# FOUNDATION INVESTIGATION REPORT
# LITTLE WABIGOON RIVER BRIDGE REPLACEMENT
# HIGHWAY 17
# BORUPS CORNERS, ONTARIO
# UNORGANIZED KENORA DISTRICT

**G.W.P. 470-00-00, SITE No. 41S-67**

**Geocres Number: 52F-39**

**Report to**

**Hatch Mott MacDonald**

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

October 16, 2012
File: 19-1605-121

H:\19\1605\121 Bridge & Culvert Rehabs NWR\Reports & Memos\Little Wabigoon River Bridge\Little Wabigoon River Bridge - FIR FINAL.doc

## TABLE OF CONTENTS



### Appendices

# FOUNDATION INVESTIGATION REPORT
# LITTLE WABIGOON RIVER BRIDGE REPLACEMENT
# HIGHWAY 17
# BORUPS CORNERS, ONTARIO
# UNORGANIZED KENORA DISTRICT

**G.W.P. 470-00-00, SITE No. 41S-67**

**Geocres Number: 52F-39**

## PART 1: FACTUAL INFORMATION

## 1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the location of a bridge at the Highway 17 crossing of the Little Wabigoon River southeast of the Borups Corners, Ontario, in the Unorganized Kenora District.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, cross sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Hatch Mott MacDonald, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0010.

## 2 SITE DESCRIPTION

The Little Wabigoon River Bridge is located on Highway 17, approximately 6.5 km southeast of the intersection of Highway 17 and Highway 603, known as Borups Corners, in the Unorganized Kenora District in Ontario. Dryden is located approximately 48 km west of the site and Ignace is located approximately 45 km east of the site.

The existing Little Wabigoon River Bridge is a five span structure supported on timber piles. The bridge is 12.0 m wide and 32.0 m long. The existing embankments are about 4.5 m to 5.0 m high.

The surrounding lands are undeveloped and heavily treed. Bedrock outcroppings and small creeks/water bodies are visible on both sides along the existing Highway 17. The Little Wabigoon River flows from south to north.

Selected photographs in Appendix C show the general nature of the surrounding lands and the existing bridge structure. Photos of the site show the presence of rock fill, cobbles and boulders on the forward and side slopes below the existing abutments. It is not confirmed if this rockfill, cobbles and boulders is for erosion control purposes or whether the embankments contain rockfil.

The region is characterized by massive to foliated granodiorite to granite intruded by later stage mafic dykes. The bedrock is mantled by sand and silt layers and extensive deposits of silty clay to clayey silt and silt.

## 3 SITE INVESTIGATION AND FIELD TESTING

The field investigation program was designed to cover both alternatives, a single span and a three span structure.

The site investigation and field testing for this project was carried out on July 13, August 10 to 13, September 15 to 23 and October 22, 2011 and consisted of drilling and sampling eleven boreholes (numbered LWR-01 to LWR-10 and LWR-6B) in the area of the existing west and east approaches, potential abutment and pier locations. Boreholes LWR-01 and LWR-10 were drilled near the west and east approaches, respectively. Boreholes LWR-2 to LWR-5 were drilled near the west abutment and west pier and Boreholes LWR-06 to LWR-09 and LWR-06B were drilled near the east abutment and east pier. Boreholes LWR-01 to LWR-03 and LWR-08 to LWR-10 were drilled Highway 17 surface, through the existing embankments. Boreholes LWR-04 to LWR-07 were drilled below the bridge deck near the abutments, at the toe of the highway embankment.

Boreholes were advanced to depths ranging from 8.1 m to 22.5 m (elevations 370.5 to 385.0). Borehole LWR-06 was terminated at 3.7 m depth (elevation 385.1). Borehole LWR-05 was terminated at 11.6 m depth (elevation 376.6) and a Dynamic Cone Penetration Test (DCPT) was extended below this depth to 14.2 m (elevation 373.9). The boreholes were generally terminated upon refusal on bedrock or boulders.

Boreholes LWR-03, LWR-04, LWR-07, LWR-07B, LWR-08 were advanced 2.9 m to 3.6 m into bedrock by NQ size diamond coring.

The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

Drilling on the highway shoulders was carried out using a truck-mounted CME 75 drill rig and the boreholes were advanced with hollow-stem augers and NQ coring techniques. The drilling at the toe of the embankment was carried out using wash-boring methods with casing and tripod. Portable split spoon sampling equipment driven with a Standard SPT hammer was used for penetration testing in the boreholes at the toe of the embankment. In general, samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the fill and native soils.

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

Rock cores were logged, and the Total Core Recovery (TCR), Fracture Index (FI) and Rock Quality Designation (RQD) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipe with slotted screen were installed in Boreholes LWR-02, LWR-05 and LWR-09 and enclosed in filter sand to permit longer term groundwater level monitoring. The boreholes were backfilled with bentonite holeplug in general accordance with O.Reg. 903 upon completion. The location and completion details of the piezometer and boreholes are shown in Table 3.1.

**Table 3.1 – Borehole Abandonment Details**

| Foundation Unit | Borehole | Piezometer Tip Depth/ Elevation (m) | Abandonment Details |
|---|---|---|---|
| West approach | LWR-01 | None installed | Borehole backfilled with holeplug to 2.5 m, auger cuttings to 0.3m, then concrete to surface. |
| West abutment | LWR-02 | 15.4/377.7 | Sand from 15.4 m to 13.2 m, holeplug from 13.2 m to 2.2 m, auger cuttings from 2.2 m to 0.6 m, sand and gravel from 0.6 m to 0.1 m, then asphalt to surface. |
| | LWR-03 | None installed | Borehole backfilled with holeplug to 2.1 m, sand to 0.3m, then concrete to surface. |
| | LWR-04 | None installed | Borehole backfilled with holeplug to surface. |
| | LWR-05 | 9.8/378.3 | Sand from 9.8 m to 7.3 m, then holeplug to surface. |
| East abutment | LWR-06 | None installed | Borehole backfilled with holeplug to surface. |
| | LWR-06B | None installed | Borehole backfilled with holeplug from 14.1 m to 4.3m, then concrete from 0.3 m to surface. |
| | LWR-07 | None installed | Borehole backfilled with holeplug from 13.5 m to 4.2 m, auger cuttings, from 4.2 m to 0.3 m, and concrete from 0.3 to surface. |
| | LWR-08 | None installed | Borehole backfilled with holeplug to 1.5 m, sand to 0.3 m, then concrete to surface. |
| | LWR-09 | 12.7/380.3 | Sand from 12.7 m to 9.4 m, holeplug from 9.4 m to 1.8 m, auger cuttings from 1.8 m to 0.6 m, sand from 0.6 m to 0.3 m, then concrete to surface. |
| East approach | LWR-10 | None Installed | Borehole caved to 7.1 m, then backfilled with holeplug to 1.5 m, sand from 1.5 m to 0.3 m, then concrete to surface. |

The piezometers will be decommissioned in accordance with O. Reg. 903 prior to the end of 2012.

## 4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and natural moisture content determination and rock samples to geological logging. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing

where appropriate. The results of this testing program are summarized on the Record of Borehole sheets included in Appendix A and on the figures presented in Appendix B.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. Results of point load tests on the rock core samples are included in Appendix B and on the Record of Borehole sheets in Appendix A (as average unconfined compressive strength per run).

## 5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil and rock stratigraphy are presented in these sheets and on the "Borehole Locations and Soil Strata" drawing included in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions.

In general terms, the overburden stratigraphy at this site consists of pavement structure overlying various layers of embankment fill (sand, silt, sand and gravel with boulders and sandy silt to silty sand). Cobbles and boulders and rock protection were observed at the toe of the embankments, below the abutments. A layer of native compact to loose sand and silt was encountered below the fill. Layers of soft to very stiff clayey silt to silty clay and loose to dense silt were encountered below the sand and silt. Below the native soils, slightly weathered to fresh grey granodiorite to granite bedrock was contacted. More detailed descriptions of the individual strata are presented below.

### 5.1 Pavement structure

Pavement structure was encountered in the boreholes drilled through the existing Highway 17 shoulders. The pavement structure consists of approximately 75 mm to 150 mm of asphalt overlying granular fill. A layer of approach slab concrete, 325 mm thick, was encountered below the asphalt in boreholes LWR-02, LWR-03, LWR-08 and LWR-09. In Borehole LWR-06B, the concrete was 400 mm thick.

### 5.2 Fill

Fill was encountered below the pavement structure in the boreholes drilled on Highway 17 shoulders and surficially in boreholes drilled at the toe of the embankments, below the abutments.

Based on soil composition, the fill comprising the existing highway embankment, consisted of the following various soil types:

- Brown sand fill containing trace to some gravel, some silt to silty, trace clay and occasional asphalt fragments and roots, immediately below the asphalt.

- Brown silt fill containing some clay to clayey, trace sand and trace gravel.
- A layer of sandy silt to silty sand fill with organics and wood fragments was encountered below the silt fill at 2.8 m and 2.7 m depth (elevations 390.3 and 390.4) in Boreholes LWR-01 and LWR-03, respectively. A thin layer of clayey silt fill was also encountered within this sandy silt/silty sand fill.
- Brown to grey sand and gravel fill with boulders and cobbles were encountered from the surface in Boreholes LWR-04 to LWR-07, drilled below the abutments and this fill is visible at the toe of the forward and side slopes, below the existing abutments, as shown in photographs in Appendix C. The cobbles, boulders and possible rockfill on the embankment surface are for erosion protection purposes.

In general, the thickness of the fill layers forming the highway embankment (boreholes drilled from the top of the highway) ranged from 1.2 m to 3.8 m. The depth to the base of the fill ranged from 1.4 m to 3.9 m (elevations 389.2 to 391.7).

Fill encountered in the boreholes drilled at the toe of the embankment (below the abutments) ranged in thickness from 0.6 m to 2.0 m. The lower boundary of Boreholes LWR-04 to LWR-07 ranged from 0.6 m to 2.0 m depth (elevations 386.8 to 387.5).

SPT N-values recorded in the fill ranged from 4 to 32 blows per 0.3 m of penetration, indicating generally a loose to compact relative density. An SPT N-value of 40 blows per 0.3 m of penetration was measured in Borehole LWR-08 near elevation 391.4, indicating a dense relative density.

The moisture content of the fill samples ranged from 4% to 28%.

Grain size distribution curves for samples of fill tested are presented on the Record of Borehole sheet and on Figures B1 to B3 of Appendix B. The results of the laboratory test are summarized as follows:

| Soil Particles | Silt Fill (%) | Sand Fill (%) | Clayey Silt Fill (%) |
|---|---|---|---|
| Gravel | 0 | 9 | 0 |
| Sand | 2 | 65 | 7 |
| Silt | 83 | 23 | 71 |
| Clay | 15 | 3 | 22 |

### 5.3 Sand and Silt

In Boreholes LWR-01 to LWR-03, drilled from the top of the embankment, a layer of native brown to grey sand and silt containing some gravel and trace clay was contacted below the fill at depths ranging from 3.4 m to 3.9 m (elevations 389.2 to 389.7). In Borehole LWR-10, also drilled from the top of the highway embankment, this layer was contacted below the clayey silt at 6.1 m depth (elevation 387.0). The thickness of the sand and silt layer ranged from 2.0 m to 4.5 m. The depth to the base of the sand and silt varied from 7.2 m to 8.1 m (elevations 385.9 to 385.0).

In Boreholes LWR-04 to LWR-07, drilled at the toes of the embankments slope, the sand and silt layer was contacted at depth ranging from 0.6 m to 2.0 m (elevations 386.8 to 387.5). In Borehole LWR-06B, also drilled at the toe of the embankment, the sand and silt layer was contacted at 5.5 m depth (elevation 387.5). The thickness of the sand and silt ranged from 1.0 m to 3.1 m. The depths to the base of the sand and silt layer were 1.8 m and 3.7 m in Boreholes LWR-04 and LWR-05 (elevations 386.1 to 384.5), respectively. The depth to the base of the silt and sand was at 8.1 m depth (elevation 384.9) in Borehole LWR-6B. Borehole LWR-06 was terminated within the sand and silt at 3.7 m depth (elevation 385.1).

SPT N-values recorded in the sand and silt ranged from 5 to 20 blows per 0.3 m of penetration, indicating a loose to compact relative density. An SPT N-value of 32, indicating a dense relative density was measured in Borehole LWR-06 near elevation 385.5. An SPT N-value of 70 blows per 0.25 m of penetration, indicating a very dense relative density, was measured in Borehole LWR-10 near borehole termination depth at elevation 385.3.

The moisture content of the sand and silt samples ranged from 20% to 30%. A moisture content of 82% was measured in Borehole LWR-04.

Grain size distribution curves for samples of the sand and silt layer tested are presented on the Record of Borehole sheet and on Figure B4 and B5 of Appendix B. The results of the laboratory test are summarized as follows:

| Soil Particles | Sand and Silt |
|---|---|
| Gravel | 0 to 12 |
| Sand | 23 to 56 |
| Silt | 38 to 69 |
| Clay | 3 to 12 |

### 5.4 Clayey Silt to Silty Clay

Native brown to grey clayey silt to silty clay containing trace sand and gravel was encountered at various depths in most of the boreholes. The depths, elevations and thicknesses corresponding to the silty clay/clayey silt layers encountered in the boreholes are listed in Table 5.1.

**Table 5.1 – Depths, Elevations and Thicknesses of Clayey Silt to Silty Clay Layers**

| Borehole | Depth below existing ground surface (m) | Elevation (m) | Thickness (m) |
|---|---|---|---|
| LWR-01 | 7.2 to 11.3 | 386.0 to 381.9 | 4.1 |
| LWR-02 | 7.8 to 12.8 | 385.3 to 380.3 | 5.0 |
| LWR-03 | 7.9 to 12.7 | 385.2 to 380.4 | 4.8 |
| LWR-04 | 7.3 to 9.6 | 380.6 to 378.3 | 2.3 |
| LWR-06B | 12.6 to 13.8 | 380.3 to 379.2 | 1.2 |
| LWR-07 | 3.0 to 5.5<br>9.1 to 9.9 | 385.7 to 383.3<br>379.7 to 378.9 | 2.5<br>0.8 |
| LWR-09 | 3.7 to 9.9 | 389.3 to 383.1 | 6.2 |
| LWR-10 | 1.4 to 6.1 | 391.7 to 387.0 | 4.7 |

Standard Penetration tests performed in the clayey silt/silty clay layers gave SPT N-values ranging from 2 to 26 blows per 0.3 m of penetration, indicating a very soft to very stiff consistency. Higher SPT N-values ranging from 23 to 31 blows for 0.3 m penetration were recorded in Borehole LWR-04, indicating a very stiff to hard consistency.

In-situ vane shear tests were carried out to assess the undrained shear strength of the soft to firm cohesive deposits. Shear strengths results were 35 kPa, 38 kPa and 80kPa. Based on remoulded shear vane tests, the clayey silt/silty clay had a Sensitivity Value of 2 to 3.

The moisture contents of samples of the clayey silt/silty clay layers typically ranged from 19% to 38%. Moisture contents of 79% and 54% were obtained from samples taken near elevations 382.3 to 382.7 in Boreholes LWR-02 and LWR-03. In Borehole LWR-07, a moisture content of 47% was encountered near elevation 384.4.

Selected samples of the clayey silt/silty clay underwent laboratory grain size analysis testing and Atterberg Limits tests. The grain size distribution curves for tested samples of clayey silt/silty clay are presented in Appendix B, Figures B6 and B7. The results of the Atterberg Limits tests are presented in Figure B11, Appendix B. The results are also summarized on the Record of Borehole sheets included in Appendix A. The results of the laboratory tests are summarized as follows:

| Soil Particles | Clayey silt to silty clay (%) |
|---|---|
| Gravel | 0 to 1 |
| Sand | 0 to 4 |
| Silt | 46 to 79 |
| Clay | 20 to 54 |

| Index Property | Clayey silt (%) | Silty clay (%) |
|---|---|---|
| Liquid Limit | 29 | 68 |
| Plastic Limit | 20 | 22 |

The above results indicate that the clayey silt is of low plasticity with a group symbol of CL and the silty clay is of high plasticity with a group symbol of CH.

### 5.5 Silt

Native reddish brown to grey silt was encountered at various depths in most of the boreholes, except in Boreholes LWR-01, LWR-06 and LWR-10. The depths, elevations and thicknesses corresponding to the silt layers encountered in each borehole are list in Table 5.2.

**Table 5.2 – Depths, Elevations and Thicknesses of Silt**

| Borehole | Depth below existing ground surface (m) | Elevation (m) | Thickness (m) |
|---|---|---|---|
| LWR-02 | 12.7 to 17.4 | 380.4 to 375.6 | 4.7 |
| LWR-03 | 12.8 to 19.4 | 380.3 to 373.6 | 6.6 |
| LWR-04 | 1.8 to 7.3 | 386.1 to 380.6 | 5.5 |
| LWR-05 | 3.7 to 11.6 | 384.5 to 376.6 | 7.9 |
| LWR-06B | 8.1 to 12.6 | 384.9 to 380.3 | 4.5 |
| LWR-07 | 5.5 to 9.1 | 383.3 to 379.7 | 3.6 |
| LWR-08 | 3.7 to 10.2 | 389.3 to 382.8 | 6.5 |
| LWR-09 | 9.9 to 12.7 | 383.1 to 380.3 | 2.8 |

Standard Penetration tests performed in the silt layers gave SPT N-values ranging from 6 to 41 blows per 0.3 m of penetration, indicating a loose to dense relative density. A low SPT N-value of 2 blows per 0.3 m of penetration, indicating very loose relative density, was measured in Borehole LWR-08, near elevation 388.7

The moisture contents of samples of the silt layers typically ranged from 7% to 41%. In Borehole LWR-04 moisture contents of 59% and 52% were noted near elevations 384.2 to 384.8 and 65% in Borehole LWR-05 near elevation 383.1.

Selected samples of the silt underwent laboratory grain size analysis testing and one sample was subjected to Atterberg Limits test. The grain size distribution curves for tested samples of silt are presented in Appendix B, Figures B8 to B10. The results of the Atterberg Limits test are presented in Figure B12, Appendix B. The results are also summarized on the Record of Borehole sheets included in Appendix A. The results of the laboratory tests are summarized as follows:

| Soil Particles | Clayey silt to silty clay (%) |
|---|---|
| Gravel | 0 |
| Sand | 0 to 17 |
| Silt | 70 to 96 |
| Clay | 4 to 13 |

| Index Property | Clayey silt (%) |
|---|---|
| Liquid Limit | 23 |
| Plastic Limit | 16 |

The above results indicate that the silt is of low plasticity with a group symbol of CL.

### 5.6 Bedrock

The native soils described above are underlain by granodiorite to granite bedrock. The bedrock is slightly weathered to fresh and grey in colour with white bands. Occasional mechanical breaks and sub-vertical fractures were observed in the rock cores. The borehole data indicates that the bedrock slopes down across the site from southeast to northwest.

Table 5.3 summarizes depths and elevations to the top of bedrock or auger refusal in the boreholes and DCPT.

**Table 5.3 – Depths and Elevations of Top of Bedrock or Auger Refusal**

| Foundation Unit | Borehole/DCPT | Top of Bedrock or Auger Refusal | |
|---|---|---|---|
| | | Depth (m) | Elevation (m) |
| West abutment | LWR-02[2] | 17.4 | 375.7 |
| | LWR-03[1,2] | 19.4 | 373.7 |
| | LWR-04[1,3] | 9.6 | 378.3 |
| | LWR-05/DCPT[3] | 14.2 | 373.9 |
| East abutment | LWR-06B[3] | 9.5 | 379.2 |
| | LWR-07[1,3] | 9.9 | 378.9 |
| | LWR-08[1,2] | 10.2 | 382.8 |
| | LWR-09[2] | 12.7 | 380.2 |
| East approach | LWR-10[2] | 8.1 | 385.0 |

[1]Bedrock proved by coring
[2]Borehole drilled from the top of highway embankment
[3]Borehole drilled from the toe of highway embankment (below the abutments)

The Total Core Recovery (TCR) in the bedrock ranged from 92% to 100%. The RQD value ranged from 72% to 97% indicating a fair to excellent rock quality.

The estimated unconfined compressive strength of the rock core ranged from 169 MPa to 389 MPa, indicating a very strong to extremely strong rock. An estimated compressive strength of 68 MPa was measured in Borehole LWR-03 Run 1, indicating a strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from one borehole. A summary of the Point Load Test Results is presented in Appendix B.

## 5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Three standpipe piezometers were installed in Boreholes LWR-02, LWR-05 and LWR-09 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.4, along with the measurements in the boreholes upon completion of drilling.

**Table 5.4 – Water Level Measurements**

| Borehole | Date | Water Level | | Comment |
|---|---|---|---|---|
| | | Depth (m) | Elev. (m) | |
| LWR-02 | August 17, 2011<br>September, 15, 2011<br>October 11, 2011 | 5.0<br>5.5<br>5.0 | 388.1<br>387.6<br>388.1 | Piezometer |
| LWR-05 | September 23, 2011 | 2.0 | 386.1 | Piezometer |
| LWR-06B | September 10, 2011 | 0.5 | 388.2 | Open Borehole |
| LWR-07 | October 10, 2011 | 4.7 | 384.1 | Open borehole |
| LWR-09 | August 17, 2011<br>September, 15, 2011<br>October 11, 2011 | 4.2<br>4.4<br>4.1 | 388.8<br>388.6<br>389.0 | Piezometer |

The piezometric reading of the current investigation indicates that the groundwater level is at 2.0 m to 4.4 m depth (elevations 386.1 to 389.0).

The GA drawing indicates that water level in the Little Wabigoon River was at elevation 387.7 on May 12, 2011.

The above values are short-term readings and 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 rainfall.

## 6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors retained by Hatch Mott MacDonald provided the co-ordinates and the ground surface elevations for the boreholes.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

OGS Drilling Inc. of Almonte, Ontario supplied the portable drilling/coring equipment to drill and core boreholes that were not accessible using a truck mounted rig.

Overall supervision of the field program was conducted by Mr. Mark Farrant, P. Eng. Interpretation of the data and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd


Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer


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

# Appendix A

## Record of Borehole Sheets

# SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

## 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

## 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

## 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

## 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

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

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

$\nabla$ Water Level

$C_{pm}$ Shear Strength Determination by Pocket Penetrometer

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

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

## UNIFIED SOILS CLASSIFICATION

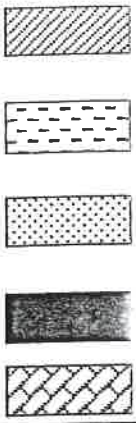
| MAJOR DIVISIONS | | GROUP SYMBOL | TYPICAL DESCRIPTION |
|---|---|---|---|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | GW | Well-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GP | Poorly-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GM | Silty gravels,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

# EXPLANATION OF ROCK LOGGING TERMS

## ROCK WEATHERING CLASSIFICATION

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

## SYMBOLS




## DISCONTINUITY SPACING

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

## TERMS

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

## STRENGTH CLASSIFICATION

| Rock Strength | Approximate Uniaxial Compressive Strength (MPa) | (psi) | Field Estimation of Hardness* |
|---|---|---|---|
| Extremely Strong | Greater than 250 | Greater than 36,000 | Specimen can only be chipped with a geological hammer |
| Very Strong | 100-250 | 15,000 to 36,000 | Requires many blows of geological hammer to break |
| Strong | 50-100 | 7,500 to 15,000 | Requires more than one blow of geological hammer to break |
| Medium Strong | 25.0 to 50.0 | 3,500 to 7,500 | Breaks under single blow of geological hammer. |
| Weak | 5.0 to 25.0 | 750 to 3,500 | Can be peeled by a pocket knife with difficulty |
| Very Weak | 1.0 to 5.0 | 150 to 750 | Can be peeled by a pocket knife, crumbles under firm blows of geological pick. |
| Extremely Weak (Rock) | 0.25 to 1.0 | 35 to 150 | Indented by thumbnail |

THURBER

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-01 1 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 520.8 E 359 232.7 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.07.13 - 2011.07.13 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.1 | | | | | | | | | | | |
| 0.0 | **ASPHALT:** (125mm) | | | | | | 393 | | | | |
| 0.1 | **SAND**, some gravel<br>Brown<br>Moist | | | | | | | | | | |
| 392.5 | (FILL) | | | | | | | | | | |
| 0.6 | **SILT**, some clay to clayey, trace sand<br>Compact<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 30 | | 392 | ○ | ○ | | |
| | | | 2 | SS | 13 | | | ○ | ○ | | 0 2 83 15 |
| | | | 3 | SS | 12 | | 391 | ○ | ○ | | |
| 390.4 | | | | | | | | | | | |
| 2.8 | Sandy **SILT** to Silty **SAND**, occasional organics and wood fragments<br>Compact<br>Brown<br>Moist<br>(FILL) | | 4 | SS | 15 | | 390 | ○ | ○ | | |
| 389.2 | | | | | | | | | | | |
| 3.9 | **SAND** and **SILT**<br>Compact to Loose<br>Brown<br>Moist to Wet | | 5 | S | 14 | | 389 | ○ | ○ | | |
| | | | 6 | SS | 6 | | 388 | ○ | ○ | | |
| 386.0 | | | | | | | 387 | | | | |
| 7.2 | Clayey **SILT**<br>Soft<br>Grey | | 7 | SS | 4 | | 386 | ○ | ○ | | 0 0 79 21 |
| | Some sand | | | | | | 385 | | | | |
| | | | 8 | SS | 4 | | 384 | ○ | ○ | | |

Continued Next Page

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

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

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-01 2 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 520.8 E 359 232.7 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.07.13 - 2011.07.13 CHECKED BY RPR

| 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/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| | Clayey **SILT**, silty sand seams<br>Stiff<br>Grey | | | | | | 383 | | | | |
| 381.9 | | | 9 | SS | 11 | | 382 | | c | | 0 0 72 28 |
| 11.3 | END OF BORHOLE AT 11.3m.<br>NO WATER OBSERVED UPON COMPLETION OF BOREHOLE.<br>BOREHOLE BACKFILLED WITH HOLEPLUG TO 2.5m, THEN CUTTINGS TO 0.3m, THEN CONCRETE TO SURFACE. | | | | | | | | | | |

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-02 1 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 509 1 E 359 235 7 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2011.08.13 - 2011.08.13 CHECKED BY RPR

| 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: O 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.1 | | | | | | | | | | | |
| 0.0 | **ASPHALT:** (75mm) | | | | | | 393 | | | | |
| 0.1 | | | | | | | | | | | |
| 392.7 | **CONCRETE:** (325mm) | | | | | | | | | | |
| 0.4 | | | | | | | | | | | |
| 392.4 | **SAND**, some gravel<br>Brown<br>Moist | | | | | | | | | | |
| 0.7 | (FILL) | | | | | | | | | | |
| | **SILT**, some clay to clayey, trace sand<br>Compact<br>Brown<br>(FILL) | | 1 | SS | 20 | | 392 | | | | |
| | | | 2 | SS | 12 | | 391 | | | | |
| | | | 3 | SS | 12 | | 390 | | | | |
| 389.7 | | | | | | | | | | | |
| 3.4 | **SAND** and **SILT**, trace clay<br>Loose<br>Grey<br>Wet | | 4 | SS | 5 | | 389 | | | | |
| | | | 5 | SS | 9 | | 388 | | | | 0 25 68 7 |
| | | | 6 | SS | 7 | | 387 | | | | 0 44 49 7 |
| 385.2 | | | | | | | 386 | | | | |
| 7.9 | Clayey **SILT**, sandy silt seams<br>Firm<br>Grey | | 7 | SS | 7 | | 385 | | | | |
| | | | | | | | 384 | | | | |

Continued Next Page

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

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

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-02 2 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 509.1 E 359 235.7 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2011.08.13 - 2011.08.13 CHECKED BY RPR

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| | Clayey **SILT**<br>Soft to Firm<br>Grey | | 8 | SS | 3 | | 383 | | | | |
| | | | | | | | 382 | +2 | ○ | | |
| | | | 9 | SS | 7 | | | | ○ | | 0 0 77 23 |
| 380.4 | | | | | | | 381 | | | | |
| 12.7 | **SILT**, trace clay<br>Compact<br>Grey<br>Moist | | 10 | SS | 21 | | 380 | | ○ | | |
| | | | | | | | 379 | | | | |
| | | | 11 | SS | 22 | | | | ○ | | 0 0 92 8 |
| | | | | | | | 378 | | | | |
| | | | 12 | SS | 17 | | 377 | | ○ | | |
| 375.6 | | | | | | | 376 | | | | |
| 17.4 | END OF BOREHOLE AT 17.4m<br>UPON REFUSAL ON PROBABLE BEDROCK.<br>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. | | | | | | | | | | |

WATER LEVEL READINGS:

| DATE | DEPTH (m) | ELEV. (m) |
|---|---|---|
| Aug 17/11 | 5.0 | 388.1 |
| Sep 15/11 | 5.5 | 387.6 |
| Oct 11/11 | 5.0 | 388.1 |

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

15 20 5 10 (%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-03 1 OF 3 METRIC

W.P. 470-00-00 LOCATION N 5 492 515.3 E 359 240.2 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.08.11 - 2011.08.12 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.1 | | | | | | | | | | | |
| 0.0 / 0.1 | **ASPHALT:** (75mm) | | | | | | 393 | | | | |
| 392.7 / 0.4 | **CONCRETE:** (325mm) | | | | | | | | | | |
| 392.3 / 0.7 | **SAND**, some gravel<br>Brown<br>Moist<br>(FILL) | | | | | | | | | | |
| | **SILT**, some clay to clayey, trace sand<br>Loose<br>Brown<br>(FILL) | | 1 | SS | 8 | | 392 | | ○ | | |
| | | | 2 | SS | 9 | | | | | | |
| 390.4 / 2.7 | Sandy **SILT** to Silty **SAND**, with organics<br>Stiff<br>Brown<br>Moist to Wet<br>(FILL) | | 3 | SS | 10 | | 391 | | ○ | | |
| 389.2 / 3.8 | Layer of clayey silt fill | | | | | | 390 | | | | 0 7 71 22 |
| | **SAND** and **SILT**<br>Loose<br>Brown<br>Moist to Wet | | 4 | SS | 9 | | 389 | | ○ | | |
| | | | 5 | SS | 10 | | 388 | | ○ | | |
| | | | 6 | SS | 6 | | 387 | | | | |
| 385.3 / 7.8 | No sample retrieved | | | | | | 386 | | | | |
| | Clayey **SILT**<br>Stiff<br>Grey | | 7 | SS | 8 | | 385 | | ○ | | |
| | | | | | | | 384 | | | | |

Continued Next Page

+ $^3$, × $^3$ : Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-03 2 OF 3 METRIC

W.P. 6936-10-00 LOCATION N 5 492 515.3 E 359 240.2 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.08.11 - 2011.08.12 CHECKED BY RPR

| 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) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continued From Previous Page | | | | | | | | | | |
| | Clayey **SILT** to Silty **CLAY**<br>Soft<br>Grey | | 8 | SS | 2 | | 383 | | | | 0 0 46 54 |
| | | | | | | | 382 | 3 | | | |
| | | | 9 | SS | 2 | | 381 | | | | |
| 380.3 | | | | | | | | 2 | | | |
| 12.8 | **SILT**, trace to some clay<br>Compact<br>Grey<br>Moist | | 10 | SS | 18 | | 380 | | | | |
| | | | 11 | SS | 27 | | 379 | | | | 0 0 91 9 |
| | | | 12 | SS | 28 | | 378 | | | | |
| | | | 13 | SS | 31 | | 377 | | | | 0 0 88 12 |
| | Dense | | | | | | 376 | | | | |
| | | | 14 | SS | 50/ | | 375 | | | | |
| 373.6 | | | | | | | 374 | | | FI | |
| 19.4 | **BEDROCK**, granodiorite to granite, slightly weathered, grey, with white bands, occasional mechanical and sub-vertical breaks | | | | 0.075 | | | | | 0 | |

Continued Next Page

+ 3, × 3 : Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-03 3 OF 3 METRIC

W.P. 6936-10-00 LOCATION N 5 492 515.3 E 359 240.2 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.08.11 - 2011.08.12 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| | Coring started at 19.4m<br>**BEDROCK**, granodiorite to granite, slightly weathered, grey, with white bands, occasional and sub-vertical breaks | | 1 | RUN | | | 373 | | | 3<br>1<br>0 | RUN #1<br>TCR=100%<br>SCR=100%<br>RQD=76%<br>UCS=241MPa<br>(Average) |
| | Sub-vertical breaks:<br>125mm at 19.8m<br>175mm at 20.1m<br>50mm at 20.8m | | | | | | 372 | | | 2<br>1<br>3 | |
| | Quartizite seams:<br>75mm at 20.0m<br>63mm at 20.3m | | 2 | RUN | | | 371 | | | 4<br>1<br>2 | RUN #2<br>TCR=100%<br>SCR=100%<br>RQD=82%<br>UCS=257MPa<br>(Average) |
| 370.5<br>22.5 | END OF BOREHOLE AT 22.5m<br>BOREHOLE BACKFILLED WITH HOLEPLUG BENTONITE TO 2.1m, SAND TO 0.3m, THEN CONCRETE TO SURFACE. | | | | | | | | | | |

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

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-04 1 OF 2 METRIC

W.P 6936-10-00 LOCATION N 5 492 502.9 E 359 244.7 Little Wabigoon River Bridge ORIGINATED BY MAT
HWY 17 BOREHOLE TYPE Wash Boring/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.09.15 - 2011.09.16 CHECKED BY RPR

| 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) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 387.9 | | | | | | | | | | | |
| 0.0 | **SAND** and **GRAVEL**, cobbles and boulders at surface<br>Loose to Compact<br>Brown<br>Moist to Wet<br>(FILL) | | 1 | SS | 12 | | 388 | | | | |
| 387.3 | | | | | | | | | | | |
| 0.6 | **SAND** and **SILT**, trace clay, occasional wood fragments<br>Loose<br>Grey<br>Moist to Wet | | 2 | SS | 5 | | 387 | | | | |
| 386.1 | | | 3 | SS | 5 | | | | | | 0 43 51 6 |
| 1.8 | **SILT**, trace gravel, trace sand, trace to some clay<br>Compact<br>Grey<br>Wet | | 4 | SS | 27 | | 386 | | | | 0 4 84 12 |
| | | | 5 | SS | 16 | | 385 | | | | |
| | | | 6 | SS | 10 | | | | | | |
| | | | 7 | SS | 13 | | 384 | | | | |
| | | | 8 | SS | 22 | | | | | | |
| | | | 9 | SS | 23 | | 383 | | | | 0 1 94 5 |
| | | | | | | | 382 | | | | |
| | | | 10 | SS | 20 | | | | | | |
| | | | 11 | SS | 21 | | 381 | | | | 0 0 93 7 |
| 380.6 | | | | | | | | | | | |
| 7.3 | Clayey **SILT**<br>Very Stiff to Hard | | 12 | SS | 23 | | 380 | | | | |
| | | | 13 | SS | 31 | | | | | | |
| | | | 14 | SS | 23 | | 379 | | | | 0 0 72 28 |
| | | | 15 | SS | 100/ 0.250 | | | | | | |
| 378.3 | Sand layer (100mm) | | 16 | SS | | | | | | | |
| 9.6 | **BEDROCK**, granodiorite to granite, slightly weathered, grey | | 1 | RUN | 57 | | | | | FI | RUN #1<br>TCR=100%<br>SCR=100% |

Continued Next Page

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

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 10/15/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-04 2 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 502 9 E 359 244.7 Little Wabigoon River Bridge ORIGINATED BY MAT
HWY 17 BOREHOLE TYPE Wash Boring/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.09.15 - 2011.09.16 CHECKED BY RPR

| 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/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continued From Previous Page | | | | | | | | | | |
| | **BEDROCK**, granodiorite to granite, slightly weathered, occasional mechanical and vertical breaks, grey, with white bands<br>Coring started at 9.6m | | 2 | RUN | | | 378 | | | 1 | RQD=75%<br>UCS=310MPa (Average)<br>RUN #2<br>TCR=100%<br>SCR=96%<br>RQD=88%<br>UCS=240MPa (Average)<br>RUN #3<br>TCR=100%<br>SCR=85%<br>RQD=77%<br>UCS=240MPa (Average)<br>RUN #4<br>TCR=100%<br>SCR=87%<br>RQD=87%<br>UCS=328MPa (Average)<br>RUN #5<br>TCR=100%<br>SCR=94%<br>RQD=94%<br>UCS=290MPa (Average) |
| | Moderately to slighlly weathered, some mechanical breaks | | 3 | RUN | | | 377 | | | 1<br>4<br>2<br>1<br>6 | |
| | Horizontal breaks at 10.7m, 10.8m, 11.0m, 11.1m,11.3m and 11.9m | | 4 | RUN | | | 376 | | | 0<br>1 | |
| 375.1 | Horizontal breaks at 12.2m and 12.4m | | 5 | RUN | | | | | | 1<br>1 | |
| 12.9 | END OF BOREHOLE AT 12.9m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE. | | | | | | | | | | |

+ ³, × ³: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-05 1 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 507.3 E 359 248.6 Little Wabigoon River Bridge ORIGINATED BY MAT
HWY 17 BOREHOLE TYPE Wash Boring COMPILED BY AN
DATUM Geodetic DATE 2011.09.20 - 2011.09.20 CHECKED BY RPR

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 388.1 | | | | | | | | | | | |
| 0.0 | **SAND** and **GRAVEL**, cobbles and boulders at surface, occasional roots<br>Loose<br>Brown | | 1 | SS | 7 | | 388 | | | | |
| 387.5 | | | | | | | | | | | |
| 0.6 | Damp<br>(FILL) | | 2 | SS | 5 | | | | | | |
| | **SAND** and **SILT**, trace clay, trace gravel<br>Loose to Compact<br>Brown to Grey<br>Moist to Wet | | 3 | SS | 11 | | 387 | | | | |
| | | | 4 | SS | 15 | ▼ | | | | | 0 56 41 3 |
| | | | 5 | SS | 16 | | 386 | | | | |
| 384.5 | | | 6 | SS | 20 | | 385 | | | | |
| 3.7 | **SILT**, some sand, some clay<br>Loose to Compact<br>Grey<br>Wet | | 7 | SS | 16 | | | | | | 0 17 70 13 |
| | | | 8 | SS | 12 | | 384 | | | | |
| | | | 9 | SS | 11 | | 383 | | | | |
| | | | 10 | SS | 6 | | | | | | |
| | | | 11 | SS | 7 | | 382 | | | | |
| | | | 12 | SS | 11 | | | | | | |
| | Dense to Compact | | 13 | SS | 41 | | 381 | | | | 0 0 93 7 |
| | | | 14 | SS | 30 | | 380 | | | | |
| | | | 15 | SS | 35 | | | | | | |
| | | | 16 | SS | 34 | | 379 | | | | |

Continued Next Page

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

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

ONTMT4S 5121.GPJ 10/15/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-05 2 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 507.3 E 359 248.6 Little Wabigoon River Bridge ORIGINATED BY MAT

HWY 17 BOREHOLE TYPE Wash Boring COMPILED BY AN

DATUM Geodetic DATE 2011.09.20 - 2011.09.20 CHECKED BY RPR

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| | **SILT**, trace clay<br>Dense to Compact<br>Grey<br>Wet | | 17 | SS | 36 | | 378 | | | | |
| | | | | | | | | | | | 0 0 95 5 |
| | | | 18 | SS | 21 | | 377 | | | | |
| 376.6<br>11.6 | End of sampling at 11.5m and start DCPT | | | | | | 376 | | | | |
| | | | | | | | 375 | | | | |
| 373.9<br>14.2 | END OF BOREHOLE AT 14.2m.<br>WATER LEVEL OBSERVED AT 1.2m UPON COMPLETION OF DRILLING.<br>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.<br><br>WATER LEVEL READINGS:<br>DATE DEPTH (m) ELEV. (m)<br>Sep.23/11 2.0 386.1 | | | | | | | | | | |

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

WATER CONTENT (%): 20 40 60

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

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

ONTMT4S 5121.GPJ 10/15/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-06 1 OF 1 METRIC

W.P. 470-00-00 LOCATION N 5 492 494.1 E 359 256.6 Little Wabigoon River Bridge ORIGINATED BY MAT

HWY 17 BOREHOLE TYPE Wash Boring COMPILED BY AN

DATUM Geodetic DATE 2011.09.23 - 2011.09.23 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 388.8 | | | | | | | | | | | |
| 0.0 | **SAND** and **GRAVEL**, with cobbles and boulders<br>Brown to Grey<br>Moist to Wet<br>(FILL) | | | | | | 388 | | | | |
| 386.8 | | | | | | | 387 | | | | |
| 2.0 | **SAND** and **SILT**, some clay, occasional roots and wood fragments<br>Loose to Compact<br>Grey<br>Wet | | 1 | SS | 7 | | | | ○ | | |
| | | | 2 | SS | 14 | | 386 | | ○ | | |
| 385.1 | Dense | | 3 | SS | 32 | | | | ○ | | 0 34 54 12 |
| 3.7 | END OF BOREHOLE AT 3.6m.<br>BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE. | | | | | | | | | | |

$+^{3}$, $\times^{3}$ Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 5/30/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-06B 1 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 494.1 E 359 256.6 Little Wabigoon River Bridge ORIGINATED BY JM

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.10.22 - 2011.10.22 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.0 | | | | | | | 393 | | | | |
| 0.0 | **ASPHALT:** (100mm) | | | | | | | | | | |
| 0.1 / 392.5 | **CONCRETE** (bridge deck): (400mm) | | | | | | 392 | | | | |
| 0.5 | Gap between underside of deck and ground surface | | | | | | 391 | | | | |
| 388.7 | | | | | | | 390 | | | | |
| 4.3 | **SAND** and **GRAVEL**<br>Loose<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 4 | ▽ | 389 | | | | |
| 387.5 | | | | | | | 388 | | ○ | | |
| 5.5 | **SAND** and **SILT**, trace gravel, trace clay<br>Loose<br>Grey<br>Moist to Wet | | 2 | SS | 8 | | 387 | | □ | | 4 23 69 4 |
| | | | 3 | SS | 8 | | | | ○ | | |
| | | | 4 | SS | 8 | | 386 | | ○ | | |
| 384.9 | | | | | | | 385 | | | | |
| 8.1 | **SILT**, trace clay<br>Compact<br>Grey<br>Wet | | 5 | SS | 29 | | 384 | | □ | | 0 0 96 4 |

ONTMT4S 5121.GPJ 10/15/12

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 LWR-06B 2 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 494.1 E 359 256.6 Little Wabigoon River Bridge ORIGINATED BY JM

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.10.22 - 2011.10.22 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| | **SILT**, trace sand, trace clay<br>Compact to Dense<br>Grey<br>Wet<br><br>Boulder from 10.7m to 11.0m | | 6 | SS | 31 | | 383 | | ○ | | |
| | | | | | | | 382 | | | | |
| | | | 7 | SS | 41 | | | | ○ | | |
| 380.3 | | | | | | | 381 | | | | |
| 12.6 | Clayey **SILT**, trace gravel and sand<br>Grey<br>Stiff | | | | | | | | | | |
| | | | 8 | SS | 12 | | 380 | | ○ | | 1 3 76 20 |
| 379.2 | | | | | | | | | | | |
| 13.8<br>378.9 | **BEDROCK**, granodiorite to granite, grey | | | | | | 379 | | | | |
| 14.1 | END OF BOREHOLE AT 14.1m<br>UPON REFUSAL ON BEDROCK.<br>BOREHOLE OPEN TO 14.1m AND WATER LEVEL AT 4.8m BELOW DECK UPON COMPLETION OF DRILLING.<br>BOREHOLE BACKFILLED WITH HOLEPLUG FROM 14.1m TO 4.3m THEN CONCRETE FROM 0.3m TO SURFACE. | | | | | | | | | | |

+ $^3$, × $^3$ Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-07 1 OF 2 METRIC

W.P 470-00-00 LOCATION N 5 492 502.6 E 359 263.8 Little Wabigoon River Bridge ORIGINATED BY MAT

HWY 17 BOREHOLE TYPE Wash Boring/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011 09 22 - 2011 09 22 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 388.8 | | | | | | | | | | | |
| 0.0 | **SAND** and **GRAVEL**, with cobbles and boulders<br>Brown to Grey<br>Moist to Wet<br>(FILL) | | | | | | 388 | | | | |
| 386.8 | | | | | | | 387 | | | | |
| 2.0 | **SAND** and **SILT**, some clay, occasional roots<br>Compact<br>Dark Grey<br>Wet | | 1 | SS | 12 | | | | | | |
| 385.7 | | | 2 | SS | 11 | | 386 | | | | |
| 3.0 | Clayey **SILT** to Silty **CLAY**<br>Stiff to Very Stiff<br>Grey | | 3 | SS | 15 | | | | | | |
| | | | 4 | SS | 19 | | 385 | | | | |
| | | | 5 | SS | 24 | ▽ | | | | | 0 0 69 31 |
| 383.3 | | | 6 | SS | 9 | | 384 | | | | |
| 5.5 | **SILT**, trace to some clay<br>Compact to Dense<br>Grey<br>Wet | | 7 | SS | 25 | | 383 | | | | |
| | | | 8 | SS | 38 | | | | | | 0 0 96 4 |
| | | | 9 | SS | 41 | | 382 | | | | |
| | | | 10 | SS | 24 | | | | | | |
| | | | 11 | SS | 37 | | 381 | | | | 0 0 91 9 |
| 379.7 | | | 12 | SS | 30 | | 380 | | | | |
| 9.1 | Clayey **SILT**<br>Very Stiff<br>Grey | | 13 | SS | 26 | | | | | FI 0 | 0 0 74 26 |
| 378.9 | | | | | | | 379 | | | | |

Continued Next Page

$+^3$ . $\times^3$ Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 5/29/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-07 2 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 502.6 E 359 263.8 Little Wabigoon River Bridge ORIGINATED BY MAT
HWY 17 BOREHOLE TYPE Wash Boring/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.09.22 - 2011.09.22 CHECKED BY RPR

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O 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/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Continued From Previous Page | | | | | | | | | | |
| 9.9 | **BEDROCK**, granodiorite to granite, slightly weathered to fresh, grey, occasional vertical and mechanical breaks<br><br>Coring started at 9.9m<br>Bedrock encountered at 10.2m<br>Horizontal fracture at 11.0m<br><br>Horizontal fracture at 18.5m<br><br><br>Sub-vertical fractures:<br>50mm at 11.9m<br>300mm at 12.1m<br>25mm at 12.5m<br>300mm at 13.1m | | 1 | RUN | | | 378 | | | 1<br>0<br>1<br>0<br>0 | RUN #1<br>TCR=92%<br>SCR=72%<br>RQD=72% |
| | | | 2 | RUN | | | 377 | | | 2<br>1<br>1 | RUN #2<br>TCR=100%<br>SCR=100%<br>RQD=95% |
| | | | 3 | RUN | | | 376 | | | 0<br>0<br>0 | RUN #3<br>TCR=100%<br>SCR=100%<br>RQD=97% |
| 375.3 | | | | | | | | | | | |
| 13.5 | END OF BOREHOLE AT 13.5m.<br>BOREHOLE OPEN TO 13.5m AND WATER LEVEL AT 4.7m BELOW DECK UPON COMPLETION OF DRILLING.<br>BOREHOLE BACKFILLED WITH HOLEPLUG FROM 13.5m TO 4.2m, AUGER CUTTINGS FROM 4.2m TO 4.1m AND CONCRETE FROM 0.3m TO SURFACE. | | | | | | | | | | |

+ ³, × ³ Numbers refer to Sensitivity

20
15 ⊕ 5 (%) STRAIN AT FAILURE
10

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-08 1 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 487 2 E 359 264 4 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.08.10 - 2011.08.10 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.0 | | | | | | | 393 | | | | |
| 0.0 | **ASPHALT:** (75mm) | | | | | | | | | | |
| 0.1 | | | | | | | | | | | |
| 392.6 | **CONCRETE:** (325mm) | | | | | | | | | | |
| 0.4 | **SAND**, trace gravel, some silt to silty, trace clay, occasional asphalt fragments<br>Compact to Dense<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 24 | | 392 | | | | |
| | | | 2 | SS | 40 | | 391 | | | | |
| 390.7 | | | | | | | | | | | |
| 2.3 | **SILT**, some sand, trace gravel, trace clay<br>Compact<br>Brown<br>Moist<br>(FILL) | | 3 | SS | 16 | | 390 | | | | |
| 389.3 | | | | | | | | | | | |
| 3.7 | **SILT**, trace to some clay, trace sand, occasional rootlets<br>Very Loose to Loose<br>Grey<br>Moist to Wet | | 4 | SS | 2 | | 389 | | | | 0 7 82 11 |
| | | | 5 | SS | 7 | | 388 | | | | |
| | | | 6 | SS | 13 | | 387 | | | | |
| | Compact | | 7 | SS | 14 | | 385 | | | | 0 0 91 9 |
| | | | | | | | 384 | | | | |

ONTMT4S 5121.GPJ 5/29/12

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 LWR-08 2 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 487.2 E 359 264.4 Little Wabigoon River Bridge ORIGINATED BY SLL
HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.08.10 - 2011.08.10 CHECKED BY RPR

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continued From Previous Page | | | | | | | 20 40 60 80 100 | 20 40 60 | | |
| 382.8 | Refusal at 10.1m and start coring | | 8 | SS | 100/ 0.100 | | 383 | | | FI | |
| 10.2 | **BEDROCK**, granodiorite to granite, slightly weathered to fresh, light grey, occasional vertical and mechanical breaks | | | | | | | | | 5 | |
| | | | | | | | | | | 1 | |
| | | | | | | | 382 | | | 0 | |
| | | | | | | | | | | 0 | |
| | | | | | | | | | | 0 | |
| | | | 1 | RUN | | | | | | 0 | RUN #1 TCR=100% SCR=100% RQD=91% UCS=247MPa (Average) |
| | Mechanical break at 12.1m | | | | | | 381 | | | 1 | |
| | | | | | | | | | | 0 | |
| | | | | | | | | | | 0 | |
| 379.9 | | | | | | | 380 | | | 0 | |
| 13.1 | END OF BOREHOLE AT 13.1m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 1.5m, SAND TO 0.3m THEN CONCRETE TO SURFACE. | | | | | | | | | | |

+ ³, × ³ Numbers refer to Sensitivity

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

ONTMT4S 5121.GPJ 7/27/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-09 1 OF 2 METRIC

W.P. 6936-10-00 LOCATION N 5 492 493.0 E 359 268.8 Little Wabigoon River Bridge ORIGINATED BY SLL
HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.08.11 - 2011.08.11 CHECKED BY RPR

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.0 | | | | | | | 393 | | | | |
| 0.0 / 0.1 / 392.6 | **ASPHALT:** (75mm) / **CONCRETE:** (325mm) | | | | | | | | | | |
| 0.4 | **SAND**, some gravel, some silt to silty, trace clay<br>Dense to Compact<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 32 | | 392 | | | | |
| | | | 2 | SS | 10 | | 391 | | C | | 9 65 23 3 |
| 390.7 | | | | | | | | | | | |
| 2.2 | **SILT**, some sand, trace gravel, trace clay<br>Compact<br>Brown<br>Moist<br>(FILL) | | 3 | SS | 16 | | 390 | | | | |
| 389.3 | | | | | | | | | | | |
| 3.7 | Clayey **SILT**, trace sand<br>Firm to Very Stiff<br>Brown to Grey<br>Moist | | 4 | SS | 5 | ▼ | 389 | | | | |
| | | | 5 | SS | 6 | | 388 | | | | 0 4 70 26 |
| | | | 6 | SS | 16 | | 387 | | | | |
| | | | 7 | SS | 22 | | 386 | | | | |
| 383.1 | | | | | | | 385 | | | | |
| | | | | | | | 384 | | | | |

Continued Next Page

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

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

ONTMT4S 5121.GPJ 10/15/12

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-09 2 OF 2 METRIC

W.P. 470-00-00 LOCATION N 5 492 493.0 E 359 268.8 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.08.11 - 2011.08.11 CHECKED BY RPR

| 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 $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continued From Previous Page | | | | | | | | | | |
| 9.9 | **SILT**, trace clay<br>Compact<br>Grey<br>Wet | | 8 | SS | 20 | | 383 | | | | 0 0 91 9 |
| | | | | | | | 382 | | | | |
| | | | 9 | SS | 26 | | 381 | | | | |
| 380.2 | | | | | | | | | | | |
| 12.7 | END OF BOREHOLE AT 12.7m<br>UPON REFUSAL ON PROBABLE BEDROCK.<br>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.<br><br>WATER LEVEL READINGS:<br>DATE DEPTH (m) ELEV. (m)<br>Aug.17/11 4.2 388.8<br>Sep.15/11 4.4 388.6<br>Oct.11/11 4.1 389.0 | | | | | | | | | | |

ONTMT4S 5121.GPJ 5/29/12

+$^3$, ×$^3$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No LWR-10 1 OF 1 METRIC

W.P. 470-00-00 LOCATION N 5 492 480.4 E 359 272.8 Little Wabigoon River Bridge ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.08.11 - 2011.08.11 CHECKED BY RPR

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 393.1 | | | | | | | | | | | | |
| 0.0 | **ASPHALT:** (150mm) | | | | | | 393 | | | | | |
| 0.2 | **SAND**, some gravel, occasional cobbles<br>Dense<br>Brown<br>Moist<br>(FILL) | | 1 | GS | | | | | | | | |
| | | | 1 | SS | 30 | | 392 | | | | | |
| 391.7 | | | | | | | | | | | | |
| 1.4 | Clayey **SILT**<br>Stiff to Very Stiff<br>Brown | | 2 | SS | 25 | | 391 | | | | | |
| | | | 3 | SS | 16 | | | | | | | 0 0 79 21 |
| | | | 4 | SS | 8 | | 390 | | | | | |
| | | | 5 | SS | 8 | | 389 | | | | | |
| 387.0 | | | | | | | 388 | | | | | |
| 6.1 | **SAND** and **SILT**, some gravel, trace clay<br>Compact to Dense<br>Grey<br>Wet | | 6 | SS | 14 | | 387 | | | | | |
| | | | 7 | SS | 70/ 0.250 | | 386 | | | | | 12 47 38 3 |
| 385.0 | | | | | | | | | | | | |
| 8.1 | END OF BOREHOLE AT 8.1m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER.<br>BOREHOLE CAVED TO 7.1m AND NO WATER WAS OBSERVED.<br>BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, SAND TO 0.3m, THEN CONCRETE TO SURFACE. | | | | | | | | | | | |

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 5/29/12

# Appendix B

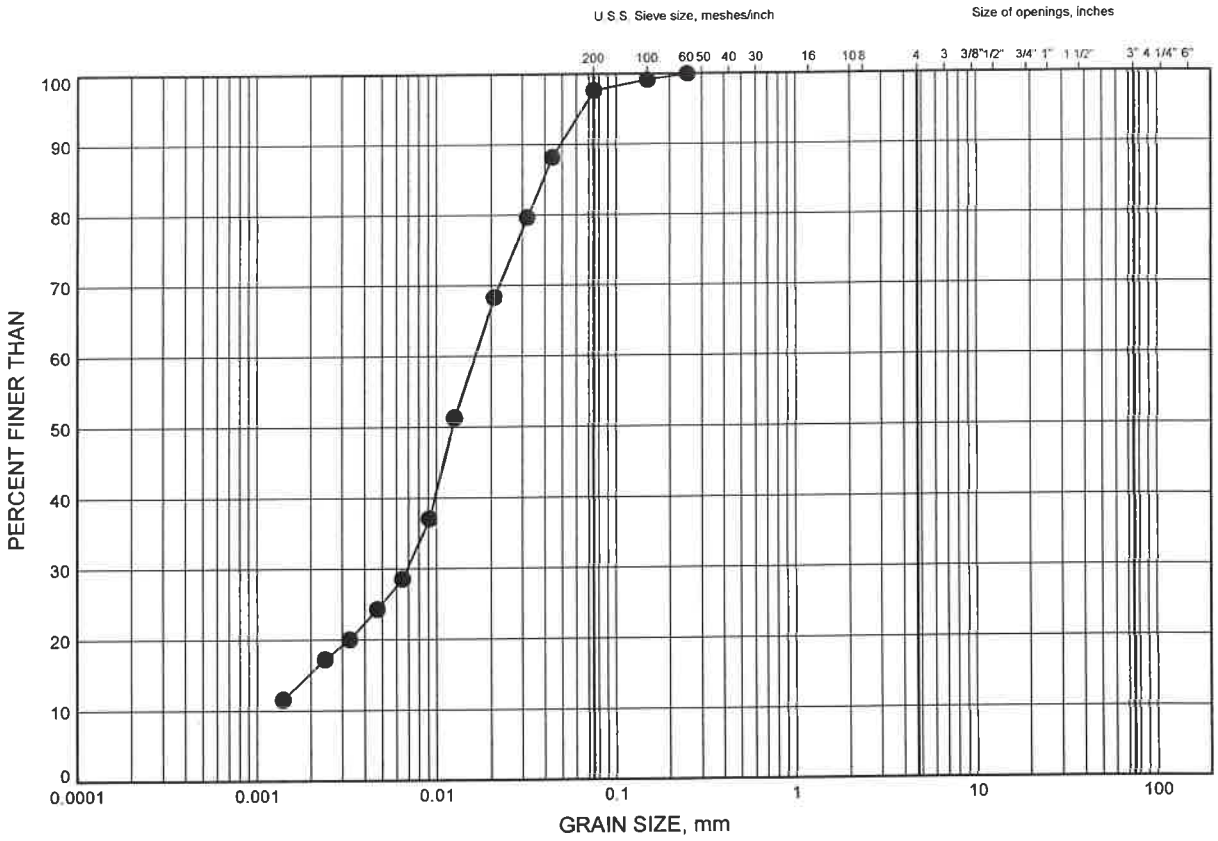
## Laboratory Test Results

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B1

## SILT FILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-01 | 1.83 | 391.31 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

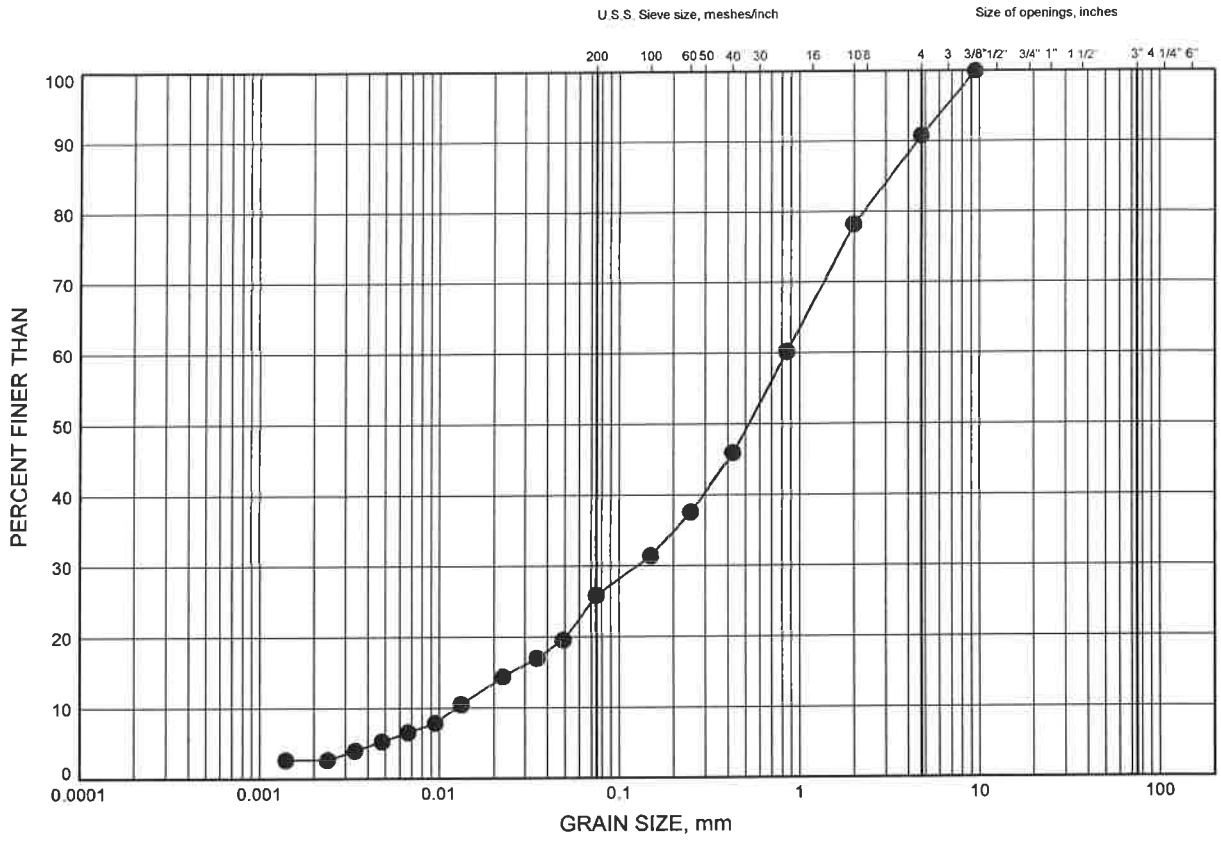
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B2

## SAND FILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-09 | 1.83 | 391.13 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

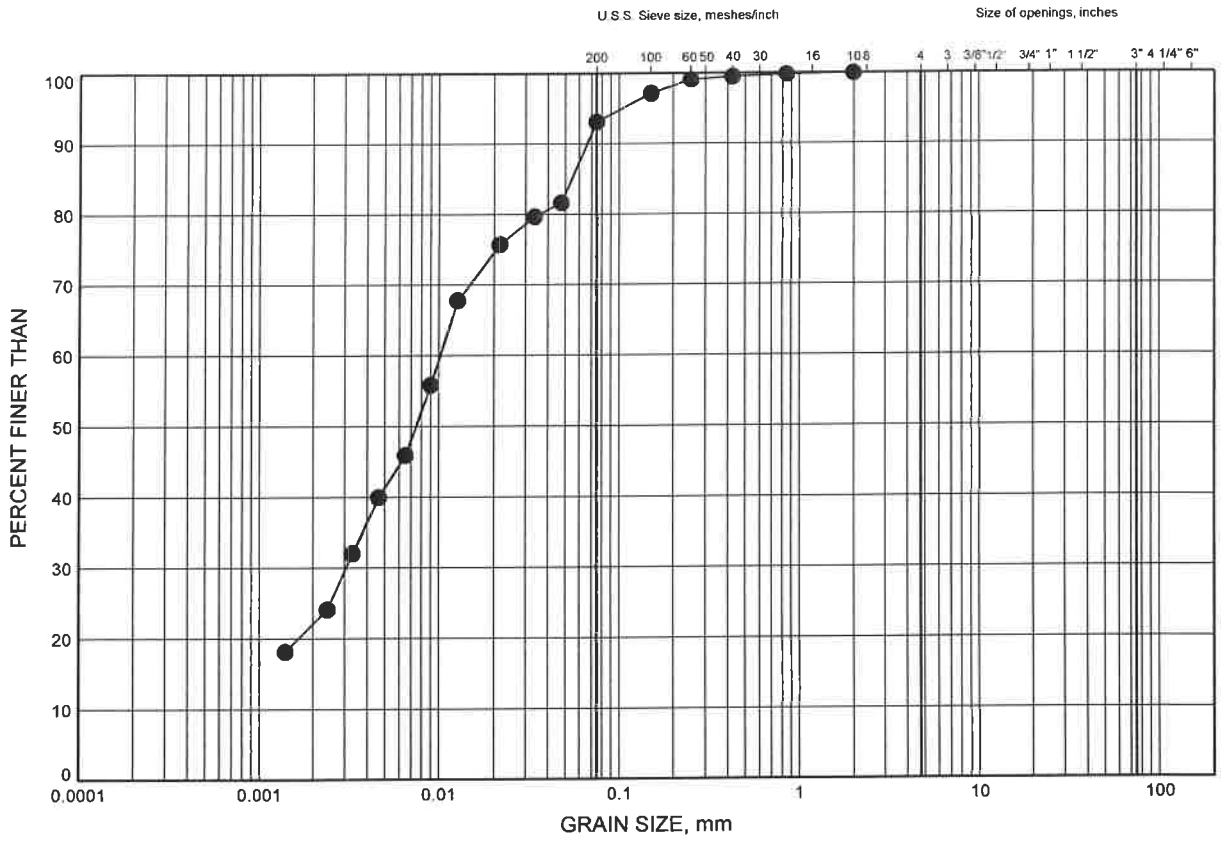
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B3

## CLAYEY SILT FILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-03 | 3.60 | 389.46 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

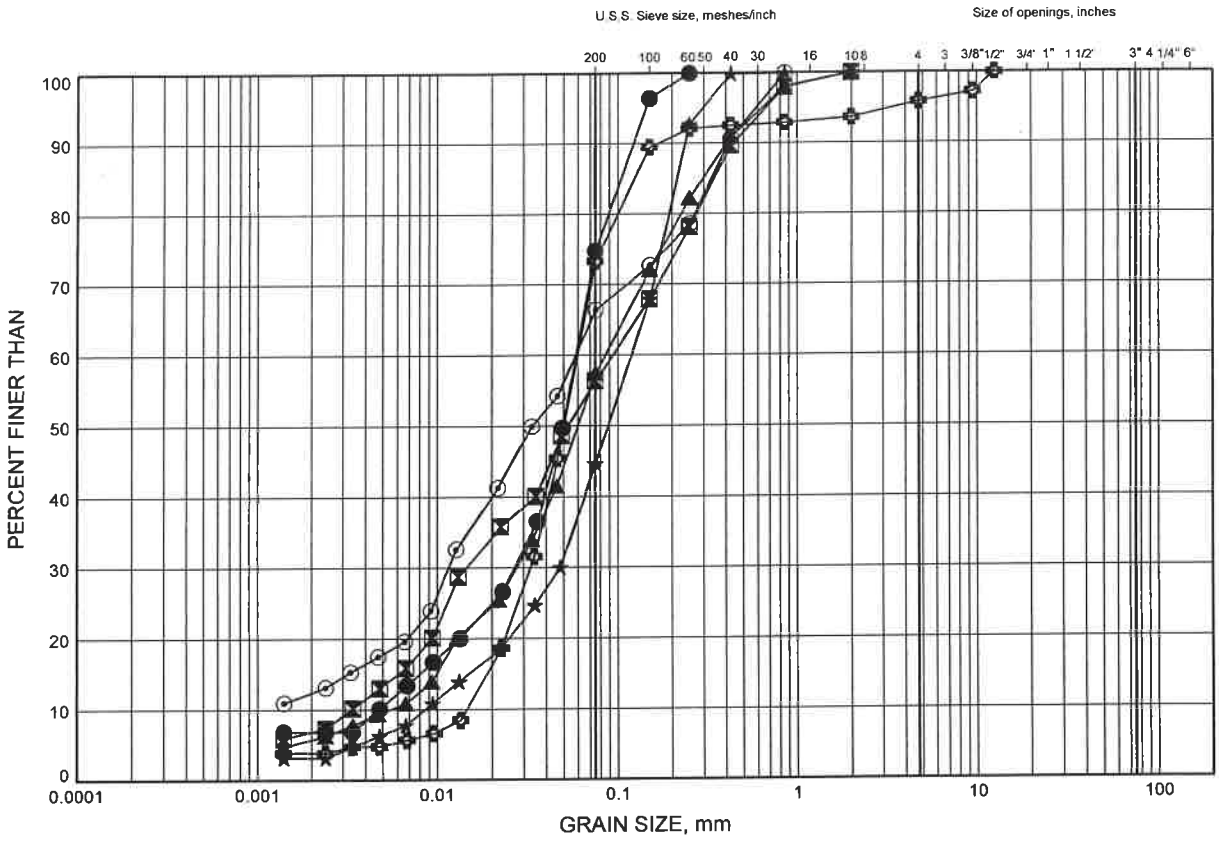
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B4

## SAND & SILT




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

## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-02 | 5.79 | 387.30 |
| ⊠ | LWR-02 | 7.32 | 385.78 |
| ▲ | LWR-04 | 1.52 | 386.42 |
| ★ | LWR-05 | 2.13 | 386.00 |
| ⊙ | LWR-06 | 3.35 | 385.44 |
| ✿ | LWR-06B | 5.79 | 387.20 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

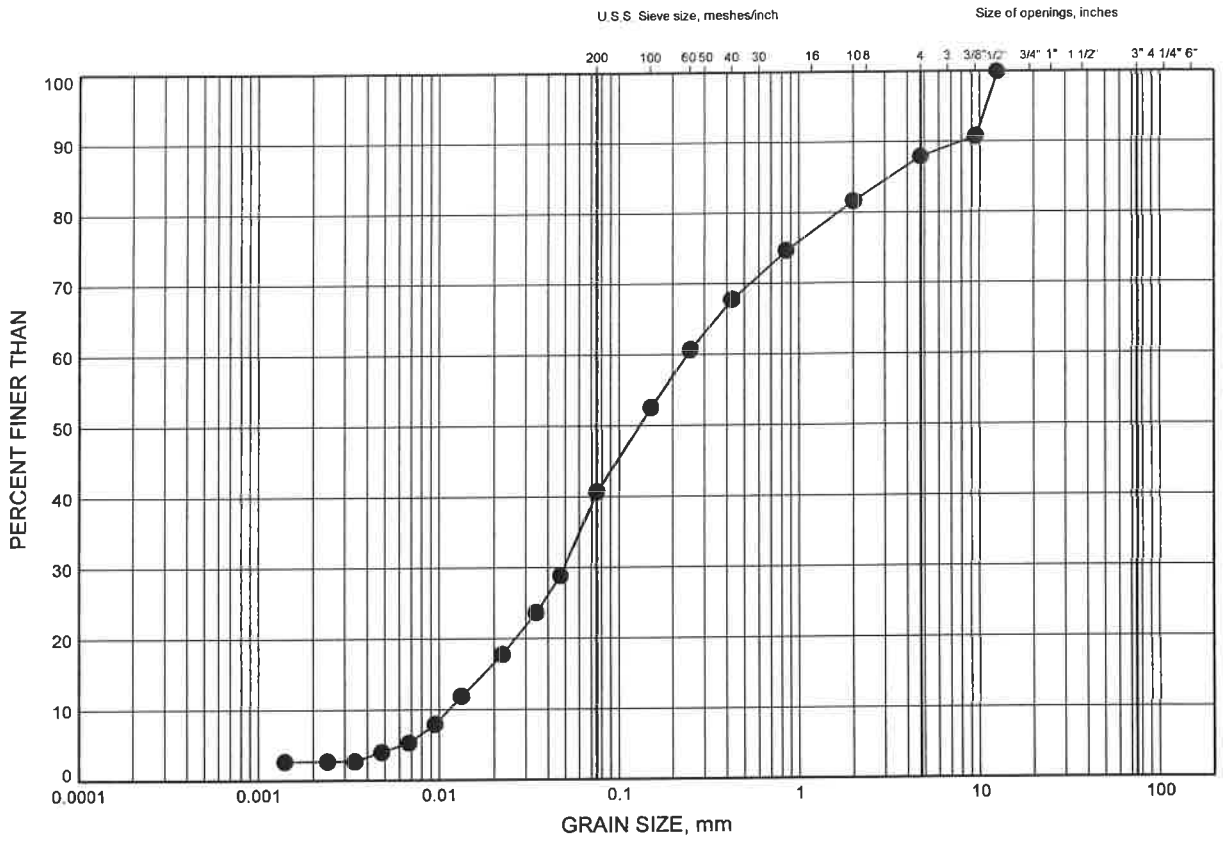
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B5

## SAND & SILT




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-10 | 7.82 | 385.28 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

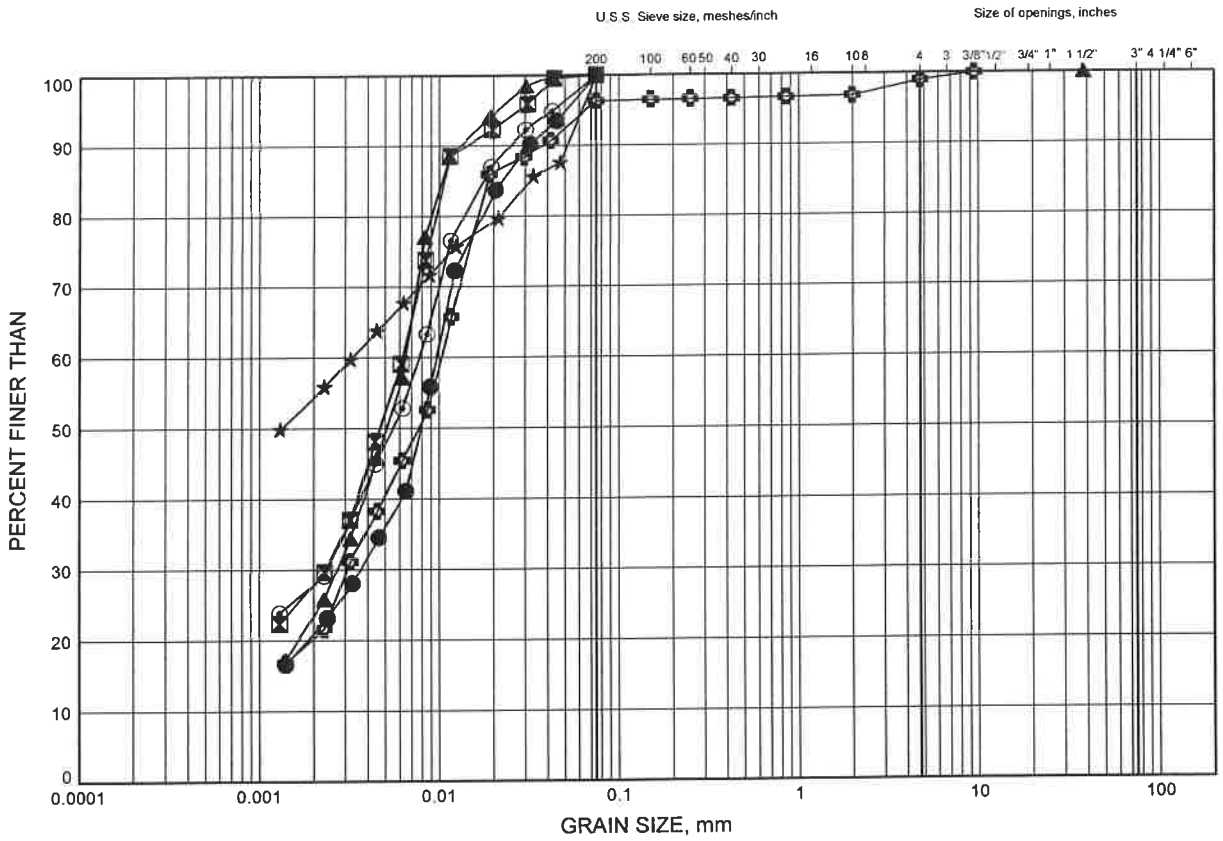
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B6

## CLAYEY SILT to SILTY CLAY




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

## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-01 | 7.92 | 385.22 |
| ⊠ | LWR-01 | 10.97 | 382.17 |
| ▲ | LWR-02 | 11.89 | 381.21 |
| ★ | LWR-03 | 10.36 | 382.69 |
| ⊙ | LWR-04 | 8.84 | 379.10 |
| ✿ | LWR-06B | 13.41 | 379.58 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

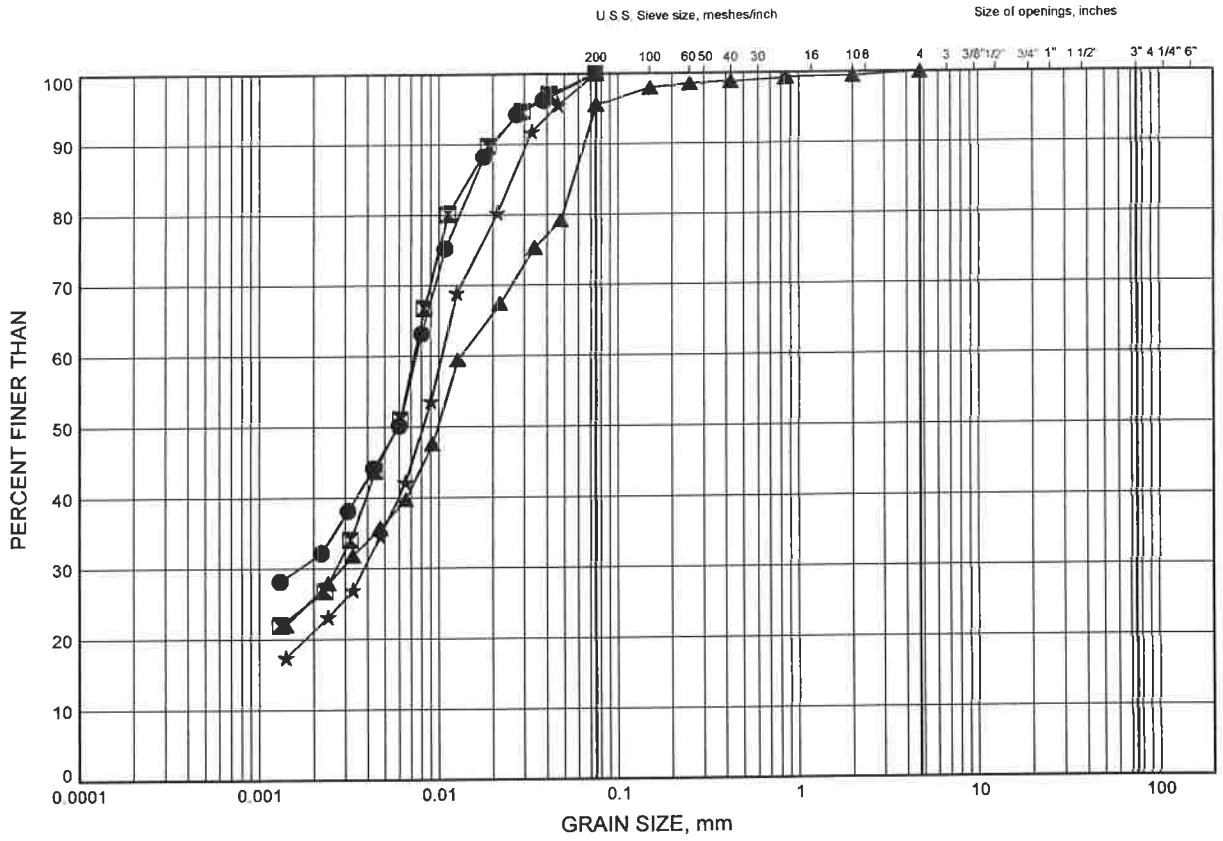
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B7

## CLAYEY SILT to SILTY CLAY




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-07 | 4.57 | 384.22 |
| ⊠ | LWR-07 | 9.45 | 379.35 |
| ▲ | LWR-09 | 5.79 | 387.17 |
| ★ | LWR-10 | 2.59 | 390.52 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

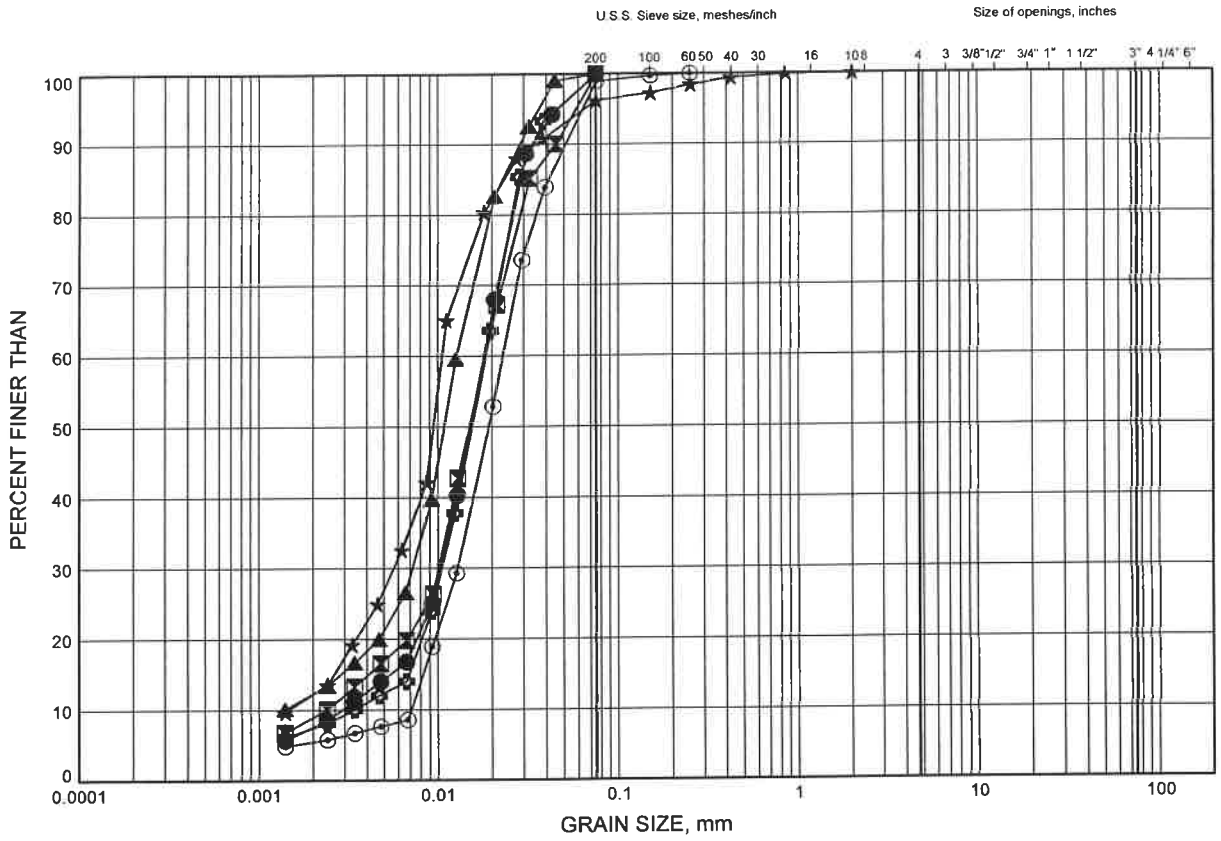
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B8

## SILT




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

## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-02 | 14.94 | 378.16 |
| ⊠ | LWR-03 | 14.94 | 378.12 |
| ▲ | LWR-03 | 17.98 | 375.07 |
| ★ | LWR-04 | 2.13 | 385.81 |
| ⊙ | LWR-04 | 5.18 | 382.76 |
| ✿ | LWR-04 | 7.01 | 380.93 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

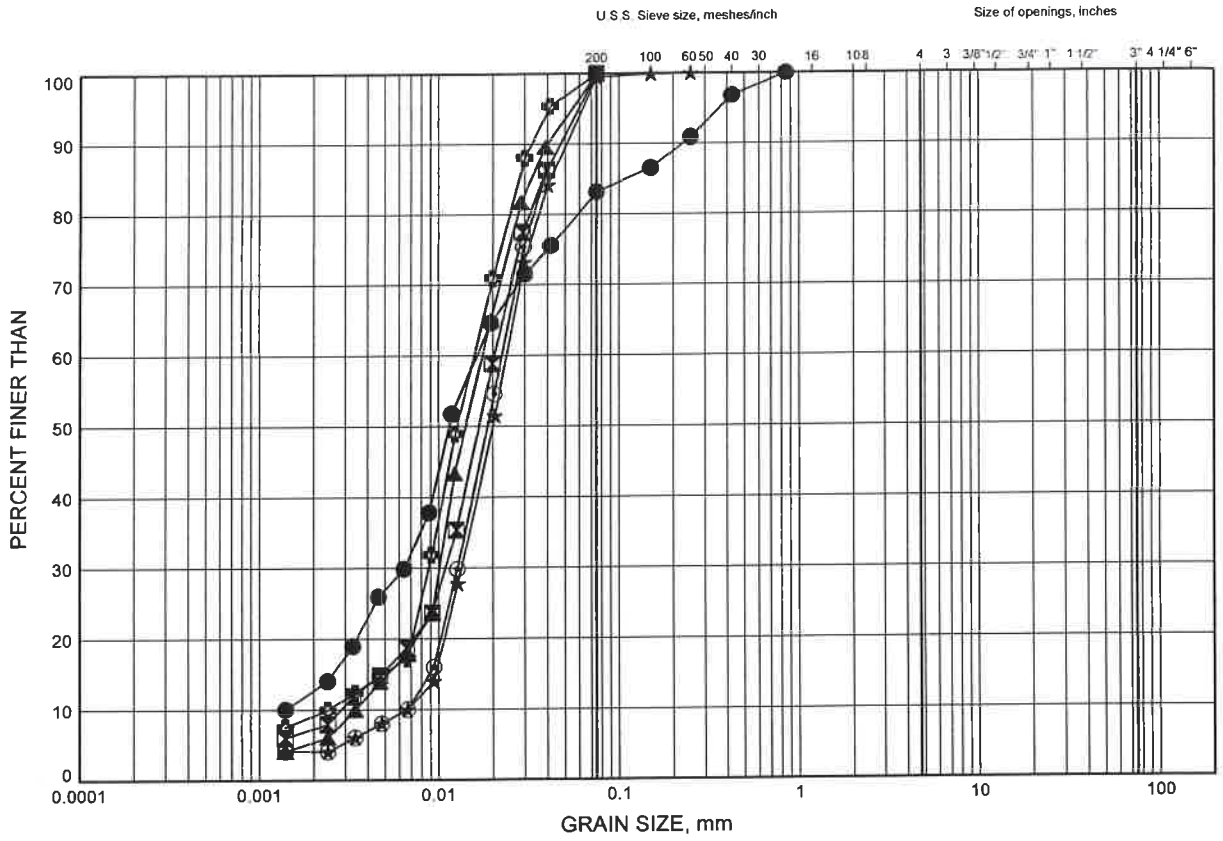
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B9

## SILT




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

## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-05 | 3.96 | 384.17 |
| ⊠ | LWR-05 | 7.62 | 380.52 |
| ▲ | LWR-05 | 10.67 | 377.47 |
| ★ | LWR-06B | 8.84 | 384.16 |
| ⊙ | LWR-07 | 6.40 | 382.39 |
| ✿ | LWR-07 | 8.23 | 380.57 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

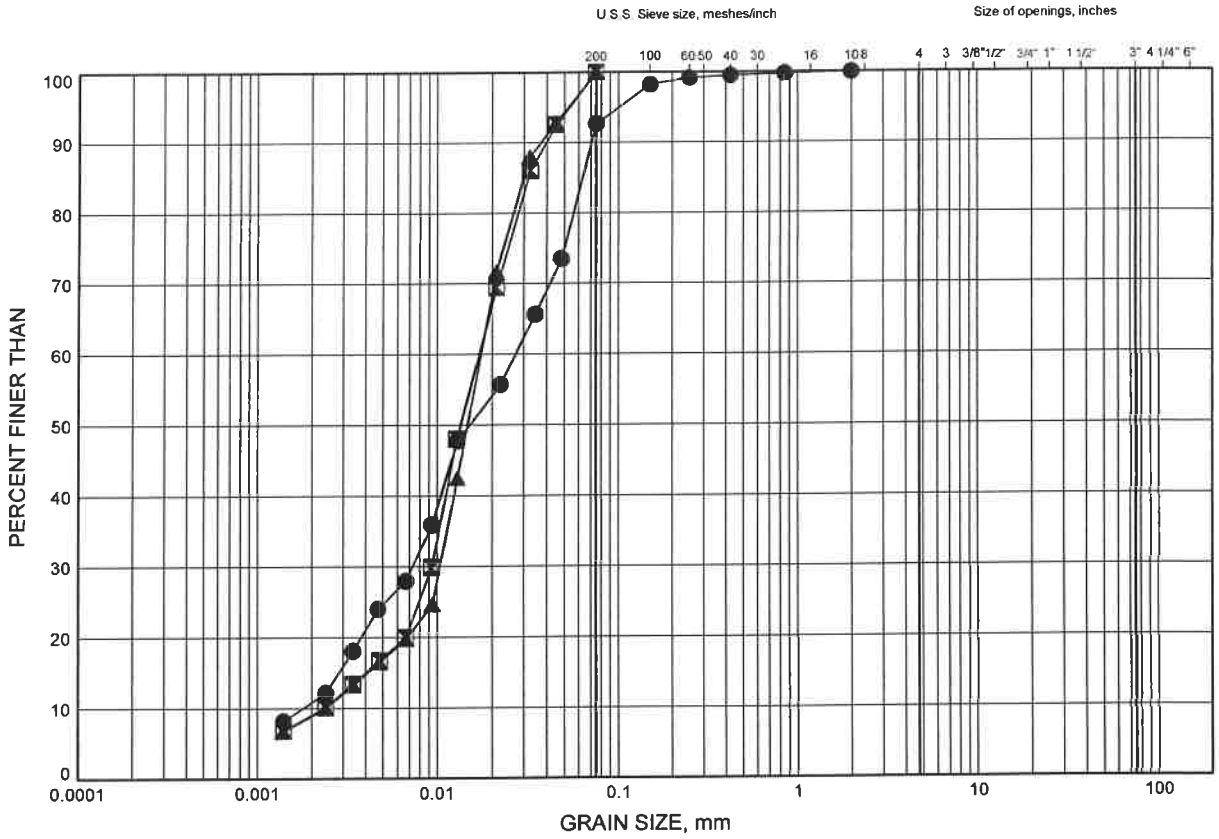
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# GRAIN SIZE DISTRIBUTION

FIGURE B10

## SILT




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

## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-08 | 4.27 | 388.72 |
| ⊠ | LWR-08 | 8.84 | 384.15 |
| ▲ | LWR-09 | 10.36 | 382.60 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

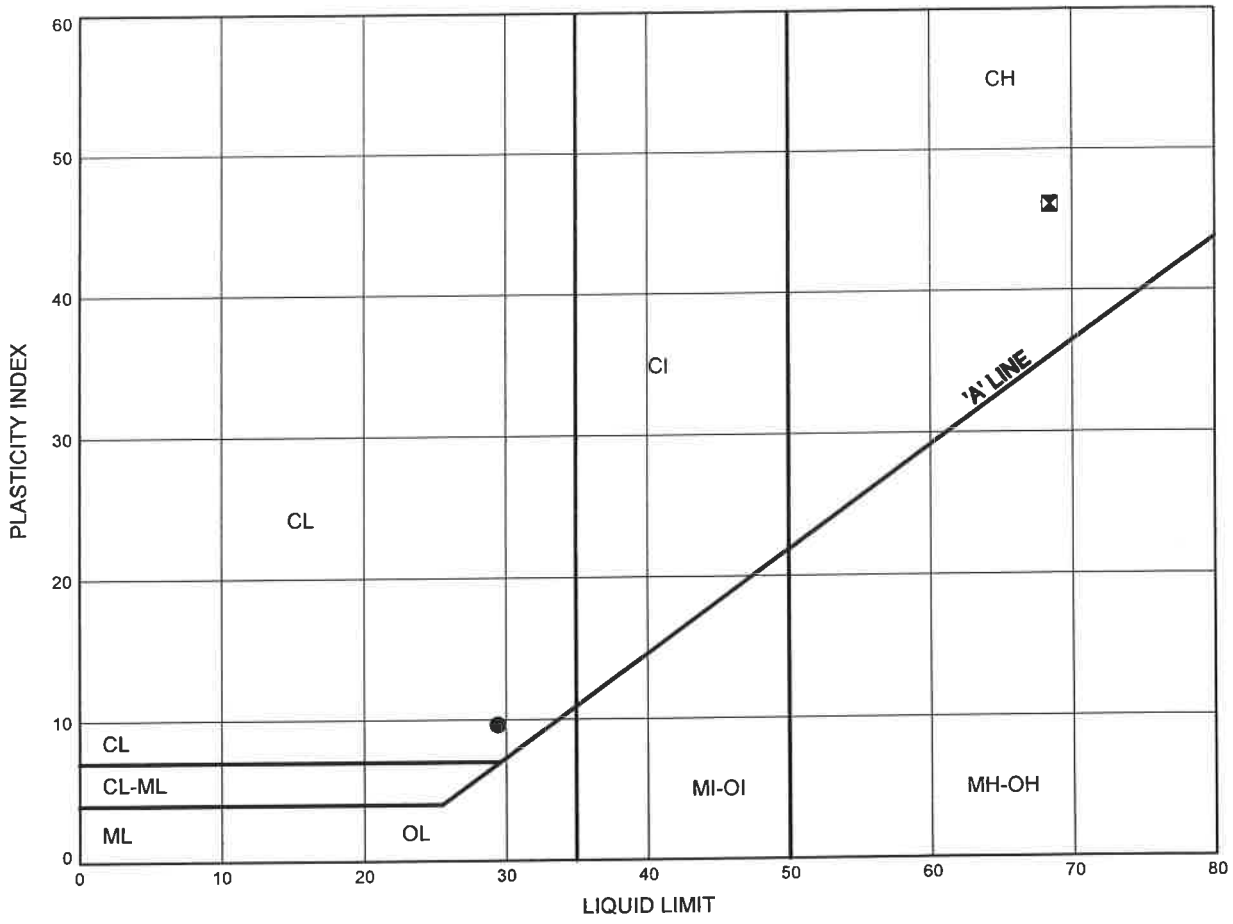
GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 5/29/12

Little Wabigoon River

# ATTERBERG LIMITS TEST RESULTS

FIGURE B11

## CLAYEY SILT to SILTY CLAY




### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-01 | 10.97 | 382.17 |
| ⊠ | LWR-03 | 10.36 | 382.69 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

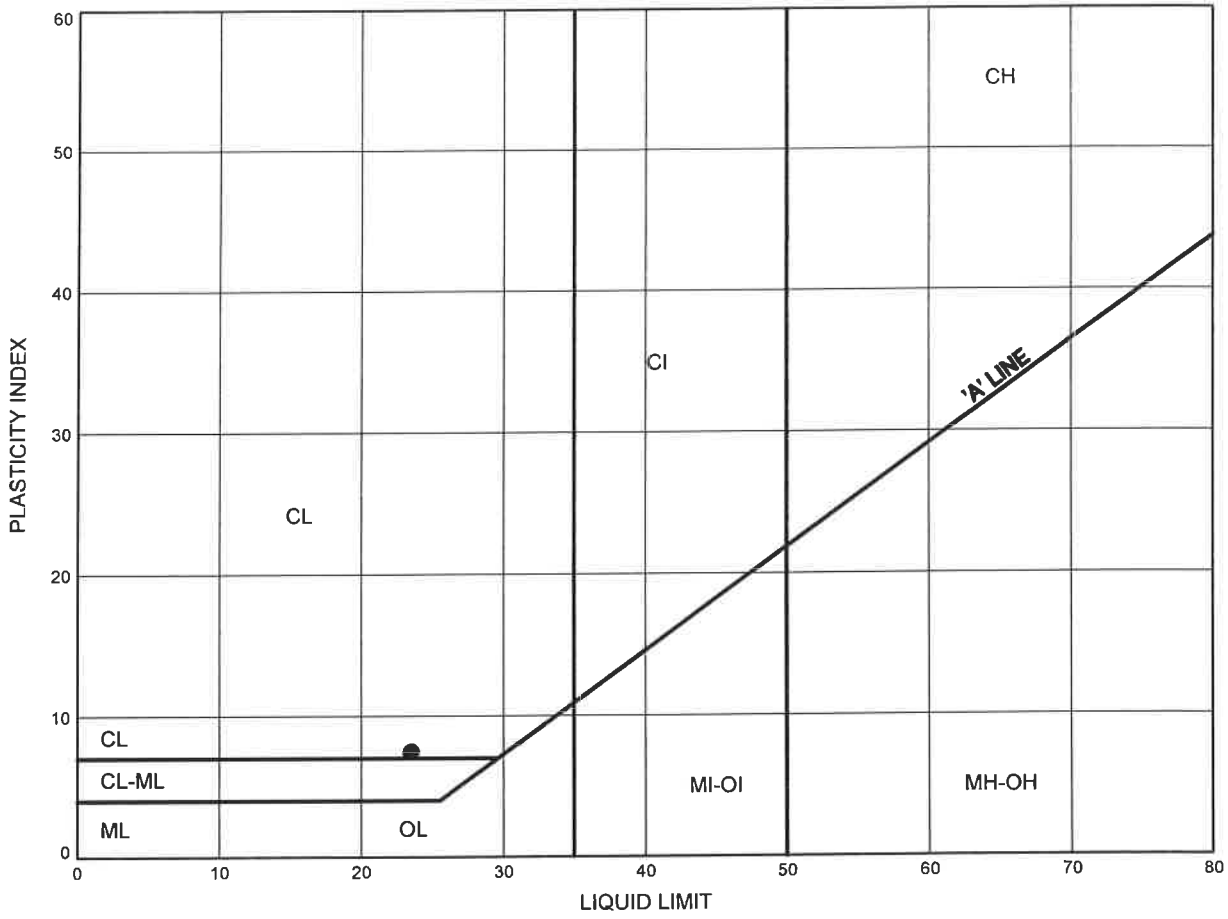
THURBALT 5121.GPJ 5/29/12

Little Wabigoon River

# ATTERBERG LIMITS TEST RESULTS

FIGURE B12

## SILT




## LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | LWR-08 | 4.27 | 388.72 |

Date May 2012

W.P.# 470-00-00

THURBER

Prep'd AN

Chkd. RPR

THURBALT 5121.GPJ 5/29/12

THURBER ENGINEERING LTD.
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS

# POINT LOAD TEST SHEET

**Job No :** 19-1605-121 **Client :** HMM

**Date Drilled :** August 10,2011

**Project Name :** Little Wabigoon River Bridge **Date Tested :** September 06,2011

**Core Size :** NQ **BH No :** LWR-08 **Tester :** DB

| Test No. | Run No. | Depth (m) | Axial or Diametral | Force (kN) | Diameter (mm) | Length (mm) | UCS (MPa) | Rock Type | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 10.4 | D | 22.3 | 47.3 | 66.4 | 233.6 | Granodiorite to granite | Very Strong |
| 2 | 1 | 10.9 | D | 19.0 | 47.3 | 63.8 | 199.3 | Granodiorite to granite | Very Strong |
| 3 | 1 | 11.5 | D | 26.5 | 47.2 | 57.9 | 278.5 | Granodiorite to granite | Extremely Strong |
| 4 | 1 | 12.5 | D | 23.2 | 47.3 | 60.1 | 242.7 | Granodiorite to granite | Very Strong |
| 5 | 1 | 13.0 | D | 26.8 | 47.2 | 59.3 | 281.0 | Granodiorite to granite | Extremely Strong |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

# POINT LOAD TEST SHEET

**Job No :** 19-1605-121 **Client :** HMM

**Date Drilled :** August 12,2011

**Project Name :** Little Wabigoon River Bridge **Date Tested :** September 06,2011

**Core Size :** NQ **BH No :** LWR-04 **Tester :** DB

| Test No. | Run No. | Depth (m) | Axial or Diametral | Force (kN) | Diameter (mm) | Length (mm) | UCS (MPa) | Rock Type | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 9.8 | D | 30.3 | 48.1 | 245.0 | 309.8 | Granodiorite to granite | Extremely Strong |
| 2 | 2 | 10.4 | D | 28.6 | 49.6 | 150.0 | 278.5 | Granodiorite to granite | Extremely Strong |
| 3 | 2 | 10.4 | A | 26.4 | 49.6 | 53.0 | 202.6 | Granodiorite to granite | Very Strong |
| 4 | 3 | 10.9 | D | 22.8 | 50.8 | 210.0 | 213.4 | Granodiorite to granite | Very Strong |
| 5 | 3 | 11.2 | D | 28.4 | 50.8 | 140.0 | 266.2 | Granodiorite to granite | Extremely Strong |
| 6 | 4 | 11.9 | D | 35.7 | 51.4 | 330.0 | 328.3 | Granodiorite to granite | Extremely Strong |
| 7 | 5 | 12.6 | D | 33.6 | 51.0 | 215.0 | 312.4 | Granodiorite to granite | Extremely Strong |
| 8 | 5 | 12.6 | A | 34.6 | 51.0 | 63.1 | 226.8 | Granodiorite to granite | Very Strong |
| 9 | 5 | 12.8 | D | 35.6 | 51.0 | 420.0 | 331.6 | Granodiorite to granite | Extremely Strong |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

# POINT LOAD TEST SHEET

**Job No :** 19-1605-121 **Client :** HMM

**Date Drilled :** August 12,2011

**Project Name :** Little Wabigoon River Bridge **Date Tested :** September 06,2011

**Core Size :** NQ **BH No :** LWR-03 **Tester :** DB

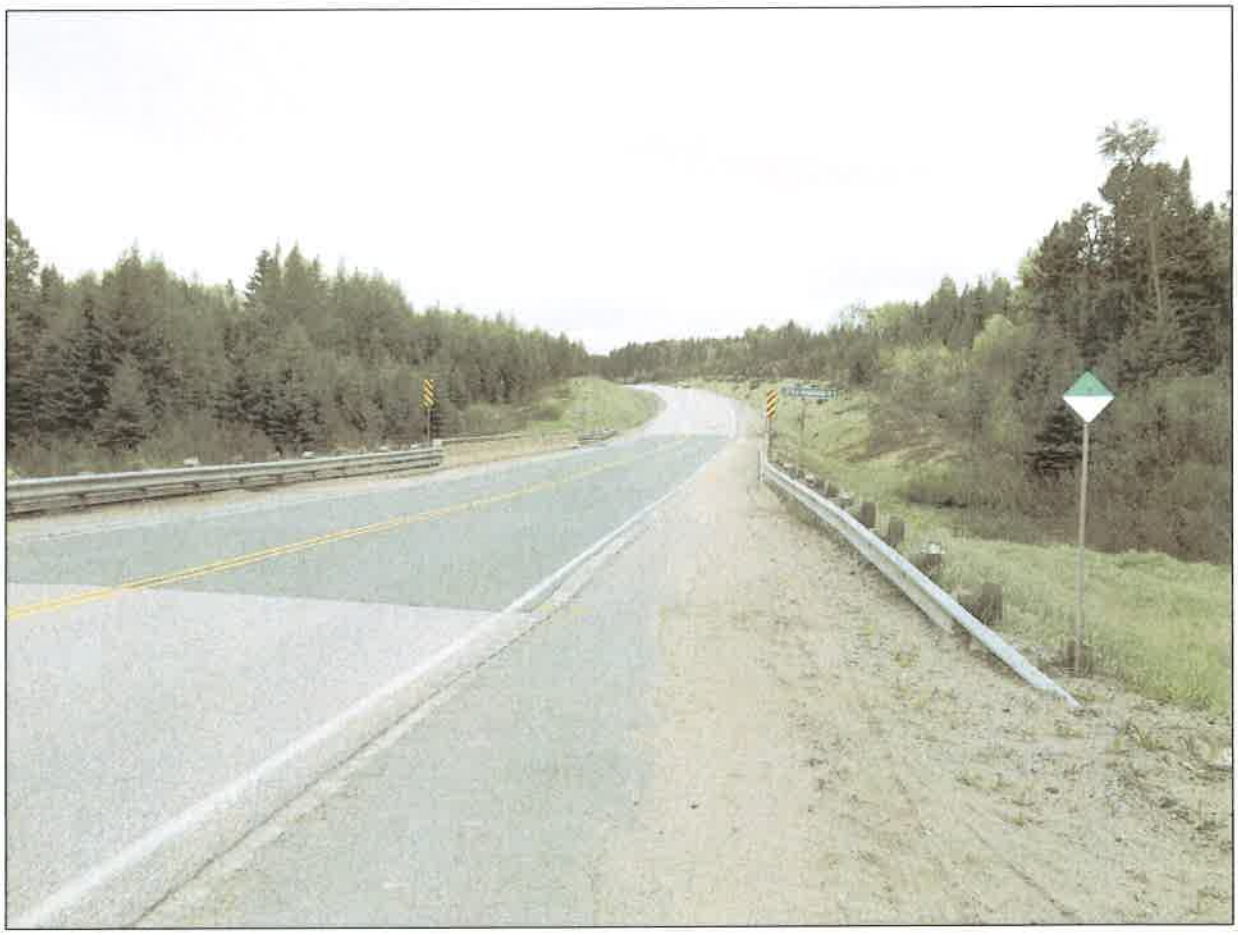
| Test No. | Run No. | Depth (m) | Axial or Diametral | Force (kN) | Diameter (mm) | Length (mm) | UCS (MPa) | Rock Type | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 19.6 | D | 30.5 | 47.5 | 60.7 | 317.5 | Granodiorite to granite | Extremely Strong |
| 2 | 1 | 20.1 | D | 37.4 | 47.5 | 64.1 | 389.4 | Granodiorite to granite | Extremely Strong |
| 3 | 1 | 20.7 | D | 18.7 | 47.5 | 61.4 | 194.3 | Granodiorite to granite | Very Strong |
| 4 | 1 | 21.2 | D | 22.7 | 47.5 | 56.9 | 235.9 | Granodiorite to granite | Very Strong |
| 5 | 1 | 21.6 | D | 6.6 | 47.4 | 58.7 | 68.4 | Granodiorite to granite | Strong |
| 6 | 2 | 21.8 | D | 16.3 | 47.5 | 60.0 | 169.1 | Granodiorite to granite | Very Strong |
| 7 | 2 | 22.4 | D | 33.2 | 47.5 | 63.1 | 345.1 | Granodiorite to granite | Extremely Strong |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

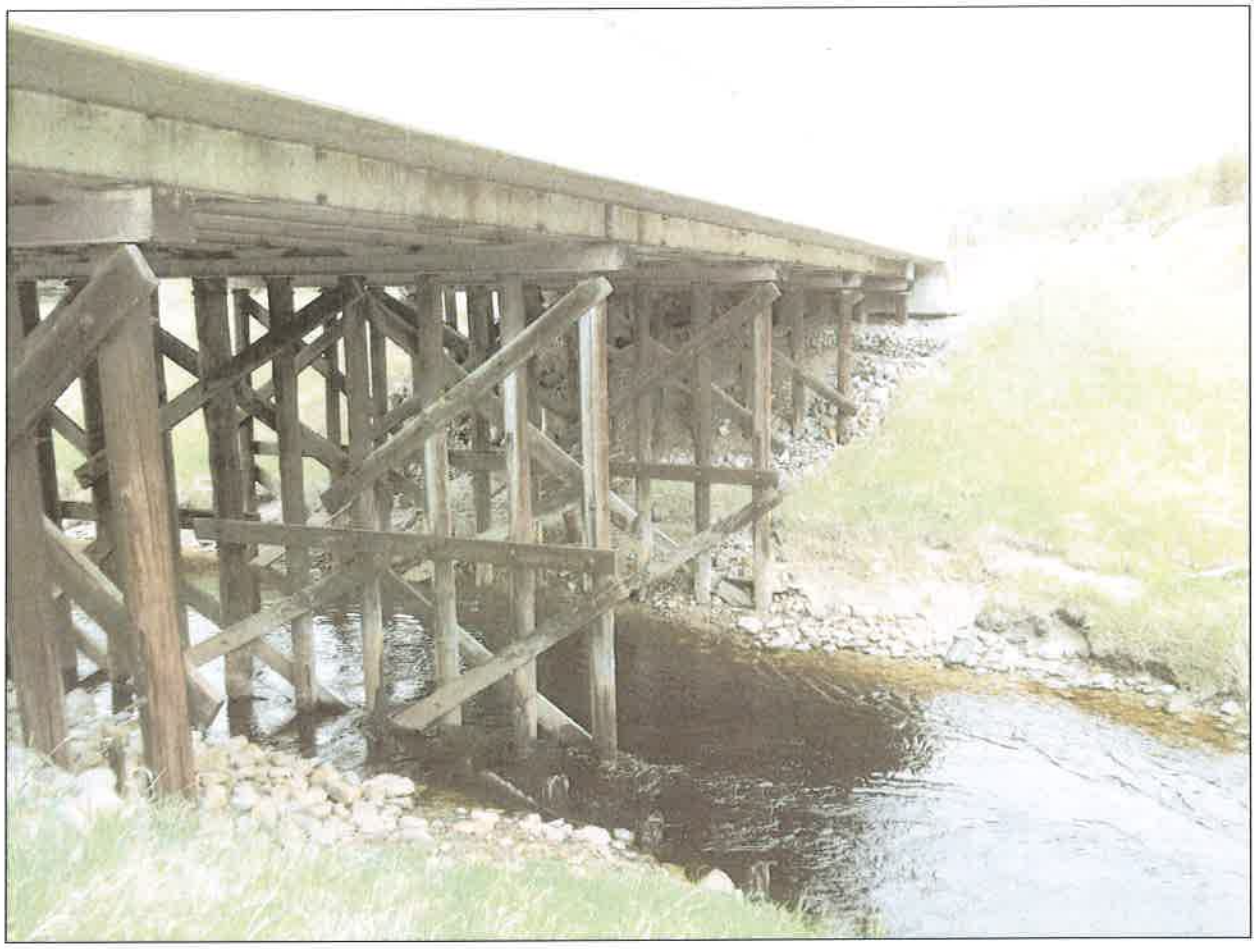
# Appendix C

## Site Photographs

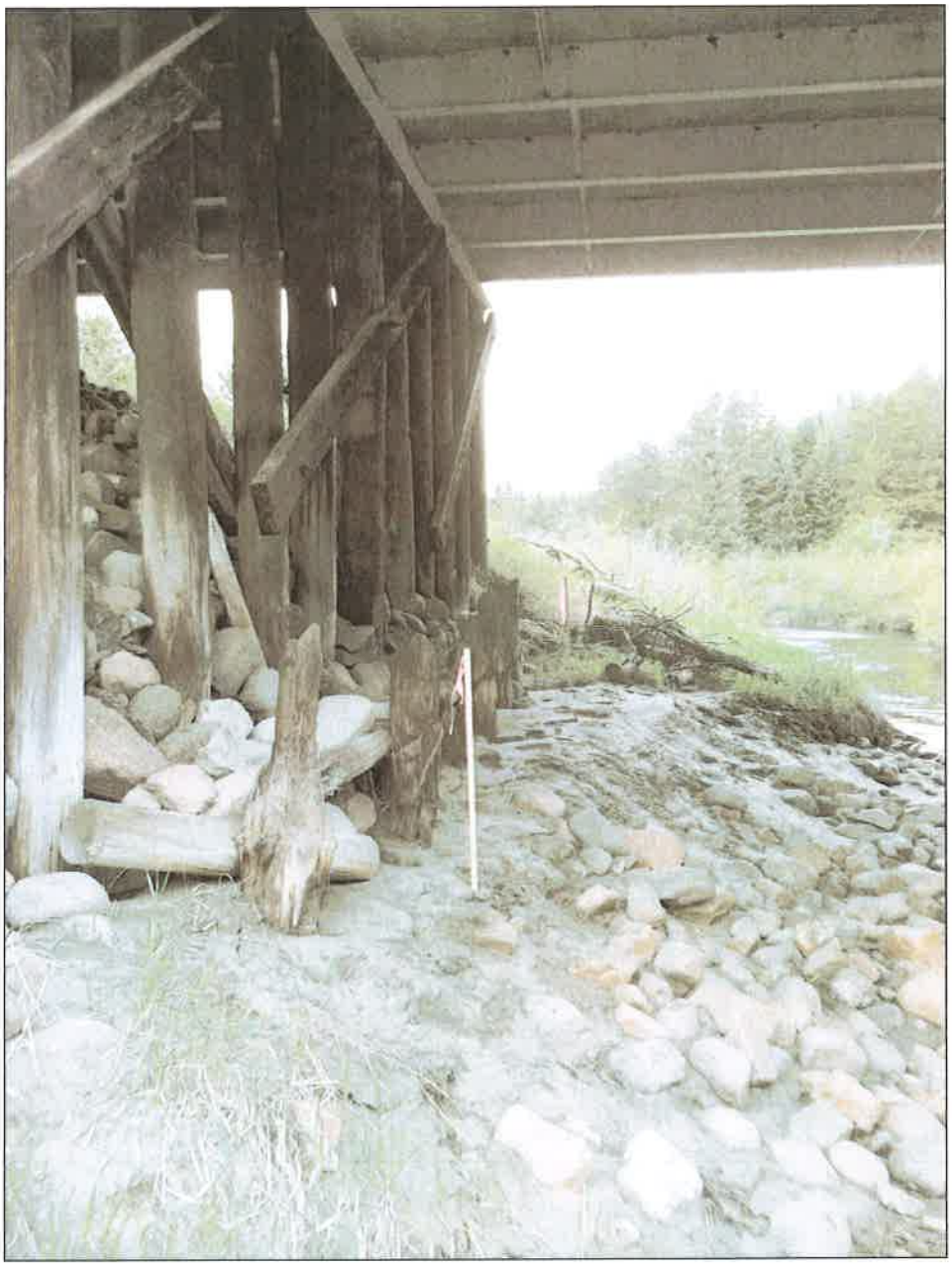


**Photograph 1** – Highway 17 and Little Wabigoon River Bridge crossing (east side of bridge)

**Photograph 2** – Highway 17 and Little Wabigoon River Bridge crossing (west side of bridge)



**Photograph 3** – Existing conditions of the Little Wabigoon River Bridge structure

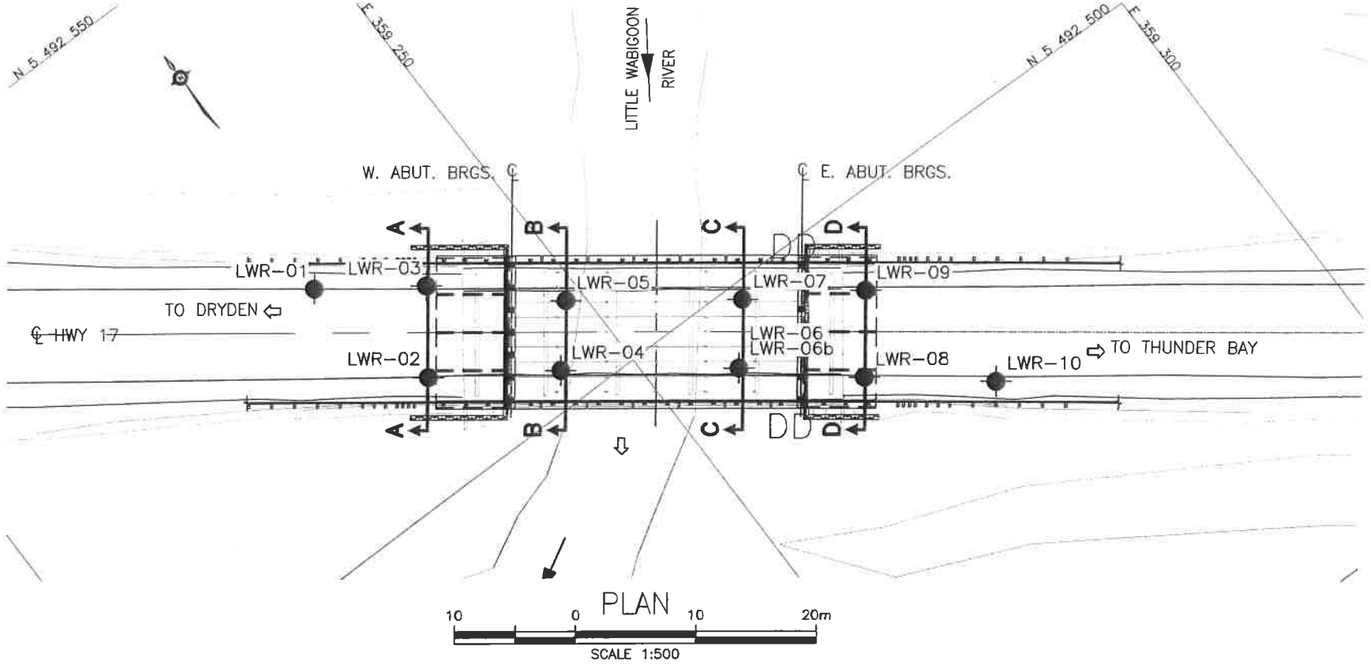


**Photograph 4** – Existing conditions of the Little Wabigoon River Bridge structure

**Photographs 5 and 6 –** Existing conditions of the Little Wabigoon River Bridge structure

# Appendix D

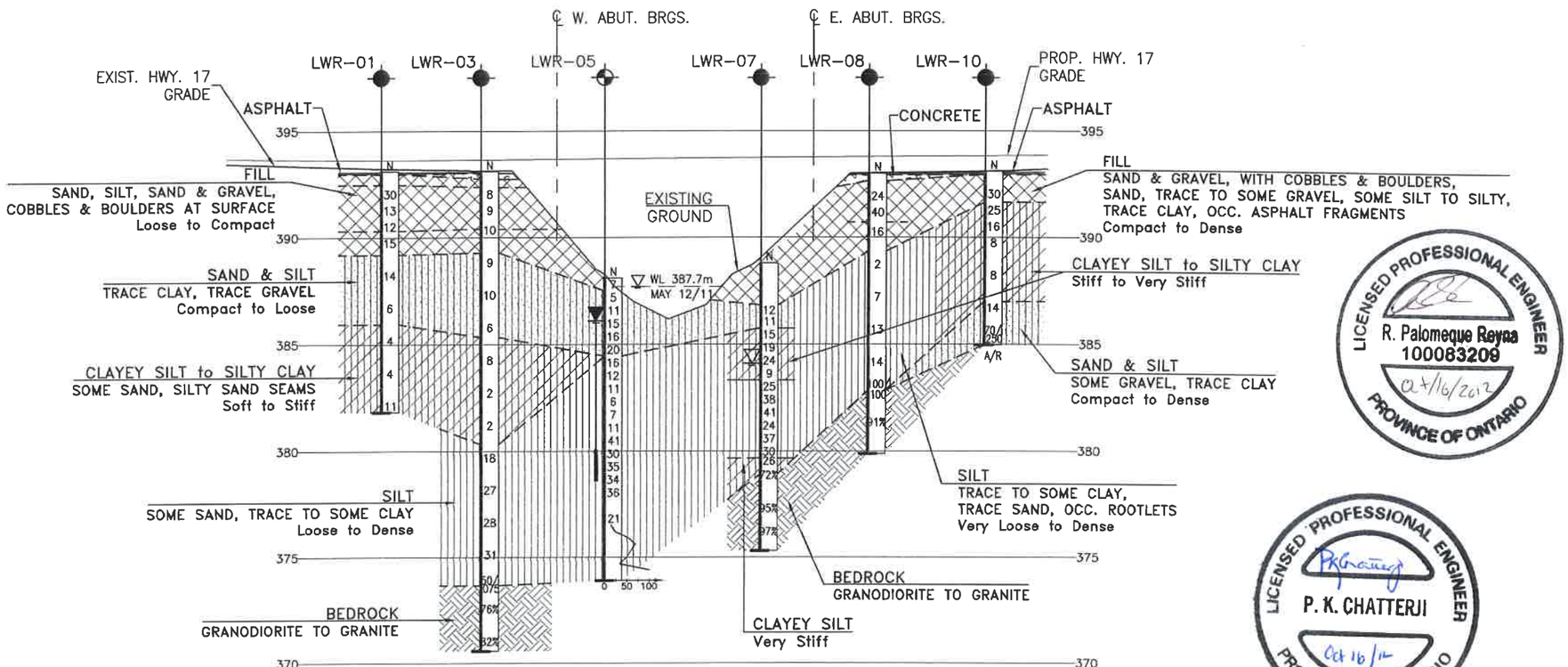
## Drawing Borehole Locations and Soil Strata




PLAN

10 0 10 20m

SCALE 1:500




PROFILE ALONG ℄ HWY. 17

10 0 10 20m H 1:500

5 0 5 10 V 1:250

## METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

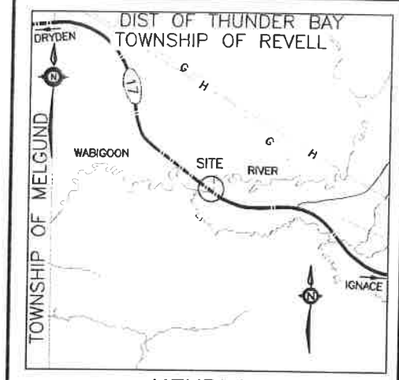
CONT No 2012-6013
WP No 470-00-01

LITTLE WABIGOON RIVER BRIDGE
STRUCTURAL REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 33

Hatch Mott MacDonald

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 |
|---|---|---|---|
| LWR-01 | 393.1 | 5 492 520.8 | 359 232.7 |
| LWR-02 | 393.1 | 5 492 509.1 | 359 235.7 |
| LWR-03 | 393.1 | 5 492 515.3 | 359 240.2 |
| LWR-04 | 387.9 | 5 492 502.9 | 359 244.7 |
| LWR-05 | 388.1 | 5 492 507.3 | 359 248.6 |
| LWR-06 | 388.8 | 5 492 494.1 | 359 256.6 |
| LWR-06B | 393.0 | 5 492 494.1 | 359 256.6 |
| LWR-07 | 388.8 | 5 492 498.6 | 359 260.3 |
| LWR-08 | 393.0 | 5 492 487.2 | 359 264.4 |
| LWR-09 | 393.0 | 5 492 493.0 | 359 268.9 |
| LWR-10 | 393.1 | 5 492 480.4 | 359 272.8 |

-NOTES-

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

**GEOCRES No. 52F-39**

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Oct/16/2012
PROVINCE OF ONTARIO

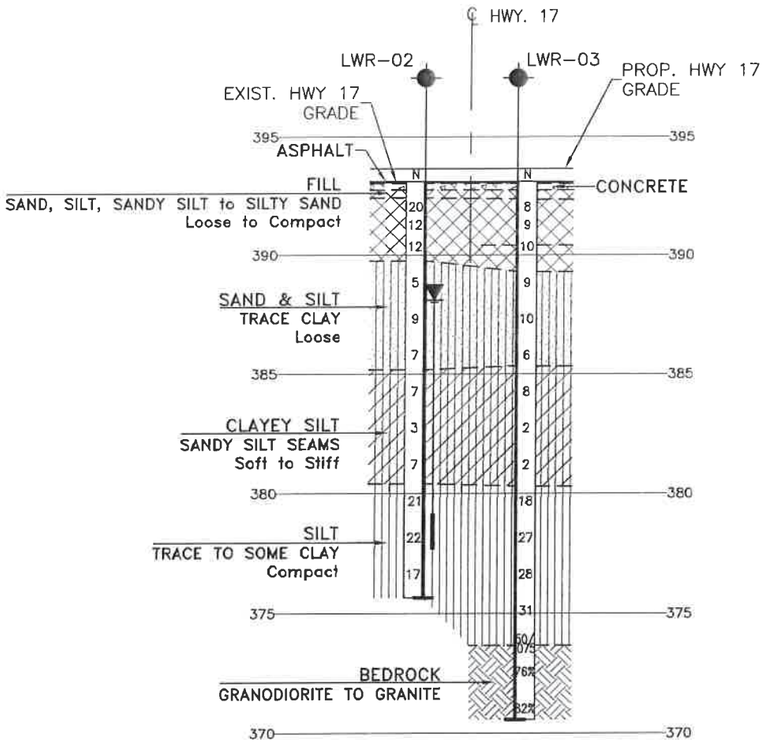
LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct 16/12
PROVINCE OF ONTARIO

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| | | |

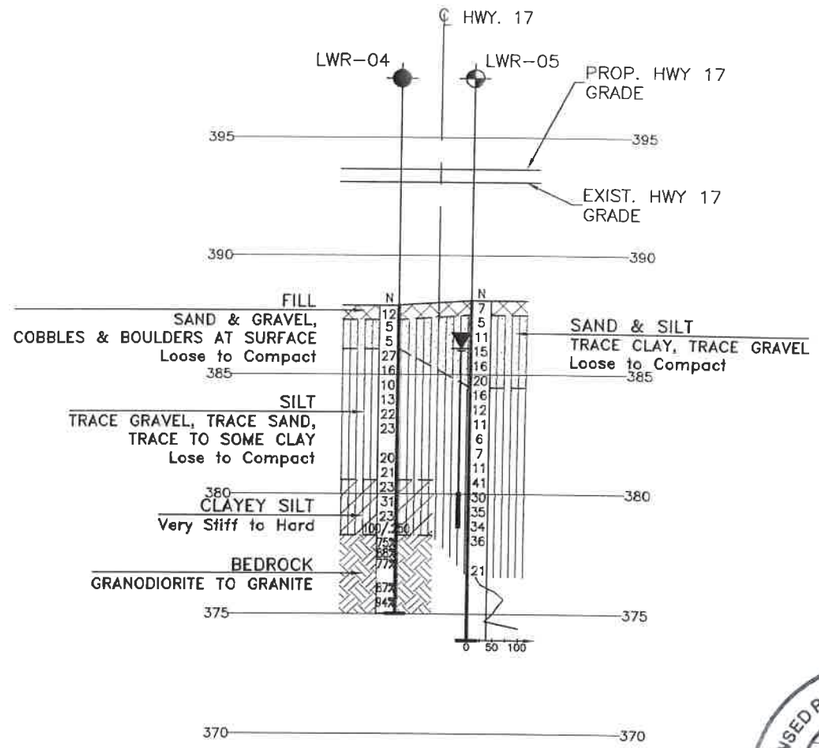
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DESIGN | RRP | CHK | RPR | CODE | CAN/CSA S6-06 | LOAD | CL-625-ONT |
| DRAWN | AN | CHK | RPR | SITE | 415-67 | STRUCT | DWG 2 |

DATE OCT. 2012

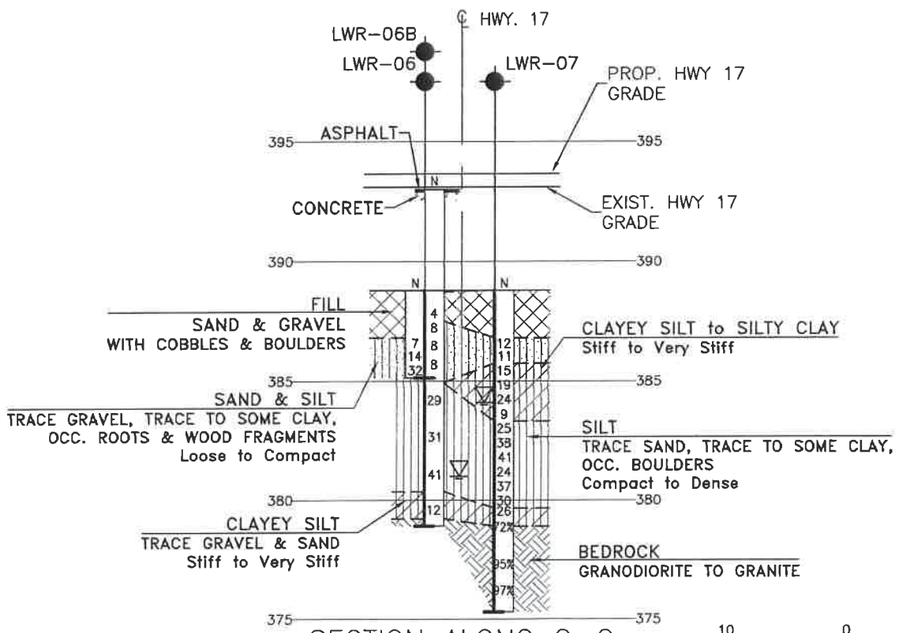
FILENAME: H:\Drafting\18\1605\121\lod5121-LittleWabigoonRiver(REVISED)Oct2012.dwg



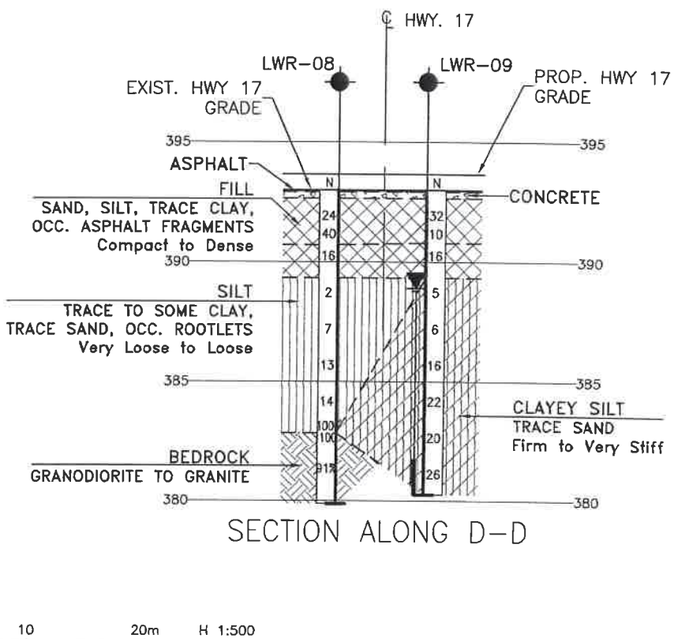

SECTION ALONG A–A




SECTION ALONG B–B




SECTION ALONG C–C




SECTION ALONG D–D

10 0 10 20m H 1:500

5 0 5 10 V 1:250

# METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

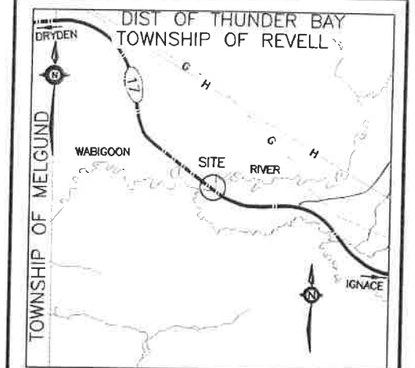
CONT No 2012–6013
WP No 470–00–01

LITTLE WABIGOON RIVER BRIDGE
STRUCTURAL REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 34

Hatch Mott MacDonald

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 |
|---|---|---|---|
| LWR–01 | 393.1 | 5 492 520.8 | 359 232.7 |
| LWR–02 | 393.1 | 5 492 509.1 | 359 235.7 |
| LWR–03 | 393.1 | 5 492 515.3 | 359 240.2 |
| LWR–04 | 387.9 | 5 492 502.9 | 359 244.7 |
| LWR–05 | 388.1 | 5 492 507.3 | 359 248.6 |
| LWR–06 | 388.8 | 5 492 494.1 | 359 256.6 |
| LWR–06B | 393.0 | 5 492 494.1 | 359 256.6 |
| LWR–07 | 388.8 | 5 492 498.6 | 359 260.3 |
| LWR–08 | 393.0 | 5 492 487.2 | 359 264.4 |
| LWR–09 | 393.0 | 5 492 493.0 | 359 268.9 |
| LWR–10 | 393.1 | 5 492 480.4 | 359 272.8 |

## -NOTES-

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

**GEOCRES No. 52F-39**

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Oct/16/2012
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct 16/12
PROVINCE OF ONTARIO

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DESIGN | RRP | CHK | RPR | CODE | CAN/CSA S6-06 | LOAD | CL-625-ONT |
| DRAWN | AN | CHK | RPR | SITE | 41S-67 | STRUCT | |
| DATE | OCT. 2012 | | | | | DWG | 3 |

FILENAME: H:\Drafting\19\1605\121\ad5121-LittleWabigoonRiver(REVISED)Oct2012.dwg