

FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGNS
HIGHWAY 69 FOUR-LANING
FROM THE SOUTH JUNCTION OF HIGHWAY 529 NORTHERLY 15 KM
G.W.P. 5076-06-00
Geocres Number: 41H-103

Report to
MMM Group Limited

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation conducted at the locations of four proposed overhead sign supports (OHS) to be constructed in connection with the proposed Highway 69 four-laning project, which extends from the south junction of Highway 529 northerly for 15 km in the Townships of Harrison and Wallbridge, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the OHS locations and, based on the data obtained, provide a borehole location plan, borehole logs, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 5006-E-0030.

2 SITE DESCRIPTION

Highway 69 is currently a two lane undivided roadway. The roadway corridor typically has a rolling topography with frequent bedrock outcrops of generally low relief, separated by low-lying swamp areas, water bodies, and small streams. In general, the area is heavily wooded except in swamp areas.

The approximate locations of the four proposed overhead signs are described below:

Structure	Location
OHS 1	Station 19+200, Hwy 69 NBL, Harrison Township; approximately 1.6 km north of Moose Lake Rd. Connection
OHS 2	Station 20+750, Hwy 69 SBL, Harrison Township; approximately 140 m north of the Naiscoot Lake centreline.
OHS 3	Station 13+050, Hwy 69 NBL, Wallbridge Township; approximately 1.4 km north of Harris Lake Rd.
OHS 4	Station 14+550, Hwy 69 NBL, Wallbridge Township; approximately 2.9 km north of Harris Lake Rd.

The sites lie within the physiographic region known as the Georgian Bay Fringe, characterized by very shallow soils and bare rock knobs and ridges. Where present, the overburden materials consist of sand, silt and clay. Recent organic deposits of peat and muck occur in abundance in bedrock hollows and valleys. The area is underlain by strongly foliated and highly to intermediately deformed rocks of Precambrian age, primarily migmatitic rocks and gneisses.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at the locations of the proposed OHS were carried out on February 12, 15 and 16, 2011. Two sampled boreholes were drilled near each proposed OHS location. A summary of the borehole designations and sampling termination depths/elevations is provided in Table 3.1.

Table 3.1 – Borehole Designations and Depths

Sign	Borehole	Sampled Borehole Termination		Rock Core
		Depth (m)	Elevation	Depth (m)
OHS 1	OHS1-01	0.9	200.7	0.9 - 4.1
	OHS1-02	0.3	200.9	0.3 - 3.7
OHS 2	OHS2-01	1.0	196.6	1.0 – 4.4
	OHS2-02	0.9	196.5	0.9 – 4.2
OHS 3	OHS3-01	1.2	200.7	1.2 – 4.6
	OHS3-02	0.1	202.6	0.1 – 3.1
OHS 4	OHS4-01	0.1	196.4	0.1 – 3.0
	OHS4-02	0.1	195.4	0.1 – 3.2

The approximate locations of the boreholes are shown on the Borehole Locations drawings in Appendix D. The coordinates and elevations of the boreholes are given on the drawing and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Hollow stem augers were used to advance the boreholes in the overburden. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). All the boreholes were advanced 2.9 m to 3.4 m into bedrock by NQ size diamond coring.

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

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

The boreholes were monitored throughout the drilling operations for the presence of groundwater.

Boreholes were backfilled with holeplug to 0.15 m, then auger cuttings to the ground surface. Completion of the boreholes was carried out in general accordance with the requirements of O. Reg. 903 (as amended by O.Reg. 372/07).

4 LABORATORY TESTING

All recovered soil and rock samples were subjected to Visual Identification (VI) and geological logging.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. The results are shown in the Point Load Test Sheets included in Appendix B and on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. Overall descriptions of the stratigraphy are given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general terms, the soil stratigraphy encountered at these sites consists of topsoil underlain by native sand over bedrock, or an organic layer directly overlying bedrock. More detailed descriptions of the individual strata are presented below.

5.1 Topsoil

A surficial topsoil layer was identified in Boreholes OHS1-01 to OHS3-01. A layer of organics (moss) was encountered over the bedrock surface in Boreholes OHS3-02 to OHS4-02. The topsoil/organic thickness ranged from 100 mm to 250 mm.

The topsoil thickness may vary between and beyond the borehole locations.

5.2 Sand

Native brown sand containing trace to some gravel, trace to some silt and occasional rootlets, cobbles and boulders was contacted below the topsoil in five boreholes (Boreholes OHS1-01, OHS1-02, OHS2-01, OHS2-02 and OHS3-01).

The thickness of the sand varied from 100 mm to 900 mm.

Sampling and augering were terminated below the sand layer, upon refusal on bedrock at depths ranging from 0.3 m to 1.2 m.

5.3 Bedrock

The soils described in the boreholes were found to be underlain by granitic gneiss bedrock. The bedrock is described as slightly weathered to fresh. The bedrock was generally grey with occasional pink and white bands visible in most cores.

Table 5.1 summarizes depths and elevations to the top of bedrock in the boreholes.

Table 5.1 – Depth and Elevation of Top of Bedrock

Sign	Borehole	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
OHS 1	OHS1-1	0.9	200.7
	OHS1-2	0.3	200.9
OHS 2	OHS2-1	1.0	196.6
	OHS2-2	0.9	196.5
OHS 3	OHS3-1	1.2	200.7
	OHS3-2	0.1	202.6
OHS 4	OHS4-1	0.1	196.4
	OHS4-2	0.1	195.4

Total core recovery (TCR) in the bedrock was 100% in the boreholes.

Rock quality designation (RQD) values generally ranged from 78% to 100%, indicating a good to excellent rock quality. RQD values of 65% and 68% were observed in Boreholes OHS2-01 Runs 2 and 3 and OHS3-01 Run 3, indicating a fair rock quality. Lower RQD values of 33% and 49%, indicating a poor rock quality, were measured in Boreholes OHS1-02 Run 1 and OHS2-02 Run 3.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 1 to 4 in the cores. Individual Fracture Indices ranging from 6 to 12 were observed in Boreholes OHS2-01 Run 3, OHS2-02 Run 3 and OHS3-01 Run 3.

The joints/fractures in the rock were typically horizontal to sub-horizontal (up to 20° from horizontal), with isolated fractures oriented at inclinations of about 45° to 80° from horizontal. The fractures were described as slightly rough to rough, typically moderately rough.

The estimated uniaxial compressive strength of the rock cores generally ranges from 74 MPa to 218 MPa, indicating a strong to very strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. The Point Load Test results are presented in Appendix B and summarized on the borehole logs.

5.4 Water Levels

Groundwater was not observed in the boreholes during or upon completion of drilling. Water is used in the rock coring process and therefore water levels in the boreholes upon completion of coring are not representative of site conditions.

6 MISCELLANEOUS

MMM Group Limited staked the borehole locations in the field and determined the ground surface elevations and coordinates at the boreholes.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. supplied a track mounted CME 75 drill rig and conducted the drilling, coring, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber Engineering Ltd.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Ms. R. Palomeque Reyna, P.Eng. Interpretation of the data and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng. and Mr. Murray R. Anderson, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Rocío Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer



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



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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and presents foundation design recommendations for four proposed overhead signs (OHS) located along the proposed Highway 69 four-laning project in the Townships of Harrison and Wallbridge, Ontario.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained during the course of the investigation. The plans used for preparation of this report were provided by MMM Group Limited.

8 SIGN SUPPORT DESIGN RECOMMENDATIONS

In general, the design of the OHS foundations should be carried out in accordance with the following document:

- Ministry of Transportation, Ontario (April 2011) "Sign Support Manual", Engineering Standards Branch, Bridge Office.

The standard foundation design for overhead signs specified in the Sign Support Manual comprises augered caissons. However, in all boreholes drilled in close proximity to the sign support foundation locations, bedrock was encountered at depths of 0.1 to 1.2 m. For these conditions, spread footings founded on bedrock are the recommended foundation type. Recommendations for design of spread footings as well as the standard caisson foundation are presented below.

8.1 Spread Footings on Bedrock

It is recommended that the overhead signs be supported on spread footings founded on sound bedrock. Based on examination of the recovered rock cores, the bedrock is considered to be sound at the bedrock surface.

A factored geotechnical resistance at ULS of 2,000 kPa is recommended for design of footings on bedrock. The bedrock is considered to be unyielding and therefore the SLS condition will not govern design.

An ultimate friction factor of 0.7 is recommended to compute the frictional resistance developed between poured concrete and a clean bedrock surface.

If required to provide additional lateral/uplift resistance, the footings should be dowelled/anchored into the rock. A factored rock-grout bond stress of 1.0 MPa at ULS is recommended for dowel design (minimum 35 MPa grout). The rock dowels should extend a minimum 1.5 m into the bedrock. A suggested NSSP for the installation of rock dowels is provided in Appendix C.

Construction of the foundations must be carried out in accordance with OPSS 902, including verification of the founding surface. Excavation backfill should consist of granular material as per OPSS 902, compacted in accordance with OPSS 501.

In areas of uneven/sloping bedrock or where sub-excavation is required to remove unsuitable material from below the design founding level, a level founding surface must be established using concrete fill of the same class of concrete as used in the footing. If the slope of the bedrock surface is steeper than 5H: 1V, the bedrock should first be excavated to provide a relatively level surface on which to place the concrete fill. This excavation must be carried out using procedures that do not fracture/shatter the underlying bedrock surface. A suggested NSSP for establishing the founding level is provided in Appendix C.

The design depth of frost penetration at this site is 1.8 m. However, frost penetration is not an issue for footings bearing on bedrock or concrete fill placed on bedrock.

Footings must not be placed on rock fill.

8.2 Caissons

The conditions at these sites meet or exceed the geotechnical parameters assumed in the Sign Support Manual and therefore the standard caisson foundation design may be considered as an alternative.

As outlined in the Sign Support Manual, the caisson depths may be reduced in view of the shallow depth to bedrock. Alternatively the diameter of the rock socket could be reduced to

lessen the effort required to advance the caisson into rock, provided the structural design of the foundation is specifically prepared for the site conditions. The horizontal bearing resistance for the bedrock, f_{horiz} , recommended for analysis is 1,000 kPa at factored ULS.

The depth of frost penetration at the site is 1.8 m. Accordingly all adhesion/skin friction or ultimate passive resistance within the overburden should be neglected in foundation design.

Caisson installation should generally be carried out in accordance with OPSS 903.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for OHS foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix C.

Caisson installation equipment must be able to core into strong to very strong bedrock and handle and remove cobbles and boulders near the ground surface if required.

8.3 Construction Concerns

Concerns during foundation construction mainly involve the handling and removal of cobbles or boulders, possible soil sloughing and water seepage from excavation sidewalls, coring of strong to very strong rock, a variable bedrock surface elevation, and excavation/drilling through rock fill placed for embankment construction.

The bedrock elevations may vary within short distances. The depth to rock at the location of the sign support may therefore be greater or less than that indicated by the borehole findings. The potential for encountering a sloping bedrock surface should also be anticipated.

Groundwater was not observed in the boreholes during the field investigation. However, seepage might occur seasonally in the sand layer, and localized use of pumps or other means may be required to handle groundwater and provide stable excavation sidewalls.

8.4 Construction Inspection and Testing

Footing or caisson construction should be monitored by qualified geotechnical personnel (as per OPSS 902 or 903) to verify the soil/bedrock conditions and to confirm that those conditions are consistent with the design assumptions in this report.

9 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Murray R. Anderson, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Murray R. Anderson, P.Eng., M.Eng.
Senior Foundations Engineer



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



Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


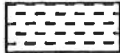



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
TERMS					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No OHS1-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 055 208.7 E 235 070.0 ORIGINATED BY SLL
 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
201.6												
0.0	TOPSOIL, roots and rootlets: (150mm)											
0.2	SAND, trace to some gravel, occasional cobbles and bedrock fragments											
200.7	Brown											
0.9	Moist											
	BEDROCK, granitic gneiss, containing feldspathic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks		1	RUN								
	Moderately rough joints at 1.1m, 1.2m, 1.4m, 3.0m, 3.8m (horizontal to 20 degrees from horizontal)		2	RUN								
	Moderately rough fractures at 1.4m (50 degrees to horizontal) and at 1.7m (75 degrees to horizontal)											
	Moderately rough fracture at 3.6m (70 degrees from horizontal)		3	RUN								
197.5												
4.1	END OF BOREHOLE AT 4.1m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.											

RECORD OF BOREHOLE No OHS1-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 055 213.2 E 235 089.5 ORIGINATED BY SLL
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
201.2												
0.0												
200.9	TOPSOIL, roots and rootlets: (150mm)						201					RUN #1 TCR=100% SCR=100% RQD=33% UCS=74MPa (Average)
0.2												
0.3	SAND, trace gravel Brown Moist		1	RUN								
	BEDROCK, granitic gneiss, containing feldspathic layers, moderately weathered, grey, pink and white bands, occasional mechanical breaks Broken zone from 0.3m to 0.5m Rough joints at 0.8m, 0.9m, 1.1m, 1.3m, 1.5m (horizontal to 15 degrees from horizontal) Slightly weathered to fresh		2	RUN			200					RUN #2 TCR=100% SCR=100% RQD=88% UCS=174MPa (Average)
			3	RUN			199					RUN #3 TCR=100% SCR=100% RQD=100% UCS=130MPa (Average)
	Moderately rough fracture at 2.6m (80 degrees from horizontal)		4	RUN			198					RUN #4 TCR=100% SCR=100% RQD=100% UCS=161MPa (Average)
197.5												
3.7	END OF BOREHOLE AT 3.7m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.										1	

ONTMT4S 6121(OHS), GPJ 1/29/13

+ 3 × 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS2-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 056 700.9 E 234 865.1 ORIGINATED BY SLL
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.02.12 - 2011.02.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _p w w _L							
197.6							20	40	60	80	100				GR	SA	SI	CL
0.0	TOPSOIL, roots and rootlets: (180mm)																	
0.2	SAND, trace gravel, occasional rootlets, occasional cobbles Brown Moist																	
196.6																		
1.0	BEDROCK, granitic gneiss, containing feldsphatic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks Moderately rough horizontal joints at 2.0m, 2.3m, 2.4m Moderately rough fractures at 1.6m, 2.1m, 2.5m (55 to 70 degrees from horizontal)		1	RUN											FI			RUN #1 TCR=100% SCR=100% RQD=100% UCS=145MPa (Average)
			2	RUN											0			RUN #2 TCR=100% SCR=100% RQD=68% UCS=164MPa (Average)
															2			
															1			
															2			
															2			
															3			
															6			
			3	RUN											2			RUN #3 TCR=100% SCR=100% RQD=65% UCS=178MPa (Average)
															3			
															2			
193.1																		
4.4	END OF BOREHOLE AT 4.4m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.																	

RECORD OF BOREHOLE No OHS2-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 056 708.1 E 234 683.8 ORIGINATED BY SLL
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.02.12 - 2011.02.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _P w w _L				
197.4							20 40 60 80 100							
0.0	TOPSOIL, roots and rootlets Moist: (180mm)													
0.2	SAND, some gravel, trace silt, occasional cobbles and boulders Brown Moist													
196.5														
0.9	BEDROCK, granitic gneiss, containing feldspatic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks Slightly to moderately rough joints at 1.4m, 1.6m, 2.1m, 3.1m (45 to 55 degrees from horizontal)		1	RUN									FI 2	RUN #1 TCR=100% SCR=89% RQD=78% UCS=162MPa (Average)
													0	RUN #2 TCR=100% SCR=87% RQD=78% UCS=188MPa (Average)
			2	RUN									3	
													0	
													1	
													12	RUN #3 TCR=100% SCR=63% RQD=49% UCS=218MPa (Average)
			3	RUN									2	
													0	
193.2	Moderately rough fracture at 3.8m (80 degrees from horizontal)												6	
4.2	END OF BOREHOLE AT 4.2m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS3-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 062 962.4 E 230 308.6 ORIGINATED BY SLL
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.02.15 - 2011.02.15 CHECKED BY RPR

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
201.9								20 40 60 80 100						
0.0								○ UNCONFINED + FIELD VANE						
201.7	TOPSOIL, roots and rootlets: (250mm)							● QUICK TRIAXIAL × LAB VANE						
0.3	SAND, some silt Very Dense Brown Moist		1	SS	53/ 0.175			20 40 60 80 100						
200.7														
1.2	BEDROCK, granitic gneiss, containing feldsphatic layers, fresh, grey, white bands, occasional mechanical breaks		1	RUN										RUN #1 TCR=100% SCR=100% RQD=100% UCS=149MPa (Average)
	Rough horizontal fractures at 1.4m, 1.7m, 2.2m, 2.4m, 2.9m													
	Rough fracture at 2.5m (30 degrees from horizontal)		2	RUN										RUN #2 TCR=100% SCR=97% RQD=85% UCS=130MPa (Average)
	50mm quartz vein at 3.0m													
	Moderately to slightly weathered Moderately rough horizontal joints at 3.2m, 3.3m, 3.5m, 3.6m, 3.7m, 3.8m													RUN #3 TCR=100% SCR=97% RQD=68% UCS=117MPa (Average)
	Slightly rough fracture at 3.1m (60 degrees from horizontal)		3	RUN										
197.3														
4.6	END OF BOREHOLE AT 4.6m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No OHS3-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 062 969.8 E 230 327.0 ORIGINATED BY SLL
 HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.02.15 - 2011.02.15 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE		w _p	w	w _L		
202.7								20 40 60 80 100							
0.0															
0.1	ORGANICS: (100mm)														
	BEDROCK, granitic gneiss, containing feldsphatic layers, slightly weathered, grey, pink and white bands, occasional mechanical breaks		1	RUN									FI	RUN #1 TCR=100% SCR=100% RQD=95% UCS=191MPa (Average)	
	Rough horizontal joints at 0.5m, 0.9m, 1.0m, 1.3m, 1.5m, 1.6m												0		
	Rough to slightly rough fractures at 1.6m, 1.9m, 3.0m (60 degrees from horizontal)												1		
	Moderately rough horizontal joints at 1.9m, 2.1m, 2.5m, 2.6m, 2.9m		2	RUN									1		
													3	RUN #2 TCR=100% SCR=100% RQD=93% UCS=173MPa (Average)	
													3		
													3		
													0		
199.5													2		
													2		
3.1	END OF BOREHOLE AT 3.1m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.														

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS4-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 064 354.0 E 229 747.3 ORIGINATED BY SLL
HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
196.5							20	40	60	80	100				
0.0	ORGANICS: (125mm)														
0.1	BEDROCK, granitic gneiss, containing feldspathic layers, fresh, dark grey, white bands, occasional mechanical breaks		1	RUN										FI	RUN #1 TCR=100% SCR=100% RQD=100% UCS=142MPa (Average)
														1	
														1	
														1	
	Slightly to moderately rough horizontal joints at 0.3m, 0.6m, 1.2m, 2.2m, 2.3m													0	RUN #2 TCR=100% SCR=100% RQD=95% UCS=175MPa (Average)
	Rough fracture at 1.0m (40 degrees to horizontal)		2	RUN										0	
														1	
														4	
193.5														0	
3.0	END OF BOREHOLE AT 3.0m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.													0	

RECORD OF BOREHOLE No OHS4-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 064 361.5 E 229 765.8 ORIGINATED BY SLL
 HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
195.5														
0.0	ORGANICS: (125mm)													
0.1	BEDROCK, granitic gneiss, containing feldspathic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks		1	RUN			195						FI	RUN #1 TCR=100% SCR=100% RQD=85% UCS=160MPa (Average)
	Slightly to moderately rough horizontal joints at 0.1m, 0.4m, 1.0m, 1.3m												2	
	Slightly to moderately rough horizontal joints at 1.7m, 1.9m, 2.1m, 2.2m, 2.3m, 2.6m, 2.7m						194						2	
	Slightly rough fracture at 0.3m (25 degrees from horizontal)		2	RUN			193						3	RUN #2 TCR=100% SCR=100% RQD=93% UCS=183MPa (Average)
192.3													1	
3.2	END OF BOREHOLE AT 3.2m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.												3	
													2	
													2	
													0	

Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

Appendix B

Laboratory Test Results



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS1-1
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/16/2011
Date Tested : 2/18/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.04	D	8.0	47.14	80.77	84.14	Granitic gneiss	Strong
2	1	1.35	D	11.1	47.15	76.52	116.71	Granitic gneiss	Very Strong
3	1	1.65	D	7.2	47.13	69.84	75.75	Granitic gneiss	Strong
4	2	1.98	D	12.2	47.13	83.11	128.36	Granitic gneiss	Very Strong
5	2	2.29	D	16.8	47.13	80.93	176.76	Granitic gneiss	Very Strong
6	2	2.59	D	17.0	47.15	91.76	178.74	Granitic gneiss	Very Strong
7	2	2.90	D	12.0	47.15	75.38	126.17	Granitic gneiss	Very Strong
8	3	3.30	D	11.0	47.13	80.41	115.73	Granitic gneiss	Very Strong
9	3	3.53	D	16.1	47.14	79.35	169.34	Granitic gneiss	Very Strong
10	3	3.94	D	14.9	47.14	85.53	156.71	Granitic gneiss	Very Strong
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS1-2
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/16/2011
Date Tested : 2/18/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.41	D	7.0	47.11	99.36	73.70	Granitic gneiss	Strong
2	2	0.81	D	18.2	47.13	79.31	191.49	Granitic gneiss	Very Strong
3	2	1.12	D	12.2	47.13	81.13	128.36	Granitic gneiss	Very Strong
4	2	1.37	D	19.3	47.13	80.08	203.06	Granitic gneiss	Very Strong
5	3	1.70	D	15.3	47.14	78.30	160.92	Granitic gneiss	Very Strong
6	3	2.03	D	14.9	47.14	76.15	156.71	Granitic gneiss	Very Strong
7	3	2.34	D	19.3	47.13	73.48	203.06	Granitic gneiss	Very Strong
8	3	2.62	D	12.0	47.14	69.89	126.21	Granitic gneiss	Very Strong
9	3	3.02	D	0.0	47.13	59.85	3.00	Granitic gneiss	Very Weak
10	4	3.25	D	13.8	47.13	79.45	145.19	Granitic gneiss	Very Strong
11	4	3.56	D	16.90	47.13	74.52	177.81	Granitic gneiss	Very Strong

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS2-1
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/15/2011
Date Tested : 3/10/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.30	D	13.8	47.13	86.38	145.19	Granitic gneiss	Very Strong
2	2	1.57	D	15.0	47.13	78.12	157.82	Granitic gneiss	Very Strong
3	2	1.91	D	17.1	47.14	83.98	179.85	Granitic gneiss	Very Strong
4	2	2.13	D	12.3	47.13	66.01	129.41	Granitic gneiss	Very Strong
5	2	2.77	D	18.0	47.13	63.31	189.38	Granitic gneiss	Very Strong
6	3	3.05	A	8.8	47.14	75.50	53.28	Granitic gneiss	Strong
7	3	3.30	D	21.9	47.14	81.32	230.34	Granitic gneiss	Very Strong
8	3	3.63	D	21.3	47.13	78.14	224.10	Granitic gneiss	Very Strong
9	3	3.96	D	19.5	47.13	86.31	205.16	Granitic gneiss	Very Strong
10									
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS2-2
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/15/2011
Date Tested : 3/10/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.19	D	15.7	47.13	80.36	165.18	Granitic gneiss	Very Strong
2	1	1.35	D	15.2	47.13	78.70	159.92	Granitic gneiss	Very Strong
3	2	1.83	D	19.7	47.14	90.08	207.20	Granitic gneiss	Very Strong
4	2	2.08	D	17.8	47.13	82.20	187.28	Granitic gneiss	Very Strong
5	2	2.39	D	7.0	47.13	86.13	73.65	Granitic gneiss	Strong
6	2	2.69	D	26.9	47.14	78.03	282.93	Granitic gneiss	Extremely Strong
7	2	3.00	D	18.1	47.14	80.34	190.37	Granitic gneiss	Very Strong
8	3	3.40	D	19.5	47.13	70.84	205.16	Granitic gneiss	Very Strong
9	3	3.66	D	22.0	47.13	78.51	231.47	Granitic gneiss	Very Strong
10									
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS3-1
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/15/2011
Date Tested : 2/18/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.37	D	14.2	47.13	80.00	149.40	Granitic gneiss	Very Strong
2	2	1.70	D	14.5	47.13	81.31	152.56	Granitic gneiss	Very Strong
3	2	1.96	D	16.0	47.14	79.91	168.28	Granitic gneiss	Very Strong
4	2	2.29	D	12.2	47.13	88.65	128.36	Granitic gneiss	Very Strong
5	2	2.59	D	9.0	47.13	82.23	94.69	Granitic gneiss	Strong
6	2	3.00	D	10.0	47.14	79.13	105.18	Granitic gneiss	Very Strong
7	3	3.35	D	14.5	47.14	80.03	152.51	Granitic gneiss	Very Strong
8	3	3.96	D	9.0	47.13	78.61	94.69	Granitic gneiss	Strong
9	3	4.32	D	9.9	47.13	76.34	104.16	Granitic gneiss	Very Strong
10	3	4.57	D	11.0	47.14	79.91	115.69	Granitic gneiss	Very Strong
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS3-2
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/15/2011
Date Tested : 2/28/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.25	D	20.0	47.13	101.11	210.42	Granitic gneiss	Very Strong
2	1	0.53	D	17.7	47.13	90.36	186.22	Granitic gneiss	Very Strong
3	1	0.84	D	17.1	47.14	83.14	179.85	Granitic gneiss	Very Strong
4	1	1.14	D	16.9	47.13	78.31	177.81	Granitic gneiss	Very Strong
5	1	1.50	D	8.0	47.13	59.03	84.17	Granitic gneiss	Strong
6	1	0.53	A	25.9	47.14	31.82	306.34	Granitic gneiss	Extremely Strong
7	2	1.85	D	17.1	47.14	80.81	179.85	Granitic gneiss	Very Strong
8	2	2.21	D	16.8	47.13	78.71	176.76	Granitic gneiss	Very Strong
9	2	2.54	D	16.6	47.13	69.56	174.65	Granitic gneiss	Very Strong
10	2	2.77	D	15.2	47.14	86.48	159.87	Granitic gneiss	Very Strong
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS4-1
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/16/2011
Date Tested : 2/18/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.20	D	16.0	47.13	150.00	168.34	Granitic gneiss	Very Strong
2	1	0.71	D	12.1	47.15	101.31	127.22	Granitic gneiss	Very Strong
3	1	1.12	D	15.5	47.11	90.31	163.19	Granitic gneiss	Very Strong
4	1	1.37	D	10.5	47.14	83.11	110.44	Granitic gneiss	Very Strong
5	2	1.65	D	16.2	47.13	84.91	170.44	Granitic gneiss	Very Strong
6	2	2.01	D	18.1	47.13	81.31	190.43	Granitic gneiss	Very Strong
7	2	2.34	D	17.2	47.13	103.48	180.96	Granitic gneiss	Very Strong
8	2	2.62	D	16.4	47.16	90.38	172.38	Granitic gneiss	Very Strong
9	2	2.92	D	15.3	47.13	85.76	160.97	Granitic gneiss	Very Strong
10									
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-5161-21
Project Name : Hwy 69 Four-Laning North of Hwy 529
BH No : OHS4-2
Core Size : NQ

Client : MMM Group Limited
Date Drilled : 2/16/2011
Date Tested : 2/18/2011
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.25	D	14.7	47.13	80.93	154.66	Granitic gneiss	Very Strong
2	1	0.56	D	12.0	47.14	78.30	126.21	Granitic gneiss	Very Strong
3	1	0.86	D	12.2	47.15	76.31	128.27	Granitic gneiss	Very Strong
4	1	1.12	D	16.3	47.15	68.81	171.38	Granitic gneiss	Very Strong
5	1	1.40	D	20.7	47.15	75.41	217.64	Granitic gneiss	Very Strong
6	2	1.70	D	17.4	47.13	69.96	183.07	Granitic gneiss	Very Strong
7	2	2.03	D	21.0	47.13	73.82	220.94	Granitic gneiss	Very Strong
8	2	2.31	D	16.5	47.15	78.40	173.49	Granitic gneiss	Very Strong
9	2	2.69	D	17.4	47.15	69.38	182.95	Granitic gneiss	Very Strong
10	2	2.92	D	14.8	47.15	80.09	155.61	Granitic gneiss	Very Strong
11									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have $0.7 \times D$ on either side of test point.

Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

Appendix C

List of Selected SPs and OPSS, and Suggested Text for NSSP

1. List of Special Provisions and OPSS Documents Referenced in this Report

- OPSS 501
- OPSS 902
- OPSS 903

2. Suggested Text for NSSP on:

“Concrete Fill and Levelling of Bedrock Surface for Overhead Sign Support (OHS) Footings”

The Contractor is advised that the bedrock surface elevation at the locations of the OHS foundations may differ from that indicated in the Foundation Investigation Report. Further, the bedrock surface may be uneven or sloping within the footing envelope.

In areas of uneven/sloping bedrock or where sub-excavation is required to remove unsuitable material from below the design founding level, a level founding surface must be established at the design elevation using concrete fill of the same class of concrete as used in the footing. If the slope of the existing bedrock surface is steeper than 5H: 1V, the bedrock must first be excavated to provide a relatively level surface on which to place the concrete fill. The rock excavation must be carried out in a manner that does not fracture or otherwise disturb the underlying bedrock surface.

3. Suggested Text for NSSP on:

“Augered Caisson Construction for Overhead Sign Support (OHS) Foundations”

The Contractor is advised that shallow bedrock at variable depths/elevations may be encountered at the locations of the OHS foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
2. There is a probability that cobbles and boulders may be encountered within native sand. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard layers.
3. The strength of the bedrock generally ranges from 74 to 218 MPa. Bulk excavation and pre-drilling through the sound bedrock may be difficult. As such, rock coring equipment, pneumatic rock splitting/breaking equipment, ripping machinery and potentially rock shatter capable of coring into strong very strong bedrock, must be supplied on site to assist in excavation and installing/drilling of caisson sockets in rock.

Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

4. The bedrock elevation may slope and/or vary from that determined at the borehole locations, and therefore the depth of rock coring required may be greater or less than that indicated.
5. Water seepage and/or soil sloughing into the caisson hole might occur from existing cohesionless soils. Use of pumps, liners or other means may be required to handle groundwater and provide stable sidewalls in these materials.

The Contractor is responsible for constructing the OHS foundations without disturbing the material at the sides or bases of the foundations.

DOWELS INTO ROCK – Item No.

Special Provision

CONSTRUCTION SPECIFICATION FOR THE SUPPLY, INSTALLATION AND TESTING OF DOWELS INTO ROCK FOR OVERHEAD SIGN (OHS) FOOTINGS

1.0 SCOPE

The work for the above noted tender item shall be in accordance with OPSS 904, including all Special Provisions, except as extended herein. This document specifies additional requirements for the supply, installation and testing of Dowels into Rock for the OHS footing.

2.0 REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

ASTM International

D1143M Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

3.0 DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Dowels into Rock: reinforcing steel bar and non-shrink grout.

Design Engineer: An Engineer who has a minimum of five (5) years experience in all aspects associated with the installation of Dowels into Rock, including drilling, grouting and doweling work. The Design Engineer shall be retained by the Contractor to design various components for the installation and testing for the Dowels into Rock.

Quality Verification Engineer: An Engineer who has a minimum of five (5) years experience in all aspects associated with the installation of Dowels into Rock, including drilling, grouting and doweling work. The Quality Verification Engineer shall be retained by the Contractor to ensure conformance with the contract documents and issue certificate(s) of conformance.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.01 Working Drawings

Working Drawings shall consist of drawings, testing and installation records, procedures and reports, and work plans.

The Contractor shall submit Working Drawings to the Contract Administrator as follows:

- a) All Working Drawings that include drawing, testing and installation procedures and reports, and work plans shall be sealed and signed by the Design Engineer.

- b) All Working Drawings that include testing and installation results and reports shall be signed and sealed by the Quality Verification Engineer.

Upon completion of testing or installation and testing for each component, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall state that the work has been carried out in conformance with the Working Drawings and in general conformance with the contract documents.

Working Drawings consisting of testing and installation records and reports shall be submitted four days after completion of testing and installation. All other Working Drawings shall be submitted two weeks prior to construction.

Working Drawings to be submitted include the following with further details outlined in the remainder of this specification:

- a) Design calculations, specifications and shop drawings covering all aspects of fabrication, installation and acceptance testing of Dowels into Rock.
- b) Test results verifying the 28 day strength of non-shrink grout.
- c) The method for constructing of the holes, maintaining the holes, and placing reinforcing steel bars, grout and other materials in the holes, including casing sizes, bit sizes and tremie grouting methods.
- d) The procedures to verify hole length. Records of measurements that verify the hole length.
- e) Records of all drilling procedures, rock conditions encountered, and installation times.
- f) Test procedures for Dowels into Rock.
- g) Drawings and design calculations for a suitable reaction system for the applied test loads.
- h) Records of vertical and horizontal movements of the reaction system, and elongation of the reinforcing steel bar.
- i) Drawings and details for reference system arrangement.
- j) Current calibration curves shall be provided for all gauges.
- k) Complete test records for all tests including plots of dowel movement versus dowel load, dowel load versus time, and dowel movement versus time.
- l) Remedial measures for unacceptable stressing results.

5.0 MATERIALS

5.01 Non-Shrink Grout

The non-shrink grout shall be an approved product from the MTO's Pre-Qualified Products List.

5.02 Anti-Washout Agent

The anti-washout agent shall be used with the non-shrink grout for the Dowels into Rock. The anti-washout agent shall be one of the following proprietary products:

- 1) Sikament 100 SC Anti-Washout Admixture
Sika Canada Inc.
6915 Davand Drive
Mississauga, ON, L5T 1L5
Toll Free Phone: 800-933-7452
- 2) Rheomac UW 450 Anti-Washout Admixture
BASF Construction Chemicals Canada Ltd (Master Builders)
1800 Clark Blvd
Brampton, ON, L6T 4M7
Toll Free Phone: 416-520-1392

5.03 Manufacturer Information

The Contractor shall provide the following information from the manufacturer for non-shrink grout and anti-washout agent:

- a) Data sheets for the non-shrink grout and anti-washout agent,
- b) Technical information that proves that the non-shrink grout and anti-washout agent are compatible, and
- c) installation procedures

6.0 EQUIPMENT

All equipment for the installation of the Dowels into Rock shall be suitable for the intended purposes and capable of working on the site under the prevailing access and clearance conditions.

The equipment shall not cause damage to the reinforcing steel bars.

7.0 CONSTRUCTION

7.01 Instructions to Contractor

These instructions are to be read in conjunction with the Contract Drawings.

A total of 2 test Dowels into Rock are required for the Dowels into Rock at the OHS.

Dowels into rock at the OHS shall be installed into sound bedrock to the specified embedment depth.

7.02 Responsibilities of the Contractor

The Contractor shall prove the allowable bond stress by tests of the Dowels into Rock on non-production Dowels into Rock.

The Contractor shall supply equipment, materials and skilled personnel to install production Dowels into Rock and conduct the specified acceptance tests. It shall be the responsibility of the Contractor to constantly monitor the acceptance tests, maintain specified test loads and record test measurements as specified by the Contract Administrator.

The Contractor is responsible for materials and workmanship. Any remedial measures, required because of defects in materials or workmanship, shall be completed by the Contractor at no cost to the Owner.

The Contractor shall submit 4 copies of all Working Drawings to the Contract Administrator as outlined in Section 4.0.

7.03 Subsurface Conditions

Rock and groundwater conditions are described in the Foundation Investigation Report for this Contract.

7.04 Construction of Holes

The sides and end of the hole shall not be disturbed. The Contractor shall submit Working Drawings to the Contract Administrator that include the method for constructing of the holes, maintaining the holes, and placing reinforcing steel bar, grout and other materials in the holes. All excavated material shall be removed from the site.

The hole diameters and hole length for this project are as specified on the Contract Drawings. Prior to commencing drilling operations, the Contractor shall submit Working Drawings to the Contract Administrator outlining devised procedures to verify hole length. The Contractor shall submit Working Drawings that include drilling operations records to the Contract Administrator that include the above noted records.

At all times, the Contractor shall keep a record of all drilling procedures, rock conditions encountered, and installation times. The Contractor shall submit Working Drawings to the Contract Administrator that include the above noted records.

7.05 Installation of Reinforcing Steel Bar

Reinforcing steel bar shall be installed in strict accordance with the Contract Drawings and installation procedures.

Centering devices shall be provided to ensure that the reinforcing steel bar is located centrally in the hole.

Dowels into Rock at the OHS shall be installed into sound bedrock.

Reinforcing steel bar shall be installed after the dowel hole has been filled with non-shrink grout.

7.06 Grout and Anti-Washout Agent

The non-shrink grout shall entirely fill the annular space between the reinforcing steel bar and side for the dowel hole.

The placement of grout for the test Dowels into Rock shall be identical to the production Dowels into Rock.

Anti-washout agent shall be used in accordance with the specifications of the manufacturer.

Non-shrink grout shall be placed into the dowel hole using tremie placement methods.

8.0 QUALITY ASSURANCE

All work for the installation of Dowels into Rock shall be inspected by the Quality Verification Engineer.

8.01 Qualifications

8.01.01 Qualifications of Staff from Contractor or Sub-Contractor Completing Work for the Dowels into Rock

All work shall be performed under the direction of personnel experienced with all aspects associated with the installation of Dowels into Rock. Such experience shall have been obtained within the preceding five (5) years on projects of similar nature and scope to the work required for this project.

8.01.02 Qualifications of the Quality Verification Engineer

A resume of the work experience of the Quality Verification Engineer shall be submitted to the Contract Administrator for record purposes. The Quality Verification Engineer shall be a Professional Engineer licensed in the Province of Ontario having a minimum of five years of experience on projects of similar nature and scope to the work required for this project.

8.01.03 Qualifications of the Design Engineer

A resume of the work experience of the Design Engineer shall be submitted to the Contract Administrator for record purposes. The Design Engineer shall be a Professional Engineer licensed in the Province of Ontario having a minimum of five years of experience of projects of similar nature and scope to the work required for this project.

8.02 Testing Requirements

All work for the testing of Dowels into Rock shall be inspected by the Quality Verification Engineer.

8.02.01 General Testing Requirements

Refer to the attached Instructions to Contractor and the Contract Drawings for specific test details.

The Contractor shall install the number of Dowels into Rock specified in the contract documents for testing purposes. The purpose of the testing the Dowels into Rock is to prove the adequacy of the proposed anchor configuration and installation procedures under the site conditions, and to provide design parameters.

The equipment, labour and materials for test dowels shall be identical to Dowels into Rock at the OHS. The Dowels into Rock for testing shall be __M dowels grouted into __ mm diameter holes filled with an approved non-shrink grout with a minimum __ mm embedment into sound bedrock.

The Contractor shall submit Working Drawings that include proposed procedures for testing of the Dowels into Rock to the Contract Administrator. Such testing shall be executed in strict accordance with the proposed procedures of the Contractor.

The Quality Verification Engineer shall supervise the testing of the Dowels into Rock. The Contractor will notify the Contract Administrator of the testing schedule at least 10 days prior to commencement of the

testing program. Testing for Dowels into Rock shall be conducted concurrently, as scheduled by the Contract Administrator. The tests shall normally be conducted between 8:00 hrs and 20:00 hrs from Monday to Friday, unless otherwise directed by the Contract Administrator.

The Contractor shall supply materials and skilled personnel to conduct the tests for the Dowels into Rock. The equipment and materials shall be capable of stressing the Dowels into Rock to the specified loads. It shall be the responsibility of the Contractor to constantly monitor the test, maintain specified test loads and to record test measurements as specified by the Quality Verification Engineer.

The test site shall be restored to its pre-test condition. Reinforcing steel bars used in tests shall be cut down 25 mm below the top of the sound bedrock.

8.02.02 Testing Location

The Contractor shall remove all loose rock down to sound bedrock at the test location.

The test Dowels into Rock shall be constructed at locations specified by the Contract Administrator.

If site conditions dictate, changes to the test locations will be considered. The Contractor shall provide the Contract Administrator at least 2 days notice in writing of this operation.

8.02.03 Testing Equipment

The dowels into rock will be carried out generally in accordance with the prevailing requirements of ASTM International D1143M superseded where applicable by the procedures specified in this document.

The Contractor shall submit Working Drawings for a suitable reaction system for the applied test loads to the Contract Administrator. Jacks must be secured with chains to provide adequate protection for the personnel in the event of breakage of the reinforcing steel bar or stressing system.

The Contractor shall submit Working Drawings for the reference system arrangement to the Contract Administrator. All reference beams shall be as follows:

The beams shall be independently supported with the support firmly embedded in the ground.

The testing device shall not apply compression to the bedrock surrounding the test for the Dowels into Rock, within a circle concentric with the dowel hole and a diameter equal to 4.0 m.

Reference beams shall be sufficiently rigid to support instrumentation such that variations in readings do not occur.

The Contractor shall construct suitable enclosures to provide complete protection for equipment and instruments from variations in the weather conditions and disturbances during the test program. These provisions must meet the approval of the Quality Verification Engineer and will include that the test enclosures must be weather-proof and provide a consistent temperature in order to eliminate temperature variations that could affect instrumentation.

8.02.04 Testing for Dowels Into Rock, and Report

At all times, the Contractor shall keep records of vertical and horizontal movements of the reaction system, elongation of reinforcing steel bar, and the record of test enclosure temperature. The movements shall be recorded with respect to an independent fixed reference point. The Contractor shall submit Working Drawings that include the above noted records to the Contract Administrator.

Dial gauges shall have at least a 76.2 mm (3.0 in.) travel. Longer gauge stems or sufficient gauge blocks shall be provided to allow for greater travel if required. Gauges shall have precision of at least 0.025 mm (0.0001 in.). The dial gauges shall be placed on smooth bearing surfaces mounted perpendicular to the direction of movement. All gauges, scales or reference points attached to the test anchor shall be mounted so as to prevent movement relative to the test anchor during the test. The Contractor shall submit Working Drawings that include details for current calibration and curves for all gauges to the Contract Administrator.

Jacks used for reinforcing steel bars shall have a minimum ram dimension of 152.6 mm (6.0 in.). The Contractor shall submit Working Drawings that include details for current calibration and curves for all gauges to the Contract Administrator.

Requirements for Clauses 5.4.1 to 5.4.4 shall be repeated as required at different testing locations.

8.02.05 Testing Loading

The testing procedures shall safely load test the Dowels into Rock in tension at a rate of approximately 100kN per minute to the test load of ____ kN. The load shall be increased by an additional 50 kN beyond this level as directed by the Quality Verification Engineer.

Each load shall be maintained for a minimum time of 15 minutes and until the rate of displacement is not greater than 0.25 mm (0.01 inches) per hour.

8.03 Acceptance Criteria

The following acceptance criteria apply:

- a) The testing of dowels shall be carried out in advance of the instalment of Dowels into Rock at the OHS footing.
- b) Tests for Dowels into Rock shall have a capacity of at least ____ kN. The Quality Verification Engineer shall report on the acceptance of the tests for Dowels into Rock. The Quality Verification Engineer shall report on the testing of the Dowels into Rock including recommendations for increasing embedment depth, if necessary.

9.0 MEASUREMENT FOR PAYMENT

For measurement purposes, a count shall be made of the number of dowels installed.

10.0 BASIS OF PAYMENT

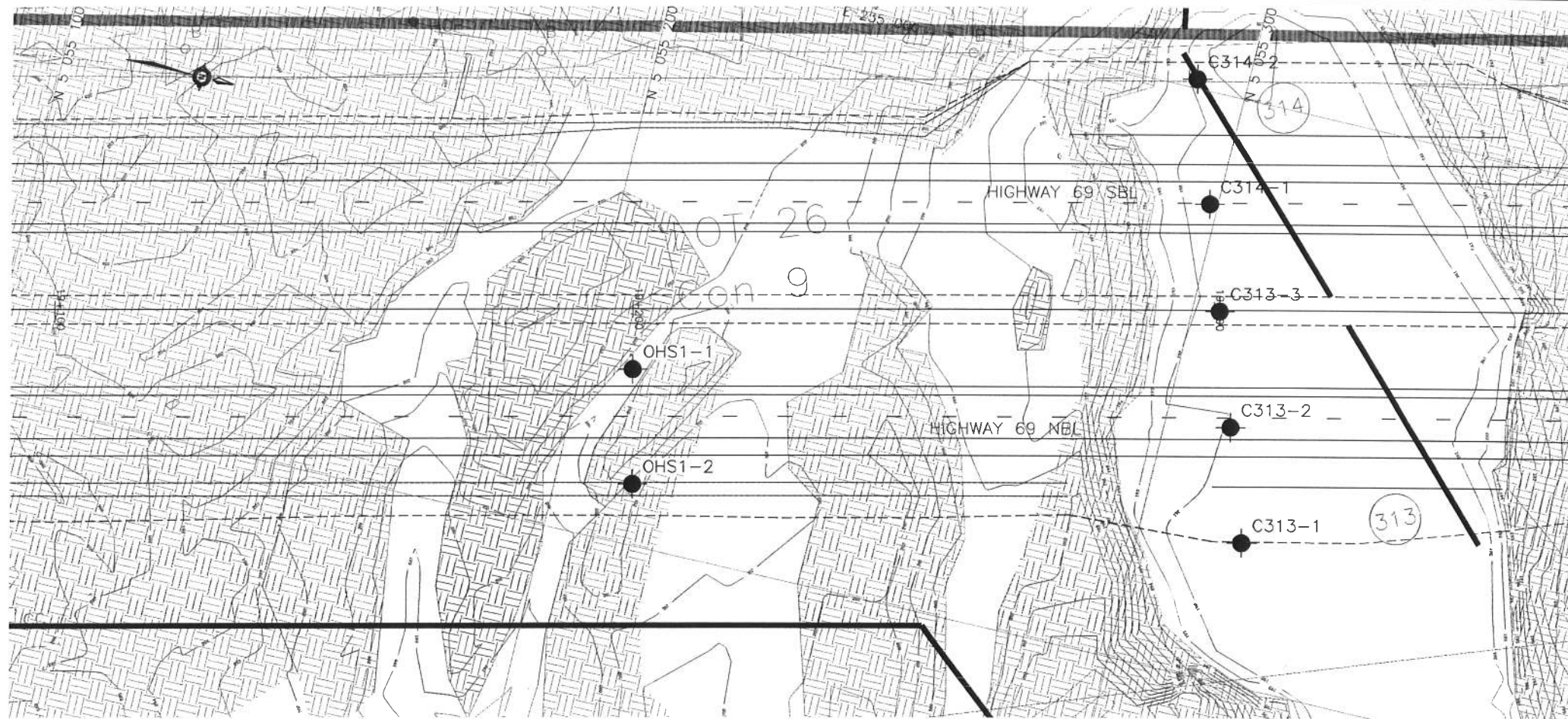
Payment at the contract unit price for the above tender item shall include full compensation for all labour, equipment, and materials to do the work. No additional payment will be made for tests for Dowels into Rock which are deemed as included as part of the work for the above noted item.

Overhead Signs

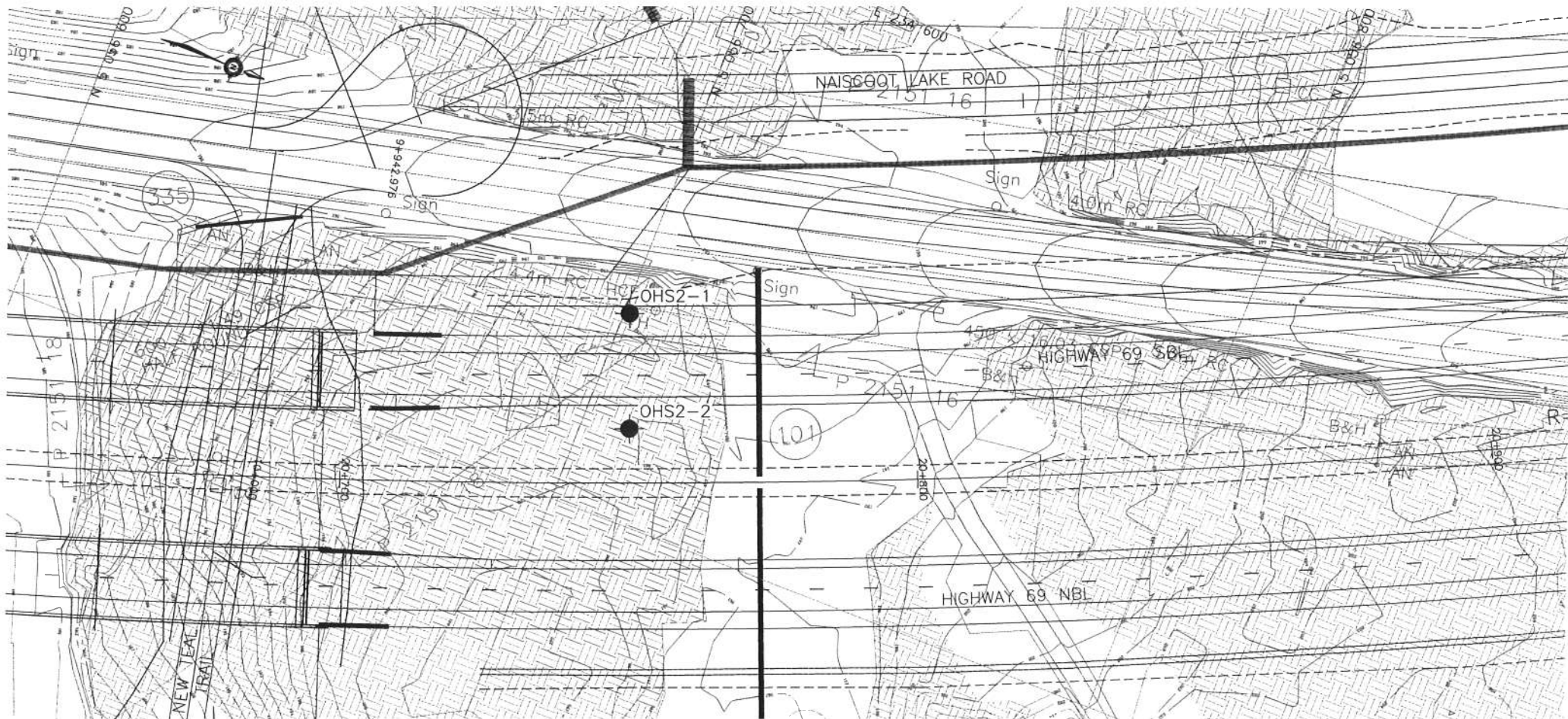
Hwy 69 – From the south junction of Hwy 529 northerly 15 km

Appendix D

Drawings titled “Borehole Locations”

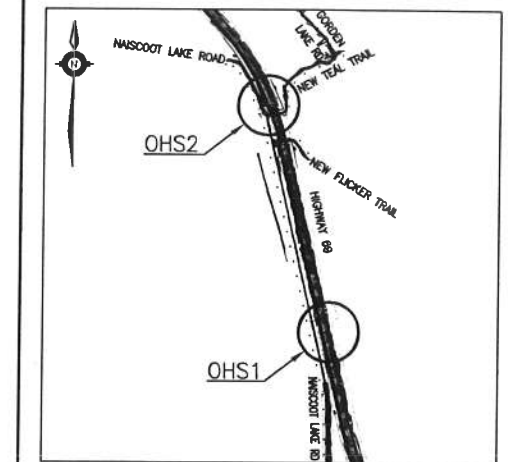


20 0 20 40m
SCALE 1:1000



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

CONT No
WP No 5196-06-01
HIGHWAY 69 FOUR-LANING
OVERHEAD SIGNS
OHS1(19+200)/OHS2(20+750)
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN
LEGEND

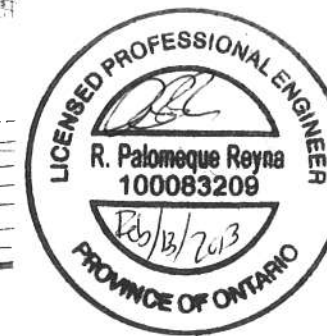
◆	Borehole
◆	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
↑	Head Artesian Water
—	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
OHS1-1	201.6	5 055 208.7	235 070.0
OHS1-2	201.2	5 055 213.2	235 089.5
OHS2-1	197.6	5 056 700.9	234 665.1
OHS2-2	197.4	5 056 708.1	234 683.8

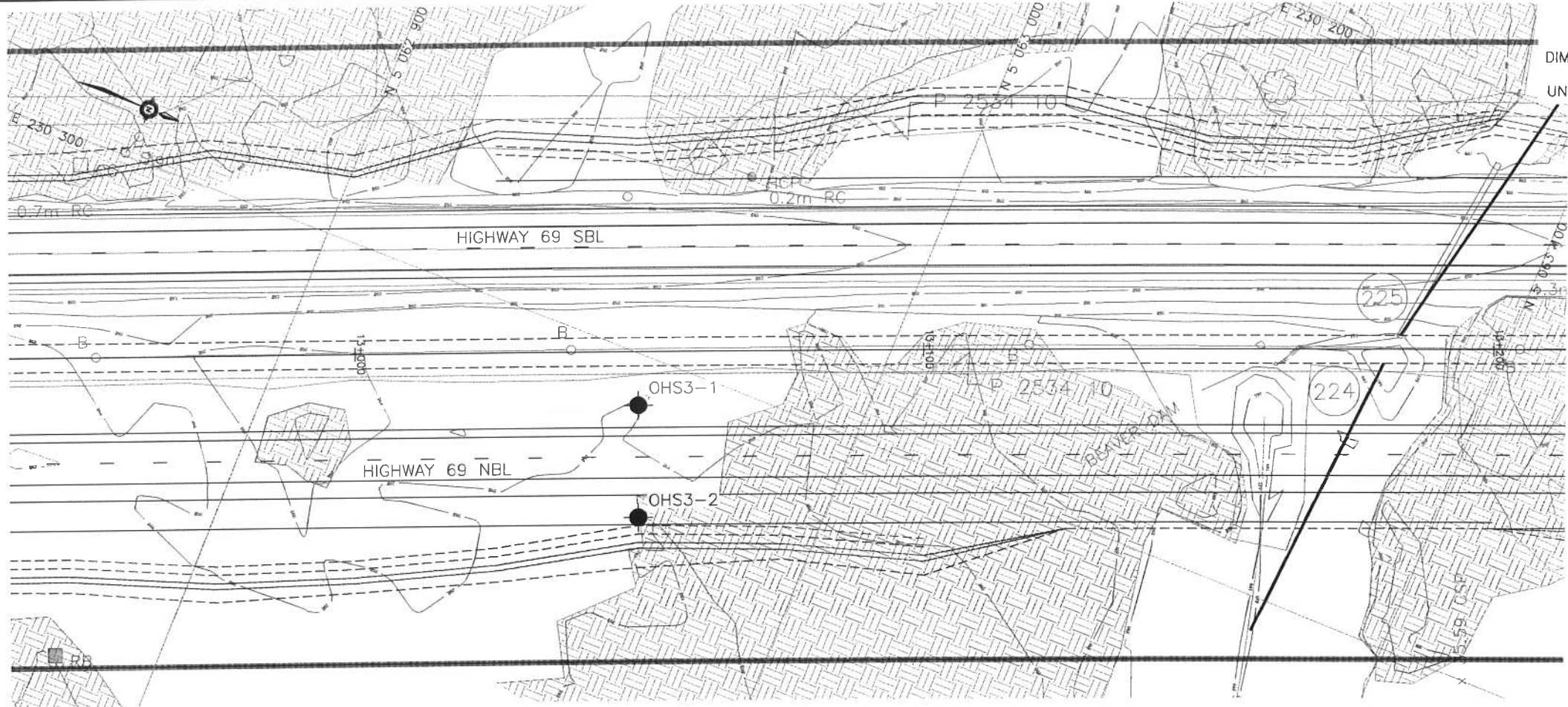
NOTES

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 41H-103

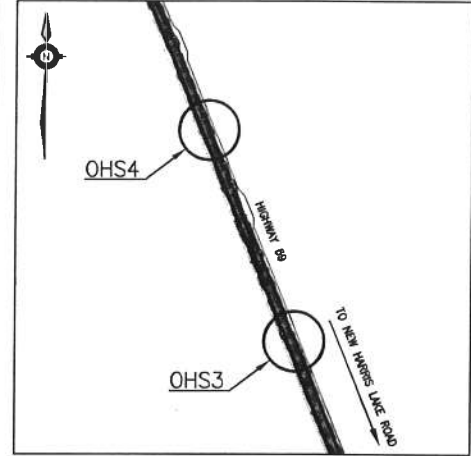


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
			LOAD
			STRUCT
			DATE FEB. 2013
			JDWG 1



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

CONT No
WP No 5196-06-01
HIGHWAY 69 FOUR-LANING
OVERHEAD SIGNS
OHS3(13+050)/OHS4(14+550)
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN
LEGEND

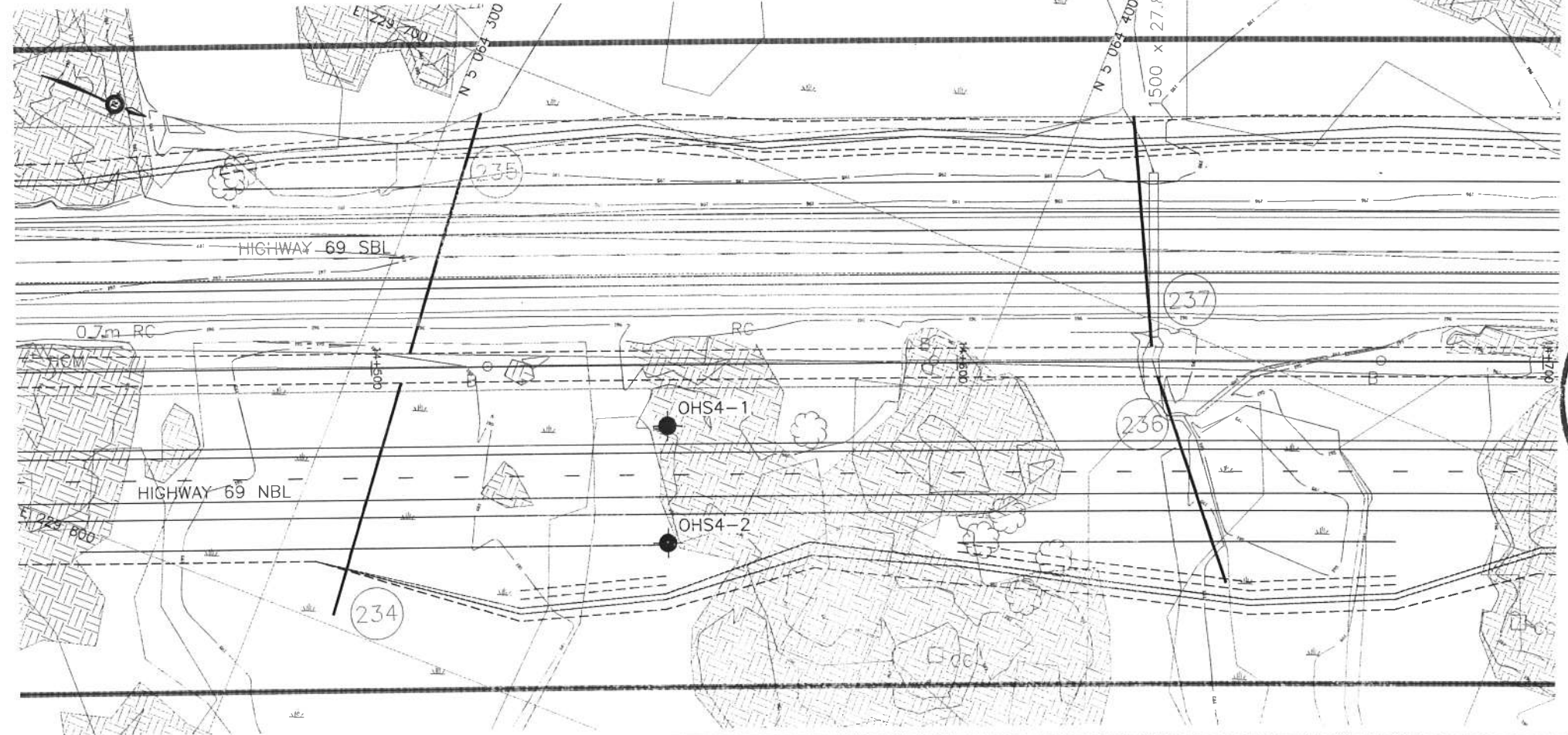
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- P Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
OHS3-1	201.9	5 062 962.4	230 308.6
OHS3-2	202.7	5 062 969.8	230 327.0
OHS4-1	196.5	5 064 354.0	229 747.3
OHS4-2	195.5	5 064 361.5	229 765.8

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 41H-103



DATE	BY	DESCRIPTION
DESIGN	RPR	CHK AEG CODE
DRAWN	MFA	CHK PKC SITE
		STRUCT
		DWG 2