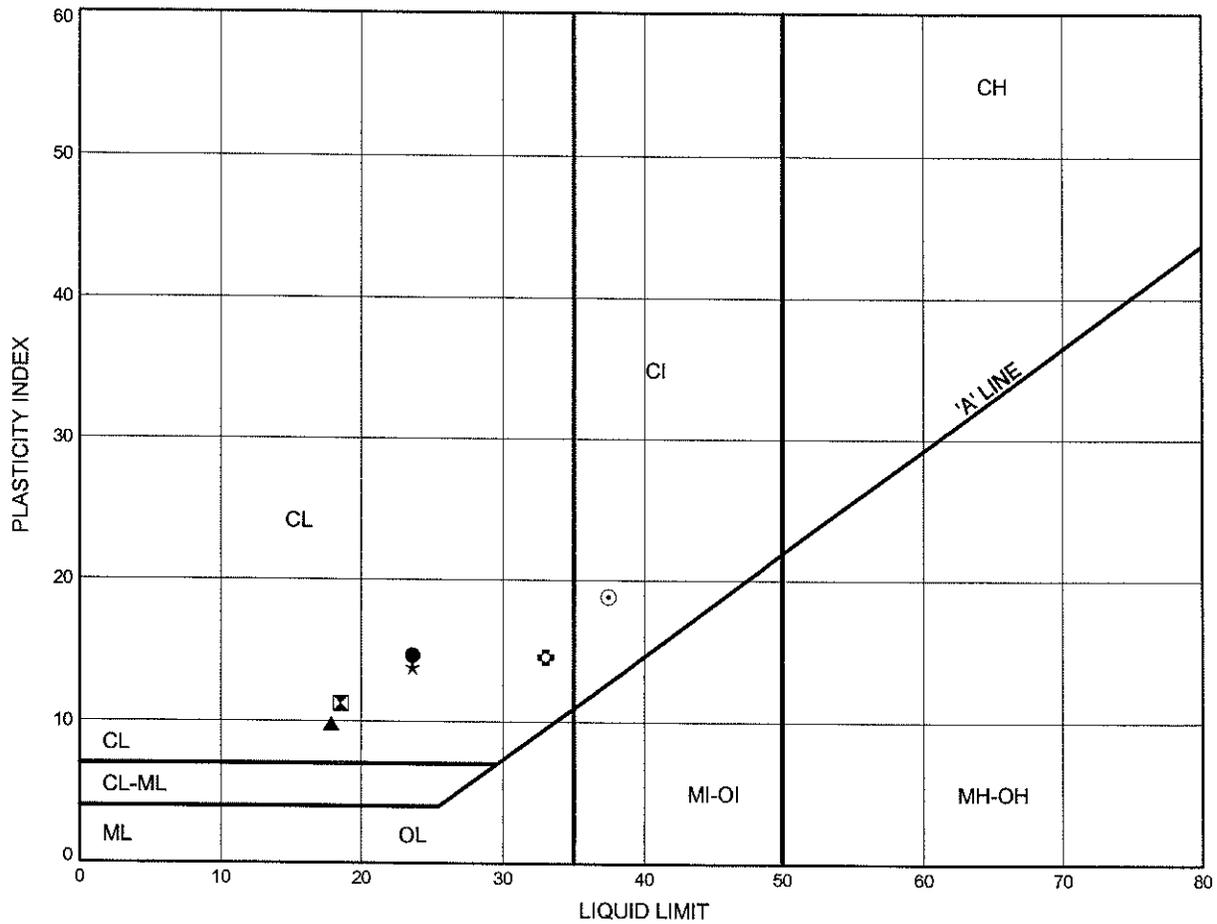


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam
ATTERBERG LIMITS TEST RESULTS

FIGURE B13

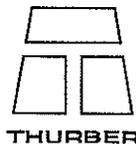
SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M01	3.35	193.55
⊠	06-M03	4.88	193.22
▲	06-M04	4.88	193.12
★	06-M07	7.62	190.18
⊙	06-M08	6.10	191.91
⊛	06-M09	7.62	190.08

THURBALT 5198.GPJ 05/12/06

Date December 2006
 Project 5460-04-00

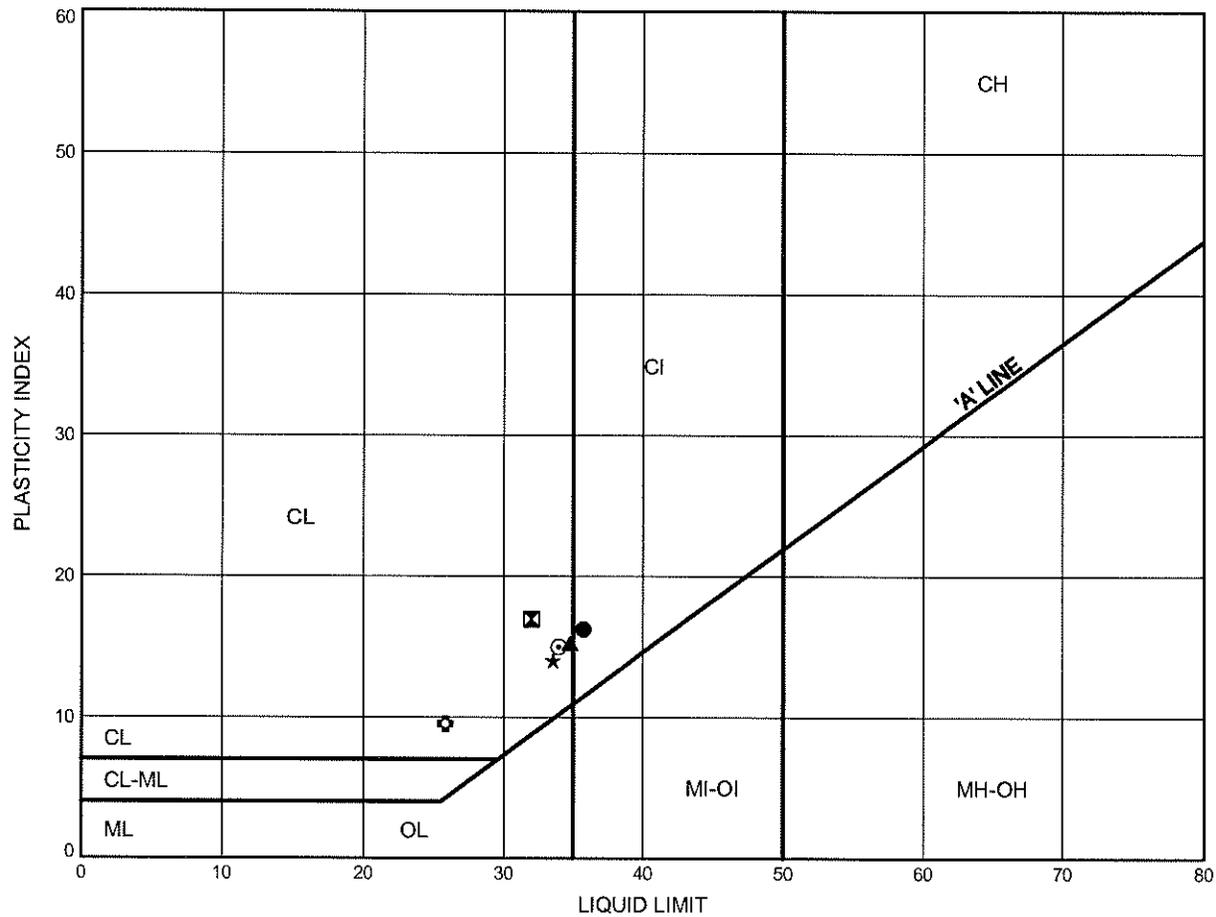


Prep'd MFA
 Chkd. MRA

Mindemoya Lake Bridge and Dam
ATTERBERG LIMITS TEST RESULTS

FIGURE B14

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M10	3.35	193.25
⊠	06-M11	4.88	193.02
▲	06-M12	3.35	194.45
★	06-M13	3.35	193.35
⊙	06-M14	3.35	194.35
⊕	06-M14	7.62	190.08

THURBALT 5198-MINDEMOYA.GPJ 15/11/07

Date November 2007

Project 5460-04-00



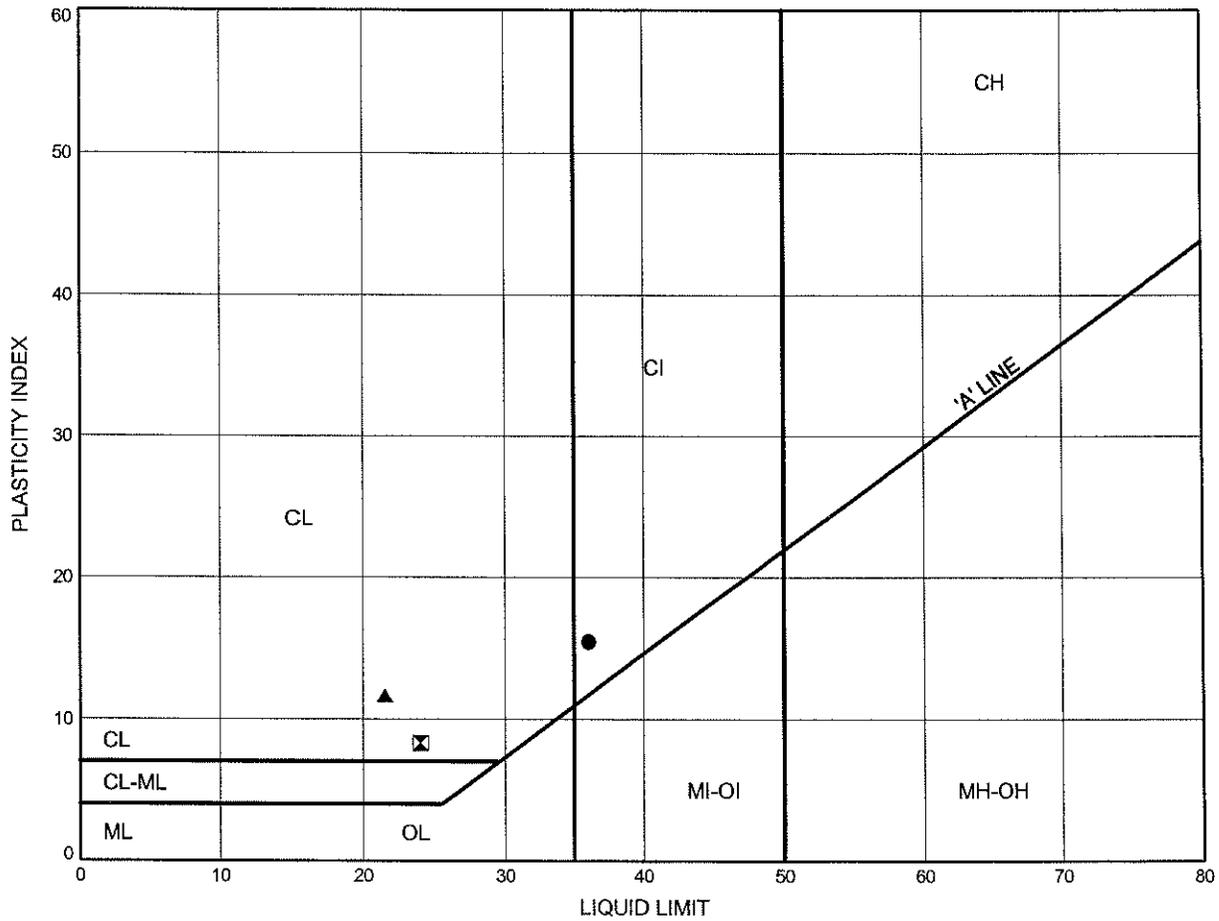
Prep'd MFA

Chkd. MRA

Mindemoya Lake Bridge and Dam
ATTERBERG LIMITS TEST RESULTS

FIGURE B15

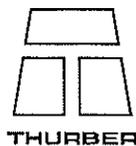
SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-M15	2.59	195.21
⊠	06-M15	7.62	190.18
▲	06-M15	10.67	187.13

THURBALT 5198.GPJ 05/12/06

Date December 2006
 Project 5460-04-00



Prep'd MFA
 Chkd. MRA

Appendix C

Photographs, Figures and Tables

Mindemoya Lake Bridge and Dam Replacement



Photograph 1: Existing dam control structure and pool (July 2006).



Photograph 2: Mindemoya River and pool (September 2007).



Mindemoya Lake Bridge and Dam Replacement



Photograph 3: Lake side of Highway 542 bridge, looking west (September 2007).



Photograph 4: Lake side of existing Highway 542 bridge, looking east (September 2007).



TABLE C1 – PIEZOMETER AND MONITORING WELL DETAILS

Location	Tip Position (m)		Completion Details
	Depth	Elevation	
BH06-M03	35.1	163.0	Sand filter and screen from 35.1 to 32.9 m, bentonite seal to 31.7 m, grout to 4.6 m, bentonite to surface.
BH06-M04	37.7	160.3	Sand filter and screen from 37.7 to 35.4 m, bentonite seal to 34.7, grout to 2.7 m, bentonite to surface.
BH06-M09	20.1	177.6	Sand filter and screen from 20.1 to 17.7 m, bentonite seal to 14.9 m, grout to 3.0 m, bentonite to surface.
BH06-M10	32.0	164.6	Sand filter and screen from 32.0 to 30.2 m, bentonite seal to 29.6 m, grout to 5.5 m, bentonite to surface.
BH06-M13	32.6	164.1	Sand filter and screen from 32.6 to 30.8 m, bentonite seal to 29.9 m, grout to 4.6 m, bentonite to surface.
BH06-M14	20.1	177.6	Sand filter and screen from 20.1 to 17.7 m, bentonite seal to 16.8 m, grout to 2.1 m, bentonite to surface.
BH07-M3	2.3	195.7	Bentonite from 13.1 to 3.0 m, bentonite seal to 2.7 m, sand filter and screen from 2.7 to 0.7 m, bentonite seal to 0.4 m, cement to 0.2 m, sand to 0.1 m, asphalt to surface.
	4.6	193.4	Sand filter and screen from 4.6 to 2.7 m, bentonite seal to 1.9 m, grout to 0.9 m, bentonite seal to 0.3 m, sand to 0.15 m, asphalt to surface.
	7.6	190.4	Sand filter and screen from 7.6 to 5.7 m, bentonite seal to 4.9 m, grout to 0.9 m, bentonite seal to 0.3 m, cement to 0.15 m, sand to 0.08 m, asphalt to surface.
BH07-M4	2.2	195.8	Grout from 13.2 to 3.0 m, bentonite seal to 2.5 m, sand filter and screen from 2.5 to 0.6 m, bentonite seal to 0.25 m, cement to 0.1 m, sand to 0.05 m, asphalt to surface.
BH07-M6	7.6	189.4	Sand filter and screen from 7.6 to 5.8 m, bentonite seal to 4.9 m, grout to 0.9 m, bentonite to surface.
	12.5	184.5	Grout from 37.2 to 13.1 m, bentonite seal to 12.5 m, sand filter and screen from 12.5 to 10.7 m, bentonite seal to 9.8 m, grout to 0.9 m, bentonite to surface.
BH07-M7	7.6	187.6	Grout from 30.2 to 8.5 m, bentonite seal to 7.6 m, sand filter and screen from 7.6 to 5.8 m, bentonite seal to 4.9 m, grout to 0.9 m, bentonite to surface
BH07-M11	15.2	181.6	Sand filter and screen from 15.2 to 13.4 m, bentonite seal to 12.2 m, grout to 0.9 m, bentonite to surface
BH07-M14	7.6	189.2	Grout from 33.8 to 8.5 m, bentonite seal to 7.6 m, sand filter and screen from 7.6 to 5.8 m, bentonite seal to 4.9 m, grout to 0.9 m, bentonite to surface
BH07-M15	16.8	178.6	Grout from 35.1 to 18.3 m, bentonite seal to 16.8 m, sand filter and screen from 16.8 to 14.9 m, bentonite seal to 14.0 m, grout to 0.9 m, bentonite to surface

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

Instructions:

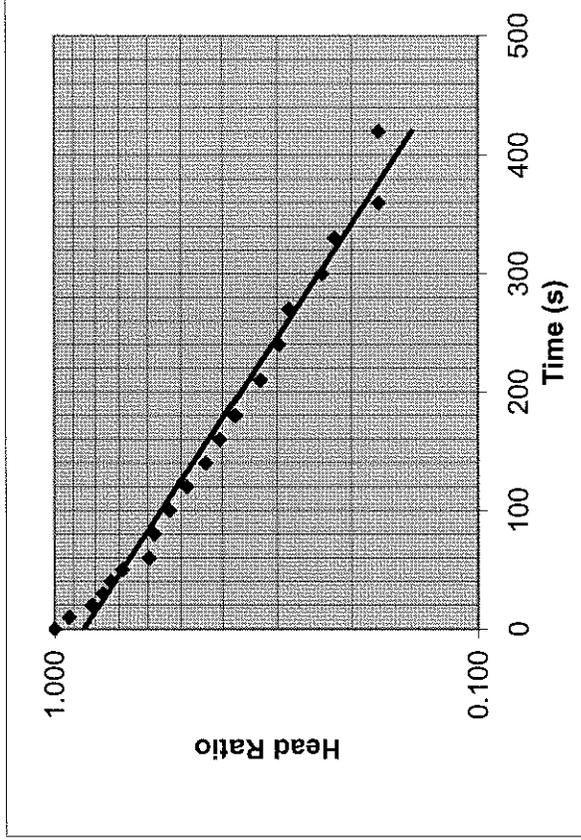
Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M3-2
 Date of Test: 29-Aug-07
 Technician: GA

Static Water Level Depth: 1.34 m
 Well Depth: 2.7 m
 Height of Water in Well (H): 1.36 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	0.70	2.00	1.000
10	0.75	1.95	0.922
20	0.82	1.88	0.813
30	0.85	1.85	0.766
40	0.87	1.83	0.734
50	0.90	1.80	0.688
60	0.96	1.74	0.594
80	0.97	1.73	0.578
100	1.00	1.70	0.531
120	1.03	1.67	0.484
140	1.06	1.64	0.438
160	1.08	1.62	0.406
180	1.10	1.60	0.375
210	1.13	1.57	0.328
240	1.15	1.55	0.297
270	1.16	1.54	0.281
300	1.19	1.51	0.234
330	1.20	1.50	0.219
360	1.23	1.47	0.172
420	1.23	1.47	0.172



Input Data

d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.06 m
 L=Length of Screen 2 m
 To=Basic Time Lag (from graph) 190 s
 (time at head ratio = 0.37)

Calculation

Hydraulic Conductivity (K) = 3.45E-06 m/s

Assumptions:

L/R > 4
 Well diameter is constant

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

Instructions:

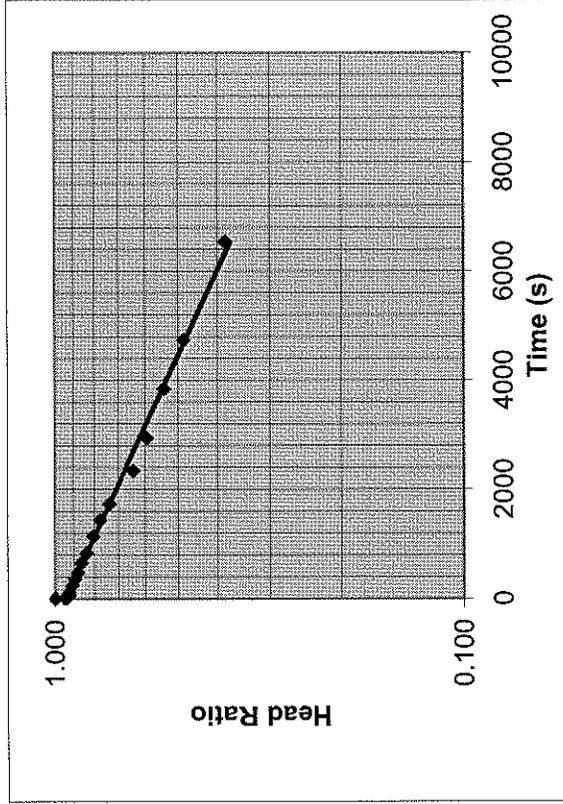
Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M3-5
 Date of Test: 28-Aug-07
 Technician: GA

Static Water Level Depth: 1.26 m
 Well Depth: 4.6 m
 Height of Water in Well (H): 3.34 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	2.54	2.06	1.000
10	2.47	2.13	0.945
20	2.46	2.14	0.938
30	2.45	2.15	0.930
45	2.45	2.15	0.930
60	2.44	2.16	0.922
90	2.44	2.16	0.922
120	2.44	2.16	0.922
240	2.42	2.18	0.906
360	2.40	2.20	0.891
480	2.38	2.22	0.875
660	2.36	2.24	0.859
840	2.33	2.27	0.836
1140	2.29	2.31	0.805
1440	2.25	2.35	0.773
1740	2.20	2.40	0.734
2340	2.08	2.52	0.641
2940	2.02	2.58	0.594
3840	1.95	2.65	0.539
4740	1.88	2.72	0.484
6540	1.75	2.85	0.383



Input Data
 d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.2 m
 L=Length of Screen 1.9 m
 To=Basic Time Lag (from graph) 6600 s
 (time at head ratio = 0.37)

Calculation
 Hydraulic Conductivity (K) = 7.34E-08 m/s

Assumptions:
 L/R > 4
 Well diameter is constant

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

Instructions:

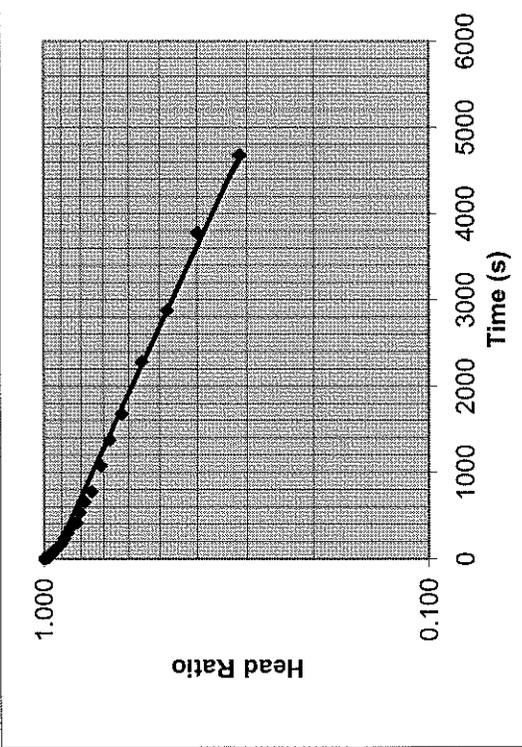
Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M3-8
 Date of Test: 28-Aug-07
 Technician: GA

Static Water Level Depth: 2.22 m
 Well Depth: 7.6 m
 Height of Water in Well (H): 5.38 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	0.94	6.66	1.000
10	0.95	6.65	0.992
20	0.97	6.63	0.977
30	0.98	6.62	0.969
40	0.99	6.61	0.961
60	1.00	6.60	0.953
90	1.01	6.59	0.945
120	1.03	6.57	0.930
150	1.05	6.55	0.914
180	1.07	6.53	0.898
240	1.09	6.51	0.883
300	1.11	6.49	0.867
360	1.13	6.47	0.852
420	1.17	6.43	0.820
540	1.19	6.41	0.805
660	1.22	6.38	0.781
780	1.26	6.34	0.750
1080	1.31	6.29	0.711
1380	1.36	6.24	0.672
1680	1.42	6.18	0.625
2280	1.51	6.09	0.555
2880	1.61	5.99	0.477
3780	1.71	5.89	0.398
4680	1.82	5.78	0.313



Input Data

d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.2 m
 L=Length of Screen 1.9 m
 To=Basic Time Lag (from graph) 4000 s
 (time at head ratio = 0.37)

Calculation

Hydraulic Conductivity (K) = 1.21E-07 m/s

Assumptions:

L/R >4
 Well diameter is constant

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

Instructions:

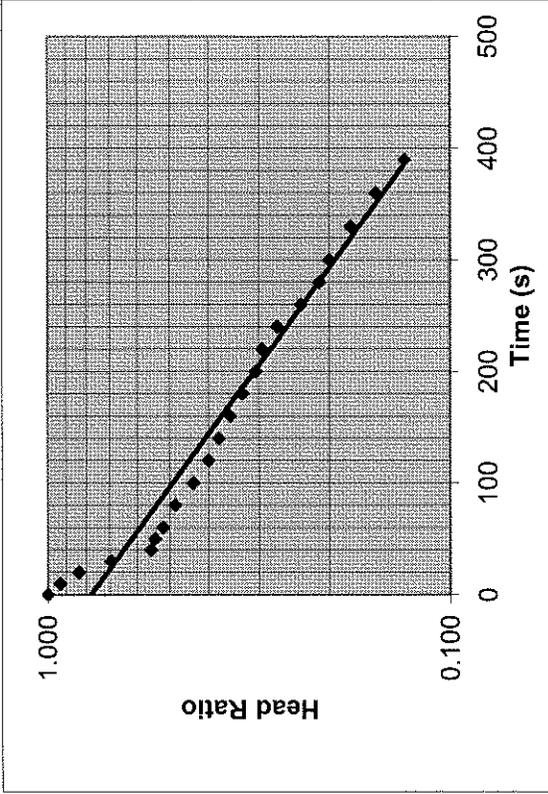
Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M4-2
 Date of Test: 29-Aug-07
 Technician: GA

Static Water Level Depth: 1.32 m
 Well Depth: 2.5 m
 Height of Water in Well (H): 1.18 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	0.47	2.03	1.000
10	0.53	1.97	0.929
20	0.61	1.89	0.835
30	0.73	1.77	0.694
40	0.85	1.65	0.553
50	0.86	1.64	0.541
60	0.88	1.62	0.518
80	0.91	1.59	0.482
100	0.95	1.55	0.435
120	0.98	1.52	0.400
140	1.00	1.50	0.376
160	1.02	1.48	0.353
180	1.04	1.46	0.329
200	1.06	1.44	0.306
220	1.07	1.43	0.294
240	1.09	1.41	0.271
260	1.12	1.38	0.235
280	1.14	1.36	0.212
300	1.15	1.35	0.200
330	1.17	1.33	0.176
360	1.19	1.31	0.153
390	1.21	1.29	0.129



Input Data

d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.06 m
 L=Length of Screen 2 m
 To=Basic Time Lag (from graph) 160 s
 (time at head ratio = 0.37)

Calculation

Hydraulic Conductivity (K) = 4.10E-06 m/s

Assumptions:

L/R > 4
 Well diameter is constant

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

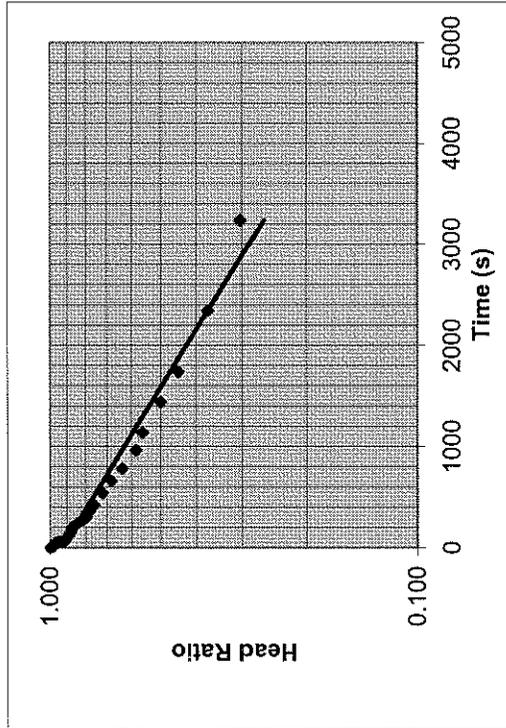
Instructions:

Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M6-8
 Date of Test: 28-Aug-07
 Technician: GA
 Static Water Level Depth: 3.05 m
 Well Depth: 7.6 m
 Height of Water in Well (H): 4.55 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	1.73	5.87	1.000
10	1.74	5.86	0.992
20	1.76	5.84	0.977
25	1.77	5.83	0.970
50	1.78	5.82	0.962
60	1.80	5.80	0.947
70	1.85	5.75	0.909
90	1.85	5.75	0.909
120	1.88	5.72	0.886
150	1.89	5.71	0.879
180	1.90	5.70	0.871
210	1.91	5.69	0.864
240	1.94	5.66	0.841
270	1.97	5.63	0.818
300	2.00	5.60	0.795
360	2.02	5.58	0.780
420	2.05	5.55	0.758
540	2.10	5.50	0.720
660	2.15	5.45	0.682
780	2.21	5.39	0.636
960	2.28	5.32	0.583
1140	2.31	5.29	0.561
1440	2.39	5.21	0.500
1740	2.46	5.14	0.447
2340	2.56	5.04	0.371
3240	2.65	4.95	0.303



Input Data

d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.2 m
 L=Length of Screen 1.8 m
 To=Basic Time Lag (from graph) 2400 s
 (time at head ratio = 0.37)

Calculation

Hydraulic Conductivity (K) = 2.09E-07 m/s

Assumptions:

L/R > 4
 Well diameter is constant

Determination of Hydraulic Conductivity from a Piezometer (Hvorslev Time-Lag Method)

Instructions:

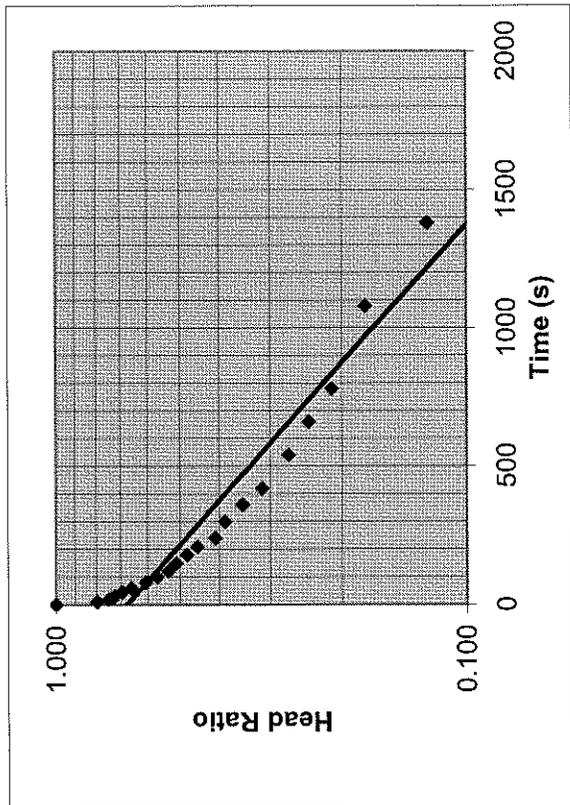
Enter field data in blue cells
 Determine Time lag from graph and enter in green cell
 Hydraulic Conductivity Calculated in pink cell

Project Number: 19-1351-98
 Borehole Number: 07-M6-12
 Date of Test: 28-Aug-07
 Technician: GA

Static Water Level Depth: 3.48 m
 Well Depth: 12.5 m
 Height of Water in Well (H): 9.02 m

Test Data

Time (sec.)	Depth to Water (m)	Height of Water in Well (h)	Head Ratio (H-h/H-ho)
0	2.11	10.39	1.000
10	2.39	10.11	0.796
20	2.46	10.04	0.745
30	2.49	10.01	0.723
45	2.53	9.97	0.693
60	2.58	9.92	0.657
80	2.65	9.85	0.606
100	2.70	9.80	0.569
120	2.75	9.75	0.533
150	2.78	9.72	0.511
180	2.82	9.68	0.482
210	2.86	9.64	0.453
240	2.92	9.58	0.409
300	2.95	9.55	0.387
360	3.00	9.50	0.350
420	3.05	9.45	0.314
540	3.11	9.39	0.270
660	3.15	9.35	0.241
780	3.19	9.31	0.212
1080	3.24	9.26	0.175
1380	3.31	9.19	0.124



Input Data
 d=Inside Diameter of Piezometer 0.05 m
 D=Diameter of Borehole 0.2 m
 L=Length of Screen 1.8 m
 To=Basic Time Lag (from graph) 450 s
 (time at head ratio = 0.37)

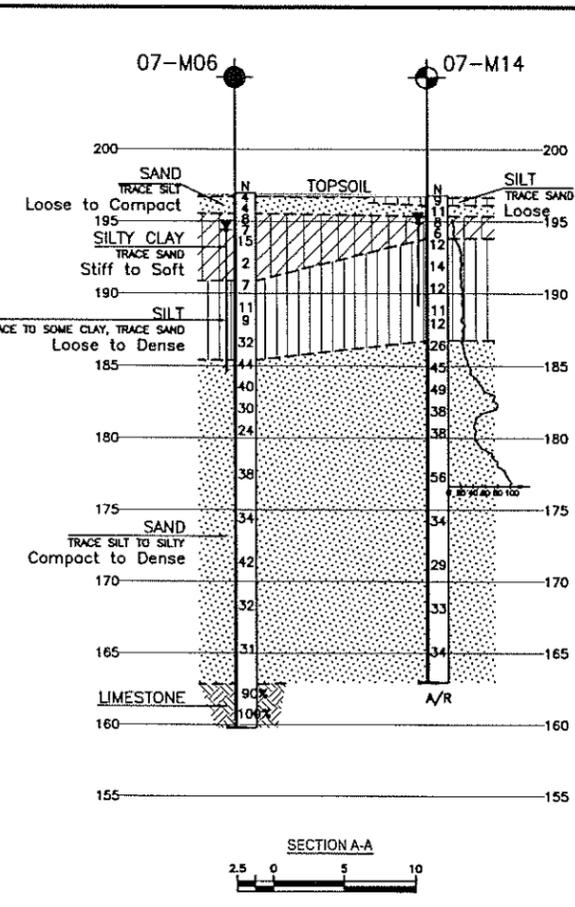
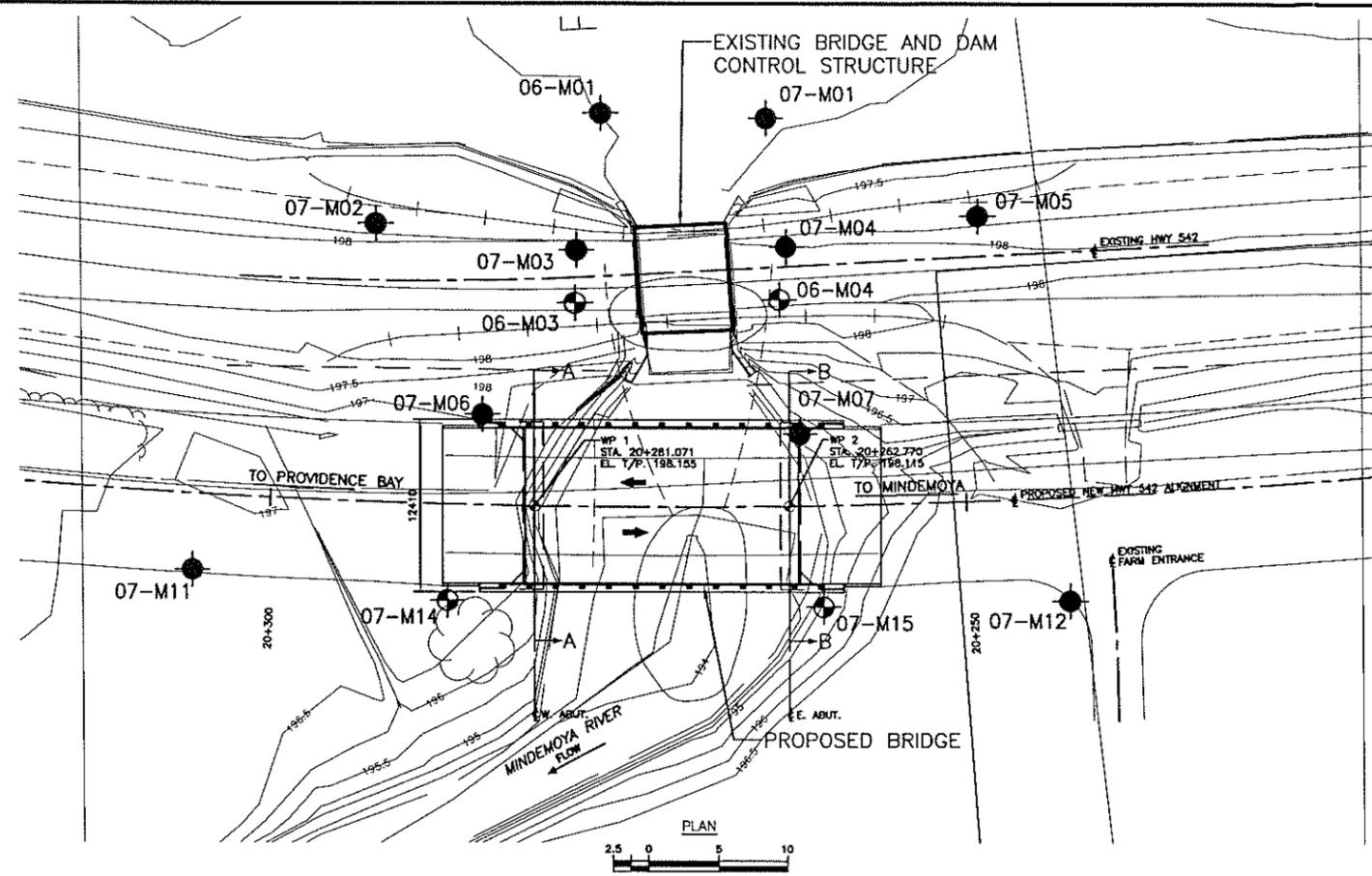
Calculation
 Hydraulic Conductivity (K) = 1.12E-06 m/s

Assumptions:
 L/R >4
 Well diameter is constant

Appendix D

Borehole Locations and Soil Strata Drawings

PLG SCALE 1:1
 88-05
 11-3-77
 MINISTRY OF TRANSPORTATION, ONTARIO



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

CONT No
 GWP No.5460-04-00

HIGHWAY 542
 MINDEMOYA LAKE BRIDGE
 REPLACEMENT
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



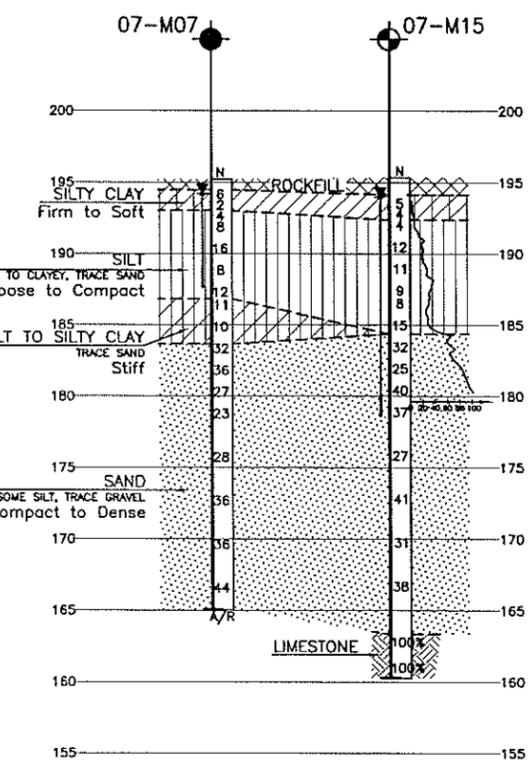
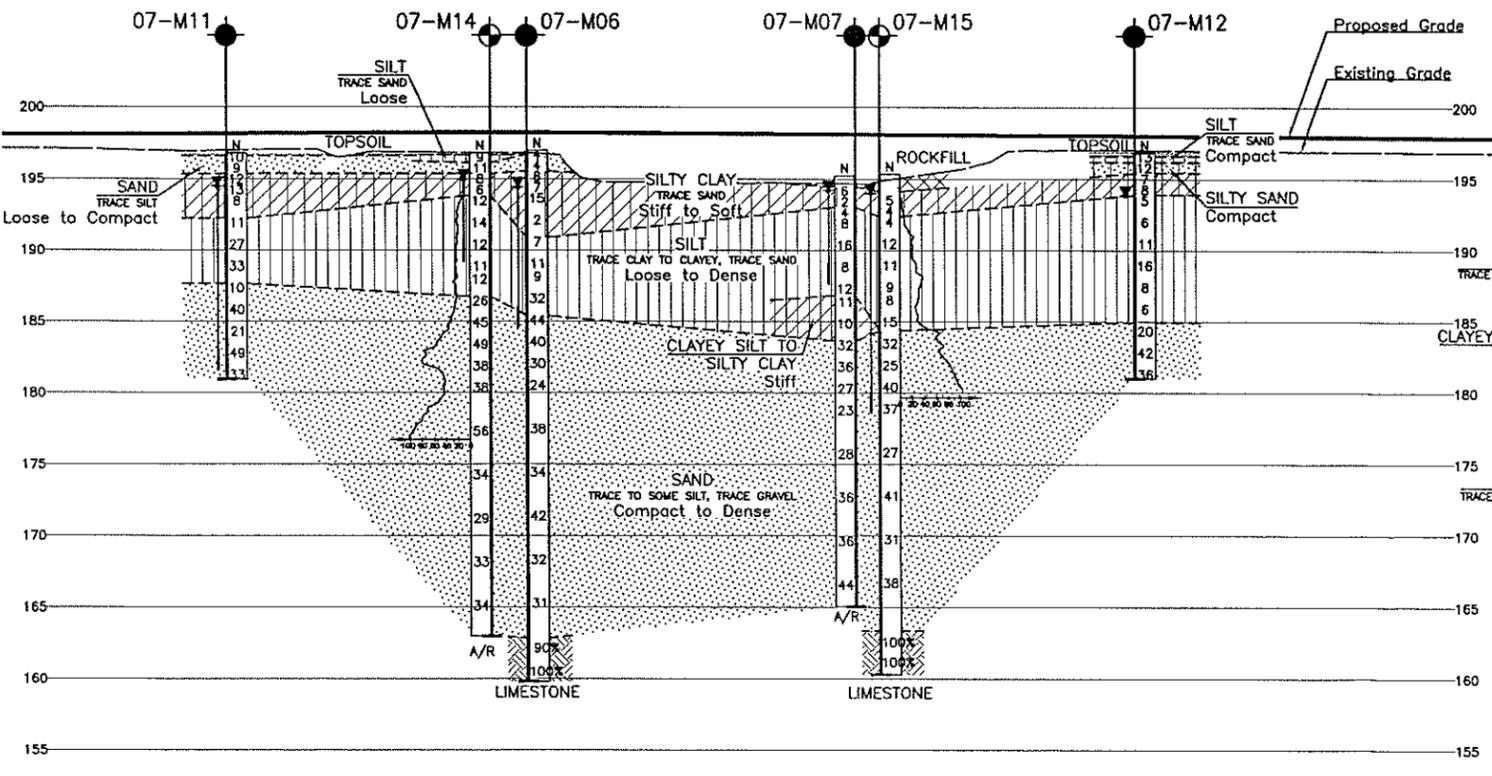
KEYPLAN
LEGEND

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

NO	ELEVATION	NORTHING	EASTING
07-M01	197.3	9876.7	9181.2
07-M02	197.9	9872.3	9152.5
07-M03	198.0	9868.8	9166.7
07-M04	198.0	9867.3	9181.6
07-M05	197.9	9868.0	9195.6
07-M06	197.0	9857.9	9158.6
07-M07	195.2	9853.9	9181.1
07-M11	196.8	9849.1	9136.6
07-M12	196.9	9839.7	9199.0
07-M14	196.8	9844.8	9154.5
07-M15	195.4	9841.3	9181.4
06-M01	196.9	9878.4	9169.6
06-M03	198.1	9865.0	9166.1
06-M04	198.0	9863.6	9180.7

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

GEOCREs No. 41G-8



PROFILE PROPOSED HWY 542
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SECTION B-B
 2.5 0 5 10

DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING

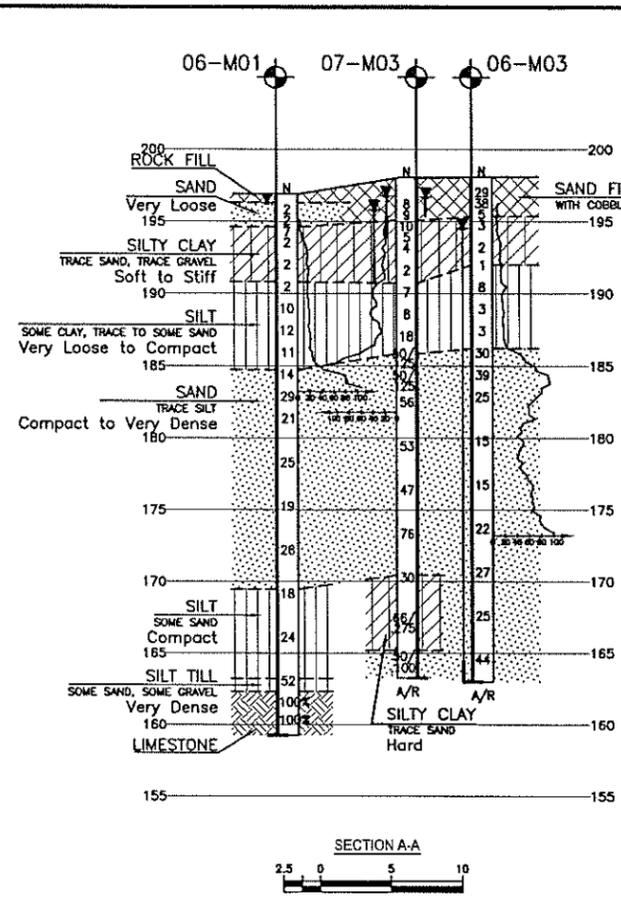
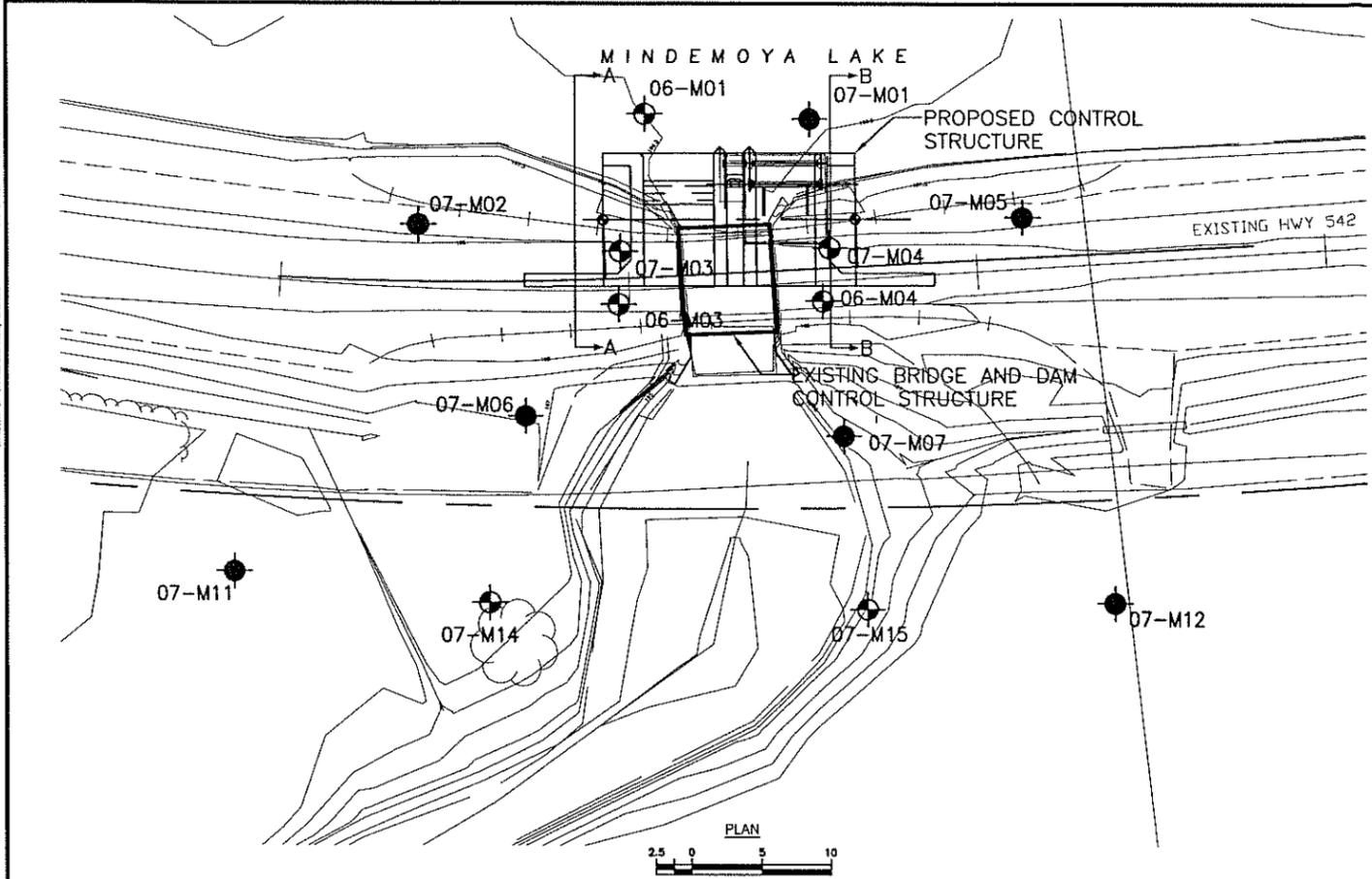
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DESIGN	MRA	CHK PKC
DRAWN	MFA	CHK MRA

CODE LOAD DATE OCT 2007
 SITE 49-023 STRUCT DWG 1

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 CREATED: JULY 08
 MODIFIED:

FILENAME: C:\web_files\19135118 Mindemoya and Betty Creek\183-MindemoyaBridge.dwg
 PLOT DATE: Jun 18, 2008 - 2:12pm

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



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

CONT No
GWP No.5460-04-00

HIGHWAY 542
MINDEMOYA LAKE DAM
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

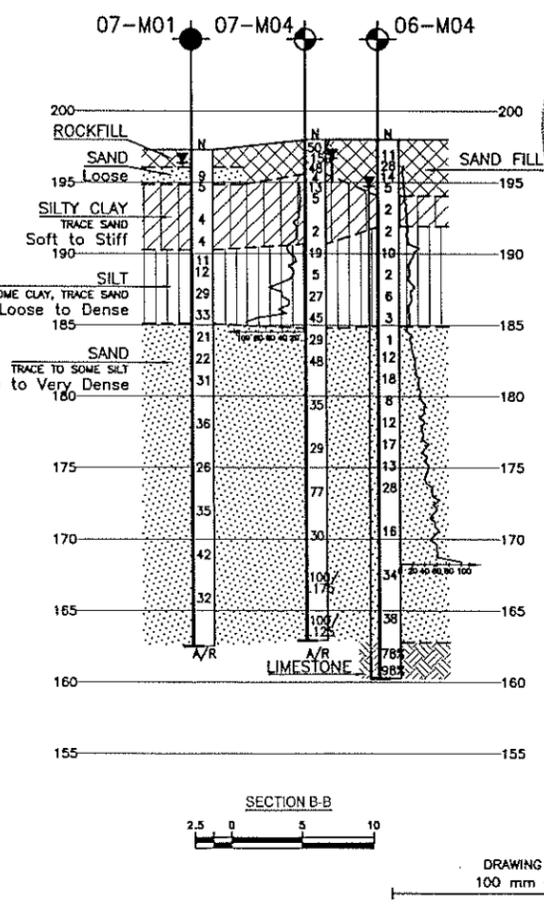
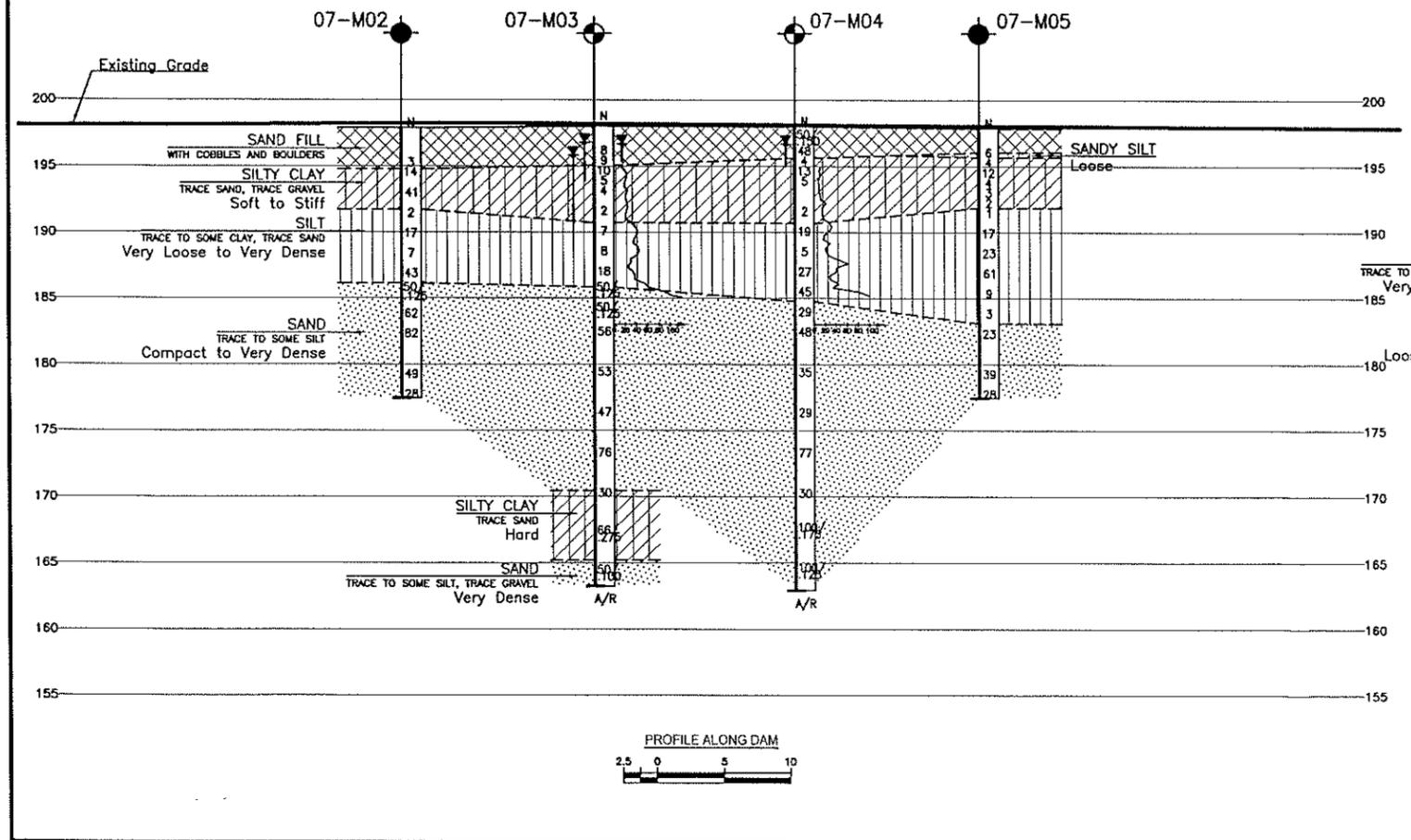
MRC MCCORMICK RANKIN
CORPORATION

THURBER ENGINEERING LTD.



**KEYPLAN
LEGEND**

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



NO	ELEVATION	NORTHING	EASTING
07-M01	197.3	9876.7	9181.2
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GEOCREs No. 41G-8

DATE	BY	DESCRIPTION
DESIGN	MRA	CHK PKC
DRAWN	MFA	CHK MRA

DATE: OCT 2007
SITE: 49-023
STRUCT: DWG 2

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100 mm ON ORIGINAL DRAWING

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CREATED: JULY 06
MODIFIED:

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PLOTDATE: Jun 18, 2008 - 2:22pm

DATE: 2008-07-08
DRAWN: MFA
CHECKED: MRA
DESIGNED: MRA
PROJECT: MINDEMOYA LAKE BRIDGE AND DAM

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

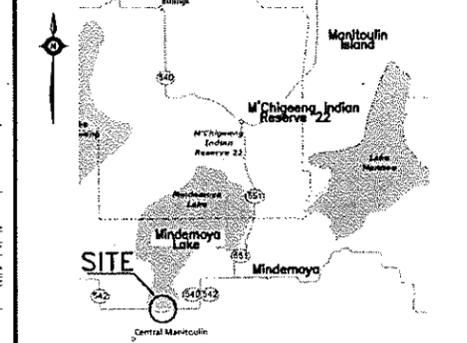
CONT No
GWP No.5460-04-00

HIGHWAY 542
MINDEMOYA LAKE BRIDGE AND DAM
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MRC **MCCORMICK RANKIN CORPORATION**

THURBER ENGINEERING LTD.



KEYPLAN
LEGEND

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

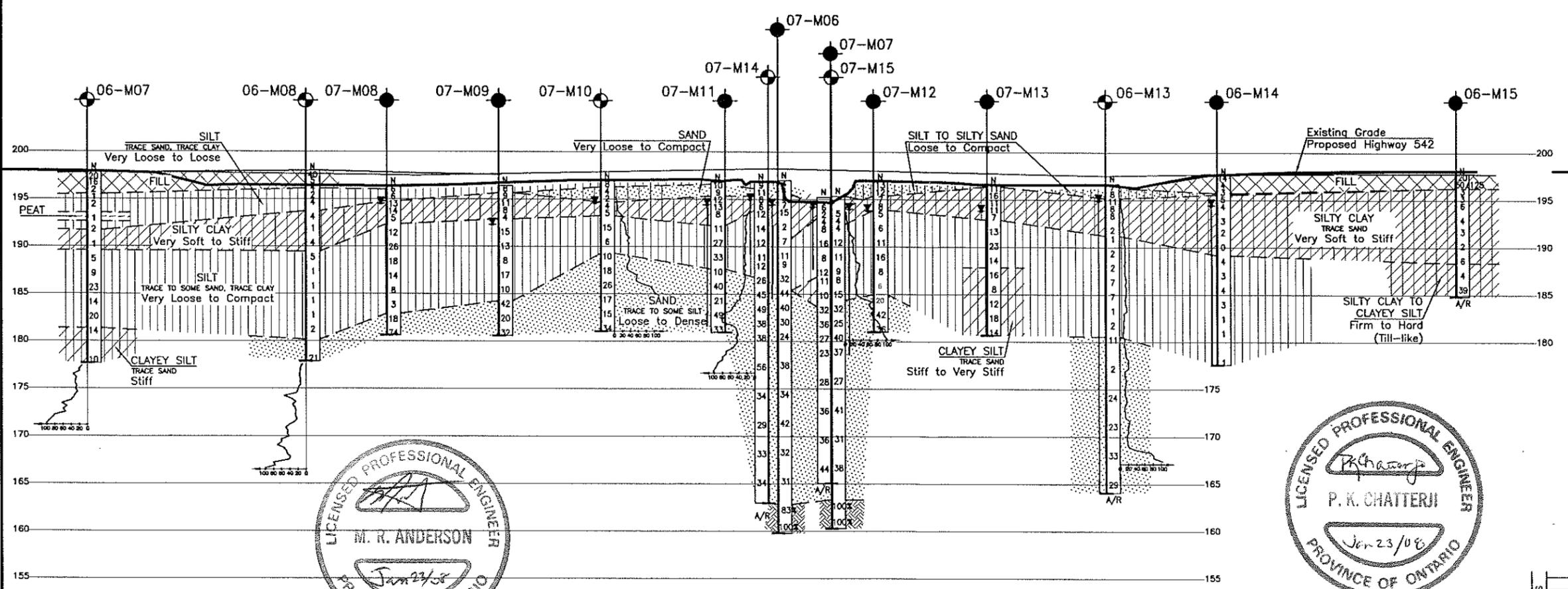
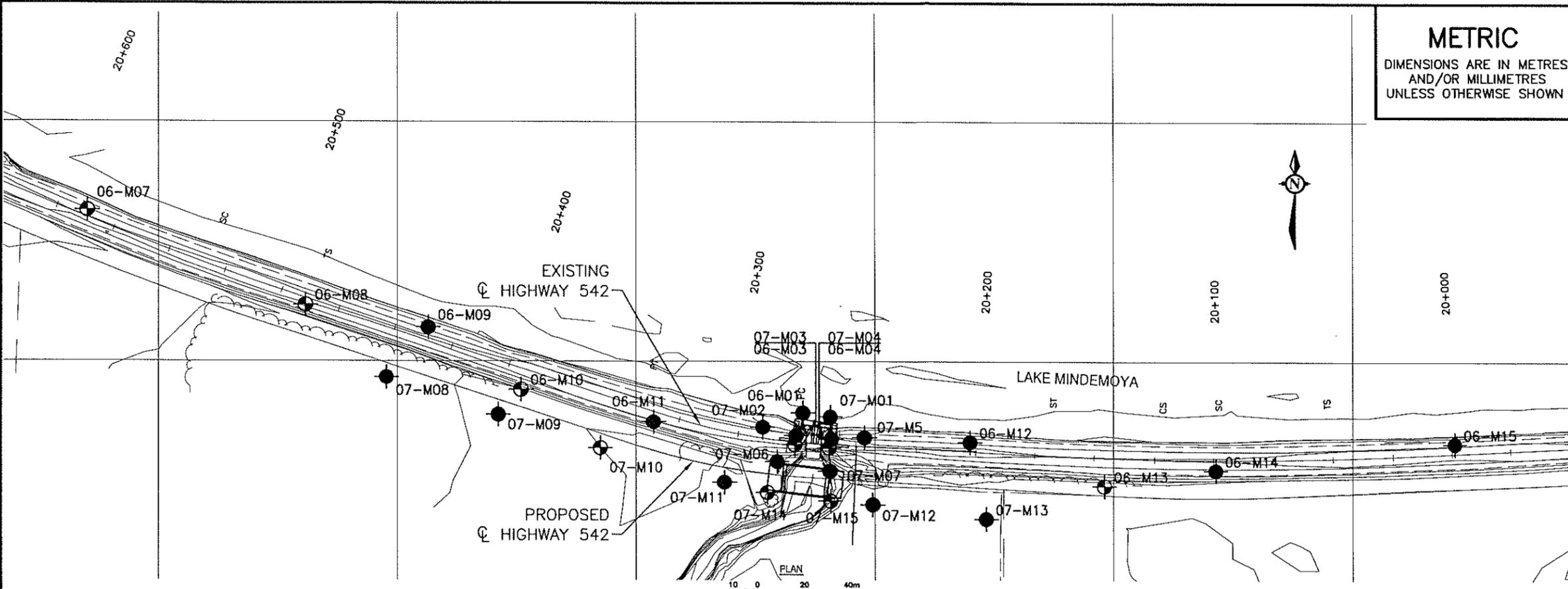
NO	ELEVATION	NORTHING	EASTING
07-M01	197.3	9876.7	9181.2
07-M02	197.9	9872.3	9152.5
07-M03	198.0	9868.6	9166.7
07-M04	198.0	9867.3	9181.6
07-M05	197.9	9868.0	9195.6
07-M06	197.0	9857.9	9158.6
07-M07	195.2	9853.9	9181.1
07-M08	196.3	9893.2	8995.4
07-M09	196.4	9877.6	9042.1
07-M10	196.9	9863.6	9084.9
07-M11	196.8	9849.1	9136.6
07-M12	196.9	9839.7	9199.0
07-M13	196.5	9833.7	9246.4
07-M14	196.8	9844.8	9154.5
07-M15	195.4	9841.3	9181.4
06-M07	197.8	9963.0	8870.2
06-M08	198.0	9923.5	8961.3
06-M13	196.7	9847.6	9296.2
06-M14	197.7	9854.2	9342.9
06-M15	197.8	9865.5	9443.1

-NOTES-

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GEOCREs No. 41G-8



LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Jan 23/08
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Jan 23/08
PROVINCE OF ONTARIO

PROFILE PROPOSED HIGHWAY 542
2.5 0 5 10m VERT
10 0 20 40m HOR

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

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DRAWN: MFA, CHK: MRA, SITE: 49-023, STRUCT: DWG 3

DRAWING NAME: TSD183 - PLAN&PROFILE
CREATED: JULY 08
MODIFIED:

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