THURBER ENGINEERING LTD.

FOUNDATION INVESTIGATION REPORT
KASABONIKA LAKE MODULAR BRIDGE
DISTRICT OF KENORA, KASABONIKA LAKE FIRST NATION, ONTARIO
LATITUDE: 53.5263°, LONGITUDE: -88.6213°
W.P. 6579-16-00, SITE No. 41N-0244/BO

GEOCRES Number: 53H-01

Report

to

HATCH

Date: November 13, 2019
File: 25489

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THURBER

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APPENDICES

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FOUNDATION INVESTIGATION REPORT
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1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed Kasabonika Lake Modular Bridge replacement in Kasabonika Lake First Nation, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the bridge site and, based on the data obtained, to provide a borehole location plan, stratigraphic profile, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by the Ministry of Transportation (MTO), Northwest Region, to carry out this foundation investigation under the MTO Agreement Number 6017-E-0022, Assignment #15.

2. SITE DESCRIPTION

The site is located in Kasabonika Lake First Nation, approximately 1 km east of the Kasabonika Airport. The existing bridge connects the island community of Kasabonika Lake First Nation to the mainland. A survey drawing provided by MTO refers to the road that the bridge is located on as “Main Road”. Main Road runs in an approximately southwest to northeast direction at the bridge.

The Ontario Structure Inspection Manual (OSIM) report prepared by MTO on June 6, 2018 indicates that the existing structure is a single span bailey panel modular bridge built in 1983. The inspection report indicates that the bridge deck is approximately 27.6 m long and 5.45 m wide. The ground surface elevation at the existing bridge deck is approximately Elevation 186.8 m. The existing bridge is in overall poor condition, with potholes at the abutments and decaying deck boards. The wearing surface and some of the deck boards have been replaced since the 2018 OSIM report. The existing bridge abutments are supported on timber cribs on a causeway placed

in the lake. The southwest approach embankment to the bridge is approximately 30 m long to the mainland and the fill is approximately 3.5 m high at the bridge. The northeast approach embankment is approximately 50 m long to the island and the fill is approximately 3 m high at the bridge. Photographs provided by MTO (see Photos C1 and C2 in Appendix C) show that the causeway beyond the bridge has previously been overtopped by high lake water levels. Photographs from 2009 (see Photos C3 and C4 in Appendix C) show that severe erosion of the approach embankments, possibly due to this flooding, has previously occurred at the bridge abutments, leading to exposure and undermining of the timber cribs. The embankment erosion was subsequently repaired at an unknown time.

The water level of Kasabonika Lake was measured at Elevation 184.0 m at the bridge on August 21, 2016, as shown on survey drawings provided by MTO, and at approximate Elevation 184.4 m in June 2019, as measured by Hatch. The previous flooding that overtopped the east approach embankment causeway indicates that the lake water level has previously been observed at greater than approximate Elevation 186 m. The lake channel is approximately 10 m wide and 0.5 to 1 m deep, which varies based on the water level.

The lands surrounding the bridge site predominantly consist of heavily forested areas with lakes, swamps, rivers, and creeks. Photographs of the bridge and surrounding area are presented in Appendix C.

Based on published geological information, the bridge lies within an area of tonalite to granodiorite bedrock. Based on local geological maps, the bedrock in the area is overlain by undifferentiated sand to silt till.

3. INVESTIGATION PROCEDURES

The field investigation for the bridge replacement project was carried out from June 5 to 10, 2019 and consisted of drilling and sampling nine (9) boreholes, labeled 19-01 to 19-05B, to depths of approximately 2.3 m to 9.4 m (Elevation 184.6 m to 176.7 m). Boreholes 19-01, 19-01B and 19-01B(2) were drilled at the west abutment, while boreholes 19-02 and 19-02B were drilled at the east abutment of the bridge. Boreholes 19-04, 19-05, 19-05B were drilled along the causeway at the east approach to the bridge, while Borehole 19-03 was drilled at the west bridge approach. All boreholes were drilled on the existing road shoulders. Most of the boreholes encountered refusal on boulders or possibly frozen soil, and therefore multiple boreholes were attempted in order to retrieve information below the boulder layer. The additional attempts for Boreholes 19-01, 19-02 and 19-05 were drilled on the opposite road shoulder and are labelled Boreholes 19-01B, 19-02B and 19-05B respectively. A third attempt for Borehole 19-01 was conduced

adjacent to Borehole 19-01B and is labelled 19-01B(2).

In addition to the boreholes, three tests pits were also excavated and are labelled TP-01 to TP-03. The test pits were all terminated at a depth of 2.1 m (Elevation 184.9 m to 183.9 m). TP-01 was excavated on the west approach while TP-02 and TP-03 were excavated along the east approach. Ten hand probes (HP1 to HP10) were also conducted near the base of the causeway embankments.

The approximate locations of the boreholes, test pits and hand probes from the investigation are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from the cross sections and topographic drawings provided to Thurber by MTO. The coordinate system MTM NAD 83, Zone 15 was used for the boreholes.

A limited access Simco drill rig (Photo C5 in Appendix C) was used to advance Boreholes 19-01 to 19-05B using solid stem augers and BW casing. The drill rig was transported to the site by plane from Pickle Lake, Ontario (Photo C6 in Appendix C). The soil samples were obtained in the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). At Boreholes 19-01, 19-01B, 19-02, 19-03, 19-04 and 19-05, BQ coring methods were used to advance the boreholes past large boulders. A backhoe supplied and operated by the Kasabonika Lake First Nation was used to excavate the test pits (Photo C7 in Appendix C). Grab samples of the excavated soil were obtained from the test pits. Photos of the test pits (Photos A1 to A3) are included in Appendix A following the borehole logs for Test Pits TP-01 to TP-03.

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

Completion details of the boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
19-01	4.3 / 182.6	Hole open to 2.0 m. Backfilled from 2.0 m to 0.15 m with Bentonite

Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
		holeplug and cuttings. Sand and gravel from 0.15 m to surface.
19-01B	4.2 / 182.7	Backfilled with Bentonite holeplug and cuttings to 0.15 m. Sand and Gravel to surface
19-01B(2)	3.5 / 183.5	Hole open to 1.8 m. Backfilled with Bentonite holeplug and cuttings from 1.8 m to 0.15 m. Sand and Gravel to surface.
19-02	3.7 / 182.8 DCPT 3.7 to 8.1 / 182.8 to 178.4	Hole open to 1.8 m. Backfilled from 1.8 m to 0.9 m with bentonite holeplug and cuttings. Sand and gravel from 0.9 m to surface.
19-02B	2.3 / 183.9	Backfilled with Sand and Gravel to surface.
19-03	2.5 / 184.6	Hole open to 0.9 m. Backfilled with Bentonite holeplug to 0.15 m. Sand and gravel to surface.
19-04	3.3 / 182.8	Hole open to 1.5 m. Backfilled with Sand and gravel to surface.
19-05	2.4 / 183.7	Backfilled with Bentonite holeplug to 0.15 m. Sand andGravel to surface.
19-05B	9.4 / 176.7	Hole open to 1.7 m. Backfilled with Bentonite holeplug and sand to 0.15 m. Sand and gravel to surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and/or hydrometer), where appropriate. The results of this laboratory testing program are shown on the Record of Borehole sheets included in Appendix A and on the figures included in Appendix B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, samples of the fill and native soil from Boreholes 19-01 and 19-05B were collected respectively. The samples were then submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing from

the investigation are summarized in Section 6 and are presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata Drawing included in Appendix D. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It must be recognized and expected that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered consisted of granular and embankment fill, underlain by deposits of large boulders, overlying native deposits of sand, gravel and sandy silt. Descriptions of the individual strata are presented below.

5.1 Granular Fill

Granular fill ranging from silty sand to sand and gravel and gravelly sand with some silt was encountered at the ground surface in all boreholes, test pits, and HP10. The granular fill also contained trace clay and occasional cobbles and extended to depths ranging from 1.4 m and 2.3 m (Elevation 185.7 m to 183.8 m). Potentially frozen fill was encountered within this material at depths between 0.8 m and 3.0 m. Borehole 19-02B and Test Pits TP-01 to TP-03 were terminated within the granular fill at depths from 2.1 to 2.3 m (Elevation 184.9 to 183.9 m) due to refusal to advance through boulders and possible frozen soil.

SPT ‘N’ values in the granular fill ranged from 9 to greater than 100 blows per 0.3 m of penetration, indicating a loose to very dense relative density. The 100 blow values may represent the presence of a cobble, boulder or frozen soil. The measured moisture content in the fill ranged from 3 percent to 26 percent.

The results of grain size analyses conducted on selected samples of the granular fill are illustrated on Figures B1 to B3 of Appendix B. The results are summarized as follows:

Soil Particle	Silty Sand Fill Percentage	Sand and Gravel to Gravelly Sand Percentage
Gravel	3 to 30	41 to 76
Sand	32 to 62	21 to 40
Silt and Clay	23 to 25	3 to 19
Silt	26 to 43	-
Clay	4 to 13	-

5.2 Clayey Silt Fill

A layer of clayey silt fill containing some sand, trace gravel and occasional cobbles and boulders was encountered below the silty sand fill in Boreholes 19-01 and 19-03. The layer was 0.4 to 0.5 m thick and extended to depths of 1.9 to 2.1 m (Elevation 185.2 to 184.8 m). This fill layer appeared to be frozen in both boreholes.

SPT 'N' values measured in the clayey silt fill ranged from 33 to 100 blows for 0.3 m penetration. The results of the SPTs indicate the layer to be hard/dense to very dense in consistency. The measured moisture content in the clayey silt fill ranged from 19 to 21 percent.

5.3 Gravelly Sand to Sand Fill

A layer of gravelly sand to sand with some gravel fill containing cobbles and boulders was encountered below the clayey silt fill or silty sand fill in Boreholes 19-01 and 19-02. This layer had a thickness ranging from approximately 1.2 to 2.2 m and extended to depths from 3.4 to 4.3 m (Elevation 183.1 to 182.6 m). Borehole 19-01 was terminated at a depth of 4.3 m (Elevation 182.6 m) within this fill layer due to refusal to advance through boulders. The fill was partially frozen in Borehole 19-02.

SPT 'N' values measured in the gravelly sand to sand fill ranged from 49 to greater than 100 blows for 0.3 m of penetration, which indicate that the fill is dense to very dense. The 100 blow values may represent the presence of cobbles, boulders or frozen fill. The measured moisture content in the fill ranged from 11 to 21 percent.

5.4 Boulders

A layer of boulders was contacted within the fill or near the top of the native soil in every borehole and test pit, excluding Borehole 19-05B. The boulder layer was encountered at 2.1 to 3.5 m depth

(Elevation 184.9 to 183.5 m) and extended to 3.4 to 3.7 m depth (Elevation 183.6 to 183.2 m) in some boreholes. A number of boreholes (19-02B, 19-03, 19-04, 19-05, and test pits TP-01 to TP-03) met refusal on the boulders at depths from 2.1 to 3.5 m (Elevation 184.9 to 183.5 m). The boulders primarily consisted of granodiorite rock and the layer ranged in thickness from approximately 0.2 m to 1.1 m, where penetrated.

5.5 Silty Sand

A deposit of native sand with some silt to silty sand was encountered below the fill in Borehole 19-05B. The deposit also contained trace clay, trace to some gravel and occasional cobbles. The upper part of this layer appeared to be frozen. The silty sand layer was 6.3 m thick and extended to a depth of 8.5 m (Elevation 177.7 m).

SPT 'N' values measured in the silty sand deposit ranged from 9 to 41 blows for 0.3 m of penetration, which indicate that the deposit is dense to loose. The measured moisture content in the silty sand ranged from 9 to 35 percent.

The results of a grain size analysis conducted on a sample of the silty sand are illustrated on Figure B4 of Appendix B. The results are summarized as follows:

Soil Particle	Silty Sand Percentage
Gravel	0
Sand	75
Silt	22
Clay	3

5.6 Sand and Gravel to Gravel

Beneath the fill, boulders or native silty sand, a deposit of native sand and gravel to gravel was encountered in Boreholes 19-01B, 19-01B(2), 19-02, 19-03, 19-04 and 19-05B. Hand probes HP1 to HP9, which were conducted at the base of the existing embankment, generally encountered gravelly sand near the existing water level. This deposit also contained trace to some silt, trace clay and occasional cobbles and boulders. The layer thickness where penetrated ranged from 0.4 to 0.9 m. Boreholes 19-01B, 19-01B(2), 19-03 and 19-04 were terminated upon refusal on boulders within this deposit at depths from 2.5 to 4.2 m (Elevation 184.6 to 182.7 m). Dynamic Cone Penetration Tests (DCPTs) were driven from the bottom of Boreholes 19-01B and 19-02 and met refusal at depths of 4.1 m and 8.1 m, respectively (Elevation 182.8 and 178.4 m).

Borehole 19-05B was terminated at a depth of 9.4 m (Elevation 176.7 m) within the sandy gravel deposit and did not encounter refusal.

SPT 'N' values measured in the sand and gravel to gravel layer ranged from 23 to greater than 100 blows per 0.3 m of penetration indicating a compact to very dense consistency. Values of 100 blows or greater may represent the presence of cobbles or boulders. The moisture content within the deposit ranged from 3 to 18 percent.

The results of grain size analyses conducted on samples of the sand and gravel to gravel deposit are illustrated on Figure B5 of Appendix B. The results are summarized as follows:

Soil Particle	Sand and Gravel to Gravel Percentage
Gravel	37 to 80
Sand	19 to 55
Silt and Clay	1 to 12

5.7 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling. The measured water levels in the open boreholes may reflect the presence of residual water in the boreholes that was added for drilling and therefore may be higher than the stabilized groundwater level. A summary of the water level measurements is provided in Table 5.1 below:

Table 5.1 - Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
19-01	June 5, 2019	1.7	185.2	Open Borehole
19-01B(2)	June 6, 2019	1.5	185.4	Open Borehole
19-02	June 6, 2019	1.4	185.1	Open Borehole
19-03	June 10, 2019	0.5	186.6	Open Borehole
19-04	June 10, 2019	0.9	185.2	Open Borehole
19-05B	June 9, 2019	1.5	184.7	Open Borehole

The groundwater level should be anticipated to reflect the local lake water level. The water level of Kasabonika Lake near the bridge was measured at Elevation 184.0 m in August 2016, as shown on drawings provided by MTO, and at approximate Elevation 184.4 m in June 2019 by

Hatch. The previous flooding that overtopped the east approach embankment in 2004 indicates that the lake water level has previously been observed at greater than approximate Elevation 186 m.

Groundwater levels are short-term observations and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation during spring and after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the silty sand fill and native sand were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix B.

Table 6.1 - Analytical Test Results

Parameter	Units (soil)	Test Results	
		19-01 SS#2A/B	19-05B SS#3
		Silty Sand Fill	Sand
Sulphide	%	<0.02	<0.02
Chloride	µg/g	7	2.7
Sulphate	µg/g	2.2	2.1
pH	no unit	7.49	7.52
Conductivity	µS/cm	155	115
Resistivity (calculated)	ohms.cm	6500	8700
Redox Potential	mV	303	121

7. ENGINEERED FILL BORROW MATERIAL

Two samples of locally available engineered granular fill were provided by MTO for gradation testing. Both samples, labelled Sample #1 and Sample #2 were collected by MTO from a stockpile of crushed rock at the MTO Kasabonika airport. The gradation test results for both samples are shown on Figures B6 to B9 in Appendix B, and have been compared to the gradation ranges for OPSS Granular A, Granular B Type II and Granular M. The results show that both samples meet the OPSS criteria for these engineered granular fill materials.

8. MISCELLANEOUS

Thurber obtained subsurface utility clearances prior to drilling. The northing and easting coordinates and ground surface elevations were estimated based on field measurements relative to the topographic plans provided by MTO.

RPM Drilling of Thunder Bay, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the drilling investigation. Kasabonika Lake First Nation supplied and operated the backhoe for the test pit excavations. The field investigation was supervised on a full-time basis by Mr. Liam Steers, EIT of Thurber. The overall supervision of the field program was conducted by Mr. Mark Farrant, P.Eng, of Thurber.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc.

Interpretation of the field data and preparation of this report was carried out by Mr. Liam Steers, EIT and Mr. Mark Farrant, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Geotechnical EIT

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

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Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-01 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 480.3 E 396 214.3 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing/BQ Coring COMPILED BY BH

DATUM Geodetic DATE 2019.06.05 - 2019.06.05 LATITUDE 53.526266 LONGITUDE -88.621400 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.9	GROUND SURFACE										
0.0	Silty **SAND**, some gravel, trace clay, occasional cobbles Loose to Dense Brown Moist (FILL)		1	GS					○		
			1	SS	9		186		○		
185.2						▽			○		13 62 25 (SI+CL)
1.7	Clayey **SILT**, some sand, trace gravel, some cobbles and boulders Dense Brown Moist (FILL, POSSIBLY FROZEN)		2	SS	33		185		○		
184.8											
2.1	Gravelly**SAND**, with cobbles and boulders Dense Brown Wet (FILL)		3	SS	50/ 0.025		184		○		
183.7											
3.2	BOULDER										
183.2											
3.7			4	SS	49		183		○		
182.6											
4.3	END OF BOREHOLE AT 4.3m UPON REFUSAL TO ADVANCE CASING THROUGH BOULDERS. BOREHOLE OPEN TO 2.0m AND WATER LEVEL AT 1.7m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.15m, THEN SAND AND GRAVEL TO SURFACE.										

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

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

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-01B 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 475.2 E 396 217.1 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing/BQ Coring COMPILED BY BH

DATUM Geodetic DATE 2019.06.06 - 2019.06.06 LATITUDE 53.526220 LONGITUDE -88.621359 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.9	GROUND SURFACE										
0.0	Silty **SAND**, some gravel, trace clay, occasional cobbles Compact to Dense Brown Moist (FILL)		1	GS					○		17 60 23 (SI+CL)
			1	SS	21		186		○		
			2	SS	48		185		○		
184.6											
2.3	**GRANODIORITE BOULDER**						184				
183.6											
3.4	Sandy **GRAVEL**, trace silt, occasional cobbles Compact Brown Wet		3	SS	27		183				76 23 1 (SI+CL)
182.7											
4.2	END OF BOREHOLE AT 4.2m UPON REFUSAL TO ADVANCE CASING THROUGH BOULDERS. BOREHOLE BACKFILLED WITH HOLEPLUG AND SAND TO 0.15m, THEN SAND AND GRAVEL TO SURFACE.										

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

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

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-01B(2) 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 474.4 E 396 216.0 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE BW Casing/ Dynamic Core Penetration Test COMPILED BY BH

DATUM Geodetic DATE 2019.06.06 - 2019.06.06 LATITUDE 53.526213 LONGITUDE -88.621377 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.9	GROUND SURFACE									
0.0	No sample until 2.7m.					▽	186			
							185			
184.2										
2.7	**GRAVEL** and **COBBLES** Compact Grey Wet		1	SS	25		184			
183.5										
3.5	END OF BOREHOLE AT 3.5m UPON CASING AND DCPT REFUSAL. BOREHOLE OPEN TO 1.8m AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING.									

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

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

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-02 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 495.3 E 396 245.6 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/ BW Casing/ Dynamic Cone Penetration Test COMPILED BY BH

DATUM Geodetic DATE 2019.06.06 - 2019.06.06 LATITUDE 53.526395 LONGITUDE -88.620925 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.5	GROUND SURFACE											
0.0	Silty **SAND**, some gravel, trace clay, occasional cobbles Compact to Dense Brown Moist (FILL)		1	GS						○		
			1	SS	14					○		
			2	SS	38	▽				○		17 53 26 4
184.3												
2.2	**SAND**, some gravel, some cobbles and boulders Very Dense Brown Wet (FILL, POSSIBLY FROZEN)		3	SS	100/ 0.150					○		
183.9												
2.6	BOULDER									○		37 51 12 (SI+CL)
183.1												
3.4	**SAND** and **GRAVEL**, some silt, trace clay, occasional boulders Very Dense Brown Wet		4	SS	104							
182.8												
3.7	End of sampling and start DCPT											
178.4												
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE OPEN TO 1.8m AND WATER LEVEL AT1.4m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, THEN SAND TO SURFACE.											

ELEVATION SCALE: 186, 185, 184, 183, 182, 181, 180, 179

+ ³, × ³: Numbers refer to Sensitivity

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

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RECORD OF BOREHOLE No 19-02B 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 499.0 E 396 241.3 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.08 - 2019.06.08 LATITUDE 53.526429 LONGITUDE -88.620988 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
186.2	GROUND SURFACE										
0.0	Silty **SAND**, some gravel, trace clay, occasional cobble Loose to Very Dense Brown Moist (FILL)		1	GS			186		○		
			1	SS	9		185		○		
	(POSSIBLY FROZEN)		2	SS	86				○ ○		
183.9							184				
2.3	END OF BOREHOLE AT 2.3m. AUGER AND CASING REFUSAL AT 2.3m ON BOULDERS. BOREHOLE BACKFILLED WITH SAND AND GRAVEL TO SURFACE.										

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

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 19-03 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 466.5 E 396 203.4 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.10 - 2019.06.10 LATITUDE 53.526145 LONGITUDE -88.621569 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.1	GROUND SURFACE										
0.0	Silty **SAND**, some gravel to gravelly, trace clay, occasional cobbles Very Dense Brown Moist (FILL) (POSSIBLY FROZEN)		1	GS		▽	187				
185.7			1	SS	78		186				28 39 28 5
1.4	Clayey**SILT**, some sand, trace gravel, occasional cobbles Brown		2	SS	100						
185.2	(FILL, POSSIBLY FROZEN)										
1.9	Gravelly **SAND** Very Dense						185				
184.8	Brown		3	SS	100/						
2.3	Wet										
184.6					<0.025						
2.5	**GRANODIORITE BOULDER** END OF BOREHOLE AT 2.5m. CASING REFUSAL AT 2.3m. CORE BARREL REFUSAL AT 2.5m. BOREHOLE OPEN TO 0.9m AND WATER LEVEL AT 0.5m UPON COMPLETION OF DRILLING . BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m, THEN SAND AND GRAVEL TO SURFACE.										

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

15 20 10 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 19-04 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 510.9 E 396 254.2 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.10 - 2019.06.10 LATITUDE 53.526534 LONGITUDE -88.620790 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.1	GROUND SURFACE										
0.0	**SAND** and **GRAVEL**, some silt, trace clay, occasional cobbles Brown Moist (FILL)		1	GS			186		○		41 40 19 (SI+CL)
185.3											
0.8	Silty **SAND**, some gravel, occasional cobbles Compact Brown Moist to Wet (FILL)		1	SS	13	▽	185		○		
184.7											
1.4	trace clay Very Dense (FILL, POSSIBLY FROZEN)		2	SS	110/ 0.125		184		○		
183.8											
183.7	**GRANODIORITE BOULDER**										
2.4	**SAND** and **GRAVEL**, trace silt, occasional cobbles Compact Brown Wet		3	SS	23				○		40 55 5 (SI+CL)
182.8			4	SS	100/ 0.225		183				
3.3	END OF BORE HOLE AT 3.3m. CASING REFUSAL AT 2.3m. BOREHOLE OPEN TO 1.5m AND WATER LEVEL AT 0.9m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH SAND AND GRAVEL TO SURFACE.										

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

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

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RECORD OF BOREHOLE No 19-05 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 515.9 E 396 276.0 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.08 - 2019.06.08 LATITUDE 53.526575 LONGITUDE -88.620459 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.1	GROUND SURFACE										
0.0	Gravelly **SAND**, trace to some silt, occasional cobbles Compact Brown Moist to Wet (FILL)		1	GS			186		○		
			1	SS	22		185		○		
184.7											
1.4	Silty **SAND**, gravelly, trace clay Very Dense Brown Wet (FILL, POSSIBLY FROZEN)		2	SS	117				○		30 32 30 8
184.0							184				
2.1	BOULDER										
183.7											
2.4	END OF BOREHOLE AT 2.4m. CASING REFUSAL AT 2.4m. ON BOULDERS. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN SAND AND GRAVEL TO SURFACE.										

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

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 19-05B 1 OF 2 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 523.0 E 396 270.9 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.09 - 2019.06.09 LATITUDE 53.526640 LONGITUDE -88.620535 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.2	GROUND SURFACE										
0.0	Gravelly **SAND**, some silt, some organics, trace clay Brown Moist (FILL)		1	GS			186		○		
	Very Dense (FILL, POSSIBLY FROZEN)		1	SS	100/ 0.100				○		
184.8							185				
1.4	**SAND** and **SILT**, some clay, trace gravel Very Dense Brown		2	SS	60	▽			○		3 41 43 13
184.0	Wet						184				
2.2	(FILL, POSSIBLY FROZEN)										
	SAND, some silt, occasional cobbles Dense Brown		3	SS	41				○		
183.2	Wet										
3.0	(POSSIBLY FROZEN)						183				
	SAND, silty, trace clay, trace to some gravel Compact to Loose Brown Wet		4	SS	28				○		0 75 22 3
			5	SS	18		182		○		
	no recovery		6	SS	16		181				
	granite cobble		7	SS	9		180				
177.7							179				
8.5	Sandy **GRAVEL**, trace silt Dense Grey Wet		8	SS	42		178		○		80 19 1 (SI+CL)
176.7							177				
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN TO 1.7m AND WATER LEVEL AT 1.5m UPON										

Continued Next Page

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

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

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

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RECORD OF BOREHOLE No 19-05B 2 OF 2 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 523.0 E 396 270.9 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Solid Stem/BW Casing COMPILED BY BH

DATUM Geodetic DATE 2019.06.09 - 2019.06.09 LATITUDE 53.526640 LONGITUDE -88.620535 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 1.5m, THEN SAND AND GRAVEL TO SURFACE.										

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

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

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RECORD OF BOREHOLE No TP-01 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 470.7 E 396 200.3 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Test Pit COMPILED BY BH

DATUM Geodetic DATE 2019.06.08 - 2019.06.08 LATITUDE 53.526182 LONGITUDE -88.621614 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.1	GROUND SURFACE										
0.0 / 186.7	Sandy **GRAVEL**, trace silt Brown (FILL)		1	GS			187		○		76 21 3 (SI+CL)
0.3	Silty **SAND**, some gravel, trace clay, occasional cobbles and boulders (FILL)		2	GS					○		
			3	GS					○		
			4	GS			186		○		19 43 29 9
			5	GS					○		
			6	GS					○		
184.9			7	GS			185		○		
2.1	END OF TEST PIT AT 2.1m DUE TO REFUSAL ON BOULDERS AND POSSIBLY FROZEN SOIL. BACKFILLED WITH CUTTINGS TO SURFACE.										

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

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

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THURBER

RECORD OF BOREHOLE No TP-02 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 506.8 E 396 246.8 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Test Pit COMPILED BY BH

DATUM Geodetic DATE 2019.06.08 - 2019.06.08 LATITUDE 53.526499 LONGITUDE -88.620903 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.0	GROUND SURFACE										
0.0	Gravelly **SAND**, some silt Brown Moist (FILL)		1	GS					○		
			2	GS					○		
			3	GS					○		
	layer of organics		4	GS			185				
184.8											
1.2	Silty **SAND**, some gravel, trace clay, occasional cobbles and boulders Brown Wet (FILL)		5	GS					○		
			6	GS					○		
			7	GS			184		○		14 52 27 7
183.9											
2.1	END OF TEST PIT AT 2.1m DUE TO REFUSAL ON BOULDERS AND POSSIBLY FROZEN SOIL. BACKFILLED WITH CUTTINGS TO SURFACE.										

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

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

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RECORD OF BOREHOLE No TP-03 1 OF 1 METRIC

W.P. 6579-16-00 LOCATION Kasabonika Lake Modular BridgeMTM NAD83 ZONE 15: N 5 933 510.1 E 396 268.9 ORIGINATED BY LS

DIST Kenora HWY Main Road BOREHOLE TYPE Test Pit COMPILED BY BH

DATUM Geodetic DATE 2019.06.08 - 2019.06.08 LATITUDE 53.526524 LONGITUDE -88.620568 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
186.2	GROUND SURFACE										
0.0	Gravelly **SAND**, some silt, occasional cobbles Brown Moist (FILL)		1	GS			186				
185.6			2	GS							
0.6	**SAND** and **SILT**, trace to some gravel, trace to some clay, occasional cobbles Brown Moist (FILL)		3	GS							
			4	GS			185				
			5	GS							3 38 41 18
			6	GS							
184.1			7	GS							
2.1	END OF TEST PIT AT 2.1m DUE TO REFUSAL ON BOULDERS AND POSSIBLY FROZEN SOIL. BACKFILLED WITH CUTTINGS TO SURFACE.										

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

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

ONTMT4S2 MTO-25489.GPJ 2017TEMPLATE(MTO).GDT 11/13/19

Photo A1: Test Pit TP-01 (Date taken: June 8, 2019).

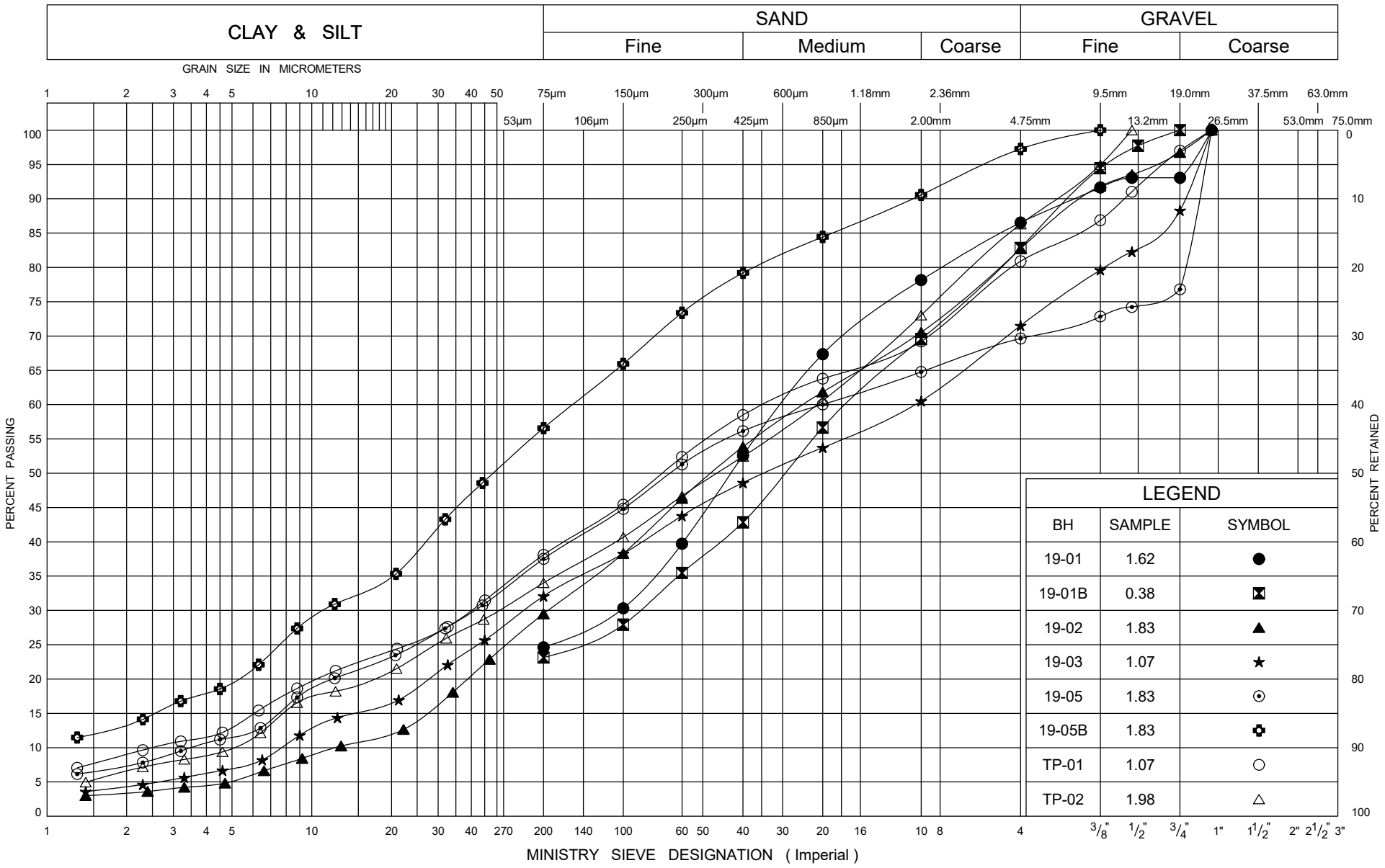
Photo A2: Test Pit TP-02 (Date taken: June 8, 2019).

Photo A3: Test Pit TP-03 (Date taken: June 8, 2019).

THURBER

Appendix B

Geotechnical and Analytical Laboratory Test Results



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GRAIN SIZE DISTRIBUTION

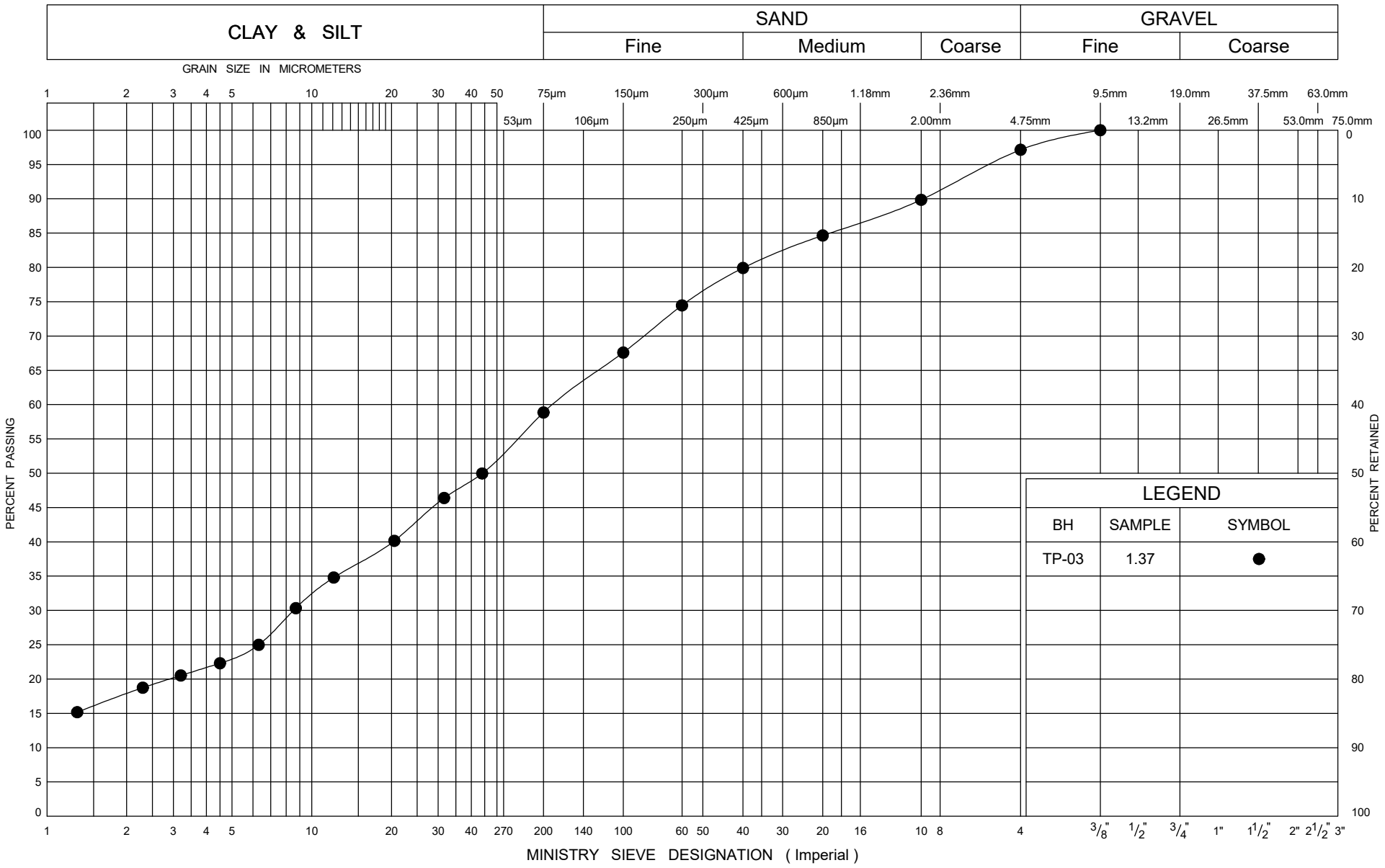
Silty SAND Fill

FIG No B1

W P 6579-16-00

Kasabonika Lake Modular Bridge

ONTARIO MOT GRAIN SIZE 2 MTO-25489.GPJ ONTARIO MOT.GDT 7/22/19



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GRAIN SIZE DISTRIBUTION

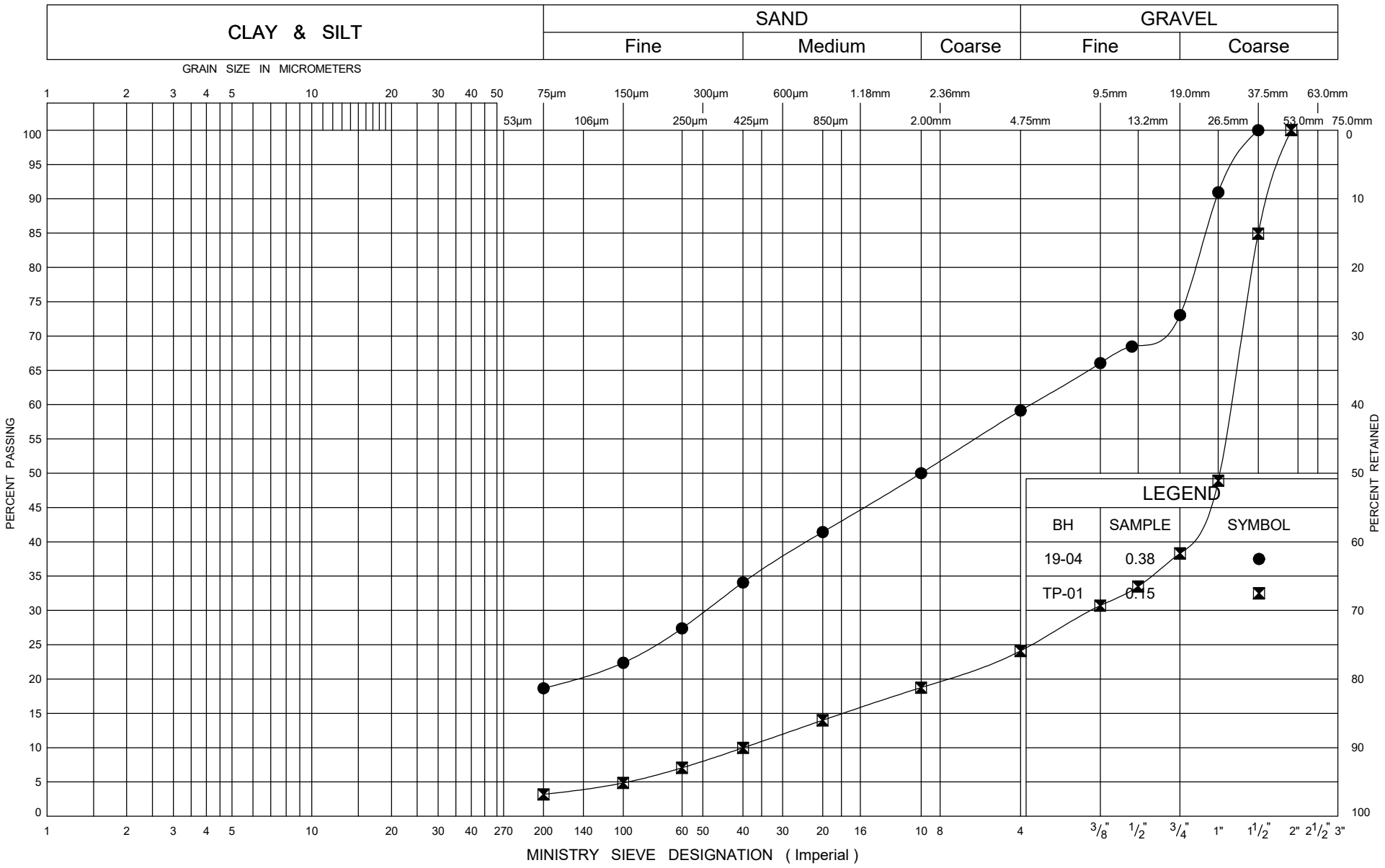
Silty SAND Fill

FIG No B2

W P 6579-16-00

Kasabonika Lake Modular Bridge

ONTARIO MOT GRAIN SIZE 2 MTO-25489.GPJ ONTARIO MOT.GDT 7/22/19



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GRAIN SIZE DISTRIBUTION

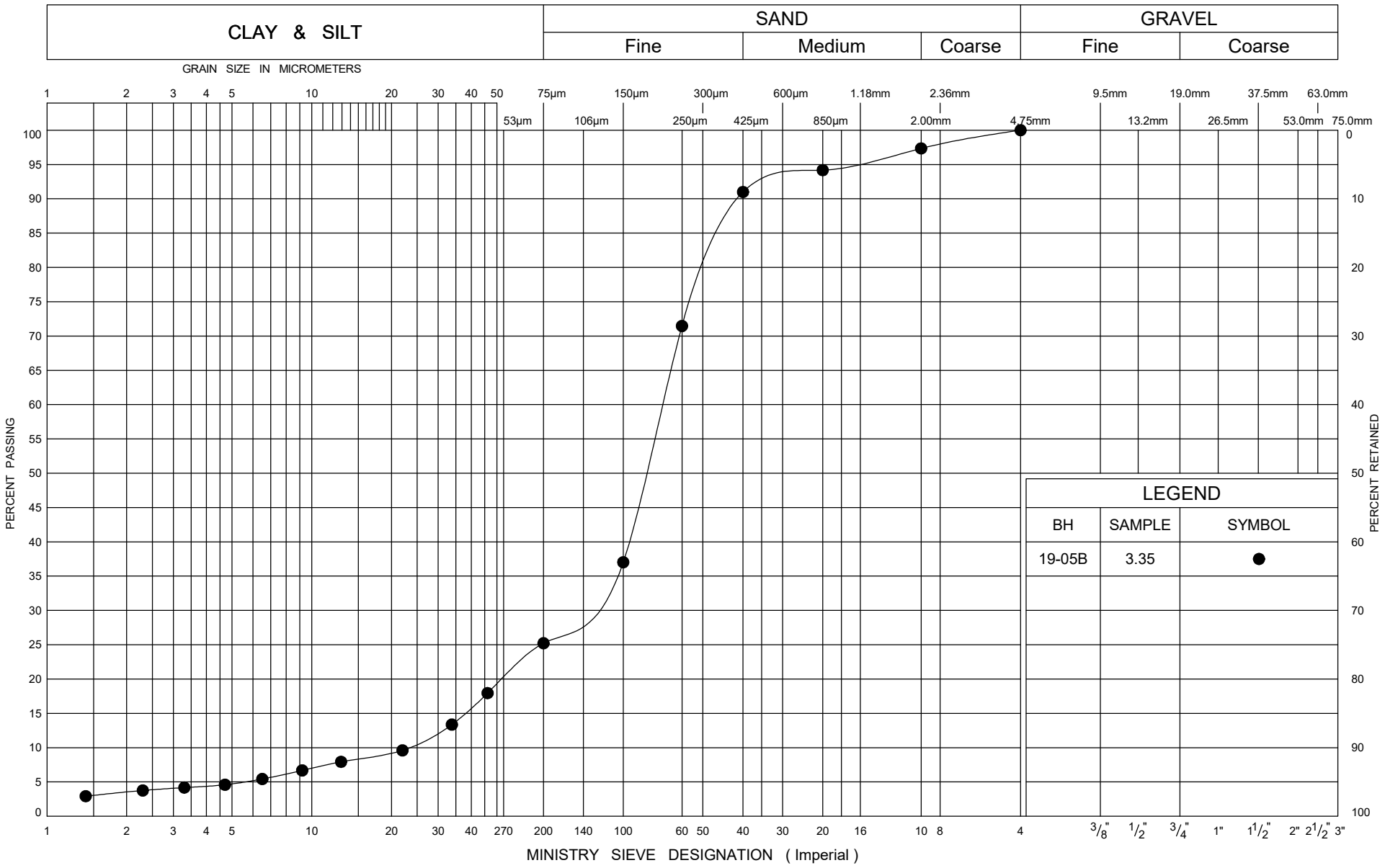
SAND AND GRAVEL to Gravelly SAND Fill

FIG No B3

W P 6579-16-00

Kasabonika Lake Modular Bridge

ONTARIO MOT GRAIN SIZE 2 MTO-25489.GPJ ONTARIO MOT.GDT 7/22/19



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GRAIN SIZE DISTRIBUTION

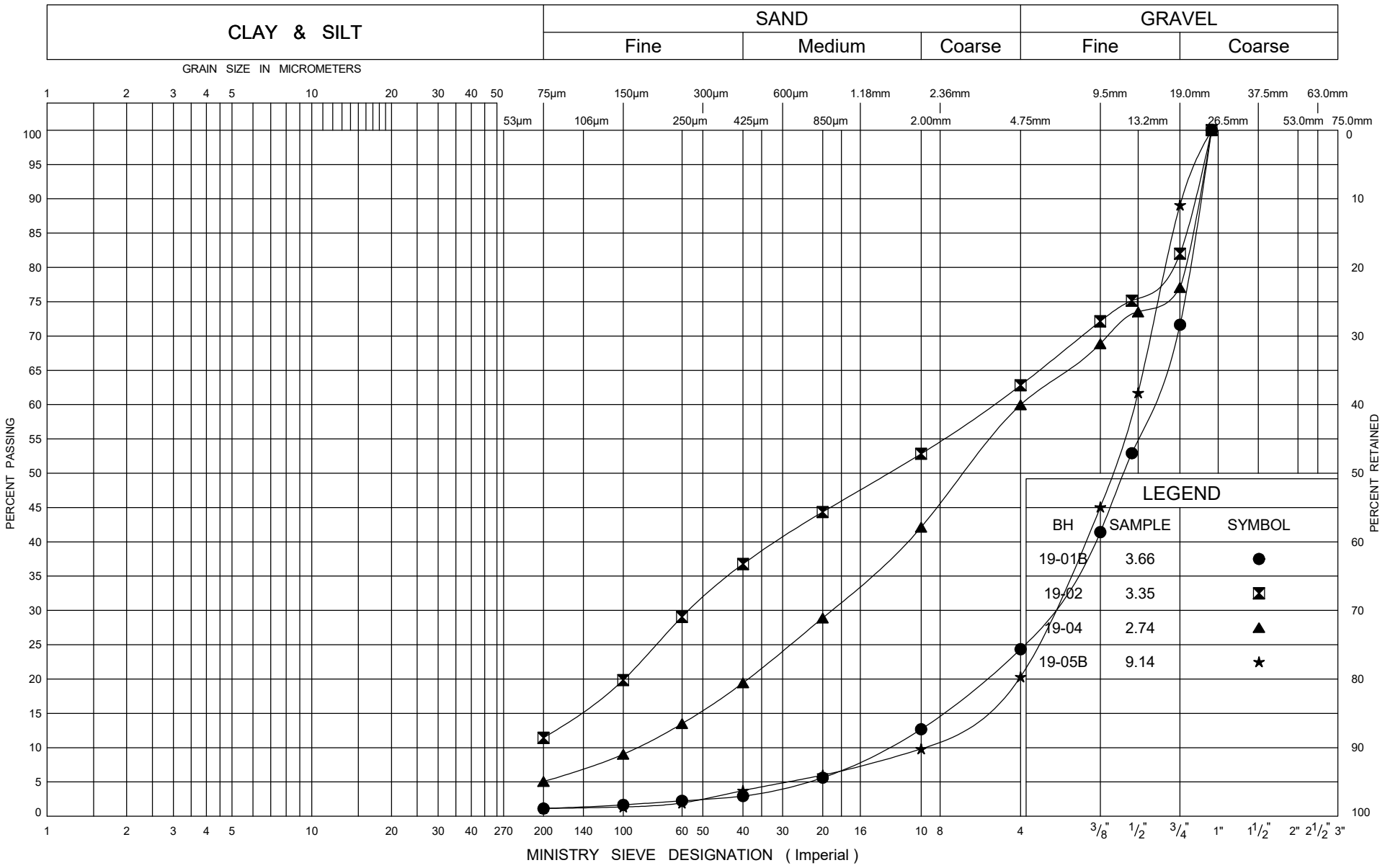
Silty SAND

FIG No B4

W P 6579-16-00

Kasabonika Lake Modular Bridge

ONTARIO MOT GRAIN SIZE 2 MTO-25489.GPJ ONTARIO MOT.GDT 7/22/19



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Ontario

GRAIN SIZE DISTRIBUTION

SAND AND GRAVEL to GRAVEL

FIG No B5

W P 6579-16-00

Kasabonika Lake Modular Bridge

ONTARIO MOT GRAIN SIZE 2 MTO-25489.GPJ ONTARIO MOT.GDT 7/22/19

THURBER ENGINEERING LTD.

Figure B6

Client: Ministry of Transportation

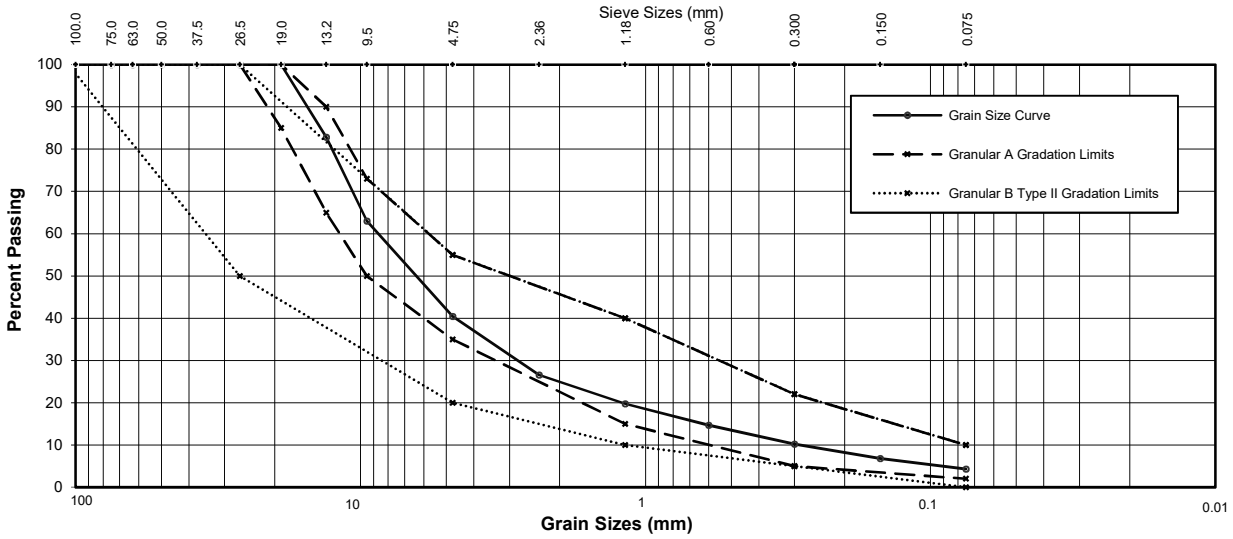
Project No.: 25489

Project: Kasabonika Lake Bridge

Date: 30-Sep-19

Sample Source: Stockpile at Kasabonika Airport
Material Type: Granular A or Granular B Type II
Specification: OPSS 1010
Sample Description: 19 mm Crusher Run Rock - Sample #1

Date Tested: 13-Sep-19
Sampled by: MTO
Date Sampled: 22-Aug-19
Test Method: ASTM



GRAVEL				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	150	100.0		
	100	100.0		
	75	100.0		
	63	100.0		
	50	100.0		
	37.5	100.0		
	26.5	100.0		
	19	100.0		
	13.2	82.8		
	9.5	63.0		
	4.75	40.5		

SAND & FINES				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	26.6		
	1.18	19.7		
	0.6	14.7		
	0.3	10.2		
	0.15	6.8		
	0.075	4.3		

SILT AND CLAY			
Silt	-		
Clay	-		
Total Fines:	4.3%		

Gravel:	59.5%	Deleterious	
Sand:	36.2%	Material:	-
Fines:	4.3%	% Crushed:	-
		Asph. Content:	-

Computer File : 26111
Series No.: 1

Comments: This sample meets OPSS 1010 requirements for Granular A and Granular B Type II.

Checked By: BT

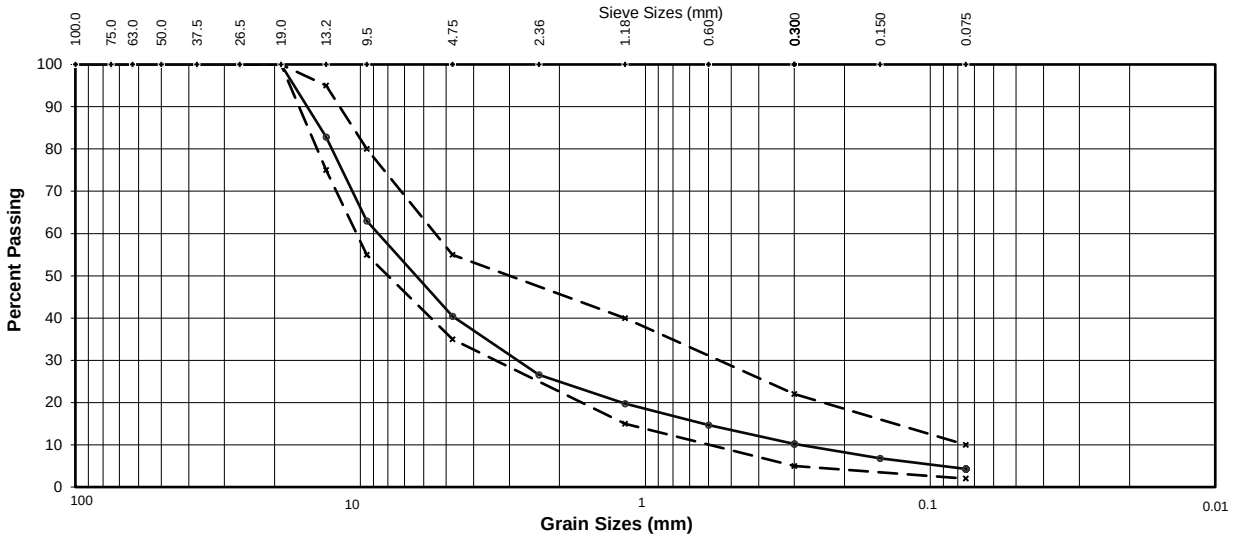
THURBER ENGINEERING LTD.

Figure B7

Client: Ministry of Transportation **Project No.:** 25489

Project: Kasabonika Lake Bridge **Date:** 30-Sep-19

Sample Source: Stockpile at Kasabonika Airport **Date Tested:** 13-Sep-19
Material Type: Granular M **Sampled by:** MTO
Specification: OPSS 1010 **Date Sampled:** 22-Aug-19
Sample Description: 19 mm Crusher Run Rock - Sample #1 **Test Method:** ASTM



GRAVEL				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	150	100.0		
	100	100.0		
	75	100.0		
	63	100.0		
	50	100.0		
	37.5	100.0		
	26.5	100.0	100	100
	19	100.0	100	100
	13.2	82.8	95	75
	9.5	63.0	80	55
	4.75	40.5	55	35

SAND & FINES				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	26.6		
	1.18	19.7	40	15
	0.6	14.7		
	0.3	10.2	22	5
	0.15	6.8		
	0.075	4.3	10	2

SILT AND CLAY			
Silt	-		
Clay	-		
Total Fines:	4.3%		

Gravel:	59.5%	Deleterious	
Sand:	36.2%	Material:	-
Fines:	4.3%	% Crushed:	-
		Asph. Content:	-

Computer File : 26111
Series No.: 2

Comments: This sample meets OPSS 1010 requirements for Granular M.

Checked By: BT

THURBER ENGINEERING LTD.

Figure B8

Client: Ministry of Transportation

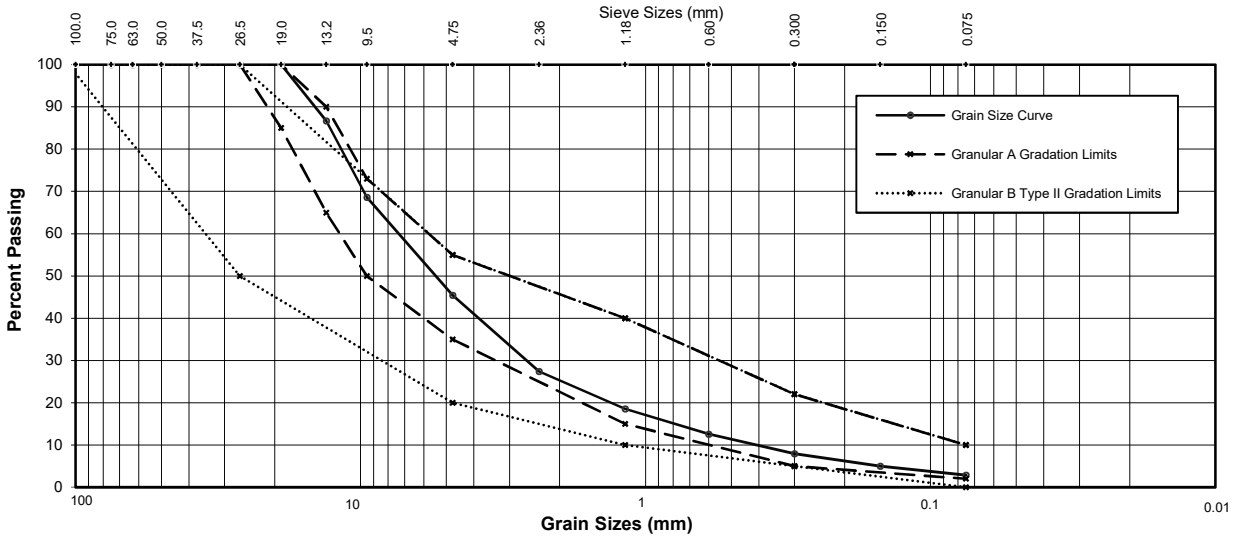
Project: Kasabonika Lake Bridge

Project No.: 25489

Date: 30-Sep-19

Sample Source: Stockpile at Kasabonika Airport
Material Type: Granular A or Granular B Type II
Specification: OPSS 1010
Sample Description: 19 mm Crusher Run Rock - Sample #2

Date Tested: 13-Sep-19
Sampled by: MTO
Date Sampled: 22-Aug-19
Test Method: ASTM



GRAVEL				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	150	100.0		
	100	100.0		
	75	100.0		
	63	100.0		
	50	100.0		
	37.5	100.0		
	26.5	100.0		
	19	100.0		
	13.2	86.7		
	9.5	68.6		
	4.75	45.4		

SAND & FINES				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	27.4		
	1.18	18.5		
	0.6	12.6		
	0.3	8.0		
	0.15	5.0		
	0.075	2.9		

SILT AND CLAY	
Silt	-
Clay	-
Total Fines:	2.9%

Gravel:	54.6%	Deleterious	
Sand:	42.6%	Material:	-
Fines:	2.9%	% Crushed:	-
		Asph. Content:	-

Computer File : 26111
Series No.: 2

Comments: This sample meets OPSS 1010 requirements for Granular A and Granular B Type II.

Checked By: BT

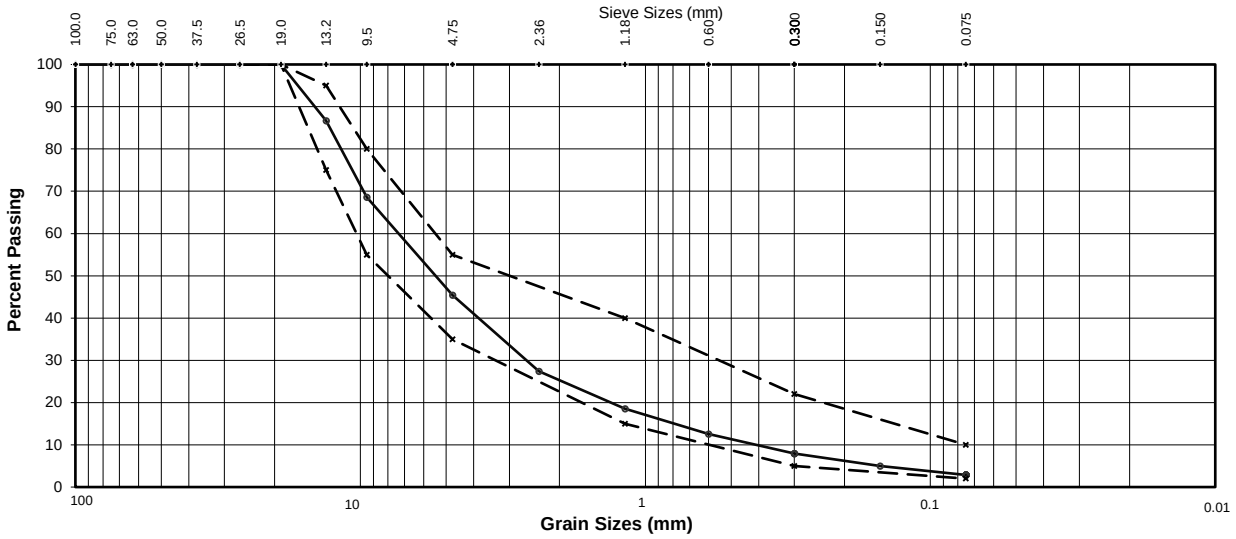
THURBER ENGINEERING LTD.

Figure B9

Client: Ministry of Transportation **Project No.:** 25489

Project: Kasabonika Lake Bridge **Date:** 30-Sep-19

Sample Source: Stockpile at Kasabonika Airport **Date Tested:** 13-Sep-19
Material Type: Granular M **Sampled by:** MTO
Specification: OPSS 1010 **Date Sampled:** 22-Aug-19
Sample Description: 19 mm Crusher Run Rock - Sample #2 **Test Method:** ASTM



GRAVEL				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	150	100.0		
	100	100.0		
	75	100.0		
	63	100.0		
	50	100.0		
	37.5	100.0		
	26.5	100.0	100	100
	19	100.0	100	100
	13.2	86.7	95	75
	9.5	68.6	80	55
	4.75	45.4	55	35

SAND & FINES				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	27.4		
	1.18	18.5	40	15
	0.6	12.6		
	0.3	8.0	22	5
	0.15	5.0		
	0.075	2.9	10	2

SILT AND CLAY			
Silt	-		
Clay	-		
Total Fines:	2.9%		

Gravel:	54.6%	Deleterious	
Sand:	42.6%	Material:	-
Fines:	2.9%	% Crushed:	-
		Asph. Content:	-

Computer File : 26111
Series No.: 4

Comments: This sample meets OPSS 1010 requirements for Granular M.

Checked By: BT

FINAL REPORT

CA14645-JUN19 R1

25489, Kasabinika Lake Bridge

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Liam Steers
Telephone	613-276-4587
Facsimile	905-829-1166
Email	lsteers@thurber.ca
Project	25489, Kasabinika Lake Bridge
Order Number	
Samples	Soil (2)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA14645-JUN19
Received	06/17/2019
Approved	06/21/2019
Report Number	CA14645-JUN19 R1
Date Reported	07/19/2019

COMMENTS

Temperature of Sample upon Receipt: 20 degrees C
Cooling Agent Present:Yes
Custody Seal Present:No

Chain of Custody Number:NA

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 25489, Kasabinika Lake Bridge
Project Manager: Liam Steers
Samplers: Liam Steers

PACKAGE: **- Corrosivity Index** (SOIL)

			Sample Number	5	6
			Sample Name	19-01 SS#2A/B	19-05B SS#3
			Sample Matrix	Soil	Soil
			Sample Date	15/06/2019	15/06/2019
Parameter	**Units**	**RL**		**Result**	**Result**
Corrosivity Index					
Corrosivity Index	none	1		1	2
Soil Redox Potential	mV	-		303	121
Sulphide	%	0.02		< 0.02	< 0.02
pH	pH Units	0.05		7.49	7.52
Resistivity (calculated)	ohms.cm	-9999		6500	8700

PACKAGE: **- General Chemistry** (SOIL)

			Sample Number	5	6
			Sample Name	19-01 SS#2A/B	19-05B SS#3
			Sample Matrix	Soil	Soil
			Sample Date	15/06/2019	15/06/2019
Parameter	**Units**	**RL**		**Result**	**Result**
General Chemistry					
Conductivity	uS/cm	2		155	115

PACKAGE: **- Metals and Inorganics** (SOIL)

			Sample Number	5	6
			Sample Name	19-01 SS#2A/B	19-05B SS#3
			Sample Matrix	Soil	Soil
			Sample Date	15/06/2019	15/06/2019
Parameter	**Units**	**RL**		**Result**	**Result**
Metals and Inorganics					
Moisture Content	%	0.1		13.4	31.8
Sulphate	µg/g	0.4		2.2	2.1

FINAL REPORT

CA14645-JUN19 R1

Client: Thurber Engineering Ltd.
Project: 25489, Kasabinika Lake Bridge
Project Manager: Liam Steers
Samplers: Liam Steers

PACKAGE: **- Other (ORP)** (SOIL)

Sample Number	5	6
Sample Name	19-01 SS#2A/B	19-05B SS#3
Sample Matrix	Soil	Soil
Sample Date	15/06/2019	15/06/2019

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		7.0	2.7

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0349-JUN19	µg/g	0.4	<0.4	4	20	96	80	120	103	75	125
Sulphate	DIO0349-JUN19	µg/g	0.4	<0.4	4	20	94	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0031-JUN19	%	0.02	<0.02	ND	20	105	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0291-JUN19	uS/cm	2	< 0.002	0	10	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0291-JUN19	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS | **SGS Environment, Health and Safety**

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

No: Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Oleg Mozhiw
Received Date: 6 \ 14 \ 19 (mm\dd\yy)
Received Time: 13 : 00 am / pm (circle)
Received By (signature):
Custody Seal Present: Y / (N) (circle)
Custody Seal Intact: Y / (N)
Cooling Agent Present: (Y) N Type: Ice
Temperature Upon Receipt (°C) 20° 20° 20°
LAB LIMS #: CA14645-Jun19

REPORT INFORMATION

Company: Thurber Engineering
Contact: Liam Steers
Address: 103-2010 Winston Park Dr.
Oakville, ON, L6H6P5
Phone: (905) 829-8666
Fax: (905) 829-1166
Email: lsteers@thurber.ca

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 25489
Site Location/ID: Kasabonika Lake Bridge

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153 (2011):
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA ____

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Corrosivity	COMMENTS: Field Filtered (F) Preserved (P)
1	19-01 SS#2A/B	15/06/2019		1	Soil	✓	
2	19-05B SS#3	15/06/2019		1	Soil	✓	
3							
4							
5							
6							
7							
8							
9							
10							

Observations/Comments/Special Instructions

Sampled By (NAME): Liam Steers **Signature:** Liam Steers Date: 06/15/19 (mm/dd/yy) Pink Copy - Client

Relinquished by (NAME): Liam Steers **Signature:** Liam Steers Date: 06/15/19 (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 25 July, 2016

THURBER

Appendix C

Site Photographs

Photo C1: Overtopping of east causeway embankment

(Date taken: Sept. 22, 2004; provided by MTO).

Photo C2: Overtopping of east causeway embankment
(Date taken: Sept. 22, 2004; provided by MTO).

Photo C3: Erosion at west abutment foundation (Date taken: July 7, 2009; provided by MTO).

Photo C4: Erosion at east abutment foundation (Date taken: July 7, 2009; provided by MTO).

Photo C5: Simco Drill Rig drilling at Borehole 19-01; north side of west abutment looking east (Date taken: June 5, 2019).

Photo C6: Unloading Simco Drill Rig from plane at Kasabonika Airport (Date taken: June 4, 2019).

Photo C7: Backhoe at Test Pit TP-02 on north side of east approach embankment, looking east (Date taken: June 8, 2019).

Photo C8: East bridge approach looking west (Date taken: June 4, 2019).

Photo C9: East bridge approach embankment looking east (Date taken: June 4, 2019).

Photo C10: South side of east approach embankment looking west (Date taken: June 4, 2019).

Photo C11: South side of east approach embankment looking east (Date taken: June 4, 2019).

Photo C12: North side of east approach embankment looking west (Date taken: June 4, 2019).

Photo C13: North side of bridge looking west showing large boulders and gabion baskets for erosion protection (Date taken: June 4, 2019).

Photo C14: East abutment footing looking north (Date taken: June 4, 2019).

Photo C15: Looking east towards west bridge abutment (Date taken: June 4, 2019).

Photo C16: West abutment footing looking north (Date taken: June 4, 2019).

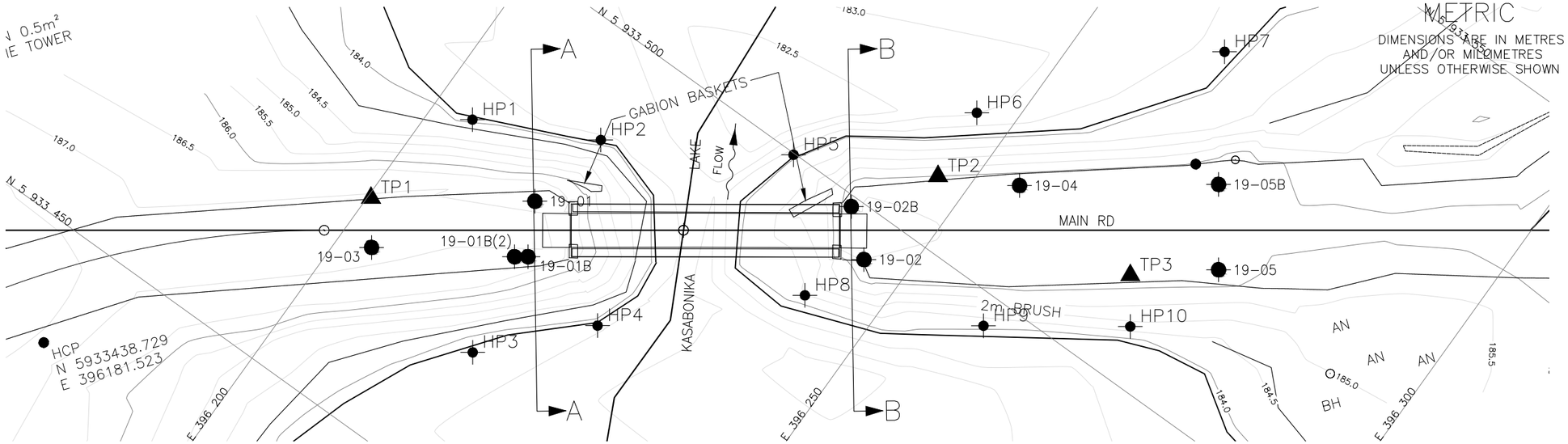
Photo C17: West abutment and south side of bridge looking east (Date taken: June 4, 2019).

THURBER

Appendix D

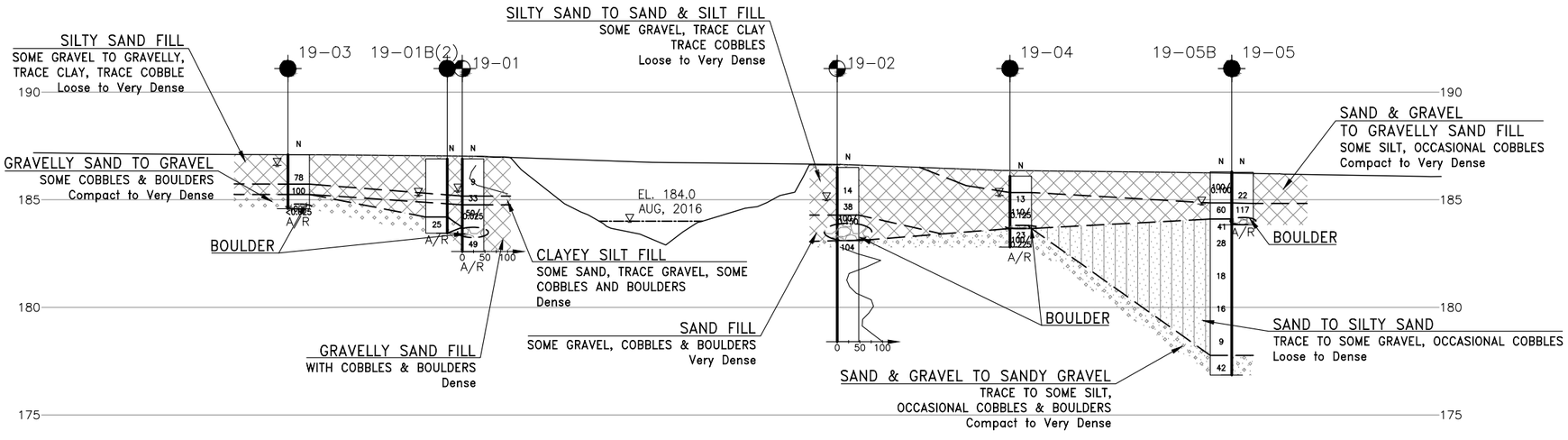
Borehole Locations and Soil Strata Drawing

MINISTRY OF TRANSPORTATION, ONTARIO



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

PLAN
10 0 10 20m
SCALE 1:500



PROFILE
10 0 10 20m H 1:500
2 0 2 4m V 1:250

CONT No
WP No 6579-16-00

Kasabonika Lake Bridge

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

HATCH

THURBER ENGINEERING LTD.

KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
▲	Test Pit
✦	Hand Probe
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
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
19-01	186.9	5 933 480.3	396 214.3
19-01B	186.9	5 933 475.2	396 217.1
19-01B(2)	186.9	5 933 474.4	396 216.0
19-02	186.5	5 933 495.3	396 245.6
19-02B	186.2	5 933 499.0	396 241.3
19-03	187.1	5 933 466.5	396 203.4
19-04	186.1	5 933 510.9	396 254.2
19-05	186.1	5 933 515.9	396 276.0
19-05B	186.2	5 933 523.0	396 270.9

-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.
3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 53H-01

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	LS	CHK	MEF	CODE		LOAD	DATE NOV 2019
DRAWN	BH	CHK	PKC	41N-0244/80	STRUCT		DWG 1

FILENAME: H:\Drafting\25000\25489\TED-25489-BHLP.dwg
PLOTDATE: 11/13/2019 2:17 PM

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No 6579-16-00

Kasabonika Lake Bridge

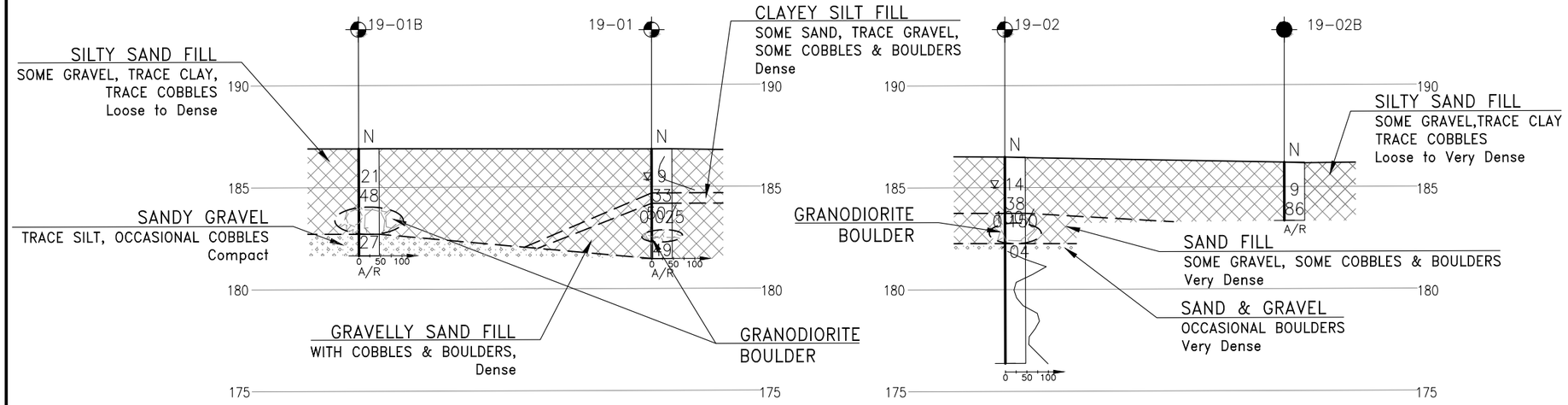
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

HATCH

THURBER ENGINEERING LTD.

KEYPLAN



SECTION A-A

2 0 2 4m H 1:100

4 0 4 8m V 1:200

SECTION B-B

2 0 2 4m H 1:100

4 0 4 8m V 1:200

LEGEND

●	Borehole
⊕	Borehole and Cone
▲	Test Pit
✦	Hand Probe
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
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
19-01	186.9	5 933 480.3	396 214.3
19-01B	186.9	5 933 475.2	396 217.1
19-01B(2)	186.9	5 933 474.4	396 216.0
19-02	186.5	5 933 495.3	396 245.6
19-02B	186.2	5 933 499.0	396 241.3
19-03	187.1	5 933 466.5	396 203.4
19-04	186.1	5 933 510.9	396 254.2
19-05	186.1	5 933 515.9	396 276.0
19-05B	186.2	5 933 523.0	396 270.9

-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.
3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 53H-01

LICENSED PROFESSIONAL ENGINEER
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Nov 13/2019
PROVINCE OF ONTARIO

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	LS	CHK	MEF	CODE	LOAD	DATE	NOV 2019
DRAWN	BH	CHK	PKC	41N-0244/80	STRUCT	DWG	2

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