



July 3, 2015

## FOUNDATION INVESTIGATION REPORT

**SHAWANAGA RIVER SERVICE ROAD (SITE NO. 9) BRIDGE STRUCTURE  
SITE NO. 44-65  
HIGHWAY 69 FOUR-LANING FROM 1.0 KM NORTH OF THE NEW HIGHWAY  
559 INTERCHANGE NORTHERLY TO 1.5 KM NORTH OF HIGHWAY 7182  
(SHEBESHEKONG ROAD) FOR 17 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
G.W.P. 5111-07-00, W.P. 5186-06-01 (Phase 2 of G.W.P. 5402 05 00)**

**Submitted to:**

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REPORT

**GEOCREs No.: 41H-143**

**Report Number:** 07-1111-0029-4

**Distribution:**

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# **PART A**

## **FOUNDATION INVESTIGATION REPORT**

### **SHAWANAGA RIVER SERVICE ROAD (SITE NO. 9) BRIDGE STRUCTURE**

#### **SITE NO. 44-65**

#### **HIGHWAY 69 FOUR-LANING**

#### **FROM 1.0 KM NORTH OF THE NEW HIGHWAY 559**

#### **INTERCHANGE NORTHERLY TO 1.5 KM NORTH OF**

#### **HIGHWAY 7182 (SHEBESHEKONG ROAD) FOR 17 KM**

#### **MINISTRY OF TRANSPORTATION, ONTARIO**

#### **G.W.P. 5111-07-00, W.P. 5186-06-01 (Phase 2 of G.W.P. 5402-05-00)**



### 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin (MRC), a member of MMM Group Limited on behalf of Ministry of Transportation, Ontario (MTO) to carry out a detail foundation investigation services for the proposed Shawanaga River Service Road (Site No. 9) one-span bridge structure over the Shawanaga River (Site No. 44-65). The proposed work is part of the detail design for the four-laning of Highway 69 from 1.0 km north of the new Highway 559 Interchange northerly to 1.5 km north of Highway 7182 (Shebeshekong Road), which involves high fill embankments and embankments over swamps, the New Woods Road and Shebeshekong Road interchanges and structures, the Shawanaga River and Site 9 Road structures, as well as culvert crossings. The general location of this section of the Highway 69 four-laning alignment is shown on Drawing 1.

The terms of reference and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2006. Golder's proposal for foundation engineering services associated with the Shawanaga River Service Road (Site No. 9) bridge structure is contained in Section 6.8 of MRC's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplemental Specialty Quality Control Plan for foundation engineering services for this project, dated July 4, 2007. The General Arrangement (GA) Drawing and the subsequent updated GA Drawing for the proposed Shawanaga River Service Road bridge were provided to Golder by MRC on June 27, 2008 and September 10 and 19, 2014.

This report addresses the investigation carried out for the Shawanaga River Service Road bridge structure and immediately adjacent approach embankments only. Separate reports address the foundation investigations and design for the related swamp crossings and high fill areas for the associated interchange ramps and roadways, culverts and other bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed structure, including the associated approach embankments, by borehole drilling, rock coring and laboratory testing on selected samples. The foundation units/limits for this investigation were located in the field by Callon Dietz Inc. (Callon Dietz), a professional surveying company retained by MRC. The investigation area is shown in plan on Drawing 2.

### 2.0 SITE DESCRIPTION

The proposed Shawanaga River Service Road (Site No. 9) bridge structure is located approximately 400 m north of the intersection of the existing Shebeshekong Road and Highway 69 and is approximately 20.5 km northwest of Nobel, Ontario. The existing Highway 69, which will become part of the future Shawanaga River Service Road (Site No. 9), runs generally in a southeast-northwest direction on the east side of the proposed new Highway 69.

In general, the topography in the area of the overall project limits consists of rolling terrain including densely treed areas and numerous bedrock outcrops separated by low-lying swamps. The proposed bridge structure and associated approach embankments are to be situated on a relatively flat, moderately treed area and a bedrock outcrop at the north abutment/approach embankment. The ground surface within the limits of the proposed structure and approach embankment areas is between about Elevation 205.1 m and 208.5 m, referenced to Geodetic datum, and is sloping upward from south to north.



## **3.0 INVESTIGATION PROCEDURES**

### **3.1 Foundation Investigation**

The field work for the Shawanaga River Service Road bridge structure investigation was carried out between October 21 and 27, 2008 during which time a total of twelve (12) boreholes were advanced: five (5) boreholes at the south abutment; five (5) boreholes at the north abutment; and two (2) boreholes at the approach embankments (i.e. one (1) borehole at each approach). The boreholes, designated as Boreholes B3-01 to B3-12, were advanced at the locations shown in plan on Drawing 2.

The field investigation was carried out using a Diedrich D-50 Turbo track-mounted drill rig supplied and operated by Walker Drilling Co. Ltd. of Utopia, Ontario. The boreholes were advanced through the overburden using 'NW' casing. Soil samples were obtained at intervals of depth of about 0.75 m using a 50 mm outside diameter (O.D.) split spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586 Standard Test Method for Standard Penetration Test); a chunk sample was obtained in one borehole containing thin overburden over a bedrock outcrop. Samples of the bedrock were obtained using an 'NQ' size rock core barrel.

The boreholes at the foundation elements were typically advanced to casing and/or sampler refusal (i.e. inferred bedrock) while the boreholes at the approach embankments were advanced to a depth approximately equal to the height of the proposed embankment or to sampler refusal. It should be noted that some of the boreholes were terminated on refusal to shovel excavation. Four (4) boreholes (Boreholes B3-05, B3-07, B3-09 and B3-10) are located on an exposed bedrock outcrop; the remaining boreholes were drilled to depths ranging from about 0.4 m to 6.9 m below existing ground surface, including coring of bedrock for core lengths between about 2.2 m and 3.2 m in Boreholes B3-01 to B3-04, B3-06, B3-08 and B3-11.

The groundwater conditions in the open boreholes were observed during the drilling operations and a piezometer was installed in Borehole B3-03 to permit monitoring of the water level at this location. The piezometer consists of 32 mm diameter PVC pipe, with a slotted screen sealed at a select depth within the borehole. The borehole and annulus surrounding the piezometer pipe above the screen sand pack was backfilled to the surface with bentonite pellets/grout. Piezometer installation details and water level readings are described on the Record of Borehole sheets presented in Appendix A. All boreholes in which standpipe piezometers were not installed were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The field work was monitored by members of our engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, 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 our Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples. Strength testing, such as uniaxial compression and point load index tests were carried out on specimen of the rock core. The results of the laboratory testing are included in Appendix A.

The perimeter limits of each foundation unit were located in the field by Callon Dietz prior to drilling. The as-drilled borehole locations and ground surface elevations were surveyed by a member of our technical staff, referenced to the survey stakes put down by Callon Dietz. The borehole locations given in the Record of



## FOUNDATION REPORT – SERVICE ROAD (SITE NO. 9) BRIDGE STRUCTURE – HIGHWAY 69 G.W.P. 5111-07-00

Borehole/Drillhole sheets and shown on Drawing 2 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum and are summarized below.

Borehole	Location (MTM NAD 83)		Ground Surface Elevation (m)	Depth Drilled (m)
	Northing	Easting		
B3-01	5045823.0	243591.4	205.6	2.6
B3-02	5045830.5	243575.2	206.4	4.6
B3-03	5045835.9	243585.8	205.5	6.9
B3-04	5045834.6	243579.0	205.9	4.4
B3-05	5045833.4	243572.1	205.1	0.0
B3-06	5045838.8	243582.7	205.6	5.9
B3-07	5045860.4	243559.5	208.5	0.0
B3-08	5045855.1	243548.9	205.6	3.7
B3-09	5045855.8	243556.3	207.9	0.0
B3-10	5045857.5	243562.6	207.8	0.0
B3-11	5045852.2	243552.0	205.6	5.5
B3-12	5045869.4	243541.7	211.6	0.4

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

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

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; numerous bare knobs and ridges of bedrock are present throughout the area. Localized 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.

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





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

## 4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced for this investigation, together with the results of the laboratory tests carried out on selected soil and bedrock core samples, are provided in Appendix A and B, respectively. The results of the in situ field tests (i.e. SPT 'N'-values) as presented on the Record of Borehole sheets and in Sections 4.2.1 to 4.2.5 are uncorrected. 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 Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. It should be noted that the interpreted stratigraphy shown on Drawings 2 and 3 is a simplification of the subsurface conditions. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions in the area of the proposed bridge structure consist of a surficial layer of sand to sand and gravel fill associated with the existing north and south abutments of the original Highway 69 structure and embankments. The sand to sand and gravel fill is in turn underlain by granitic rock fill in places, underlain by granite gneiss/ syenite gneiss bedrock. Bedrock was observed to outcrop within the vicinity of the proposed foundation elements and the north approach embankment.

A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

### 4.2.1 Topsoil / Asphalt

Approximately 40 mm to 80 mm of topsoil or asphalt was encountered at the ground surface in Boreholes B3-01, B3-03, B3-08, B3-11 and B3-12.

### 4.2.2 Sand and Gravel to Gravelly Sand Fill

A deposit of fill comprised of brown sand to sand and gravel was encountered at the ground surface or below the topsoil/asphalt in Boreholes B3-01 to B3-04, B3-06, B3-08 and B3-11. The top of the fill was encountered at about Elevation 205.5 m and 205.4 m in the boreholes drilled at the south abutment/approach embankment and between about Elevation 207.9 m and 205.5 m at the north abutment/approach embankment. The thickness of the fill deposit is highly variable across the site, ranging from about 0.4 m to 2.4 m. In general, the fill deposit is thicker at the south abutment than at the north abutment.

The fill varies in composition from sand some gravel, to gravelly sand, to sand and gravel, trace to some silt, trace clay containing cobbles, boulders, rock and asphalt fragments, organics, topsoil and rootlets. In some boreholes, oxidation zones were encountered to a depth of about 2.4 m below ground surface. The grain size

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



distributions of seven (7) samples from the fill are presented on Figures B1-1 and B1-2, in Appendix B. The organic content measured on three (3) samples of the fill is about 2 percent and 3 percent, indicating that the fill is slightly organic. The natural water content measured on samples of the sand to sand and gravel fill range from about 3 percent to 18 percent.

The Standard Penetration Test (SPT) 'N'-values measured within the fill deposit range from 6 blows to 46 blows per 0.3 m of penetration, but typically greater than 11 blows per 0.3 m of penetration, indicating a loose to dense relative density.

### 4.2.3 Rock Fill

In Boreholes B3-03 and B3-06 the sand fill is underlain locally by rock fill extending to the bedrock at depths of about 3.7 m and 2.7 m, respectively, below ground surface. The top of the rock fill was encountered at Elevation 204.9 m and 205 m and the thickness of the deposit is 3.1 m and 2.1 m in Boreholes B3-03 and B3-06, respectively. The rock fill consists of cobble and boulder sizes containing gravel, sand and silt.

The natural water content measured on two (2) samples of the rock fill is about 1 percent and 4 percent.

The SPT 'N'-values measured within the rock fill range from 5 blows per 0.3 m of penetration to 50 blows per 0.08 m of penetration, generally indicating a loose to very dense relative density.

### 4.2.4 Sand and Gravel

In Borehole B3-12, a layer of sand and gravel was encountered immediately below the ground surface at Elevation 211.6 m. The sand and gravel deposit extends to refusal on inferred bedrock at a depth of 0.4 m below ground surface corresponding to Elevation 211.2 m.

The sand and gravel contains some silt and trace clay. A grain size distribution of one (1) sample from the sand and gravel is presented on Figure B1-3, in Appendix B.

### 4.2.5 Bedrock

Bedrock was encountered and core samples were recovered from Boreholes B3-01 to B3-04, B3-06, B3-08 and B3-11. Bedrock outcrops were observed towards the west edge of the south abutment near the location of Borehole B3-05 and across the north abutment from the middle to the east edge near the locations of Boreholes B3-07, B3-09 and B3-10; the presence of bedrock was inferred from shovel refusal at Borehole B3-12. The depth of the surface of the bedrock is variable and ranges from ground surface to 3.7 m below ground surface. Across the south abutment and north abutment, from west to east (a distance of about 10 m between borehole locations), the bedrock surface elevation varies between about 2.2 m and 3.9 m; equivalent to approximately 4.5H:1V (4.5H:1V) slope or a dip of approximately 12 degrees from the horizontal at the south abutment and approximately 2.6H:1V slope or a dip of approximately 21 degrees from the horizontal at the north abutment.

The depth to bedrock below ground surface, corresponding bedrock surface elevation and refusal type is summarised below.





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Foundation Element / Approach Embankment	Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Refusal Type
South Approach Embankment	B3-01	0.4	205.2	Bedrock Cored
South Abutment	B3-02	1.4	205.0	Bedrock Cored
	B3-03	3.7	201.8	Bedrock Cored
	B3-04	1.3	204.6	Bedrock Cored
	B3-05	0.0	205.1	Bedrock Outcrop
	B3-06	2.7	202.9	Bedrock Cored
North Abutment	B3-07	0.0	208.5	Bedrock Outcrop
	B3-08	1.0	204.6	Bedrock Cored
	B3-09	0.0	207.9	Bedrock Outcrop
	B3-10	0.0	207.8	Bedrock Outcrop
	B3-11	2.4	203.2	Bedrock Cored
North Approach Embankment	B3-12	0.4	207.5	Bedrock Outcrop

Based on the cored bedrock samples, the bedrock generally consists of syenite gneiss (at the south abutment) and granite gneiss (at the north abutment). In general, the bedrock samples are described as slightly weathered to fresh, fine to coarse crystalline, slightly foliated to foliated, fine to coarse grained/fine crystalline, black, white and pink syenite/granite containing pink veins and porphyry. The Rock Quality Designation (RQD) measured on the core samples is typically between about 53 percent and 100 percent, indicating a rock mass of fair to excellent quality. However, upper portions of core recovered from Boreholes B3-01 at the south abutment contains zones of highly weathered rock with RQD of about 0 percent, indicating a rock mass of very poor quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered is typically between 92 percent and 100 percent and 61 percent and 94 percent, respectively; however at Boreholes B3-02 to B3-04 and B3-08 the SCR of samples recovered within the upper portion of the core is between about 33 percent and 57 percent.

Point load strength tests were performed on selected samples of the rock core. The diametral and axial point load strength index values are shown on the Record of Drillhole sheets and are presented in Table B1 in Appendix B. The axial point load index ( $Is_{50}$ ) results from the laboratory tests carried out on three (3) samples of the syenite gneiss bedrock range from approximately 5.6 MPa to 8.5 MPa with an average of about 6.9 MPa. The diametral tests carried out on two (2) samples of the syenite gneiss bedrock measured  $Is_{50}$  values of about 7.1 MPa and 7.7 MPa. The axial point load index ( $Is_{50}$ ) results from the laboratory tests carried out on two (2) samples of the granite gneiss bedrock were approximately 5.4 MPa and 6.9 MPa. The diametral tests carried out on four (4) samples of the granite gneiss bedrock measured  $Is_{50}$  values ranging from 6.5 MPa to 11.4 MPa with an average of 7.3 MPa. A lower axial  $Is_{50}$  value of 0.6 MPa and a lower diametral  $Is_{50}$  value of 2.4 MPa were measured on two samples within the upper weathered portion of the granite gneiss bedrock and may not be representative of the overall strength of the granite gneiss bedrock.

Two (2) Unconfined Compression (UC) tests were carried out, in accordance to ASTM D7102 (Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures), on selected samples of the syenite gneiss bedrock measured compressive strengths of about 79 MPa and 115 MPa, and one (1) UC test completed on a sample of the granite gneiss bedrock



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measured a compressive strength of about 70 MPa, as summarised on Table B2-1 and detailed in Tables B2-2 to B2-4 in Appendix B.

Also presented in Table B1 are the estimated Uniaxial Compressive Strength (UCS) values for each sample tested for point load strength based on a relationship between  $Is_{50}$  and UCS which is given by a correlation factor (K) in accordance with (ASTM D5731 Standard Test Method for Determination of the Point Load Strength Index of Rock), which varies depending on the size of the core sample and the strength of the rock. For this site, the UCS values are based on an estimated average correlation factor (K) of 14 which was calculated based on a comparison of the UC test results and the point load strength test results. These values have been given for comparison only and should be interpreted together with the results of the UC test.

Based on the laboratory UC tests and point load testing results in accordance with Table 3.5, CFEM (2006)<sup>3</sup> the syenite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa) and the granitic gneiss bedrock is classified as weak (R2, 5 MPa < UCS < 25 MPa) within the upper weathered zones to strong (R4, 50 MPa < UCS < 100 MPa).

### 4.2.6 Groundwater Conditions

The water level noted during and upon completion of drilling operations in Borehole B3-11 is at about Elevation 203.3 m, measured at about 2.3 m below ground surface and the remaining open boreholes were dry. In general, the samples taken in all the overburden boreholes advanced in this area were moist. A standpipe piezometer was installed in Borehole B3-03 to permit monitoring of the groundwater level at this location. Details of the piezometer installation are shown the Record of Borehole and Drillhole sheets in Appendix A. The groundwater levels measured in the piezometer installation are summarized below.

Foundation Element	Borehole No.	Ground Surface Elevation (m)	Groundwater Elevation (m)	Date of Measurement
South Abutment	B3-03	205.5	201.6	November 5, 2008
			201.5	November 6, 2008

It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.

## 5.0 CLOSURE

The field technician directing the drilling program was Mr. Chris Radway. This report was prepared by Ms. T. Veronica Ayetan, P. Eng., and was reviewed by Mr. J. Paul Dittrich, Ph.D., P. Eng., a senior geotechnical engineer and Principal with Golder. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and Principal with Golder, conducted an independent quality control review of the report.

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



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## Report Signature Page



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Senior Geotechnical Engineer, Principal



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

TVA/JPD/JMAC/tva/jl

\\golder.gds\gal\mississauga\active\2007\1111\07-1111-0029 - mrc - hwy 69 four-laning -report\final\4 - site 9 road bridge structure (shawanaga river)\07-1111-0029-4 fdr 15jul03 highway 69 - site 9 road bridge.docx



## REFERENCES

Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition. The Canadian Geotechnical Society c/o BiTech Publisher Ltd., British Columbia.

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.

Geology of Ontario. 1991. Ontario Geological Society, Special Volume 4, Part 2. Eds. P.C. Thurston, H.R. Williams, R.H. Sutcliffe and G.M. Stott. Ministry of Northern Development and Mines, Ontario.

## STANDARDS:

ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.
ASTM D5731	Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications.
ASTM D7102	Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures.

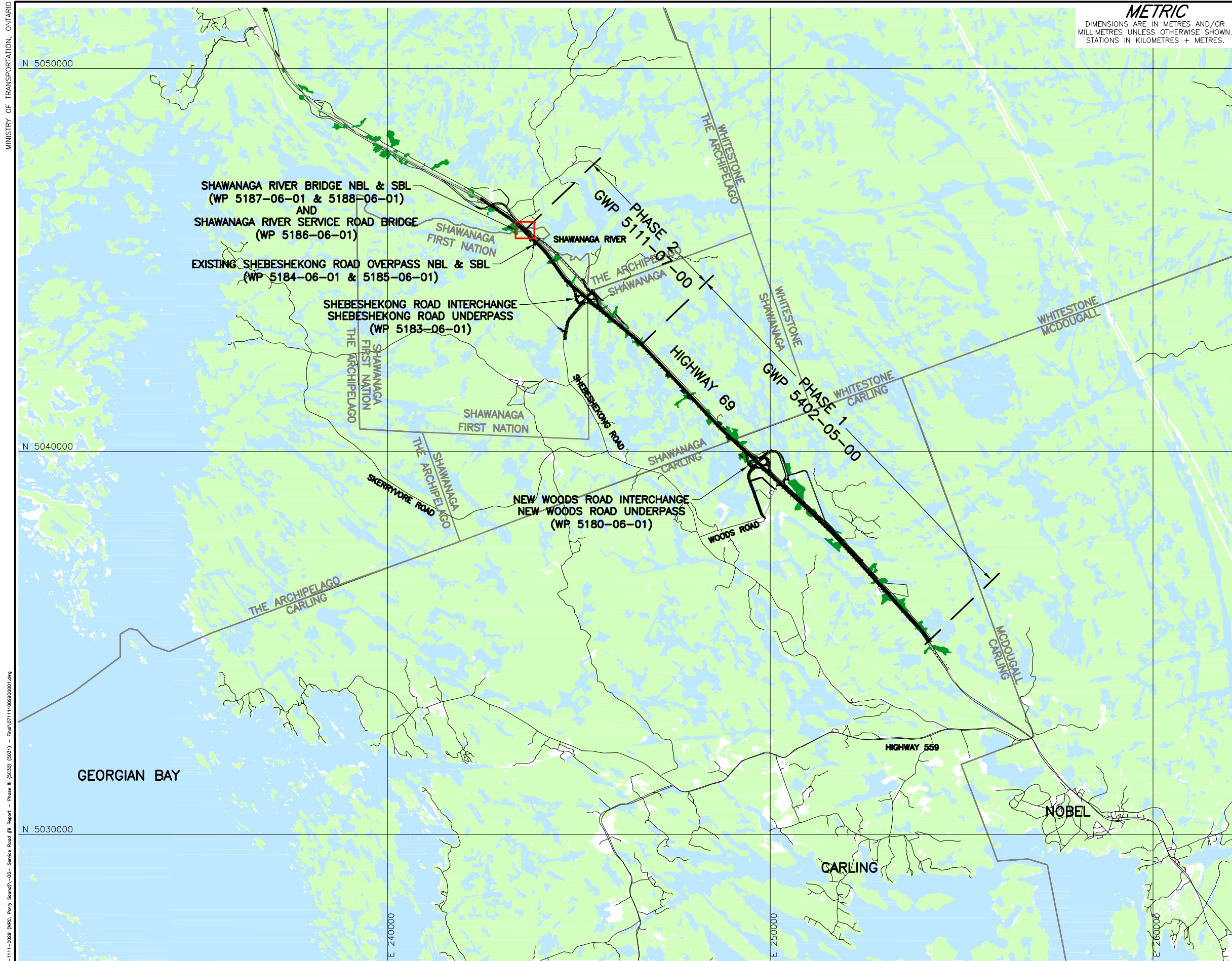
Ontario Water Resources Act:

Ontario Regulation 903	Wells.
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# **DRAWINGS**





PLAN



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

CONT No. WP No. 5186-06-01	
HIGHWAY 69 SITE LOCATION PLAN	SHEET



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



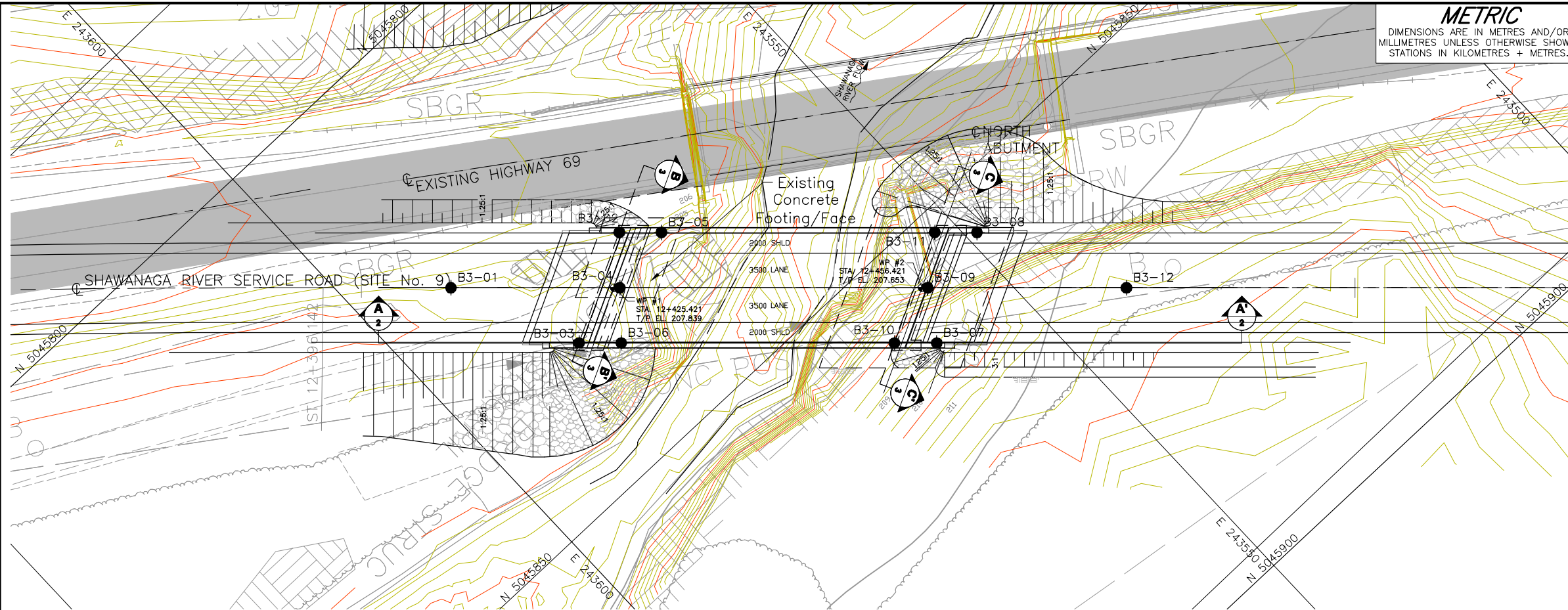
KEY PLAN  
NOT TO SCALE



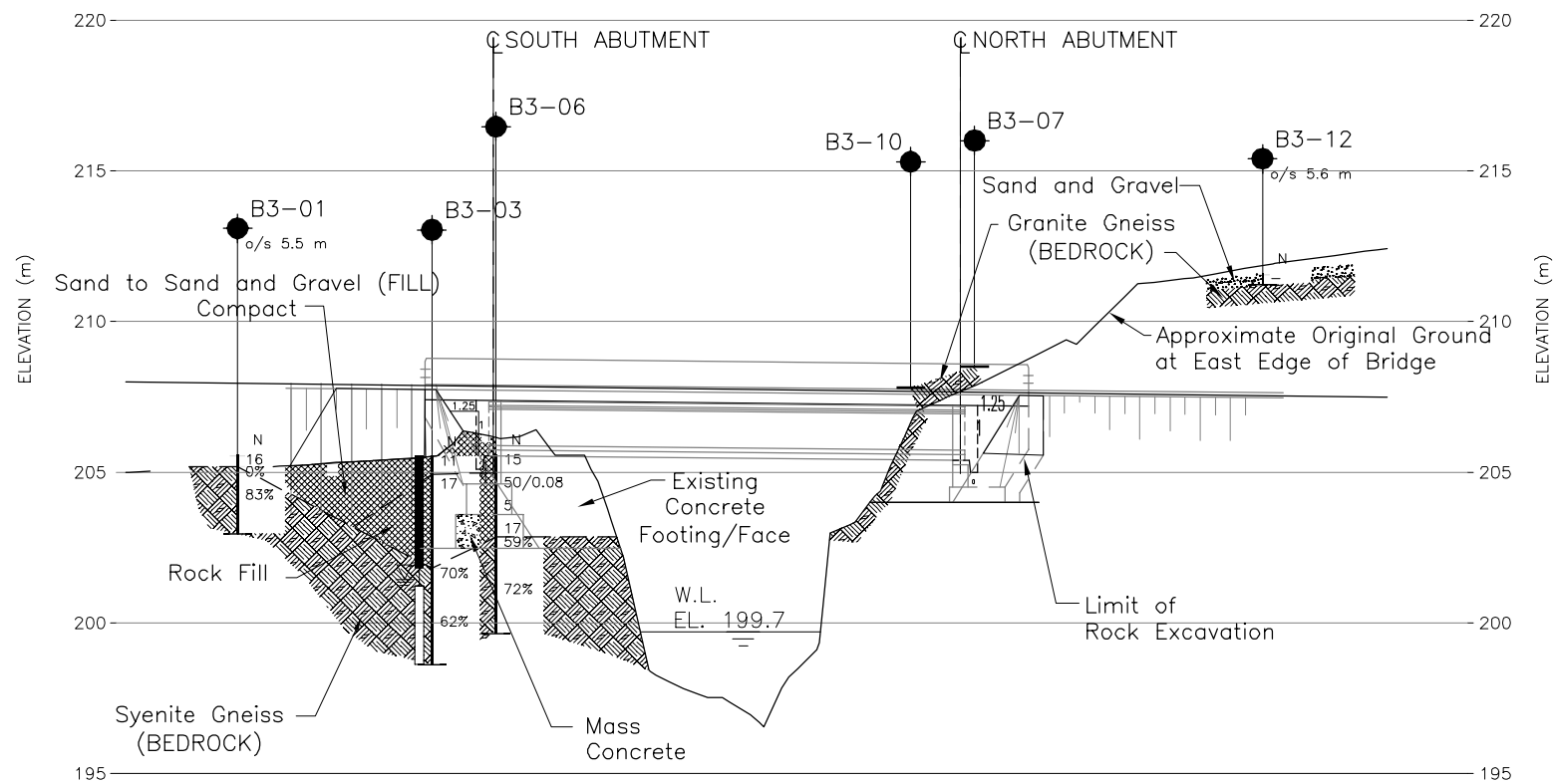
REFERENCE			
Base Data — MNR NRVS, obtained 2004, CANMAP v2006.4 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008 Datum : NAD 83 Projection : MTM Zone 10			

NO.	DATE	BY	REVISION
Geocres No. 41H-143			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. VA	DATE: Jul. 2015	SITE: 44-65
DRAWN: DD/CD	CHKD. CN	APPD. JPD/JMAC	DWG. 1

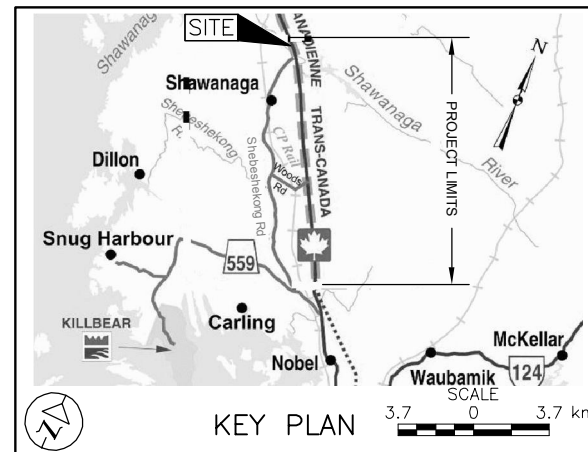




PLAN

SCALE  
5 0 5 10 mA-A'  
2EAST EDGE OF BRIDGE  
HIGHWAY 69 - SHAWANAGA RIVER SERVICE ROAD (SITE No. 9)HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.CONT No.  
WP No. 5186-06-01HIGHWAY 69  
SHAWANAGA RIVER SERVICE ROAD (SITE No. 9)  
BOREHOLE LOCATION  
AND SOIL STRATA

SHEET

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

## LEGEND

- Borehole - Current Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated  
(Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- ≡ WL in piezometer, measured on June 11, 2008
- ≡ WL upon completion of drilling
- R Refusal

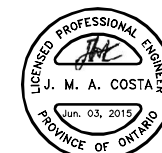
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
B3-01	205.6	5045823.0	243591.4
B3-02	206.4	5045830.5	243575.2
B3-03	205.5	5045835.9	243585.8
B3-04	205.9	5045834.6	243579.0
B3-05	205.1	5045833.4	243572.1
B3-06	205.6	5045838.8	243582.7
B3-07	208.5	5045860.4	243559.5
B3-08	205.6	5045855.1	243548.9
B3-09	207.9	5045855.8	243556.3
B3-10	207.8	5045857.5	243562.6
B3-11	205.6	5045852.2	243552.0
B3-12	211.6	5045869.4	243541.7

## 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 MRC, drawing file 5271XB01.DWG, 5271-XPDI-ARCHIPELAGO.dwg, 5271-XPDI-Carling.dwg, 5271-XPDI-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878xb1.dwg, h6878xb07 Phase-2 contours 1m intervals.dwg, S6878-315-001GA.dwg, received September 10, 2014.

NO.	DATE	BY	REVISION
Geocres No. 41H-143			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. CN	DATE: JUL. 2015	SITE: 44-65
DRAWN: JFC/RJ	CHKD. SMM	APPD. JPD	DWG. 2

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

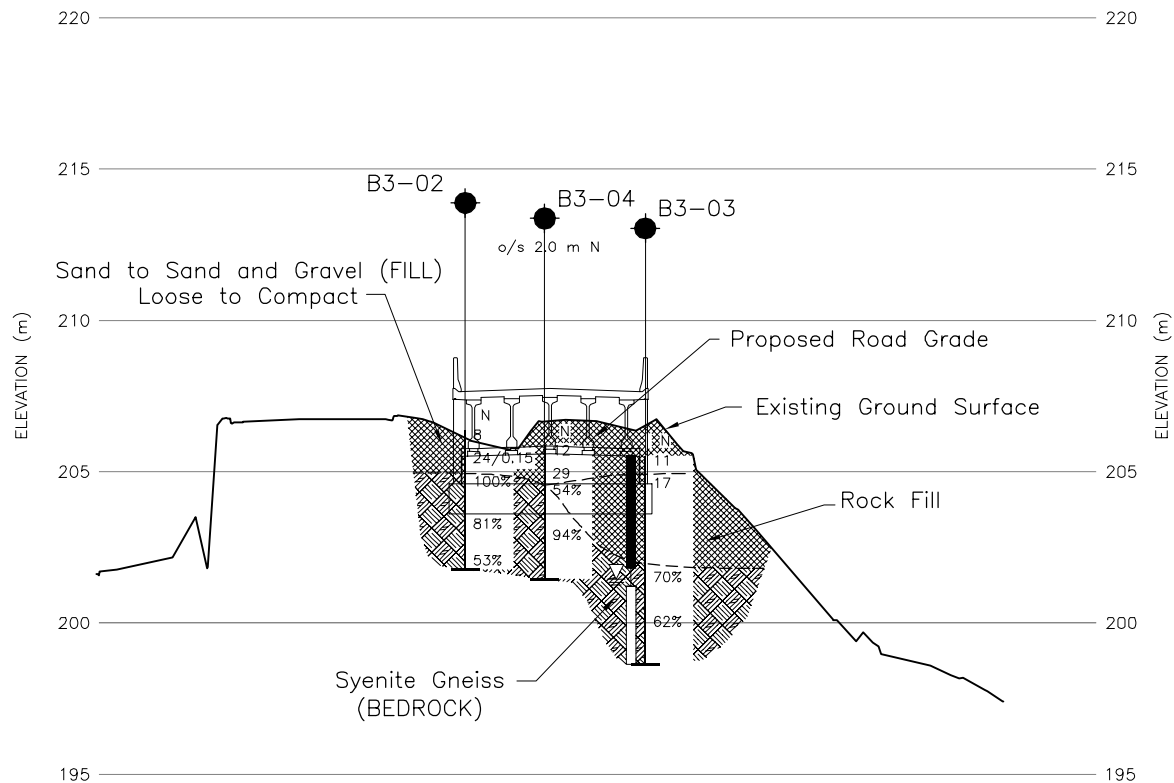
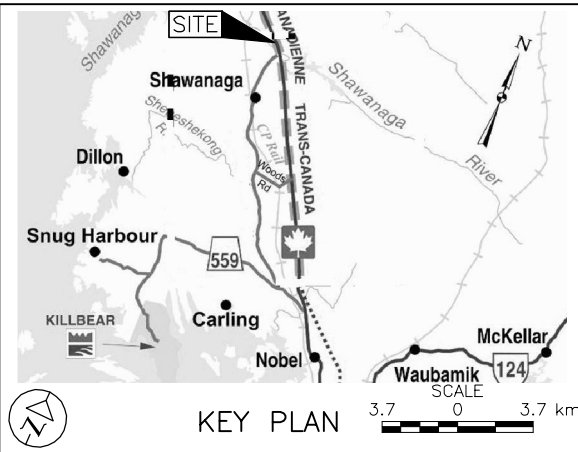
CONT No.  
WP No. 5186-06-01

HIGHWAY 69  
SHAWANAGA RIVER SERVICE ROAD (SITE No. 9)  
SOIL STRATA

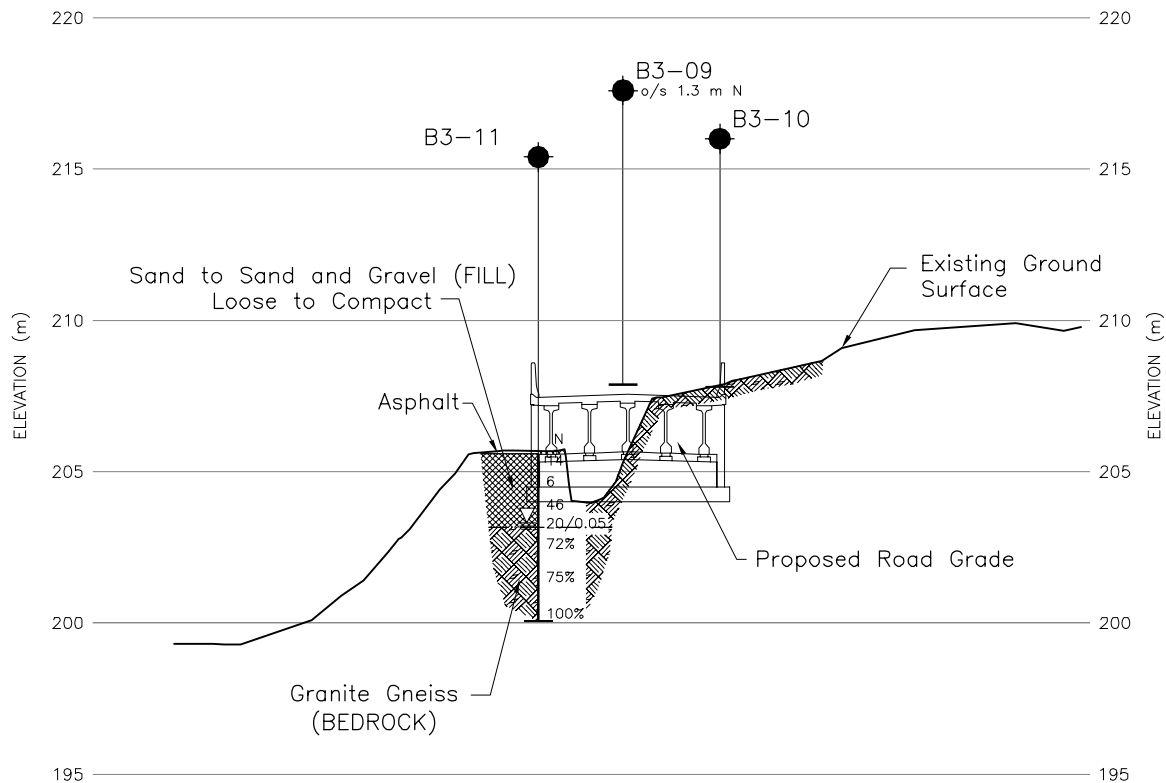
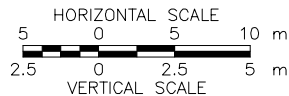
SHEET



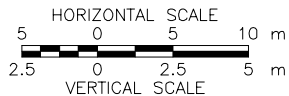
**Golder Associates Ltd.**  
MISSISSAUGA, ONTARIO, CANADA



**B-B'**  
**2** **SOUTH ABUTMENT**  
**HIGHWAY 69 - SHAWANAGA RIVER SERVICE ROAD (SITE No. 9)**



**C-C'**  
**2** **NORTH ABUTMENT**  
**HIGHWAY 69 - SHAWANAGA RIVER SERVICE ROAD (SITE No. 9)**



### LEGEND

- Borehole - Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on June 11, 2008
- WL upon completion of drilling

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
B3-02	206.4	5045830.5	243575.2
B3-03	205.5	5045835.9	243585.8
B3-04	205.9	5045834.6	243579.0
B3-09	207.9	5045855.8	243556.3
B3-10	207.8	5045857.5	243562.6
B3-11	205.6	5045852.2	243552.0

### 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.

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### REFERENCE

Base plans provided in digital format by MRC, drawing file 5271XB01.DWG, 5271-XPB-ARCHIPELAGO.dwg, 5271-XPB-Carling.dwg, 5271-XPB-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and S6878-315-001GA\_1mSOUTH.dwg, received July 27, 2009  
Existing ground surface provided in digital format by MMM, drawing file 6878 jh XS at Site 9 Abut for Fnd-4.dwg received September 16, 2014.  
Proposed bridge and abutments provided in digital format by MMM, drawing file Shawanaga Sections\_Sept 26 2014.dwg, received September 26, 2014.



NO.	DATE	BY	REVISION
Geocres No. 41H-143			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. CR	CHKD. CN	DATE: JUL. 2015	SITE: 44-65
DRAWN: JFC/RJ	CHKD. SMM	APPD. JPD	DWG. 3



# **APPENDIX A**

## **RECORD OF BOREHOLES AND DRILLHOLES**



## LIST OF SYMBOLS

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

### I. GENERAL

$\pi$	3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

### II. STRESS AND STRAIN

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

### III. SOIL PROPERTIES

#### (a) Index Properties

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

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

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

w	water content
$w_l$ 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
$C_{\alpha}$	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
$\sigma'_p$	pre-consolidation stress
OCR	over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

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

Notes: 1  
2

$\tau = c' + \sigma' \tan \phi'$   
shear strength = (compressive strength)/2





## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
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 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ( $Q_t$ ), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

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

#### (b) Cohesive Soils Consistency

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

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

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

### V. MINOR SOIL CONSTITUENTS

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



# LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

## 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

<u>Description</u>	<u>Bedding Plane Spacing</u>
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

<u>Description</u>	<u>Spacing</u>
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

<u>Term</u>	<u>Size*</u>
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	



PROJECT		RECORD OF BOREHOLE		No B3-01		SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION		N 5045823.0 ; E 243591.4		ORIGINATED BY		CR									
DIST		HWY 69		BOREHOLE TYPE		NW Casing, Wash Boring		COMPILED BY									
DATUM		Geodetic		DATE		October 27, 2008		CHECKED BY									
								SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
205.6	GROUND SURFACE																
0.0	TOPSOIL		1	SS	16												
205.2	Sand and gravel, some silt, containing organics, rootlets and topsoil (FILL)		1	RC	REC 100%												RQD = 0%
0.4	Compact Brown Moist Syenite Gneiss (BEDROCK)																
	Bedrock cored from depths of 0.4 m to 2.6 m.		2	RC	REC 100%												RQD = 83%
203.0	For bedrock coring details, refer to Record of Drillhole B3-01.																
2.6	END OF BOREHOLE																
	NOTE:  1. Open borehole dry prior to coring.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT: 07-1111-0029

**RECORD OF DRILLHOLE: B3-01**

SHEET 1 OF 1

LOCATION: N 5045823.0 ;E 243591.4

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH	JN - Joint FLT - Fault SH - 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 VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES
		Continued from Record of Borehole B3-01		205.18									
1	NW Casing October 27, 2008	SYENITE GNEISS Slightly weathered to fresh, fine to coarse grained, foliated, black, white, and pink, contains pink veins and porphy		0.41	1	0.2	Brown to light brown 90 - 80						
2	NO RC October 27, 2008				2	0.4	Brown to light brown 70 - 80						
3		END OF DRILLHOLE		202.95									
4				2.64									
5													
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: SMM

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

PROJECT		RECORD OF BOREHOLE		No B3-02		SHEET 1 OF 1		METRIC					
W.P.		LOCATION		ORIGINATED BY		COMPILED BY		CHECKED BY					
DIST		BOREHOLE TYPE		DATE		DATE		DATE					
DATUM		DATE		DATE		DATE		DATE					
PROJECT 07-1111-0029		N 5045830.5 ; E 243575.2		CR		MWK/VA		SMM					
5111-07-00		NW Casing, Wash Boring		October 22, 2008									
HWY 69													
Geodetic													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	GR SA SI CL
206.4	GROUND SURFACE												
0.0	Sand, some gravel, some silt, containing rootlets and topsoil (FILL)		1A	SS	8		206						OC = 2.1%
0.3	Loose Brown Moist		1B										
			2	SS	24/0.15								60 34 5 1
205.0	Sand and gravel, trace silt, trace clay, containing cobbles/boulders and rootlets (FILL)						205						
1.4	Loose to compact Brown Moist												
	Syenite Gneiss (BEDROCK)		1	RC	REC 100%		204						RQD = 100%
	Bedrock cored from depths of 1.4 m to 4.6 m.												
	For bedrock coring details, refer to Record of Drillhole B3-02.		2	RC	REC 100%		203						RQD = 81%
			3	RC	REC 95%		202						RQD = 53%
201.8	END OF BOREHOLE												
4.6	NOTE: 1. Open borehole dry prior to coring.												

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Walker Drilling

T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

CHECKED: SMM

+3, ×3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT: 07-1111-0029

## RECORD OF DRILLHOLE: B3-03

SHEET 1 OF 1

LOCATION: N 5045835.9 ;E 243585.8

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH % RETURN	JN - Joint FLT - Fault SH - 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 VR - Very Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																		NOTES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
								RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA												HYDRAULIC CONDUCTIVITY K, cm/sec			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	10 10 10 10	10 10 10 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
								80-90 90-100 100-110 110-120	80-90 90-100 100-110 110-120			0-10 10-20 20-30 30-40	40-50 50-60 60-70 70-80	80-90 90-100 100-110 110-120	FR,IR,VR FR,IR,RO FR,PL,RO FO-JN,PL,RO JN,PL,RO JN,PL,RO FR,PL,VR FR,PL,VR JN,IR,RO JN,IR,RO FR,PL,RO FR,PL,RO FR,IR,VR	10 10 10 10	10 10 10 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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4	NW Facing October 24, 2008	Continued from Record of Borehole B3-03  SYENITE GNEISS Slightly weathered to fresh, fine to coarse grained, foliated, black, white, and pink, contains pink feldspar veins and porphyr		201.81 3.73	1	Brown to light brown 80 - 90																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: SMM



PROJECT		RECORD OF BOREHOLE		No B3-04		SHEET 1 OF 1		METRIC										
W.P. 07-1111-0029		LOCATION		N 5045834.6 ; E 243579.0		ORIGINATED BY		CR										
DIST		HWY 69		BOREHOLE TYPE		NW Casing, Wash Boring		COMPILED BY										
MWK/VA		DATE		October 23, 2008		CHECKED BY		SMM										
Geodetic																		
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
205.9	GROUND SURFACE							20	40	60	80	100						
0.0	Gravelly sand, trace to some silt, trace clay, containing asphalt fragments and oxidation zones (FILL)		1	SS	12													21 71 7 1
205.2	Compact Brown Moist		2	SS	29													17 69 12 2
0.7																		OC = 2.9%
204.6	Sand, some gravel, some silt, containing rock fragments, cobbles and rootlets (FILL)		1	RC	REC 97%													RQD = 54%
1.3	Compact Brown Moist																	
	Syenite Gneiss (BEDROCK)																	
	Bedrock cored from depths of 1.3 m to 4.4 m.																	
	For bedrock coring details, refer to Record of Drillhole B3-04.		2	RC	REC 100%													RQD = 94%
201.5																		
4.4	END OF BOREHOLE																	
	NOTE:																	
	1. Open borehole dry prior to coring.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT: 07-1111-0029

**RECORD OF DRILLHOLE: B3-04**

SHEET 1 OF 1

LOCATION: N 5045834.6 ;E 243579.0

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SH - 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 VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES																										
	NW casing October 23, 2008	NQ RC October 23, 2008			DEPTH (m)	FLUSH									RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY K, cm/sec		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	10 °			10 °	10 °	10 °										

| 2 |  |  | Continued from Record of Borehole B3-04 |  | 204.55 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

DEPTH SCALE

1 : 50



LOGGED: CR



CHECKED: SMM

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-MISS.GDT 07/09/15 DD/SAC



+3, ×3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT		RECORD OF BOREHOLE No B3-06				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5045838.8 ; E 243582.7				ORIGINATED BY CR											
DIST _____ HWY 69		BOREHOLE TYPE NW Casing, Wash Boring				COMPILED BY MWK/VA											
DATUM Geodetic		DATE October 23, 2008				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
205.6	GROUND SURFACE							20	40	60	80	100					
0.0	Sand, some gravel, some silt, containing asphalt fragments and organics (FILL)		1	SS	15												OC = 2.4%
205.0	Compact Brown Moist ROCK FILL		2	SS	50/0.08												
0.6			3	SS	5												
			4	SS	17												
202.9	Syenite Gneiss (BEDROCK)																
2.7	Bedrock cored from depths of 2.7 m to 5.9 m.  For bedrock coring details, refer to Record of Drillhole B3-06.		1	RC	REC 100%												RQD = 59%
			2	RC	REC 100%												
199.7	END OF BOREHOLE																
5.9	NOTE:  1. Open borehole dry prior to coring.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT: 07-1111-0029

**RECORD OF DRILLHOLE: B3-06**

SHEET 1 OF 1

LOCATION: N 5045838.8 ;E 243582.7

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH % RETURN	JN - Joint FLT - Fault SH - 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 VR - Very Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.														NOTES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
							RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY K, cm/sec		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	10 10 10 10			10 10 10 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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3	NW Casing October 23, 2008	Continued from Record of Borehole B3-06  SYENITE GNEISS Slightly weathered to fresh, fine to coarse grained, foliated, black, white, and pink, contains pink veins and porphyr		202.85 2.74	1	0.4	Brown to light brown 80 - 90																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	</

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: SMM



+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT		RECORD OF BOREHOLE		No B3-08		SHEET 1 OF 1		METRIC									
W.P. 07-1111-0029		LOCATION		N 5045855.1 ; E 243548.9		ORIGINATED BY		CR									
DIST		HWY 69		BOREHOLE TYPE		NW Casing, Wash Boring		COMPILED BY									
MWK/VA		DATE		October 22, 2008		CHECKED BY		SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
205.6	GROUND SURFACE							20	40	60	80	100					
8.9	TOPSOIL		1	SS	21												43 46 9 2
204.6	Sand and gravel, trace to some silt, trace clay, containing cobbles and boulders (FILL) Compact to dense Brown Moist		2	SS	40/0.10												39 46 12 3
1.0	Granite Gneiss (BEDROCK)		1	RC	REC 100%												RQD = 50%
	Bedrock cored from depths of 1.0 m to 3.7 m.																
	For bedrock coring details, refer to Record of Drillhole B3-08.		2	RC	REC 100%												RQD = 89%
201.9	END OF BOREHOLE																
3.7	NOTE:  1. Open borehole dry prior to coring.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT: 07-1111-0029

## RECORD OF DRILLHOLE: B3-08

SHEET 1 OF 1

LOCATION: N 5045855.1 ;E 243548.9

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SH - 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 VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
				DEPTH (m)	FLUSH									RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA						HYDRAULIC CONDUCTIVITY K, cm <sup>3</sup> /sec			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	10 <sup>-6</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>			10 <sup>-3</sup>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
		Continued from Record of Borehole B3-08		204.99 0.61																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															</

DEPTH SCALE

1 : 50

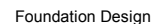


LOGGED: CR

CHECKED: SMM

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-MISS.GDT 07/09/15 DD/SAC





+3, ×3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



+3, ×3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

PROJECT		RECORD OF BOREHOLE		No B3-11		SHEET 1 OF 1		METRIC									
W.P. 07-1111-0029		LOCATION		N 5045852.2 ; E 243552.0		ORIGINATED BY		CR									
DIST		HWY 69		BOREHOLE TYPE		NW Casing, Wash Boring		COMPILED BY									
MWK/VA		DATE		October 21, 2008		CHECKED BY		SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
205.6	GROUND SURFACE							20	40	60	80	100					
0.7	ASPHALT																
	Sand and gravel, trace to some silt, trace clay, containing rock fragments (FILL) Loose to dense Brown Moist		1	SS	14												
			2	SS	6												
	Cobbles/boulders and oxidation zones encountered below a depth of 0.7 m		3	SS	46												
203.2			4	SS	20/0.05												
2.4	Granite Gneiss (BEDROCK)																
	Bedrock cored from depths of 2.4 m to 5.5 m. For bedrock coring details, refer to Record of Drillhole B3-11.		1	RC	REC 100%												
			2	RC	REC 100%												
			3	RC	REC 100%												
200.1	END OF BOREHOLE																
5.5	NOTE:  1. Water level in open borehole at a depth of 2.3 m below ground surface (Elev. 203.3 m) prior to coring.																

PROJECT: 07-1111-0029

## RECORD OF DRILLHOLE: B3-11

SHEET 1 OF 1

LOCATION: N 5045852.2 ;E 243552.0

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH	RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	B Angle	DIP w.r.t CORE AXIS	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY				Diametral Point Load Index (MPa)	RMC -Q AVG	NOTES	
									TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K, cm/sec	10 <sup>-6</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>				10 <sup>-3</sup>
	NW Casing October 21, 2008			203.18 2.44	Brown 10 - 20																					
3		GRANITE GNEISS Slightly weathered to fresh, fine grained, foliated, black, white, and pink		1		0.3																				(Axial)
4				2		0.2																				
5				3		0.2																				
			END OF DRILLHOLE		200.08 5.54																					
6																										
7																										
8																										
9																										
10																										
11																										
12																										

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: SMM

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

PROJECT		RECORD OF BOREHOLE		No B3-12		SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION		N 5045869.4 ;E 243541.7		ORIGINATED BY		CR									
DIST		HWY 69		BOREHOLE TYPE		Shovel Excavation		COMPILED BY		VA							
DATUM		Geodetic		DATE		October 27, 2008		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
211.6	GROUND SURFACE																
0.0	TOPSOIL		1	CS	-												31 48 19 2
211.2	SAND and GRAVEL, some silt, trace clay, containing rootlets																
0.4	Brown Moist END OF EXCAVATION BEDROCK OUTCROP																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SERVICE ROAD #9-PHASE III.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

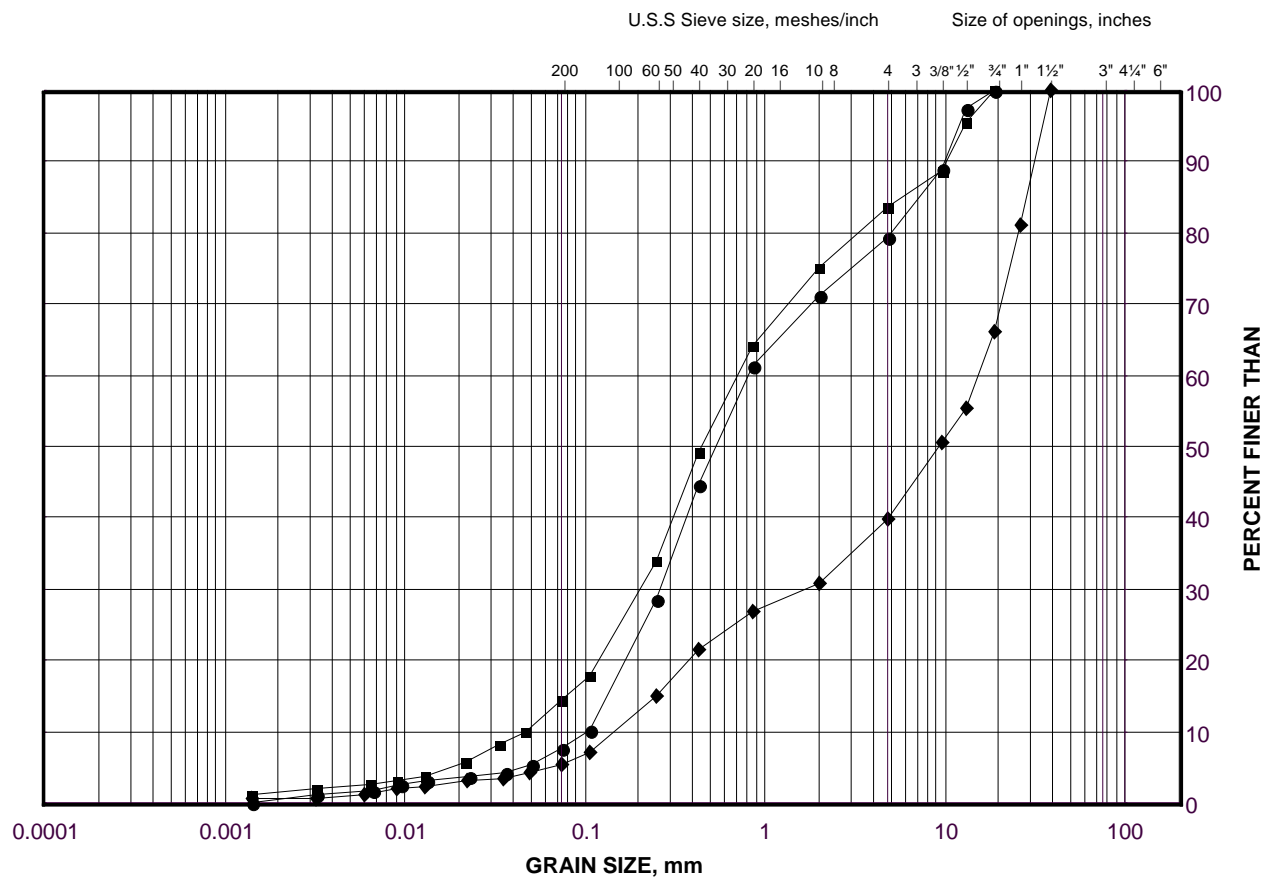


# **APPENDIX B**

## **LABORATORY TEST RESULTS**

### Sand to Sand and Gravel Fill South Abutment

FIGURE B1-1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	B3-04	1	205.7
■	B3-04	2	204.9
◆	B3-02	2	205.5

Project Number: 07-1111-0029

Checked By: SMM

## Golder Associates

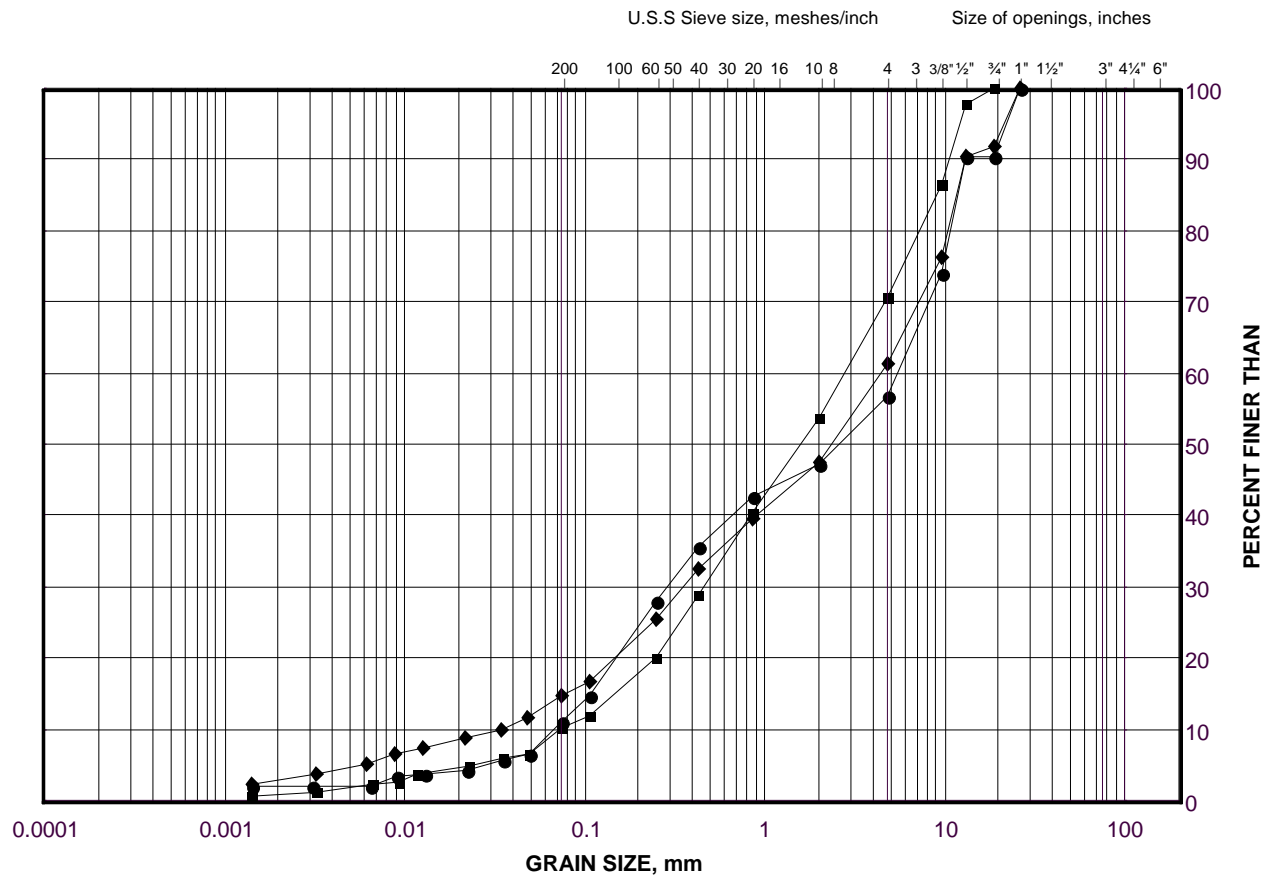
Date: 27-Jul-09



# GRAIN SIZE DISTRIBUTION

Sand and Gravel Fill  
North Abutment

FIGURE B1-2



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	B3-08	1	205.4
■	B3-11	2	204.6
◆	B3-08	2	204.7

Project Number: 07-1111-0029

Checked By: SMM

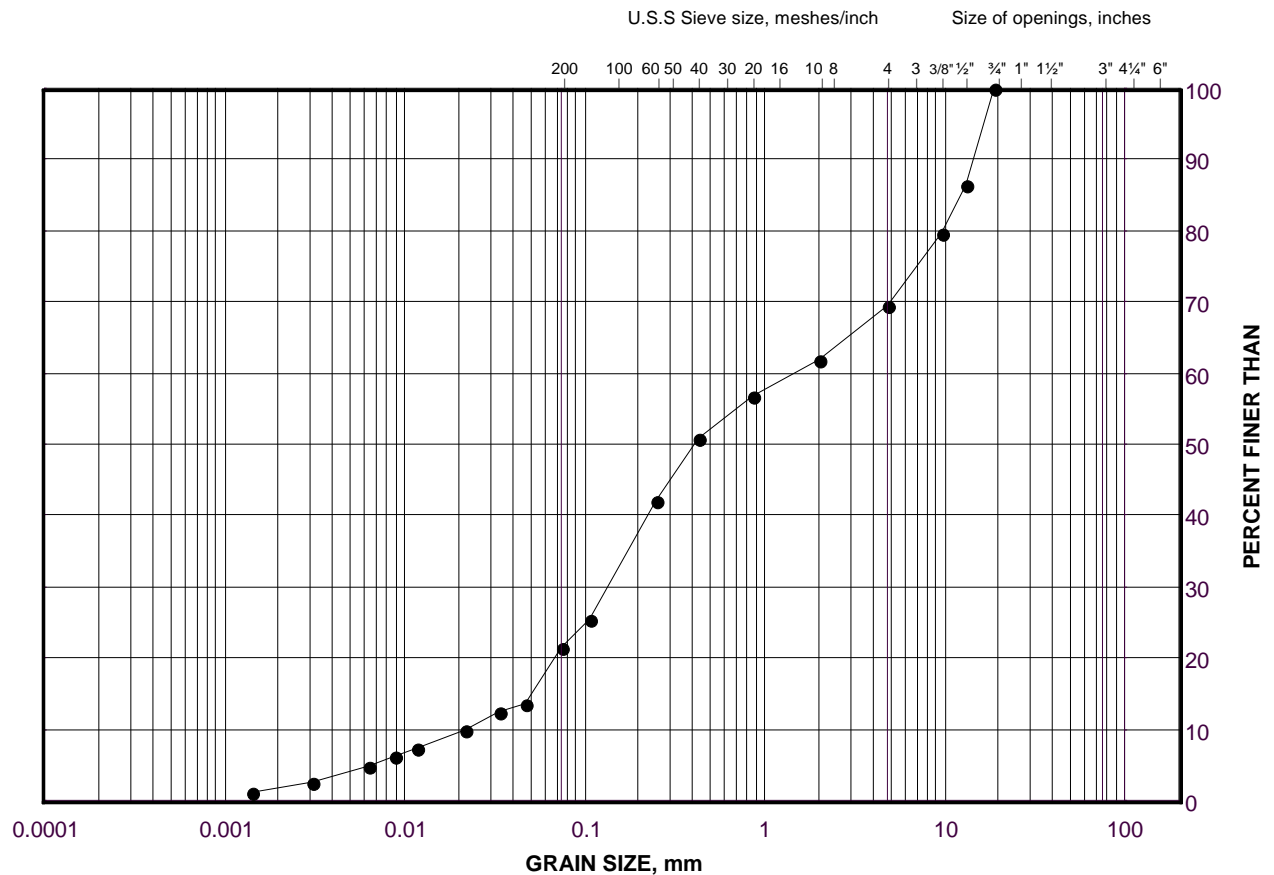
**Golder Associates**

Date: 21-Sep-09

# GRAIN SIZE DISTRIBUTION

Sand and Gravel  
North Approach

FIGURE B1-3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	B3-12	1	207.7

Project Number: 07-1111-0029

Checked By: SMM

**Golder Associates**

Date: 21-Sep-09

**TABLE B1**  
**POINT LOAD TEST RESULTS ON ROCK SAMPLES**

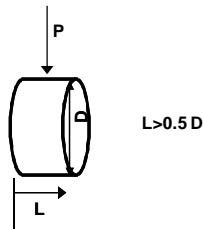
Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)	Approx. <sup>(1)</sup> UCS (MPa)
B3-02	1	1.5	204.9	Syenite Gneiss	Axial	6.521	91
B3-02	1	1.5	204.9	Syenite Gneiss	Diametral	7.085	99
B3-02	1	2.1	204.3	Syenite Gneiss	Axial	8.515	119
B3-06	1	3.0	202.6	Syenite Gneiss	Axial	5.624	79
B3-06	1	3.0	202.6	Syenite Gneiss	Diametral	7.720	108
B3-08	1	1.2-1.5	205.6	Granite Gneiss	Axial	0.555	8
B3-08	1	1.2-1.5	205.6	Granite Gneiss	Diametral	2.422	34
B3-08	1	2	203.6	Granite Gneiss	Axial	5.423	76
B3-08	2	2.3	203.3	Granite Gneiss	Diametral	11.373	159
B3-08	2	2.7	202.9	Granite Gneiss	Diametral	8.936	125
B3-11	1	2.5	203.1	Granite Gneiss	Diametral	6.569	92
B3-11	1	2.9	202.7	Granite Gneiss	Axial	6.938	97
B3-11	1	3.1	202.5	Granite Gneiss	Diametral	7.397	104

<sup>(1)</sup>  $I_{s50} \times C$  (actual value could be confirmed by UCS testing), from ISRM. A value of  $C = 14$  has been used and is based on correlation with UCS testing for this site.

("Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, Int. J. Rock. Mech. Min. Sci. and Geomechanical Abstr., Vol 22, No. 2 1985, pp. 53-60.

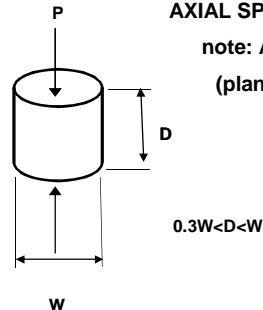
#### DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

note: Diametral tests are perpendicular to core axis  
(planes of weakness)



#### AXIAL SPECIMEN SHAPE REQUIREMENTS

note: Axial tests are parallel to core axis  
(planes of weakness)



Compiled By: TVA  
 Checked By: SMM/CN  
 Reviewed By: JPD/JMAC

**TABLE B2-1**  
**SUMMARY OF UNCONFINED COMPRESSION (UC) TEST RESULTS**  
**SHAWANAGA RIVER SERVICE ROAD (SITE NO. 9)**  
**GWP 5186-06-01**  
**HIGHWAY 69, TOWNSHIP OF PARRY SOUND**

<b>Borehole Number</b>	<b>Sample Depth (m)</b>	<b>Sample Elevation (m)</b>	<b>Rock Type</b>	<b>Core Diameter (mm)</b>	<b>Uniaxial Compressive Strength (MPa)</b>
B3-02	2.1	203.5	Syenite Gneiss	47.0	115
B3-06	3.1	202.6	Syenite Gneiss	47.1	79
B3-08	1.4	204.2	Granite Gneiss	47.5	70

Compiled by: SMM/CN

Reviewed By: JMAC

**TABLE B2-2**  
**UNCONFINED COMPRESSION (UC) TEST**  
**ASTM D 7012-04**

**SAMPLE IDENTIFICATION**

PROJECT NUMBER	07-1111-0029	RUN NUMBER	1
BOREHOLE NUMBER	B3-02	SAMPLE DEPTH, m	2.13
		ELEVATION, m	203.5

**TEST CONDITIONS**

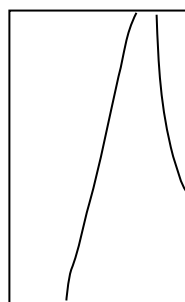
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.19

**SPECIMEN INFORMATION**

SAMPLE HEIGHT, cm	10.30	WATER CONTENT, (specimen) %	0.15
SAMPLE DIAMETER, cm	4.70	UNIT WEIGHT, kN/m <sup>3</sup>	26.45
SAMPLE AREA, cm <sup>2</sup>	17.35	DRY UNIT WT., kN/m <sup>3</sup>	26.41
SAMPLE VOLUME, cm <sup>3</sup>	178.70	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	482.22	VOID RATIO	0.00
DRY WEIGHT, g	481.50		

**VISUAL INSPECTION**

**FAILURE SKETCH**



**TEST RESULTS**

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	115.4
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REMARKS:

DATE:

12/29/2008

**TABLE B2-3**  
**UNCONFINED COMPRESSION (UC) TEST**  
**ASTM D 7012-04**

SAMPLE IDENTIFICATION			
PROJECT NUMBER	07-1111-0029	RUN NUMBER	1
BOREHOLE NUMBER	B3-06	SAMPLE DEPTH, m	3.05
		ELEVATION, m	202.6

TEST CONDITIONS			
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.29

SPECIMEN INFORMATION			
SAMPLE HEIGHT, cm	10.80	WATER CONTENT, (specimen) %	0.12
SAMPLE DIAMETER, cm	4.71	UNIT WEIGHT, kN/m <sup>3</sup>	26.72
SAMPLE AREA, cm <sup>2</sup>	17.42	DRY UNIT WT., kN/m <sup>3</sup>	26.69
SAMPLE VOLUME, cm <sup>3</sup>	188.17	SPECIFIC GRAVITY, assumed	2.80
WET WEIGHT, g	512.96	VOID RATIO	0.03
DRY WEIGHT, g	512.35		

**VISUAL INSPECTION****FAILURE SKETCH**

TEST RESULTS			
STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	79.1

REMARKS:

DATE:

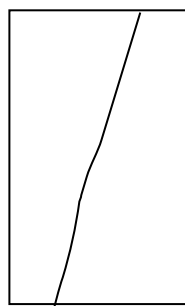
12/29/2008

**TABLE B2-4**  
**UNCONFINED COMPRESSION (UC) TEST**  
**ASTM D 7012-04**

SAMPLE IDENTIFICATION			
PROJECT NUMBER	07-1111-0029	RUN NUMBER	1
BOREHOLE NUMBER	B3-08	SAMPLE DEPTH, m	1.40
		ELEVATION, m	204.2

TEST CONDITIONS			
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.27

SPECIMEN INFORMATION			
SAMPLE HEIGHT, cm	10.80	WATER CONTENT, (specimen) %	0.27
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m <sup>3</sup>	26.56
SAMPLE AREA, cm <sup>2</sup>	17.72	DRY UNIT WT., kN/m <sup>3</sup>	26.49
SAMPLE VOLUME, cm <sup>3</sup>	191.38	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	518.55	VOID RATIO	0.00
DRY WEIGHT, g	517.15		

**VISUAL INSPECTION****FAILURE SKETCH**

TEST RESULTS			
STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	70.3

REMARKS:

DATE:

12/29/2008

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

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