



November 4, 2015

FOUNDATION INVESTIGATION REPORT

**SHEBESHEKONG ROAD NBL OVERPASS STRUCTURE, SITE NO. 44-452/C1
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. 5184-06-01 (Phase 2 of G.W.P. 5402-05-00)**

Submitted to:

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GEOCRES No: 41H-154

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REPORT



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FOUNDATION REPORT – SHEBESHEKONG ROAD NBL OVERPASS STRUCTURE – HIGHWAY 69 G.W.P. 5111-07-00

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PART A

FOUNDATION INVESTIGATION REPORT

SHEBESHEKONG ROAD NBL OVERPASS STRUCTURE

SITE NO. 44-452/C1

**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. 5184-06-01 (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 provide foundation engineering services for the proposed single-span Highway 69-Shebeshekong Road Northbound Lane (NBL) 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 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 NBL 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 NBL Overpass Structure was provided to Golder by MRC on November 10, 2014.

This report addresses the investigation carried out for the Shebeshekong Road NBL 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, test pitting 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 NBL 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 NBL 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 and test pit locations advanced for the foundations investigation, varies between Elevations 207.7 m and 203.7 m, referenced to Geodetic datum.



3.0 INVESTIGATION PROCEDURES

The fieldwork for the Shebeshekong Road NBL Overpass Structure subsurface investigation was carried out between January 15 and 21, 2015 during which time a total of four (4) boreholes and four (4) test pits were advanced: two (2) test pits (Test Pits B7-01 and B7-02) and one (1) borehole (Borehole B7-03) were advanced on the south side of the structure; two (2) test pits (Test Pits B7-05 and B7-06) and one (1) borehole (Borehole B7-04) were advanced on the north side of the structure; and one (1) borehole was advanced at each of the south and north approach embankments (Boreholes B7-07 and B7-08, respectively). The Record of Borehole/Drillhole sheets, Field Test Pit Logs 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 and 135D John Deere excavator 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, or split-spoon sampler refusal (i.e. inferred bedrock) and bedrock was confirmed by coring. Test pits located at the foundation elements were advanced to bedrock. The boreholes and test pits were advanced to depths ranging from 0.3 m to 6.8 m below existing ground surface, including coring of bedrock for core lengths of about 5.5 m and 5.0 m in Boreholes B7-03 and B7-04, respectively. The groundwater conditions and water levels in the open boreholes were observed during the drilling and test pitting 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/test pits, arranged for the clearance of underground services, observed the drilling/test pitting, sampling and in situ testing operations, logged the boreholes and test pits, 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 for Test Pits/Boreholes B7-01 to B7-06 were surveyed by Callon Dietz and Boreholes B7-07 and B7-08 were surveyed by a member of our technical staff, referenced to the test pit/borehole locations surveyed by Callon Dietz. The test pit and borehole locations given in the Record of Borehole/Drillhole sheets and Field Test Pit Logs 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 / Test Pit | Location (MTM NAD83) | | Ground Surface Elevation (m) | Depth of Borehole (m) |
|------------------------|----------------------|----------|---------------------------------|--------------------------|
| | Northing | Easting | | |
| B7-01 | 5045465.0 | 243894.0 | 207.0 | 1.8 |
| B7-02 | 5045470.7 | 243899.5 | 205.8 | 1.9 |
| B7-03 | 5045476.8 | 243905.5 | 205.5 | 6.1 |
| B7-04 | 5045469.4 | 243889.4 | 206.4 | 6.8 |
| B7-05 | 5045475.1 | 243894.9 | 205.2 | 1.7 |
| B7-06 | 5045481.2 | 243900.7 | 204.1 | 0.3 |
| B7-07 | 5045465.8 | 243904.6 | 207.7 | 1.2 |
| B7-08 | 5045480.1 | 243889.7 | 203.7 | 0.7 |

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

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

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 4². 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 test pits and 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 Field Test Pit Logs and 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

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.



exact planes of geological change. Further, subsurface conditions will vary between and beyond the test pit and 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 NBL Overpass site consist of a surficial layer of topsoil or fill underlain by a silt to sand non-cohesive deposit, a sand and gravel layer and bedrock. A detailed description of the subsurface conditions encountered in the boreholes and test pits advanced at the footing locations and approach areas is provided in the following sections.

4.3 South Footing and Approach Embankment

A total of two test pits (Test Pits B7-01 and B7-02) and one borehole (Borehole B7-03) were advanced at the location of the south footing and one borehole (Borehole B7-07) was advanced on the centerline at the south approach. In general, the subsurface conditions consist of topsoil, underlain by a deposit of silt to sand, sand and gravel at one location, and bedrock.

4.3.1 Topsoil

A layer of topsoil 0.2 m to 0.6 m thick was encountered at ground surface in Boreholes B7-01 to B7-03.

A SPT 'N'-value measured within the topsoil is 5 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on two (2) samples of the topsoil is about 81 per cent and 109 per cent.

4.3.2 Silt to Sand

A deposit of silt to silty sand to sand was encountered below the topsoil in Test Pits B7-01 and B7-02 and at ground surface in Borehole B7-07. The top of this deposit was encountered at Elevations between 207.7 m and 205.5 m and its thickness ranges from 0.9 m to 1.6 m.

An SPT 'N'-value measured within this deposit is 7 blows per 0.3 m of penetration, indicating a loose relative density; however, an SPT 'N'-value of 65 blows per 0.3 m of penetration was measured at the interface with inferred bedrock in Borehole B7-07.

The natural water content measured on six (6) samples of this deposit range between about 8 per cent and 43 per cent, with typical values ranging between about 20 per cent and 27 per cent.

The result of one (1) grain size distribution test completed on a sample of silty sand and one (1) grain size distribution test completed on a sample of silt are shown in Figures B1 and B2 in Appendix B, respectively.

4.3.3 Sand and Gravel with Cobbles and Boulders

A 0.7 m thick deposit of sand and gravel with cobbles and boulders was encountered below the silt to sand deposit in Test Pit B7-02 at Elevation 204.6 m. The cobbles and boulders encountered within this deposit were observed to be up to about 0.4 m in size.



4.3.4 Bedrock/Refusal

Bedrock was encountered and core samples were recovered below the topsoil deposit in Borehole B7-03. Photographs of the recovered rock samples are shown on Figure B3 in Appendix B. The presence of bedrock was inferred by split-spoon sampler refusal in Borehole B7-07 and by exposing bedrock in Test Pits B7-01 and B7-02.

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 | B7-07 | 1.2 | 206.5 | Split-Spoon |
| South Footing | B7-01 | 1.8 | 205.2 | Test Pitting |
| | B7-02 | 1.9 | 203.9 | Test Pitting |
| | B7-03 | 0.6 | 204.9 | 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, fine to coarse grained, foliated, non-porous and grey, white and pink. The Rock Quality Designation (RQD) measured on the core samples are between 65 per cent and 100 per cent, indicating a rock mass of fair to 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 100 per cent and between 67 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 four (4) core samples of granite gneiss bedrock measured Is_{50} values ranging from about 6.0 MPa to 11.8 MPa. The diametral tests carried out on three (3) core samples of granite gneiss bedrock measured Is_{50} values of about 0.3 MPa and 2.7 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 B7-03 and measured a compressive strength of about 56 MPa, as detailed in Table B2 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) to extremely strong (R6, Point Load Index >10 MPa).

4.3.5 Groundwater Conditions

In general, the test pits and boreholes were dry upon completion of drilling and the overburden samples recovered in the boreholes were moist. The water level in Borehole B7-07 upon completion of drilling operations was measured at the base of the borehole (i.e. at refusal/inferred bedrock) at a depth of 1.2 m below ground surface, corresponding to Elevation 206.5 m. The groundwater level in the area is subject to seasonal fluctuations, snow melt and variation due to precipitation events.

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



4.4 North Footing and Approach Embankment

A total of two test pits (Test Pits B7-05 and B7-06) and one borehole (Borehole B7-04) were advanced at the location of the north footing and one borehole (Borehole B7-08) was advanced on the centerline at the north approach. In general, the subsurface conditions consist of topsoil, underlain by a deposit of silt to silty sand underlain by bedrock.

4.4.1 Topsoil

A 0.2 m to 0.3 m thick layer of topsoil was encountered at the ground surface in Test Pits B7-05, B7-06 and in Borehole B7-04.

The natural water content measured on one (1) sample of the topsoil is about 36 per cent.

4.4.2 Silt to Silty Sand

A deposit of silt to sandy silt to silt and sand to silty sand was encountered below the topsoil layer in Test Pits B7-05 and B7-06 and Borehole B7-04 and at the ground surface in Borehole B7-08. The top of this deposit was encountered between Elevations 206.1 m and 203.7 m and the thickness of the deposit ranges from 0.1 m to 1.5 m.

The SPT 'N'-values measured within the silt to silty sand deposit are 4 blows and 5 blows per 0.3 m of penetration, indicating a loose relative density; however an SPT 'N'-value of 41 blows per 0.3 m of penetration was measured at the interface with bedrock in Borehole B7-04.

The natural water content measured on seven (7) samples of this deposit range between about 19 per cent and 52 per cent, with typical values ranging between 19 per cent and 34 per cent.

The result of two (2) grain size distribution test completed on samples of the silt and sandy silt portions of the deposit are shown in Figure B2 in Appendix B.

4.4.3 Bedrock/Refusal

Bedrock was encountered and core samples were recovered below the sandy silt in Borehole B7-04. Photographs of the recovered rock samples are shown on Figure B3 in Appendix B. The presence of bedrock was inferred by refusal to auger advancement in Borehole B7-08 and by bedrock exposure by excavation in Test Pits B7-05 and B7-06.

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 | B7-08 | 0.7 | 203.0 | Auger |
| North Footing | B7-04 | 1.8 | 204.6 | Bedrock Cored Test Pitting Test Pitting |
| | B7-05 | 1.7 | 203.5 | |
| | B7-06 | 0.3 | 203.8 | |



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 is 100 per cent, indicating a rock mass of 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 94 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 four (4) core samples of granite gneiss bedrock measured Is_{50} values ranging from about 3.7 MPa to 9.7 MPa. The diametral tests carried out on three (3) core samples of granite gneiss bedrock measured Is_{50} values between about 2.2 MPa and 3.7 MPa.

According to Table 3.5 in CFEM (2006), the granite gneiss bedrock is classified as strong (R4, 2 MPa < Point Load Index < 4 MPa) to very strong (R5, 4 MPa < Point Load Index < 10 MPa).

4.4.4 Groundwater Conditions

In general, test pits and boreholes were dry upon completion of drilling and the overburden samples recovered in the boreholes were moist. The perched water level in Borehole B7-04 upon completion of drilling operations was measured below the bedrock surface at a depth of 3.7 m below ground surface, corresponding to Elevation 202.7 m. The groundwater level in the area is subject to seasonal fluctuations, snow melt and variation due to precipitation events and in Borehole B7-04 is due to the water introduced during coring.

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.



FOUNDATION REPORT – SHEBESHEKONG ROAD SBL OVERPASS STRUCTURE – HIGHWAY 69 G.W.P. 5111-07-00

Report Signature Page

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Geotechnical Engineering Group



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Geotechnical Engineer, Associate



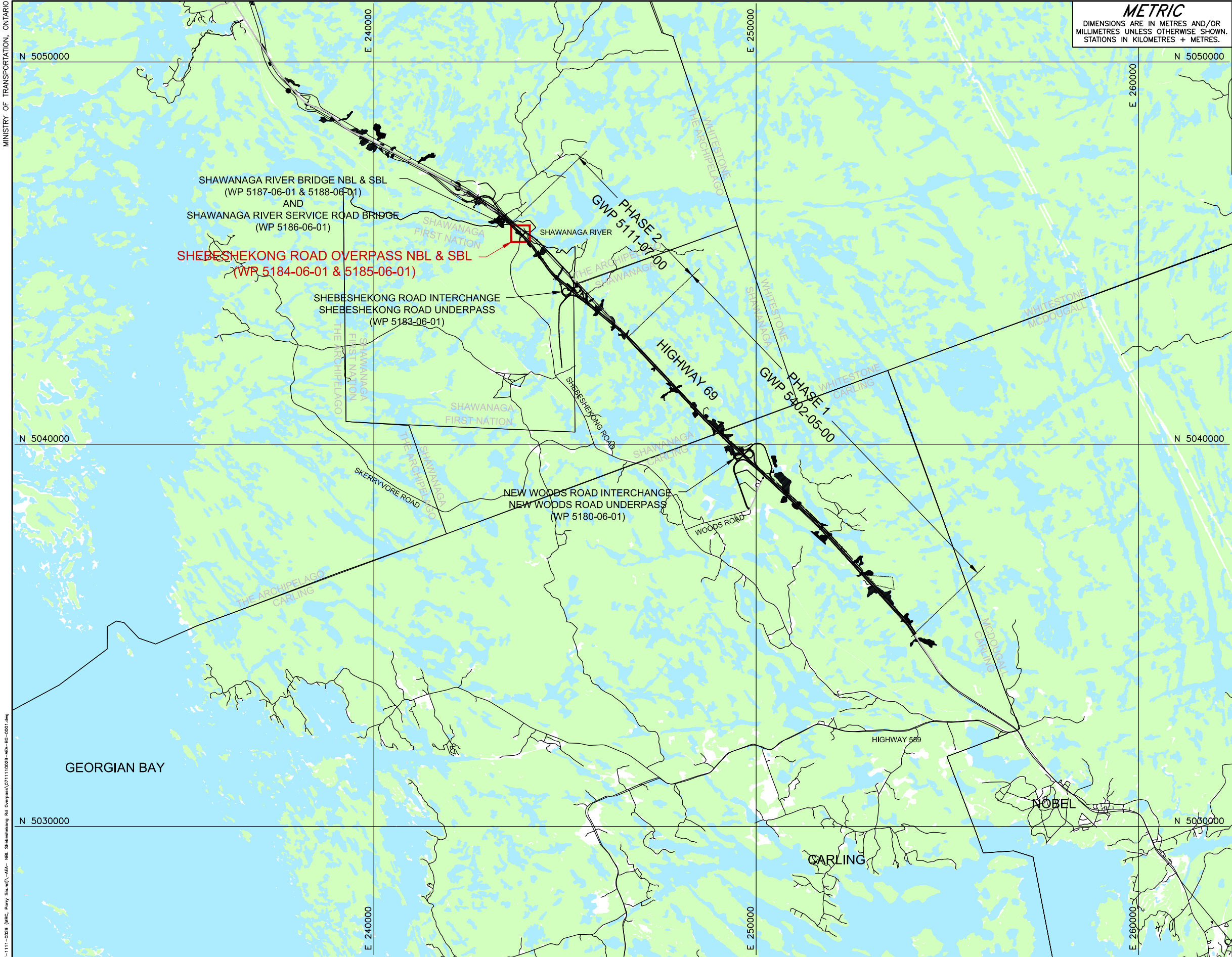
Jorge M. A. Costa, P. Eng.,
Designated MTO Contact, Principal

MCK/CN/JMAC/cn

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15nov04 highway 69 shebeshekong rd sbl overpass.docx



DRAWINGS



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

CONT No.
 WP No. 5184-06-01

HIGHWAY 69
 SITE LOCATION PLAN

SHEET
 .



KEY PLAN
NOT TO SCALE

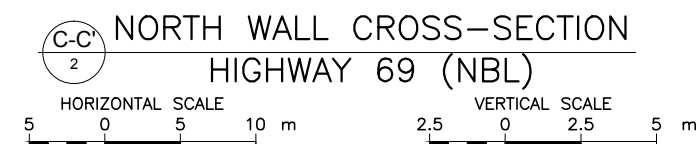
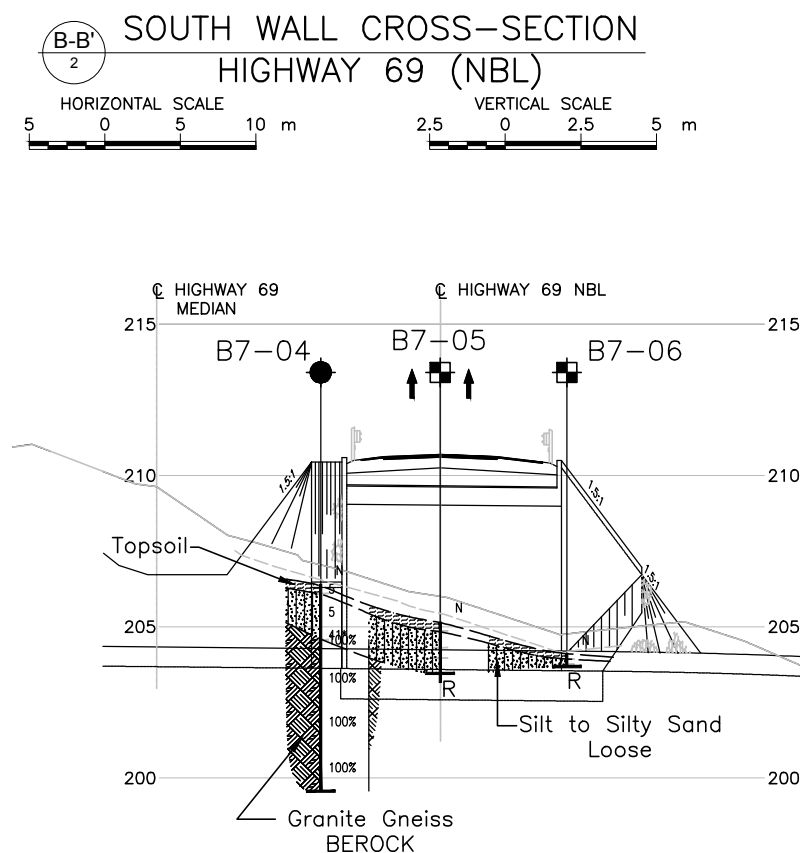
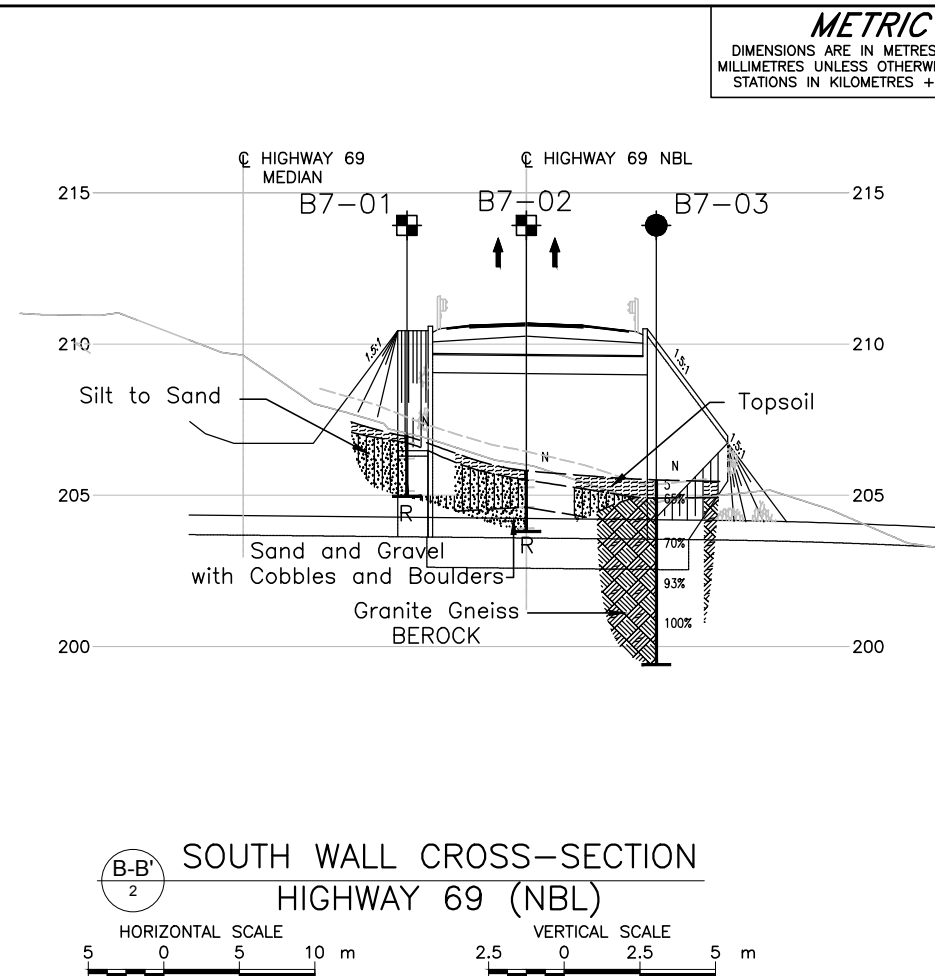
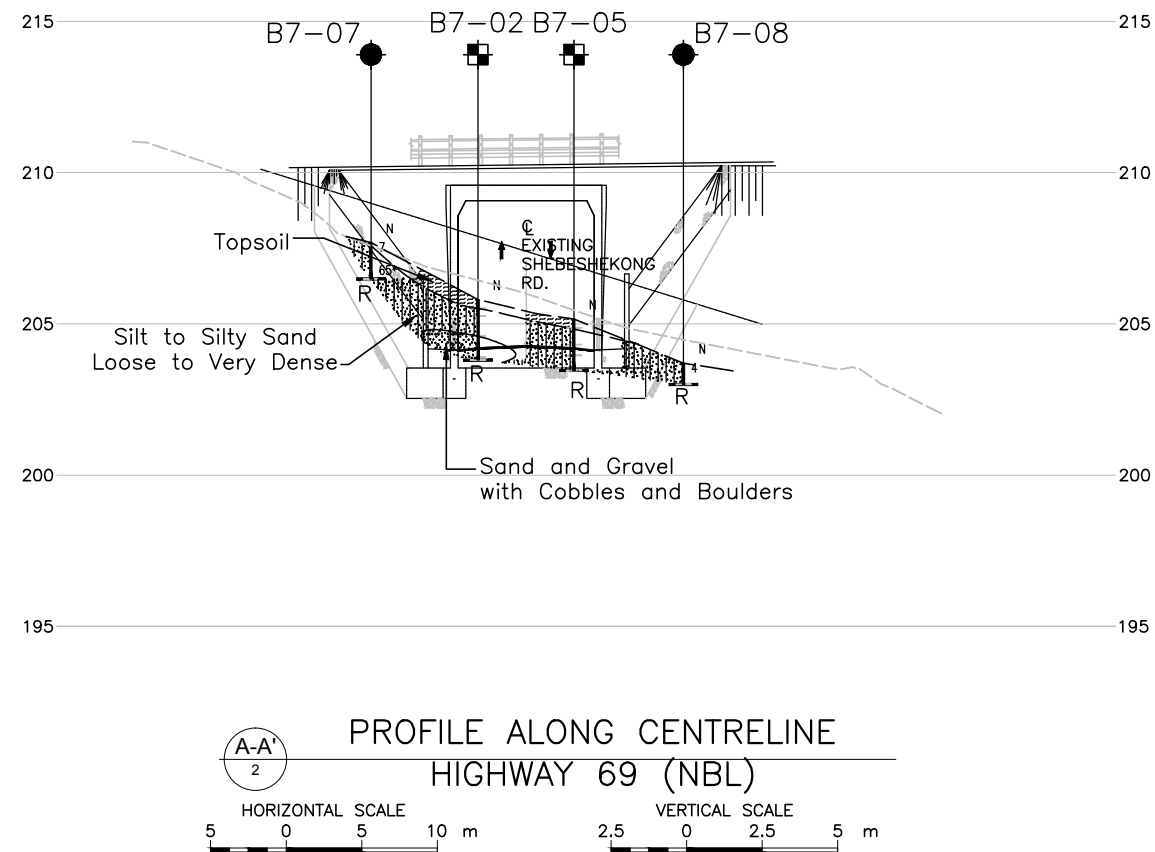
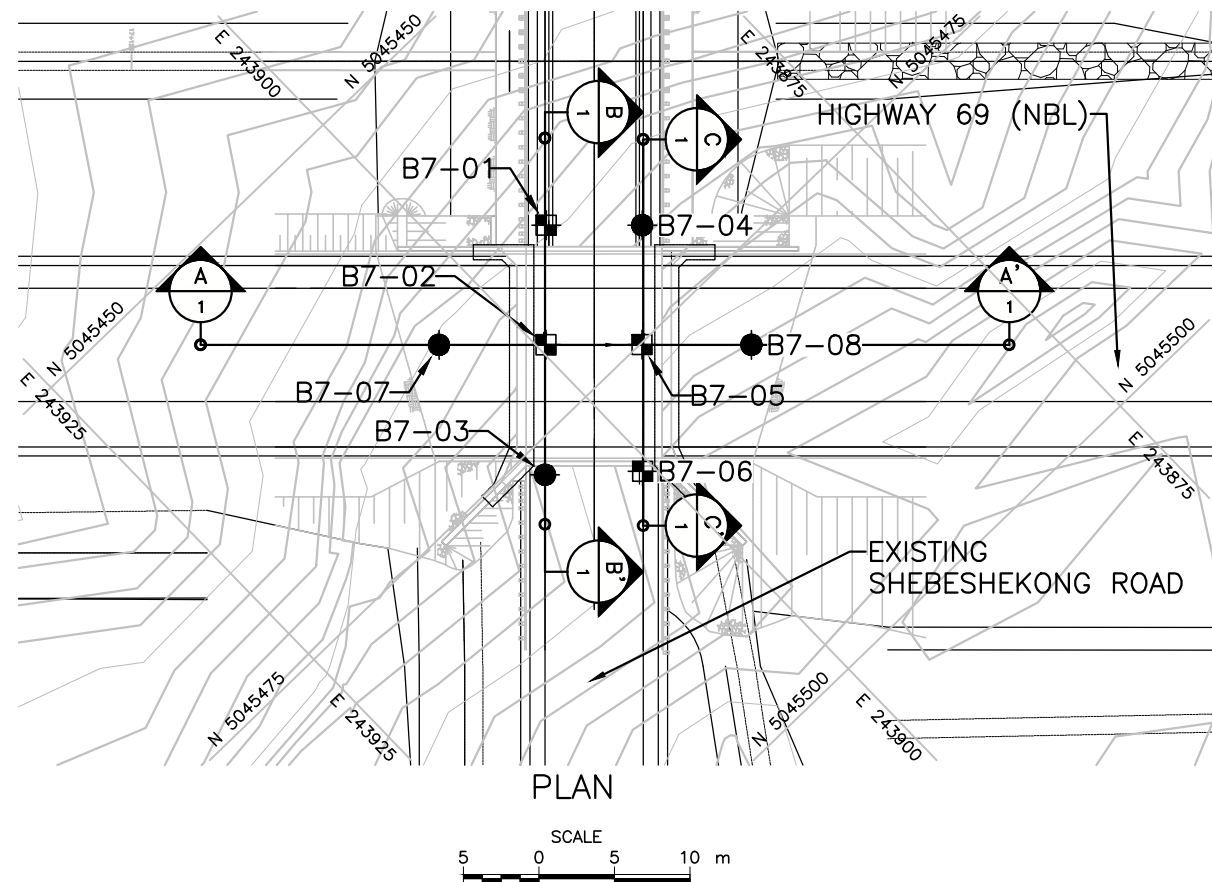


REFERENCE

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-154 | | | |
| HWY. 69 | | PROJECT NO. 07-1111-0029 | DIST. . |
| SUBM'D. MCK | CHKD. CN | DATE: Nov. 2015 | SITE:44-452/C1 |
| DRAWN: JFC | CHKD. . | APPD. JMAC | DWG. 1 |



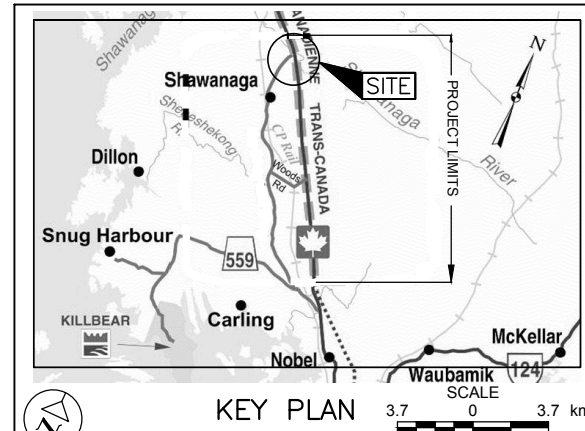
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.




CONT No.
WP No.5184-06-01



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

SHEET



- | | |
|---|--|
|  | Borehole – Current Investigation |
|  | Test Pit |
| 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 |
| B7-01 | 207.0 | 5045465.0 | 243894.0 |
| B7-02 | 205.8 | 5045470.7 | 243899.5 |
| B7-03 | 205.5 | 5045476.8 | 243905.5 |
| B7-04 | 206.4 | 5045469.4 | 243889.4 |
| B7-05 | 205.2 | 5045475.1 | 243894.9 |
| B7-06 | 204.1 | 5045481.2 | 243900.7 |
| B7-07 | 207.7 | 5045465.8 | 243904.6 |
| B7-08 | 203.7 | 5045480.1 | 243889.7 |

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

| | | | | | | | |
|---------------------|--|----------|--------------------------|-----------------|--|----------------|--|
| NO. | | DATE | | BY | | REVISION | |
| Geocres No. 41H-154 | | | | | | | |
| HWY. 69 | | | PROJECT NO. 07-1111-0029 | | | DIST. . | |
| SUBM'D. MCK | | CHKD. CN | | DATE: Nov. 2015 | | SITE:44-452/C1 | |
| DRAWN: MR/JFC | | CHKD. . | | APPD. JMAC | | DWG. 2 | |





APPENDIX A

FIELD TEST PIT LOGS AND 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 |
| ν | Poisson's ratio |
| σ | total stress |
| σ' | effective stress ($\sigma' = \sigma - u$) |
| σ'_{vo} | initial effective overburden stress |
| $\sigma_1, \sigma_2, \sigma_3$ | principal stress (major, intermediate, minor) |
| σ_{oct} | mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$ |
| τ | shear stress |
| u | porewater pressure |
| E | modulus of deformation |
| G | shear modulus of deformation |
| K | bulk modulus of compressibility |

III. SOIL PROPERTIES

(a) Index Properties

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

* 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 = $\tan \delta$ |
| 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 |

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 |

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.)

(b) Cohesive Soils Consistency

| | kPa | Cu, Su | 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 |

Dynamic Cone Penetration Resistance; N_d:

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

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



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

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

FIELD TEST PIT LOG: B7-01

SHEET: 1/1

PROJECT: 07-1111-0029

DATE: January 15, 2015

LOCATION: N 5045465.0 E 243894.0

CONTRACTOR: Landcore Drilling

ELEVATION: 207.0 m

MACHINE TYPE: 135D John Deere

TEMPERATURE -8 °C

WEATHER: Cloudy with flurries

| DEPTH (m) | | SOIL DESCRIPTION | SAMPLE | | Laboratory Results | | Remarks |
|--------------|-----|--|--------|--------------|-------------------------|---|---------|
| | | | No. | Depth (m) | Water Content (%) | Grain Size Distribution Gr Sa Si Cl | |
| From | To | | | | | | |
| 0.0 | 0.2 | TOPSOIL | 1 | 0.2 | | | |
| 0.2 | 0.8 | Silty SAND, trace organics Brown Moist | 2 | 0.6 | 8.1 | | |
| 0.8 | 1.8 | SAND, some silt Light brown Moist to wet | 3 | 1.5 | 20.3 | | |
| 1.8 | | BEDROCK | | | | | |
| | | END OF TEST PIT | | | | | |

Notes :

- 1) Side of test pit stable
- 2) Bedrock sloping to the East at about 45 degrees

ORIGINATED BY: ID
COMPILED BY: MP
CHECKED BY: MCK

WATER CONDITIONS IN TEST PIT

☒ Test Pit Dry



FIELD TEST PIT LOG: B7-02

SHEET: 1/1

PROJECT: 07-1111-0029

DATE: January 15, 2015

LOCATION: N 5045470.7 E 243899.5

CONTRACTOR: Landcore Drilling

ELEVATION: 205.8 m

MACHINE TYPE: 135D John Deere

TEMPERATURE -8 °C

WEATHER: Cloudy with flurries

| DEPTH (m) | | SOIL DESCRIPTION | SAMPLE | | Laboratory Results | | Remarks |
|--------------|-----|--|--------|--------------|-------------------------|---|---------|
| | | | No. | Depth (m) | Water Content (%) | Grain Size Distribution Gr Sa Si Cl | |
| 0.0 | 0.3 | TOPSOIL | 1 | 0.2 | 81.4 | | |
| 0.3 | 0.6 | Silty SAND, trace gravel, trace organics, with pieces of wood and rootlets Brown Moist | 2 | 0.5 | 42.7 | | |
| 0.6 | 1.2 | SILT, some sand Light brown Moist | 3 | 0.9 | 26.6 | 0 18 78 4 | |
| 1.2 | 1.9 | SAND and GRAVEL, some silt, with cobbles and boulder (0.4 m diameter) Light brown Moist | 4 | 1.5 | | | |
| 1.9 | | BEDROCK | | | | | |

END OF TEST PIT

Notes :

- 1) Side of test pit stable
- 2) Bedrock sloping to the East

ORIGINATED BY: ID
COMPILED BY: MP
CHECKED BY: MCK

WATER CONDITIONS IN TEST PIT

☒ Test Pit Dry



| PROJECT | | 07-1111-0029 | | RECORD OF BOREHOLE No B7-03 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | | |
|---------------|--|--------------|---------|-----------------------------|------------|--|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| W.P. | | 5183-06-01 | | LOCATION | | N 5045476.8 ; E 243905.5 | | 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 21, 2015 | | CHECKED BY MCK | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) |
| 205.5 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 0.0 | TOPSOIL Loose | | 1 | SS | 5 | | | | | | | | | | | | | |
| 204.9 | Granite Gneiss (BEDROCK) | | | | | | | | | | | | | | | | | |
| 0.6 | Bedrock cored from depths of 0.6 m to 6.1 m. For bedrock coring details refer to Record of Drillhole B7-03. | | 1 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 2 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 3 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 4 | RC | REC 100% | | | | | | | | | | | | | |
| 199.4 | END OF BOREHOLE | | | | | | | | | | | | | | | | | |
| 6.1 | NOTE: 1. Water level not recorded upon completion of drilling. | | | | | | | | | | | | | | | | | |

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B7-03

SHEET 1 OF 1

LOCATION: N 5045476.8 ; E 243905.5

DRILLING DATE: January 21, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | DEPTH (m) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | RECOVERY | | R.Q.D. % | FRACT. INDEX PER 0.25 m | DISCONTINUITY DATA | | | | HYDRAULIC CONDUCTIVITY K, cm/sec | | | | Diametral 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 10 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Continued from Record of Borehole B7-03 | | 204.89 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PROJECT | | 07-1111-0029 | | RECORD OF BOREHOLE No B7-04 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | | |
|---------------|--|--------------|---------|-----------------------------|------------|--|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| W.P. | | 5183-06-01 | | LOCATION | | N 5045469.4 ; E 243889.4 | | ORIGINATED BY | | | | | | | | | | |
| DIST | | HWY 69 | | BOREHOLE TYPE | | CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers | | COMPILED BY | | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | January 19, 2015 | | CHECKED BY | | | | | | | | | | |
| | | | | | | | | MCK | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) |
| 206.4 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 0.0 | TOPSOIL | | 1A | SS | 5 | | | | | | | | | | | | | |
| 0.3 | Sandy SILT, trace gravel, trace clay, trace organics Loose Brown Moist | | 1B | SS | 5 | | | | | | | | | | | | | |
| | | | 2 | SS | 5 | | | | | | | | | | | | | |
| 204.6 | Granite Gneiss (BEDROCK) | | 3 | SS | 41/0.15 | | | | | | | | | | | | | |
| 1.8 | Bedrock cored from depths of 1.8 m to 6.8 m. For bedrock coring details refer to Record of Drillhole B7-04. | | 1 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 2 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 3 | RC | REC 100% | | | | | | | | | | | | | |
| | | | 4 | RC | REC 100% | | | | | | | | | | | | | |
| 199.6 | END OF BOREHOLE | | | | | | | | | | | | | | | | | |
| 6.8 | NOTE: 1. Water level in open borehole at a depth of 3.7 m below ground surface (Elev. 202.7 m) upon completion of drilling. | | | | | | | | | | | | | | | | | |

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: **B7-04**

SHEET 1 OF 1

LOCATION: N 5045469.4 ; E 243889.4

DRILLING DATE: January 19, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH | RECOVERY TOTAL CORE % | SOLID CORE % | R.Q.D. % | FRACT. INDEX PER 0.25 m | B Angle | 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 B7-04 | | 204.57 1.83 | | | | | | | | | | | | | | | | |
| 2 | NQRC January 19, 2015 | GRANITE GNEISS Fresh to slightly weathered, foliated, dark grey, white and pink, fine to coarse grained, non-porous, medium strong to strong | | | 1 | 100 | | | | | | | JN,IR,RO | | | | | | | |
| 3 | | | | | | | | | | | | | JN,IR,RO | | | | | | | |
| 4 | | | | | 2 | 100 | | | | | | | JN,IR,RO JN,IR,RO JN,IR,RO | | | | | | | Axial Axial |
| 5 | | | | | 3 | 100 | | | | | | | JN,IR,RO | | | | | | | |
| 6 | | | | | 4 | 100 | | | | | | | | | | | | | | 9.7 MPa Axial |
| 7 | | END OF DRILLHOLE | | 199.57 6.83 | | | | | | | | | | | | | | | | Axial |
| 8 | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: MCK

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-SHEBESHEKONG RD-PHASE II\GPJ_GAL-MISS.GDT 8/31/15 DD/SAC

FIELD TEST PIT LOG: B7-05

SHEET: 1/1

PROJECT: 07-1111-0029

DATE: January 15, 2015

LOCATION: N 5045475.1 E 243894.9

CONTRACTOR: Landcore Drilling

ELEVATION: 205.2 m

MACHINE TYPE: 135D John Deere

TEMPERATURE -8 ° C

WEATHER: Cloudy with flurries

| DEPTH (m) | | SOIL DESCRIPTION | SAMPLE | | Laboratory Results | | Remarks |
|--------------|-----|---|--------|--------------|-------------------------|---|---------|
| | | | No. | Depth (m) | Water Content (%) | Grain Size Distribution Gr Sa Si Cl | |
| From | To | | | | | | |
| 0.0 | 0.3 | TOPSOIL | 1 | 0.2 | 36.3 | | |
| 0.3 | 0.9 | Silty SAND to SILT and SAND, trace gravel, trace organics Brown Moist | 2 | 0.6 | 34 | | |
| 0.9 | 1.2 | Sandy SILT, trace of clay, trace to some gravel Light brown Moist | 3 | 1.1 | | | |
| 1.2 | 1.7 | SILT, some sand, trace clay, trace organics Light brown Moist | 4 | 1.5 | 19.2 | 0 17 78 5 | |
| 1.7 | | BEDROCK | | | | | |

END OF TEST PIT

Notes :

- 1) Side of test pit stable
- 2) Bedrock gently sloping down to the Northeast

ORIGINATED BY: ID
COMPILED BY: MP
CHECKED BY: MCK

WATER CONDITIONS IN TEST PIT

☒ Test Pit Dry



FIELD TEST PIT LOG: B7-06

SHEET: 1/1

PROJECT: 07-1111-0029

DATE: January 15, 2015

LOCATION: N 5045481.2 E 243900.7

CONTRACTOR: Landcore Drilling

ELEVATION: 204.1 m

MACHINE TYPE: 135D John Deere

TEMPERATURE -8 °C

WEATHER: Cloudy with flurries

| DEPTH (m) | | SOIL DESCRIPTION | SAMPLE | | Laboratory Results | | | | Remarks |
|--------------|-----|--|--------|--------------|-------------------------|----------------------------|----|----|---------|
| | | | No. | Depth (m) | Water Content (%) | Grain Size Distribution | | | |
| From | To | | | | | | Gr | Sa | |
| 0.0 | 0.2 | TOPSOIL | 1 | 0.15 | | | | | |
| 0.2 | 0.3 | Silty SAND to Sandy SILT, trace organics Reddish brown Moist | 2 | 0.27 | 33.6 | | | | |
| 0.3 | | BEDROCK | | | | | | | |
| | | END OF TEST PIT | | | | | | | |

Notes :

- 1) Side of test pit stable
- 2) Bedrock gently slopping down to the Northeast

ORIGINATED BY: ID
COMPILED BY: MP
CHECKED BY: MCK


WATER CONDITIONS IN TEST PIT

☒ Test Pit Dry



| PROJECT | | RECORD OF BOREHOLE | | No B7-07 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|-----------------|--|--------------------|---------|--------------------------|------------|--|-----------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---|--|
| W.P. 5183-06-01 | | LOCATION | | N 5045465.8 ; E 243904.6 | | ORIGINATED BY | | ID | | | | | | | | | |
| DIST | | HWY 69 | | BOREHOLE TYPE | | CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers | | COMPILED BY | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | January 20, 2015 | | CHECKED BY | | | | | | | | | |
| | | | | | | | | MCK | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 207.7 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | Silty SAND, trace clay, trace organics Loose to very dense Light brown Moist | | 1A | SS | 7 | | | | | | | | | | | | |
| | | | 1B | | | | | | | | | | | | | | |
| 206.5 | | | 2 | SS | 65 | | | | | | | | | | | | 0 78 21 1 |
| 1.2 | END OF BOREHOLE SPLIT-SPOON REFUSAL NOTE: 1. Water level in open borehole at a depth of 1.2 m below ground surface (Elev. 206.5 m) upon completion of drilling. | | | | | | | | | | | | | | | | |

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-GTA.GDT 8/31/15 DD/SAC

| PROJECT | | 07-1111-0029 | | RECORD OF BOREHOLE No B7-08 | | SHEET 1 OF 1 | | METRIC | | | | | | | | |
|---------------|---|---|--------|-----------------------------|-------------------------|--|--|--------------------|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| W.P. | | 5183-06-01 | | LOCATION | | N 5045480.1 ; E 243889.7 | | ORIGINATED BY | | | | | | | | |
| DIST | | HWY 69 | | BOREHOLE TYPE | | CME 550, 108 mm I.D. Continuous Flight, Hollow Stem Augers | | COMPILED BY | | | | | | | | |
| DATUM | | Geodetic | | DATE | | January 21, 2015 | | CHECKED BY | | | | | | | | |
| | | | | | | | | MCK | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | |
| 203.7 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 0.0 | SILT and SAND, trace organics Very loose Brown Moist |  | 1 | SS | 4 | | | | | | | | | | 51.5 | |
| 203.0 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | |
| 0.7 | NOTES: 1. Open borehole dry upon completion of drilling. 2. Additional boreholes advanced 1 m southeast and 1 m northwest of Borehole B7-08 location encountered auger refusal at a depth of about 0.6 m. | | | | | | | | | | | | | | | |

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-GTA.GDT 8/31/15 DD/SAC



APPENDIX B

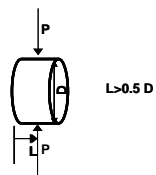
LABORATORY TEST RESULTS

Summary of Point Load Test Results on Rock Samples

[illegible]

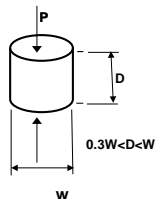
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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



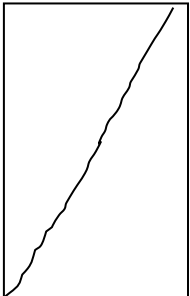
AXIAL SPECIMEN SHAPE REQUIREMENTS

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



Compiled By: MCK
Checked By: CN
Reviewed By: JMAC

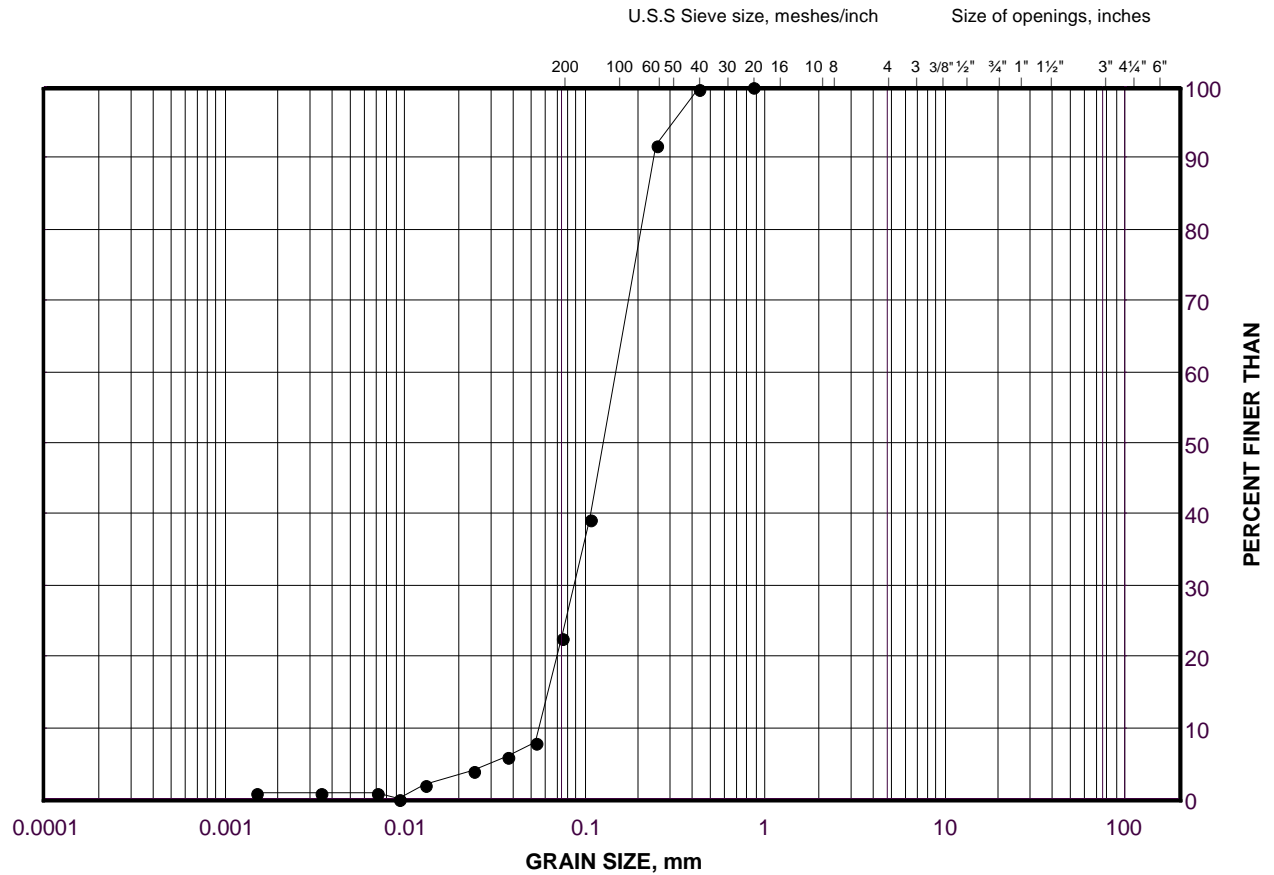
TABLE B2
UNCONFINED COMPRESSION (UC) TEST
ASTM D7012

| SAMPLE IDENTIFICATION | | | |
|--------------------------------|--------------|--|-----------|
| PROJECT NUMBER | 07-1111-0029 | SAMPLE NUMBER | 03 |
| BOREHOLE NUMBER | B7-03 | SAMPLE DEPTH, m | 3.43-3.66 |
| 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 | 10.37 | WATER CONTENT, (specimen) % | 0.17 |
| SAMPLE DIAMETER, cm | 4.73 | UNIT WEIGHT, kN/m ³ | 26.83 |
| SAMPLE AREA, cm ² | 17.53 | DRY UNIT WT., kN/m ³ | 26.78 |
| SAMPLE VOLUME, cm ³ | 181.83 | SPECIFIC GRAVITY | - |
| WET WEIGHT, g | 497.60 | VOID RATIO | - |
| DRY WEIGHT, g | 496.76 | | |
| VISUAL INSPECTION | | FAILURE SKETCH | |
| | |  | |
| TEST RESULTS | | | |
| STRAIN AT FAILURE, % | 0.0 | COMPRESSIVE STRENGTH, MPa | 55.8 |
| REMARKS: | | DATE: 2015-03-02 | |
| CHECKED BY: MCK | | REVIEWED BY: CN / JMAC | |

GRAIN SIZE DISTRIBUTION

Silty Sand
Shebeshekong Road NBL Overpass Structure

FIGURE B1



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

LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| • | B7-07 | 2 | 206.7 |

Project Number: 07-1111-0029

Checked By: CN

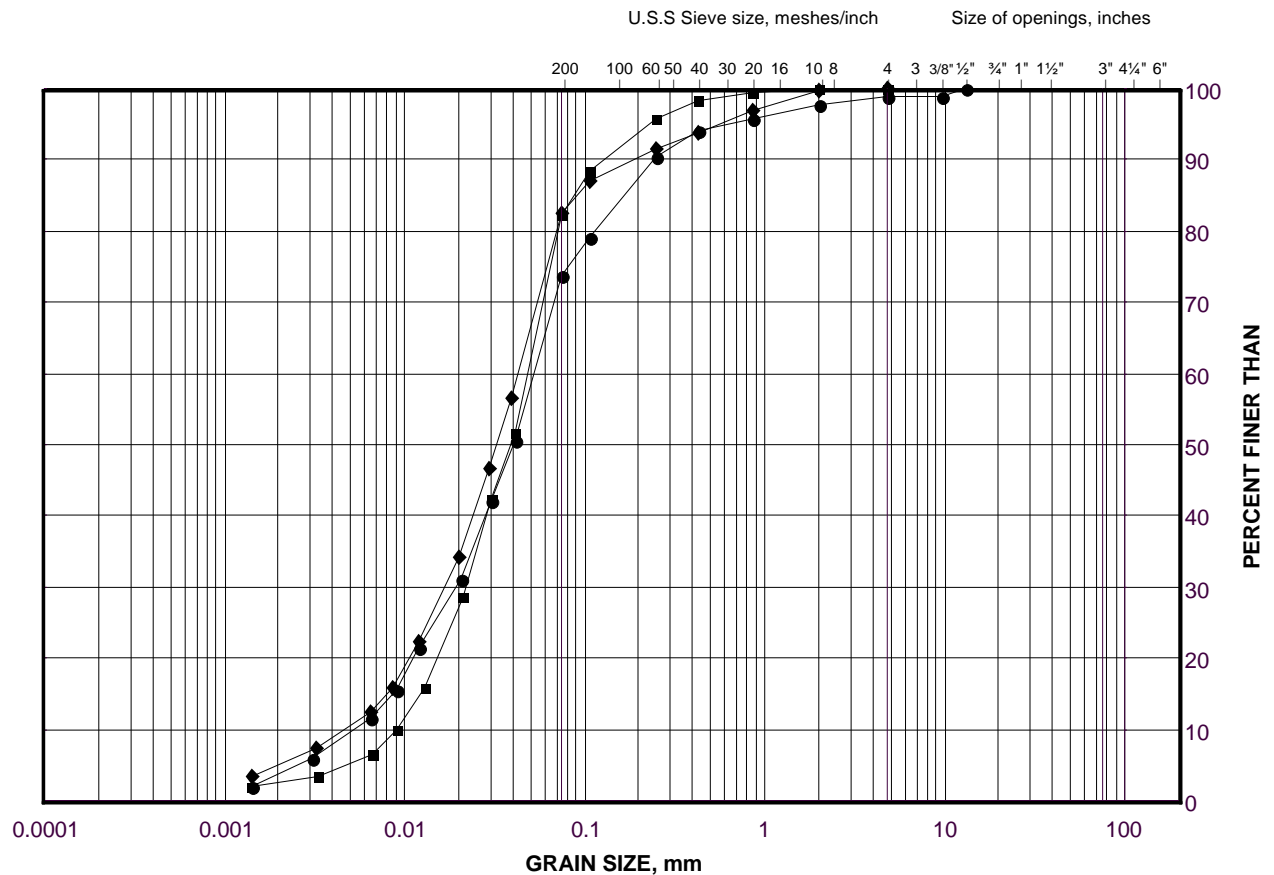
Golder Associates

Date: 24-Apr-15

GRAIN SIZE DISTRIBUTION

Silt to Sandy Silt
Shebeshekong Road NBL Overpass Structure

FIGURE B2



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

LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | B7-04 | 2 | 205.4 |
| ■ | B7-02 | 3 | 204.9 |
| ◆ | B7-05 | 4 | 203.7 |

Project Number: 07-1111-0029

Checked By: CN

Golder Associates

Date: 24-Apr-15

Borehole B7-03



Box 1: 0.61 m – 4.72 m



Box 2: 4.72 m – 6.10 m

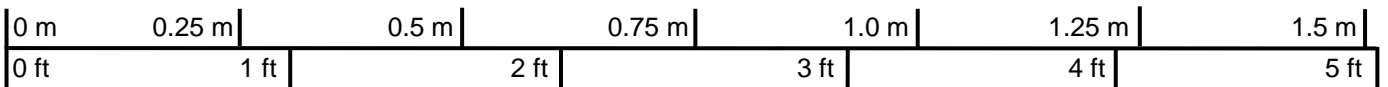
Borehole B7-04




Box 1: 1.83 m – 6.05 m



Box 2: 6.05 m – 6.83 m



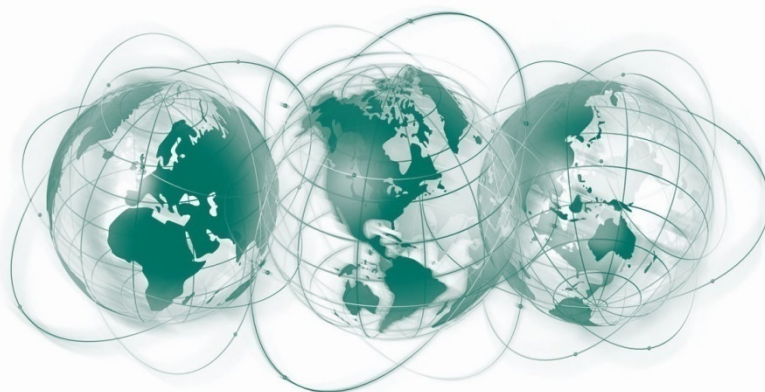
Scale

| | | | | | |
|--|--|---|-------|---------------|-----------|
| PROJECT | | KEY RIVER (NBL) Highway 69 GWP 511-07-00; WP 5184-06-01 | | | |
| TITLE | | Bedrock Core Photograph – Boreholes B7–03 and B7–04 | | | |
|  | | PROJECT No. 07-1111-0029 | | FILE No. ---- | |
| | | DESIGN | MCK | APR 15 | SCALE NTS |
| | | CADD | -- -- | | REV. |
| | | CHECK | CN | APR 15 | FIGURE B3 |
| | | REVIEW | JMAC | APR 15 | |

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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