



April 11, 2016

FOUNDATION INVESTIGATION REPORT

**CULVERTS - PHASE 2
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 (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



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REPORT



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PART A

FOUNDATION INVESTIGATION REPORT

CULVERTS – PHASE 2

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 (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 detailed engineering services for twenty (20) culverts within the Phase 2 limits of the new Highway 69 alignment. The proposed work is part of the detail design for the four-laning of Highway 69 from 1.0 km north of the new Highway 559 Interchange northerly to 1.5 km north of Highway 7182 (Shebeshekong Road), which involves high fill embankments and embankments over swamps, the New Woods Road and Shebeshekong Road interchanges and structures, the Shawanaga River and Site 9 Road structures, the Shebeshekong Road Overpass structures, as well as culvert crossings. The Phase 2 limits of the project extend from 3 km north of the existing Woods Road to 6.1 km north of Highway 7182 (Shebeshekong Road). The general location of this section of the Highway 69 four-laning alignment is shown on Drawing 1.

The Terms of Reference and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2007. Golder's original proposal for foundation engineering services associated with the Phase 2 culverts is contained in Section 6.8 of MRC's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated July 4, 2007. Foundation engineering services for the culverts, the majority of which were not addressed in MTO's original Request for Proposal, are outlined in Golder's Addenda No. 2 and No. 5 dated, March 26, 2009 and April 07, 2011, and were approved by MTO on April 29, 2009 and August 8, 2011, respectively. The foundation engineering services for the additional culverts, some associated with Species At Risk (SAR) requirements, are outlined in Golder Addendum No.7 dated February 14, 2013, and was approved by MTO on July 11, 2013. The General Arrangement (GA) drawings for the proposed culvert alignments were provided to Golder by MRC on January 21, 2009 and May 15, 2015, and the updated GA drawings were provided to Golder on May 29, 2015.

This report addresses the investigation carried out for the twenty (20) Phase 2 culvert crossings only. A detailed list of the Phase 2 culverts investigated is presented in Table 1. Separate reports address the foundation investigations for the Phase 1 culvert crossings, as well as for the swamp crossings and high fill areas and the bridge structures for Phase 1 and 2 components of the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed culverts associated with the existing and the new Highway 69 by borehole drilling, rock coring, in situ testing and laboratory testing on selected samples. The culverts were located in the field by Callon Dietz Inc. (Callon Dietz), a professional surveying company retained by MRC. The investigation areas are shown in plan on Drawing 2. In general, the culverts are typically located within or adjacent to the swamp crossings which were investigated by Golder Associates Ltd. as documented in:

- Foundation Investigation and Design Report, Swamp Crossings – Phase 2, 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, Geocres No. 41H-161 report dated April 11, 2016.

2.0 SITE DESCRIPTION

The proposed culvert alignments addressed in this report are located within the existing and new Phase 2 highway alignment for the section from about 1.5 km north of Nobel, Ontario, northerly for about 17 km. Re-aligned and/or newly proposed highways and access / service roads associated with the four-laning of the new Highway 69 in this phase of the project include Shebeshekong Road, the adjoining ramps for the proposed Shebeshekong Road underpass (interchange) and overpass structures and Site No. 9 Road northerly from the interchange. The new four-lane Highway 69 alignment is oriented generally in a southeast-northwest direction with the Phase 2 project limits located within the Shawanaga Township.



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 containing areas of standing water and various vegetation types and organic soils. The

ground surface within the investigated limits of the Phase 2 culvert crossings varies between about Elevation 201.8 m and Elevation 215.2 m, referenced to Geodetic datum, and is gently sloping downward from northeast to southwest towards Georgian Bay. A detailed description of each investigated culvert alignment is presented in Section 4.0. The locations of these culverts relative to the Highway 69 (NBL and SBL) alignments are shown on Drawing 2.

3.0 INVESTIGATION PROCEDURES

3.1 Foundation Investigation

The field work for the Phase 2 culvert crossings investigation was carried out in two periods to cover the additional scope of work, between March 9 and July 14, 2009 and January 30 and June 17, 2015 during which time a total of forty-two (42) boreholes and twenty-nine (29) Dynamic Cone Penetration Tests (DCPTs) were advanced at or near the culvert locations. In addition, twenty-five (25) boreholes and three (3) DCPTs advanced as part of the field investigation work carried out by Golder Associates Ltd. for the Phase 1 and 2 swamp crossings and high fill areas were used to supplement this investigation, and the methods of investigation of this field work are included in the Swamp Crossings Report referenced in Section 1.0. The locations of the boreholes and DCPTs utilized for the culverts are shown on Drawings A1 to K1, and are summarized in Table 1.

The field investigation was carried out using: portable equipment supplied and operated by Walker Drilling Ltd. of Utopia, Ontario, Landcore Drilling of Sudbury, Ontario and OGS Inc. of Almonte, Ontario; track-mounted CME 55 and CME 550 drill rigs supplied and operated by Landcore Drilling of Sudbury, Ontario. The boreholes were advanced through the overburden using hollow-stem augers, or 'NW' or 'BW' casing with wash boring techniques. Soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter (O.D.) split-spoon sampler, performed in accordance with Standard Penetration Test (SPT) procedures ASTM D1586 (Standard Test Method for Standard Penetration Test), where driven by full weight (automatic) hammers. Where half weight or one-third weight hammers were used, the 'N'-values were corrected for the lower energy drive. Select samples of the cohesive soils were obtained using 50 mm or 76 mm O.D. thin-walled 'Shelby' tubes (ASTM D1587 Standard Practice for Thin-Walled Tube Sampling) for relatively undisturbed samples. Field vane shear tests were conducted in cohesive soils for determination of undrained shear strengths (ASTM D2573 Standard Test Method for Field Vane Shear Test) using the MTO Standard 'N'-size vane supplemented with a 'B'-size vane in the boreholes advanced by the smaller diameter 'BW' casing. Samples of the bedrock were obtained using 'NQ' and 'BQ' size rock core barrels. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The boreholes and DCPTs were advanced to depths up to 15.1 m below existing ground surface and were terminated on refusal to further split-spoon and/or casing advancement. The depths to refusal do not confirm bedrock surface elevations, but may be inferred to indicate potential proximity to the bedrock surface. In twenty-three (23) boreholes, bedrock was cored for depths ranging from about 1.4 m to 4.4 m below the surface of the bedrock.

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 Appendices A to K, inclusive. It should be noted that groundwater elevations as encountered in the boreholes may not be representative of static groundwater levels since the groundwater levels in the boreholes may not have stabilized on completion of drilling. Furthermore, groundwater elevations will vary depending on seasonal fluctuations, precipitation and local soil permeability.

The field work 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 and/or ASTM Standards, as appropriate. Classification testing (water content, organic content, Atterberg limits and grain size distribution) was carried out on selected samples.

Classification of the bedrock rock mass quality with respect to the Rock Quality Designation (RQD) is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)¹. Point load strength index tests, both perpendicular to the core axis (diametral test) and along the core axis (axial test) were performed on selected samples of the rock core to provide an indication of the point load strength index (Is_{50})² of the rock. Laboratory Unconfined Compression (UC) Tests were also carried out on select sections of the bedrock core to assess the uniaxial compressive strength (UCS) of the bedrock. The bedrock was then classified with respect to strength based on the Is_{50} and UCS values as suggested in Table 3.5 of the CFEM (2006)¹. The results of the laboratory testing for each of the culvert crossing are included in the associated appendices.

The proposed centreline of the highway was staked in the field by Callon Dietz prior to drilling. The as-drilled borehole locations, in stations and offsets, were measured by Golder in reference to the centreline alignment and were subsequently converted into MTM NAD 83 (Zone 10) coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to the ground surface elevations at the centreline median which were indicated on the stakes. The borehole locations shown on Drawings A1 to K1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in The Physiography of Southern Ontario³, 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 and localised 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 4⁴. Deposition of Paleozoic strata and later erosion during glaciation exposed these Precambrian rocks.

¹Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

²International Society for Rock Mechanics (ISRM), 1985. Suggested Method for Determining Point Load Strength. Int. J. Rock Mech. Min. Sci. and Geomech. Abst., Vol. 22, pp 51-60.

³Chapman, L.J. and Putnam, D.F., 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

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



4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are presented on the attached Record of Borehole and Drillhole sheets in Appendices A to K. The detailed results of the laboratory testing are also provided in Appendices A to K. The results of the in situ field tests (i.e. SPT 'N'-values and undrained shear strengths from the filed vanes) as presented on the Record of Borehole sheets and in Sections 4.3 through 4.22 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 (SPTs), Dynamic Cone Penetration Test (DCPT) and in situ field vane tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations. Where applicable, the thickness of the overburden in the investigated areas as inferred from the resistance to DCPT results are shown on the Record of DCPT sheets in Appendices A to K.

The inferred soil stratigraphy as encountered in the boreholes and DCPTs advanced for the proposed Phase 2 culverts is shown on Drawings A1 to K1. It should be noted that the orientation (i.e. north, south, east, west) stated in the text of the report is typically referenced to project north (along the proposed Highway 69 alignment) and therefore may differ from that shown on the drawings which represents magnetic north.

In general, the stratigraphy encountered at the various culvert areas investigated is similar, however, the thickness of the overburden (soil materials) is variable, ranging from about 0 (i.e. bedrock present at ground surface) to about 16.1 m below ground surface. The stratigraphy from ground surface to refusal generally consists of:

- Surficial layers of root mat / peat, organic silty sand to sand, and/or sand and gravel fill and rock fill associated with the existing Highway 69 embankment;
- Relatively thin deposits of silt and sand to sand;
- Deposits of clay interbedded with silt in some areas; and,
- Deep deposits of silt and sand to sand to sand and gravel, and sand and silt till in places.

Detailed descriptions of the subsurface conditions at each investigated culvert alignment are provided in the following sections of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit.



4.3 Highway 69 SBL – STA 13+380 (Culvert C45)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+380 in the Township of Shawanaga are shown on Drawing A1 in Appendix A. The culvert will extend across a swamp area and the proposed Highway 69 SBL embankment which will be up to about 3.5 m above the existing grade at the proposed culvert location. A total of three (3) boreholes (Boreholes C45-S1 to C45-S3, inclusive) were advanced along the length of the culvert to investigate the subsurface conditions at this culvert location. In addition, a total of six (6) Dynamic Cone Penetration Tests (DCPTs C45-DC01 to C45-DC06, inclusive) were advanced near the west and east ends of the culvert to further confirm the depth to refusal in these areas. The topography in the area is relatively flat with ground cover consisting of grassy and swampy areas located within the confines of tree covered valley slopes to the north and south sides of the culvert.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of silty peat / organic silty sand, underlain in places by a non-cohesive deposit of sand. The deposit of sand or organic silty sand is underlain by granite gneiss bedrock. Bedrock outcrops are present to the north and south of the culvert.

Silty Peat / Organic Silty Sand

A deposit of dark brown, moist to wet, silty peat and/or organic silty sand was encountered at the ground surface in all the boreholes advanced at this culvert location. The organic silty sand deposit contains trace to some clay, trace gravel, rootlets and oxidation zones. The top of the organic deposit is between Elevation 210.7 and 210.4 m and the deposit thickness varies from 0.2 m to 1.2 m. The bottom of this deposit was defined by bedrock in Borehole C45-S2.

The Standard Penetration Test (SPT) 'N'-values measured within the silty peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, indicating a very soft consistency. Within the organic silty sand deposit, SPT 'N'-values of 2 blows per 0.2 m of penetration and 3 blows per 0.3 m of penetration were recorded, indicating a very loose relative density.

The natural water content measured on one (1) sample of the silty peat and one (1) sample of the organic silty sand is about 707 per cent and 46 per cent, respectively.

Sand

A non-cohesive deposit of brown and grey sand, trace to some silt, trace gravel and trace clay was encountered below the silty peat and organic silty sand deposits in Boreholes C45-S1 and C45-S3. The top of the sand deposit is at Elevation 209.2 m and 209.5 m, and its thickness is 0.7 m and 0.2 m in the respective boreholes. The bottom of this deposit was defined by bedrock.

The SPT 'N'-values recorded within the sand deposit are 3 blows and 12 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit is about 23 per cent and 24 per cent.

A grain size distribution of one (1) sample from this deposit is shown on Figure A.C45-1 in Appendix A.

Bedrock / Refusal

Bedrock outcrops are present to the north and south of the culvert. The bedrock surface was encountered at depths between 0.2 m and 1.9 m in the boreholes, and refusal to further cone penetration was encountered at



depths between 1.1 m and 2.7 m below ground surface in DCPTs C45-DC01 to C45-DC06, ranging between Elevation 209.3 m and 207.7 m.

Bedrock core samples were recovered from all the boreholes (Boreholes C45-S1 to C45-S3) drilled at this culvert location. The bedrock generally consists of granite gneiss and the core samples are described as fresh, non to moderately foliated, black, pink, green and grey, fine to coarse grained, faintly to moderately porous, and very strong to extremely strong,. The Rock Quality Designation (RQD) measured on the core samples are between 64 per cent and 100 per cent, indicating a rock mass of fair to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are between 99 per cent and 100 per cent, and between 40 per cent and 97 per cent, respectively.

Diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table A1 in Appendix A. The point load index (I_{s50}) results from the diametral laboratory tests carried out on eleven (11) samples of the granitic bedrock range from approximately 6.6 MPa to 13.8 MPa, but were typically greater than 8.2 MPa and average about 9.8 MPa.

Based on point load tests in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as very strong (R5, 100 MPa < UCS < 250 MPa) to extremely strong (R6, UCS > 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in Boreholes C45-S1 and C45-S3 upon completion of drilling were at Elevation 210.4 m, measured at the ground surface, while Borehole C45-S2 was observed to be dry upon completion of drilling.



4.4 Highway 69 NBL – STA 13+380 (Culvert C45)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+380 in the Township of Shawanaga are shown on Drawing A1 in Appendix A. The culvert alignment extends across the existing Highway 69 roadway embankment and the embankment height at the proposed culvert location will be about 5.0 m above the existing ground surface. A total of three (3) boreholes (Boreholes C45-N1 to C45-N3, inclusive) were advanced along the length of the culvert to investigate the subsurface conditions at this culvert location. In addition, two (2) Dynamic Cone Penetration Tests (DCPTs C45-DC07 and C45-DC08) were advanced near the west and east ends of the culvert to further confirm the depth to refusal in this area. The topography in the area is relatively flat to low-lying with ground cover consisting of occasional bedrock knobs and swampy areas located within the confines of tree valley slopes to the north and south of the proposed culvert.

In general, the subsurface soils along the culvert alignment consist of a deposit of fill associated with the existing Highway 69 embankment and surficial deposit of sandy peat / organic silty sand beyond the toes of the embankment, underlain by a non-cohesive deposit of silty sand to sand containing a localized pocket of clay. The silty sand to sand deposit or the organic silty sand deposit is underlain by granite gneiss bedrock. Bedrock was observed to outcrop to the north and south sides of the culvert, as well as along the toes of the existing highway embankment.

Embankment Fill

A deposit of granular fill comprised of brown and grey sand, trace gravel, trace silt to sand and gravel, and rock fill was encountered below an 0.1 m thick layer of asphalt in Borehole C45-N2 drilled through the west shoulder of the existing highway. The top of the embankment fill is at Elevation 214.8 m and its thickness is 5.5 m, comprised of an upper 0.4 m thick layer of sand and gravel, a middle 2.3 m thick layer of rock fill, a lower 0.3 m thick layer of sand and a lower 2.5 m thick layer of rock fill.

The Standard Penetration Test (SPT) 'N'-values recorded within the fill deposit are 8 blows and 12 blows per 0.3 m of penetration, typically indicating a loose relative density.

Sandy Peat / Organic Sandy Silt

A deposit of brown, wet, sandy peat to brown and grey, wet, organic silty sand was encountered at the ground surface in Boreholes C45-N1 and C45-N3 drilled at the toes of the existing highway embankment. The organic deposit contains trace gravel, trace silt and wood fragments near the upper portion. The top of the sandy peat / organic silty sand deposit is at Elevation 211.0 m and 210.9 m, and its thickness is 1.2 m and 1.5 m in Boreholes C45-N1 and C45-N3, respectively. The bottom of this deposit is defined by bedrock in Borehole C45-N1.

The natural water content measured on two (2) samples of the organic silty sand is about 57 per cent and 175 per cent.

Silty Sand to Sand

A non-cohesive deposit of grey to dark brown silty sand to sand, trace to some gravel, trace to some silt and trace clay was encountered below the embankment rock fill and organic silty sand deposits in Boreholes C45-N2 and C45-N3. The upper portion of this deposit was noted to be slightly organic and contains a localized pocket of silty clay. The top of the silty sand to sand deposit is at Elevation 209.3 m and 209.4 m, and the thickness is 0.7 m and 2.0 m in Boreholes C45-N2 and C45-N3, respectively. The localized pocket of silty clay is 0.2 m thick



and was encountered at Elevation 208.2 m. The bottom of silty sand to sand deposit was defined by bedrock in both boreholes.

The SPT 'N'-values measured within the silty sand to sand deposit range from 2 blows to 11 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit is 22 per cent and 26 per cent.

The grain size distributions of two (2) samples from the sand portion of this deposit are shown on Figure A.C45-2 in Appendix A.

The natural water content measured on a sample of the silty clay pocket is about 67 per cent. An Atterberg limits test carried out on this specimen measured a liquid limit of about 50 per cent and a plastic limit of about 18 per cent, corresponding to a plasticity index of about 32 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure A.C45-3 in Appendix A and indicate that the material is silty clay of intermediate plasticity.

Bedrock / Refusal

Bedrock outcrops are present to the north and south of the culvert and along the toes of the existing highway embankment. The bedrock surface was encountered at depths between 1.2 m and 7.9 m in the boreholes and refusal to further cone penetration was encountered at depths of 1.1 m and 3.7 m below ground surface in DCPTs C45-DC07 and C45-DC08 ranging between Elevation 209.9 m and 207.0 m.

Bedrock core samples were recovered from all the boreholes (Boreholes C45-N1 to C45-N3) advanced at this culvert location. The bedrock generally consists of granite gneiss and the core samples are described as fresh to slightly weathered, moderately to strongly foliated, black, pink, green and grey, medium to coarse grained, moderately to faintly porous, and strong to very strong. The Rock Quality Designation (RQD) measured on the core samples are between 85 per cent and 100 per cent, indicating a rock mass of good to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are between 99 per cent and 100 per cent, and between 85 per cent and 96 per cent, respectively.

Diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table A1 in Appendix A. The point load index (I_{s50}) results from the diametral laboratory tests carried out on ten (10) samples of the granitic bedrock range from approximately 2.5 MPa to 9.1 MPa, but were typically greater than 4.2 MPa and average about 6.1 MPa.

Based on point load tests in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the boreholes upon completion of drilling range from Elevation 212.3 m to 206.9 m, measured at a depth of 0.3 m and 2.6 m below ground surface.



4.5 Highway 69 SBL – STA 13+778 (Culvert C47 – Site No. 44-616/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+778 in the Township of Shawanaga are shown on Drawing B1 in Appendix B. The culvert will extend across a swamp area and the proposed Highway 69 SBL embankment which will be up to about 3.5 m above the existing grade at the proposed culvert location. Two (2) boreholes (Boreholes C47-S1 and C47-S2) were completed specifically to investigate the subsurface conditions along the culvert alignment, and augmented with Borehole S19-05 advanced for the proposed Highway 69 SBL embankment. In addition, three (3) Dynamic Cone Penetration Tests (DCPTs C47-DC01 to C47-DC03, inclusive) were advanced near the west end of the culvert to further confirm the depth to refusal in this area. The topography in the culvert area is relatively flat to low-lying consisting of occasional bedrock knobs, grassy and moderately treed ground with areas of shallow open water.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of peat, underlain in places by a non-cohesive deposit of sand and silt to sand or granite gneiss bedrock. Bedrock outcrop was observed to the northwest and northeast of the culvert.

Ice / Water

Ice or water to depths of 0.2 m and 0.3 m was encountered in Boreholes S19-05 and C47-S2.

Peat

A deposit of dark brown to black, wet, fibrous/amorphous peat containing trace sand and trace silt was encountered at the ground surface in Borehole C47-S1 and under the ice/water in Boreholes S19-05 and C47-S2. The top of the peat deposit ranges from Elevation 210.7 m to 210.3 m and the thickness of the deposit ranges from 1.2 m to 2.1 m. The bottom of this deposit was defined by bedrock in Borehole C47-S1.

The Standard Penetration Test 'N'-values measured within the peat deposit range between 0 blows (weight of hammer) per 0.3 m of penetration and 1 blow per 0.23 m of penetration, indicating a very soft consistency.

The natural water content measured on samples of the peat deposit range from about 1162 per cent to 1694 per cent, and the organic content measured on a sample of the peat is about 87 per cent.

Silt and Sand to Sand

A non-cohesive deposit of brown to grey silt and sand to sand, some silt, trace gravel and trace clay was encountered below the peat deposit in Boreholes S19-05 and C47-S2 and the upper portion of the sand deposit encountered in Borehole S19-05 contains silt layers and wood fragments. The silt and sand deposit encountered in Borehole C47-S2 is intersected by a localized pocket of clay. The top of the silt and sand to sand deposit is at Elevation 209.1 m and 208.6 m, and its thickness is between 1.4 m and 2.8 m. The bottom of this deposit was defined by refusal to further split-spoon and auger/casing advancement.

The SPT 'N'-values recorded within the silt and sand to sand deposit typically range from 1 blow to 28 blows per 0.3 m of penetration, indicating a very loose to compact relative density. A SPT 'N'-value of 38 blows per 0.23 m of penetration was recorded prior to split-spoon and casing refusal on inferred bedrock, indicating a compact relative density.

The natural water content measured on samples of this deposit range from about 23 per cent to 26 per cent.

The grain size distributions of two (2) samples from this deposit are shown on Figure B.C47-1 in Appendix B.



Within the silt and sand to sand deposit in Borehole C47-S2, an 0.2 m thick layer of brown clay containing some silt and trace sand was encountered at Elevation 207.4 m. The natural water content measured on the clay specimen is about 75 per cent. An Atterberg limits test carried out on this specimen measured a liquid limit of about 51 per cent and a plastic limit of about 19 per cent, corresponding to a plasticity index of about 32 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure B.C47-2 in Appendix B and indicate that the material is clay of high plasticity.

Bedrock / Refusal

Bedrock outcropping was observed to the northeast and northwest of the culvert. In Boreholes S19-05 and C47-S2, and DCPTs C47-DC01 to C47-DC03, refusal to further auger/split-spoon and casing advancement or cone penetration was encountered between depths of 1.1 m and 5.3 m below ground surface corresponding to between Elevation 209.6 m and 205.3 m.

Bedrock was encountered at a depth of 1.6 m (Elevation 209.0 m) and cored for a depth of 1.5 m in Borehole C47-S1. The bedrock generally consists of granite gneiss and the core samples are described as fresh, moderately foliated, black, grey and white, medium to coarse grained, moderately porous, and strong to very strong,. The Rock Quality Designation (RQD) measured on the core sample is 100 per cent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the sample recovered are 100 per cent and 98 per cent, respectively.

Diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table B1 in Appendix B. The point load index (Is_{50}) results from the diametral laboratory tests carried out on three (3) samples of the granitic bedrock range from approximately 3.5 MPa to 5.7 MPa and average about 4.8 MPa.

Based on point load tests in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels observed in the boreholes upon completion of drilling range between Elevation 210.9 m and 210.6 m, measured either at the ground or ice/water surface.



4.6 Highway 69 NBL –STA 13+791 (Culvert C47 – Site No. 44-616/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+791 in the Township of Shawanaga are shown on Drawing B1 in Appendix B. The culvert will extend across a swamp area and the proposed Highway 69 NBL embankment which will be up to about 4 m above the existing grade at the proposed culvert location. A total of three (3) boreholes (Boreholes C47-N1 to C47-N3) were advanced along the culvert length to investigate the subsurface conditions at this culvert location. The topography in the area is low-lying to undulating, consisting of bedrock knobs surrounded by grassy and moderately treed ground with areas of shallow open water. Rock fill was observed on the side slopes of the existing highway embankment traversing the area to the east.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of peat/organic sand, underlain by a deposit of silt and sand. The silt and sand deposit is underlain by granite gneiss bedrock. Bedrock was observed to outcrop to the north and in isolated areas to the south of the culvert alignment, as well as along the toes of the existing Highway 69.

Water

Water to depths of 0.2 m and 0.3 m was encountered in all the boreholes advanced at this culvert location.

Peat / Organic Sand

A deposit of dark brown, wet, silty/fibrous peat to dark brown, wet, organic sand containing rootlets was encountered under the water in all the boreholes. The top of the peat/organic sand deposit varies between Elevation 210.4 and 210.3 m, and its thickness is 1.2 m in all boreholes.

The Standard Penetration Test (SPT) 'N'-values recorded within the peat/organic sand deposit are 0 blows (weight of hammer) per 0.3 m of penetration, indicating a very soft consistency.

The natural water content measured on two (2) samples of the peat deposit is about 535 per cent and 628 per cent, and water content measured on a sample of the organic sand is about 46 per cent. The organic content measured on a sample of the silty peat is about 56 per cent.

Silt and Sand

A deposit of grey silt and sand, trace gravel and trace clay was encountered below the peat/organic sand deposit in all the boreholes. The silt and sand deposit encountered in Borehole C47-N3 contains an 50 mm thick layer of silty clay. The top of the silt and sand deposit varies between Elevation 209.2 m and 209.1 m, and the thickness ranges from 1.1 m to 2.3 m. The bottom of this deposit was defined by bedrock in Boreholes C47-N1 and C47-N2, and by refusal to further split-spoon and casing advancement in Borehole C47-N3.

The SPT 'N'-values measured within this deposit range from 8 blows to 27 blows per 0.3 m of penetration, indicating a loose to compact relative density. A SPT 'N'-value of 15 blows per 0.15 m of penetration was recorded immediately above the bedrock surface in Borehole C47-N2, indicating a compact relative density.

The natural water content measured on samples of this deposit range from about 20 per cent to 26 per cent.

The grain size distributions of three (3) samples from this deposit are shown on Figure B.C47-3 in Appendix B.



Bedrock / Refusal

Bedrock outcropping was observed to the north and south sides of the culvert and along the toes of the existing highway. Borehole C47-N3 encountered refusal to further split- spoon and casing advancement at a depth of 3.7 m below ground surface, Elevation 206.9 m.

Bedrock was encountered and core samples were recovered from Boreholes C47-N1 and C47-N2. The depth to the surface of the bedrock is 2.6 m and 3.4 m below ground surface, corresponding to Elevation 208.0 m and 207.3 m. The bedrock generally consists of granite gneiss and the core samples are described as fresh, moderately to strongly foliated, black, pink, green and white, medium to coarse grained, moderately porous, and strong to very strong,. The Rock Quality Designation (RQD) measured on the core samples are between 62 per cent and 100 per cent, indicating a rock mass of fair to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are 100 per cent, and between 71 per cent and 100 per cent, respectively.

Diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table B1 in Appendix B. The point load index (I_{s50}) results from the diametral laboratory tests carried out on six (6) samples of the granitic bedrock range from approximately 2.3 MPa to 6.8 MPa, but were typically greater than about 5.2 MPa, and average about 4.9 MPa.

Based on point load tests in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet. The ponded water level noted at the boreholes location was at Elevation 210.6 m.



4.7 Highway 69 SBL – STA 14+315 (Culvert C48.1 – Site No. 44-617/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 14+315 in the Township of Shewanaga are shown on Drawing C1 in Appendix C. The culvert will extend across a swamp area and the proposed Highway 69 SBL embankment which will be up to about 3 m above the existing grade at the proposed culvert location. Two (2) boreholes (Boreholes C48.1-S1 and C48.1-S2) were completed specifically to investigate the subsurface conditions along the culvert alignment, and augmented with Borehole S20-02 advanced for the proposed Highway 69 SBL embankment. In addition, three (3) Dynamic Cone Penetration Tests (DCPTs C48.1-DC01 to C48.1-DC03, inclusive) were advanced near the east end of the culvert to further confirm the depth to refusal in this area. The topography in the culvert area is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, and the area is located within the confines of tree covered valley slopes at the north and south limits of the proposed culvert.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of silty peat, underlain by a non-cohesive deposit of silt and sand to sand. Bedrock outcrops are present to the north and south of the culvert.

Snow / Ice

Snow or ice to depths of 0.6 m and 0.8 m was encountered in Boreholes C48.1-S1 and C48.1-S2.

Silty Peat

A deposit of black, wet, silty peat containing rootlets was encountered at the ground surface in Borehole S20-02 and under the snow/ice in Boreholes C48.1-S1 and C48.1-S2. The top of the silty peat deposit range from Elevation 213.2 m to 212.4 and its thickness varies between 0.3 m and 0.8 m.

The Standard Penetration Test 'N'-values recorded within the silty peat deposit are 1 blow and 3 blows per 0.3 m of penetration, indicating a very soft to soft consistency.

The natural water content measured on samples of the silty peat deposit is 177 per cent and 369 per cent, and the organic content measured on a sample of this deposit is about 38 per cent.

Silt and Sand to Sand

A non-cohesive deposit of dark brown to grey silt and sand to sand, trace to some silt, trace to some clay and trace gravel was encountered below the silty peat deposit in all the boreholes. In Boreholes S20-02 and C48.1-S2, the silt and sand deposit contains organics and rootlets. The top of the silt and sand to sand deposit ranges from Elevation 212.4 m to 211.8 m, and its thickness ranges from 0.5 m to 2.3 m. The bottom of the deposit was defined by refusal to further auger or casing advancement.

The SPT 'N'-values recorded within the silt and sand to sand deposit range from 2 blows to 21 blows per 0.3 m of penetration, indicating a very loose to compact relative density, although a SPT 'N'-value of 84 blows per 0.3 m of penetration was recorded within this deposit at the interface between the silt and sand and sand layers, indicating a very dense relative density.

The natural water content measured on samples of this deposit is about 16 per cent.

The grain size distributions of two (2) samples from the silt and sand portion of this deposit are shown on Figure C.C48.1-1 in Appendix C.



Bedrock / Refusal

Bedrock outcrops are present to the north and south of the culvert alignment. In Boreholes C48.1-S1, C48.1-S2 and S20-02; and DCPTs C48.1-DC01 to C48.1-DC03, refusal to further auger or casing advancement or cone penetration was encountered at depths between 1.5 m and 3.7 m below ground/snow surface, corresponding to between Elevation 211.7 m and 209.5 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels observed in the boreholes upon completion of drilling range between Elevation 213.2 m and 212.7 m, measured either at the ground surface or up to a depth of 0.5 m below the snow surface.



4.8 Highway 69 NBL –STA 14+325 (Culvert C48.1 – Site No. 44-617/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 14+325 in the Township of Shawanaga are shown on Drawing C1 in Appendix C. The culvert will extend across a swamp area and the proposed Highway 69 NBL embankment which will be up to about 2.5 m above the existing grade at the proposed culvert location. Two (2) boreholes (Boreholes C48.1-N1 and C48.1-N2) were completed specifically to investigate the subsurface conditions along the culvert alignment, and augmented with Boreholes S20-12 and S20-12A advanced for the proposed Highway 69 NBL embankment. In addition, three (3) Dynamic Cone Penetration Tests (DCPTs C48.1-DC04 to C48.1-DC06, inclusive) were advanced near the west end of the culvert to further confirm the depth to refusal in this area. The topography in the culvert area is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, and located within the confines of tree covered valley slopes at the north and south limits of the associated swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of silty peat, underlain by a deposit of silty clay or silt. The silty clay or silt deposit is in turn underlain by a silt and sand till deposit. Bedrock outcrops are present immediately to the north and south of the culvert alignment, and also further to the northeast of the culvert.

Silty Peat

A deposit of black to brown, wet, silty peat containing rootlets was encountered at the ground surface in all the boreholes. The top of the silty peat deposit ranges from Elevation 213.4 to 213.1 m and the thickness of the deposit ranges from 0.2 m to 0.8 m. Borehole C48.1-N1 was terminated within this deposit upon split-spoon refusal.

The Standard Penetration Test 'N'-value recorded within the silty peat deposit is 1 blow per 0.15 m of penetration, indicating a very soft consistency.

Silty Clay

A deposit of brown silty clay, trace sand, was encountered beneath the silty peat in Borehole S20-12. The top of the silty clay deposit is at Elevation 212.4 m and its thickness is 0.9 m.

The SPT 'N'-value recorded within the silty clay deposit is 3 blows per 0.3 m of penetration, indicating soft consistency.

The natural water content measured on a sample of this deposit is about 32 per cent.

An Atterberg limits test carried out on a specimen of the silty clay deposit measured a liquid limit of about 44 per cent and a plastic limit of about 17 per cent, corresponding to a plasticity index of about 27 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure C.C48.1-2 in Appendix C and indicate that the material is silty clay of intermediate plasticity.

Silt

Immediately underlying the silty peat layer in Borehole C48.1-N2 is a deposit of grey silt, trace to some clay, trace to some sand and containing rootlets. The top of the silt deposit is at Elevation 212.9 m and its thickness is 1.2 m.

The SPT 'N'-values recorded within this deposit are 3 blows and 6 blows per 0.3 m of penetration, indicating that the silt has a very loose to loose relative density.



The natural water content measured on a sample of this deposit is about 20 per cent.

An Atterberg limits test carried out on a sample of the silt deposit measured a liquid limit of about 19 per cent and a plastic limit of about 16 per cent corresponding to a plasticity index of about 3 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure C.C48.1-3 in Appendix C and indicate the material to be a silt of low plasticity.

Silt and Sand Till

A deposit of non-cohesive till consisting of brown and grey silt and sand, trace to some clay, trace gravel and containing sandy silt seams was encountered below the silty clay deposit and silt deposit in Boreholes S20-12 and C48.1-N2. The top of the till deposit is at Elevation 211.7 m and 211.5 m, and its thickness is 1.0 m and 1.2 m in both boreholes. The bottom of this deposit was defined by refusal to further split-spoon and auger/casing advancement.

The SPT 'N'-values measured within this deposit are 13 blows per 0.25 m of penetration, 34 blows per 0.3 m of penetration and 82 blows per 0.15 m of penetration, generally indicating a compact to very dense relative density.

The natural water content measured on two samples of the silt and sand till deposit is about 20 per cent and 32 per cent.

The grain size distributions of two (2) samples from this till deposit are shown on Figure C.C48.1-4 in Appendix C.

Bedrock / Refusal

Bedrock outcrops are present to the north and south of the culvert alignment. In Boreholes C48.1-N1, C48.1-N2 and S20-12 and DCPTs C48.1-DC04 to C48.1-DC06, refusal to further split-spoon and auger/casing advancement or cone penetration was encountered at depths between 0.2 m and 2.7 m, corresponding to between Elevation 213.2 m and 210.5 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels observed in the boreholes upon completion of drilling range from Elevation 213.4 m to 213.1 m, measured at the ground surface.



4.9 Highway 69 SBL – STA 14+649 (Culvert C49A – Site No. 44-618/C2)

The plan and profiles along the length of the culvert showing the borehole locations and interpreted stratigraphy at approximately STA 14+649 in the Township of Shawanaga are shown on Drawings D1 and D2 in Appendix D. The culvert will extend across the proposed Highway 69 SBL embankment which will be up to about 5 m high above the existing grade at the proposed culvert location. A total of four (4) boreholes (Boreholes C49A-S1A, C49A-S1B, C49A-S2 and C49A-S3) were advanced specifically to investigate the subsurface conditions along the culvert, supplemented with Borehole H9-01 advanced for the proposed Highway 69 SBL embankment for High Fill 9. In addition, two (2) Dynamic Cone Penetration Tests (DCPTs C49A-DC01 and C49A-DC02, inclusive) were advanced near the centre and east end of the culvert to further confirm the depth to refusal in these areas. The topography in the area is low-lying encompassing wet grassy areas, shallow open water and bedrock knobs, confined by moderately tree covered slopes immediately to the south as well as to the north of the adjacent swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of topsoil or peat underlain by a deposit of sandy silt to sand which in turn is generally underlain by granite gneiss bedrock. At the west end of the culvert the deposit of silty sand is underlain by a deposit of silty sand and gravel which in turn is also underlain by granite gneiss bedrock.

Topsoil / Peat

A 0.1 m to 0.2 m thick layer of topsoil was encountered at the ground surface in Boreholes C49A-S1A, C49A-S2 and C49A-S3. A 0.2 m thick layer of amorphous peat was encountered at the ground surface in Borehole H9-01.

Sandy Silt to Sand

A non-cohesive deposit of brown to grey sandy silt, trace clay, trace organic to silt and sand to silty sand, trace organics to sand, some silt, trace organics was encountered below the topsoil in Boreholes C49A-S1A, C49A-S2 and C49A-S3 and below the peat in Borehole H9-01. The top of the deposit varies between Elevations 208.3 m and 207.7 m, and the thickness of the deposit ranges from 0.6 m to 3.7 m, and potentially may be up to about 6.4 m as inferred in DCPT C49A-DC02. The bottom of this deposit is defined by granite gneiss bedrock in Borehole C49A-S2 and C49A-S3, and by refusal to casing advancement in Borehole H9-01.

The SPT 'N'-values recorded within the non-cohesive deposit range between 1 blow and 36 blows per 0.3 m of penetration, indicating a very loose to dense relative density. Two SPT 'N'-values of 47 blows per 0.13 m of penetration and 25 blows per 0.08 m of penetration were measured within Boreholes C49A-S2 and C49A-S3, on refusal on bedrock.

The natural water content measured on samples of this deposit range from about 19 per cent and 29 per cent.

The grain size distributions of three (3) samples from this deposit are shown on Figure D.C49A-1 in Appendix D.

Silty Sand and Gravel

A deposit of brown, moist to wet, silty sand and gravel, trace clay was encountered below the deposit of silty sand in Borehole C49A-S1A and confirmed upon re-drilling in Borehole C49A-S1B. The top of the granular deposit was encountered at Elevations 207.2 m and 206.4 m and the thickness of this deposit was 0.3 m in both boreholes. The bottom of this deposit is defined by split-spoon refusal and bedrock.



Two SPT 'N'-values measured within the silty sand and gravel deposit are 27 blows for 0.08 m of penetration, and 20 blows for 0.15 m of penetration prior to split-spoon refusal on bedrock.

The natural water content measured on one (1) sample of the silty sand and gravel is about 10 per cent.

Bedrock / Refusal

In Boreholes C49A-S1A and H9-01 and DCPTs C49A-DC01 and C49A-DC02, refusal to further split-spoon or casing advancement or cone penetration was encountered between depths of 1.0 m and 6.4 m below ground surface corresponding to between Elevations 206.9 m and 201.4 m.

Bedrock was encountered and core samples were recovered from Boreholes C49A-S1B, C49A-S2 and C49A-S3. The depth to the surface of the bedrock ranges between 1.8 m and 3.9 m below ground surface, corresponding to between Elevations 206.1 m and 203.8 m. The bedrock consists of granite gneiss and the core samples are described as slightly weathered to fresh, foliated, grey, green, pink, and black, medium to coarse grained, and medium strong to strong, . The Rock Quality Designation (RQD) measured on the core samples ranges between 74 per cent and 100 per cent, indicating a rock mass of fair to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the samples recovered are between 96 per cent and 100 per cent and 74 per cent and 100 per cent, respectively.

Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table D1 in Appendix D. The point load index (I_{s50}) results from the axial laboratory tests carried out on six (6) samples of the granite gneiss bedrock range from approximately 1.6 MPa to 8.5 MPa, but are typically greater than 5.0 MPa. The point load index (I_{s50}) results from the diametral laboratory tests carried out on five (5) samples of the granite gneiss bedrock range from approximately 3.8 MPa to 9.2 MPa, but are typically greater than 4.9 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7012 (Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens), on a selected core sample of the granite gneiss bedrock from Borehole C49A-S1B and measured a compressive strength of about 84 MPa, as detailed in Table D2 in Appendix D.

Based on a laboratory UC tests and point load tests, in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as medium strong (R3, 25 MPa < UCS < 50 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in Boreholes C49A-S1B, C49A-S2, C49A-S3 and H9-01 upon completion of drilling rang between Elevations 207.6 m and 207.3 m, measured at a depth between 0.4 m and 0.7 m below the ground surface.



4.10 Highway 69 NBL – STA 14+656 (Culvert C49A – Site No. 44-618/C1)

The plan and profiles along the length of the culvert showing the borehole locations and interpreted stratigraphy at approximately STA 14+656 in the Township of Shawanaga are shown on Drawings D1 and D2 in Appendix D. The culvert will extend across the proposed Highway 69 NBL embankment which will be up to about 5 m high above the existing grade at the proposed culvert location. A total of three (3) boreholes (Boreholes C49A-N1 to C49A-N3, inclusive) were advanced specifically to investigate the subsurface conditions along the culvert. In addition, two (2) Dynamic Cone Penetration Tests (DCPTs C49A-DC03 and C49A-DC04, inclusive) were advanced near the centre and east end of the culvert to further confirm the depth to refusal in these areas. The topography in the area is low-lying encompassing wet grassy areas, shallow open water and bedrock knobs, confined by moderately tree covered slopes immediately to the south as well as to the north of the adjacent swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of topsoil/organic silty sand underlain by a deposit of silt and sand to sand which in turn is generally underlain by a sand and gravel deposit over granite gneiss bedrock. At one location a boulder was encountered between the silt and sand to sand deposit and the deposit of sand and gravel.

Topsoil

A 0.1 m to 0.3 m thick layer of topsoil was encountered at the ground surface in Boreholes C49A-N1 to C49A-N3.

The natural water content measured on one (1) sample of the topsoil from Borehole C49A-N3 is about 59 per cent.

Organic Silty Sand

A 0.5 m thick deposit of red to dark brown, moist, organic silty sand was encountered underlying the topsoil in Borehole C49A-N2 at Elevation 208.3 m.

A SPT 'N'-value recorded within the organic deposit is 8 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on a sample of the organic deposit is about 29 per cent and the organic content measured on this sample is about 7 per cent.

Silt and Sand to Sand

A non-cohesive deposit of brown/reddish brown to grey, silt and sand, trace clay to silty sand, trace organics to silty sand to sand, some silt, trace gravel was encountered below the topsoil in Boreholes C49A-N1 and C49A-N3 and below the organic silty sand in Borehole C49A-N2. A 0.3 m thick boulder was encountered below the deposit of silt and sand in Borehole C49A-N2 at Elevation 206.2 m. The top of the deposit varies between Elevations 208.2 m and 207.8 m, and the thickness of the deposit ranges from 1.6 m to 4.8 m. The bottom of this deposit is defined by bedrock in Borehole C49A-N3.

The SPT 'N'-values recorded within the non-cohesive deposit range between 2 blows and 36 blows per 0.3 m of penetration, indicating a very loose to dense relative density. One SPT 'N'-value of 27 blows per 0.15 m of penetration was measured within Boreholes C49A-N1 prior to split-spoon refusal on cobbles.

The natural water content measured on samples of this deposit range from about 17 per cent and 27 per cent.



The grain size distributions of three (3) samples from this deposit are shown on Figure D.C49A-2 in Appendix D.

Sand and Gravel

A deposit of brown, wet, sand and gravel, some silt to silty, was encountered below the boulder in Borehole C49A-N2. The top of the granular deposit is at Elevation 205.9 m and the deposit is 1.7 m thick. The bottom of this deposit is defined by bedrock.

Two SPT 'N'-values measured within the sand and gravel deposit are 36 blows and 51 blows per 0.3 m of penetration, indicating a dense to very dense relative density. One SPT 'N'-value measured within the bottom portion of the granular deposit is 36 blows per 0.15 m of penetration prior to split-spoon refusal on bedrock.

The natural water content measured on one (1) sample of the sand and gravel is about 12 per cent.

A grain size distribution of one (1) sample from this deposit is shown on Figure D.C49A-3.

Cobbles

A deposit of cobbles was encountered below the silty sand deposit in Borehole C49A-N1. The top of the cobbles deposit is at Elevation 205.9 m and the deposit is 1.6 m thick. The bottom of this deposit is defined by bedrock.

Bedrock / Refusal

In DCPTs C49A-DC03 and C49A-DC04, refusal to further cone penetration was encountered at depths of 3.2 m and 5.1 m below ground surface, respectively, corresponding to Elevations 205.7 m and 202.4 m.

Bedrock was encountered and core samples were recovered from Boreholes C49A-N1 to C49A-N3. The depth to the surface of the bedrock ranges between 4.0 m and 5.1 m below ground surface, corresponding to between Elevations 204.3 m and 203.2 m. The bedrock consists of granite gneiss and the core samples are described as fresh, foliated, black, grey and pink, medium to coarse grained, and very strong. The Rock Quality Designation (RQD) measured on the core samples ranges between 86 per cent and 100 per cent, indicating a rock mass of good to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the sample recovered are between 86 per cent and 100 per cent and between 76 per cent and 100 per cent, respectively.

Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table D1 in Appendix D. The point load index (Is_{50}) results from the axial laboratory tests carried out on three (3) samples of the granite gneiss bedrock range from approximately 4.1 MPa to 6.7 MPa. The point load index (Is_{50}) results from the diametral laboratory tests carried out on three (3) samples of the granite gneiss bedrock range from approximately 5.3 MPa to 8.1 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7012, on a selected core sample of the granite gneiss bedrock from Borehole C49A-N2 and measured a compressive strength of about 48 MPa, as detailed in Table D3 in Appendix D.

Based on a laboratory UC tests and point load tests in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as medium strong (R3, 25 MPa < UCS < 50 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).



Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in Boreholes C49A-N1 to C49A-N3 upon completion of drilling rang between Elevations 207.6 m and 206.9 m, measured at depths between 0.7 m and 1.5 m below the ground surface.



4.11 Highway 69 SBL – STA 14+706 (Culvert C50 – Site No. 44-619/C2)

The plan and profile along the length of the culvert showing the borehole locations and interpreted stratigraphy at approximately STA 14+706 in the Township of Shawanaga are shown on Drawing E1 in Appendix E. The culvert will extend across the proposed Highway 69 SBL embankment which will be up to about 5.5 m high above the existing grade at the proposed culvert location. One (1) borehole (Borehole C50-S1) was advanced to specifically investigate the subsurface conditions at the west end of the culvert, supplemented with Boreholes S21-01 and S21-02 advanced for the proposed Highway 69 SBL embankment for Swamp 21 crossing. The topography is relatively flat and low lying encompassing a wet grassy area, shallow open water and bedrock knobs; located within the confines of moderately tree covered valley slopes to the north and south.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of peat and organic sand, underlain by interlayered deposits of silty sand and silt and sand. The non-cohesive deposits are underlain by granite gneiss bedrock. At one location inferred bedrock was encountered immediately below ponded water which covers the entire culvert site.

Ice / Water

Ice and/or water to depths ranging between 0.7 m and 0.9 m was encountered in all boreholes. Refusal to casing advancement was encountered below the water in Borehole S21-01 at a depth of 0.7 m, corresponding to Elevation 206.6 m.

Peat

A 0.4 m thick layer of dark brown, wet, fibrous peat was encountered underlying the water in Borehole C50-S1 at Elevation 206.7 m.

A SPT 'N'-value recorded within the peat is 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The natural water content measured on a sample of the organic deposit is about 80 per cent.

Organic Sand

A 1 m thick deposit of dark brown, wet, organic sand containing some silt was encountered underlying the peat in Borehole C50-S1 at Elevation 206.3 m.

A SPT 'N'-value recorded within the organic deposit is 3 blows per 0.3 m of penetration, indicating a very loose relative density.

The natural water content measured on a sample of the organic deposit is about 40 per cent.

A grain size distribution of one (1) sample from this deposit is shown on Figure E.C50-1.

Silt and Sand to Silty Sand

A non-cohesive deposit of dark brown to grey, silt and sand, trace to some clay to silty sand, trace gravel, organics and rootlets, was encountered below the water in Borehole S21-02 and below the organic sand in Borehole C50-S1. The top of the deposit was encountered at Elevations 206.6 m and 205.3 m, and the thickness of the deposit is 0.4 m and 1.4 m. The bottom of this deposit is defined by refusal to further split-spoon advancement.



The SPT 'N'-values recorded within the non-cohesive deposit in Borehole S21-02 are 1 blow and 9 blows per 0.3 m of penetration, indicating a very loose to loose relative density. Two SPT 'N'-values of 16 blows per 0.13 m and 0.15 m of penetration were measured within Boreholes S21-02 and C50-S1, respectively, on split-spoon refusal on bedrock.

The natural water content measured on samples of this deposit are about 20 per cent and 36 per cent. An organic content measured on a sample of the silty sand recovered from Borehole S21-02 is about 2 per cent.

An Atterberg limits test carried out on a specimen of silt and sand deposit measured a liquid limit of about 16 per cent and a plastic limit of about 13 per cent, corresponding to a plasticity index of about 3 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure E.C50-2 in Appendix E and indicates that the fines component of the material is a silt of slight plasticity.

Bedrock / Refusal

In Boreholes S21-01 and S21-02, refusal to further split-spoon advancement was encountered at a depth of 0.7 m and 2.3 m, respectively, corresponding to Elevation 206.7 m and 205.2 m.

Bedrock was encountered and core samples were recovered from Borehole C50-S1. The depth to the surface of the bedrock is 2.6 m below ground surface, corresponding to Elevation 204.9 m. The bedrock consists of granite gneiss and the core samples are described as slightly weathered to fresh, foliated, medium grained, green, grey and pink, and medium strong. The Rock Quality Designation (RQD) measured on the core samples is 73 per cent and 97 per cent, indicating a rock mass of fair to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the sample recovered are 97 per cent and between 73 per cent and 97 per cent, respectively.

Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table E1 in Appendix E. The point load index (Is_{50}) result from the axial laboratory test carried out on one (1) sample of the granite gneiss bedrock is approximately 5.1 MPa. The point load index (Is_{50}) result from the diametral laboratory test carried out on one (1) sample of the granite gneiss bedrock is approximately 4.8 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7012, on a selected core sample of the granite gneiss bedrock from Borehole C50-S1 and measured a compressive strength of about 46 MPa, as detailed in Table E2 in Appendix E.

Based on the laboratory UC test and point load tests, in accordance with Table 3.5, CFEM 2006³, the granite gneiss bedrock is classified as medium strong (R3, 25 MPa < UCS < 50 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels observed in Boreholes C49A-N1 to C49A-N3 upon completion of drilling are at Elevation 207.5 m in open water and between Elevations 207.5 m and 207.3 m, measured at the ice surface.



4.12 Highway 69 NBL – STA 14+726 (Culvert C50 – Site No. 44-619/C1)

The plan and profile along the length of the culvert showing the borehole locations and interpreted stratigraphy at approximately STA 14+726 in the Township of Shawanaga are shown on Drawing E1 in Appendix E. The culvert will extend across the proposed Highway 69 NBL embankment which will be up to about 5 m high above the existing grade at the proposed culvert location. Four (4) boreholes (Boreholes S21-10, S21-10A, S21-11 and S21-19) advanced for the proposed Highway 69 NBL embankment crossing of Swamp 21, but located in close proximity to the proposed culvert, were utilized to investigate the subsurface conditions along the culvert alignment. In addition, one (1) Dynamic Cone Penetration Test (DCPT C50-DC01) was advanced near the west end of the culvert to further confirm the depth to refusal in this area. The topography is relatively flat and low lying encompassing a wet grassy area, shallow open water and bedrock knobs located within the confines of moderately tree covered valley slopes to the north and south.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of peat and organic sand underlain by a non-cohesive deposit comprised of various layers of silt to silty sand, in places overlain by a deposit containing layers/pockets of clayey silt to clay. At some locations, the silt to silty sand deposit is underlain by a granular deposit comprised of sand and gravel prior to refusal.

Ice / Water

Ice and water at one location, was encountered in all boreholes to depths ranging between 0.5 m and 0.6 m.

Peat

A 0.4 m and 0.3 m thick layer of peat was encountered below the ice in Borehole S21-11 and below the water in Borehole S21-19, at Elevations 207 m and 206.9 m, respectively.

The natural water content measured on one (1) sample of the peat recovered from Borehole S21-11 is about 68 per cent.

Organic Sand

A 0.3 m thick deposit of dark brown, wet, organic sand was encountered underlying the peat in Borehole S21-19 at Elevation 206.6 m.

A SPT 'N'-value recorded within the organic deposit is 1 blow per 0.3 m of penetration, indicating a very loose relative density.

Clayey Silt

A 0.8 m thick near-surface deposit of grey, wet, clayey silt was encountered below the organic sand in Borehole S21-19 at Elevation 206.3 m.

One SPT 'N'-values recorded within the cohesive deposit is 3 blows per 0.3 m of penetration, suggesting a soft consistency.

The natural water content measured on one (1) sample of the clayey silt is about 23 per cent.

An Atterberg limits test carried out on a specimen of the cohesive layer measured a liquid limit of about 19 per cent and a plastic limit of about 13 per cent, corresponding to a plasticity index of about 6 per cent. The



result of the Atterberg limits test is shown on the plasticity chart on Figure E.C50-3 in Appendix E and indicates that the material is a clayey silt of low plasticity.

Silt to Sand

An interlayered deposit of dark brown to grey, silt to sandy silt to silt and sand to silty sand to sand was encountered below the ice in Boreholes S21-10 and S21-10A, below the peat in Borehole S21-11, and below the clayey silt layer in Borehole S21-19. The upper portion the deposit in Boreholes S21-10 and S21-11 has trace organics and contains rootlets to a depth of 1.6 m. Pockets of silt clay to clay were encountered within the silt to silty sand portions of the deposit in Boreholes S21-10, S21-10A and S21-19. The top of the deposit ranges between Elevation 207 m and 205.5 m, and the overall thickness of the deposit ranges from 7.2 m to 9.8 m, but may be inferred to be only 3.3 m thick (or less) in DCPT C50-DC01. In Borehole S21-29 and DCPT C50-DC01 the bottom of this deposit is defined by refusal to further casing advancement and cone penetration, respectively.

The SPT 'N'-values recorded within the non-cohesive deposit range between 1 blow and 17 blows per 0.3 m of penetration, indicating a very loose to compact relative density. A SPT 'N'-value of 4 blows per 0.07 m of penetration was recorded at split-spoon refusal in Borehole S21-10A.

The natural water content measured on samples of this deposit ranges between about 14 per cent and 28 per cent. The natural water content measured on one (1) sample recovered from the upper portion of the silty sand deposit immediately below the ice cover in Borehole S21-10 is about 150 per cent.

The grain size distributions of six (6) samples of the silt to silt and sand portion of this deposit are shown on Figure E.C50-4 in Appendix E.

An Atterberg limits test carried out on a specimen of the silt deposit measured a liquid limit of about 19 per cent and a plastic limit of about 16 per cent, corresponding to a plasticity index of about 3 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure E.C50-5 in Appendix E and indicates that the material is a silt of slight plasticity. An Atterberg limits test on one (1) sample of this deposit from Borehole S21-10A indicates this material to be non-plastic.

Silt Clay to Clay (Pockets)

Pockets of light brown/grey, wet, silty clay to clay were encountered within the silt to sand deposit in Boreholes S21-10, S21-10A and S21-19 at Elevations 202.8 m and 200 m, and were penetrated for thicknesses of 2 m and 0.5 m.

Two SPT 'N'-values measured within the silty clay to clay pocket encountered in Borehole S21-10 are 2 blows and 11 blows per 0.3 m of penetration, suggesting a very soft and stiff consistency. An in situ field vane test carried out within this deposit measured an undrained shear strength of about 23 kPa and a sensitivity is calculated to be about 3. The field vane test results indicate that the clay pocket has a soft consistency.

The natural water content measured on samples of this deposit generally ranges between about 52 per cent and 63 per cent.

The grain size distribution of one (1) sample of the silty clay pocket is shown on Figure E.C50-6 in Appendix E.

Atterberg limits tests were carried out on three (3) specimens of the silty clay to clay pockets. The liquid limits range between about 44 per cent and 53 per cent, the plastic limits range between about 18 per cent and 20 per cent, and the plasticity indices range between about 26 per cent and 33 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure E.C50-7 in Appendix E and indicate that the material is classified as silty clay of intermediate plasticity to clay of high plasticity.



Sand and Gravel

A deposit of brown to grey, wet, sand and gravel, trace to some silt, was encountered below the silt to silty sand deposit in Boreholes S21-10 and S21-11. The top of the granular deposit was encountered at Elevations 200 m and 196.8 m and the thickness of the deposit is 0.2 m and 0.1 m in the respective boreholes. The bottom of this deposit is defined by refusal to further split-spoon advancement.

Two SPT 'N'-values measured within the sand and gravel deposit are 22 blows per 0.15 m of penetration and 54 blows per 0.03 m of penetration prior to split-spoon refusal.

The natural water content measured on one (1) sample of the sand and gravel is about 20 per cent.

Bedrock / Refusal

In Boreholes S21-10, S21-10A, S21-11 and S21-19 and DCPT C50-DC01, refusal to further split-spoon or casing advancement or cone penetration was encountered at depths ranging between 3.9 m and 10.8 m below ice or water surface, corresponding to between Elevations 203.6 m and 196.7 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels observed in Boreholes S21-10, S21-11 and S21-19 upon completion of drilling are at Elevation 207.5 m, measured at the ice surface, or corresponding to the surface of the open water.



4.13 Highway 69 SBL – STA 15+710 (Culvert C55 – Site No. 44-620/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 15+710 in the Township of Shawanaga are shown on Drawing F1 in Appendix F. The culvert alignment will extend across the proposed Highway 69 SBL and Shebeshekong Road North to East-West Ramp embankment which will be up to about 6.5 m high above the existing grade at the proposed culvert location. Three (3) boreholes (Boreholes S23-03A, S23-04 and S23-06) and one (1) DCPT (S23-DCPT02) advanced for the proposed highway embankment crossing of Swamp 23, but located in close proximity to the culvert, were utilized to investigate the subsurface conditions along the culvert alignment. The topography in the culvert area is relatively flat, with ground cover consisting of shrubs and wet grassy areas, and is located within the confines of tree covered valley slopes at the north and south limits of the associated swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of peat (where present) underlain by a predominant deposit of sand which extends to the refusal depth. Bedrock outcrops are present to the south of the culvert.

Ice / Water

Ice or ice and water to depths of between 0.8 m and 0.9 m was encountered in all the boreholes.

Peat

A deposit of dark brown, wet, amorphous peat containing trace roots and wood fragments was encountered underlying the ice/water cover in Boreholes S23-03A and S23-04. The top of the peat deposit is at Elevations 208.1 m and 208.0 m and the thickness of this deposit is 1.8 m and 0.4 m at the respective borehole.

The Standard Penetration Test (SPT) 'N'-values recorded within the peat deposit range from 1 blow to 13 blows per 0.3 m of penetration, suggesting a very soft to stiff consistency.

The natural water content measured on two (2) samples of the peat deposit is about 353 per cent and 357 per cent and the organic content measured on one (1) sample of the peat deposit is about 56 per cent.

Sand

A deposit of brown to grey sand, trace to some silt, trace to some gravel and trace clay was encountered underlying the peat deposit or ice cover in the boreholes. The upper portion of the sand deposit in Boreholes S23-04 and S23-06 contains trace organics, and in Borehole S23-06, clay seams were present near the top of the deposit between Elevations 207.8 m and 207.0 m. The top of the sand deposit ranges from Elevation 208.5 m to 206.2 m and the thickness of the deposit ranges from 3.4 m to 6 m, and potentially may be up to about 7.5 m thick as inferred in DCPT S23-DC02. The bottom of this deposit is defined by refusal to further split-spoon and casing advancement or cone penetration.

The SPT 'N'-values measured within this deposit typically range from 1 blow to 22 blows per 0.3 m of penetration, with 'N'-values between 54 blows and 106 blows per 0.3 m of penetration and up to 68 blows per 0.15 m of penetration recorded within the lower portion of the deposit in Borehole S23-04, indicating an overall very loose to very dense relative density.

The natural water content measured on samples of this deposit ranges from about 14 per cent to 42 per cent but is typically less than 30 per cent. The organic content measured on two (2) samples of the upper portion of the sand deposit containing trace organics is about 2 per cent and 4 per cent.



The grain size distributions of five (5) samples of this deposit are shown on Figure F.C55-1 in Appendix F.

Bedrock / Refusal

Bedrock outcrops are present to the south of the proposed culvert alignment. In Boreholes S23-03A, S23-04 and S23-06 and DCPT S23-DC02, refusal to further split-spoon and casing advancement or cone penetration was encountered at depths between 4.2 m and 9.6 m below ice or ground surface, corresponding to between Elevations 205.1 m and 199.3 m.

Groundwater Conditions

The samples taken in the boreholes were wet with free water noted in a number of the sand samples. Water levels observed in the boreholes upon completion of drilling range between Elevation 208.9 m and 208.7 m, measured to a depth of 0.6 m below the ice surface.



4.14 Highway 69 NBL – STA 15+717 (Culvert C55 – Site No. 44-620/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at about STA 15+717 in the Township of Shawanaga are shown on Drawing F1 in Appendix F. The culvert alignment will extend across the proposed Highway 69 NBL embankment which will be up to about 6.5 m high above the existing grade at the proposed culvert location. Three (3) boreholes (Boreholes S23-08 to S23-10, inclusive) advanced for the proposed highway embankment crossing of Swamp 23, but located in close proximity to the culvert, were utilized to investigate the subsurface conditions along the culvert alignment. The topography in the culvert area is relatively flat, with ground cover consisting of shrubs and wet grassy areas, within the confines of tree covered valley slopes at the north and south limits of the associated swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of peat (where present) underlain by a predominant deposit of silty sand to sand which extends to the refusal depth. Bedrock outcrops are present to the south of the culvert.

Ice / Water

Ice or ice and water to depths of between 0.7 m and 0.9 m was encountered in all the boreholes.

Peat

A 0.8 m thick deposit of brown, wet, fibrous peat containing trace wood fragments was encountered underlying the ice/water cover in Boreholes S23-08 at Elevation 208.2 m.

A Standard Penetration Test (SPT) 'N'-value recorded within the peat deposit is 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The natural water content measured on a sample of the peat deposit is about 326 per cent and an organic content measured on this sample is about 64 per cent.

Silty Sand to Sand

A deposit of brown and grey silty sand to sand, containing trace to some gravel and trace clay was encountered underlying the peat deposit or ice/water cover in the boreholes. The upper portion of the sand deposit in Boreholes S23-09 and S23-10 contains trace organics and clay seams. In Borehole S23-09 a 0.7 m thick layer of brown and grey organic sand, trace to some silt, trace clay, was encountered within the sand deposit at Elevation 207.4 m. The top of the silty sand to sand deposit ranges from Elevation 208.6 m to 207.5 m and the overall thickness of the deposit, including the organic sand pocket, ranges from 7.5 m to 10.2 m. Boreholes S23-08 to S23-10 were terminated within this deposit upon refusal to further split-spoon and/or casing advancement.

The SPT 'N'-values measured within this deposit typically range from 1 blow to 30 blows per 0.3 m of penetration, with values of 53 blows to 89 blows per 0.3 m of penetration recorded at varying depths in Borehole S23-08, indicating an overall very loose to very dense relative density.

The natural water content measured on samples of this deposit ranges from about 12 per cent to 24 per cent. The grain size distributions of five (5) samples of this deposit are shown on Figure F.C55-2 in Appendix F.

A SPT 'N'-value recorded within the layer is 6 blows per 0.3 m of penetration, indicating a loose relative density. The natural water content measured on a sample of this layer is about 58 per cent.



Bedrock / Refusal

Bedrock outcrops are present to the south of the proposed culvert alignment. In Boreholes S23-08 to S23-10, refusal to further split-spoon and/or casing advancement was encountered at depths between 8.4 m and 11.0 m below ice surface, corresponding to between Elevations 200.5 m and 198.4 m.

Groundwater Conditions

The samples taken in the boreholes were wet with free water noted in a number of sand samples. Water levels observed in the boreholes upon completion of drilling range from Elevation 208.9 m to 208.6 m, measured to a depth of 0.6 m below the ice surface.



4.15 Highway 69 SBL – STA 16+345 (Culvert C57.1 – Site No. 44-621/C2)

The plan and profile along the length of the culvert showing the borehole locations and interpreted stratigraphy at about STA 16+345 in the Township of Shawanaga are shown on Drawing G1 in Appendix G. The culvert will extend across the proposed Highway 69 SBL embankment which will be up to about 4.5 m high above existing grade at the proposed culvert location. Five (5) boreholes (Boreholes C57.1-S1 to C57.1-S5, inclusive) were advanced to specifically investigate the subsurface conditions along the culvert. In addition, three (3) Dynamic Cone Penetration Tests (DCPTs C57.1-DC01 to C57.1-DC03, inclusive) were advanced near the culvert to further confirm the depth to refusal in this area. The topography in the culvert area is relatively flat with ground cover consisting of relatively densely treed areas. In general, the ground surface slopes down relatively gently towards the north towards a low-lying swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of topsoil, underlain by a non-cohesive deposit ranging in composition from silt to sand with pockets of gravelly silty sand to sand and gravel, containing some cobbles, which is underlain by a silty sand and gravel to gravelly silt and sand deposit in places, in turn underlain by granite gneiss bedrock.

Topsoil

A 0.1 m to 0.3 m thick layer of topsoil was encountered at the ground surface in all boreholes.

The natural water content measured on one (1) sample of the topsoil is about 28 per cent.

Silt to Sand

A non-cohesive deposit of brown to grey, silt, some sand to silt and sand to silty sand to sand was encountered below the topsoil in all boreholes. The silty sand deposit and silt deposit encountered in Boreholes C57.1-S4 and C57.1-S5, respectively, contain trace organics. Pockets of gravelly silty sand, and sand and gravel are encountered within the silt to sand deposit in Boreholes C57.1-S3 and C57.1-S5, respectively. The top of the deposit varies between Elevation 208.7 m and 207 m, and its thickness ranges from 2.1 m to 4.6 m. In Boreholes C57.1-S1, the bottom of this deposit was defined by bedrock. Auger grinding was observed in Boreholes C57.1-S1 and C57.1-S2 at a depth of 1.4 m, corresponding to Elevations 205.9 m and 207.3 m, respectively.

The SPT 'N'-values recorded within the non-cohesive deposit range between 3 blows and 52 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The natural water content measured on samples of this deposit range from about 12 per cent and 28 per cent.

The grain size distributions of six (6) samples from this deposit are shown on Figure G.57.1-1 in Appendix G.

Gravelly Silty Sand and Sand and Gravel (Pockets)

Pockets of gravelly silty sand and sand and gravel, containing some cobbles, were encountered within the silt to sand deposit in Boreholes C57.1-S3 and C57.1-S5 at Elevations 208.2 m and 207.2 m, respectively and are approximately 0.7 m thick.

The SPT 'N'-values recorded within the gravelly silty sand and sand and gravel are 44 blows and 28 blows per 0.3 m of penetration, respectively, indicating a dense and compact relative density.

The natural water content measured on a sample of the gravelly silty sand, and sand and gravel is about 13 per cent and 11 per cent.



The grain size distribution of one (1) sample of the gravelly silty sand is shown on Figure G.57.1-2 in Appendix G.

Gravelly Silt and Sand to Sand and Gravel

A non-cohesive deposit of grey, wet, gravelly silt and sand to silty sand and gravel to sand and gravel was encountered below the silt to sand deposit in all boreholes except in Borehole C57.1-S1. The top of the granular deposit varies between Elevation 205 m and 204.1 m, and its thickness ranges from 0.3 m to 1.9 m. In Borehole C57.1-S2, the bottom of this deposit is defined by bedrock and in Boreholes C57.1-S3 to C57.1-S5, the bottom of the deposit is defined by refusal to split-spoon and casing advancement.

The SPT 'N'-values recorded within this granular deposit range between 16 blows and 41 blows per 0.3 m of penetration, indicating a compact to dense relative density. SPT 'N'-values measured within the bottom portion of the granular deposit in Boreholes C57.1-S4 and C57.1-S5 are 15 blows per 0.08 m of penetration and 35 blows per 0 m of penetration, respectively, prior to split-spoon refusal.

The natural water content measured on two samples of this deposit is about 1 per cent and 14 per cent.

The grain size distributions of two (2) samples from this deposit are shown on Figure G.C57.1-3.

Bedrock / Refusal

In Boreholes C57.1-S3 to C57.1-S5 and DCPTs C57.1-DC01 to C57.1-DC03, refusal to further split-spoon/casing advancement or cone penetration was encountered between depths of 3.0 m and 5.9 m, between Elevations 205.4 m and 203.1 m.

Bedrock was encountered and core samples were recovered from Boreholes C57.1-S1 and C57.1-S2. The depth to the bedrock is 2.4 m and 5.2 m below ground surface, corresponding to Elevation 204.9 m and 203.5 m in the respective boreholes. The bedrock consists of granite gneiss and the core samples are described as slightly weathered, grey, pink white and black, coarse to very coarse grained, foliated, non-porous, and strong to very strong. The Rock Quality Designation (RQD) measured on the core samples ranges between 92 per cent and 100 per cent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the samples recovered are 100 per cent, and between 92 per cent and 100 per cent, respectively.

Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table G1 in Appendix G. The point load index (I_{s50}) results from the axial laboratory tests carried out on four (4) samples of the granite gneiss bedrock range from approximately 4.9 MPa to 8.8 MPa. The point load index (I_{s50}) results from the diametral laboratory tests carried out on four (4) samples of the granite gneiss bedrock range from approximately 4.5 MPa to 7.4 MPa.

One (1) Unconfined Compression (UC) test was carried out in accordance to ASTM D7012, on a selected core sample of the granite gneiss bedrock from Borehole C57.1-S1 and measured a compressive strength of about 60 MPa, as detailed in Table G2 in Appendix G.

Based on a laboratory UC tests and point load tests in accordance with Table 3.5 of CFEM (2006)³, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) and very strong (R5, 100 MPa < UCS < 250 MPa).



Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in Boreholes C57.1-S1 to C57.1-S5 upon completion of drilling range between Elevations 207.8 m and 207.1 m, between depths of 0.2 m and 1.5 m below ground surface.



4.16 Highway 69 NBL – STA 16+345 (Culvert C57.1 – Site No. 44-621/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at about STA 16+345 in the Township of Shawanaga are shown on Drawing G1 in Appendix G. The culvert alignment will extend across the proposed Highway 69 NBL embankment which will be up to about 5 m high above existing grade at the proposed culvert location. Five (5) boreholes (Boreholes C57.1-N1 to C57.1-N5, inclusive) were advanced to specifically investigate the subsurface conditions along the culvert. In addition, four (4) Dynamic Cone Penetration Tests (DCPTs C57.1-DC04 to C57.1-DC07, inclusive) were advanced near the culvert to further confirm the depth to refusal in this area. The topography in the culvert area is relatively flat with ground cover consisting of relatively densely treed areas. In general, the ground surface slopes down relatively gently towards the north where a low-lying swamp is located.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of topsoil underlain in places by a near-surface deposit of silt of high plasticity or sandy clayey silt. The topsoil and the near-surface cohesive deposit are underlain by a non-cohesive deposit ranging in composition from silt to sand inferred to contain some cobbles at the west end of the culvert, which in turn is underlain by a deposit of gravelly silt and sand to sand and gravel, underlain by granite gneiss and schist bedrock.

Topsoil

A 0.1 m to 0.2 m thick layer of topsoil was encountered at the ground surface in all boreholes.

Silt / Sandy Clayey Silt

A near-surface cohesive deposit of light brown/brown, moist, silt, some sand, trace organics to sandy clayey silt, trace organics, was encountered below the topsoil in Borehole C57.1-N2 and C57.1-N4, respectively. The top of the deposit is at Elevation 207.7 m and 208.5 m, and the thickness of the deposit is 0.7 m and 0.6 m, at the respective boreholes.

Two SPT 'N'-values recorded within the cohesive deposit were 8 blows and 10 blows per 0.3 m of penetration, indicating a firm to stiff consistency.

The natural water content measured on two (2) samples of this deposit is about 24 per cent and 71 per cent.

An Atterberg limits test carried out on a specimen of the silt deposit measured a liquid limit of about 55 per cent and a plastic limit of about 43 per cent, corresponding to a plasticity index of about 12 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure G.C57.1-4 in Appendix G and indicates that the material is a silt of high plasticity.

Sandy Silt to Sand

A non-cohesive deposit of brown to grey, moist to wet, sandy silt to silty sand to sand was encountered in all boreholes either below the topsoil or below the silt / sandy clayey silt deposit. The upper portion of the sandy silt to sand deposit in places contains trace to some organics. A pocket of sand and gravel was encountered within the sandy silt to sand deposit in Borehole C57.1-N1. The top of the deposit varies between Elevation 208.9 m and 207.0 m, and the overall thickness of the deposit ranges from 0.6 m to 2.7 m. Inferred cobbles, indicated by auger grinding, were encountered at the west end of the culvert in Borehole C57.1-N1 at a depth of 0.6 m, corresponding to Elevation 207.6 m.

The SPT 'N'-values recorded within the non-cohesive deposit range between 3 blows and 27 blows per 0.3 m of penetration, indicating a very loose to compact relative density.



The natural water content measured on samples of this deposit range from about 18 per cent and 33 per cent. The grain size distributions of two (2) samples from this deposit are shown on Figure G.57.1-5 in Appendix G.

Sand and Gravel (Pocket)

A 0.7 m thick granular pocket of sand and gravel containing trace to some silt was encountered within the sand to sandy silt deposit in Boreholes C57.1-N1 at Elevation 207.4 m. Inferred cobbles, indicated by auger grinding, were encountered within this pocket at a depth of 1.4 m, corresponding to Elevation 206.8 m.

One (1) SPT 'N'-value recorded within the sand and gravel was 54 blows per 0.3 m of penetration, indicating a very dense relative density.

The natural water content measured on a sample of the sand and gravel is about 10 per cent.

A grain size distribution of one (1) sample of the sand and gravel is shown on Figure G.57.1-6 in Appendix G.

Gravelly Silt and Sand to Sand and Gravel

A non-cohesive deposit of brown to grey, moist to wet, gravelly silt and sand to sand and gravel was encountered below the sandy silt to sand deposit in all boreholes. At the west end of the culvert the deposit is inferred to contain cobbles below a depth of 2.3 m to 2.4 m below ground surface, below Elevations 205.8 m to 205.3 m. The top of the granular deposit varies between Elevations 208.2 m and 205.2 m, and the thickness of the deposit ranges from 0.2 m to 2.1 m. The bottom of this deposit is defined by bedrock in four boreholes and by refusal to split-spoon and casing advancement in Borehole C57.1-N4.

The SPT 'N'-values recorded within this granular deposit range between 16 blows per 0.3 m of penetration and 50 blows per 0.07 m of penetration, indicating a compact to very dense relative density. SPT 'N'-values measured within the bottom portion of the granular deposit in Boreholes C57.1-N4 and C57.1-N5 are 15 blows per 0 m of penetration and 22 blows per 15 m of penetration, respectively, prior to split-spoon and casing refusal on bedrock.

The natural water content measured on four (4) samples of this deposit range between about 9 per cent and 18 per cent.

The grain size distribution of two (2) samples from this deposit are shown on Figure G.C57.1-7.

Bedrock / Refusal

In Borehole C57.1-N4 and DCPTs C57.1-DC04 to C57.1-DC07, refusal to further split-spoon/casing advancement or cone penetration was encountered at depths between 1.0 m and 5.2 m below ground surface, corresponding to between Elevation 208.0 m and 203.4 m.

Bedrock was encountered and core samples were recovered from Boreholes C57.1-N1 to C57.1-N3 and C57.1-N5. The depth to the surface of the bedrock varies between 0.9 m and 2.9 m below ground surface, between Elevations 207.3 m and 205.0 m. The bedrock generally consists of granite gneiss in places consisting of granite gneiss and migmatite or granite gneiss and schist. The core samples are described as fresh, medium to coarse grained, moderately foliated, moderately porous, medium strong, black, grey and white. The Rock Quality Designation (RQD) measured on the core samples generally ranges between 69 per cent and 100 per cent, indicating a rock mass of fair to excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the sample recovered are 100 per cent, and between 82 per cent and 100 per cent, respectively.



Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheets and in Table G1 in Appendix G. The point load index (Is_{50}) results from the axial laboratory tests carried out on eleven (11) samples of the granite gneiss bedrock range from approximately 2.6 MPa to 7.9 MPa. The point load index (Is_{50}) results from the diametral laboratory tests carried out on eleven (11) samples of the granite gneiss and one (1) sample of the granite gneiss and schist bedrock range from approximately 4.5 MPa to 9.3 MPa.

Three (3) Unconfined Compression (UC) tests were carried out in accordance to ASTM D7012, on selected core samples of the granite gneiss bedrock from Boreholes C57.1-N2, C57.1-N3 and C57.1-N5, and measured compressive strengths between about 73 MPa and 107 MPa, as detailed in Table G3 to G5 in Appendix G.

Based on the laboratory UC tests and point load tests, in accordance with Table 3.5, CFEM (2006)³, the granite gneiss / granite gneiss and migmatite / granite gneiss and schist bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in Boreholes C57.1-N1 to C57.1-N5 upon completion of drilling range between about Elevations 208.0 m and 207.3 m, at depths between 0.5 m and 1.0 m below ground surface.



4.17 Highway 69 SBL – STA 16+499 (Culvert C57 – Site No. 44-622/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at about STA 16+499 in the Township of Shawanaga are shown on Drawing H1 in Appendix H. The culvert alignment will extend across the proposed Highway 69 SBL embankment which will be up to about 9 m high above existing grade at the proposed culvert location. Three (3) boreholes (Boreholes S24-03, S24-04 and S23-06) and one (1) DCPT (S24-DC01), advanced for the proposed highway embankment crossing of Swamp 24, but located in close proximity to the culvert, were utilized to investigate the subsurface conditions along the culvert alignment. The topography in the culvert area is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, within the confines of tree covered valley slopes at the north and south limits of the associated swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of root mat/peat underlain by a non-cohesive deposit generally grading from sandy silt to sand, underlain in places by a deposit of sand and gravel. Bedrock outcrops are present to the south of the proposed culvert alignment.

Ice / Water

Ice and water to a depth of 0.2 m was encountered in Borehole S24-06.

Root Mat / Peat

A deposit of dark brown, wet, root mat or amorphous peat containing rootlets was encountered either at the ground surface or below the ice/water cover in all the boreholes. The top of the root mat/peat deposit is between Elevation 203.1 m and 202.7 m and the thickness of the peat deposit is between 0.2 m and 0.4 m.

The Standard Penetration Test (SPT) 'N'-values recorded within the peat deposit are 3 blows and 4 blows per 0.3 m of penetration, suggesting a soft consistency.

Silt

A 0.1 m to 0.2 m thick layer of brown to grey, wet silt, trace to some sand, trace clay was encountered in Boreholes S24-03 and S24-04 at surface, Elevations 202.4 m and 202.7 m, respectively.

Silt and Sand to Sand

A deposit of brown to grey non-cohesive soil grading from silt and sand to sand was encountered below the silt layer or peat deposit in all boreholes. The deposit generally contains trace gravel, trace clay, trace organics and root mat/rootlets near the surface. The top of this deposit ranges between Elevations 202.6 m and 202.2 m and the thickness of the deposit ranges between 9.0 m and 11.7 m. Boreholes S24-04 and S24-06 were terminated within this deposit upon refusal to further split-spoon and/or casing/auger advancement.

The SPT 'N'-values measured within this deposit range from 3 blows to 21 blows per 0.3 m of penetration, with 100 blows per 0.02 m and 0.25 m of penetrations recorded at the bottom of the deposit prior to split-spoon and casing refusal, indicating a very loose to compact relative density.

The natural water content measured on sixteen (16) samples of this deposit ranges from about 19 per cent to 28 per cent. The organic content measured on one (1) sample of the near surface of this deposit is about 1 per cent.



The grain size distributions of nine (9) samples of the silt and sand to sand portion of this deposit are shown on Figures H.C57-1A and H.C57-1B in Appendix H. An Atterberg limits test on one (1) sample of this deposit indicates this material to be non-plastic.

Sand and Gravel

A non-cohesive deposit of grey sand and gravel, trace silt was encountered below the sand deposit in Borehole 24-03, and extends to refusal at a depth of 12.7 m below ground surface. The top of the sand and gravel deposit is at Elevation 191.6 m and the thickness of the deposit is 1.6 m.

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

Bedrock / Refusal

Bedrock outcrops are present to the south of the proposed culvert alignment. In Boreholes S24-03, S24-04, S24-06 and DCPT S24-DC01, refusal to further split-spoon, casing and/or auger advancement or cone penetration was encountered at depths between 9.5 m and 14.4 m below ice or ground surface, corresponding to between Elevations 193.6 m and 188.3 m.

Groundwater Conditions

The samples taken in the boreholes were wet with free water noted in a number of silt and sand and sand samples. Water levels observed in the boreholes upon completion of drilling range between Elevation 202.8 m and 202.7 m, measured at the ice and peat surface and at a depth of 0.3 m below the peat surface.



4.18 Highway 69 NBL – STA 16+485 (Culvert C57 – Site No. 44-622/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at about STA 16+485 in the Township of Shawanaga are shown on Drawing H1 in Appendix H. The culvert alignment will extend across the proposed Highway 69 NBL embankment which will be up to about 9 m high above existing grade at the proposed culvert location. Three (3) boreholes (Boreholes S24-06, S24-10 and S24-11) and one (1) DCPT (DCPT S24-DC01), advanced for the proposed highway embankment crossing of Swamp 24, but located in close proximity to the culvert, were utilized to investigate the subsurface conditions along the culvert alignment. The topography in the culvert area is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, within the confines of tree covered valley slopes at the north and south limits of the associated swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of root mat/peat underlain by a deposit of sandy silt to sand, which in turn is underlain by a deposit of sand and gravel. The sand and gravel deposit is underlain by a lower deposit of silt and sand that extends to the refusal depth. Resistance to dynamic cone penetration and borehole advancement was encountered at greatest depth at about STA 16+475. Bedrock outcrops are present along the southern limit of the swamp.

Ice / Water

Ice and water to depths between 0.2 m and 0.3 m were encountered in all the boreholes.

Root Mat / Peat

A deposit of dark brown, wet, root mat and/or amorphous peat containing sand lenses was encountered below the ice/water cover in all the boreholes. The top of the root mat/peat deposit ranges between Elevation 202.5 m and 201.9 m and the thickness of the peat deposit is between 0.2 m and 1.1 m.

An SPT 'N'-value recorded within the peat was 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

Silt

In Borehole S24-10, a 0.1 m thick layer of grey, wet silt was encountered underlying the peat deposit at Elevation 201.9 m; and a 0.6 m thick pocket of grey, wet silt was encountered within the silt and sand deposit (described below) at Elevation 190.2 m.

Sandy Silt to Sand

A non-cohesive deposit of brown to grey soil grading from sandy silt to silt and sand to silty sand to sand was encountered below the root mat/peat deposit or silt layer in all boreholes. The deposit generally contains trace gravel, trace clay, trace organics and root mat/rootlets near the surface. The sandy silt to silt deposit is interlayered with a 1.4 m thick deposit of sand and gravel (described below) and 0.6 m thick pocket of silt (described above). The top of this deposit ranges between Elevation 202.3 m and 200.8 m and the overall thickness of the deposit ranges between 5.4 m and 13.9 m, including the sand and gravel layer and the silt pocket. Boreholes S24-06 and S24-11 were terminated within this deposit upon refusal to further split-spoon and/or auger/casing refusal.

The SPT 'N'-values measured within the sandy silt to sand deposit range from 2 blows to 49 blows per 0.3 m of penetration but are typically greater than 10 blows, and an SPT 'N'-value of 100 blows per 0.25 m of penetration



was recorded at the bottom of the deposit prior to split-spoon and auger refusal in Borehole S24-06. The SPT 'N'-values measured in this deposit indicate a very loose to dense relative density.

The natural water content measured on seventeen (17) samples of this deposit ranges from about 14 per cent to 46 per cent. The organic content measured on two (2) samples of the near surface of this deposit is about 0.5 per cent and 1 per cent.

The grain size distributions of nine (9) samples from this deposit are shown on Figures H.C57-2A and H.C57-2B in Appendix H.

Sand and Gravel

A deposit of grey sand and gravel trace silt containing some cobbles and a boulder was in Borehole S24-10 interlayered with the sand / silt and sand and underlying the silt and sand portions of the sandy silt to sand deposit. The sand and gravel interlayer is 1.4 m thick and was encountered at Elevation 192.5 m; and the lower sand and gravel deposit is 1.6 m thick and was encountered at Elevation 187.9 m. The bottom of the lower deposit of the sand and gravel deposit is defined by refusal to further split-spoon and casing advancement.

The SPT 'N'-values measured within the sand and gravel interlayer and deposit are 17 blows and 33 blows per 0.3 m of penetration, indicating a compact to dense relative density.

Bedrock / Refusal

Bedrock outcrops are present to the south of the proposed culvert alignment. In Boreholes S24-06, S24-10 and S24-11, refusal to further split-spoon and/or auger/casing advancement was encountered at depths ranging between 6.8 m and 16.1 m below ice surface, corresponding to between Elevation 195.4 m and 186.3 m.

Groundwater Conditions

The samples taken in the boreholes were wet with free water noted. Water levels observed in the boreholes upon completion of drilling range from Elevation 202.7 m to 202.2 m, measured at the ice surface.



4.19 Highway 69 SBL – STA 17+272 (Culvert C60)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+272 in the Township of Shawanaga are shown on Drawing I1 in Appendix I. The culvert will extend across a swamp area (Swamp 25) and the proposed Highway 69 SBL embankment, which will be up to about 8.5 m above the existing grade at the proposed culvert location. A total of three (3) boreholes (Boreholes C60-S1 to C60-S3, inclusive) were advanced along the length of the culvert to investigate the subsurface conditions at this culvert location. The topography in the area is relatively flat to low-lying consisting of bedrock knobs, grassy and heavily treed ground with areas of shallow open water.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of peat underlain by a deposit of silty sand, over a deposit of clay. The clay deposit is in turn underlain by a deposit of silt in places, underlain by a deposit of sand which extends to the refusal depth. Bedrock outcrops are present to the north and south of the swamp in which the culvert is located.

Ice / Water

Ice and water to depths between 0.8 m and 1.2 m was encountered in Boreholes C60-S1 to C60-S3.

Peat

A 0.1 m to 0.2 m thick layer of dark brown, wet, fibrous peat was encountered underlying the ice/water cover in all boreholes drilled at this culvert location. The top of the peat varies between Elevation 201.8 m and 201.5 m.

A SPT 'N'-value recorded within this layer is 0 blows (weight of hammer) per 0.3 m of penetration, indicating a very soft consistency.

Silty Sand

A deposit of brown to grey silty sand, trace clay containing organics was encountered below the peat in all boreholes. The top of the silty sand deposit ranges from Elevation 201.7 m to 201.2 m and its thickness ranges from 1.5 m to 2.2 m.

The SPT 'N'-values measured within this deposit range from 6 blows to 14 blows per 0.3 m of penetration, but are typically less than 9 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on samples of this deposit ranges between about 25 per cent and 27 per cent. The upper portion of the silty sand deposit was visually noted to be slightly organic. Laboratory testing on one (1) sample of the silty sand measured an organic content of about 1 per cent.

A grain size distribution of one (1) sample of the silty sand deposit is shown on Figure I.C60-1 in Appendix I.

Clay

A deposit of brown and grey clay, some silt and trace sand was encountered below the deposit of silty sand in all boreholes advanced at this culvert location. The top of the clay deposit is at between Elevation 199.7 m and 199.6 m and its thickness ranges from 0.7 m to 2.8 m.

The SPT 'N'-values recorded within the cohesive deposit are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths



between about 14 kPa and 20 kPa and the sensitivity is calculated to range from about 5 to 8. The field vane tests results together with the SPT 'N'-values indicate that the clay deposit has a very soft to soft consistency.

The natural water content measured on two (2) samples of this deposit is about 45 per cent and 74 per cent.

An Atterberg limits test carried out on one (1) sample of the clay deposit measured a liquid limit of about 60 per cent, a plastic limit of about 20 per cent and a corresponding plasticity index of about 40 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure I.C60-2 in Appendix I and indicate that the material is classified as clay of high plasticity.

Silt

Underlying the clay deposit in Boreholes C60-S1 and C60-S2 is a deposit of grey silt, some sand and trace clay. The top of the silt deposit is at Elevation 198.8 and 197.6 m and its thickness is 0.8 m and 0.3 m in Boreholes C60-S1 and C60-S2, respectively.

The SPT 'N'-values recorded within this deposit are 0 blows (weight of hammer) and 3 blows per 0.3 m of penetration, indicating that the silt has a very loose relative density.

The natural water content measured on a sample of this deposit is about 23 per cent.

An Atterberg limits test carried out on a sample of the silt deposit measured a liquid limit of about 17 per cent and a plastic limit of about 14 per cent, corresponding to a plasticity index of about 3 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure I.C60-3 in Appendix I and indicate the material to be a silt of low plasticity.

Sand

A deposit of grey to brown sand, trace to some gravel and trace to some silt was encountered below the deposit of silt in Boreholes C60-S1 and C60-S2 and below the clay deposit in Borehole C60-S3. The top of the sand deposit ranges from Elevation 198 m to 196.9 m and its thickness ranges from 0.1 m to 9.3 m. The bottom of this deposit was defined by refusal to further split-spoon and/or casing advancement.

The SPT 'N'-values recorded within this deposit typically range from 3 blows to 21 blows per 0.3 m of penetration, but are typically greater than 6 blows per 0.3 m of penetration, indicating a generally loose to compact relative density. A SPT 'N'-value of 4 blows per 0.13 m of penetration was recorded prior to split-spoon refusal in Borehole C60-S1 and a SPT 'N'-value of 150 blows per 0.15 m of penetration was recorded prior to casing refusal.

The natural water content measured on samples of the sand deposit ranges from about 11 per cent to 36 per cent.

The grain size distributions of two (2) samples from this deposit are shown on Figure I.C60-4 in Appendix I.

Bedrock / Refusal

Bedrock outcrops are present to the north and south of the swamp area in which the culvert is located. In Boreholes C60-S1 to C60-S3, refusal to further split-spoon and/or casing advancement was encountered at depths between 4.7 m and 15.1 m, corresponding to Elevation 197.9 m and 187.6 m.



Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select sand samples. The water levels observed in the boreholes upon completion of drilling were at Elevation 202.6 m and 202.5 m, measured at a depth of 0.1 m below the ice surface.



4.20 Highway 69 NBL – STA 17+276 (Culvert C60)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+276 in the Township of Shawanaga are shown on Drawing I1 in Appendix I. The culvert will extend across a swamp area (Swamp 25) and the proposed Highway 69 NBL embankment which will be up to about 8 m above the existing grade at the proposed culvert location. A total of three (3) boreholes (Boreholes C60-N1 to C60-N3, inclusive) were advanced along the length of the culvert to investigate the subsurface conditions at this culvert location. The topography in the area is relatively flat to low-lying consisting of bedrock knobs, grassy and heavily treed ground with areas of shallow open water.

In general, the subsurface soils along the culvert alignment consist of a surficial deposit of peat underlain by a deposit of silt and sand to sand, underlain by a deposit of silty clay. The silty clay deposit is underlain by deposits of silt and/or silty sand in places, which in turn is underlain by a deposit of silt and sand to sand. Bedrock outcrops are present to the north and south of the swamp in which the culvert is located.

Ice / Water

Ice and water to a depth of 0.8 m was encountered in Borehole C60-N3.

Peat

A deposit of dark brown, wet, fibrous peat containing rootlets was encountered at the ground surface in Boreholes C60-N1 and C60-N2 and below the ice/water cover in Borehole C60-N3. The top of the peat ranges from Elevation 203.2 m to 201.8 m and its thickness varies between 0.1 m and 0.6 m.

The Standard Penetration Test (SPT) 'N'-values recorded within the peat deposit are 0 blows (weight of hammer) and 4 blows per 0.3 m of penetration, indicating a very soft to soft consistency.

Silt and Sand to Sand (Upper Deposit)

A deposit of non-cohesive soil comprised of brown to grey silt and sand, silty sand and sand some silt was encountered below the peat in all boreholes. The deposit generally contains trace clay and the near surface portion of the deposit contains organics and wood fragments. The top of the silt and sand to sand deposit ranges from Elevation 202.6 m to 201.6 m and its thickness ranges from 1.6 m to 3.1 m.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 18 blows per 0.3 m of penetration, but are typically greater than 6 blows per 0.3 m of penetration, indicating a generally loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 24 per cent to 35 per cent. The upper portion of the silt and sand to sand deposit was visually noted to be slightly organic. Laboratory testing on one (1) sample of the silty sand measured an organic content of about 2 per cent.

The grain size distributions of three (3) samples of the silt and sand to sand deposit are shown on Figure I.C60-5 in Appendix I.



Silty Clay

A deposit of brown to grey silty clay trace sand was encountered below the deposit of silt and sand to sand in all boreholes advanced in this area. The top of the silty clay deposit ranges from Elevation 200 m to 199.2 m and its thickness ranges from 0.8 m to 3.1 m.

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 4 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths of about 19 kPa and 20 kPa and the sensitivity is calculated to be about 6. The field vane tests results together with the SPT 'N'-values indicate that the silty clay deposit has a very soft to soft consistency.

The natural water content measured on samples of this deposit ranges from about 32 per cent to 67 per cent.

Atterberg limits tests carried out on two (2) samples of the silty clay deposit measured liquid limits of about 38 per cent and 49 per cent, plastic limits of about 17 per cent and 18 per cent, corresponding to plasticity indices of about 21 per cent and 31 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure I.C60-6 in Appendix I and indicate that the material is classified as silty clay of intermediate plasticity.

Silty Sand

Underlying the silty clay deposit in Borehole C60-N2 is a deposit of grey silty sand, trace gravel and trace clay. The top of the silty sand deposit is at Elevation 198.7 m and its thickness is 1.4 m.

A SPT 'N'-value recorded within this deposit is about 5 blows per 0.3 m of penetration, indicating a loose relative density.

Silt

A deposit of grey and reddish brown silt, some sand and trace clay was encountered underlying the silty clay deposit in Borehole C60-N1 and below the deposit of silty sand in Borehole C60-N2. The top of the silt deposit is at Elevation 196.9 and 197.3 m and its thickness is 0.7 m and 1.3 m in Boreholes C60-N1 and C60-N2, respectively.

The SPT 'N'-values recorded within this deposit are 5 blows and 6 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on two (2) samples of this deposit is about 22 per cent and 30 per cent.

A grain size distribution of one (1) sample from the silt deposit is shown on Figure I.C60-7 in Appendix I.

An Atterberg limits test carried out on a sample of the silt deposit measured a liquid limit of about 19 per cent and a plastic limit of about 17 per cent, corresponding to a plasticity index of about 2 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure I.C60-8 in Appendix I and indicate the material to be a silt of low plasticity.

Silt and Sand to Sand (Lower Deposit)

A deposit of grey to brown silt and sand to sand, trace to some silt and trace to some gravel was encountered below the silt deposit in Boreholes C60-N1 and C60-N2 and below the silty clay deposit in Borehole C60-N3. The top of the silt and sand to sand deposit ranges from Elevation 196.8 m to 196 m and its thickness ranges



from 4.6 m to 9.1 m. The bottom of this deposit was defined by refusal to further split-spoon and/or casing advancement.

The SPT 'N'-values measured within this deposit range from 4 blows to 22 blows per 0.3 m of penetration, indicating a loose to compact relative density. The natural water content measured on samples of this deposit ranges between about 21 per cent and 25 per cent.

A grain size distribution of one (1) sample of the silt and sand deposit is shown on Figure I.C60-9 in Appendix I.

Bedrock / Refusal

Bedrock outcrops are present to the north and south of the swamp area in which the culvert is located. In Boreholes C60-N1 to C60-N3, refusal to further casing advancement was encountered at depths between 10.6 m and 14.9 m, corresponding to Elevation 191.6 m and 187.7 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select sand samples. Water levels observed in the boreholes upon completion of drilling range from Elevation 202.9 m and 202.2 m, measured at the ground surface and up to a depth of 0.3 m below the ice or ground surface.



4.21 Shebeshekong Road S-E/W Ramp – STA 14+990 (Culvert C51)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 14+990 in the Township of Shawanaga are shown on Drawing J1 in Appendix J. The culvert will extend across the proposed Shebeshekong Road S-E/W Ramp embankment which will be up to about 5.5 m high above the existing grade at the proposed culvert location. One (1) borehole (Borehole C51-R1) was advanced to specifically investigate the subsurface conditions at the east end of the culvert and is supplemented with Boreholes S22-02 and S22-03 advanced for the proposed Shebeshekong Road S-E/W Ramp embankment crossing of Swamp 22. In addition, one (1) Dynamic Cone Penetration Test (DCPT S22-DC03) was advanced near the culvert to further confirm the depth of refusal in this area. The topography in the area is relatively flat to low-lying consisting of bedrock knobs, grassy and heavily treed ground with areas of shallow open water.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of topsoil (where present) and a deposit of sandy silt to sand which in turn is underlain by a stratum of clayey silt. The clayey silt stratum is underlain by an upper deposit of silt and sand which is underlain in places by a clay stratum. The clay stratum or silt and sand deposit in turn is underlain by a lower deposit of silt and sand to sand and refusal conditions.

Topsoil

A 0.2 m thick layer of topsoil was encountered in Borehole C51-R1.

Sandy Silt to Sand

A non-cohesive deposit of light/dark brown to grey, moist to wet, sandy silt to sand, trace to some silt, trace organics was encountered below the topsoil in Borehole C51-R1 and at the ground surface in Boreholes S22-02 and S22-03. The top of the sandy silt to sand deposit ranges from Elevation 207.7 m to 207.0 m, and the thickness of this deposit ranges from 2.5 m to 3.2 m.

The SPT 'N'-values measured within this deposit range from 1 blow to 32 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The natural water content measured on samples of this deposit ranges from about 23 per cent to 37 per cent and the organic content of one (1) sample of the sandy silt deposit recovered from Borehole S22-03 is about 3 per cent.

The grain size distributions of two (2) samples of this deposit are shown on Figure J.C51-1 in Appendix J.

Clayey Silt

A stratum of grey/reddish brown, wet, clayey silt containing trace sand was encountered below the deposit of sandy silt to sand in all boreholes. The top of the clayey silt deposit ranges from Elevation 204.5 m to 204.2 m, and the thickness of this deposit ranges between 1.0 m and 1.2 m.

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 6 blows per 0.3 m of penetration. Two in situ field vane tests carried out in Boreholes C51-R1 and S22-02 within this stratum measured undrained shear strengths of about 25 kPa and 36 kPa and sensitivities of 7 and 4, respectively. The field vane test results indicate that the clayey silt stratum has a firm consistency.

The natural water content measured on samples of this deposit ranges from about 39 per cent to 51 per cent.

Atterberg limits tests carried out on two (2) samples of the clayey silt deposit measured liquid limits of about 27 per cent and 33 per cent, plastic limits of about 14 per cent, corresponding to plasticity indices of about



13 per cent and 18 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure J.C51-2 in Appendix J and indicate that the material is classified as clayey silt of low plasticity.

Silt and Sand (Upper Deposit)

A non-cohesive upper deposit of grey, wet, silt and sand containing trace to some clay and trace gravel was encountered below the clayey silt stratum in all boreholes. The top of the silt and sand deposit ranges from Elevation 203.4 m to 203.1 m, and the thickness of the deposit ranges from 2.8 m to 3.4 m.

The SPT 'N'-values measured within this deposit range from 1 blow to 8 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

The natural water content measured on samples of this deposit ranges from about 20 per cent to 22 per cent.

The grain size distributions of two (2) samples of the silt and sand deposit are shown on Figure J.C51-3 in Appendix J.

Clay

A stratum of reddish brown, wet, clay containing some silt, trace sand, was encountered below the upper silt and sand deposit in Boreholes S22-02 and S22-03. The top of the clay deposit is at Elevation 200.3 m and 200.1 m, and the thickness of this deposit is 1.5 m.

An SPT 'N'-value measured within the cohesive deposit is 2 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths of about 35 kPa and 36 kPa. The sensitivity is calculated to be about 4 and 6. The field vane tests results together with the SPT 'N'-values suggest that the clay deposit has a soft to firm consistency.

The natural water content measured on samples of this deposit ranges from about 56 per cent to 73 per cent.

Atterberg limits tests carried out on two (2) samples of the clay deposit measured liquid limits of about 59 per cent and 62 per cent, plastic limits of about 20 per cent and 21 per cent, corresponding to plasticity indices of about 39 per cent and 41 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure J.C57-4 in Appendix J and indicate that the material is classified as clay of high plasticity.

Silt and Sand to Sand (Lower Deposit)

A lower non-cohesive deposit of grey/reddish brown, wet, silt and sand to silty sand to sand, containing trace to some clay, trace gravel, was encountered below the clay stratum in Boreholes S22-02 and S22-03 and below the upper deposit of silt and sand in Borehole C51-R1. The top of silt and sand to sand lower deposit ranges from Elevation 200.0 m to 198.6 m, and the thickness of this deposit ranges from 1.8 m to 4.7 m.

The SPT 'N'-values measured within this deposit range from 4 blows to 18 blows per 0.3 m of penetration, indicating a loose to compact relative density. SPT 'N'-values measured within the bottom portion of the non-cohesive deposit in Boreholes S22-02 and S22-03 are 50 blows per 0.05 m of penetration and 2 blows per 0.08 m of penetration, respectively, prior to split-spoon refusal.

The natural water content measured on samples of this deposit ranges from about 16 per cent to 24 per cent.

The grain size distributions of two (2) samples of the silt and sand portion of the deposit are shown on Figure J.C51-5 in Appendix J.



Bedrock / Refusal

Boreholes C51-1R, S22-02 and S22-03 and DCPT S22-DC03 (including a DCPT advanced about 0.5 m east of Borehole C51-R1) encountered refusal to further split-spoon or casing advancement or cone penetration at depths between 9.0 m and 13.8 m below ground surface, corresponding to between Elevation 198.3 m and 193.9 m; however, the DCPT advanced near Borehole C51-R1 penetrated to a depth of 13.0 m below ground surface, inferred due to sliding along a sloping bedrock surface.

Groundwater Conditions

In general, the samples taken in the boreholes were wet. Water levels were measured in the Boreholes C51-R1 and S22-03 upon completion of drilling at Elevation 206.8 m and 207.0 m, respectively, at depths of 0.4 m and 0.7 m below the ground surface. In Borehole S22-02, the water level was measured at 0.6 m above the ground surface, corresponding to Elevation 207.8 m, indicating artesian conditions.



4.22 Site No. 9 Road – STA 10+235 (Culvert C53)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+235 in the Township of Shawanaga are shown on Drawing K1 in Appendix K. The culvert will extend across the proposed Site No. 9 Road which will be up to about 4 m high above the existing grade at the proposed culvert location. A total of two (2) borehole (Boreholes C53-01 and C53-02) were advanced to specifically investigate the subsurface conditions along the culvert and are supplemented with Borehole S26-03 advanced for the proposed Site No. 9 Road embankment crossing of Swamp 26. The topography in the area is relatively flat, with ground cover consisting of shrubs, sparse trees and wet grassy areas, located within the confines of a relatively higher ground and densely treed area and bounded to the east by the existing Highway 69. Bedrock outcrops are present along the southern limit of the swamp.

In general, the subsurface soils along the culvert alignment consist of a surficial layer of sandy organic silt (where present) underlain by a non-cohesive deposit of silt to sand which is underlain by granite gneiss bedrock.

Sandy Organic Silt

A 0.3 m thick, non-cohesive deposit of brown, wet, sandy organic silt was encountered at the ground surface in Boreholes C53-01 and C53-02.

The SPT 'N'-values measured within the sandy organic silt are 2 blows and 4 blows per 0.3 m of penetration, indicating a very loose relative density.

The natural water content measured on one (1) sample of the sandy organic silt from Borehole C53-02 is about 539 per cent.

Silt to Sand

A non-cohesive deposit of brown to grey, moist to wet, silt, some sand to sandy silt to silt and sand to silty sand to sand was encountered below the sandy organic silt in Boreholes C53-01 and C53-02 and at the ground surface in Borehole S26-03. The upper portion of the non-cohesive deposit (up to a depth of 2.2 m below ground surface) contains trace organics. A pocket of silty clay was encountered between the silt and sand and the silt portions of the overall deposit in Borehole C53-01. The top of the silt and sand deposit ranges between Elevation 210.9 m and 210.5 m, and the overall thickness of the deposit ranges from 5.1 m to 7.1 m. In Borehole C53-02 the bottom of this deposit is defined by bedrock, and in Boreholes C53-01 and S26-03 the bottom of the deposit is defined by refusal to further split-spoon/casing advancement.

The SPT 'N'-values recorded within the non-cohesive deposit range between 0 blows (weight of hammer) and 15 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit range between about 19 per cent and 26 per cent.

The grain size distributions of seven (7) samples of this deposit are shown on Figure K.C53-1 in Appendix K.

Silty Clay (Pocket)

A 0.5 m thick pocket of grey, wet, silty clay was encountered between the silt to sand / silt portions of the non-cohesive deposit in Borehole C53-01 at Elevation 202.8 m.

One (1) SPT 'N'-value measured within the silty clay pocket is 7 blows per 0.3 m of penetration, suggesting a firm consistency.



The natural water content measured on one (1) sample of the silty clay pocket is about 55 per cent.

An Atterberg limits test carried out on a specimen of the silt clay measured a liquid limit of about 41 per cent and a plastic limit of about 17 per cent, corresponding to a plasticity index of about 24 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure K.C53-2 in Appendix K and indicates that the material is a silty clay of intermediate plasticity.

Bedrock / Refusal

In Boreholes C53-01 and S26-03, refusal to further split- spoon/casing advancement was encountered at a depth of 7.4 m and 6.1 m below ground surface, respectively, corresponding to Elevations 203.6 m and 204.8 m.

Bedrock was encountered and core samples were recovered from Borehole C53-02. The depth to bedrock is 5.4 m below ground surface, corresponding to Elevation 205.4 m. The bedrock consists of granite gneiss and the core samples are described as fresh, foliated, grey, white and pink, coarse to fine grained containing garnet porphyries, non-porous, and strong to extremely strong. The Rock Quality Designation (RQD) measured on the core samples is 100 per cent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the samples recovered are 100 per cent and between 78 per cent and 100 per cent, respectively.

Axial and diametral point load strength index values for selected samples of rock core are shown on the Record of Drillhole Sheet and in Table K1 in Appendix K. The point load index (Is_{50}) results from the axial laboratory tests carried out on four (4) samples of the granite gneiss bedrock range from approximately 3.7 MPa to 10.5 MPa. The point load index (Is_{50}) results from the diametral laboratory tests carried out on two (2) samples of the granite gneiss bedrock are approximately 4.3 MPa and 4.5 MPa.

Based on laboratory point load tests, in accordance with Table 3.5, CFEM (2006)³, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to extremely strong (R6, UCS >250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet. The depth to the water levels measured in the boreholes upon completion of drilling range from ground surface to 0.3 m below the ground surface, ranging from Elevation 210.8 m to 210.6 m.



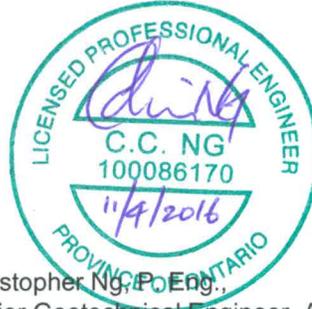
5.0 CLOSURE

The field technicians directing the drilling program were Messrs. Matt Rhody, Indulis Dumpis and Mathew Riopelle. This report was prepared by Mr. Tomaz Zalucki, P. Eng., Ms. Veronica T. Ayetan, P. Eng., and Mr. Alex Szot and was reviewed by Mr. Christopher Ng, P.Eng., a Senior Geotechnical Engineer and Associate of Golder. Mr. Jorge M. A. Costa, P. Eng., Golder's Designated MTO Contact for this project and Principal of Golder, conducted an independent quality control review of the report.



Report Signature Page

Alex Szot, EIT
Geotechnical Engineer-in-Training



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



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

CN/VA/TZ/AJS/MCK/JPD/JMAC/mck

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STANDARDS:

ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM D1587	Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D7012	Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperature
ASTM D2573	Standard Test Method for Field Vane Shear Test in Cohesive Soil

Ontario Water Resources Act:

Ontario Regulation 903	Wells (as amended)
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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

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

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



LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

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

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

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

III. SOIL DESCRIPTION

(a) Non-Cohesive Soils

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

(b) Cohesive Soils Consistency

	<u>kPa</u>	<u>Cu, Su</u>	<u>psf</u>
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.



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	



TABLES



**FOUNDATION REPORT – CULVERTS – PHASE 2
HIGHWAY 69 G.W.P. 5111-07-00**

**TABLE 1 – SUMMARY OF CULVERT DETAILS
HIGHWAY 69 FOUR-LANING – PHASE 2**

Culvert Designation	Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls and Wing Walls ¹	Boreholes / DCPTs	Reference Appendix
			East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
C45 (Precast Box)	Highway 69 SBL STA 13+380 (Swamp 18)	4.0 m	210.477	210.390	2.4	1.8	29.1	No	3 Boreholes (C45-S1 to C45-S3) / 6 DCPTs (C45-DC01 to C45-DC06)	A
	Highway 69 NBL STA 13+380 (Swamp 18)	5.0 m (< 0.5 m grade raise)	210.600	210.497	2.4	1.8	34.4	No	3 Boreholes (C45-N1 to C45-N3) / 2 DCPTs (C45-DC07 and C45-DC08)	
C47 (Site No. 44-616/C2 & 44-616/C1) (Precast Box)	Highway 69 SBL STA 13+778 (Swamp 19)	5.0 m	210.610	210.508	3.0	1.5	35.3	No	3 Boreholes (S19-05, C47-S1 and C47-S2) / 3 DCPTs (C47-DC01 to C47-DC03)	B
	Highway 69 NBL STA 13+791 (Swamp 19)	4.0 m	210.729	210.634	3.0	1.5	32.4	No	3 Boreholes (C47-N1 to C47-N3)	
C48.1 (Site No. 44-617/C2 & 44-617/C1) (Precast Box)	Highway 69 SBL STA 14+315 (Swamp 20)	3.0 m	213.117	213.175	3.0	1.8	19.1	Yes	3 Boreholes (S20-02, C48.1-S1 and C48.1-S2) / 3 DCPTs (C48.1-DC01 to C48.1-DC03)	C
	Highway 69 NBL STA 14+325 (Swamp 20)	3.0 m	212.971	213.024	3.0	1.8	17.7	Yes	4 Boreholes (S20-12, S20-12A, C48.1-N1 and C48.1-N2) / 3 DCPTs (C48.1-DC04 to C48.1-DC06)	



**FOUNDATION REPORT – CULVERTS – PHASE 2
HIGHWAY 69 G.W.P. 5111-07-00**

**TABLE 1 – SUMMARY OF CULVERT DETAILS
HIGHWAY 69 FOUR-LANING – PHASE 2**

Culvert Designation	Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls and Wing Walls ¹	Boreholes / DCPTs	Reference Appendix
			East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
C49A (Site No. 44-618/C2 & 44-618/C1) (Closed Box Cast-in-Place)	Highway 69 SBL STA 14+649 (NA)	5.0 m	207.539	207.600	7.5	4.2	20.5	Yes	5 Boreholes (C49A-S1A, C49A-S1B, C49A-S2, C49A-S3 and H9-01) / 2 DCPTs (C49A-DC01 and C49A-DC02)	D
	Highway 69 NBL STA 14+656 (NA)	4.5 m	207.530	207.597	7.5	4.2	22.4	Yes		
C50 (Site No. 44-619/C2 & 44-619/C1) (Precast Box)	Highway 69 SBL STA 14+706 (NA)	5.0 m	206.534	206.641	3.0	2.4	36.2	Yes	3 Boreholes (C50-S1, S21-01 and S21-02)	E
	Highway 69 NBL STA 14+726 (NA)	5.0 m	206.353	206.480	3.0	2.4	46.4	Yes		
C55 (Site No. 44-620/C2 & 44-620/C1) (Cast-in-Place)	Highway 69 SBL STA 15+710 (Swamp 23)	6.5 m	208.145	208.257	4	3	38.3	Yes	3 Boreholes (S23-03A, S23-04 and S23-06) / 1 DCPT (S23-DC02)	F
	Highway 69 NBL STA 15+717 (Swamp 23)	6.5 m	208.027	208.114	4	3	29.3	Yes		



FOUNDATION REPORT – CULVERTS – PHASE 2
HIGHWAY 69 G.W.P. 5111-07-00

TABLE 1 – SUMMARY OF CULVERT DETAILS
HIGHWAY 69 FOUR-LANING – PHASE 2

Culvert Designation	Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls and Wing Walls ¹	Boreholes / DCPTs	Reference Appendix
			East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
C57.1 (Site No. 44-621/C2 & 44-621/C1) (Closed Box Cast-in-Place)	Highway 69 SBL STA 16+345 (N/A)	5.0 m	206.638	207.010	7	4.5	16.9	Yes	5 Boreholes (C57.1-S1 to C57.1-S5) / 3 DCPTs (C57.1-DC01 to C57.1-DC03)	G
	Highway 69 NBL STA 15+345 (N/A)	5.0 m	205.770	206.171	7	4.5	16.9	Yes	5 Boreholes (C57.1-N1 to C57.1-N5) / 4 DCPTs (C57.1-DC04 to C57.1-DC047)	
C57 (Site No. 44-622/C2 & 44-622/C1) (Closed Box Cast-in-Place)	Highway 69 SBL STA 16+499 (Swamp 24)	8.5 m	202.693	202.817	3	2	41.2	Median Only	3 Boreholes (S24-03, S24-04 and S24-06) / 1 DCPT (S24-DC01)	H
	Highway 69 NBL STA 16+485 (Swamp 24)	8.0 m	202.453	202.579	3	2	42.4	Median Only	3 Boreholes (S24-06, S24-10 and S24-11) / 1 DCPT (S24-DC01)	
C60 (Closed Box Cast-in-Place)	Highway 69 SBL STA 17+272 (Swamp 25)	9.0 m	202.017	202.132	2.5	1.5	38.3	Median Only	3 Boreholes (C60-S1 to C60-S3)	I
	Highway 69 NBL STA 17+276 (Swamp 25)	9.0 m	201.891	202.006	2.5	1.5	38.6	Median Only	3 Boreholes (C60-N1 to C60-N3)	



**FOUNDATION REPORT – CULVERTS – PHASE 2
HIGHWAY 69 G.W.P. 5111-07-00**

**TABLE 1 – SUMMARY OF CULVERT DETAILS
HIGHWAY 69 FOUR-LANING – PHASE 2**

Culvert Designation	Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls and Wing Walls ¹	Boreholes / DCPTs	Reference Appendix
			East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
C51 (Precast Box)	Shebesheko ng Road S-E/W Ramp STA 14+990 (Swamp 22)	5.5 m	207.366	207.550	2.4	1.5	30.5	No	3 Boreholes (C51-R1, S22-02 and S22-03) / 1 DCPT (S22-DC03)	J
C53 (Precast – circular pipe)	Site No. 9 Road STA 10+235 (Swamp 26)	4.5 m	211.164	211.358	0.6	0.6	38.8	No	3 Boreholes (C53-01, C53-02 and S26-03)	K

Note: 1. Culvert invert elevations and dimensions provided by MRC on November 11, 2014.

Prepared By: MCK/AJS

Reviewed By: CN/JPD



DRAWINGS

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

CONT No. GWP No. 5111-07-00

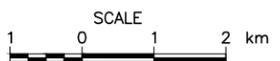


HIGHWAY 69
 SITE LOCATION PLAN

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-160			
HWY. 69	PROJECT NO. 07-1111-0029	DIST. .	
SUBM'D. TVA	CHKD. TVA/MCK	DATE: Mar. 2016	SITE: .
DRAWN: JFC/MR	CHKD. CN	APPD. JPD/JMAC	DWG. 1

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

CONT No.
GWP No. 5111-07-00

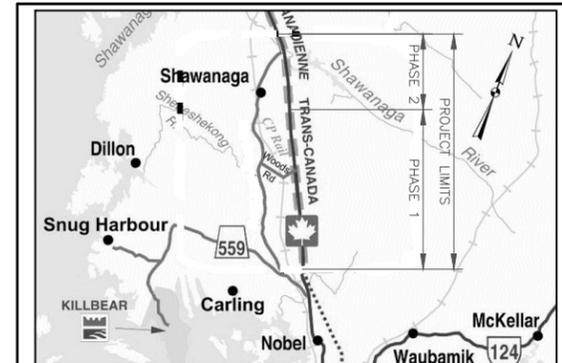


HIGHWAY 69
CULVERTS - PHASE 2
INDEX PLAN

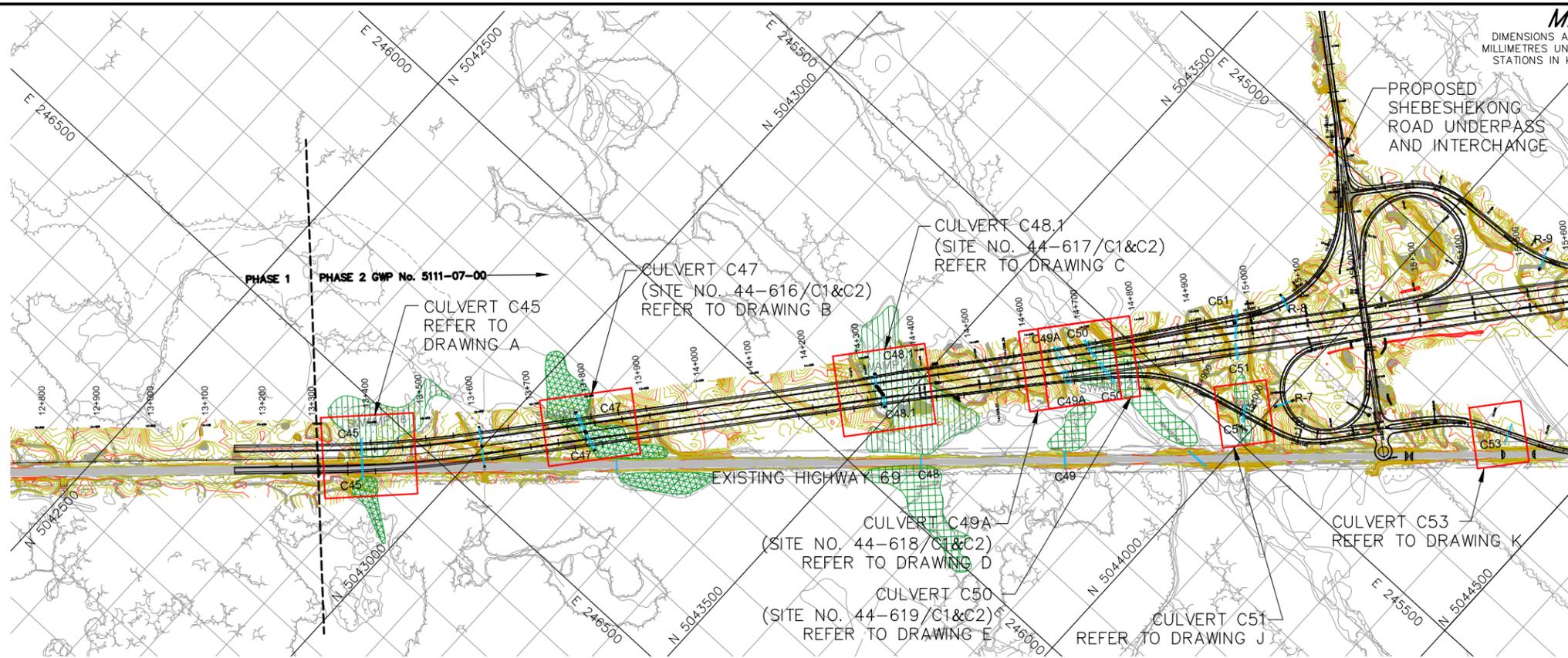
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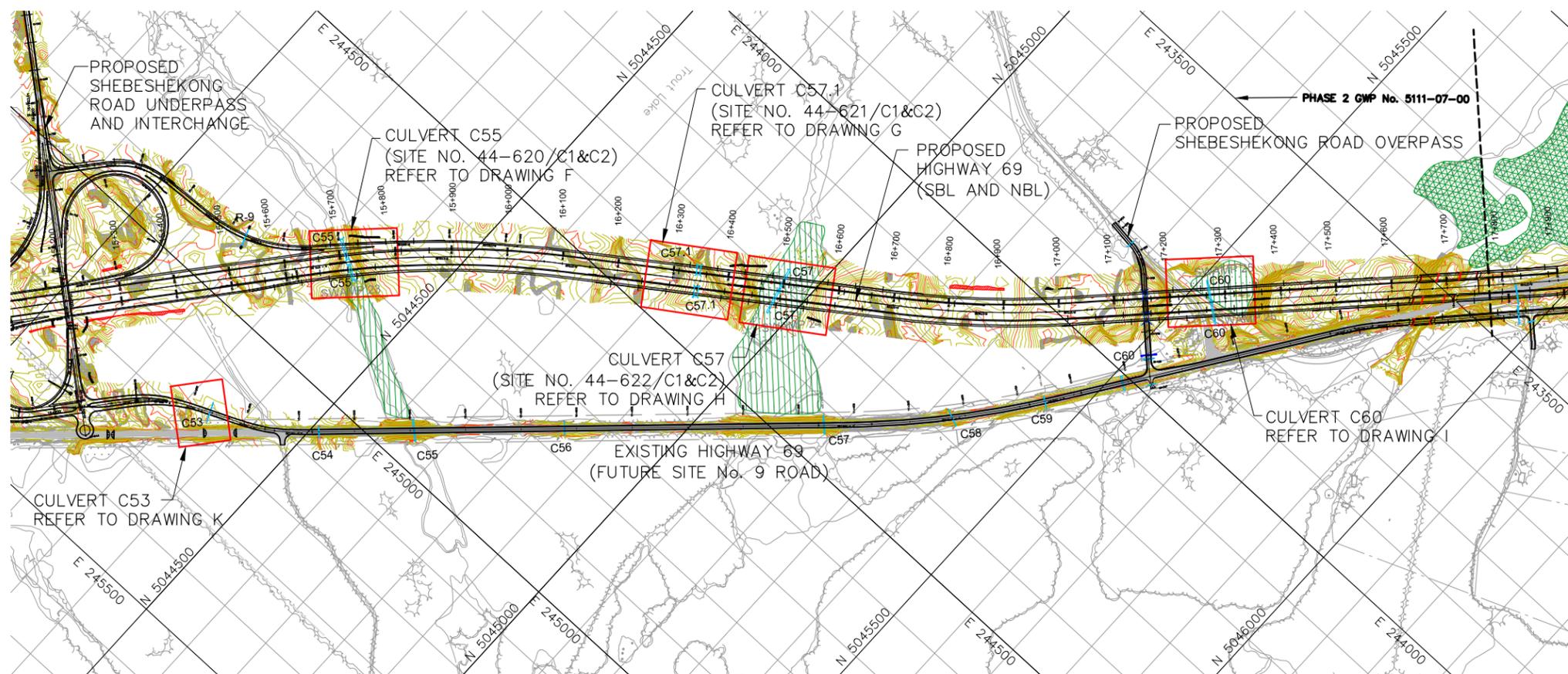
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



PLAN



PLAN



REFERENCE
Base plans provided in digital format by MRC, drawing file 5271XB01.DWG, 5271-XPB-ARCHIPELAGO.dwg, 5271-XPB-Carling.dwg, 5271-XPB-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878_PHASE1_XA1 and h6878_PHASE2_XA1, received January 21, 2009. Phase 2 Alignment and Culvert plan provided in digital format by MMM, drawing file h6878_PHASE2_XN1.dwg, received May 29, 2014.

NO.	DATE	BY	REVISION

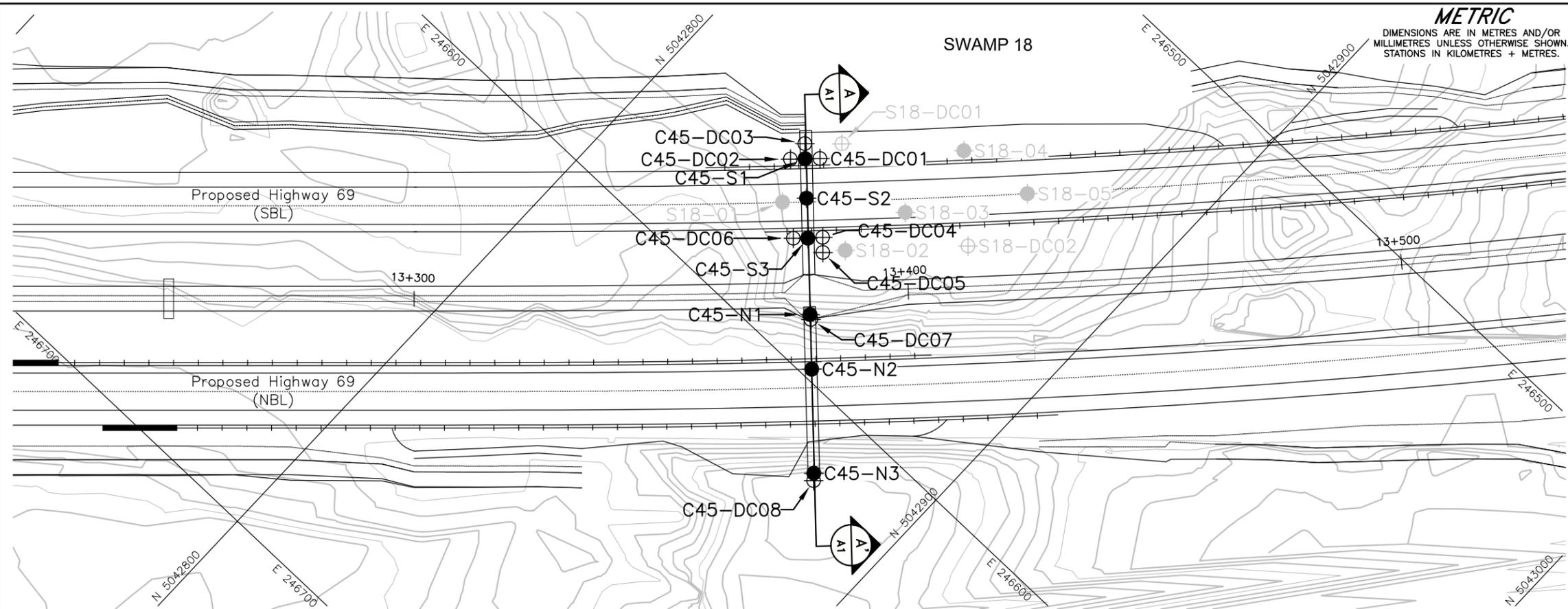
Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST.
SUBM'D. TVA	CHKD. TVA/MCK	DATE: March 2016
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC
		DWG. 2



APPENDIX A

Highway 69 SBL and NBL – STA 13+380 (Culvert C45)



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

CONT No.
GWP No. 5117-07-00

HIGHWAY 69 (SBL AND NBL)
CULVERT C45 STA 13+380

BOREHOLE LOCATIONS AND SOIL STRATA

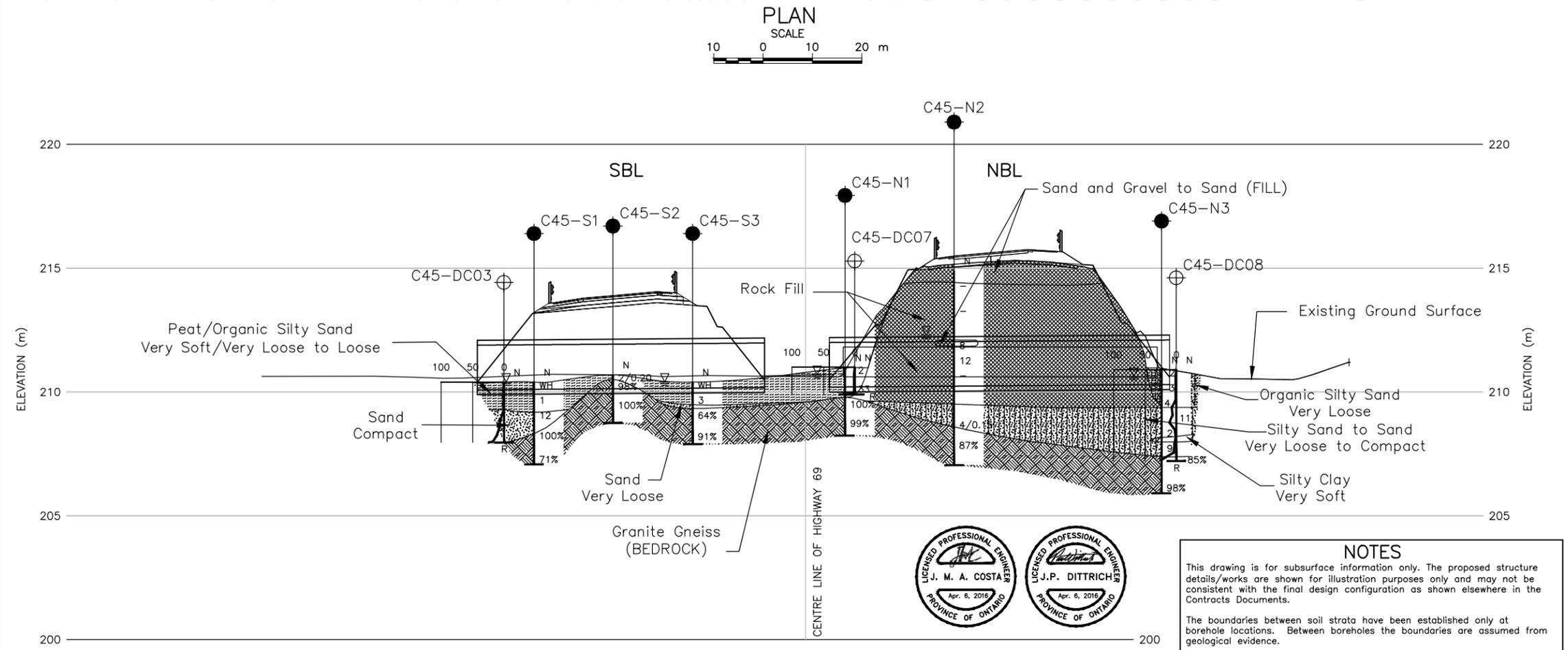
Golder Associates

KEY PLAN
SCALE 1:37000
0 3.7 km



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C45-DC01	210.4	5042835.7	246565.9
C45-DC02	210.4	5042831.4	246570.1
C45-DC03	210.4	5042831.4	246565.8
C45-DC04	210.4	5042847.0	246577.1
C45-DC05	210.4	5042849.1	246579.3
C45-DC06	210.4	5042842.8	246581.3
C45-DC07	211.0	5042856.6	246590.8
C45-DC08	210.9	5042879.3	246614.1
C45-N1	211.0	5042855.8	246590.2
C45-N2	214.9	5042863.6	246598.0
C45-N3	210.9	5042878.3	246613.0
C45-S1	210.4	5042833.5	246568.0
C45-S2	210.7	5042839.2	246573.6
C45-S3	210.4	5042844.9	246579.3

REFERENCE

Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.

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.

PROFESSIONAL ENGINEER
J. M. A. COSTA
Apr. 6, 2016
PROVINCE OF ONTARIO

PROFESSIONAL ENGINEER
J.P. DITTRICH
Apr. 6, 2016
PROVINCE OF ONTARIO

HORIZONTAL SCALE
5 0 5 10 m

VERTICAL SCALE
2 0 2 4 m

A-A
A1

CULVERT C49A PROFILE STA 14+649 AND STA 14+656

NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. TVA	CHKD. CN	DATE: 3/17/2016
DRAWN: JFC/MR	CHKD. JMAC	APPD. JPD/JMAC
		DWG. A1

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C45-S1	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042833.5 ; E 246568.0</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
							20	40	60	80	100						
210.4	GROUND SURFACE																
0.0	Silty PEAT Very soft Dark brown Wet		1	SS	WH												
			2	SS	1												
209.2																	
1.2	SAND, trace to some silt, trace clay Compact Grey Wet		3	SS	12												
208.5																	
1.9	Granite Gneiss (BEDROCK)		1	RC	REC 100%												RQD = 100%
	Bedrock cored from depths of 1.9 m to 3.3 m																
207.1	For bedrock coring details, refer to Record of Drillhole C45-S1		2	RC	REC 100%												RQD = 71%
3.3	END OF BOREHOLE																
	NOTES: 1. Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Water level in open borehole at ground surface (Elev. 210.4 m) upon completion of drilling. 3. Three Dynamic Cone Penetration Tests were advanced adjacent to Borehole C45-S1 to confirm depth to bedrock; see Record of DCPT No. C45-DC01 to C45-DC03 for details.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-S1

SHEET 1 OF 1

LOCATION: N 5042833.5 ;E 246568.0

DRILLING DATE: May 7, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W.Z.L. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION			K, cm/sec							
								80	80					Jr	Ja	Un	10 ⁰	10 ¹	10 ²					
		Continued from Record of Borehole C45-S1		208.51																				
2	NQ RC May 7, 2009	GRANITE GNEISS Fresh, fine to coarse grained, weakly to moderately foliated, moderately porous, very strong, black, pink, green and grey		1.89	1																	8.2 MPa 8.6 MPa		
3																								
		END OF DRILLHOLE		207.08 3.32	2																			
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-L-GFJ GAL-MISS.GDT 03/25/16 DD/SAC

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: TZ

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C45-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042839.2 ; E 246573.6</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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	
			NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
							20	40	60	80	100						
210.7	GROUND SURFACE																
0.0	Organic Silty SAND, containing rootlets		1	SS	2/0.20												
0.2	Very loose Dark brown Moist Granite Gneiss (BEDROCK)		1	RC	REC 100%												RQD = 98%
	Bedrock cored from depths of 0.2 m to 2.0 m		2	RC	REC 100%												RQD = 100%
208.8	For bedrock coring details, refer to Record of Drillhole C45-S2																
2.0	END OF BOREHOLE																
	NOTES: 1. Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Open borehole dry upon completion of drilling. 3. Two Dynamic Cone Penetration Tests were drilled 3.0 m south and 3.0 m north of Borehole C45-S2 to confirm depth to bedrock; refusal encountered at depths of 0.2 m and 0.4 m below ground surface (Elev. 210.5 m and 210.3 m).																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-S2

SHEET 1 OF 1

LOCATION: N 5042839.2 ; E 246573.6

DRILLING DATE: May 7, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	Legend										NOTES					
							JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break	FLT - Fault	FO - Foliation	CU - Curved	K - Slickensided	BR - Broken Rock		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth	NOTE: For additional abbreviations refer to list of abbreviations & symbols.
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough		CJ - Conjugate	CL - Cleavage	IR - Irregular	VR - Very Rough							
							RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec			Diametral Point Load (MPa)	RMC -Q' AVG.			
FLUSH	TOTAL CORE %	SOLID CORE %	PER	B Angle	DIP W.Z.L. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	10 ⁰	10 ¹	10 ²	10 ³	2	4	8						
1	NO RC May 7, 2009	Continued from Record of Borehole C45-S2 GRANITE GNEISS Fresh, fine to coarse grained, non to moderately foliated, faintly to moderately porous, very strong to extremely strong, black, green and grey		210.50 0.20	1																	
2		END OF DRILLHOLE		208.75 1.95	2																	
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

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PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C45-S3	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042844.9 ; E 246579.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30	kN/m ³	GR SA SI CL
210.4	GROUND SURFACE																
0.0	Silty PEAT Very soft Dark brown Wet		1	SS	WH		210										
209.8																	
209.5	Organic Silty SAND, trace to some clay, trace gravel, containing oxidation zones Very loose Brown Wet		2	SS	3												
1.1			1	RC	REC 100%		209									RQD = 64%	
	SAND, some silt, trace gravel Very loose Brown Wet		2	RC	REC 100%											RQD = 91%	
207.9							208										
2.5	Granite Gneiss (BEDROCK) Bedrock cored from depths of 1.1 m to 2.5 m For bedrock coring details, refer to Record of Drillhole C45-S3 END OF BOREHOLE																
	NOTES: 1. Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Water level in open borehole at ground surface (Elev. 210.4 m) upon completion of drilling. 3. Three Dynamic Cone Penetration Tests were advanced adjacent to Borehole C45-S3 to confirm depth to bedrock; see Record of DCPT No. C45-DC04 to C45-DC06 for details.																

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-S3

SHEET 1 OF 1

LOCATION: N 5042844.9 ;E 246579.3

DRILLING DATE: May 7, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	LEGEND										NOTES		
							RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.
							TOTAL CORE %	SOLID CORE %		B Angle	DIP W.Z.L. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K, cm/sec			
		Continued from Record of Borehole C45-S3		209.33			JN - Joint	BD - Bedding	PL - Planar	PO - Polished	MB - Mechanical Break								
		GRANITE GNEISS Fresh, medium to coarse grained, moderately foliated, moderately porous, very strong to extremely strong, pink, green and grey		1.07	1		FLT - Fault	FO - Foliation	CU - Curved	K - Slickensided	BR - Broken Rock								
					2		SH - Shear	CO - Contact	UN - Undulating	SM - Smooth									
							VN - Vein	OR - Orthogonal	ST - Stepped	RO - Rough									
							CJ - Conjugate	CL - Cleavage	IR - Irregular	VR - Very Rough									
		END OF DRILLHOLE		207.89															
				2.51															

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DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: TZ

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C45-N1	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042855.8 ; E 246590.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
211.0	GROUND SURFACE																
0.0	Sandy PEAT, trace gravel, trace silt Very soft Brown Wet		1	SS	2	▽											
210.4																	
0.6	Organic Silty SAND, trace gravel Loose Brown and grey Wet		2	SS	33		210										OC=5.8%
209.8																	
1.2	Granite Gneiss (BEDROCK)		1	RC	REC 100%												RQD = 100%
	Bedrock cored from depths of 1.2 m to 2.8 m						209										
208.2	For bedrock coring details, refer to Record of Drillhole C45-N1		2	RC	REC 99%												RQD = 99%
2.8	END OF BOREHOLE																
	NOTES: 1. Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 210.7 m) upon completion of drilling. 3. A Dynamic Cone Penetration Test was advanced adjacent to Borehole C45-N1 to confirm depth to bedrock; see Record of DCPT No. C45-DC07 for details.																

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PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-N1

SHEET 1 OF 1

LOCATION: N 5042855.8 ; E 246590.2

DRILLING DATE: May 7, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W/EL CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %					PL - Planar	PO - Polished	MB - Mechanical Break	UR - Undulating	SM - Smooth	BR - Broken Rock					
								UN - Undulating	RO - Rough					VR - Very Rough	K - Slickensided	NOTE: For additional abbreviations refer to list of abbreviations & symbols.								
								SH - Shear	CO - Contact					OR - Orthogonal	CL - Cleavage	Ir	Ja	Un	10 ⁰				10 ¹	10 ²
		Continued from Record of Borehole C45-N1		209.78																				
2	NO RC May 26, 2009	GRANITE GNEISS Fresh, medium to coarse grained, moderately to strongly foliated, thinly to moderately porous, strong to very strong, black, pink, green and grey		1.22	1																			
3		END OF DRILLHOLE		208.24 2.76																				
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-MISS.GDT 03/25/16 DD/SAC



PROJECT 07-1111-0029 **RECORD OF BOREHOLE No C45-N2** SHEET 1 OF 1 **METRIC**
G.W.P. 5402-05-00 **LOCATION** N 5042863.6 ; E 246598.0 **ORIGINATED BY** ID
DIST HWY 69 **BOREHOLE TYPE** Portable Equipment, NW Casing, Wash Boring **COMPILED BY** AM
DATUM Geodetic **DATE** May 21, 2009 **CHECKED BY** TZ

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)				
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								20	40	60	80	100						GR	SA	SI	CL
214.9	GROUND SURFACE																				
0.0	ASPHALT																				
214.4	Sand and gravel, trace silt (FILL)																				
0.5	Brown Moist ROCK FILL		1	RC	-		214														
			2	RC	-		213														
212.1	Sand, trace gravel, trace silt (FILL)						212														
3.1	Loose Grey Wet ROCK FILL		3	SS	8																
			4	SS	12		211														
			5	RC	-		210														
209.3	SAND, trace to some gravel, trace to some silt, trace clay, slightly organic						209														
5.6	Loose Dark brown Wet		6	SS	4/0.15																6 81 11 2
208.6	Granite Gneiss (BEDROCK)						208														
6.3	Bedrock cored from depths of 6.3 m to 7.9 m		1	RC	REC 100%																RQD = 87%
207.0	For bedrock coring details, refer to Record of Drillhole C45-N2																				
7.9	END OF BOREHOLE																				
	NOTE: 1. Water level in open borehole at a depth of 2.6 m below ground surface (Elev. 212.3 m) upon completion of drilling.																				

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-N2

SHEET 1 OF 1

LOCATION: N 5042863.6 ; E 246598.0

DRILLING DATE: May 21, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME55

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25	B Angle	DIP W.Z.L. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %					Ur	Ja	Un	K, cm/sec	10	10				10
								80	80					80	80	80	80	80	80				80
		Continued from Record of Borehole C45-N2		208.59																			
7	NO RC May 21, 2009	GRANITE GNEISS Fresh to slightly weathered, medium to coarse grained, strongly foliated, moderately to faintly porous, very strong, black, pink, green and grey		6.31	1									FO,ST,VR JN,ST,VR AX,J,UN,VR JN,UN,RO JN,ST,RO JN,CU,RO JN,CU,RO JN,UN,RO							8.2 MPa		
8		END OF DRILLHOLE		207.04										SEAM,CU,SM									
9																							
10																							
11																							
12																							
13																							
14																							
15																							
16																							

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DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: TZ

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C45-N3	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042878.3 ; E 246613.0</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
210.9 0.0	GROUND SURFACE Organic Silty SAND, containing wood fragments Very loose Brown and grey Wet		1	SS	2	▽											
			2	SS	3												
209.4 1.5	Silty SAND, trace gravel, slightly organic to a depth of 1.8 m Very loose to compact Grey Wet		3	SS	4												
			4	SS	11												
208.2 2.9	SILTY CLAY, trace sand Very soft Brown Wet		5	SS	2												
207.4 3.5	SAND, some silt, trace clay Very loose to loose Grey Wet		6	SS	9												0 80 18 2
	Granite Gneiss (BEDROCK)		1	RC	REC 100%											RQD = 85%	
205.9 5.0	Bedrock cored from depths of 3.5 m to 5.0 m		2	RC	REC 98%											RQD = 98%	
	For bedrock coring details, refer to Record of Drillhole C45-N3 END OF BOREHOLE																

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- NOTES:
- Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer.
 - Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 206.9 m) upon completion of drilling.
 - A Dynamic Cone Penetration Test was advanced 1.5 m east of Borehole C45-N3 to confirm depth to bedrock; see Record of DCPT No. C45-DC08 for details.

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C45-N3

SHEET 1 OF 1

LOCATION: N 5042878.3 ;E 246613.0

DRILLING DATE: May 7, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25	B Angle	DIP W/EL. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
							TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION			K, cm/sec					
							FLUSH	FLUSH					Jr	Ja	Un	10 ⁰	10 ¹	10 ²			
		Continued from Record of Borehole C45-N2		207.39																	
4	BG RC May 7, 2009	GRANITE GNEISS Fresh to slightly weatehred, medium grained, moderately to strongly foliated, moderately porous, very strong, black, pink, green and grey		3.51	1																9.1 MPa
5		END OF DRILLHOLE		205.91	2																
4.99				4.99																	

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DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: TZ

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042835.7 ; E 246565.9</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L			10
210.4 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					210											
207.7 2.7	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.					208											

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC02	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042831.4 ; E 246570.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
210.4	GROUND SURFACE																						
0.0	Dynamic Cone Penetration Test (DCPT)					210																	
208.8						209																	
1.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.																						

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC03	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042831.4 ; E 246565.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
					20	40	60	80	100							
210.4	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)															
208.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															
2.4	NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC04	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042847.0 ; E 246577.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
210.4	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					210										
208.9						209										
1.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC05	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042849.1 ; E 246579.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L			
210.4	GROUND SURFACE						20	40	60	80	100						
0.0	Dynamic Cone Penetration Test (DCPT)					210											
208.8						209											
1.7	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.																

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC06	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042842.8 ; E 246581.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L			10
210.4	GROUND SURFACE																
0.0	Dynamic Cone Penetration Test (DCPT)					210											
209.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)																
1.1	NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.																

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C45-DC07	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5042856.6 ; E 246590.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

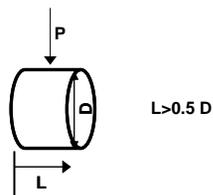
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
211.0	GROUND SURFACE																		
0.0	Dynamic Cone Penetration Test (DCPT)																		
209.9	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)						210												
1.1	NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

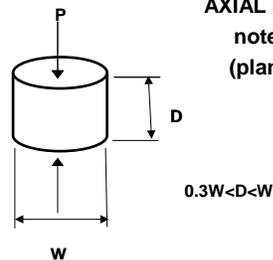
**TABLE A1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C45-S1	1	2.0	208.4	Granite Gneiss	Diametral	6.807
C45-S1	1	2.1	208.3	Granite Gneiss	Diametral	8.168
C45-S1	1	2.2	208.2	Granite Gneiss	Diametral	8.606
C45-S2	1	0.3	210.4	Granite Gneiss	Diametral	6.777
C45-S2	1	0.4	210.3	Granite Gneiss	Diametral	6.618
C45-S2	1	0.7	210.0	Granite Gneiss	Diametral	13.823
C45-S2	1	0.8	209.9	Granite Gneiss	Diametral	12.759
C45-S2	1	0.9	209.8	Granite Gneiss	Diametral	12.590
C45-S3	2	1.5	208.9	Granite Gneiss	Diametral	11.974
C45-S3	2	1.5	208.9	Granite Gneiss	Diametral	11.567
C45-S3	2	1.6	208.8	Granite Gneiss	Diametral	7.711
C45-N1	1	1.3	209.7	Granite Gneiss	Diametral	2.544
C45-N1	1	1.4	209.6	Granite Gneiss	Diametral	4.194
C45-N1	1	1.5	209.5	Granite Gneiss	Diametral	7.681
C45-N1	1	1.6	209.4	Granite Gneiss	Diametral	3.200
C45-N2	1	6.8	208.1	Granite Gneiss	Diametral	7.404
C45-N2	1	6.9	208.0	Granite Gneiss	Diametral	8.189
C45-N2	1	7.1	207.8	Granite Gneiss	Diametral	5.234
C45-N3	1	3.6	207.3	Granite Gneiss	Diametral	4.780
C45-N3	1	3.8	207.1	Granite Gneiss	Diametral	9.103
C45-N3	1	4.1	206.8	Granite Gneiss	Diametral	8.546

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)

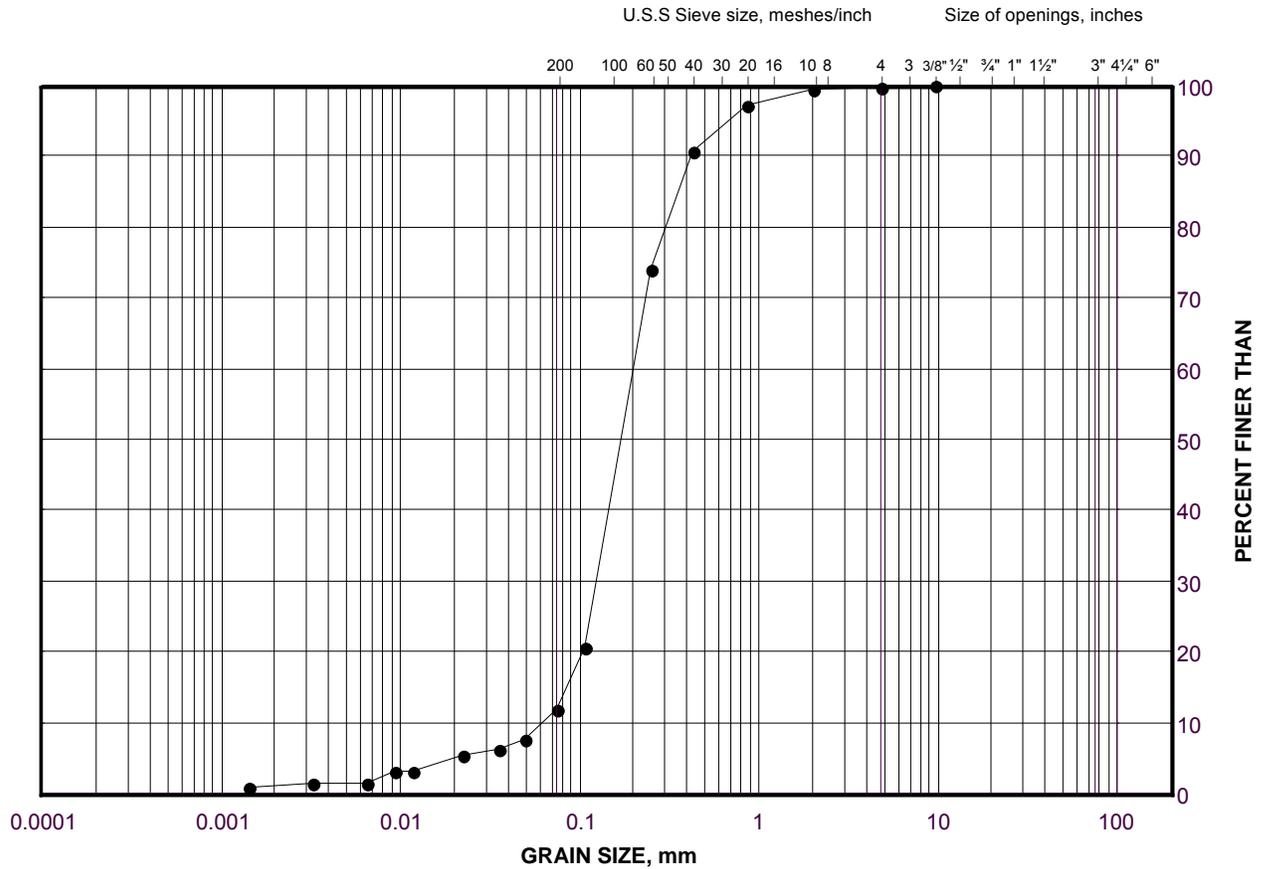


Compiled By: MCK
Checked By: CN
Reviewed By: JMAC

GRAIN SIZE DISTRIBUTION

Sand
Highway 69 (SBL) STA 13+380

FIGURE A.C45-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C45-S1	3	208.9

Project Number: 07-1111-0029

Checked By: TVA

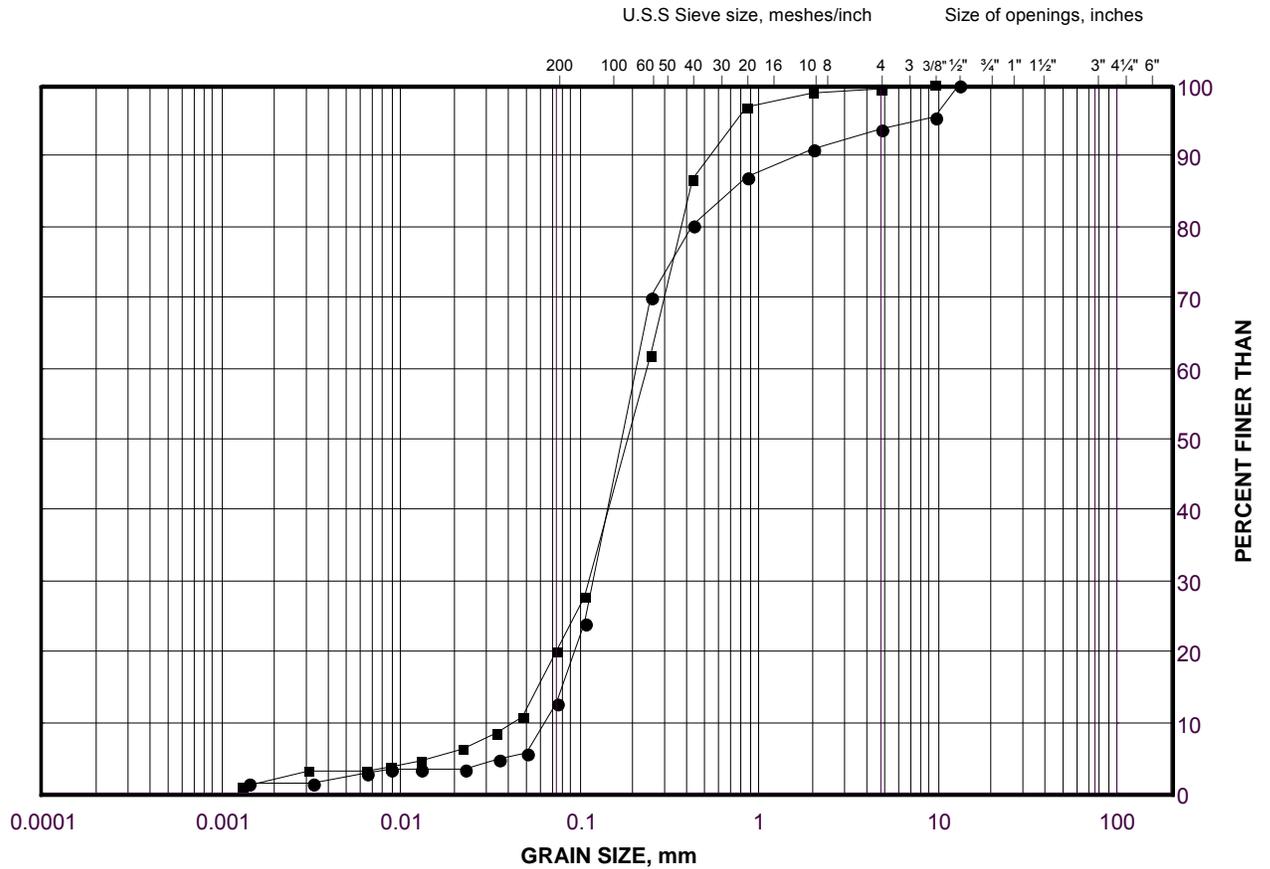
Golder Associates

Date: 19-Aug-14

GRAIN SIZE DISTRIBUTION

Sand
Highway 69 (NBL) STA 13+380

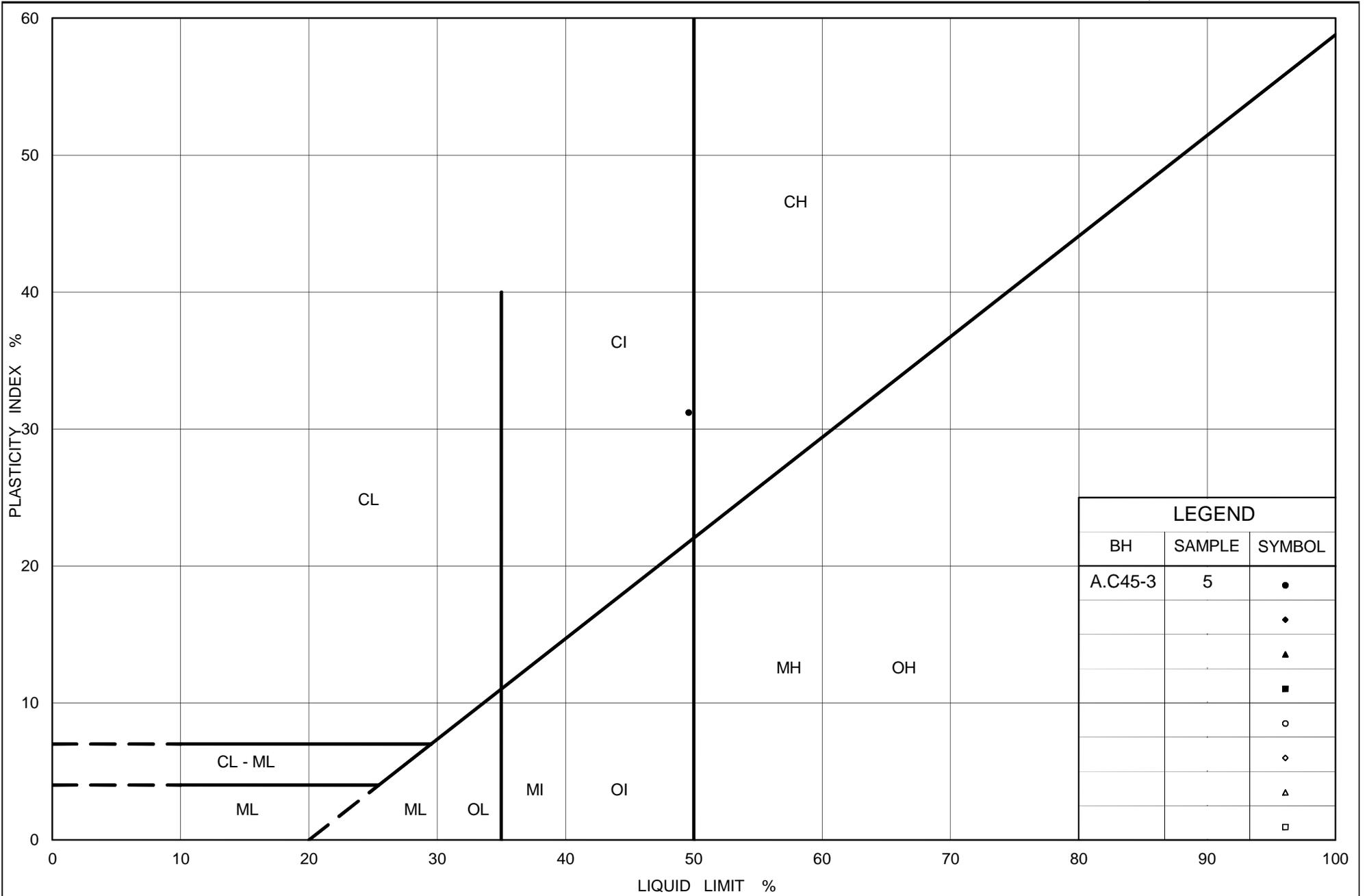
FIGURE A.C45-2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C45-N2	6	208.8
■	C45-N3	6	207.7



LEGEND		
BH	SAMPLE	SYMBOL
A.C45-3	5	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silty Clay
 Highway 69 (NBL) STA 13+380

Figure No. A.C45-3

Project No. 07-1111-0029

Checked By: TVA



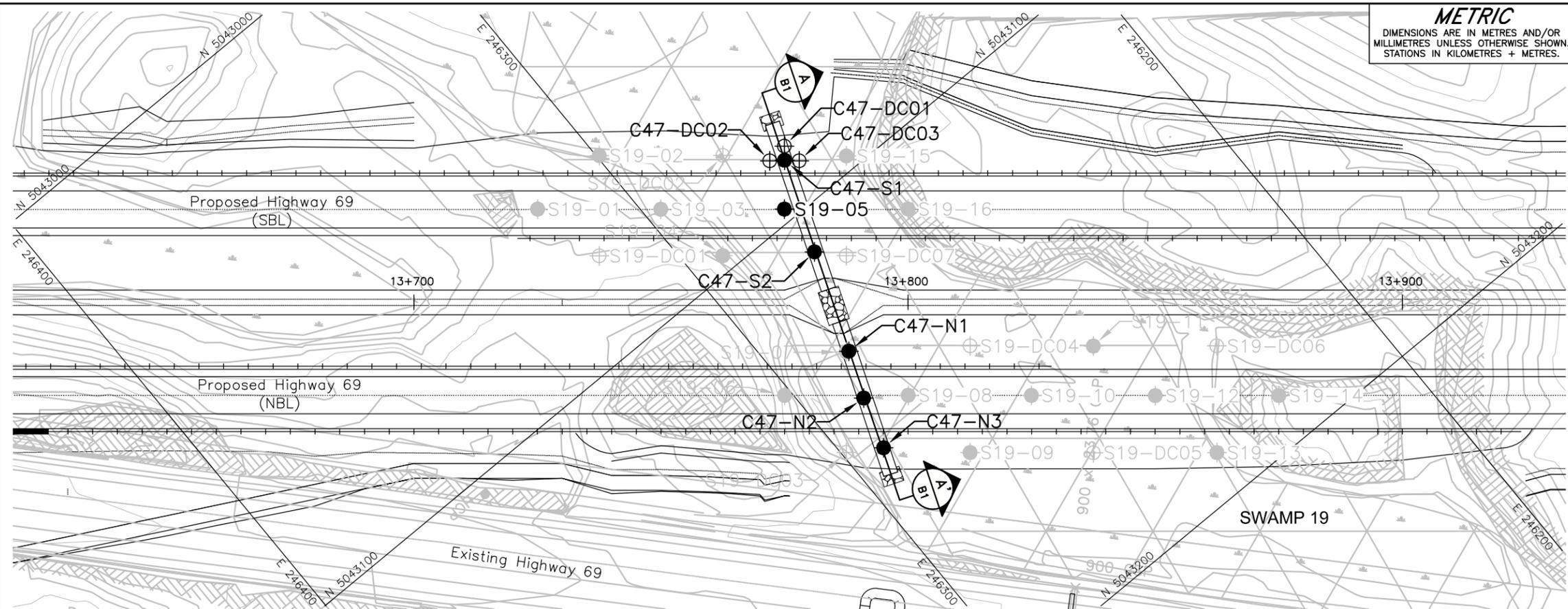
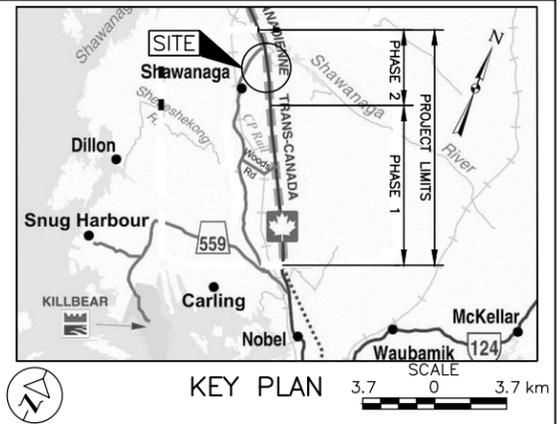
APPENDIX B

**Highway 69 SBL and NBL – STA 13+778 and STA 13+791
(Culvert C47 – Site No. 44-616/C2 and 44-616/C1)**

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

CONT No.
WP No. 5077-13-01 (NBL) and 5077-13-02 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C47 STA 13+778 AND STA 13+791
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET S28

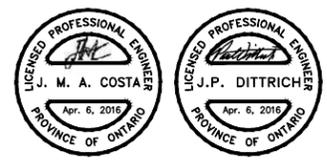
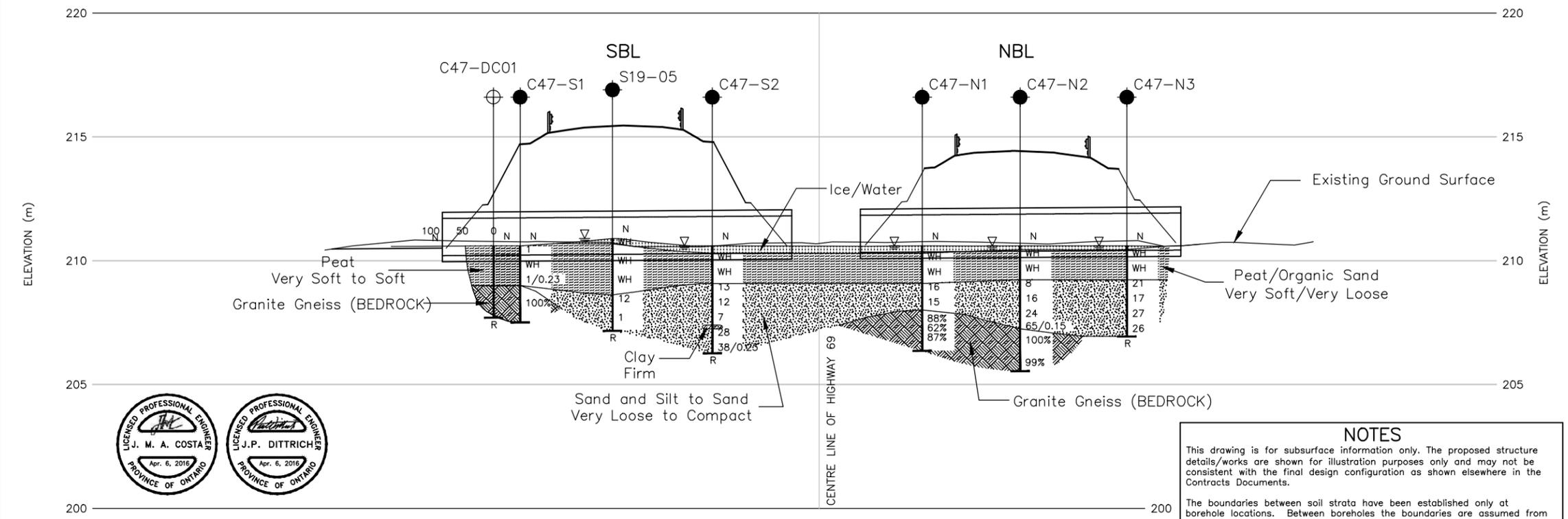


LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C47-DC01	210.6	5043087.7	246269.4
C47-DC02	210.7	5043088.1	246273.6
C47-DC03	210.6	5043091.9	246269.0
C47-N1	210.6	5043127.9	246285.7
C47-N2	210.6	5043137.1	246289.4
C47-N3	210.6	5043147.4	246292.7
C47-S1	210.6	5043089.9	246271.2
C47-S2	210.6	5043108.0	246278.3
S19-05	210.9	5043097.5	246277.5



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 received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.

NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY.	PROJECT NO.	DIST.
SUBM'D. TVA/AJS	CHKD. TVA/AJS	DATE: 3/17/2016
DRAWN: JFC/MR	CHKD. TVA/CN	APPD. JPD/JMAC
SITE: 44-616/C1&C2		DWG: B1

CULVERT C47 PROFILE STA 13+778 AND STA 13+791

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C47-S1	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043089.9 ; E 246271.2</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
210.6	GROUND SURFACE																
0.0	PEAT, trace sand, trace silt (Fibrous) Very soft Dark brown Wet		1	SS	1		210										
			2	SS	WH												
			3	SS	1/0.23												1257.4
209.0	Granite Gneiss (BEDROCK)						209										
1.6	Bedrock cored from depths of 1.6 m to 3.1 m For bedrock coring details, refer to Record of Drillhole C47-S1		1	RC	REC 100%		208										RQD = 100%
207.5	END OF BOREHOLE																
3.1	NOTES: 1. Borehole advanced using portable drilling equipment with a one-third weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Water level in open borehole at ground surface (Elev. 210.6 m) upon completion of drilling. 3. Three Dynamic Cone Penetration Tests were advanced adjacent to Borehole C47-S1 to confirm depth to bedrock; see Record of DCPT No. C47-DC01 to C47-DC03 for details.																

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C47-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043108.0; E 246278.3</u>	ORIGINATED BY <u>MJR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 8, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100									
210.6	WATER SURFACE																		
0.0	Water																		
210.3																			
0.3	PEAT (Fibrous) Very soft Dark brown Wet		1	SS	WH											1694.4			
			2	SS	WH														
209.1																			
1.5	SAND and SILT, trace clay Loose to compact Grey Wet		3	SS	13														
			4	SS	12														
			5A	SS	7														
207.4			5B	SS	7														
3.4	CLAY, some silt, trace sand Firm Grey Wet		6	SS	28											75.51			
			7	SS	38/0.23														
206.3	SAND and SILT, trace gravel Compact Grey Wet																		
4.3	END OF BOREHOLE SPOON AND CASING REFUSAL																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C47-N1	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043127.9 ; E 246285.7</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 9, 2009</u>	CHECKED BY <u>TZ</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
210.6	WATER SURFACE																
0.0	Water																
210.3																	
0.3	Silty PEAT Very soft Dark brown Wet		1	SS	WH												
			2	SS	WH												
209.1																	
1.5	SAND and SILT, trace clay Compact Grey Wet		3	SS	16												
			4	SS	15												
208.0																	
2.6	Granite Gneiss (BEDROCK)		1	RC	REC 100%												
	Bedrock cored from depths of 2.6 m to 4.3 m		2	RC	REC 100%												
	For bedrock coring details, refer to Record of Drillhole C47-N1		3	RC	REC 100%												
206.4																	
4.3	END OF BOREHOLE																

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C47-N2	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043137.1 ; E 246289.4</u>	ORIGINATED BY <u>MJR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 10, 2009</u>	CHECKED BY <u>TZ</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
210.6	WATER SURFACE																
0.0	Water																
0.2	PEAT (Fibrous) Very soft Dark brown		1	SS	WH		210										
209.8	Wet																
0.8	Organic SAND, containing rootlets Very loose Dark brown		2	SS	WH										45.8		
209.2	Wet																
1.4	SAND and SILT, trace gravel, trace clay Loose to compact Grey Wet		3	SS	8		209										
			4	SS	16		208										
			5	SS	24												0 43 55 2
207.3			6	SS	15/0.15												
3.4	Granite Gneiss (BEDROCK)						207										RQD = 100%
	Bedrock cored from depths of 3.4 m to 5.1 m		1	RC	REC 100%												
	For bedrock coring details, refer to Record of Drillhole C47-N2																
			2	RC	REC 99%		206										RQD = 99%
205.5	END OF BOREHOLE																
5.1																	

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PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C47-N2

SHEET 1 OF 1

LOCATION: N 5043137.1 ; E 246289.4

DRILLING DATE: May 10, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: OGS

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25	B Angle	DIP W.Z.L. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES		
							TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION			K, cm/sec	10 ⁰				10 ¹	10 ²
							FLUSH	80					80	80	80	80	80				80	80
		Continued from Record of Borehole C47-N2		207.25																		
4	BW Casing BQ RC May 10, 2009	GRANITE GNEISS Fresh, medium to coarse grained, moderately porous, strong to very strong, strongly foliated, black, green and white		3.35	1																	
5		END OF DRILLHOLE		205.54	2																	
5.06																						

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE I-GFJ GAL-MISS.GDT 03/25/16 DD/SAC

DEPTH SCALE

1 : 50



LOGGED: MJR

CHECKED: TZ

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C47-N3	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043147.4 ; E 246292.7</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AT</u>	
DATUM <u>Geodetic</u>	DATE <u>May 10, 2009</u>	CHECKED BY <u>TZ</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR
210.6	WATER SURFACE																	
0.0	Water																	
0.2	PEAT (Fibrous) Very soft Dark brown Wet		1	SS	WH													
209.2			2	SS	WH													
1.4	SAND and SILT, trace gravel, trace clay Compact Grey Wet Containing about 50 mm thick silty clay layer at a depth of 2.1 m		3	SS	21													
			4	SS	17													
			5	SS	27													
			6	SS	26													
206.9																		
3.7	END OF BOREHOLE SPOON AND CASING REFUSAL																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S19-05	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043097.5 ; E 246277.5</u>	ORIGINATED BY <u>DM</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>February 29, 2008</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100									
210.9	ICE SURFACE																		
0.0	Ice																		
0.2	PEAT (Amorphous) Very soft Black Wet		1	SS	WH														
			2	SS	WH														
			3	SS	WH														
208.6	SAND, some silt, trace clay, containing silt layers and wood fragments to a depth of 3.0 m Very loose to compact Brown to grey Wet		4	SS	12														
2.3																			
			5	SS	1														
207.2	3.7																		
END OF BOREHOLE AUGER REFUSAL																			
NOTE: 1. Water level in open borehole at ice surface (Elev. 210.9 m) upon completion of drilling.																			

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C47-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043087.7 ; E 246269.4</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
210.6	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					210										
						209										
207.7						208										
2.9	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a one-third weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C47-DC02	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043088.1 ; E 246273.6</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
210.7	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					210										
209.6																
1.1	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

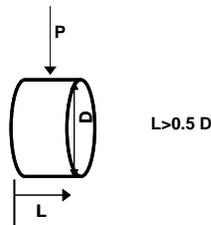
+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**TABLE B1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C47-S1	1	45.0	165.6	Granite Gneiss	Diametral	3.549
C47-S1	1	1.8	208.8	Granite Gneiss	Diametral	5.225
C47-S1	1	2.1	208.5	Granite Gneiss	Diametral	5.673
C47-N1	3	3.6	207.0	Granite Gneiss	Diametral	5.165
C47-N1	3	3.7	206.9	Granite Gneiss	Diametral	6.773
C47-N1	3	3.8	206.8	Granite Gneiss	Diametral	5.430
C47-N2	1	3.6	207.0	Granite Gneiss	Diametral	5.286
C47-N2	1	3.7	206.9	Granite Gneiss	Diametral	4.285
C47-N2	1	3.8	206.8	Granite Gneiss	Diametral	2.313

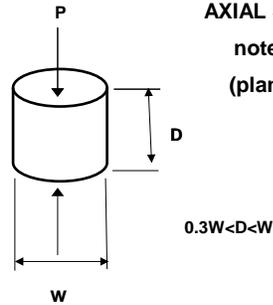
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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)

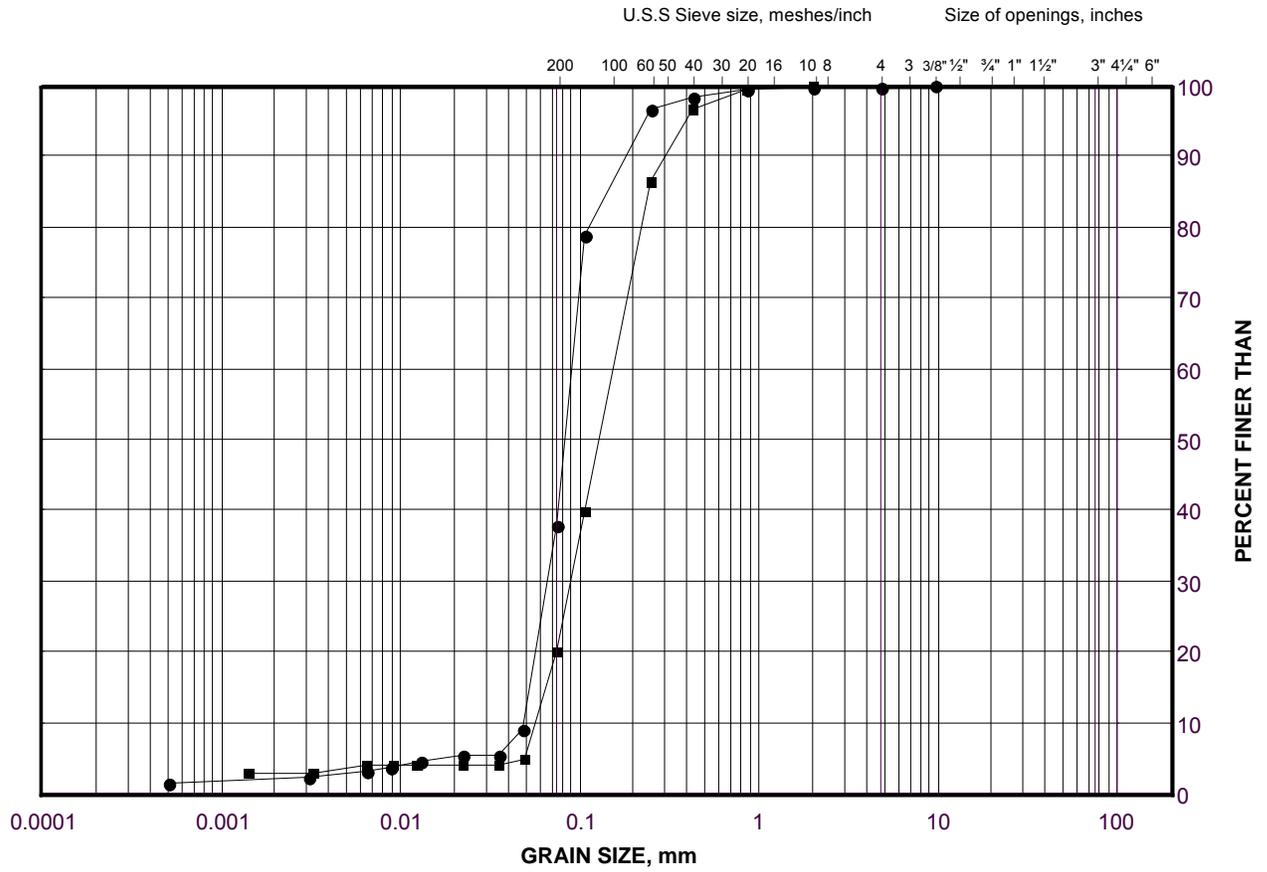


Compiled By: MCK
 Checked By: CN
 Reviewed By: JMAC

GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand
Highway 69 (SBL) STA 13+778

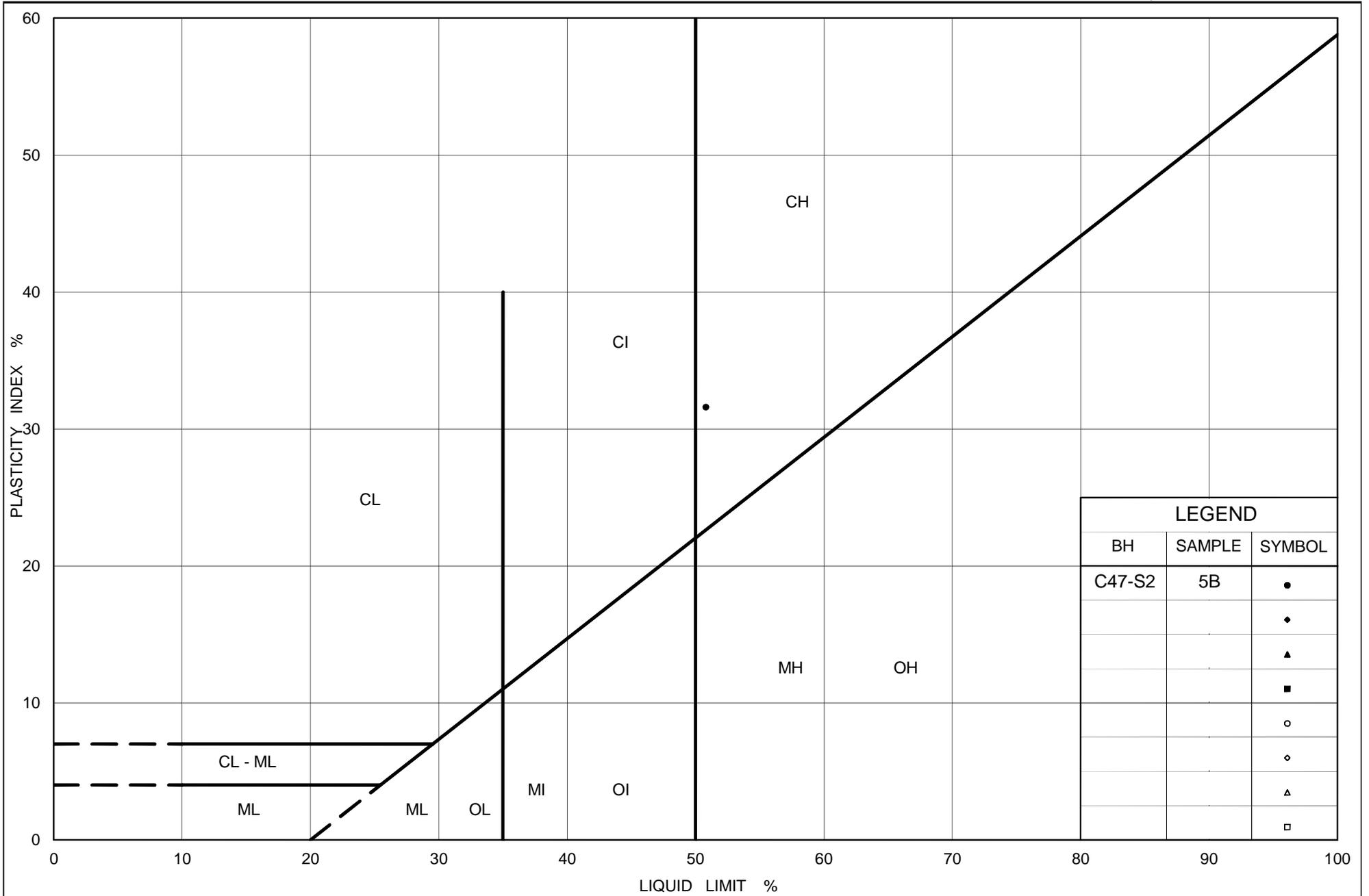
FIGURE B.C47-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C47-S2	4	208.2
■	S19-05	4	208.3



LEGEND		
BH	SAMPLE	SYMBOL
C47-S2	5B	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Clay
 Highway 69 (SBL) STA 13+778

Figure No. B.C47-2

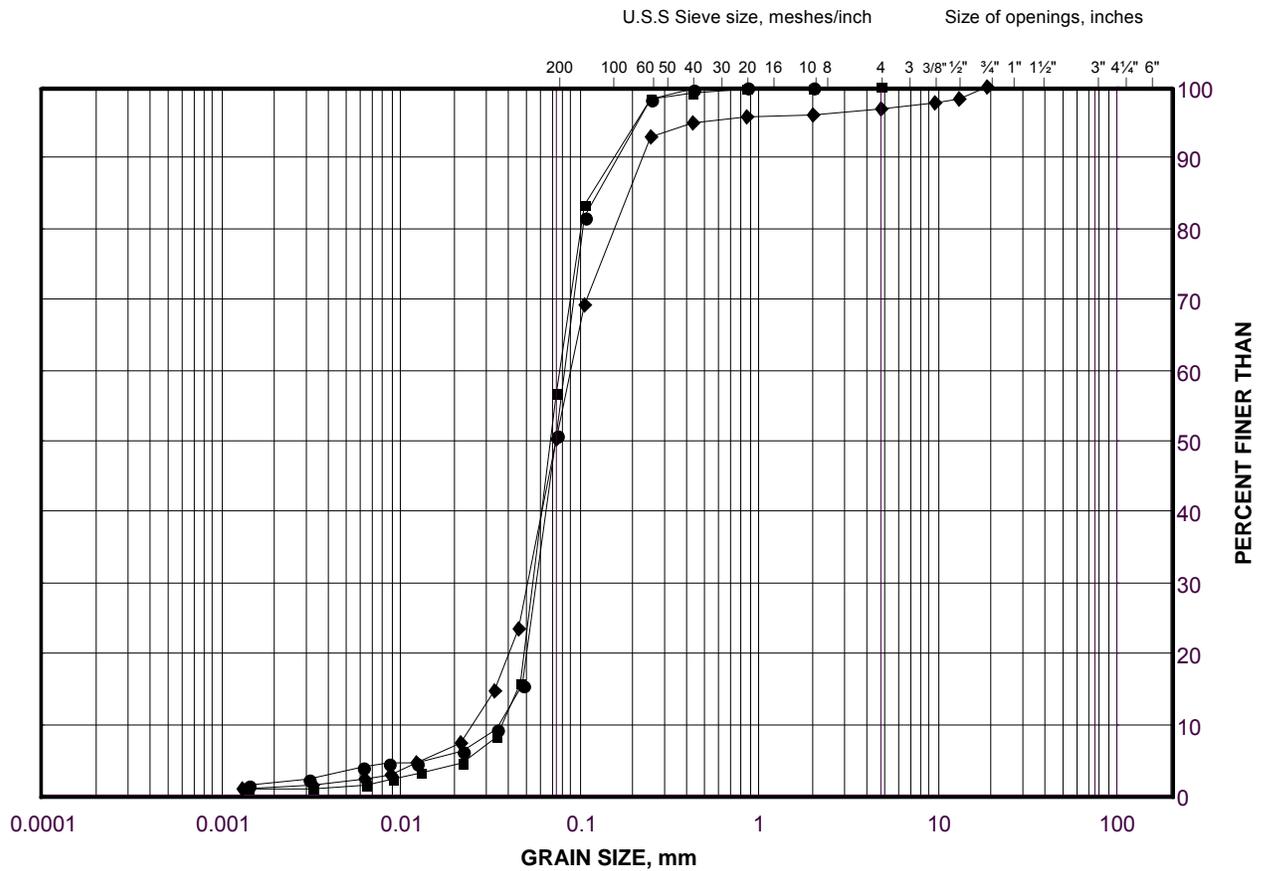
Project No. 07-1111-0029

Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silt and Sand
Highway 69 (NBL) STA 13+791

FIGURE B.C47-3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C47-N1	4	208.2
■	C47-N2	5	207.8
◆	C47-N3	5	207.8



APPENDIX C

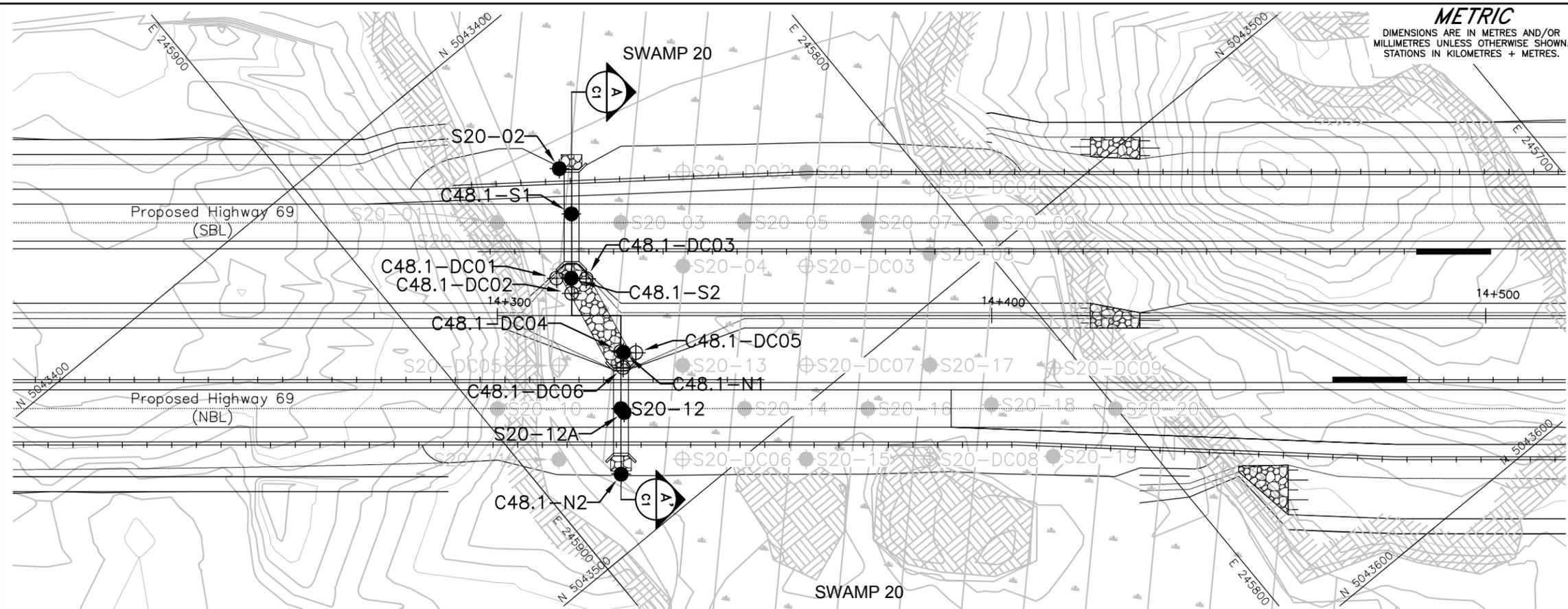
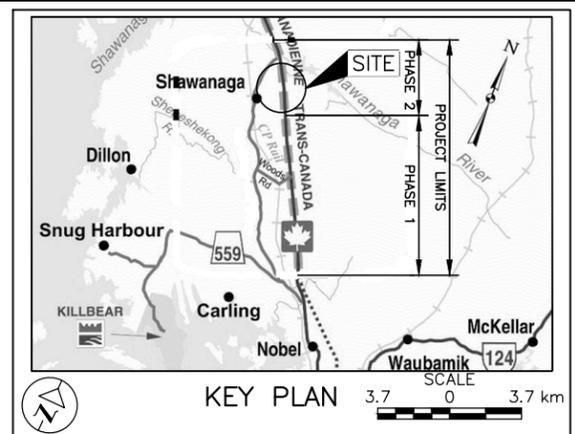
**Highway 69 SBL and NBL – STA 14+315 and STA 14+325
(Culvert C48.1 – Site No. 44-617/C2 and 44-617/C1)**

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

CONT No. WP No. 5077-13-03 (NBL) and 5077-13-04 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C48.1 STA 14+315 AND STA 14+325
BOREHOLE LOCATIONS AND SOIL STRATA
STRATA

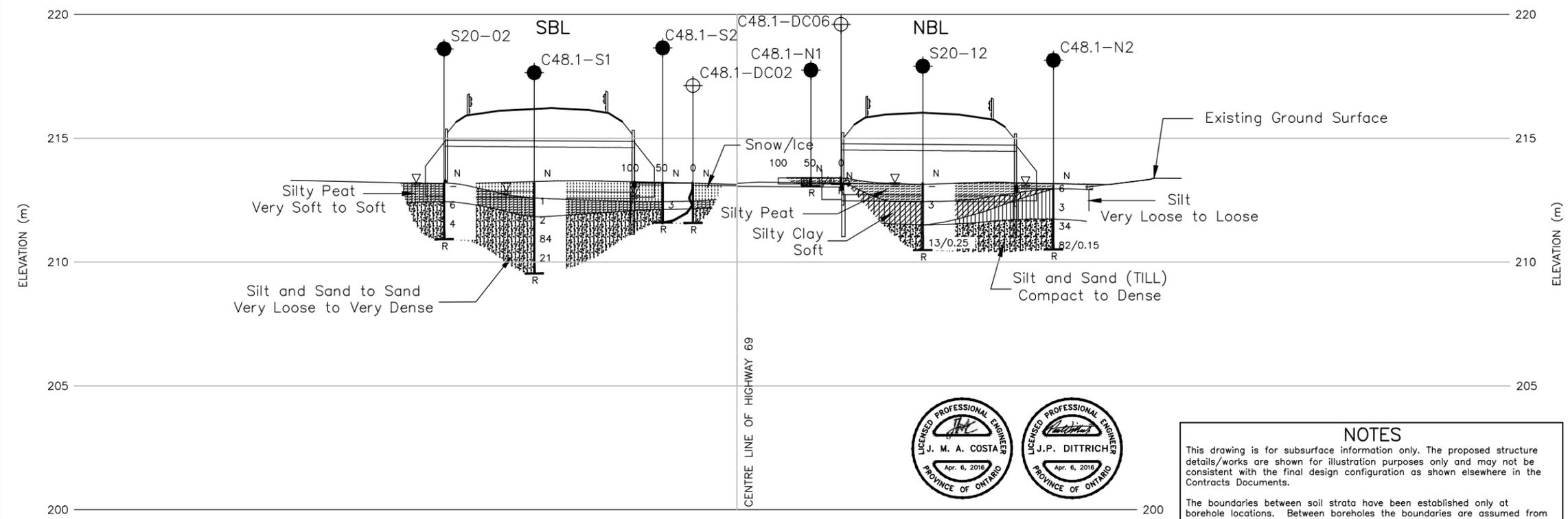


SHEET S29



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C48.1-DC01	213.2	5043448.1	245870.6
C48.1-DC02	213.2	5043452.4	245870.2
C48.1-DC03	213.2	5043452.0	245866.0
C48.1-DC04	213.1	5043467.8	245870.0
C48.1-DC05	213.1	5043469.9	245867.8
C48.1-DC06	213.4	5043470.6	245871.7
C48.1-N1	213.4	5043468.3	245869.7
C48.1-N2	213.1	5043486.9	245885.7
C48.1-S1	213.2	5043440.0	245860.0
C48.1-S2	213.2	5043450.0	245868.3
S20-02	213.2	5043431.4	245856.1
S20-12	213.2	5043476.7	245877.3
S20-12A	213.2	5043477.7	245877.3



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 received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

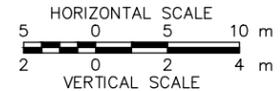
Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.

NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. TVA	CHKD. CN	DATE: 3/17/2016
DRAWN: JFC/MR	CHKD. JMAC	APPD. .
		SITE: 44-617/c1&c2
		DWG: C1

A-A CULVERT C48.1 PROFILE STA 14+315 AND STA 14+325



PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C48.1-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043450.0 ; E 245868.3</u>	ORIGINATED BY <u>EC</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>VA/TZ</u>	
DATUM <u>Geodetic</u>	DATE <u>March 9, 2009</u>	CHECKED BY <u>VA</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
213.2 0.0	SNOW SURFACE Snow/Ice						213										
212.4							212										
212.1 1.1	Silty PEAT Soft Black Wet		1A 1B	SS	3										176.6	OC = 37.9%	
211.6 1.6	SAND and SILT, trace clay, containing rootlets Very loose Grey Wet END OF BOREHOLE CASING REFUSAL NOTES: 1. Water level in open borehole at a depth of 0.5 m below snow surface (Elev 212.7 m) upon completion of drilling. 2. Three Dynamic Cone Penetration Tests were advanced adjacent to Borehole C48.1-S2 to confirm depth to refusal; see Record of DCPT No. C48.1-DC01 to C48.1-DC03 for details.																

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C48.1-N1	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043468.3 ;E 245869.7</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>July 14, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
213.4	GROUND SURFACE															
0.0	Silty PEAT		1	SS	1/0.15											
213.1	Very soft															
0.3	Brown Wet															
	END OF BOREHOLE SPOON REFUSAL															
	NOTES:															
	1. Borehole advanced using portable drilling equipment with a half weight hammer. SPT "N" values shown have been adjusted to infer values that would be obtained using a standard weight hammer.															
	2. Water level in open borehole at ground surface (Elev. 213.4 m) upon completion of drilling.															
	3. Three Dynamic Cone Penetration Tests were advanced adjacent to Borehole C48.1-N1 to confirm depth to bedrock; see Record of DCPT No. C48.1-DC04 to C48.1-DC06 for details.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C48.1-N2	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043486.9 ; E 245885.7</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>VA/TZ</u>	
DATUM <u>Geodetic</u>	DATE <u>March 18, 2009</u>	CHECKED BY <u>VA</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30	kn/m ³	GR SA SI CL
213.1	GROUND SURFACE																
0.0	Silty PEAT Dark brown Wet		1	SS	6		213										
0.2	SILT, trace to some clay, trace to some sand, containing rootlets Very loose to loose Grey Wet		2	SS	3		212										
211.7																	
1.4	SAND and SILT, some clay, trace gravel (TILL) Dense Brown and grey Wet		3	SS	34		211										0 41 43 16
210.5																	
2.6	END OF BOREHOLE SPOON AND CASING REFUSAL NOTES: 1. Water level in open borehole at ground surface (Elev 213.1 m) upon completion of drilling. 2. Borehole caved to a depth of 1.6 m below ground surface (Elev. 211.5 m) upon removal of casing.		4	SS	82/0.15												

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S20-02	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043431.4 ;E 245856.1</u>	ORIGINATED BY <u>DM</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>February 26, 2008</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
213.2	GROUND SURFACE															
0.0	Silty PEAT, containing rootlets Black Wet		1	AS	-											
212.4																
0.8	SAND and SILT, trace to some clay, slightly organic to a depth of 1.4 m Loose Dark brown to grey Wet		2	SS	6											
210.9																
2.3	END OF BOREHOLE AUGER REFUSAL NOTE: 1. Water level in open borehole at ground surface (Elev. 213.2 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S20-12	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043476.7 ; E 245877.3</u>	ORIGINATED BY <u>DM</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>February 26, 2008</u>	CHECKED BY <u>VA</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
213.2	GROUND SURFACE																
0.0	Silty PEAT, containing rootlets Black Wet		1	AS	-		213										
212.4																	
0.8	SILTY CLAY, trace sand Soft Brown Wet		2	SS	3		212									44	
211.5																	
1.7	SAND and SILT, trace gravel, trace clay, containing sandy silt seams (TILL) Compact Grey Wet		3	SS	13/0.25		211										0 44 52 4
210.5																	
2.7	END OF BOREHOLE SPOON AND AUGER REFUSAL																
	NOTES: 1. Water level in open borehole at ground surface (Elev. 213.2 m) upon completion of drilling. 2. An additional borehole was drilled 1.0 m north of Borehole S20-12 to obtain Shelby tube sample; see Record of Borehole No. S20-12A for details.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S20-12A	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043477.7 ; E 245877.3</u>	ORIGINATED BY <u>DM</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>February 26, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	10
213.2	GROUND SURFACE																	
0.0	See Record of Borehole S20-12 for subsurface conditions within these elevations.																	
212.4	SILTY CLAY Brown to reddish brown Wet		1	TO	PM													
0.8																		
211.8	END OF BOREHOLE																	
1.4																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ_GAL-GTA.GDT 03/30/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043448.1 ; E 245870.6</u>	ORIGINATED BY <u>EC</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 16, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
213.2	GROUND SURFACE					20	40	60	80	100						
0.0	Dynamic Cone Penetration Test (DCPT)					20	40	60	80	100						
211.7	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					20	40	60	80	100						
1.5																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC02	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043452.4 ; E 245870.2</u>	ORIGINATED BY <u>EC</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 16, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
						20	40	60	80	100						
213.2	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					213										
211.6						212										
1.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC03	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043452.0 ; E 245866.0</u>	ORIGINATED BY <u>EC</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 16, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
213.2	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					213										
211.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					212										
2.0																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC04	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043467.8 ; E 245870.0</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 17, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
						20	40	60	80	100						
213.1	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					213										
211.8						212										
1.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC05	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043469.9 ; E 245867.8</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 17, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
213.1	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					213										
211.9						212										
1.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE I-GPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C48.1-DC06	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043470.6 ; E 245871.7</u>	ORIGINATED BY <u>MJR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>March 17, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
213.4	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)															
0.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half weight hammer. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

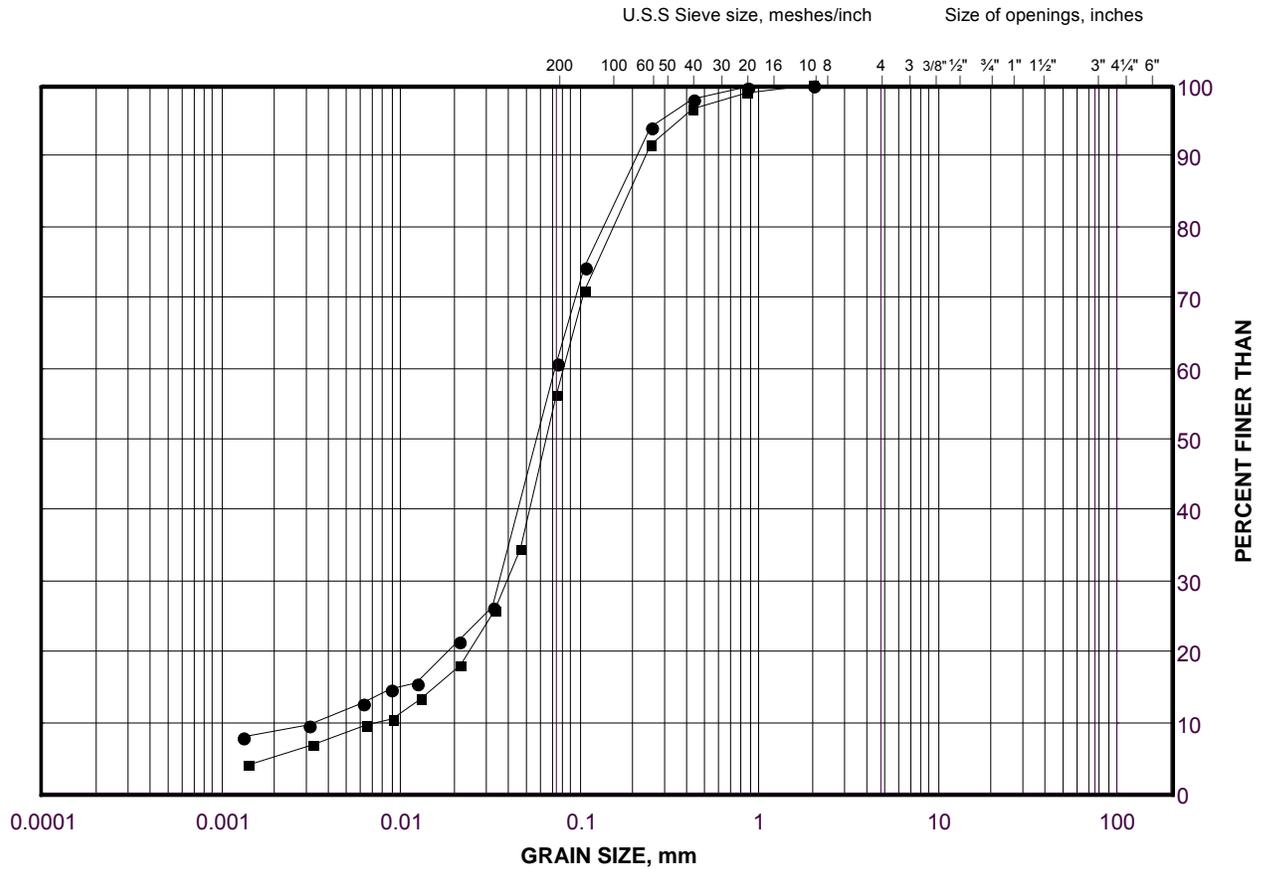
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+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Silt and Sand
Highway 69 (SBL) STA 14+315

FIGURE C.C48.1-1



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

LEGEND

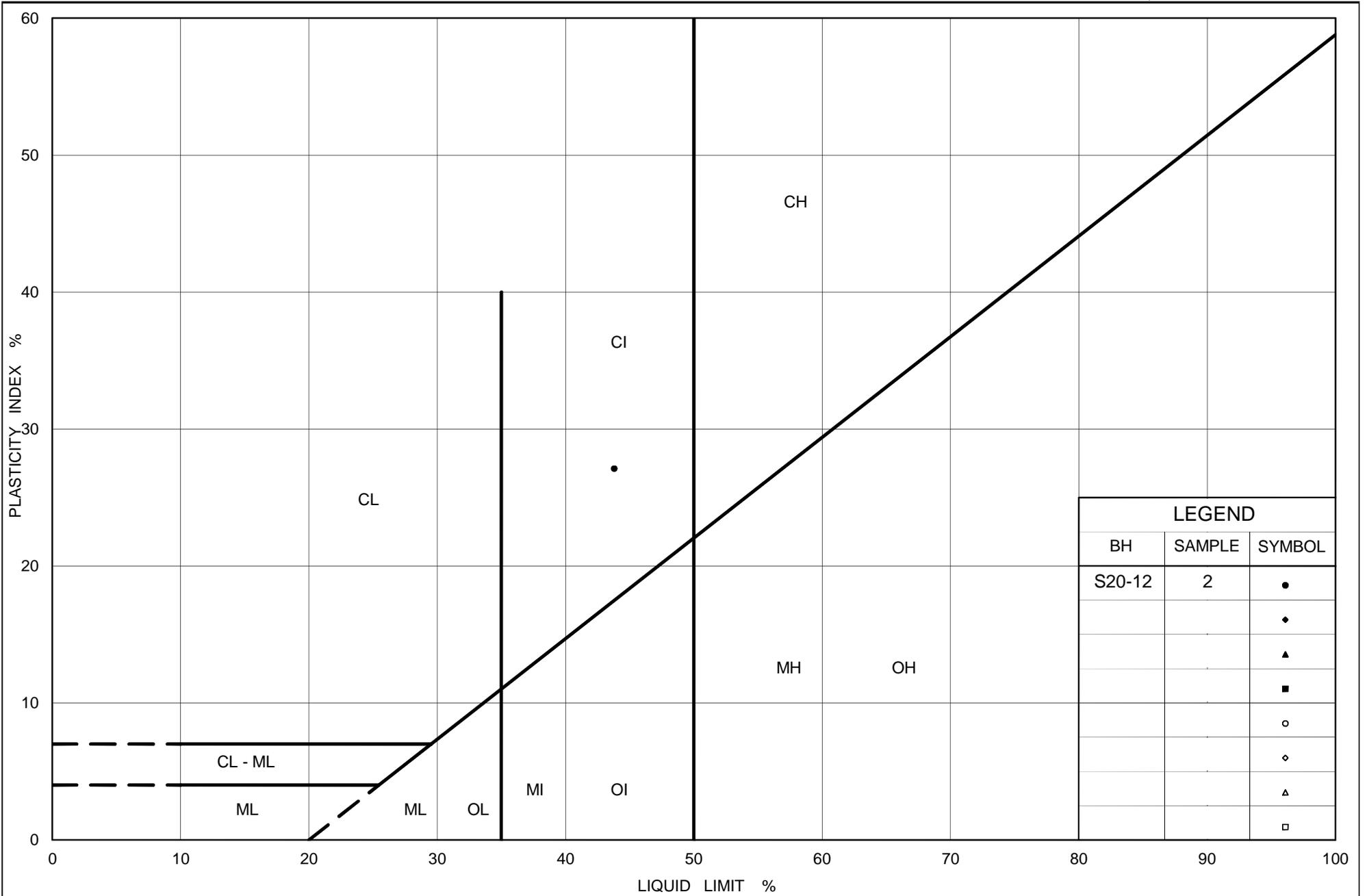
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S20-02	3	211.4
■	C48.1-S1	3A	210.9

Project Number: 07-1111-0029

Checked By: TVA

Golder Associates

1Date: 25-Aug-09



LEGEND		
BH	SAMPLE	SYMBOL
S20-12	2	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

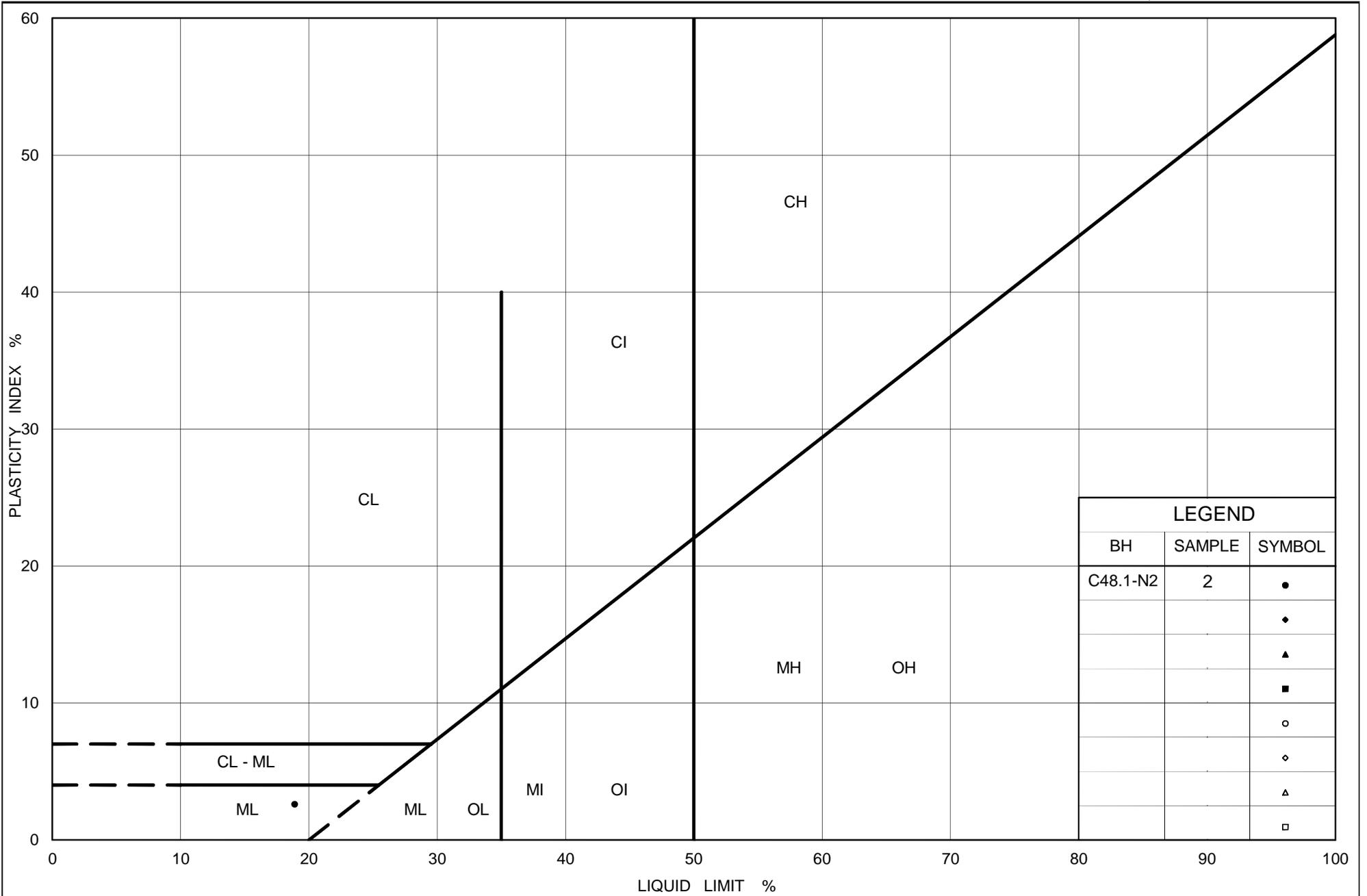
Ontario

PLASTICITY CHART
 Silty Clay
 Highway 69 (NBL) STA 14+325

Figure No. C.C48.1-2

Project No. 07-1111-0029

Checked By: TVA



LEGEND		
BH	SAMPLE	SYMBOL
C48.1-N2	2	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silt
 Highway 69 (NBL) STA 14+325

Figure No. C.C48.1-3

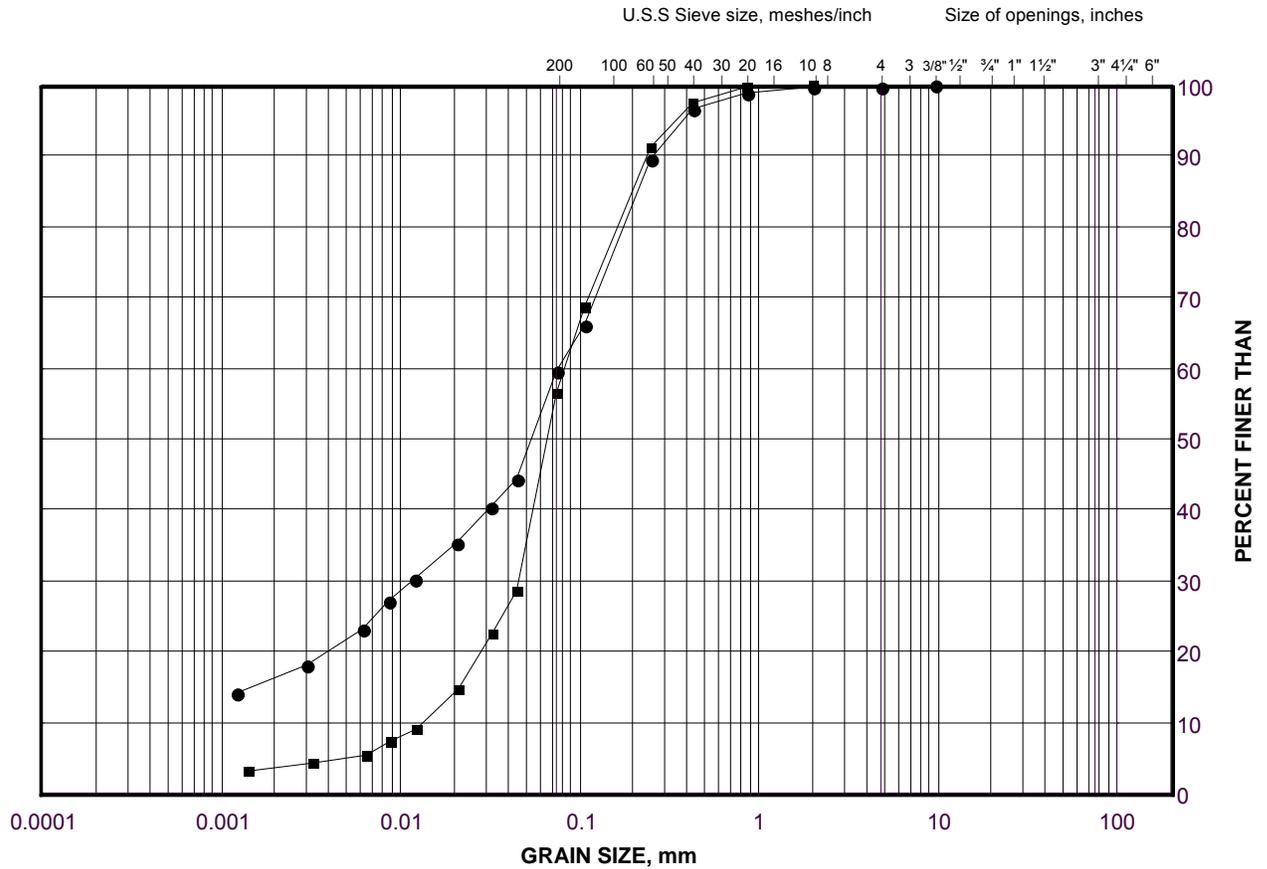
Project No. 07-1111-0029

Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silt and Sand Till
Highway 69 (NBL) STA 14+325

FIGURE C.C48.1-4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C48.1-N2	3	211.3
■	S20-12	3	210.7

Project Number: 07-1111-0029

Checked By: TVA

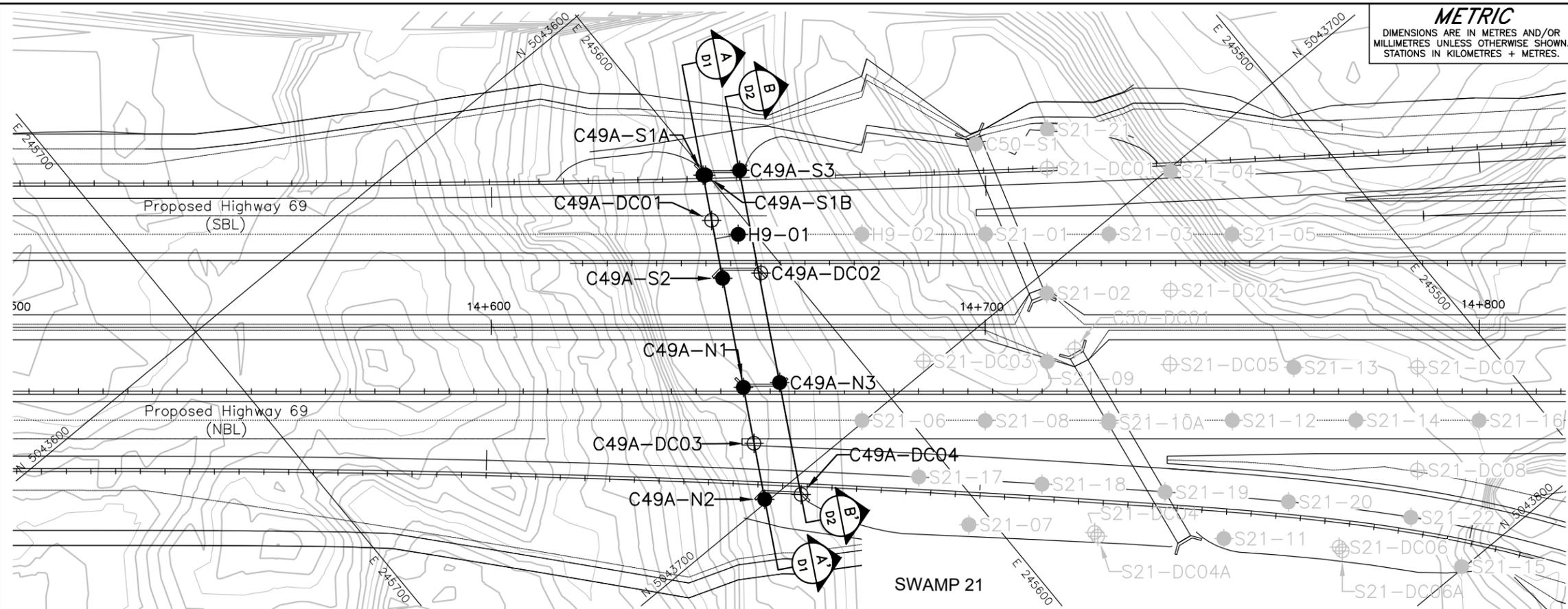
Golder Associates

Date: 27-Aug-09



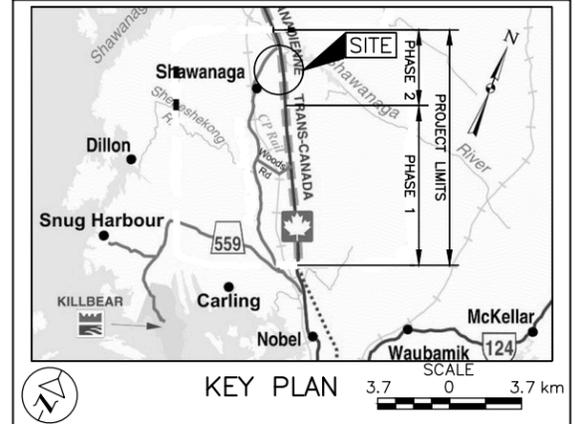
APPENDIX D

**Highway 69 SBL and NBL – STA 14+649 and STA 14+656
(Culvert 49A – Site No. 44-618/C2 and 44-618/C1)**



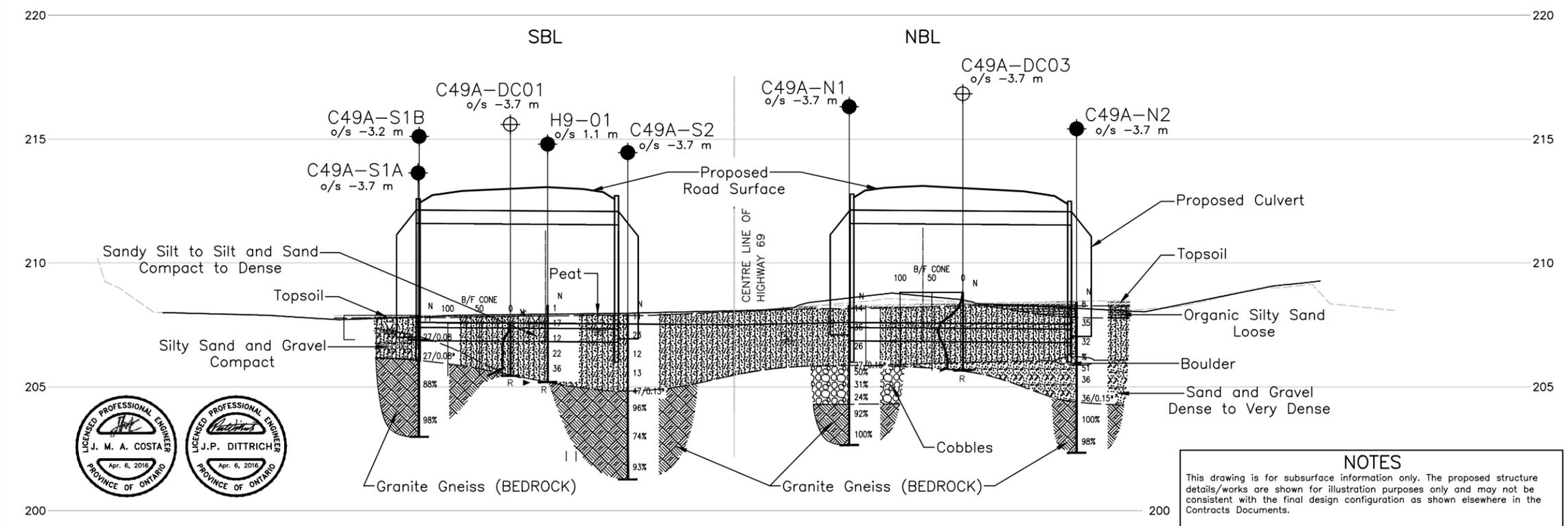
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. WP No. 5077-13-05 (NBL) and 5077-13-06 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C49A STA 14+649 AND STA 14+656
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET S2



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C49A-DC01	207.6	5043649.1	245605.2
C49A-DC02	207.8	5043663.7	245604.2
C49A-DC03	208.8	5043689.3	245627.2
C49A-DC04	207.5	5043703.3	245626.4
C49A-N1	208.3	5043679.2	245621.6
C49A-N2	208.5	5043699.3	245632.7
C49A-N3	208.3	5043683.1	245615.4
C49A-S1A	207.9	5043640.9	245600.7
C49A-S1B	207.9	5043641.2	245600.3
C49A-S2	208.0	5043659.5	245610.9
C49A-S3	207.7	5043644.9	245594.3
H9-01	208.3	5043654.7	245602.8



NOTES

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

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

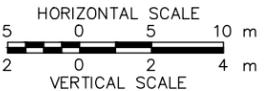
REFERENCE

Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878 jh Revised C49A & C50-Nov 4, 2015.dwg, received November 30, 2015.

(A-A) CULVERT C49A PROFILE STA 14+649 AND STA 14+656



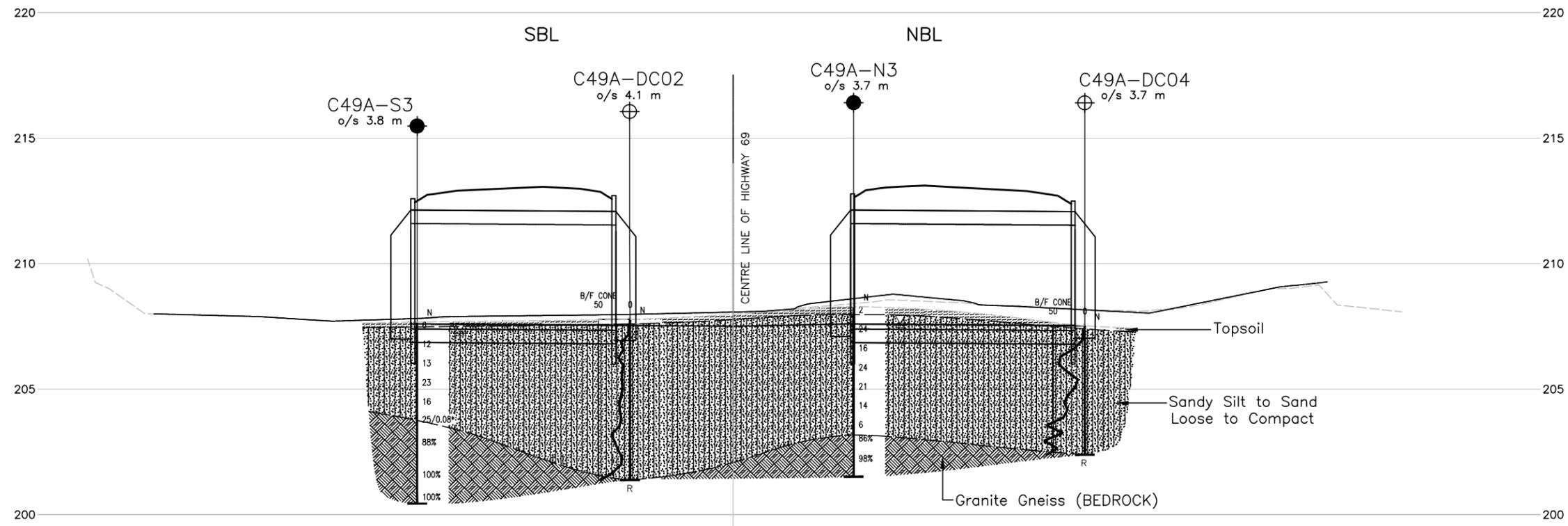
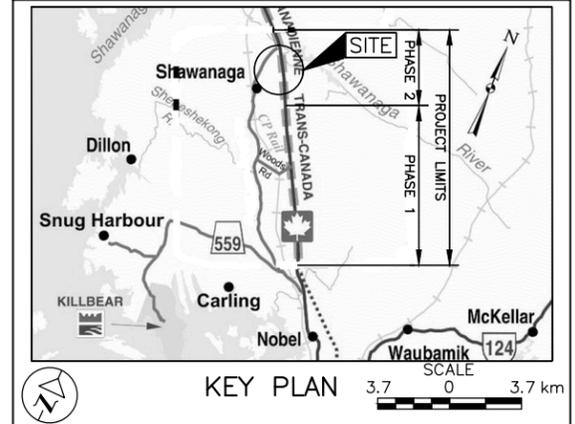
NO.	DATE	BY	REVISION

Geocres No. 41H-160

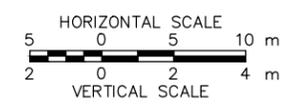
HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 12/9/2015
DRAWN: MR	CHKD. JMCA	APPD. JPD/JMAC
		SITE: 44-618/C1&C2
		DWG: D1

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

CONT No. .
 WP No. 5077-13-05 (NBL) and 5077-13-06 (SBL)
 HIGHWAY 69 (SBL AND NBL)
 CULVERT C49A STA 14+649 AND STA 14+656
 SOIL STRATA
 SHEET S3



B-B CULVERT C49A PROFILE STA 14+649 AND STA 14+656
 D1



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C49A-DC02	207.8	5043663.7	245604.2
C49A-DC04	207.5	5043703.3	245626.4
C49A-N3	208.3	5043683.0	245615.4
C49A-S3	207.7	5043644.9	245594.3

NOTES

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

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

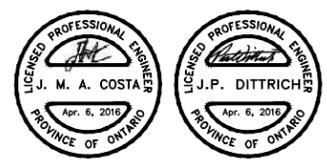
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878 jh Revised C49A & C50-Nov 4, 2015.dwg, received November 30, 2015.



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 3/17/2016
DRAWN: MR	CHKD. JMAC	APPD. JPD/JMAC
		SITE: .44-618/C1&C2
		DWG. D2

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C49A-S1A SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043640.9 ; E 245600.7</u>	ORIGINATED BY <u>ID</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>
DATUM <u>Geodetic</u>	DATE <u>June 3, 2015</u>	CHECKED BY <u>MCK</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
207.9	GROUND SURFACE																	
0.0	TOPSOIL		1A		11													
207.2	Silty SAND, trace organics Compact Brown Moist		1B	SS														
206.9			2	SS	27/0.08													
1.0	Silty SAND and GRAVEL, trace clay Brown Moist to wet END OF BOREHOLE SPOON REFUSAL																	
	NOTE: 1. Water level in open borehole not recorded.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C49A-S1B	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043641.2 ; E 245600.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 3, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
207.9 0.0	GROUND SURFACE No sample taken. Refer to Record of Borehole C49A-S1A.				▽											
206.4 206.1 1.8	Silty SAND and GRAVEL, trace clay Brown Moist to wet Granite Gneiss (BEDROCK) Bedrock cored from depths of 1.8 m to 4.9 m. For bedrock coring details refer to Record of Drillhole C49A-S1B.	[Hatched Pattern]	1	SS	20/0.15							○				
			1	RC	REC 97%											RQD = 88%
			2	RC	REC 100%											RQD = 98%
203.0 4.9	END OF BOREHOLE NOTE: 1. Water level measured in open borehole at a depth of 0.6 m below ground surface (Elev. 207.3 m) upon completion of drilling. * Split-spoon bouncing															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C49A-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043659.5 ; E 245610.9</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 5, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
208.0	GROUND SURFACE																
0.0	TOPSOIL		1A	SS	11												
0.1	SAND, some silt, trace organics Compact Light brown		1B														
207.3	Moist																
0.7	Sandy SILT Compact Grey to light brown Moist to wet		2	SS	23		207										
			3	SS	12		206										0 28 69 3
			4	SS	13		205										
204.8	Granite Gneiss (BEDROCK)		5	SS	47/0 13		205										
3.2	Bedrock cored from depths of 3.2 m to 6.7 m. For bedrock coring details refer to Record of Drillhole C49A-S2.		1	RC	REC 100%		204										RQD = 96%
			2	RC	REC 100%		203										RQD = 74%
			3	RC	REC 100%		202										RQD = 93%
201.6	END OF BOREHOLE																
6.4	NOTE: 1. Water level measured in open borehole at a depth of 0.7 m below ground surface (Elev. 207.3 m) upon completion of drilling. * Split-spoon bouncing																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C49A-S2

SHEET 1 OF 1

LOCATION: N 5043659.5 ; E 245610.9

DRILLING DATE: June 5, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Motorized Tri-Pod

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES	
							TOTAL CORE %	SOLID CORE %				K, cm/sec	10	10				10
							FLUSH	FLUSH				Ur	Ja	Jun				
		Continued from Record of Borehole C49A-S2		204.80														
3.17	NVY Casing	Slightly weathered to fresh, foliated, grey, coarse grained, very strong GRANITE GNEISS			1					JN,PL,RO,CL	1.5	1				(Axial)		
										JN,PL,RO,SA	1.5	2				(Axial)		
	NORC June 5, 2015				2					JN,UN,RO,CL	3	1						
										JN,PL,RO,CL	1.5	1	6					
										FO,PL,RO,SA	1.5	2						
										JN,UN,SM,CL	2	1						
										FO,UN,RO,CL	3	1						
										JN,IR,RO,CL	3	1						
										JN,UN,VR,CL	3	1						
					3					JN,UN,RO,CL SPUN	3	1	3					
										FO,PL,SM,CL	1	1						
		END OF DRILLHOLE		201.57						FO,PL,SM,CL	1	1						
				6.40														

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE II.GPJ GAL-MISS.GDT 03/25/16 DV

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: MCK

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C49A-S3	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043644.9 ; E 245594.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 4, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)				
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
							20	40	60	80	100	20	40	60		GR	SA	SI	CL		
207.7	GROUND SURFACE																				
0.0	TOPSOIL		1A		6																
0.2	Sandy SILT Loose to compact Light brown to grey Moist to wet		1B	SS																	
			2	SS	12															0 26 70 4	
			3	SS	13																
			4	SS	23																
			5	SS	16																
203.8	Granite Gneiss (BEDROCK)		6	SS	25/0.08																
3.9	Bedrock cored from depths of 3.9 m to 7.2 m. For bedrock coring details refer to Record of Drillhole C49A-S3.		1	RC	REC 96%															RQD = 88%	
			2	RC	REC 100%																RQD = 100%
			3	RC	REC 100%																RQD = 100%
200.5	END OF BOREHOLE																				
7.2	NOTE: 1. Water level measured in open borehole at a depth of 0.4 m below ground surface (Elev. 207.3 m) upon completion of drilling. * Split-spoon bouncing																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C49A-S3

SHEET 1 OF 1

LOCATION: N 5043644.9 ; E 245594.3

DRILLING DATE: June 4, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Motorized Tri-Pod

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W/CL CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES									
							TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ju	K, cm/sec	10 ⁰				10 ¹	10 ²							
							FLUSH	FLY																JN,ST,RO,CL	FO,UN,RO,CL	JN,PL,RO,CL	JN,UN,RO,CL	FO,UN,RO,CL	JN,UN,RO,CL SPUN	FO,PL,SM,CL
							80	80																						
		Continued from Record of Borehole C49A-S3		203.79																										
4	NW Casing	Slightly weathered to fresh, foliated, grey-black-pink, coarse grained, very strong GRANITE GNEISS		3.89																										
5				1																			8.0 MPa (Axial)							
6	NORC June 4, 2015			2																				8.5 MPa (Axial)						
7		END OF DRILLHOLE		200.44																										
				7.24																										
8																														
9																														
10																														
11																														
12																														
13																														

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE II\GPJ GAL-MISS.GDT 03/25/16 DV



RECORD OF BOREHOLE No C49A-N1 SHEET 1 OF 1 METRIC

PROJECT 07-1111-0029 G.W.P. 5111-07-00 LOCATION N 5043679.2 ; E 245621.6 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment COMPILED BY ZR/MR

DATUM Geodetic DATE June 8 and 9, 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								
						20	40	60	80	100						
208.3	GROUND SURFACE															
0.0	TOPSOIL		1A		14											
0.1	Silty SAND, trace organics Compact Light brown Moist		1B	SS												
			2	SS	36											
			3	SS	26											
205.9			4	SS	27/0.15											
2.4	COBBLES		1	RC	REC 50%											
			2	RC	REC 31%											
			3	RC	REC 24%											
204.3	Granite Gneiss (BEDROCK)		4	RC	REC 92%											RQD = 92%
4.0	Bedrock cored from depths of 4.0 m to 5.7 m. For bedrock coring details refer to Record of Drillhole C49A-N1.		5	RC	REC 100%											RQD = 100%
202.7	END OF BOREHOLE															
5.6	NOTE: 1. Water level measured in open borehole at a depth of 1.4 m below ground surface (Elev. 206.9 m) upon completion of drilling. * Split-spoon bouncing															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No C49A-N2** SHEET 1 OF 1 **METRIC**
 G.W.P. 5111-07-00 LOCATION N 5043699.3 ; E 245632.7 ORIGINATED BY ID
 DIST HWY 69 BOREHOLE TYPE Portable Equipment COMPILED BY ZR/MR
 DATUM Geodetic DATE June 11, 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 (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
208.5	GROUND SURFACE																		
0.0	TOPSOIL		1A	SS	8														
0.2	Organic Silty SAND		1B	SS	8														OC = 7.2%
207.8	Loose Red to dark brown Moist																		
0.7	SILT and SAND Compact Brown Moist		2	SS	35														0 37 63 0
206.2	BOULDER		3	SS	32														
205.9	SAND and GRAVEL, trace to some silt to silty Dense to very dense Brown Wet		4	SS	51														39 53 7 1
2.6			5	SS	36														
204.2	Cobbles encountered at a depth of 4.1 m (Elev. 204.4 m)		6	SS	36/0.15														
4.3	Granite Gneiss (BEDROCK)		1	RC	REC 100%														RQD = 100%
	Bedrock cored from depths of 4.3 m to 6.1 m. For bedrock coring details refer to Record of Drillhole C49A-N2.		2	RC	REC 98%														RQD = 98%
202.4	END OF BOREHOLE																		
6.1	NOTE: 1. Water level measured in open borehole at a depth of 1.5 m below ground surface (Elev. 207.0 m) upon completion of drilling. * Split-spoon bouncing																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C49A-N2

SHEET 1 OF 1

LOCATION: N 5043699.3 ; E 245632.7

DRILLING DATE: June 11, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Motorized Tri-Pod

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W/ ZEL CORE AXIS	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES			
								TOTAL CORE %	SOLID CORE %					Type and Surface Description	Jr	Ja	Ja	K, cm/sec				10 ⁰	10 ¹	10 ²
								80	80															
		Continued from Record of Borehole C49A-N2		204.14																				
5	NQRC June 11, 2015	Fresh, foliated, grey-black-pink, coarse grained, medium strong GRANITE GNEISS		4.33	1																			
6					2									JN, PL, RO, CL	1.5	1							(Axial) UC = 48.3 MPa	
6		END OF DRILLHOLE		202.34										JN, CU, RO, CL	3	1								
				6.13																				
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE II\GPJ GAL-MISS.GDT 03/25/16 DV



PROJECT 07-1111-0029 **RECORD OF BOREHOLE No C49A-N3** SHEET 1 OF 1 **METRIC**
G.W.P. 5111-07-00 **LOCATION** N 5043683.1 ; E 245615.4 **ORIGINATED BY** ID
DIST HWY 69 **BOREHOLE TYPE** Portable Equipment **COMPILED BY** ZR/MR
DATUM Geodetic **DATE** June 8, 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 (%)	
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
208.3	GROUND SURFACE																	
0.0	TOPSOIL		1A	SS	2													
0.3	Silty SAND, trace organics Very loose to compact Light brown Moist		1B															
			2	SS	24													
206.8																		
1.5	SILT and SAND, trace clay Compact Reddish brown to grey Wet		3	SS	16													0 31 66 3
			4	SS	24													
			5	SS	21													0 42 56 2
			6	SS	14													
203.8																		
4.5	SAND, some silt, trace gravel Loose Grey Wet		7	SS	6													
203.2			1	RC	REC 86%													RQD = 86%
5.1	Granite Gneiss (BEDROCK)		2	RC	REC 98%													RQD = 98%
	Bedrock cored from depths of 5.1 m to 6.8 m. For bedrock coring details refer to Record of Drillhole C49A-N3.																	
201.5																		
6.8	END OF BOREHOLE																	
	NOTE: 1. Water level measured in open borehole at a depth of 0.7 m below ground surface (Elev. 207.6 m) upon completion of drilling.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C49A-N3

SHEET 1 OF 1

LOCATION: N 5043683.1 ; E 245615.4

DRILLING DATE: June 8, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Motorized Tri-Pod

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W/CL CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES			
								TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION	Ur	Ja	Jn	K	cm/sec						
								80	80														10	10	10
								00	00														00	00	00
		Continued from Record of Borehole C49-N3		203.17																					
	NW Casings NRRC June 8, 2015	Fresh, foliated, grey, medium grained, very strong GRANITE GNEISS		5.11	1																				
6					2																				
		END OF DRILLHOLE		201.51																					
7				6.77																					
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II\GPJ GAL-MISS.GDT 03/25/16 DV



PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No H9-01	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043654.7 ; E 245602.8</u>	ORIGINATED BY <u>TDM</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 12, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
							20	40	60	80	100						
208.3	GROUND SURFACE																
0.0	PEAT (Amorphous) Black Moist		1	SS	1	208										OC = 79.5%	
0.2	SILT and SAND, trace clay, trace organics, rootlets to a depth of 0.6 m Very loose to dense Brown to grey Moist		2	SS	17	207											
			3	SS	12	207											
			4	SS	22	206											
			5	SS	36	206										0 30 66 4	
205.2	END OF BOREHOLE CASING REFUSAL																
3.1	NOTES: 1. Borehole advanced using portable drilling equipment with a half-weight hammer. SPT N values shown have been adjusted to infer values that would be obtained using a standard weight hammer. 2. Water level in open borehole at a depth of 0.7 m below ground surface (Elev. 207.6 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C49A-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043649.1 ; E 245605.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 4, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L					
207.6	GROUND SURFACE						20	40	60	80	100								
0.0	Dynamic Cone Penetration Test (DCPT)																		
207																			
206																			
205.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)																		
2.1																			

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C49A-DC02	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043663.7 ; E 245604.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 3, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
207.8 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
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						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
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						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						
						20	40	60	80	100						



RECORD OF DCPT No C49A-DC03 SHEET 1 OF 1 **METRIC**

PROJECT 07-1111-0029 G.W.P. 5111-07-00 LOCATION N 5043689.3 ; E 245627.2 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test COMPILED BY ZR/MR

DATUM Geodetic DATE June 10, 2015 CHECKED BY AJS

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									
						20	40	60	80	100	20	40	60	γ	GR SA SI CL	
208.8 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)															
206																
205.7 3.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C49A-DC04	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043703.3; E 245626.4</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 10, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40					
207.5 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)												
207													
206													
205													
204													
203													
202.4 5.1	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)												

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

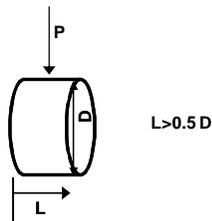
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**TABLE D1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C49A-S1B	2	3.3	204.6	Granite Gneiss	Diametral	9.18
C49A-S1B	2	3.6	204.3	Granite Gneiss	Axial	4.95
C49A-S1B	2	4.1	203.8	Granite Gneiss	Diametral	5.21
C49A-S1B	2	4.3	203.7	Granite Gneiss	Axial	1.56
C49A-S2	1	3.9	204.1	Granite Gneiss	Axial	5.56
C49A-S2	2	4.7	203.3	Granite Gneiss	Axial	6.06
C49A-S2	3	6.0	202.0	Granite Gneiss	Diametral	4.85
C49A-S3	1	4.2	203.5	Granite Gneiss	Diametral	5.64
C49A-S3	1	4.2	203.5	Granite Gneiss	Axial	8.01
C49A-S3	2	5.9	201.8	Granite Gneiss	Diametral	3.77
C49A-S3	2	5.9	201.8	Granite Gneiss	Axial	8.54
C49A-N1	5	5.2	203.1	Granite Gneiss	Diametral	8.12
C49A-N1	5	5.2	203.1	Granite Gneiss	Axial	6.73
C49A-N2	1	5.1	203.4	Granite Gneiss	Diametral	5.22
C49A-N2	1	5.2	203.3	Granite Gneiss	Axial	5.44
C49A-N3	2	5.6	202.7	Granite Gneiss	Diametral	5.26
C49A-N3	2	5.6	202.7	Granite Gneiss	Axial	4.08

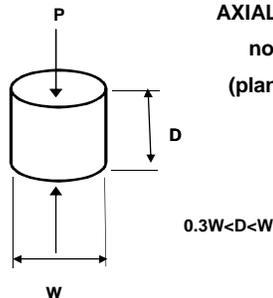
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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 D2

**UNCONFINED COMPRESSION TEST (UC)
ASTM D7012**

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 1
BOREHOLE NUMBER	C49A-S1B	SAMPLE DEPTH, m	1.82

TEST CONDITIONS

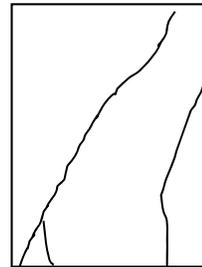
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.24

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	9.55	WATER CONTENT, (specimen) %	0.09
SAMPLE DIAMETER, cm	4.26	UNIT WEIGHT, kN/m ³	25.84
SAMPLE AREA, cm ²	14.25	DRY UNIT WT., kN/m ³	25.81
SAMPLE VOLUME, cm ³	136.15	SPECIFIC GRAVITY	-
WET WEIGHT, g	358.84	VOID RATIO	-
DRY WEIGHT, g	358.52		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	84.3
----------------------	-----	---------------------------	------

REMARKS:

DATE:

2015-06-25

Table D3

**UNCONFINED COMPRESSION TEST (UC)
ASTM D7012**

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 3
BOREHOLE NUMBER	C49A-N2	SAMPLE DEPTH, m	5.25

TEST CONDITIONS

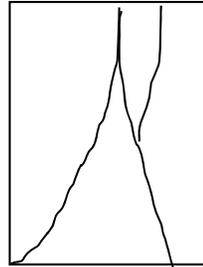
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.19

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	9.34	WATER CONTENT, (specimen) %	0.39
SAMPLE DIAMETER, cm	4.27	UNIT WEIGHT, kN/m ³	26.00
SAMPLE AREA, cm ²	14.29	DRY UNIT WT., kN/m ³	25.90
SAMPLE VOLUME, cm ³	133.49	SPECIFIC GRAVITY	-
WET WEIGHT, g	354.06	VOID RATIO	-
DRY WEIGHT, g	352.68		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	48.3
----------------------	-----	---------------------------	------

REMARKS:

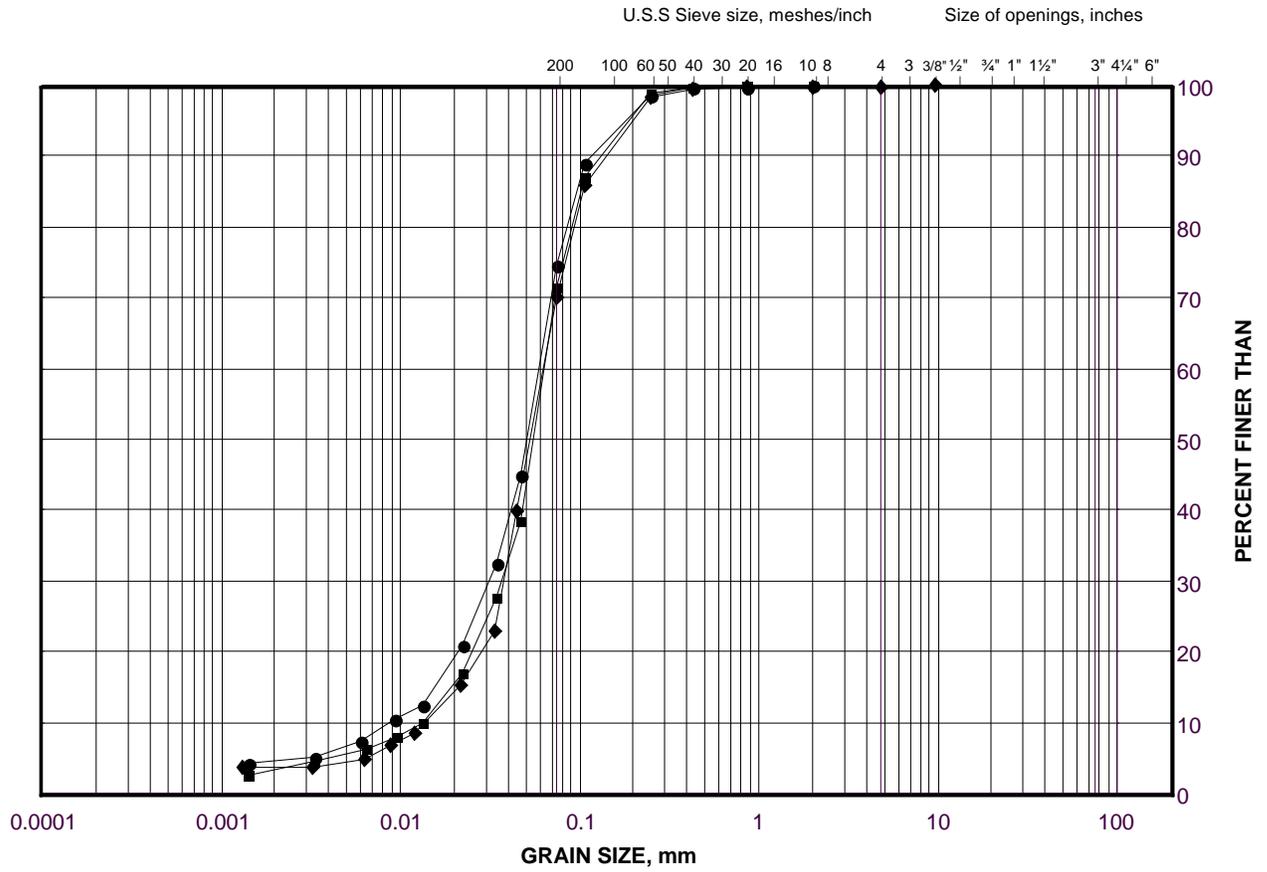
DATE:

2015-06-25

GRAIN SIZE DISTRIBUTION

Sandy Silt
Highway 69 (SBL) STA 14+649

FIGURE D.C49A-1



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

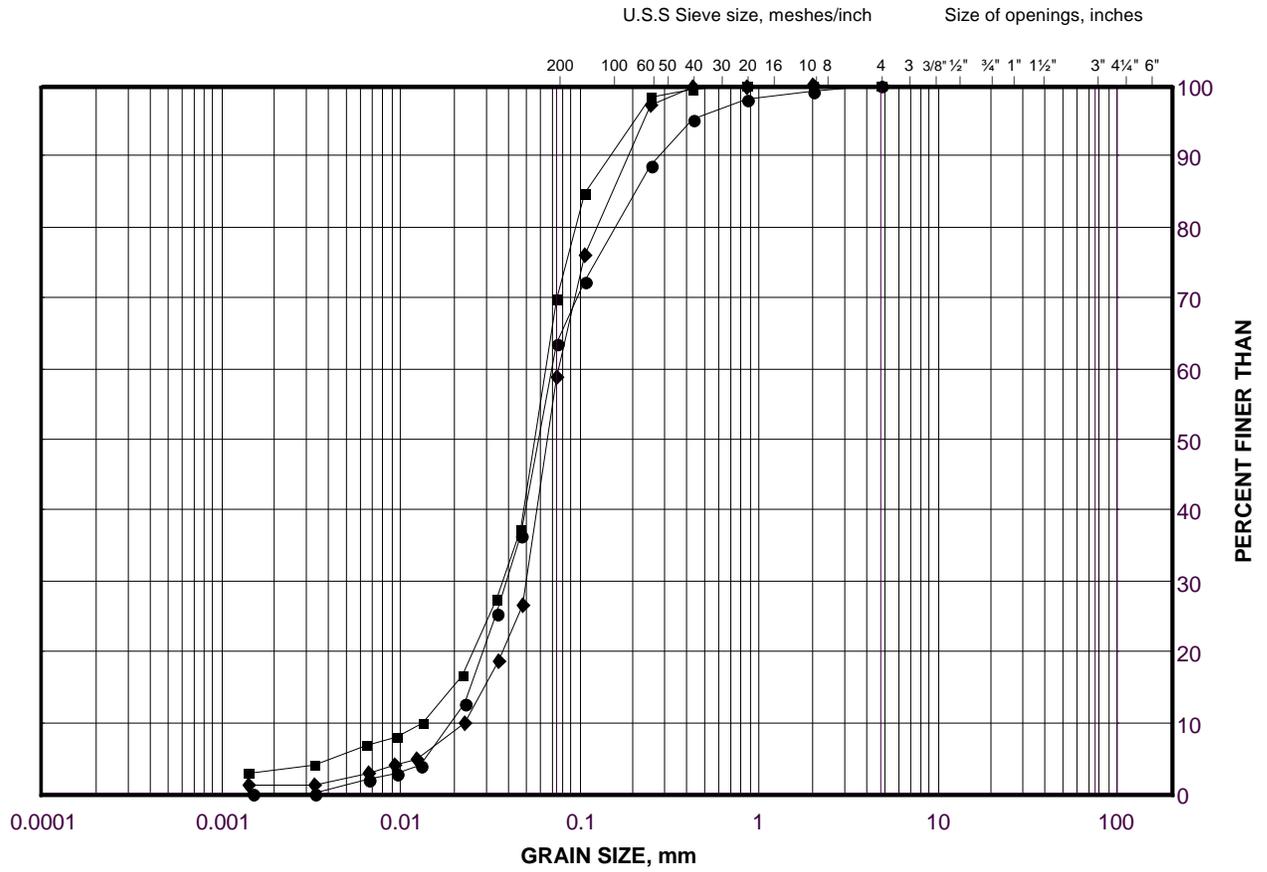
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C49A-S3	2	206.7
■	C49A-S2	3	206.2
◆	H9-01	5	205.6

GRAIN SIZE DISTRIBUTION

Silt and Sand
Highway 69 (NBL) STA 14+656

FIGURE D.C49A-2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C49A-N2	3	206.7
■	C49A-N3	3	206.5
◆	C49A-N3	5	205.0

Project Number: 07-1111-0029

Checked By: AJS

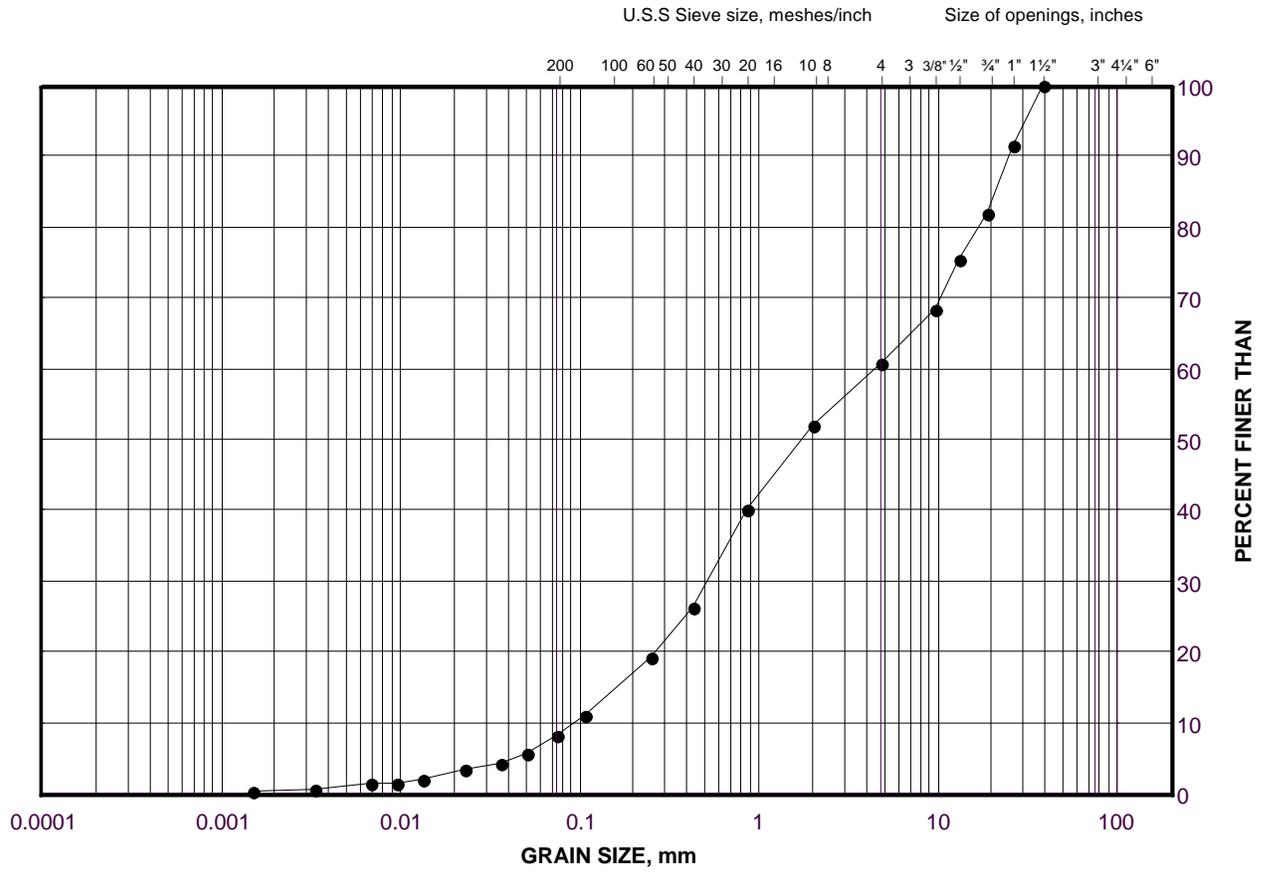
Golder Associates

Date: 16-Aug-15

GRAIN SIZE DISTRIBUTION

Sand and Gravel
Highway 69 (NBL) STA 14+656

FIGURE D.C49A-3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C49A-N2	5	205.2

Project Number: 07-1111-0029

Checked By: AJS

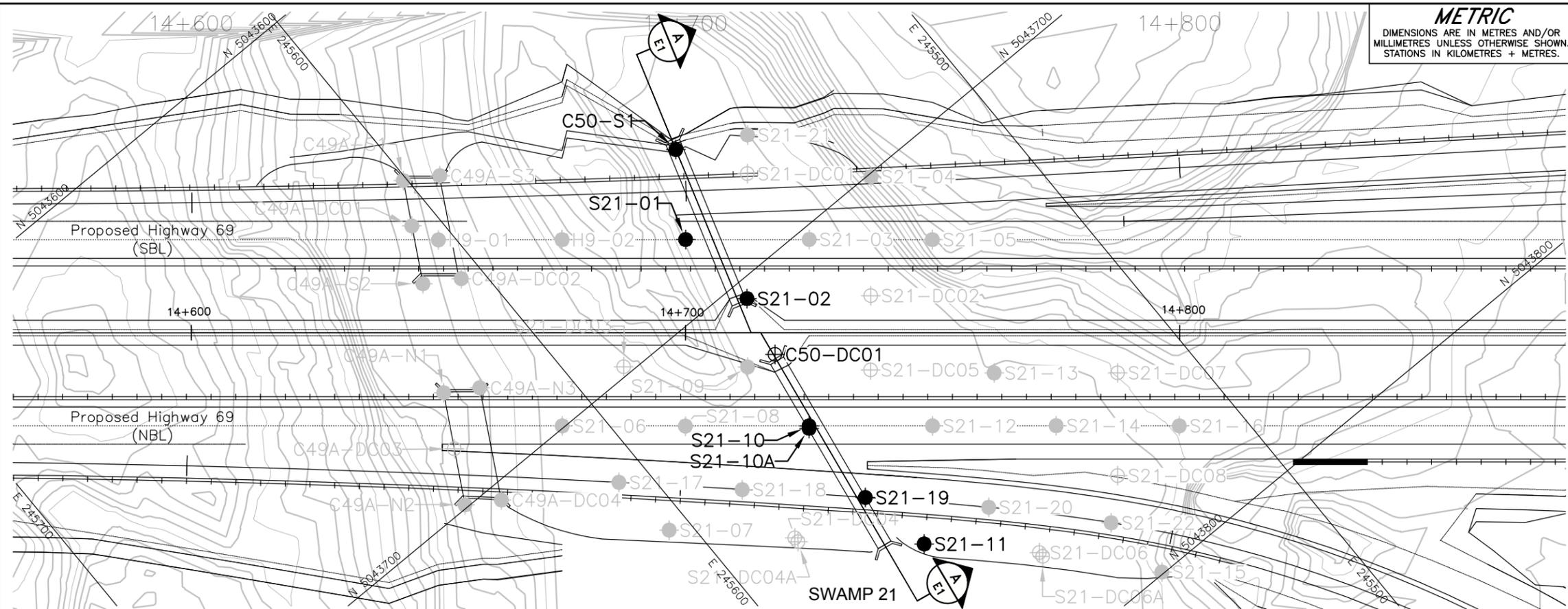
Golder Associates

Date: 17-Aug-15



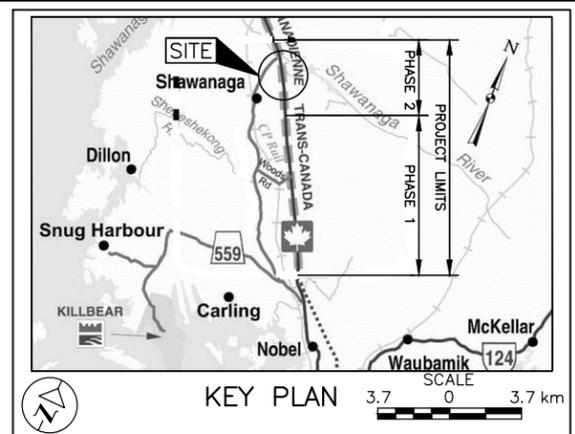
APPENDIX E

**Highway 69 SBL and NBL – STA 14+706 and STA 14+726
(Culvert C50 – Site No. 44-619/C2 and 44-619/C1)**



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

CONT No. WP No. 5077-13-07 (NBL) and 5077-13-08 (SBL)
HIGHWAY 69 (SBL AND NBL) CULVERT C50 STA 14+706 AND STA 14+726
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET S33



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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

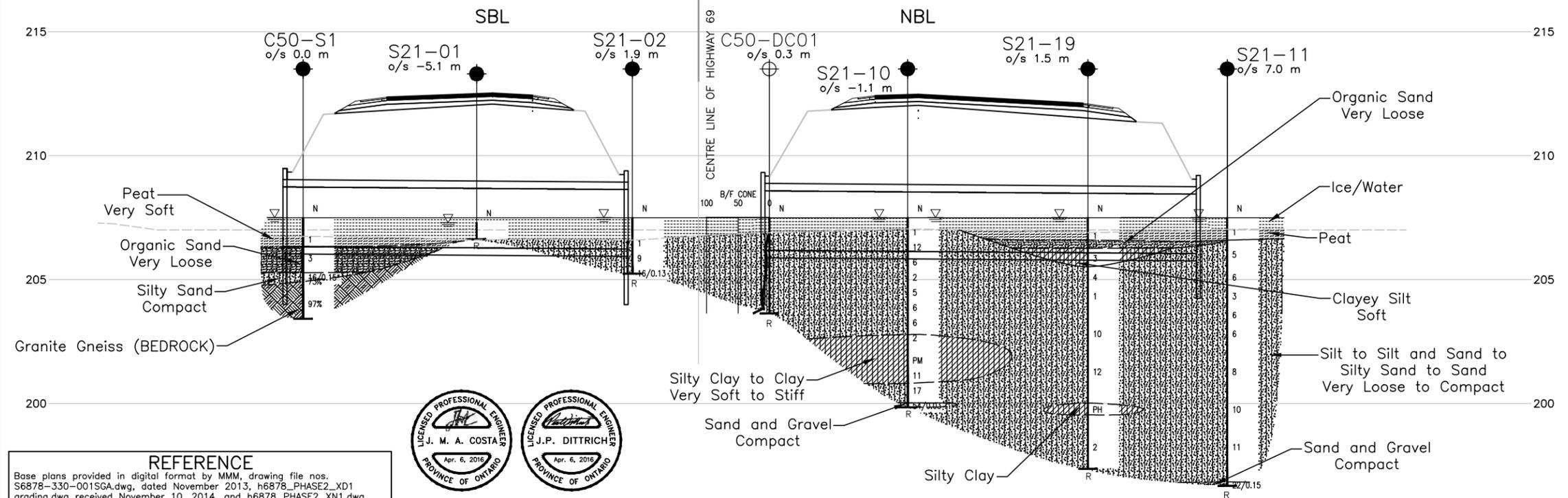
No.	ELEVATION	NORTHING	EASTING
C50-DC01	207.5	5043715.9	245565.0
C50-S1	207.5	5043671.2	245554.2
S21-01	207.3	5043686.5	245564.2
S21-02	207.5	5043703.6	245562.2
S21-10	207.5	5043731.4	245568.9
S21-11	207.5	5043764.6	245566.1
S21-19	207.5	5043749.8	245569.3

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.

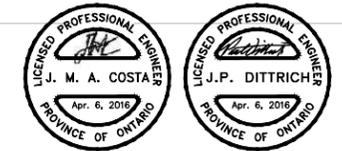


REFERENCE

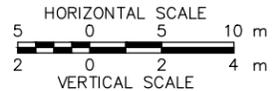
Base plans provided in digital format by MMM, drawing file no. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878 jh Revised C49A & C50-Nov 4, 2015.dwg, received November 30, 2015.



A-A CULVERT C50 PROFILE STA 14+706 AND 14+726



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 12/9/2015
SITE: 44-619/C1&C2		
DRAWN: MR	CHKD. JMCA	APPD. JMCA
DWG. E1		

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C50-S1	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043671.2 ; E 245554.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 2, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
207.5	GROUND SURFACE																
0.0	WATER																
206.7							207										
0.8	PEAT (Fibrous)																
206.3	Very soft		1A	SS	1												
1.2	Dark brown Wet		1B														
205.3	Organic SAND, some silt						206										0 82 16 2
	Very loose Dark brown Wet		2	SS	3												
204.9	Silty SAND						205										
2.6	Compact Light grey Wet		3	SS	16/0.15												
	Granite Gneiss (BEDROCK)																RQD = 73%
	Bedrock cored from depths of 2.6 m to 4.1 m.						204										
203.4	For bedrock coring details refer to Record of Drillhole C50-S1.																
4.1	END OF BOREHOLE																
	NOTE: * Split-spoon bouncing																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/30/16 DV

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C50-S1

SHEET 1 OF 1

LOCATION: N 5043671.2 ;E 245554.2

DRILLING DATE: June 2, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Motorized Tri-Pod

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W.Z.L. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES		
								TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION			K, cm/sec							
								80 90 100	80 90 100					Jr	Ja	Jun	10	10	10					
		Continued from Record of Borehole C50-S1		204.91																				
3	NGRC NWY Casing June 2, 2015	Slightly weathered to fresh, foliated, green-grey-pink, medium grained, medium strong GRANITE GNEISS		2.59	1									JN,PL,RO,CL JN,UN,RO,SA JN,UN,RO,CL	1.5 1 3 2 3 1									
4					2									FO,PL,RO,CL JN,ST,SM,CL	1.5 1 2 1									(Axial) UC = 45.7 MPa
4		END OF DRILLHOLE		203.44										JN,UN,SM,SA FO,CU,RO,CL	2 2 3 1 3									
5				4.06																				
6																								
7																								
8																								
9																								
10																								
11																								
12																								

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE II\GPJ GAL-MISS.GDT 03/25/16 DV



PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S21-01	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043686.5 ; E 245564.2</u>	ORIGINATED BY <u>TDM</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 10, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20	40	60	80	100	10	20	30	GR
207.3	ICE SURFACE																									
0.0	Ice																									
206.8	Water																									
0.7	END OF BOREHOLE CASING REFUSAL																									
	NOTE: 1. Water level in open borehole at ice surface (Elev. 207.3 m) upon completion of drilling.																									

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S21-10** SHEET 1 OF 1 **METRIC**
 G.W.P. 5402-05-00 LOCATION N 5043731.4 ; E 245568.9 ORIGINATED BY TDM
 DIST HWY 69 BOREHOLE TYPE Portable Equipment, NW Casing, Wash Boring COMPILED BY VO
 DATUM Geodetic DATE March 11, 2008 CHECKED BY CN

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			T _N VALUES	20	40	60	80						100	20	40	60	80	100	10	20	30
207.5	ICE SURFACE																								
0.0	Ice																								
207.0	Silty SAND, trace to some clay, trace organics, rootlets to a depth of 1.6 m Very loose to compact Dark brown and black Wet		1	SS	1																				
0.5			2	SS	12																				
				3	SS	6																			
				4	SS	2																			
204.6	SILT and SAND, trace to some clay Loose Grey Wet Some gravel below a depth of 4.1 m		5	SS	5																			0 32 62 6	
2.9			6	SS	6																				
				7	SS	6																			
202.8	CLAY, trace silt Very soft Light brown and grey Wet		8	SS	2																				
4.7																									
201.2	SILTY CLAY, some sand Stiff Grey Wet		9	TO	PM																				
6.3			10A	SS	11																			0 13 36 51	
200.8	SILT and SAND, trace clay, containing silt seams Compact Grey Wet		10B																						
6.7			11	SS	17																				
200.0	SAND and GRAVEL, some silt Compact Grey Wet END OF BOREHOLE SPOON REFUSAL		12	SS	54/0.03																				
7.7																									

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE I.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

NOTES:

- Borehole advanced using portable drilling equipment with half weight hammer. SPT N values shown have been adjusted to infer values that would be obtained using a standard weight hammer.
- Water level in open borehole at ice surface (Elev. 207.5 m) upon completion of drilling.
- An additional borehole was drilled 0.5 m north of Borehole S21-10 to carry out in situ vane testing and to obtain split spoon samples; see Record of Borehole No. S21-10A for details.

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S21-19** SHEET 1 OF 1 **METRIC**
G.W.P. 5402-05-00 **LOCATION** N 5043749.8 ; E 245569.3 **ORIGINATED BY** ID
DIST _____ **HWY** 69 **BOREHOLE TYPE** Portable Equipment, NW Casing, Wash Boring **COMPILED BY** VO
DATUM Geodetic **DATE** March 18, 2008 **CHECKED BY** CN

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 (%)					
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
207.5	ICE SURFACE																						
0.0	Ice																						
207.0																							
206.6	Water																						
206.6	PEAT (Amorphous)		1	SS	1																		
206.3	Organic SAND																						
206.3	Very loose																						
206.3	Dark brown																						
206.3	Wet																						
205.5	CLAYEY SILT		2	SS	3																		
205.5	Soft																						
205.5	Grey																						
205.5	Wet																						
	SILT, trace clay seams		3	SS	4																		
	Very loose																						
	Grey																						
	Wet																						
			4	SS	1																		
203.2	SAND and SILT, trace clay																						
203.2	Compact																						
203.2	Grey																						
203.2	Moist		5	SS	10																		
			6	SS	12																		
200.0	SILTY CLAY																						
200.0	Light brown																						
200.0	Wet		7A	TO	PH																		
199.6																							
199.6	SILT, some sand, trace to some																						
199.6	clay																						
199.6	Very loose																						
199.6	Grey																						
199.6	Wet																						
			8	SS	2																		
197.4	END OF BOREHOLE CASING REFUSAL																						
197.4	NOTES:																						
	1. Borehole caved to a depth of 6.3 m below ice surface (Elev. 201.2 m) upon removal of casing.																						
	2. Water level in open borehole at ice surface (Elev. 207.5 m) upon completion of drilling.																						

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C50-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043715.9 ; E 245565.0</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 2, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60		GR SA SI CL	
207.5 0.0	WATER SURFACE WATER															
206.9 0.6	Dynamic Cone Penetration Test (DCPT)					207										
						206										
						205										
						204										
203.6 3.9	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

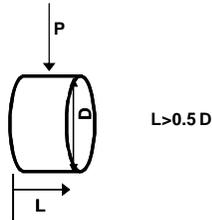
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**TABLE E1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C50-S1	1	2.9	204.6	Granite Gneiss	Diametral	5.06
C50-S1	2	3.7	203.9	Granite Gneiss	Axial	4.83

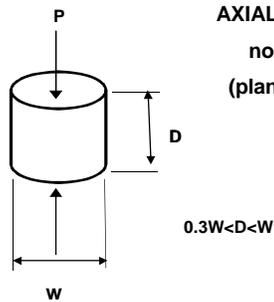
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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 E2

**UNCONFINED COMPRESSION TEST (UC)
ASTM D7012**

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 2
BOREHOLE NUMBER	C50-S1	SAMPLE DEPTH, m	3.92

TEST CONDITIONS

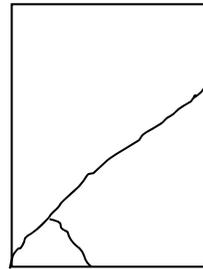
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.25

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	9.56	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.24	UNIT WEIGHT, kN/m ³	26.38
SAMPLE AREA, cm ²	14.11	DRY UNIT WT., kN/m ³	26.36
SAMPLE VOLUME, cm ³	134.89	SPECIFIC GRAVITY	-
WET WEIGHT, g	363.05	VOID RATIO	-
DRY WEIGHT, g	362.69		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	45.7
----------------------	-----	---------------------------	------

REMARKS:

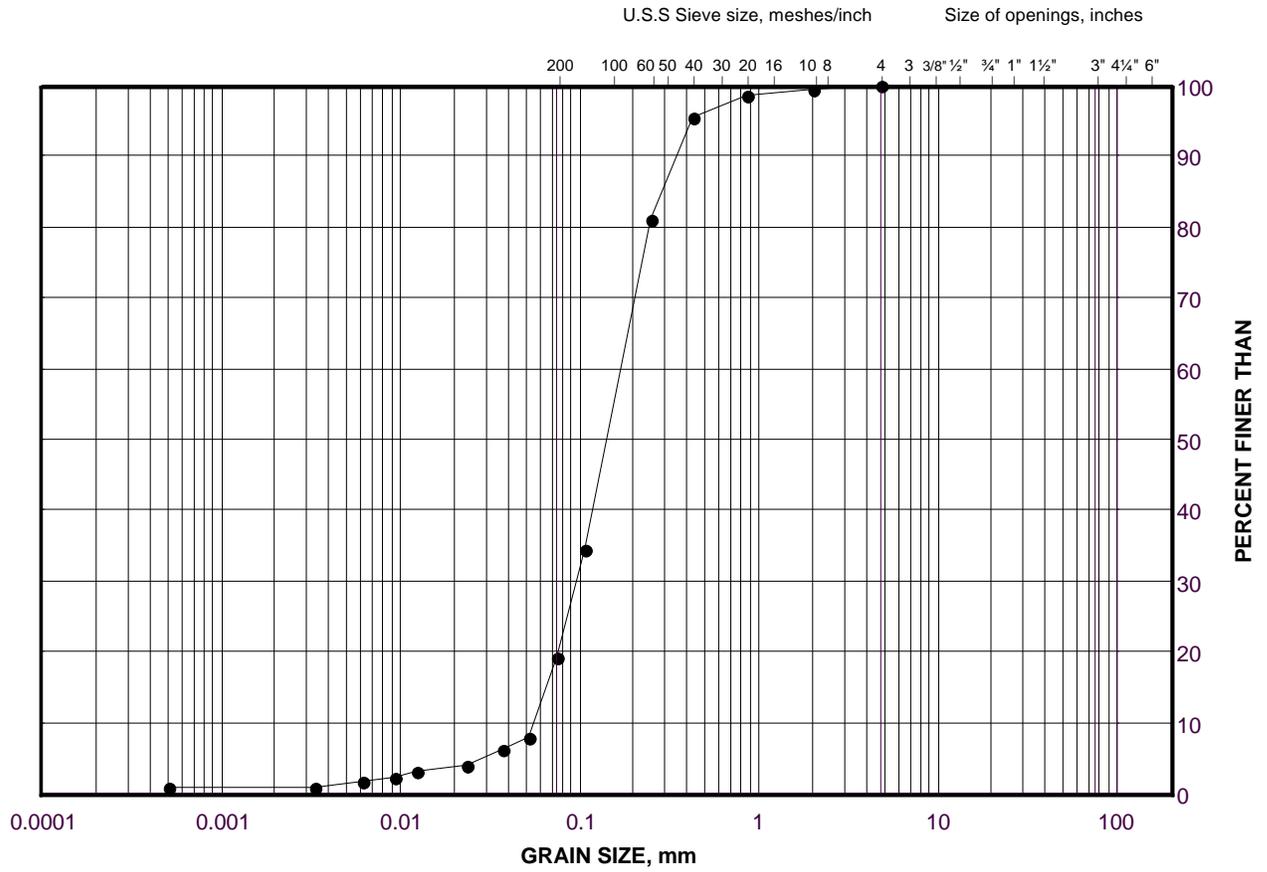
DATE:

2015-06-25

GRAIN SIZE DISTRIBUTION

Organic Sand
Highway 69 (SBL) STA 14+706

FIGURE E.C50-1



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

LEGEND

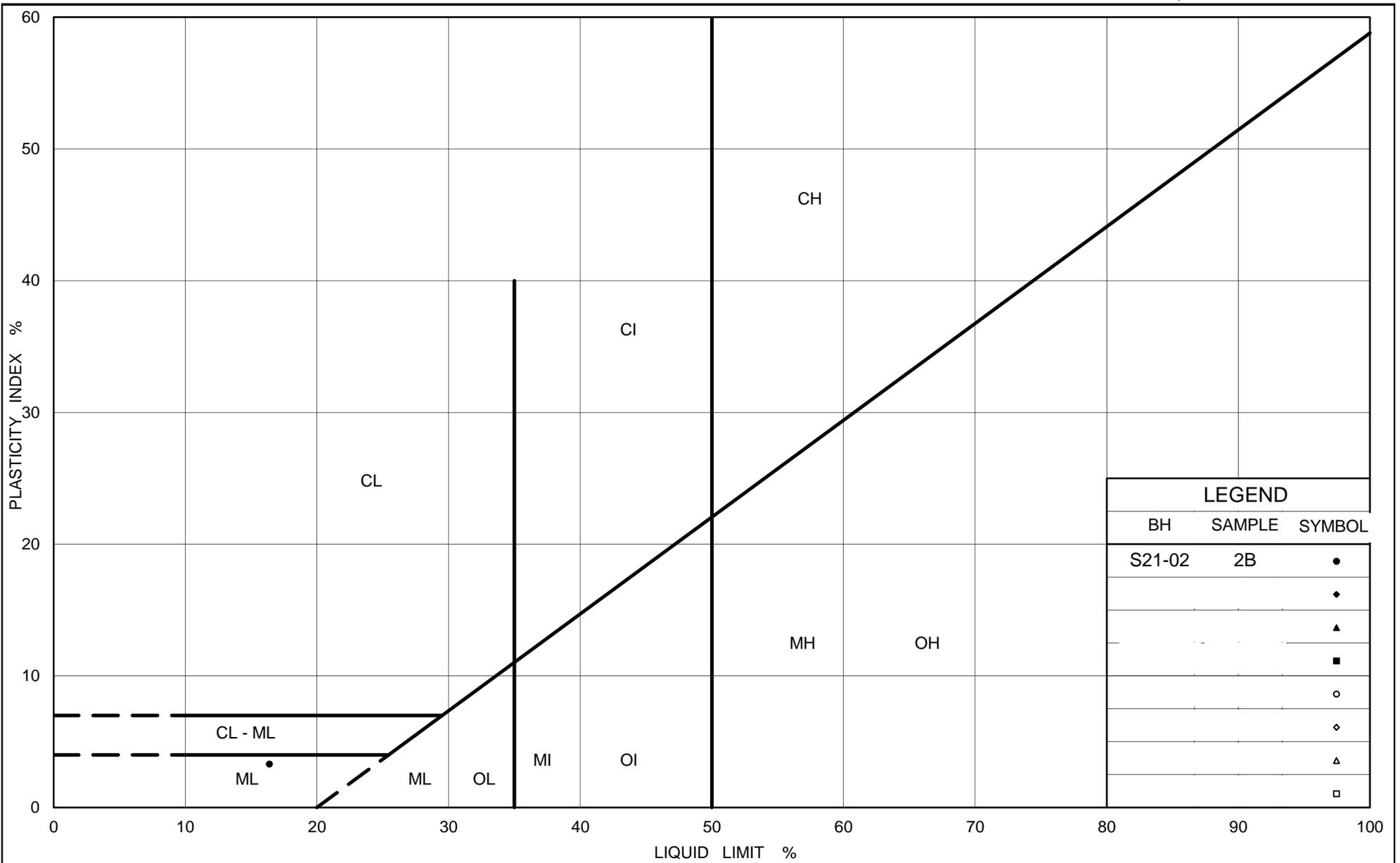
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C50-S1	2	205.7

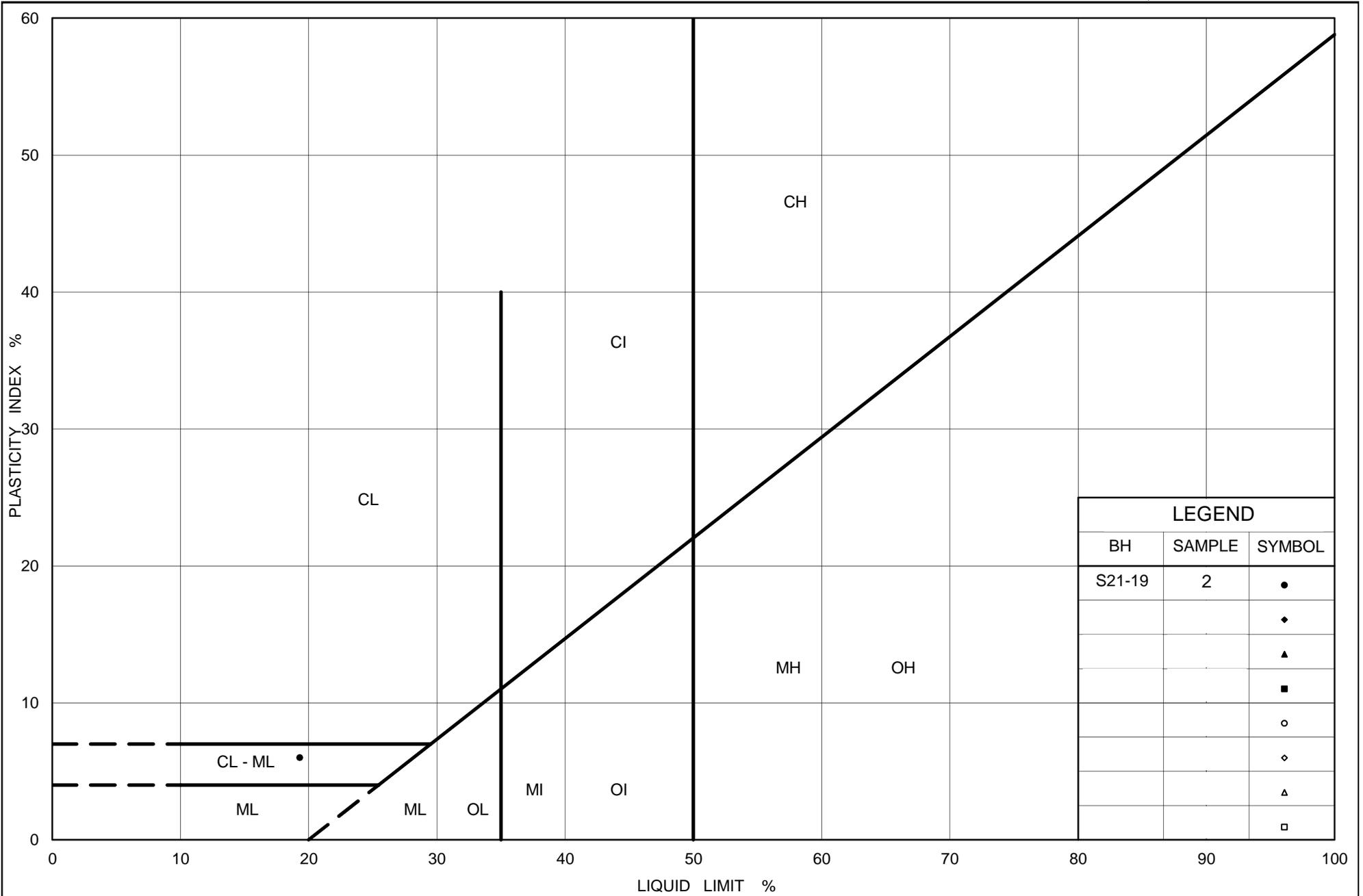
Project Number: 07-1111-0029

Checked By: AJS

Golder Associates

Date: 16-Aug-15





LEGEND		
BH	SAMPLE	SYMBOL
S21-19	2	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Clayey Silt
 Highway 69 (NBL) STA 14+726

Figure No. E.C50-3

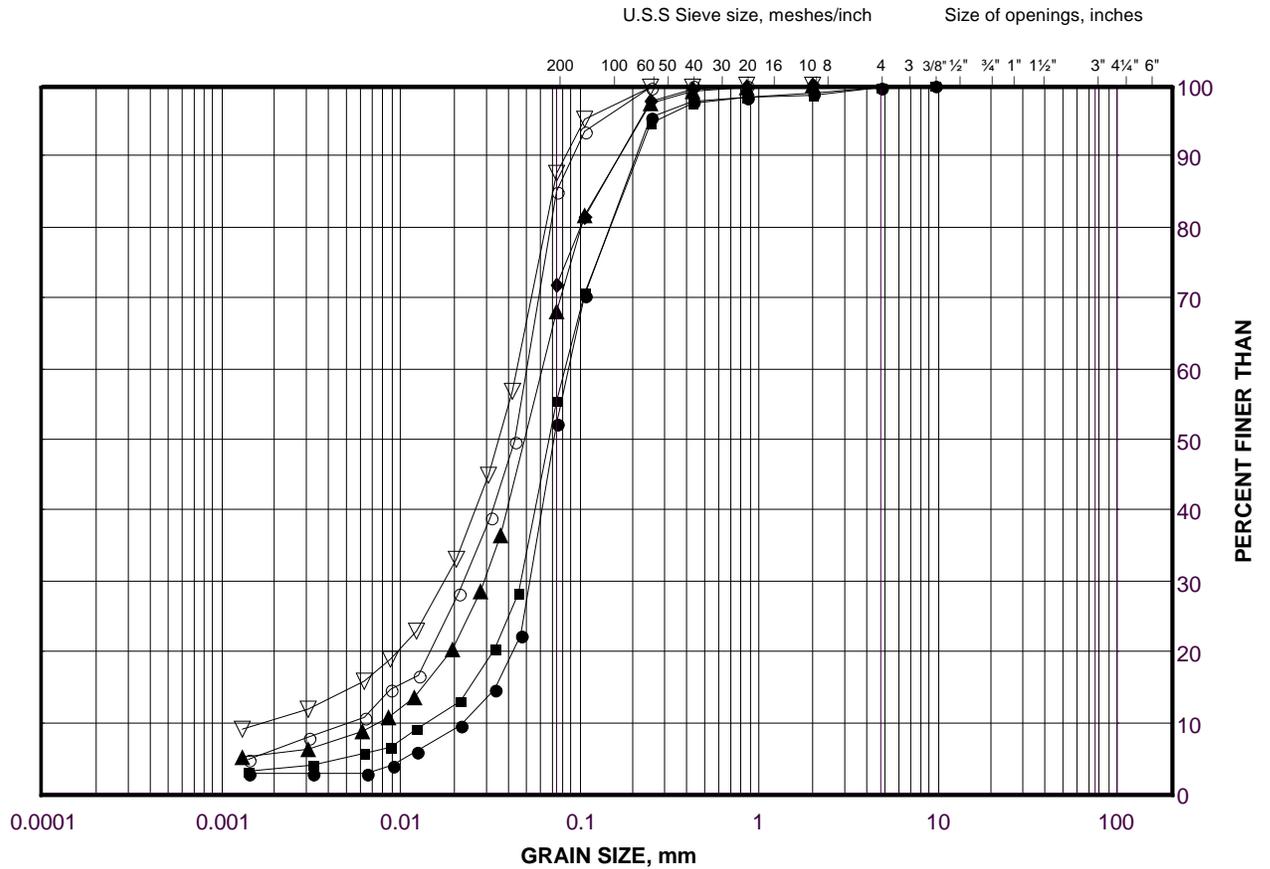
Project No. 07-1111-0029

Checked By: MCK

GRAIN SIZE DISTRIBUTION

Silt to Silt and Sand
Highway 69 (NBL) STA 14+726

FIGURE E.C50-4



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

LEGEND

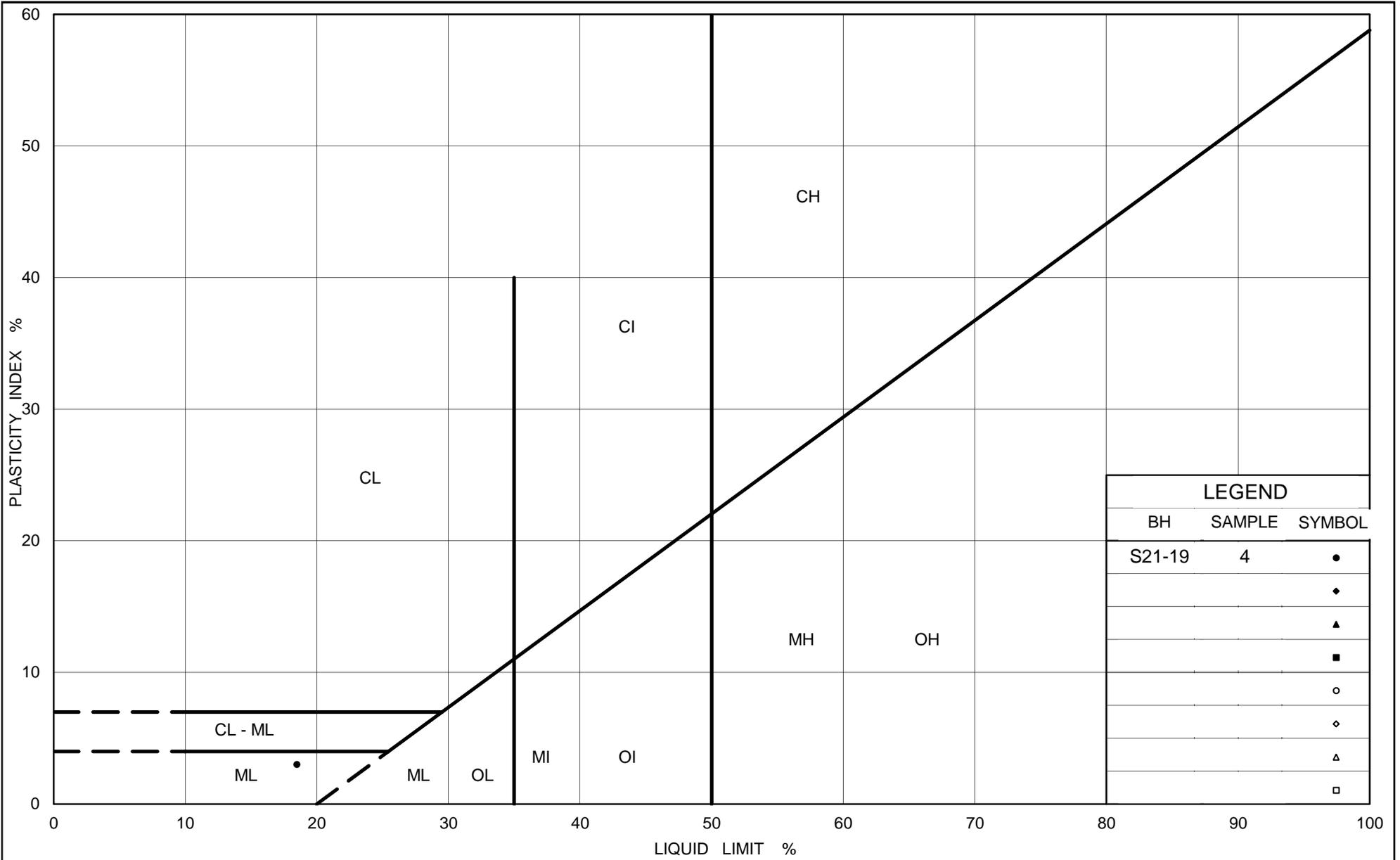
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S21-10A	1	201.7
■	S21-10A	2	201.4
◆	S21-11	4	204.1
▲	S21-10	5	204.3
▽	S21-19	7B	199.4
○	S21-11	9A	198.4

Project Number: 07-1111-0029

Checked By: AJS

Golder Associates

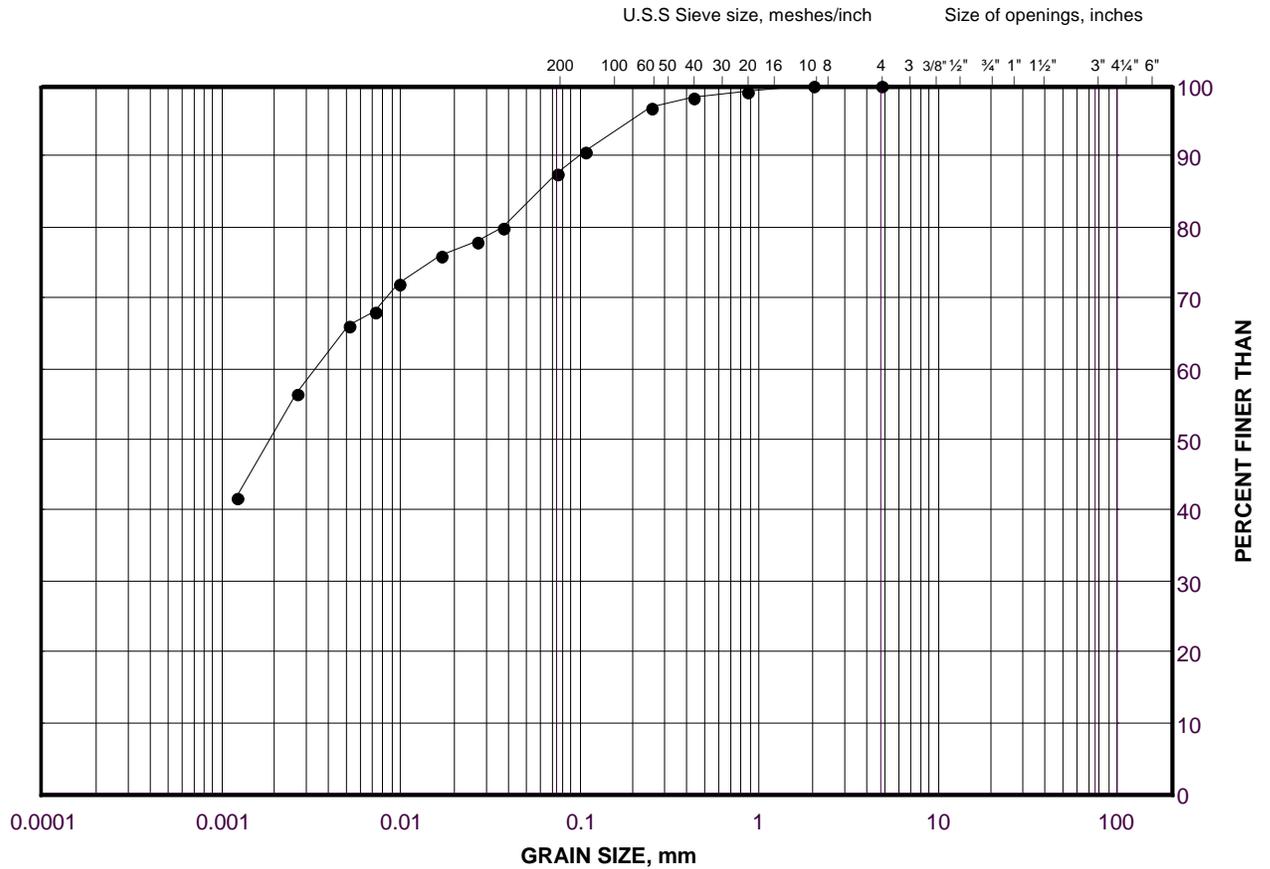
Date: 06-Jan-16



GRAIN SIZE DISTRIBUTION

Silty Clay (Pocket)
Highway 69 (NBL) STA 14+726

FIGURE E.C50-6



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

LEGEND

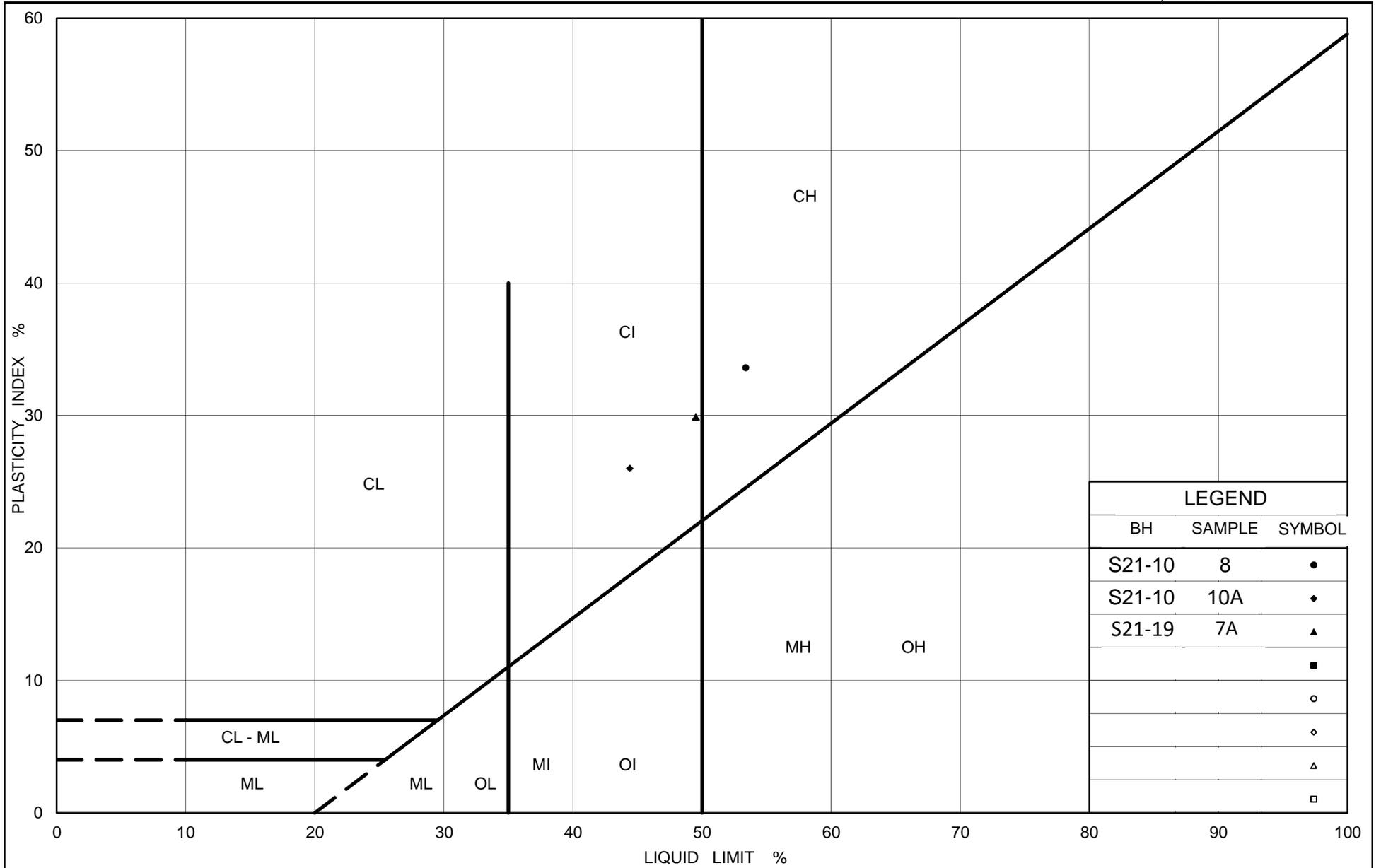
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S21-10	10A	201.1

Project Number: 07-1111-0029

Checked By: AJS

Golder Associates

Date: 16-Aug-15



LEGEND		
BH	SAMPLE	SYMBOL
S21-10	8	•
S21-10	10A	◆
S21-19	7A	▲
		■
		○
		◇
		△
		□

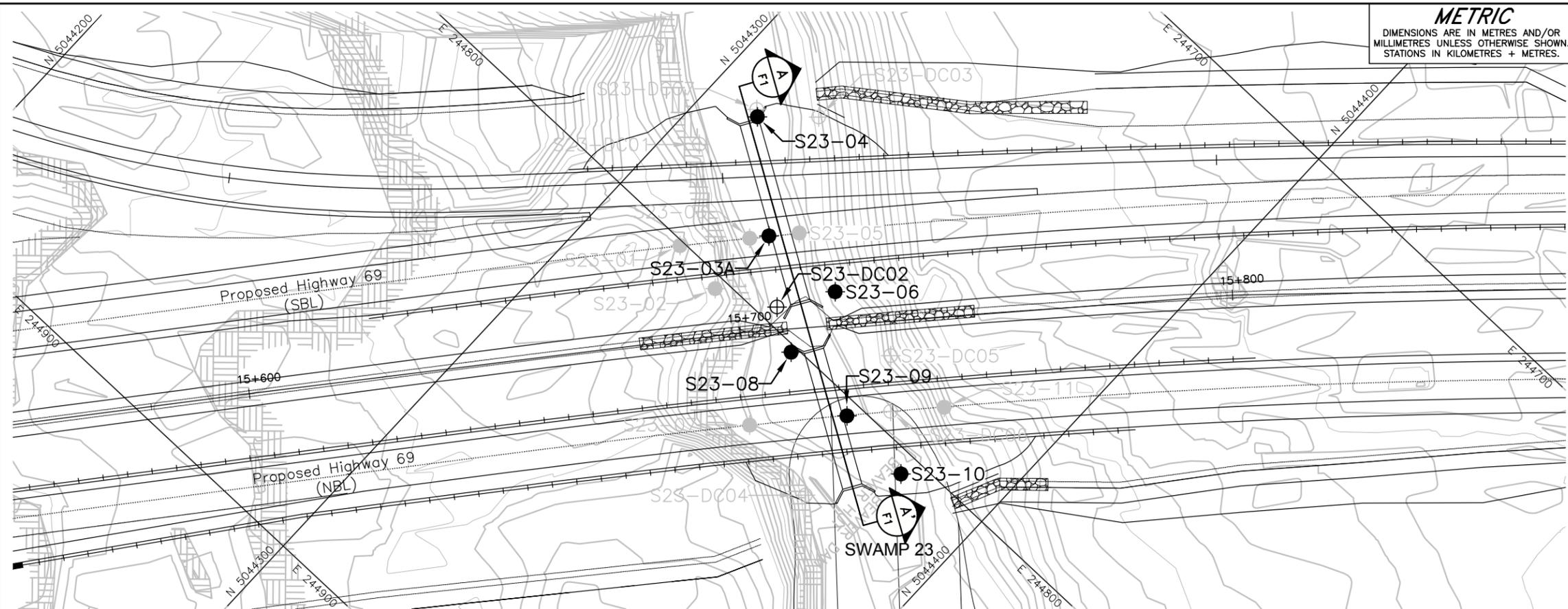
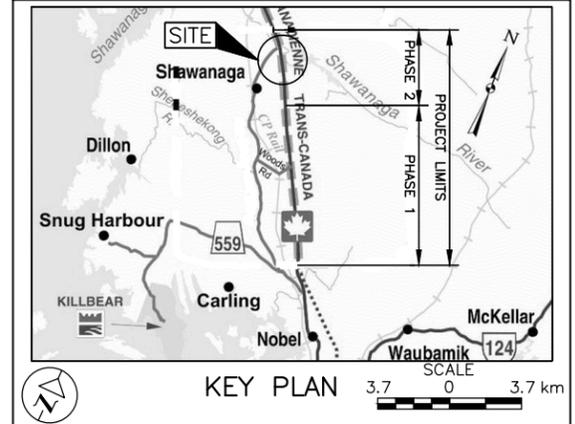


APPENDIX F

**Highway 69 SBL and NBL – STA 15+710 and STA 15+717
(Culvert C55 – Site No. 44-620/C2 and 44-620/C1)**

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

CONT No. WP No. 5077-13-09 (NBL) and 5077-13-10 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C55 STA 15+710 AND STA 15+717
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET S8



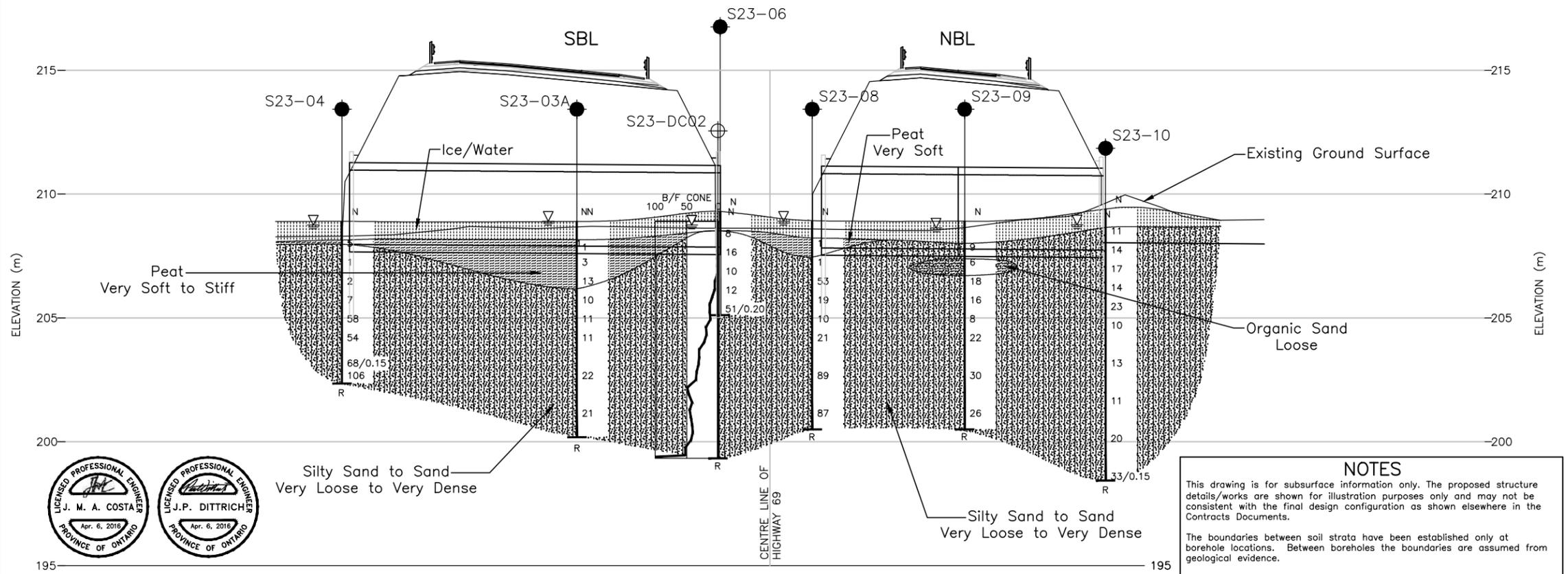
PLAN SCALE 10 0 10 20 m

LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ≡ WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S23-03A	0.0	5044329.2	244787.2
S23-04	0.0	5044311.1	244771.2
S23-06	0.0	5044346.7	244786.3
S23-08	0.0	5044348.5	244801.3
S23-09	0.0	5044365.5	244803.0
S23-10	0.0	5044381.5	244804.1
S23-DC02	0.0	5044340.2	244796.6



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 received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.

NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. TVA/AJS	CHKD. TVA/AJS	DATE: 3/18/2016
DRAWN: JFC/MR	CHKD. TVA/JMAC	APPD. JPD/JMAC

CULVERT C55 PROFILE STA 15+710 AND STA 15+717

HORIZONTAL SCALE 5 0 5 10 m
VERTICAL SCALE 2 0 2 4 m

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S23-03A** SHEET 1 OF 1 **METRIC**
 G.W.P. 5111-07-00 LOCATION N 5044329.2 ; E 244787.2 ORIGINATED BY ID
 DIST HWY 69 BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring COMPILED BY PKS
 DATUM Geodetic DATE February 18, 2009 CHECKED BY VA/OK

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	20	40	60	80						100	20
208.9	ICE SURFACE																	
0.0	Ice																	
208.5																		
0.4	Water																	
208.0																		
0.9	PEAT, trace roots and wood fragments (Amorphous) Very soft to stiff Dark brown Wet		1	SS	1													OC=55.5%
			2	SS	3													
206.2			3	SS	13													
2.7	SAND, trace to some silt, trace to some gravel Compact Brown Wet																	
			4	SS	10													7 85 7 1
			5	SS	11													
			6	SS	11													
			7	SS	22													17 76 7 0
			8	SS	21													
200.2	END OF BOREHOLE CASING AND SPOON REFUSAL (HAMMER BOUNCING)																	
8.7	NOTES: 1. Water level in open borehole at ice surface (Elev. 208.9 m) upon completion of drilling 2. Borehole caved to a depth of 3.1 m below ice surface (Elev. 205.8 m) upon removal of casing.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S23-04	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044311.1; E 244771.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>February 17 and 18, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
208.9	ICE SURFACE																		
0.0	Ice																		
208.4	Water																		
208.1	Water																		
0.9	PEAT, trace roots and wood fragments (Amorphous) Dark brown Wet		1A	SS	5									357.3					OC = 2.2%
	SAND, trace to some silt, trace clay, trace organics Very loose to loose Brown Wet		1B	SS	1														OC = 3.8%
			2	SS	1														
			3	SS	2														0 89 10 1
			4	SS	7														
205.2	SAND, some gravel, trace to some silt, trace clay Very dense Brown to grey Wet		5	SS	58														
3.7			6	SS	54														
			7	SS	68/0.15														15 76 8 1
	Grey below a depth of 6.1 m		8	SS	106														
202.4	END OF BOREHOLE SPOON AND CASING REFUSAL																		
6.6	NOTES: 1. Borehole advanced using portable drilling equipment with half-weight hammer to a depth of 5.9 . SPT 'N' values shown have been adjusted to reflect values that would be obtained using a standard weight hammer. 2. Water level in open borehole at a depth of 0.2 m below ice surface (Elev. 208.7 m) upon completion of drilling.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.CPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S23-06	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044346.7 ; E 244786.3</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>February 19, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR	SA
209.3 0.0	ICE SURFACE Ice	[Strat Plot]																	
208.5 0.8	SAND, trace to some silt, trace gravel, trace clay, trace organics to a depth of 1.5 m, clay seams between depths of 1.5 m and 2.3 m Loose to compact Brown Wet	[Strat Plot]	1	SS	8								○						
			2	SS	16								○						1 89 9 1
			3	SS	10														
			4	SS	12														
205.1 4.2	END OF BOREHOLE SPOON AND CASING REFUSAL NOTES: 1. Water level in open borehole at a depth of 0.6 m below ice surface (Elev. 208.7 m) upon completion of drilling. 2. Borehole caved to a depth of 1.6 m below snow surface (Elev. 207.7 m) upon removal of casing.		5	SS	51/0.20								○						

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DDJ/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S23-08	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044348.5; E 244801.3</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>February 17, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
							20	40	60	80	100						
208.9	ICE SURFACE																
0.0	Ice																
208.6	Water																
208.2																	
0.7	PEAT, trace wood fragments (Fibrous) Very soft Brown Wet		1	SS	1									326.3		OC = 64.3%	
207.5																	
1.5	SAND, trace gravel, trace silt Very loose to very dense Grey Wet		2	SS	1												
			3	SS	53						○						
			4	SS	19												
			5	SS	10						○				0	95 5 0	
			6	SS	21												
			7	SS	89												
			8	SS	87						○				1	95 4 0	
200.5	END OF BOREHOLE CASING REFUSAL																
8.4	NOTES: 1. Water level in open borehole at ice surface (Elev. 208.9 m) upon completion of drilling. 2. Borehole caved to a depth of 1.5 m below ice surface (Elev. 207.4 m) upon removal of casing.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S23-09	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044365.5 ; E 244803.0</u>	ORIGINATED BY <u>MJR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>February 19, 2009</u>	CHECKED BY <u>VA/OK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
208.9	ICE SURFACE																
0.0	Ice																
208.3																	
208.0	Water																
0.9	SAND, trace gravel, trace silt, trace organics						208										
207.4	Loose Brown and grey		1	SS	9												
1.5	Wet																
206.7	Organic SAND, trace to some silt, trace clay						207										
2.2	Loose Dark brown/grey		2	SS	6												
	Wet																
	SAND, trace to some silt, trace gravel, trace clay						206										
	Loose to compact		3	SS	18												
	Brown																
	Wet		4	SS	16												0 89 10 1
			5	SS	8		205										
			6	SS	22		204										
							203										
			7	SS	30												
							202										
			8	SS	26		201										
200.5	END OF BOREHOLE CASING REFUSAL																
8.4	NOTES: 1. Water level in open borehole at a depth of 0.3 m below ice surface (Elev. 208.6 m) upon completion of drilling. 2. Borehole caved to a depth of 1.4 m below ice surface (Elev. 207.5 m) upon removal of casing.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/30/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S23-10	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044381.5; E 244804.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>February 19 and 20, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
209.4 0.0	ICE SURFACE Ice																		
208.6 0.8	SAND, trace silt, trace organics Compact Brown Wet		1	SS	11														
207.9 1.5	Silty SAND, trace gravel, containing clay seams Compact Brown Wet		2	SS	14														
			3	SS	17														
			4	SS	14														0 75 24 1
			5	SS	23														
			6	SS	10														1 78 20 1
			7	SS	13														
			8	SS	11														
			9	SS	20														
199.2 10.2	SAND, some gravel, trace silt Dense Brown Wet		10	SS	33/0.15														
198.4 11.0	END OF BOREHOLE SPOON AND CASING REFUSAL NOTES: 1. Water level in open borehole at a depth of 0.6 m below ice surface (Elev. 208.8 m) upon completion of drilling. 2. Borehole caved to a depth of 2.1 m below ice surface (Elev. 207.3 m) upon removal of casing.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No S23-DC02	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044340.2 ; E 244796.6</u>	ORIGINATED BY <u>MJR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VA</u>	
DATUM <u>Geodetic</u>	DATE <u>February 17, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _p	W	W _L		
208.9 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					20	40	60	80	100					GR SA SI CL
199.3 9.6	END OF DCPT Refusal to Further Penetration (150 Blows / 0.1 m)					200	201	202	203	204	205	206	207	208	

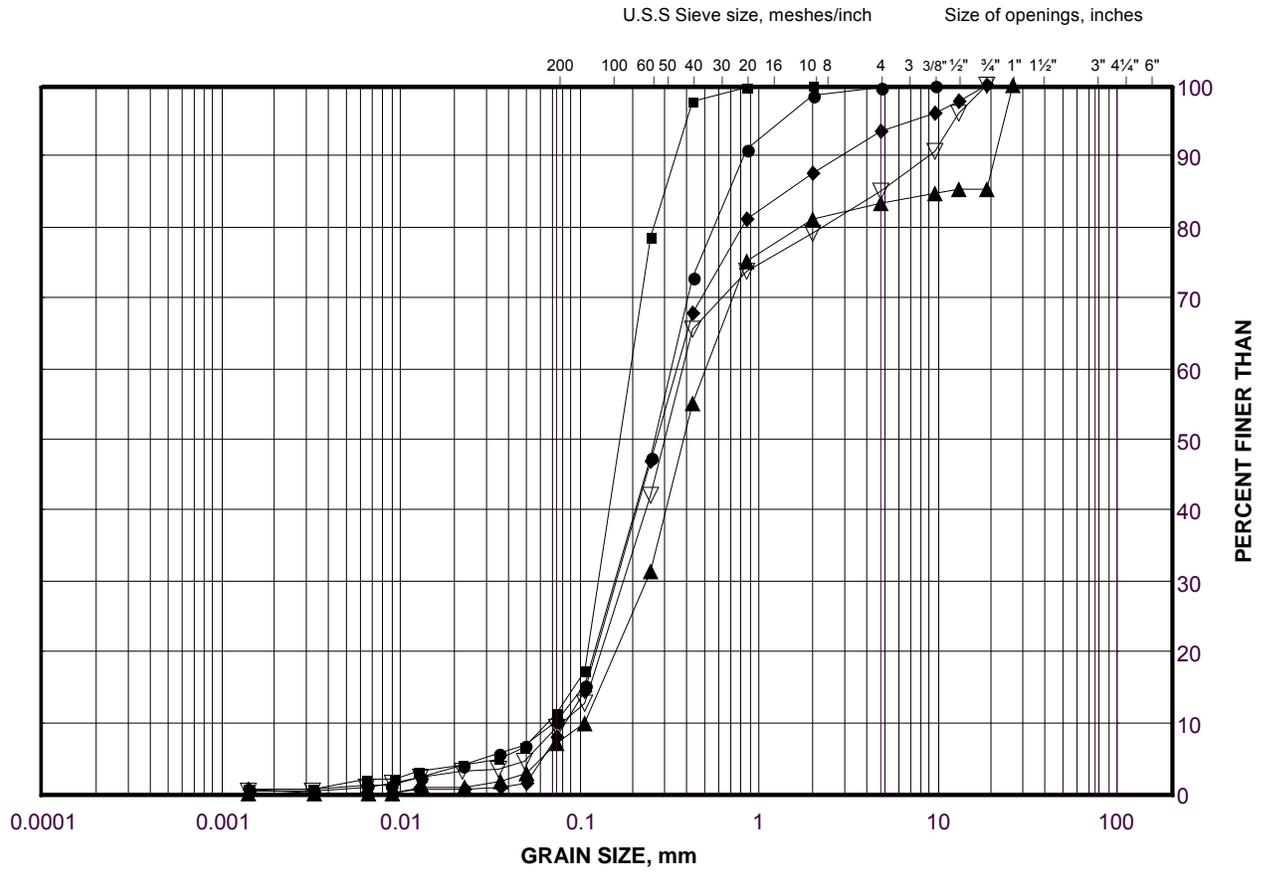
GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

GRAIN SIZE DISTRIBUTION

Sand
Highway 69 (SBL) STA 15+710

FIGURE F.C55-1



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

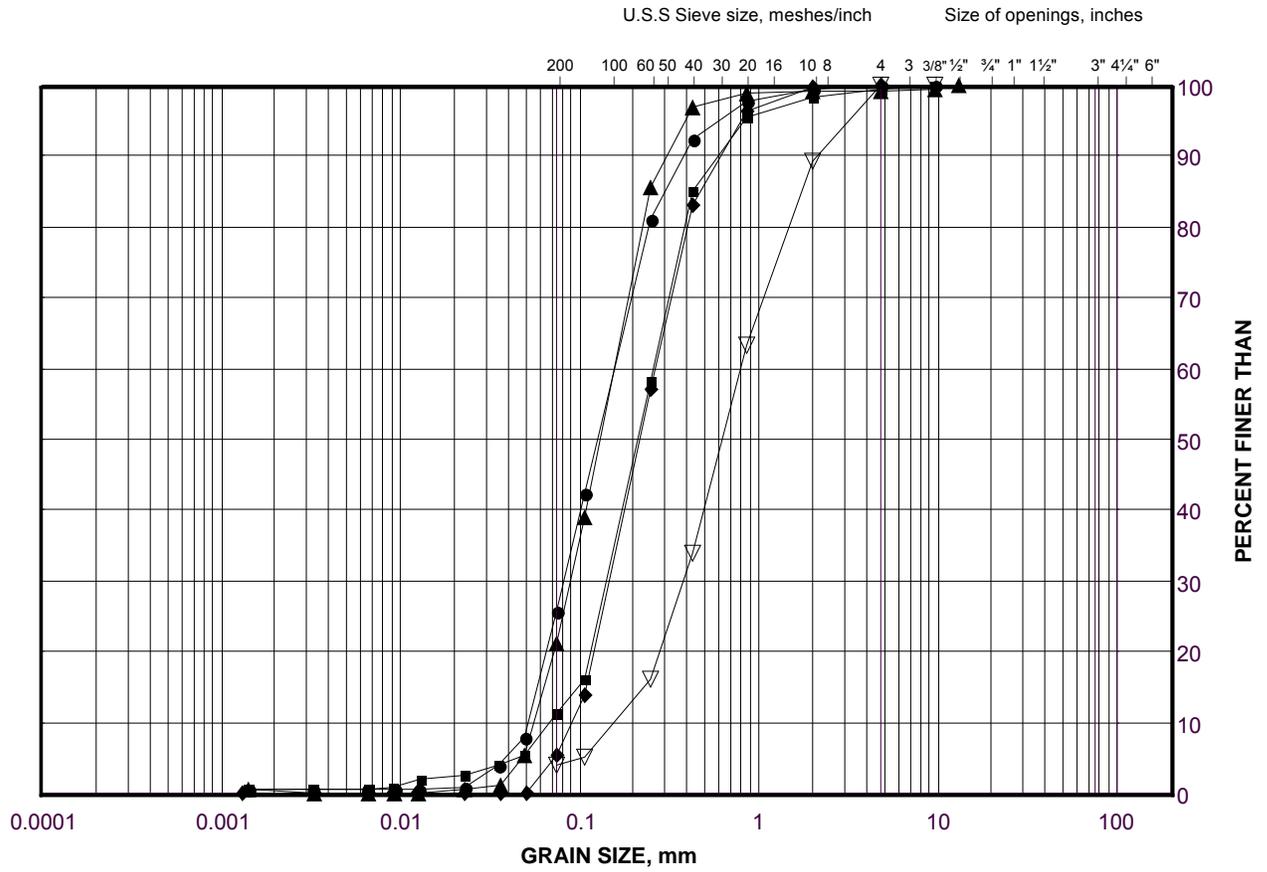
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S23-06	2	207.5
■	S23-04	3	206.3
◆	S23-03A	4	205.6
▲	S23-03A	7	202.5
▽	S23-04	7	203.1

GRAIN SIZE DISTRIBUTION

Silty Sand to Sand
Highway 69 (NBL) STA 15+717

FIGURE F.C55-2



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

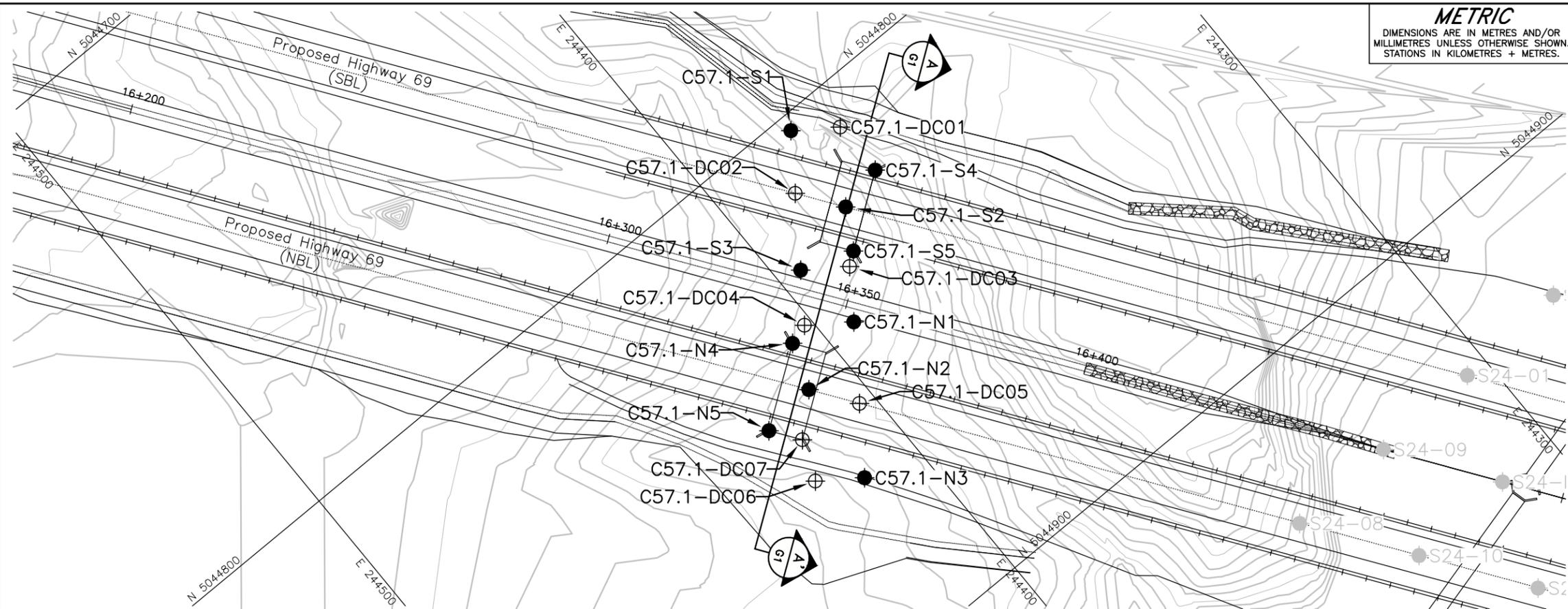
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S23-10	4	206.1
■	S23-09	4	205.5
◆	S23-08	5	204.8
▲	S23-10	6	204.5
▽	S23-08	8	201.0



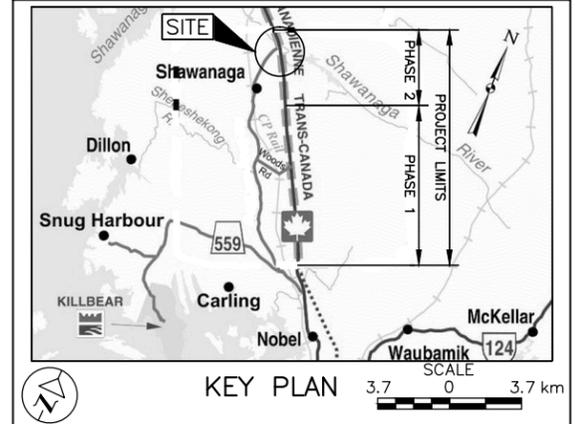
APPENDIX G

**Highway 69 SBL and NBL – STA 16+345
(Culvert C57.1 – Site No. 44-621/C2 and 44-621/C1)**



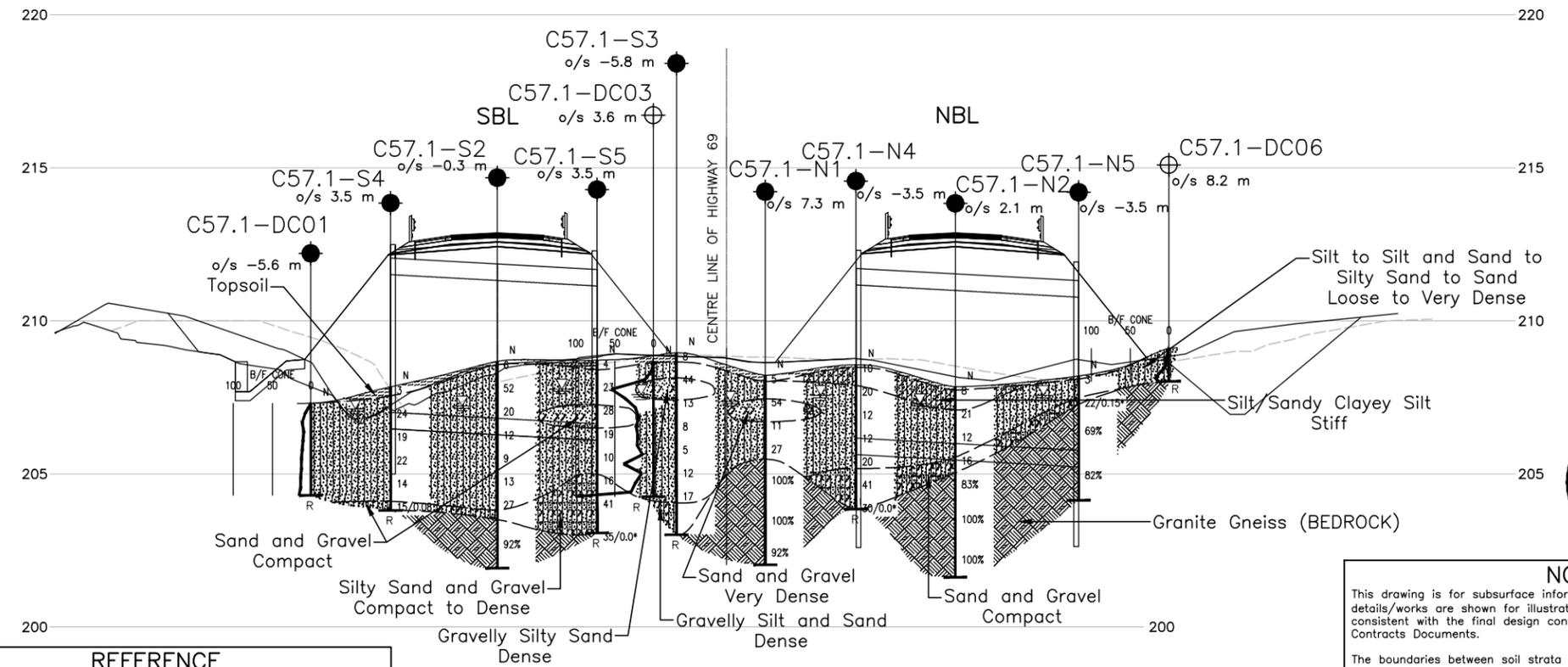
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. WP No. 5077-13-11 (NBL) and 5077-13-12 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C57.1 STA 16+345
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET S13



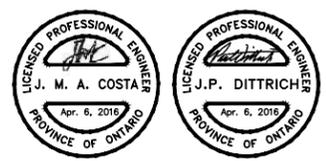
LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- 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
C57.1-DC01	207.3	5044809.0	244370.6
C57.1-DC02	209.2	5044813.5	244386.2
C57.1-DC03	208.7	5044831.9	244387.1
C57.1-DC04	208.6	5044835.2	244401.7
C57.1-DC05	207.3	5044854.4	244403.2
C57.1-DC06	209.1	5044860.8	244420.0
C57.1-DC07	208.0	5044852.7	244416.7
C57.1-N1	208.2	5044841.0	244393.6
C57.1-N2	207.8	5044845.8	244409.3
C57.1-N3	209.0	5044866.7	244411.9
C57.1-N4	208.6	5044836.5	244405.9
C57.1-N5	208.2	5044847.0	244420.8
C57.1-S1	207.3	5044803.2	244378.8
C57.1-S2	208.7	5044822.1	244380.1
C57.1-S3	209.0	5044826.1	244395.2
C57.1-S4	207.9	5044820.2	244370.7
C57.1-S5	208.7	5044829.9	244384.5



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.

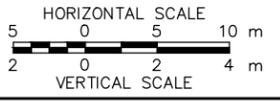
REFERENCE

Base plans provided in digital format by MMM, drawing file no. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. S6878-340-117-001GA.dwg, received November 30, 2015.

A-A CULVERT C57.1 PROFILE STA 16+345



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 3/17/2016
DRAWN: MR	CHKD. JMAC	APPD. JMAC
		SITE: 44-621/C1&C2
		DWG: G1

RECORD OF BOREHOLE No C57.1-S1 SHEET 1 OF 1 METRIC

PROJECT 07-1111-0029 G.W.P. 5111-07-00 LOCATION N 5044803.2 ; E 244378.8 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Continuous Flight 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY KD

DATUM Geodetic DATE February 11, 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								
						20	40	60	80	100						
207.3	GROUND SURFACE															
0.0	TOPSOIL		1A	SS	6/0.15							○				
0.3	SAND, trace to some silt, trace gravel Loose Brown to grey Wet		1B													
	Auger grinding at a depth of 1.4 m (Elev. 205.9 m)		2	SS	4											
			3	SS	4							○				0 81 19 0
204.9	Granite Gneiss (BEDROCK)		4	SS	6/0.15							○				
2.4	Bedrock cored from depths of 2.4 m to 5.7 m. For bedrock coring details refer to Record of Drillhole C57.1-S1.		1	RC	REC 100%											RQD = 96%
			2	RC	REC 100%											RQD = 100%
			3	RC	REC 100%											RQD = 100%
201.6	END OF BOREHOLE															
5.7	NOTE: 1. Water level in open borehole measured at a depth of 0.2 m below ground surface (Elev. 207.1 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044822.1 ; E 244380.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Continuous Flight 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring</u>	COMPILED BY <u>KD</u>	
DATUM <u>Geodetic</u>	DATE <u>February 17, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)				
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								20	40	60	80	100						GR	SA	SI	CL
208.7	GROUND SURFACE																				
0.0	TOPSOIL		1A	SS	6																
	SILTY SAND, trace to some gravel Loose to very dense Brown to grey Moist		1B	SS																	
			2	SS	52													9	61	27	3
	Auger grinding at a depth of 1.4 m (Elev. 207.3 m)																				
			3	SS	20																
206.4																					
2.3	SILT and SAND Loose to compact Brown to grey Wet		4	SS	12																
			5	SS	9																
204.9																					
3.8	SAND, some silt Compact Grey Wet		6	SS	13																
204.1																					
4.6	SAND and GRAVEL Compact Grey Wet		7	SS	27																
203.5																					
5.2	Granite Gneiss (BEDROCK)																				
	Bedrock cored from depths of 5.2 m to 6.8 m.																				
	For bedrock coring details refer to Record of Drillhole C57.1-S2.		1	RC	REC 100%																RQD = 92%
201.9																					
6.8	END OF BOREHOLE																				
	NOTE: 1. Water level in open borehole measured at a depth of 1.5 m below ground surface (Elev. 207.2 m) upon completion of drilling.																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-S3	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044826.1 ; E 244395.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Continuous Flight 203 mm O.D. Hollow Stem Augers</u>	COMPILED BY <u>KD</u>	
DATUM <u>Geodetic</u>	DATE <u>February 18, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)				
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								20	40	60	80	100						GR	SA	SI	CL
209.0	GROUND SURFACE																				
0.0	TOPSOIL		1A	SS	8																
0.3	SILT and SAND, trace gravel Loose Light brown Moist		1B	SS	8																
208.2	Gravelly SILTY SAND, trace to some clay, some cobbles Dense Light brown Moist		2	SS	44		208											22	47	25	6
207.5	SAND, some silt, some gravel Loose to compact Brown to grey Wet		3	SS	13		207														
1.5			4	SS	8		206														
			5	SS	5		205											13	72	14	1
			6	SS	12		204														
204.1	Gravelly SILT and SAND, oxidation staining Compact Grey Wet		7A	SS	17		204											23	44	30	3
4.9			7B																		
203.1	SPOON SAMPLER AND AUGER REFUSAL END OF BOREHOLE																				
5.9	NOTE: 1. Water level in open borehole measured at a depth of 1.4 m below ground surface (Elev. 207.6 m) upon completion of drilling.																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-S4	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044820.2 ; E 244370.7</u>	ORIGINATED BY <u>I.D</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 15, 2015</u>	CHECKED BY <u>MCK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
207.9	GROUND SURFACE																		
0.0	TOPSOIL		1A	SS	3														
207.6			1B																
0.3	Silty SAND, trace organics Loose to compact Brown to grey Moist to wet		2	SS	24						○								
			3	SS	19						○								
			4	SS	22						○								0 76 24 0
			5	SS	14														
204.2																			
203.9	SAND and GRAVEL Compact Grey Wet		6	SS	15/0.08						○								
4.0	END OF BOREHOLE SPOON AND CASING REFUSAL																		
	NOTE: 1. Water level measured in open borehole at a depth of 0.7 m below ground surface (Elev. 207.2 m) upon completion of drilling. * Split-spoon bouncing																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-S5	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044829.9 ; E 244384.5</u>	ORIGINATED BY <u>I.D</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 15, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
208.7	GROUND SURFACE																
0.0	TOPSOIL		1A	SS	4												
208.4			1B														
0.3	SILT, some sand, trace to some clay, trace organics Brown to grey		2	SS	23												
207.2																	
1.5	SAND and GRAVEL, some silt, some cobbles Compact Grey Wet		3	SS	28												
206.5																	
2.2	SAND, some silt, some gravel Compact Grey Wet		4	SS	19												
			5	SS	10												
205.0																	
3.7	Silty SAND and GRAVEL Compact to dense Grey Wet		6	SS	16												
			7	SS	41												
203.1																	
5.6	END OF BOREHOLE SPOON AND CASING REFUSAL		8	SS	35/0.0*												
	NOTE: 1. Water level measured in open borehole at a depth of 0.9 m below ground surface (Elev. 207.8 m) upon completion of drilling. * Split-spoon bouncing																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-N3	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044866.7 ; E 244411.9</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Continuous Flight 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring</u>	COMPILED BY <u>KD</u>	
DATUM <u>Geodetic</u>	DATE <u>February 23, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
209.0	GROUND SURFACE																
0.0	TOPSOIL		1A	SS	6												
208.2	Sandy SILT, trace organics Loose Brown Moist		1B														
0.8	SAND and GRAVEL, trace to some silt, trace clay, trace organics to a depth of 1.5 m Very dense Grey Moist		2	SS	50/0.07	∇	208										
			3	SS	55		207										32 55 10 3
			4	SS	54		206										
206.1	Granite Gneiss (BEDROCK)						206										
2.9	Bedrock cored from depths of 2.9 m to 7.3 m. For bedrock coring details refer to Record of Drillhole C57.1-N3.		1	RC	REC 100%		205										RQD = 100%
			2	RC	REC 100%		204										RQD = 82%
			3	RC	REC 100%		203										RQD = 96%
201.7	END OF BOREHOLE						202										
7.3	NOTE: 1. Water level in open borehole measured at a depth of 1.0 m below ground surface (Elev. 208.0 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-N4	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044836.5; E 244405.9</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 16, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
208.6	GROUND SURFACE																
0.0	TOPSOIL		1A	SS	10												
0.1	Sandy CLAYEY SILT, trace organics		1B	SS													
0.7	Light brown Moist		2	SS	20												
207.9	Sandy SILT, some gravel, pockets of clay																
207.1	Compact Grey Wet		3	SS	12												
1.5	SAND, some silt, trace gravel		4	SS	12												
	Compact Grey Wet																
205.2	SAND and GRAVEL, trace silt		5A	SS	20												
3.4	Compact to dense Grey Wet		5B														
			6	SS	41												
203.9	END OF BOREHOLE SPOON AND CASING REFUSAL		7	SS	30/0.0*												
4.7	NOTE: 1. Water level measured in open borehole at a depth of 1.0 m below ground surface (Elev. 207.6 m) upon completion of drilling. * Split-spoon bouncing																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C57.1-N5	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044847.0 ; E 244420.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>ZR/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>June 16 and 17, 2015</u>	CHECKED BY <u>MCK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
208.2	GROUND SURFACE															
0.0	TOPSOIL		1A	SS	3											
207.5	Silty SAND, trace clay, trace organics Very loose Light brown Moist to wet		1B													
0.9	SAND and GRAVEL Brown Wet		2	SS	22/0.15											
	Granite Gneiss to Schist (BEDROCK)		1	RC	REC 100%											RQD = 69%
	Bedrock cored from depths of 0.9 m to 4.1 m. For bedrock coring details refer to Record of Drillhole C57.1-N5.		2	RC	REC 100%											RQD = 82%
204.1	END OF BOREHOLE															
4.1	NOTE: 1. Water level in open borehole measured at a depth of 0.6 m below ground surface (Elev. 207.6 m) upon completion of drilling. * Split-spoon bouncing															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C57.1-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044809.0; E 244370.6</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 11, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L			20	40	60	GR
207.3 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					207														
204.3 3.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					205														

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV



RECORD OF DCPT No C57.1-DC02 SHEET 1 OF 1 METRIC

PROJECT 07-1111-0029 G.W.P. 5111-07-00 LOCATION N 5044813.5; E 244386.2 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE CME 55, Dynamic Cone Penetration Test COMPILED BY MR

DATUM Geodetic DATE February 11, 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			20	40	60	80	100						20
209.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					209											
205.4 3.8	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					206											

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C57.1-DC03	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044831.9; E 244387.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 11, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES						
208.7 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)									
204.3 4.4	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)									

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C57.1-DC04	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044835.2 ; E 244401.7</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 11, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _p	W	W _L		
208.6 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					20	40	60	80	100					
208						20	40	60	80	100					
207						20	40	60	80	100					
206						20	40	60	80	100					
205						20	40	60	80	100					
204						20	40	60	80	100					
203.4 5.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					20	40	60	80	100					

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C57.1-DC05	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044854.4 ; E 244403.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 11, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
207.3 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					207										
204.9 2.4	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)					205				127						

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No C57.1-DC06	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044860.8 ; E 244420.0</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 11, 2015</u>	CHECKED BY <u>AJS</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L				
							20	40	60	80	100							
							○ UNCONFINED + FIELD VANE											
							● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)						
							20	40	60	80	100	20	40	60				
209.1	GROUND SURFACE					209												
0.0	Dynamic Cone Penetration Test (DCPT)																	
208.0																		
1.1	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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



RECORD OF DCPT No C57.1-DC07 SHEET 1 OF 1 METRIC

PROJECT 07-1111-0029 G.W.P. 5111-07-00 LOCATION N 5044852.7 ; E 244416.7 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test COMPILED BY ZR/MR

DATUM Geodetic DATE June 16, 2015 CHECKED BY AJS

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			20	40	60	80	100						20
208.0	GROUND SURFACE																
0.0	Dynamic Cone Penetration Test (DCPT)																
207.0						207											
1.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

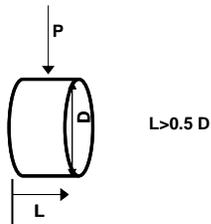
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**TABLE G1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C57.1-S1	1	3.0	204.3	Granite Gneiss	Diametral	7.37
C57.1-S1	1	3.0	204.3	Granite Gneiss	Axial	8.82
C57.1-S1	2	4.3	203.0	Granite Gneiss	Diametral	4.45
C57.1-S1	2	4.3	203.0	Granite Gneiss	Axial	4.99
C57.1-S1	3	5.4	201.9	Granite Gneiss	Diametral	5.72
C57.1-S1	3	5.4	201.9	Granite Gneiss	Axial	5.80
C57.1-S2	1	6.1	202.6	Granite Gneiss	Diametral	6.83
C57.1-S2	1	6.1	202.6	Granite Gneiss	Axial	4.89
C57.1-N1	1	3.6	204.6	Granite Gneiss	Diametral	5.79
C57.1-N1	1	3.6	204.6	Granite Gneiss	Axial	7.76
C57.1-N1	2	5.2	203.0	Granite Gneiss	Diametral	9.25
C57.1-N1	2	5.2	203.0	Granite Gneiss	Axial	7.79
C57.1-N1	1	6.1	202.1	Granite Gneiss	Diametral	6.72
C57.1-N1	1	6.1	202.1	Granite Gneiss	Axial	5.49
C57.1-N2	1	3.5	204.4	Granite Gneiss	Diametral	6.25
C57.1-N2	1	3.5	204.3	Granite Gneiss	Axial	5.77
C57.1-N2	2	4.5	203.3	Granite Gneiss	Diametral	7.58
C57.1-N2	2	4.5	203.3	Granite Gneiss	Axial	7.94
C57.1-N2	3	6.1	201.7	Granite Gneiss	Axial	5.63
C57.1-N2	3	6.4	201.4	Granite Gneiss	Diametral	5.87
C57.1-N3	1	3.2	205.8	Granite Gneiss	Diametral	7.58
C57.1-N3	1	3.2	205.8	Granite Gneiss	Axial	5.06

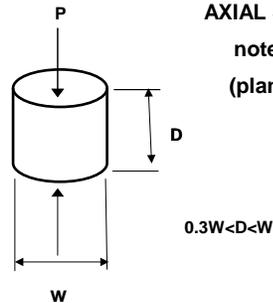
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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)

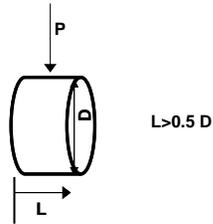


**TABLE G1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C57.1-N3	2	5.5	203.5	Granite Gneiss	Diametral	5.15
C57.1-N3	2	5.5	203.5	Granite Gneiss	Axial	5.12
C57.1-N3	3	6.3	202.8	Granite Gneiss	Diametral	7.08
C57.1-N3	3	6.3	202.7	Granite Gneiss	Axial	5.55
C57.1-N5	1	1.0	207.2	Granite Gneiss	Diametral	4.90
C57.1-N5	1	1.0	207.2	Granite Gneiss	Axial	4.23
C57.1-N5	2	2.0	206.2	Granite Gneiss	Diametral	4.54
C57.1-N5	2	2.1	206.1	Granite Gneiss	Axial	2.62
C57.1-N5	3	4.0	204.3	Granite Gneiss	Diametral	4.98

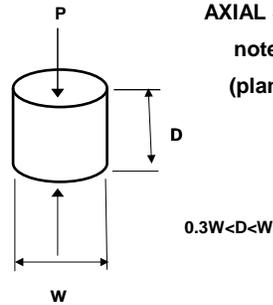
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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 G2
UNCONFINED COMPRESSION TEST (UC)

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 2
BOREHOLE NUMBER	C57.1-S1	SAMPLE DEPTH, m	3.96

TEST CONDITIONS

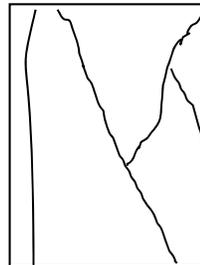
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.37

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	11.18	WATER CONTENT, (specimen) %	0.06
SAMPLE DIAMETER, cm	4.71	UNIT WEIGHT, kN/m ³	26.52
SAMPLE AREA, cm ²	17.44	DRY UNIT WT., kN/m ³	26.51
SAMPLE VOLUME, cm ³	195.03	SPECIFIC GRAVITY	-
WET WEIGHT, g	527.70	VOID RATIO	-
DRY WEIGHT, g	527.40		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	59.9
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REMARKS:

DATE:

2015-03-11

Table G3
UNCONFINED COMPRESSION TEST (UC)

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 3
BOREHOLE NUMBER	C57.1-N2	SAMPLE DEPTH, m	5.95

TEST CONDITIONS

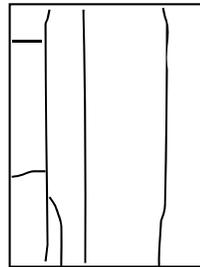
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.45

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	11.56	WATER CONTENT, (specimen) %	0.05
SAMPLE DIAMETER, cm	4.73	UNIT WEIGHT, kN/m ³	26.15
SAMPLE AREA, cm ²	17.53	DRY UNIT WT., kN/m ³	26.14
SAMPLE VOLUME, cm ³	202.68	SPECIFIC GRAVITY	-
WET WEIGHT, g	540.65	VOID RATIO	-
DRY WEIGHT, g	540.38		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	106.5
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REMARKS:

DATE:

2015-03-11

Table G4

UNCONFINED COMPRESSION TEST (UC)

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 1
BOREHOLE NUMBER	C57.1-N3	SAMPLE DEPTH, m	3.96

TEST CONDITIONS

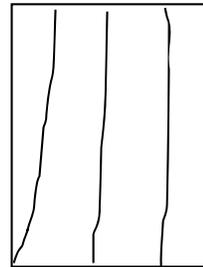
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.35

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	11.15	WATER CONTENT, (specimen) %	0.04
SAMPLE DIAMETER, cm	4.74	UNIT WEIGHT, kN/m ³	26.34
SAMPLE AREA, cm ²	17.63	DRY UNIT WT., kN/m ³	26.33
SAMPLE VOLUME, cm ³	196.55	SPECIFIC GRAVITY	-
WET WEIGHT, g	528.15	VOID RATIO	-
DRY WEIGHT, g	527.95		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	78.2
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REMARKS:

DATE:

2015-03-11

Checked By: MCK

Golder Associates

Table G5
UNCONFINED COMPRESSION TEST (UC)

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	Run 1
BOREHOLE NUMBER	C57.1-N5	SAMPLE DEPTH, m	2.15

TEST CONDITIONS

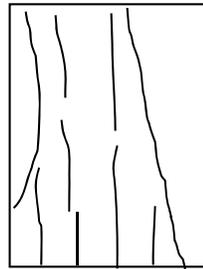
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.23

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	9.47	WATER CONTENT, (specimen) %	0.04
SAMPLE DIAMETER, cm	4.24	UNIT WEIGHT, kN/m ³	25.71
SAMPLE AREA, cm ²	14.11	DRY UNIT WT., kN/m ³	25.70
SAMPLE VOLUME, cm ³	133.71	SPECIFIC GRAVITY	-
WET WEIGHT, g	350.68	VOID RATIO	-
DRY WEIGHT, g	350.54		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	0.0	COMPRESSIVE STRENGTH, MPa	72.5
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REMARKS:

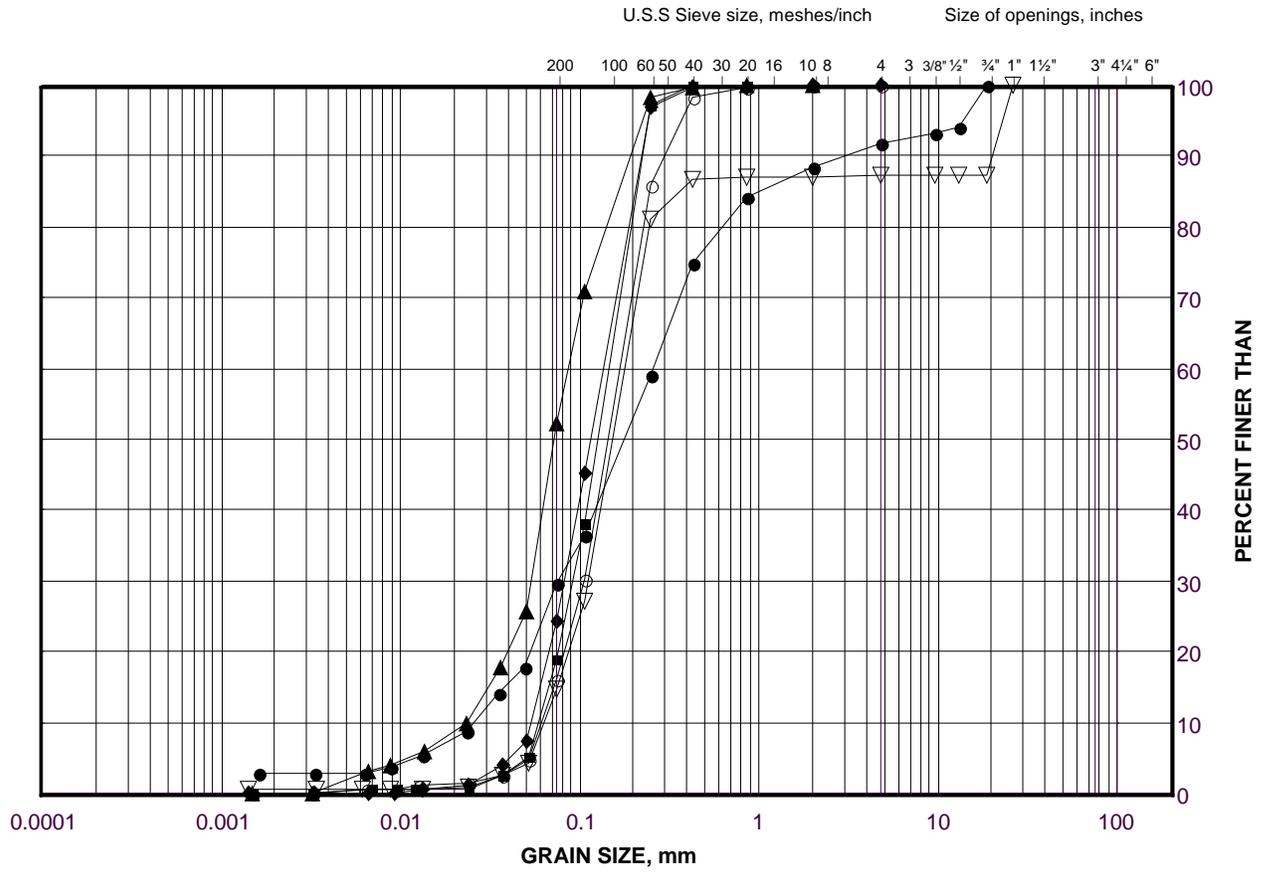
DATE:

2015-06-25

GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand
Highway 69 (SBL) STA 16+345

FIGURE G.C57.1-1



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

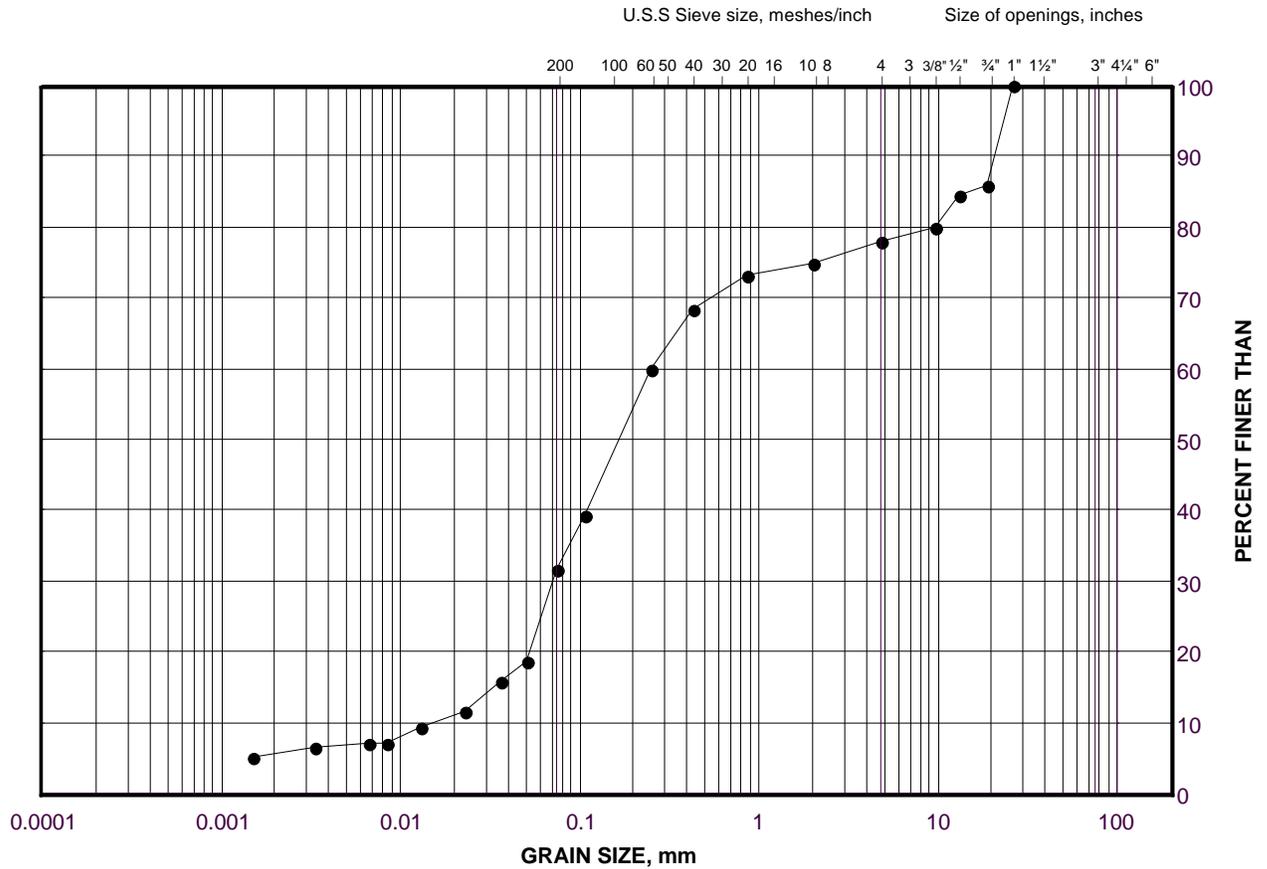
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C57.1-S2	2	207.6
■	C57.1-S1	3	205.6
◆	C57.1-S4	4	205.3
▲	C57.1-S2	4	206.1
▽	C57.1-S3	5	205.7
○	C57.1-S2	6	204.6

GRAIN SIZE DISTRIBUTION

Gravelly Silty Sand (Pocket)
Highway 69 (SBL) STA 16+345

FIGURE G.C57.1-2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C57.1-S3	2	207.9

Project Number: 07-1111-0029

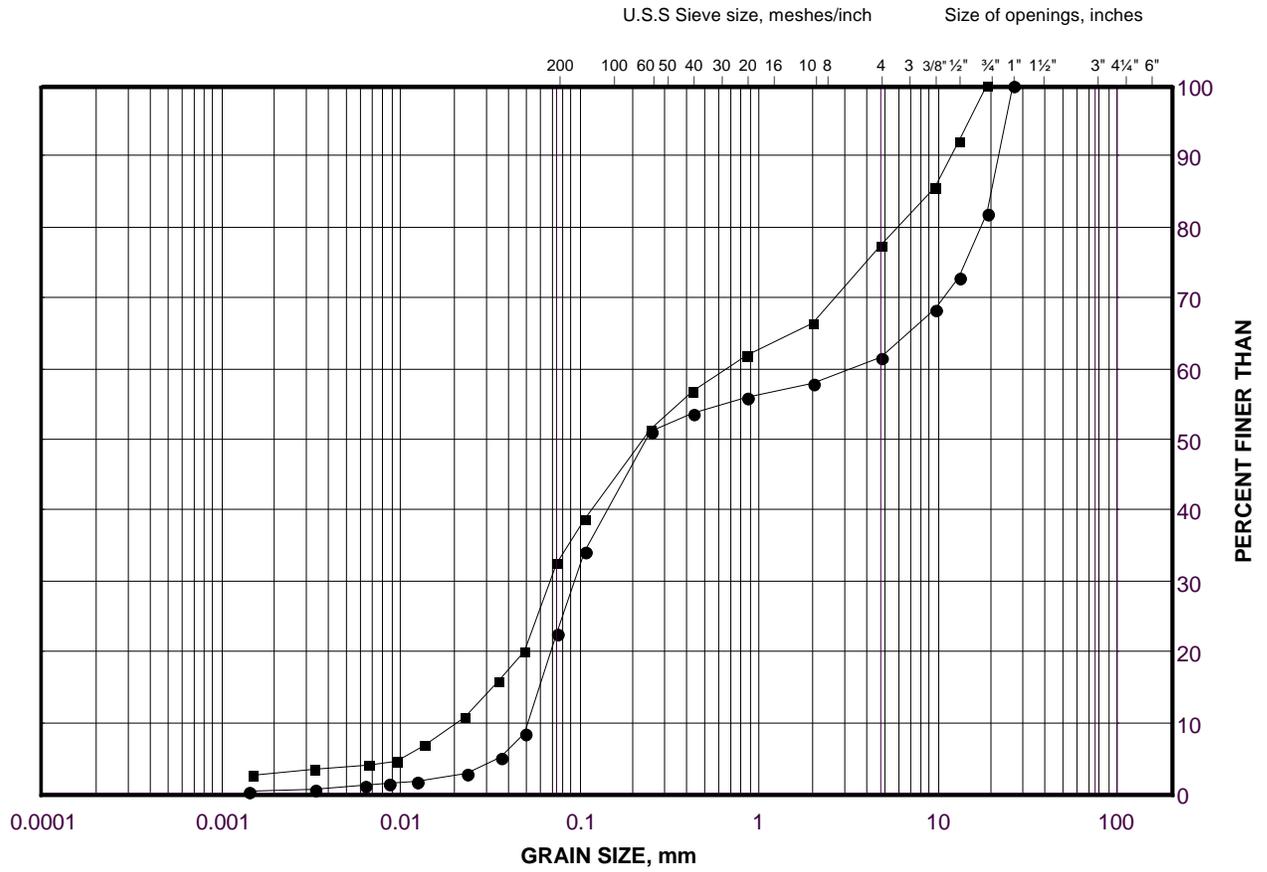
Checked By: AJS

Golder Associates

Date: 17-Aug-15

GRAIN SIZE DISTRIBUTION
 Gravelly Silt and Sand to Silty Sand and Gravel
 Highway 69 (SBL) STA 16+345

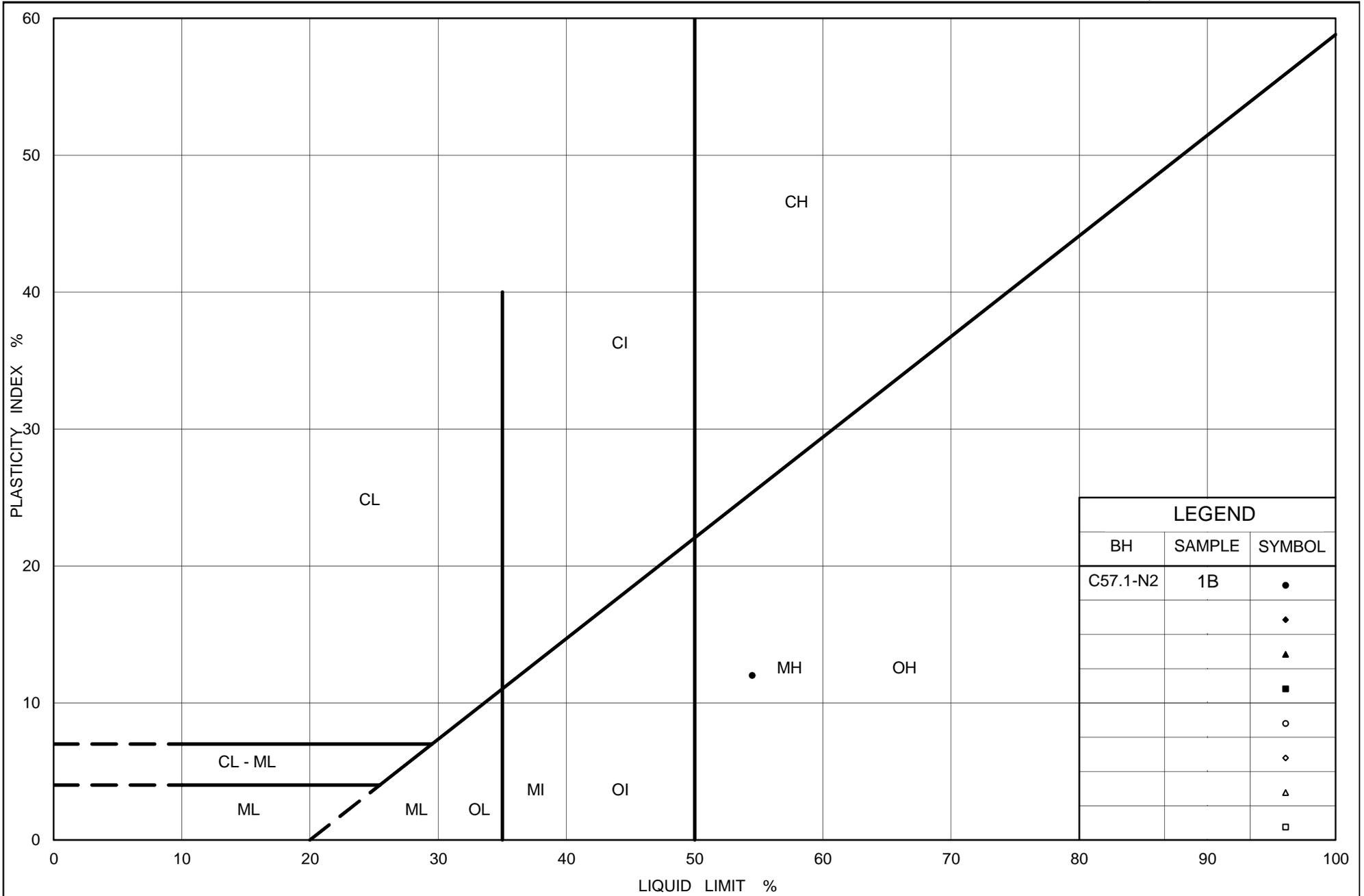
FIGURE G.57.1-3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C57.1-S5	6	204.6
■	C57.1-S3	7B	204.1



Ministry of Transportation

Ontario

PLASTICITY CHART
Silt
 Highway 69 (NBL) STA 16+345

Figure No. G.C57.1-4

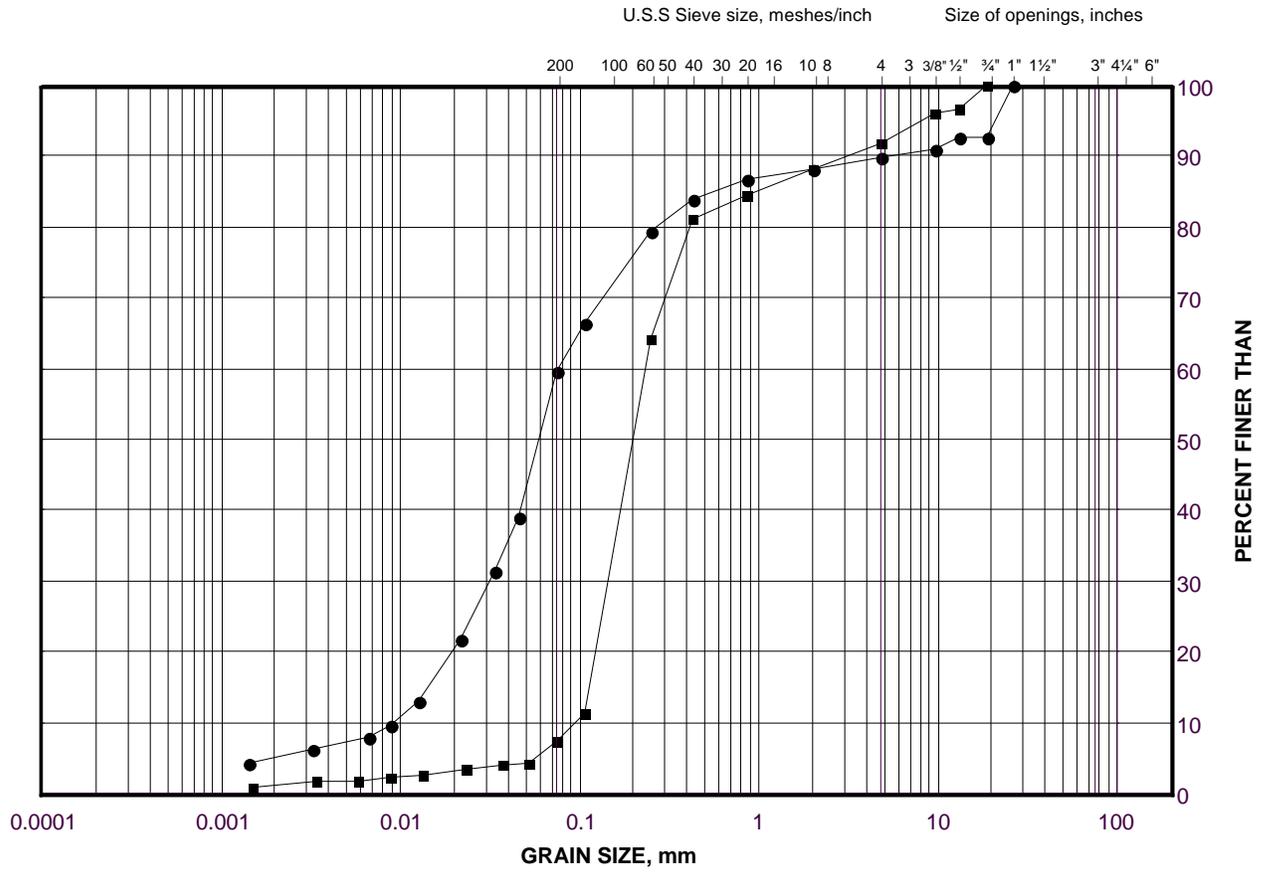
Project No. 07-1111-0029

Checked By: AJS

GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand
Highway 69 (NBL) STA 16+345

FIGURE G.C57.1-5



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

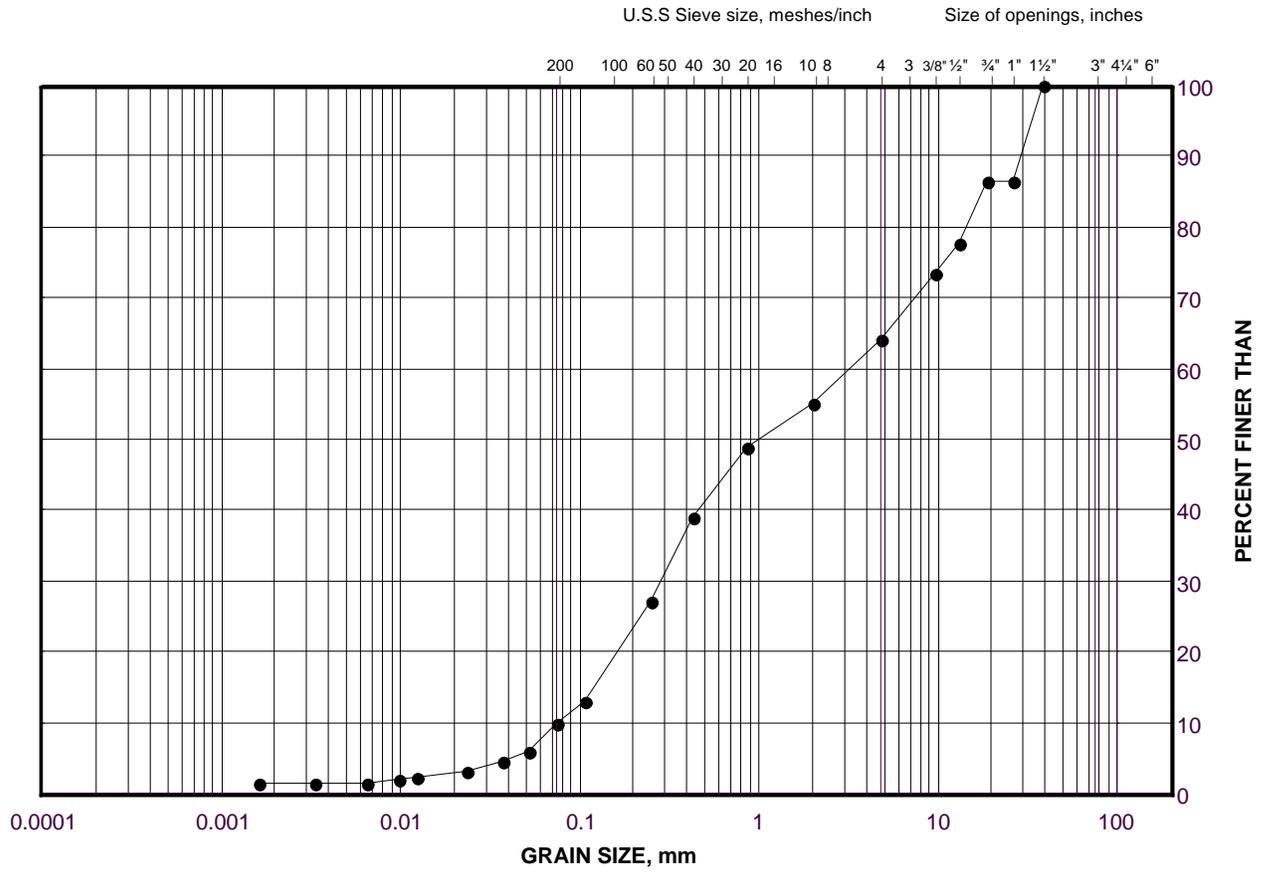
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C57.1-N4	2	207.5
■	C57.1-N2	2	206.7

GRAIN SIZE DISTRIBUTION

Sand and Gravel (Pocket)
Highway 69 (NBL) STA 16+345

FIGURE G.C57.1-6



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C57.1-N1	2	207.1

Project Number: 07-1111-0029

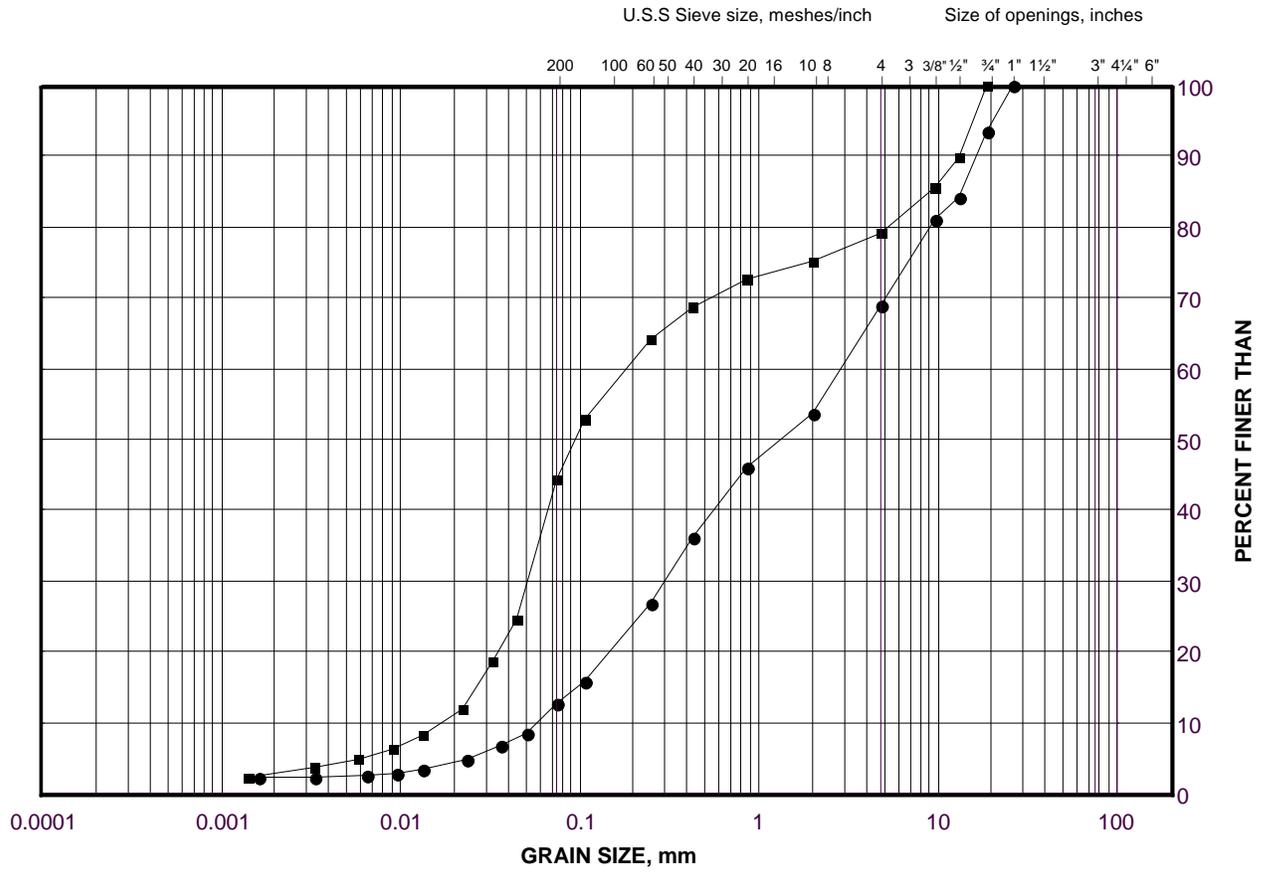
Checked By: AJS

Golder Associates

Date: 16-Aug-15

GRAIN SIZE DISTRIBUTION
Gravelly Silt and Sand to Sand and Gravel
Highway 69 (NBL) STA 16+345

FIGURE G.C57.1-7



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C57.1-N3	3	207.2
■	C57.1-N1	4	205.8

Project Number: 07-1111-0029

Checked By: AJS

Golder Associates

Date: 16-Aug-15



APPENDIX H

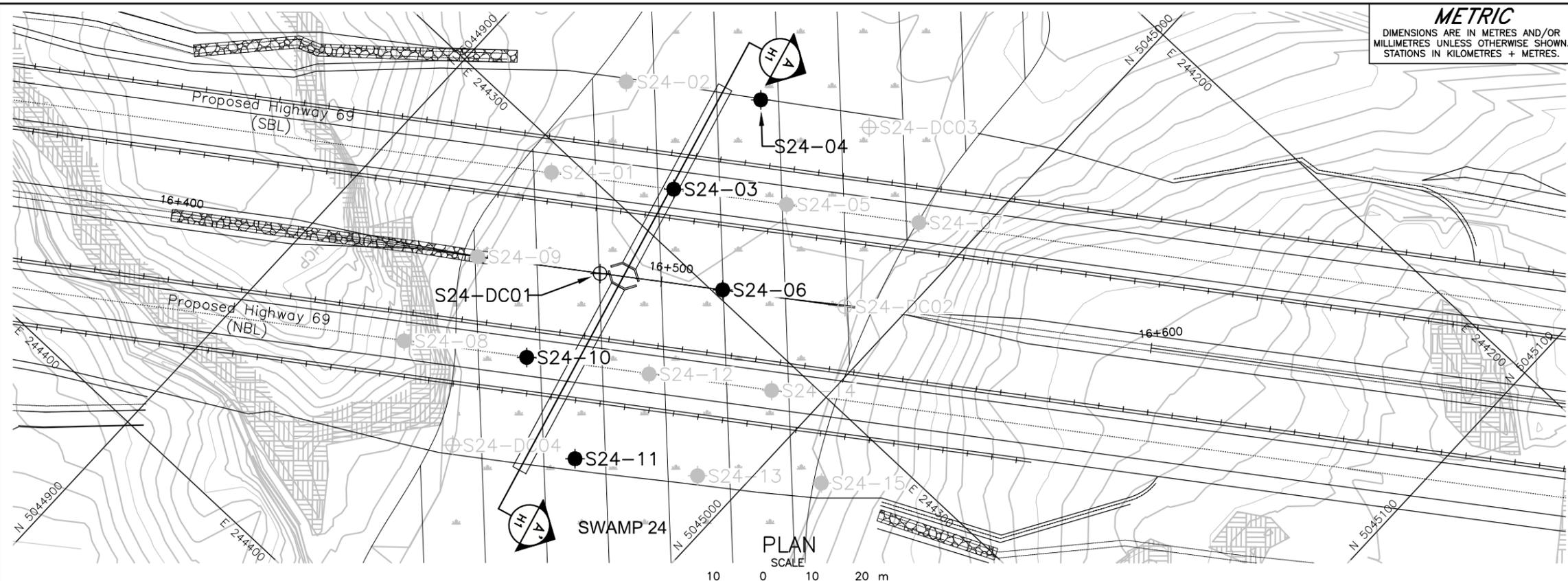
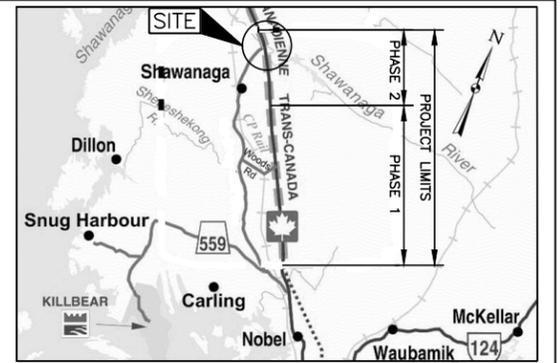
**Highway 69 SBL and NBL – STA 16+499 and STA 16+485
(Culvert C57 – Site No. 44-622/C2 and 44-622/C1)**

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

CONT No. GWP No. 5077-13-13 (NBL) and 5077-13-14 (SBL)
HIGHWAY 69 (SBL AND NBL)
CULVERT C57 STA 16+499 AND STA 16+485
BOREHOLE LOCATIONS AND SOIL STRATA
STRATA



SHEET S18



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ▽ WL on completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S24-03	0.0	5044948.8	244290.3
S24-04	0.0	5044949.4	244265.1
S24-06	0.0	5044969.9	244298.4
S24-10	0.0	5044950.2	244335.4
S24-11	0.0	5044971.3	244343.7
S24-DC01	0.0	5044949.5	244312.9

NOTES

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

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

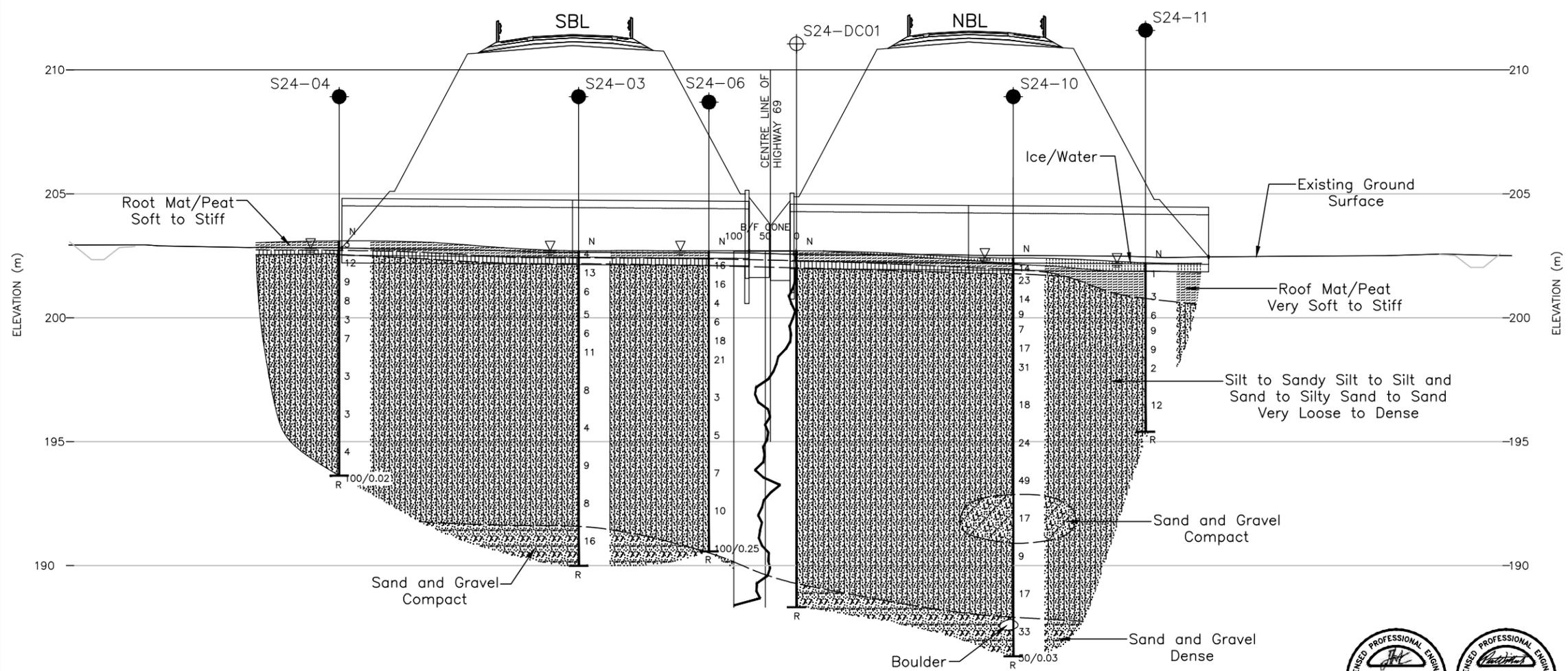
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

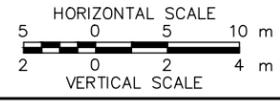
Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.



A-A CULVERT C57 PROFILE STA 16+499 AND STA 16+485



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. TVA/AJS	CHKD. TVA/AJS	DATE: 3/18/2016
DRAWN: JFC/MR	CHKD. TVA/CN	APPD. JPD/JMAC
		SITE: .44-622/C1&C2
		DWG. H1

FILE NAME: \\golder\proj\Mississauga\CAD\Projects\2007\07-1111-0029 (MRC, Perry Savard)_A-A- Profile - Culvert Report - Phase 1\071111029-A-A-BC-0008.dwg
 DATE PLOTTED: April 9, 2016

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S24-04** SHEET 1 OF 1 **METRIC**
G.W.P. 5111-07-00 **LOCATION** N 5044949.4 ; E 244265.1 **ORIGINATED BY** MR
DIST HWY 69 **BOREHOLE TYPE** 115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring **COMPILED BY** MWK
DATUM Geodetic **DATE** January 28, 2009 **CHECKED BY** VA/OK

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 (%)
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
203.1	GROUND SURFACE																
0.0	PEAT (Amorphous)																
202.7	Soft Dark brown Wet		1	SS	3												
0.5	SILT, trace sand, trace clay, trace organics Brown and grey Wet		2	SS	12									0	82	17	1
201.3	SAND, some silt, trace clay Loose to compact Grey to brownish grey Wet		3A	SS	9												
1.8	SAND, trace silt, trace clay Very loose to loose Grey Wet		3B														
			4	SS	8												
			5	SS	3									0	94	4	2
			6	SS	7												
			7	SS	3												
	Trace gravel below a depth of 6.4 m																
			8	SS	3									1	96	2	1
			9	SS	4												
193.6	END OF BOREHOLE SPOON AND CASING REFUSAL		10	SS	100/0.02												
9.5	NOTE: 1. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 202.8 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.CPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S24-10** **SHEET 1 OF 2** **METRIC**
G.W.P. 5111-07-00 **LOCATION** N 5044950.2 ; E 244335.4 **ORIGINATED BY** MR
DIST HWY 69 **BOREHOLE TYPE** 115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring **COMPILED BY** MWK
DATUM Geodetic **DATE** January 23, 2009 **CHECKED BY** VA/OK

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									
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
202.4	ICE SURFACE																
0.0	Ice																
	Water																
0.6	PEAT (Amorphous) Stiff Dark brown Wet		1A 1B 1C	SS	14												
	SILT, trace sand, trace clay, trace rootlets Compact Grey Wet		2	SS	23												
	SILT and SAND, trace clay, trace rootlets to a depth of 0.8 m Loose to compact Grey Wet		3	SS	14												0 39 60 1
			4	SS	9												
			5	SS	7												
199.0																	
3.4	Silty SAND, trace clay Compact to dense Grey Wet		6	SS	17												
			7	SS	31												0 76 21 3
			8	SS	18												
			9	SS	24												
194.0																	
8.4	SAND, some silt, trace gravel, trace clay Dense Grey Wet		10	SS	49												3 80 15 2
			11	SS	17												
192.5																	
9.9	SAND and GRAVEL, trace silt Compact Grey Wet		12	SS	9												
191.1																	
11.3	SILT and SAND, trace clay Loose Grey Wet		13	SS	17												0 69 30 1
190.2																	
12.2	SILT, trace sand, trace clay Loose Grey Wet																
189.6																	
12.8	SILT and SAND, trace clay, some cobbles and boulder Compact Grey Wet																
187.9																	
14.5																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

Continued Next Page

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S24-10	SHEET 2 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044950.2 ; E 244335.4</u>	ORIGINATED BY <u>MR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 23, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
186.3	--- CONTINUED FROM PREVIOUS PAGE --- SAND and GRAVEL, trace silt, containing cobbles and boulders between depths of 14.5 m and 14.8 m Dense Grey Wet	*	14	SS	33											
16.1		END OF BOREHOLE SPOON AND CASING REFUSAL NOTE: 1. Water level in open borehole at ice surface (Elev. 202.4 m) upon completion of drilling.	*	15	SS	50/0.03										

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S24-11	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044971.3; E 244343.7</u>	ORIGINATED BY <u>MR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 23, 2009</u>	CHECKED BY <u>VA/OK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			TN VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100	20 40 60 80 100	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60
202.2	ICE SURFACE															
0.0	Ice															
0.3	Water															
200.8	PEAT, trace sand layers (Amorphous) Very soft Dark brown Wet		1	SS	1											
200.8			2A	SS												
200.3	SILT and SAND, trace gravel, trace organics Very loose Grey Wet		2B	SS	3											OC=0.4%
200.3			3	SS	6						○					0 23 75 2
198.9	Sandy SILT, trace clay Loose Grey Wet		4	SS	9											
198.9			5	SS	9						○					
195.4	Silty SAND, trace clay Very loose to compact Grey Wet		6	SS	2						○					0 77 22 1
195.4			7	SS	12						○					
195.4	END OF BOREHOLE CASING REFUSAL															
	NOTES: 1. Water level in open borehole at ice surface (Elev. 202.2 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II\CPJ GAL-GTA.GDT 03/25/16 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No S24-DC-01	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044949.5 ; E 244312.9</u>	ORIGINATED BY <u>MR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>D-25 Track Mount, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 24, 2009</u>	CHECKED BY <u>VA/OK</u>	

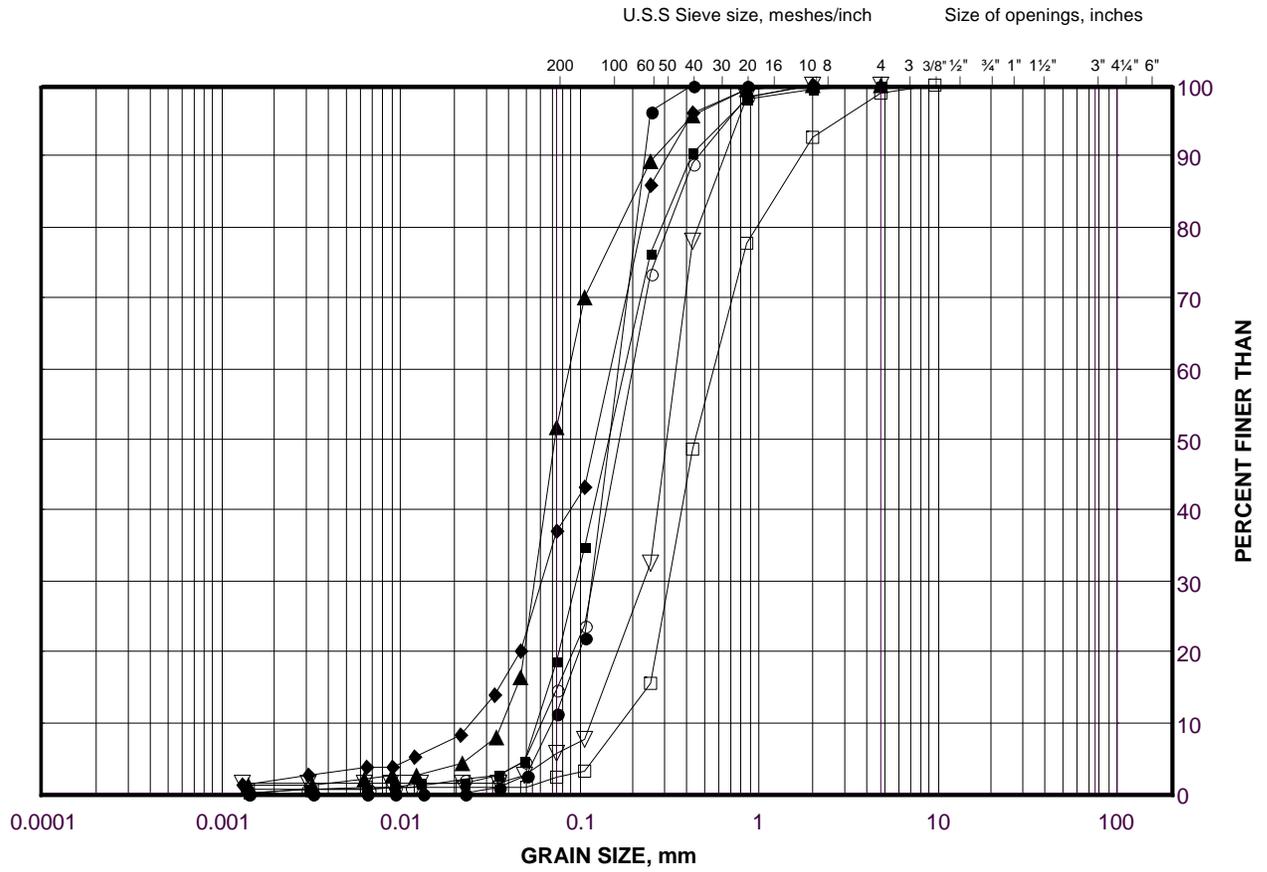
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
202.7 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)						20 40 60 80 100	20 40 60					
188.3 14.4	END OF DCPT Refusal to Further Penetration (100 Blows / 0.03 m)						20 40 60 80 100	20 40 60					

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

GRAIN SIZE DISTRIBUTION
 Silt and Sand to Sand
 Highway 69 (SBL) STA 16+475 to 16+550

FIGURE H.C57-1A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-03	10	192.3
■	S24-04	2	202.0
◆	S24-06	3	200.4
▲	S24-03	3	200.9
▽	S24-04	5	199.7
○	S24-03	7	196.9
□	S24-04	8	195.9

Project Number: 07-1111-0029

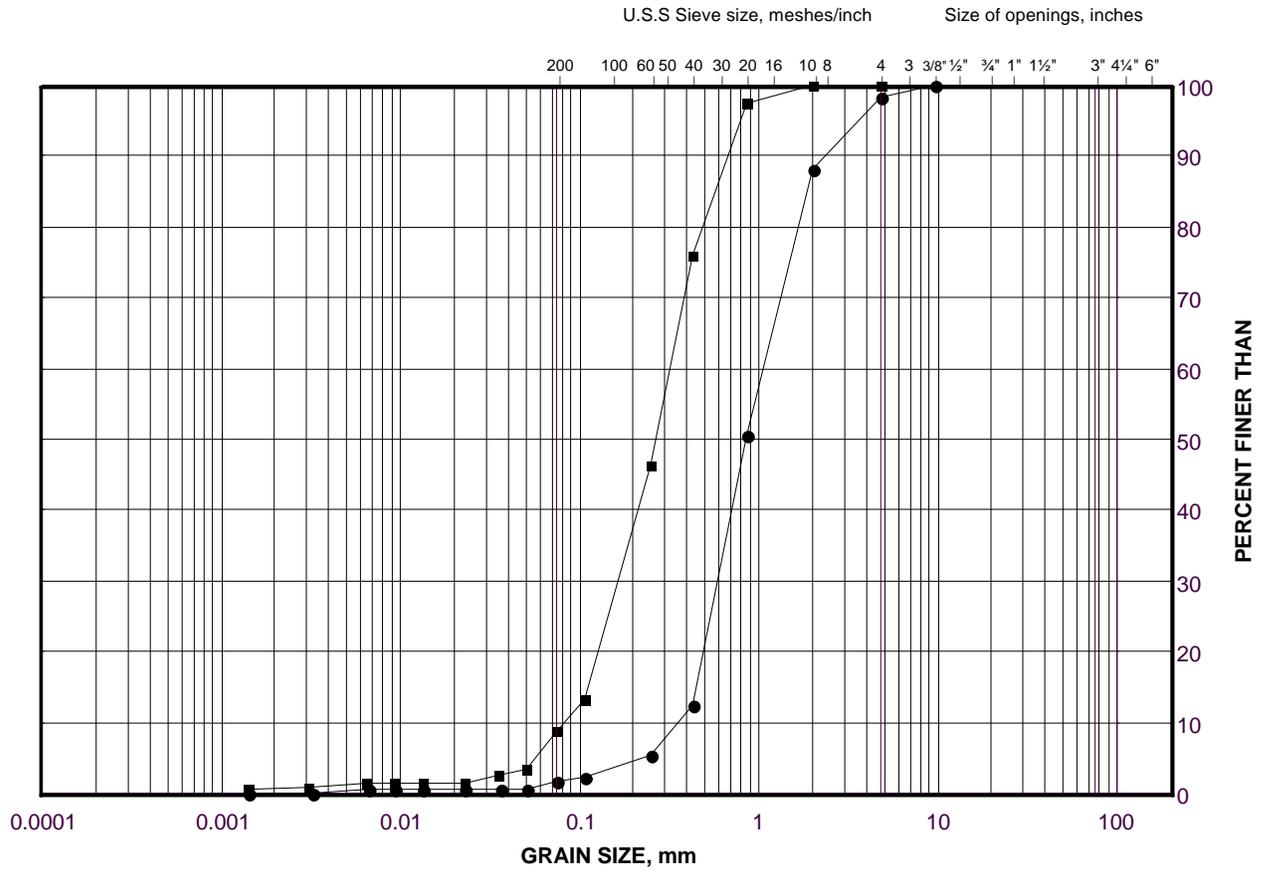
Checked By: TVA

Golder Associates

Date: 14-Aug-15

GRAIN SIZE DISTRIBUTION
 Silt and Sand to Sand
 Highway 69 (SBL) STA 16+475 to 16+550

FIGURE H.C57-1B



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

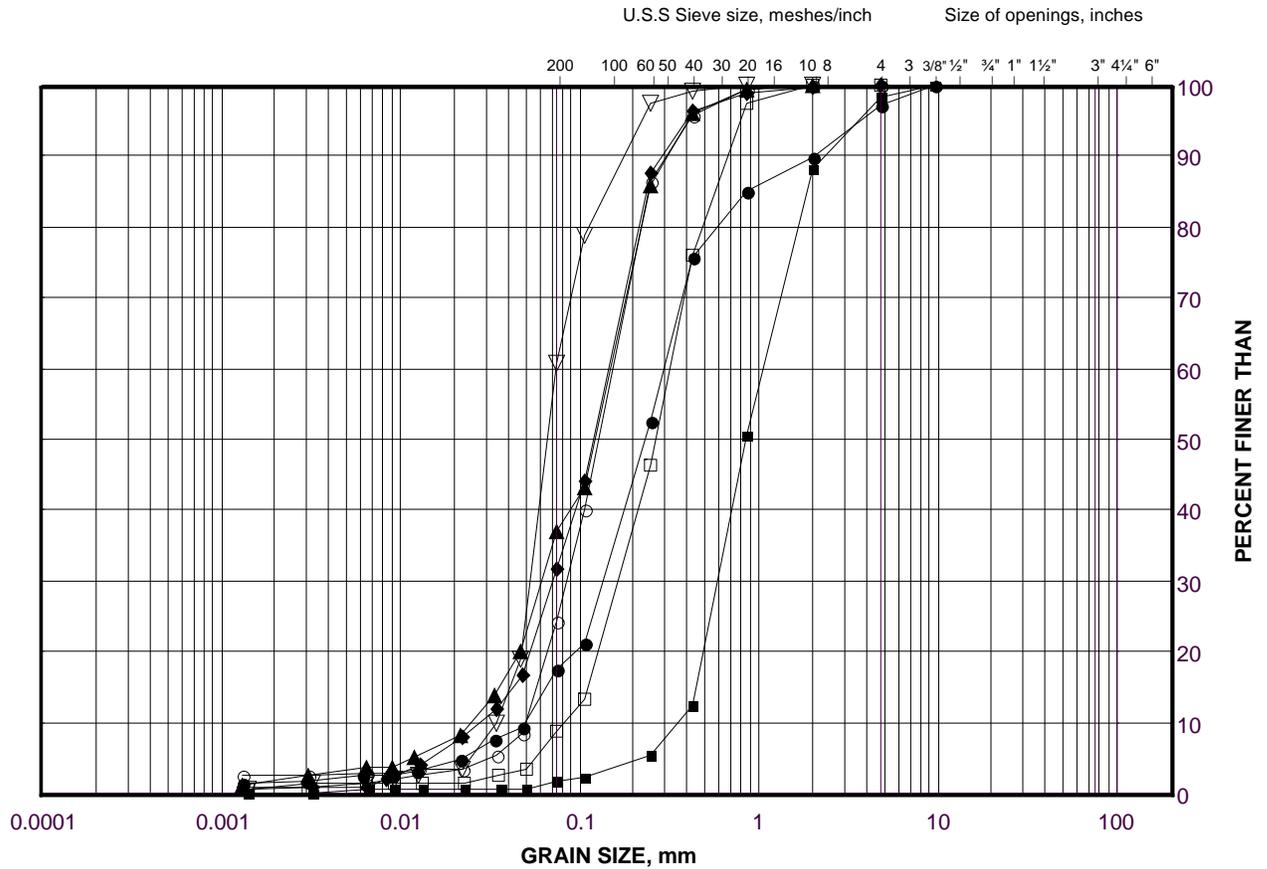
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-06	10A	192.1
■	S24-06	7	196.6

GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand
Highway 69 (NBL) STA 16+485

FIGURE H.C57-2A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-10	10	193.3
■	S24-06	10A	192.1
◆	S24-10	13	188.7
▲	S24-06	3	200.4
▽	S24-10	3	200.6
○	S24-10	7	197.8
□	S24-06	7	196.6

Project Number: 07-1111-0029

Checked By: TVA

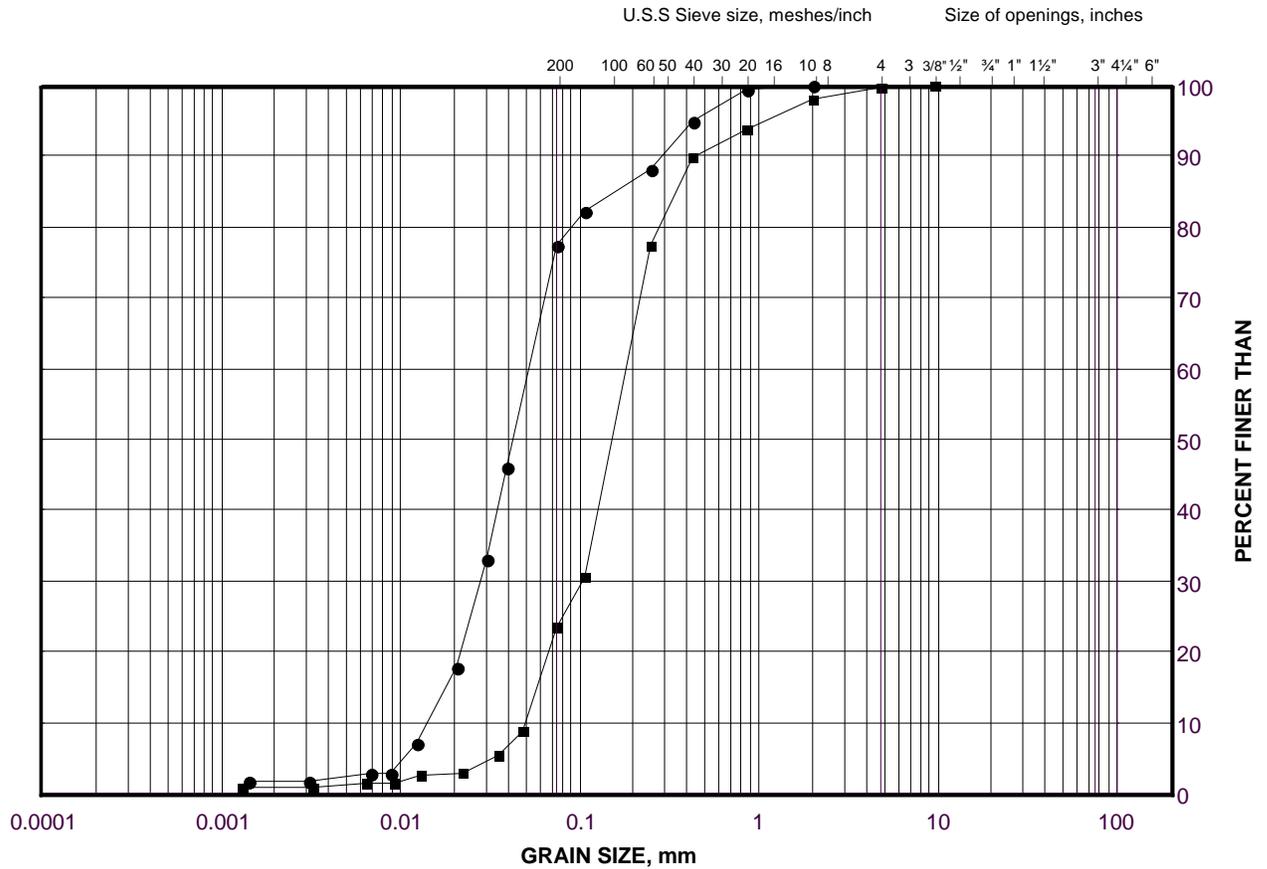
Golder Associates

Date: 14-Aug-15

GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand
Highway 69 (NBL) STA 16+485

FIGURE H.C57-2B



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

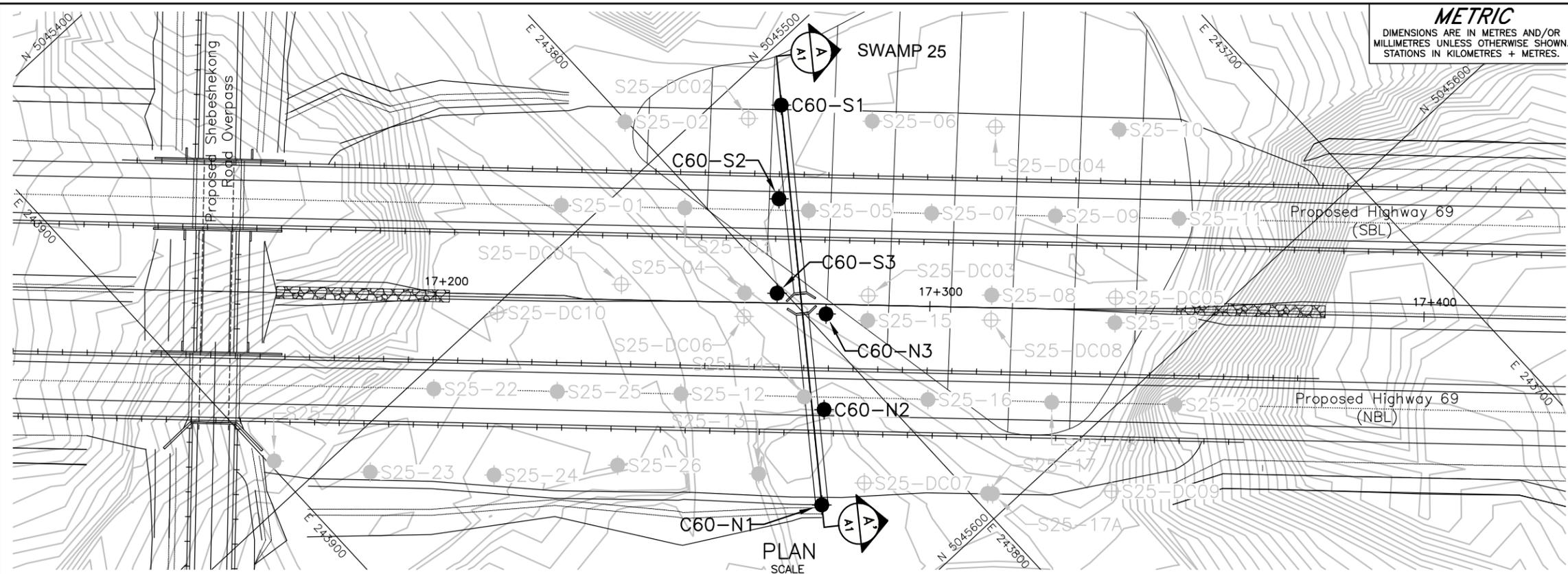
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-11	3	199.9
■	S24-11	6	197.8



APPENDIX I

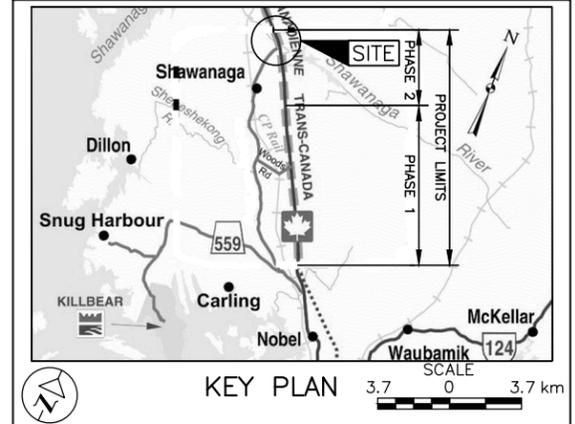
**Highway 69 SBL and NBL – STA 17+272 and STA 17+276
(Culvert C60)**



CONT No. GWP No. 5117-07-00

HIGHWAY 69 (SBL AND NBL)
CULVERT C60 STA 17+272 AND STA 17+276
BOREHOLE LOCATIONS AND SOIL STRATA

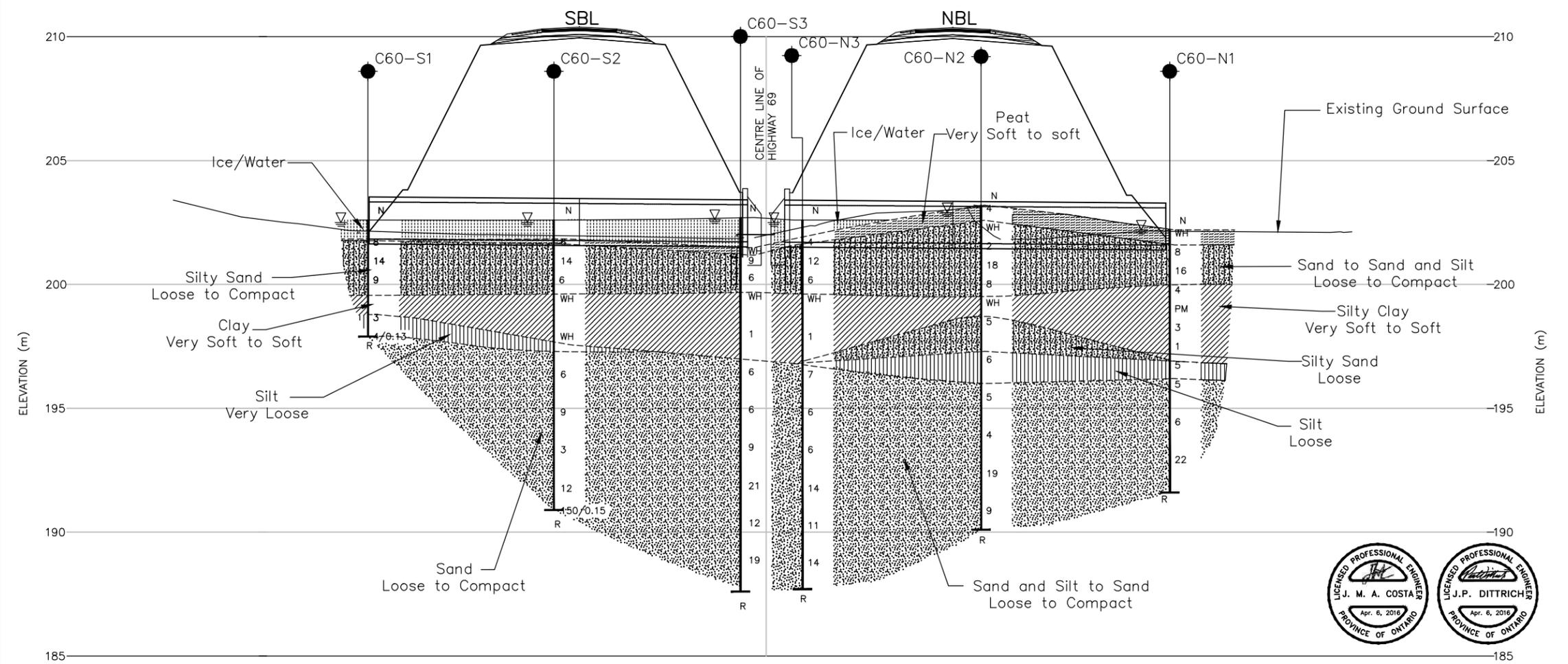
SHEET S23



- LEGEND**
- Borehole - Current Investigation
 - Borehole - Previous Investigation
 - ⊕ Dynamic Cone Penetration Test
 - ⊕ Dynamic Cone Penetration Test - Previous Investigation
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - ∇ WL upon completion of drilling
 - R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C60-N1	202.2	5045574.3	243823.6
C60-N2	203.2	5045560.5	243810.2
C60-N3	202.6	5045546.6	243796.8
C60-S1	202.6	5045509.5	243774.8
C60-S2	202.6	5045523.1	243788.0
C60-S3	202.7	5045536.8	243801.2



NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

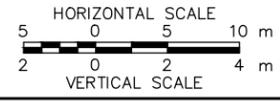
Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.



A-A CULVERT C60 PROFILE STA 17+272 AND STA 17+276



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. TVA/AJS	CHKD. TVA/AJS	DATE: 3/18/2016
DRAWN: JFC/MR	CHKD. CN	APPD. JMAC
		SITE: .
		DWG. 11

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C60-S1	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5045509.5 ; E 243774.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>March 10, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
202.6	ICE SURFACE															
0.0	Ice															
202.1																
201.8	Water															
0.9	PEAT (Fibrous) Soft Dark brown Wet		1	SS	8											
	Silty SAND, slightly organic to a depth of 1.5 m Loose to compact Brown to grey Wet		2	SS	14											
			3	SS	9											
199.6																
3.1	CLAY, some silt, trace sand Soft Brown and grey Wet															
198.8																
3.8	SILT, some sand, trace clay Very Loose Grey Wet		4	SS	3											
198.0																
4.7	SAND, trace to some silt Very loose Grey Wet		5	SS	4/0.13											
	END OF BOREHOLE SPOON AND CASING REFUSAL															
	NOTES: 1. Water level in open borehole at a depth of 0.1 m below ice surface (Elev. 202.5 m) upon completion of drilling. 2. Borehole caved to a depth of 1.4 m below ice surface (Elev. 201.2 m) upon removal of casing.															

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PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C60-S2	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5045523.1 ; E 243788.0</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>March 10, 2009</u>	CHECKED BY <u>VA</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				GR SA SI CL
								20	40	60	80	100	20	40	60	kN/m ³	
202.6	ICE SURFACE																
0.0	Ice																
202.1	Water						202										
1.0	PEAT (Fibrous) Dark brown Wet		1	SS	6												
	Silty SAND, trace clay, slightly organic to a depth of 1.5 m Loose to compact Brown Wet		2	SS	14		201						○				0 74 25 1
			3	SS	6		200										
199.6	CLAY, some silt, trace sand Soft Brown Wet		4	TO	WH		199										
							198										
197.6	SILT, trace clay Very loose Grey Wet		5	SS	WH		197										
197.3	SAND, trace to some silt Very loose to compact Grey Wet		6	SS	6		196										
			7	SS	9		195						○				0 81 19 0
			8	SS	3		194										
	Containing some gravel below a depth of 10.5 m		9	SS	12		192										
190.9	END OF BOREHOLE CASING REFUSAL		10	WS*	50/0 15		191										
11.7	NOTES: 1. Water level in open borehole at a depth of 0.1 m below ice surface (Elev. 202.5 m) upon completion of drilling. 2. Borehole caved to a depth of 1.9 m below ice surface (Elev. 200.7 m) upon removal of casing. * Sample obtained from bottom of casing after the split spoon sampling attempt.																

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C60-S3	SHEET 2 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5045536.8 ; E 243801.2</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>March 11, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
187.6 195.1	END OF BOREHOLE CASING REFUSAL NOTES: 1. Water level in open borehole at a depth of 0.1 m below ice surface (Elev. 202.6 m) upon completion of drilling. 2. An additional borehole was drilled 1.0 m north of Borehole C60-S3 to obtain a Shelby tube sample between depths of 4.6 m and 5.2 m (Elev. 198.1 m and 197.5 m).															

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C60-N2	SHEET 2 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5045560.5; E 243810.2</u>	ORIGINATED BY <u>MJR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>March 11, 2009</u>	CHECKED BY <u>VA</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
--- CONTINUED FROM PREVIOUS PAGE ---																
	NOTES: 1. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 202.9 m) upon completion of drilling. 2. Unable to turn in situ vane at depths of 4.5 m and 6.8 m (Elev. 198.7 m and 196.4 m). 3. Borehole caved to a depth of 5.9 m below ground surface (Elev. 197.3 m) upon removal of casing.															

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No C60-N3** **SHEET 1 OF 2** **METRIC**
G.W.P. 5111-07-00 **LOCATION** N 5045546.6 ; E 243796.8 **ORIGINATED BY** ID
DIST HWY 69 **BOREHOLE TYPE** Portable Equipment, BW Casing, Wash Boring **COMPILED BY** PKS
DATUM Geodetic **DATE** March 12, 2009 **CHECKED BY** VA

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	20						40	60	80	100	20
202.6	ICE SURFACE																	
0.0	Ice																	
202.1	Water																	
201.8	Water																	
0.9	PEAT (Fibrous) Dark brown Wet		1	SS	4													
201.1	SAND, some silt, slightly organic to a depth of 1.5 m Very Loose Brown to grey Wet		2	SS	12													
1.5	SAND and SILT, trace clay Loose to compact Grey Wet		3	SS	6													
199.2			4A	TO	WH													
3.4	SILTY CLAY, trace sand Soft Brown Wet		4B															
196.8			5	SS	1													
196.8	SAND and SILT Loose to compact Grey to brown Wet		6	SS	7													
192.4			7	SS	6													
192.4	SAND, some gravel, some silt Compact Grey Wet		8	SS	6													
10.2			9	SS	14													
187.7			10	SS	11													
			11	SS	14													

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

Continued Next Page

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C60-N3	SHEET 2 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5045546.6 ; E 243796.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>PKS</u>	
DATUM <u>Geodetic</u>	DATE <u>March 12, 2009</u>	CHECKED BY <u>VA</u>	

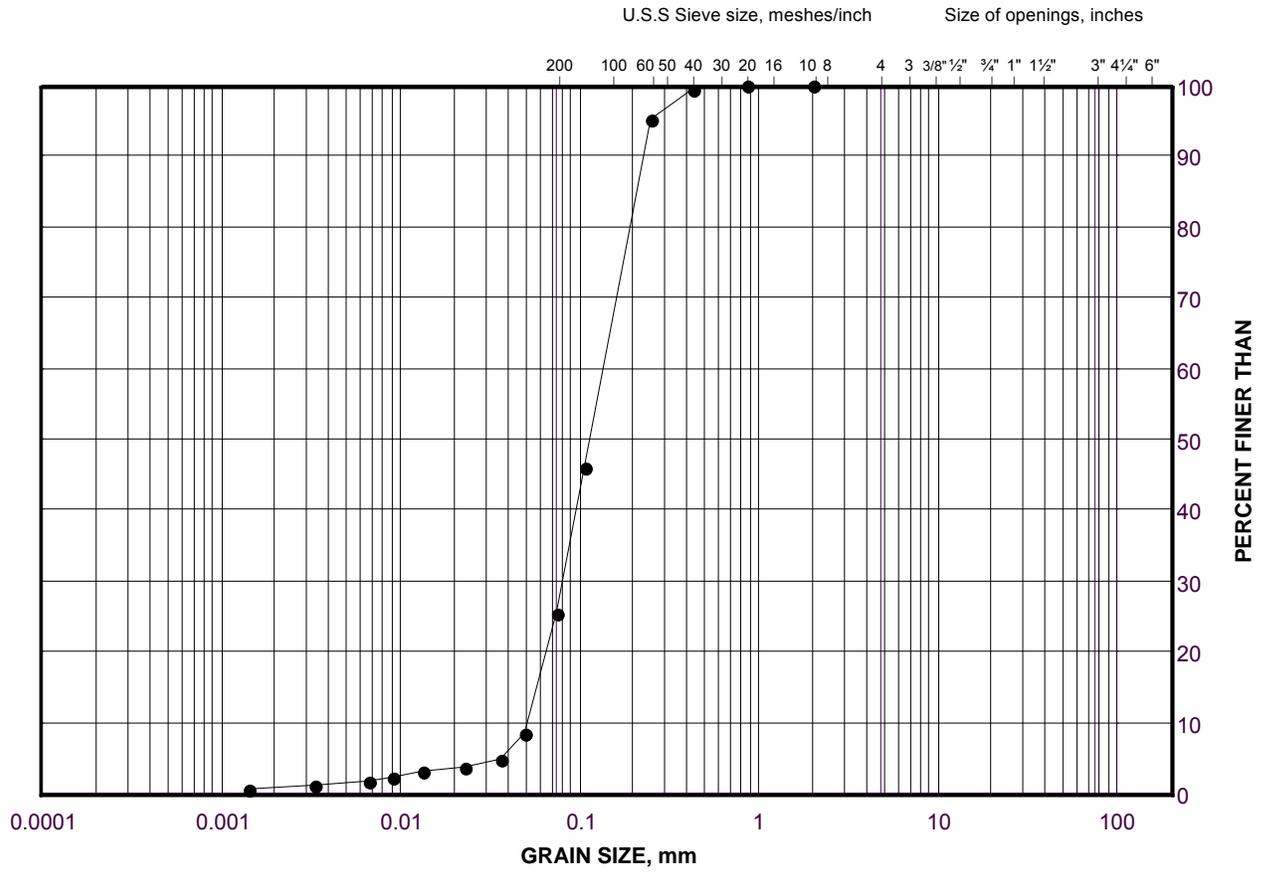
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
14.9	END OF BOREHOLE CASING REFUSAL NOTES: 1. Water level in open borehole at a depth of 0.1 m below ice surface (Elev. 202.5 m) upon completion of drilling. 2. Borehole caved to a depth of 1.7 m below ice surface (Elev. 200.9 m) upon removal of casing.															

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GRAIN SIZE DISTRIBUTION

Silty Sand
Highway 69 (SBL) STA 17+269

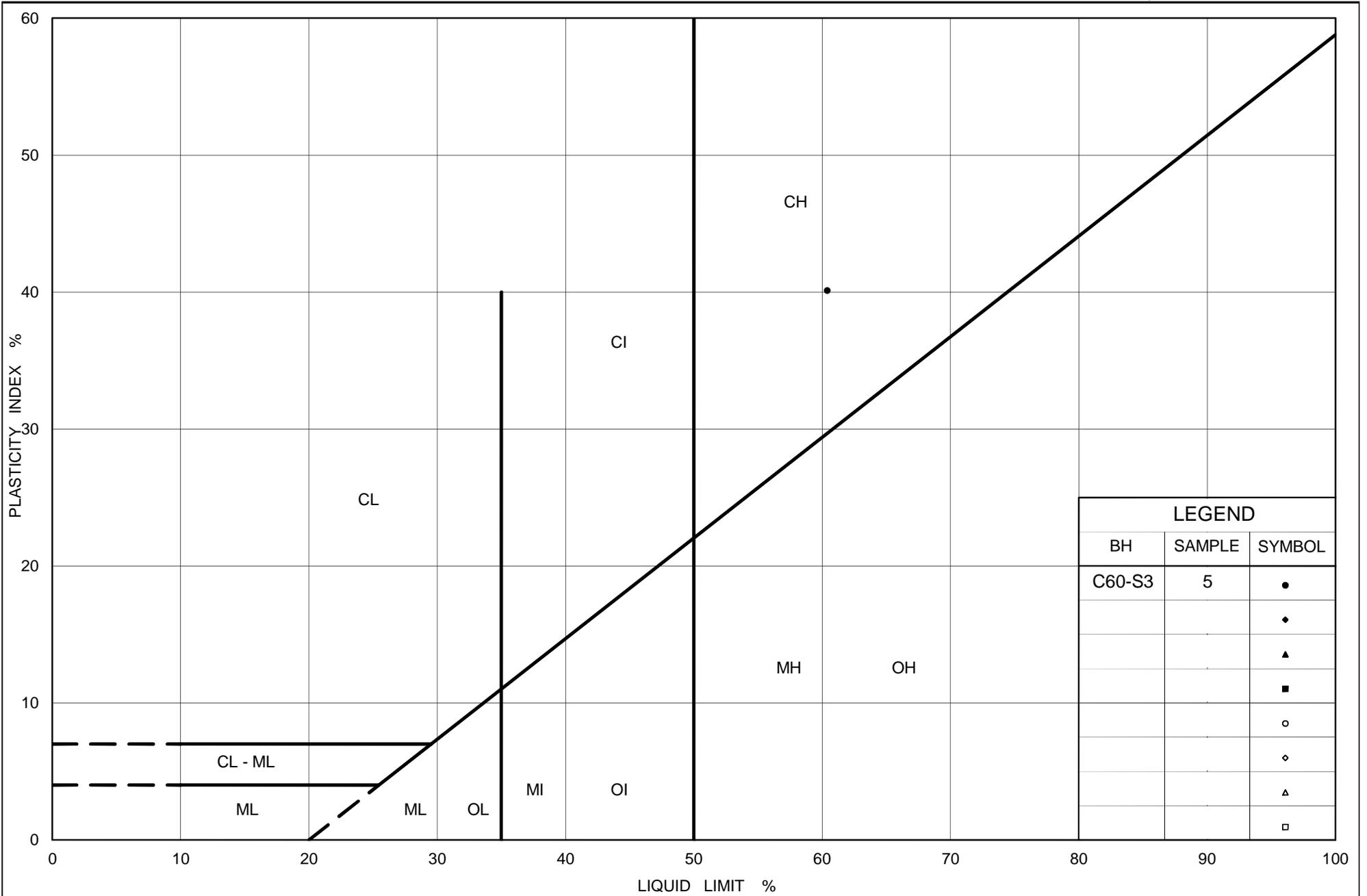
FIGURE I.C60-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C60-S2	2	199.9



Ministry of Transportation

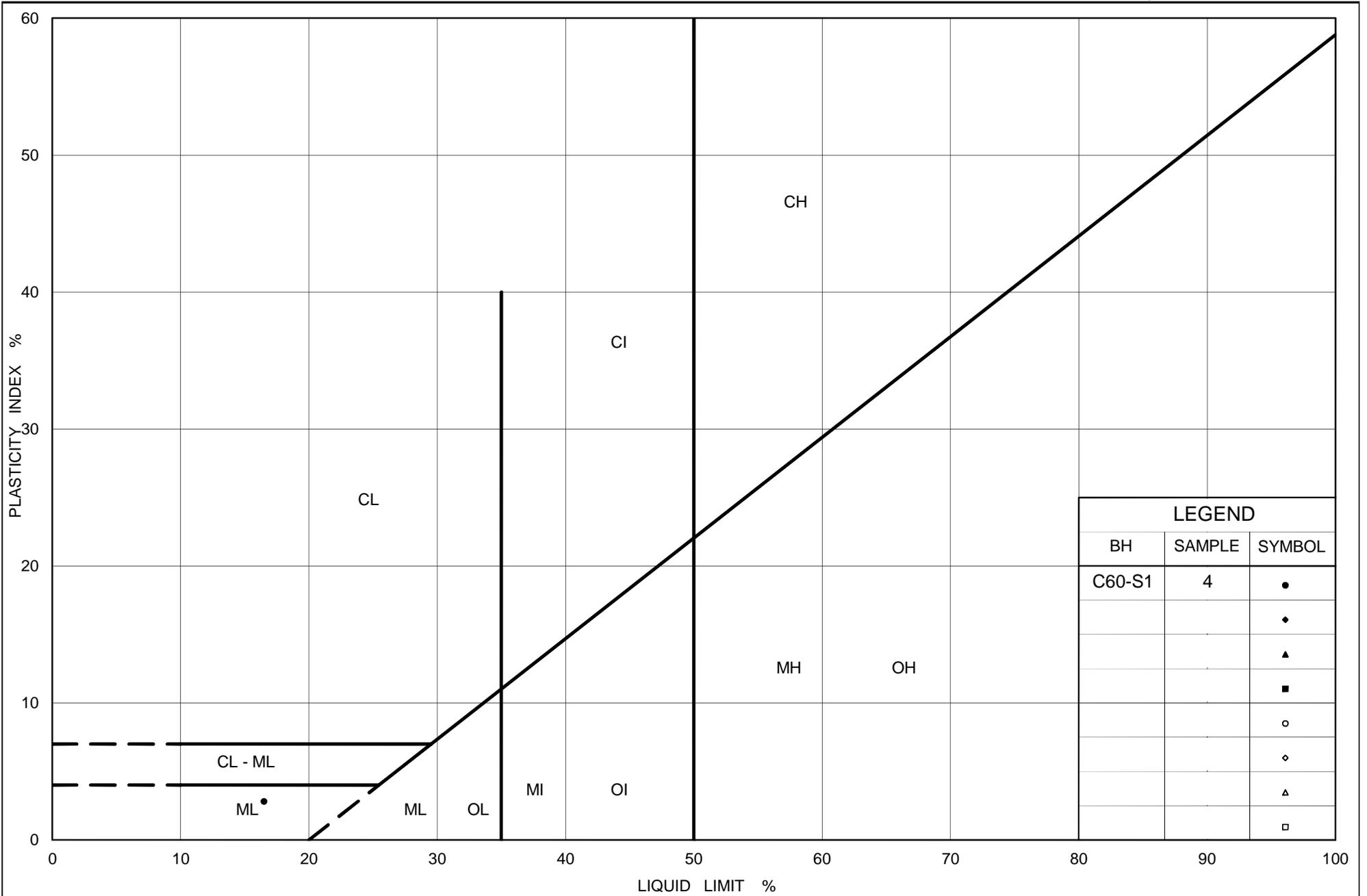
Ontario

PLASTICITY CHART
 Clay
 Highway 69 (SBL) STA 17+269

Figure No. I.C60-2

Project No. 07-1111-0029

Checked By: TVA



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silt
 Highway 69 (SBL) STA 17+269

Figure No. I.C60-3

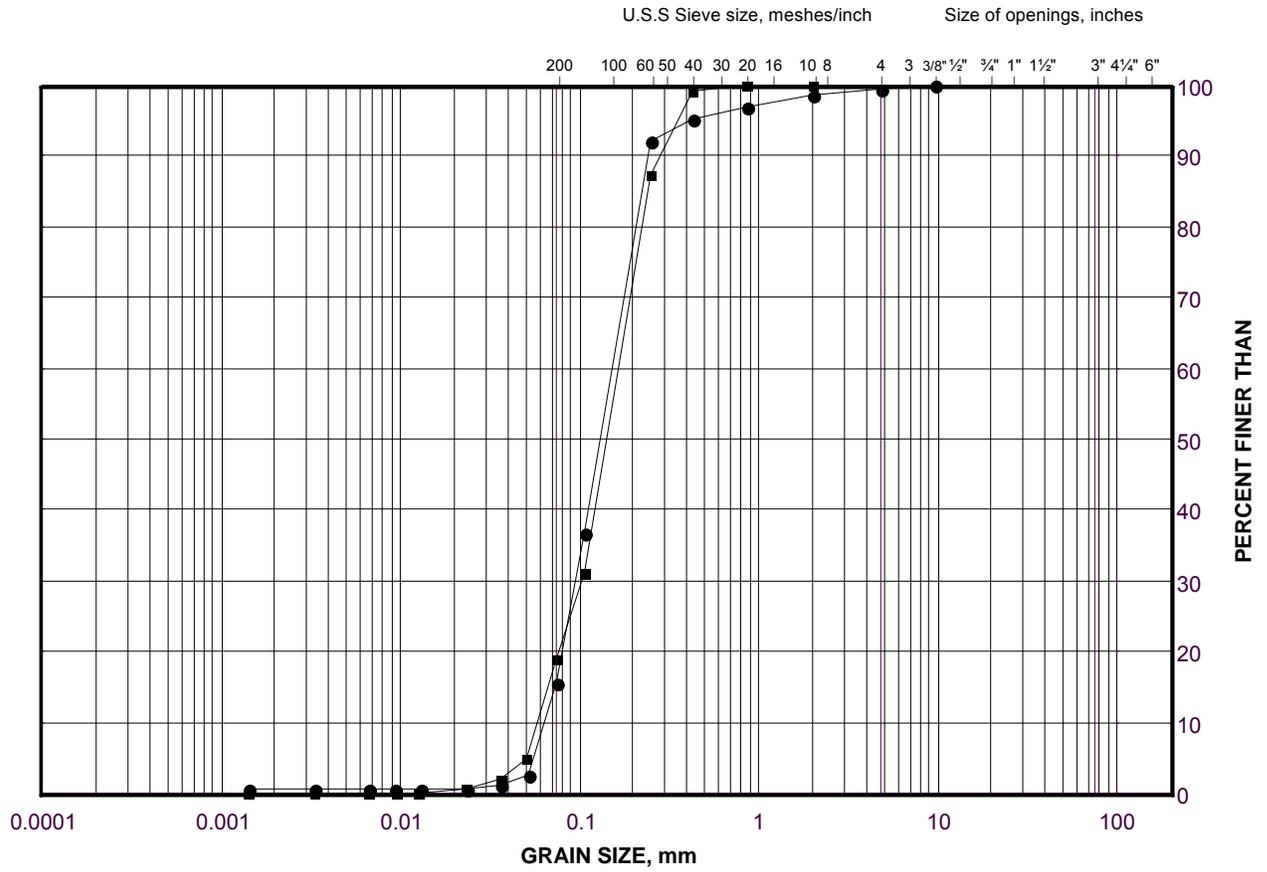
Project No. 07-1111-0029

Checked By: TVA

GRAIN SIZE DISTRIBUTION

Sand
Highway 69 (SBL) STA 17+269

FIGURE I.C60-4



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

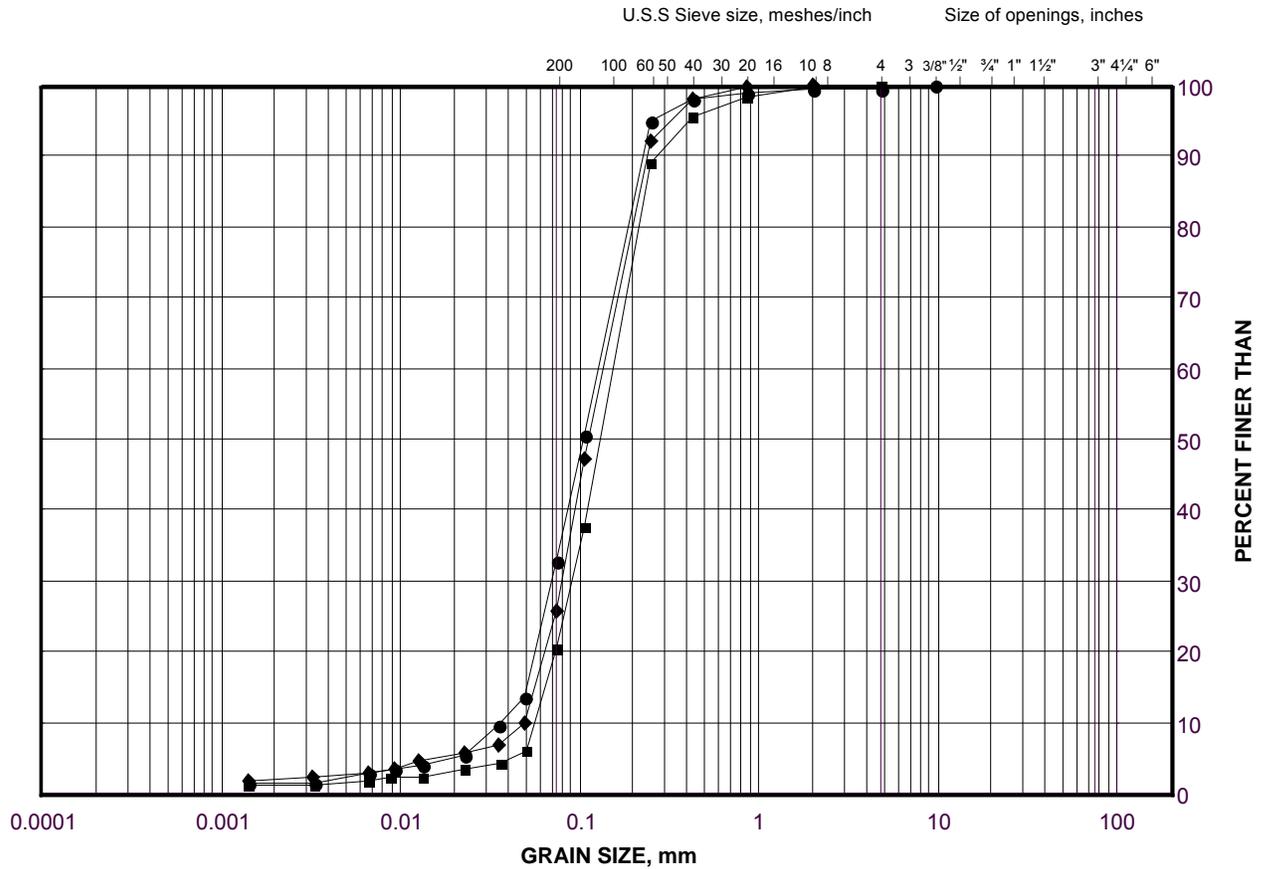
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C60-S3	11	187.8
■	C60-S2	7	193.8

GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand (Upper)
Highway 69 (NBL) STA 17+279

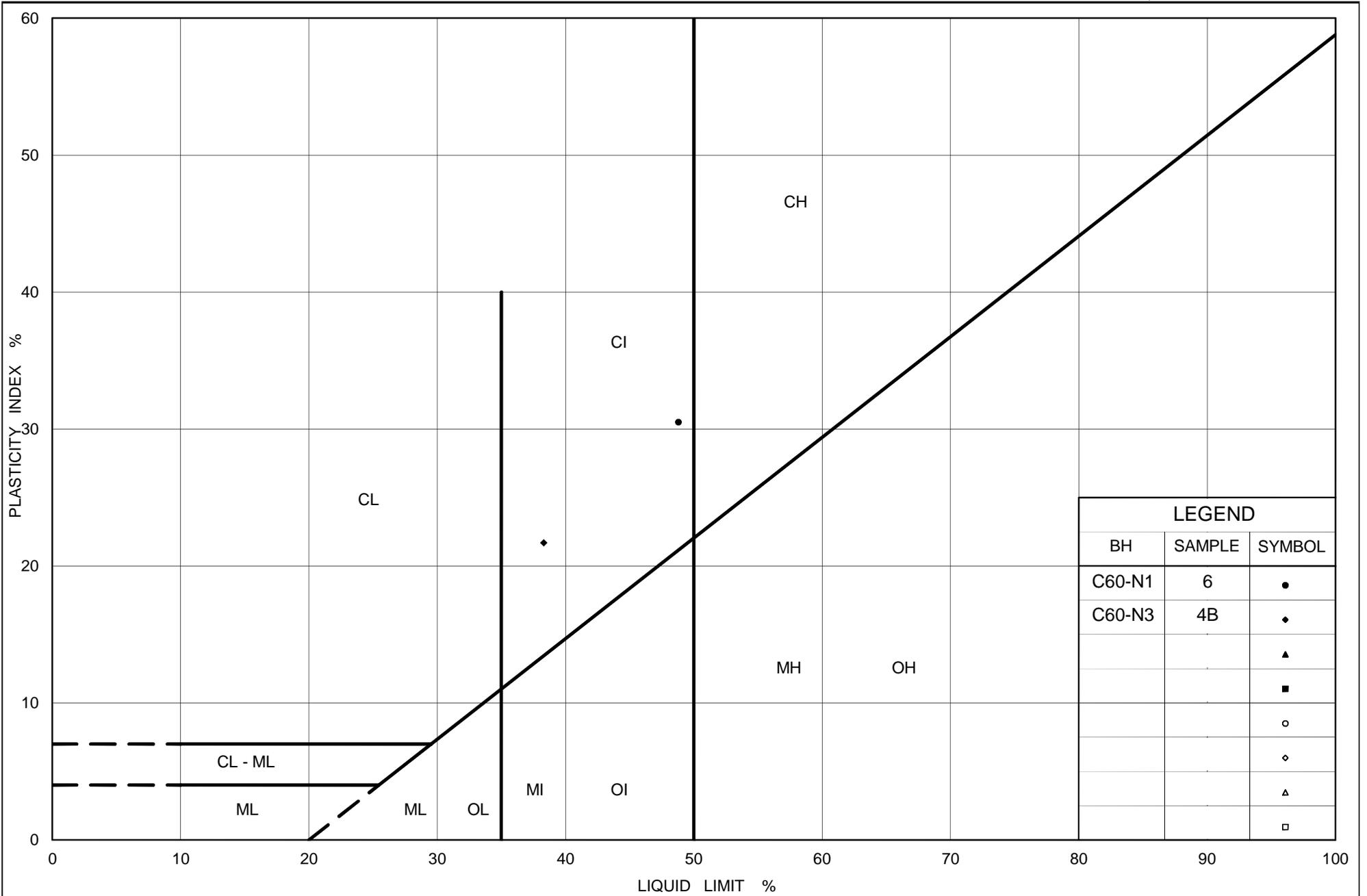
FIGURE I.C60-5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C60-N3	3	199.1
■	C60-N1	3	199.5
◆	C60-N2	4	199.7



LEGEND		
BH	SAMPLE	SYMBOL
C60-N1	6	●
C60-N3	4B	◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silty Clay
 Highway 69 (NBL) STA 17+279

Figure No. I.C60-6

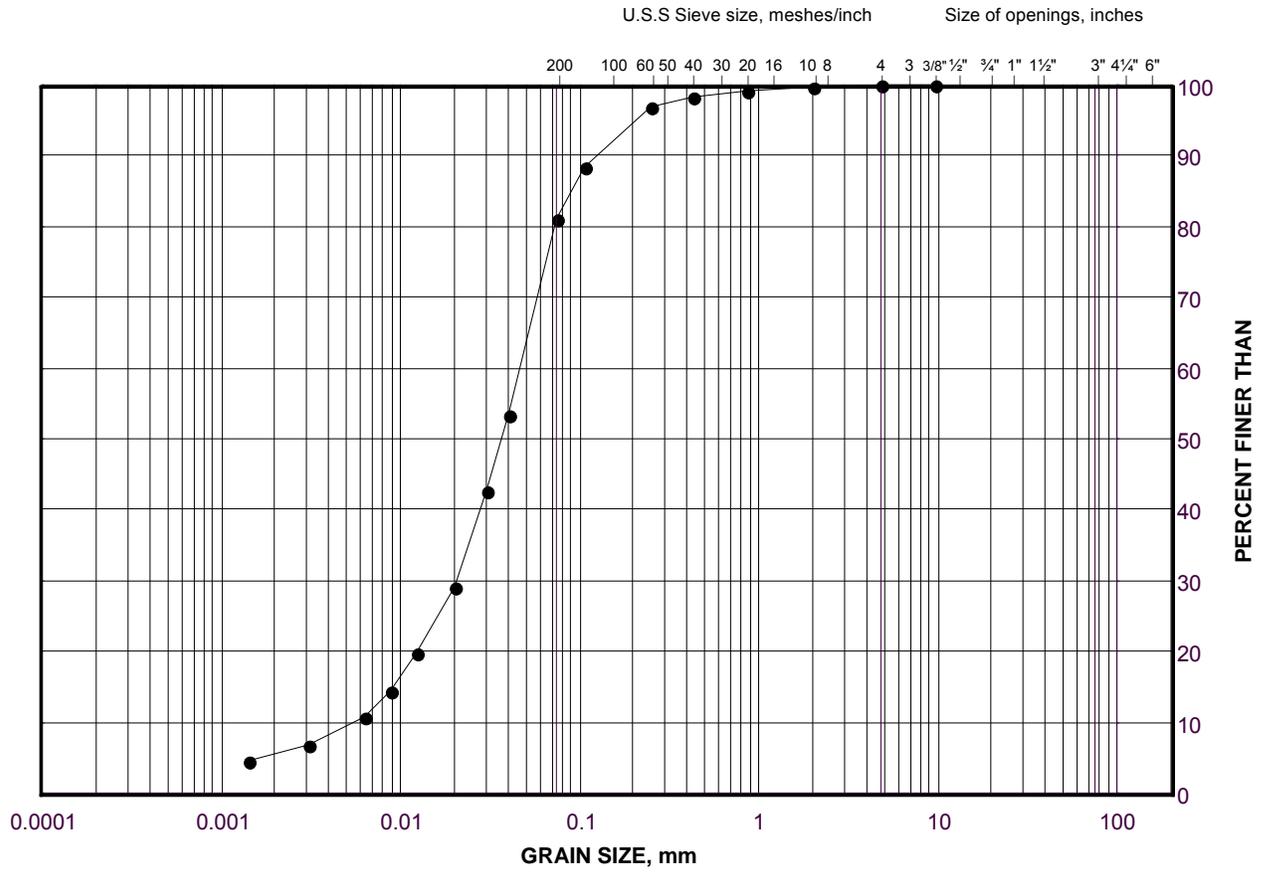
Project No. 07-1111-0029

Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silt
Highway 69 (NBL) STA 17+279

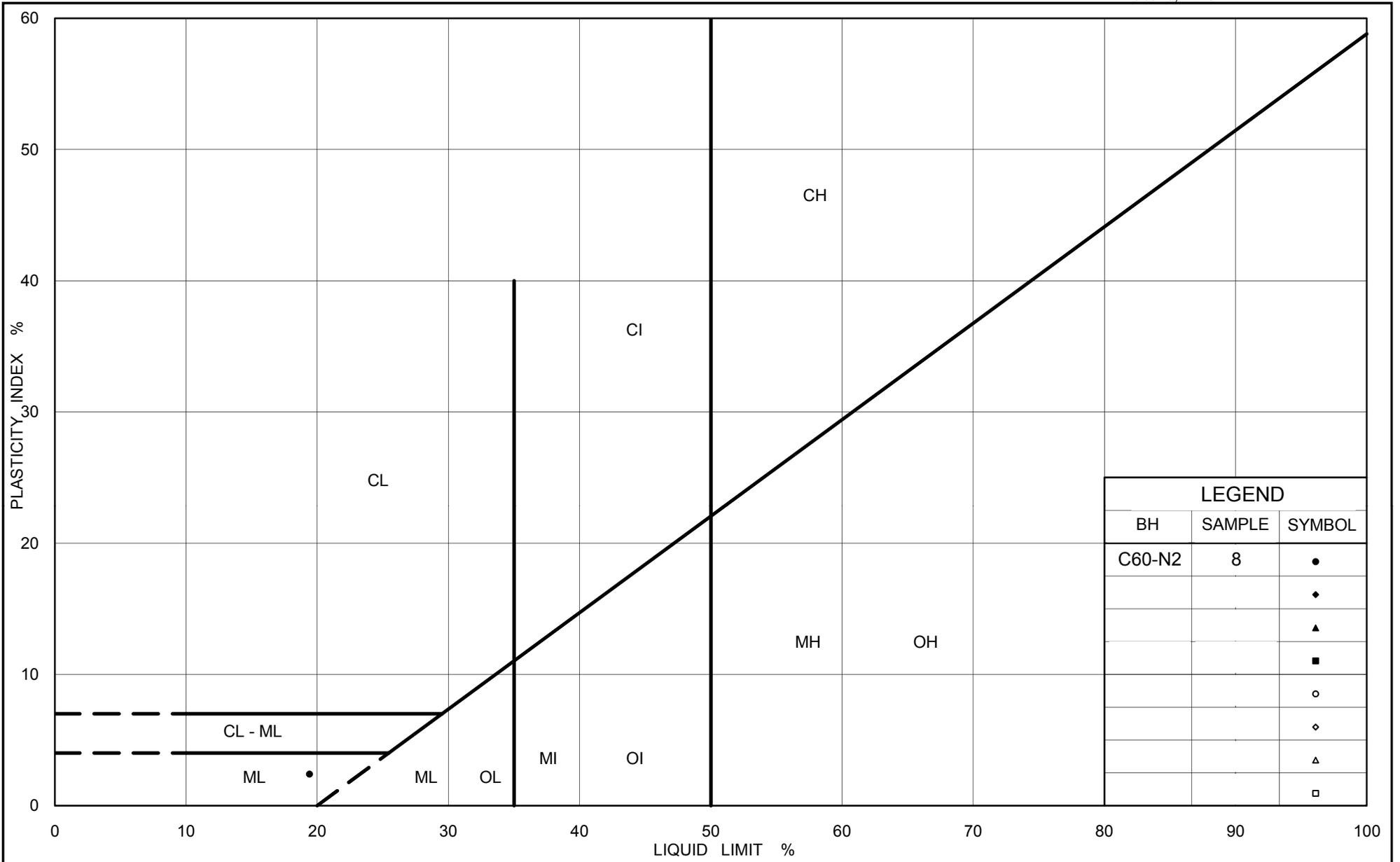
FIGURE I.C60-7



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C60-N1	8	195.7



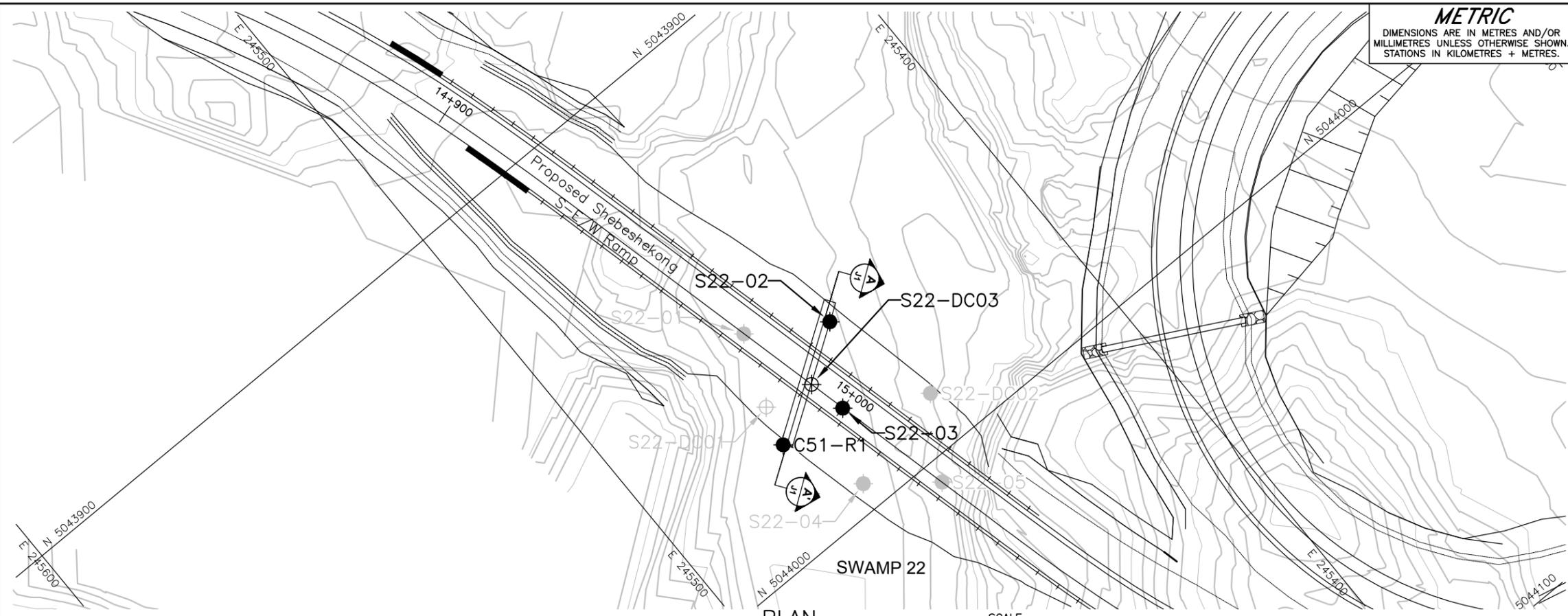
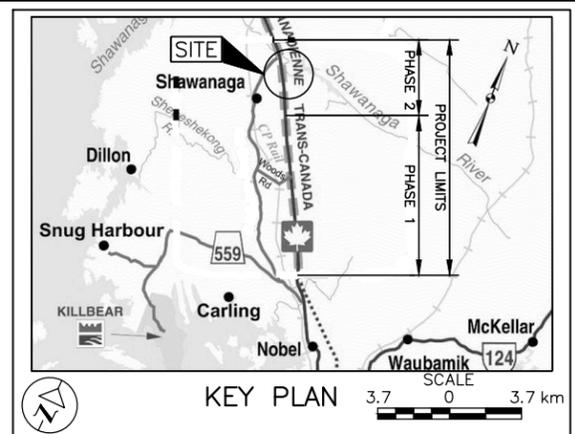


APPENDIX J

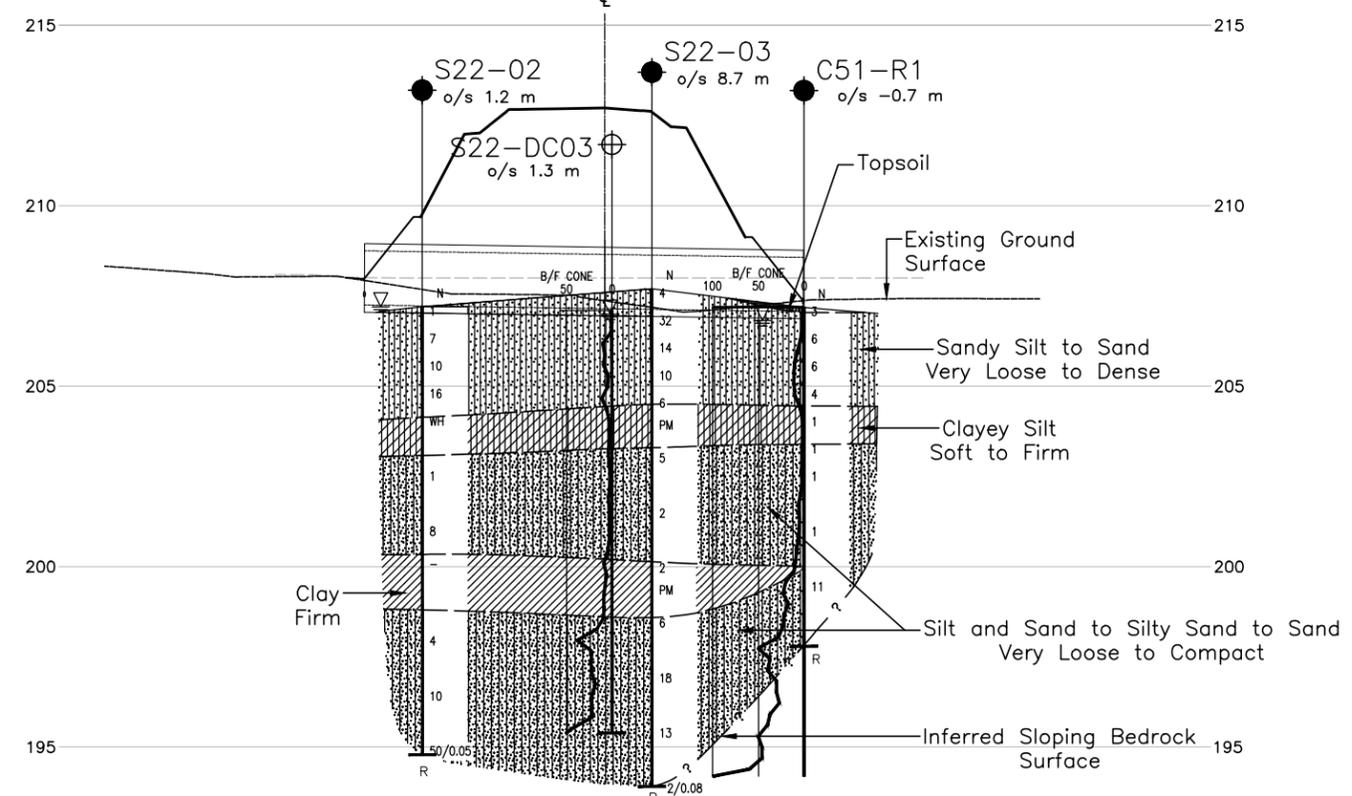
Shebeshekong S-E/W Ramp – STA 14+990 (Culvert C51)

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

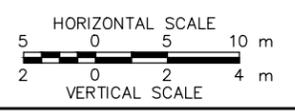
CONT No. GWP No. 5111-07-00
HIGHWAY 69 SHEBESHEKONG S-E/W
TIE-IN CULVERT C51 STA 14+990
BOREHOLE LOCATIONS AND SOIL STRATA



PLAN
Shebeshekong S-E/W Ramp



A-A CULVERT C51 PROFILE STA 14+990



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ∇ WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C51-R1	207.2	5043978.2	245470.1
S22-02	207.2	5043965.1	245447.0
S22-03	207.7	5043980.2	245456.1
S22-DC03	207.1	5043972.5	245457.9

NOTES

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

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg received November 10, 2014, and h6878_PHASE2_XN1.dwg received May 15, 2015.

Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014.

Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.

NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 6/5/2015
DRAWN: MR	CHKD. JMAC	APPD. JPD/JMAC
		DWG. J1



PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C51-R1	SHEET 1 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043978.2 ; E 245470.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>KD/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>March 5, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)		
			NUMBER	TYPE	"N" VALUES			20	40						60	80
207.2	GROUND SURFACE															
0.0	TOPSOIL		1A	SS	3	∇	207									
0.2	SAND, trace to some silt, trace organics Very loose		1B	SS												
206.4	Brown Wet		2	SS	6		206						0	27	69	4
0.8	Sandy SILT, trace clay Very loose to loose															
	Grey to brown Wet		3	SS	6											
	Becoming grey at a depth of 2.2 m						205									
204.5	CLAYEY SILT		4A	SS	4											
2.7	Soft Grey Wet		4B	SS												
			5	SS	1		204	7	+							
203.4	SILT and SAND, trace to some clay Very loose		6	SS	1		203									
3.8	Grey Wet		7	SS	1		202									
			8	SS	1		201									
			9	SS	11		200									
200.0	SAND, trace to some silt Compact Grey Wet						199									
7.2							198									
198.2	CASING REFUSAL						198									
197.8	END OF BOREHOLE						197									
9.4	DCPT REFUSAL						196									
	Inferred sloping bedrock surface						195									
194.2	END OF DCPT						194.2									
13.0	END OF DCPT															

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NOTES:

- Water level in open borehole measured at a depth of 0.4 m below ground surface (Elev. 206.8 m) upon completion of drilling.

Continued Next Page

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C51-R1	SHEET 2 OF 2	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5043978.2 ; E 245470.1</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>KD/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>March 5, 2015</u>	CHECKED BY <u>MCK</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L			GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100									
	2. A Dynamic Cone Penetration Test was advanced 0.5 m east of Borehole C51-R1 to confirm depth to refusal. Inferred sloping bedrock surface encountered at a depth of 9.4 m (Elev. 197.8 m). 3. An additional borehole was advanced 1.2 m north of Borehole C51-R1 to carry out an in situ vane test at a depth of 3.5 m (Elev. 203.7 m).																			

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S22-02	SHEET 1 OF 2	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043965.1 ; E 245447.0</u>	ORIGINATED BY <u>EHS</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 26, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
207.2	GROUND SURFACE																
0.0	Sandy SILT, trace gravel, trace organics Very loose to compact Dark brown to grey Wet		1	SS	1		207										
			2	SS	7		206										
			3	SS	10		205										
	Becoming grey at a depth of 2.3 m		4	SS	16		204										
204.2																	
3.1	CLAYEY SILT, trace sand Firm Reddish brown Wet		5	SS	WH		204										
203.1							203										
4.1	SILT and SAND, trace to some clay Very loose to loose Grey Wet		6	SS	1		203										
							202										
							201										0 50 45 5
200.3																	
6.9	CLAY, some silt, trace sand Firm Reddish brown Wet		8	WS	-		200										
198.8							199										
8.4	SILT and SAND, trace gravel, trace clay Loose to compact Grey Wet		10	SS	4		199										
							198										
	Reddish brown clay seams to a depth of 9.8 m						197										
							196										0 39 (61)
195.3																	
11.9	Silty SAND, some gravel Compact Grey Wet		12	SS	50/0.05		195										
194.8																	
12.4	END OF BOREHOLE SPOON REFUSAL																
	NOTES: 1. Borehole caved to a depth of 11.6 m below ground surface (Elev. 195.6 m) upon removal of casing.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

Continued Next Page

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S22-02	SHEET 2 OF 2	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043965.1 ; E 245447.0</u>	ORIGINATED BY <u>EHS</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 26, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L			
--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			10	20	30	
	2. Water level in open borehole at a depth of 0.6 m above ground surface (Elev. 207.8 m) upon completion of drilling - Artesian Condition.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S22-03** SHEET 1 OF 2 **METRIC**
G.W.P. 5402-05-00 **LOCATION** N 5043980.2 ; E 245456.1 **ORIGINATED BY** EHS
DIST HWY 69 **BOREHOLE TYPE** Portable Equipment, NW Casing, Wash Boring **COMPILED BY** VO
DATUM Geodetic **DATE** March 25, 2008 **CHECKED BY** CN

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					
207.7	GROUND SURFACE												
0.0	Sandy SILT, trace organics		1	SS	4							OC = 3.1%	
207.2	Loose Dark brown												
0.5	Moist SILT and SAND		2	SS	32								
	Compact to dense												
	Light brown to grey		3	SS	14							0 45 (55)	
	Wet												
205.4	Sandy SILT		4	SS	10								
2.3	Loose to compact												
	Grey												
	Wet												
204.5	CLAYEY SILT, trace sand		5	SS	6						51.3		
3.2	Firm												
	Reddish brown		6	TO	PM							18.0	
	Wet												
203.3	SILT and SAND, trace gravel		7	SS	5								
4.4	Very loose to loose												
	Grey												
	Wet												
			8	SS	2								
200.1	CLAY, some silt, trace sand		9	SS	2								
7.6	Firm												
	Reddish brown												
	Wet												
			10	TO	PM							16.5	
198.6	SILT and SAND, trace to some clay		11	SS	6								
9.1	Loose to compact												
	Grey and reddish brown												
	Wet												
	Clay seams to a depth of 10.7 m		12	SS	18							0 32 66 2	
			13	SS	13								
194.0	Silty SAND, some gravel		14	SS	20.08								
13.8	Grey												
	Wet												
	END OF BOREHOLE SPOON REFUSAL												

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

Continued Next Page

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No S22-03	SHEET 2 OF 2	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043980.2 ; E 245456.1</u>	ORIGINATED BY <u>EHS</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 25, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	--- CONTINUED FROM PREVIOUS PAGE ---															
	NOTES: 1. Borehole caved to a depth of 13.1 m below ground surface (Elev. 194.6 m) upon removal of casing. 2. Water level in open borehole at a depth of 0.7 m below ground surface (Elev. 207.0 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF DCPT No S22-DC03	SHEET 1 OF 1	METRIC
G.W.P. <u>5402-05-00</u>	LOCATION <u>N 5043972.5 ; E 245457.9</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>	COMPILED BY <u>VO</u>	
DATUM <u>Geodetic</u>	DATE <u>March 19, 2008</u>	CHECKED BY <u>CN</u>	

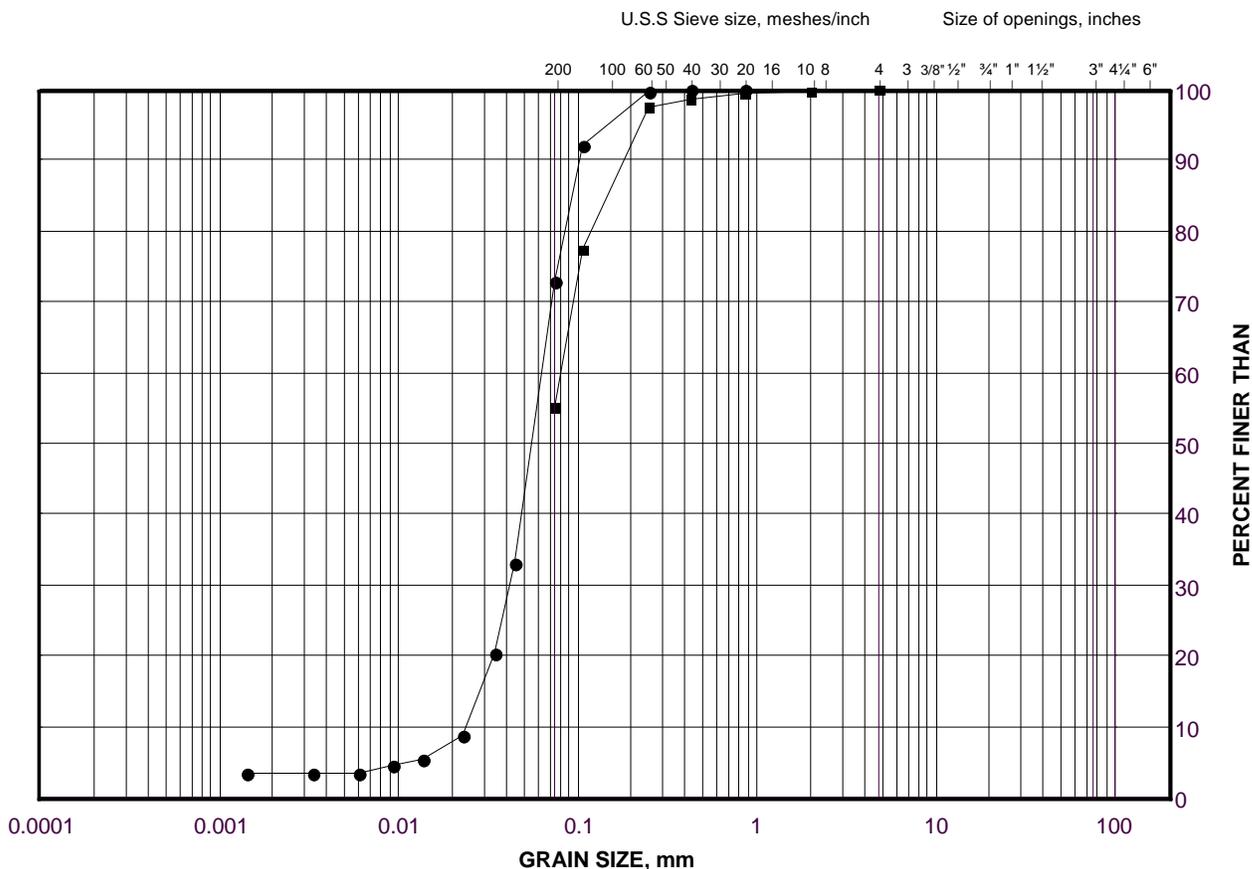
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
207.1 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					207										
						206										
						205										
						204										
						203										
						202										
						201										
						200										
						199										
						198										
						197										
						196										
195.4 11.7	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with half weight hammer from ground surface to a depth of 7.3 m. Blows shown have been adjusted to infer values that would be obtained using a standard weight hammer.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE\GPJ GAL-GTA.GDT 03/25/16 DD/SAC

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

GRAIN SIZE DISTRIBUTION
 Sandy Silt to Silt and Sand
 Shebeshekong Road S-E/W Ramp STA 14+990

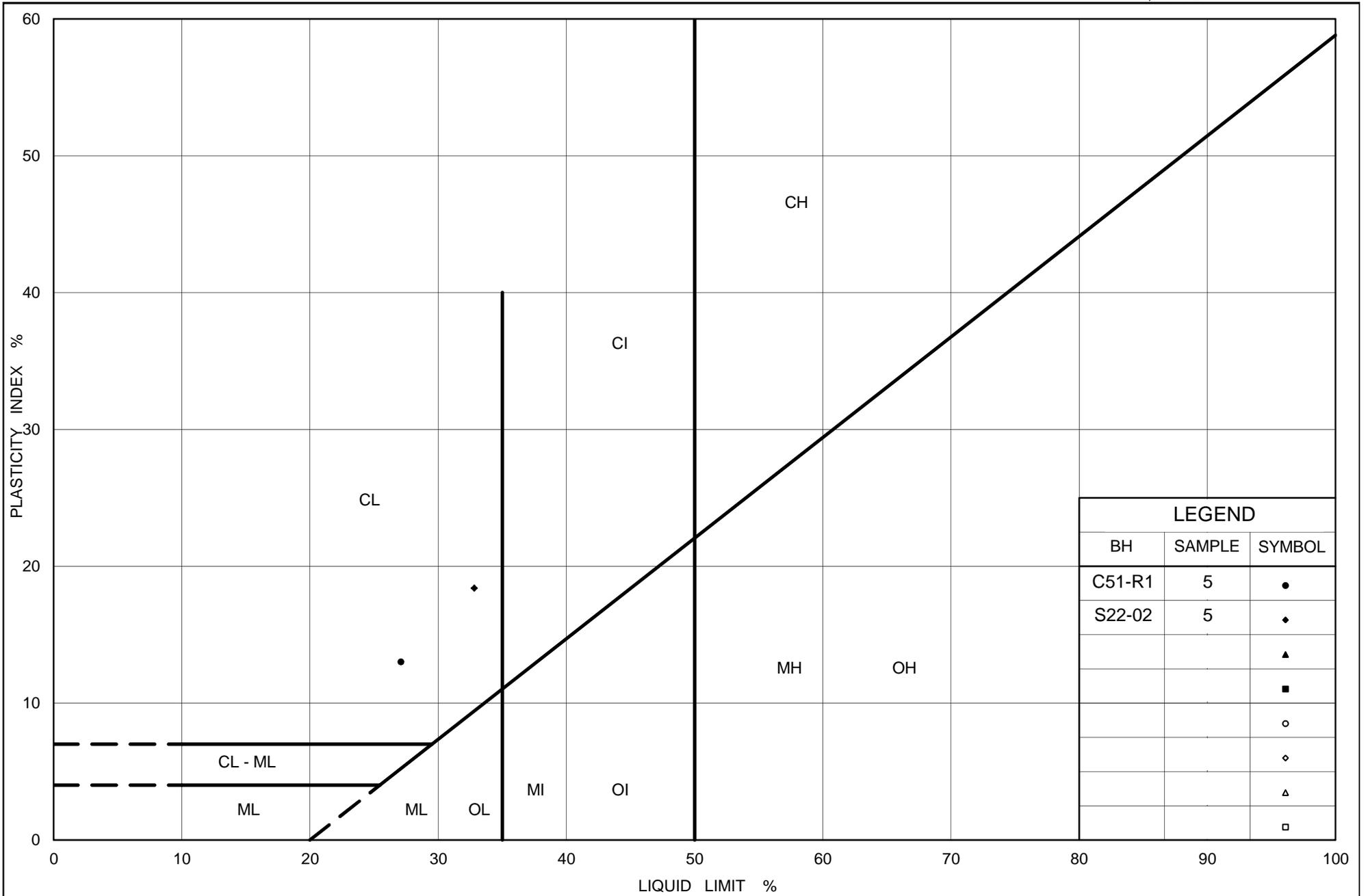
FIGURE J.C51-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C51-R1	2	206.1
■	S22-03	3	205.9



Ministry of Transportation

Ontario

PLASTICITY CHART
 Clayey Silt
 Shebeshekong Road S-E/W Ramp STA 14+990

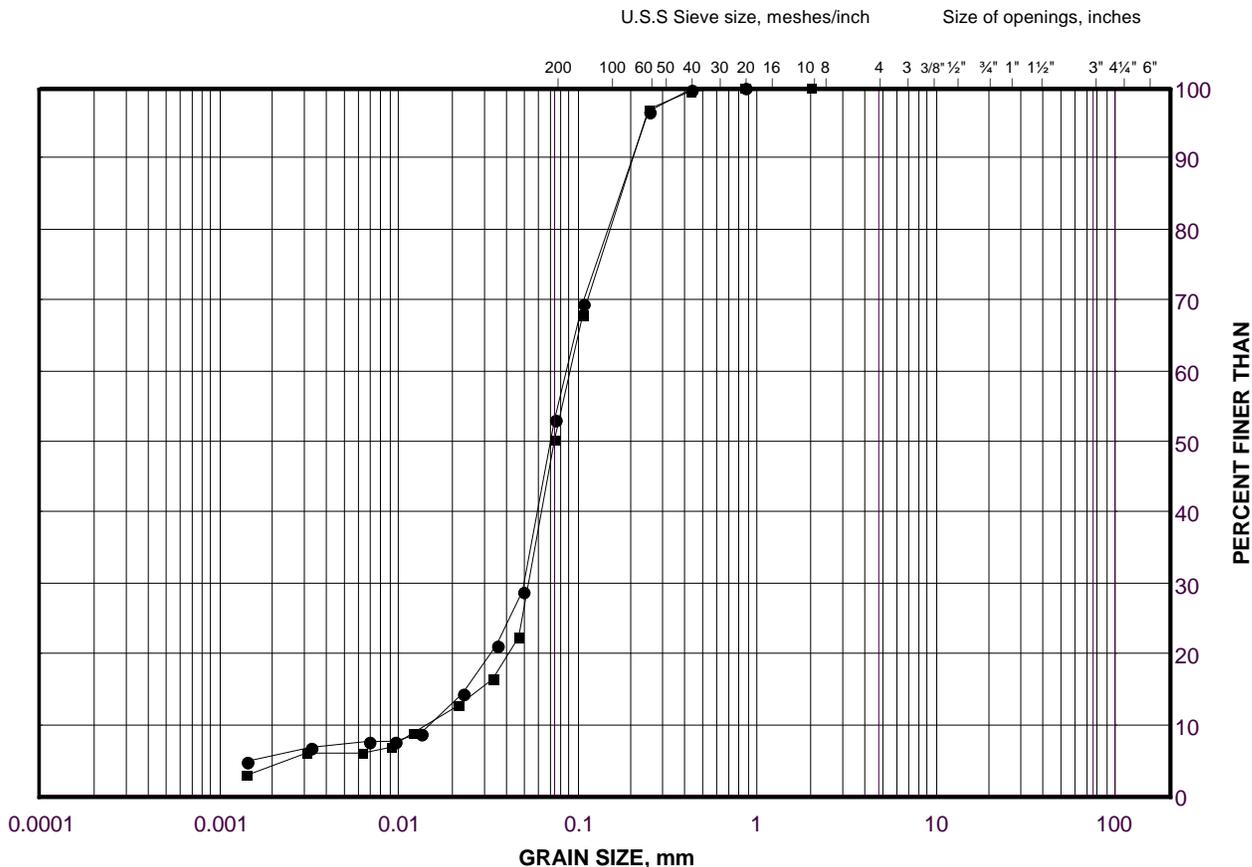
Figure No. J.C51-2

Project No. 07-1111-0029

Checked By: AJS

GRAIN SIZE DISTRIBUTION
 Silt and Sand (Upper)
 Shebeshekong Road S-E/W Ramp STA 14+990

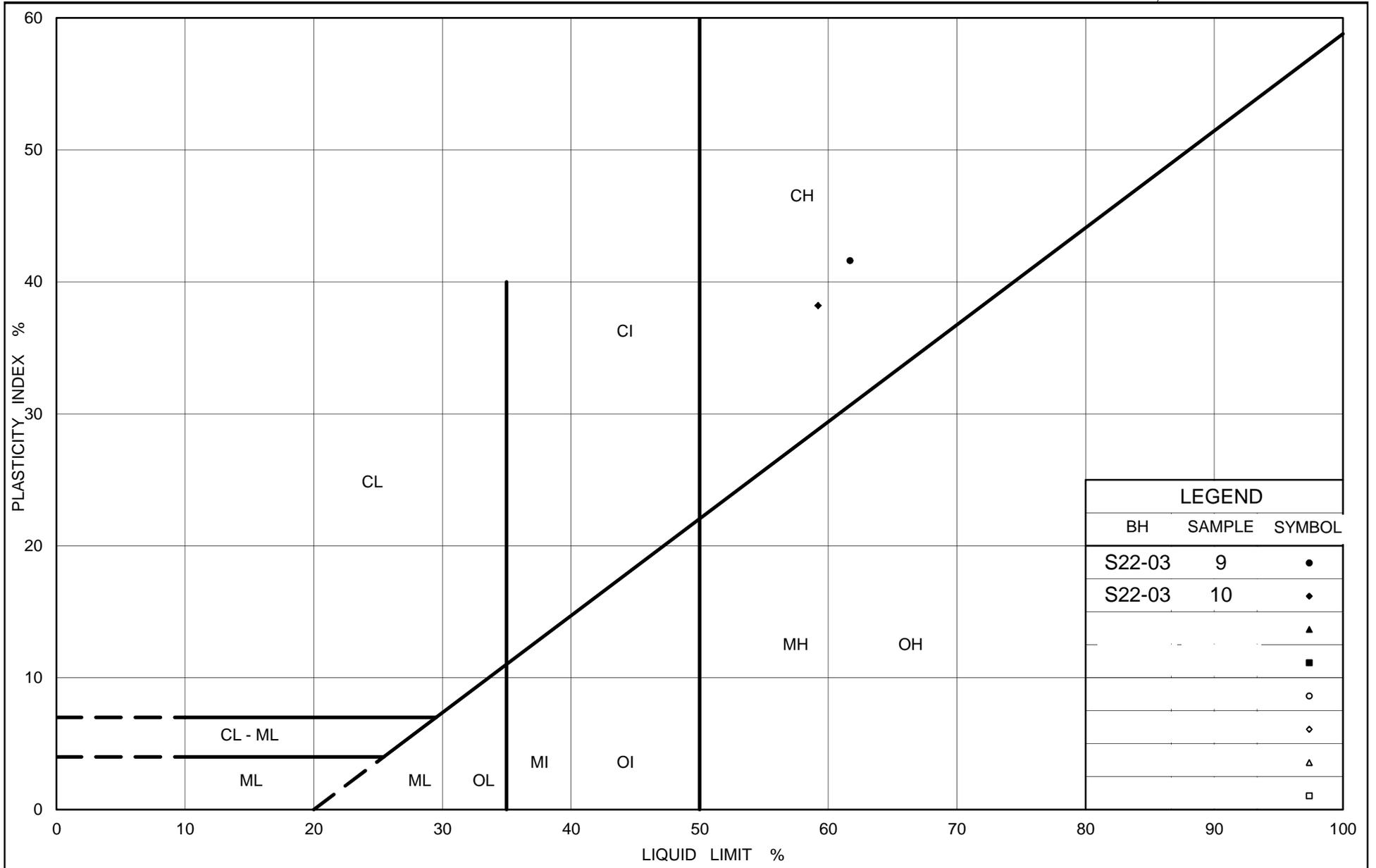
FIGURE J.C51-3



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

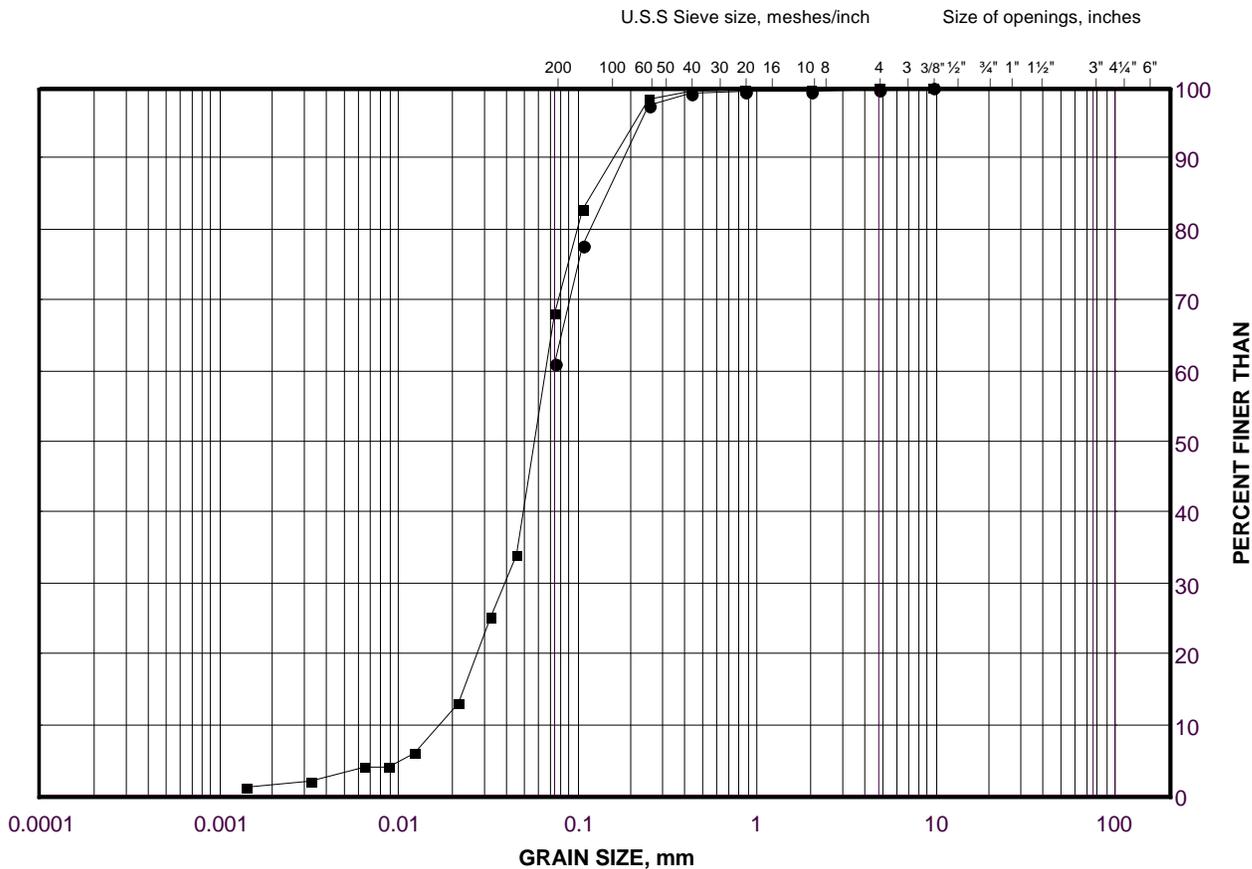
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C51-R1	7	202.3
■	S22-02	7	200.8



GRAIN SIZE DISTRIBUTION
 Silt and Sand (Lower)
 Shebeshekong Road S-E/W Ramp STA 14+990

FIGURE J.C51-5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S22-02	11	196.2
■	S22-03	12	196.7



APPENDIX K

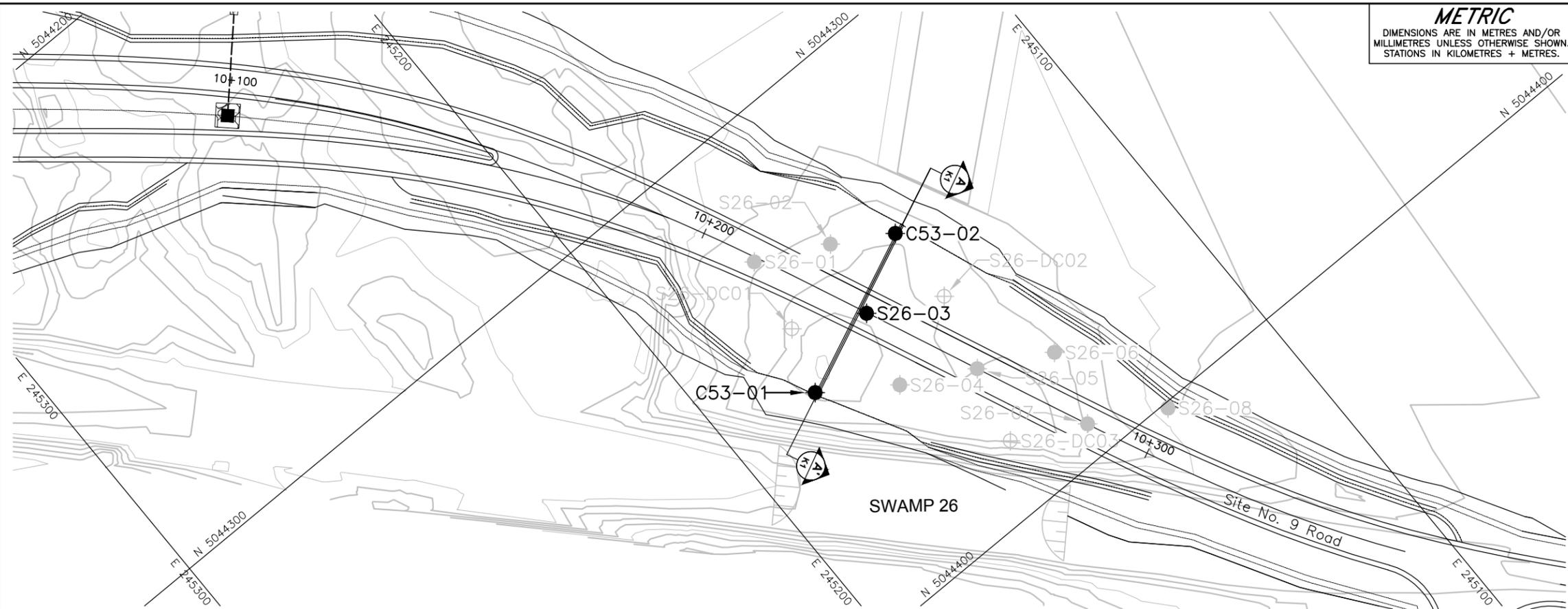
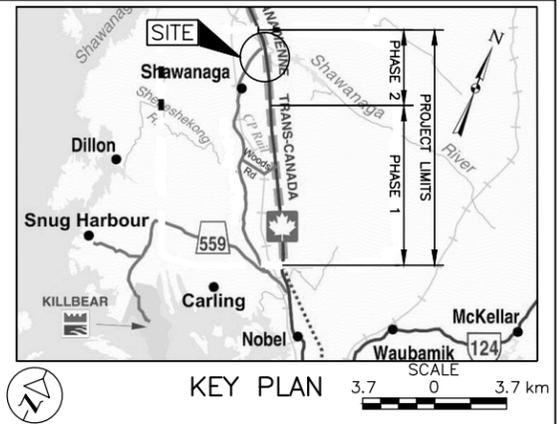
Site No. 9 Road – STA 10+235 (Culvert C53)

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

CONT No.
GWP No. 5111-07-00

HIGHWAY 69 TIE-IN
CULVERT C53 STA 10+235 (SITE No. 9 ROAD)
BOREHOLE LOCATIONS
AND SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊕ Dynamic Cone Penetration Test
- ⊕ Dynamic Cone Penetration Test - Previous 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
C53-01	211.0	5044353.2	245179.8
C53-02	210.8	5044338.8	245146.8
S26-03	210.9	5044347.5	245161.6

NOTES

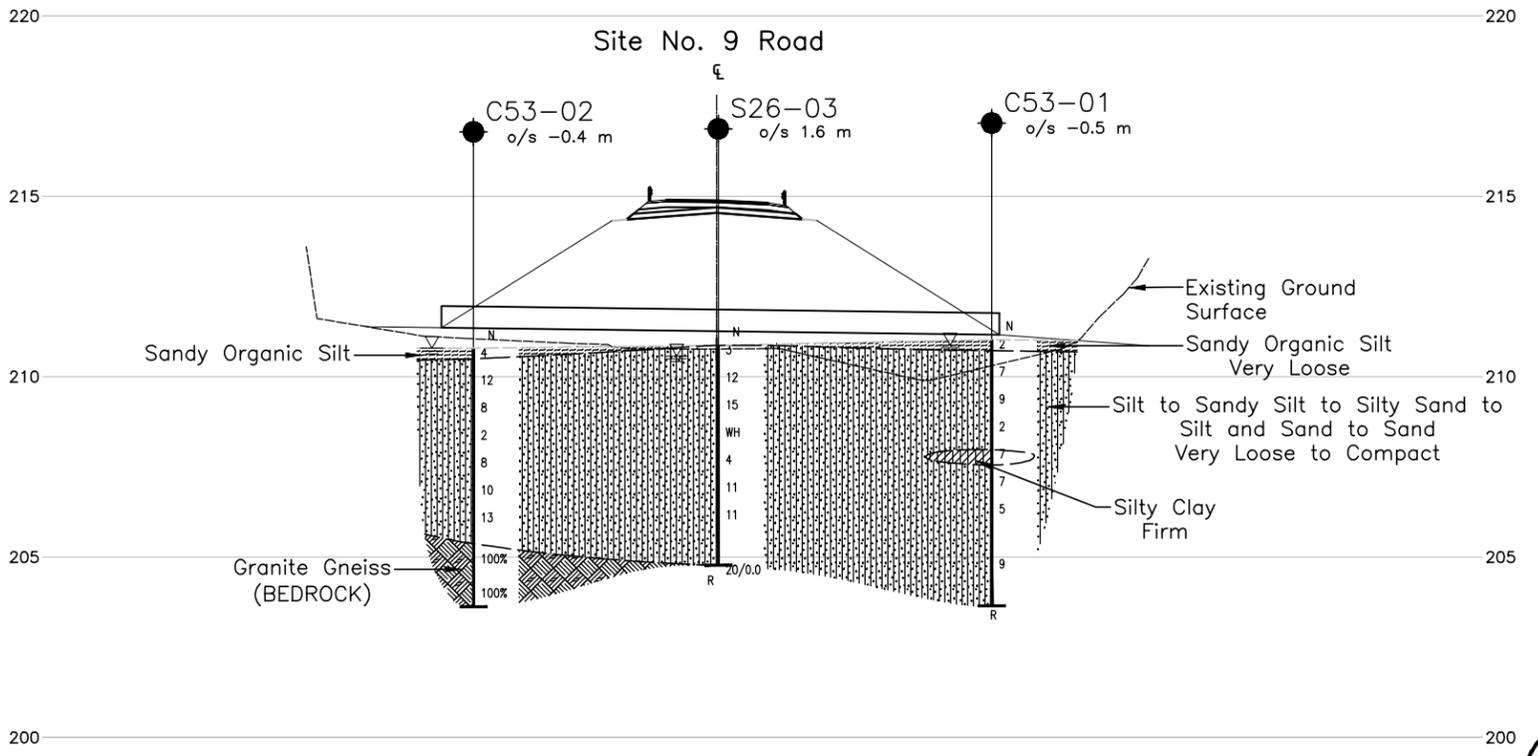
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

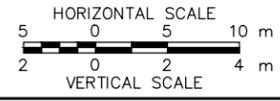
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, h6878_PHASE2_XD1 grading.dwg and h6878_PHASE2_XN1.dwg, received November 10, 2014. Contours provided in digital format by MRC, drawing file no. h6878xb07 Phase-2 contours 1m intervals.dwg, received October 31, 2014. Cross-section provided in digital format by MMM, drawing file no. 6878-Ph 2 Hwy 69 - Culvert XS-May 7, 2015.dwg, received May 15, 2015.



A-A CULVERT C53 PROFILE STA 10+235



NO.	DATE	BY	REVISION

Geocres No. 41H-160

HWY. 69	PROJECT NO. 07-1111-0029	DIST. .
SUBM'D. AJS	CHKD. CN	DATE: 3/18/2016
DRAWN: MR	CHKD. JMAC	APPD. JMAC
		SITE: .
		DWG. K1

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C53-01	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044353.2 ; E 245179.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Continuous Flight 203 mm O.D. Hollow Stem Augers</u>	COMPILED BY <u>KD/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 2, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)				
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								20	40	60	80	100						GR	SA	SI	CL
211.0	GROUND SURFACE																				
0.0	Sandy ORGANIC SILT		1A	SS	2																
210.7	Brown Wet		1B																		
0.3																					
210.2	Silty SAND, trace organics		2	SS	7		210														
0.8	Very loose Brown Wet																				
	SILT and SAND, trace gravel, trace to some clay		3	SS	9		209											1	55	38	6
	Very loose to loose Grey Wet		4	SS	2																
208.0							208														
3.0	SILTY CLAY, trace sand		5A	SS	7																
207.5	Firm Grey Wet		5B																		
3.5							207														
	SILT, some sand, trace clay		6	SS	7																
	Loose Grey Wet		7	SS	5		206											0	16	79	5
205.4							205														
5.6	SAND, trace silt		8	SS	9																
	Loose Grey Moist						204														
203.6																					
7.4	AUGER REFUSAL END OF BOREHOLE																				
	NOTE: 1. Water level measured in open borehole at a depth of 0.2 m below ground surface (Elev. 210.8 m) upon completion of drilling.																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No C53-02	SHEET 1 OF 1	METRIC
G.W.P. <u>5111-07-00</u>	LOCATION <u>N 5044338.8 ; E 245146.8</u>	ORIGINATED BY <u>ID</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Continuous Flight 203 mm O.D. Hollow Stem Augers</u>	COMPILED BY <u>KD/MR</u>	
DATUM <u>Geodetic</u>	DATE <u>February 3 and 4, 2015</u>	CHECKED BY <u>MCK</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
210.8	GROUND SURFACE																
0.0	Sandy ORGANIC SILT Very loose Brown Wet SAND, some silt, trace clay, trace gravel, trace organics Very loose to compact Brown Wet		1A	SS	4												
210.5			1B														
0.3			2	SS	12												0 79 19 2
			3	SS	8												
208.6			4	SS	2												0 40 57 3
2.2		SILT and SAND Very loose to loose Brown to grey Wet		5	SS	8											
207.8				6	SS	10											0 91 9 0
3.0	SAND, trace to some clay Loose to compact Brown to grey Wet		7	SS	13												
205.4	Granite Gneiss (BEDROCK) Bedrock cored from depths of 5.4 m to 7.2 m. For bedrock coring details refer to Record of Drillhole C53-02.		1	RC	REC 100%												RQD = 100%
5.4			2	RC	REC 100%												
203.6	END OF BOREHOLE																
7.2	NOTE: 1. Water level encountered at ground surface (Elev. 210.8 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-CULVERT-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DV

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: C53-02

SHEET 1 OF 1

LOCATION: N 5044338.8 ; E 245146.8

DRILLING DATE: February 4, 2015

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: C.M.E 550

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP W.Z.L. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load (MPa)	RMC -Q' AVG.	NOTES	
								TOTAL CORE %	SOLID CORE %					Ir	Ja	Ja	K, cm/sec	10 ⁰	10 ¹				10 ²
								80	80					80	80	80	80	80	80				80
		Continued from Record of Borehole C53-02		205.36																			
	NW Casings NORC February 4, 2015	Fresh, foliated, grey, white and pink, coarse to fine grained, large garnet porphyrys, non-porous, strong to extremely strong GRANITE GNEISS		5.43	1																		(Axial) 10.5 MPa (Axial)
					2																		(Axial)
		END OF DRILLHOLE		203.63																			(Axial)
				7.16																			

GTA-RCK 018 T:\PROJECTS\2007-11-11-0029 (MRC, PARRY SOUND)\LOG\07-11-11-0029-CULVERT-PHASE II\GPJ GAL-MISS.GDT 03/25/16 DV

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: MCK

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No S26-03** SHEET 1 OF 1 **METRIC**
G.W.P. 5111-07-00 **LOCATION** N 5044347.5;E 245161.6 **ORIGINATED BY** ID
DIST HWY 69 **BOREHOLE TYPE** Continuous Flight 108 mm I.D. Hollow Stem Augers **COMPILED BY** KD/MR
DATUM Geodetic **DATE** January 30, 2015 **CHECKED BY** AJS/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 (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
210.9	GROUND SURFACE																		
0.0	Silty SAND, trace clay, trace organics to a depth of 0.8 m Very loose to compact Brown to grey Wet		1	SS	3														
			2	SS	12														
			3	SS	15														
208.6																			
2.3	Sandy SILT, trace clay Very loose to compact Brown to grey Wet		4	SS	WH														
			5	SS	4														
			6	SS	11														
			7	SS	11														
204.8																			
6.1	SPOON AND AUGER REFUSAL END OF BOREHOLE		8	SS	20/0.0														
	NOTE: 1. Water level in open borehole measured at a depth of 0.3 m below ground surface (Elev. 210.6 m) upon completion of drilling.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

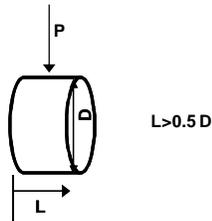
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**TABLE K1
SUMMARY OF POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C53-02	1	5.7	205.1	Granite Gneiss	Diametral	4.48
C53-02	2	6.0	204.8	Granite Gneiss	Axial	6.01
C53-02	2	6.1	204.7	Granite Gneiss	Axial	10.49
C53-02	2	6.7	204.1	Granite Gneiss	Diametral	4.25
C53-02	2	6.7	204.1	Granite Gneiss	Axial	3.70
C53-02	2	7.2	203.6	Granite Gneiss	Axial	4.89

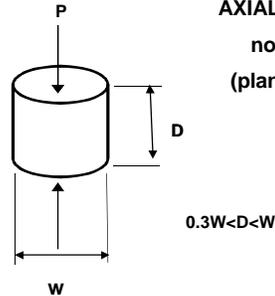
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

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)



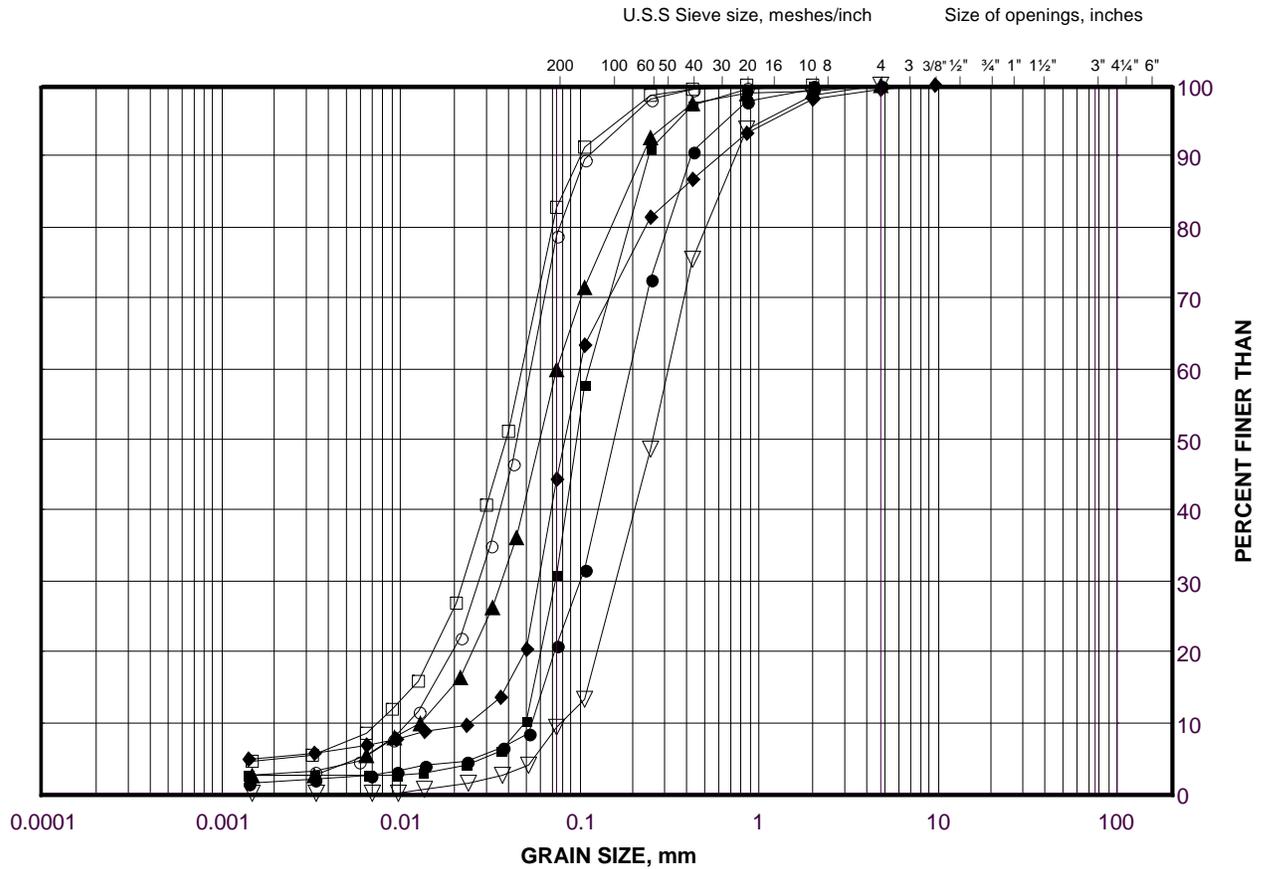
Compiled By: MCK
 Checked By: CN
 Reviewed By: JMAC

GRAIN SIZE DISTRIBUTION

Silt to Sand

Site No.9 Road STA 10+235

FIGURE K.C53-1



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

LEGEND

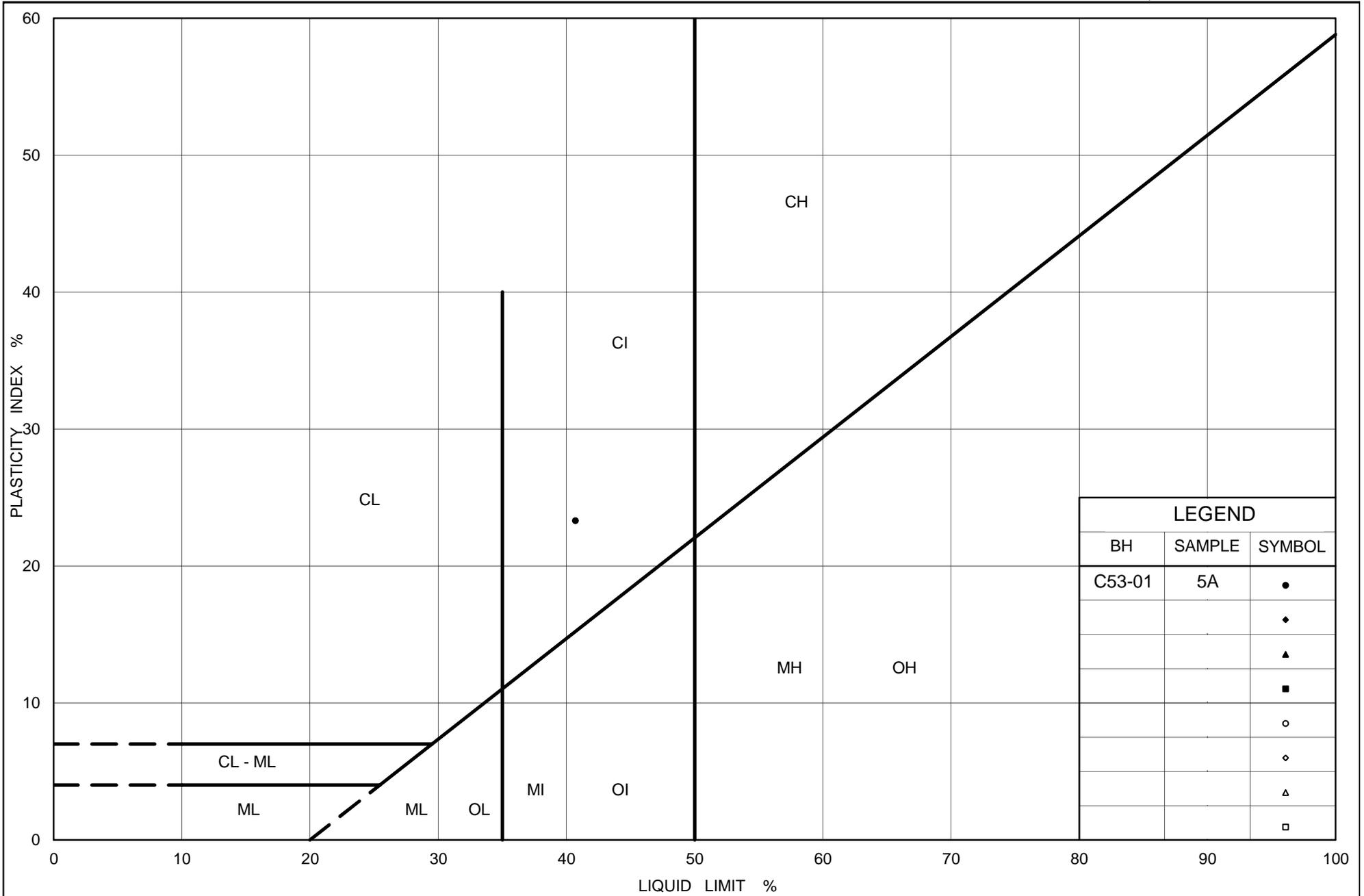
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C53-02	2	209.7
■	S26-03	3	209.1
◆	C53-01	3	209.2
▲	C53-02	4	208.2
▽	C53-02	6	206.7
○	S26-03	6	206.8
□	C53-01	7	206.1

Project Number: 07-1111-0029

Checked By: AJS

Golder Associates

Date: 17-Aug-15



LEGEND		
BH	SAMPLE	SYMBOL
C53-01	5A	●
		◆
		▲
		■
		○
		◇
		△
		□



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silty Clay (Pocket)
 Site No. 9 Road STA 10+235

Figure No. K.C53-2

Project No. 07-1111-0029

Checked By: AJS

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.
2390 Argentia Road
Mississauga, Ontario, L5N 5Z7
Canada
T: +1 (905) 567 4444

