



October 21, 2016

FOUNDATION INVESTIGATION REPORT

**OVERHEAD SIGNS STA 9+662 AND STA 15+700
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-167

Report Number: 07-1191-0020

Distribution:

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

REPORT





Table of Contents

PART A – FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
3.0 INVESTIGATION PROCEDURES	1
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS	2
4.1 Regional Geology	2
4.2 Subsurface Conditions.....	3
4.3 STA 9+662 NBL-Connection (Harrison Township)	3
4.3.1 Silty Sand to Sand and Gravel (FILL).....	3
4.3.2 Blast Rock (FILL)	4
4.3.3 Peat.....	4
4.3.4 Bedrock.....	4
4.3.5 Groundwater Conditions	4
4.4 STA 15+700 SBL (Harrison Township).....	4
4.4.1 Sandy Topsoil	5
4.4.2 Sand.....	5
4.4.3 Bedrock.....	5
5.0 CLOSURE.....	5

DRAWINGS

Drawing 1 Overhead Signs – Index Plan

LIST OF SYMBOLS AND ABBREVIATIONS

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

APPENDICES

Appendix A	Highway 69 NBL-Connection – Overhead Sign at STA 9+962
Drawing A1	Borehole Locations
Record of Boreholes	09-01 and 09-02
Record of Drillholes	09-01 and 09-02



FOUNDATION REPORT

HIGHWAY 69 OVERHEAD SIGNS, GWP 5403-05-00

Appendix B

Highway 69 NBL – Overhead Sign at STA 15+700

Drawing B1

Borehole Locations

Record of Boreholes

09-07 and 09-08

Record of Drillholes

09-07 and 09-08



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 overhead signs for the new Highway 69 alignment. The two signs are located at STA 9+662 of the Northbound Lanes (NBL) Connection of the Existing Highway 69 and at STA 15+700 of the Northbound Lanes (NBL) 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 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 2009 prior to the start of fieldwork; and updated drawings with sign locations were provided to us in February 2016.

This report addresses the investigations carried out for two overhead sign structures crossing Highway 69. Separate reports were submitted detailing the foundation investigations for two other overhead signs, as well as for 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 A1 and B1 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 highway supported by a spread footing on each side of the highway embankment.

2.0 SITE DESCRIPTION

The new NBL overhead sign at STA 9+662 is located along the existing two-lane alignment of the existing Highway 69 in the Township of Harrison approximately 0.6 km north of the south junction of Highway 529; and the new NBL overhead sign at STA 15+700 is located along the proposed alignment of the new four-lane section of Highway 69 in the Township of Harrison approximately 0.9 km south of the south junction of Highway 529.

In general, the topography in the area of the NBL overhead sign at STA 9+662 is generally flat to gently sloping down to the south with tree cover and bedrock exposed on both sides of the highway. The topography in the area of the NBL overhead sign at STA 15+700 is sloping to the south and to the west, with tree cover on both sides of proposed highway alignment and exposed bedrock on the east side.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the investigation at the proposed overhead sign locations was carried out between September 1 and 8, 2009, during which time a total of four boreholes were advanced at the locations shown on Drawings A1



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

and B1 in Appendices A and B, respectively. Two boreholes were advanced for each sign, one at each foundation location, designated Boreholes 09-01 and 09-02 and Boreholes 09-07 and 09-08.

The foundation investigation was carried out using a track-mounted CME 850 drill rig supplied and operated by Landcore Drilling of Chelmsford, Ontario. The boreholes were advanced to depths that ranging from 3.1 m to 5.4 m, including 3.0 m to 3.3 m of bedrock coring. The boreholes were advanced using 108 mm inside diameter continuous flight hollow stem augers and/or NQ coring. Where possible, soil samples were obtained either from the augers or from a 50 mm outside diameter split-spoon sampler driven in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Rock core samples were obtained using an 'NQ' size core barrel. 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 limited thickness or composition or lack of overburden present at the borehole locations, two auger soil samples and four split spoon samples were 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 positions staked by MMM. The borehole locations shown on Drawings A1 and B1 are positioned relative to MTM NAD 83 (Zone 10) 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.

Sign Location	Borehole Number	MTM NAD83 Zone 10 Northing (m)	MTM NAD83 Zone 10 Easting (m)	Ground Surface Elevation (m)	Drilled Depth (m)
STA 9+662	09-01	5053471.6	235860.1	198.1	5.4
	09-02	5053464.2	235844.8	197.1	3.8
STA 15+700	09-07	5052189.9	236713.1	205.1	3.1
	09-08	5052184.4	236698.1	204.3	3.7

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*¹, 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.

¹ 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 4². 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 embankment fill, organics and/or sand underlain by bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.3 STA 9+662 NBL-Connection (Harrison Township)

Two boreholes (Boreholes 09-01 and 09-02) were advanced at the locations of the west and east foundation support elements of the proposed overhead sign at STA 9+662.

4.3.1 Silty Sand to Sand and Gravel (FILL)

In Borehole 09-01, a 75 mm thick layer of asphalt was encountered at ground surface, at Elevation 198.1 m, and is underlain by a 0.9 m thick layer of sand to sand and gravel fill.

In Borehole 09-02, a 0.5 m thick deposit of silty sand to gravelly sand fill was encountered at ground surface, at Elevation 197.1 m.

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



4.3.2 Blast Rock (FILL)

In Borehole 09-01, a 1.3 m thick deposit of blast rock fill was encountered at a depth of 1.0 m below the asphalt surface at Elevation 197.1 m.

4.3.3 Peat

In Borehole 09-01, a 0.1 m thick layer of peat was encountered at a depth of 2.3 m below the asphalt surface at Elevation 195.8 m.

4.3.4 Bedrock

Bedrock was encountered below the peat deposit in Borehole 09-01 at Elevation 195.7 m and below the silty sand to sand and gravel fill in Borehole 09-02 at Elevation 196.6 m, and 3.0 m to 3.3 m of bedrock core was recovered in the respective boreholes.

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

The Total Core Recovery (TCR) is 100 per cent. Rock Quality Designation (RQD) values measured on the recovered bedrock core samples range from 74 per cent to 100 per cent, indicating that the rock is of fair to excellent quality in accordance with Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)³.

An Unconfined Compressive Strength (UCS) test was carried out on representative samples of the rock core taken from Boreholes 09-01 and 09-02 and the measured uniaxial compressive strength of the bedrock core samples is 105 MPa and 101 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).

4.3.5 Groundwater Conditions

The groundwater level in Borehole 09-01 was measured at a depth of 1.2 m below ground surface (at Elevation 196.9 m) and in Borehole 09-02 the groundwater level was measured at a depth of 0.5 m below ground surface (at Elevation 196.6 m) 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 15+700 SBL (Harrison Township)

Two boreholes (Boreholes 09-07 and 09-08) were advanced at the locations of the west and east foundation support elements of the proposed overhead sign at STA 15+700.

³ Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.



4.4.1 Sandy Topsoil

In Boreholes 09-07 and 09-08, a 0.1 m and 0.3 m thick deposit of sandy topsoil was encountered at the ground surface, at Elevations 205.1 m and 204.3 m, in the respective boreholes.

4.4.2 Sand

In Borehole 09-08, a 0.2 m thick deposit of sand was encountered underlying the sandy topsoil at Elevation 204.0 m.

4.4.3 Bedrock

Bedrock was encountered below the sandy organic deposit in Borehole 09-07 at Elevation 205.0 m and below the sand in Borehole 09-08 at Elevation 203.8 m and 3.0 m and 3.2 m of bedrock core were recovered in the respective boreholes.

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

The TCR is 100 per cent for all core samples. RQD values measured on the recovered bedrock core samples range from 33 per cent to 84 per cent, indicating that the rock is of poor to good 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 09-07 and 09-08 and the measured uniaxial compressive strength of the bedrock core samples is 98 MPa and 104 MPa, respectively, indicating that the bedrock is strong to very strong (R4 to R5, 50 MPa < UCS < 250 MPa) in accordance with Table 3.5 of CFEM (2006).

5.0 CLOSURE

The fieldwork for this project was monitored by Mr. Ed Savard from our Sudbury office. This report was prepared by Mr. Tibor Berecz, and the technical aspects were reviewed by Mr. André Bom, P.Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a senior consultant with Golder and Designated MTO Foundations Contact for Golder, conducted a quality control review of the report.



Report Signature Page

GOLDER ASSOCIATES LTD.

Tibor Berecz

Tibor Berecz, M.Sc. Civil Eng.
Geotechnical Group



Andre Bom

Andre Bom, P.Eng.
Geotechnical Engineer, Associate



Jorge M.A. Costa, P.Eng
Designated MTO Foundations Contact, Senior Consultant

AB/JMAC/kp

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

n:\active\2007\07-1191-0020 mmm hwy 69 twinning\7000 reporting\final\2016 - overhead signs\07-1191-0020 rpt 16oct21 ohs fdr.docx

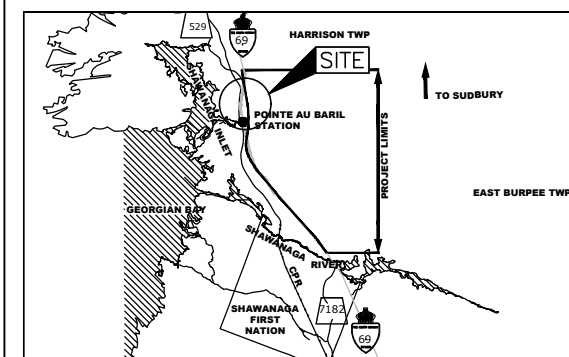
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 5403-05-00



HIGHWAY 69
OVERHEAD SIGNS
INDEX PLAN

SHEET



KEY PLAN
SCALE

4 0 4 8 km

NOTES

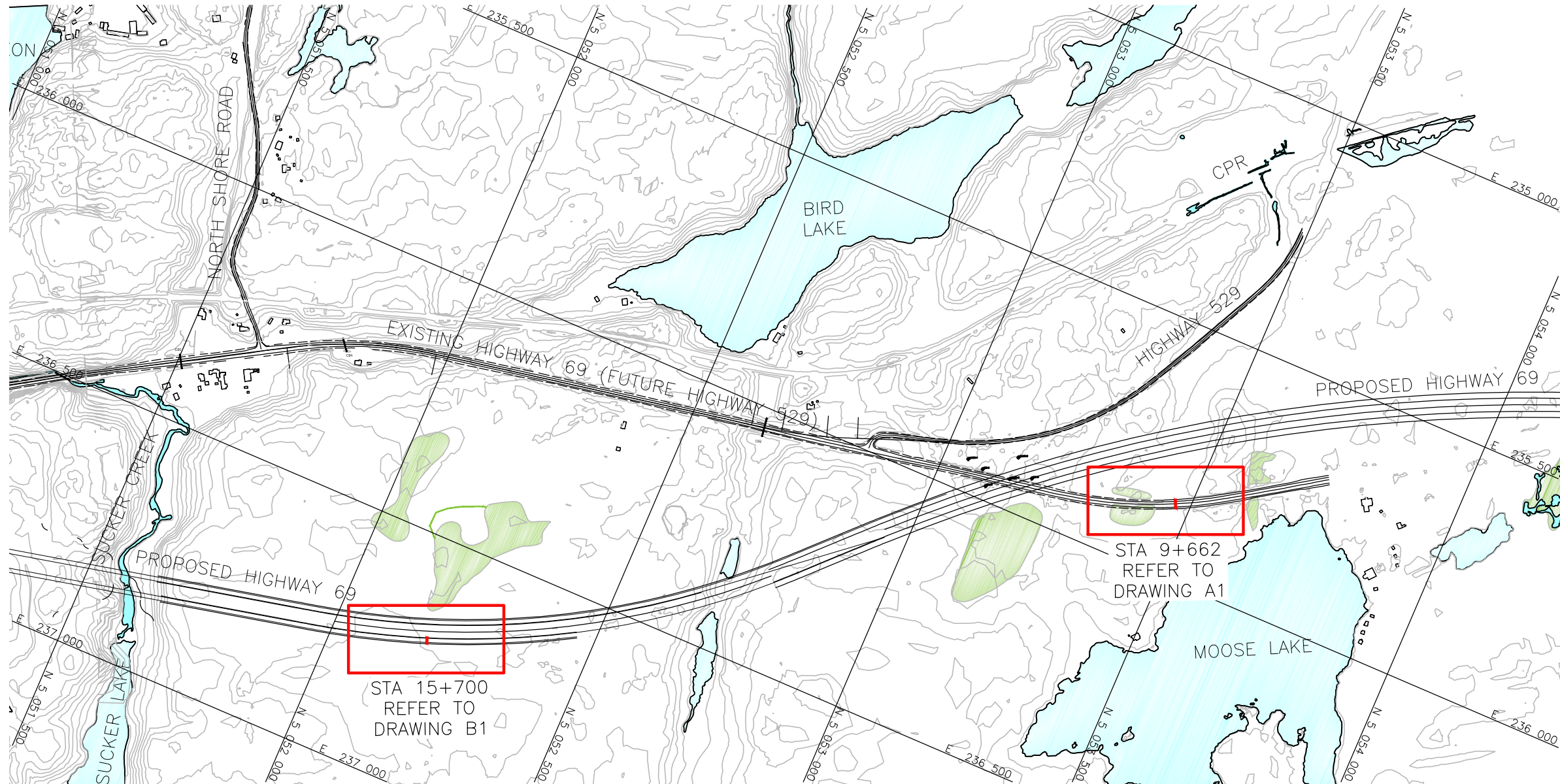
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 plans provided in digital format by MMM, drawing file nos. Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM_Sign.dwg, received FEB 16, 2016.



PLAN

SCALE

100 0 100 200 m

NO.	DATE	BY	REVISION
Geocres No. 41H-167			
HWY. 69	PROJECT NO. 07-1191-0020		DIST. .
SUBM'D.	CHKD.	DATE: 10/20/2016	SITE: .
DRAWN: TB	CHKD. AB	APPD. JMAC	DWG. 1



LIST OF SYMBOLS

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

I. GENERAL

π	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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	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
γ'	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

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	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_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	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

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

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



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
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
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.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: 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 cm² 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) Non-Cohesive (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 ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
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)
γ	unit weight

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

V. MINOR SOIL CONSTITUENTS

Per cent 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 (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS 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 and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 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	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 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 varied 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 separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to 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 abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features 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

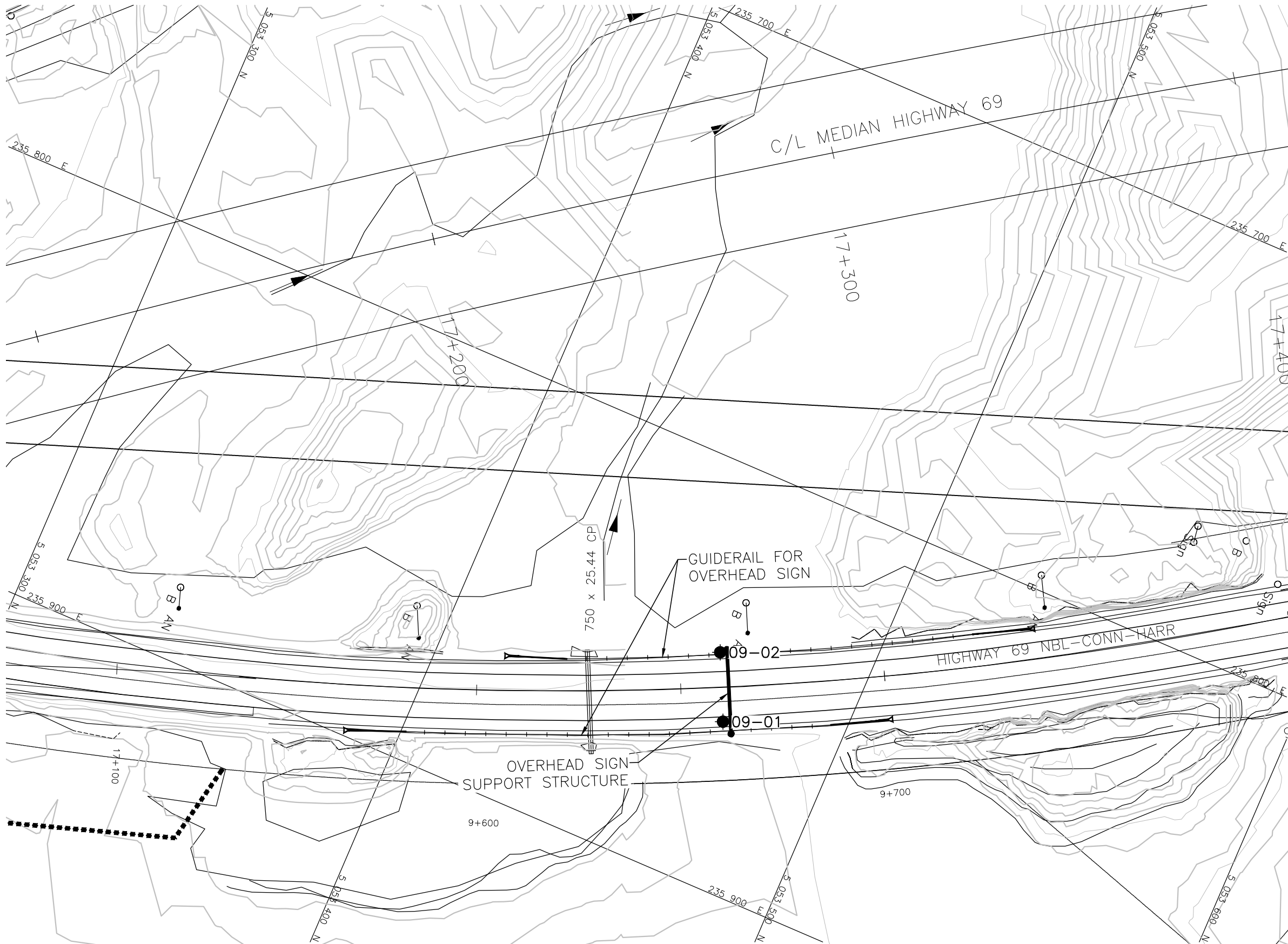
JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	



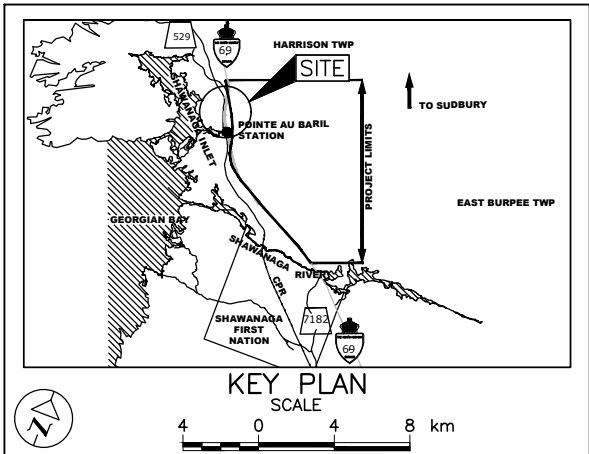
APPENDIX A

Highway 69 NBL - Connection – Overhead Sign at STA 9+962

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



CONT No. GWP No. 5403-05-00	
HIGHWAY 69 OVERHEAD SIGN AT STA. 9+662 BOREHOLE LOCATIONS	SHEET



BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
09-01	198.1	5053471.6	235860.1
09-02	197.1	5053464.2	235844.8

NOTES

This drawing is for subsurface information only. The proposed structure 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 plans provided in digital format by MMM, drawing file nos. Base 5403-05-00.dwg, Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM_Sign.dwg, received FEB 16, 2016.



NO.	DATE	BY	REVISION
Geocres No. 41H-167			
HWY. 69	PROJECT NO. 07-1191-0020	DIST.	
SUBM'D.	CHKD.	DATE: 10/20/2016	SITE:
DRAWN: TB	CHKD. AB	APPD. JMAC	DWG. A1

PROJECT 07-1191-0020				RECORD OF BOREHOLE No 09-01				1 OF 2 METRIC									
G.W.P. 5403-05-00				LOCATION N 5053471.6; E 235860.1				ORIGINATED BY EHS									
DIST _____ HWY 69				BOREHOLE TYPE 108 mm Continuous Flight Hollow Stem Augers				COMPILED BY TB									
DATUM Geodetic				DATE September 1, 2009				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
198.1	GROUND SURFACE							20	40	60	80	100					
0.9	ASPHALT (75 mm)		1	AS	-		198										
	Sand to sand and gravel (FILL) Brown Moist		2	AS	-												
197.1	Blast Rock (FILL)	3	SS	40/0.1	197												
1.0							196										
195.8	PEAT						195										
2.4	Gneiss (BEDROCK)		1	RC	REC 100%												
	Bedrock cored from 2.4 m to 5.4 m depth. For coring details see Record of Drillhole 09-01.		2	RC	REC 100%	194											
192.7	END OF BOREHOLE						193										
5.4	Note: 1. Water level at depth of 1.2 m below ground surface (Elev. 196.2 m) upon completion of drilling (and decreasing).																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: 09-01

SHEET 2 OF 2

LOCATION: N 5053471.6 ;E 235860.1

DRILLING DATE: September 1, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	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	Jn				
		REFER TO PREVIOUS PAGE		195.7 2.4			88 88 88	88 88 88	88 88 88	88 88 88	88 88 88	88 88 88								
3	NW	GNEISS Very strong Fresh Fine to medium grained Pinkish grey			1	Grey 100							JNIRRO							
													JNFORO							
4	CME-850 Track NQ Coring												JNFORO							
													MB JNFORO							
													JNFORO							
													JNIRRO							
5					2	Grey 100							JNFORO							
													MB MB JNIRRO							
													MB MB							
		END OF DRILLHOLE		192.7 5.4																
6																				
7																				
8																				
9																				
10																				
11																				
12																				

USC = 104.8 MPa

DEPTH SCALE



1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT 07-1191-0020				RECORD OF BOREHOLE No 09-02				1 OF 2 METRIC									
G.W.P. 5403-05-00				LOCATION N 5053464.2; E 235844.8				ORIGINATED BY EHS									
DIST _____ HWY 69				BOREHOLE TYPE 108 mm Continuous Flight Hollow Stem Augers				COMPILED BY TB									
DATUM Geodetic				DATE September 2, 2009				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
197.1	GROUND SURFACE						20	40	60	80	100						
0.0	Silty sand to gravelly sand (FILL)		1	SS	5		197										
196.6	Loose Brown Moist																
0.5	GNEISS (BEDROCK)		1	RC	REC 93%		196										
	Bedrock cored from 0.5 m to 3.8 m depth. For coring details see Record of Drillhole 09-02.		2	RC	REC 100%		195										
193.3	END OF BOREHOLE						194										
3.8	Note: 1. Water level at depth of 0.5 m below ground surface (Elev. 195.6 m) upon completion of drilling.																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: 09-02

SHEET 2 OF 2

LOCATION: N 5053464.2 ;E 235844.8

DRILLING DATE: September 2, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	CORRELATION LOG																	NOTES WATER LEVELS INSTRUMENTATION																											
						COLOUR % RETURN	RECOVERY				FRACT. INDEX METRES	DISCONTINUITY DATA							HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)		RMC -Q AVG																										
							FLUSH	TOTAL CORE %	SOLID CORE %	R.Q.D. %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s	σ ₁	σ ₃																														
								80 60 40 20 0	80 60 40 20 0	80 60 40 20 0											0 20 40 60 80 100				0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100																		
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.																																																		
		REFER TO PREVIOUS PAGE		196.6 0.5																																														
1	CME-850 Track NQ Coring	GNEISS Very strong Fresh Fine to medium grained Grey			1	Grey 100																																												
2																																																		
3																																																		
4		END OF DRILLHOLE		193.3 3.8																																														
5																																																		
6																																																		
7																																																		
8																																																		
9																																																		
10																																																		

DEPTH SCALE

1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS GDT 31/05/16 DATA INPUT:



APPENDIX B


Highway 69 NBL – Overhead Sign at STA 15+700

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

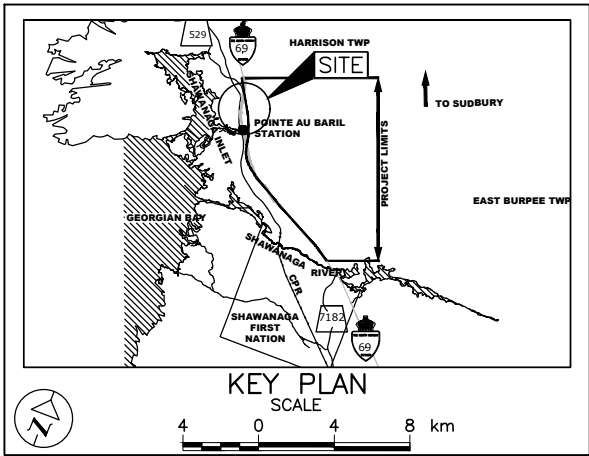
CONT No.
GWP No. 5403-05-00


HIGHWAY 69
OVERHEAD SIGN AT STA. 15+700

BOREHOLE LOCATIONS



SHEET



 Borehole – Current Investigation

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
09-07	205.1	5052189.9	236713.1
09-08	204.3	5052184.4	236698.1

NOTES

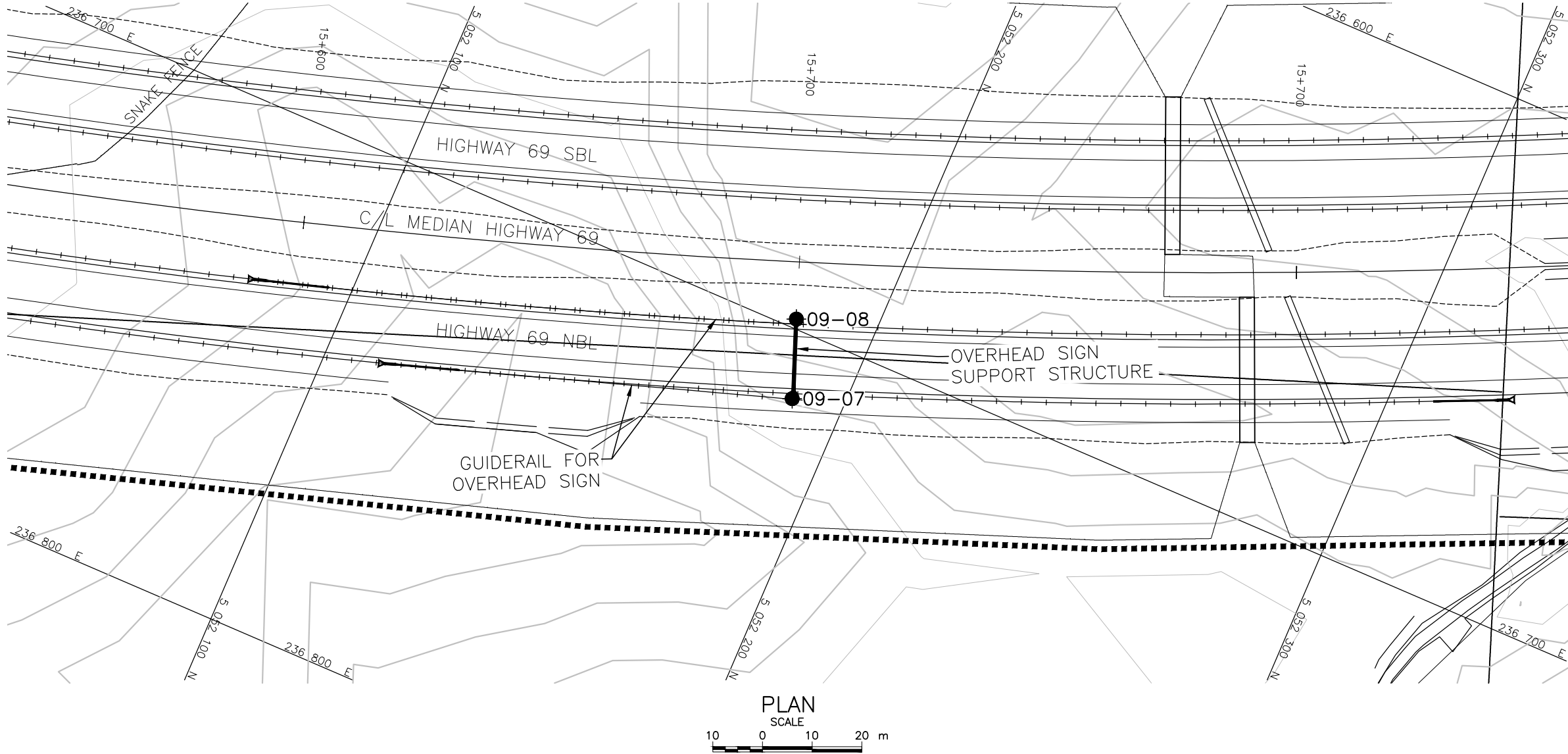
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 plans provided in digital format by MMM, drawing file nos. Base 5403-05-00.dwg, Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM_Sign.dwg, received FEB 16, 2016.



NO.	DATE	BY	REVISION
Geocres No. 41H-167			
HWY. 69		PROJECT NO. 07-1191-0020	DIST. .
SUBM'D.	CHKD.	DATE: 10/20/2016	SITE: .
DRAWN: TB	CHKD. AB	APPD. JMAC	DWG. B1

PROJECT 07-1191-0020				RECORD OF BOREHOLE No 09-07				1 OF 2 METRIC									
G.W.P. 5403-05-00				LOCATION N 5052189.9; E 236713.1				ORIGINATED BY EHS									
DIST _____ HWY 69				BOREHOLE TYPE 108 mm Continuous Flight Hollow Stem Augers				COMPILED BY TB									
DATUM Geodetic				DATE September 8, 2009				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
205.1	GROUND SURFACE						20	40	60	80	100						
0.1	Sandy TOPSOIL		1	SS	5/0.1												
	GNEISS (BEDROCK)																
	Bedrock cored from 0.1 m to 3.1 m depth. For coring details see Record of Drillhole 09-07.		1	RC	REC 100%												RQD = 71%
			2	RC	REC 100%												RQD = 39%
202.0	END OF BOREHOLE																
3.1	Note: 1. Water level not recorded.																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: 09-07

SHEET 2 OF 2

LOCATION: N 5052189.9 ;E 236713.1

DRILLING DATE: September 8, 2009



DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	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								
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	B Angle	DIP w.r.t CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY k, cm/s	Diametral Point Load Index (MPa)	RMC -Q AVG						
								TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION	Jr	Ja				Jn					
								80 60 40 20	80 60 40 20																
		REFER TO PREVIOUS PAGE		205.0																					
1	NQ Coring	GNEISS Strong Slightly weathered Fine to medium grained Grey to pinkish grey		0.1	1	Grey 100																			
2																									

PROJECT <u>07-1191-0020</u>				RECORD OF BOREHOLE No 09-08				1 OF 2 METRIC									
G.W.P. <u>5403-05-00</u>				LOCATION <u>N 5052184.4; E 236698.1</u>				ORIGINATED BY <u>EHS</u>									
DIST <u> </u> HWY <u>69</u>				BOREHOLE TYPE <u>108 mm Continuous Flight Hollow Stem Augers</u>				COMPILED BY <u>TB</u>									
DATUM <u>Geodetic</u>				DATE <u>September 8, 2009</u>				CHECKED BY <u>AB</u>									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
204.3	GROUND SURFACE							20	40	60	80	100					
0.0 204.0	Sandy TOPSOIL		1	SS	13		204										
0.5	SAND Compact Brown Moist GNEISS (BEDROCK) Bedrock cored from 0.5 m to 3.7 m depth. For coring details see Record of Drillhole 09-08.		1	RC	REC 100%		203										RQD = 33%
			2	RC	REC 100%		202										RQD = 84%
200.6	END OF BOREHOLE						201										
3.7	Note: 1. Water level not recorded.																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: 09-08

SHEET 2 OF 2

LOCATION: N 5052184.4 ;E 236698.1

DRILLING DATE: September 8, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	CORING LOG															NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY			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	Jn	k, cm/s																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
																		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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		REFER TO PREVIOUS PAGE		203.8 0.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

DEPTH SCALE

1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
33 Mackenzie Street, Suite 100
Sudbury, Ontario, P3C 4Y1
Canada
T: +1 (705) 524 6861

