REPORT

A world of capabilities delivered locally

November 4, 2015

FOUNDATION INVESTIGATION REPORT

SHEBESHEKONG ROAD SBL OVERPASS STRUCTURE, SITE NO. 44-452/C2 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. 5185-06-01 (Phase 2 of G.W.P. 5402-05-00)

Submitted to:
McCormick Rankin, a member of MMM Group Limited
2655 North Sheridan Way
Mississauga, Ontario
L5K 2P8

GEOCRES No: 41H-155

Report Number: 07-1111-0029-13

Distribution:

3 Copies - Ministry of Transportation, Ontario, North Bay, Ontario, (Northeastern Region)
1 Copy - Ministry of Transportation, Ontario, Downsview, Ontario (Foundations Section)
2 Copies - McCormick Rankin, a member of MMM Group Limited, Mississauga, Ontario
1 Copy - Golder Associates Ltd., Mississauga, Ontario

Golder Associates

Table of Contents

Appendix B **Laboratory Test Results**

PART A

FOUNDATION INVESTIGATION REPORT

SHEBESHEKONG ROAD SBL OVERPASS STRUCTURE

SITE NO. 44-452/C2

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. 5185-06-01 (Phase 2 of G.W.P. 5402-05-00)

November 4, 2015
Report No. 07-1111-0029-13

Golder Associates

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 provide foundation engineering services for the proposed single-span Highway 69-Shebeshekong Road Southbound Lane (SBL) Overpass structure. The proposed work is part of 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 No. 9 Road structures, as well as culvert crossings. The general location of the overpass structure along the new Highway 69 alignment is shown on Drawing 1.

The Terms of Reference and the Scope of Work for the foundation engineering services are outlined in MTO's Request for Proposal, dated July 2006. Golder's original proposal for foundation engineering services associated with this section of the four-laning of Highway 69 is contained in Section 6.8 of MRC's Technical Proposal for this assignment. Golder's scope of work for the Shebeshekong Road SBL Overpass is contained in Addendum No. 7, dated February 14, 2013. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for this project, dated July 4, 2007. The General Arrangement (GA) Drawing for the proposed Shebeshekong Road SBL Overpass Structure was provided to Golder by MRC on November 10, 2014.

This report addresses the investigation carried out for the Shebeshekong Road SBL Overpass rigid frame structure and the associated approach embankments only. Separate reports address the foundation investigations for the swamp crossings, high fill areas associated with interchange ramps and roadways, culverts and 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 overpass structure centerline and the foundation units/limits for this investigation were located in the field prior to drilling 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 Shebeshekong Road SBL Overpass is located approximately 150 m southwest of the existing intersection of Highway 69 and Shebeshekong Road and approximately 550 m south of Shawanaga River. The proposed new Highway 69 alignment runs generally in a southeast-northwest direction on the west side of the existing Highway 69, which will become part of the future Shawanaga River Service Road (Site No. 9 Road) in this area. For the purposes of this report the SBL Overpass structure is considered oriented North-South for the ease of reference.

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 and rivers. The proposed overpass structure and associated approach embankments are to be situated on a relatively flat, densely treed area with bedrock outcrops. The existing ground surface within the limits of the proposed structure and approach embankments, as encountered at borehole locations advanced for the foundations investigation, varies between Elevations 211.5 m and 210.5 m, referenced to Geodetic datum.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the Shebeshekong Road SBL Overpass Structure subsurface investigation was carried out between January 12 and 16, 2015 during which time a total of eight (8) boreholes were advanced: three (3) boreholes (Boreholes B6-01 to B6-03) were advanced on the south side of the structure; three (3) boreholes (Boreholes B6-04 to B6-06) were advanced on the north side of the structure; and one borehole was advanced at each of the south and north approach embankments (Boreholes B6-07 and B6-08, respectively). The Record of Borehole/Drillhole sheets and the results of the laboratory testing are presented in Appendices A and B, respectively. The locations of the boreholes are shown in plan on Drawing 2.

The field investigation was carried out using a modified rubber tire backhoe-loader equipped with a CME 550 drill rig supplied and operated by Landcore Drilling of Sudbury, Ontario.

The boreholes were advanced through the overburden using 108 mm inside diameter hollow-stem augers and/or NW casing. In general, soil samples were obtained at intervals of depth of about 0.75 m, using a 50 mm O.D. split-spoon sampler operated by an automatic hammer on the drill rig, performed in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Bedrock coring was carried out using an 'NQ' core barrel in two of the boreholes. All open boreholes were backfilled with soil cuttings and/or bentonite upon completion in accordance with Ontario Regulation 903-Wells (as amended).

The boreholes at the location of the foundation elements and approach embankments were advanced to auger, casing and/or split-spoon sampler refusal (i.e. inferred bedrock) and bedrock was confirmed by coring in selected boreholes. The boreholes were advanced to depths ranging from 0.5 m to 12.2 m below existing ground surface, including coring of bedrock for core lengths of about 9.0 m and 10.8 m in Boreholes B6-03 and B6-04, respectively. The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets in Appendix A.

The fieldwork was observed 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 Laboratory Standards and/or ASTM Standards, as appropriate. Classification testing (i.e. water content and grain size distribution) was carried out on selected soil samples. Strength tests, such as unconfined compression and point load index, were carried out on specimen of the rock core.

The as-drilled borehole locations and the ground surface elevations were surveyed by Callon Dietz. The borehole locations given in the Record of Borehole/Drillhole sheets and shown on Drawing 2 are positioned relative to MTM NAD83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum and are summarized below.

Borehole	Location (MTM NAD83)		Ground Surface Elevation (m)	Depth of Borehole (m)
	Northing	Easting		
B6-01	5045437.3	243867.3	211.1	0.5
B6-02	5045443.7	243873.4	211.1	2.1
B6-03	5045449.1	243878.5	210.9	11.7
B6-04	5045441.8	243862.7	210.9	12.2
B6-05	5045448.2	243868.9	211.1	1.4
B6-06	5045453.5	243874.0	210.9	1.5
B6-07	5045436.8	243880.6	211.5	1.5
B6-08	5045455.1	243861.7	210.5	1.2

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

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

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 underlain by 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 underlain by soft/loose native soils, are present in valleys between the bedrock knobs and ridges.

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[2]. Deposition of Palaeozoic strata initially covered, and later erosion during glaciation subsequently exposed, these Precambrian rocks.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions 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 presented in the Record of Boreholes sheets provided in Appendix A. The results of the laboratory tests as well as photographs of the recovered rock core samples are also provided in Appendix B. The results of the in situ field tests (i.e. SPT 'N'-values) as presented on the Record of Borehole sheets and in Section 4.3 and 4.4 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole 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.

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

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

Further, subsurface conditions will vary between and beyond the borehole locations. It should be noted that the interpreted stratigraphy shown on Drawing 2 is a simplification of the subsurface conditions.

In general, the subsurface conditions at the Shebeshekong Road SBL Overpass site consist of a surficial layer of topsoil or fill underlain by a silty sand/gravelly sand non-cohesive deposit, and bedrock. A detailed description of the subsurface conditions encountered in the boreholes advanced at the footing locations and approach areas is provided in the following sections.

4.3 South Footing and Approach Embankment

A total three boreholes (Borehole B6-01 to B6-03) were advanced at the location of the south footing and one borehole (Borehole B6-07) was advanced on the centerline at the south approach. In general, the subsurface conditions consist of topsoil or fill, underlain by a silty sand deposit and bedrock.

4.3.1 Topsoil

A layer of topsoil 0.2 m to 0.5 m thick was encountered at ground surface in Boreholes B6-01 to B6-03.

The SPT 'N'-values measured within the topsoil range from 24 blows to 53 blows per 0.3 m of penetration, indicating a compact to very dense relative density. However, it should be noted that the topsoil was frozen at the time of drilling and as such, the SPT 'N'-values measured may not be representative of the actual relative density of the topsoil layer.

The natural water content measured on two (2) samples of the topsoil are about 37 per cent and 42 per cent.

4.3.2 Silty Sand and Gravel Fill

A layer of silty sand and gravel fill 0.3 m thick was encountered at ground surface in Borehole B6-07.

An SPT 'N'-value measured within the silty sand and gravel fill is 26 blows per 0.3 m of penetration, indicating a compact relative density.

4.3.3 Silty Sand

A deposit of silty sand was encountered below the topsoil in Boreholes B6-02 and B6-03 and below the fill in Borehole B6-07. The top of this deposit was encountered between Elevations 211.2 m and 210.7 m and its thickness ranges from 1.2 m to 2.5 m.

The SPT 'N'-values measured within this deposit range from 5 blows to 49 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The natural water content measured on eight (8) samples of this deposit ranged from about 6 per cent to 18 per cent.

The results of three (3) grain size distribution tests completed on the silty sand deposit are shown on Figure B1 in Appendix B.

4.3.4 Bedrock/Refusal

Bedrock was encountered and core samples were recovered below the silty sand deposit in Borehole B6-03. Photographs of the recovered rock samples are shown on Figure B3 in Appendix B. The presence of bedrock was inferred by auger, casing and/or split-spoon sampler refusal in Borehole B6-01, B6-02 and B6-07.

The depth to bedrock below ground surface and corresponding bedrock surface elevation is summarized below.

Foundation Element / Approach Area	Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Refusal Type
South Approach	B6-07	1.5	210.0	Auger
South Footing	B6-01 B6-02 B6-03	0.5 2.1 2.7	210.6 209.0 208.2	Split-Spoon and Auger Casing Bedrock Cored

Based on the bedrock core samples, the bedrock consists of granite gneiss. In general the bedrock samples are described as fresh to slightly weathered, medium to coarse grained, foliated, non-porous and grey, white and pink. The Rock Quality Designation (RQD) measured on the core samples are between 89 per cent and 100 per cent, indicating a rock mass of excellent quality, according to Table 3.10 in CFEM (2006)[3]. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the core samples is between 98 per cent and 100 per cent and between 71 per cent and 97 per cent, respectively.

Point load index tests were carried out in accordance to ASTM D5731 on selected samples of the granite gneiss bedrock core and the point load strength index values are shown on the Record of Drillhole sheets in Appendix A and are presented in Table B1 in Appendix B. The axial tests carried out on four (4) core samples of granite gneiss bedrock measured Is_{50} values ranging from about 4.6 MPa to 10.6 MPa. The diametral tests carried out on two (2) core samples of granite gneiss bedrock measured Is_{50} values of about 0.2 MPa and 0.4 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7102, on a selected core sample of the granite gneiss bedrock and measured a compressive strength of about 49 MPa, as detailed in Table B2 in Appendix B.

According to Table 3.5 in CFEM (2006), the granite gneiss bedrock is classified as medium strong (R3, 25 MPa < UCS < 50 MPa) to very strong (R5, 4 MPa < Point Load Index < 10 MPa).

4.3.5 Groundwater Conditions

In general, the boreholes were dry upon completion of drilling and the overburden samples recovered in the boreholes were moist. The perched water level in Borehole B6-03 upon completion of drilling operations was measured at a depth of 4.1 m below ground surface, corresponding to Elevation 206.8 m. The groundwater level in the area is subject to seasonal fluctuations, snow melt and variation due to precipitation events and thickness of overburden.

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

4.4 North Footing and Approach Embankment

A total three boreholes (Borehole B6-04 to B6-06) were advanced at the location of the north footing and one borehole (Borehole B6-08) was advanced on the centerline at the north approach. In general, the subsurface conditions consist of topsoil or fill, underlain by a silty sand or gravelly sand deposit over bedrock.

4.4.1 Topsoil

A layer of topsoil 0.2 m to 0.3 m thick was encountered at ground surface in Boreholes B6-04 and B6-05.

An SPT 'N'-value measured within the topsoil is 54 blows per 0.3 m of penetration, indicating a very dense relative density. However, it should be noted that the topsoil was frozen at the time of drilling and as such, the SPT 'N'-value measured may not be representative of the actual relative density of the topsoil layer.

The natural water content measured on one (1) sample of the topsoil is about 31 per cent.

4.4.2 Gravelly Silty Sand Fill

A layer of gravelly silty sand fill 0.3 m thick was encountered at ground surface in Borehole B6-06 at Elevation 210.9 m.

An SPT 'N'-value measured within the gravelly silty sand fill is 16 blows per 0.3 m of penetration, indicating a compact relative density.

4.4.3 Gravelly Sand

A 1.2 m thick deposit of gravelly sand was encountered at ground surface in Borehole B6-08 at Elevation 210.5 m.

The SPT 'N'-values measured within this deposit was 6 blows and 7 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on one sample of this deposit is about 33 per cent.

The result of one grain size distribution test completed on a sample of gravelly sand is shown in Figure B2 in Appendix B.

4.4.4 Silty Sand

A deposit of silty sand was encountered below the topsoil in Boreholes B6-04 and B6-05 and below the fill in Boreholes B6-06. The top of this deposit was encountered at between Elevations 210.9 m and 210.6 m and the thickness of the deposit ranges from 1.1 m to 1.2 m.

The SPT 'N'-values measured within this deposit range from 16 blows to 74 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The natural water content measured on four (4) samples of this deposit range from about 8 per cent to 22 per cent.

The result of one grain size distribution test completed on the silty sand deposit is shown in Figure B1 in Appendix B.

4.4.5 Bedrock/Refusal

Bedrock was encountered and core samples were recovered below the silty sand deposit in Borehole B6-04. Photographs of the recovered rock samples are shown on Figure B3 in Appendix B. The presence of bedrock was inferred by auger and/or split-spoon sampler refusal in Borehole B6-05, B6-06 and B6-08.

The depth to bedrock below ground surface and corresponding bedrock surface elevation is summarized below.

Foundation Element / Approach Area	Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Refusal Type
North Approach	B6-08	1.2	209.3	Split-Spoon and Auger
North Footing	B6-04 B6-05 B6-06	1.4 1.4 1.5	209.5 209.7 209.4	Bedrock Cored Auger Auger

Based on the bedrock core samples, the bedrock consists of granite gneiss. In general the bedrock samples are described as fresh to slightly weathered, fine to coarse grained, foliated, non-porous, dark grey, white and pink. The Rock Quality Designation (RQD) measured on the core samples are between 92 per cent and 100 per cent, indicating a rock mass of fair to excellent quality, according to Table 3.10 in CFEM (2006). The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the core samples is 100 per cent and between 86 per cent and 100 per cent, respectively.

Point load index tests were carried out in accordance to ASTM D5731 on selected samples of the granite gneiss bedrock core and the point load strength index values are shown on the Record of Drillhole sheets in Appendix A and are presented in Table B1 in Appendix B. The axial tests carried out on five (5) core samples of granite gneiss bedrock measured Is_{50} values ranging from about 3.3 MPa to 11.7 MPa. The diametral tests carried out on five (5) core samples of granite gneiss bedrock measured Is_{50} values of about 2.7 MPa to 7.2 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7102 on a selected core sample of the granite gneiss bedrock from Borehole B6-04 and measured a compressive strength of about 59 MPa, as detailed in Table B3 in Appendix B.

According to Table 3.5 in CFEM (2006), the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa, 2 MPa < Point Load Index < 4 MPa) to extremely strong (R6, Point Load Index >10 MPa).

4.4.6 Groundwater Conditions

All boreholes drilled in the north footing were dry upon completion of drilling; however the overburden samples recovered in the boreholes were moist, based on field observations. The groundwater level in the area is subject to seasonal fluctuations, snow melt and variation due to precipitation events.

5.0 CLOSURE

The field personnel supervising the drilling program was Mr. Indulis Dumpis, a senior technician with Golder. This report was prepared by Ms. Madison C. Kennedy, B.A.Sc. and reviewed by Mr. Christopher Ng, P.Eng., geotechnical engineer and an Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and Principal of Golder, carried out a quality control review of the report.

Report Signature Page

Madison C. Kennedy, B.A.Sc.
Geotechnical Engineering Group

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
4/11/2015
PROVINCE OF ONTARIO

Christopher Ng, P. Eng.,
Geotechnical Engineer, Associate

LICENSED PROFESSIONAL ENGINEER
J. M. A. COSTA
4/11/2015
PROVINCE OF ONTARIO

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

MCK/CN/JMAC/cn

\\golder.gds\gal\mississauga\active\2007\1111\07-1111-0029 - mrc - hwy 69 four-laning -\report\final\12 - shebeshekong road nbl overpass\07-1111-0029-12 fidr 15nov04 highway 69 shebeshekong rd nbl overpass.docx

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO

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

CONT No.
WP No. 5185-06-01

SHEET
.

HIGHWAY 69
SITE LOCATION PLAN

Golder Associates

KEY PLAN
NOT TO SCALE

N 5050000
N 5040000
N 5030000
E 240000
E 250000
E 260000

SHAWANAGA RIVER BRIDGE NBL & SBL
(WP 5187-06-01 & 5188-06-01)
AND
SHAWANAGA RIVER SERVICE ROAD BRIDGE
(WP 5186-06-01)

SHEBESHEKONG ROAD OVERPASS NBL & SBL
(WP 5184-06-01 & 5185-06-01)

SHEBESHEKONG ROAD INTERCHANGE
SHEBESHEKONG ROAD UNDERPASS
(WP 5183-06-01)

NEW WOODS ROAD INTERCHANGE
NEW WOODS ROAD UNDERPASS
(WP 5180-06-01)

SHAWANAGA RIVER

PHASE 2
GWP 5111-07-00

PHASE 1
GWP 5402-05-00

HIGHWAY 69

HIGHWAY 559

SHEBESHEKONG ROAD

SKERRYVORE ROAD

WOODS ROAD

SHAWANAGA FIRST NATION

THE ARCHIPELAGO

WHITESTONE

CARLING

McDOUGALL

GEORGIAN BAY

NOBEL

CARLING

SCALE
1 0 1 2 km

REFERENCE

Base Data – MNR NRVIS, 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

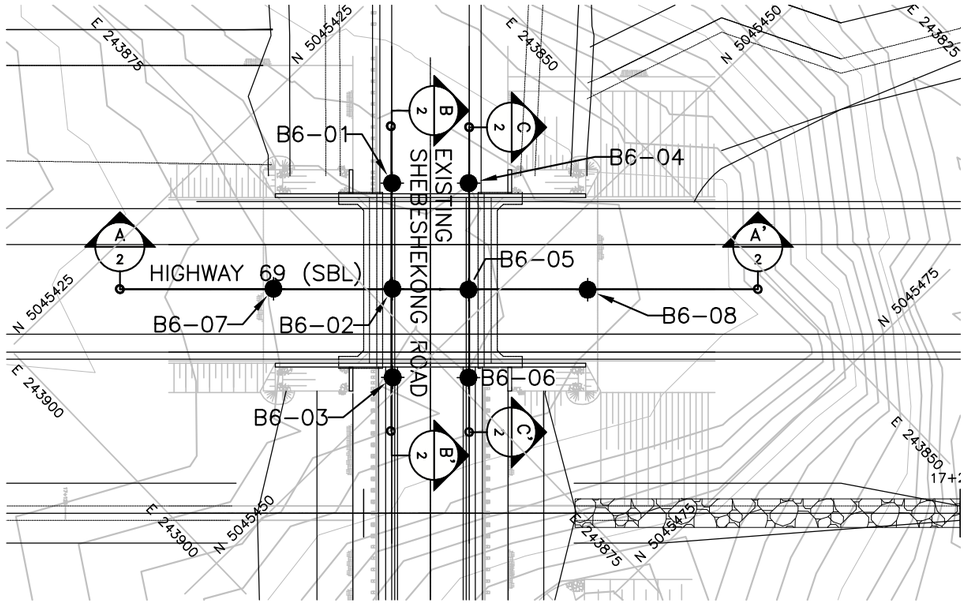
NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 41H-155

HWY. 69	PROJECT NO. 07-1111-0029		DIST. .
SUBM'D. MCK	CHKD. CN	DATE: Nov. 2015	SITE:44-452/C2
DRAWN: JFC	CHKD. .	APPD. JMAC	DWG. 1

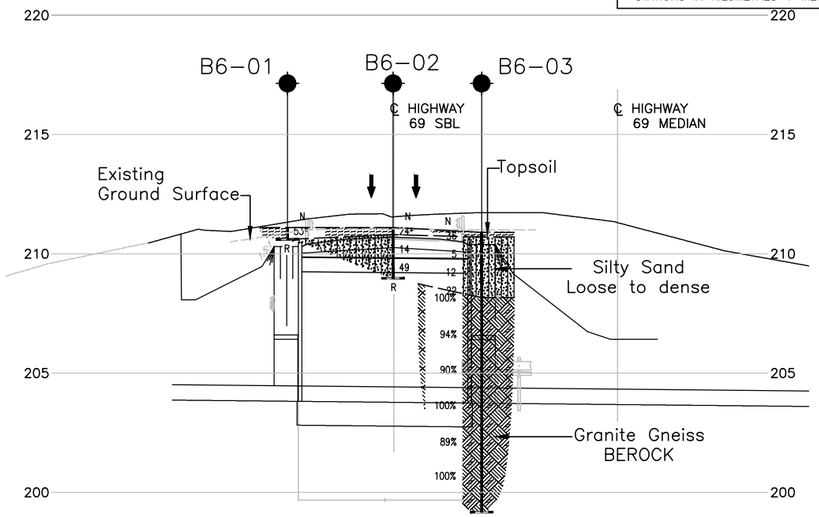
PLOT DATE: November 4, 2015
FILENAME: T:\Projects\2007\07-1111-0029 (MTC, Parry Sound)\-ADA- SBL Shebeshekong Rd Overpass\07111100029-ADA-BS-0001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

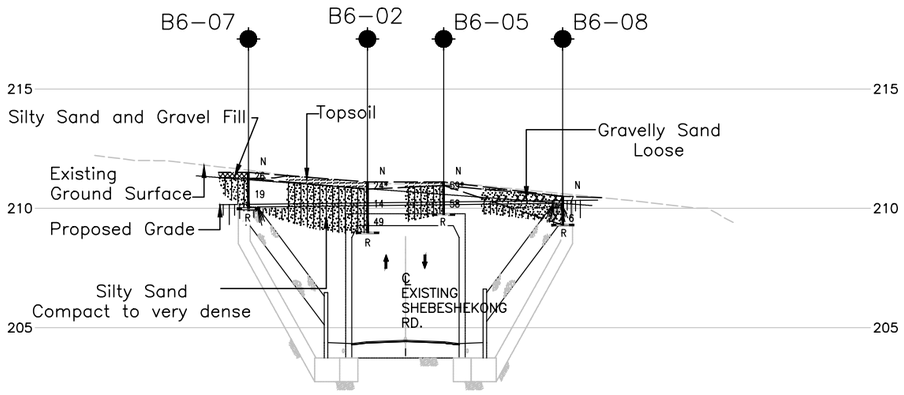
SCALE
5 0 5 10 m



B-B' 2 SOUTH WALL CROSS-SECTION
HIGHWAY 69 (SBL)

HORIZONTAL SCALE
5 0 5 10 m

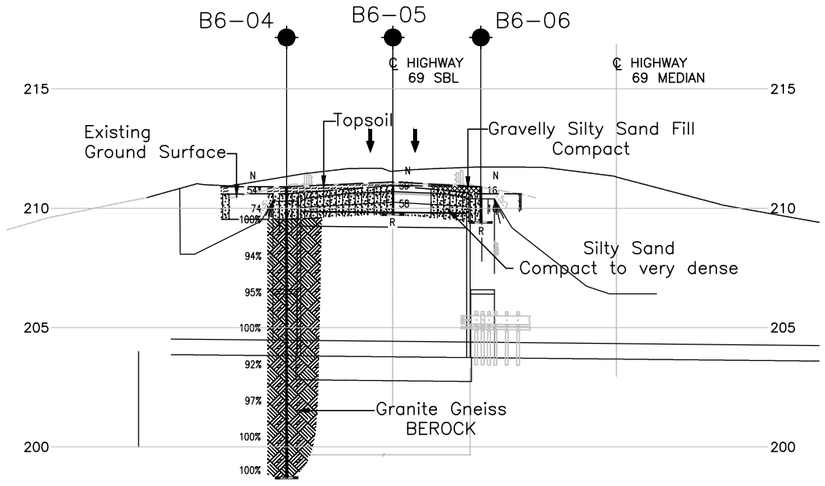
VERTICAL SCALE
2.5 0 2.5 5 m



A-A' 2 PROFILE ALONG CENTRELINE
HIGHWAY 69 (SBL)

HORIZONTAL SCALE
5 0 5 10 m

VERTICAL SCALE
2.5 0 2.5 5 m



C-C' 2 NORTH WALL CROSS-SECTION
HIGHWAY 69 (SBL)

HORIZONTAL SCALE
5 0 5 10 m

VERTICAL SCALE
2.5 0 2.5 5 m

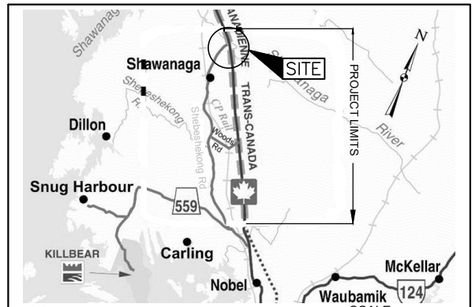
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. .
WP No. 5185-06-01

HIGHWAY 69
SHEBESHEKONG ROAD SBL OVERPASS STRUCTURE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET .

Golder Associates



KEY PLAN
SCALE
3.7 0 3.7 km

LEGEND

- Borehole – Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B6-01	211.1	5045437.3	243867.3
B6-02	211.1	5045443.7	243873.4
B6-03	210.9	5045449.1	243878.5
B6-04	210.9	5045441.8	243862.7
B6-05	211.1	5045448.2	243868.9
B6-06	210.9	5045453.5	243874.0
B6-07	211.5	5045436.8	243880.6
B6-08	210.5	5045455.1	243861.7

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 MMM, drawing file no. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg and h6878_PHASE2_XN1.dwg, received November 17, 2014

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA Nov. 4, 2015 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Nov. 4, 2015 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 41H-155

HWY. 69		PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. MCK	CHKD. CN	DATE: Nov. 2015	SITE:44-452/C2
DRAWN: MR/JFC	CHKD. .	APPD. JMAC	DWG. 2

PLOT DATE: November 4, 2015
FILENAME: T:\Projects\2007\07-1111-0029 (MRC, Parry Sound)\-ADA- SBL Shebeshekong Rd Overpass\07111110029-ADA-BD-0002.dwg

APPENDIX A

RECORD OF BOREHOLES AND DRILLHOLES

LIST OF SYMBOLS

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

I.	**GENERAL**
π	3.1416
ln x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety
II.	**STRESS AND STRAIN**
γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility
III.	**SOIL PROPERTIES**
(a)	**Index Properties**
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ 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_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}
(d)	**Shear Strength**
τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
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, 60º 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^2 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 / Relative Density	N Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency

	c_u, s_u kPa	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[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

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

V. MINOR SOIL CONSTITUENTS

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	Sand and Gravel
	With (cohesive)	Silty Clay with sand / Clayey Silt with sand

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} 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		

Golder Associates

RECORD OF BOREHOLE No B6-01

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045437.3 ;E 243867.3
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
211.1	GROUND SURFACE										
0.0 / 210.6	TOPSOIL Frozen		1	SS	53*		211		42.1 ○		
0.5	END OF BOREHOLE SPLIT-SPOON AND AUGER REFUSAL NOTES: 1. Open borehole dry upon completion of drilling. 2. An additional borehole was advanced 1 m west of Borehole B6-01 location to confirm refusal. * SPT 'N' value impacted by frost.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No B6-02

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045443.7 ;E 243873.4
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, NW Casing
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	WATER CONTENT (%)	γ kN/m^3	GR SA SI CL
211.1 GROUND SURFACE								20 40 60 80 100	10 20 30		
0.0 / 210.8	TOPSOIL Frozen		1A 1B	SS	24*		211		○		
0.3	Silty SAND, trace gravel, trace clay Compact to dense Light brown to grey Moist		2	SS	14		210		○		
209.0			3	SS	49		209		○		4 68 24 4
2.1	END OF BOREHOLE CASING REFUSAL										

NOTES:

1. Open borehole dry upon completion of drilling.

* SPT 'N' value impacted by frost.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No B6-03

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045449.1 ;E 243878.5
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers, NW Casing
COMPILED BY MP
DATUM Geodetic
DATE January 12, 2015
CHECKED BY MCK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.9	GROUND SURFACE										
0.0	TOPSOIL		1A								
0.2	Frozen		1B	SS	36*				○		10 60 28 2
	Silty SAND, trace to some gravel, trace clay Loose to compact Light brown, becoming grey below a depth of 1.5 m Moist to wet		2	SS	5		210		○		
			3	SS	12		209		○		
208.2			4	SS	22				○		1 72 26 1
2.7	Granite Gneiss (BEDROCK) Bedrock cored from depths of 2.7 m to 11.7 m. For bedrock coring details refer to Record of Drillhole B6-03.		1	RC	REC 100%	▽	208				RQD = 100%
			2	RC	REC 98%		207				RQD = 94%
			3	RC	REC 100%		206				RQD = 90%
			4	RC	REC 100%		205				RQD = 100%
			5	RC	REC 100%		204				RQD = 89%
			6	RC	REC 100%		203				RQD = 100%
199.2							202				
11.7	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 4.1 m below ground surface (Elev. 206.8 m) upon completion of drilling. * SPT 'N' value impacted by frost.						201				RQD = 100%
							200				

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B6-03

SHEET 1 OF 1

LOCATION: N 5045449.1 ;E 243878.5

DRILLING DATE: January 12 and 14, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole B6-03		208.16																	
3	NQRC January 12 and 14, 2015	GRANITE GNEISS Fresh to slightly weathered, foliated, grey, white and pink, medium to coarse grained, non-porous, medium strong to strong		2.74	1	100								JN,IR,RO							10.6 MPa Axial
4																					
5					2	100								JN,IR,RO							
6					3	100								JN,IR,RO							
7																					Axial
8					4	100															
9																					UC = 48.9 MPa
10					5	100								JN,IR,RO JN,IR,RO JN,IR,RO							9.1 MPa Axial
11					6	100															Axial
12		END OF DRILLHOLE		199.17 11.73																	

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ID
CHECKED: MCK

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 8/31/15 DD/SAC

Golder Associates

RECORD OF BOREHOLE No B6-04

SHEET 1 OF 1

METRIC

PROJECT 07-1111-0029 | W.P. 5183-06-01 | LOCATION N 5045441.8 ;E 243862.7 | ORIGINATED BY ID

DIST HWY 69 | BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers, NW Casing | COMPILED BY MP

DATUM Geodetic | DATE January 15, 2015 | CHECKED BY MCK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.9	GROUND SURFACE										
0.0 / 210.6	TOPSOIL Frozen		1A, 1B	SS	54*				○		
0.3 / 209.5	Silty SAND, trace gravel, trace clay Very dense Light brown Moist to wet		2	SS	74		210		○		4 68 26 2
1.4	Granite Gneiss (BEDROCK) Bedrock cored from depths of 1.4 m to 12.2 m. For bedrock coring details refer to Record of Drillhole B6-04.		1	RC	REC 100%		209				RQD = 100%
			2	RC	REC 100%		208				RQD = 94%
			3	RC	REC 100%		207				RQD = 95%
			4	RC	REC 100%		206				RQD = 100%
			5	RC	REC 100%		205				RQD = 92%
			6	RC	REC 100%		204				RQD = 97%
			7	RC	REC 100%		203				RQD = 100%
198.7			8	RC	REC 100%		202				RQD = 100%
12.2	END OF BOREHOLE						201				
	NOTES: 1. Open borehole dry upon completion of drilling. * SPT 'N' value impacted by frost.						200				
							199				

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B6-04

SHEET 1 OF 2

LOCATION: N 5045441.8 ;E 243862.7

DRILLING DATE: January 15, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN (FLUSH)	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole B6-04		209.53																
	NQRC January 15, 2015	GRANITE GNEISS Fresh to slightly weathered, foliated, grey, white and pink, fine to coarse grained, non-porous, medium strong to strong		1.37																8.2 MPa Axial
2					1	100														
3					2	100							JN,IR,RO							
4													JN,IR,RO JN,IR,RO							UC = 58.5 MPa
5					3	100							JN,IR,RO JN,IR,RO							
6					4	100							JN,IR,RO							6.3 MPa Axial
7																				
8					5	100							JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO							11.7 MPa Axial
9																				
10					6	100							JN,IR,RO JN,IR,RO							11.2 MPa Axial
11					7	100							JN,IR,RO							
																				Axial

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ID
CHECKED: MCK

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B6-04

SHEET 2 OF 2

LOCATION: N 5045441.8 ;E 243862.7

DRILLING DATE: January 15, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		--- CONTINUED FROM PREVIOUS PAGE ---																		
12	NQRC January 15, 2015	GRANITE GNEISS Fresh to slightly weathered, foliated, grey, white and pink, fine to coarse grained, non-porous, medium strong to strong			7	100														
					8	100														
				198.71																
		END OF DRILLHOLE		12.19																
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				
21																				

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: ID

CHECKED: MCK

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 8/31/15 DD/SAC

Golder Associates

RECORD OF BOREHOLE No B6-05

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045448.2 ;E 243868.9
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
211.1	GROUND SURFACE										
0.0	TOPSOIL		1A				211				
0.2	Silty SAND, trace clay, trace organics, trace rootlets Very dense Dark brown Moist		1B	SS	59						
			2	SS	58		210		○		
209.7											
1.4	END OF BOREHOLE AUGER REFUSAL										

NOTES:

1. Open borehole dry upon completion of drilling.

* SPT 'N' value impacted by frost.

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No B6-06

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045453.5 ;E 243874.0
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.9	GROUND SURFACE										
0.0 / 210.6	Gravelly silty sand (FILL) Compact Dark brown Moist		1A 1B	SS	16				○ at 20		
0.3 / 209.4	Silty SAND, some gravel, trace organics Compact Light brown to dark brown Moist		2	SS	16		210		○ at 10		
1.5	END OF BOREHOLE AUGER REFUSAL NOTE: 1. Open borehole dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No B6-07

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045436.8 ;E 243880.6
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
211.5	GROUND SURFACE										
0.0	Silty sand and gravel, trace asphalt fragments (FILL)		1A	SS	26						
0.3	Brown Moist		1B				211		○		
	Silty SAND Compact Grey to dark grey Moist		2	SS	19				○		
210.0							210				
1.5	END OF BOREHOLE AUGER REFUSAL										
	NOTE: 1. Open borehole dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No B6-08

SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029
W.P. 5183-06-01
LOCATION N 5045455.1 ;E 243861.7
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers
COMPILED BY MP
DATUM Geodetic
DATE January 16, 2015
CHECKED BY MCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
210.5	GROUND SURFACE										
0.0	Gravelly SAND, some silt, trace organics, trace wood fragments and rootlets Loose Dark brown Wet		1	SS	7		210				
209.3			2	SS	6				○		30 50 18 2
1.2	END OF BOREHOLE SPLIT-SPOON AND AUGER REFUSAL NOTE: 1. Open borehole dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

APPENDIX B

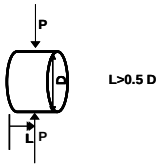
LABORATORY TEST RESULTS

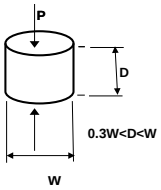
TABLE B1

Summary of Point Load Test Results on Rock Samples

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Core Length (mm)	Core [(2)] Diameter (mm)	**Is (50mm)** (MPa)
B6-03	1	3.5	207.39	Granite Gneiss	Diametral	139.70	47.63	0.17
B6-03	1	3.6	207.29	Granite Gneiss	Axial	50.80	47.63	10.62
B6-03	3	6.7	204.19	Granite Gneiss	Diametral	127.00	47.63	0.41
B6-03	3	6.9	203.97	Granite Gneiss	Axial	50.80	47.63	7.53
B6-03	5	9.3	201.60	Granite Gneiss	Axial	50.80	47.63	9.11
B6-03	6	10.9	200.00	Granite Gneiss	Axial	50.80	47.63	4.55
B6-04	1	1.4	209.48	Granite Gneiss	Diametral	127.00	47.63	7.15
B6-04	1	1.7	209.22	Granite Gneiss	Axial	63.50	47.63	8.15
B6-04	3	5.7	205.17	Granite Gneiss	Diametral	127.00	47.63	4.07
B6-04	3	5.9	204.98	Granite Gneiss	Axial	63.50	47.63	6.34
B6-04	4	7.0	203.89	Granite Gneiss	Diametral	101.60	47.63	3.25
B6-04	5	8.2	202.70	Granite Gneiss	Axial	38.10	47.63	11.69
B6-04	6	9.6	201.35	Granite Gneiss	Diametral	76.2	47.63	5.86
B6-04	6	10.0	200.94	Granite Gneiss	Axial	50.80	47.63	11.21
B6-04	7	11.2	199.70	Granite Gneiss	Diametral	114.30	47.63	2.69
B6-04	7	11.3	199.57	Granite Gneiss	Axial	38.1	47.63	3.30

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: MCK
Checked By: CN
Reviewed By: JMAC

TABLE B2
UNCONFINED COMPRESSION (UC) TEST
ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	02
BOREHOLE NUMBER	B6-03	SAMPLE DEPTH, m	9.03-9.26

TEST CONDITIONS

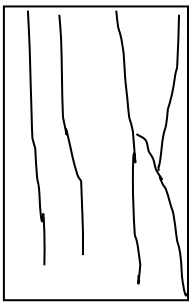
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.20

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.39	WATER CONTENT, (specimen) %	0.29
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	27.92
SAMPLE AREA, cm^2	17.46	DRY UNIT WT., kN/m^3	27.84
SAMPLE VOLUME, cm^3	181.41	SPECIFIC GRAVITY	-
WET WEIGHT, g	516.75	VOID RATIO	-
DRY WEIGHT, g	515.26		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	48.9

REMARKS:

DATE: 2015-03-02

CHECKED BY: MCK

REVIEWED BY: CN / JMAC

TABLE B3
UNCONFINED COMPRESSION (UC) TEST
ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	01
BOREHOLE NUMBER	B6-04	SAMPLE DEPTH, m	4.07-4.33

TEST CONDITIONS

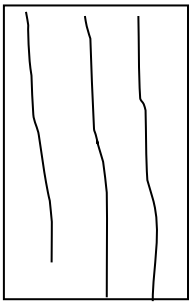
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.20

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.38	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	26.89
SAMPLE AREA, cm^2	17.50	DRY UNIT WT., kN/m^3	26.87
SAMPLE VOLUME, cm^3	181.62	SPECIFIC GRAVITY	-
WET WEIGHT, g	498.25	VOID RATIO	-
DRY WEIGHT, g	497.75		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	58.5

REMARKS:

DATE: 2015-03-11

CHECKED BY: MCK

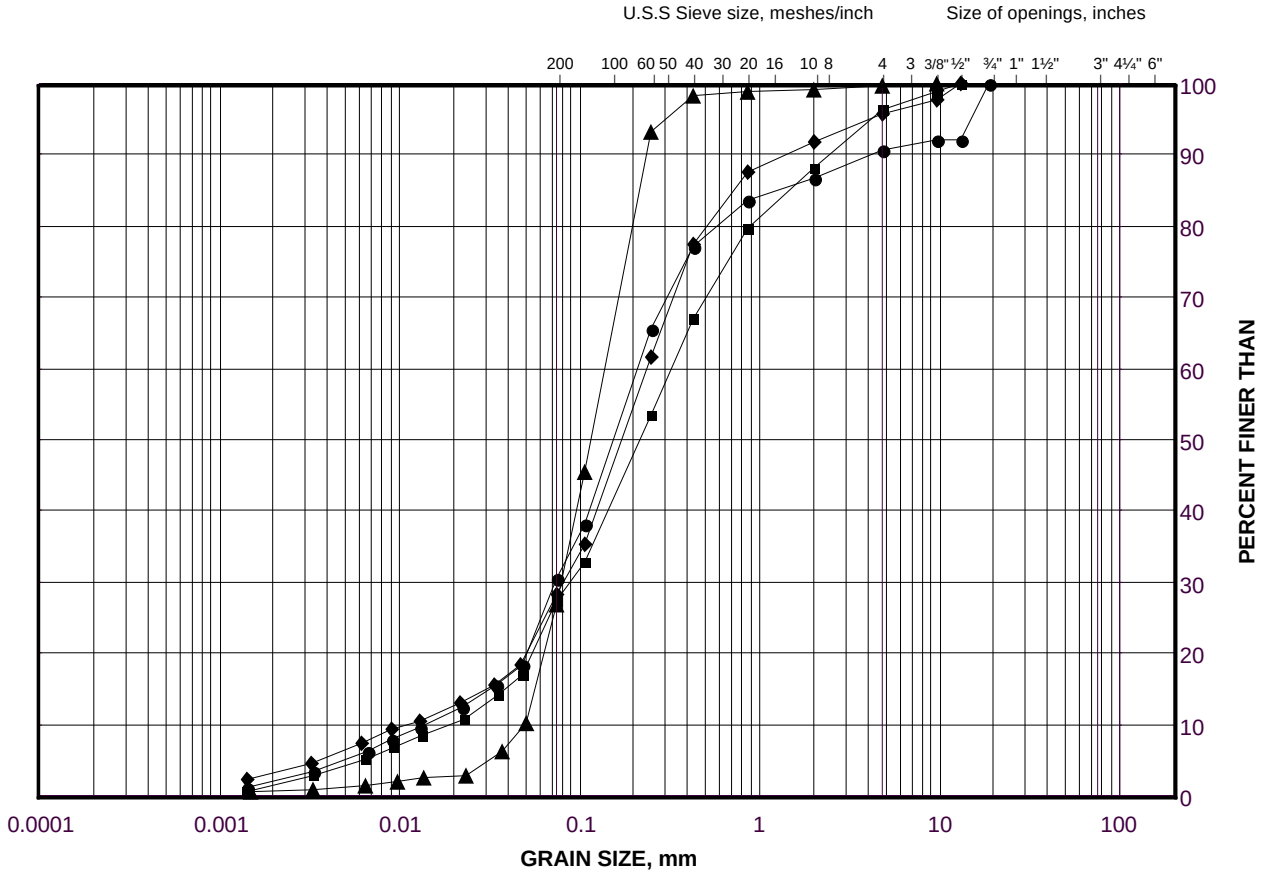
REVIEWED BY: CN / JMAC

GRAIN SIZE DISTRIBUTION

Silty Sand

Shebeshekong Road SBL Overpass Structure

FIGURE B1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	B6-03	1B	210.5
■	B6-04	2	209.9
◆	B6-02	3	209.3
▲	B6-03	4	208.3

Project Number: 07-1111-0029

Checked By: CN

Golder Associates

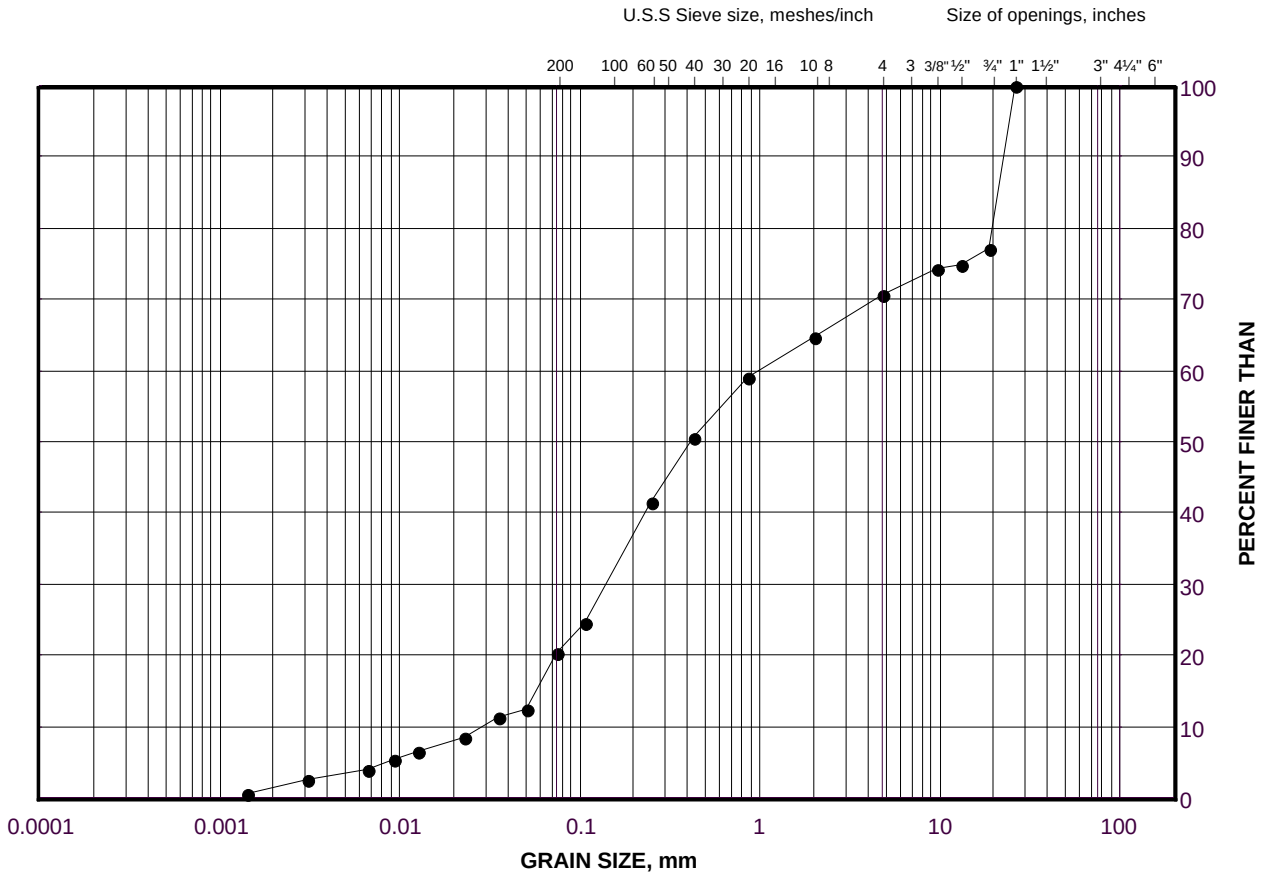
Date: 22-Apr-15

GRAIN SIZE DISTRIBUTION

Gravelly Sand

Shebeshekong Road SBL Overpass Structure

FIGURE B2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	B6-08	2	209.4

Project Number: 07-1111-0029

Checked By: CN

Golder Associates

Date: 22-Apr-15

Borehole B6-03

Box 1: 2.74 m – 7.25 m

Box 2: 7.25 m – 11.73 m

Borehole B6-04

Box 1: 1.37 m – 5.91 m

Box 2: 5.91 m – 10.47 m

Box 3: 10.47 m – 12.19 m

0 m | 0.25 m | 0.5 m | 0.75 m | 1.0 m | 1.25 m | 1.5 m

0 ft | 1 ft | 2 ft | 3 ft | 4 ft | 5 ft

Scale

PROJECT

KEY RIVER (SBL)
Highway 69
GWP 511-07-00; WP 5185-06-01

TITLE

Bedrock Core Photograph – Boreholes B6–03 and B6–04

Golder Associates

PROJECT No. 07-1111-0029			FILE No. ----		
DESIGN	MCK	APR 15	SCALE	NTS	REV.
CADD	-- --				
CHECK	CN	APR 15	**FIGURE B3**		
REVIEW	JMAC	APR 15			

REVISION DATE: April 22, 2015 BY: MCK Project: 07-1111-0029

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

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

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

Golder Associates