



November 30, 2011

## FOUNDATION INVESTIGATION AND DESIGN REPORT

### OVERHEAD SIGNS

HIGHWAY 69 FOUR-LANING FROM 0.4 KM  
NORTH OF HIGHWAY 7182 (SHEBESHEKONG ROAD)  
NORTHERLY 11 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5403-05-00

#### Submitted to:

MMM Group  
100 Commerce Valley Drive West  
Thornhill, Ontario  
L3T 0A1



**GEOCRES NO.: 41H-102**

**Report Number:** 07-1191-0020-OHS

#### Distribution:

- 3 Copies Ministry of Transportation, Ontario, North Bay, ON (Northeastern Region)
- 1 Copy Ministry of Transportation, Ontario, Downsview, Ontario (Foundations Section)
- 2 Copies MMM Group, Thornhill, ON
- 2 Copies Golder Associates Ltd., Sudbury, ON

REPORT



A world of  
capabilities  
delivered locally





## Table of Contents

### **PART A – FOUNDATION INVESTIGATION REPORT**

<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 SITE DESCRIPTION.....</b>	<b>1</b>
<b>3.0 INVESTIGATION PROCEDURES .....</b>	<b>1</b>
<b>4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY .....</b>	<b>2</b>
4.1 Regional Geology .....	2
4.2 Subsurface Conditions.....	3
4.3 STA 20+770 NBL (Shawanaga Township) .....	3
4.3.1 Sand.....	3
4.3.2 Bedrock.....	3
4.3.3 Groundwater Conditions .....	4
4.4 STA 10+480 SBL (Harrison Township).....	4
4.4.1 Silty/Sandy Peat.....	4
4.4.2 Sand.....	4
4.4.3 Bedrock.....	4
4.4.4 Groundwater Conditions .....	5
<b>5.0 CLOSURE.....</b>	<b>5</b>

### **PART B – FOUNDATION DESIGN REPORT**

<b>6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS.....</b>	<b>7</b>
6.1 General.....	7
6.2 Overhead Sign Foundations .....	7
6.2.1 Spread Footings.....	7
6.2.2 Geotechnical Resistance .....	8
6.2.3 Resistance to Lateral Loads.....	8
6.3 Construction Considerations.....	9
<b>7.0 CLOSURE.....</b>	<b>9</b>



## DRAWINGS

Drawing 1                      Overhead Signs – Index Plan

List of Symbols and Abbreviations

Lithological and Geotechnical Rock Description Terminology

## APPENDICES

### **Appendix A                      Highway 69 NBL – Overhead Sign at STA 20+770**

Drawing A-1	Borehole Locations
Record of Boreholes	OHS1-1 and OHS1-2
Record of Drillholes	OHS1-1 and OHS1-2

### **Appendix B                      Highway 69 SBL – Overhead Sign at STA 10+480**

Drawing B-1	Borehole Locations
Record of Boreholes	OHS2-1 and OHS2-2
Record of Drillholes	OHS2-1 and OHS2-2

### **Appendix C                      Non-Standard Special Provisions**

NSSP	Mass Concrete
NSSP	Dowels into Rock



# **PART A**

**FOUNDATION INVESTIGATION REPORT  
OVERHEAD SIGNS  
HIGHWAY 69 FOUR-LANING  
FROM 0.4 KM NORTH OF HIGHWAY 7182  
(SHEBESHEKONG ROAD) NORTHERLY 11 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5403-05-00**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by MMM Group (MMM) on behalf of Ministry of Transportation, Ontario (MTO) to provide detail foundation engineering services for two (2) overhead signs for the new Highway 69 alignment. The two signs are located at STA 20+770 facing the Northbound Lanes (NBL) and STA 10+480 facing the Southbound Lanes (SBL) on Highway 69. This project is part of the four-laning of Highway 69 from 0.4 km north of Highway 7182 (Shebeshekong Road) northerly 11 km. The general location of the two signs is shown on the Index Plan on Drawing 1.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) dated March 28, 2007. Golder's proposal (P7-1191-0020, dated April 24, 2007) for foundation engineering services associated with the overhead signs is contained in Section 6.8 of MMM's Technical Proposal that forms part of the Consultant's Agreement (Purchase Order Number 5006-E-0031) for this project. The work was carried out in accordance with Golder's Supplemental Specialty Quality Control Plan for this project dated September 2007. The locations of the proposed overhead signs were provided to Golder by MMM in November 2010.

This report addresses the investigations carried out for the two overhead sign structures crossing Highway 69. Separate reports will be submitted detailing the foundation investigations for the related swamp crossings, high fill areas, culverts and bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed sign locations, by borehole drilling, rock coring and laboratory testing on selected soil and rock core samples. The investigated areas are shown on Drawings A-1 and B-1 in Appendices A and B, following the text of this report.

We understand that the proposed overhead sign will be a truss-mounted sign extending over the NBL or SBL supported by a spread footing on each side of the highway embankment.

## **2.0 SITE DESCRIPTION**

The new NBL overhead sign at STA 20+770 is located in the Township of Shawanaga approximately 2.1 km north of Dumont Road and the new SBL overhead sign at STA 10+480 is located in the Township of Harrison approximately 3.6 km north of Dumont Road. The existing ground surface at the boreholes advanced for the NBL sign is about Elevation 220 m and for the SBL sign is about Elevation 205 m.

In general, the topography in the area of the NBL overhead sign at STA 20+770 is generally flat to gently sloping down to the north with bedrock exposed at the sign location. The topography in the area of the SBL overhead sign at STA 10+480 is generally flat and low-lying, with sparse tree cover in the surrounding swamp with a bedrock outcrop present within the centre of the swamp at the sign location.

## **3.0 INVESTIGATION PROCEDURES**

The fieldwork for the investigation at the proposed structure locations was carried out between March 21 and 24, 2011 and on May 5, 2011 during which time a total of four (4) boreholes were advanced at the locations shown on Drawings A-1 and B-1 in Appendices A and B, respectively. Two (2) boreholes were advanced for each sign, one at each foundation location. The boreholes are designated OHS1-1, OHS1-2, OHS2-1 and OHS2-2.



The foundation investigation was carried out using equipment supplied and operated by Landcore Drilling of Chelmsford, Ontario. Boreholes OHS1-1 and OHS1-2 were advanced using portable equipment while Boreholes OHS2-1 and OHS2-2 were advanced using a track-mounted CME 55 drill rig. The boreholes were advanced to depths that range from 2.9 m to 4.1 m, including 2.8 m to 3.4 m of bedrock coring. The boreholes were advanced using 108 mm inside diameter (I.D.) continuous flight hollow stem augers and/or NQ coring. Auger samples were obtained, where possible over the shallow bedrock. Rock core samples were obtained using an 'NQ' size core barrel. The groundwater conditions in the open boreholes were observed during the drilling operations. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 (as amended).

The fieldwork was supervised throughout by a member of Golder's technical staff, who located the boreholes, arranged for the clearance of underground services and for traffic protection, supervised the drilling, sampling and in situ testing operations, logged the boreholes and drillholes, and examined and cared for the soil and rock samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Sudbury geotechnical laboratory, where the samples underwent further visual examination. Due to the thin or non-existent overburden present at the borehole locations, only one auger soil sample was obtained; hence, classification testing (water contents, Atterberg limits and grain size distributions) was not carried out. Unconfined Compressive Strength (UCS) tests were carried out on select samples of the bedrock core. The laboratory UCS tests were carried out to MTO and/or ASTM standards, as appropriate.

The boreholes were located in the field by Golder based on the position staked by MMM. The borehole locations shown on Drawings A-1 and B-1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations and drilled depths are also provided below.

Borehole Number	MTM NAD83 Zone 17 Northing (m)	MTM NAD83 Zone 17 Easting (m)	Ground Surface Elevation (m)	Drilled Depth (m)
OHS1-1	5047461.9	240898.3	219.6	2.9
OHS1-2	5047479.5	240907.8	220.4	3.0
OHS2-1	5048195.3	239507.0	204.8	3.7
OHS2-2	5048178.0	239497.0	205.1	4.1

## 4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

### 4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*<sup>1</sup>, this section of Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the Parry Sound and Muskoka areas, then eastward from Muskoka in patches into the area north of the Kawartha Lakes.

<sup>1</sup> Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.





This part of the Georgian Bay Fringe physiographic region was never submerged during periods of glacial recession. As a result, the surficial soils in this area consist of very shallow deposits of sand, silt and clay overlying metamorphic bedrock, and numerous bare knobs and ridges of bedrock are present throughout the area. Localised low-lying swampy areas, containing peat and/or organic soils overlying soft/loose native soils, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of granitic gneisses of the Britt Domain of the Central Gneiss Belt, a subdivision of the Grenville Structural Province, as described in Geology of Ontario, OGS Special Volume 4<sup>2</sup>. Deposition of Palaeozoic strata initially covered the bedrock and later erosion during glaciation exposed these Precambrian rocks.

## **4.2 Subsurface Conditions**

Detailed descriptions of the subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected rock core samples, are given on the attached Record of Borehole and Drillhole sheets in Appendices A and B. The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of bedrock core sampling. These boundaries, therefore, represent transitions between material types rather than exact planes of geological change. Further, subsurface conditions will vary beyond the borehole locations.

In general, the subsoil conditions consist of a surficial layer of silty or sandy organics and/or sand, underlain by bedrock. Bedrock was exposed at ground surface in one borehole. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

## **4.3 STA 20+770 NBL (Shawanaga Township)**

Two (2) boreholes (Boreholes OHS1-1 and OHS1-2) were advanced at the west and east foundation support elements of the proposed overhead sign at STA 20+770. The subsoils generally consist of a deposit of sand containing organics (where encountered) over bedrock.

### **4.3.1 Sand**

In Borehole OHS1-1, a 0.1 m thick deposit of moist, brown to black slightly organic sand was encountered at ground surface at Elevation 219.6 m.

### **4.3.2 Bedrock**

Bedrock was encountered and 2.8 m and 3.0 m of bedrock core were recovered below the sand deposit in Borehole OHS1-1 at Elevation 219.5 m and at ground surface in Borehole OHS1-2 at Elevation 220.4 m, respectively.

---

<sup>2</sup> Geology of Ontario, 1991. Ontario Geological Society Special Volume 4, Part 2. Ministry of Northern Development and Mines, Ontario.



Based on a review of the bedrock core samples, the bedrock generally consists of fine to medium grained, fresh, grey to pink gneiss.

The Total Core Recovery (TCR) is 100 percent for all core samples. The Solid Core Recovery (SCR) ranges from about 82 percent to 100 percent. Rock Quality Designation (RQD) values measured on the recovered bedrock core samples range from 82 percent to 100 percent indicating that the rock is of good to excellent quality in accordance with Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)<sup>3</sup>.

A UCS test was carried out on representative samples of the rock core taken from Boreholes OHS1-1 and OHS1-2 and the measured UCS is 157 MPa and 152 MPa, respectively, indicating that the bedrock is very strong ( $R_5$ ,  $100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$ ) in accordance with Table 3.5 of CFEM (2006).

### **4.3.3 Groundwater Conditions**

Boreholes OHS1-1 and OHS1-2 were dry upon completion of drilling. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

## **4.4 STA 10+480 SBL (Harrison Township)**

Two (2) boreholes (Boreholes OHS2-1 and OHS2-2) were advanced at the west and east foundation support elements of the proposed overhead sign at STA 10+480. The subsoils generally consist of a deposit of silty or sandy peat underlain by a sand deposit (where encountered) and bedrock.

### **4.4.1 Silty/Sandy Peat**

In Boreholes OHS2-1 and OHS2-2, a 0.4 m and 0.3 m thick deposit of moist to wet, brown, fibrous silty peat or sandy peat was encountered at the ground surface at Elevations 204.8 m and 205.1 m, in the respective boreholes.

### **4.4.2 Sand**

In Borehole OHS2-2, underlying the sandy peat, a 0.4 m thick deposit of moist to wet, brown sand containing some gravel and trace silt was encountered at Elevation 204.8 m.

### **4.4.3 Bedrock**

Bedrock was encountered and 3.3 m and 3.4 m of bedrock core were recovered below the silty peat deposit in Borehole OHS2-1 at a depth of 0.4 m and below the sand deposit in Borehole OHS2-2 at a depth of 0.7 m, corresponding to Elevation 204.4 m in both boreholes.

Based on a review of the bedrock core samples, the bedrock generally consists of fine to medium grained, fresh to slightly weathered, grey to pink gneiss.

---

<sup>3</sup> Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition.





The TCR is 100 percent for all core samples. The SCR ranges from about 84 percent to 100 percent. RQD values measured on the recovered bedrock core samples range from 68 percent to 100 percent, and are typically greater than 80 percent, indicating that the rock is of good to excellent quality in accordance with Table 3.10 of CFEM (2006).

A UCS test was carried out on representative samples of the rock core taken from Boreholes OHS2-1 and OHS2-2 and the measured UCS is 143 MPa and 121 MPa, respectively, indicating that the bedrock is very strong ( $R5, 100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$ ) in accordance with Table 3.5 of CFEM (2006).

#### **4.4.4 Groundwater Conditions**

Borehole OHS2-1 was dry upon completion of drilling and the unstabilized water level in Borehole OHS2-2 was measured at a depth of 0.6 m below ground surface corresponding to Elevation 204.5 m. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

## **5.0 CLOSURE**

The fieldwork for this project was monitored by Mr. Ed Savard and Mr. Evan Childerhose from our Sudbury office. This report was prepared by Mr. Evan Childerhose, P.Eng., and the technical aspects were reviewed by Mr. André Bom, P.Eng., and Mr. Jorge M.A. Costa, P.Eng., a Principal with Golder. Mr. Costa, also a Designated MTO Contact for Golder, conducted a quality control review of the report.



## FOUNDATION REPORT, HIGHWAY 69 OVERHEAD SIGNS GWP 5403-05-00

### Report Signature Page

**GOLDER ASSOCIATES LTD.**

Evan Childerhose, P.Eng.  
Geotechnical Engineer

Andre Bom, P.Eng.  
Geotechnical Engineer

Jorge M.A. Costa, P.Eng.  
Designated MTO Contact, Principal

EC/AB/JMAC/lb

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

N:\Active\2007\1190 Sudbury\1191\07-1191-0020 MMM Hwy 69 Twinning\7000 Reporting\Final\Overhead Signs\07-1191-0020 FIDR 11Nov30 OHS.Docx



# **PART B**

**FOUNDATION DESIGN REPORT**  
**OVERHEAD SIGNS**  
**HIGHWAY 69 FOUR-LANING**  
**FROM 0.4 KM NORTH OF HIGHWAY 7182**  
**(SHEBESHEKONG ROAD) NORTHERLY 11 KM**  
**MINISTRY OF TRANSPORTATION, ONTARIO**  
**GWP 5403-05-00**



## **6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS**

### **6.1 General**

This section of the report provides foundation design recommendations for two proposed overhead signs along Highway 69 at STA 20+770 NBL (Township of Shawanaga) and 10+480 SBL (Township of Harrison). The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation at this site and from site observations. The interpretation and recommendations provided are intended only to provide the designers with sufficient information to assess feasible foundation design alternatives and to design the proposed sign foundations. As such, where comments are made on construction, they are provided only in order to highlight those aspects which could affect the planning of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

### **6.2 Overhead Sign Foundations**

We understand that the two proposed overhead signs will be supported on shallow foundations located on both the west and east sides of Highway 69 NBL at STA 20+770 and SBL at STA 10+480. We understand that the centre of each footing will be located approximately 4.5 m from the edge of pavement. We further understand that MMM selected the sign locations where bedrock was observed to be at or near ground surface in order that the overhead signs would be supported by spread footings founded on bedrock.

The four boreholes advanced during the field program were advanced generally at or near the approximate proposed footing locations. Boreholes OHS1-1, OHS2-1 and OHS2-2 encountered between 0.1 m and 0.7 m of overburden overlying bedrock, while Borehole OHS1-2 encountered bedrock at ground surface. The overburden material generally consists of silty peat to sand containing organics and a thin sand deposit in places. Boreholes OHS1-1, OHS1-2 and OHS2-1 were dry upon the completion of drilling, whereas at Borehole OHS2-2, the unstabilized groundwater level in the open borehole was measured at 0.6 m below the existing ground surface, corresponding to the bedrock surface at this location, at Elevation 204.5 m.

Overhead sign supports are typically designed with a standard caisson foundation in accordance with the requirements in MTO's *Sign Support Manual* (2011). The foundations for the sign support can be designed as caissons drilled into the overburden or socketted into the rock or, alternatively, the sign can be supported on spread footings, founded on suitable overburden, fill, or on bedrock. At this site, due to the presence of bedrock at shallow depth below ground surface, caisson foundations are cost prohibitive and have not been considered. Foundations comprised of spread footings on bedrock are recommended as presented in the following sections.

#### **6.2.1 Spread Footings**

Spread footings constructed directly on bedrock will require the removal of between 0.1 m and 0.7 m of existing overburden material to expose the bedrock surface at the location of Borehole OHS1-1 at the west footing for the sign at STA 20+770 and at the locations of Boreholes OHS2-1 and OHS2-2 for the sign at STA 10+480; bedrock is exposed at ground surface at Borehole OHS1-2 at the east footing for the sign at STA 20+770.



Variation in the bedrock surface elevation should be anticipated and excavation of the bedrock or placement of a layer of mass concrete may be required in order to provide a level surface for the footing subgrade. Bedrock excavation within the footing footprint (assumed to be 1.5 m wide by 4 m long) can likely be achieved by the use of hoe-ramming or similar excavation techniques. The bedrock at the founding depth will be of good quality but, nevertheless, the founding surface should be properly prepared (i.e. removing loose shattered rock fragments). Depending on the final bedrock surface slope, dowelling may be required to resist lateral sliding, as discussed in Section 6.2.3.

As the bedrock is present at shallow depth below ground surface at the two sign locations, excavations are relatively minor. However, excavations for the proposed footings should be carried out in accordance with the latest Occupational Health and Safety Act for Construction Projects (OHSa).

As noted in Section 6.2, the unstabilized groundwater level in Borehole OHS2-2 was encountered at a depth of 0.6 m below the existing ground surface. Depending on the seasonal time of footing construction, the groundwater level or perched groundwater may be encountered during construction. Excavations at this footing location will generally be carried out in-the-dry, given the bedrock topography and existing ground surface elevation at this location. Groundwater/surface water is anticipated to drain away from the sign footings based on the topography surrounding the footings.

Inspection and approval of the foundation area by the Quality Verification Engineer prior to footing construction should be required in accordance with OPSS 902 (Excavating and Backfilling), to ensure that all rock fragments have been removed from the foundation areas and that the foundation base has been properly prepared for the placement of concrete.

For spread footings founded directly on the bedrock or on mass concrete over bedrock, frost susceptibility is not an issue. If mass concrete is used as a levelling platform at these sites, an NSSP should be included in the Contract Documents to specify the quality and placement of the material; an example NSSP is provided in Appendix C.

## **6.2.2 Geotechnical Resistance**

For footings bearing directly on the bedrock surface or on mass concrete, a factored geotechnical resistance at Ultimate Limit States (ULS) of 10 MPa may be used for design. Serviceability Limit States (SLS) for 25 mm settlement conditions do not apply for footings founded on bedrock or on mass concrete.

The geotechnical resistances provided above are for loads that will be applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with Clauses 6.7.4 and C6.7.4 of the Canadian Highway Bridge Design Code (CHBDC, 2006) and the related commentary.

## **6.2.3 Resistance to Lateral Loads**

Resistance to lateral forces/sliding resistance between the cast-in-place concrete footings or mass concrete and the prepared bedrock surface should be calculated in accordance with Section 6.7.5 of the CHBDC using a coefficient of friction,  $\tan \phi'$ , equal to 0.70.



For footings on bedrock, the sliding/lateral resistance between the concrete footing/mass concrete and the bedrock may be supplemented by dowelling/anchoring into the bedrock, if necessary. The horizontal resistance of the dowels is dependent on the strength of the bedrock, grout and steel. For this site, where the rock mass is essentially as strong as or stronger than concrete, the design of the dowels into the rock may be considered in the same way as dowels embedded into the concrete. This assumes that the UCS of the grout will be similar to that of the concrete. The dowels should have a 1 m minimum embedded length within the bedrock, and the structural strength of the dowel and compressive strength of the grout should not be exceeded. If dowelling into bedrock is adopted at these sites, an NSSP should be included in the Contract Documents to specify the installation, materials and testing of the dowels; an example is provided in Appendix C.

### **6.3 Construction Considerations**

The excavation around and above the spread footing may be backfilled using an approved granular material such as MTO's Special Provision (SP) 110S13 (Aggregates) Granular 'A' or 'B' (Type I or II) placed in 0.3 m thick loose lifts and uniformly compacted to not less than 95 percent of the standard Proctor maximum dry density of the material. The use of native excavated materials, where encountered, as backfill is not recommended.

The final grade surrounding the sign support should be sloped to promote surface water drainage and pavement structure drainage away from the pavement and sign support, to the adjacent ditch.

## **7.0 CLOSURE**

This report was prepared by Mr. Evan Childerhose, P.Eng., and the technical aspects were reviewed by Mr. André Bom, P.Eng., and Mr. Jorge M.A. Costa, P.Eng., a Principal with Golder. Mr. Costa, also a Designated MTO Contact for Golder, conducted a quality control review of the report.





## FOUNDATION REPORT, HIGHWAY 69 OVERHEAD SIGNS GWP 5403-05-00

### Report Signature Page

**GOLDER ASSOCIATES LTD.**

Evan Childerhose, P.Eng.  
Geotechnical Engineer

Andre Bom, P.Eng.  
Geotechnical Engineer

Jorge M.A. Costa, P.Eng.  
Designated MTO Contact, Principal

EC/AB/JMAC/lb

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

N:\Active\2007\1190 Sudbury\1191\07-1191-0020 MMM Hwy 69 Twinning\7000 Reporting\Final\Overhead Signs\07-1191-0020 FIDR 11Nov30 OHS.Docx



## **REFERENCES**

Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, Fourth Edition.

Canadian Highway Bridge Design Code (CHBDC) and Commentary on CAN/CSA-S6-06, 2006. CSA Special Publication, S6.1-06. Canadian Standard Association.

Ministry of Transportation, Ontario, 2011. Sign Support Manual. Policy, Planning & Standards Division, Engineering Standards Branch, Bridge Office.

## **STANDARDS**

Ministry of Transportation, Ontario, Special Provisions

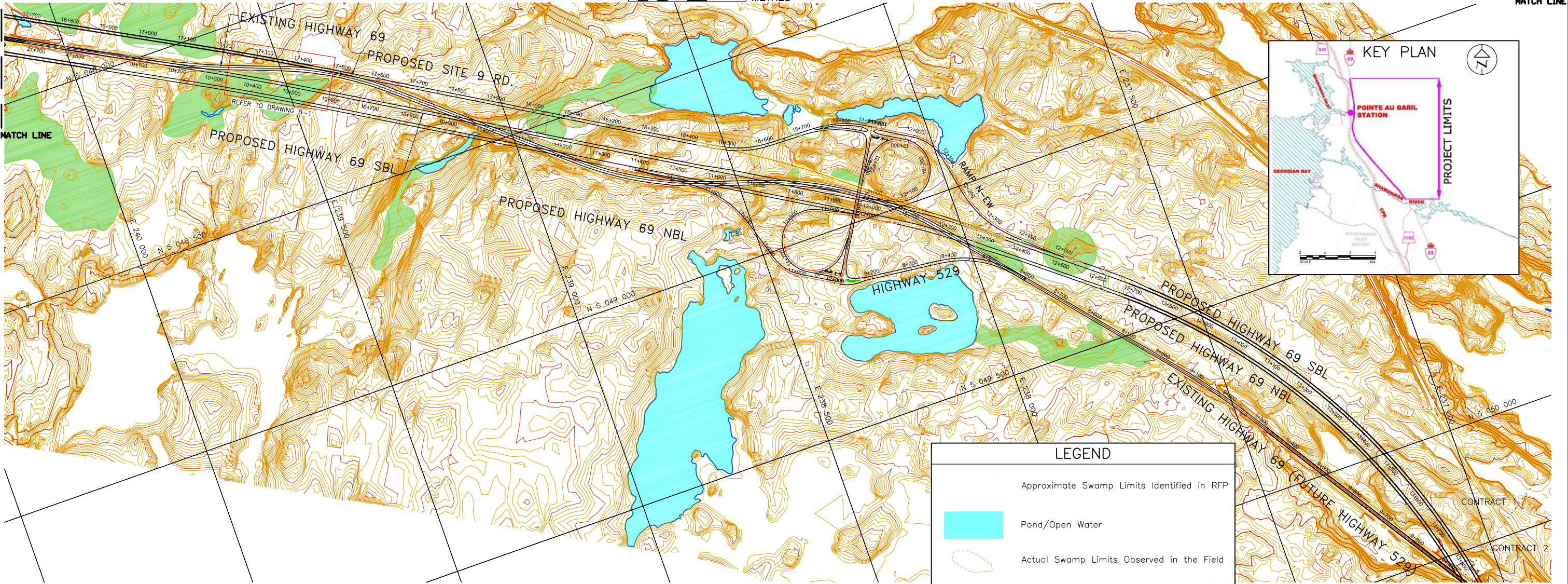
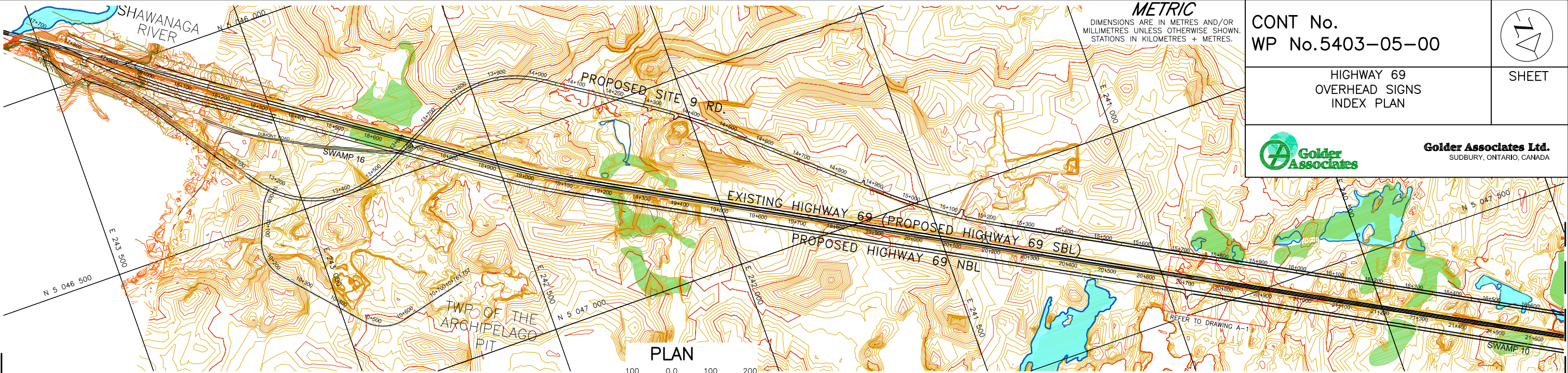
SP 110S13	Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
-----------	---

Ontario Water Resources Act

Ontario Regulation 468/10 Amendment to Ontario Regulation 903

Ontario Regulation 903/90 Wells

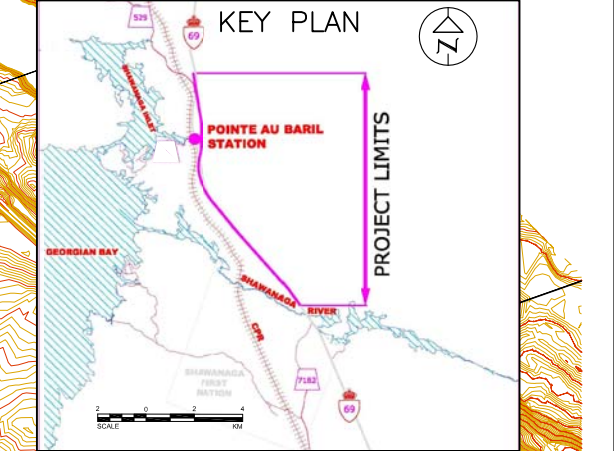




CONT No.  
WP No.5403-05-00

HIGHWAY 69  
OVERHEAD SIGNS  
INDEX PLAN

**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



LEGEND

Approximate Swamp Limits Identified in RFP

Pond/Open Water

Actual Swamp Limits Observed in the Field

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008)

NO.				REVISION			
Geocres No.				PROJECT NO.07-1191-0020			
HWY. 69		CHKD. AB		DATE: NOV 2011		DIST.	
SUBM'D. EC		CHKD.		APPD. JMAC		SITE:	
DRAWN: JJL						DWG. 1	





## LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

### 1. GENERAL

$\pi$	3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	Factor of Safety
V	volume
W	weight

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. stress: $\Delta\sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s/\rho_w$ ) (formerly $G_s$ )
e	void ratio
n	porosity
S	degree of saturation

\* Density symbol is  $\rho$ . Unit weight symbol is  $\gamma$  where  $\gamma = \rho g$  (i.e. mass density multiplied by acceleration due to gravity).

#### (a) Index Properties (continued)

w	water content
$w_l$	liquid limit
$w_p$	plastic limit
$I_p$	plasticity index $= (w_l - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index $= (w - w_p)/I_p$
$I_c$	consistency index $= (w_l - w)/I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

#### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_a$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	coefficient of friction $= \tan \delta$
$c'$	effective cohesion
$c_u, s_u$	undrained shear strength ( $\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
$p'$	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
$q_u$	compressive strength $(\sigma_1 + \sigma_3)$
$S_t$	sensitivity

**Notes:** 1  $\tau = c' + \sigma' \tan \phi'$   
2 Shear strength = (Compressive strength)/2



## LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

### I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

#### Dynamic Cone Penetration Resistance; $N_d$ :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

<b>PH:</b>	Sampler advanced by hydraulic pressure
<b>PM:</b>	Sampler advanced by manual pressure
<b>WH:</b>	Sampler advanced by static weight of hammer
<b>WR:</b>	Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ( $Q_t$ ), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

Density Index	N
Relative Density	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

#### (b) Cohesive Soils Consistency

	$C_u, S_u$	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
$SO_4$	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

**Note: 1** Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

### V. MINOR SOIL CONSTITUENTS

Percent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (cohesionless) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



## LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

### WEATHERING STATE

**Fresh:** no visible sign of weathering

**Faintly weathered:** weathering limited to the surface of Major discontinuities

**Slightly weathered:** penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

**Moderately weathered:** weathering extends throughout the rock mass but the rock material is not friable.

**Highly weathered:** weathering extends throughout rock Mass and the rock material is partly friable.

**Completely weathered:** rock is wholly decomposed and in a friable condition but the rock texture and structure are preserved.

### BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	> 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	< 6 mm

### JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	> 3 m
Wide	1 – 3 m
Moderately close	0.3 – 1 m
Close	50 – 300 mm
Very close	< 50 mm

### GRAIN SIZE

<u>Terms</u>	<u>Size*</u>
Very Coarse Grained	> 60 mm
Coarse Grained	2 – 60 mm
Medium Grained	60 microns – 2 mm
Fine Grained	2 – 60 microns
Very Fine Grained	< 2 microns

\* Note: Grains > 60 microns diameter are visible to the naked eye.

### CORE CONDITION

#### Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

#### Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

#### Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid sticks.

### DISCONTINUITY DATA

#### Fracture Index

A count of the number of discontinuities (physical separation) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

#### Dip with Respect to (W.R.T.) Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90° angle is horizontal.

#### Description and Notes

An abbreviated description of the discontinuities, whether naturally occurring separation such as fractures, bedding planes and foliation planes or mechanically induced fractures caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

### Abbreviations

B - Bedding	⊥ - Perpendicular To
FO - Foliation / Schistosity	- Parallel To
CL - Cleavage	P - Polished
SH - Shear Plane / Zone	K - Slickensided
VN - Vein	SM - Smooth
F - Fault	R - Rough
CO - Contact	ST - Stepped
J - Joint	PL - Planar
FR - Fracture	U - Undulating
MF - Mechanical Fracture	C - Curved





# **APPENDIX A**

## **Highway 69 NBL – Overhead Sign at STA 20+770**

**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
WP No. 5403-05-00

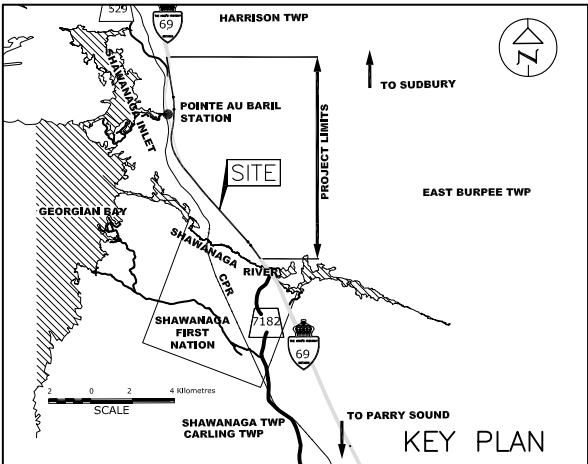


HIGHWAY 69 (NBL)  
OVERHEAD SIGN AT STA. 20+770  
BOREHOLE LOCATIONS

SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test Previous Investigation

No.	ELEVATION(m)	CO-ORDINATES	
		NORTHING	EASTING
OHS1-1	219.6	5047461.9	240898.3
OHS1-2	220.4	5047479.5	240907.8

NOTES

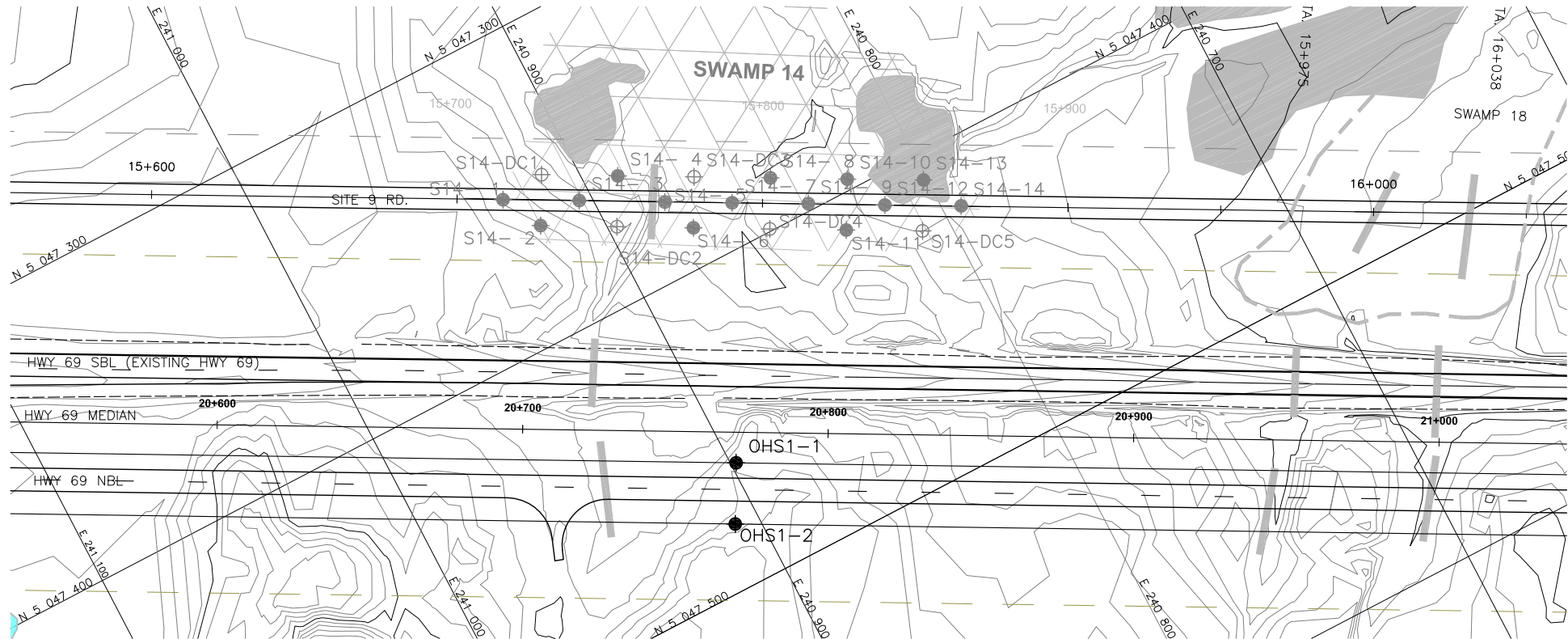
This drawing is for subsurface information only. The proposed site details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE


Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008).



PLAN



NO.	DATE	BY	REVISION
Geocres No. 41H-102			
HWY. 69	PROJECT NO. 07-1191-0020		DIST.
SUBM'D. EC	CHKD. AB	DATE: NOV 2011	SITE:
DRAWN: JJJ	CHKD.	APPD. JMAC	DWG. A-1

PROJECT		RECORD OF BOREHOLE No OHS1-1				1 OF 1		METRIC									
W.P. 5403-05-00		LOCATION N 5047461.9; E 240898.3				ORIGINATED BY EC											
DIST _____ HWY 69		BOREHOLE TYPE Portable Equipment				COMPILED BY EC											
DATUM Geodetic		DATE March 21 and 22, 2011				CHECKED BY AB											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
219.6	GROUND SURFACE							20	40	60	80	100					
0.0	SAND slightly organic		1	RC	REC 100%												
0.1	Brown to black Moist																
	GNEISS (BEDROCK)																
	Bedrock cored from 0.1 m depth to 2.9 m depth.																
	For coring details see Record of Drillhole OHS1-1.																
216.7	END OF BOREHOLE																
2.9	Note: 1. Borehole dry upon completion of drilling.																

SUD-MTO 001 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

PROJECT: 07-1191-0020 OHS

**RECORD OF DRILLHOLE: OHS1-1**

SHEET 1 OF 1

LOCATION: N 5047461.9 ;E 240898.3

DRILLING DATE: March 21 and 22, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	CORRELATION LOG														NOTES WATER LEVELS INSTRUMENTATION	
						FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)		RMC -Q AVG
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				
																		JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate			
NOTE: For additional abbreviations refer to list of abbreviations & symbols.																					
1	Portable Hilti Drill March 21 and 22, 2011	REFER TO PREVIOUS PAGE		219.5																	
2		GNEISS Fine to medium grained Fresh Very strong Grey to pink		0.1	1																
3		END OF DRILLHOLE		216.7	2														UCS = 157 MPa		
4				2.9																	
5																					
6																					
7																					
8																					
9																					
10																					

DEPTH SCALE

1 : 50



LOGGED: EC

CHECKED: AB

SUD-RCK 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

PROJECT <u>07-1191-0020 OHS</u>		<b>RECORD OF BOREHOLE No OHS1-2</b>				1 OF 1 <b>METRIC</b>										
W.P. <u>5403-05-00</u>		LOCATION <u>N 5047479.5; E 240907.8</u>				ORIGINATED BY <u>EC</u>										
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>Portable Equipment</u>				COMPILED BY <u>EC</u>										
DATUM <u>Geodetic</u>		DATE <u>March 23 and 24, 2011</u>				CHECKED BY <u>AB</u>										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
220.4	GROUND SURFACE															
0.0	GNEISS (BEDROCK)		1	RC	REC 100%											
	Bedrock cored from ground surface to 3.0 m depth.															
	For coring details see Record of Drillhole OHS1-2.															
			2	RC	REC 100%											
217.4	END OF BOREHOLE															
3.0	Note:  1. Borehole dry upon completion of drilling.															

SUD-MTO 001 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

PROJECT: 07-1191-0020 OHS

**RECORD OF DRILLHOLE: OHS1-2**

SHEET 1 OF 1

LOCATION: N 5047479.5 ;E 240907.8

DRILLING DATE: March 23 and 24, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN FLUSH	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										NOTES WATER LEVELS INSTRUMENTATION									
							RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY k, cm/s					Diametral Point Load Index (MPa)	RMC -Q AVG				
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jun	φ	ψ	τ	σ						
0	Portable Hiti Drill March 23 and 24, 2011	REFER TO PREVIOUS PAGE		220.4 0.0																						
1		GNEISS Fine to medium grained Fresh Very strong Grey			1																					
2					2																					
3		END OF DRILLHOLE		217.4 3.0																						
4																										
5																										
6																										
7																										
8																										
9																										
10																										

DEPTH SCALE

1 : 50



LOGGED: EC

CHECKED: AB

SUD-RCK 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:





# **APPENDIX B**

## **Highway 69 SBL – Overhead Sign at STA 10+480**

METRIC  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
WP No.5403-05-00

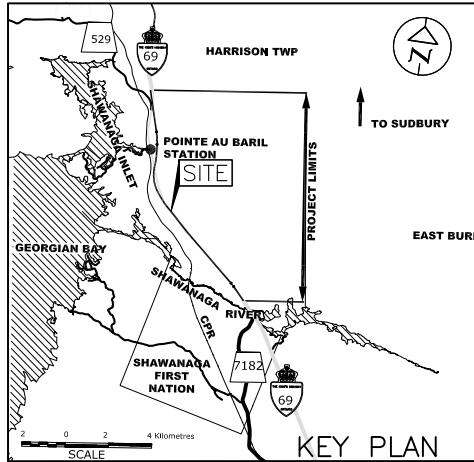


HIGHWAY 69 (SBL)  
OVERHEAD SIGN AT STA. 10+480  
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.  
SUDBURY, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- Dynamic Cone Penetration Test Previous Investigation

No.	ELEVATION(m)	CO-ORDINATES	
		NORTHING	EASTING
OHS2-1	204.8	5048195.3	239507.0
OHS2-2	205.1	5048178.0	239497.0

NOTES

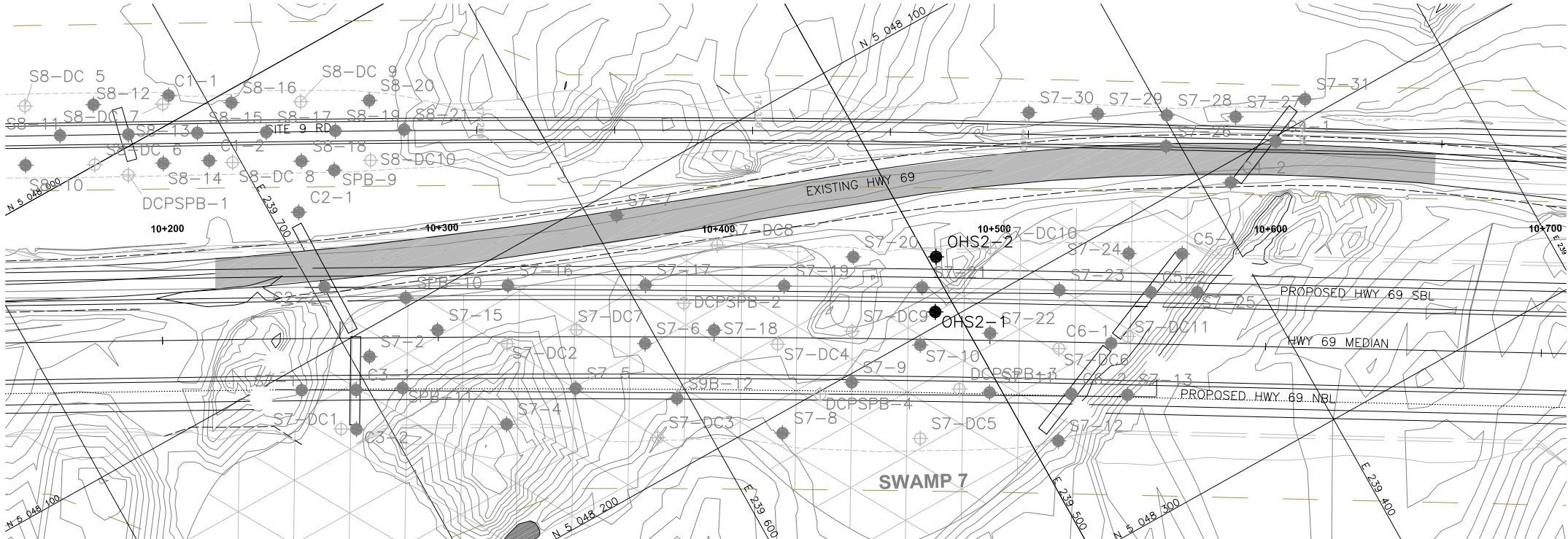
This drawing is for subsurface information only. The proposed site details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE


Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008), Trow Associates Inc. Preliminary Foundation Report dated September 2005.



PLAN



NO.				REVISION			
Geocres No. 41H-102							
HWY. 69		PROJECT NO.07-1191-0020		DIST.			
SUBM'D. EC		CHKD. AB		DATE: NOV 2011		SITE:	
DRAWN: JJJ		CHKD.		APPD. JMAC		DWG. B-1	

PROJECT <u>07-1191-0020 OHS</u>		<b>RECORD OF BOREHOLE No OHS2-1</b>				1 OF 1 <b>METRIC</b>											
W.P. <u>5403-05-00</u>		LOCATION <u>N 5048195.3; E 239507.0</u>				ORIGINATED BY <u>EHS</u>											
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>				COMPILED BY <u>EC</u>											
DATUM <u>Geodetic</u>		DATE <u>May 5, 2011</u>				CHECKED BY <u>AB</u>											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
204.8	GROUND SURFACE																
0.0	Silty PEAT (Fibrous)																
204.4	Brown Moist																
0.4	GNEISS (BEDROCK)																
	Bedrock cored from 0.4 m depth to 3.7 m depth. For coring details see Record of Drillhole OHS2-1.																
204			1	RC	REC 100%												RQD = 95%
203																	
202			2	RC	REC 100%												RQD = 86%
201.1																	
			3	RC	REC 100%												RQD = 100%
3.7	END OF BOREHOLE																
	Note: 1. Borehole dry upon completion of drilling.																

SUD-MTO 001 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore

CHECKED: AB

SUD-RCK 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

PROJECT <u>07-1191-0020 OHS</u>		<b>RECORD OF BOREHOLE No OHS2-2</b>		1 OF 1 <b>METRIC</b>													
W.P. <u>5403-05-00</u>		LOCATION <u>N 5048178.0; E 239497.0</u>		ORIGINATED BY <u>EHS</u>													
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>		COMPILED BY <u>EC</u>													
DATUM <u>Geodetic</u>		DATE <u>May 5, 2011</u>		CHECKED BY <u>AB</u>													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
205.1	GROUND SURFACE																
0.0	Sandy PEAT (Fibrous)																
0.3	Brown Moist																
204.4	SAND, some gravel, trace silt		1	AS	-												
0.7	Brown Moist to wet GNEISS (BEDROCK)		1	RC	REC 100%												RQD = 96%
	Bedrock cored from 0.7 m depth to 4.1 m depth.																
	For coring details see Record of Drillhole OHS2-2.		2	RC	REC 100%												RQD = 90%
			3	RC	REC 100%												RQD = 68%
201.0	END OF BOREHOLE																
4.1	Note: 1. Water level at a depth of 0.6 m below ground surface (Elev. 204.5 m) upon completion of drilling.																

SUD-MTO 001 07-1191-0020-8000 OHS BH LOGS.GPJ GAL-MISS.GDT 12/10/11 DATA INPUT:

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore

CHECKED: AB





# **APPENDIX C**

## **Non-Standard Special Provisions**



**MASS CONCRETE – Item No.**

---

**Non-Standard Special Provision**

---

**Scope of Work**

The scope of work for the above noted tender item includes the mass concrete under the centre pier footing.

**Construction**

Concrete shall be of the same strength as the footing concrete and placed in accordance with OPSS 904.

**Basis of Payment**

Payment at the contract price for the above noted tender item includes full compensation for all labour, equipment and materials to do the required work.



## **DOWELS INTO ROCK – Item No.**

### **Non-Standard Special Provision**

#### **Scope of Work**

Work under this item is for the placement and field testing of dowels into rock.

#### **Construction**

Dowels into rock shall be constructed in accordance with OPSS 904 (Concrete Structures). All reinforcing steel supplied shall be in accordance with OPSS 1440 (Steel Reinforcement for Concrete) (dowel bars conforming to CSA Standard CSAG30.18, Grade 400).

For dowels into rock, holes shall be drilled to the required depth and size. Hole diameter shall be two times the nominal diameter of the dowel. Each hole shall be cleaned out, grouted and the dowel set in place. Grout shall be of the same strength as the footing concrete, or at least 25 MPa at 28 days.

If the hole contains water, the contractor shall remove the water; otherwise, a tremie procedure shall be used to completely fill the hole with grout. The dowel shall be forced into the hole after the grout has been placed and while it is still fresh.

#### **Rock Dowel Testing**

All proposed testing procedures shall be in general conformance with ASTM D3689-90 and ASTM D1143M-07. Field testing must be carried out in the presence of, and the results reviewed and approved by, the Contract Administrator.

#### **Performance Tests**

The following summarizes the number of dowels into rock where performance testing shall be carried out to confirm that the design load of the rock dowels can be achieved. The Contract Administrator will select the rock dowels to be tested.

<b>Foundation</b>	<b>Number of Dowels for Performance Testing</b>
Overhead Sign at STA 20+770 NBL (OHS1)	2 per foundation element
Overhead Sign at STA 10+480 SBL (OHS2)	2 per foundation element

Performance test shall be by axial tensioning using a hydraulic jack with a capacity of at least 1.5 times the ultimate strength of the dowels.



Rock dowels shall be loaded and unloaded in 3 cycles and measurements of the displacement of the dowel shall be carried out at each load increment (step) in accordance with the following schedule:

Cycle-Step	1-1	1-2	1-3	2-1	2-2	2-3	2-4
% Design Load	50	75	25	50	75	100	25

Cycle-Step	3-1	3-2	3-3	3-4	3-5
% Design Load	50	75	100	110	25

The design load shall be taken as 360 kN for 35M dowels, 252 kN for 30M dowels, 180 kN for 25M dowels, and 108 kN for 20M dowels.

Displacement measurements shall be carried out at each load increment using calibrated displacement gauges capable of measuring movements of 0.025 mm. Measurements shall be referenced to an independent fixed referenced pint.

Rock dowels which fail to meet the acceptance criteria shall be replaced at the Contractor's expense and re-tested. If a rock dowel fails, 3 additional rock dowels shall be tested at the same abutment and pier footing as directed by the Contract Administrator.

Acceptance criteria for the rock dowels will be in accordance with the Post-tensioning Institute (1985) as follows:

- The dowels are acceptable if the total elastic movement is greater than 80 percent of the theoretical elastic elongation of the free stressing and is less than the theoretical elongation of the free stressing length plus 50 percent of the bond length.

### **Basis of Payment**

Payment at the Contract Price for the above tender item includes full compensation for all labour, equipment and material to do the required work.

END OF SECTION

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ltd.**  
**1010 Lorne Street**  
**Sudbury, Ontario, P3C 4R9**  
**Canada**  
**T: +1 (705) 524 6861**

