# FOUNDATION INVESTIGATION REPORT
# OVERHEAD SIGN SUPPORTS
# HIGHWAY 401, CITY OF WOODSTOCK, ONTARIO
# G.W.P. 3054-13-00

**GEOCRES No. 40P2-82**

**Submitted**

**to**

**MMM Group Limited**

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File: 19-5161-224

H:\19\5161\224 Hwy 401 Ingersoll 3013-E-0027 Foundations\Reports & Memos\Norwich Avenue\3 - OH Sign - Norwich\Final Report - March 31 2016\OH FIDR Norwich Apr 4 2016.doc

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**FOUNDATION INVESTIGATION REPORT**

**OVERHEAD SIGN SUPPORTS**

**HIGHWAY 401, CITY OF WOODSTOCK, ONTARIO**

**G.W.P. 3054-13-00**

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## PART 1. FACTUAL INFORMATION

### 1.0 INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of Overhead Sign (OH) supports to be located along Highway 401 to the west of the Highway 401 Underpass at Norwich Avenue in Woodstock, Ontario. The installation of the signs constitutes part of the Highway 401 improvement project.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 3013-E-0027.

The purpose of this investigation was to explore the subsurface conditions at selected locations of the Overhead Sign supports and, based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results and a written description of the subsurface conditions.

Design parameters for the proposed sign supports have been provided in a tabularized format following the text of the report.

### 2.0 SITE DESCRIPTION

The project site is located to the west of the intersection of Highway 401 and Norwich Avenue (County Road 59), in the City of Woodstock. The overhead signs are proposed to be installed along the Eastbound Lanes of Highway 401, at the following locations:

Station 10+700, and
Station 11+700.

At the project site, Highway 401 runs approximately in the southwest-northeast direction, and for the purpose of this report, Highway 401 is assumed to run west-east.

The surrounding land use generally consists of a mixture of commercial properties and agricultural land. The developed area of the City of Woodstock lies a short distance to the north.

Based on the Quaternary Geology Map, the site is situated in the Physiographic Region known as the Oxford Till Plain characterized by drumlinized till deposits. The surficial deposits contain mainly silt with variable amounts of clay, sand and gravel particles.

## 3.0 INVESTIGATION PROCEDURES

### 3.1 Field Investigation and Testing

The field investigation for this project was carried out on December 17, 2015 and on March 22, 2016, when a total of three boreholes were drilled at the selected locations on the south side of the Eastbound Lanes of Highway 401 and west of the Underpass Structure. Boreholes OH-01 and OH-02 were drilled in December 2015. Following revision of the location of the Advance Overhead Sign, an additional investigation was carried out in March 2016, and Borehole OH-03 was completed at that time. The locations of the boreholes were determined based on the drawings provided by MMM, and approximate locations of the boreholes are shown on the Borehole Location Plan enclosed in Appendix C. The boreholes were advanced using hollow stem augers to depths ranging from 8.1 m to 9.8 m. In each borehole, soil samples were obtained at selected intervals with a 50 mm outside diameter split spoon sampler driven in conjunction with the Standard Penetration Test (SPT).

Groundwater conditions were observed in the boreholes during and upon completion of drilling operations. Upon completion, boreholes were backfilled in general accordance with MOE Regulation 903. Details of the borehole depths, base elevations and completion are summarized in Table 3.1 below.

**Table 3-1. Borehole Installation and Backfilling Details**

| Borehole | Borehole Depth/ Base Elevation (m) | Borehole Backfilling Details |
|---|---|---|
| OH-01 | 9.8 / 286.6 | Backfilled with cuttings to 1.8 m, bentonite chips to 0.3 m, concrete mix to 0.1 m and capped with cold mix asphalt. |
| OH-02 | 9.8 / 278.7 | Backfilled with cuttings to 4.0 m, bentonite chips to 0.3 m, concrete mix to 0.1 m and capped with cold mix asphalt. |
| OH-03 | 8.1* | Backfilled with cuttings and bentonite holeplug to 0.6 m, concrete mix to 0.2 m and capped with cold mix asphalt. |

* Ground surface elevation at the borehole location was not available at the time of writing the report.

The drilling investigations were supervised on a full-time basis by a member of Thurber's technical staff who located the boreholes in the field, cleared borehole locations of underground utilities, directed the drilling, sampling and in-situ testing operations, and logged the boreholes. The supervisor processed the recovered soil samples for transport to Thurber's laboratory for

further examination and testing. Results of field sampling and testing are presented in the Record of Borehole sheets included in Appendix A.

Ground surface elevations and coordinates at Boreholes OH-01 and OH-02 were obtained from the base drawing provided by MMM. Ground surface elevation at the location of Borehole OH-03 was not available at the time of writing of this report.

### 3.2 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analyses were conducted on selected samples. The results of laboratory tests are summarized on the Record of Borehole sheets included in Appendix A and are illustrated on figures included in Appendix B.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 General

This section presents a generalized summary of the subsurface conditions encountered in the boreholes. The detailed subsurface soil and groundwater conditions encountered in these boreholes are presented on the Record of Borehole sheets included in Appendix A. The factual data presented in the records of boreholes govern any interpretation of the site conditions. It should be recognized that the subsurface conditions may vary between and beyond the borehole locations.

The native soils encountered in the boreholes consist of predominantly glacial till deposits. Water level in open boreholes were measured between 2.1 m and 7.0 m depth below the existing ground surface upon completion of drilling operations.

### 4.2 Pavement Structure

All boreholes were drilled through the shoulder of the highway embankment and encountered between 150 mm and 250 mm of asphalt underlain by a fill consisting of sand and gravel with some silt content forming the pavement base material. The fill extended to a depth of 1.5 m to 2.3 m or to Elev. 294.9 and 286.2 in Boreholes OH-01 and OH-02, respectively, and to 1.5 m depth in Borehole OH-03.

SPT ‘N’ values recorded in the fill materials varied from 22 to 43 blows per 0.3 m penetration, indicating a compact to dense relative density.

Grain size distribution analyses were completed on two samples of fill. The results are summarized on the Record of Borehole sheets in Appendix A, and the grain size distribution

curves of this fill are presented on Figure B1 of Appendix B. The results of the analyses are summarized as follows:

| Soil Particles | Percentage (%) |
|---|---|
| Gravel | 46 to 47 |
| Sand | 41 |
| Silt and Clay | 12 to 13 |

The measured water contents of the fill material ranged from 2% to 4%.

### 4.3 Silty Sand Till

Underlying the pavement structure in all boreholes was a cohesionless till consisting of silty sand with trace to some gravel and trace to some clay. In Borehole OH-01, the silty sand till extended to a depth of 9.8 m investigated in the borehole. In Boreholes OH-02 and OH-03, the till was 3.6 m and 2.5 m in thickness and extended to depths of 5.9 m and 4.0 m, respectively.

SPT 'N' values recorded in the silty sand till varied from 16 to 67 blows per 0.3 m penetration, indicating a compact to very dense relative density.

Grain size distribution analyses were completed on samples of the silty sand till. The results are summarized on the Record of Borehole sheets in Appendix A, and the grain size distribution curves are presented on Figure B2 of Appendix B. The results of the analyses are summarized as follows:

| Soil Particles | Percentage (%) |
|---|---|
| Gravel | 0 to 17 |
| Sand | 44 to 72 |
| Silt | 23 to 31 |
| Clay | 5 to 13 |

The measured water contents of the till ranged from 3% to 17%.

Glacial till inherently contain cobbles and boulders.

### 4.4 Silty Clay Till

A till deposit consisting of silty clay with some sand and some gravel was encountered in Borehole OH-02 underlying the silty sand till.

The silty clay till was 2.9 m thick and extended to a depth of 8.8 m (Elev. 279.7). The cohesive till was grey in colour. The measured SPT 'N' values in this till were 29 and 45 blows for 0.3 m penetration indicating a very stiff to hard consistency.

Measured moisture contents of the silty clay till samples were 8% and 10%.

Glacial till inherently contain cobbles and boulders.

### 4.5 Gravelly Sand/Silty Sand Till

A deposit of gravelly silty sand till was encountered underlying the silty clay till in Borehole OH-02. The borehole was terminated in this till layer at a depth of 9.8 m (Elev. 278.7). In Borehole OH-03, the till deposit of gravelly sand with some silt and trace clay was underlying the silty sand till to a depth of 8.1 m investigated in the borehole.

SPT tests performed in this deposit gave N-Values ranging from 66 to 94 blows per 0.3 m of penetration, indicating a very dense relative density.

Grain size analyses were completed on two samples of this deposit. The results are presented on the Record of Borehole sheets in Appendix A and are shown on Figure B3 in Appendix B. The results of the grain size distribution tests are summarized below:

| Soil Particles | Percentage (%) |
|---|---|
| Gravel | 25 to 28 |
| Sand | 39 to 49 |
| Silt | 18 |
| Clay | 8 |
| Silt and Clay | 33 |

Moisture content in this layer was measured between 6% and 13%.

Glacial till inherently contains cobbles and boulders.

### 4.6 Groundwater Conditions

Groundwater conditions were observed during drilling operations and water levels were measured in the boreholes upon completion of drilling. The water levels as observed during drilling and on completion of drilling are summarized below.

**Table 4.1 Water Level Observations in Boreholes**

| Borehole Number | Date | Depth /Elevation (m) | Comments |
|---|---|---|---|
| OH-01 | Dec. 17, 2015 | 6.4 m / Elev. 290.0<br>2.1 m / Elev. 294.3 | During drilling operations<br>On completion of drilling |
| OH-02 | Dec. 17, 2015 | 2.4 m / Elev. 286.1<br>2.7 m / Elev. 285.8 | During drilling operations<br>On completion of drilling |
| OH-03 | Mar. 22, 2016 | 7.0 m | During drilling and on completion of drilling |

It should be noted that these are very short term observations and the actual groundwater levels may be higher and are subject to seasonal fluctuations and severe climatic events.

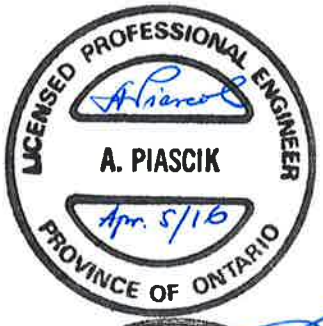
## 5.0 MISCELLANEOUS

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

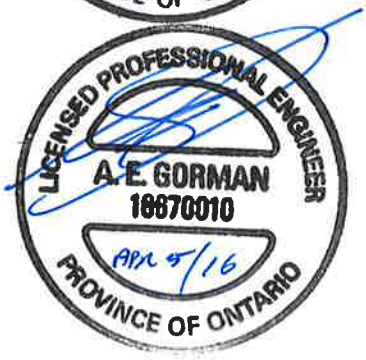
Altech Drilling and Investigative Services Ltd. of Elmira, Ontario, supplied and operated the drilling, sampling and in-situ testing equipment for the field program. The field investigation was supervised on a full time basis by Mr. Tim Craplewe in December 2015, and Mr. George Azzopardi in March 2016, both of Thurber. Overall supervision of the investigation program was conducted by Mr. Stephane Loranger, C.E.T.

Routine laboratory testing was carried out by Thurber's geotechnical laboratory in Oakville, Ontario. Interpretation of the data and preparation of this report was carried out by Ms. Anna Piascik, P.Eng. The report was reviewed by Mr. Alastair Gorman, P.Eng. and by Dr. P.K. Chatterji, P.Eng., who is a Designated Principal Contact for MTO Foundations Projects.

**Thurber Engineering Ltd.**




Anna Piascik, P.Eng.
Senior Geotechnical Engineer




Alastair Gorman, P.Eng.
Senior Foundation Engineer/Senior Associate


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

**TABLE 1**
**FOUNDATION DESIGN PARAMETERS**
**OVERHEAD SIGN SUPPORTS**
**HIGHWAY 401, CITY OF WOODSTOCK**
**G.W.P. 3054-13-00**

| Approx. Sign Location | Relevant Borehole No | Simplified Stratigraphy | Ground Surface Elev. (m) | Depth Below Existing Grade (m) | Foundation Design Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $c_u$ (kPa) | $\phi'$ (deg.) | $\gamma$ (kN/m$^3$) | $\gamma'$ (kN/m$^3$) | $n_h$ (MN/m$^3$) | $K_p$ | Groundwater depth (m) |
| Sta. 10+700 | OH-03 | Sand and Gravel Fill | - | 0.2 – 1.5 | - | 30 | 20 | - | 3.0 | 3.0 | |
| | | Silty Sand Till (above wl) | | 1.5 – 4.0 | - | 33 | 21 | - | 6.5 | 3.4 | |
| | | Gravelly Sand Till (above wl) | | 4.0 – 7.0 | - | 35 | 21 | - | 10.0 | 3.7 | 7.0 |
| | | Gravelly Sand Till (below wl) | | 7.0 – 8.1 | - | 35 | - | 11 | 6.0 | 3.7 | |
| Sta. 11+200*) | OH-01 | Sand and Gravel Fill | 296.4 | 0.3 – 1.5 | - | 30 | 20 | - | 3.0 | 3.0 | |
| | | Silty Sand Till (above wl) | | 1.5 – 2.1 | - | 32 | - | 11 | 4.0 | 3.3 | 2.1 |
| | | Silty Sand Till (below wl) | | 2.1 – 9.8 | - | 34 | - | 11 | 5.5 | 3.5 | |
| Sta. 11+700 | OH-02 | Sand and Gravel Fill | 288.5 | 0.2 – 2.3 | - | 30 | 20 | - | 3.0 | 3.0 | |
| | | Silty Sand Till | | 2.3 – 5.9 | - | 32 | - | 11 | 4.0 | 3.3 | 2.7 |
| | | Silty Clay Till | | 5.9 – 8.8 | 100 | - | - | 9 | - | - | |
| | | Gravelly Silty Sand Till | | 8.8 - 9.8 | - | 35 | - | 11 | 6.0 | 3.7 | |

*) Overhead Sign at Sta. 11+200 has been relocated to Sta. 10+700.

Legend:

$c_u$ = undrained shear strength
$\phi'$ = angle of internal friction
$\gamma$ = bulk unit weight
$\gamma'$ = submerged unit weight
$K_p$ = coefficient of passive earth pressure.

Note: The ultimate lateral resistance in front of the caisson within the upper 1.3 m below the final grade should be neglected to account for frost action and surficial disturbance.

# Appendix A

## Record of Borehole Sheets

# SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

▼ Water Level

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

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

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

UNIFIED SOILS CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

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

GWP# 3054-13-00 LOCATION N 4 774 656.0 E 203 413.7 ORIGINATED BY TIM

HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2015.12.17 - 2015.12.17 CHECKED BY AMP

| 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 γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 296.4 | GROUND SURFACE | | | | | | | | | | |
| 0.0 / 296.1 | **ASPHALT:** (250mm) | | | | | | | | | | |
| 0.3 | **SAND** and **GRAVEL**, some silt<br>Dense<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 42 | | 296 | | ○ | | |
| 294.9 | | | 2 | SS | 36 | | 295 | | ○ | | 46 41 13 (SI+CL) |
| 1.5 | Silty **SAND**, some gravel, some clay<br>Compact to Very Dense<br>Brown<br>Moist<br>(TILL) | | 3 | SS | 34 | ▽ | | | ○ | | |
| | | | 4 | SS | 23 | | 294 | | ○ | | 10 46 31 13 |
| | | | 5 | SS | 16 | | 293 | | ○ | | |
| | | | 6 | SS | 67 | | 292 | | ○ | | |
| | | | 7 | SS | 49 | | 291 | | ○ | | 17 44 27 12 |
| | | | 8 | SS | 48 | | 290 | | ○ | | |
| | | | 9 | SS | 35 | | 289 | | ○ | | |
| 286.6 | | | | | | | 288 | | | | |
| 9.8 | END OF BOREHOLE AT 9.8m. | | | | | | 287 | | ○ | | |

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+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S 1224.GPJ 2015TEMPLATE(MTO).GDT 2/11/16

Ministry of Transportation
Ontario

THURBER

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

GWP# 3054-13-00 LOCATION N 4 774 656.0 E 203 413.7 ORIGINATED BY TIM

HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2015.12.17 - 2015.12.17 CHECKED BY AMP

| 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 (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| | Continued From Previous Page | | | | | | | | | | |
| | WATER ENCOUNTERED AT 6.4m DEPTH DURING DRILLING. WATER LEVEL AT 2.1m DEPTH ON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO 1.8m, BENTONITE CHIPS TO 0.3m, CONCRETE MIX TO 0.1m, THEN COLD MIX TO SURFACE. | | | | | | | | | | |

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

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

ONTMT4S 1224.GPJ 2015TEMPLATE(MTO).GDT 2/11/16

Ministry of Transportation
Ontario

THURBER

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

GWP# 3054-13-00 LOCATION N 4 774 948.8 E 203 814.5 ORIGINATED BY TIM

HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2015.12.17 - 2015.12.17 CHECKED BY AMP

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 288.5 | GROUND SURFACE | | | | | | | | | | |
| 0.0 | **ASPHALT:**(150mm) | | | | | | | | | | |
| 0.2 | **SAND** and **GRAVEL**, some silt<br>Compact to Dense<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 38 | | 288 | | ○ | | |
| | | | 2 | SS | 25 | | | | ○ | | |
| 286.2 | | | 3 | SS | 22 | | 287 | | ○ | | |
| 2.3 | Silty **SAND**, trace to some gravel, trace clay<br>Compact to Dense<br>Brown<br>Wet<br>(TILL) | | 4 | SS | 18 | ▽ | 286 | | | | |
| | | | 5 | SS | 18 | | 285 | | ○ | | 0 72 23 5 |
| | | | 6 | SS | 35 | | 284 | | ○ | | |
| 282.6 | | | | | | | 283 | | | | |
| 5.9 | Silty **CLAY**, some sand, some gravel<br>Very Stiff to Hard<br>Grey<br>Moist<br>(TILL) | | 7 | SS | 29 | | 282 | | ○ | | |
| | | | 8 | SS | 45 | | 281 | | ○ | | |
| 279.7 | | | | | | | 280 | | | | |
| 8.8 | Gravelly Silty **SAND**, trace clay<br>Very Dense<br>Grey<br>Wet<br>(TILL) | | 9 | SS | 87 | | 279 | | ○ | | 28 39 33 (SI+CL) |
| 278.7 | | | | | | | | | | | |
| 9.8 | END OF BOREHOLE AT 9.8m. | | | | | | | | | | |

Continued Next Page

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

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

ONTMT4S 1224.GPJ 2015TEMPLATE(MTO).GDT 2/11/16

Ministry of Transportation
Ontario

THURBER

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

GWP# 3054-13-00 LOCATION N 4 774 948.8 E 203 814.5 ORIGINATED BY TIM

HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2015.12.17 - 2015.12.17 CHECKED BY AMP

| 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 | | | | | | | | | | |
| | WATER LEVEL AT 2.4m DEPTH DURING DRILLING AND AT 2.7m DEPTH ON COMPLETION OF DRILLING.<br>BOREHOLE BACKFILLED WITH CUTTINGS TO 4.0m, BENTONITE CHIPS TO 0.3m, CONCRETE MIX TO 0.1m, THEN COLD MIX TO SURFACE. | | | | | | | | | | |

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

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S 1224.GPJ 2015TEMPLATE(MTO).GDT 2/11/16

Ministry of Transportation
Ontario

THURBER

# RECORD OF BOREHOLE No OH-03 1 OF 1 METRIC

GWP# 3054-13-00 LOCATION N 4 774 319.9 E 203 020.6 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2016.03.22 - 2016.03.22 CHECKED BY AMP

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | | | | | | | | | | |
| 0.0 | **ASPHALT:** (200mm) | | | | | | | | | | |
| 0.2 | **SAND** and **GRAVEL,** some silt<br>Dense<br>Brown<br>Moist<br>(FILL) | | 1 | SS | 40 | | | | ○ | | 47 41 12 (SI+CL) |
| | | | 2 | SS | 43 | | | | ○ | | |
| 1.5 | Silty **SAND**, some clay, trace gravel<br>Compact to Dense<br>Brown<br>Moist<br>(TILL) | | 3 | SS | 26 | | | | ○ | | |
| | | | 4 | SS | 31 | | | | ○ | | |
| | | | 5 | SS | 26 | | | | ○ | | |
| 4.0 | Gravelly **SAND**, some silt, trace clay<br>Very Dense<br>Brown<br>Moist<br>(TILL) | | 6 | SS | 66 | | | | ○ | | 25 49 18 8 |
| | | | 7 | SS | 91 | | | | ○ | | |
| | Becoming wet below 7.0m depth | | | | | ▽ | | | | | |
| | | | 8 | SS | 94 | | | | ○ | | |
| 8.1 | END OF BOREHOLE AT 8.1m.<br>BOREHOLE OPEN TO 8.1m AND WATER LEVEL AT 7.0m.<br>BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.6m, CONCRETE TO 0.2m, THEN ASPHALT PATCH TO SURFACE. | | | | | | | | | | |

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

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

ONTMT4S 1224.GPJ 2015TEMPLATE(MTO).GDT 3/31/16

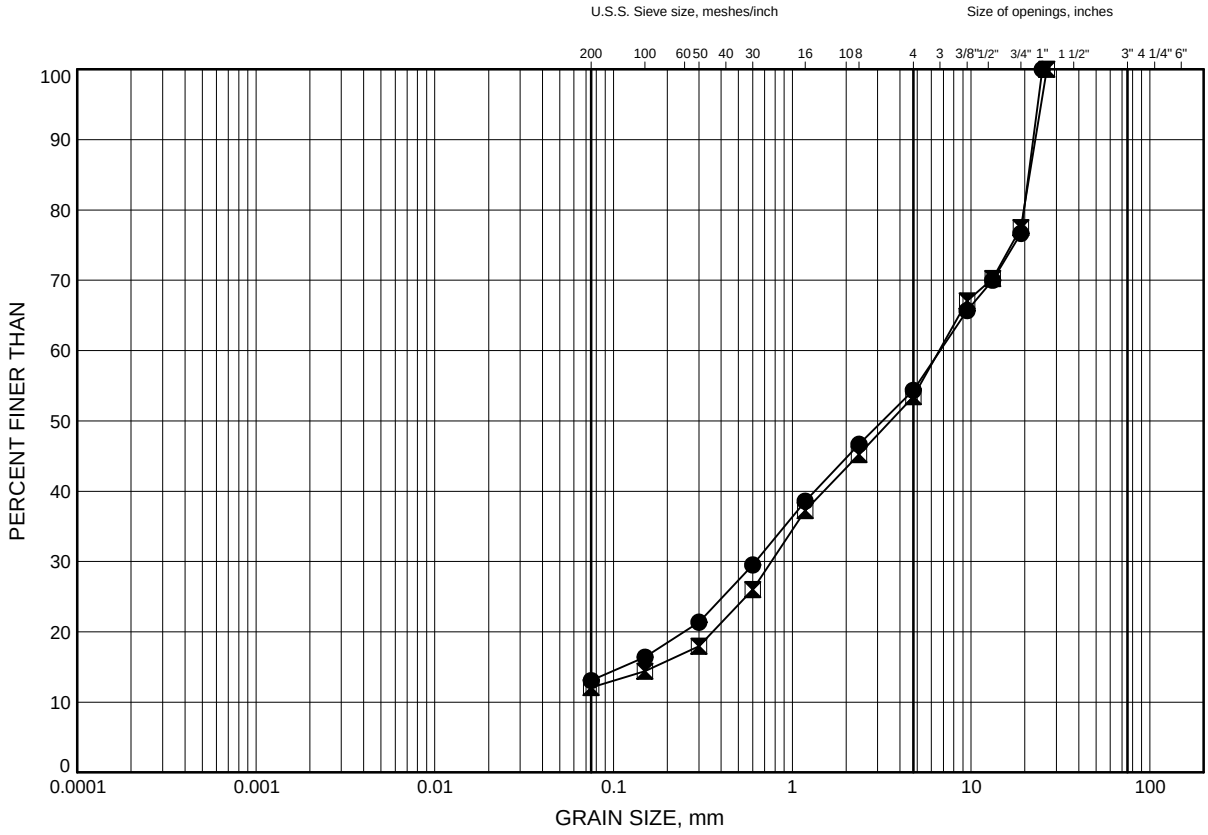
# Appendix B

## Laboratory Test Results

# GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND & GRAVEL FILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | OH-01 | 1.22 | 295.18 |
| ⧓ | OH-03 | 0.53 | |

Date March 2016

GWP# 3054-13-00

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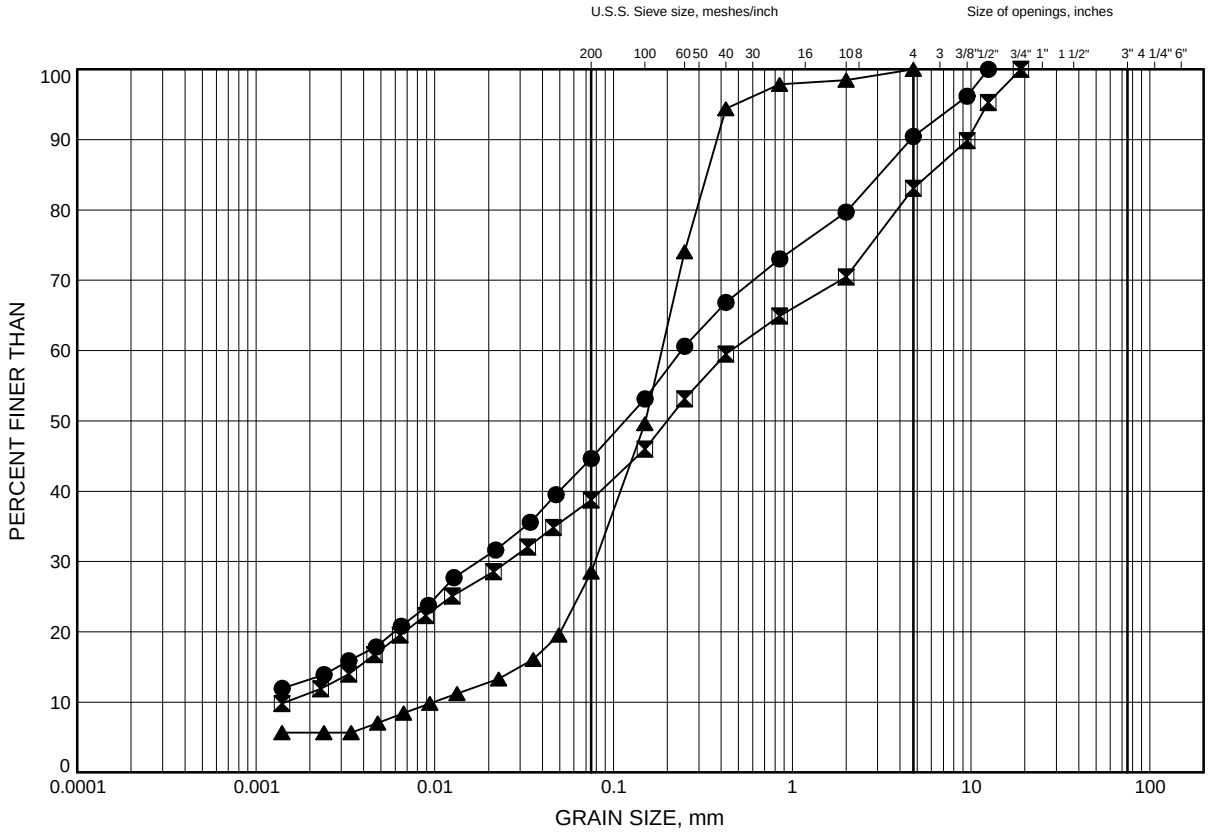
GRAIN SIZE DISTRIBUTION - THURBER 1224.GPJ 3/30/16

# GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty SAND TILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | OH-01 | 2.59 | 293.81 |
| ⊠ | OH-01 | 6.40 | 290.00 |
| ▲ | OH-02 | 3.35 | 285.15 |

Date March 2016

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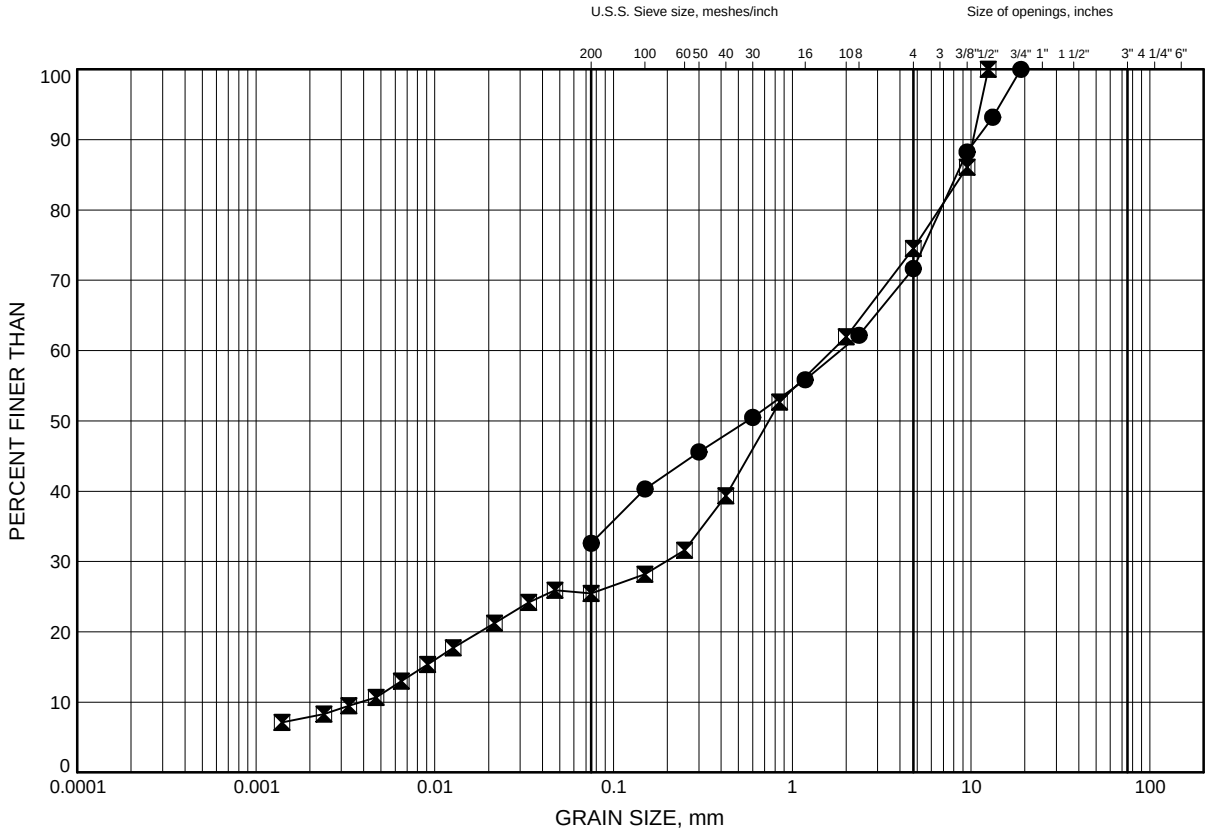
GRAIN SIZE DISTRIBUTION - THURBER 1224.GPJ 3/30/16

# GRAIN SIZE DISTRIBUTION

FIGURE B3

## Gravelly Silty SAND TILL




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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|---|---|---|---|
| ● | OH-02 | 9.45 | 279.05 |
| ⧓ | OH-03 | 4.88 | |

Date March 2016

GWP# 3054-13-00

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GRAIN SIZE DISTRIBUTION - THURBER 1224.GPJ 3/30/16

**Appendix C**

**Borehole Location Plan**

MINISTRY OF TRANSPORTATION, ONTARIO

E 203 000 | E 203 100 | E 203 200 | E 203 300 | E 203 400 | E 203 500 | E 203 600 | E 203 700 | E 203 800 | E 203 900 | E 204 000 | E 204 100

N 4 775 200
N 4 775 100
N 4 775 000
N 4 774 900
N 4 774 800
N 4 774 700
N 4 774 600
N 4 774 500
N 4 774 400

NORWICH AVENUE

RAMP W-N/S

18.75m [5-LANE]

OH-02
PROPOSED OH SIGN
11+700, 33.08m From HWY 401 CL

PATTULLO AVENUE WEST

HIGHWAY 401

Cedar Creek

18.75m [5-LANE]

OH-01
PROPOSED OH SIGN
11+200, 31.30m From HWY 401 CL

OH-03

PLAN
80 0 80 160m
SCALE 1:4000

DRAWING NOT TO BE SCALED
50mm ON ORIGINAL DRAWING

CONT No
GWP No 3054-13-00

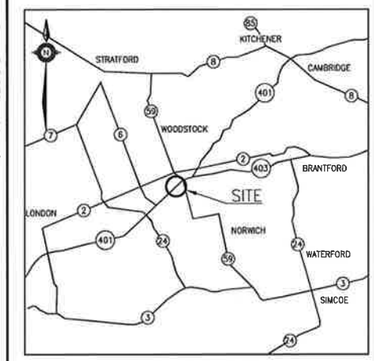
HIGHWAY 401
CITY OF WOODSTOCK
OVERHEAD SIGNS
BOREHOLE LOCATIONS PLAN

SHEET

MMM GROUP

METRIC

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 |
|---|---|---|---|
| OH-01 | 296.4 | 4 774 656.0 | 203 413.7 |
| OH-02 | 288.5 | 4 774 948.8 | 203 814.5 |
| OH-03 | – | 4 774 319.9 | 203 020.6 |

-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. 40P2-82**

LICENSED PROFESSIONAL ENGINEER
A. PIASCIK
Apr. 5/16
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. N. CHATTERJI
Apr 15/16
PROVINCE OF ONTARIO

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

| | | | | | |
|---|---|---|---|---|---|
| DESIGN | AMP | CHK | PKC | CODE | LOAD |
| DRAWN | MFA | CHK | AMP | SITE | STRUCT |

DATE MAR 2016
DWG 1

CAD FILE LOCATION AND NAME: H:\Drafting\195\161224\tod122a-BoreholePlan-HWY401(OverheadSigns).dwg
MODIFIED: 3/30/2016 4:55:52 PM BY: DRAFTING02
DATE PLOTTED: 3/31/2016 2:09:58 PM BY: DRAFTING02