THURBER ENGINEERING LTD.

FOUNDATION INVESTIGATION REPORT
OVERHEAD SIGN REPLACEMENT
NICHOLAS STREET ON-RAMP TO HIGHWAY 417
OTTAWA, ONTARIO

GWP 4048-11-00
WP 4253-15-01

Geocres No.: 31G5-290

Report to:

WSP Canada

Latitude: 45.4182
Longitude: -75.6772

March 2018
Thurber File: 18006

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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed for the proposed overhead sign replacement on the Nicholas Street on-ramp to Highway 417 within the City of Ottawa. Thurber Engineering Limited (Thurber) carried out the current investigation as a sub-consultant to WSP Canada (WSP) under 4015-E-0013, Assignment 18.

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, laboratory test results and a written description of the subsurface conditions.

2 SITE DESCRIPTION

An existing overhead sign is present over the southbound lanes of the Nicholas Street on-ramp to Highway 417. The sign is located about 320 metres north of the existing Highway 417 overpass structure and about 90 metres south of the Mann Avenue overpass structure. The sign spans three lanes of traffic with the eastern footing located on the concrete median of Nicholas Street and the western footing located on the embankment just outside the roadway on the west side of the existing guardrail. It is understood that the new overhead sign will be located about 5.9 m north of the existing sign and will have similar dimensions, but with the western footing located further from the guardrail (about 3.6 m) than existing.

The existing ground surface elevation of Nicholas Street at the sign location is about 67 m. The embankment slope on the west side of Nicholas Street is vegetated with grass and has a slope inclination of about 15H:1V.

Select photographs showing the area of the new sign are included in Appendix D for reference.

A review of previous borehole records in the vicinity of this site indicate that the subsurface conditions in this area consist of fill overlying a cohesive deposit of native silty clay to clayey silt, over a non-cohesive silt to sand, over glacial till. Published geological mapping indicates that the depth to bedrock is in the range of 10 to 15 metres below the pre-development

ground surface. The bedrock surface was confirmed at previous boreholes at the nearby Nicholas Street overpass at elevations ranging from of 49 m to 55 m (see Geocres references below), which is about 12 to 18 m below the existing ground surface at the overhead sign location. The published geological mapping indicates that the bedrock consists of shale of the Carlsbad Formation.

The following foundation investigation reports were obtained from the online Geocres library and reviewed in preparation of this report:

- Preliminary Site Investigation, Proposed Queensway – Nicholas Street Interchange, Bridges 38, 39, 40 and 41, Ottawa, Ontario, dated December 1963. [Geocres 31G05-056].
- Site Investigation, Proposed Canal Road Bridge No. 38, Stage IV Interchange, Ottawa Queensway, W.P. 954-59, Ottawa, Ontario, dated March 1964. [Geocres 31G05-062].

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program was carried out on October 26th and 27th, 2017. The field investigation consisted of advancing two boreholes identified as 17-01 and 17-02. The drilling was carried out using a track mounted CME 550 drill rig (Borehole 17-01) and a truck mounted CME 55 drill rig (Borehole 17-02). Prior to the commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). In-situ vane shear testing was completed in the cohesive soil deposits. Boreholes 17-01 and 17-02 were drilled and sampled to depths of 9.8 and 10.4 m below the existing ground surface, respectively (elev. 56.3 and 56.7 m, respectively).

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

A vibrating wire piezometer was installed in Borehole 17-01 with its sensor tip at a depth below ground surface of 8.4 m (elev. 57.7 m) to allow for measurements of the groundwater level after completion of drilling. The vibrating wire piezometer was installed within sand and sealed with bentonite. Following completion of the field investigation, the vibrating wire piezometer will be decommissioned. The boreholes were backfilled in general accordance with MOEE requirements (O.Reg. 903).

The approximate borehole locations are shown on the Borehole Location drawing included in Appendix A. The coordinates and elevation of the boreholes are provided on this drawing and on the individual Record of Borehole sheets.

4 LABORATORY TESTING

Geotechnical laboratory testing consisted of visual identification and natural moisture content determination on all the recovered soil samples. Grain size distribution and Atterberg Limit testing were also carried out on selected soil samples. One sample of soil

recovered from Borehole 17-02 was selected and submitted for analytical testing of corrosivity parameters and sulphate content.

The results of the geotechnical laboratory testing are summarized on the Record of Borehole sheets included in Appendix B and all laboratory test results are provided in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location drawing included in Appendix A. A general description of the stratigraphy based on the conditions encountered in the boreholes from the current investigation is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

In general terms, the subsurface conditions at the borehole locations consist of surficial pavement structure overlying heterogeneous embankment fill, the lower portions of which contain waste debris (e.g., coal, brick, ash). The off-road borehole encountered topsoil above the fill. The fill is underlain by a native deposit of sensitive marine clay.

5.2 Fill

5.2.1 Surficial Pavement Structure

Borehole 17-02 was drilled through the pavement structure of Nicholas Street in the easternmost southbound lane. The pavement structure consisted of 200 mm of asphaltic concrete over granular fill consisting of gravel with sand. The granular fill was 1.0 m thick with a base elevation of 65.9 m.

Two SPT tests conducted in the granular fill gave N-values of 34 and 47 blows, indicating a dense state of packing.

The recorded moisture contents of the two granular fill samples were 2 and 14%.

5.2.2 Surficial Silty Sand (Topsoil)

Borehole 17-01 was drilled on the west side of the Nicholas Street embankment and encountered topsoil at the surface. The topsoil consisted of silty sand with organics and had a thickness of 500 mm.

An SPT test conducted in the topsoil gave an N-value of 5 blows per 0.3 m of penetration, indicating a loose state of packing.

The recorded moisture content of the topsoil sample was 29%.

5.2.3 Heterogeneous Fill

Heterogeneous embankment fill was present below the pavement structure or topsoil at both of the borehole locations. The composition of the fill is highly variable and ranges from sand, to silty sand, to clay, and contains variable amounts of gravel and waste debris (e.g.,

coal, brick, ash). Borehole 17-01 encountered a 0.9 m thick layer of waste at a depth of 2.9 m. Cobbles and/or boulders could also be present within the fill based on the resistance to augering encountered during drilling. The heterogeneous embankment fill was 4.7 and 7.6 m thick at Boreholes 17-01 and 17-02, respectively, with base elevations of 60.9 and 58.2 m, respectively.

The SPT tests conducted in the heterogeneous fill gave N-values ranging from 2 to 33 blows, indicating a very loose to dense state of packing.

The recorded moisture contents of the heterogeneous fill samples that contained primarily cohesionless soil ranged from 4 to 16%. The recorded moisture contents of the two samples that contained primarily clay were 32 and 33 percent.

The results of grain size distribution testing conducted on five samples of the heterogeneous fill are summarized below and are illustrated on Figure C1 in Appendix C.

Soil Particle	Percentage (%)	
	Primarily Sand Samples	Primarily Clay Sample
Gravel	3 – 39	0
Sand	52 – 90	10
Silt	7 – 40	29
Clay		61

Atterberg Limit testing was completed on two samples of the heterogeneous fill (one sample of primarily clay and one sample of primarily silty sand that also contained waste and pockets of silty clay). The results are summarized on the Record of Borehole sheets in Appendix B and on Figure C3 in Appendix C. The results of the Atterberg limit testing indicated that the clay fill sample had a Liquid Limit of 59%, a Plasticity Limit of 25% and a Plasticity Index of 34%, which indicate that the clay fill has high plasticity. The results also indicated that the silty sand fill sample was non-plastic.

5.3 Marine Clay

A native deposit of sensitive marine clay was present below the heterogeneous fill.

At Borehole 17-01, the marine clay contains trace sand and is grey in colour. The clay in Borehole 17-01 was not fully penetrated, but was proven to extend to a minimum depth of 9.8 m depth (elevation 56.3 m). SPT tests conducted in the grey clay gave N-values of 2 to 7 blows. Field vane tests were performed within the deposit and recorded undrained shear strengths ranging from 42 to greater than 106 kPa, indicating a firm to very stiff consistency. Remoulded field vane testing in the grey clay indicates sensitivity. The recorded moisture contents of the grey clay samples ranged from 44 to 61%.

At Borehole 17-02, the marine clay is grey brown in colour and contains sand seams and natural wood fragments below elev. 54.4 m. The clay in borehole 17-02 was not fully penetrated, but was proven to extend to a minimum depth of 10.4 m (elevation 56.7 m). Two SPT tests conducted in the grey brown clay gave N-values of 1 and 7 blows, indicating

a firm to very stiff consistency based on similar results observed in Borehole 17-01. The recorded moisture contents of the grey brown clay samples ranged from 24 to 36%.

The results of grain size distribution testing conducted on three samples of the marine clay are summarized below and are illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0 – 1
Sand	2 – 32
Silt	28 – 36
Clay	35 – 70

Atterberg Limit testing was completed on three samples of the marine clay. The results are summarized on the Record of Borehole sheets in Appendix B and on Figure C4 in Appendix C. The laboratory results are summarized below and indicate that the clay is of low to high plasticity (CL/CI/CH).

Parameter	Value
Liquid Limit	32 – 62
Plastic Limit	15 – 25
Plasticity Index	17 – 37

5.4 Groundwater

At the completion of drilling, a vibrating wire piezometer was installed in Borehole 17-01 with its sensor tip at a depth of 8.4 m (elev. 57.7 m) to allow for measurements of the groundwater level. The groundwater level was measured at an approximate depth of 2.6 m (elev. 63.5 m) on November 27th, 2017.

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be higher and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation during the spring and/or after periods of significant and/or prolonged precipitation.

5.5 Analytical Testing

One sample of soil was submitted to Paracel Laboratories in Ottawa, Ontario for analysis of water soluble sulphate and chloride concentrations, pH, and resistivity. The analysis results are included in Appendix C and are summarized in the table below:

Borehole	Sample	Depth (m)	Sulphate (μg/g)	pH	Resistivity (Ohm-m)	Chloride (μg/g)
17-02	SS3	1.5 – 2.1	1,700	7.86	3.90	763

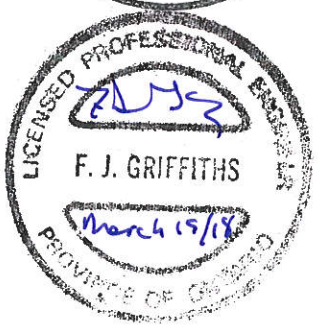
6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features and the anticipated foundation locations. The as-drilled locations and ground surface elevation were measured by Thurber following completion of the field program relative to a temporary benchmark provided by WSP.

George Downing Estate Drilling Ltd. of Hawksbury, Ontario supplied and operated the drilling equipment to conduct the drilling, soil sampling, in-situ testing, vibrating wire piezometer installation and borehole decommissioning of the boreholes. Beacon Lite Ltd. of Ottawa, Ontario supplied, erected, and dismantled the traffic protection required during the drilling. The field investigation was supervised on a full-time basis by Ms. Katya Edney, P.Eng. of Thurber. Overall supervision of the investigation program was provided by Mr. Stephen Peters, P.Eng.

Geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Analytical testing was completed by Paracel Laboratories in Ottawa, Ontario. Interpretation of the factual data and preparation of this report were carried out by Mr. Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundation Projects.

Stephen Dunlop, P.Eng.
Senior Geotechnical Engineer



Dr. Fred Griffiths, P.Eng.
Senior Associate
Senior Geotechnical Engineer

Appendix A.

Borehole Location Plan

MINISTRY OF TRANSPORTATION, ONTARIO

N 5 031 400

N 5 031 300

N 5 031 200

N 5 031 100

N 5 031 000

E 368 900

E 369 000

E 369 100

E 369 200

E 369 300

E 369 400

E 369 500

17-02

17-01

LEES AVE.

TRANSITWAY

NICHOLAS ST.

HWY 417 WBL

HWY 417 EBL

PLAN

40 0 40 80m

SCALE 1:2000

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

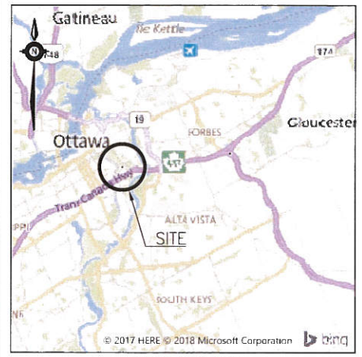
GWP No 4048-11-00

HIGHWAY 417
NICHOLAS STREET
OVERHEAD SIGN
BOREHOLE LOCATION PLAN

SHEET

wsp

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

Borehole

NO	ELEVATION	NORTHING	EASTING
17-01	66.1	5 031 234.5	369 191.2
17-02	67.1	5 031 251.4	369 198.2

-NOTES-

GEOCRES No. 31G5-290

LICENSED PROFESSIONAL ENGINEER
Mar. 19/18
S. W. DUNLOP
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LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
March 19/18
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN DJP	CHK –	CODE	LOAD	DATE MAR 2018	
DRAWN MFA	CHK SD	SITE	STRUCT	DWG 1	

FILENAME: H:\Drafting\18000\18065\TED-18065-BHPL.dwg
PLOTDATE: 3/9/2018 9:32 AM

Appendix B.

Record of Borehole Sheets

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

RECOVERY:

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

N-VALUE:

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

DYNAMIC CONE PENETRATION TEST (DCPT):

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

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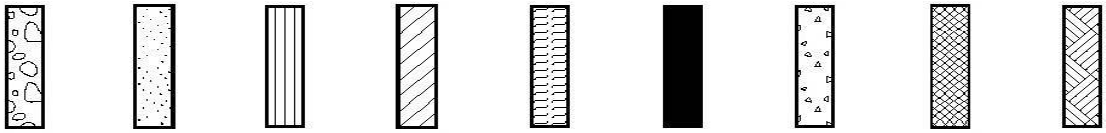
STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel
Sand
Silt
Clay
Organics
Asphalt
Concrete
Fill
Bedrock

TEXTURING CLASSIFICATION OF SOILS

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

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

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

SAMPLE TYPES

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

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

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

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MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

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EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

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

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-01 1 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 234.5 E 369 191.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.26 - 2017.10.26 CHECKED BY SD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (UNCONFINED, FIELD VANE, QUICK TRIAXIAL, LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.1											
0.0 / 65.6	SILTY SAND, trace organics **TOPSOIL** Loose Brown		1	SS	5		66				
0.5 / 64.2	SILTY SAND with gravel Very loose to dense Grey-brown **FILL** - auger resistance (grinding) on possible cobbles/boulders between 0.5 m and 0.9 m depth		2	SS	33		65				16 66 18 (SI+CL)
			3	SS	2						
1.9 / 64.0	CLAY, trace gravel Grey						64				
2.1 / 63.2	**FILL** SILTY SAND with gravel Compact Grey-brown **FILL**		4	SS	15						
2.9 / 62.3	WASTE: coal, brick and ash mixed with SILTY SAND, trace gravel Compact Black **FILL**		5	SS	18		63				
3.8 / 61.5	CLAY with sand pockets, trace gravel and WASTE: brick, ash Grey-brown **FILL**		6	SS	4		62				0 10 29 61
4.6 / 60.9	SAND Loose Brown **FILL**		7	SS	5		61				
5.2	**CLAY (CH)**, trace sand Firm to very stiff Grey		8	SS	2						
			9	SS	2		60				
							59	>>			vane attempts maxed out at 106 kPa
								>>			
			10	SS	2		58				0 2 28 70
	- becoming firm at 8.5 m							10.5 +			
								>>			vane attempt maxed out at 106 kPa
			11	SS	7		57				
56.3											
9.8	End of Borehole										

Continued Next Page

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

(%) STRAIN AT FAILURE

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-01 2 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 234.5 E 369 191.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.26 - 2017.10.26 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Vibrating Wire Piezometer (VWP) installed at 8.4 m. Groundwater level measured in VWP at 2.6 m BGS (Elev. 63.5 m) on 2017/11/27										

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

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

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-02 1 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 251.4 E 369 198.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.27 - 2017.10.27 CHECKED BY SD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
67.1											
0.0	**200 mm ASPHALT**						67				
0.2	GRAVEL with sand Dense Grey **FILL**		1	SS	47						
65.9			2	SS	34		66				
1.2	SAND, trace gravel										
65.6	Dense										
1.5	Brown **FILL**		3	SS	22		65				
	SAND with gravel, trace WASTE: bricks, coal, occasional silty clay pockets Compact to dense Grey-brown **FILL**		4	SS	15						39 53 8 (SI+CL)
63.3			5	SS	30		64				
3.8	SILTY SAND, trace to some gravel, occasional silty clay pockets Compact Grey-bown **FILL**		6	SS	15						
			7	SS	15		63				
	- trace WASTE: coal, bricks at 5.3 m - frequent sand pockets below 5.3 m		8	SS	18						8 52 25 15 non-plastic
60.0			9	SS	13		62				
7.1	SAND, trace gravel Very loose to loose Brown **FILL**		10	SS	2						
			11	SS	5		61				3 90 7 (SI+CL)
58.2			12	SS	3						
8.9	**CLAY (CL to CI)** with frequent sand seams / interbeds, trace gravel Firm to very stiff Grey-brown		13	SS	1		60				1 32 28 39
	- wood fragments below 12.7 m		14	SS	7		59				
							58				

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 17-02 2 OF 2 METRIC

GWP# 4048-11-00 LOCATION Nicholas Street Overhead Signs - MTM z9: N 5 031 251.4 E 369 198.2 ORIGINATED BY KE

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP

DATUM Geodetic DATE 2017.10.27 - 2017.10.27 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
56.7			14	SS	7		57				0 29 36 35
10.4	End of Borehole at 10.4 m										

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

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

ONTMT4S 18006_HWY417SIGNS - NICHOLAS.GPJ 2012TEMPLATE(MTO).GDT 12/3/18

Appendix C.

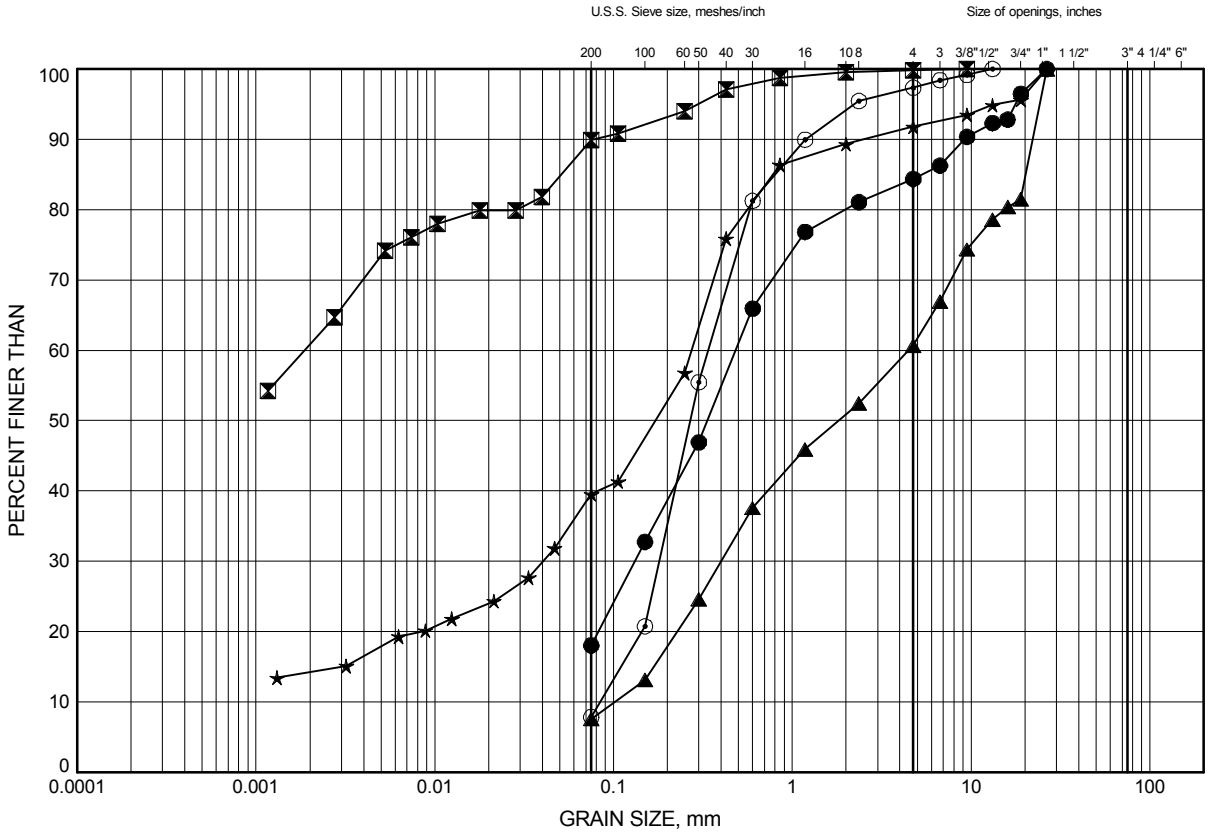
Laboratory Testing

Nicholas Overhead Signs

GRAIN SIZE DISTRIBUTION

FIGURE C1

FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	1.07	65.03
⊠	17-01	4.11	61.98
▲	17-02	2.59	64.51
★	17-02	5.64	61.46
⊙	17-02	7.92	59.17

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

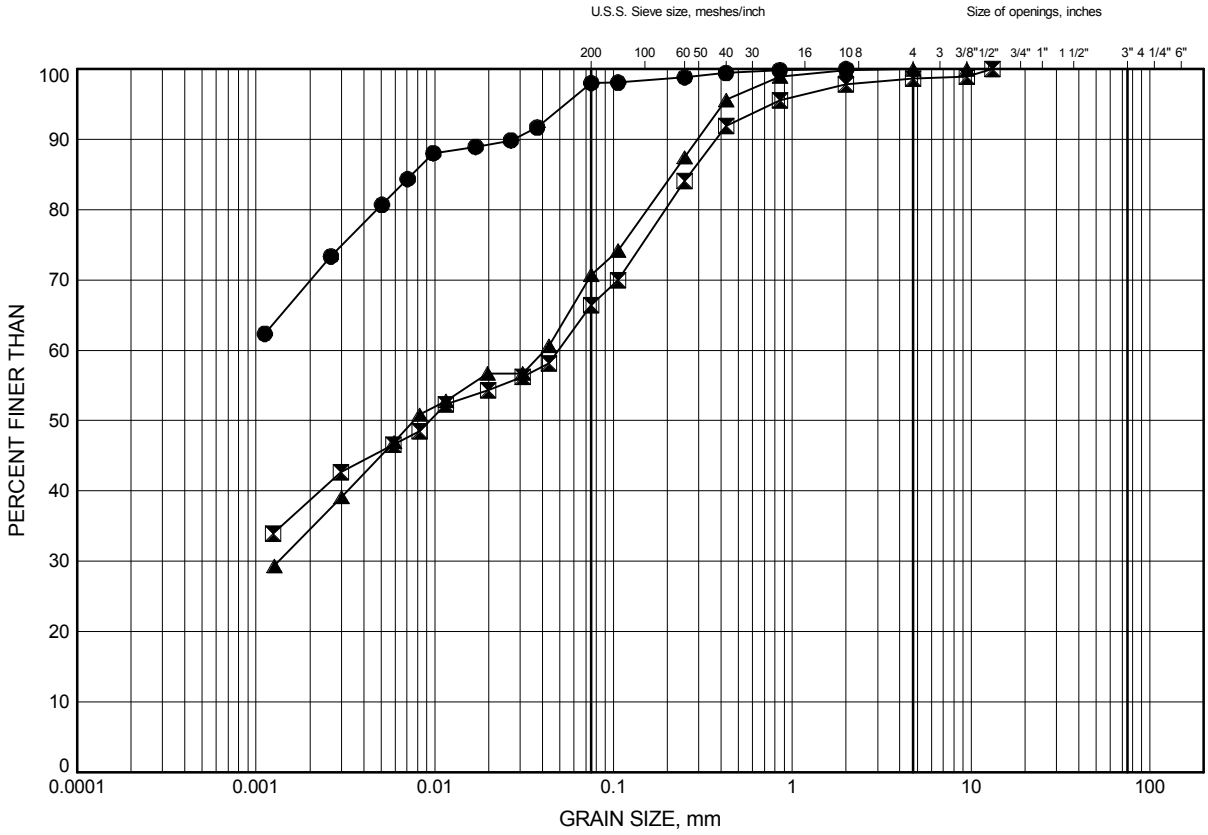
GRAIN SIZE DISTRIBUTION - THURBER 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

GRAIN SIZE DISTRIBUTION

FIGURE C2

CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	7.92	58.17
⊠	17-02	9.45	57.65
▲	17-02	10.21	56.89

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

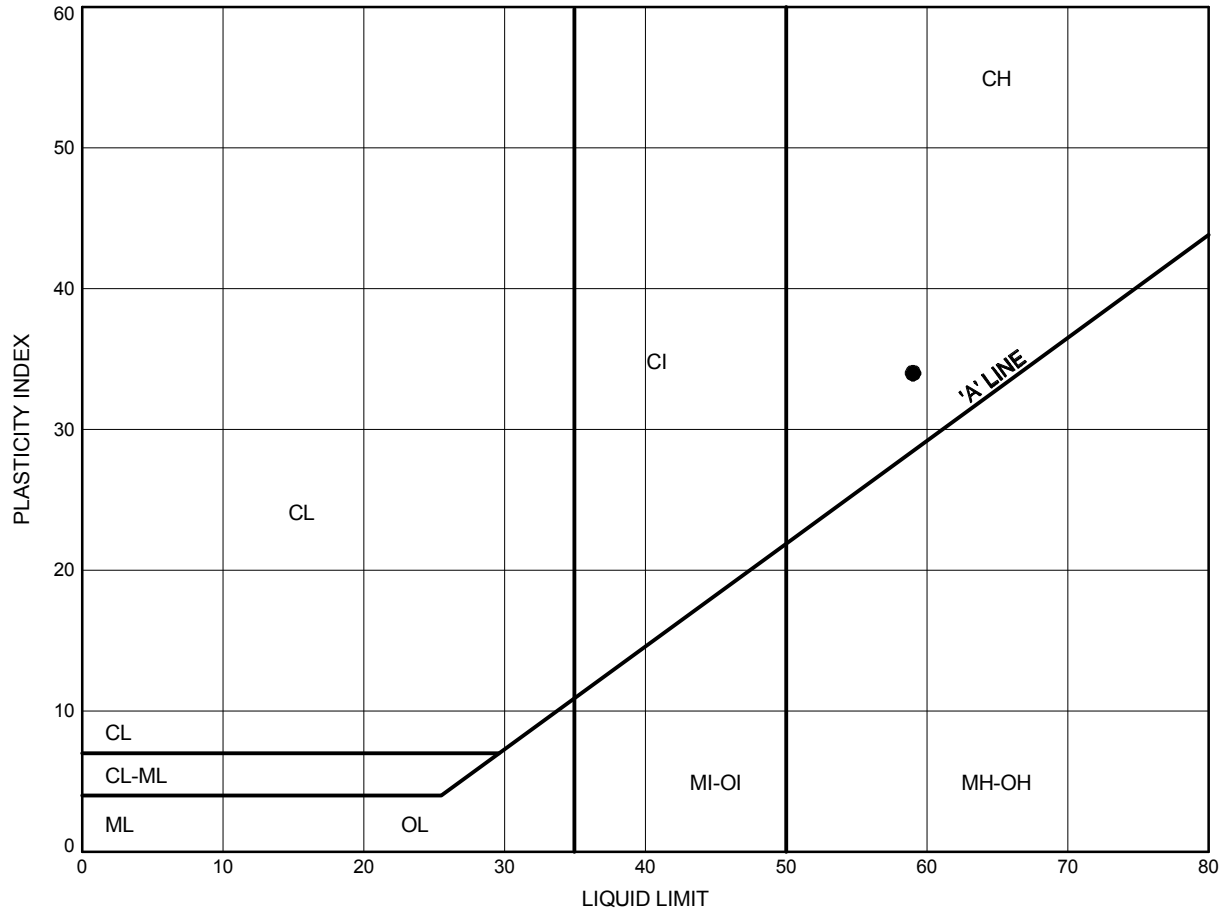
GRAIN SIZE DISTRIBUTION - THURBER 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

ATTERBERG LIMITS TEST RESULTS

FIGURE C3

FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	4.11	61.98

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

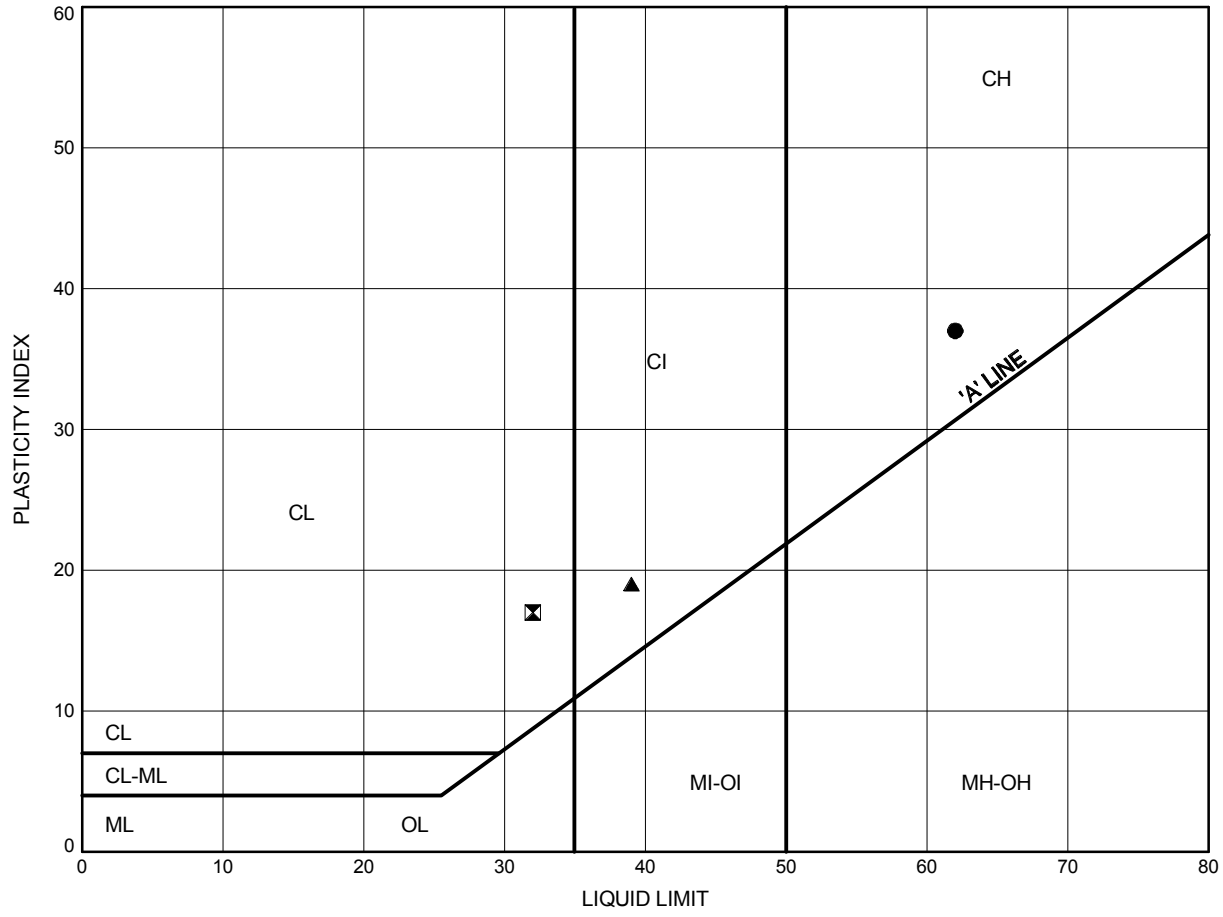
THURBALT 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Nicholas Overhead Signs

ATTERBERG LIMITS TEST RESULTS

FIGURE C4

CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	7.92	58.17
⊠	17-02	9.45	57.65
▲	17-02	10.21	56.89

Date January 2018

GWP# 4048-11-00

THURBER

Prep'd DJP

Chkd. SD

THURBALT 18006_HWY417SIGNS - NICHOLAS.GPJ 8/1/18

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 18006

Report Date: 09-Nov-2017
Order Date: 3-Nov-2017
Project Description: Hwy 417 Signs- Nicholas St

	Client ID:	17-02 SS#3 (5-7')	-	-	-
	Sample Date:	27-Oct-17	-	-	-
	Sample ID:	1744507-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	93.9	-	-	-
General Inorganics					
Conductivity	5 uS/cm	2560	-	-	-
pH	0.05 pH Units	7.86	-	-	-
Resistivity	0.10 Ohm.m	3.90	-	-	-
Anions					
Chloride	5 ug/g dry	763	-	-	-
Sulphate	5 ug/g dry	1700	-	-	-

Appendix D.

Site Photographs

Photo 1. Drill rig set up on Borehole 17-01, looking south (2017-10-26).

Photo 2. Borehole 17-01 upon completion of vibrating wire installation (2017-10-26).

Photo 3. Drill rig set up on Borehole 17-02, looking south (2017-10-27).

Photo 4. Borehole 17-02 upon completion of backfilling (2017-10-27).