



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
PROPOSED OVERHEAD SIGN  
WESTBOUND HIGHWAY 417 AT AVIATION PARKWAY OFF-RAMP  
OTTAWA, ONTARIO**

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

Geocres No.: 31G5-291

Report to:

**WSP Canada**

Latitude: 45.4230  
Longitude: -75.6171

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 on the westbound Highway 417 at the Aviation Parkway off-ramp 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**

The proposed overhead sign will span over the westbound lanes of Highway 417 about 140 metres south of the Highway 174 overpass structure. The sign will span three lanes of traffic, and the two footings will be located outside the guardrails on either side of the roadway on the existing embankment.

The existing ground surface elevation of Highway 417 at the sign location is about 75 m. The embankment slopes on both sides of Highway 417 have an inclination of about 4H:1V and are vegetated with grasses and shrubs.

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

The following foundation investigation report was obtained from the online Geocres library and reviewed in preparation of this report.

- Foundation Investigation Report for Proposed Structures (Bridges 1, 2 and 3) at the Intersection of the Ottawa Queensway with Eastern Parkway and Hwy. 417, Twp. Of Gloucester, Re. Mun. Ottawa-Carleton District #9 (Ottawa), W.O. 72-11083, dated December 1, 1972. [Geocres 31G05-086].

The previous boreholes are not located in the direct vicinity of the proposed sign and therefore are not included in this document; however, the previous investigation indicates that the subsurface conditions in the general area consist of silty sand to sand and gravel

overlying shale bedrock. The previous boreholes indicate that the bedrock surface is present at elevations ranging from about 62 to 64 m (about 3 to 5 m below the pre-development ground surface). A review of the published surficial geology mapping indicates that the site is underlain by a deposit of glacial till. The bedrock geology mapping indicates that the bedrock consists of shale of the Billings Formation.

### **3 SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing program was carried out on November 7<sup>th</sup> and 8<sup>th</sup>, 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). Both of the boreholes were drilled and sampled to a depth of 8.2 m below the existing ground surface (elev. 65.6 and 67.2 m at Boreholes 17-01 and 17-02, 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 7.4 m (elev. 66.4 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 was 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. The elevations were determined relative to a temporary benchmark established by WSP.

### **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 off-road borehole encountered topsoil above the fill. The fill is underlain by thin native deposits of organic silt and marl, which in turn are underlain by a native deposit of glacial till.

### 5.2 Fill

#### 5.2.1 Surficial Pavement Structure

Borehole 17-02 was drilled through the pavement structure of Highway 417 in the northside shoulder of the westbound lanes. The pavement structure consisted of 150 mm of asphaltic concrete over granular fill consisting of a layer of silty sand with gravel underlain by a separate layer of sand. The granular fill was 1.3 m thick with a base elevation of 73.9 m.

Two SPT tests conducted in the granular fill gave N-values of 23 and 29 blows, indicating a compact state of packing.

The recorded moisture contents of the two granular fill samples were 3 and 4%.

The results of one grain size distribution test conducted on a sample of the granular fill are summarized below and are illustrated on Figure C1 in Appendix C.

Soil Particle	Percentage (%)
Gravel	32
Sand	55
Silt	13
Clay	

#### 5.2.2 Surficial Silty Sand (Topsoil)

Borehole 17-01 was drilled on the southwest side of the Highway 417 embankment and encountered topsoil at the surface. The topsoil consisted of silty sand with organics and had a thickness of 400 mm.

An SPT test conducted in the topsoil gave an N-value of 7 blows, indicating a loose state of packing.

The recorded moisture content of the topsoil sample was 23%.

### 5.2.3 Heterogeneous Fill

Heterogeneous embankment fill was present below the pavement structure or topsoil at both borehole locations. The fill is generally composed of silty sand with gravel. 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 7.2 m thick at Borehole 17-01 with a base elevation of 66.2 m. At Borehole 17-02, the embankment fill was not fully penetrated, but was proven to extend to a minimum depth of 8.2 m (elev. 67.2 m).

The SPT tests conducted in the heterogeneous fill gave N-values ranging from 13 to 51 blows, indicating a compact to very dense state of packing.

The recorded moisture contents of the heterogeneous fill samples ranged from 3 to 17%.

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

Soil Particle	Percentage (%)
Gravel	12 – 24
Sand	52 – 53
Silt	23 – 36
Clay	

### 5.3 Organic Silt and Marl

A thin layer of native organic silt was present below the heterogeneous fill at Borehole 17-01. The organic silt was 300 mm thick with a base elevation of 65.9 m. The recorded moisture content of the organic silt sample was 87%.

A thin layer of marl was present below the organic silt at Borehole 17-01. The marl was 230 mm thick with a base elevation of about 65.6 m. The recorded moisture content of the marl sample was 68%. Atterberg limit testing carried out on the marl sample indicated that the sample is non-plastic. The results of grain size distribution testing conducted on the sample of the marl are summarized below and are illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	15
Silt	53
Clay	32

The SPT test conducted in the combined organic silt and marl layers gave an N-value of 22 blows. This N-value would generally indicate a compact state of packing; however, it should be recognized that the correlation between N values and relative density are not intended for organic soils such as organic silt and marl.

#### 5.4 Silty Sand with Gravel (Glacial Till)

A native deposit of silty sand with gravel (glacial till) was present below the marl in Borehole 17-01. The glacial till was only penetrated about 10 mm; however, the glacial till deposits in the Ottawa area are generally considered to consist of a heterogeneous mixture of gravel, cobbles and boulders in a matrix of silty sand. The glacial till was not fully penetrated in Borehole 17-01, but was proven to extend to a minimum depth of 8.2 m (elev. 65.6 m).

The recorded moisture content of the glacial till sample was 14%.

#### 5.5 Groundwater

At the completion of drilling, a vibrating wire piezometer was installed in Borehole 17-01 with its sensor tip at a depth of 7.4 m (elev. 66.4 m) to allow for measurements of the groundwater level. On January 4<sup>th</sup>, 2018, the vibrating wire piezometer indicated that the borehole was dry (no groundwater was detected at the sensor tip).

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 after periods of significant and/or prolonged precipitation.

#### 5.6 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	SS4	2.3 – 2.9	328	8.08	13.5	222

## 6 MISCELLANEOUS

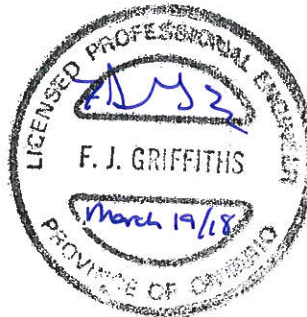
Borehole locations were selected by Thurber relative to existing site features and the anticipated foundation locations. The as-drilled locations and ground surface elevation were measured by Thurber following completion of the field program relative to a temporary benchmark provided by WSP.

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



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**PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 GENERAL**

This section of the report presents interpretation of the factual data in Part 1 of this report for the proposed overhead sign on the westbound Highway 417 at the Aviation Parkway off-ramp within the City of Ottawa. Geotechnical assessment and recommendations are provided to assist the design team in designing a suitable foundation for the proposed overhead sign.

Information on the general location of the proposed sign was provided to Thurber by WSP. It is anticipated that the sign will be designed as a tri-chord static sign with two supports. Based on the design layout, one borehole was drilled near each of the sign support locations to provide subsurface information for detailed foundation design of the sign supports. The Records of Boreholes are presented in Appendix B.

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

**7.1 Foundation Design Parameters**

Design of the sign support foundations should be carried out in accordance with the following document:

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Provincial Highways Management Division, Highway Standards Branch, Bridge Office (Reference 1).

Reference should also be made to the following document:

- Canadian Highway Bridge Design Code (2014) CSA S6-14 (Reference 2).

The sign supports should be designed in accordance with the MTO Sign Support Manual for a Tri-Chord Static Sign (Section 4). Based on this document, each sign support would typically consist of a 1,200 mm diameter concrete caisson as shown in standard drawing SS118-3 of the Sign Support Manual (copy in Appendix E). The standard footing details a minimum footing depth extending to 5 m below the frost depth, which is given as 1.8 m per OPSD 3090.101.

The standard design is based on the minimum soil parameters outlined in Section 4.5.4 of the Sign and Support Manual. At this site, the foundation soil consists of engineered embankment fill (compact to very dense silty sand with gravel, which also likely contains cobbles and/or boulders). The geotechnical design parameters for this material, which are summarized in Table E1 in Appendix E, are better than the minimum soil parameters outlined in Section 4.5.4 of the Sign Support Manual. As such, the standard foundation details provided in the Sign Support Manual will apply.

It should be noted that the boreholes were drilled as close as feasible to the proposed footing locations; however, some variation should be anticipated in soil conditions between locations.

Borehole 17-01 was drilled mid-slope through the existing embankment slope. It is anticipated that the western footing may be supported on non-level (sloping) ground. The geotechnical design parameters to be used for design will need to take into consideration the vertical offset between the ground surface at the borehole location and the ground surface at the footing location.

## **7.2 Caisson Installation**

Caisson installation should generally be carried out in accordance with OPSS 915 (sign support structures) and OPSS 903 (deep foundations). The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for the sign support foundations at this site. Suggested wordings for this NSSP are provided in Appendix E.

Caisson installation equipment must be able to dislodge, handle and remove obstructions, cobbles and boulders within the fill. Based on the subsurface conditions encountered during the investigation, the drilled holes for the caissons are expected to remain open during construction even if they are unsupported; however, unexpected soil sloughing or water seepage could occur. As such, temporary liners should be available to support the caisson sidewalls and provide seepage cut-off, as required.

## **7.3 Construction Concerns**

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, and seepage into the foundation excavation. Recommendations on how to address these issues have been outlined in the previous section.

## **7.4 Construction Inspection and Testing**

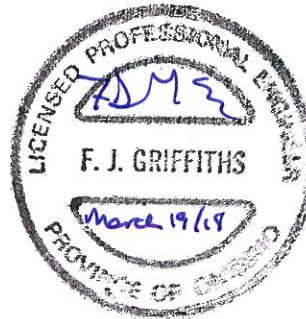
Caisson construction should be monitored by qualified geotechnical personnel as per OPSS 903 to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

## 8 CLOSURE

Engineering analysis and preparation of this report was completed Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



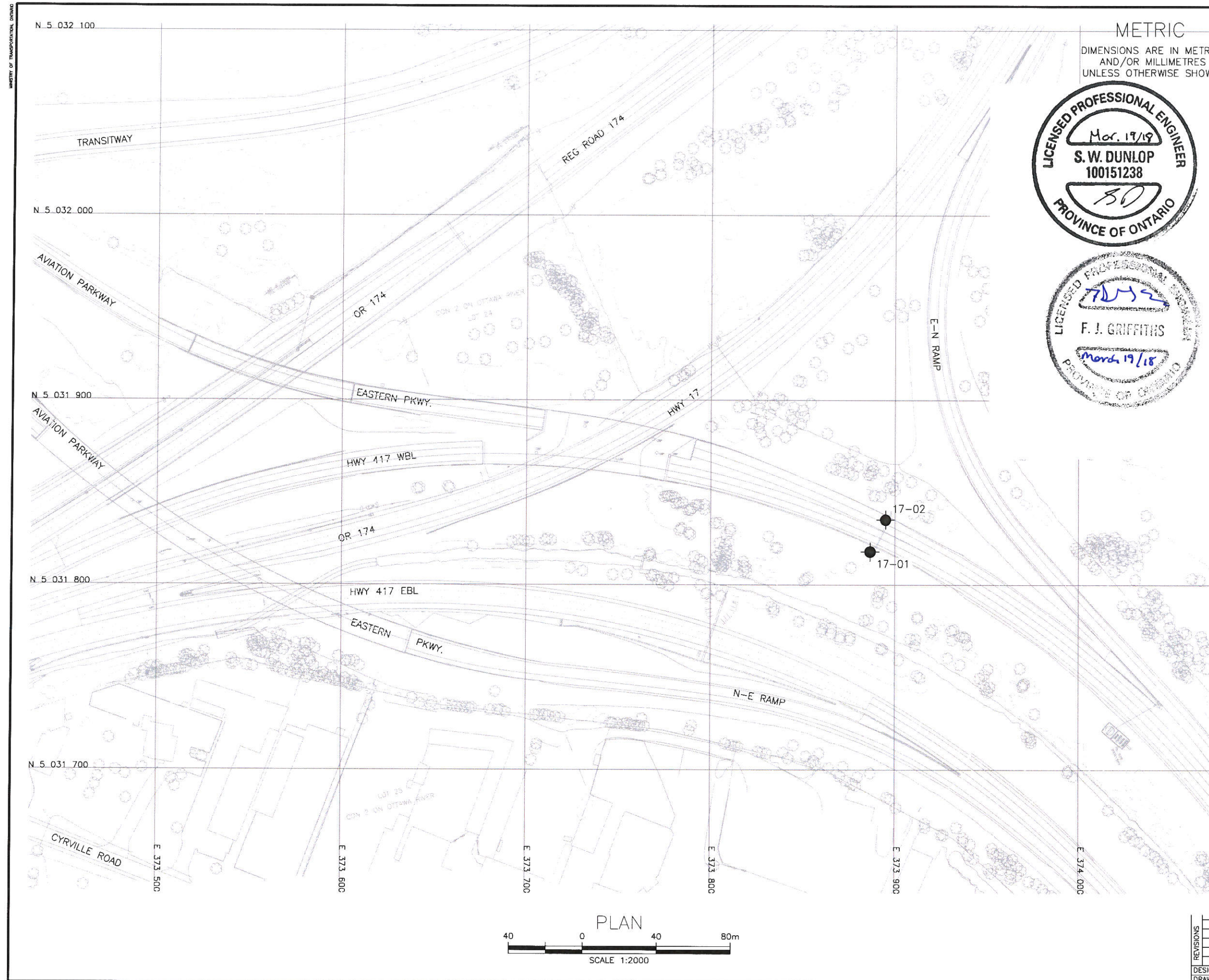
Stephen Dunlop, P.Eng.  
Senior Geotechnical Engineer



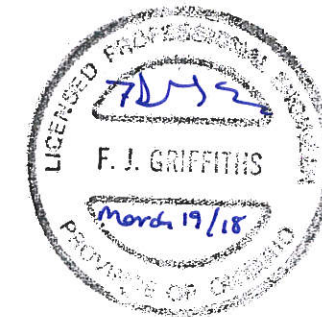
Dr. Fred Griffiths, P.Eng.  
Senior Associate  
Senior Geotechnical Engineer

**Appendix A.**  
**Borehole Location Plan**





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

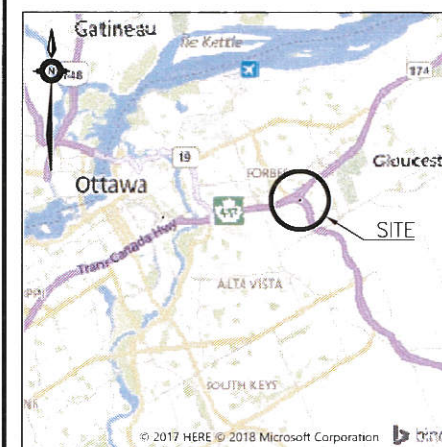


CONT No  
GWP No 4048-11-00

HIGHWAY 417  
AVIATION PARKWAY  
OVERHEAD SIGN  
BOREHOLE LOCATION PLAN



**THURBER** ENGINEERING LTD.



KEYPLAN  
LEGEND



Borehole

NO	ELEVATION	NORTHING	EASTING
17-01	73.8	5 031 817.8	373 886.5
17-02	75.4	5 031 835.1	373 894.9

-NOTES-

GEOCRES No. 31G5-291

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	DJP	CHK -	LOAD				DATE	MAR 20	
DRAWN	MFA	CHK SD	SITE		INSTRUCT	DWG	1		

**Appendix B.**  
**Record of Borehole Sheets**





## **SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS**

### **TERMINOLOGY DESCRIBING COMMON SOIL GENESIS**

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

### **TERMINOLOGY DESCRIBING SOIL STRUCTURE:**

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

### **RECOVERY:**

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

### **N-VALUE:**

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

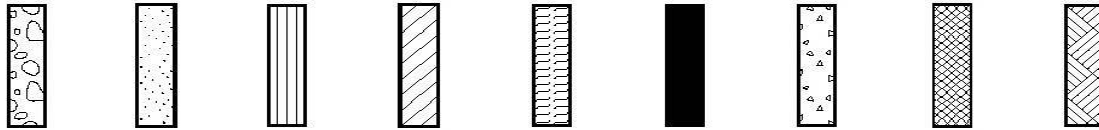
### **DYNAMIC CONE PENETRATION TEST (DCPT):**

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



### STRATA PLOT:

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



Boulders  
Cobbles  
Gravel      Sand      Silt      Clay      Organics      Asphalt      Concrete      Fill      Bedrock

### TEXTURING CLASSIFICATION OF SOILS

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

### TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

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

### SAMPLE TYPES

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

### TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

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



### MODIFIED UNIFIED SOIL CLASSIFICATION

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

Note -  $W_L$  = Liquid Limit



## EXPLANATION OF ROCK LOGGING TERMS

### ROCK WEATHERING CLASSIFICATION

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

### TERMS

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

### DISCONTINUITY SPACING

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

### STRENGTH CLASSIFICATION

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

## METRIC

[illegible]

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

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 17-02

1 OF 1

METRIC

GWP# 4048-11-00 LOCATION Aviation Parkway Overhead Signs - MTM z9: N 5 031 835.1 E 373 894.9 ORIGINATED BY KE  
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DJP  
 DATUM Geodetic DATE 2017.11.08 - 2017.11.08 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
75.4																			
0.0	150 mm ASPHALT																		
0.2	SILTY SAND with gravel Compact Grey FILL		1	SS	29		75						○				32	55	13 (SI+CL)
74.3			2	SS	23								○						
1.1	SAND, trace gravel Compact Brown FILL						74						○						
73.9																			
1.5	SILTY SAND with gravel (shale fragments) Very dense to compact Grey FILL		3	SS	51								○						
			4	SS	28		73						○						
	- significant auger resistance (grinding) on possible cobbles or boulders between 3.0 m and 4.6 m depth - becoming grey-brown at 3.5 m		5	SS	27		72						○						
							71												
			6	SS	26		70						○						
	- inferred to be soft and wet based on auger resistance at 5.5 m depth																		
			7	SS	15		69						○				12	52	36 (SI+CL)
							68												
			8	SS	15								○						
67.2																			
8.2	End of Borehole at 8.2 m																		

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

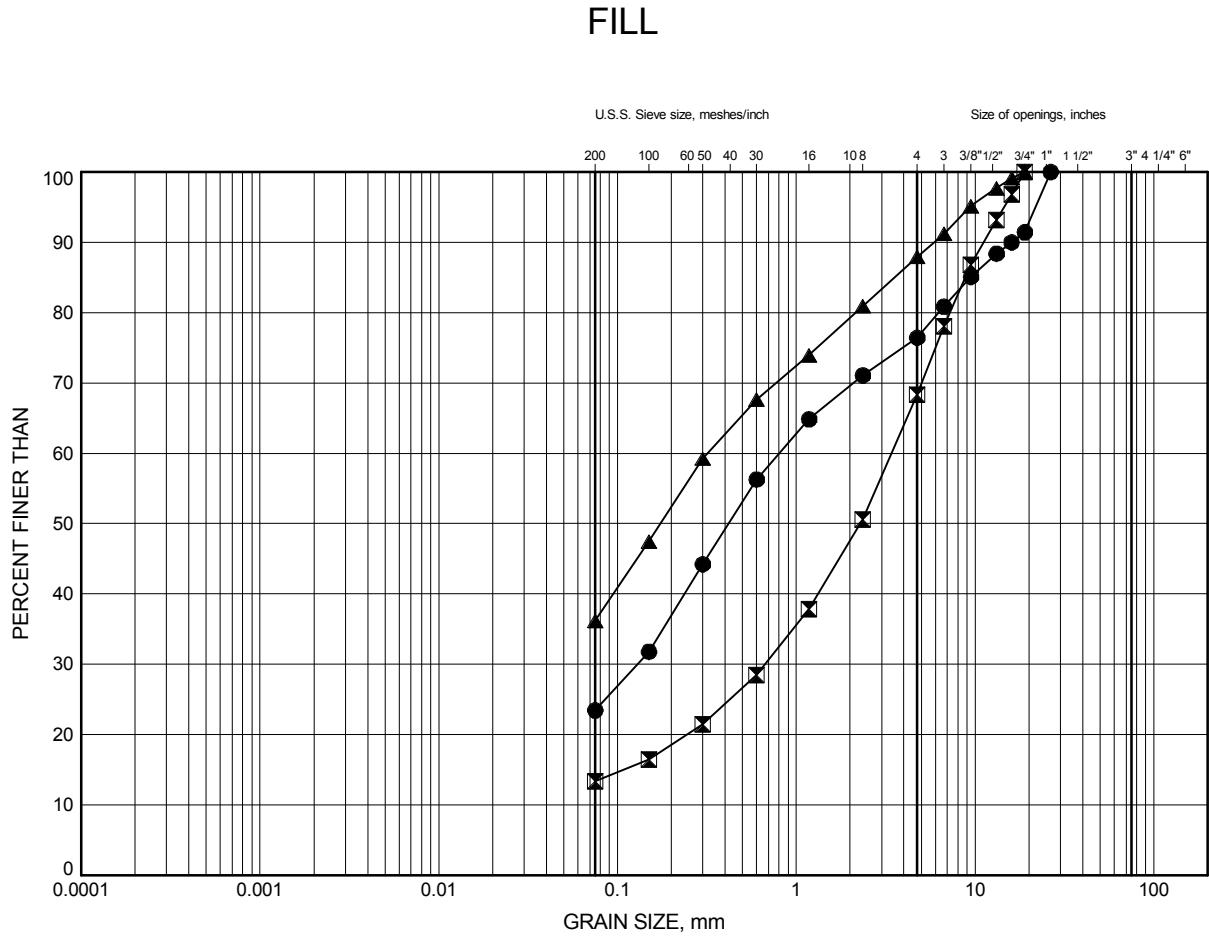
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE

**Appendix C.**  
**Laboratory Testing**

# Aviation Parkway Overhead Signs

## GRAIN SIZE DISTRIBUTION

FIGURE C1



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	2.59	71.21
◻	17-02	0.46	74.94
▲	17-02	6.40	69.00

Date January 2018  
GWP# 4048-11-00



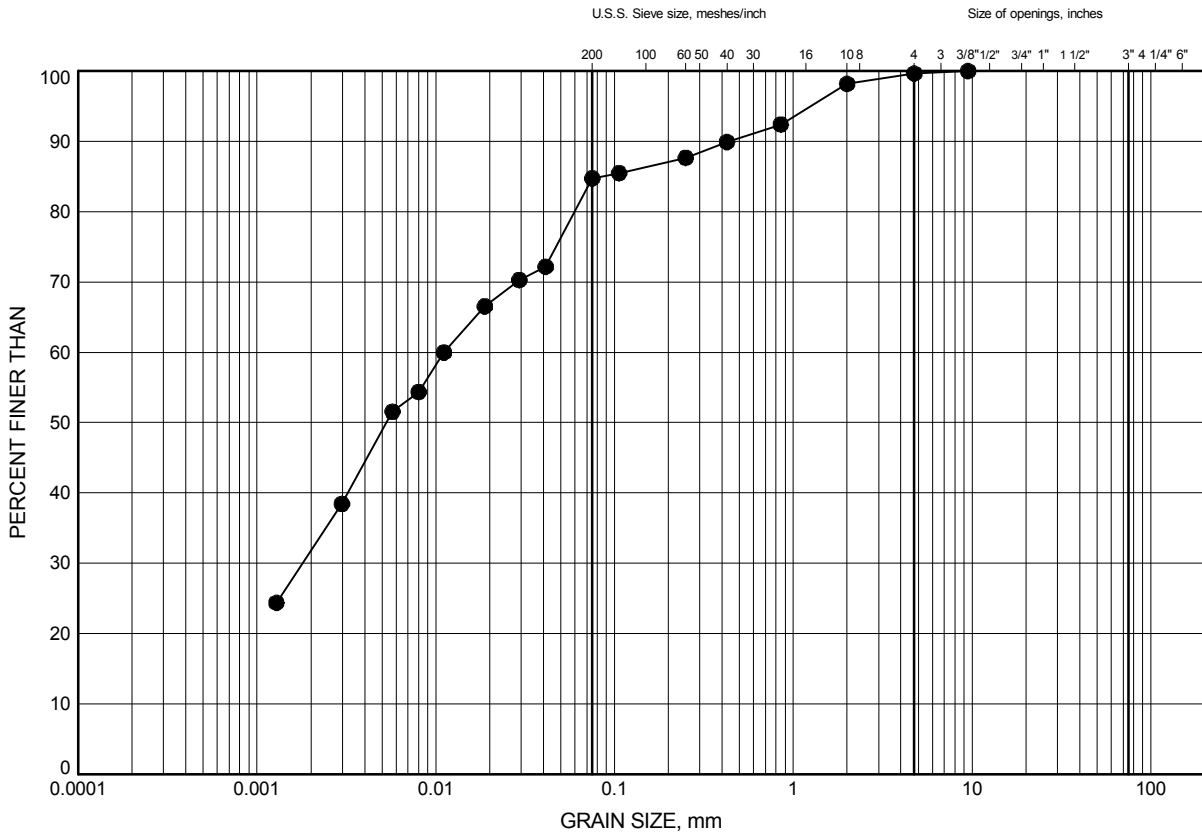
Prep'd DJP  
Chkd. SD

# Aviation Parkway Overhead Signs

## GRAIN SIZE DISTRIBUTION

FIGURE C2

### MARL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-01	8.04	65.76

Date January 2018

GWP# 4048-11-00



Prep'd DJP

Chkd. SD

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

Report Date: 15-Nov-2017

Order Date: 9-Nov-2017

**Project Description: Hwy 417 Sign @ Aviation**

<b>Client ID:</b>	17-02 SS#4 (7'6"-9'6")	-	-	-
<b>Sample Date:</b>	08-Nov-17	-	-	-
<b>Sample ID:</b>	1745560-01	-	-	-
<b>MDL/Units</b>	Soil	-	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	95.8	-	-	-
----------	--------------	------	---	---	---

**General Inorganics**

Conductivity	5 uS/cm	741	-	-	-
pH	0.05 pH Units	8.08	-	-	-
Resistivity	0.10 Ohm.m	13.5	-	-	-

**Anions**

Chloride	5 ug/g dry	222	-	-	-
Sulphate	5 ug/g dry	328	-	-	-



**Appendix D.**  
**Site Photographs**

PROPOSED OVERHEAD SIGN  
WESTBOUND HIGHWAY 417 AT AVIATION PARKWAY OFF-RAMP



**Photo 1. Looking southeast, staked location of Borehole 17-01 in foreground (2017-11-07).**



**Photo 2. Borehole 17-01 upon completion of vibrating wire installation (2017-11-07).**



PROPOSED OVERHEAD SIGN  
WESTBOUND HIGHWAY 417 AT AVIATION PARKWAY OFF-RAMP



**Photo 3. Drill rig set up on Borehole 17-02, looking northwest, old sign foundation visible to the right (2017-11-08).**



**Photo 4. Borehole 17-02 upon completion of backfilling (2017-11-08).**

**Appendix E.**

**Table E1 – Geotechnical Design Parameters**

**MTO Sign Support Manual Standard Drawings**

**List of Special Provisions, Suggested Text for NSSP**

**TABLE E1**  
**GEOTECHNICAL DESIGN PARAMETERS**  
**OVERHEAD SIGN REPLACEMENT**  
**WESTBOUND HIGHWAY 417 AT AVIATION PARKWAY OFF-RAMP**

Footing	Borehole Details		Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Foundation Design Parameters					Groundwater Depth (m)
	Borehole	Depth (m)			$C_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Kp	
Left	17-01	8.2	Topsoil	0.0 - 0.4	*	*	19	9	*	> 7.6 m
			Fill: silty sand with gravel	0.4 - 7.6	-	32	21	11	3.3	
			Organic silt	7.6 - 7.9	*	*	15	5	*	
			Marl	7.9 - 8.1	*	*	15	5	*	
			Glacial till	8.1 - 8.2	-	32	21	11	3.3	
Right	17-02	8.2	Fill: silty sand with gravel	0.0 - 8.2	-	32	21	11	3.3	-

\* Note - strength from the topsoil, organic silt, and marl should be neglected in the analysis

Definitions:

$C_u$  = Undrained shear strength

$\phi'$  = Effective friction angle

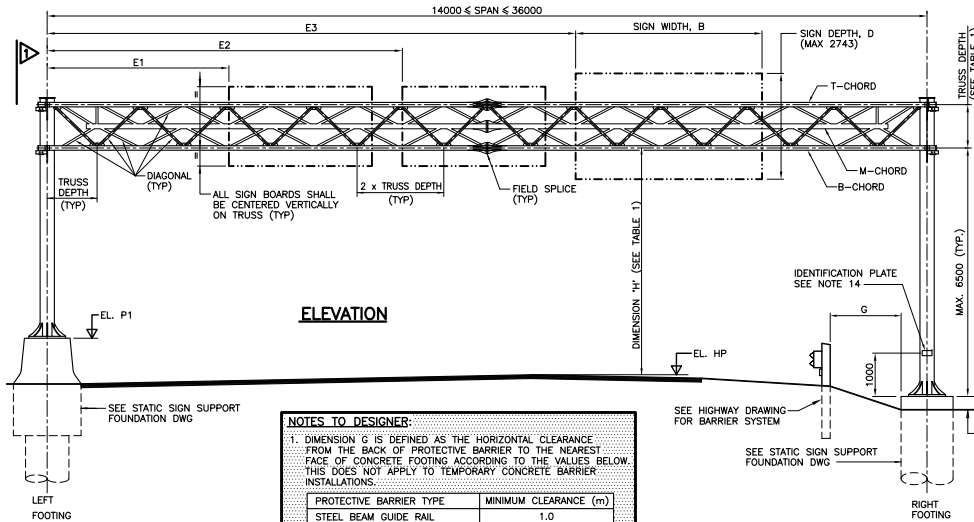
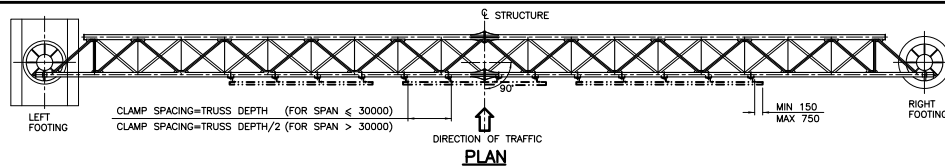
$\gamma$  = Total unit weight

$\gamma'$  = Effective unit weight

Kp = Passive earth pressure coefficient

1. The information provided herein is presented for design purposes only.
2. The frost depth in Ottawa is 1.8 m.
3. Reference: MTO Sign Support Manual 2015

REVISIONS						
	DATE	BY	DESCRIPTION			
DESIGN		CHK	CODE	CHBDC-06	LOAD	DATE
DRAWN		CHK	SITE			DWG.



#### NOTES TO DESIGNER:

- DIMENSION G IS DEFINED AS THE HORIZONTAL CLEARANCE FROM THE BACK OF PROTECTIVE BARRIER TO THE NEAREST FACE OF CONCRETE FOOTING ACCORDING TO THE VALUES BELOW. THIS DOES NOT APPLY TO TEMPORARY CONCRETE BARRIER INSTALLATIONS.
- THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

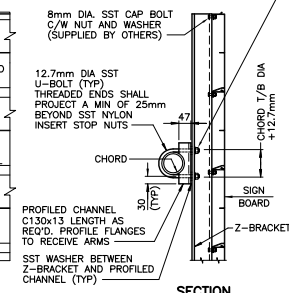
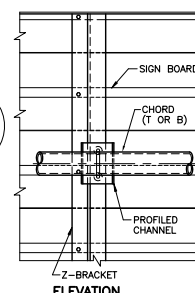
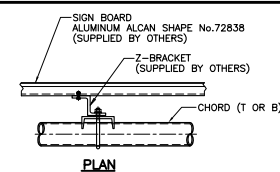
PROTECTIVE BARRIER TYPE	MINIMUM CLEARANCE (m)
STEEL BEAM GUIDE RAIL	1.0
PERMANENT CONCRETE BARRIER	0.3

TABLE 1 - GENERAL

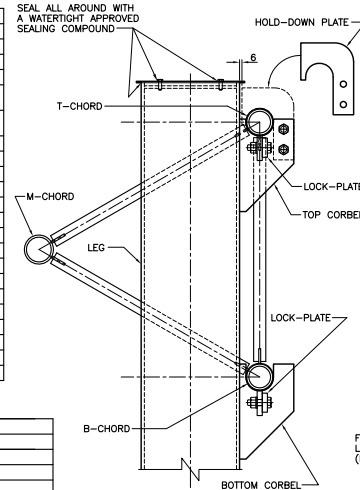
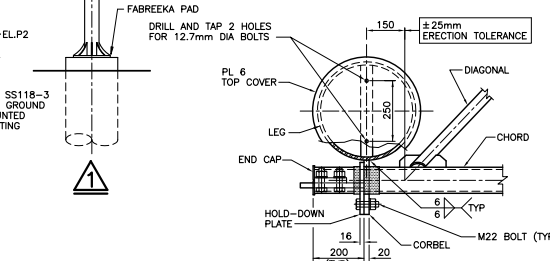
STATION	----
STRUCTURE I.D. No.	----
SPAN	----
TRUSS DEPTH (C/C OF CHORDS)	----
DIMENSION 'H'	----
LOCAL REFERENCE WIND PRESSURE, P <sub>0</sub>	----
MAXIMUM ALLOWABLE SIGN BOARD AREA, m <sup>2</sup>	----
1 SIGN SIZE (DxB)	----
2 SIGN SIZE (DxB)	----
3 SIGN SIZE (DxB)	----
E1	----
E2	----
E3	----
G	----
ELHP	----
ELP1	----
ELP2	----
SUPPORT LEG	O.D. ----
CHORDS	T/B O.D. ----
DIAGONALS	M O.D. ----
FOOTING TYPE (LEFT)	O.D. ----
FOOTING TYPE (RIGHT)	O.D. ----

TABLE 2 - SIGN BOARD: PARTS/HARDWARE

STATION	----
DESCRIPTION	QUANT.
12.7mm DIA. SST U-BOLT	----
SST NYLON INSERT STOP NUTS	----
SST WASHERS	----
PROFILLED CHANNEL (C130x13, LENGTH AS REQ'D PROFILE FLANGES TO RECEIVE ARMS)	----
Z-BRACKET (SUPPLIED BY OTHERS)	----
Z-BRACKET SPACING	----



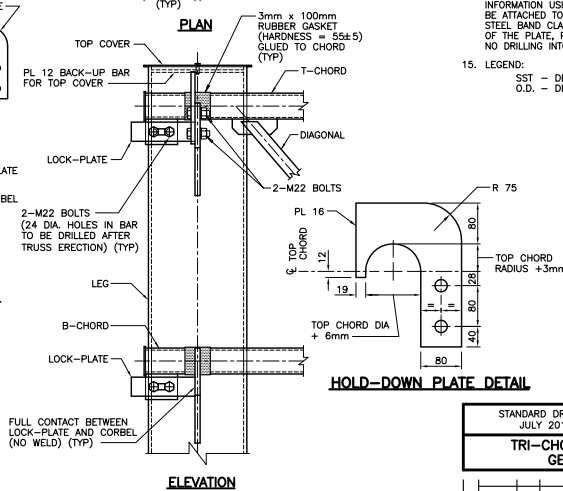
#### SIGN CONNECTION DETAIL



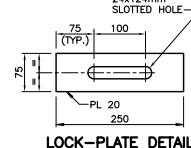
NOTE: NO END CAPS SHOWN FOR CLARITY

#### SIDE VIEW

#### TRUSS TO LEG CONNECTION TYPICAL DETAIL



#### HOLD-DOWN PLATE DETAIL



#### LOCK-PLATE DETAIL

REFER TO 2.4.1 IN THE SIGN SUPPORT MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

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

CONT No  
WP No

TRI-CHORD STATIC SIGN SUPPORT  
GENERAL ARRANGEMENT

SHEET

#### NOTES:

- ALL SECTIONS SHALL BE STRUCTURAL STEEL UNLESS NOTED.
- ALL STRUCTURAL STEEL SHALL BE ACCORDING TO CAN/CSA G40.20-04/ G40.21-04 GRADE 300W OR ASTM SPECIFICATION A500 GRADE C, STRUCTURAL TUBING.
- WALL THICKNESS OF MEMBERS:  
- CHORDS 6.4mm  
- DIAGONALS 3.2mm  
- LEGS 12.7mm
- TOTAL SIGN BOARD AREA ON STRUCTURE SHALL NOT EXCEED 45m<sup>2</sup>, BASED ON A REFERENCE WIND PRESSURE OF 600Pa.
- ALL NON-STAINLESS STEEL BOLTS, NUTS, AND WASHERS SHALL BE ACCORDING TO ASTM A325M AND BE HOT-DIP GALVANIZED UNLESS NOTED.
- ALL STAINLESS STEEL BOLTS, NUTS, AND WASHERS SHALL BE ACCORDING TO ASTM F593 ALLOY 304 WITH A MINIMUM YIELD OF 480 MPa AND A MINIMUM TENSILE STRENGTH OF 715 MPa.
- ALL BOLTS SHALL BE INSTALLED BY TURN OF NUT TIGHTENING IN CONFORMANCE WITH CAN/CSA S6-06.
- ALL STRUCTURAL STEEL SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. LEGS ONLY SHALL BE SUBSEQUENTLY COATED WITH AN APPROVED PAINT SYSTEM ACCORDING TO OPS9 911.
- STRUCTURE SHALL NOT BE ERRECTED UNTIL FOUNDATION CONCRETE HAS REACHED 80% OF SPECIFIED STRENGTH.
- NO SHOP SPLICES IN ANY MEMBER. TRUSS FIELD SPLICES SHALL BE KEPT TO A MAXIMUM OF 2.
- CLAMPS SHALL BE POSITIONED NEXT TO NODES.
- SPAN LENGTHS AND ELEVATIONS TO BE VERIFIED IN THE FIELD BEFORE SIGN SUPPORT STRUCTURE FABRICATION.
- THIS STANDARD IS TO BE READ IN CONJUNCTION WITH SS18-27 (STRUCTURE ASSEMBLY DETAILS), SS18-3 (GROUND MOUNTED FOOTING), AND/OR SS18-4 (MEDIAN MOUNTED FOOTING - STMM), AND/OR SS18-5 (MEDIAN MOUNTED FOOTING - ASYMM).
- EACH SIGN SUPPORT SHALL HAVE AN IDENTIFICATION MARKING SHOWING THE STRUCTURE I.D. NUMBER, THE SIGN AREA AND THE LOCAL REFERENCE WIND PRESSURE AS SHOWN IN TABLE 1, THE MANUFACTURER'S NAME OR TRADEMARK, AND THE DATE OF MANUFACTURE. THIS 4mm THICK RECTANGULAR STAINLESS STEEL PLATE SHALL HAVE A RUBBER BACKING, AND BE OF SUFFICIENT DIMENSIONS TO ACCOMMODATE THE REQUIRED INFORMATION USING 6mm HIGH ENGRAVED LETTERING. THE PLATE SHALL BE ATTACHED TO THE LEG OF THE STRUCTURE BY MEANS OF STAINLESS STEEL BAND CLAMPS THAT GO THROUGH VERTICAL HOLES AT EACH SIDE OF THE PLATE, PASS BEHIND THE PLATE, AND WRAP AROUND THE LEG. NO DRILLING INTO THE HSS FOR ATTACHMENT OF PLATE IS PERMITTED.
- LEGEND:  
SST - DENOTES STAINLESS STEEL  
O.D. - DENOTES OUTSIDE DIAMETER

STANDARD DRAWING  
JULY 2014

SS18-26

TRI-CHORD STATIC SIGN SUPPORT  
GENERAL ARRANGEMENT

DATE	BY	DESCRIPTION	DATE
DESIGN	STD	CHK	CODE CHBDC '91
DRAWN	CHK	SITE	LOAD
			DWG

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

PROPOSED OVERHEAD SIGN  
WESTBOUND HIGHWAY 417 AT AVIATION PARKWAY OFF-RAMP

1. The following Special Provisions and OPSS Documents are referenced in this report:

OPSS 903	Construction Specification for Deep Foundations
OPSS 915	Construction Specification for Sign Support Structures
OPSD 3090.101	Foundation Frost Penetration Depths for Southern Ontario

2. Suggested text for a NSSP on “Caisson Construction for Overhead Sign Foundations”

The Contractor is advised that variable types of subsurface materials may be encountered at the overhead sign foundation locations. For additional information regarding soil conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at a foundation location are the same as those encountered in the borehole closest to the subject foundation location.
2. There is a probability that occasional cobbles and boulders or other obstructions may be encountered within the fill. Caisson installation equipment must be able to penetrate or remove these obstructions.
3. Water seepage and/or soil sloughing into the caisson hole may occur from existing fill and cohesionless soils at some locations. Temporary liners must be available on site, or be made available on very short notice, to support the caisson sidewalls and provide seepage cut-off where required.
4. The Contractor is responsible for constructing the sign foundations without disturbing the material at the sides or bases of the foundations.
5. The contractor is responsible for proper disposal of materials generated from the site.