



**THURBER** ENGINEERING LTD.

**FINAL  
FOUNDATION INVESTIGATION AND DESIGN REPORT  
TEMPORARY DETOUR BRIDGE  
NEMEGOSENDA RIVER BRIDGE HIGHWAY 101  
AGREEMENT NO.: 5015-E-0027**

**G.W.P. 5144-10-00**

**Geocres No.: 41O-30**

Report to:

**McIntosh Perry Consulting Engineers Limited**

Latitude: 47.93808°  
Longitude: -83.06024°

October 2018  
Thurber File No.: 13624

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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 temporary detour bridge proposed for use during the replacement of the Nemegosenda River Bridge (Structure No. 46-215). The existing 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 Change Proposal 1 for 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.

This report is provided to supplement the Foundation Investigation and Design Report completed for the replacement of the mainline Nemegosenda River Bridge (Geocres No. 41O-29) and should be read in conjunction with that report. Please also refer to the Pavement Design Report for the embankment widening prepared by others.

**2 SITE DESCRIPTION**

The existing Nemegosenda River structure is located on Highway 101 within 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. At the bridge site, Highway 101 is a two-lane, undivided highway with a rural cross-section. Steel guide rails are present on both sides of the highway for a short distance from the bridge.

To the southwest of the bridge is a gravel access road leading to a water monitoring shed located at the river's west 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).

Site photographs showing the general conditions in the area of the temporary detour bridge during the time of the field investigation are presented in Appendix D.

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### 3 SITE INVESTIGATION AND FIELD TESTING

Thurber contacted Ontario One Call in advance of the field investigation to provide utility locate clearances in the vicinity of the intended borehole locations.

The current field investigation for the detour bridge included advancing two foundation boreholes drilled on May 11, 2017 and May 24, 2017. 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.

**Table 3-1: Borehole Summary**

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth below Existing Ground Surface (m)
17-01	West Temporary Abutment	5 311 467.8	374 980.8	403.2	5.9
17-04	East Temporary Abutment	5 311 450.7	375 024.2	402.4	7.1

Borehole 17-01 was advanced with a track mounted CME 550 drill rig equipped with hollow stem augers and HW/NW casing. Borehole 17-04 was not accessible by a track drill rig and was advanced using a portable tripod and electric casing/coring drill and a full-weight hammer. Two Dynamic Cone Penetration Tests (DCPTs), identified as 17-04A and 17-04B, were advanced to refusal at approximately 1 m offsets from Borehole 17-04. The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. 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.

The boreholes were backfilled with a low-permeability mixture of bentonite pellets and auger cuttings in accordance with Ontario MOE Regulation 903. The coordinates and elevations were surveyed by Thurber following completion of drilling relative to site features and elevation benchmarks provided by MPCE. The coordinates are provided on the Borehole Locations and Stratigraphy Drawing included in Appendix A and on the individual Record of Borehole sheets.

### 4 LABORATORY TESTING

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification on all retained soil samples in accordance with the current MTO standards. Grain size distribution analyses testing were carried out on selected samples to MTO and ASTM standards.

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 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 along the alignment of the proposed temporary bridge structure is generally characterized by a sand fill overlying native organic silt, underlain by silty sand with gravel overlying bedrock.

### **5.1 Topsoil**

A thin veneer of topsoil was noted in Borehole 17-04 and was found to be 100 mm thick.

### **5.2 Fill**

Granular fill varying in composition from silty sand, some gravel to sand with gravel was encountered from surface in Borehole 17-01 and below the topsoil in Borehole 17-04. Trace organics were noted in the upper portion of the fill and occasional cobbles were noted in the lower portion of the fill. This fill had a thickness ranging from 1.1 m to 2.6 m (base elevation of 400.6 m to 401.2 m). The SPT 'N' values ranged from 2 to 8 blows indicating a very loose to loose condition.

The moisture content of the samples tested ranged from 7% to 20%. The results of grain size analyses conducted on three samples of this material are summarized in Table 5-1 and are illustrated on Figure C1 in Appendix C.

**Table 5-1: Gradation Results for Fill**

Soil Particle	%
Gravel	5 to 22
Sand	69 to 91
Silt and Clay	4 to 17

### **5.3 Organic Silt**

A layer of organic silt with occasional wood fragments was encountered below the fill in Borehole 17-04. This layer has a thickness of 2.0 m and an underside elevation of 399.2 m. The SPT 'N' values ranged from 7 to 10 blows indicating a loose condition.

The moisture content for the samples tested ranged from 32% to 96%. The results of an organic content analysis conducted on one sample of this material indicated an organic content of 19.8%.

#### 5.4 Silty Sand with Gravel

Silty sand with gravel was encountered below the fill in Borehole 17-01 and below the organic silt in Borehole 17-04. Occasional cobbles and boulders were noted in this layer in Borehole 17-01 and frequent cobbles and boulders were noted in Borehole 17-04. This layer had a thickness ranging from 0.3 m to 2.2 m (underside elevation of 397.0 m to 400.3 m). An SPT 'N' value of 22 blows was recorded, indicating a compact condition. Refusal blow counts were obtained where cobbles/boulders were encountered.

The moisture content of the samples tested ranged from 9% to 15%. No grain size analyses were conducted on this material due to very poor split spoon sample recovery.

#### 5.5 Bedrock

The overburden materials were underlain by granite bedrock. Both Boreholes 17-01 and 17-04 were advanced into the bedrock by coring. The inferred and cored bedrock surface ranges from elevation 396.7 to 400.3 m and is summarized in the table below:

**Table 5-2 Summary of Bedrock Elevation**

Location	Borehole No.	Depth Below Existing Ground Surface (m)	Top of Bedrock or Inferred Bedrock Elevation (m)
West Abutment	17-01	2.9	400.3
East Abutment	17-04	5.4	397.0
	17-04A	5.6	396.9(*)
	17-04B	5.6	396.7(*)

Note: (\*) inferred by DCPT refusal completed at approximately 1 m off-sets from Borehole 17-04

The Total Core Recovery (TCR) was 100% within the granite bedrock, the Solid Core Recovery (SCR) ranged from 64 to 100% and the Rock Quality Designation (RQD) ranged from 38 to 100%. Based on the RQD value the bedrock is classified to be of poor to excellent quality. Photographs of the recovered core are provided in Appendix C.

#### 5.6 Groundwater

Groundwater was observed in Borehole 17-04 after completion of coring and was noted to be at elevation 401.2 m. It is noted that water was introduced into the drill stem during coring, thus the measured water level may be not be representative of the stabilized water level. The water level in Nemegosenda River was measured in October 2016 by Thurber 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 River.

## 6 MISCELLANEOUS

Borehole locations were selected and positioned relative to existing site features and the proposed foundation locations and the as-drilled locations and elevations were surveyed by Thurber after completion of drilling. Elevation benchmarks were provided MPCE.

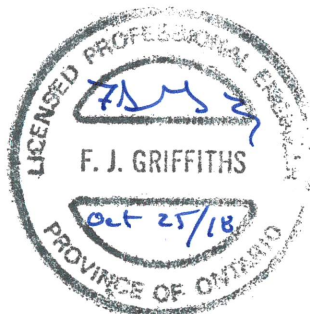
George Downing Estate Drilling Ltd. of Hawkesbury, Ontario supplied and operated the track mounted CME 550 drill and equipment to carry out the drilling, sampling, in-situ testing, and borehole decommissioning at the west abutment. OGS Drilling of Almonte, Ontario supplied and operated the portable drilling equipment to carry out the drilling, sampling, in-situ testing, and borehole at the east abutment. The field investigation was supervised on a full-time basis by Ms. Katya Edney, 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. Organic content testing was completed by Stantec's MTO-approved laboratory in Ottawa. Interpretation of the field data and preparation of this report was completed by Mr. Christopher Murray P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.

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**PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 INTRODUCTION**

This section of the report provides an interpretation of the factual data in Part 1 of this report and presents geotechnical recommendations to assist the project team in designing a suitable foundation for the proposed temporary detour bridge to be located approximately 12 m to the north of the existing Nemegosenda River Bridge. The discussion and recommendations presented in this report are based on the information provided by McIntosh Perry Consulting Engineers Ltd. (MPCE) including the 30% Contract Drawings dated October 2017 and on the factual data obtained during the course of the investigation.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation, and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The construction or design-build contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

This report is provided to supplement the Foundation Investigation and Design Report completed for the replacement of the existing mainline Nemegosenda River bridge (Geocres 41O-29) and should be read in conjunction with that report. The following sections address the foundation aspects of the installation of the temporary foundations.

**7.1 Proposed Structure**

At the time of preparation of this Foundation Investigation and Design Report, a General Arrangement (GA) drawing, Sheet 47 of the 30% Contract Drawings, shows that the temporary detour structure is proposed to consist of a one lane temporary modular bridge 51.816 m long and supported on spread footings with a sleeper slab placed on granular pads.

Maximum fill heights of 3.2 and 1.5 m are proposed, as indicated in an email from MPCE dated June 21, 2017, at the west and east sides, respectively, to match the existing Highway 101 vertical profile at the tie-ins. It is understood that based on the proposed Contract scheduling for the structures included in the GWP, the temporary detour bridge at

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this site will not be required within the first year of the contract. It is also understood that the bridge will be in service for less than a year and will not be subject to winter conditions.

## **7.2 Applicable Codes and Design Considerations**

The geotechnical assessment presented below has been prepared based on the available data regarding the proposed foundations and existing ground conditions and in accordance with the Canadian Highway Bridge Design Code (CHBDC), version CSA S6-14.

In accordance with CHBDC CSA S6-14, the analysis and design of structures takes into consideration the importance of the structure and the consequence associated with exceeding limit states. The importance category and consequence classification are defined by the Regulatory Authority, which in this case is the Ministry of Transportation, Ontario (MTO). Although this structure is a temporary structure it is understood to be the only river crossing to connect with Highway 101 in which case the temporary bridge is understood to be a *Major Route Bridge with Typical Consequence*. Accordingly, a consequence factor ( $\Psi$ ) of 1.0, as per Table 6.1 of the CHBDC, has been used in assessing factored geotechnical resistances. If the consequence classification changes, the geotechnical assessment will need to be reviewed and revised.

## **8 DESIGN OPTIONS**

Based on the proposed structure type, the evaluation of foundation alternatives and taking into consideration the length of required service life of the structure, spread footings supported on an engineered granular pad are the recommended foundation alternative at both abutments after completion of a preload period. Deep foundations are not considered a cost effective option and have not been developed further within this report.

## **9 FOUNDATIONS DESIGN RECOMMENDATIONS**

### **9.1 Settlement and Stability**

It is understood that as much as 1.5 m and 3.2 m of fill will be placed to construct the temporary detour at the east and west approaches respectively. Embankment widening should be carried out in accordance with OPSS.PROV 206. The embankment should be constructed with side slopes of 2H:1V (or flatter) and be constructed using Select Subgrade Material (SSM) or Granular B Type I. Where new embankment fill is placed against existing embankment slopes or on a sloping ground surface steeper than 3H:1V, benching of the existing slope should be carried out in accordance with OPSD 208.010.

No long term or global stability issues are anticipated for embankments built at this site to convey temporary traffic. Material stockpiling above the existing grades is a temporary construction measure and the stability implications should be reviewed by the contractor. In addition, the Contractor's selection and placement of construction equipment (such as heavy cranes) must be included in that stability assessment.

Organic silt was encountered at the location of the temporary east abutment during the borehole investigation. It is estimated that settlement in the order of 100 mm and 40 mm will be induced in the soils beneath the east and west temporary abutments respectively. The footprint of the temporary east approach and abutment fill should be preloaded by

placing fill a minimum of 3 months prior to initiation of the construction of the temporary abutment foundation to allow for settlement of the organic soils. As indicated in Section 7.1, it is understood that the detour alignment will not be in use within the first year of the contract, thus the time for preloading should not be a concern.

It is expected that some settlement may also be noted at the existing Nemegosenda River Bridge approaches as a result of fill placement for the temporary approach embankments; asphalt padding of the existing approaches may be required during the preload period.

The alternative to preloading at the east approach widening includes excavation of the organic silt and its replacement with rock fill or Granular A. Groundwater and surface water control would be required to allow compaction if the backfill consisted of Granular A. Dewatering would not be required if rock fill was used as replacement material for the organic silt. Based on conditions observed in Borehole 17-04, it is anticipated that the removal would extend down to approximate elevation 399.2 m, thus a Temporary Protection System (TPS) would be required to protect the existing highway embankment. Given the limited depth to bedrock and the presence of boulders and cobbles below that elevation, the TPS would likely consist of drilled in soldier piles socketed into bedrock and lagging.

## **9.2 Geotechnical Resistance for Spread Footings**

The geotechnical bearing resistances provided in this report for spread footings include a resistance factor of 0.5 ( $\phi_{gu}$ ) and 0.8 ( $\phi_{gs}$ ) for the ULS and SLS values, respectively, as per Table 6.2 of the CHBDC (static analysis – typical understanding). The geotechnical resistances presented herein are for vertical concentric loading only on cast-in-place footings and will need to be adjusted for the effects of inclined or eccentric loadings, where applicable, in accordance with CHBDC Clause 6.10.3 and 6.10.4.

The depth to bedrock in the boreholes advanced at the west and east abutment was noted to be 2.9 and 5.4 m below the existing ground surface, respectively. Excavation for the installation of a spread footing on bedrock for the temporary detour bridge abutments will encroach into the existing mainline embankment slope and a temporary protection system will be required. In addition, dewatering an excavation extending through the native silts and sands below the water table will be difficult.

Therefore, after removal of the topsoil and leveling of the existing foundation soils, a spread footing can be constructed on an engineered pad consisting of 1.0 m thick Granular 'A' material placed directly over the undisturbed existing soils. A geotextile (Class II non-woven FOS 50 to 150  $\mu\text{m}$ , OPSS.PROV 1860) should be placed as a separator between the Granular 'A' and the existing soil. The top of the Granular 'A' pad must extend to 1.0 m beyond the surface of the edge of all sides of the footing and be sloped away from the footing at 1H:1V, or flatter. It is anticipated that the founding elevation of the base of the footing will be above the highwater level. The structure should be provided with frost protection if the service life will extend into winter months.

Based on a 3-month preloading prior to foundation construction, the following factored geotechnical resistance values are recommended at this site for a 2.5 m wide cast-in-place footing positioned a minimum of 5 m from the crest of the forward slope, 2 m offset from the crest of the side slopes and founded on a minimum 1.0 m thick engineered fill pad:

- Factored Geotechnical Resistance at ULS of 200 kPa
- Factored Geotechnical Resistance at SLS of 125 kPa

The horizontal resistance against sliding for a cast-in-place concrete footing founded on engineered fill can be computed using a friction factor of 0.55. Appropriate resistance factors should be applied for the design.

In the case of spread footings or sleeper slabs under a modular bridge, it is considered acceptable to found the footings on granular pads with a minimum embedment of 0.5 m.

The 25 mm settlement based on the SLS bearing capacity provided above is in addition to the settlement of the native soils (see Section 9.1) and compression of the newly placed temporary detour embankment fill. Therefore, the total settlement of the temporary detour abutment foundations may be in excess of allowable limits if the footings are built early in the construction schedule.

### **9.3 Subgrade Preparation, Backfill and Embankment Construction**

Further discussions on subgrade preparation, bedding, backfilling, earth pressures and embankment construction should follow Sections 10.4 through 10.8 of the mainline Nemegosenda River Bridge Foundation Investigation and Design Report (Geocres No.: 41O-29).

## **10 CONSTRUCTION CONSIDERATIONS**

### **10.1 Excavation**

All excavation must take into consideration the proximity to the existing bridge foundation and must not encroach within 1.5H:1V from the base of the temporary excavation to the existing or newly constructed bridge foundation to avoid undermining those foundations.

All excavations must be conducted in accordance with the requirements of the Occupational Health & Safety Act & Regulations (OHSA) for Construction Projects. The fills and native soils above the water table at the site should be classified as Type 3. All soils below the water table should be classified as Type 4.

Excavation for the structure replacement must be carried out in accordance with OPSS 902. Selection of the equipment and methodology to excavate and prepare the founding surface is the responsibility of the Contractor. Stockpiling or surface surcharge should not be allowed on the temporary embankment or side slopes.

At locations where there are space restrictions or where a slope has to be retained, the excavations will need to be carried out within a protection system. Design of the temporary protection system is the responsibility of the Contractor and all TPS's should be designed by a licensed Professional Engineer experienced in such design and retained by the Contractor. The Contractor should be made aware that cobbles and boulders were encountered within the boreholes.

## **10.2 Surface and Groundwater Control**

Subgrade preparation and placement of granular pads and abutments must be carried out in the dry. Based on the ground surface provided, the footings will likely be at or above the water table.

The Contractor must be prepared to control the groundwater and surface water flow at the site to permit engineered fill and footing construction in a dry and stable excavation

Water from either surface flow and/or groundwater must be diverted away from the excavation at all times. Groundwater perched within the fill and, surface runoff will tend to seep into, and accumulate in proposed excavations.

Dewatering and surface water diversion must remain operational and effective until the temporary excavation is backfilled. Design of an effective dewatering system must be carried out by the Contractor.

## **10.3 Scour Protection and Erosion Control**

Slope protection and drainage measures will be required to ensure the surficial stability of the temporary embankment slopes and protect the integrity of the soils supporting the foundations. The contractor should provide silt fences and erosion control blankets, as required, throughout the duration of the construction to prevent silt/sediment from running off the site as per OPSS 805.

Scour and erosion protection should be provided in the area of the temporary bridge abutments. Typically, rock protection should be provided over all earth surfaces subjected to flowing water in accordance with OPSS 511. Earth embankment slopes should also be protected from erosion.

## **11 CONSTRUCTION CONCERNS**

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

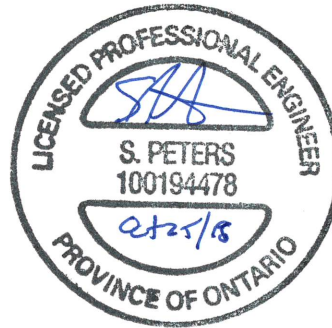
- The presence of cobbles and boulders in the native silty sand may interfere with installation of roadway protection installation (if required). The contractor must be able to dislodge, penetrate or remove such obstructions.
- Seasonal fluctuations of the groundwater and river level are to be expected which may impact the construction.
- Interference with the existing timber cribbing and disturbance to the existing slopes.
- The Contractor's selection of construction equipment and methodology must include assessment of the capability of the existing ground to support the proposed construction equipment and temporary structure fill (i.e., as a pad for crane support).

The successful performance of the bridge will depend largely upon good workmanship and quality control during construction. Subgrade examination and field density testing should be carried out by qualified geotechnical personnel during construction in accordance with SP109S12 to confirm that foundation recommendations are correctly implemented, and material specifications are met.

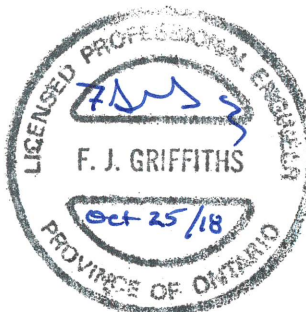
## 12 CLOSURE

Engineering analysis and preparation of this report were carried out by Mr. Christopher Murray, P.Eng. and Mr. Stephen Peters P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng and Dr. P.K. Chatterji, P.Eng a Designated Principal Contact for MTO Foundation Projects.

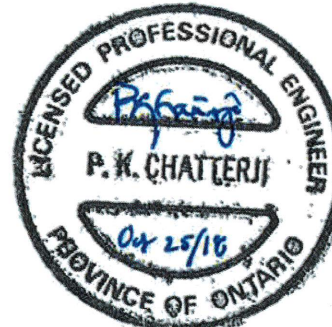
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Senior Associate  
Senior Geotechnical Engineer



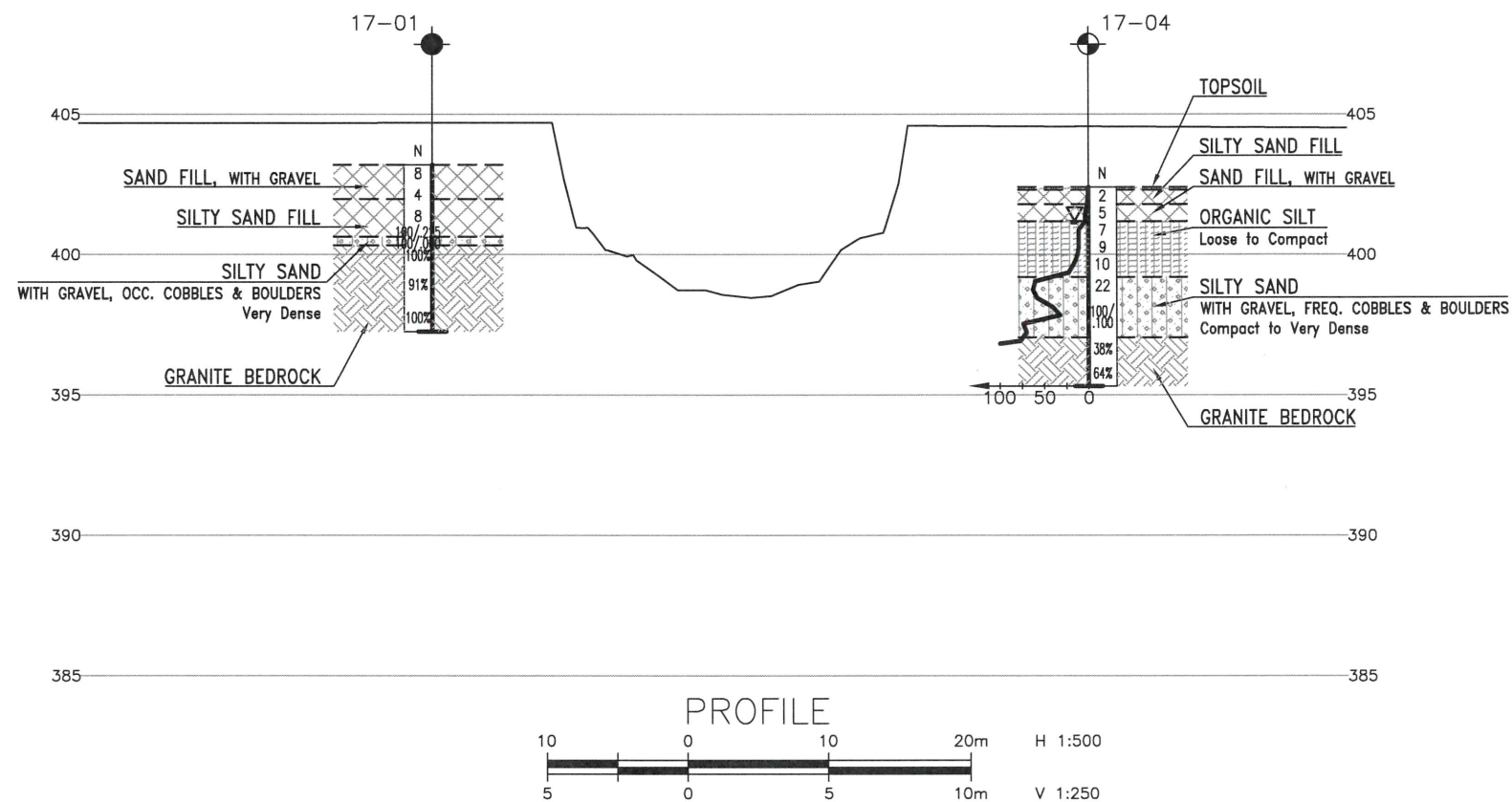
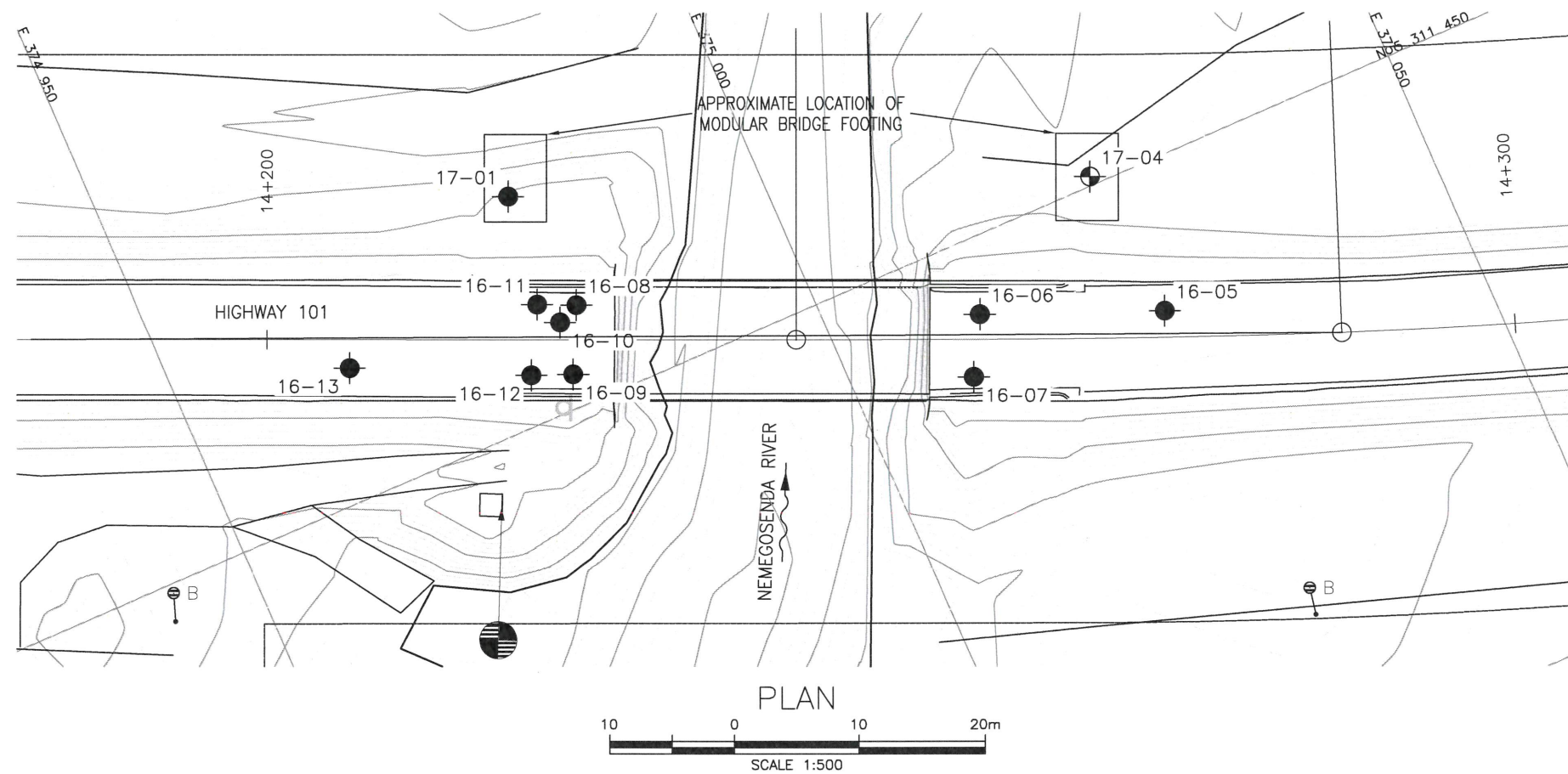
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Senior Geotechnical Engineer

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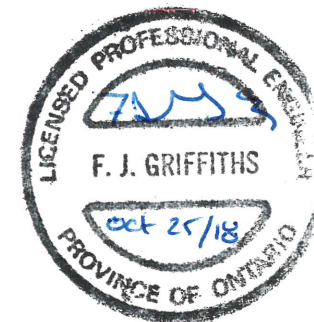
**Appendix A.**

**Borehole Location Plan and Stratigraphic Drawings**





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



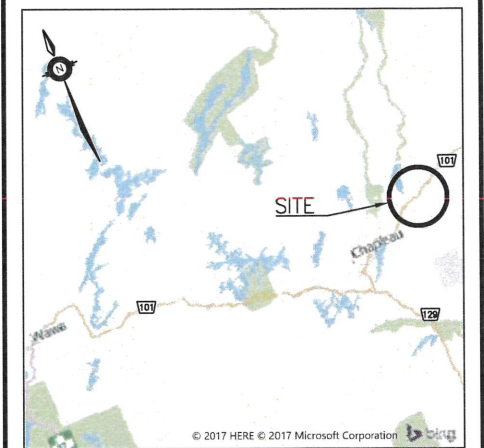
CONT No  
GWP No 5144-10-00

HIGHWAY 101  
NEMEGOSENDA RIVER  
TEMPORARY BRIDGE  
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
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
17-01	403.2	5 311 467.8	374 980.8
17-04	402.4	5 311 450.7	375 024.2

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Borehole locations are shown in MTM Zone 13 coordinates.

GEOCRES No. 410-30

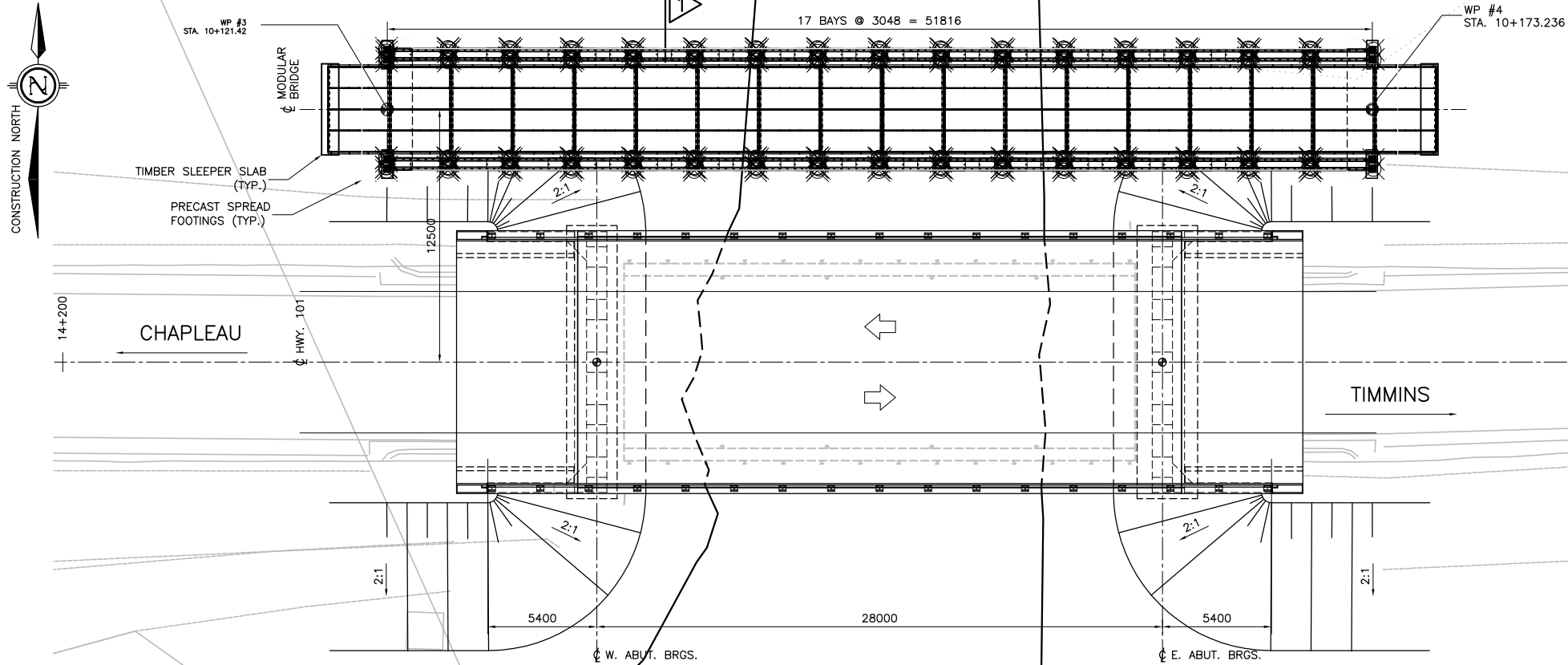
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JG	CHK -	CODE
DRAWN	MFA	CHK JG	SITE 46-215
LOAD			DATE OCT 2018
STRUCT			DWG 1



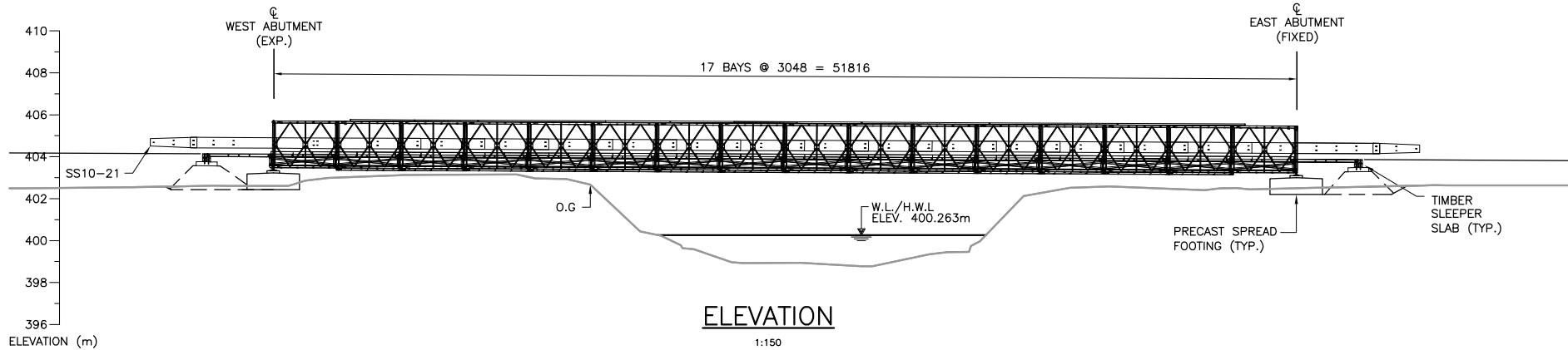
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MODIFIED: 10/4/2017 8:56:13 AM BY: A. STUART  
DATE PLOTTED: 10/4/2017 10:10:13 AM BY: GREG PENNY

PR-D-707 BB-05

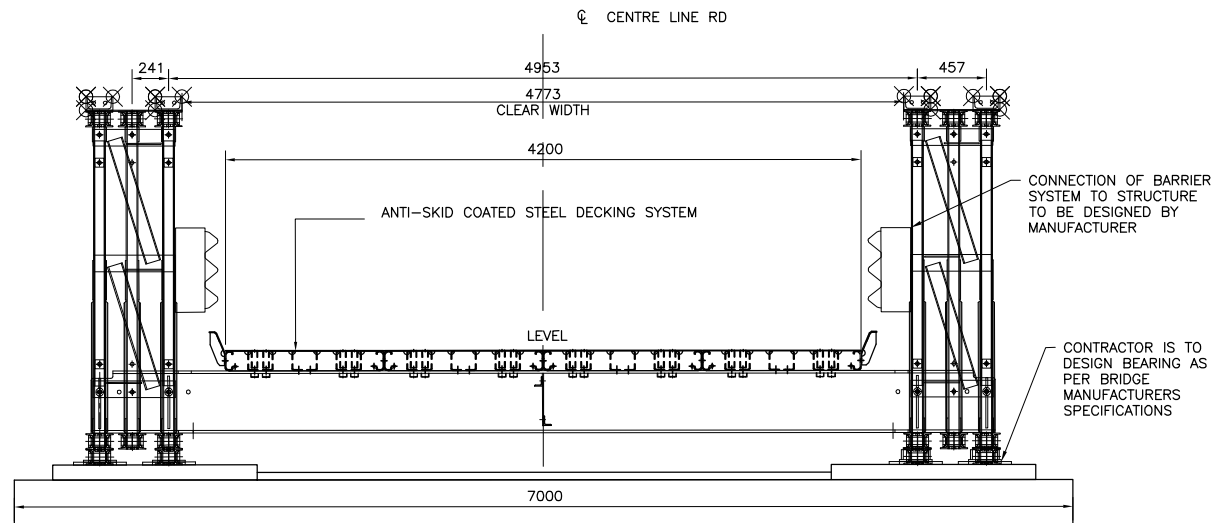
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN  
1:150



ELEVATION  
1:150



1

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

DISTRICT  
CONT. No. 2017-XXXX  
WP No. 5845-05-01



SHEET

47

CLASS OF CONCRETE :

- PRECAST . . . . . 40 MPa
- REMAINDER . . . . . 30 MPa

CLEAR COVER TO REINFORCING STEEL

- PRECAST . . . . . 55 ± 10mm
- REMAINDER . . . . . 70 ± 20mm
- UNLESS OTHERWISE NOTED

REINFORCING STEEL:

- REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.
- STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa. UNLESS OTHERWISE SPECIFIED.
- UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS 'B'
- BAR MARKS WITH PREFIX 'S' DENOTES STAINLESS STEEL BARS

STRUCTURAL STEEL:

- ALL STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH MANUFACTURE'S SPECIFICATIONS.

STEEL MODULAR BRIDGE:

- THE NEW STEEL MODULAR BRIDGE SHALL BE HOT DIPPED GALVANIZED.
- THE NEW MODULAR BRIDGE SHALL BE "MABEY" COMPACT 200 MODULAR EW DSHR2+ SD C/W ANTI-SKID COATED STEEL DECK OR APPROVED EQUIVALENT. CONTRACTOR IS RESPONSIBLE FOR THE SUPPLY, DELIVERY, AND ERECTION OF THE NEW MODULAR BRIDGE.
- THE CONTRACTOR SHALL VERIFY AND ADJUST DIMENSIONS AS NECESSARY FOR A STRUCTURE PROVIDED BY AN APPROVED EQUIVALENT
- THE NEW MODULAR BRIDGE SHALL BE DESIGNED TO ACCOMMODATE A DIFFERENTIAL SETTLEMENT OF 50mm.

CONSTRUCTION NOTES:

- ASSEMBLY AND ERECTION OF THE MODULAR BRIDGE TO BE IN ACCORDANCE WITH THE MANUFACTURE'S INSTRUCTIONS.
- ALL PINS, BOLTS AND THREADED PARTS MUST BE FREE OF DIRT AND BE LUBRICATED AT THE TIME OF INSTALLATION.
- THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO THE COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENTS OF THE WORK REQUIRED TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL.
- CONTRACTOR IS RESPONSIBLE FOR STABILITY OF STRUCTURE THROUGHOUT CONSTRUCTION.
- CONTRACTOR TO PLACE SLEEPER SLABS AFTER ERECTION OF BRIDGE TO ENSURE THE PROPER DIMENSIONS OF EXPANSION JOINT GAPS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ERECTION OF THE STRUCTURE AND SHALL SUBMIT TO THE CONTRACT ADMINISTRATOR WORKING DRAWINGS AS PER THE SPECIAL PROVISION AND SPECIFICATIONS WITH ALL NECESSARY DETAILS AND REQUIREMENTS TO CARRY OUT THE OPERATIONS. CONTRACTOR SHALL SUBMIT A DETAILED WORK PLAN WITH PROJECT SCHEDULE TO THE CONTRACT ADMINISTRATOR FOR REVIEW BEFORE ERECTION.
- THE CONTRACTOR SHALL CARRYOUT SITE SURVEY AND FIELD VERIFY UTILITY LOCATIONS BEFORE COMMENCING WITH CONSTRUCTION.

SPECIFICATIONS:

- CANADIAN HIGHWAY BRIDGE DESIGN CODE, S6-14
- LIVE LOAD: CL-625-ONT.
- CURRENT LOW VOLUME ROAD GUIDELINES (STRUCTURAL MANUAL)

APPLICABLE STANDARD DRAWINGS:

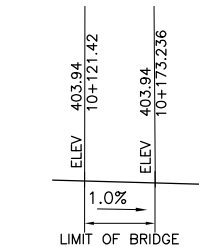
- OPSD 925.020 THRIE BEAM MEDIAN GUIDE  
RAIL- POST, OFFSET BLOCK  
AND BACK-UP PLATE
- OPSD 3941.200 FIGURES IN CONCRETE

LIST OF ABBREVIATIONS:

- T/D DENOTES TOP OF DECK
- T/F TOP OF FOOTING
- T/B TOP OF BEARING SEAT
- EL. DENOTES ELEVATION
- BRGS. DENOTES BEARINGS
- ABUT. DENOTES ABUTMENT
- TYP. DENOTES TYPICAL
- W.P. DENOTES WORKING POINT
- STA. DENOTES STATION
- NTS DENOTES NOT TO SCALE
- EXP DENOTES EXPANSION
- DWG DENOTES DRAWING
- EXT. DENOTES EXISTING
- O.G. ORIGINAL GROUND

LIST OF DRAWINGS:

- 1 GENERAL ARRANGEMENT
- 2 BOREHOLE LOCATION AND SOIL STRATA
- 3 FOOTING DETAILS, SLEEPER SLAB AND APPROACH DETAIL
- 4 STANDARD DETAILS



PROFILE OF DETOUR  
N.T.S.

W.P.#	STATION	NORTHING	EASTING	T/D ELEVATION	LOCATION
3	10+121.42	5311470.01	374978.25	403.94	CL. WEST ABUT. BRGS.
4	10+173.236	5311450.57	375022.97	403.43	CL. EAST ABUT. BRGS.

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	REV	DESCRIPTION
1	10/4/2017	AS	1	ISSUED FOR CONSTRUCTION
2	10/4/2017	AS	2	ISSUED FOR CONSTRUCTION
3	10/4/2017	AS	3	ISSUED FOR CONSTRUCTION
4	10/4/2017	AS	4	ISSUED FOR CONSTRUCTION
5	10/4/2017	AS	5	ISSUED FOR CONSTRUCTION
6	10/4/2017	AS	6	ISSUED FOR CONSTRUCTION
7	10/4/2017	AS	7	ISSUED FOR CONSTRUCTION
8	10/4/2017	AS	8	ISSUED FOR CONSTRUCTION
9	10/4/2017	AS	9	ISSUED FOR CONSTRUCTION
10	10/4/2017	AS	10	ISSUED FOR CONSTRUCTION

402  
BM 403.499  
CC ON BOLT AT NE CORNER  
WEATHER STATION

TEMPORARY DETOUR BRIDGE  
NEMEGOSENDA RIVER BRIDGE HIGHWAY 101

**Appendix B.**

**Record of Borehole Sheets**



## 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).

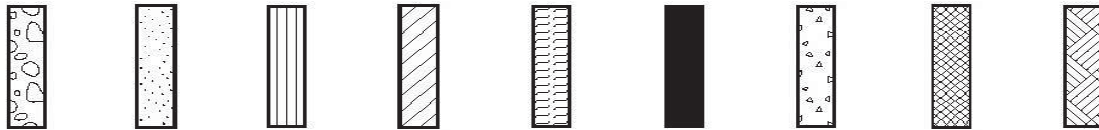
### DYNAMIC CONE PENETRATION TEST (DCPT):

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.



### 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

### 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



## 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

# RECORD OF BOREHOLE No 17-01

1 OF 1

METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemосenda River Temporary Bridge N 5 311 467.8 E 374 980.8 ORIGINATED BY KE  
 HWY 101 BOREHOLE TYPE HSA / HW Casing / HQ Coring COMPILED BY CM  
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								UNCONFINED      +      FIELD VANE						
								● QUICK TRIAXIAL      × LAB VANE						
							WATER CONTENT (%)							
							PLASTIC      NATURAL      LIQUID LIMIT      MOISTURE      LIMIT 							

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

# RECORD OF BOREHOLE No 17-04

1 OF 1

METRIC

GWP# 5144-10-00 LOCATION Hwy 101 - Negemosenda River Temporary Bridge N 5 311 450.7 E 375 024.2 ORIGINATED BY KE  
HWY 101 BOREHOLE TYPE Portable / BW Casing / BQ Coring COMPILED BY CM  
DATUM Geodetic DATE 2017.05.24 - 2017.05.24 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
402.4													
0.0	<b>100mm Topsoil</b>												
0.1	Silty SAND, trace Gravel and Organics <b>FILL</b>		1	SS	2								5 91 4 (SI+CL)
401.8	Very Loose Brown												
0.6	SAND with Gravel <b>FILL</b>		2	SS	5								
401.2	Loose Brown												
1.2	<b>Organic SILT</b> , occasional Wood fragments Loose to Compact Dark Brown		3	SS	7								
			4	SS	9								19.8% organic content
			5	SS	10								
399.2													
3.2	<b>Silty SAND</b> with Gravel, trace wood, frequent Cobbles and Boulders Compact to Very Dense Grey  -150 mm Boulder at 3.8 m		6	SS	22								
	-Used core barrel below 4.7 m due to casing refusal -250 mm Boulder at 4.7 m		7	SS	100/								
397.0			1	RUN									
5.4	<b>GRANITE BEDROCK</b> Grey Medium Grained Fresh		2	RUN									RUN #2 TCR=100% SCR=66% RQD=38%
	-Core barrel jammed at 7.1 m, no core recovery in Run 3 below 6.5 m		3	RUN									RUN #3 TCR=100% SCR=64% RQD=64%
395.3													
7.1	End of Borehole Ground Water at 1.2 m BGS (Elev. 401.2 m) on completion of drilling Two DCPTs were performed in the area to confirm bedrock elevation: <b>DCPT INFERRED BR ELEV.</b> 17-4A 396.9 m 17-4B 396.7 m (shown)												

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

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



## **Appendix C.**

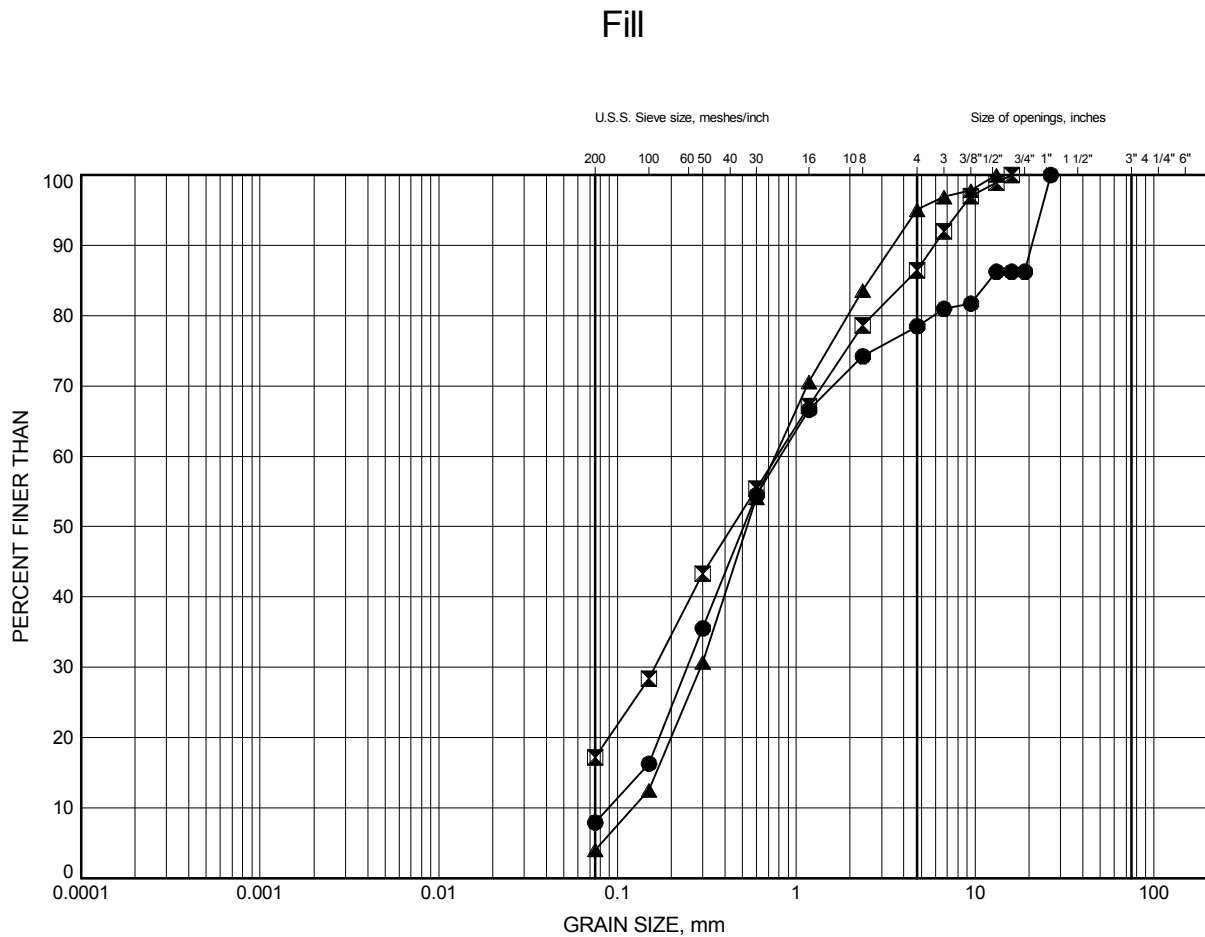
### **Laboratory Testing**

**Appendix C.1**  
**Particle Size Analysis Figures**

# Nemegosenda River Bridge

## GRAIN SIZE DISTRIBUTION

FIGURE C1



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	1.07	402.13
⊠	17-01	2.44	400.76
▲	17-04	0.30	402.07

Date July 2017  
GWP# 5144-10-00



Prep'd CM  
Chkd. SP

**Appendix C.2**  
**Analytical Testing Results**



**Stantec**

**Stantec Consulting Ltd**  
100 A&B-2781 Lancaster Rd  
Ottawa, ON K1B 1A7  
Tel: (613) 738-6075  
Fax: (613) 738-6067

July 4, 2017  
File: 122410864

**Attention: Thurber Engineering Ltd., File #13624**

**Reference: ASTM D2974 Organic Matter of Peat & Other Soils**

The table below summarizes one test result for Organic Matter of Peat and Other Soils.

Source	Depth	Location	Organic Content
BH17-4 SS4	6'-8'	Highway 101 & 129	19.8%

Sincerely,

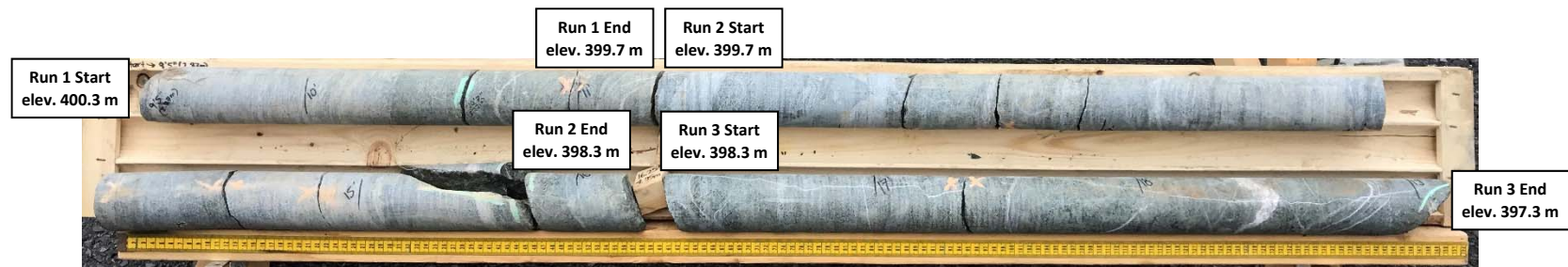
**Stantec Consulting Ltd.**

Brian Prevost  
Laboratory Supervisor  
Tel: 613-738-6075  
Fax: 613-738-6067  
[brian.prevost@stantec.com](mailto:brian.prevost@stantec.com)

TEMPORARY DETOUR BRIDGE  
NEMEGOSENDA RIVER BRIDGE HIGHWAY 101

**Appendix C.3**  
**Rock Core Photographs**

**Borehole 17-1**  
**Run 1 to 3 (of 3)**  
**Elevation 400.3 m to 397.3 m**



**Borehole 17-4**  
**Run 1 to 3 (of 3)**  
**Elevation 397.7 m to 395.3 m**





**Appendix D.**

**Selected Site Photographs**

TEMPORARY DETOUR BRIDGE  
NEMEGOSENDA RIVER BRIDGE HIGHWAY 101



**Photo 1. Looking northeast at north side of the east abutment [taken May 2017].**



**Photo 2. Looking northwest at north side of the west abutment [taken  
\_May 2017].**