THURBER ENGINEERING LTD.

FINAL

FOUNDATION INVESTIGATION REPORT
HIGHWAY 101 NEMEGOSENDA RIVER BRIDGE
32 KM EAST OF HIGHWAY 129, CHEWETT TOWNSHIP
SITE NO.: 46-215, G.W.P. 5144-10-00

5015-E-0027

Geocres No.: 41O-29

Report to:

McIntosh Perry Consulting Engineers

Latitude: 47.93808
Longitude: -83.06024

October 2018
Thurber File No.: 13624

104, 2460 Lancaster Road, Ottawa ON K1B 4S5 T. 613 247 2121 F. 613 247 2185
thurber.ca

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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed for the proposed replacement of the Nemegosenda Lake Bridge (Structure No. 46-215). The structure is located on Highway 101 approximately 32 km east of Highway 129. Thurber Engineering Ltd. (Thurber) carried out the investigation as a subconsultant to McIntosh Perry Consulting Engineers (MPCE) as part of Agreement No. 5015-E-0027.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on this data, provide a borehole location plan, record of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A base plan survey drawing was provided by MPCE for the preparation of this report.

An earlier foundation investigation report that has been obtained from the online Geocres Library in preparation of this report is as follows:

> Foundation Investigation Report, Nemegosenda River and Highway 101 Crossing between Chapleau and Foleyet, W.J. 61-F-21, District #18 (Geocres 41O00-004), dated April 1961.

The position of the boreholes from the historical report relative to the boreholes completed as part of the current investigation are not known, therefore the historic boreholes have been included in Appendix B for information purposes only and have not been included in the description of the subsurface conditions within this report.

2 SITE DESCRIPTION

The existing structure is located on Highway 101 in the township of Chewett (Linear Highway Referencing System Base Points: 40420, Offset: 0.0). The location of the bridge is shown on the inset Key Plan on Drawing No. 1 in Appendix A. The existing bridge is a 25.3 m long single span, rectangular-solid wood beam (glulam) bridge with a laminated timber deck. A 1982 rehabilitation included placement of a concrete topping slab above the timber decking. The bridge deck is approximately 4 m above the river water level. The embankment slopes located adjacent to the abutment are inclined at approximately 2.0H:1V with the surface consisting of granular material near the abutments and vegetation.

Within the project limits, Highway 101 is a two-lane, undivided highway with a rural cross-section. The base plan drawing indicates that the roadway cross-section consists of two, 3.5 m wide lanes, and paved shoulders with a width of 0.5 m and 0.9 m in the east bound and west bound directions respectively. Steel guide rails are present at all four corners of the structure. On the southwest side of the bridge alignment is a gravel access road leading to a water monitoring shed located at the river's bank. The topography adjacent to the bridge site is rolling forested lands with frequent bedrock outcrops. The land in the vicinity of the bridge is uninhabited and undeveloped. Traffic volumes are understood to be less than 1000 AADT (2012)

Select site photographs showing the general conditions in the area of the bridge during the time of the field investigation are presented in Appendix D.

3 SITE INVESTIGATION AND FIELD TESTING

The field investigation for this site included advancing nine boreholes drilled from October 27, 2016 to October 30, 2016. The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A and are summarized in Table 3-1. In advance of the field investigation, utility locate clearances were obtained at the location of the boreholes.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth below Existing Ground Surface (m)
16-05	East Approach – westbound lane	5 311 438	375 025	404.5	9.5
16-06	East Abutment – westbound lane	5 311 444	375 011	404.6	11.7
16-07	East Abutment – eastbound lane	5 311 440	375 009	404.6	8.8
16-08	West Abutment – westbound lane	5 311 458	374 982	404.7	7.1
16-09	West Abutment – eastbound lane	5 311 453	374 980	404.7	3.8
16-10	West Abutment – westbound lane	5 311 457	374 981	404.7	7.8
16-11	West Approach – westbound lane	5 311 459	374 980	404.7	5.3
16-12	West Abutment – eastbound land	5 311 454	374 977	404.7	7.2
16-13	West Approach – eastbound lane	5 311 460	374 964	404.6	5.1

All boreholes were advanced through the roadway embankment with a truck mounted CME 75 drill rig equipped with hollow stem augers and HW/NW casing. The drilling and

sampling operations were supervised on a full time basis by a member of Thurber's technical staff. Where possible soil samples were collected at regular depth intervals in the boreholes using a split spoon sampler in conjunction with Standard Penetration Tests (SPT). All soil samples recovered from the boreholes were transported to Thurber's Ottawa geotechnical laboratory for further examination and testing.

A 19 mm inside diameter PVC standpipe piezometer was installed in Borehole 16-06 to allow for measurement of the groundwater level at the east abutment following completion of drilling. The piezometer construction details are illustrated on the Record of Borehole sheet for Borehole 16-06, provided in Appendix B. The piezometer was decommissioned on November 6, 2016 following completion of the field investigation program.

The other boreholes were backfilled with a low-permeability mixture of auger cuttings and bentonite pellets in accordance with Ontario MOE Regulation 903. Boreholes advanced within paved areas were capped with cuttings followed by 150 mm of cold patch asphalt to reinstate the travelling surface.

4 LABORATORY TESTING

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples in accordance with the current MTO standards. Grain size distribution analyses testing was also carried out on selected samples to MTO and ASTM standards. Chemical analyses for determination of pH, resistivity, soluble sulphate and chloride concentrations were carried out on two soil samples.

The results of the geotechnical tests are summarized on the Record of Borehole sheets included in Appendix B and all laboratory results are presented on the figures included in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile and cross section for the bridge area are presented on Drawing No. 1 and 2 in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the Record of Boreholes governs any interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

The stratigraphy in the boreholes through the embankment is generally characterized by an asphalt pavement structure overlaying an embankment constructed with granular fill overlying native silty sand overlying bedrock.

5.1 Embankment

5.1.1 Asphalt

All boreholes were advanced from the surface of Highway 101 and encountered an asphalt pavement structure. The thickness of the asphalt ranged from 40 mm to 80 mm.

5.1.2 Fill: Sand

Granular fill varying in composition from silty sand with gravel to gravel with sand was encountered below the asphalt in all boreholes. Boulders and cobbles were noted within the fill layers. This fill had a thickness ranging from 3.0 m to 4.3 m (bottom elevation of 400.5 m to 401.7 m). The SPT 'N' values ranged from 8 to 79 blows indicating a loose to very dense condition. SPT 'N' values greater than 100 blows per 225 mm of penetration were recorded locally in zones containing cobbles.

The moisture content of the samples tested ranged from 2% to 15%. The results of grain size analyses conducted on ten samples of this material are summarized in Table 5-1 and are illustrated on Figures C1 and C2 in Appendix C.

Table 5-1: Gradation Results for Granular Fill

Soil Particle	%	
	Sand Fill	Gravel Fill
Gravel	4 - 39	47 – 55
Sand	48 - 89	37 – 41
Silt and Clay	5 - 13	8 - 12

5.2 Silty Sand to Sand with Silt

Native layers of silty sand to sand with silt with varying amounts of gravel were encountered below the fill materials in Boreholes 16-05, 16-06, 16-07, 16-11 and 16-13. This layer has a thickness ranging from 1.5 m to 6.5 m with an underside elevation of 395.0 to 399.5 m. The SPT 'N' values ranged from weight of hammer to 32 blows indicating a very loose to dense condition.

The moisture content for the samples tested typically ranged from was 8% to 19%. The results of grain size analyses conducted on seven samples of this material are summarized in Table 5-2 and are illustrated on Figures C3 and C4 in Appendix C.

Table 5-2: Gradation Results for Silty Sand to Sand with Silt

Soil Particle	%	
Gravel	2 - 26	
Sand	49 - 72	
Silt	17 - 23	10 - 46
Clay	2 - 3	

5.3 Bedrock

The overburden materials were underlain by granite bedrock. Boreholes 16-06, 16-08, 16-10 and 16-12 were advanced into the bedrock by coring. The bedrock surface elevation ranges from 396.5 to 401.7 m and is summarized in the table below:

Table 5-3 Summary of Bedrock Elevation

Location	Borehole No.	Depth Below Existing Ground Surface (m)	Top of Bedrock or Inferred Bedrock Elevation (m)
East Approach	16-05	9.5	395.0(*)
East Abutment	16-06	8.1	396.5
	16-07	8.8	395.8(*)
West Abutment	16-08	3.0	401.7
	16-09	3.8	400.8(*)
	16-10	4.3	400.5
	16-11	5.3	399.4(*)
	16-12	3.8	400.8
West Approach	16-13	5.1	399.5(*)

Note: (*) inferred by SPT refusal and/or casing advancement refusal

The Total Core Recovery (TCR) ranged from 87 to 100%, the Solid Core Recovery (SCR) ranged from 60 to 100% and the Rock Quality Designation (RQD) ranged from 17 to 93%. Based on the RQD value the bedrock is classified as poor to excellent quality. It is noted that rock quality in Borehole 16-06 near the east abutment was significantly poorer (RQD as low as 17 in the surficial run) than in the other boreholes. Rock core photos have been included in Appendix C.

5.4 Groundwater

Groundwater was observed in Boreholes 16-05 and 16-07 during drilling and was noted to range from elevation 398.2 to 398.6 m. Groundwater was not observed in Boreholes 16-09, 16-11 and 16-13 which were dry following completion of drilling.

The groundwater level was measured in the standpipe piezometer installed in Borehole 16-06 on November 6, 2016 at an approximate depth of 4.1 m; corresponding to an elevation of 400.5 m. The water level in Nemegosenda Lake was measured at the time of Thurber's field investigation at an elevation of 400.3 m.

These observations are considered short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy and/or prolonged precipitation. It is expected that the groundwater level will largely be controlled by the water level in Nemegosenda Lake.

5.5 Analytical Results

Two samples of the native soils were submitted to Paracel Laboratories in Ottawa, Ontario for analysis of pH, water soluble sulphate and chloride concentrations, resistivity and conductivity. The analysis results are summarized in the table below.

Table 5-4: Results of Chemical Analysis

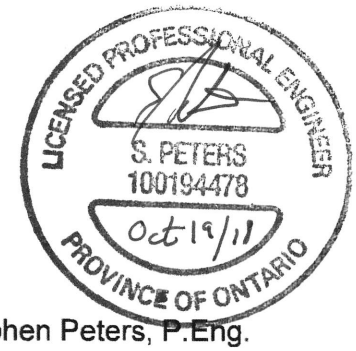
Borehole	Sample	Depth (m)	Sulphate (µg/g)	pH	Resistivity (Ohm-cm)	Chloride (µg/g)
16-6	SS3	1.8	10	7.9	2600	159
16-8	SS4	2.6	31	7.9	1370	346

6 MISCELLANEOUS

Borehole locations were selected and positioned relative to existing site features and the proposed foundation locations by Thurber. MPCE surveyed the borehole locations and ground surface elevations.

George Downing Estate Drilling Ltd. of Hawkesbury, Ontario supplied and operated the drilling equipment to carry out the drilling, sampling, in-situ testing, standpipe piezometer installation and borehole decommissioning. The field investigation was supervised on a full-time basis by Mr. Christopher Murray, P.Eng. of Thurber. Overall project management and direction of the field program was provided by Mr. Stephen Peters, P.Eng.

Routine laboratory testing was carried out in Thurber's MTO-approved laboratory in Ottawa. Analytical testing was completed by Paracel Laboratories. Interpretation of the field data and preparation of this report was completed by Dr. Fred Griffiths, P.Eng. and Mr. Stephen Peters, P.Eng. The report was reviewed by and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.



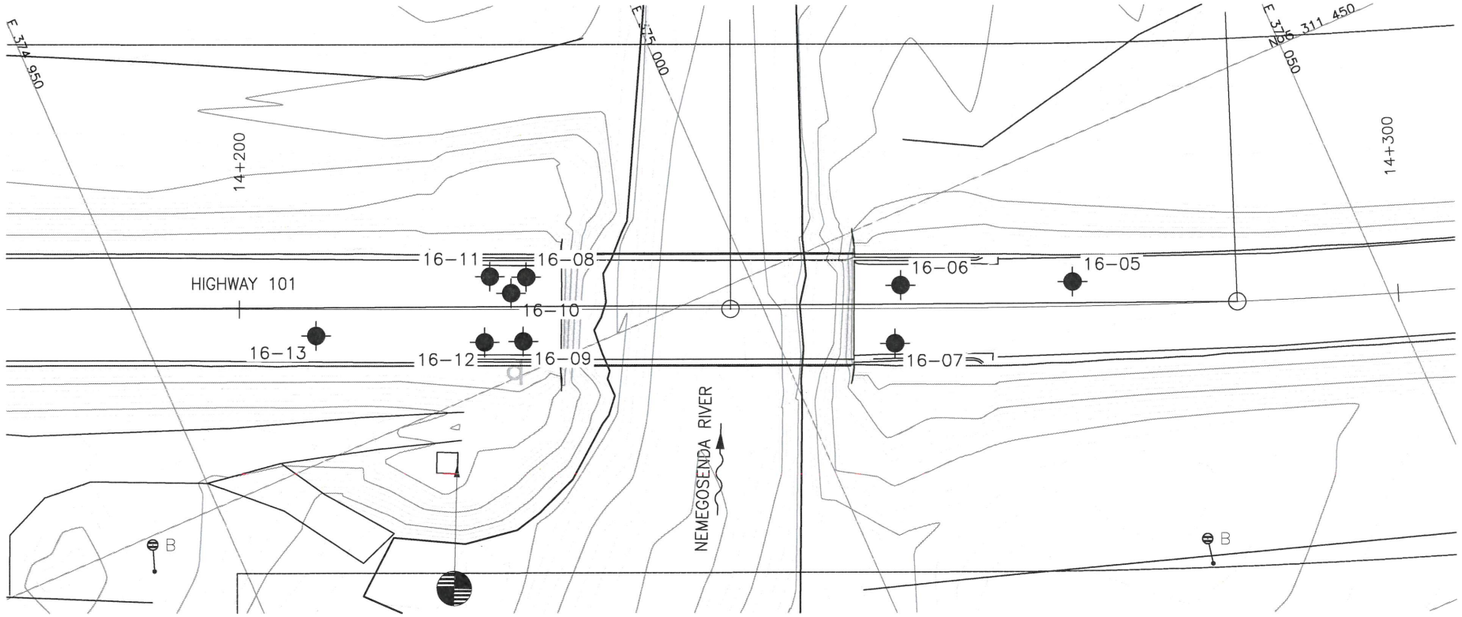
Stephen Peters, P.Eng.
Geotechnical Engineer

Fred Griffiths, P.Eng., Ph.D.
Senior Associate
Senior Geotechnical Engineer

P.K. Chatterji, P.Eng., Ph.D.
MTO Review Principal
Senior Geotechnical Engineer

Appendix A.

Borehole Location Plan and Stratigraphic Drawings



PLAN

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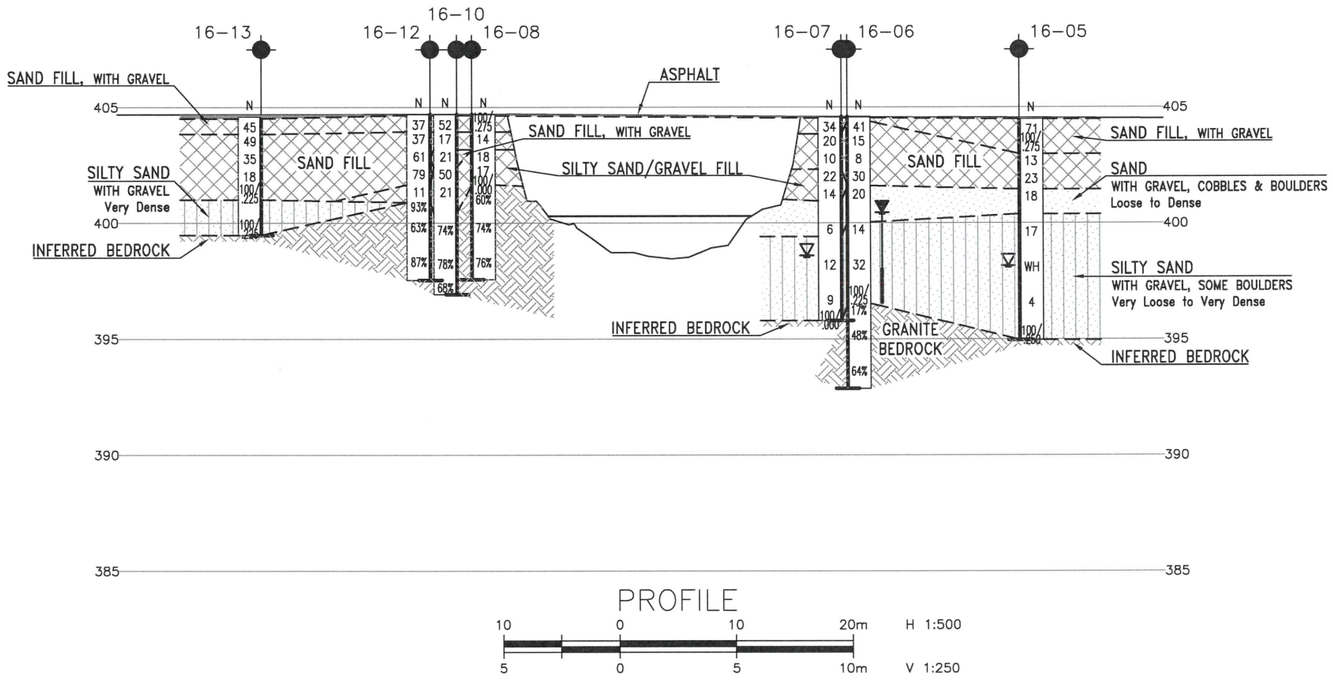

PROFILE

10 0 10 20m H 1:500

5 0 5 10m V 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct 19/18
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
Oct 25/18
PROVINCE OF ONTARIO

CONT No
GWP No 5144-10-00

SHEET

HIGHWAY 101
NEMEGOSENDA RIVER
BRIDGE REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY

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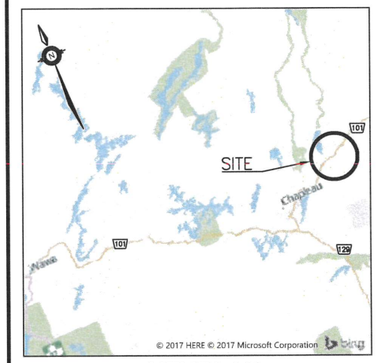

KEYPLAN

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
16-05	404.5	5 311 438.4	375 025.3
16-06	404.6	5 311 444.1	375 011.6
16-07	404.6	5 311 439.7	375 009.2
16-08	404.7	5 311 457.6	374 982.4
16-09	404.7	5 311 452.6	374 979.9
16-10	404.7	5 311 456.9	374 980.6
16-11	404.7	5 311 458.9	374 979.5
16-12	404.7	5 311 453.9	374 976.8
16-13	404.6	5 311 460.2	374 963.7

-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.
3) Borehole locations are shown in MTM Zone 13 coordinates.

GEOCRES No. 41O-29

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN JG	CHK –	CODE	LOAD	DATE OCT 2018	
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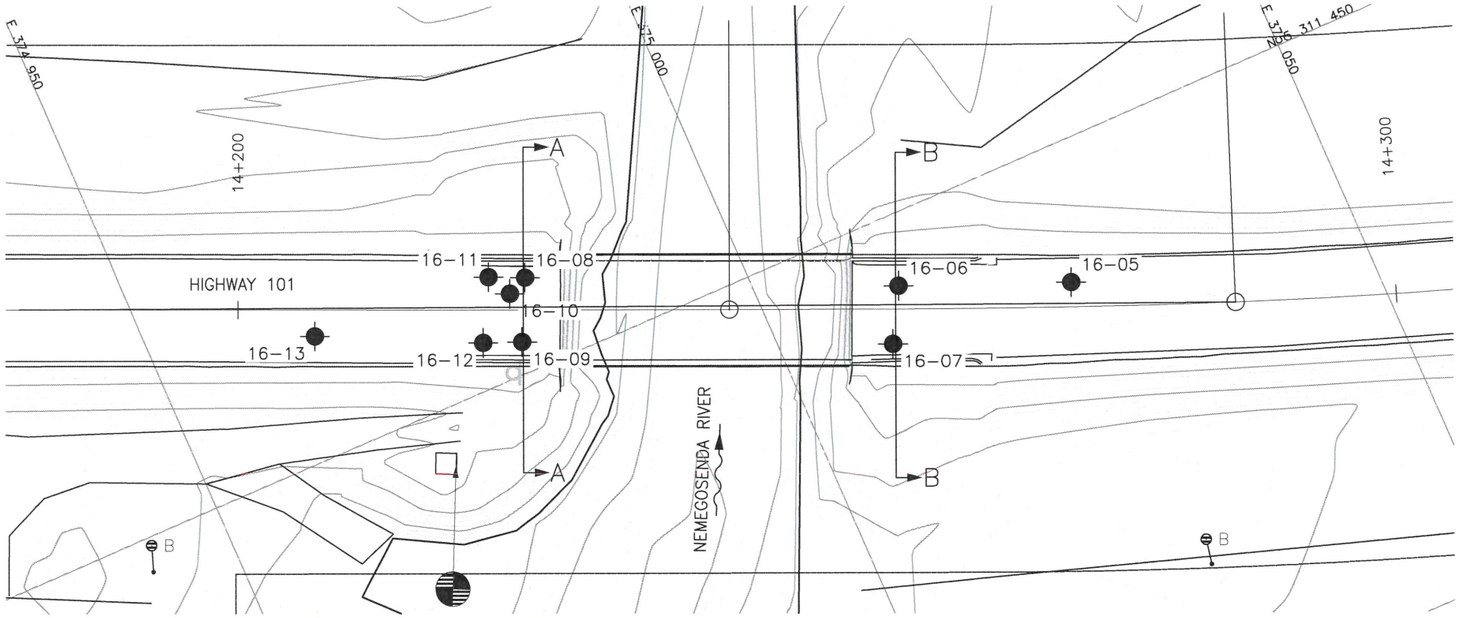

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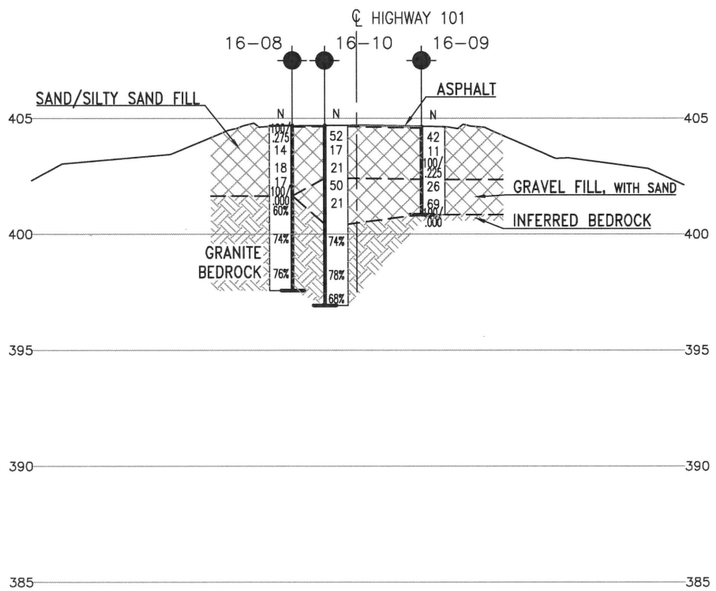

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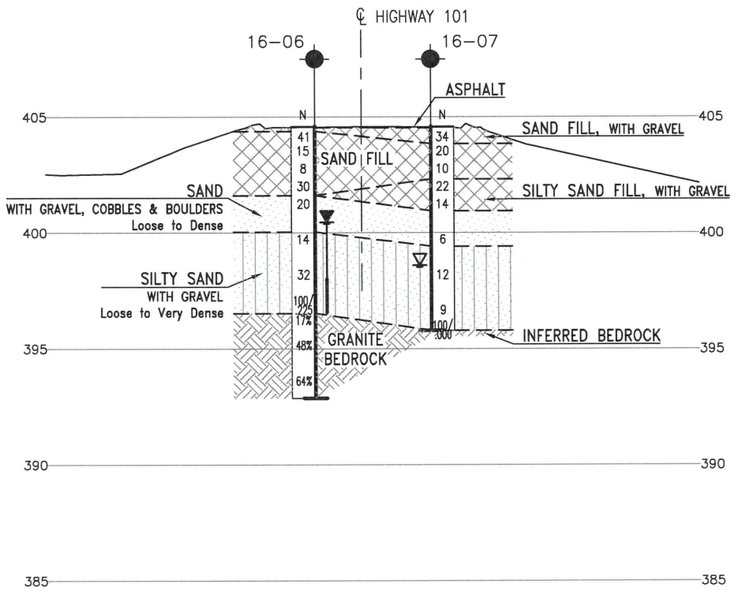

SECTION B–B

5 0 5 10m

SCALE 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct 19/18
PROVINCE OF ONTARIO

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CONT No
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HIGHWAY 101
NEMEGOSENDA RIVER
BRIDGE REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

McINTOSH PERRY

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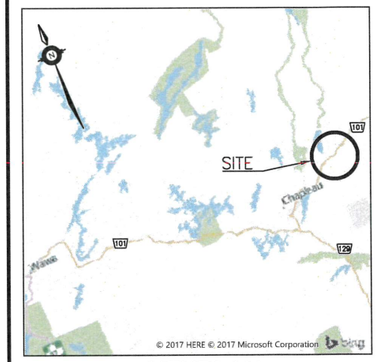

KEYPLAN

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
16-05	404.5	5 311 438.4	375 025.3
16-06	404.6	5 311 444.1	375 011.6
16-07	404.6	5 311 439.7	375 009.2
16-08	404.7	5 311 457.6	374 982.4
16-09	404.7	5 311 452.6	374 979.9
16-10	404.7	5 311 456.9	374 980.6
16-11	404.7	5 311 458.9	374 979.5
16-12	404.7	5 311 453.9	374 976.8
16-13	404.6	5 311 460.2	374 963.7

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GEOCRES No. 41O-29

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	JG	CHK –	CODE	LOAD	DATE OCT 2018
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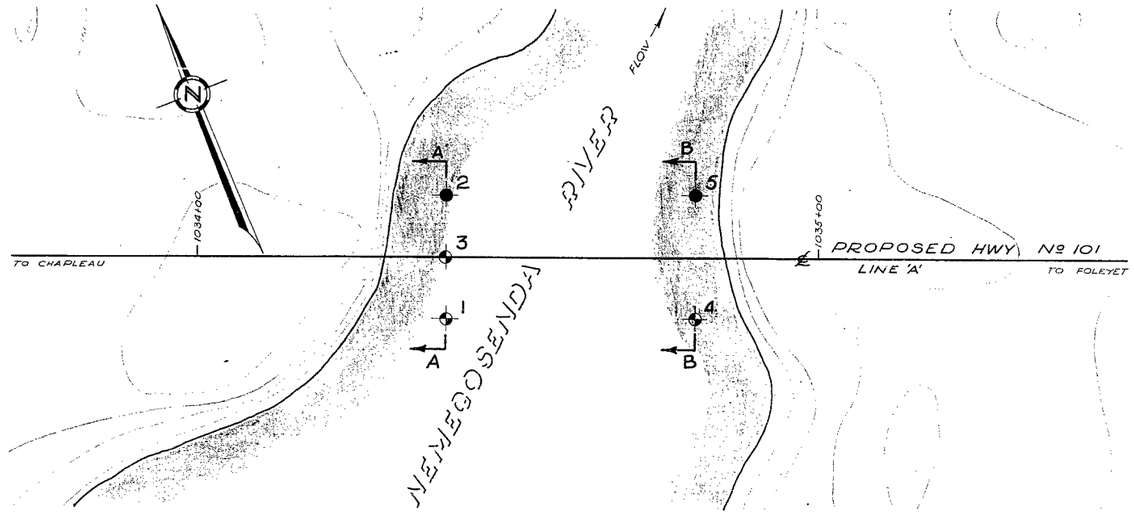

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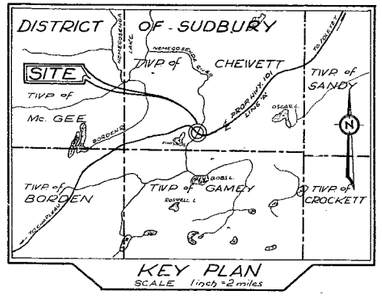

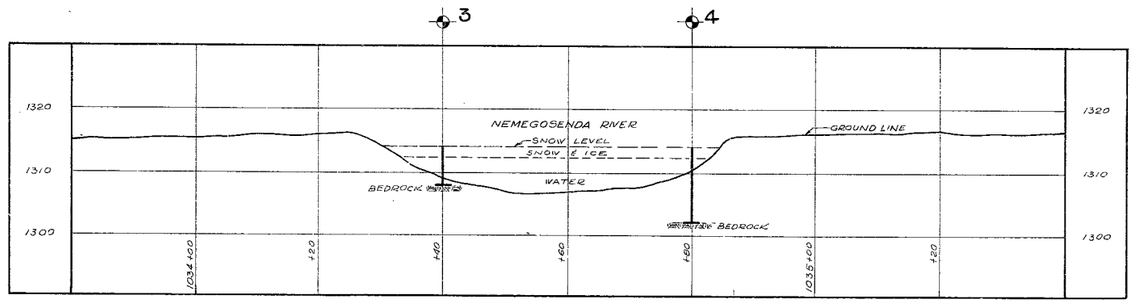

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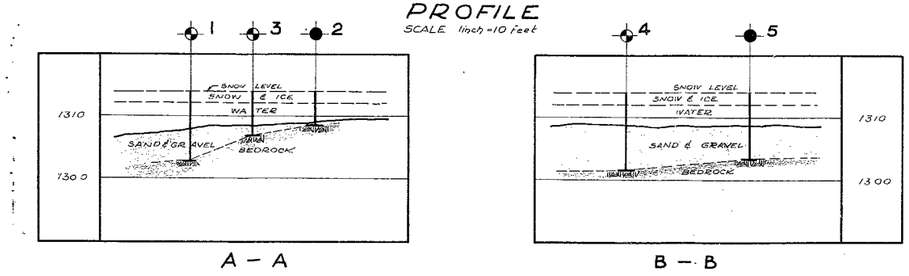

A – A

B – B

REFERENCE PLAN E-3630-1

LEGEND

BORE HOLE

BORE AND PENETRATION HOLE

HOLE	ELEVATION	STATION	DISTANCE FROM ℄
1	1314·00	1034 + 40	10' RT.
2	1314·00	1034 + 40	10' LT.
3	1314·00	1034 + 40	℄
4	1314·00	1034 + 80	10' RT.
5	1314·00	1034 + 80	10' LT.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

NEMEGOSENDA RIVER AND PROPOSED HIGHWAY Nº 101
LINE 'A'

ORIGINATED VART KORLU	DISTRICT NO. 17	DATE 27 APR. 1961
DRAWN [illegible]	W.P. NO	JOB NO. 61-F-21
CHECKED VAK	SCALE 1 inch = 10 feet	DRAWING NO. 61-F-21 A
APPROVED [illegible]		

Appendix B.

Record of Borehole Sheets

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

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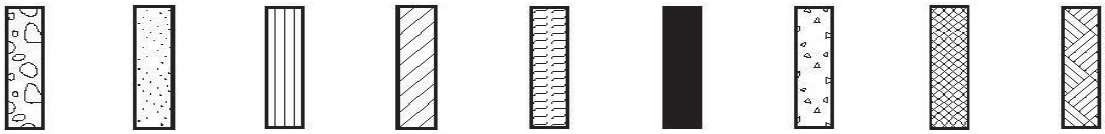
STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel

Sand

Silt

Clay

Organics

Asphalt

Concrete

Fill

Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

THURBER

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	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	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, 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.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

THURBER

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-05 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 438.4 E 375 025.3 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / CME 75 Truck Mount COMPILED BY JM

DATUM Geodetic DATE 2016.10.28 - 2016.10.28 CHECKED BY SP

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
404.5											
0.0	**40 mm ASPHALT**										
	SAND with Gravel Brown Very Dense **FILL**		1	SS	71		404		○		
	-Frequent boulders 0.9 m to 1.5 m		2	SS	100/275mm				○		
403.0							403				
1.5	SAND Brown Compact **FILL**		3	SS	13				○		7 84 9 (SI+CL)
			4	SS	23		402		○		
401.5											
3.0	**SAND (SP)**, trace Wood Grey Compact		5	SS	18		401		○		
400.4											
4.1	**Silty SAND (SM)** Grey Very Loose to Very Dense		6	SS	17		400		○		2 52 46 (SI+CL)
			7	SS	WH	▼	399		○		
	- Some gravel		8	SS	4		398		○		13 59 26 2
							397				
	- With gravel		9	SS	100/250mm		396		○		
395.0							395				
9.5	End of borehole (Inferred Bedrock) Groundwater at 6.34 m BGS (Elev. 398.2 m) on completion of drilling										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-06 1 OF 2 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 444.1 E 375 011.6 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2016.10.27 - 2016.10.27 CHECKED BY SP

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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
404.6											
0.0	**60 mm ASPHALT**										
0.1											
0.2	SAND with Gravel Brown Dense **FILL**		1	SS	41		404				
	SAND Brown Dense to Loose **FILL**		2	SS	15						6 86 8 (SI+CL)
			3	SS	8		403				
			4	SS	30		402				
401.6											
3.0	**SAND (SW)** with Gravel Brown Dense to Compact - Frequent cobbles/boulders 3.0 m to 4.6 m		5	SS	20	▽	401				
400.0											
4.6	**Silty SAND (SM)** with Gravel Brown Compact to Very Dense		6	SS	14		400				
			7	SS	32		399				21 60 17 2
			8	SS	100/ 225mm		398				
396.5							397				
8.1	**Bedrock** Granite Occassional Quartz seams Grey Fresh Moderately Bedded		1	RUN			396				RUN #1 TCR=100% SCR=65% RQD=17%
			2	RUN			395				RUN #2 TCR=95% SCR=90% RQD=48%

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-06 2 OF 2 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 444.1 E 375 011.6 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2016.10.27 - 2016.10.27 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
			3	RUN			394				RUN #3 TCR=100% SCR=60% RQD=64%
392.8							393				
11.7	End of Borehole Groundwater level in piezometer at 4.14 m BGS (Elev. 400.5 m) on 2016/11/06										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-07 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 439.7 E 375 009.2 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / CME 75 Truck Mount COMPILED BY JM

DATUM Geodetic DATE 2016.10.30 - 2016.10.30 CHECKED BY SP

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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
404.6											
0.0 / 0.1	**75 mm ASPHALT**										
	SAND with Gravel Brown Dense **FILL**		1	SS	34		404		○		
403.8 / 0.8	SAND Brown Compact **FILL**		2	SS	20						
			3	SS	10		403		○		
402.3 / 2.3	Silty SAND with Gravel Brown Compact **FILL**		4	SS	22		402		○		39 48 13 (SI+CL)
			5	SS	14				○		
400.9 / 3.7	**SAND (SW)** with Gravel, Frequent Boulders Brown Loose - Difficulty augering below 3.7 m		6	SS	6		401 400		○		26 64 10 (SI+CL)
399.4 / 5.2	**Silty SAND (SM)** Grey Compact to Loose		7	SS	12	▼	399 398		○		
			8	SS	9		397		○		6 72 20 2
395.8 / 8.8	End of Borehole (auger refusal on inferred bedrock)		9	SS	100/ 0mm		396				
	Groundwater level was measured at 4.58 m BGS (Elev. 400.0 m) on 2016/10/30										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-08 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 457.6 E 374 982.4 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2016.10.28 - 2016.10.28 CHECKED BY SP

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
404.7											
0.0 / 0.1	**50 mm ASPHALT**										
	SAND with Gravel, frequent Cobbles Brown Very Dense		1	SS	100/ 275mm				○		
403.9	**FILL**						404				
0.8	SAND Brown Compact **FILL**		2	SS	14				○		6 89 5 (SI+CL)
403.2											
1.5	Silty SAND with Gravel, frequent Cobbles Brown Compact **FILL**		3	SS	18		403		○		
			4	SS	17		402		○		
401.7			~~5~~	~~SS~~	~~100/ 0mm~~						
3.0	**Bedrock** Granite Grey Fresh Moderately Bedded Occassional mud seams from 3.1 m to 5.5 m		1	RUN			401				RUN #1 TCR=90% SCR=86% RQD=60%
			2	RUN			400				RUN #2 TCR=87% SCR=85% RQD=74%
			3	RUN			399				RUN #3 TCR=100% SCR=100% RQD=76%
397.6							398				
7.1	End of borehole Borehole dry prior to coring										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-09 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 452.6 E 374 979.9 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / CME 75 Truck Mount COMPILED BY JM

DATUM Geodetic DATE 2016.10.29 - 2016.10.29 CHECKED BY SP

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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
404.7											
0.0 / 0.1	**75 mm ASPHALT**										
	Silty SAND some Gravel Brown Dense **FILL**		1	SS	42		404		○		
403.9 / 0.8	SAND, frequent Cobbles Brown Compact **FILL**		2	SS	11				○		
403.1 / 1.5	Silty SAND, frequent Cobbles Brown Loose **FILL**		3	SS	100/ 225mm		403		○		
402.4 / 2.3	GRAVEL, Silty with Sand Brown Compact **FILL**		4	SS	26		402		○		47 41 12 (SI+CL)
	- Frequent Cobbles/Boulders below 3.1 m		5	SS	69						
400.8			6	SS	100/ 0mm		401				
3.8	End of Borehole (inferred bedrock) Borehole dry on completion										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-10 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 456.9 E 374 980.6 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2016.10.28 - 2016.10.28 CHECKED BY SP

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
404.7											
0.0	**40 mm ASPHALT**										
0.0	SAND with Gravel Brown Very Dense **FILL**		1	SS	52		404		○		
404.0											
0.8	SAND Brown Compact **FILL**		2	SS	17				○		
403.2							403				
1.5	SAND with Gravel, frequent Cobbles Brown Compact **FILL**		3	SS	21				○		27 65 8 (SI+CL)
402.5											
2.3	GRAVEL with Sand Grey Dense to Compact **FILL**		4	SS	50		402		○		55 37 8 (SI+CL)
			5	SS	21				○		
400.5	- Auger refusal at 4.3 m						401				
4.3	**Bedrock** Granite Grey Fresh Moderately Bedded		1	RUN			400				RUN #1 TCR=98% SCR=95% RQD=74%
			2	RUN			399				RUN #2 TCR=98% SCR=97% RQD=78%
			3	RUN			398				RUN #3 TCR=95% SCR=95% RQD=68%
397.0							397				
7.8	End of borehole Borehole dry prior to coring										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-11 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 458.9 E 374 979.5 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / CME 75 Truck Mount COMPILED BY JM

DATUM Geodetic DATE 2016.10.28 - 2016.10.28 CHECKED BY SP

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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
404.7											
0.0 / 0.1	**65 mm ASPHALT**										
	SAND with Gravel Brown Dense to Compact		1	SS	47				○		
403.9	**FILL**						404				
0.8	SAND Brown Compact **FILL**		2	SS	10				○		
			3	SS	14		403		○		
			4	SS	14				○		
401.6							402				
3.0	**Silty SAND (SM)** with Gravel Brown Compact		5	SS	28				○		
							401				
			6	SS	100/ 250mm		400		○		21 49 30 (SI+CL)
399.4			7	SS	100/ 0mm						
5.3	End of Borehole (inferred bedrock) Borehole dry on completion										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-12 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 453.9 E 374 976.8 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2016.10.29 - 2016.10.29 CHECKED BY SP

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
404.7											
0.0	**40 mm ASPHALT**										
	Sand with Gravel Brown Dense		1	SS	37		404		○		18 73 9 (SI+CL)
403.9	**FILL**										
0.8	SAND Brown Dense to Very Dense **FILL**		2	SS	37				○		
			3	SS	61		403		○		
	- Frequent Cobbles/Boulders below 2.2 m		4	SS	79		402		○		
401.6											
3.0	GRAVEL, Silty with Sand Frequent Cobbles and Boulders Brown Compact		5	SS	11				○		47 41 12 (SI+CL)
400.8	**FILL**						401				
3.8	- Auger refusal at 3.8 m		1	RUN							RUN #1 TCR=93% SCR=93% RQD=93%
	Bedrock Granite Grey Fresh Moderately Bedded		2	RUN			400				RUN #2 TCR=100% SCR=91% RQD=63%
			3	RUN			399				RUN #3 TCR=100% SCR=100% RQD=87%
397.5							398				
7.2	End of borehole Borehole dry prior to coring										

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

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

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-13 1 OF 1 METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Bridge N 5 311 460.2 E 374 963.7 ORIGINATED BY CM

HWY 101 BOREHOLE TYPE HSA / CME 75 Truck Mount COMPILED BY JM

DATUM Geodetic DATE 2016.10.29 - 2016.10.29 CHECKED BY SP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
404.6											
0.0	**80 mm ASPHALT**										
0.1	SAND with Gravel Brown Dense **FILL**		1	SS	45		404		○		
403.9											
0.8	SAND Brown Dense **FILL**		2	SS	49				○		
			3	SS	35		403		○		
			4	SS	18		402		○		4 86 10 (SI+CL)
401.0	- Wood log at 3.4 m		5	SS	100/ 225mm						
3.6	**Silty SAND (SM)** with Gravel Grey Very Dense						401				
			6	SS	100/ 225mm		400		○		20 54 23 3
399.5											
5.1	End of Borehole (inferred bedrock) Borehole dry on completion										

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

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 2012TEMPLATE(MTO).GDT 23/10/18

FORM OB-ML-126 (REV. 1959.)—58-5691

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W.P. - BORE HOLE NO. 1

JOB 61-F-21 STATION 1034+40 (10' Lt.)

DATUM 1313.0' COMPILED BY B.K.

BORING DATE Mar. 25/61 CHECKED BY V.K.

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) ○
VANE TEST (C) AND SENSITIVITY (S) +S
NATURAL MOISTURE AND LIQUIDITY INDEX LI X
LIQUID LIMIT —o
PLASTIC LIMIT —|

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	↓ Snow Level	1313.0	0
	Snow & ice	1310.5	
	Water	1307.0	5
	Coarse sand & gravel	1302.0	10
	Bedrock	1297.5	15
	End of borehole Penetration resistance profile shown; obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 350 ft. lb. per blow.		

STRENGTH AND PENETRATION RESISTANCE P.S.F.

BLOWS/FT. 25 50 75 100

Penetration refusal @ elev. 1302.2'

CONSISTENCY

MOIST. CONTENT - % DRY WT.

SAMPLE: RC1

NATURAL UNIT WT. P.C.F.: -

FORM OR-ML-126 (REV. 1959.)—59-5008

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W P - BORE HOLE NO. 2

JOB 61-F-21 STATION 1034+40 (10' Lt.)

DATUM 1313.0' COMPILED BY B.K.

BORING DATE Apr. 25/61 CHECKED BY V.K.

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Snow Level	1313.0	0
	Snow & ice	1310.5	
	Water	1308.3	5
	Bedrock?		10
			15

STRENGTH AND PENETRATION RESISTANCE
P.S.F.
BLOWS/FT

CONSISTENCY
MOIST. CONTENT - % DRY WT.

SAMPLE

NATURAL UNIT WT. P.C.F.

FORM OB ML-126 (REV 1959.) 59-5008

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W.P. -

JOB 61-F-21

DATUM 1313.0'

BORING DATE Apr. 25/61

BORE HOLE NO 3

STATION 1034+40 ℄

COMPILED BY B.K.

CHECKED BY V.K.

2" DIA. SPLIT TUBE

2" SHELBY TUBE

2" SPLIT TUBE

2" DIA CONE

2" SHELBY

CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)

VANE TEST (C) AND SENSITIVITY (S)

NATURAL MOISTURE AND LIQUIDITY INDEX

LIQUID LIMIT

PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	↓ Snow Level	1313.0	0
	Snow & ice	1310.5	
	Water	1308.0	5
	Sand & gravel	1306.0	
	Bedrock?		

Penetration resistance profile shown; obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 350 ft. lb. per blow.

STRENGTH AND PENETRATION RESISTANCE P.S.F.

BLOWS/FT 25 50 75 100

0 5 10 15 20

Penetration refusal at elev. 1306.0'

CONSISTENCY

MOIST CONTENT % DRY WT.

SAMPLE

NATURAL UNIT WT P.C.F.

FORM OB-ME-126 (REV 1959) 59-5008

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W P - BORE HOLE NO. 4

JOB 61-F-21 STATION 1034+80 (10' Rt.)

DATUM 1313.0' COMPILED BY B.K.

BORING DATE Apr. 25/61 CHECKED BY V.K.

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O
VANE TEST (C) AND SENSITIVITY (S) +S
NATURAL MOISTURE AND LIQUIDITY INDEX X
LIQUID LIMIT
PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	↓ Snow Level	1313.0	0
	Snow & ice	1311.8	
	Water	1307.5	5
		1301.0	10
	End of cone penetration Bedrock?		15
			20

STRENGTH AND PENETRATION RESISTANCE
P.S.F.
BLOWS/FT.

Penetration refusal at elev. 1301.0'

CONSISTENCY
MOIST. CONTENT % DRY WT.

NATURAL SAMPLE UNIT WT. P.C.F.

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W P -

JOB 61-F-21

DATUM 1313.0'

BORING DATE Apr. 25/61

BORE HOLE NO 5

STATION 1034+80 (10' Lt.)

COMPILED BY B.K.

CHECKED BY V.K.

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	↓ Snow Level	1313.0	0
	Snow & ice	1312.0	
	Water	1308.0	5
	Sand and gravel	1302.5	10
	Bedrock	1297.5	15
	End of borehole		20

STRENGTH AND PENETRATION RESISTANCE P.S.F.
BLOWS P.F. 25 50 75 100

CONSISTENCY
MOIST. CONTENT - % DRY WT. 10 20 30

SAMPLE	NATURAL UNIT WT. P.C.F.
S1	-
S2	-
RC3	-

Appendix C.

Laboratory Testing

Appendix C.1

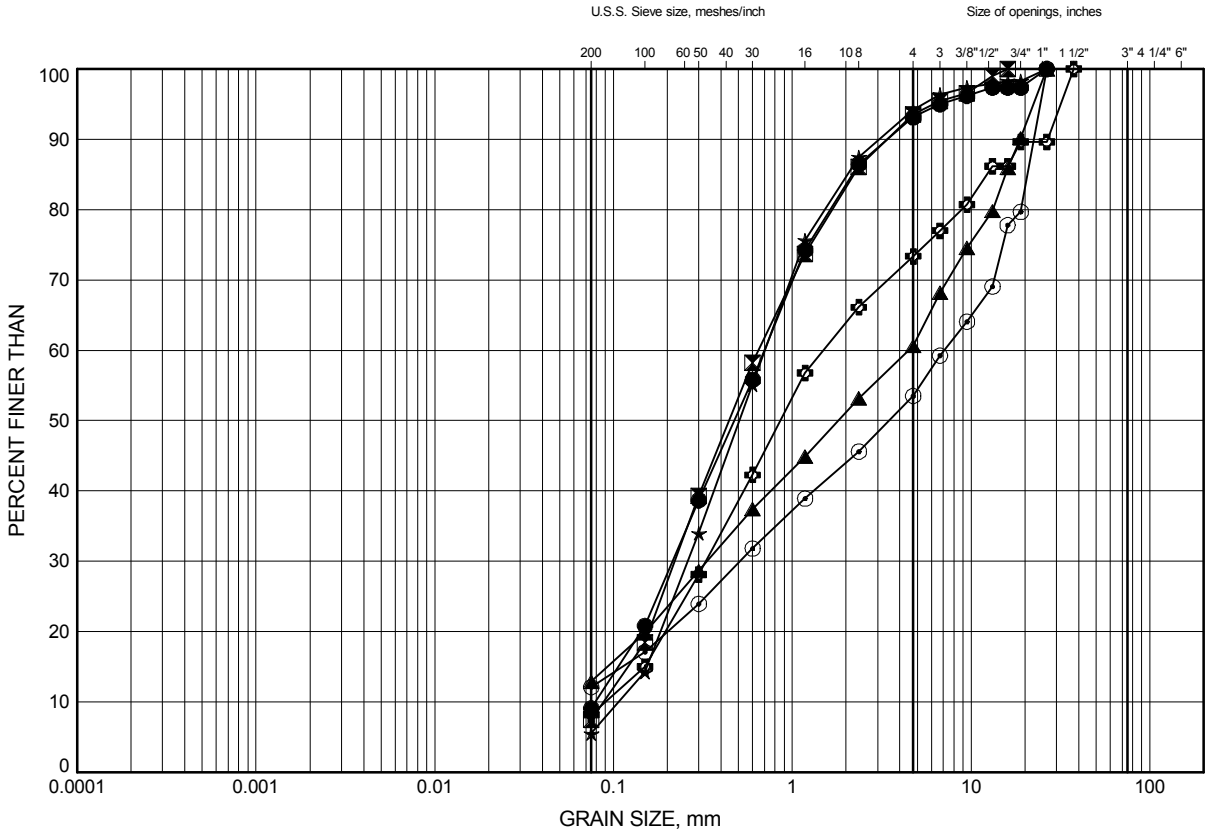
Particle Size Analysis Figures

Nemegosenda River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE C1

Embankment FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-05	1.83	402.68
⊠	16-06	1.07	403.49
▲	16-07	2.59	401.99
★	16-08	1.07	403.64
⊙	16-09	2.59	402.06
✿	16-10	1.83	402.91

Date December 2016

GWP# 5144-10-00

THURBER

Prep'd JM

Chkd. FJG

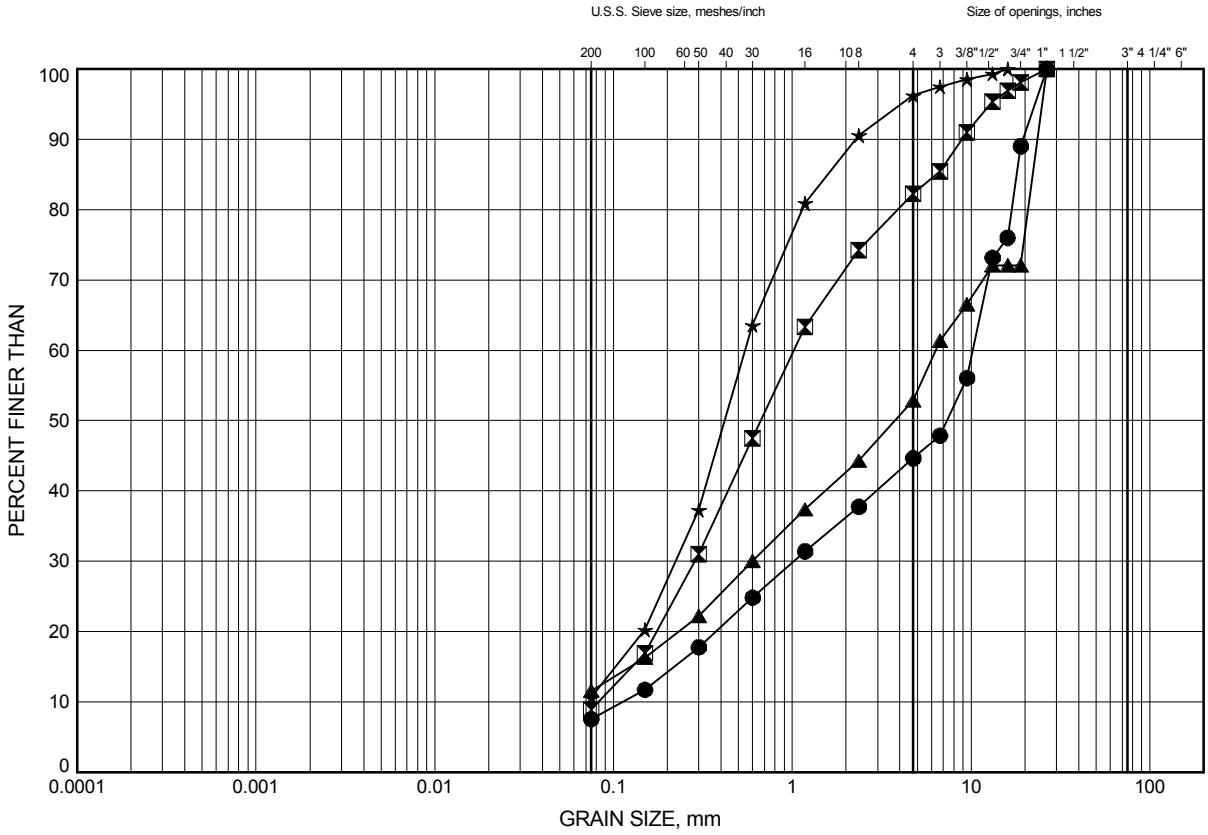
GRAIN SIZE DISTRIBUTION - THURBER 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 21/12/16

Nemegosenda River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE C2

Embankment FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-10	2.59	402.15
⊠	16-12	0.46	404.20
▲	16-12	3.35	401.30
★	16-13	2.59	402.04

Date December 2016

GWP# 5144-10-00

THURBER

Prep'd JM

Chkd. FJG

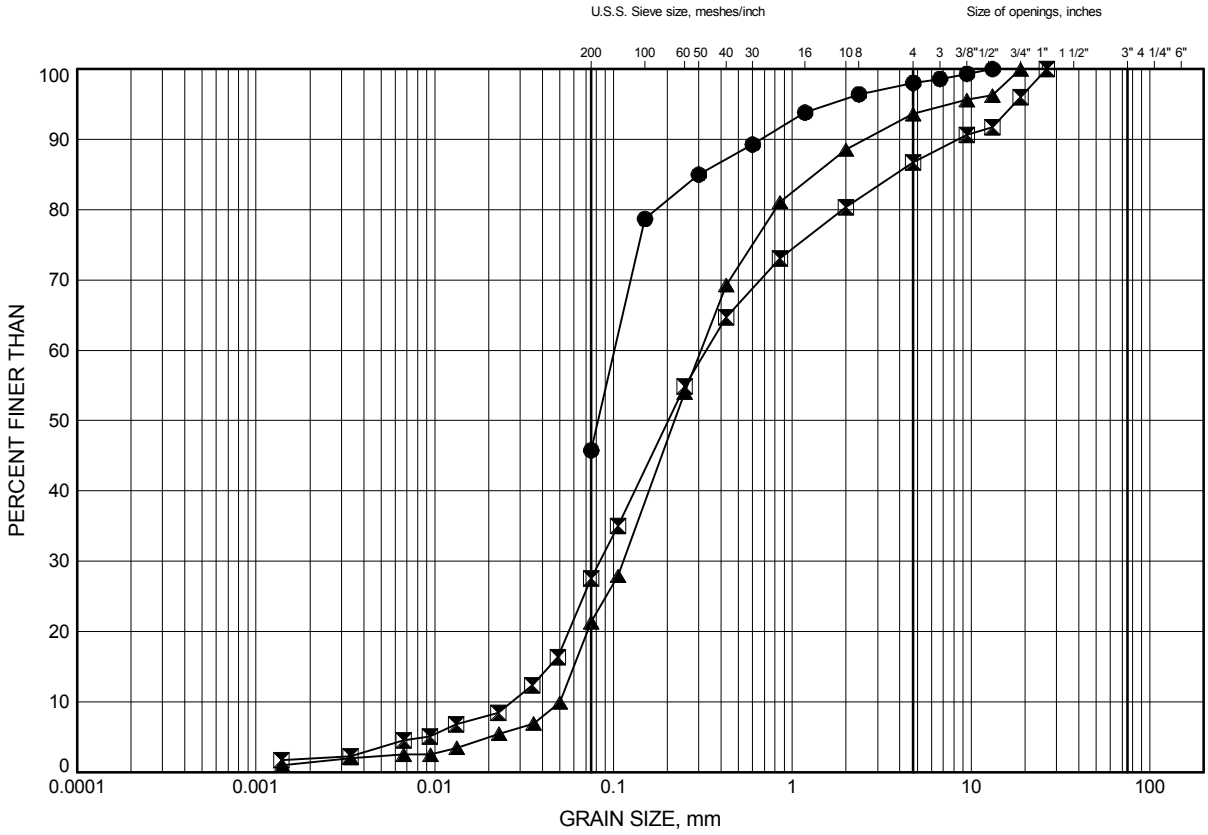
GRAIN SIZE DISTRIBUTION - THURBER 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 21/12/16

Nemegosenda River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE C3

Silty SAND to Silty SAND with Gravel



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-05	4.88	399.63
⊠	16-05	7.92	396.58
▲	16-07	7.92	396.65

Date December 2016

GWP# 5144-10-00

THURBER

Prep'd JM

Chkd. FJG

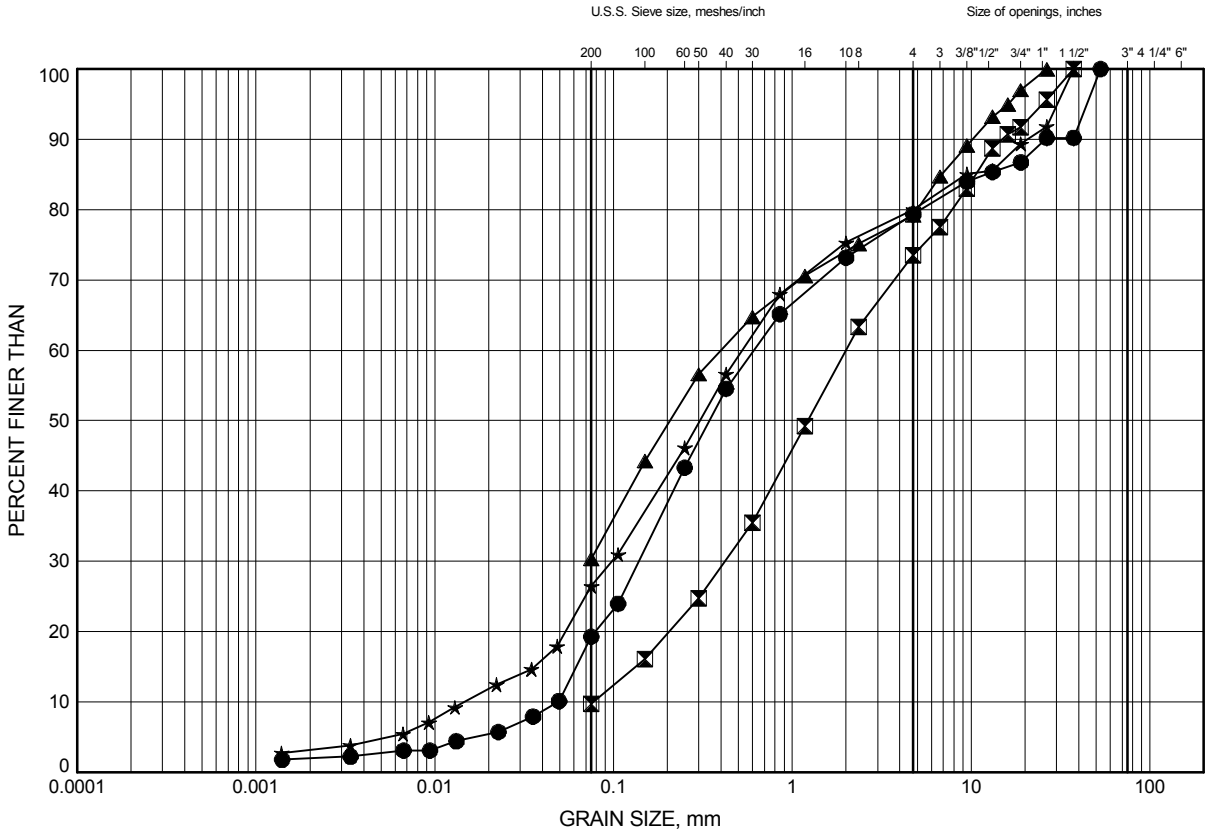
GRAIN SIZE DISTRIBUTION - THURBER 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 21/12/16

Nemegosenda River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE C4

Silty SAND to Silty SAND with Gravel



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-06	6.40	398.15
⊠	16-07	4.88	399.70
▲	16-11	4.85	399.85
★	16-13	4.85	399.78

Date December 2016

GWP# 5144-10-00

THURBER

Prep'd JM

Chkd. FJG

GRAIN SIZE DISTRIBUTION - THURBER 13624 - 101 AND 129 - NEMEGOSENDA.GPJ 21/12/16

Appendix C.2

Analytical Testing Results

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO:

Report Date: 17-Nov-2016
Order Date: 11-Nov-2016
Project Description: 13624

	Client ID:	16-1 SS2 (2'-4')	16-4 (1-4)	16-6 SS3 (5'-7')	16-8 SS4 (7'6-9'6)
	Sample Date:	21-Oct-16	23-Oct-16	27-Oct-16	28-Oct-16
	Sample ID:	1646369-01	1646369-02	1646369-03	1646369-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	81.8	85.3	96.7	92.0
General Inorganics					
Conductivity	5 uS/cm	109	109	385	728
pH	0.05 pH Units	7.41	6.41	7.89	7.89
Resistivity	0.10 Ohm.m	91.5	91.7	26.0	13.7
Anions					
Chloride	5 ug/g dry	16	15	159	346
Sulphate	5 ug/g dry	19	14	10	31

	Client ID:	16-15 SS6 (40-41-4)	16-18 SS6 (15-17)	-	-
	Sample Date:	31-Oct-16	03-Nov-16	-	-
	Sample ID:	1646369-05	1646369-06	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	89.1	84.1	-	-
General Inorganics					
Conductivity	5 uS/cm	171	351	-	-
pH	0.05 pH Units	7.78	6.84	-	-
Resistivity	0.10 Ohm.m	58.4	28.5	-	-
Anions					
Chloride	5 ug/g dry	24	171	-	-
Sulphate	5 ug/g dry	54	18	-	-

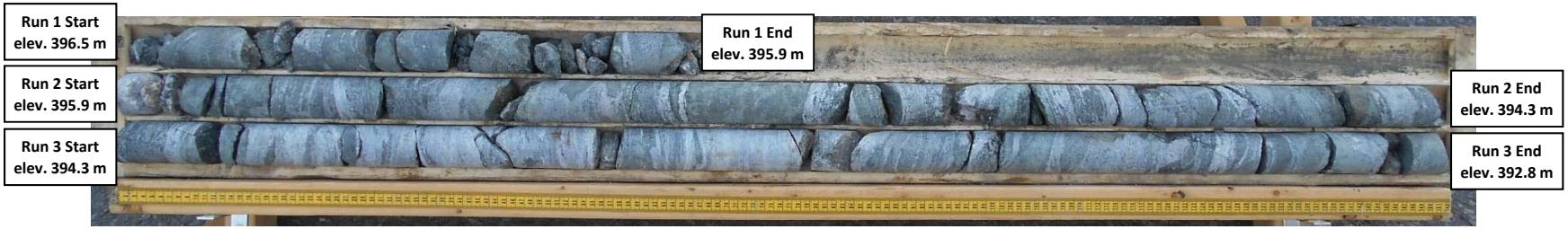
Appendix C.3

Rock Core Photographs

Borehole 16-6

Run 1 to 3 (of 3)

Elevation 396.5 m to 392.8 m



THURBER ENGINEERING LTD.

Foundation Investigation
Highway 101 – Nemegosenda River Bridge
Site 46-215

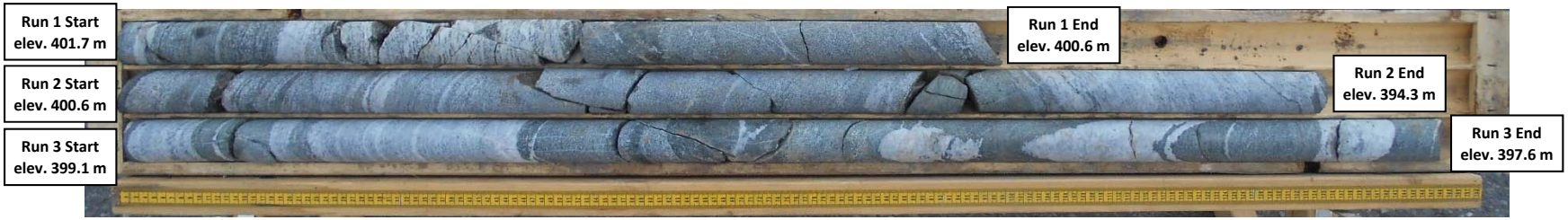
GWP: 5144-10-00

Project No.: 13624

Borehole 16-8

Run 1 to 3 (of 3)

Elevation 401.7 m to 397.6 m



THURBER ENGINEERING LTD.

Foundation Investigation
Highway 101 – Nemegosenda River Bridge
Site 46-215

GWP: 5144-10-00

Project No.: 13624

Borehole 16-10

Run 1 to 3 (of 3)

Elevation 400.5 m to 397.0 m

THURBER ENGINEERING LTD.

Foundation Investigation
Highway 101 – Nemegosenda River Bridge
Site 46-215

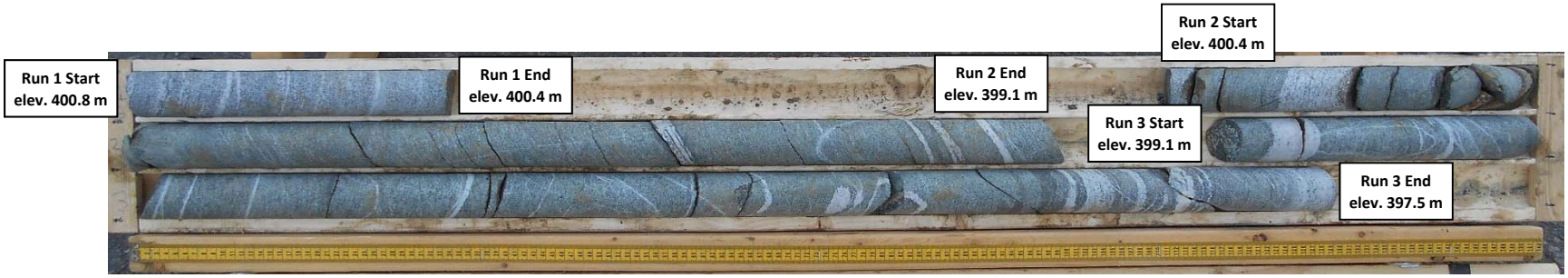
GWP: 5144-10-00

Project No.: 13624

Borehole 16-12

Run 1 to 3 (of 3)

Elevation 400.8 m to 397.5 m



THURBER ENGINEERING LTD.

Foundation Investigation
Highway 101 – Nemegosenda River Bridge
Site 46-215

GWP: 5144-10-00

Project No.: 13624

Appendix D.

Selected Site Photographs

Photo 1. Looking southwest at the Bridge from near the east abutment. [taken October 2016]

Photo 2. Looking northeast at the bridge from near the west abutment. [taken October 2016]

Photo 3. Looking at the west abutment. [taken October 2016]

Photo 4. Looking at the east abutment. [taken October 2016]

Photo 5. Looking at the gravel access road south of the highway alignment [taken October 2016]