



April 11, 2016

## FOUNDATION INVESTIGATION 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 (PHASE 2 OF G.W.P. 5402-05-00)**

**Submitted to:**

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REPORT

**GEOCRES No: 41H-161**

**Report Number: 07-1111-0029-7**

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# **PART A**

**FOUNDATION INVESTIGATION 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 (PHASE 2 OF G.W.P. 5402-05-00)**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin (MRC), a member of MMM Group Limited on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for four (4) swamp crossings 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 swamp crossings is contained in Section 6.8 of MRC's Technical Proposal for this assignment. Golder's additional scope of work for the crossings at Swamp 25 and Swamp 26 is contained in Addendum No. 7, dated February 14, 2013. The work has been carried out in accordance with Golder's Supplemental Specialty Quality Control Plan for foundation engineering services for this project, dated July 4, 2007. The General Arrangement (GA) drawing for the proposed new alignment of Highway 69 was provided to Golder by MRC on March 4, 2009 and May 15, 2015.

This report addresses the investigation carried out for the crossings at Swamp 23 to Swamp 26 within the Phase 2 limits. A detailed list of the crossings at Swamp 23 to Swamp 26 Phase 2 is presented in Table 1. Separate reports address the foundation investigations for the Phase 1 swamp crossings and high fill areas, as well as for the culverts and the bridge structures for Phase 1 and 2 components of the project. It should be noted that the crossings at Swamp 18 to Swamp 22 within the Phase 2 limits have been report in the Swamp Crossings and High Fill Areas – Phase 1 report, Geocres No. 41H-73, dated November 2011.

The purpose of this investigation is to establish the subsurface conditions along the roadway alignment at the proposed Phase 2 swamp crossings by borehole drilling, rock coring, in situ testing and laboratory testing on selected samples. The swamp limits 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.

## **2.0 SITE DESCRIPTION**

The section of the new highway alignment being addressed by this report begins approximately 19 km northwest of Nobel, Ontario. 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 swamp crossings varies between about Elevation 201.7 m and 213.5 m, referenced to Geodetic datum, and is gently sloping downward from northeast to southwest towards Georgian Bay. A detailed description of each investigated swamp crossing is presented in Section 4.0. The locations of these areas are shown on Drawing 2.



## **3.0 INVESTIGATION PROCEDURES**

### **3.1 Foundation Investigation**

The field work for the Phase 2 swamp crossings investigation was carried out in two periods to cover the additional scope of work, between January 19 and March 22, 2009 and January 22 and February 5, 2015 during which time a total of sixty-two (62) boreholes and twenty-four (24) Dynamic Cone Penetration Tests (DCPTs) were advanced at the locations summarized in Table 1 and shown on Drawings A1 to D1 in Appendices A to D. In general, the boreholes and DCPTs were advanced along the centreline and the toes of the proposed embankment alignment (in accordance with the Terms of Reference).

The field investigation was carried out using a variety of drilling equipment as a result of the varying nature of the terrain within the Phase 2 project limits. The details of the drilling equipment and suppliers are listed below. Hand excavation methods were used as appropriate depending on the terrain.

<b>Drilling Equipment</b>	<b>Supplied and Operated By</b>
Track-mounted CME 55	Landcore Drilling of Sudbury, Ontario
Track-mounted CME 550	Landcore Drilling of Sudbury, Ontario
Track-mounted D-25	Walker Drilling Ltd. of Utopia, Ontario
Portable Equipment	Walker Drilling Ltd. of Utopia, Ontario Landcore Drilling of Sudbury, Ontario

The boreholes were advanced through the overburden using 108 mm inside diameter hollow-stem augers, 101 mm or 115 mm O.D. solid-stem augers, and 'HW', 'BW' or 'NW' casing. Soil samples were obtained continuously at some borehole locations but generally at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter (O.D.) split-spoon sampler operated by automatic hammers on the drill rigs, performed in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586 Standard Test Method for Standard Penetration Test). Boreholes advanced by portable equipment employed full weight or half (1/2) weight hammers lifted manually. Where a half weight hammer was used, the hammer was dropped from the SPT height and 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 D15878 Standard Practice for Thin-Walled Tube Sampling) for relatively undisturbed samples. Where BW casing was used to advance the boreholes, 48 mm O.D. Shelby tubes were used to obtain 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 and 'N' size vanes, except where carried out in boreholes advanced by BW casing where a 'B' size vane was used. Samples of the bedrock were obtained using an 'HQ' size rock core barrel. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903-Wells (as amended).

The boreholes and DCPTs were advanced to refusal to further auger, casing and/or split soon advancement, shovel penetration, or cone penetration. The boreholes and DCPT's were advanced to depths ranging from 0 m (bedrock outcrop) to 20 m below existing ground surface, including coring of bedrock for core lengths of 1.5 m and 1.6 m in three (3) boreholes. Refusal at locations where bedrock was not cored does not confirm bedrock surface elevations, but may be inferred to indicate potential proximity to the bedrock surface. At various borehole locations where refusal was encountered at shallow depth, the bedrock was exposed by hand shovel excavation to confirm the refusal condition.

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 D. 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 detailed 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. In addition, a one-dimensional consolidation (oedometer) test was carried out on a sample of the cohesive deposit and the summary of the consolidation test results is presented in Table 2. The results of the laboratory classification testing for the swamp crossings are included in Appendices A to D.

The proposed centreline of the highway was staked in the field by Callon Dietz prior to drilling. The borehole locations for the 2009 investigation were surveyed by a member of our technical staff in reference to the centreline stakes and the ground surface elevations at the stakes were provided by MRC (received on November 23, 2009). The boreholes for the 2015 investigation were staked in the field by Callon Dietz and the as-drilled borehole locations, in stations and offsets, and the ground surface elevation at the boreholes were measured in reference to the centreline alignment and were subsequently converted into MTM NAD 83 (Zone 10) coordinates in AutoCAD. The borehole locations shown on Drawings A1 to D1 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 Ontario*<sup>1</sup>, this section of Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the Parry Sound and Muskoka areas, then eastward from Muskoka in patches into the area north of the Kawartha Lakes.

This part of the Georgian Bay Fringe physiographic region was never submerged during periods of glacial recession. As a result, the surficial soils in this area consist of very shallow deposits of sand, silt and clay underlain by metamorphic bedrock; numerous bare knobs and ridges of bedrock are present throughout the area. 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 4<sup>2</sup>. Deposition of Paleozoic strata and later erosion during glaciation exposed these Precambrian rocks.

### 4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes (including excavations by hand shovel) advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole sheets in Appendices A to D. The detailed results of the laboratory testing are provided in Appendices A to D. The results of the in situ field tests (i.e. SPT

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

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



'N'-values) as presented on the Record of Borehole sheets and in Section 4.0 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) and in situ testing. 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. The thickness of the overburden in the investigated areas as inferred from the resistance to Dynamic Cone Penetration Test (DCPT) results are shown on the Record of Penetration Test sheets in Appendices A to D.

The inferred soil stratigraphy as encountered in the boreholes and DCPTs advanced for the proposed Phase 2 swamp crossings are shown on Drawings A1 to D1, inclusive. 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 swamp areas investigated is similar, however, the thickness of the overburden (soil materials) is variable, ranging from no cover (i.e. bedrock outcrops present at ground surface) to about 20 m. The stratigraphy from ground surface to refusal or bedrock generally consists of:

- Surficial layers of peat, organic sand/silt/clayey silt, topsoil, sand and gravel fill and rock fill;
- Deposits of sandy silt to sand with interlayers of clayey silt to silty clay;
- Deposits of mixtures of clayey silt to clay interbedded with sand and silt layers and underlain by deposits of sand and silt, sand, and sand and gravel.

Detailed descriptions of the subsurface conditions at each investigated swamp crossing 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 or stratum.

### 4.3 Highway 69 SBL – STA 15+690 to 15+720 (Swamp 23)

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 15+690 and 15+720 are shown on Drawing A1 in Appendix A. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 7 m above existing grade. A total of seven (7) boreholes (Boreholes S23-01 to S23-06, inclusive, and S23-03A), and four (4) Dynamic Cone Penetration Tests (DCPTs S23-DC01 to S23-DC03 and S23-DC07) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat with ground cover consisting of shrubs and wet grassy areas, located within the confines of tree covered valley slopes at the north and south limits of the swamp.

In general, the subsurface soils along the SBL alignment in this area consist of a surficial deposit of peat underlain by a deposit of sand which extends to the refusal depth. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at a greater depth at about STA 15+710. Bedrock outcrops are present along the southern limit of the swamp.

#### Snow / Ice / Water

Snow, ice and water to depths between 0.6 m and 0.9 m was encountered in all boreholes except at Boreholes S23-01 and S23-02.



## Peat

A deposit of dark brown, wet, fibrous/amorphous peat containing roots and wood fragments was encountered underlying the ice/water cover in Boreholes S23-03, S23-03A, S23-04 and S23-05. The top of the peat deposit ranges from Elevation 208.8 m to 208.0 m and its thickness ranges from 0.1 m to 1.8 m.

The Standard Penetration Test (SPT) 'N'-values measured 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 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 and snow cover or at ground surface in all boreholes except at Borehole S23-02. In Borehole S23-06, the deposit contains clay seams near the top between Elevation 207.8 m and 207.0 m. The top of this deposit ranges from Elevation 212.3 m to 206.2 m and its thickness ranges from 0.1 m to 6 m in Boreholes S23-01 to S23-06, including S23-03A and potentially up to about 7.5 m as inferred in DCPT S23-DC02. The bottom of this deposit was defined by refusal to further split-spoon and/or casing advancement, cone penetration or hand (shovel) excavation.

The SPT 'N'-values measured within this deposit range from 1 blow to 22 blows per 0.3 m of penetration, with values between 54 blows and 106 blows per 0.3 m of penetration and up to 68 blows per 0.15 m of penetration measured within the lower portion of the deposit, indicating a 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 25 per cent. The upper portion of the sand deposit contains organics. Laboratory testing on two (2) samples of the deposit measured organic contents of about 2 per cent and 4 per cent.

The grain size distributions of six (6) samples of this deposit are shown on Figure A.S23-1 in Appendix A.

## Bedrock / Refusal

Bedrock outcrops are present along the southern limit of the swamp and along the east toe of the proposed embankment. Bedrock is present below a thin cover of sandy soil on the centreline of the roadway at the south limit of the swamp (Boreholes S23-02 and S23-01, respectively). In Boreholes S23-03 to S23-06 and DCPTs S23-DC01 to S23-DC03 and S23-DC07, refusal to further split-spoon and/or casing advancement or cone penetration was encountered at depths between 1.4 m and 9.6 m below snow/ice or ground surface, corresponding to Elevation 207.5 m and 199.3 m. In general, refusal was encountered at greater depths towards the centre of the swamp between about STA 15+700 and 15+710.

## Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet with free water noted in select sand samples. The water levels observed in the boreholes upon completion of drilling range from Elevation 209.4 m to 208.7 m, measured at the ice surface and up to a depth of about 0.6 m below the ice or snow surface.





#### **4.4 Highway 69 NBL – STA 15+700 to 15+740 (Swamp 23)**

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 15+700 and 15+740 are shown on Drawings A1 and A2 in Appendix A. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 7 m above existing grade. A total of five (5) boreholes (Boreholes S23-07 to S23-11, inclusive), and three (3) Dynamic Cone Penetration Tests (DCPTs S23-DC04 to S23-DC06) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat with ground cover consisting of shrubs and wet grassy areas, located within the confines of tree covered valley slopes at the north and south limits of the swamp.

In general, the subsurface soils along the NBL alignment in this area consist of a surficial deposit of peat underlain by a deposit of silty sand to sand which extends to refusal depth or is underlain by a deposit of gravelly sand in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at greater depth at about STA 15+730. Bedrock outcrops are present along the southern limit of the swamp.

##### **Ice / Water**

Ice and water to depths between 0.7 m and 0.9 m was encountered in all boreholes except Borehole S23-11.

##### **Peat**

A 0.6 m and 0.8 m thick deposit of brown, wet, fibrous peat was encountered underlying the ice/water cover in Boreholes S23-07 and S23-08 at Elevation 208.1 m and 208.2 m, respectively.

The Standard Penetration Test (SPT) 'N'-values measured within the peat deposit are between 1 blow and 2 blows 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 containing trace to some gravel and clay seams to sand, trace to some silt, was encountered underlying the peat deposit and ice/water cover or at ground surface in all boreholes. The upper portion of the deposit contains a 0.7 m thick pocket of organic sand in Borehole S23-09. The top of this deposit ranges from Elevation 213.5 m to 207.5 m and its thickness ranges from about 4.3 m to 10.2 m as encountered in the boreholes and inferred in the DCPTs, except in Borehole S23-07 where the thickness is 0.7 m. Boreholes S23-08 to S23-10 were terminated within this deposit upon refusal to further split-spoon and/or casing advancement, while Borehole S23-11 was terminated within this deposit on a very dense material.

The SPT 'N'-values measured within this deposit range from 1 blow to 55 blows per 0.3 m of penetration, with values of 87 blows and 89 blows per 0.3 m of penetration measured within the lower portion of the deposit in Borehole S23-08, indicating a very loose to very dense relative density.

The natural water content measured on samples of this deposit ranges from about 9 per cent to 26 per cent. The upper portion of the sand deposit contains trace organics and laboratory testing on one (1) sample of the sand measured an organic content of about 1 per cent.

The grain size distributions of seven (7) samples of this deposit are shown on Figure A.S23-2 in Appendix A.



As noted above, a 0.7 m thick layer of brown and grey organic sand, trace to some silt and trace clay was encountered within the sand deposit in Borehole S23-09. A SPT 'N'-value measured within the layer is 6 blows per 0.3 m of penetration, indicating a loose relative density. The natural water content measured on a specimen of this layer is about 58 per cent.

### **Gravelly Sand**

A deposit of brown gravelly sand some silt was encountered below the sand deposit in Borehole S23-07. The top of this deposit is at Elevation 206.8 and its thickness is 1.2 m. The bottom of this deposit was defined by refusal to further split-spoon and casing advancement.

The SPT 'N'-values measured within this deposit are 48 blows per 0.3 m of penetration and 109 blows per 0.2 m of penetration, indicating a dense to very dense relative density.

The natural water content measured on a sample of this deposit is about 11 per cent.

A grain size distribution of one (1) sample of this deposit is shown on Figure A.S23-3 in Appendix A.

### **Bedrock / Refusal**

Bedrock outcrops are present along the southern limit of the swamp. In Boreholes S23-07 to S23-10 and DCPTs S23-DC04 to S23-DC06, refusal to further split-spoon and/or casing advancement or cone penetration was encountered at depths between 2.8 m and 11 m below ice or ground surface, corresponding to Elevation 209.1 m and 198.4 m. In general, refusal was encountered at greater depths towards the centre of the swamp between about STA 15+710 and 15+730.

### **Groundwater Conditions**

In general, the samples taken in the boreholes were damp to wet with free water noted in select sand samples. Water levels observed in the boreholes upon completion of drilling range from Elevation 211.1 m to 208.4 m, measured at the ice surface or up to a depth of 2.4 m below the ice or ground surface.

## **4.5 Highway 69 SBL – STA 16+475 to 16+550 (Swamp 24)**

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 16+475 and 16+550 are shown on Drawing B1 in Appendix B. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 9 m above existing grade. A total of eight (8) boreholes (Boreholes S24-01 to S24-07 and S24-09), and three (3) Dynamic Cone Penetration Test (DCPTs S24-DC01 to S24-DC03) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, located within the confines of tree covered valley slopes at the north and south limits of the swamp.

In general, the subsurface soils along the SBL alignment in this area consist of a surficial deposit of root mat/peat underlain by a deposit of sand and silt to sand which in turn is underlain by a deposit of sand to sand and gravel in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at greatest depth at about STA 16+525. Bedrock outcrops are present along the southern limit of the swamp.



## **Ice / Water**

Ice and/or water to depths of 0.1 m and 0.2 m were encountered in Boreholes S24-01 and S24-06.

## **Root Mat / Peat**

A deposit of dark brown, wet, root mat and/or amorphous peat was encountered either at the ground surface or below the ice/water cover in all boreholes advanced for this alignment. The top of the root mat/peat deposit ranges from Elevation 203.1 m to 202.5 m and its thickness ranges from 0.2 m to 0.7 m.

The Standard Penetration Test (SPT) 'N'-values measured within the root mat/peat range from 2 blows to 4 blows per 0.3 m of penetration, suggesting a very soft to soft consistency.

## **Sand and Silt to Sand**

A deposit of non-cohesive soil comprised of brown to grey sand and silt to silty sand to sand some silt, was encountered below the peat deposit in all boreholes. The deposit generally contains trace clay, silt layers, pockets of silty clay and sand and gravel, and organics and rootlets near the surface. The top of this deposit ranges from Elevation 202.6 m to 201.9 m and its thickness ranges from about 2.8 m to 11.7 m and possibly up to 14.2 m. Boreholes S24-01, S24-02, S24-04, S24-06 and S24-09 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 2 blows to 23 blows per 0.3 m of penetration, but are typically greater than 5 blows per 0.3 m of penetration and a value of 100 blows per 0.25 m of penetration was measured at a location, indicating a generally loose to very dense relative density.

The natural water content measured on samples of this deposit typically ranges from about 19 per cent to 28 per cent and a water content of about 72 per cent was measured on a sample noted to contain organics. In general, the upper portion of this deposit contains trace organics and laboratory testing on specimens of the sand and silt deposit from Boreholes S24-05 and S24-06 measured organic contents of about 1 per cent.

The grain size distributions of eighteen (18) samples of three groupings of similar soil layers comprising this overall non-cohesive deposit are shown on Figures B.S24-1A to B.S24-1D in Appendix B for sand and silt to silty sand, sand and silt to sand, and silty sand to sand. Atterberg limits tests on two (2) specimens of the sand and silt deposit indicate this material to be non-plastic.

In Boreholes S24-03 and S24-04, a 0.1 m and 0.2 m thick layer of brown and grey silt, trace to some sand, trace gravel and trace clay containing slight organic and rootlets was encountered below the peat deposit that locally overlies the sand and silt to sand deposit. The SPT 'N'-values measured within the silt layer are 3 blows and 4 blows per 0.3 m of penetration, indicating very loose relative density.

As noted above, two approximately 0.1 m thick lenses of brown or grey silty clay were encountered in Borehole S24-01 and a 0.2 m thick layer of silty clay lens was encountered in Borehole S24-05 within or underlying the upper non-cohesive layer (zone) of sand and silt to silty sand. The natural water content measured on a specimen of the cohesive layer is about 70 per cent and the Atterberg limits test carried out on this specimen measured a liquid limit of about 46 per cent, a plastic limit of about 19 per cent and a plasticity index of about 27 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure B.S24-2 in Appendix B and indicate the material to be silty clay of intermediate plasticity.



### **Sand to Sand and Gravel**

A deposit comprised of grey to brown gravelly sand to sand and gravel, and underlying sand layer was encountered below the sand and silt to sand deposit in Boreholes S24-03, S24-05 and S24-07. The deposit generally contains trace to some silt and trace clay. The top of this deposit ranges from Elevation 196.4 m to 191.6 m and its thickness ranges from 1.6 m to 5.8 m. The bottom of this deposit was defined by refusal to further casing advancement or cone penetration as inferred in Borehole S24-07.

The SPT 'N'-values measured within the sand and gravel to sand deposit range from 15 blows to 33 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on samples of this deposit ranges from about 9 per cent to 21 per cent, generally greater than 20 per cent.

The grain size distributions of two (2) samples from the sand and gravel layer and one (1) sample from the underlying sand layer are shown on Figure B.S24-3A and B.S24-3B, respectively, in Appendix B.

### **Bedrock / Refusal**

Bedrock outcrops are present along the southern limit of the swamp. In Boreholes S24-01 to S24-07 and S24-09, and DCPTs S24-DC01 to S24-DC03, refusal to further split-spoon, auger and/or casing advancement or cone penetration was encountered at depths between 3.1 m and 15.5 m below ice or ground surface, corresponding to Elevation 199.6 m and 187.3 m. In general, refusal was encountered at greater depths towards the northern limit of the swamp between about STA 16+525 and 16+550.

### **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 202.8 m to 202.5 m, measured at the ice and ground surface or up to a depth of 0.3 m below the ground surface.

## **4.6 Highway 69 NBL – STA 16+450 to 16+550 (Swamp 24)**

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 16+450 and 16+550 are shown on Drawings B1 and B2 in Appendix B. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 9.5 m above existing grade. A total of nine (9) boreholes (Boreholes S24-06 and S24-08 to S24-15, inclusive), and three (3) Dynamic Cone Penetration Tests (DCPTs S24-DC01, S24-DC02 and S24-DC04) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat to low-lying with ground cover consisting of shrubs and wet grassy areas, located within the confines of tree covered valley slopes at the north and south limits of the swamp.

In general, the subsurface soils along the NBL alignment in this area 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 interlayered with sand and silt that extends to the refusal depth or by granite gneiss bedrock in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, 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/or water to depths between 0.1 m and 0.3 m were encountered in Boreholes S24-06, S24-10, S24-11, S24-13 and S24-14.

## **Root Mat / Peat**

A deposit of dark brown and grey, wet, root mat and/or amorphous peat containing sand lenses and rootlets was encountered either at the ground surface or underlying the ice and/or water cover in all boreholes except in Borehole S24-08 where bedrock is exposed. The top of the root mat/peat deposit ranges from Elevation 202.8 m to 201.9 m and its thickness ranges from 0.1 m to 0.4 m across the site except in Borehole S24-11 where the thickness is 1.1 m.

The Standard Penetration Test (SPT) 'N'-values measured within the root mat/peat range from 1 blow to 3 blows per 0.3 m of penetration, with a value of 14 blows per 0.3 m of penetration measured in Boreholes S24-10 and S24-14 at the interface of this deposit with the underlying sand or silt deposit, generally suggesting a very soft to stiff consistency.

## **Silt**

In Boreholes S24-10, S24-12 and S24-15, a 0.2 m and 0.3 m thick layer of brown and grey silt, trace to some sand and trace clay containing slight organic and rootlets was encountered below the peat deposit that is generally underlain by the sand to sandy silt deposit in the other boreholes. The top of the silt layer varies between Elevation 202.7 m and 202.2 m.

The SPT 'N'-values measured within this layer range between 5 blows and 14 blows per 0.3 m of penetration, indicating a loose to compact relative density.

## **Sandy Silt to Sand**

A deposit comprised of brown to grey sandy silt to silt and sand to sand was encountered below the root mat/peat deposit in all boreholes except in Borehole S24-08 and inferred in all DCPTs based on resistance to cone penetration. The deposit generally contains trace gravel, trace clay, silty sand and silt layers, and organics and rootlets near the top surface. The top of this deposit ranges from Elevation 202.5 m to 200.8 m and its thickness ranges from 2.8 m to 11.7 m. Boreholes S24-06, S24-09, S24-11 and S24-14 were terminated within this deposit upon refusal to further split-spoon and/or auger/casing refusal. Borehole S24-15 was extended by a DCPT driven from the bottom of the borehole to refusal to further cone penetration.

The SPT 'N'-values measured within this deposit range from 2 blows to 49 blows per 0.3 m of penetration, and SPT 'N'-values up to 100 blows per 0.05 m of penetration were measured at the bottom of the deposit prior to split-spoon and casing refusal, generally indicating a very loose to very dense relative density.

The natural water content measured on samples of this deposit typically ranges from about 14 per cent to 30 per cent. Water content of about 72 per cent and 82 per cent were also measured within this deposit. The upper portion of this deposit contains organics and laboratory testing on specimens of this deposit measured organic contents up to about 1 per cent.

The grain size distributions of seventeen (17) samples from this deposit are shown on Figures B.S24-4A to B.S24-4C in Appendix B. An Atterberg limits test on one (1) specimen of the sand deposit indicates this material to be non-plastic.





## **Sand and Gravel**

A deposit of grey sand and gravel trace silt containing cobbles and boulders at /near the base of the deposit was encountered below the sand to sand and silt deposit in Borehole S24-10. The sand and gravel deposit is intersected by a 3.2 m thick layer of sand and silt, which is intersected by a 0.6 m thick pocket of silt containing trace sand and trace clay. The top of the sand and gravel deposit is at Elevation 192.5 m and its thickness is 6.2 m. The top of the sand and silt layer within the sand and gravel deposit is at Elevation 191.1 m. The bottom of the lower portion of the sand and gravel deposit containing cobbles and boulders was defined by refusal to further split-spoon and casing advancement.

The SPT 'N'-values measured within the sand and gravel deposit range from 9 blows to 33 blows per 0.3 m of penetration, indicating a loose to dense relative density, with the lower 'N'-value measured at the interface between the sand and silt layer and the silt pocket.

The natural water content measured on a sample of the sand and silt portion of the deposit is about 46 per cent. The grain size distribution of one (1) sample from the sand and silt layer is shown on Figure B.S24-5 in Appendix B.

## **Bedrock / Refusal**

Bedrock outcrops are present along the southern limit of the swamp and on the centreline of the proposed embankment at the location of Borehole S24-08 (at about STA 16+450) at Elevation 206.3 m. In Boreholes S24-06, S24-09 to S24-11, S24-14 and S24-15, and DCPTs S24-DC01, S24-DC02 and S24-DC04, refusal to further split-spoon and/or auger/casing advancement or cone penetration was encountered at depths between 3.1 m and 16.1 m below ice/water or ground surface, corresponding to Elevation 199.6 m and 186.3 m.

Bedrock was encountered and core samples were recovered from Boreholes S24-12 and S24-13. The depth to the surface of the bedrock is 5.1 m and 6.8 m corresponding to Elevation 197.5 m and 195.8 m, and the bedrock was cored for depths of about 1.5 m and 1.6 m. The bedrock generally consists of granite gneiss and the core samples are described as slightly weathered to fresh, fine to medium grained with feldspar banding, foliated, black, pink and grey. The Rock Quality Designation (RQD) measured on the core samples is 98 per cent and 100 per cent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) is 100 per cent in both boreholes, and the Solid Core Recovery (SCR) is 55 per cent and 98 per cent, in the respective boreholes.

## **Groundwater Conditions**

In general, the samples taken in the boreholes were wet. The water levels observed in the boreholes upon completion of drilling range from Elevation 202.7 m to 202.2 m, measured at the ice or ground surface or at a depth of 0.2 m below the ground surface.

## **4.7 Highway 69 SBL – STA 17+230 to 17+350 (Swamp 25)**

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 17+230 and 17+350 are shown on Drawing C1 in Appendix C. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 8.5 m high above existing grade. A total of eleven (11) boreholes (Boreholes S25-01 to S25-11, inclusive), and five (5) Dynamic Cone Penetration Tests (DCPTs S25-DC01 to S25-DC05, inclusive) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat to low-lying consisting of bedrock knobs, grassy and heavily treed ground with areas of shallow open water. The swamp is bounded to the north by a valley slope and to the south by the existing Shebeshekong Road.





In general, the subsurface soils along the SBL alignment in this area consist of a deposit of fill associated with the embankment of the existing Shebeshekong Road and surficial deposit of peat/organic silty sand underlain by a deposit of sandy silt to sand, which in turn is underlain by a clayey silt to clay stratum in places containing pockets of silt or silty sand. The clayey silt to clay strata are underlain by a deposit of sandy silt to sand, underlain by a deposit of sand and gravel in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at greatest depth between about STA 17+275 and 17+315. Bedrock outcrops are present along the northern limit of the swamp and to the south of the swamp beyond the adjacent existing Shebeshekong Road traversing the area.

### Sand and Gravel Fill

A deposit of fill comprised of grey to brown sand and gravel was encountered at the ground surface in Borehole S25-01 advanced along the south toe of the existing Shebeshekong Road. The top of the granular fill is at Elevation 203.7 m and its thickness is 1.1 m.

A Standard Penetration Test (SPT) 'N'-value measured within this deposit is 8 blows per 0.3 m of penetration, indicating a loose relative density.

### Ice / Water

Ice and water to depths between 0.6 m and 0.9 m was encountered in all boreholes and DCPTs except in Borehole S25-01, as noted above.

### Peat / Organic Silty Sand to Sand

A deposit of black, wet, amorphous peat or dark brown, wet, organic silty sand to organic sand containing rootlets was encountered underlying the ice/water cover in Boreholes S25-03, S25-08 and S25-09. The top of the peat/organic silty sand to sand ranges from Elevations 202.0 m to 201.7 m and its thickness ranges from 0.2 m to 0.6 m.

The Standard Penetration Test (SPT) 'N'-values measured within the organic silty sand to sand deposit are 4 blows and 13 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on one (1) sample of the organic silty sand is about 80 per cent, and the organic content measured on this sample is about 11 per cent.

### Sandy Silt to Sand

A deposit of non-cohesive soil comprised of dark brown to grey sandy silt, silty sand and sand trace to some silt was encountered underlying the ice/water cover and fill or peat/organic silty sand to organic sand deposit in all boreholes. The deposit generally contains trace to some gravel, trace to some clay, trace organics, wood fibres and rootlets near the top surface. The top of this deposit ranges from Elevations 202.6 m to 201.1 m and its thickness ranges from 1.1 m to 3.8 m. Boreholes S25-01 and S25-11 were terminated within this deposit upon refusal to further split-spoon and auger/casing refusal.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 22 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. SPT 'N'-values of 15 blows per 0.15 m of penetration and 6 blows per 0.1 m of penetration were measured prior to split-spoon and auger/casing refusal in Boreholes S25-01 and S25-11.



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The natural water content measured on samples of this deposit ranges from about 15 per cent to 65 per cent, but are typically less than 29 per cent. The upper portion of this deposit was observed to have trace organics and laboratory testing on two (2) specimens of this deposit measured organic contents of about 4 per cent and 5 per cent.

A grain size distribution of one (1) sample of the silty sand deposit is shown on Figure C.S25-1 in Appendix C.

A 0.5 m and 0.9 m thick layer of brown and grey silt some sand, trace organics and containing rootlets was encountered below the peat deposit in Borehole S25-09 at Elevation 201.6 m and within the sand deposit in Borehole S25-11 at Elevation 201.5 m. The natural water content measured on a specimen of the silt layer is about 22 per cent. A grain size distribution of this specimen is shown on Figure C.S25-2 in Appendix C. An Atterberg limits test carried out on this specimen measured a liquid limit of about 18 per cent, a plastic limit of about 17 per cent and a plasticity index of about 1 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure C.S25-3 in Appendix C and classified the material as silt of slight plasticity.

### Clayey Silt to Clay

A stratum of grey to reddish brown clayey silt to clay, trace sand to clay containing silt seams was encountered below the sandy silt to sand deposit in all boreholes advanced for this alignment except in Boreholes S25-01 and S25-11. The top of this stratum ranges from Elevations 200.0 m to 199.3 m and its thickness ranges from 0.5 m to 2.6 m.

The SPT 'N'-values measured within the cohesive deposit range from 0 blows (weight of hammer) to 3 blows per 0.3 m of penetration. In situ field vane tests carried out within this stratum measured undrained shear strengths ranging from about 13 kPa to 35 kPa and the sensitivity is calculated to range from 1 to 7. The field vane tests results together with the SPT 'N'-values indicate that the clay to clayey silt stratum has a very soft to firm consistency.

The natural water content measured on samples of this stratum ranges from about 29 per cent to 71 per cent.

Atterberg limits tests were carried out on eight (8) specimens (including two Shelby tube samples) of the cohesive stratum and indicate liquid limits ranging from about 22 per cent to 56 per cent, plastic limits ranging from about 13 per cent to 22 per cent and plasticity indices ranging from about 9 per cent to 34 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C.S25-4 in Appendix C and indicate the material to be clayey silt of low plasticity to clay of high plasticity.

Borehole Sample No.	Sample Depth / Elevation	$\sigma'_{vo}$ (kPa)	$\sigma'_p$ (kPa)	$\sigma'_p - \sigma'_{vo}$ (kPa)	OCR	$C_c$	$C_r$	$e_o$	$c_v^*$ (cm <sup>2</sup> /s)
Borehole S25-08 Sample 4	3.3 m / 199.3 m	18	85	67	4.7	0.71	0.07	1.56	$2.7 \times 10^{-3}$

Note: \* For stress range of  $20 \text{ kPa} \leq \sigma_v' \leq 160 \text{ kPa}$

where:  $\sigma_{vo}'$  is the effective overburden stress in kPa  
 $\sigma_p'$  is the preconsolidation stress in kPa  
OCR is overconsolidation ratio  
 $e_o$  is initial void ratio  
 $C_c$  is the compression index  
 $C_r$  is the recompression index  
 $c_v$  is the coefficient of consolidation in cm<sup>2</sup>/s



## **Silt**

A pocket and a layer of grey silt, trace sand and trace clay was encountered within the clay stratum in Borehole S25-05 and underlying the clayey silt stratum in Borehole S25-07. The top of this stratum is at Elevation 198.9 m and 198.0 m and its thickness is 0.9 m and 2.7 m in the respective boreholes.

The SPT 'N'-values measured within the silt stratum are 3 blows per 0.3 m of penetration, indicating a very loose relative density.

The natural water content measured on two (2) samples of this stratum is about 23 per cent and 27 per cent.

A grain size distribution of one (1) sample of the silt stratum is shown on Figure C.S25-6 in Appendix C.

## **Sandy Silt to Sand**

A deposit comprised of grey to brown sandy silt, silt and sand, silty sand and sand trace to some silt, and a pocket of silt was encountered underlying the clayey silt to clay stratum in all boreholes except in Boreholes S25-01 and S25-11. The deposit generally contains trace to some gravel and trace clay. The top of this deposit ranges from Elevation 199.1 m to 195.3 m and its thickness ranges from 2.3 m to 8.6 m. Boreholes S25-02 to S25-04, S25-06 and S25-08 to S25-10 were terminated within this deposit upon refusal to further split-spoon and/or casing refusal.

The SPT 'N'-values measured within this deposit range from 1 blow to 39 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 dense relative density.

The natural water content measured on samples of this deposit ranges from about 12 per cent to 32 per cent.

The grain size distributions of five (5) samples of the silt and sand to sand deposit are shown on Figure C.S25-7 in Appendix C. An Atterberg limits test on one (1) sample of the sand and silt deposit indicate the material to be non-plastic.

As noted above, a 0.6 m thick pocket of grey silt trace sand was encountered within the silty sand to sand deposit in Boreholes S25-02 Elevation 198.0 m. The natural water content measured on a specimen of the silt pocket is about 29 per cent and an Atterberg limits test carried out on this specimen measured a liquid limit of about 19 per cent, a plastic limit of about 17 per cent and a plasticity index of about 2 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure C.S25-8 in Appendix C and classifies the material as silt of slight plasticity.

## **Sand and Gravel**

A deposit of grey sand and gravel was encountered below the sandy silt to sand deposit in Boreholes S25-05 and S25-07. The top of this deposit is at Elevation 190.9 m and 186.7 m and its thickness is 1.7 m and 0.5 m, at the respective boreholes. The bottom of this deposit is defined by refusal to further casing advancement.

A SPT 'N'-value measured within this deposit is 16 blows per 0.3 m of penetration, indicating a compact relative density.

## **Bedrock / Refusal**

Bedrock outcrops are present to the north and to the south of the swamp beyond the adjacent existing Shebeshekong Road. In Boreholes S25-01 to S25-11, and DCPTs S25-DC01 to S25-DC05, refusal to further split-spoon and/or auger/casing advancement or cone penetration was encountered at depths between 4.7 m and 16.5 m below ice/water or ground surface, corresponding to between Elevations 197.9 m and 186.2 m. In general, refusal was encountered at greater depths towards the toe of the embankment in the centre of the swamp between about STA 17+275 and 17+315.



## **Groundwater Conditions**

In general, the samples taken in the boreholes were moist to wet with free water noted in some sand samples. A few boreholes encountered sand flow into the casing due to water pressure confined below cohesive deposits, which required water to be pumped into the borehole casing to maintain a constant head of water in order to allow for sampling by SPT and/or Shelby tube. Water levels observed in the boreholes upon completion of drilling range from Elevations 202.6 m to 202.1 m, measured at the ice surface or up to a depth of 1.6 m below the ice or ground surface.

### **4.8 Highway 69 NBL – STA 17+150 to 17+350 (Swamp 25)**

The plan and profiles along the centreline and toes of the embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 17+150 and 17+350 are shown on Drawings C1 and C2 in Appendix C. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 9 m high above existing grade. A total of sixteen (16) boreholes (Boreholes S25-12 to S25-26, inclusive, and S25-17A), and five (5) Dynamic Cone Penetration Tests (DCPTs S25-DC06 to S25-DC10, inclusive) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed highway is relatively flat to low-lying consisting of bedrock knobs, grassy and heavily treed ground with areas of shallow open water as well as an area of granular/rock fill. The existing Highway 69 is located about 80 m to the east of the proposed NBL alignment.

In general, the subsurface soils along the NBL alignment in this area consist of a deposit of fill associated with the Shawanaga First Nation gas station access road and platform as well as the embankment of the existing Shebeshekong Road and surficial deposit of peat/organic clayey silt/silt. The fill and organic deposits are underlain by a deposit of sandy silt to sand which in turn is underlain by a stratum of clayey silt to clay containing a pocket of silt and sand, or pockets. The clayey silt to clay stratum or silt layer(s) are underlain by a deposit of silt and sand to sand which is in turn underlain by a deposit of gravelly sand at to sand and gravel in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at greatest depth between about STA 17+230 and 17+300. Bedrock outcrops are present along the northern limit of the swamp and to the south of the swamp beyond the adjacent existing Shebeshekong Road traversing the area.

#### **Silty Sand to Sand and Gravel Fill and Rock Fill**

A deposit of granular fill comprised of brown to grey silt and sand, silty sand, sand and sand and gravel was encountered at the ground surface in Boreholes S25-12 to S25-14, S25-17, S25-23, S25-25 and S25-26, and inferred as observed at ground surface in DCPT S25-DC07. The top of the granular fill ranges from Elevations 203.9 m to 202.7 m and the thickness of the fill ranges from 0.5 m to 2.2 m.

Rock fill was encountered in Boreholes S25-22 to S25-24 and S25-26 and was inferred at ground surface at DCPT S25-DC10. The top of the rock fill ranges from Elevation 202.8 m to 201.9 m and its thickness ranges from 0.6 m to 1.5 m.

The Standard Penetration Test (SPT) 'N'-values measured within the granular deposit range from 7 blows to 50 blows per 0.3 m of penetration, indicating a loose to dense to very dense relative density. The SPT 'N'-values measures within the rock fill range from 54 blows per 0.3 m of penetration to 122 blows per 0.15 m of penetration, indicating a very dense relative density.

The natural water content measured on one (1) sample of the sand and gravel fill is about 6 per cent.



## **Snow / Ice / Water**

Snow, ice and water to depths between 0.2 m and 1.2 m was encountered in Boreholes S25-15, S25-16, S25-18, S25-19 and S25-21.

## **Peat / Organic Clayey Silt / Organic Silt**

An organic deposit was encountered below the snow/ice/water in Boreholes S25-18, S25-19 and S25-21 and over and below the rock fill in Boreholes S25-22. A 0.6 m thick deposit of peat, organic clayey silt and organic silt was encountered in Boreholes S25-19, S25-18 and S25-21, respectively, between Elevations 202.2 m and 201.7 m. Two (2) layers of organic silt, each about 0.3 m thick, were encountered over and below the rock fill in Borehole B25-22 at Elevations 203.1 m and 201.9 m.

The Standard Penetration Test (SPT) 'N'-values measured within the organic deposits are 3 blows and 5 blows per 0.3 m of penetration, suggesting a soft to firm consistency/very loose relative density.

The natural water content measured on samples of the organic deposits is between about 38 per cent and 56 per cent, and the organic content measured on a sample of the organic clayey silt is about 6 per cent.

## **Sandy Silt to Sand (Upper Deposit)**

A non-cohesive deposit comprised of brown to grey sandy silt, silt and sand, silty sand and sand was encountered underlying the ice/water cover and below the fill or peat/organic clayey silt/organic silt deposit in all boreholes, except in Borehole S25-20 which is located on a bedrock outcrop. The deposit generally contains trace gravel, trace clay, clayey silt and sand seams and sandy silt layers, organics and rootlets. The top of this deposit ranges from Elevations 202.4 m to 201.1 m and the thickness of the deposit ranges from 0.8 m to 4.1 m.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 24 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on fifteen (15) samples of this deposit ranges from about 17 per cent to 35 per cent. The upper portion of this deposit was observed to contain trace organic and laboratory testing on one (1) specimen of the silty sand deposit measured an organic content of about 3 per cent.

The grain size distributions of six (6) samples of the silt and sand to sand portion of the deposit are shown on Figure C.S25-9 in Appendix C.

## **Clayey Silt to Clay**

A stratum of grey and reddish brown clayey silt, silty clay and clay, containing trace to some sand and silt seams was encountered below the sandy silt to sand deposit in all boreholes, except in Boreholes S25-14, S25-20 and S25-21. The stratum was observed to contain a pocket of silt and sand in Borehole S25-15. The top of this stratum ranges from Elevation 200.8 m to 198.6 m and the thickness of the deposit ranges from 0.3 m to 4 m. Borehole S25-17A was terminated within this stratum, penetrating it for a depth of 0.6 m.

The SPT 'N'-values measured within the cohesive stratum range from 0 blows (weight of hammer) to 5 blows per 0.3 m of penetration with a SPT 'N'-value of 11 blows per 0.3 m of penetration measured at the interface with the underlying silt layer. In situ field vane tests carried out within this stratum measured undrained shear strengths ranging from about 15 kPa to 57 kPa and the sensitivity is calculated to be between 2 and 8. The field vane tests results together with the SPT 'N'-values indicate that the clayey silt to clay stratum has a very soft to stiff consistency.





The natural water content measured on thirteen (13) samples of this stratum ranges from about 22 per cent to 75 per cent.

Atterberg limits tests were carried out on twelve (12) specimens of the clayey silt to clay stratum and indicate liquid limits ranging from about 20 per cent to 61 per cent, plastic limits ranging from about 13 per cent to 24 per cent and plasticity indices ranging from about 7 per cent to 40 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures C.S25-10A and C.S25-10B in Appendix C and indicate the material to be clayey silt of low plasticity to clay of high plasticity.

Within the cohesive stratum in Borehole S25-15, a 0.6 m thick pocket of silt and sand trace clay was encountered at Elevation 198.6 m. A SPT 'N'-value measured in this layer is 6 blows per 0.3 m of penetration, indicating a loose relative density. The natural water content measured on the samples from this pocket is about 19 per cent.

### Silt

Underlying the cohesive stratum in Boreholes S25-13, S25-17, S25-22, S25-25 and S25-26 is a stratum of grey silt, some sand and trace to some clay containing an estimated 0.4 m diameter boulder at the top of the deposit in Borehole S25-13. The top of this stratum is between Elevations 200.5 m and 197.3 m and the thickness of the layer ranges from 0.3 m to 2.3 m. Borehole S23-22 was terminated in this deposit due to refusal to further auger advancement.

The SPT 'N'-values measured within the silt stratum range between 4 blows and 8 blows per 0.3 m of penetration, indicating a loose relative density. A SPT 'N'-value of 29 blows per 0.2 m of penetration was measured in Borehole S25-22 at borehole termination on refusal.

The natural water content measured on five (5) samples of this stratum are between about 24 per cent and 31 per cent.

Grain size distributions of four (4) samples of the silt stratum are shown on Figure C.S25-11 in Appendix C.

### Silt and Sand to Sand (Lower Deposit)

A deposit comprised of grey to brown silt and sand, silty sand and sand trace to some silt containing trace gravel and trace clay was encountered below the clayey silt to clay stratum or silt stratum in Boreholes S25-12, S25-13, S25-15 to S25-19 and S25-23 to S25-26, and underlying the upper sandy silt to sand deposit in Borehole S25-14. In Borehole S25-14, the deposit contains silty clay seams and a boulder at the bottom of the deposit, and in Borehole S25-17, the auger was noted to be grinding inferred on a boulder. The top of this deposit ranges from Elevations 199.1 m to 195.8 m and the thickness of the deposit ranges from 3 m to 10.3 m and may be up to about 12.2 m thick as inferred from the resistance to cone penetration for the DCPT driven from the bottom of Borehole S25-13. The bottom of this deposit is defined by refusal to further split-spoon, auger and/or casing advancement or cone penetration in all boreholes which the deposit was encountered except for S25-12, S25-24 and S25-25 where it is underlain by a gravelly sand to sand and gravel deposit.

The SPT 'N'-values measured within this deposit typically range from 0 blows (weight of sampler and rod) to 44 blows per 0.3 m of penetration, with occasional SPT 'N'-values between about 73 blows and 101 blows per 0.3 m of penetration, indicating very loose to very dense relative density.

The natural water content measured on twenty-four (24) samples of this deposit range from about 15 per cent to 30 per cent.

The grain size distributions of twelve (12) samples of this deposit are shown on Figures C.S25-12A and C.S25-12B in Appendix C.





### **Gravelly Sand and Sand and Gravel**

A deposit of grey gravelly sand and sand and gravel, trace to some silt and trace clay 1.2 m to 2.2 m thick was encountered below the lower silt and sand to sand deposit in Boreholes S25-12, S25-24 and S25-25 at Elevations 185.7 m and 189.7 m, respectively. The boreholes were terminated in this deposit upon refusal to casing advancement.

A SPT 'N'-values measured within this deposit are 19 blows and 44 blows per 0.3 m of penetration, indicating a compact to dense relative density. A SPT 'N'-value of 23 blows per 0.15 m of penetration was measured in Borehole S25-24 on a silt and sand pocket.

The natural water content measured on three (3) samples of this deposit are about 11 per cent and 17 per cent. The grain size distribution of a sample of the gravelly sand portion of the deposit is shown on Figure C.S25-13A in Appendix C. The grain size distribution of the sample of the silt and sand pocket is shown on Figure C.S25-13B in Appendix C.

### **Bedrock / Refusal**

Bedrock outcrops are present along the northern limit of the swamp at the location of Borehole S25-20 and DCPT S25-DC09 at Elevation 204.7 m and 203.9 m, respectively, and to the south of the swamp near the adjacent existing Shebeshekong Road at about STA 17+200. In Boreholes S25-12 to S25-19 and S25-21 to S25-26 and DCPTs S25-DC06 to S25-DC08 and S25-DC10 refusal to further split-spoon and/or auger/casing advancement or cone penetration was encountered at depths between 3.4 m and 20 m below ice/water or ground surface, corresponding to between Elevations 199.7 m and 183.9 m. In general, refusal was encountered at greater depths near the existing Shebeshekong Road between about STA 17+230 and 17+300.

Bedrock was encountered and core samples were recovered from Borehole S25-21. The depth to the surface of the bedrock is 1.7 m corresponding to Elevation 200.7 m, and the bedrock was cored for a depth of 1.6 m. The bedrock consists of granite gneiss and the core sample is described as slightly weathered, coarse grained with strong banding, foliated, pink, white and grey. The Rock Quality Designation (RQD) measured on the core samples is 100 per cent, indicating a rock mass of excellent quality (Table 3.10 of CFEM, 2006). The Total Core Recovery (TCR) is 100 per cent, and the Solid Core Recovery (SCR) is 90 per cent.

A point load strength index test (ASTM D5731 – Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications) was carried out on one sample of the bedrock core. The diametral point load test carried out on the sample of the bedrock core measured an  $Is_{50}$  strength index value of 13.7 MPa, as presented on the Record of Drillhole sheet in Appendix C. The point load strength index value suggests that the sample of gneiss is extremely strong (Table 3.5 of CFEM, 2006).

### **Groundwater Conditions**

In general, the samples taken in the boreholes were moist to wet. A few boreholes encountered sand flow into the casing when the penetrating into non-cohesive deposits below cohesive deposits, requiring the casing to maintain a constant head of water in order to allow for sampling by SPT. The water level observed in the boreholes upon completion of drilling ranges from Elevation 202.6 m to 201.0 m, measured at the ice surface or up to a depth of 1.9 m below ground surface.

## **4.9 Site 9 Road – STA 10+225 to 10+300 (Swamp 26)**

The plan and profiles along the centreline and toes of the embankment of the Site 9 Road alignment showing the borehole locations and interpreted stratigraphy between about STA 10+225 and 10+300 are shown on Drawing D1



in Appendix D. The alignment extends across a swamp area and the proposed roadway embankment will be up to about 9 m above existing grade. A total of eight (8) boreholes (Boreholes S26-01 to S26-08, inclusive), and three (3) Dynamic Cone Penetration Tests (DCPTs S26-DC01 to S26-DC03, inclusive) were completed to investigate the subsurface conditions within this swamp area. The topography of this section of the proposed Site 9 Road 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 Site 9 Road alignment in this area consist of surficial deposits of topsoil, organic silt and clayey silt underlain by a deposit of silt to sandy sand which in turn is underlain by a gravelly sand to sand and gravel stratum in places. Resistance to dynamic cone penetration and borehole advancement, indicative of the potential bedrock surface, was encountered at shallower depths at the southern limit of the swamp, at about STA 10+200. Bedrock outcrops are present along the southern limit of the swamp.

### Topsoil / Organic Silt

A 0.2 m to 0.6 m thick deposit of topsoil, organic silt, some sand was encountered at ground surface in Boreholes S26-02 and S26-04 to S26-08. The top of the organic deposits was encountered between Elevations 212.9 m to 210.7 m.

A Standard Penetration Test (SPT) 'N'-value measured within the organic silt is 3 blows per 0.3 m of penetration, indicating a very loose relative density.

The natural water content measured on three (3) samples of the organic silt are about 49 per cent and 188 per cent, and the organic content of two (2) samples of the organic silt are about 6 per cent and 25 per cent.

### Clayey Silt

A 0.7 m thick deposit of clayey silt was encountered below the topsoil in Borehole S26-06 at a depth of 0.2 m below ground surface, corresponding to Elevation 211.5 m.

The Standard Penetration Test (SPT) 'N'-value measured within the clayey silt is 5 blows per 0.3 m of penetration, suggesting a firm 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 this specimen measured a liquid limit of about 33 per cent, a plastic limit of about 14 per cent and a plasticity index of about 19 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure D.S23-1 in Appendix D and indicate the material to be clayey silt of low plasticity.

### Silt to Sand

A 2.3 m to 9.8 m thick non-cohesive deposit consisting of silt, sandy silt, silt and sand, silty sand and sand was encountered in all of the boreholes between Elevations 212.7 m and 210.4 m. The deposit was encountered at ground surface in Boreholes S26-01 and S26-03, below the organic silt in Borehole S26-02, S26-04, S26-05 and S26-07, below the clayey silt deposit in S26-06 and below the topsoil in S26-08. A 0.8 m thick pocket of clayey silt was encountered within the silt and sand/silty sand portion of the deposit in Borehole S26-05 at Elevation 209.4 m.

The Standard Penetration Test (SPT) 'N'-values measured within the silt to sand deposit range from 0 blows (weight of hammer) to 26 blows per 0.3 m of penetration, indicating a very loose to compact relative density. SPT



'N'-values of 66 blows per 0.13 m of penetration and 20 blows for 0 m of penetration were measured at the bottom of the deposit prior to split-spoon and casing refusal

The SPT 'N'-value measured within the clayey silt pocket is 3 blows per 0.3 m of penetration. Two (2) in situ field vane tests carried out within this pocket measured undrained shear strengths of about 46 kPa to 67 kPa and the sensitivity is calculated to be 7 and 5, respectively. The field vane test results indicate that the clayey silt pocket has a firm to stiff consistency.

The natural water content measured on thirty-five (35) samples of the silt to sand deposit range between about 14 per cent and 31 per cent and the organic content of one (1) sample of the silty sand portion of the deposit immediately underlying the organic silt deposit is about 1 per cent.

The natural water content measured on a sample of the clayey silt pocket is about 41 per cent, and the Atterberg limits test carried out on this specimen measured a liquid limit of about 30 per cent, a plastic limit of about 16 per cent and a plasticity index of about 14 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure D.S23-1 in Appendix D and indicate the material to be clayey silt of low plasticity.

The grain size distributions of twelve (12) samples of the silt to sand deposit classified the selected samples as silt, sandy silt, silty sand and sand. The results are shown on Figures D.S26-2A and D.S26-2B in Appendix D. Atterberg limits tests carried out in two (2) samples of the sandy silt deposit indicates that this material is non-plastic.

### **Gravelly Sand / Sand and Gravel**

A 0.1 m to 1.4 m deposit of gravelly sand to sand and gravel was encountered below the silt and sand deposit in Boreholes 26-01 and 26-05 at depths of 2.3 m and 7.2 m below ground surface, corresponding to Elevations 209.0 m and 203.7 m.

The Standard Penetration Test (SPT) 'N'-value measured within the gravelly sand/sand and gravel is 41 blows per 0.3 m of penetration and 20 blows per 0.15 m of penetration (measured at the bottom of the deposit prior to split-spoon and casing refusal), indicating a dense relative density

The natural water content measured on two (2) samples of the gravelly sand/sand and gravel deposit are about 11 per cent and 15 per cent.

The grain size distribution of one (1) sample of the gravelly sand portion of the deposit is shown on Figure D.S26-3 in Appendix D.

### **Bedrock / Refusal**

Bedrock outcrops are present along the southern limit of the swamp. In Boreholes S26-01 to S26-08 and DCPTs S26-DC01 to S26-DC03, refusal to further split-spoon and/or auger advancement or cone penetration was encountered at depths ranging between 2.4 m and 10.1 m below ground surface, corresponding to between Elevations 208.9 m and 200.6 m. In general, refusal was encountered at shallower depths at the southern limit of the swamp, at about STA 10+200.

### **Groundwater Conditions**

In general, the samples taken in the boreholes were wet. The water levels observed in the boreholes upon completion of drilling range from Elevation 212.0 m to 209.1 m, measured at the ground surface or at depths ranging from 0.2 m to 2.2 m below the ground surface.



## **5.0 CLOSURE**

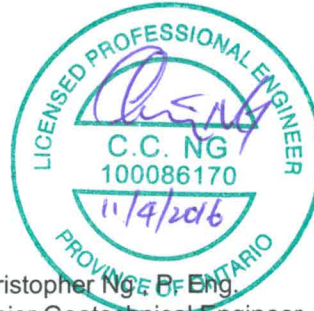
The field technicians directing the drilling program were Messrs. Indulis Dumpis, Mathew Riopelle and Matt Rhody. This report was prepared by Mmes Veronica T. Ayetan, P. Eng., and Madison C. Kennedy and was reviewed by Mr. Christopher Ng, P. Eng., a Geotechnical Engineer and Associate of Golder. Mr.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



## FOUNDATION REPORT – SWAMP CROSSINGS – PHASE 2 – HIGHWAY 69 G.W.P. 5111-07-00

### Report Signature Page

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Chapman, L.J., and Putnam, D.F. 1984. The Physiography of Southern, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

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

Golder Associates Ltd. 2011. Foundation Investigation and Design Report, Swamp Crossings and High Fill Areas – Phase 1, 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. 5402-05-00, Geocres No. 41H-73.

### 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 D2573	Standard Test Method for Field Vane Shear Test in Cohesive Soil
ASTM D5731	Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications

#### Ontario Provincial Standard Drawing:

OPSD 202.010	Slope Flattening Using Surplus Excavated Material on Earth or Rock Embankments.
OPSD 203.010	Embankments Over Swamp – New Construction

#### Ontario Provincial Standard Specification:

OPSS.PROV 206	Construction Specification for Grading
OPSS.PROV 209	Construction Specification for Embankments Over Swamps and Compressible Soils
OPSS.PROV 539	Construction Specification for Temporary Protection Systems

#### Ontario Water Resources Act:

Ontario Regulation 372/97	Amendment to Ontario Regulation 903
Ontario Regulation 903/90	Wells





## LIST OF SYMBOLS

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

### I. GENERAL

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

### II. STRESS AND STRAIN

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

### III. SOIL PROPERTIES

#### (a) Index Properties

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

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

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

w	water content
$w_l$ or LL	liquid limit
$w_p$ or PL	plastic limit
$I_p$ or PI	plasticity index = $(w_l - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_p) / I_p$
$I_c$	consistency index = $(w_l - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

#### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_{\alpha}$	secondary compression index
$m_v$	coefficient of volume change
$C_v$	coefficient of consolidation (vertical direction)
$C_h$	coefficient of consolidation (horizontal direction)
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation stress
OCR	over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

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

Notes: 1  
2

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



## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

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

#### Dynamic Cone Penetration Resistance; $N_d$ :

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

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

### III. SOIL DESCRIPTION

#### (a) 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

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

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
$SO_4$	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

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

### V. MINOR SOIL CONSTITUENTS

Per cent 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



# LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

## WEATHERINGS STATE

**Fresh:** no visible sign of weathering

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

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

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

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

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

## BEDDING THICKNESS

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

## JOINT OR FOLIATION SPACING

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

## GRAIN SIZE

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

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

## CORE CONDITION

### Total Core Recovery (TCR)

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

### Solid Core Recovery (SCR)

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

### Rock Quality Designation (RQD)

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

## DISCONTINUITY DATA

### Fracture Index

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

### Dip with Respect to Core Axis

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

### Description and Notes

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

### Abbreviations

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



# TABLES



## FOUNDATION REPORT – SWAMP CROSSINGS – PHASE 2 – HIGHWAY 69 G.W.P. 5111-07-00

**TABLE 1 – SUMMARY OF SWAMP CROSSINGS  
HIGHWAY 69 FOUR-LANING – PHASE 2**

<i>Highway</i>	<i>Approx. Station</i>	<i>Designation</i>	<i>Proposed Embankment Height<sup>1</sup></i>	<i>Boreholes/DCPT</i>
Highway 69 SBL	15+690 to 15+720	Swamp 23	2.5 m to 7 m	7 Boreholes (S23-01 to S23-06 and S23-03A) 4 DCPTs (S23-DC01 to S23-DC03 and S23-DC07)
Highway 69 NBL	15+700 to 15+740	Swamp 23	1.5 m to 7 m	5 Boreholes (S23-07 to S23-11) 3 DCPTs (S23-DC04 to S23-DC06)
Highway 69 SBL	16+475 to 16+550	Swamp 24	8 m to 9 m	8 Boreholes (S24-01 to S24-07 and S24-09) 3 DCPTs (S24-DC01 to S24-DC03)
Highway 69 NBL	16+450 to 16+550	Swamp 24	5.5 m to 9.5 m	9 Boreholes (S24-06 and S24-08 to S24-15) 3 DCPTs (S24-DC01, S24-DC02 and S24-DC04)
Highway 69 SBL	17+230 to 17+350	Swamp 25	7 m to 8.5 m	11 Boreholes (S25-01 to S25-11) 5 DCPTs (S25-DC01 to S25-DC05)
Highway 69 NBL	17+150 to 17+350	Swamp 25	7 m to 9 m	16 Boreholes (S25-12 to S25-26 and S25-17A) 5 DCPTs (S25-DC06 to S25-DC10)
Site 9 Road	10+225 to 10+300	Swamp 26	9 m	8 Boreholes (S26-01 to S26-08) 3 DCPTs (S26-DC01 to S26-DC03)

Note: 1. Based on centreline of highway alignments and existing ground surface profiles provided by MRC on January 10, 2007.

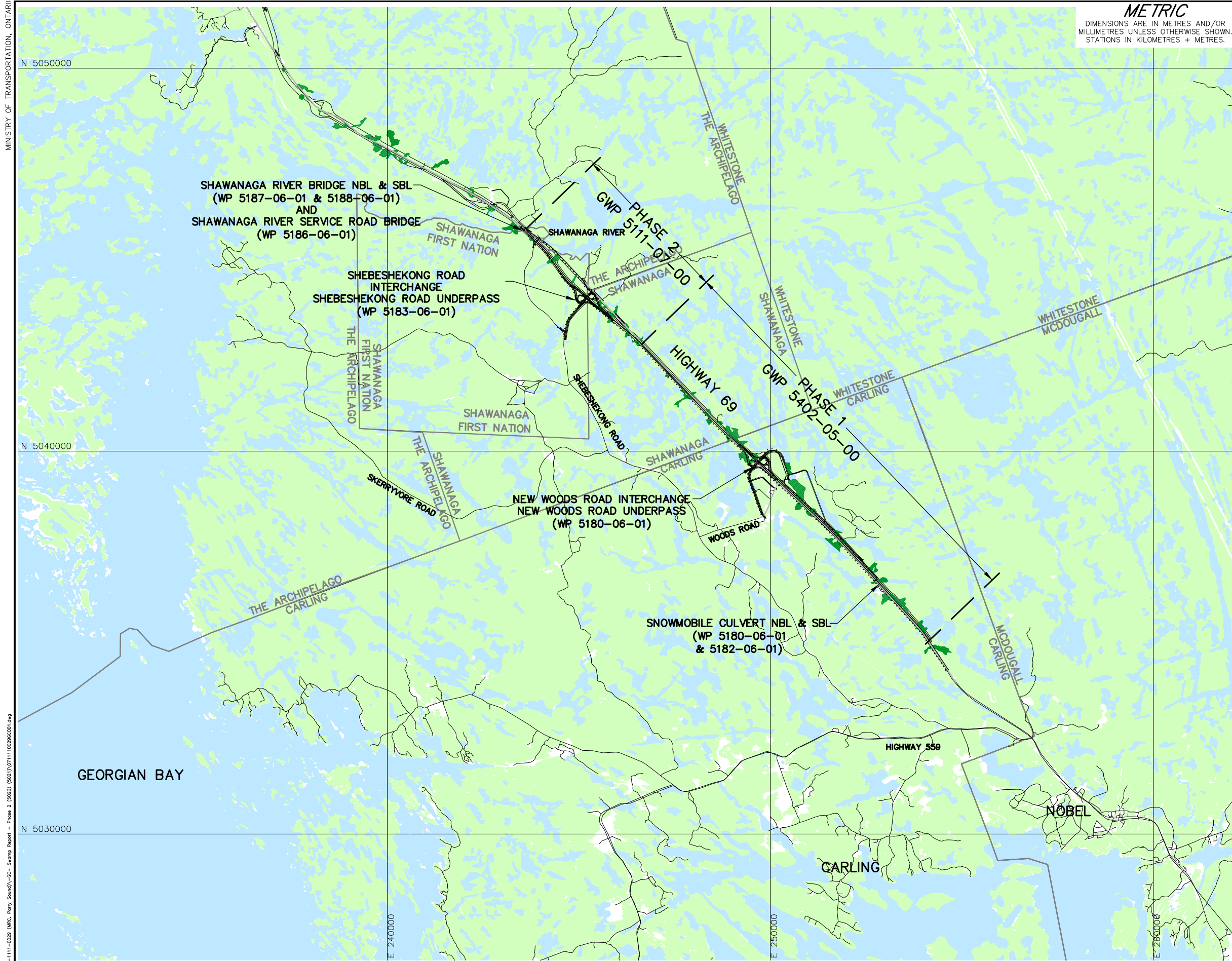
Prepared By: VA/MCK

Reviewed By: CN/JMAC

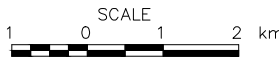


# **DRAWINGS**





PLAN



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

CONT No. GWP No. 5111-07-00		 SHEET
HIGHWAY 69 SITE LOCATION PLAN		



KEY PLAN  
NOT TO SCALE

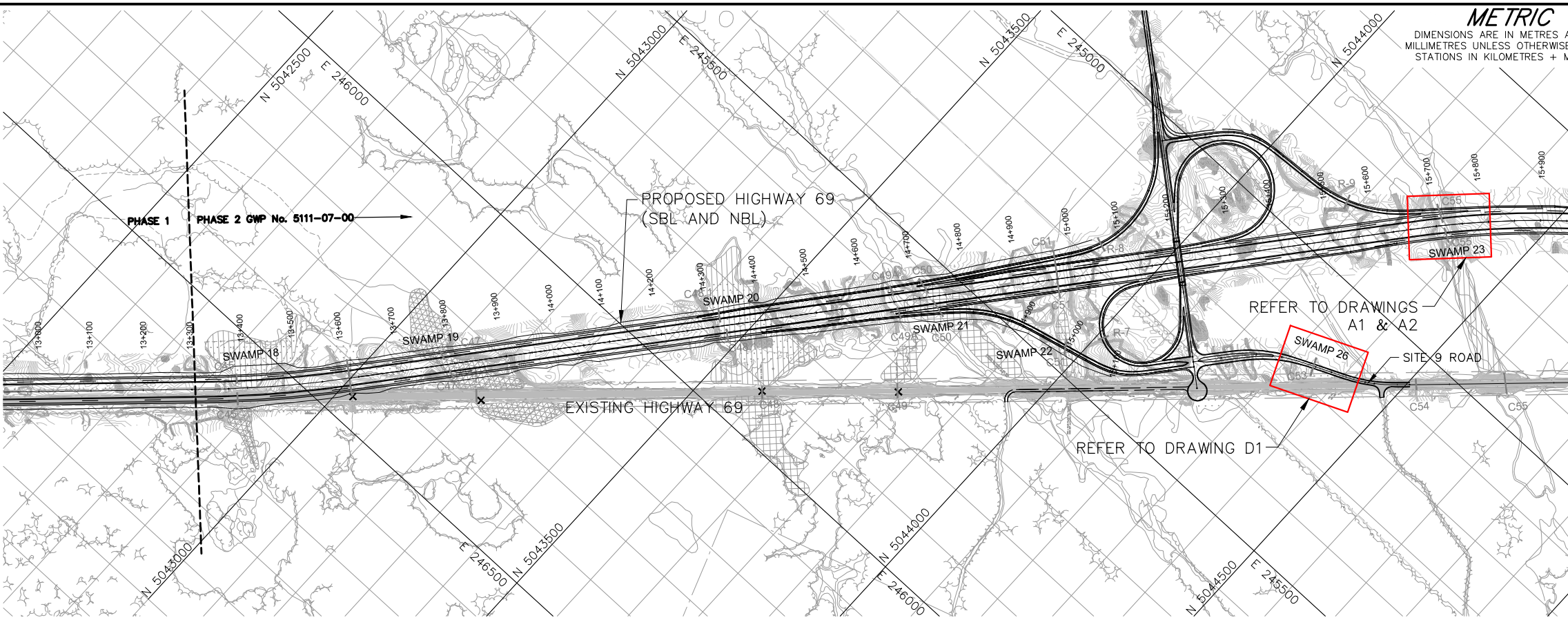
**REFERENCE**

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
Geores No. 41H-161			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. VA/OK	DATE: May 2012	SITE:
DRAWN: JFC/CD	CHKD. CN	APPD. JPD/JMAC	DWG. 1

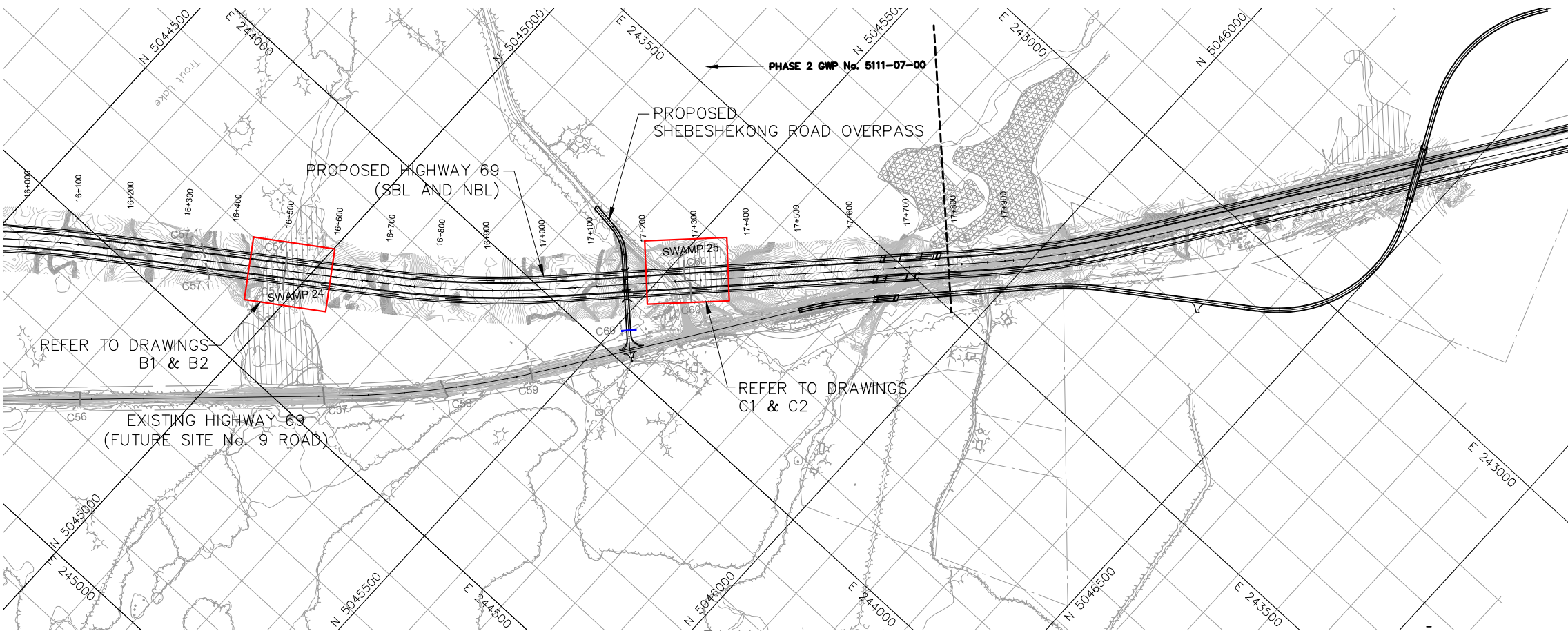


**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.



PLAN

SCALE  
100 0 100 200 m



PLAN

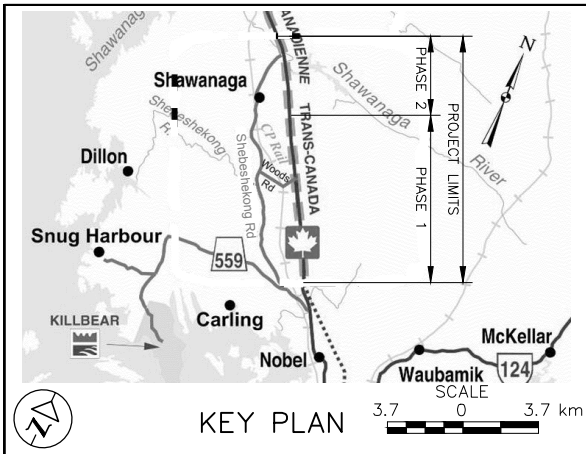
SCALE  
100 0 100 200 m

CONT No.  
GWP No. 5111-07-00



HIGHWAY 69  
SWAMP CROSSINGS – PHASE 2  
INDEX PLAN

SHEET



KEY PLAN

**NOTE**

Crossing at Swamp 18 to Swamp 22 within the Phase 2 limits are reported in "Swamp Crossing and High Fill Areas – Phase 1" report Geocres No. 41H-73 dated November 2011, (Golder 2011).

**REFERENCE**

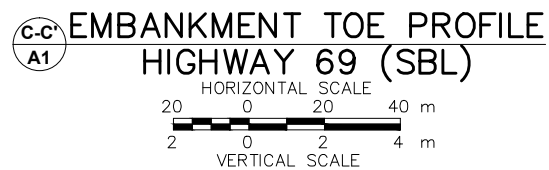
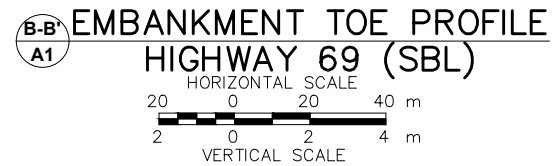
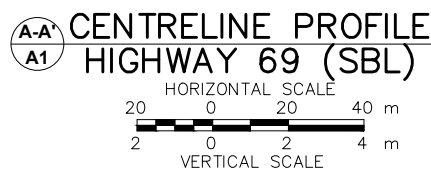
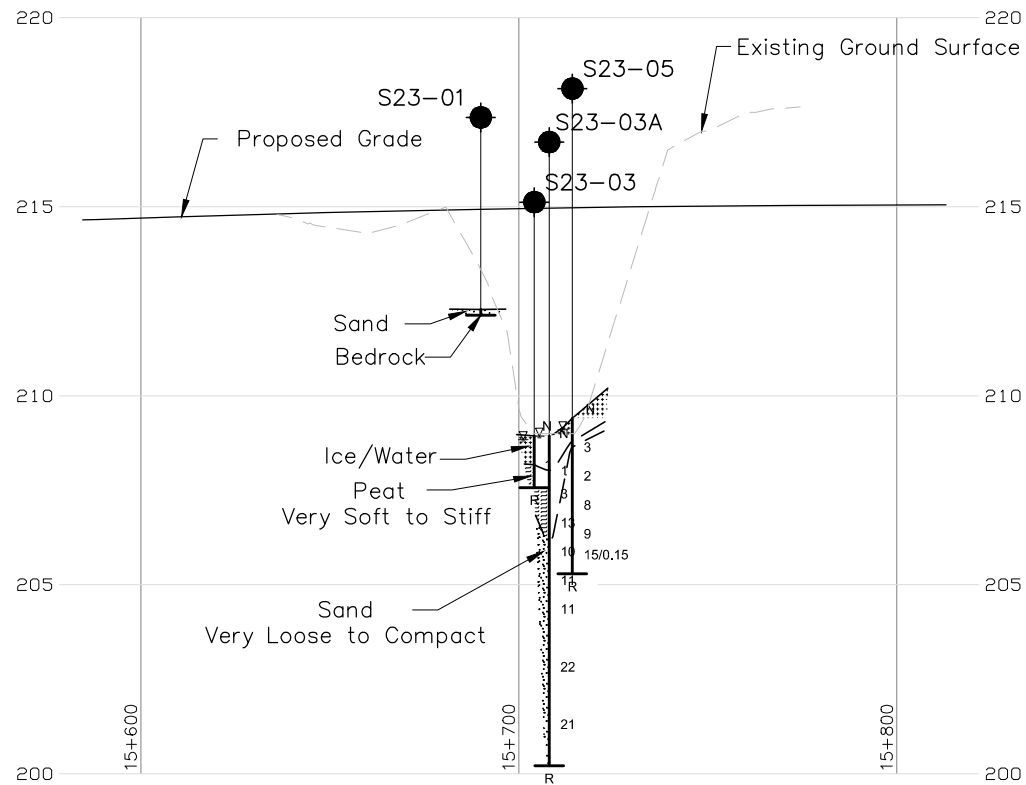
Base plans provided in digital format by MRC, drawing file 5271XB01.DWG, 5271-XPD-ARCHIPELAGO.dwg, 5271-XPD-Carling.dwg, 5271-XPD-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878\_PHASE1\_XA1, h6878\_PHASE1\_XN1.dwg, received January 21, 2009, h6878\_PHASE2\_XA1, h6878\_PHASE2\_XN1.dwg, received January 21, 2009.

NO.	DATE	BY	REVISION
Geocres No. 41H-161			
HWY. 69	PROJECT NO. 07-1111-0029	DIST.	
SUBM'D. VA	CHKD. VA/OK	DATE: Nov. 2009	SITE:
DRAWN: DD/RJ	CHKD. CN	APPD. JPD/JMAC	DWG. 2



# **APPENDIX A**

**Highway 69 SBL – STA 15+690 to 15+720 and  
Highway 69 NBL – STA 15+700 to 15+740 (Swamp 23)**



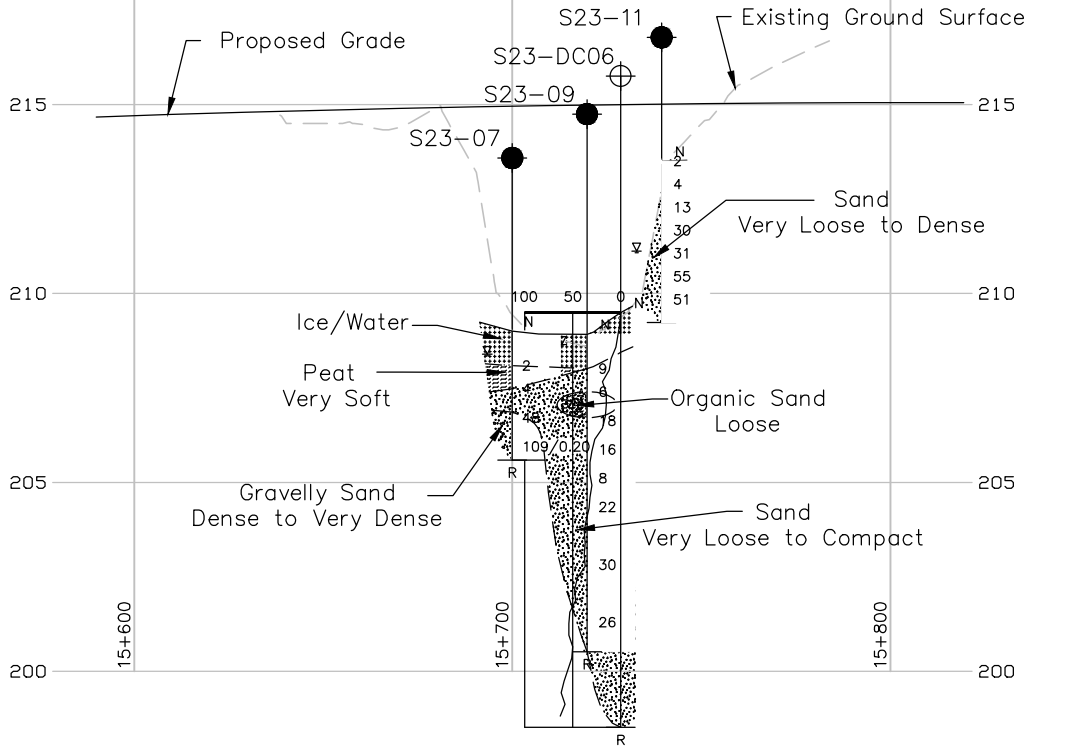
## REFERENCE

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Base plans provided in digital format by MRC, drawing file 5271XB01.DWG, 5271-XPD-ARCHIPELAGO.dwg, 5271-XPD-Carling.dwg, 5271-XPD-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878\_PHASE1\_XA1, h6878\_PHASE1\_XN1.dwg, received January 21, 2009, h6878\_PHASE2\_XA1, h6878\_PHASE2\_XN1.dwg, received January 21, 2009.

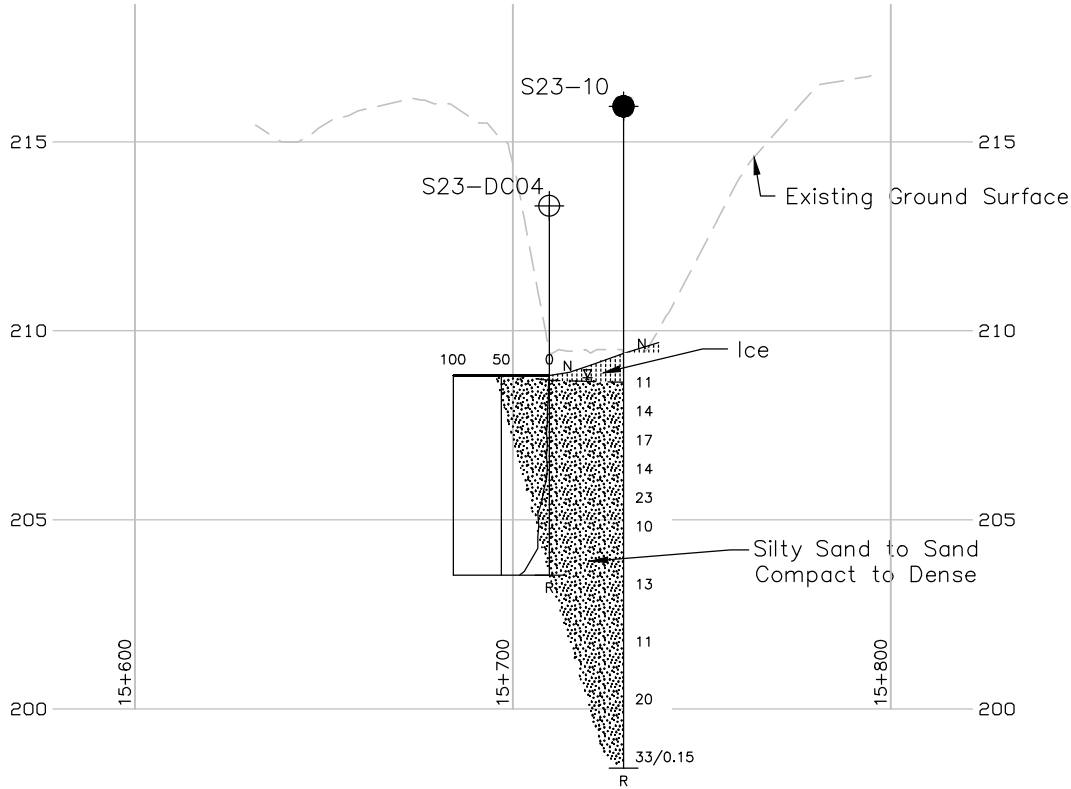
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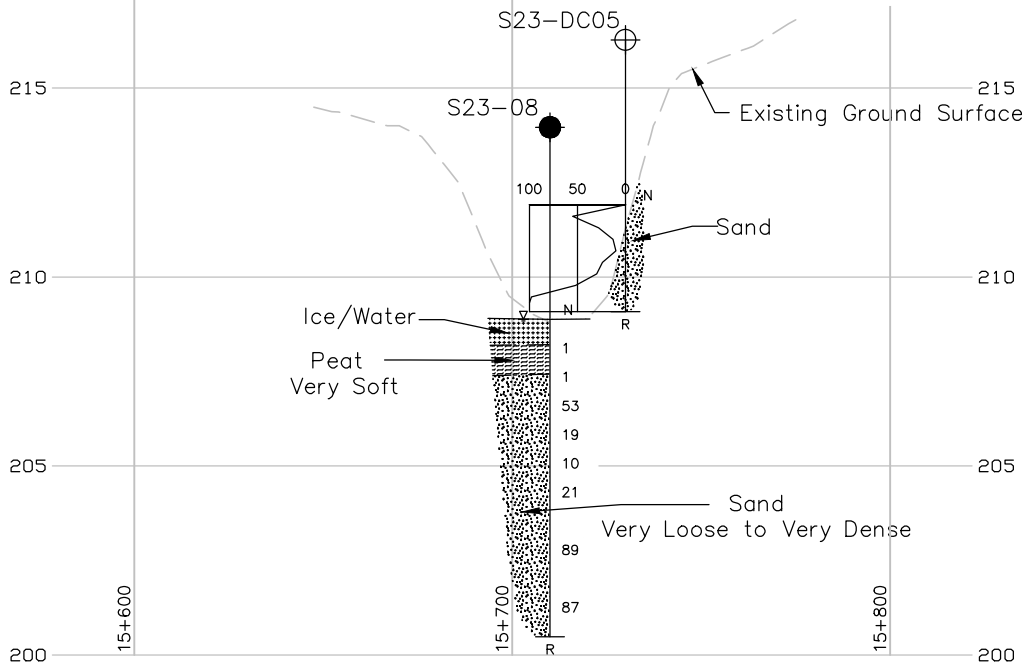
**D-D**  
**A1** CENTRELINE PROFILE  
HIGHWAY 69 (NBL)

HORIZONTAL SCALE  
20 0 20 40 m  
2 0 2 4 m  
VERTICAL SCALE



**F-F**  
**A1** EMBANKMENT TOE PROFILE  
HIGHWAY 69 (NBL)

HORIZONTAL SCALE  
20 0 20 40 m  
2 0 2 4 m  
VERTICAL SCALE



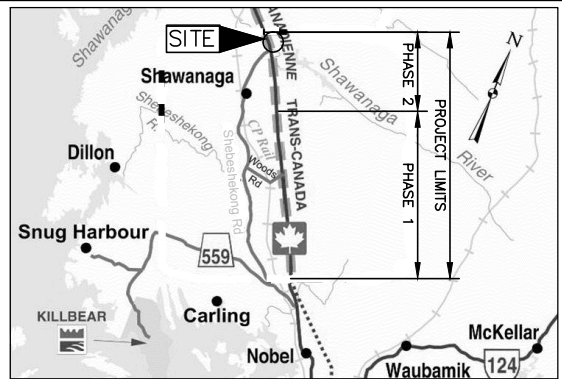
**E-E**  
**A1** EMBANKMENT TOE PROFILE  
HIGHWAY 69 (NBL)

HORIZONTAL SCALE  
20 0 20 40 m  
2 0 2 4 m  
VERTICAL SCALE

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

CONT No.  
GWP No. 5111-07-00

HIGHWAY 69 (NBL) STA 15+700 TO STA 15+740  
SOIL STRATA



KEY PLAN  
SCALE  
3.7 0 3.7 km

#### LEGEND

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

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
S23-07	209.0	5044352.4	244817.8
S23-08	208.9	5044348.5	244801.3
S23-09	208.9	5044365.5	244803.0
S23-10	209.4	5044381.5	244804.1
S23-11	213.5	5044378.7	244788.3
S23-DC04	208.8	5044370.3	244820.4
S23-DC05	211.9	5044363.7	244788.1
S23-DC06	209.5	5044371.4	244796.3

#### 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 MRC, drawing file S271XB01.DWG, S271-XPD-ARCHIPELAGO.dwg, S271-XPD-Carling.dwg, S271-XPD-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878\_PHASE1\_XA1, h6878\_PHASE1\_XN1.dwg, received January 21, 2009, h6878\_PHASE2\_XA1, h6878\_PHASE2\_XN1.dwg, received January 21, 2009.



NO.	DATE	BY	REVISION
Geocres No. 41H-161			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. MCK	DATE: Nov. 2009	SITE:
DRAWN: DD/RJ	CHKD. CN	APPD. JPD/JMAC	DWG. A2

PROJECT		RECORD OF BOREHOLE		No S23-01		SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION		N 5044317.4 ; E 244800.9		ORIGINATED BY		MJR									
DIST		HWY 69		BOREHOLE TYPE		Hand Excavation		COMPILED BY									
DATUM		Geodetic		DATE		February 20, 2009		CHECKED BY									
								VA/OK									
SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
212.3	GROUND SURFACE																
0.0	SAND, trace silt, trace organics																
0.2	Brown Moist																
	END OF EXCAVATION																
	BEDROCK																
	NOTES:																
	1. Hand digging carried out at proposed borehole location to expose bedrock.																
	2. Water level in excavation not noted.																

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

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PROJECT		RECORD OF BOREHOLE		No S23-03		SHEET 1 OF 1		METRIC													
W.P.		LOCATION		ORIGINATED BY		ID															
DIST		BOREHOLE TYPE		COMPILED BY		PKS															
DATUM		DATE		CHECKED BY		VA/OK															
07-1111-0029		N 5044326.7 ;E 244790.2																			
5111-07-00		Portable Equipment, BW Casing, Wash Boring																			
Geodetic		February 18, 2009																			
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20	40	60	80	100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	GR	SA	SI	CL
208.9	0.0	ICE SURFACE																			
		Ice																			
208.3																					
0.8		Water																			
		PEAT (Fibrous)																			
207.6		Very soft		1	SS	1		208													
		Dark brown																			
1.4		Wet																			
		SAND, trace to some silt, trace organics																			
		Brown																			
		Wet																			
		END OF BOREHOLE																			
		CASING REFUSAL																			
		NOTES:																			
		1. Water level in open borehole at a depth of 0.1 m below ice surface (Elev. 208.8 m) upon completion of drilling.																			
		2. An additional borehole was drilled adjacent to Borehole S23-03; see Record of Borehole S23-03A for details.																			

PROJECT		RECORD OF BOREHOLE				No S23-03A		SHEET 1 OF 1		METRIC								
W.P.		LOCATION		ORIGINATED BY		ID												
DIST		BOREHOLE TYPE		COMPILED BY		PKS												
DATUM		DATE		CHECKED BY		VA/OK												
PROJECT 07-1111-0029		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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
208.9	ICE SURFACE							20	40	60	80	100						
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													
			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													
			5	SS	11													
			6	SS	11													
			7	SS	22													
			8	SS	21													
200.2																		
8.7	END OF BOREHOLE CASING AND SPOON REFUSAL (HAMMER BOUNCING)																	
	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.																	

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-04		SHEET 1 OF 1		METRIC												
W.P. 5111-07-00		LOCATION N 5044311.1 ; E 244771.2		ORIGINATED BY ID														
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY PKS														
DATUM Geodetic		DATE February 17 and 18, 2009		CHECKED BY VA/OK														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)					
								20 40 60 80 100	20 40 60 80 100	20 40 60	W <sub>p</sub>	W	W <sub>L</sub>	γ	GR	SA	SI	CL
208.9	ICE SURFACE																	
0.0	Ice																	
208.4																		
208.1	Water																	
0.9	PEAT, trace roots and wood fragments (Amorphous) Dark brown Wet		1A	SS	5		208							357.3				OC = 2.2%
	SAND, trace to some silt, trace clay, trace organics Very loose to loose Brown Wet		1B															OC = 3.8%
			2	SS	1		207											
			3	SS	2		206											0 89 10 1
			4	SS	7													
205.2							205											
3.7	SAND, some gravel, trace to some silt, trace clay Very dense Brown to grey Wet		5	SS	58													
			6	SS	54		204											
			7	SS	68/0.15		203											15 76 8 1
202.4	Grey below a depth of 6.1 m		8	SS	106													
6.6	END OF BOREHOLE SPOON AND CASING REFUSAL																	
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.																		

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-05				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5044333.3 ; E 244782.6				ORIGINATED BY ID											
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring				COMPILED BY PKS											
DATUM Geodetic		DATE February 19, 2009				CHECKED BY VA/OK											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
209.4	ICE SURFACE																
0.0	Ice																
209.1	Water																
208.8							209										
0.8	PEAT, containing wood fragments (Fibrous) Dark brown Wet		1	SS	3		208										
	SAND, some gravel, trace to some silt Very loose to compact Brown Wet		2	SS	2		207										
			3	SS	8		206										
			4	SS	9												
			5	SS	15/0.15												
205.3	END OF BOREHOLE SPOON AND CASING REFUSAL																
4.1	NOTES:  1. Water level in open borehole at ice surface (Elev. 209.4 m) upon completion of drilling.  2. Borehole caved to a depth of 2.2 m below ice surface (Elev. 207.2 m) upon removal of casing.																

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PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-06				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5044346.7 ; E 244786.3				ORIGINATED BY ID											
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring				COMPILED BY PKS											
DATUM Geodetic		DATE February 19, 2009				CHECKED BY VA/OK											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
209.3 0.0	ICE SURFACE Ice						209									1 89 9 1	
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		1	SS	8		208										
			2	SS	16												
			3	SS	10		207										
			4	SS	12		206										
			5	SS	51/0.20												
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.																



PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-07				SHEET 1 OF 1		METRIC										
W.P. 5111-07-00		LOCATION N 5044352.4 ;E 244817.8				ORIGINATED BY MJR												
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring				COMPILED BY VA												
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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
209.0	ICE SURFACE							20	40	60	80	100						
0.0	Ice																	
208.1																		
0.9	PEAT (Fibrous) Very soft Brown		1	SS	2													
207.5	Wet																	
1.5	SAND, trace gravel, trace organic Very loose Brown/grey		2	SS	4													
206.8	Wet																	
2.2	Gravelly SAND, some silt Dense to very dense Brown		3	SS	48													
205.6	Wet																	
3.4	END OF BOREHOLE SPOON AND CASING REFUSAL		4	SS	109/0.20													
NOTES: 1. Water level in open borehole at a depth of 0.6 m below ice surface (Elev. 208.4 m) upon completion of drilling. 2. Borehole caved to a depth of 1.2 m below ice surface (Elev. 207.8 m) upon removal of casing.																		

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S23-08</b>		SHEET 1 OF 1		<b>METRIC</b>	
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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
208.9	ICE SURFACE					▽	208	20	40	60	80	100	20	40	60	328.3	OC = 64.3%
0.0	Ice							20	40	60	80	100	20	40	60		
208.6																	
208.2	Water																
0.7	PEAT, trace wood fragments (Fibrous) Very soft Brown Wet		1	SS	1												
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												
			6	SS	21												
			7	SS	89												
			8	SS	87												
200.5																	
8.4	END OF BOREHOLE CASING REFUSAL																
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

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-09		SHEET 1 OF 1		METRIC																		
W.P. 5111-07-00		LOCATION N 5044365.5 ; E 244803.0		ORIGINATED BY MJR																				
DIST _____ HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY VA																				
DATUM Geodetic		DATE February 19, 2009		CHECKED BY VA/OK																				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																			
208.9	ICE SURFACE																							
0.0	Ice																							
208.3																								
208.0	Water																							
0.9	SAND, trace gravel, trace silt, trace organics		1	SS	9																			
207.4	Loose Brown and grey Wet		2	SS	6																			
1.5	Organic SAND, trace to some silt, trace clay																							
206.7	Loose Dark brown/grey Wet		3	SS	18																			
2.2	SAND, trace to some silt, trace gravel, trace clay		4	SS	16																			
	Loose to compact Brown Wet		5	SS	8																			
			6	SS	22																			
			7	SS	30																			
			8	SS	26																			
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.																							

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S23-10</b>		SHEET 1 OF 1		<b>METRIC</b>	
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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
209.4	ICE SURFACE						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
0.0	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																
198.4			10	SS	33/0.15								○				
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.																

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PROJECT 07-1111-0029		RECORD OF BOREHOLE No S23-11		SHEET 1 OF 1		METRIC										
W.P. 5111-07-00		LOCATION N 5044378.7 ; E 244788.3		ORIGINATED BY MJR												
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY VA												
DATUM Geodetic		DATE February 20, 2009		CHECKED BY VA/OK												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
213.5	GROUND SURFACE						20	40	60	80	100					
0.0	SAND, trace to some silt, trace gravel, trace organics to a depth of 1.8 m Very loose to very dense Brown Damp to wet		1	SS	2											
			2	SS	4											
			3	SS	13											
			4	SS	30											
			5	SS	31											
			6	SS	55											
			7	SS	51											
209.2	END OF BOREHOLE															
4.3	NOTE:  1. Borehole advanced using portable drilling equipment with half-weight hammer. 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 2.4 m below ground surface (Elev. 211.1 m) upon completion of drilling.															

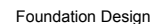
PROJECT		RECORD OF DCPT No S23-DC01				SHEET 1 OF 1		METRIC								
W.P. 07-1111-0029		LOCATION N 5044306.3 ; E 244783.3				ORIGINATED BY ID										
DIST _____ HWY 69		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test				COMPILED BY VA										
DATUM Geodetic		DATE February 18, 2009				CHECKED BY VA/OK										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
208.8	GROUND SURFACE						20	40	60	80	100	20	40	60		
0.0	Dynamic Cone Penetration Test (DCPT)															
206.5																
2.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

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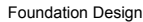




+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



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



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



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

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



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



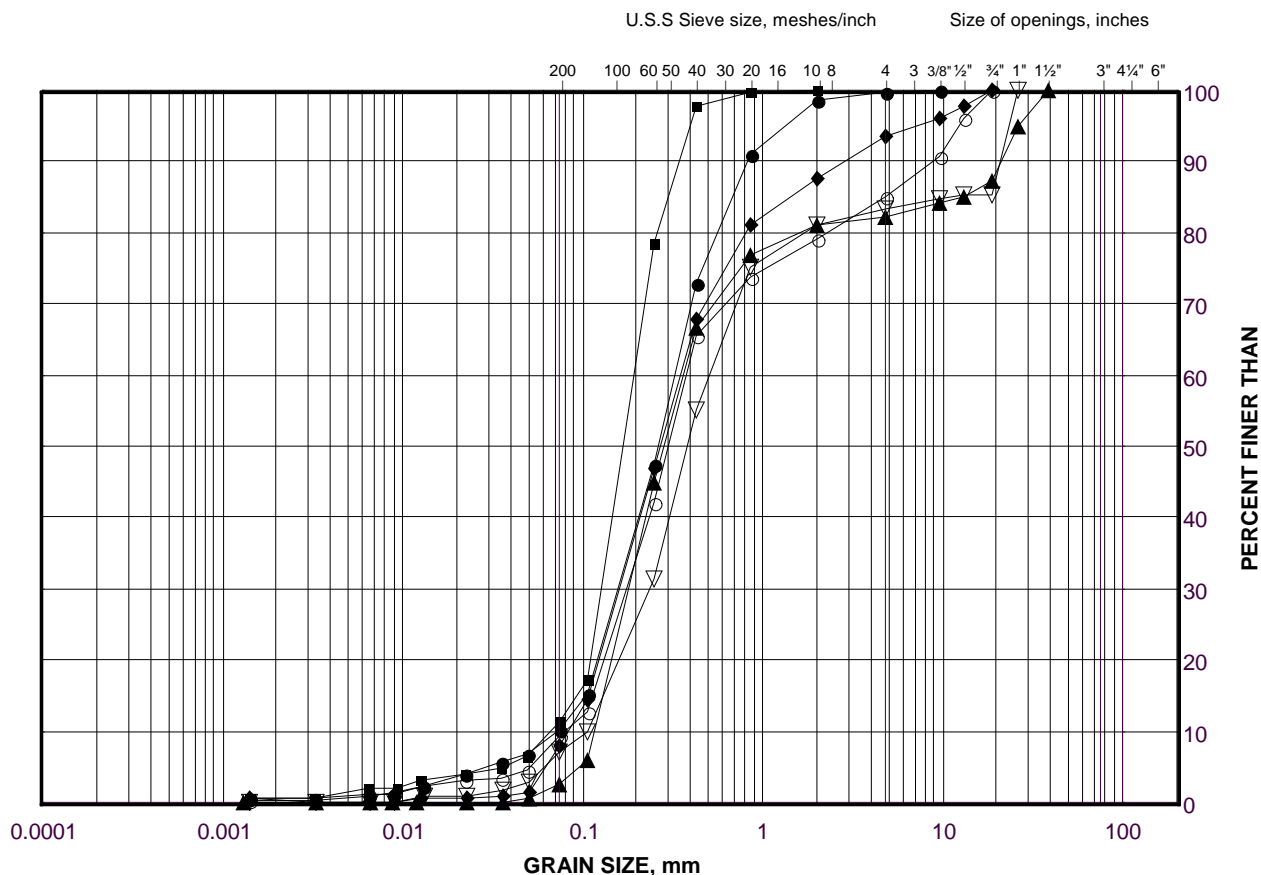
+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



# GRAIN SIZE DISTRIBUTION

Sand  
Highway 69 (SBL) STA 15+690 to 15+720

FIGURE A.S23-1



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
▲	S23-05	5	205.5
▽	S23-03A	7	202.5
○	S23-04	7	203.1

Project Number: 07-1111-0029

Checked By: CN

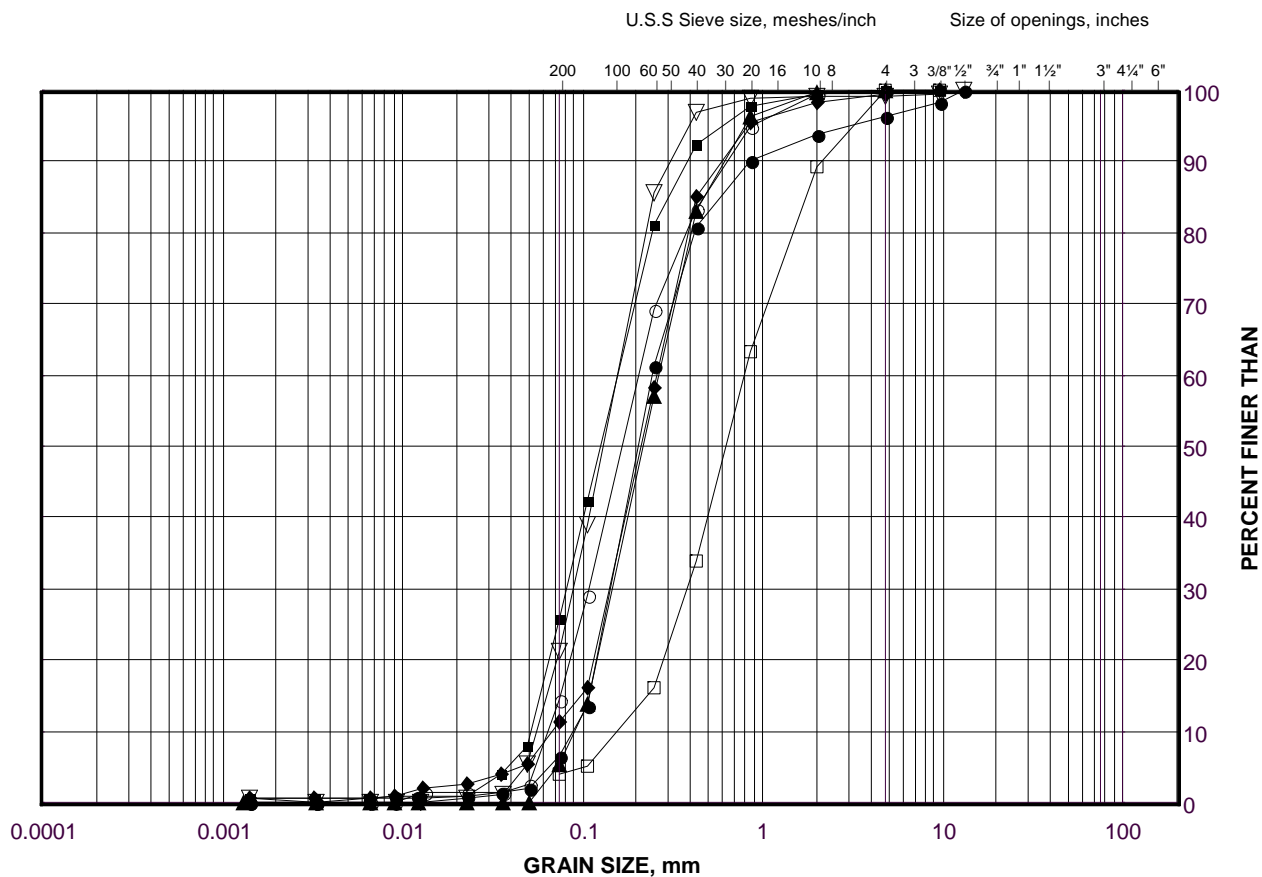
**Golder Associates**

Date: 27-Nov-09

# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand  
Highway 69 (NBL) STA 15+700 to 15+740

FIGURE A.S23-2



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S23-11	3	212.0
■	S23-10	4	206.1
◆	S23-09	4	205.5
▲	S23-08	5	204.8
▽	S23-10	6	204.5
○	S23-11	7	209.5
□	S23-08	8	201.0

Project Number: 07-1111-0029

Checked By: CN

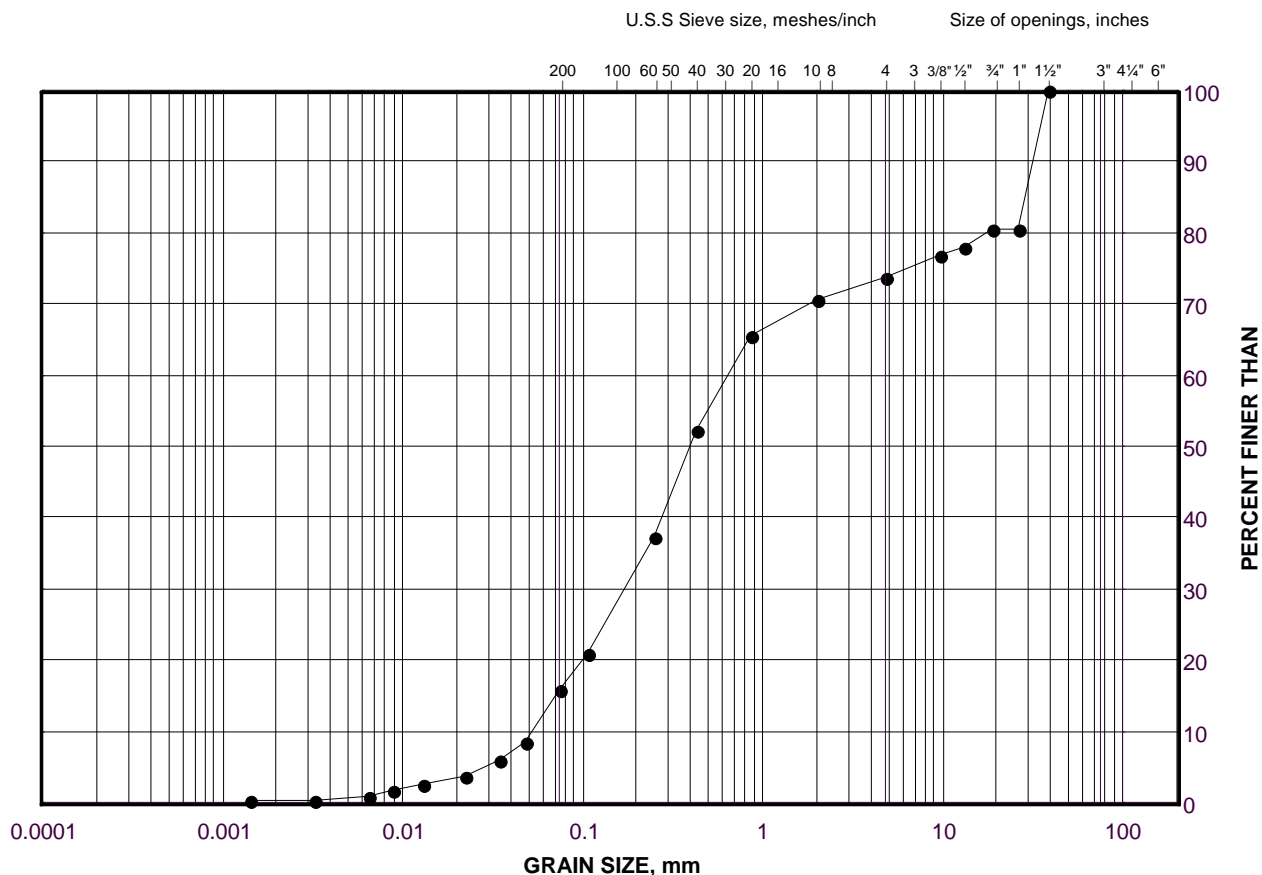
**Golder Associates**

Date: 27-Nov-09

# GRAIN SIZE DISTRIBUTION

Gravelly Sand  
Highway 69 (NBL) STA 15+700 to 15+740

FIGURE A.S23-3



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S23-07	3	206.4

Project Number: 07-1111-0029

Checked By: CN

**Golder Associates**

Date: 27-Nov-09



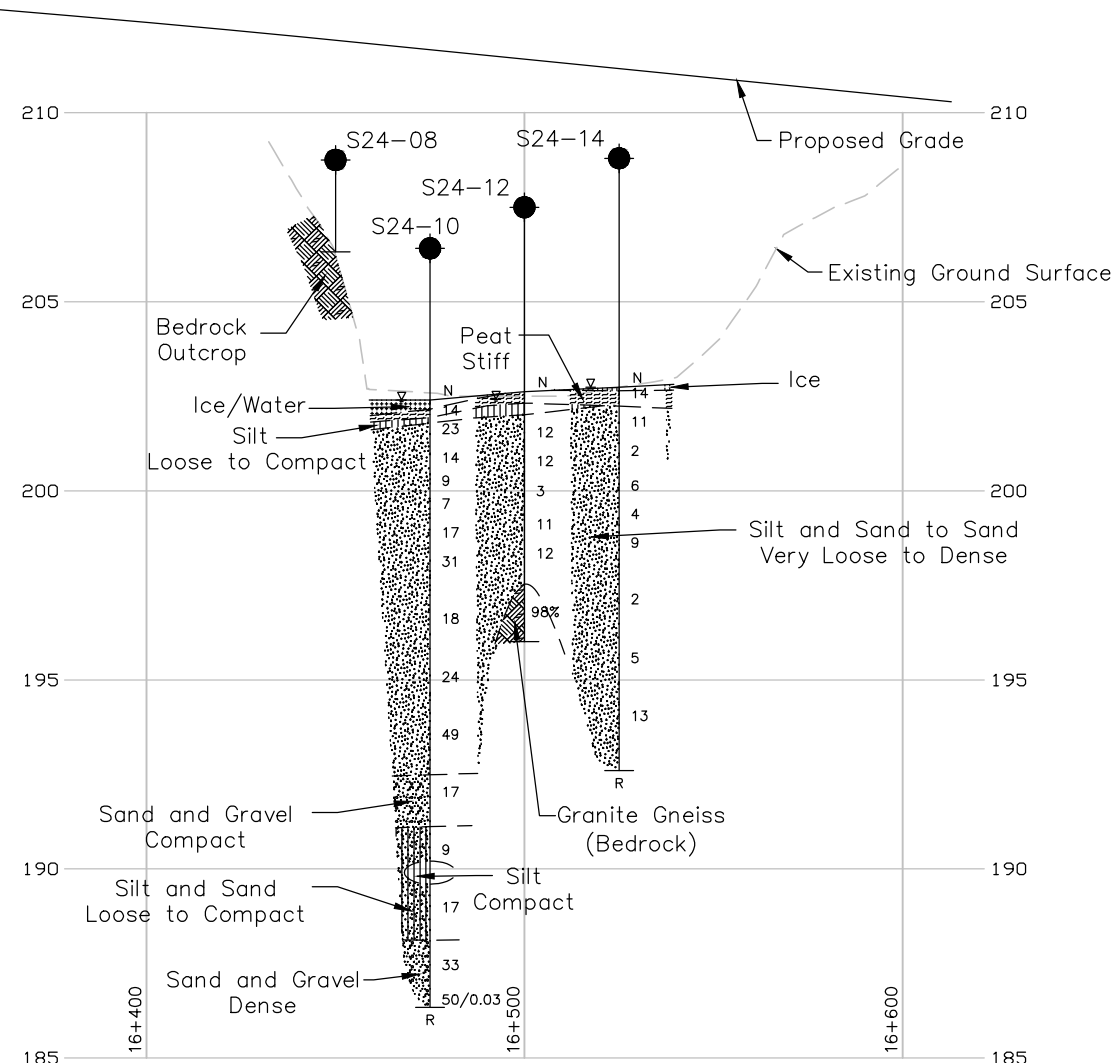
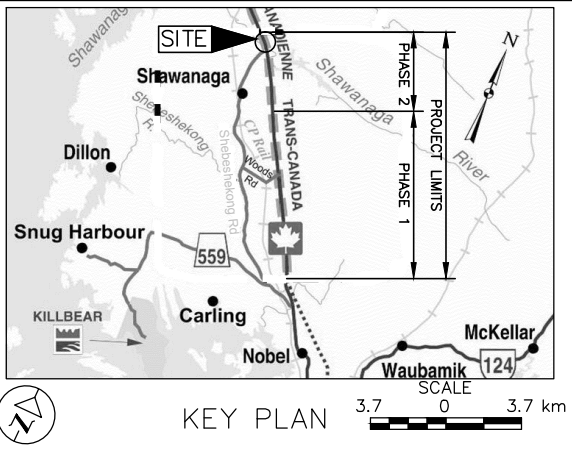
# **APPENDIX B**

**Highway 69 SBL – STA 16+475 to 16+550 and  
Highway 69 NBL – STA 16+450 to 16+550 (Swamp 24)**

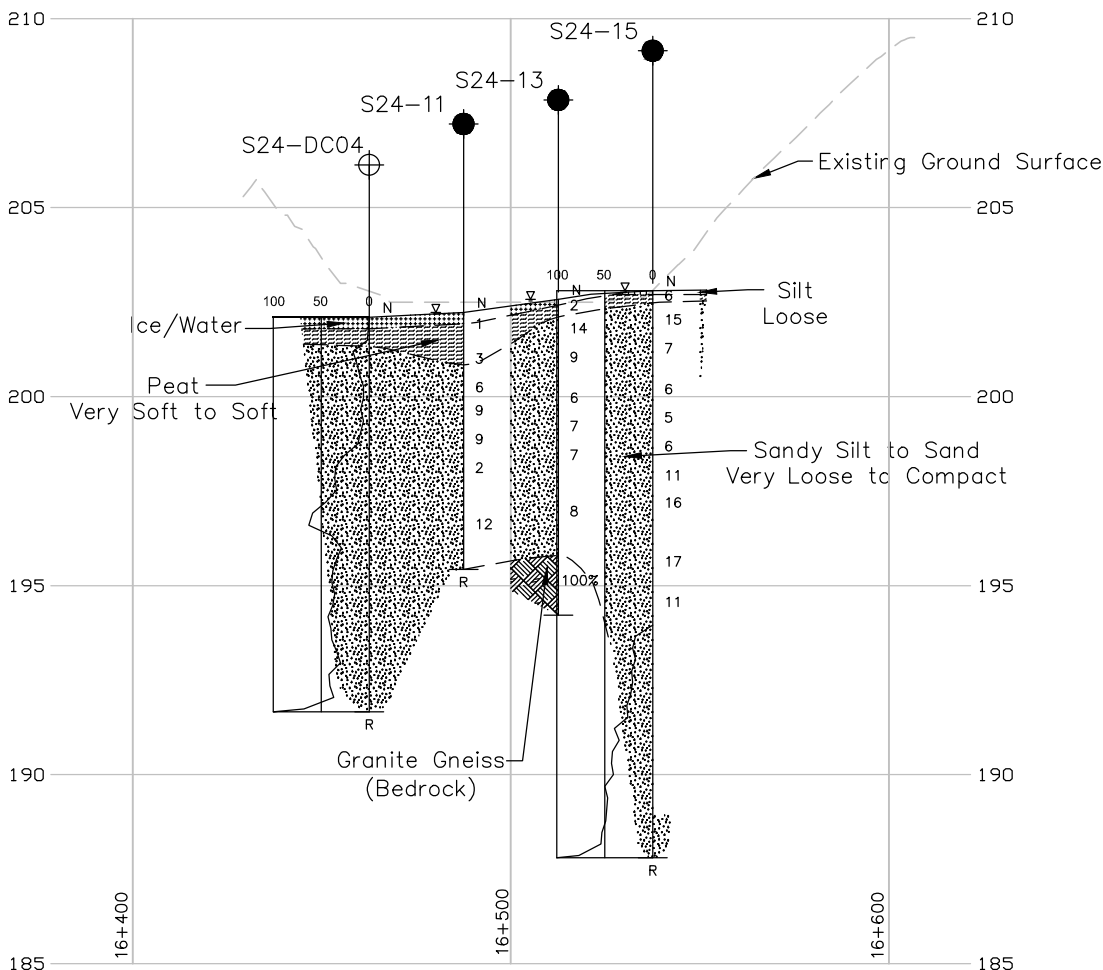
NO.	DATE	BY	REVISION			
Geocres No. 41H-161						
HWY. 69			PROJECT NO. 07-1111-0029		DIST.	
SUBM'D. VA	CHKD. VA / OK		DATE: Nov. 2009		SITE:	
DRAWN: DD/RJ	CHKD. CN		APPD. JPD/JMAC		DWG. B1	

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

CONT No. GWP No. 5111-07-00		
HIGHWAY 69 (NBL) STA 16+450 TO STA 16+550		SHEET
SOIL STRATA		



**D-D'**  
**B1** CENTRELINE PROFILE  
HIGHWAY 69 (NBL)  
HORIZONTAL SCALE  
20 0 20 40 m  
VERTICAL SCALE  
2 0 2 4 m



**E-E'**  
**B1** EMBANKMENT TOE PROFILE  
HIGHWAY 69 (NBL)  
HORIZONTAL SCALE  
20 0 20 40 m  
VERTICAL SCALE  
2 0 2 4 m

- LEGEND**
- Borehole - Current Investigation
  - ⊕ Dynamic Cone Penetration Test
  - 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
  - 100% Rock Quality Designation (RQD)

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
S24-08	206.3	5044929.8	244349.9
S24-10	202.4	5044950.2	244335.4
S24-11	202.2	5044971.3	244343.7
S24-12	202.6	5044970.6	244321.0
S24-13	202.6	5044991.8	244329.3
S24-14	202.7	5044991.0	244306.5
S24-15	202.8	5045011.1	244313.3
S24-DC04	202.1	5044951.3	244358.6

**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 MRC, drawing file 5271XB01.DWG, 5271-XPD-ARCHIPELAGO.dwg, 5271-XPD-Carling.dwg, 5271-XPD-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878\_PHASE1\_XA1, h6878\_PHASE1\_XN1.dwg, received January 21, 2009, h6878\_PHASE2\_XA1, h6878\_PHASE2\_XN1.dwg, received January 21, 2009.



NO.	DATE	BY	REVISION
Geocres No. 41H-161			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. VA/OK	DATE: Nov. 2009	SITE:
DRAWN: DD/RJ	CHKD. CN	APPD. JPD/JMAC	DWG. B2

PROJECT		RECORD OF BOREHOLE		No S24-01		SHEET 1 OF 1		METRIC								
W.P. 07-1111-0029		LOCATION		N 5044928.4 ; E 244304.7		ORIGINATED BY		MR								
DIST		HWY 69		BOREHOLE TYPE		115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring		COMPILED BY								
DATUM		Geodetic		DATE		January 26, 2009		CHECKED BY								
								VA/OK								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
202.7	ICE SURFACE															
0.0	Ice															
0.3	Root mat															
201.9	PEAT, trace rootlets (Amorphous)		1	AS	2											
0.8	Very soft Dark brown Wet															
	Silty SAND, trace clay		2	SS	12											
	Loose to compact															
	Brown															
	Wet		3B	SS	8											
200.5																
2.3	SILTY CLAY, trace sand															
	Grey															
	Wet		4	SS	12											
199.8	SILT and SAND, trace clay															
	Compact															
	Grey		5A	SS	6											
	Wet		5B	SS	6											
	SILTY CLAY, trace sand															
	Brown															
	Wet		6	SS	2											
	SILT and SAND, trace clay,															
	containing silt layers															
	Very loose to compact															
198.0	Grey		7A	SS	13											
4.7	Wet		7B	SS	13											
197.5	SAND, trace silt															
	Compact															
5.2	Grey															
	Wet															
196.9	END OF BOREHOLE															
5.8	CASING REFUSAL															
	END OF DCPT															
	Refusal to Further Penetration															
	(100 Blows / 0.03 m)															
	NOTES:															
	1. Water level in open borehole at															
	ice surface (Elev. 202.7 m) upon															
	completion of drilling.															
	2. A Dynamic Cone Penetration															
	Test was advanced 1.5 m west of															
	Borehole S24-01, refusal															
	encountered at a depth of 5.8 m															
	below ice surface (Elev. 196.9 m).															



PROJECT		RECORD OF BOREHOLE		No S24-02		SHEET 1 OF 1		METRIC								
W.P.		LOCATION		ORIGINATED BY		MR										
DIST		BOREHOLE TYPE		COMPILED BY		MWK										
DATUM		DATE		CHECKED BY		VA/OK										
PROJECT 07-1111-0029		N 5044927.0 ; E 244281.0														
W.P. 5111-07-00		LOCATION		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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
202.7	GROUND SURFACE															
0.0	PEAT (Amorphous)		1	SS	4											
202.4	Soft Dark brown Wet															
202.0	SAND, some silt Loose Brown Wet		2	SS	15											
0.7	SILT and SAND, trace clay Loose to compact Grey Wet		3	SS	7											
200.4	SAND, some silt, trace gravel, trace clay Loose to compact Grey Wet		4	SS	6											
2.3			5	SS	4											
			6	SS	14											
197.5	Silty SAND, trace to some gravel below a depth of 9.5 m, trace clay Loose to dense Grey Wet		7	SS	5											
5.2																
			8	SS	6											
			9	SS	5											
192.5	END OF BOREHOLE SPOON AND CASING REFUSAL		10	SS	100/0.03											
10.2	NOTE: 1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 202.5 m) upon completion of drilling.															

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S24-03				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5044948.8 ; E 244290.3				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 26, 2009				CHECKED BY VA/OK											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
202.7	GROUND SURFACE							20	40	60	80	100					
0.0	PEAT, trace rootlets (Amorphous)		1	SS	4												
202.4	Soft Dark brown Wet																
0.5	SILT, some sand, trace gravel, trace clay, trace organics and rootlets Very loose Grey Wet		2	SS	13												
	SILT and SAND, trace clay Loose to compact Grey Wet		3	SS	6												
			4	SS	5												
			5	SS	6												
198.8	SAND, some silt, trace clay Loose to compact Grey Wet		6	SS	11												
3.9																	
			7	SS	8												
			8	SS	4												
			9	SS	9												
			10	SS	8												
191.6	SAND and GRAVEL, trace silt Compact Grey Wet		11	SS	16												
11.1																	
190.0	END OF BOREHOLE CASING REFUSAL																
12.7	NOTE: 1. Water level in open borehole at ground surface (Elev. 202.7 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE		No S24-04		SHEET 1 OF 1		METRIC																		
W.P.		LOCATION		ORIGINATED BY		DIST		BOREHOLE TYPE																		
5111-07-00		N 5044949.4 ; E 244265.1		MR		HWY 69		115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring																		
DATUM		DATE		CHECKED BY		COMPILED BY																				
Geodetic		January 28, 2009		VA/OK		MWK																				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			SHEAR STRENGTH kPa			WATER CONTENT (%)			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>	γ	GR	SA	SI	CL						
203.1	0.0	GROUND SURFACE					203																			
202.7	0.5	PEAT (Amorphous) Soft Dark brown Wet		1	SS	3																				
		SILT, trace sand, trace clay, trace organics Brown and grey Wet		2	SS	12	202											0	82	17	1					
201.3	1.8	SAND, some silt, trace clay Loose to compact Grey to brownish grey Wet		3A	SS	9	201																			
		SAND, trace silt, trace clay Very loose to loose Grey Wet		3B																						
				4	SS	8	200																			
				5	SS	3	199											0	94	4	2					
				6	SS	7	198																			
				7	SS	3	197																			
		Trace gravel below a depth of 6.4 m		8	SS	3	196											1	96	2	1					
				9	SS	4	195																			
193.6	9.5	END OF BOREHOLE SPOON AND CASING REFUSAL		10	SS	100/0.02	194																			
		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.																								

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S24-05		SHEET 1 OF 2		METRIC														
W.P. 5111-07-00		LOCATION N 5044967.6 ; E 244277.0		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 27, 2009		CHECKED BY VA/OK																
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ	GR	SA	SI	CL
202.8	GROUND SURFACE							20 40 60 80 100												
0.0	Root mat																			
0.2	SILT and SAND, trace clay, trace organics to a depth of 1.4 m Loose to compact Brown to grey Wet		1	SS	15		202												OC=1.0%	
			2	SS	13															
			3	SS	5		201													
	Silt layer between depths of 2.2 m and 3.5 m		4	SS	6		200													
199.3			5A	SS	12															
			5B	SS															Non-Plastic	
3.7	SILTY CLAY, trace sand Very soft Brown Wet		6	SS	15		199													
	SAND, trace to some silt, trace clay Compact Grey Wet						198													
			7	SS	23		197												0 83 15 2	
196.4																				
6.4	Gravelly SAND, trace to some silt, trace clay Loose to compact Grey Wet		8	SS	20		196												20 73 7 2	
							195													
			9	SS	9		194													
							193													
			10	SS	8		192													
191.8																				
11.0	SAND and GRAVEL, trace silt Compact Grey Wet		11	SS	16		191													
190.6							190													
12.2	SAND, trace to some silt Compact Grey Wet		12	SS	15														0 90 10 0	
							189													
			13	SS	15		188													

Continued Next Page

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

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PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S24-05</b>		SHEET 2 OF 2		<b>METRIC</b>										
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044967.6 ; E 244277.0</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 27, 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  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W		
187.3	END OF BOREHOLE CASING REFUSAL															
15.5	NOTE:  1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 202.6 m) upon completion of drilling.															

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PROJECT 07-1111-0029		<b>RECORD OF BOREHOLE No S24-06</b>		SHEET 1 OF 1		<b>METRIC</b>											
W.P. 5111-07-00		LOCATION N 5044969.9 ; E 244298.4		ORIGINATED BY MR													
DIST HWY 69		BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers		COMPILED BY MWK													
DATUM Geodetic		DATE January 19, 2009		CHECKED BY VA/OK													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL
							20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub> W W <sub>L</sub>	20 40 60						
202.7	ICE SURFACE																
0.0	Ice																
	Water																
0.4	Root mat																
	SILT and SAND, trace clay, trace organics to a depth of 1.1 m, containing root mat and rootlets		1	SS	16		202										OC=1.3%
	Loose to compact		2	SS	16		201										
	Brown and grey		3	SS	4		200										0 63 35 2
	Wet		4	SS	6		199										
199.3																	
3.4	SAND, trace to some silt, trace clay		5	SS	18		199										
	Very loose to compact		6	SS	21		198										
	Grey						197										0 91 8 1
	Wet		7	SS	3		196										
			8	SS	5		195										
			9	SS	7		194										
			10A	SS	10		193										
			10B	SS	10		192										2 96 2 0
							191										
190.6			11	SS	100/0.25												
12.1	END OF BOREHOLE SPOON AND AUGER REFUSAL																
	NOTE:																
	1. Water level in open borehole at ice surface (Elev. 202.7 m) upon completion of drilling.																

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S24-07		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5044989.7 ; E 244261.4		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 27, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
202.8	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			kN/m <sup>3</sup>					
0.0	PEAT (Amorphous)																				
0.2	SILT and SAND, trace clay, trace organics to a depth of 0.8 m and rootlets Compact Brown to grey Wet		1	SS	12		202														
			2	SS	14		201														
			3	SS	13		200														
200.4	SAND and GRAVEL, trace silt Compact Grey Wet		4	SS	11		199														
199.5	SAND, trace to some silt, trace gravel Very loose to compact Brown to brownish grey Wet		5	SS	5		198														
			6	SS	7		197														
			7	SS	3		196														
			8	SS	14		195														
194.6	SAND and GRAVEL, trace to some silt Compact to dense Brown to brownish grey Wet		9	SS	33		194														
			10	SS	15		193														
192.0	END OF BOREHOLE						192														
10.8							191														
190.4	END OF DCPT Refusal to Further Penetration (100 Blows / 0.23 m)  NOTES: 1. Water level in open borehole at ground surface (Elev. 202.8 m) upon completion of drilling. 2. A Dynamic Cone Penetration Test was carried out below a depth of 10.8 m; refusal encountered at a depth of 12.4 m below ground surface (Elev. 190.4 m).																				

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

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

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-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>		<b>RECORD OF BOREHOLE No S24-10</b>		SHEET 1 OF 2		<b>METRIC</b>	
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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>		
202.4	ICE SURFACE						20 40 60 80 100		20 40 60					
0.0	Ice													
	Water													
0.6	PEAT (Amorphous)		1A	SS	14					○				
	Stiff		1B											
	Dark brown		2	SS	23									
	Wet													
	SILT, trace sand, trace clay, trace rootlets													
	Compact		3	SS	14					○				0 39 60 1
	Grey													
	Wet													
	SILT and SAND, trace clay, trace rootlets to a depth of 0.8 m		4	SS	9									
	Loose to compact		5	SS	7					○				
	Grey													
	Wet													
199.0														
3.4	Silty SAND, trace clay													
	Compact to dense		6	SS	17									
	Grey													
	Wet		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		10	SS	49					○				3 80 15 2
	Wet													
192.5														
9.9	SAND and GRAVEL, trace silt													
	Compact													
	Grey													
	Wet		11	SS	17									
191.1														
11.3	SILT and SAND, trace clay													
	Loose													
	Grey													
	Wet													
190.2														
12.2	SILT, trace sand, trace clay		12	SS	9									
	Loose													
	Grey													
	Wet													
189.6														
12.8	SILT and SAND, trace clay, some cobbles and boulder										○			0 69 30 1
	Compact													
	Grey		13	SS	17									
	Wet													
187.9														
14.5														

Continued Next Page

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

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

PROJECT		RECORD OF BOREHOLE		No S24-10		SHEET 2 OF 2		METRIC									
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									
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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
186.3	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		187										
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												

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S24-11		SHEET 1 OF 1		METRIC																
W.P. 5111-07-00		LOCATION N 5044971.3 ; E 244343.7		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			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ			GR	SA	SI	CL
202.2	ICE SURFACE							20	40	60	80	100	20	40	60							
0.0	Ice						202															
0.3	Water						201															
200.8	PEAT, trace sand layers (Amorphous) Very soft Dark brown Wet		1	SS	1		200															
1.4	SILT and SAND, trace gravel, trace organics Very loose Grey Wet		2A	SS	3		199															
200.3	Sandy SILT, trace clay		2B				198															
1.9	Loose Grey Wet		3	SS	6		197															
198.9	Very loose to compact Grey Wet		4	SS	9		196															
3.3			5	SS	9																	
			6	SS	2																	
			7	SS	12																	
195.4	END OF BOREHOLE CASING REFUSAL																					
6.8	NOTES: 1. Water level in open borehole at ice surface (Elev. 202.2 m) upon completion of drilling.																					

PROJECT		RECORD OF BOREHOLE		No S24-12		SHEET 1 OF 1		METRIC													
W.P.		LOCATION		ORIGINATED BY																	
DIST		BOREHOLE TYPE		COMPILED BY																	
DATUM		DATE		CHECKED BY																	
07-1111-0029		N 5044970.6 ; E 244321.0		MR																	
5111-07-00		115 mm O.D. Continuous Flight Solid Stem Augers and HW Casing, Wash Boring		VA																	
Geodetic		January 24, 2009		VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20	40	60	80	100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	GR	SA	SI	CL
202.6	0.0	GROUND SURFACE																			
202.3	0.3	PEAT (Amorphous) Dark brown Wet		1	AS	-															
202.0	1.0	SILT, some sand, trace clay, trace organics and rootlets Loose Grey Wet		2A	SS	5		202													
201.6	1.0	SAND, some silt, trace clay, trace organics and rootlets Loose Grey Wet		2B	SS																
				3	SS	12															
				4	SS	12															
				5	SS	3															
				6	SS	11															
				7	SS	12															
197.5	5.1	Granite Gneiss (BEDROCK)																			
		Bedrock cored from depths of 5.1 m to 6.6 m		1	RC	REC 100%															
		For bedrock coring details, refer to Record of Drillhole S24-12																			
196.0	6.6	END OF BOREHOLE						196													
		NOTE:  1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 202.4 m) upon completion of drilling.																			



PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S24-13</b>		SHEET 1 OF 1		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044991.8 ; E 244329.3</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>VA</u>			
DATUM <u>Geodetic</u>		DATE <u>January 22, 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
202.6	ICE SURFACE																
0.0	Ice																
202.1	PEAT (amorphous), containing rootlets Soft Grey Wet		1	SS	2												
0.5	Silty SAND to SAND, trace gravel, trace organics and rootlets near surface of deposit Very loose to compact Grey Wet		2	SS	14												
			3	SS	9												
			4	SS	6												
			5	SS	7												
			6	SS	7												
			7	SS	8												
195.8	Granite Gneiss (BEDROCK)																
6.8	Bedrock cored from depths of 6.8 m to 8.4 m  For bedrock coring details, refer to Record of Drillhole S24-13		1	RC	REC 100%												
194.3	END OF BOREHOLE																
8.4	NOTE:  1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling.																

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

PROJECT: 07-1111-0029

**RECORD OF DRILLHOLE: S24-13**

SHEET 1 OF 1

LOCATION: N 5044991.8 ;E 244329.3


DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: D25

DRILLING CONTRACTOR: Walker Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth RO - Rough VR - Very Rough MB - Mechanical Break BR - Broken Rock <b>NOTE:</b> For additional abbreviations refer to list of abbreviations & symbols.																NOTES
				DEPTH (m)			RECOVERY				FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA						HYDRAULIC CONDUCTIVITY K, cm/sec			Diametral Point Load Index (MPa)	RMC -Q' AVG.	
				FLUSH			TOTAL CORE %	SOLID CORE %	R.Q.D. %	B Angle		DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	10 °	10 °	10 °				
7	HQRC January 22, 2009	Continued from Record of Borehole S24-13		195.83	1																		
8		GRANITE GNEISS Slightly weathered to fresh, fine to medium grained with feldspar banding, foliated, black, pink and grey		6.77																			
9		END OF DRILLHOLE		194.25																			
10				8.35																			
11																							
12																							
13																							
14																							
15																							
16																							

DEPTH SCALE

1 : 50



LOGGED: MR

CHECKED: VA/OK

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



PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S24-14</b>		SHEET 1 OF 1		<b>METRIC</b>														
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044991.0 ; E 244306.5</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 25, 2009</u>		CHECKED BY <u>VA/OK</u>																
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ	GR SA SI CL			
202.7	ICE SURFACE							20 40 60 80 100												
0.0	Ice																			
0.1	PEAT, containing rootlets (Amorphous)		1	SS	14		202													
202.2	Stiff Dark brown Wet																			
0.5	SAND, trace to some silt, trace gravel, trace clay, trace organics to a depth of 0.8 m		2	SS	11												1 87 11 1			
	Very loose to compact Grey Wet						201													
			3	SS	2															
							200													
			4	SS	6															
							199													
			5	SS	4															
							198										0 94 6 0			
			6	SS	9															
							197													
			7	SS	2															
							196													
			8	SS	5															
							195													
194.5	SAND, trace silt, containing cobbles and boulders						194													
8.2	Compact Grey Wet		9	SS	13															
	Containing cobbles and boulder below a depth of 9.8 m						193													
192.6	END OF BOREHOLE CASING REFUSAL																			
10.1	NOTE: 1. Water level in open borehole at ice surface (Elev. 202.7 m) upon completion of drilling.																			



PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE</b>		<b>No S24-15</b>	SHEET 1 OF 2	<b>METRIC</b>
W.P. <u>5111-07-00</u>	LOCATION <u>N 5045011.1 ;E 244313.3</u>	ORIGINATED BY <u>MR</u>				
DIST <u>          </u> HWY <u>69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers and HW Casing, Wash Boring</u>				COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>January 21, 2009</u>				CHECKED BY <u>VA/OK</u>	

[illegible]

Continued Next Page

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



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

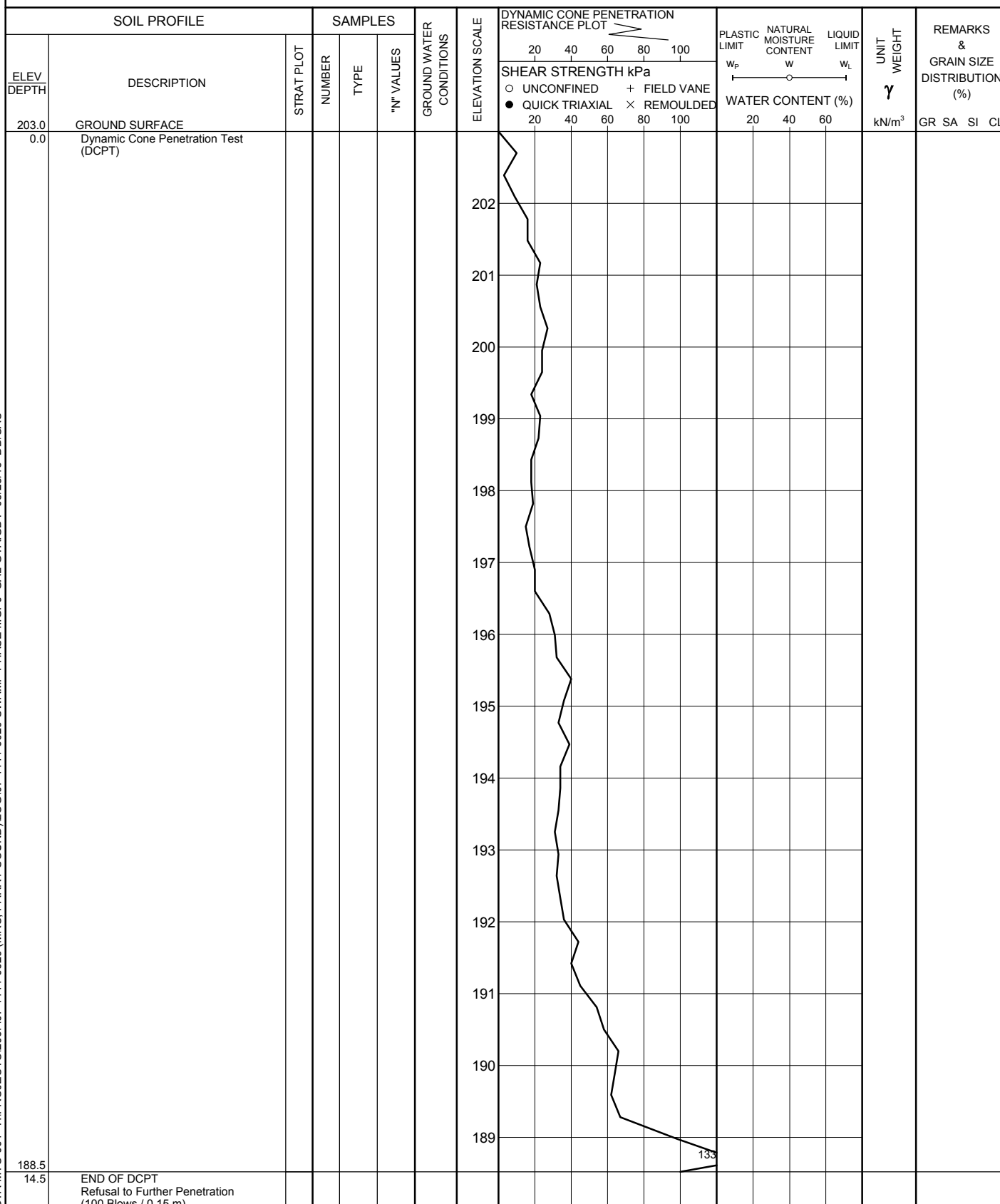
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PROJECT <u>07-1111-0029</u>				<b>RECORD OF DCPT No S24-DC-01</b>				SHEET 1 OF 1		<b>METRIC</b>				
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044949.5 ; E 244312.9</u>				ORIGINATED BY <u>MR</u>								
DIST <u>          </u> HWY <u>69</u>		BOREHOLE 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	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
202.7 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)							20 40 60 80 100	20 40 60	W <sub>p</sub>	W	W <sub>L</sub>		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED						
188.3 14.4	END OF DCPT Refusal to Further Penetration (100 Blows / 0.03 m)													

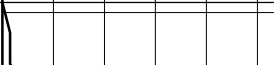











GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC




PROJECT <u>07-1111-0029</u>		<b>RECORD OF DCPT No S24-DC-02</b>		SHEET 1 OF 1		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044990.3 ;E 244284.0</u>		ORIGINATED BY <u>MR</u>			
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>PENETRATION TEST</u>		COMPILED BY <u>MWK</u>			
DATUM <u>Geodetic</u>		DATE <u>January 21, 2009</u>		CHECKED BY <u>VA/OK</u>			



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

PROJECT <u>07-1111-0029</u>				<b>RECORD OF DCPT No S24-DC-03</b>				SHEET 1 OF 1				<b>METRIC</b>					
W.P. <u>5111-07-00</u>				LOCATION <u>N 5044969.2 ; E 244254.2</u>				ORIGINATED BY <u>MR</u>									
DIST <u>          </u> HWY <u>69</u>				BOREHOLE TYPE <u>PENETRATION TEST</u>				COMPILED BY <u>MWK</u>									
DATUM <u>Geodetic</u>				DATE <u>January 22, 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
203.1 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)						203	<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED + FIELD VANE</span> <span>● QUICK TRIAXIAL × REMOULDED</span> </div>									
							202										
							201										
							200										
							199										
							198										
							197										
							196										
							195										
							194										
							193										
							192										
191.1 12.0	END OF DCPT Refusal to Further Penetration (100 Blows / 0.15 m)																

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

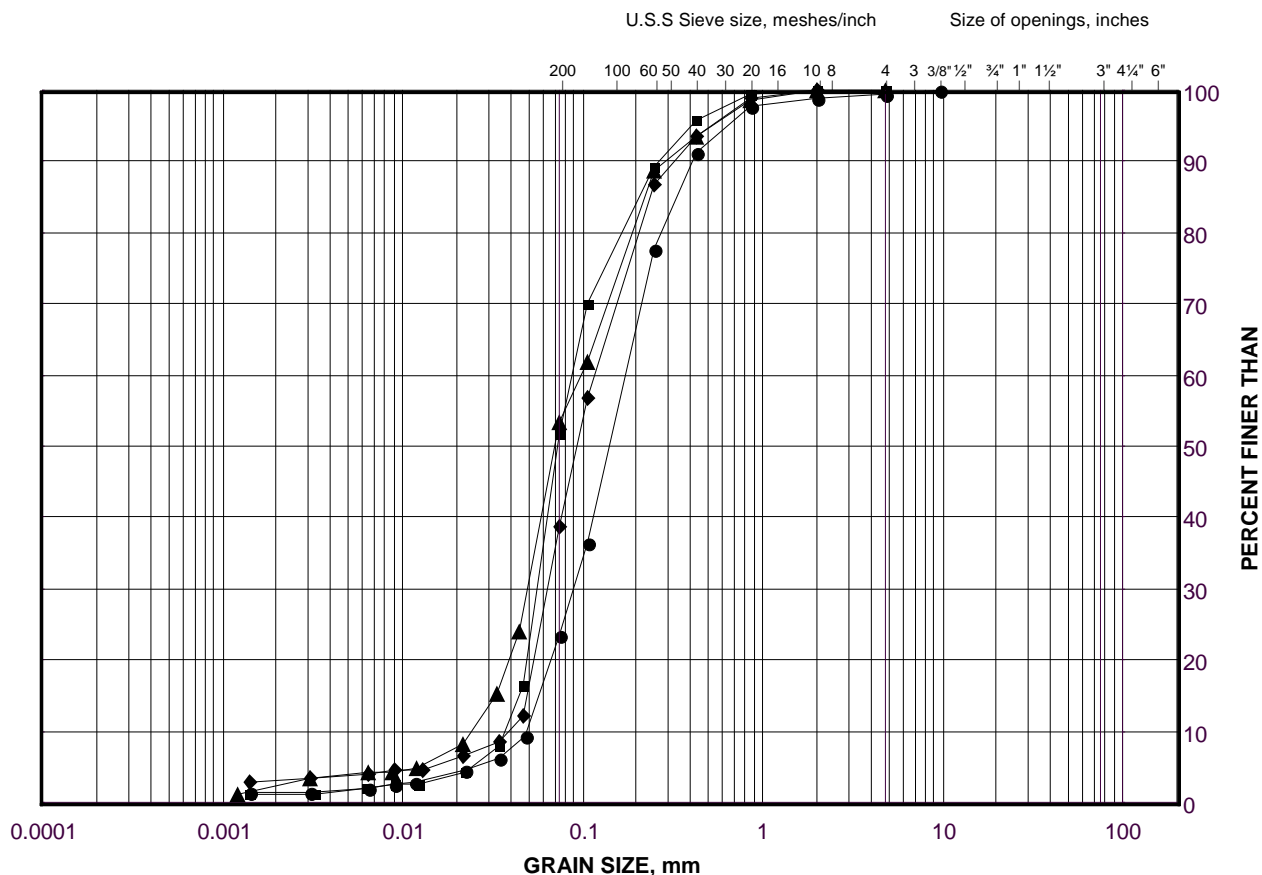
PROJECT <u>07-1111-0029</u>				<b>RECORD OF DCPT No S24-DC-04</b>				SHEET 1 OF 1				<b>METRIC</b>								
W.P. <u>5111-07-00</u>				LOCATION <u>N 5044951.3 ; E 244358.6</u>				ORIGINATED BY <u>MR</u>												
DIST <u>          </u> HWY <u>69</u>				BOREHOLE TYPE <u>PENETRATION TEST</u>				COMPILED 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
202.1	GROUND SURFACE						202	<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div>							
0.0	Dynamic Cone Penetration Test (DCPT)						202													
						201														
						200														
						199														
						198														
						197														
						196														
						195														
						194														
						193														
191.7	END OF DCPT Refusal to Further Penetration (100 Blows / 0.08 m)						192													

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

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Silty Sand  
Highway 69 (SBL) STA 16+475 to 16+550

FIGURE B.S24-1A



## LEGEND

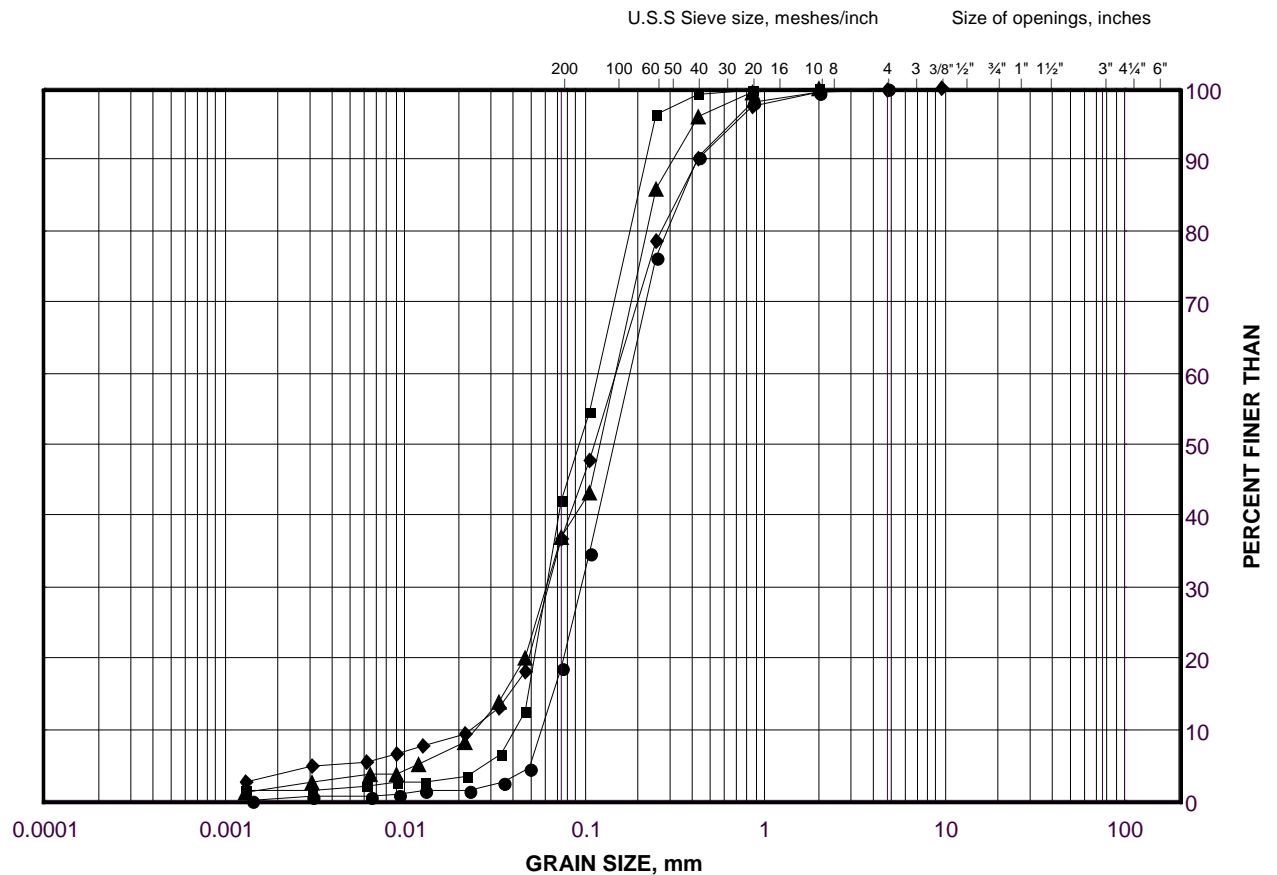
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-01	2	201.4
■	S24-03	3	200.9
◆	S24-01	4	200.1
▲	S24-01	5B	199.5



# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand  
Highway 69 (SBL) STA 16+475 to 16+550

FIGURE B.S24-1B



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

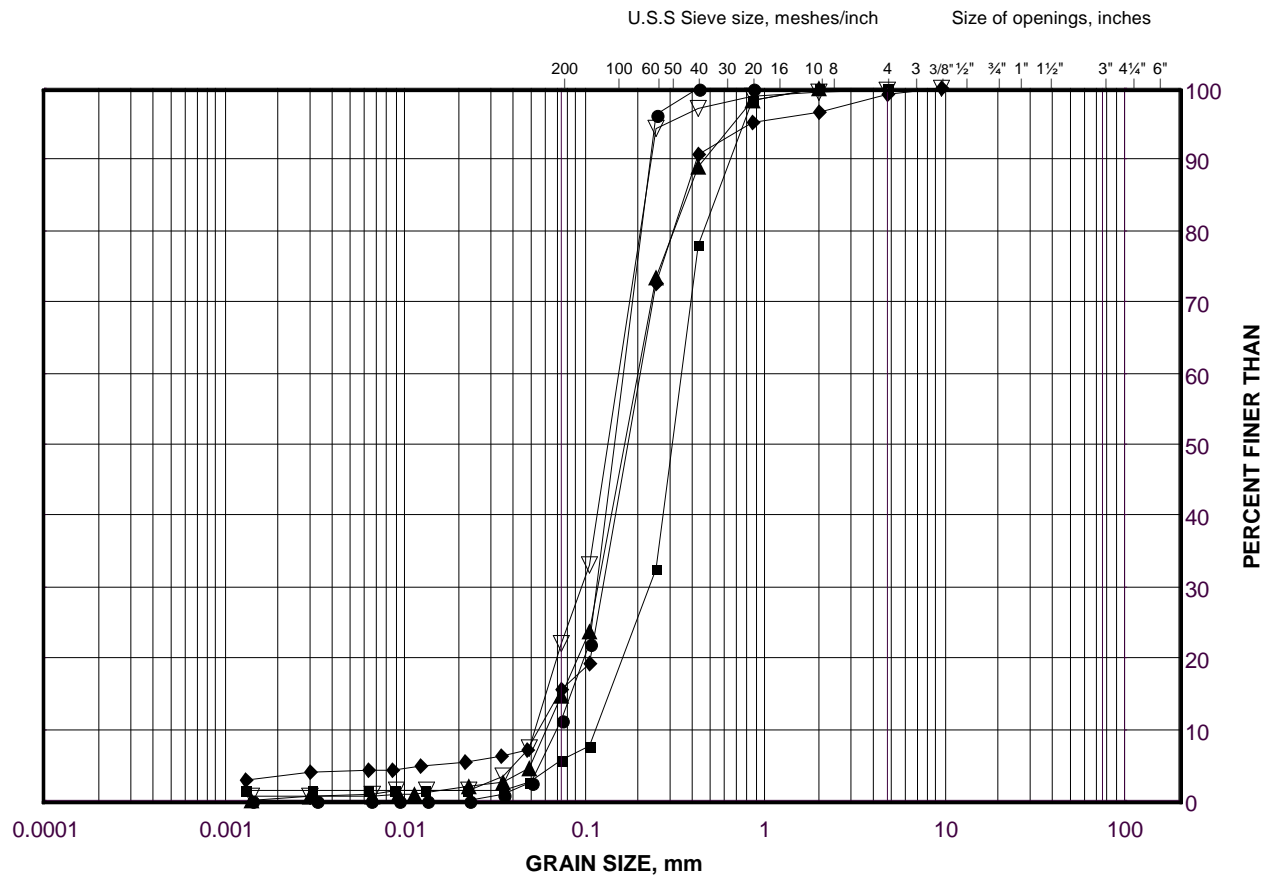
## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-04	2	202.0
■	S24-02	2	201.6
◆	S24-09	3	200.9
▲	S24-06	3	200.4

# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand  
Highway 69 (SBL) STA 16+475 to 16+550

FIGURE B.S24-1C



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	5	199.7
◆	S24-02	6	198.4
▲	S24-03	7	196.9
▽	S24-02	9	193.9

Project Number: 07-1111-0029

Checked By: CN

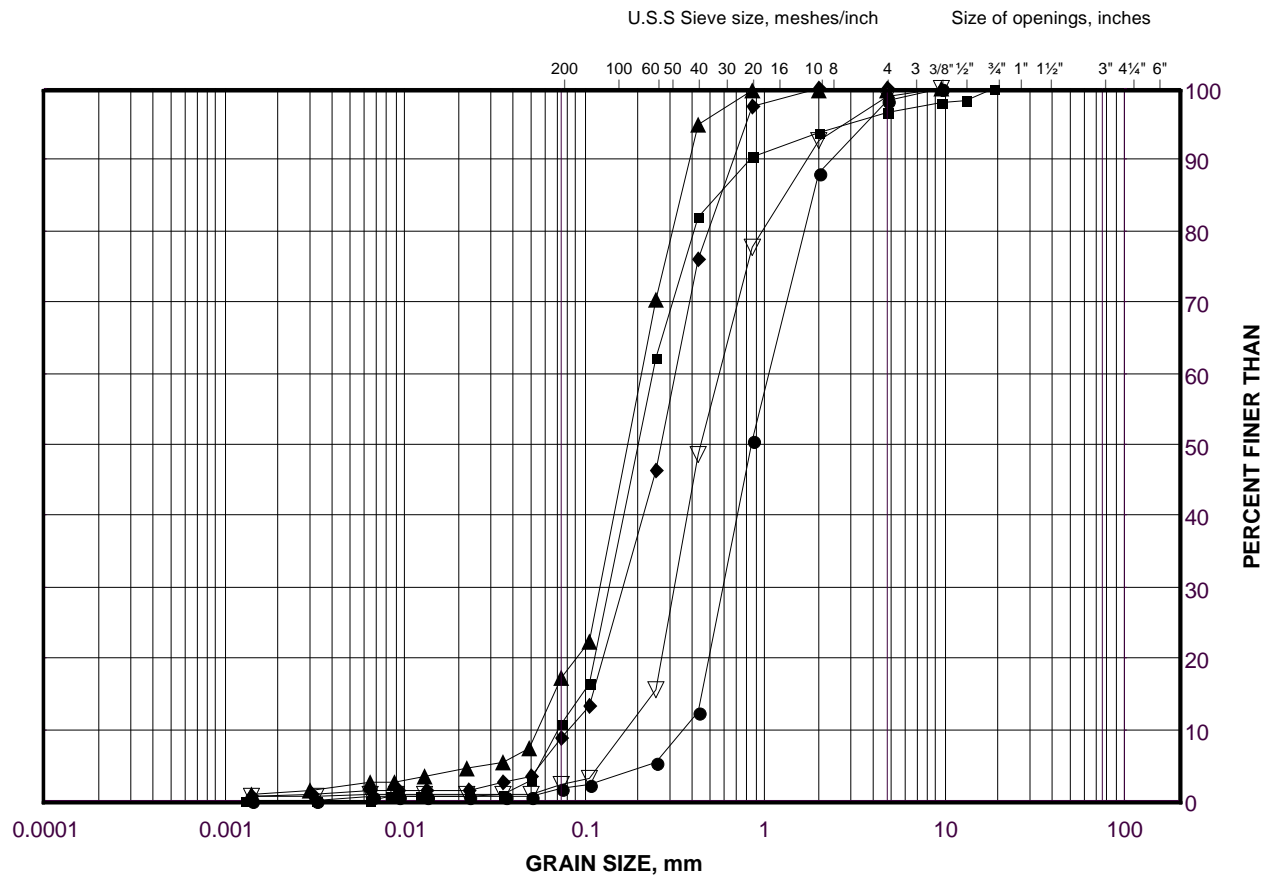
**Golder Associates**

Date: 15-Dec-09

# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand  
Highway 69 (SBL) STA 16+475 to 16+550

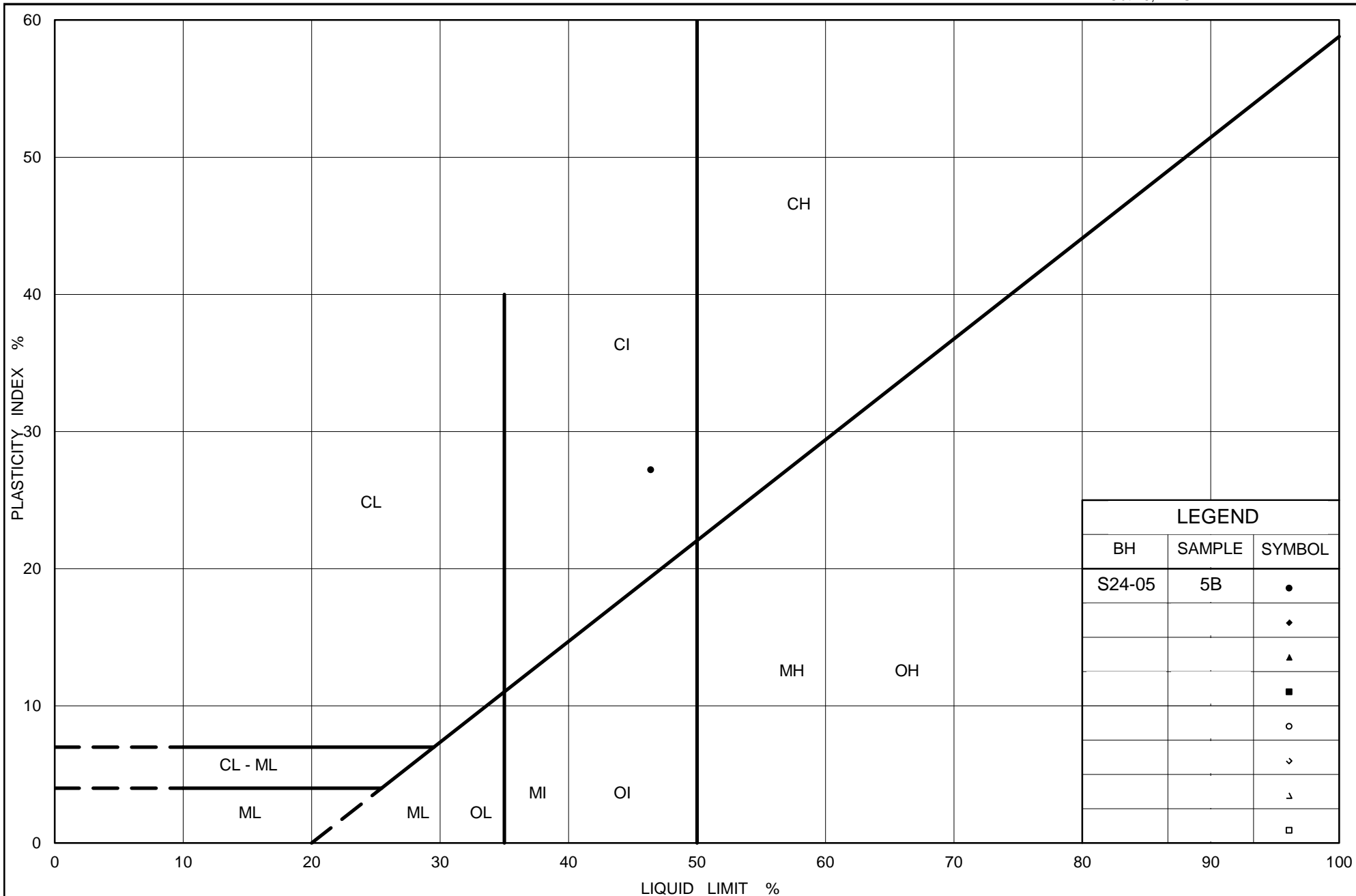
FIGURE B.S24-1D



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
■	S24-07	7	196.9
◆	S24-06	7	196.6
▲	S24-05	7	197.2
▽	S24-04	8	195.9



Ministry of Transportation

Ontario

**PLASTICITY CHART**  
**Silty Clay**  
**Highway 69 (SBL) STA 16+475 to 16+550**

Figure No. B.S24-2

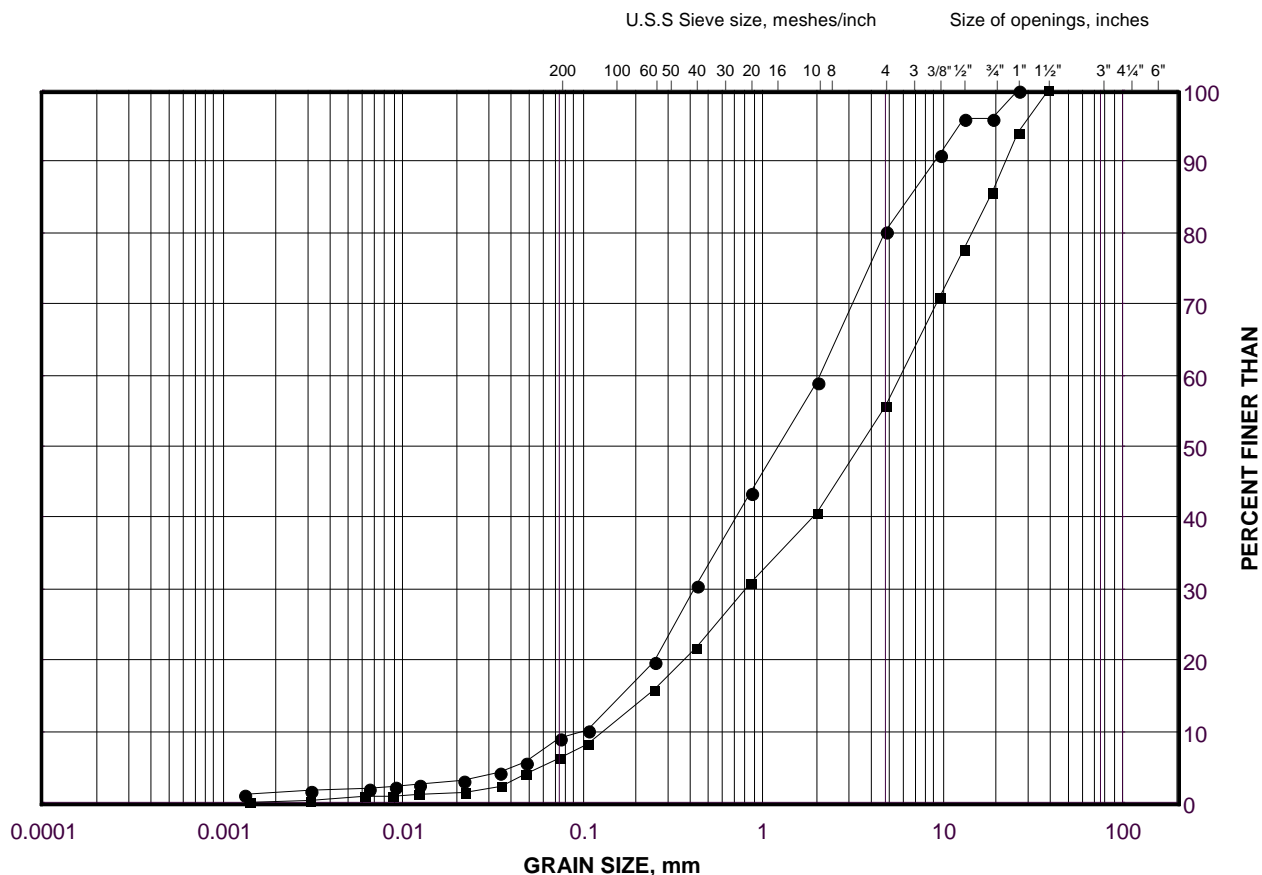
Project No. 07-1111-0029

Checked By: CN

# GRAIN SIZE DISTRIBUTION

Sand and Gravel  
Highway 69 (SBL) STA 16+475 to 16+550

FIGURE B.S24-3A



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-05	8	195.6
■	S24-07	9	193.8

Project Number: 07-1111-0029

Checked By: CN

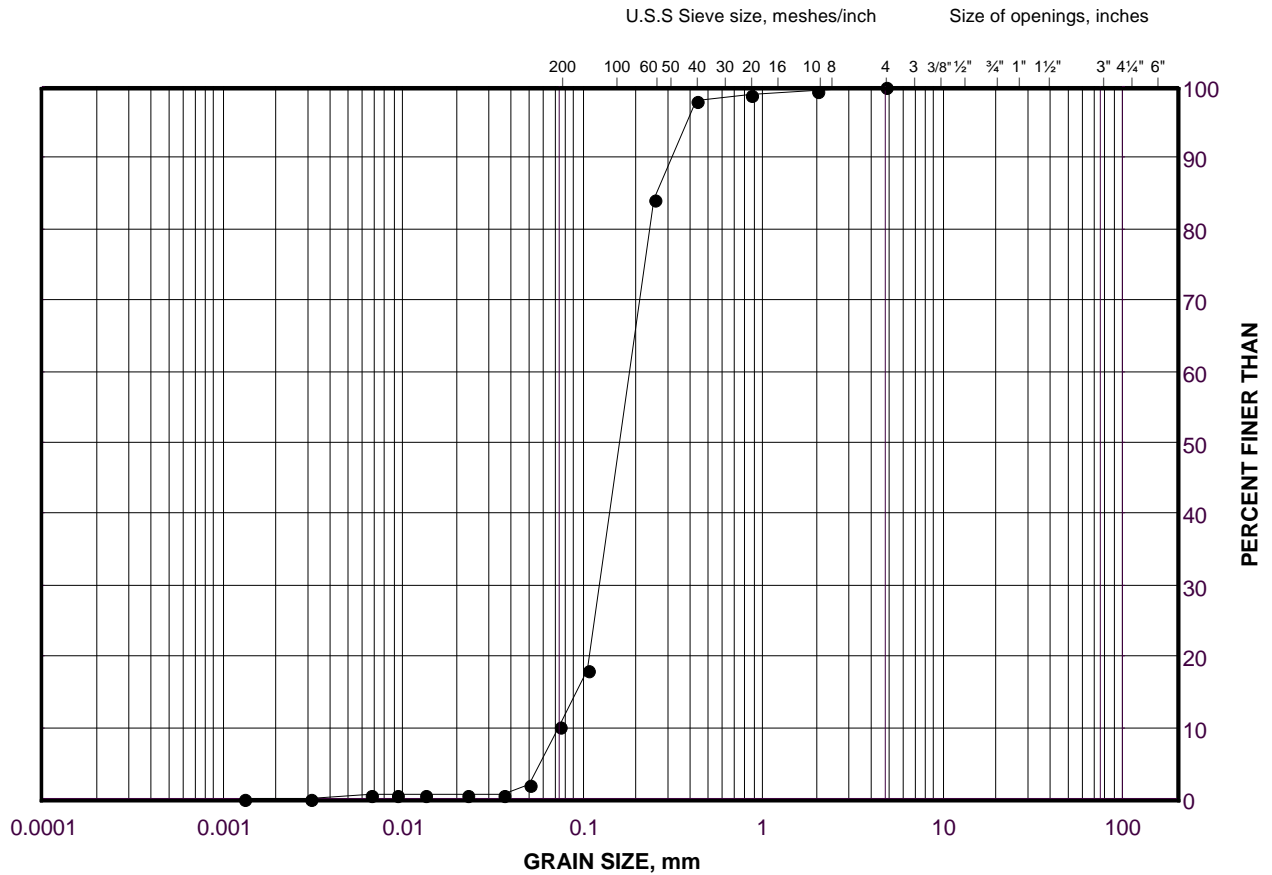
**Golder Associates**

Date: 15-Dec-09

# GRAIN SIZE DISTRIBUTION

Sand  
Highway 69 (SBL) STA 16+475 to 16+550

FIGURE B.S24-3B



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S24-05	12	189.6

Project Number: 07-1111-0029

Checked By: CN

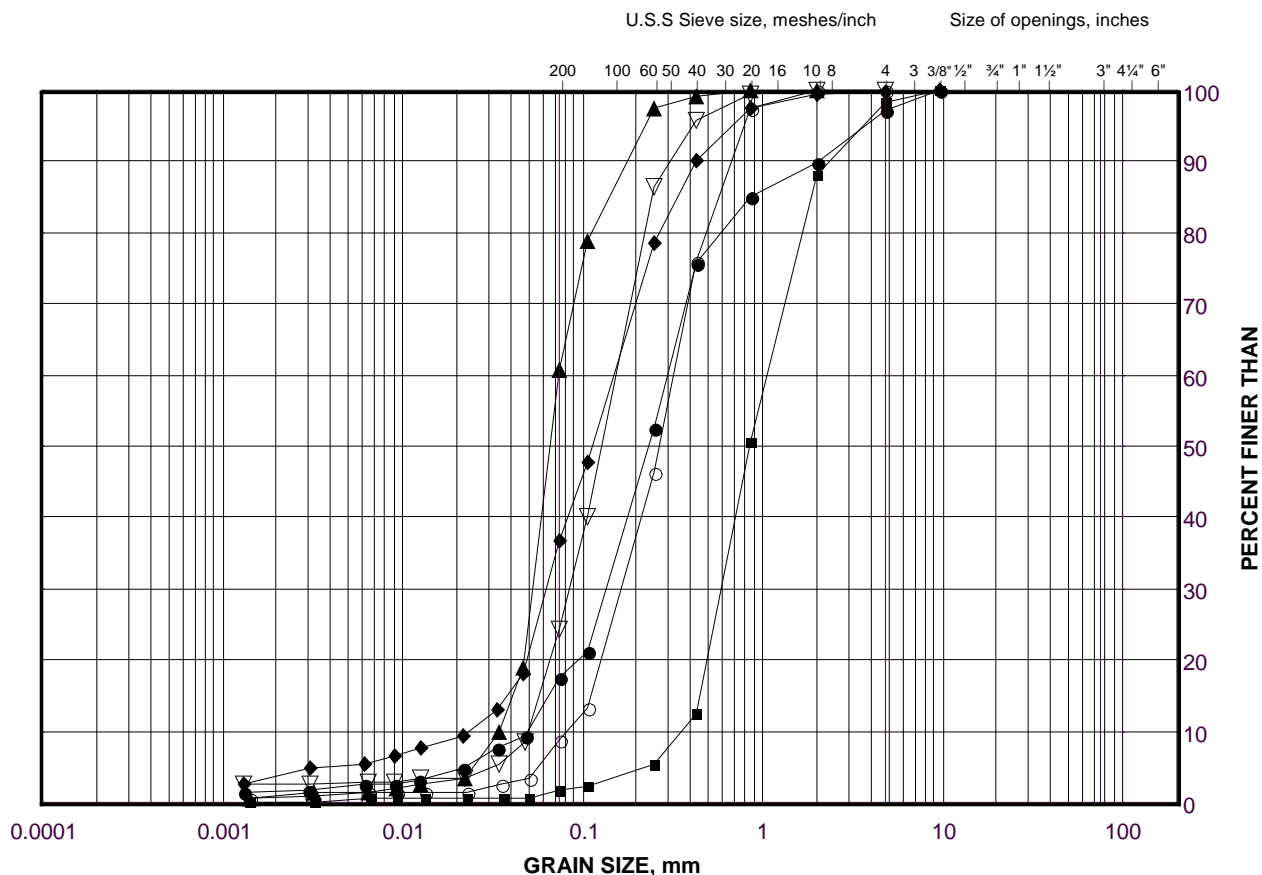
**Golder Associates**

Date: 15-Dec-09

# GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand  
Highway 69 (NBL) STA 16+450 to 16+550

FIGURE B.S24-4A



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
◆	S24-09	3	200.8
▲	S24-10	3	200.6
▽	S24-10	7	197.8
○	S24-06	7	196.6

Project Number: 07-1111-0029

Checked By: CN

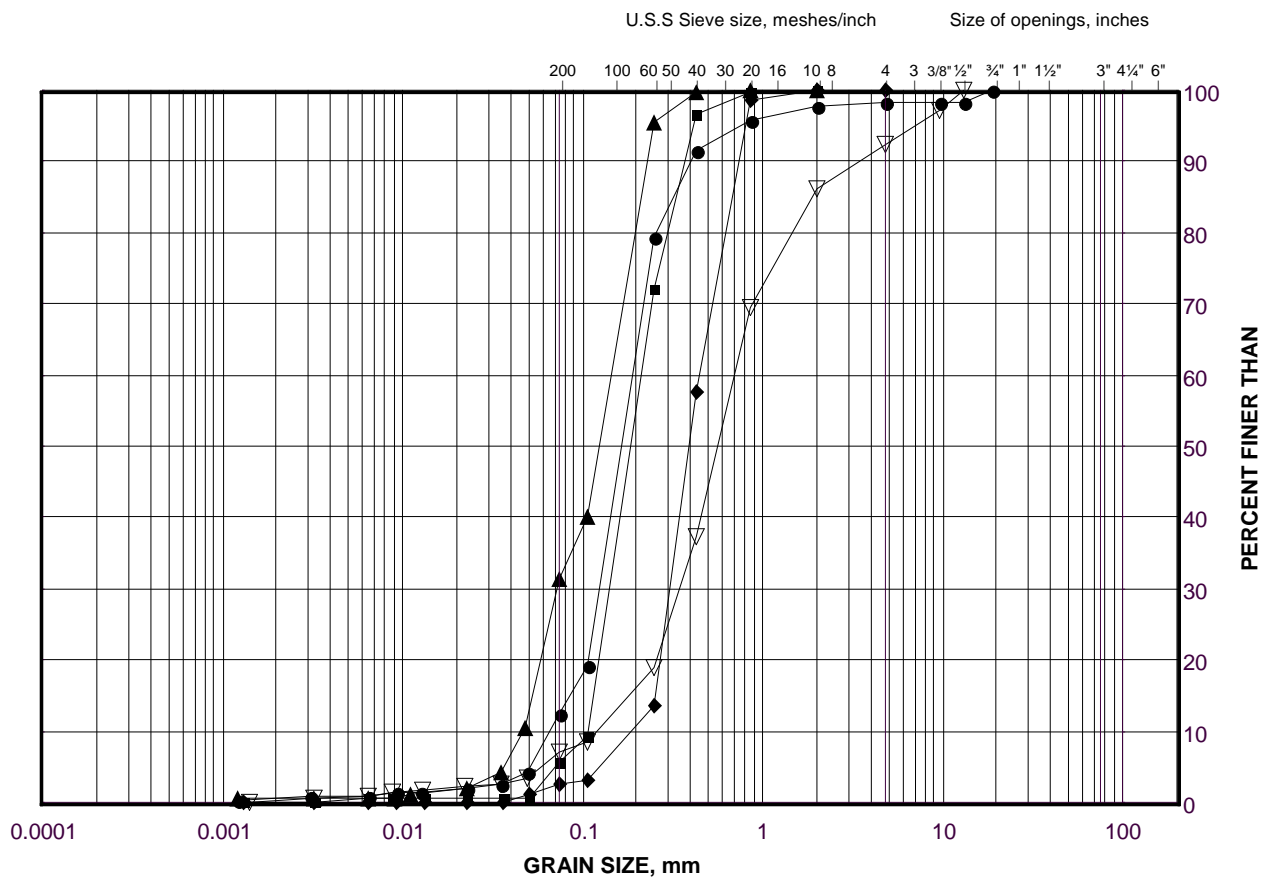
**Golder Associates**

Date: 15-Dec-09

# GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand  
Highway 69 (NBL) STA 16+450 to 16+550

FIGURE B.S24-4B



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S24-14	2	201.5
■	S24-14	6	198.3
◆	S24-15	7	197.6
▲	S24-13	7	196.7
▽	S24-15	8	196.9

Project Number: 07-1111-0029

Checked By: CN

**Golder Associates**

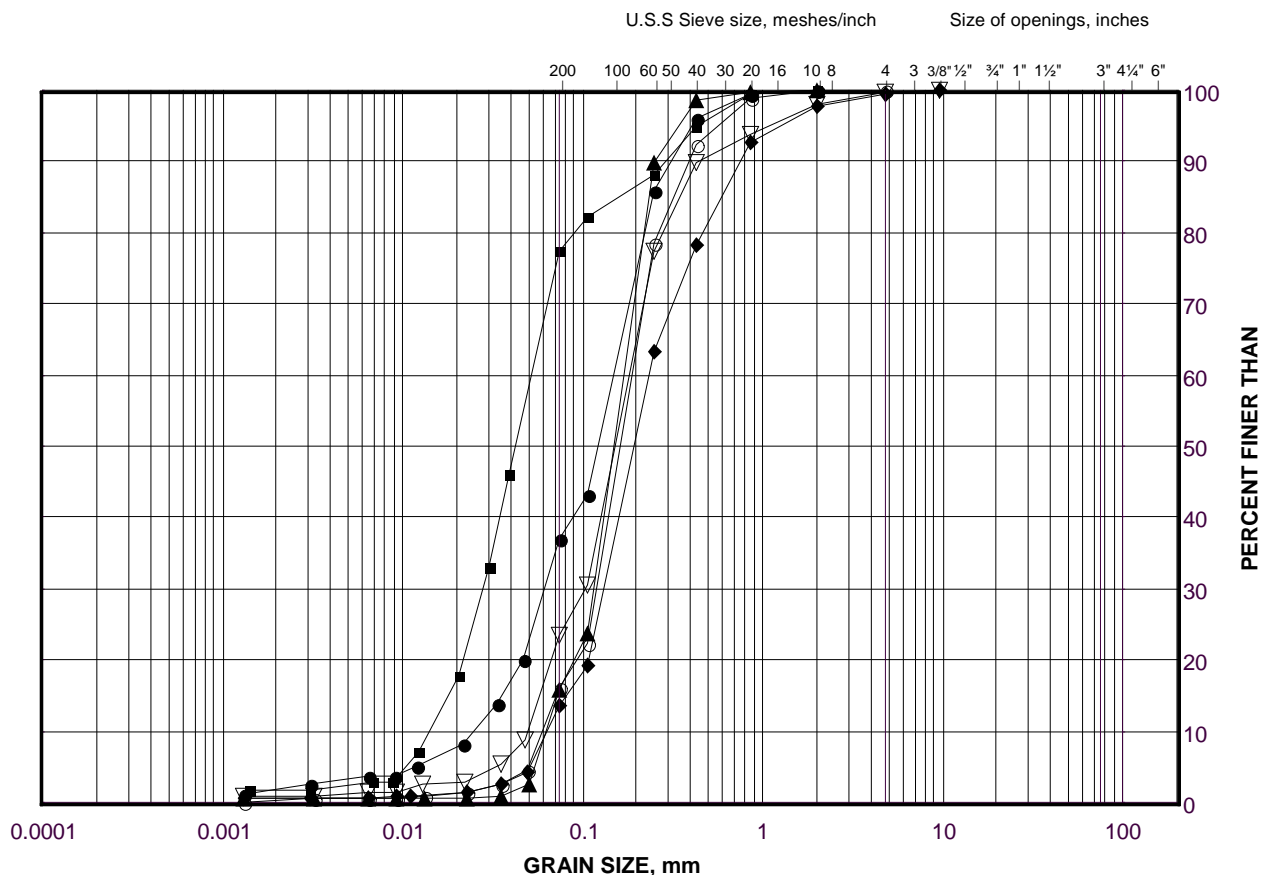
Date: 15-Dec-09



# GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand  
Highway 69 (NBL) STA 16+450 to 16+550

FIGURE B.S24-4C



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	3	200.4
■	S24-11	3	199.9
◆	S24-13	4	199.7
▲	S24-12	4	200.5
▽	S24-11	6	197.8
○	S24-12	7	198.0

Project Number: 07-1111-0029

Checked By: CN

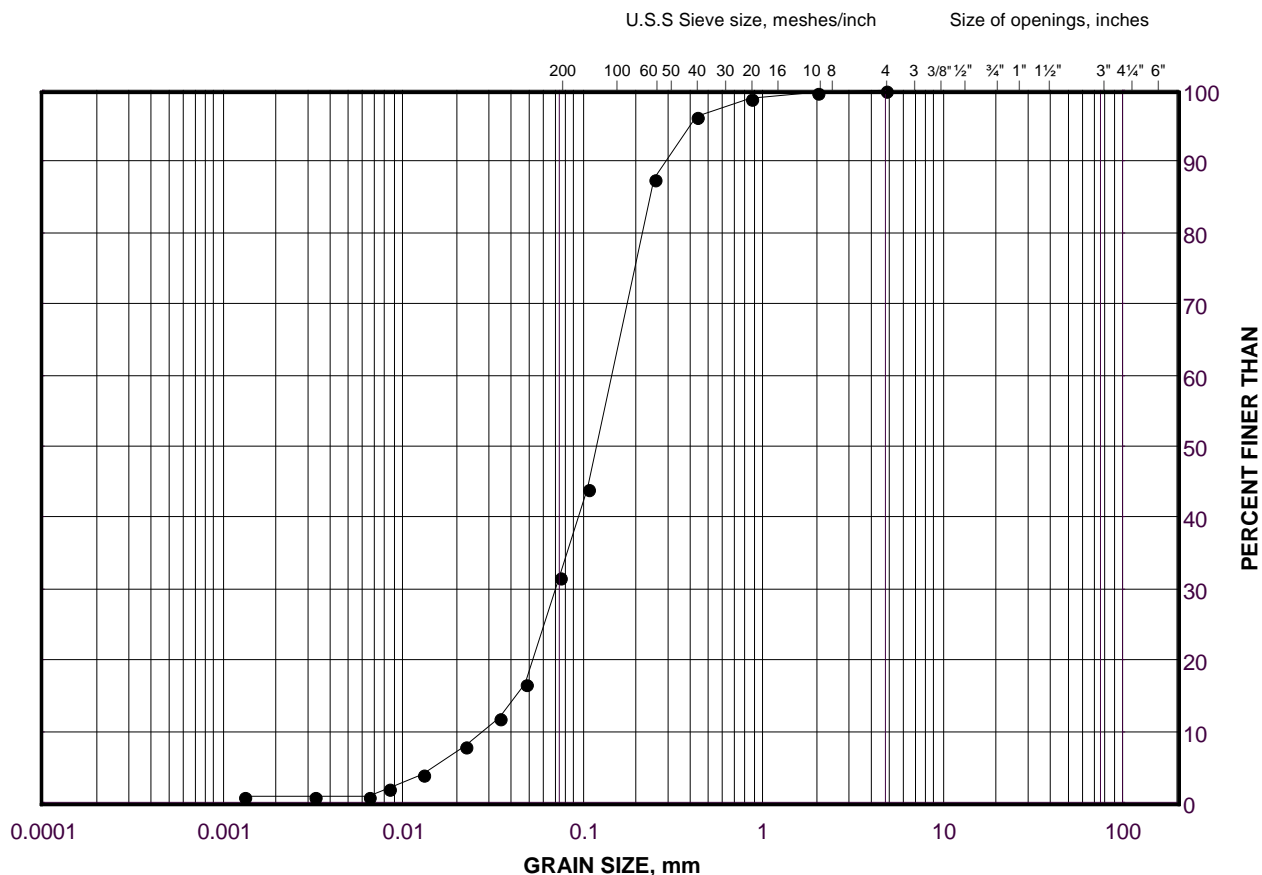
**Golder Associates**

Date: 15-Dec-09

# GRAIN SIZE DISTRIBUTION

Silt and Sand  
Highway 69 (NBL) STA 16+450 to 16+550

FIGURE B.S24-5



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	13	188.7

Project Number: 07-1111-0029

Checked By: CN

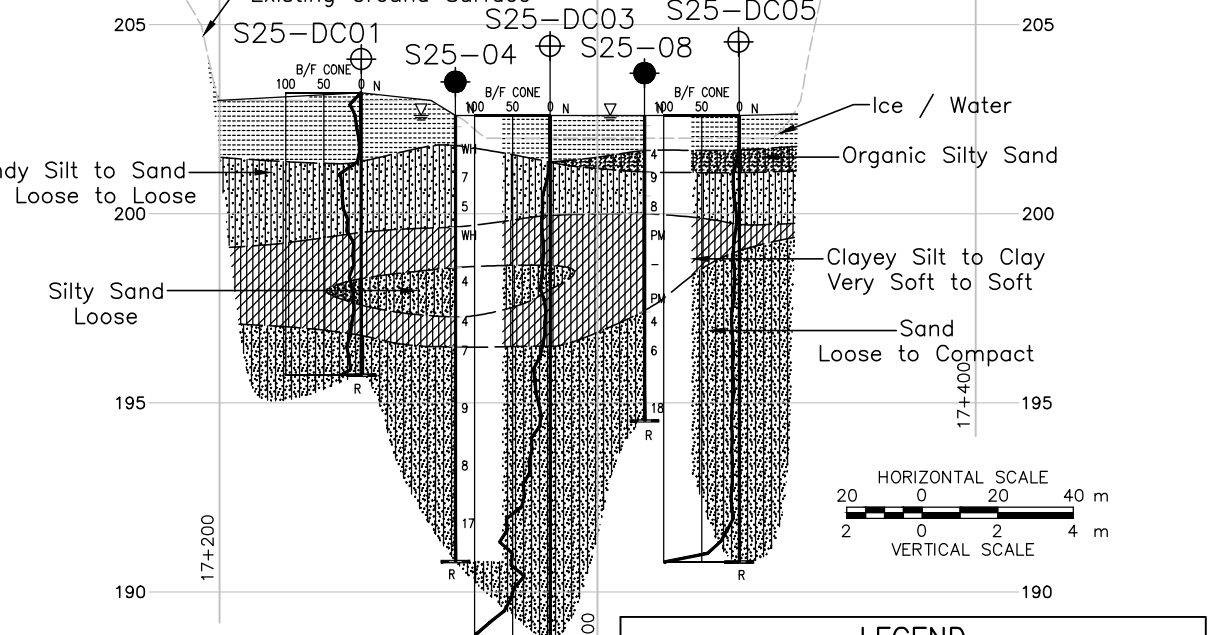
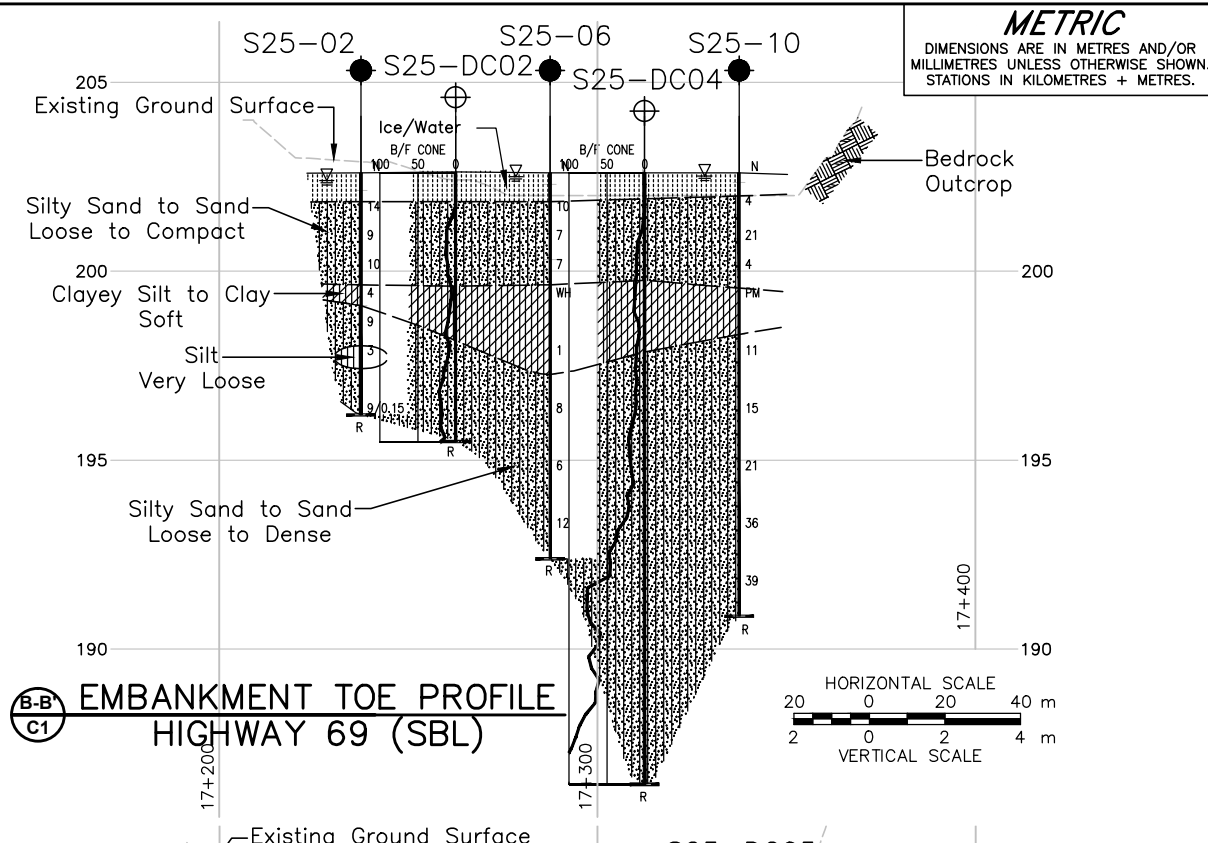
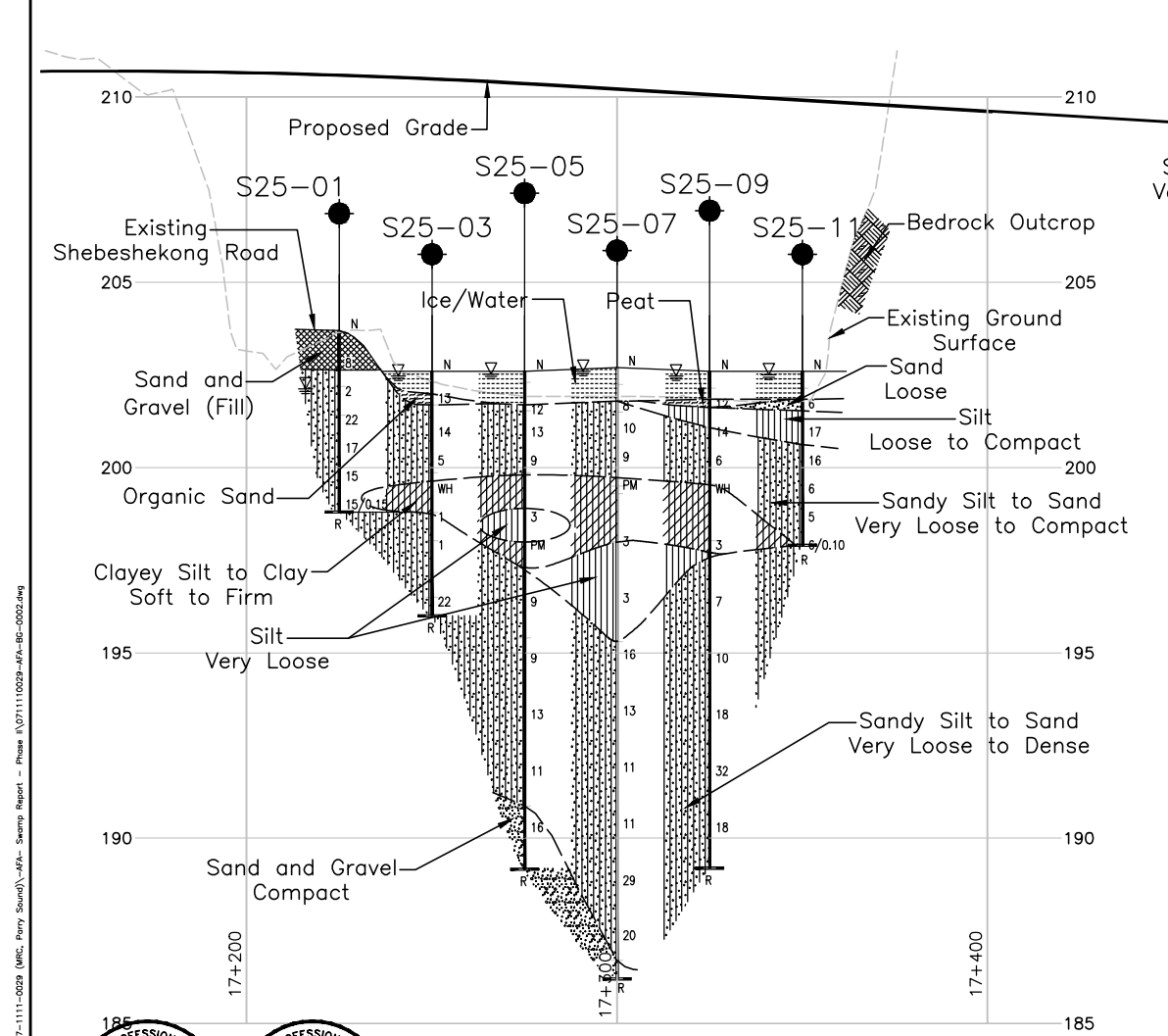
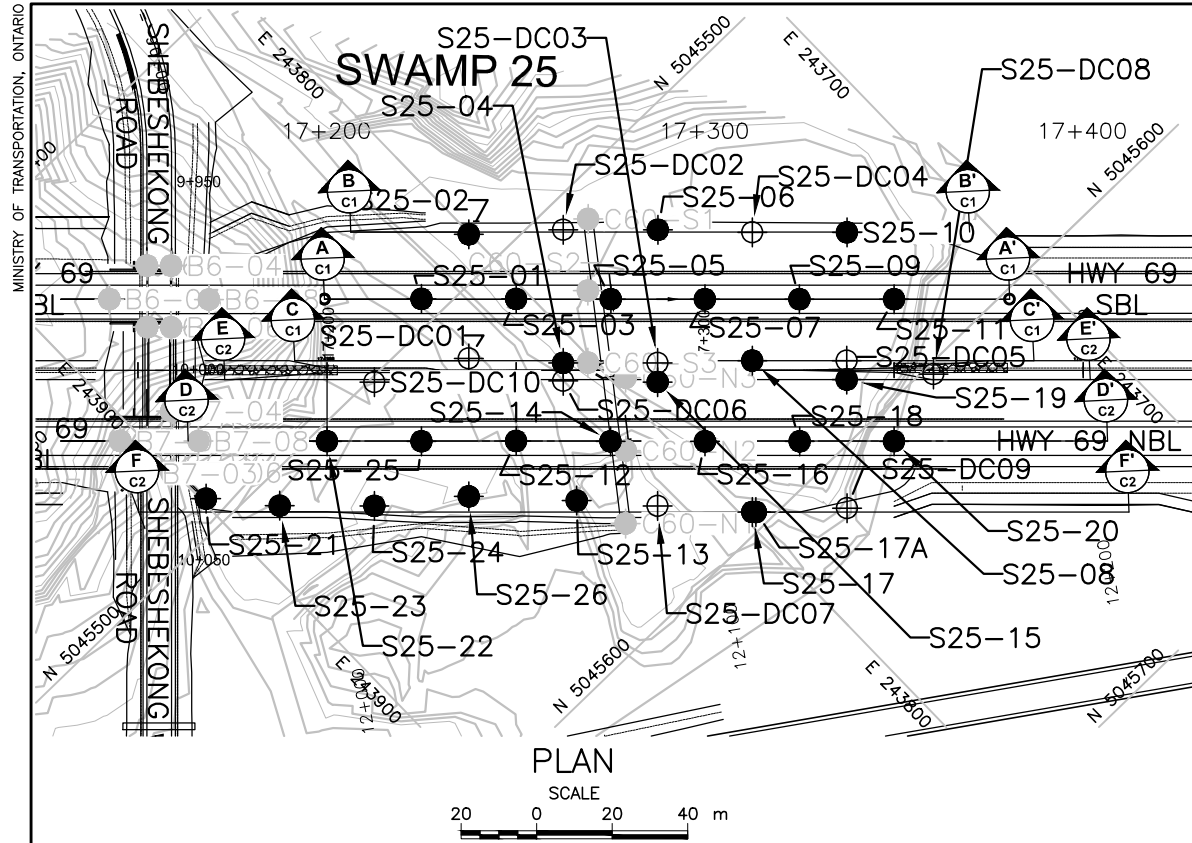
**Golder Associates**

Date: 15-Dec-09



# **APPENDIX C**

**Highway 69 SBL – STA 17+230 to 17+350 and  
Highway 69 NBL – STA 17+150 to 17+350 (Swamp 25)**



**LEGEND**

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

**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.

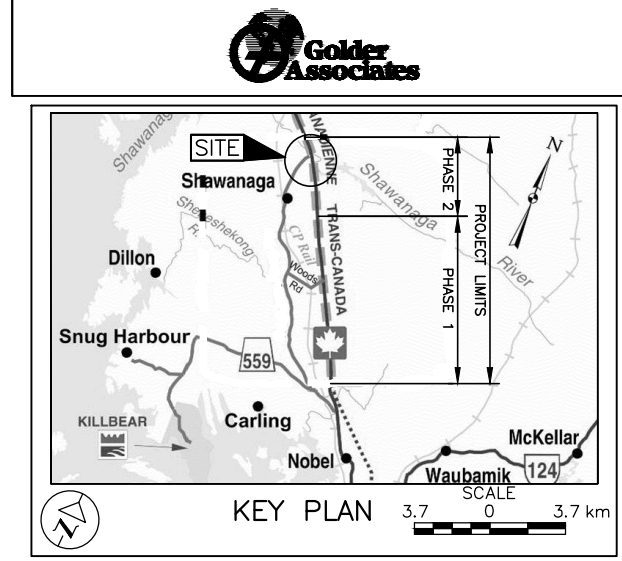
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S25-DC01	203.2	5045514.1	243823.1
S25-DC02	202.6	5045507.0	243781.5
S25-DC03	202.6	5045549.7	243788.0
S25-DC04	202.6	5045542.2	243746.0
S25-DC05	202.6	5045584.0	243751.6
S25-DC06	203.0	5045535.7	243809.3
S25-DC07	202.2	5045576.9	243814.3
S25-DC08	202.6	5045602.5	243737.6
S25-DC09	203.9	5045612.1	243778.7
S25-DC10	202.9	5045501.2	243845.4

**CONT No.**  
**WP No. 5111-07-00**

HIGHWAY 69 (SBL) STA 17+230 TO 17+350  
HIGHWAY 69 (NBL) STA 17+150 TO 17+350

**BOREHOLE LOCATIONS AND SOIL STRATA**



**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
S25-01	203.7	5045494.1	243821.2
S25-02	202.6	5045490.5	243800.3
S25-03	202.6	5045511.5	243803.2
S25-04	202.6	5045532.3	243806.0
S25-05	202.6	5045528.9	243785.2
S25-06	202.6	5045524.4	243763.5
S25-07	202.7	5045546.2	243767.3
S25-08	202.6	5045566.6	243769.6
S25-09	202.6	5045563.6	243749.3
S25-10	202.6	5045559.6	243728.0
S25-11	202.6	5045581.0	243731.3
S25-12	203.5	5045538.5	243829.3
S25-13	203.9	5045561.0	243828.7
S25-14	203.2	5045555.9	243811.4
S25-15	202.6	5045553.3	243791.5
S25-16	202.5	5045573.3	243793.4
S25-17	203.3	5045595.4	243797.4
S25-17A	203.3	5045596.1	243796.7
S25-18	202.6	5045590.7	243775.4
S25-19	202.6	5045587.6	243755.1
S25-20	204.7	5045608.0	243757.4
S25-21	202.4	5045492.5	243898.9
S25-22	203.1	5045503.8	243865.3
S25-23	202.9	5045507.4	243886.2
S25-24	203.0	5045524.8	243868.2
S25-25	203.0	5045521.2	243847.3
S25-26	202.7	5045540.4	243848.5

**REFERENCE**

Base plans contours and centreline profile provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, s6878xb02 contours.dwg, h6878\_PHASE2\_XD1 grading.dwg and h6878\_PHASE2\_XN1.dwg, received November 10, 2014, 6878 jh Hwy 69 Profile Raise-July 23, 2013.dwg received May 14, 2015.

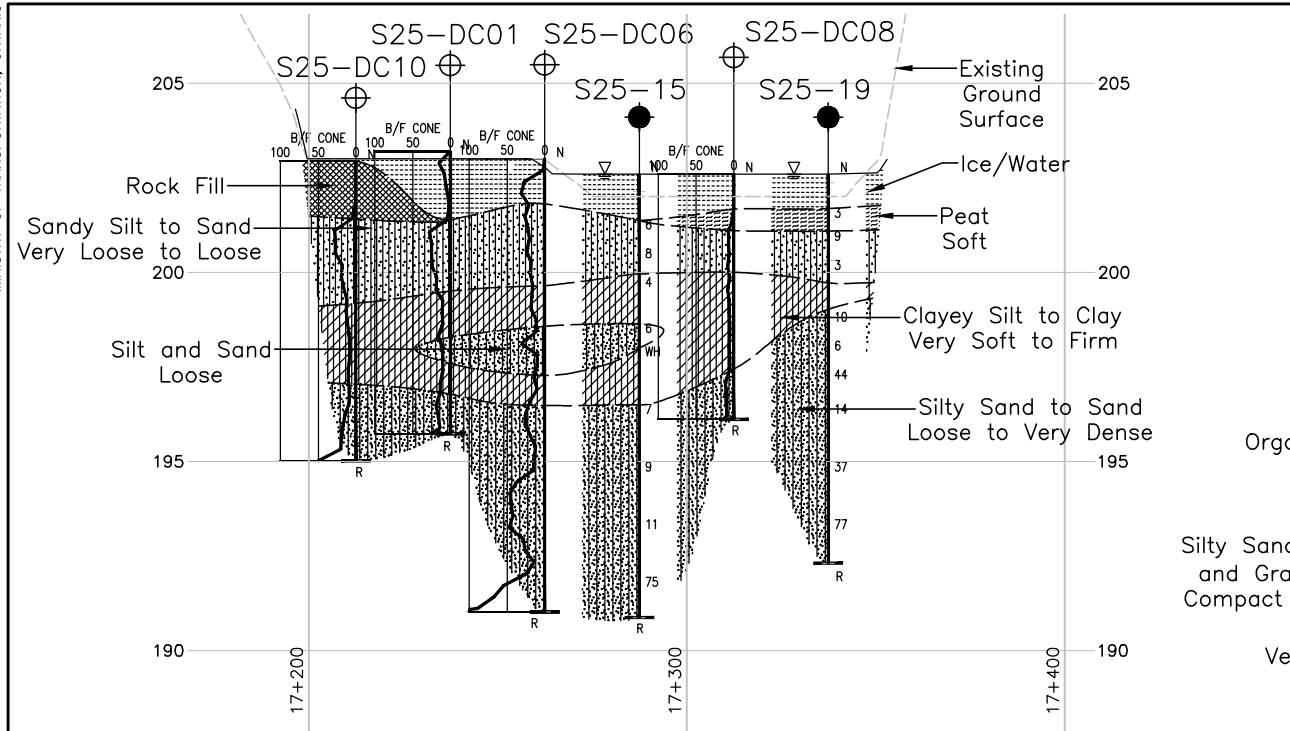
NO.	DATE	BY	REVISION
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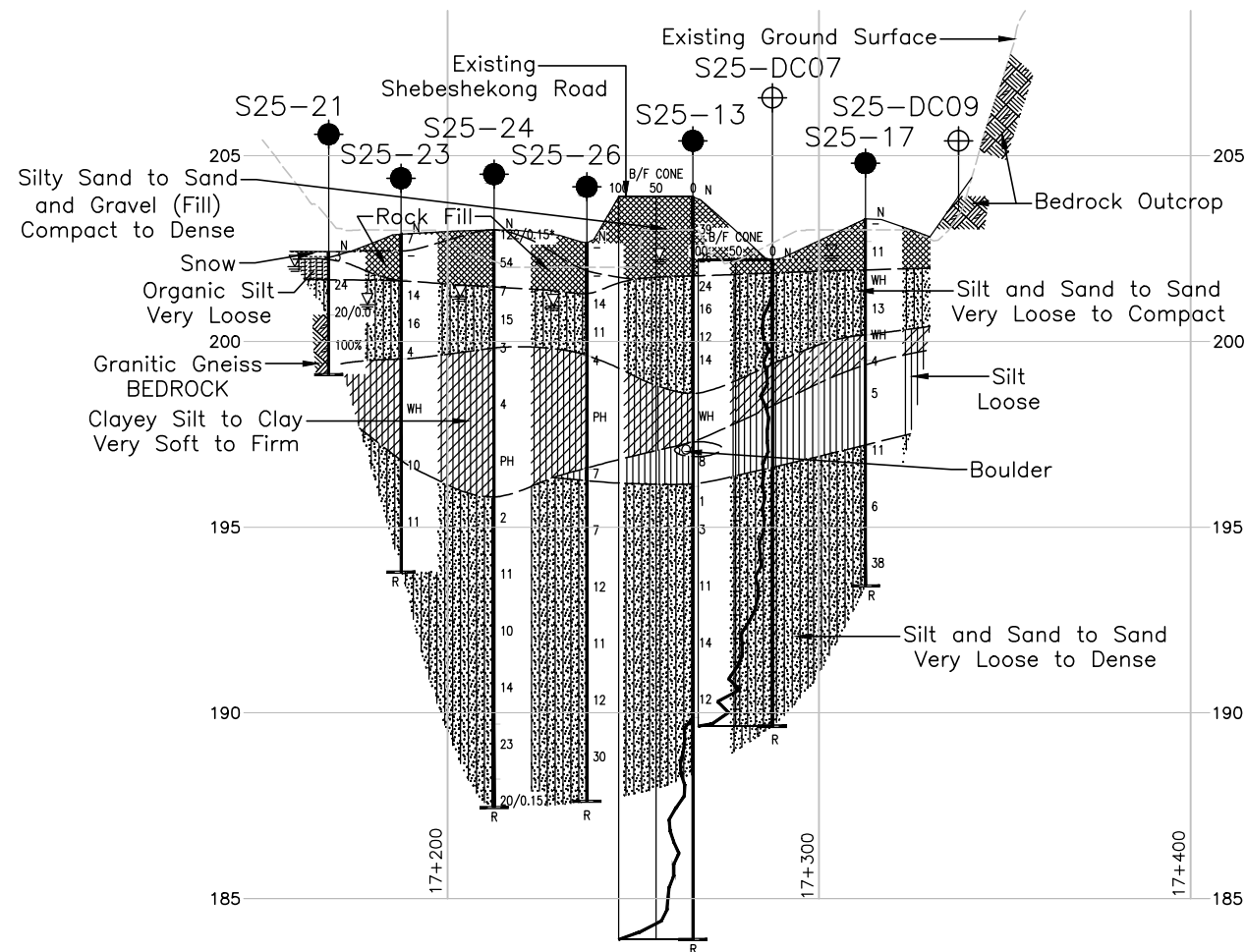
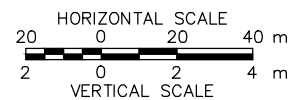
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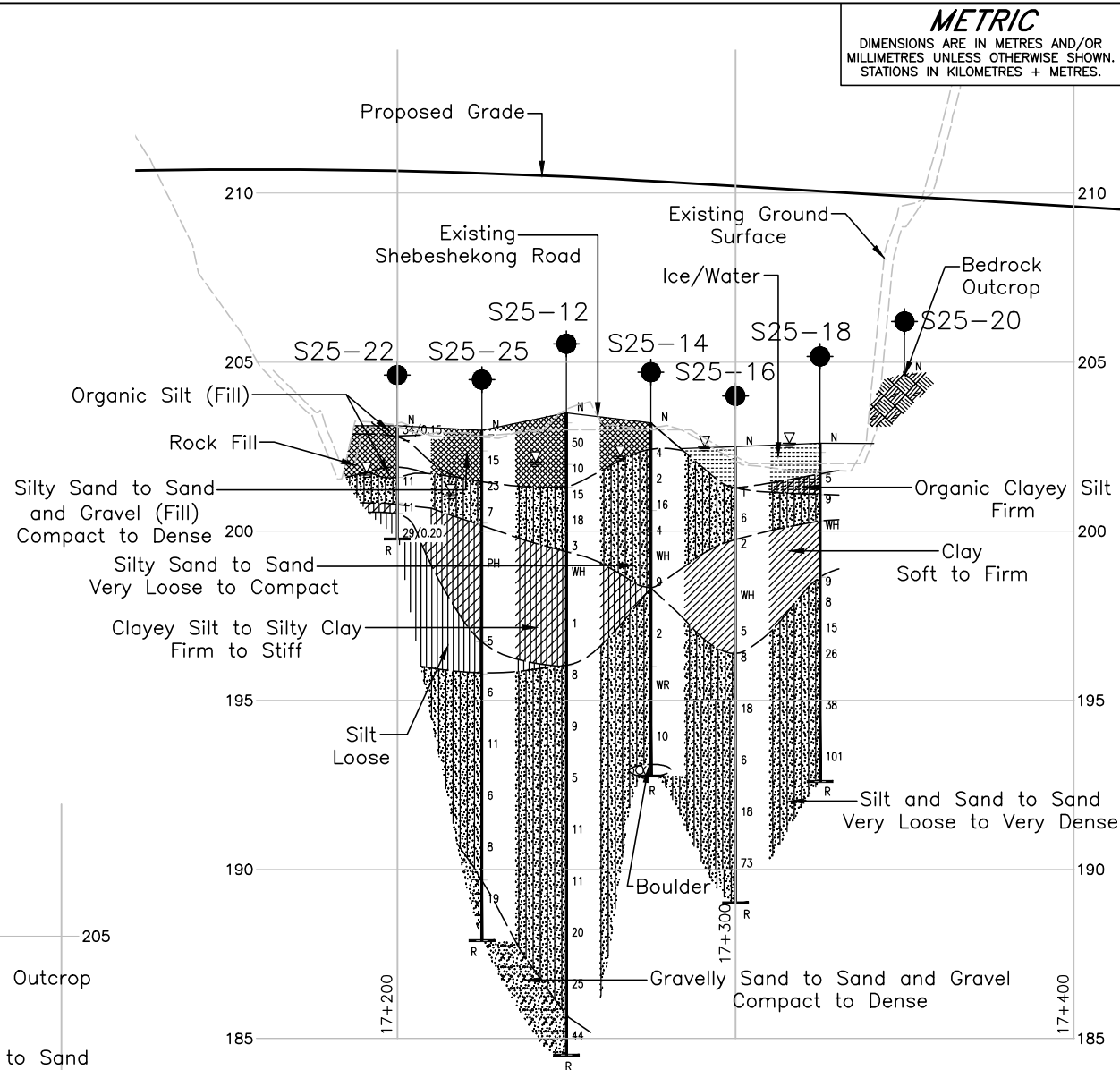
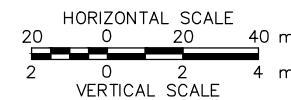
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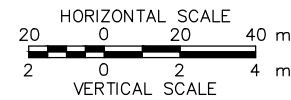
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**C2** EMBANKMENT TOE PROFILE  
HIGHWAY 69 (NBL)



**F-F**  
**C2** EMBANKMENT TOE PROFILE  
HIGHWAY 69 (NBL)



**D-D**  
**C2** CENTRELINE PROFILE  
HIGHWAY 69 (NBL)



### LEGEND

- Borehole - Current 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

### 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.

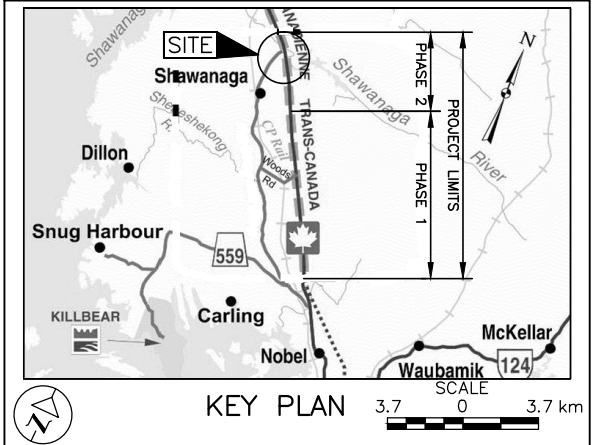
### METRIC

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

CONT No.  
WP No. 5111-07-00

HIGHWAY 69 (NBL) STA 17+150 TO 17+350

SOIL STRATA



### BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S25-12	203.5	5045538.5	243829.3
S25-13	203.9	5045561.0	243828.7
S25-14	203.2	5045555.9	243811.4
S25-15	202.6	5045553.3	243791.5
S25-16	202.5	5045573.3	243793.4
S25-17	203.3	5045595.4	243797.4
S25-18	202.6	5045590.7	243775.4
S25-19	202.6	5045587.6	243755.1
S25-20	204.7	5045608.0	243757.4
S25-21	202.4	5045492.5	243898.9
S25-22	203.1	5045503.8	243865.3
S25-23	202.9	5045507.4	243886.2
S25-24	203.0	5045524.8	243868.2
S25-25	203.0	5045521.2	243847.3
S25-26	202.7	5045540.4	243848.5
S25-DC01	203.2	5045514.1	243823.1
S25-DC06	203.0	5045535.7	243809.3
S25-DC07	202.2	5045576.9	243814.3
S25-DC08	202.6	5045570.2	243773.1
S25-DC09	203.9	5045612.1	243778.7
S25-DC10	202.9	5045501.2	243845.4

### REFERENCE

Base plans contours and centreline profile provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, s6878xb02 contours.dwg, h6878\_PHASE2\_XD1 grading.dwg and h6878\_PHASE2\_XN1.dwg, received November 10, 2014, 6878 jh Hwy 69 Profile Raise-July 23, 2013.dwg received May 14, 2015.

NO.	DATE	BY	REVISION
1			
Geocres No. 41H-161			
HWY. 69	PROJECT NO. 07-1111-0029		DIST. .
SUBM'D. CN/AJS	CHKD. CN	DATE: 5/20/2015	SITE: .
DRAWN: MR	CHKD. CN	APPD. JPD/JMAC	DWG. C2



PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-01		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5045494.1 ; E 243821.2		ORIGINATED BY ID																	
DIST HWY 69		BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers		COMPILED BY TZ																	
DATUM Geodetic		DATE March 21, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)			γ			GR SA SI CL		
203.7 0.0	GROUND SURFACE Sand and gravel (FILL) Grey to brown Moist to wet Loose						203														
202.6 1.1	SAND, some gravel Loose Brown		1	SS	8		202														
202.2 1.5	Moist Silty SAND, trace organics, trace wood fibres Very loose		2	SS	2		201												0 70 30 0 OC=4.8%		
201.4 2.3	Grey Wet SAND, trace silt Compact Brown to grey Wet		3	SS	22		200														
			4	SS	17		199														
			5	SS	15																
198.8 4.9	Some gravel below a depth of 4.7 m END OF BOREHOLE SPOON AND AUGER REFUSAL  NOTES:  1. Water level in open borehole at a depth of 1.6 m below ground surface (Elev. 202.1 m) upon completion of drilling.		6	SS	15/0.15																

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-02		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5045490.5 ; E 243800.3		ORIGINATED BY ID																	
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ																	
DATUM Geodetic		DATE February 25, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ					
202.6	ICE SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			kN/m <sup>3</sup>			GR SA SI CL		
0.0	Ice																				
202.1	Water																				
201.8																					
0.8	SAND, trace organics to a depth of 1.4 m Loose to compact Brown to grey Wet		1	SS	14																
			2	SS	9																
			3	SS	10																
199.6																					
3.0	CLAY, trace sand Soft Grey Wet		4	SS	4																
199.1																					
3.5	Silty SAND, trace clay Loose Grey Wet		5	SS	9																
198.0																					
4.6	SILT, trace sand Very loose Grey Wet		6	SS	3																
197.4																					
5.2	SAND, trace silt Compact Grey Wet																				
196.2			7	SS	9/0.15																
6.4	END OF BOREHOLE SPOON AND CASING REFUSAL																				
NOTES: 1. Water level in open borehole at a depth of 0.2 m below ice surface (Elev. 202.4 m) upon completion of drilling. 2. An additional borehole was drilled 1.5 m east of Borehole S25-02 to carry out in situ vane testing at depths of 3.4 m and 3.7 m below ice surface (Elev. 199.2 m and 198.9 m).																					

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-03		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5045511.5 ; E 243803.2		ORIGINATED BY ID																	
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ																	
DATUM Geodetic		DATE February 26, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)								
								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			γ kN/m <sup>3</sup>			GR SA SI CL		
202.6	ICE SURFACE																				
0.0	Ice																				
202.3	Water																				
202.0							202														
201.7	Organic SAND Dark brown Wet		1	SS	13																
0.9	SAND, trace silt Loose to compact Brown Wet		2	SS	14		201														
199.9			3	SS	5		200														
	Sandy SILT Loose Grey Wet																				
3.0			4	SS	WH		199														
198.8	SILTY CLAY Soft Grey Wet		5	SS	1																
3.8																					
198.0	Sandy SILT Very loose Grey Wet		6	SS	1		198														
4.6																					
	SILT and SAND, trace clay Very loose Grey Wet						197														
196.5																					
6.1	SAND, trace gravel Compact Grey Wet		7	SS	22		196														
196.0																					
6.6	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. Two additional boreholes were drilled 1.5 m north and 1.5 m north-east of Borehole S25-03 to obtain a Shelby tube sample between depths of 2.9 m and 3.3 m below ice surface (Elev. 199.7 m and 199.2 m), and to carry out in situ vane testing at depths of 3.0 m and 3.4 m below ice surface (Elev. 199.6 m and 199.2 m).																					



PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-04		SHEET 1 OF 1		METRIC												
W.P. 5111-07-00		LOCATION N 5045532.3 ; E 243806.0		ORIGINATED BY MJR														
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ														
DATUM Geodetic		DATE March 4, 2009		CHECKED BY VA/OK														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)					
202.6	ICE SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			GR SA SI CL		
0.0	Ice																	
202.3	Water																	
0.3																		
201.8																		
0.8	Silty SAND, trace gravel, trace organics to a depth of 2.1 m Very loose to loose Dark brown Wet		1	SS	WH		202											
			2	SS	7		201											
			3	SS	5		200											
199.6																		
3.0	CLAYEY SILT Very soft Grey Wet		4	SS	WH		199											
198.6																		
4.0	Silty SAND, trace clay Loose Grey Wet		5	SS	4		198											
197.3																		
5.3	SILTY CLAY Soft Reddish brown Wet		6	SS	4		197											
196.5																		
6.1	SAND, trace to some silt Loose to compact Grey Wet		7	SS	7		196											
			8	SS	9		195											
							194											
			9	SS	8		193											
			10	SS	17		192											
							191											
190.8																		
11.8	END OF BOREHOLE CASING REFUSAL																	
NOTES:																		
1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling.																		
2. Borehole caved to a depth of 6.2 m below ice surface (Elev. 196.4 m) upon removal of casing.																		

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-05		SHEET 1 OF 2		METRIC															
W.P. 5111-07-00		LOCATION N 5045528.9 ; E 243785.2		ORIGINATED BY ID																	
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ																	
DATUM Geodetic		DATE February 26, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ					
202.6	ICE SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			kN/m <sup>3</sup>			GR SA SI CL		
0.0	Ice																				
202.3	Water																				
0.3																					
201.7							202														
1.1	SAND, trace organics Loose Dark brown Wet		1	SS	12		201														
	SAND, trace silt Loose to compact Brown Wet		2	SS	13																
							200														
199.9			3	SS	9																
2.7	CLAY Soft Grey and brown Wet						199														
198.9																					
3.7	SILT, trace sand, trace clay Very loose Grey Wet		4	SS	3		198														
198.0																					
4.6	CLAY Grey and brown Wet		5	TO	PM		197														
197.3																					
5.3	Silty SAND Loose Grey Wet		6	SS	9		196														
195.4																					
7.2	SAND, trace gravel, trace silt Loose to compact Grey Wet		7	SS	9		195														
							194														
			8	SS	13		193														
							192														
			9	SS	11		191														
190.9																					
11.7	SAND and GRAVEL Compact Grey Wet		10	SS	16		190														
189.2																					
13.4	END OF BOREHOLE CASING REFUSAL																				

Continued Next Page

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

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

PROJECT		RECORD OF BOREHOLE		No S25-06		SHEET 1 OF 1		METRIC								
W.P. 07-1111-0029		LOCATION		N 5045524.4 ; E 243763.5		ORIGINATED BY		ID								
DIST		HWY 69		BOREHOLE TYPE		Portable Equipment, BW Casing, Wash Boring		COMPILED BY								
DATUM		Geodetic		DATE		February 25, 2009		CHECKED BY								
								VA/OK								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
202.6	ICE SURFACE															
0.0	Ice															
202.3																
0.3	Water															
201.8																
0.8	SAND, trace organics to a depth of 0.9 m Loose Brown and grey Wet		1	SS	10											
			2	SS	7											
200.3																
2.3	Silty SAND Loose Grey Wet		3	SS	7											
199.6																
3.0	CLAYEY SILT, some silt seams Soft Grey Wet		4	SS	WH											
			5	SS	1											
197.3																
5.3	SAND, trace gravel, trace silt Loose to compact Grey Wet															
			6	SS	8											
			7	SS	6											
			8	SS	12											
192.4																
10.2	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 2.2 m below ice surface (Elev. 200.4 m) upon removal of casing.															



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

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-07				SHEET 2 OF 2		METRIC								
W.P. 5111-07-00		LOCATION N 5045546.2 ; E 243767.3				ORIGINATED BY ID										
DIST _____ HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring				COMPILED BY TZ										
DATUM Geodetic		DATE March 2, 2009				CHECKED BY VA/OK										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
186.7	SAND, trace to some silt, trace gravel Compact Grey Moist		12	SS	20											
16.0	SAND and GRAVEL Grey Wet															
186.2																
16.5	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. Borehole caved to a depth of 2.5 m below ice surface (Elev. 200.2 m) upon removal of casing.															

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PROJECT		RECORD OF BOREHOLE		No S25-08		SHEET 1 OF 1		METRIC						
W.P. 5111-07-00		LOCATION		N 5045566.6 ; E 243769.6		ORIGINATED BY		MJR						
DIST		HWY 69		BOREHOLE TYPE		Portable Equipment, BW Casing, Wash Boring		COMPILED BY						
DATUM		Geodetic		DATE		February 25, 2009		CHECKED BY						
								VA/OK						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
202.6	ICE SURFACE													
202.9	Ice													
202.3	Water													
201.7														
201.1	Organic Silty SAND, trace rootlets Loose Dark brown Wet		1	SS	4								80.4	OC=11.4 %
200.5	SAND, trace to some silt, trace gravel Loose Grey Wet		2	SS	9									
200.0			3A	SS	8									
200.0	Sandy SILT, trace to some clay Loose Grey Wet		3B	SS	8									
199.4	SILTY CLAY, trace sand Soft Grey and reddish brown Wet		4	TO	PM								16.5	
198.4			5	WS	-									
197.4			6	TO	PM									
197.4	SAND, some silt, trace clay Loose to compact Grey to brown Wet		7	SS	4									
196.4			8	SS	6									0 82 18 0
195.4														
194.5			9	SS	18									
194.5	END OF BOREHOLE SPOON AND CASING REFUSAL													
8.1	NOTES:  1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling.  2. An additional borehole was drilled 1.0 m west of Borehole S25-08 to carry out in situ vane testing between depths of 3.0 m and 4.9 m below ice surface (Elev. 199.6 m and 197.7 m).													

PROJECT		RECORD OF BOREHOLE		No S25-09		SHEET 1 OF 2		METRIC							
W.P. 5111-07-00		LOCATION		N 5045563.6 ; E 243749.3		ORIGINATED BY		ID							
DIST		HWY 69		BOREHOLE TYPE		Portable Equipment, BW Casing, Wash Boring		COMPILED BY							
DATUM Geodetic		DATE		March 3, 2009		CHECKED BY		VA/OK							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
202.6	ICE SURFACE														
0.0	Ice														
202.1															
201.8	Water														
1.0	PEAT (Amorphous) Black Wet		1	SS	12										
201.1	SILT Compact Grey Wet		2	SS	14										
1.5	SAND, trace to some silt Loose to compact Brown and grey Wet		3	SS	6										
199.6															
3.1	CLAY, trace sand Soft to firm Grey Wet		4	SS	WH										
198.0															
197.7	CLAYEY SILT Firm Grey and brown Wet		5	SS	3										
4.9	SAND, trace gravel, trace silt Loose to dense Grey to brown Wet														
			6	SS	7										
			7	SS	10										
			8	SS	18										
			9	SS	32										
			10	SS	18										
189.2	END OF BOREHOLE CASING REFUSAL														
13.4															

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

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

PROJECT		RECORD OF BOREHOLE		No S25-10		SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION		N 5045559.6 ; E 243728.0		ORIGINATED BY		ID									
DIST		HWY 69		BOREHOLE TYPE		Portable Equipment, BW Casing, Wash Boring		COMPILED BY									
DATUM		Geodetic		DATE		February 24, 2009		CHECKED BY									
								VA/OK									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
202.6	ICE SURFACE																
0.0	Ice																
202.0	Water																
0.6	SAND, trace to some silt, trace gravel, trace organics and rootlets to a depth of 0.9 m Loose to compact Brown Wet		1A 1B	SS	4												OC = 3.9%
			2	SS	21												
			3	SS	4												
199.5																	
3.1	CLAY Soft Grey Wet		4	TO	PM												
198.3																	
4.3	SAND, trace to some gravel, trace to some silt Compact to dense Brown Wet		5	SS	11												
			6	SS	15												8 81 11 0
			7	SS	21												
			8	SS	36												
			9	SS	39												
190.9																	
11.7	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.																	

PROJECT		RECORD OF BOREHOLE		No S25-11		SHEET 1 OF 1		METRIC					
W.P.		LOCATION		ORIGINATED BY		ID							
DIST		BOREHOLE TYPE		COMPILED BY		TZ							
DATUM		DATE		CHECKED BY		VA/OK							
PROJECT 07-1111-0029		N 5045581.0 ; E 243731.3											
W.P. 5111-07-00		PORTABLE EQUIPMENT, BW CASING, WASH BORING											
DIST HWY 69		March 3, 2009											
DATUM Geodetic													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	GR SA SI CL
202.6	ICE SURFACE												
0.0	Ice												
202.1													
201.8	Water												
201.5	SAND, trace organics, trace rootlets Loose Dark brown Wet		1	SS	6								
1.1													
200.6	SILT, some sand, containing organics to a depth of 1.4 m Loose to compact Grey to brown Wet		2	SS	17								
2.0													
	SAND, trace gravel Loose to compact Brown Wet		3	SS	16								
			4	SS	6								
			5	SS	5								
197.9	END OF BOREHOLE SPOON AND CASING REFUSAL		6	SS	6/0.10								
4.7	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 2.7 m below ice surface (Elev. 199.9 m) upon removal of casing.												



PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-12</b>		SHEET 1 OF 2		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045538.5 ;E 243829.3</u>		ORIGINATED BY <u>ID</u>			
DIST <u>        </u> HWY <u>69</u>		BOREHOLE TYPE <u>115 mm O.D. Continuous Flight Solid Stem Augers and NW Casing, Wash Boring</u>		COMPILED BY <u>TZ</u>			
DATUM <u>Geodetic</u>		DATE <u>March 21, 2009</u>		CHECKED BY <u>VA/OK</u>			

SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
203.5	GROUND SURFACE				
203.2	Sand and gravel (FILL) Grey Dry				
203.2	Sand (FILL) Dense Brown Wet		1	SS	50
202.0	Frozen to a depth of 1.1 m Sand and gravel (FILL) Compact Brown Wet		2	SS	10
201.3	SAND, trace to some silt, trace organics to a depth of 3.1 m Very loose to compact Brown Wet		3	SS	15
200.8			4	SS	18
199.4	SILTY CLAY, trace sand Firm to stiff Brown Wet		5	SS	3
199.4			6	TO	WH
197.5	Silt seams below a depth of 7.0 m		7	SS	1
196.0	Silty SAND, trace gravel Loose to compact Grey to brown Wet		8	SS	8
195.5					
195.0					
194.5			9	SS	9
194.0					
193.5					
193.0			10	SS	5
192.5					
192.0					
191.5			11	SS	11
191.0					
190.5					
190.0			12	SS	11
189.5					

DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED

WATER CONTENT (%)

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT


UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Continued Next Page

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

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-12</b>		SHEET 2 OF 2		<b>METRIC</b>												
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045538.5 ; E 243829.3</u>		ORIGINATED BY <u>ID</u>														
DIST <u>        </u> HWY <u>69</u>		BOREHOLE TYPE <u>115 mm O.D. Continuous Flight Solid Stem Augers and NW Casing, Wash Boring</u>		COMPILED BY <u>TZ</u>														
DATUM <u>Geodetic</u>		DATE <u>March 21, 2009</u>		CHECKED BY <u>VA/OK</u>														
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
--- CONTINUED FROM PREVIOUS PAGE ---																		
185.7	Gravelly SAND, trace to some silt, trace clay Dense Grey Wet		13	SS	20		188											
187																		
186			14	SS	25													
185			15	SS	44													
184.5 19.0	END OF BOREHOLE CASING REFUSAL																	
NOTE:  1. Water level in open borehole at a depth of 1.5 m below ground surface (Elev. 202.0 m) upon completion of drilling.																		




PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-13</b>		SHEET 1 OF 2		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045561.0 ;E 243828.7</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 NW Casing, Wash Boring</u>		COMPILED BY <u>TZ</u>			
DATUM <u>Geodetic</u>		DATE <u>March 22, 2009</u>		CHECKED BY <u>VA/OK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa										WATER CONTENT (%)		
							○ UNCONFINED    + FIELD VANE										○		
							● QUICK TRIAXIAL    × REMOULDED												
						20	40	60	80	100	20	40	60						
203.9	GROUND SURFACE																		
0.0	Sand and gravel, trace silt (FILL) Compact to dense Grey Moist to wet						203												
			1	SS	39														
			2	SS	26		202												
201.8																			
2.1	SAND, some silt, trace gravel Compact Brown Wet		3	SS	24		201												
			4	SS	16														
			5	SS	12		200												
			6	SS	14														
198.6							199												
5.3	CLAY, trace sand Firm Brown Wet		7	SS	WH		198												
197.3																			
6.6	SILT, some sand, trace clay, boulder between depths of 6.6 m and 7.0 m Loose Grey Wet		8	SS	8		197												
196.1						196													
7.8	SILT and SAND, trace gravel, trace silt Very loose to compact Grey to brown Wet		9	SS	1														
			10	SS	3	195													
						194													
	Becoming brown below a depth of 10.4 m		11	SS	11	193													
						192													
			12	SS	14														
						191													
			13	SS	12	190													
189.9																			
14.0	END OF BOREHOLE																		

Continued Next Page

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

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-13</b>		SHEET 2 OF 2		<b>METRIC</b>				
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045561.0 ; E 243828.7</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 NW Casing, Wash Boring</u>		COMPILED BY <u>TZ</u>						
DATUM <u>Geodetic</u>		DATE <u>March 22, 2009</u>		CHECKED BY <u>VA/OK</u>						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
--- CONTINUED FROM PREVIOUS PAGE ---										
183.9										
20.0	END OF DCPT Refusal to Further Penetration (100 Blows / 0.18 m)  NOTES:  1. Water level in open borehole at a depth of 1.7 m below ground surface (Elev. 202.2 m) upon completion of drilling.  2. An additional borehole was drilled 1.0 m west of Borehole S25-13 to carry out in situ vane testing at depths of 5.9 m and 6.2 m below ground surface (Elev. 198.0 m and 197.7 m).									

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PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-14		SHEET 1 OF 1		METRIC														
W.P. 5111-07-00		LOCATION N 5045555.9 ; E 243811.4		ORIGINATED BY EHS																
DIST HWY 69		BOREHOLE TYPE 101 mm O.D. Continuous Flight Solid Stem Augers and NW Casing, Wash Boring		COMPILED BY TZ																
DATUM Geodetic		DATE March 5, 2009		CHECKED BY VA/OK																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL			
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60							
203.2 0.0	GROUND SURFACE Sand, trace gravel, trace silt, trace rootlets (FILL) Light brown Moist						203													
202.4 0.8	Frozen to a depth of 0.3 m Silty SAND, trace clay, trace organics Very loose to loose Brown to grey Moist to wet		1	SS	4		202													
			2	SS	2		201													
200.6 2.6	SAND, trace to some silt, clayey silt seams and sandy silt layers throughout Very loose to compact Light grey Wet		3	SS	16		200													
			4	SS	4		199													
			5	SS	WH		198													
198.3 4.9	SILT and SAND, trace clay, silty clay seams Very loose to loose Grey and reddish brown Wet		6A 6B	SS	9		197													
			7	SS	2		196													
196.0 7.2	SAND, trace to some silt Very loose to compact Grey Wet		8	SS	WR		195													
			9	SS	10		194													
192.8 10.4	Boulder encountered at depth of 10.1 m END OF BOREHOLE CASING REFUSAL  NOTE:  1. Water level in open borehole at a depth of 1.0 m below ground surface (Elev. 202.2 m) upon completion of drilling.						193													



PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-15				SHEET 1 OF 1		METRIC						
W.P. 5111-07-00		LOCATION N 5045553.3 ; E 243791.5				ORIGINATED BY MJR								
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring				COMPILED BY TZ								
DATUM Geodetic		DATE March 3, 2009				CHECKED BY VA/OK								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
202.6	ICE SURFACE													
0.0	Ice													
202.1	Water													
0.5														
201.4														
1.2	SAND, trace to some silt, trace organics Loose Brown to grey Wet		1	SS	6									
			2	SS	8									
200.0														
2.6	CLAYEY SILT, trace to some sand Firm Grey Wet		3	SS	4									
198.6														
4.0	SILT and SAND, trace clay Loose Grey Wet		4	SS	6									
198.0														
4.6	CLAY, trace silt, trace sand Soft Grey and reddish brown Wet		5	SS	WH									
196.5														
6.1	Silty SAND, trace gravel Loose to very dense Grey to brown Wet		6	SS	7									
			7	SS	9									
			8	SS	11									
			9	SS	75									
190.9	END OF BOREHOLE CASING REFUSAL													
11.7														
NOTES: 1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling. 2. Borehole caved to a depth of 6.4 m below ice surface (Elev. 196.2 m) upon removal of casing.														

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-16		SHEET 1 OF 2		METRIC												
W.P. 5111-07-00		LOCATION N 5045573.3 ; E 243793.4		ORIGINATED BY MJR														
DIST _____ HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ														
DATUM Geodetic		DATE March 2, 2009		CHECKED BY VA/OK														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)					
								20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	20 40 60	γ	GR	SA	SI	CL
202.5	ICE SURFACE																	
0.0	Ice																	
202.0																		
0.5	Water																	
201.3																		
1.2	SAND, trace silt, trace organics, trace rootlets Very loose to loose Brown Wet		1	SS	1													
			2	SS	6													
199.8																		
2.7	CLAY, trace silt, trace sand Soft Grey and reddish brown Wet		3	SS	2													
			4	SS	WH													
	Sand seams below a depth of 5.3 m		5	SS	5													
196.4																		
6.1	SAND, trace gravel, trace silt Loose to very dense Grey Wet		6	SS	8													
			7	SS	18													
			8	SS	6													
			9	SS	18													
			10	SS	73													
189.0																		
13.5	END OF BOREHOLE CASING REFUSAL																	

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

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

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PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-17				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5045595.4 ;E 243797.4				ORIGINATED BY EHS											
DIST _____ HWY 69		BOREHOLE TYPE 101 mm O.D. Continuous Flight Solid Stem Augers				COMPILED BY TZ											
DATUM Geodetic		DATE March 5, 2009				CHECKED BY VA/OK											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
203.3	GROUND SURFACE							20	40	60	80	100					
0.0	Sand, trace gravel, trace silt, trace rootlets (FILL) Brown		1	AS	-		203										
202.7	Frozen to moist																
0.6	Silty sand and cobbles, trace to some gravel (FILL) Compact	2	SS	11	202												
201.9	Brown Moist to wet																
1.4	SILT and SAND, trace clay, trace organics Very loose to compact Brownish grey Wet	3	SS	WH													
		4	SS	13	201												
200.2																	
3.1	SILTY CLAY, trace to some sand Very soft to soft Brown Wet	5	SS	1	200												
199.5																	
3.8	SILT, some sand, trace to some clay Loose Brown Wet	6	SS	4	199												
		7	SS	5													
197.2																	
6.1	SAND, trace gravel, trace silt Loose to dense Grey Wet Auger grinding between depths of 6.6 m and 7.0 m	8	SS	11	197												
		9	SS	6	196												
		10	SS	38	194												
193.4																	
9.9	END OF BOREHOLE AUGER REFUSAL  NOTES:  1. Water level in open borehole at a depth of 1.0 m below ground surface (Elev. 202.3 m) upon completion of drilling.  2. Borehole caved to a depth of 1.4 m below ground surface (Elev. 201.9 m) upon removal of casing.  3. An additional borehole was drilled 1.0 m up-chainage in order to confirm soil samples between depths of 1.5 m and 3.7 m below ground surface (Elev. 201.8 m and 199.6 m); see Record of Borehole S25-17A for details.																

PROJECT		RECORD OF BOREHOLE				No S25-17A		SHEET 1 OF 1		METRIC							
W.P. 07-1111-0029		LOCATION		N 5045596.1 ; E 243796.7		ORIGINATED BY		EHS									
DIST		HWY 69		BOREHOLE TYPE		101 mm O.D. Continuous Flight Solid Stem Augers		COMPILED BY		TZ							
DATUM		Geodetic		DATE		March 4 & 5, 2009		CHECKED BY		VA/OK							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
203.3	GROUND SURFACE							20	40	60	80	100					
0.0	See Record of Borehole S25-17 for subsurface conditions within these elevations.						203										
201.8							202										
1.5	Silty SAND, trace gravel, trace clay, trace organics, some sand seams Very loose to compact Brownish grey Wet		1	SS	WH		201										
200.2			2	SS	15												
3.1	CLAY, trace sand Soft Reddish brown Wet		3A	SS	1		200										
199.6			3B														
3.7	END OF BOREHOLE																

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PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-18		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5045590.7 ; E 243775.4		ORIGINATED BY MJR																	
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ																	
DATUM Geodetic		DATE February 26, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)								
								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			γ kN/m <sup>3</sup>			GR SA SI CL		
202.6	ICE SURFACE																				
202.9	Ice																				
0.3	Water																				
201.7							202														
0.9	Organic CLAYEY SILT, trace rootlets		1	SS	5																
201.1	Firm Dark brown and grey						201														
1.5	Wet SAND, trace to some silt, trace clay		2	SS	9																
200.3	Loose Brown to grey						200														
2.3	Wet CLAY, trace silt		3	SS	WH																
	Soft to firm Grey to reddish brown						199														
	Wet						198														
198.6	SAND, trace gravel, trace silt		4	SS	9																
4.0	Loose to very dense Grey		5	SS	8																
	Wet						197														
			6	SS	15																
			7	SS	26		196														
			8	SS	38		195														
			9	SS	101		194														
192.6	END OF BOREHOLE CASING REFUSAL						193														
10.0	NOTES: 1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling. 2. Borehole caved to a depth of 2.0 m below ice surface (Elev. 200.6 m) upon removal of casing.																				

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S25-19		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5045587.6 ; E 243755.1		ORIGINATED BY MJR																	
DIST HWY 69		BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring		COMPILED BY TZ																	
DATUM Geodetic		DATE February 24, 2009		CHECKED BY VA/OK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
202.6	ICE SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60			kN/m <sup>3</sup>					
0.0	Ice																				
0.2	Water																				
201.7							202														
0.9	PEAT (Amorphous), some wood fragments		1	SS	3																
201.1	Soft Dark brown						201														
1.5	Wet		2	SS	9																
200.3	SAND, trace to some silt						200														
2.3	Loose Grey Wet		3	SS	3																
199.7	SANDY SILT Very loose																				
2.9	Grey Wet																				
199.1	SILTY CLAY						199														
3.5	Soft Grey Wet		4	SS	10																
	SAND, trace gravel, trace silt						198												2 96 2 0		
	Loose to very dense		5	SS	6																
	Grey Wet		6	SS	44		197														
			7	SS	14		196														
			8	SS	37		195														
							194														
			9	SS	77		193														
192.3	END OF BOREHOLE CASING REFUSAL																				
10.3	NOTES:																				
	1. Water level in open borehole at ice surface (Elev. 202.6 m) upon completion of drilling.																				
	2. Borehole caved to a depth of 1.7 m below ground surface (Elev. 200.9 m) upon removal of casing.																				

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% STRAIN AT FAILURE

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



PROJECT 07-1111-0029				RECORD OF BOREHOLE No S25-21				SHEET 1 OF 1				METRIC					
W.P. 5111-07-00				LOCATION N 5045492.5 ; E 243898.9				ORIGINATED BY ID									
DIST HWY 69				BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring				COMPILED BY KD									
DATUM Geodetic				DATE January 22, 2015				CHECKED BY AJS/MCK									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
202.4	GROUND SURFACE							20	40	60	80	100					
0.0	SNOW		1A	SS	3		202										
0.2	ORGANIC SILT Very loose		1B														
201.6																	
0.8	SILT and SAND, trace to some clay, trace gravel Compact Brown Wet		2	SS	24		201										
200.7			3	SS	20/0.0												
1.7	Granite Gneiss (BEDROCK)																
	Bedrock cored from depths of 1.7 m to 3.3 m.  For bedrock coring details refer to Record of Drillhole S25-21.		1	RC	REC 100%		200										1 35 59 5
199.1																	RQD = 100%
3.3	END OF BOREHOLE																
	NOTE:  1. Water level in open borehole measured at a depth of 0.4 m below ground surface (Elev. 202.0 m) upon completion of drilling.																

SHEET 1 OF 1

DATUM: Geodetic


DRILLING CONTRACTOR: Landcore Drilling Inc.

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1 : 50








LOGGED: ID  
CHECKED: AJS/MCK

PROJECT		RECORD OF BOREHOLE		No S25-22		SHEET 1 OF 1		METRIC							
W.P. 07-1111-0029		LOCATION		N 5045503.8 ; E 243865.3		ORIGINATED BY		ID							
DIST		HWY 69		BOREHOLE TYPE		108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring		COMPILED BY							
DATUM Geodetic		DATE		January 23, 2015		CHECKED BY		AJS/MCK							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
203.1	GROUND SURFACE														
0.0	Organic silt, some sand (FILL)		1A	SS	34/0.15	▽	203								
0.3	Dark grey to grey Moist Rock fill (FILL)		1B	RC	-		202								
201.9	ORGANIC SILT				202										
201.6	Sandy SILT, trace organics				201										
1.5	Compact Grey to brown Wet		2	SS	11		201								
200.8	SILTY CLAY						201								
200.5	Stiff Brown to grey Moist		3A	SS	11		201								
2.6			3B	SS	11		201								
199.7	SILT, some sand, some clay						200								
3.4	Compact Brown to grey Wet		4	SS	29/0.20		200								
SPOON AND AUGER REFUSAL END OF BOREHOLE															
NOTE:  1. Water level in open borehole measured at a depth of 1.4 m below ground surface (Elev. 201.7 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SWAMP-PHASE II.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>		<b>RECORD OF BOREHOLE No S25-24</b>		SHEET 1 OF 2		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045524.8 ; E 243868.2</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>NW Casing, Wash Boring</u>		COMPILED BY <u>KD</u>			
DATUM <u>Geodetic</u>		DATE <u>January 23, 2015</u>		CHECKED BY <u>AJS/MCK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>		
203.0	GROUND SURFACE													
0.0	Rock fill (FILL) Very dense Grey		1	SS	22/0.15									
			2	SS	54									
201.5														
1.5	Silty SAND, trace organics Loose to compact Dark brown to brown Wet		3	SS	7									
			4	SS	15									
199.8														
3.2	CLAY Soft to firm Brown to grey Wet		5A 5B	SS	3									
			6	SS	4									
	Sand seams at a depth of 6.1 m		7	TO	PH									
195.8														
7.2	SAND, trace to some silt Very loose to compact Brown to grey Wet		8	SS	2									
			9	SS	11									
			10	SS	10									
			11	SS	14									
189.7														
13.3	SILT and SAND, some gravel, some silt, containing silt pockets Compact Grey Wet		12	SS	23									
	Auger grinding below a depth of 14.6 m													

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

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PROJECT		RECORD OF BOREHOLE No S25-24				SHEET 2 OF 2		METRIC								
W.P. 07-1111-0029		LOCATION N 5045524.8 ; E 243868.2				ORIGINATED BY ID										
DIST HWY 69		BOREHOLE TYPE NW Casing, Wash Boring				COMPILED BY KD										
DATUM Geodetic		DATE January 23, 2015				CHECKED BY AJS/MCK										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
187.5	SILT and SAND, some gravel, containing silt pockets		13	SS	20/0.15											
15.5	Compact Grey Wet SPOON AND CASING REFUSAL END OF BOREHOLE															
	NOTES:  1. Water level in open borehole measured at a depth of 1.8 m below ground surface (Elev. 201.2 m) upon completion of drilling.															

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PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-25</b>		SHEET 1 OF 2		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045521.2 ;E 243847.3</u>		ORIGINATED BY <u>ID</u>			
DIST _____ HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>		COMPILED BY <u>KD</u>			
DATUM <u>Geodetic</u>		DATE <u>January 27, 2015</u>		CHECKED BY <u>AJS/MCK</u>			

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

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-25</b>				SHEET 2 OF 2		<b>METRIC</b>								
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045521.2 ; E 243847.3</u>				ORIGINATED BY <u>ID</u>										
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>				COMPILED BY <u>KD</u>										
DATUM <u>Geodetic</u>		DATE <u>January 27, 2015</u>				CHECKED BY <u>AJS/MCK</u>										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
187.9 15.1	CASING REFUSAL END OF BOREHOLE  NOTE:  1. Water level in open borehole measured at a depth of 1.9 m below ground surface (Elev. 201.1 m) upon completion of drilling.															

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PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-26</b>		SHEET 1 OF 2		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045540.4 ; E 243848.5</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>		COMPILED BY <u>KD</u>			
DATUM <u>Geodetic</u>		DATE <u>January 28, 2015</u>		CHECKED BY <u>AJS/MCK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					W <sub>p</sub> W W <sub>L</sub>				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
202.7	GROUND SURFACE																
0.0	Silty sand, some gravel (FILL) Dark grey Wet		1A	AS	-		202										
201.9																	
0.8	Rock fill (FILL)		1B	RC	-												
201.3																	
1.4	Silty SAND, some gravel, trace clay, trace organics Compact Dark brown Wet		2	SS	14			201									
			3	SS	11			200									
199.7																	
3.0	CLAYEY SILT, some sand Firm Brown to grey Wet		4	SS	4			199									
			5	TO	PH			198									
							197										
196.6																	
196.3	SILT, some sand, trace to some clay Loose Grey Wet		6A	SS	7		196							0 14 81 5			
6.4	SAND, trace to some silt Loose to compact Brown to grey Wet		6B														
			7	SS	7		195							0 92 8 0			
							194										
			8	SS	12		193										
							192										
			9	SS	11		191										
							190							0 87 12 1			
			10	SS	12												
							189										
			11	SS	30												
187.7							188										

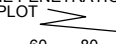
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+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

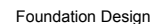
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PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S25-26</b>				SHEET 2 OF 2		<b>METRIC</b>								
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045540.4 ;E 243848.5</u>				ORIGINATED BY <u>ID</u>										
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>				COMPILED BY <u>KD</u>										
DATUM <u>Geodetic</u>		DATE <u>January 28, 2015</u>				CHECKED BY <u>AJS/MCK</u>										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
15.0	CASING REFUSAL END OF BOREHOLE  NOTE:  1. Water level in open borehole measured at a depth of 1.7 m below ground surface (Elev. 201.0 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

PROJECT		RECORD OF DCPT No S25-DC01		SHEET 1 OF 1		METRIC				
W.P.		LOCATION		ORIGINATED BY		ID				
DIST		BOREHOLE TYPE		COMPILED BY		VA				
DATUM		DATE		CHECKED BY		VA/OK				
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
203.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)									
195.7 7.5	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-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC



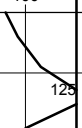
+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>07-1111-0029</u>		<b>RECORD OF DCPT No S25-DC03</b>		SHEET 1 OF 1		<b>METRIC</b>							
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045549.7 ; E 243788.0</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>VA</u>									
DATUM <u>Geodetic</u>		DATE <u>March 3, 2009</u>		CHECKED BY <u>VA/OK</u>									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
202.6 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>						
188.8 13.8	END OF DCPT Refusal to Further Penetration						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>						

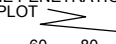
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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

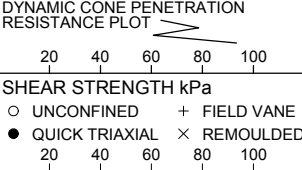
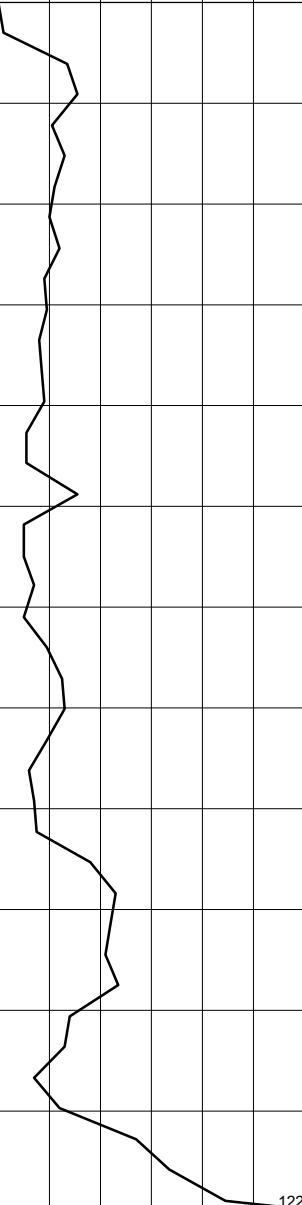
PROJECT <u>07-1111-0029</u>										RECORD OF DCPT No <b>S25-DC04</b>										SHEET 2 OF 2										<b>METRIC</b>									
W.P. <u>5111-07-00</u>										LOCATION <u>N 5045542.2 ; E 243746.0</u>										ORIGINATED BY <u>ID</u>																			
DIST <u>          </u> HWY <u>69</u>										BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>										COMPILED BY <u>VA</u>																			
DATUM <u>Geodetic</u>										DATE <u>February 25, 2009</u>										CHECKED BY <u>VA/OK</u>																			
SOIL PROFILE					SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					UNIT WEIGHT					REMARKS & GRAIN SIZE DISTRIBUTION (%)														
ELEV DEPTH	DESCRIPTION				STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)					γ kN/m³	GR SA SI CL																	
										20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 20 40 60																								
	--- CONTINUED FROM PREVIOUS PAGE ---																																						
186.4	Dynamic Cone Penetration Test (DCPT)									187																													
16.2	END OF DCPT Refusal to Further Penetration																																						

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

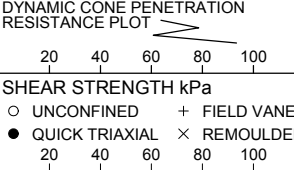
PROJECT <u>07-1111-0029</u>		<b>RECORD OF DCPT No S25-DC05</b>		SHEET 1 OF 1		<b>METRIC</b>				
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045584.0 ; E 243751.6</u>		ORIGINATED BY <u>MJR</u>						
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>		COMPILED BY <u>VA</u>						
DATUM <u>Geodetic</u>		DATE <u>February 23, 2009</u>		CHECKED BY <u>VA/OK</u>						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> — W — W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
202.6 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)									
						202 201 200 199 198 197 196 195 194 193 192 191				
190.8 11.8	END OF DCPT Refusal to Further Penetration									

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

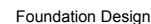


PROJECT <u>07-1111-0029</u>		<b>RECORD OF DCPT No S25-DC06</b>		SHEET 1 OF 1		<b>METRIC</b>					
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045535.7 ;E 243809.3</u>		ORIGINATED BY <u>MJR</u>							
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>		COMPILED BY <u>VA</u>							
DATUM <u>Geodetic</u>		DATE <u>March 4, 2009</u>		CHECKED BY <u>VA/OK</u>							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W      LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
203.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
191.0	END OF DCPT Refusal to Further Penetration						122				
12.0											

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

PROJECT <u>07-1111-0029</u>		<b>RECORD OF DCPT No S25-DC07</b>		SHEET 1 OF 1		<b>METRIC</b>					
W.P. <u>5111-07-00</u>		LOCATION <u>N 5045576.9 ; E 243814.3</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 5, 2009</u>		CHECKED BY <u>VA/OK</u>							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W    LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
202.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)										
						202					
						201					
						200					
						199					
						198					
						197					
						196					
						195					
						194					
						193					
						192					
						191					
						190					
189.6 12.6	END OF DCPT Refusal to Further Penetration										

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

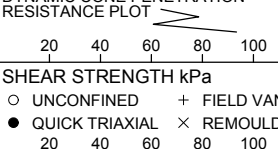


+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% STRAIN AT FAILURE

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

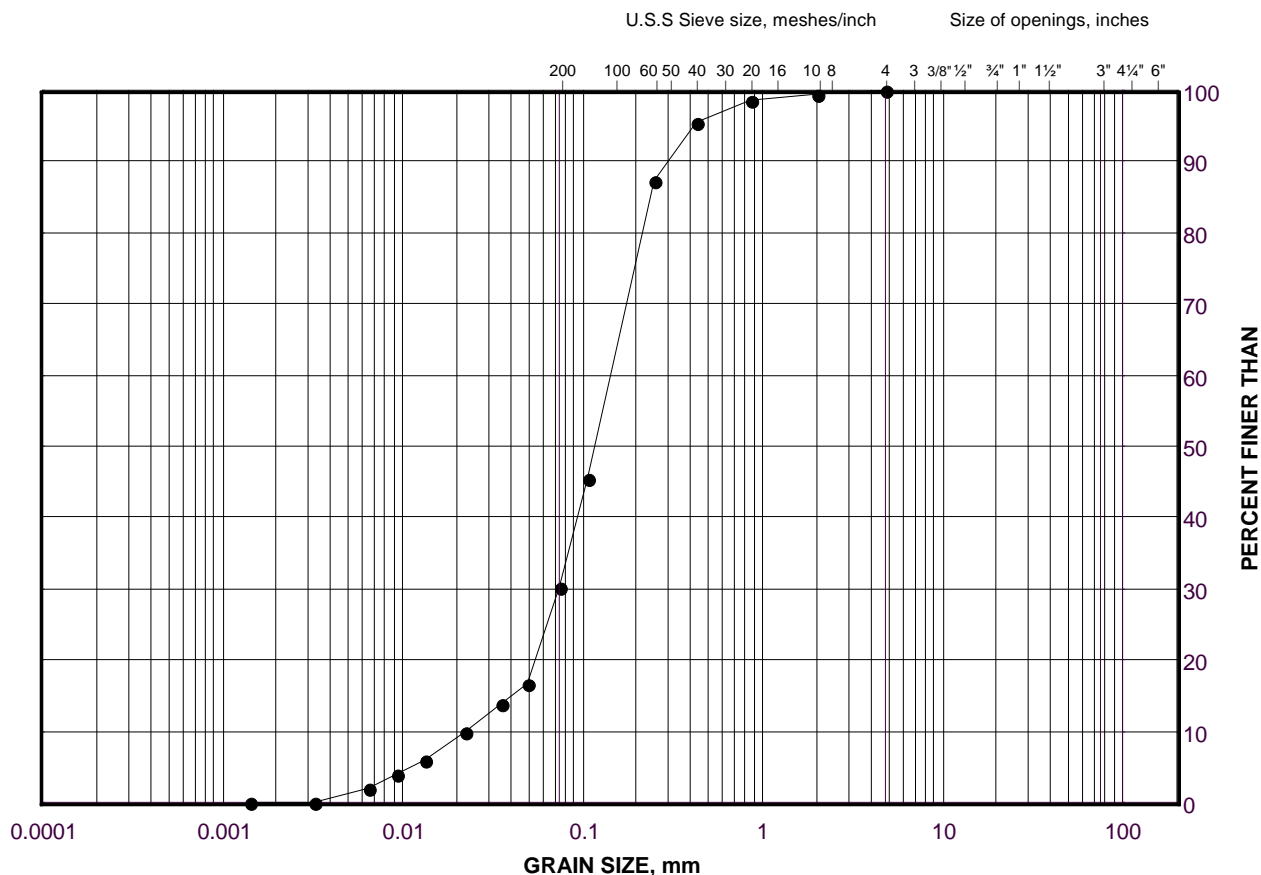
PROJECT		RECORD OF DCPT No S25-DC10		SHEET 1 OF 1		METRIC					
W.P. 07-1111-0029		LOCATION N 5045501.2 ; E 243845.4		ORIGINATED BY ID							
DIST HWY 69		BOREHOLE TYPE Dynamic Cone Penetration Test		COMPILED BY MR							
DATUM Geodetic		DATE January 27, 2015		CHECKED BY AJS/MCK							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W   LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
202.9 0.0	GROUND SURFACE AUGERED THROUGH ROCK FILL										
201.7 1.2	Dynamic Cone Penetration Test (DCPT)										
195.0 7.9	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-SWAMP-PHASE II.GPJ GAL-GTA.GDT 03/25/16 DD/SAC

# GRAIN SIZE DISTRIBUTION

Silty Sand  
Highway 69 (SBL) STA 17+230 to 17+350

FIGURE C.S25-1



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-01	2	201.9

Project Number: 07-1111-0029

Checked By: CN

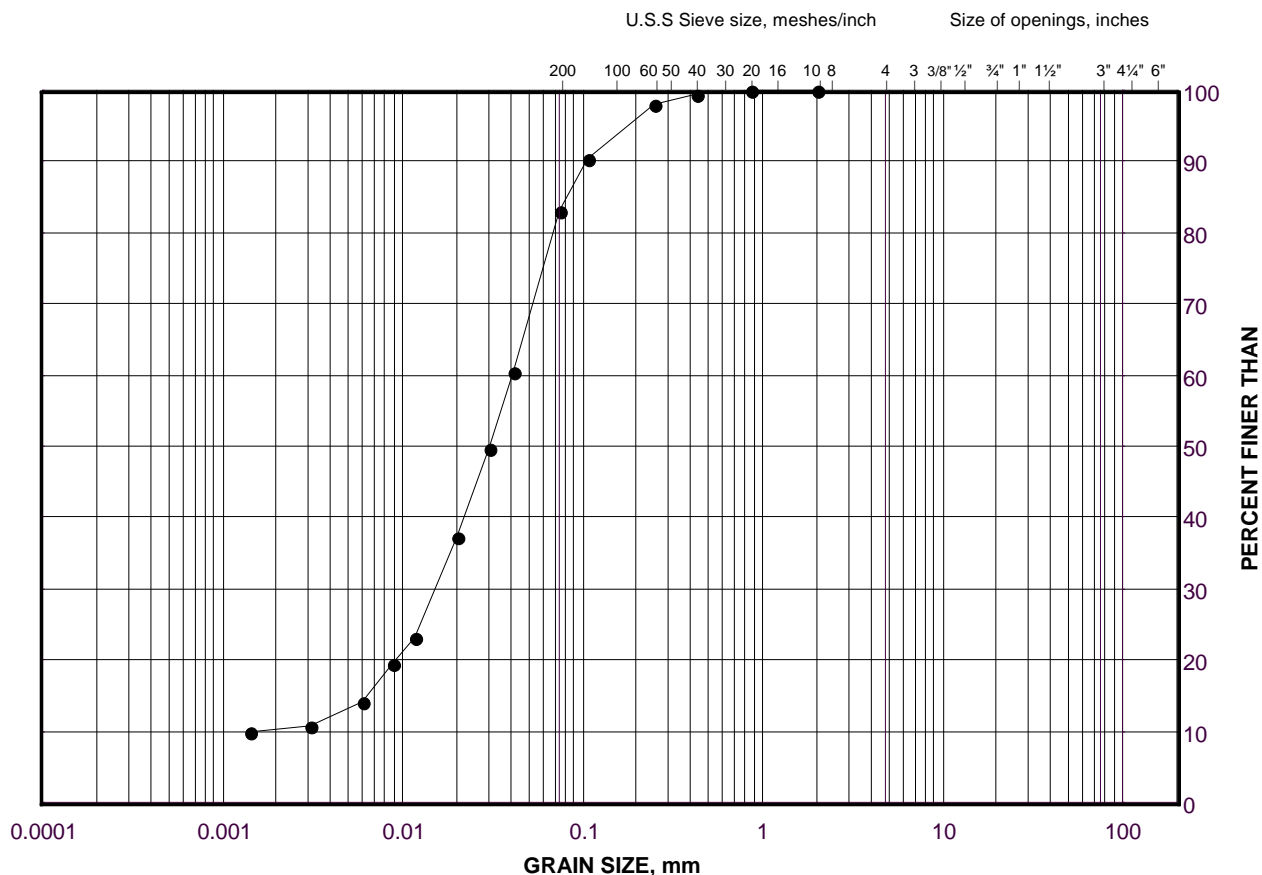
**Golder Associates**

Date: 27-Nov-09

# GRAIN SIZE DISTRIBUTION

Silt  
Highway 69 (SBL) STA 17+230 to 17+350

FIGURE C.S25-2



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

## LEGEND

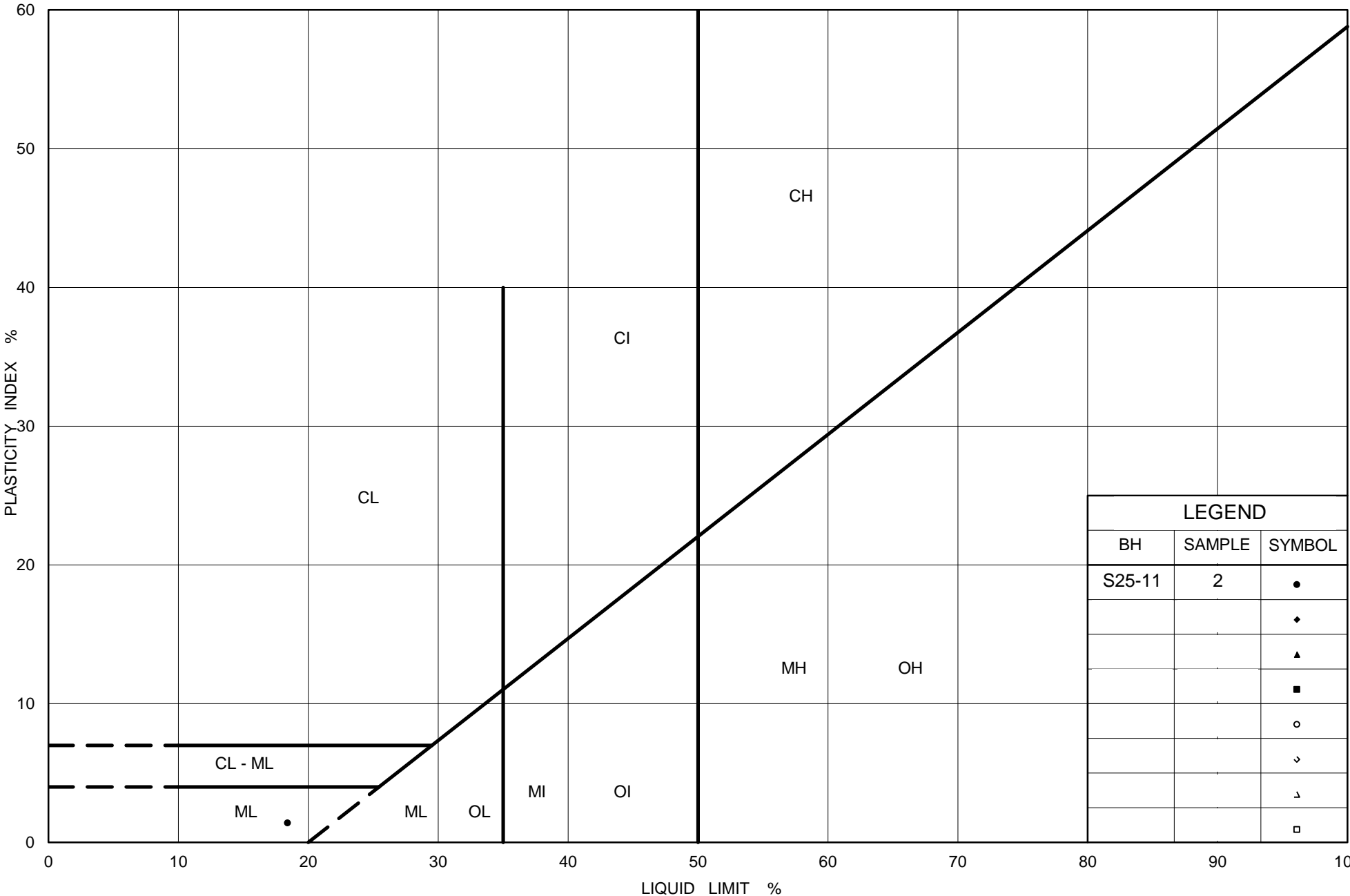
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-11	2	200.8

Project Number: 07-1111-0029

Checked By: CN

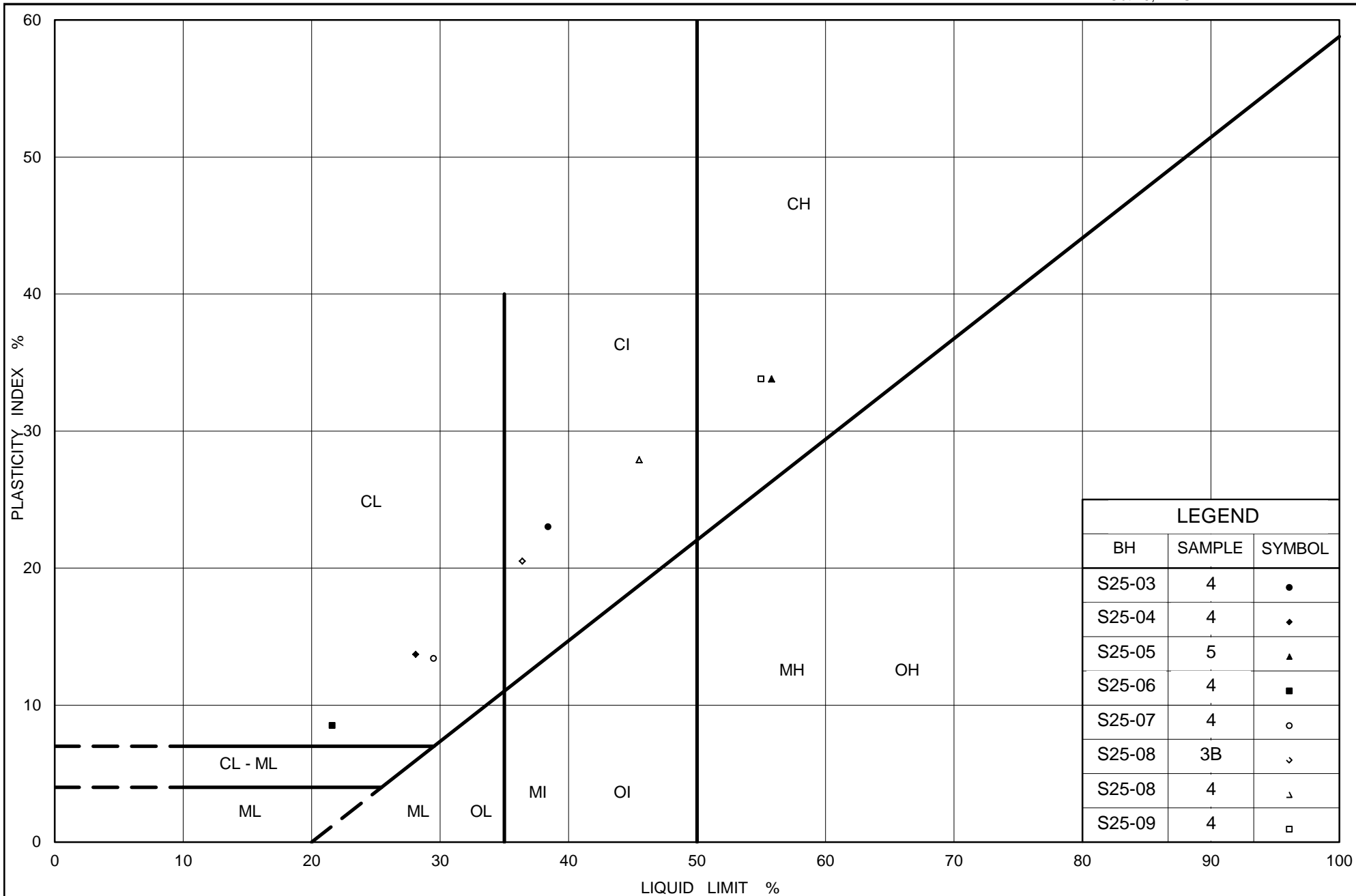
**Golder Associates**

Date: 27-Nov-09



LEGEND		
BH	SAMPLE	SYMBOL
S25-11	2	•
		◆
		▲
		■
		○
		▽
		△
		□





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**PLASTICITY CHART**  
 Clayey Silt to Clay  
 Highway 69 (SBL) STA 17+230 to 17+350

Figure No. C.S25-4

Project No. 07-1111-0029

Checked By: CN

**OEDOMETER CONSOLIDATION SUMMARY****FIGURE C.S25-5**  
**Sheet 1 of 4****SAMPLE IDENTIFICATION**

Project Number	07-1111-0029	Sample Number	4
Borehole Number	S25-08	Sample Depth, m	3.0-3.7

**TEST CONDITIONS**

Test Type	Standard	Load Duration, hr	24
Oedometer Number	8		
Date Started	10/2/2009		
Date Completed	10/24/2009		

**SAMPLE DIMENSIONS AND PROPERTIES - INITIAL**

Sample Height, cm	1.25	Unit Weight, kN/m <sup>3</sup>	16.52
Sample Diameter, cm	4.97	Dry Unit Weight, kN/m <sup>3</sup>	10.58
Area, cm <sup>2</sup>	19.40	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	24.31	Solids Height, cm	0.490
Water Content, %	56.12	Volume of Solids, cm <sup>3</sup>	9.50
Wet Mass, g	40.95	Volume of Voids, cm <sup>3</sup>	14.80
Dry Mass, g	26.23	Degree of Saturation, %	99.4

**TEST COMPUTATIONS**

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv. cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	1.253	1.558	1.253				
5.00	1.243	1.537	1.248	12	2.75E-02	1.61E-03	4.35E-06
10.00	1.231	1.513	1.237	43	7.54E-03	1.88E-03	1.39E-06
20.00	1.212	1.474	1.222	94	3.37E-03	1.52E-03	5.00E-07
40.00	1.184	1.418	1.198	86	3.54E-03	1.11E-03	3.85E-07
80.00	1.140	1.327	1.162	140	2.05E-03	8.84E-04	1.77E-07
160.00	1.074	1.192	1.107	158	1.64E-03	6.59E-04	1.06E-07
320.00	0.984	1.008	1.029	206	1.09E-03	4.49E-04	4.79E-08
640.00	0.895	0.826	0.939	171	1.09E-03	2.23E-04	2.39E-08
1280.00	0.819	0.671	0.857	135	1.15E-03	9.45E-05	1.07E-08
2560.00	0.753	0.537	0.786	124	1.06E-03	4.12E-05	4.26E-09
1280.00	0.767	0.566	0.760				
320.00	0.775	0.582	0.771				
80.00	0.804	0.642	0.790				
20.00	0.837	0.709	0.821				
5.00	0.852	0.738	0.844				

Note:

k calculated using cv based on  $t_{90}$  values.**SAMPLE DIMENSIONS AND PROPERTIES - FINAL**

Sample Height, cm	0.85	Unit Weight, kN/m <sup>3</sup>	20.23
Sample Diameter, cm	4.97	Dry Unit Weight, kN/m <sup>3</sup>	15.57
Area, cm <sup>2</sup>	19.40	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	16.52	Solids Height, cm	0.490
Water Content, %	29.89	Volume of Solids, cm <sup>3</sup>	9.50
Wet Mass, g	34.07	Volume of Voids, cm <sup>3</sup>	7.02
Dry Mass, g	26.23		

Prepared By: LFG

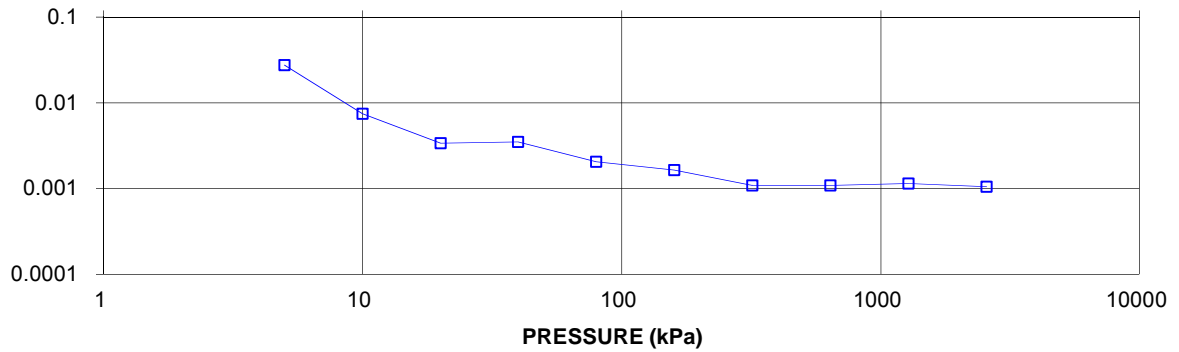
**Golder Associates**

Checked By:

CN

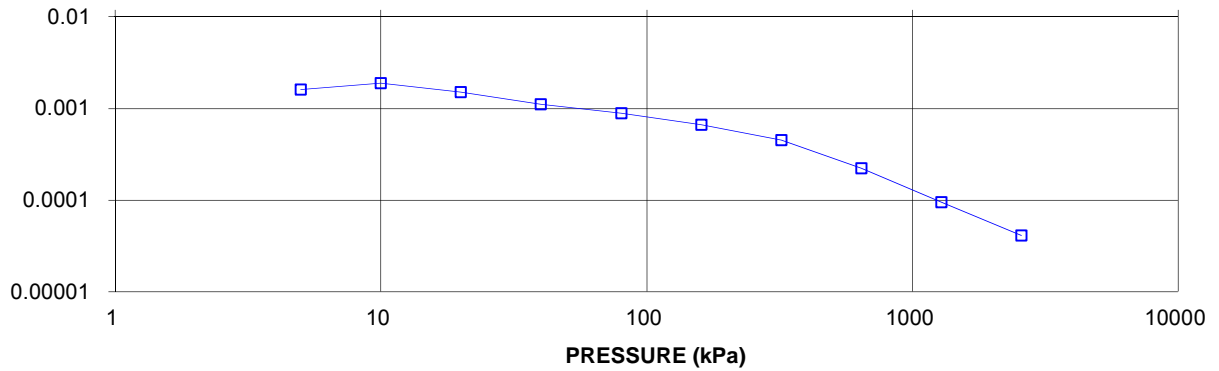
COEFFICIENT OF CONSOLIDATION,  
cm<sup>2</sup>/s

CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS PRESSURE (kPa)  
BH S25-08 SA 4



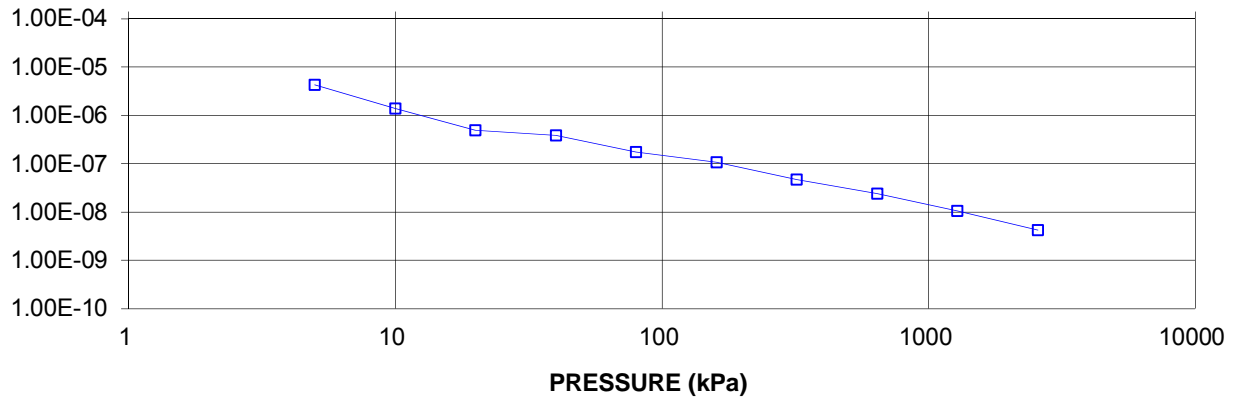
VOLUME COMPRESSIBILITY, m<sup>2</sup>/kN

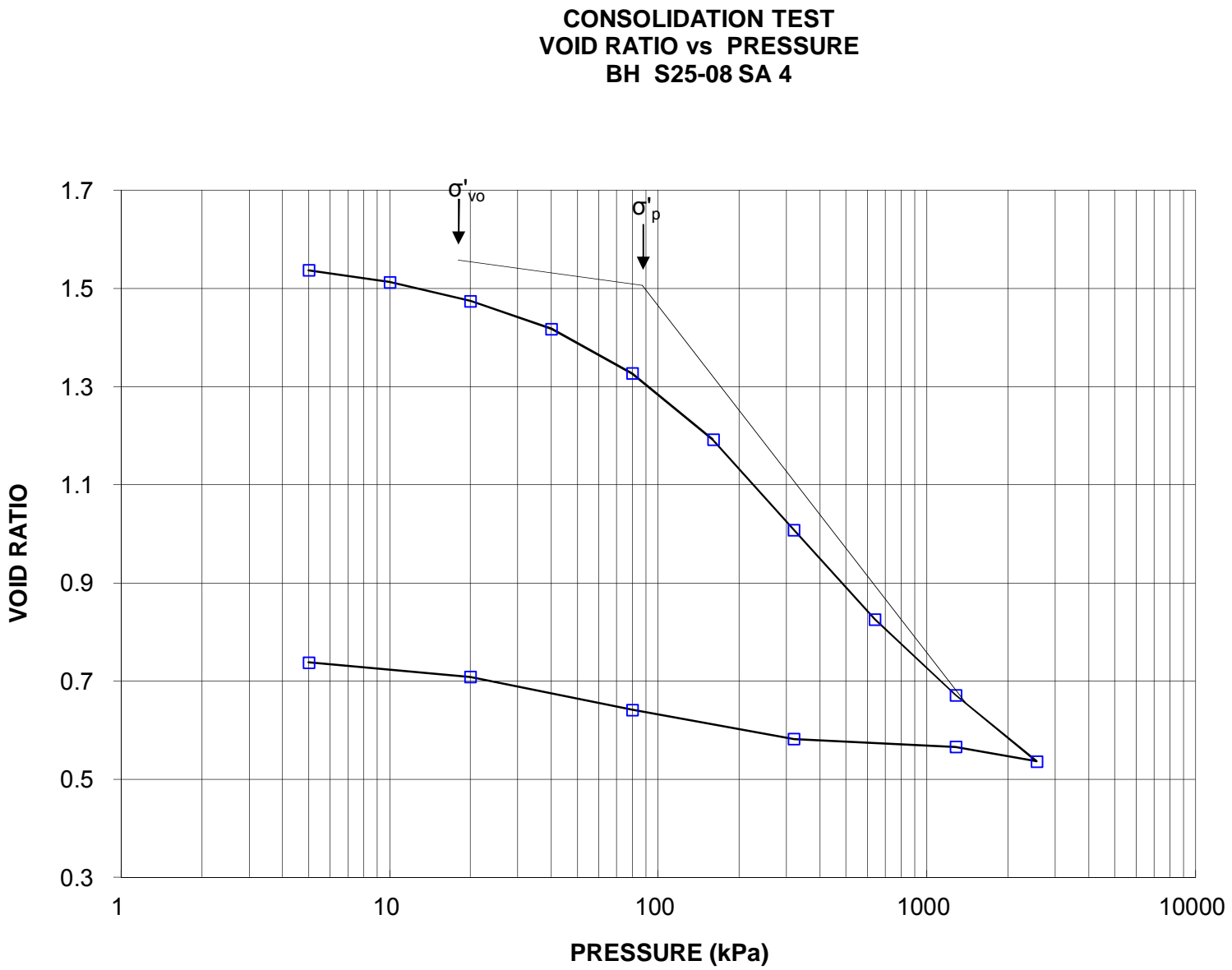
CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs PRESSURE (kPa)  
BH S25-08 SA 4

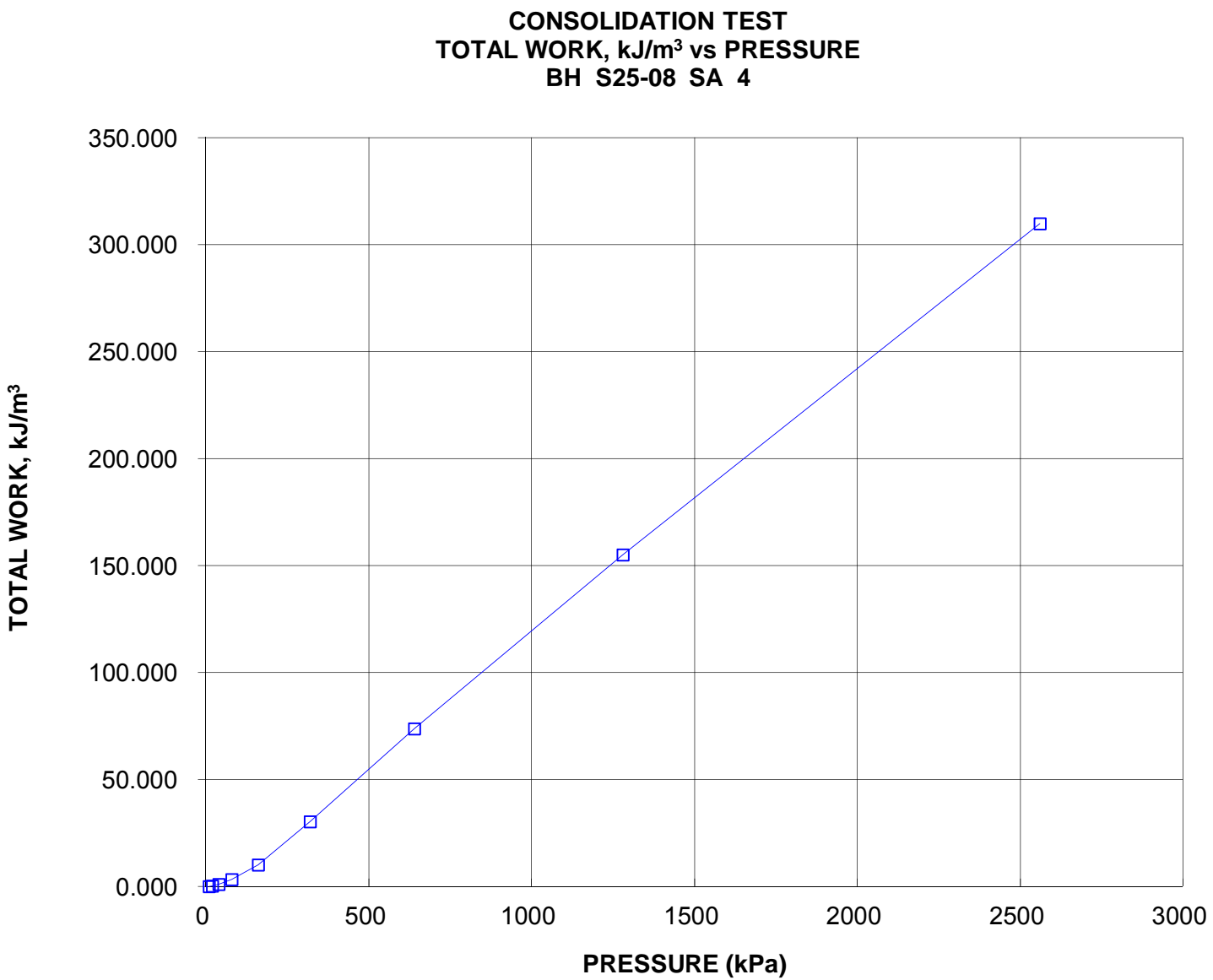


HYDRAULIC CONDUCTIVITY,  
cm/s

CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
BH S25-08 SA 4





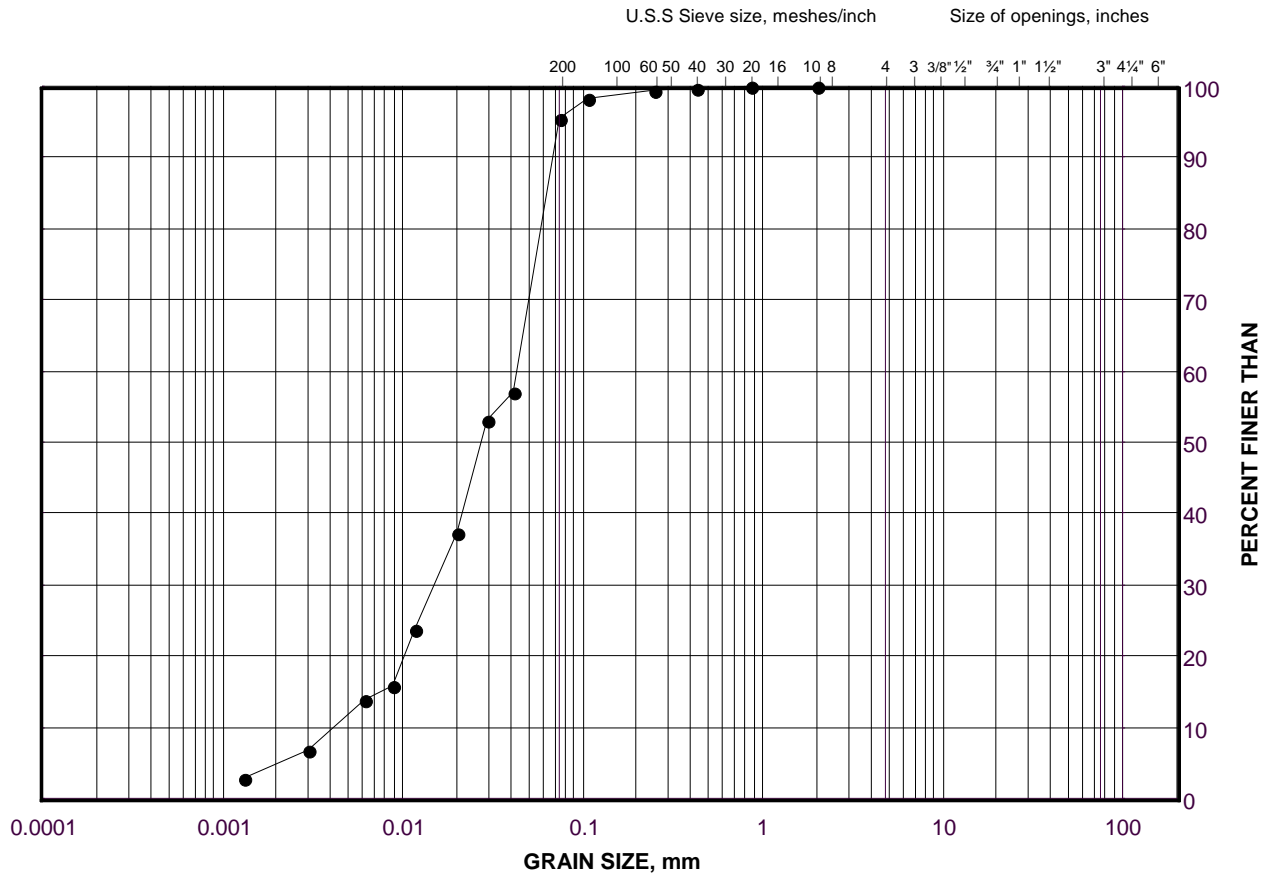


# GRAIN SIZE DISTRIBUTION

Silt

Highway 69 (SBL) STA 17+230 to 17+350

FIGURE C.S25-6



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-07	6	196.3

Project Number: 07-1111-0029

Checked By: CN

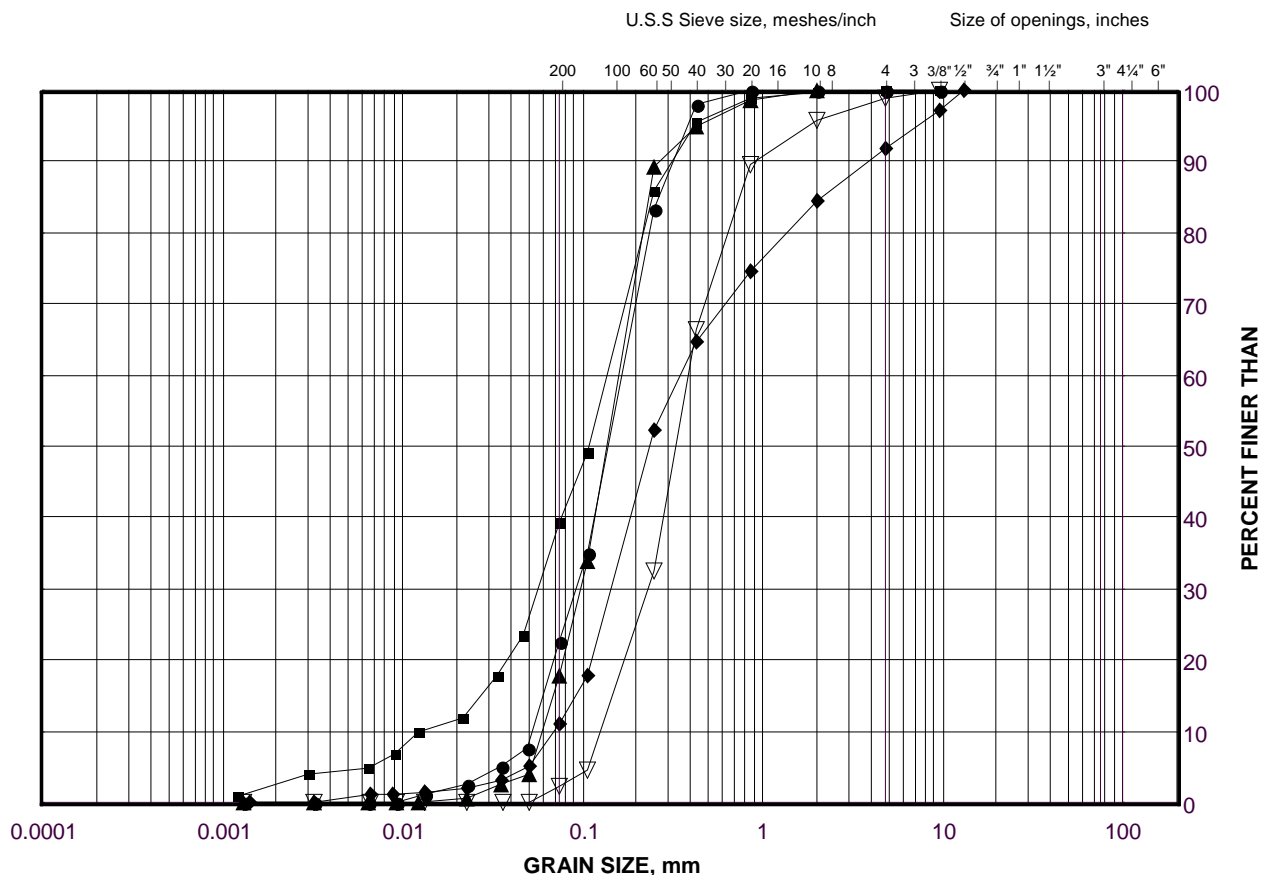
**Golder Associates**

Date: 27-Nov-09

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand  
Highway 69 (SBL) STA 17+230 to 17+350

FIGURE C.S25-7



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

## LEGEND

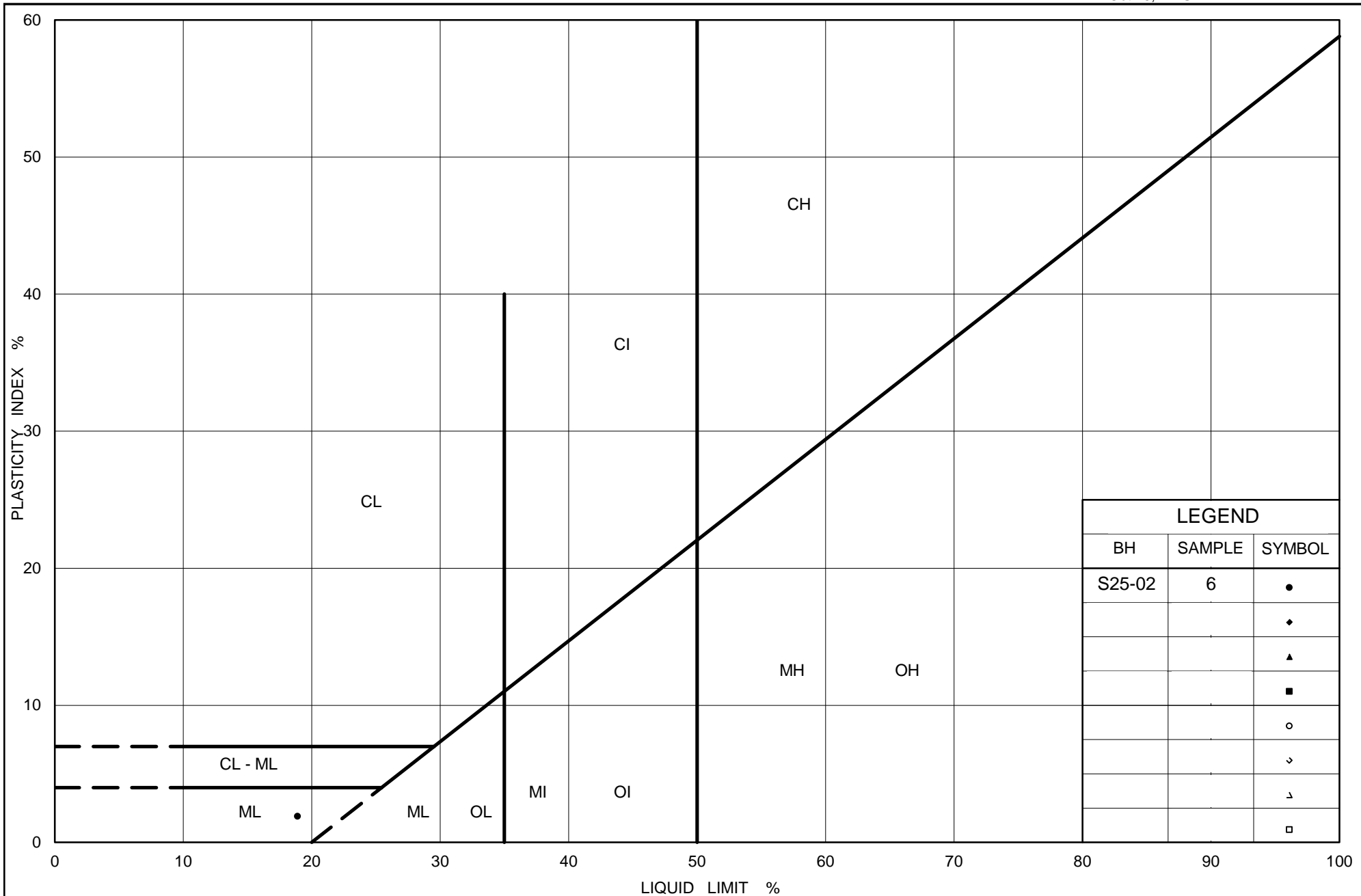
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S25-05	6	196.2
■	S25-03	6	197.7
◆	S25-10	6	196.2
▲	S25-08	8	196.2
▽	S25-09	9	191.6

Project Number: 07-1111-0029

Checked By: CN

**Golder Associates**

Date: 15-Dec-09



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## PLASTICITY CHART

Silt

Highway 69 (SBL) STA 17+230 to 17+350

Figure No. C.S25-8

Project No. 07-1111-0029

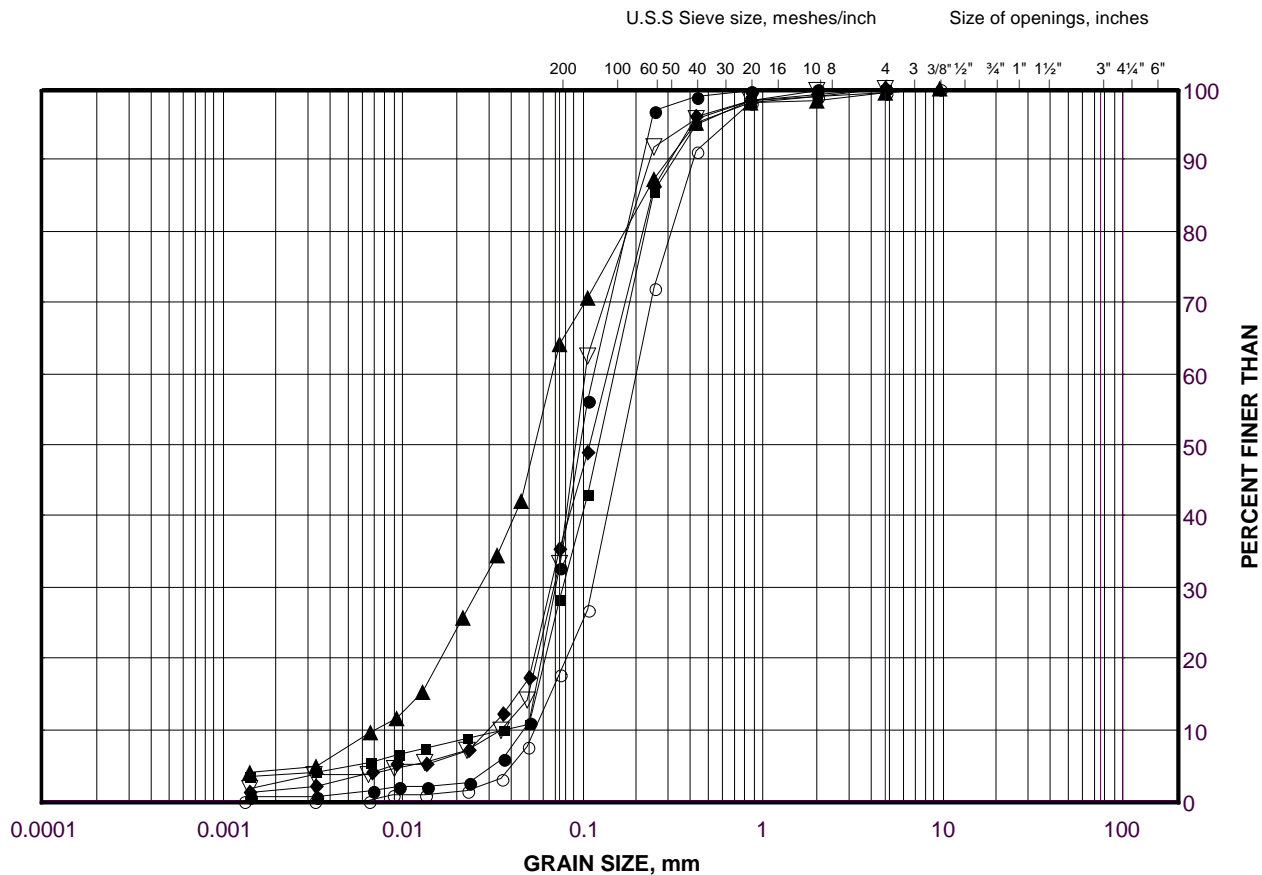
Checked By: CN



# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand (Upper Deposit)  
Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-9



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

## LEGEND

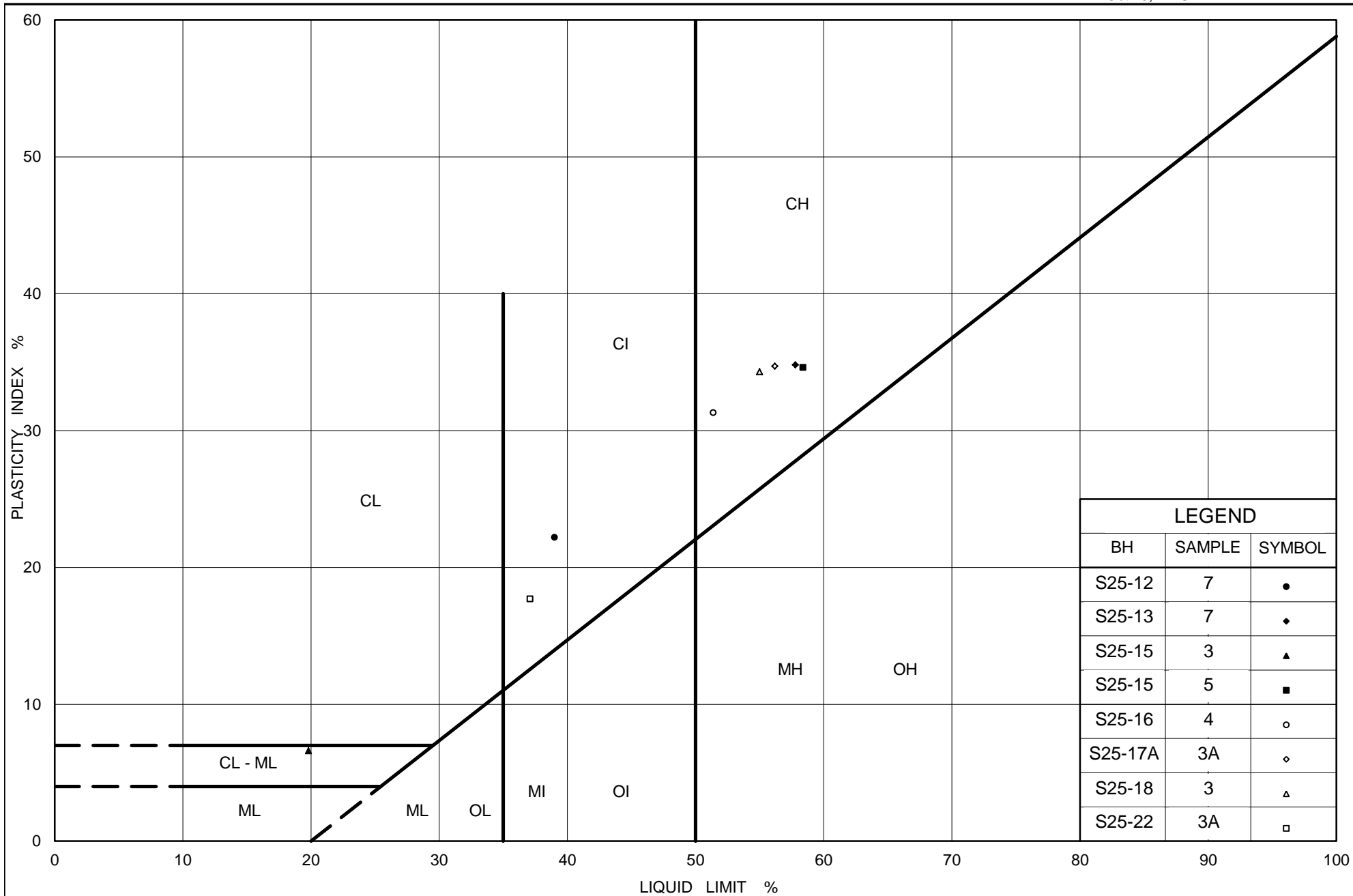
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S25-25	3	201.2
■	S25-24	3	201.2
◆	S25-23	3	200.3
▲	S25-21	3	200.6
▽	S25-17	4	200.9
○	S25-13	5	199.9

Project Number: 07-1111-0029

Checked By: CN

**Golder Associates**

Date: 22-May-15



Ministry of Transportation

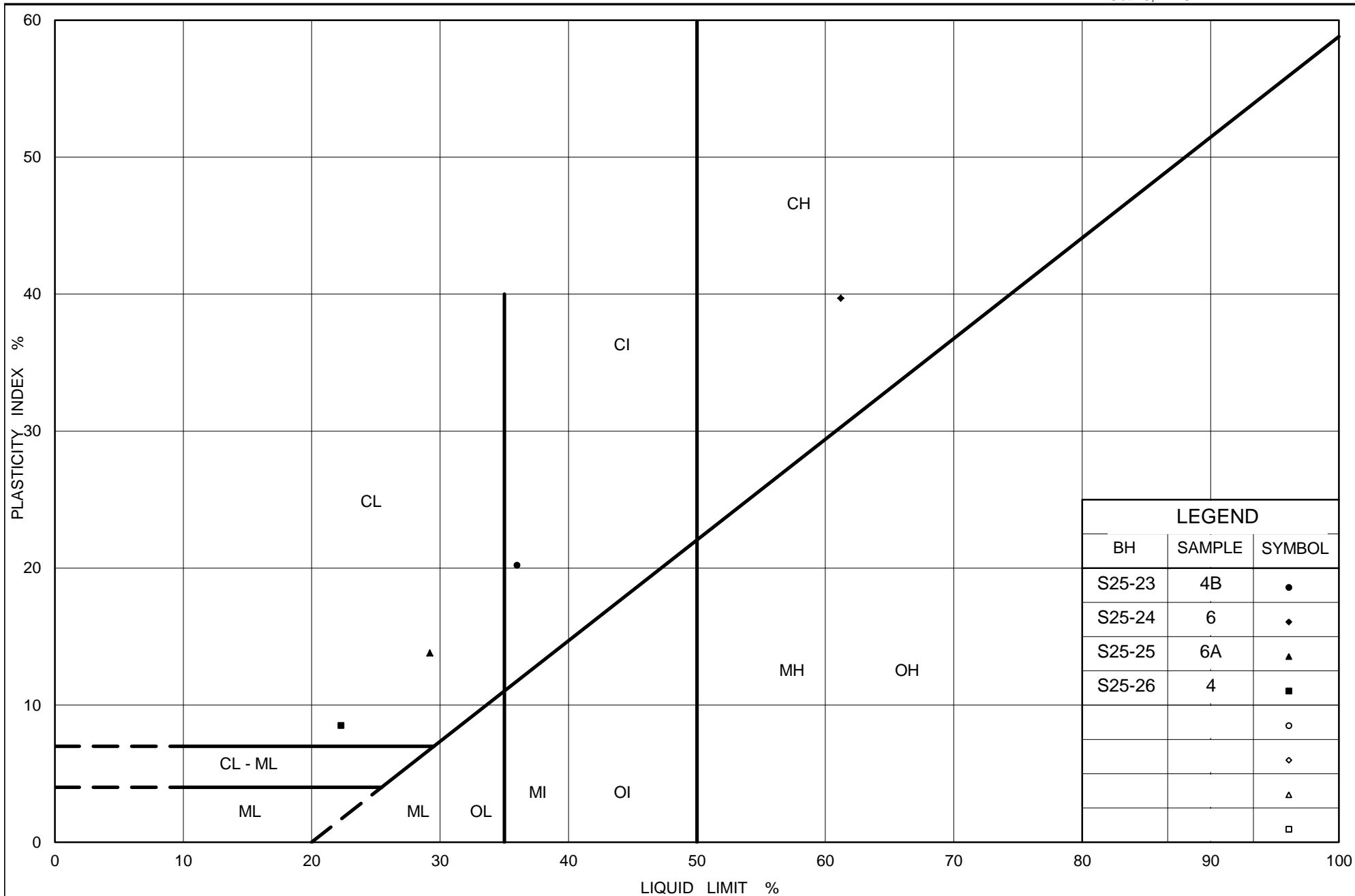
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**PLASTICITY CHART**  
 Clayey Silt to Clay  
 Highway 69 (NBL) STA 17+150 to 17+350

Figure No. C.S25-10A

Project No. 07-1111-0029

Checked By: CN



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**PLASTICITY CHART**  
 Clayey Silt to Clay  
 Highway 69 (NBL) STA 17+150 to 17+350

Figure No. C.S25-10B

Project No. 07-1111-0029

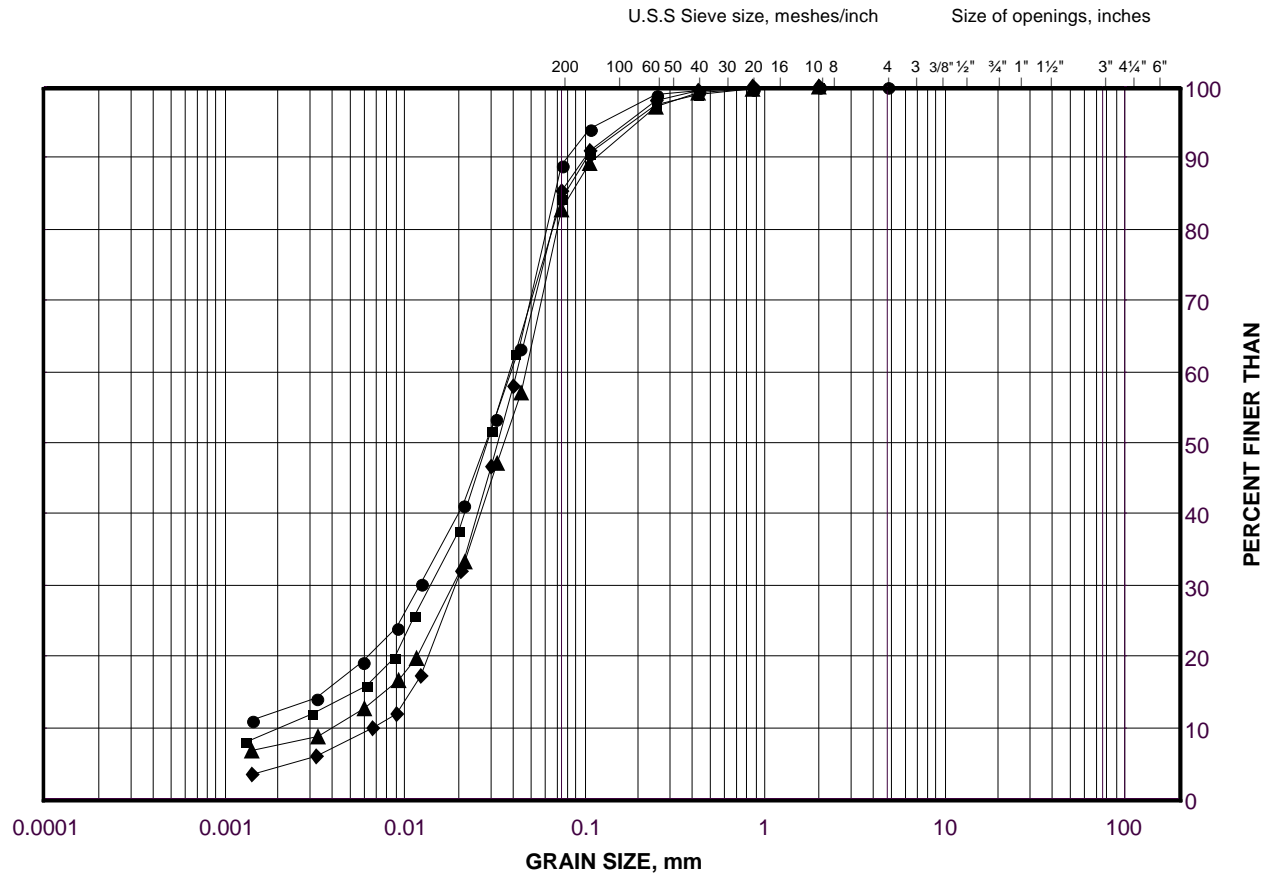
Checked By: CN

# GRAIN SIZE DISTRIBUTION

Silt

Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-11



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-22	4	199.8
■	S25-17	6	199.2
◆	S25-26	6A	196.5
▲	S25-25	6B	196.5

Project Number: 07-1111-0029

Checked By: CN

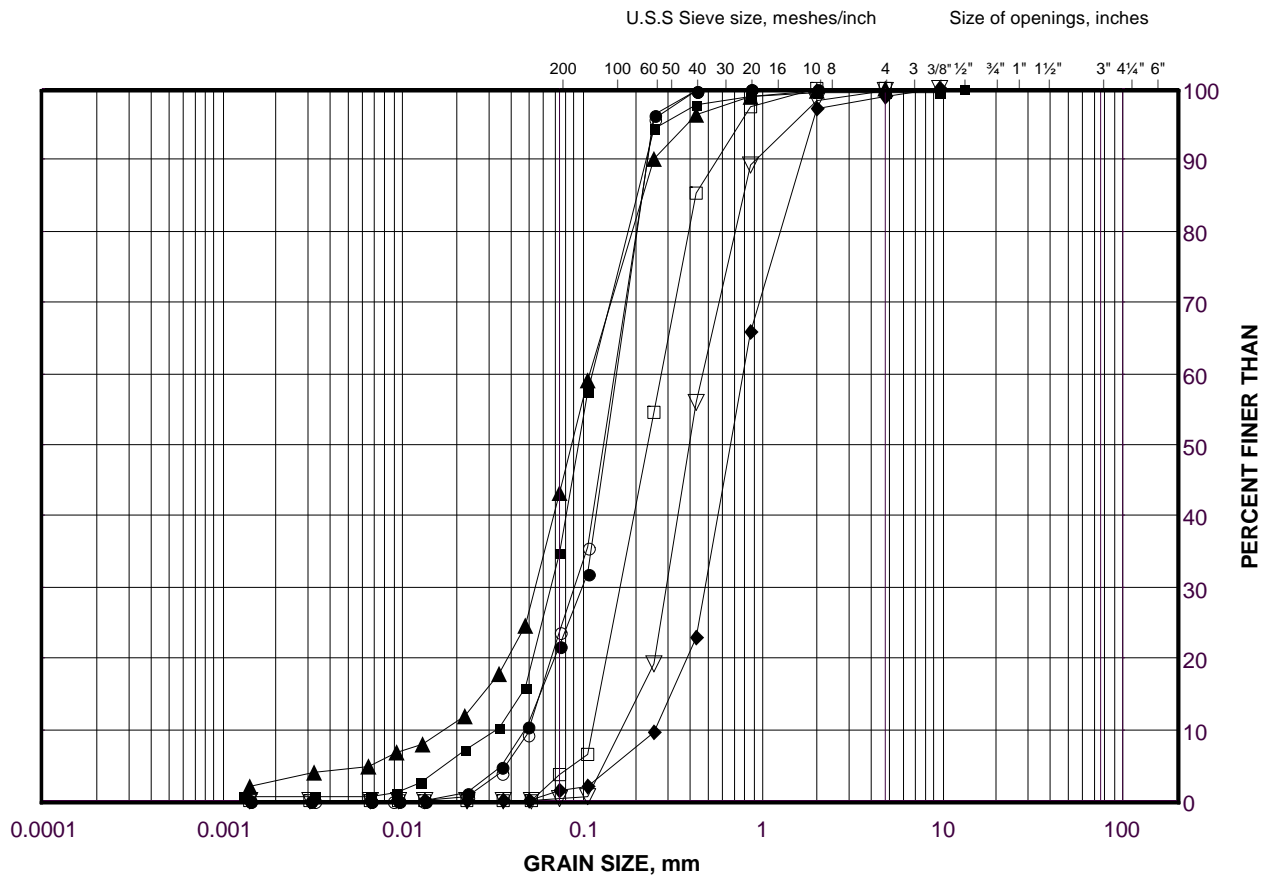
**Golder Associates**

Date: 31-Jul-15

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand (Lower Deposit)  
Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-12A



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S25-12	11	191.0
■	S25-13	12	191.7
◆	S25-19	5	197.9
▲	S25-14	6B	198.3
▽	S25-18	8	194.7
○	S25-15	8	193.2
□	S25-16	9	191.5

Project Number: 07-1111-0029

Checked By: CN

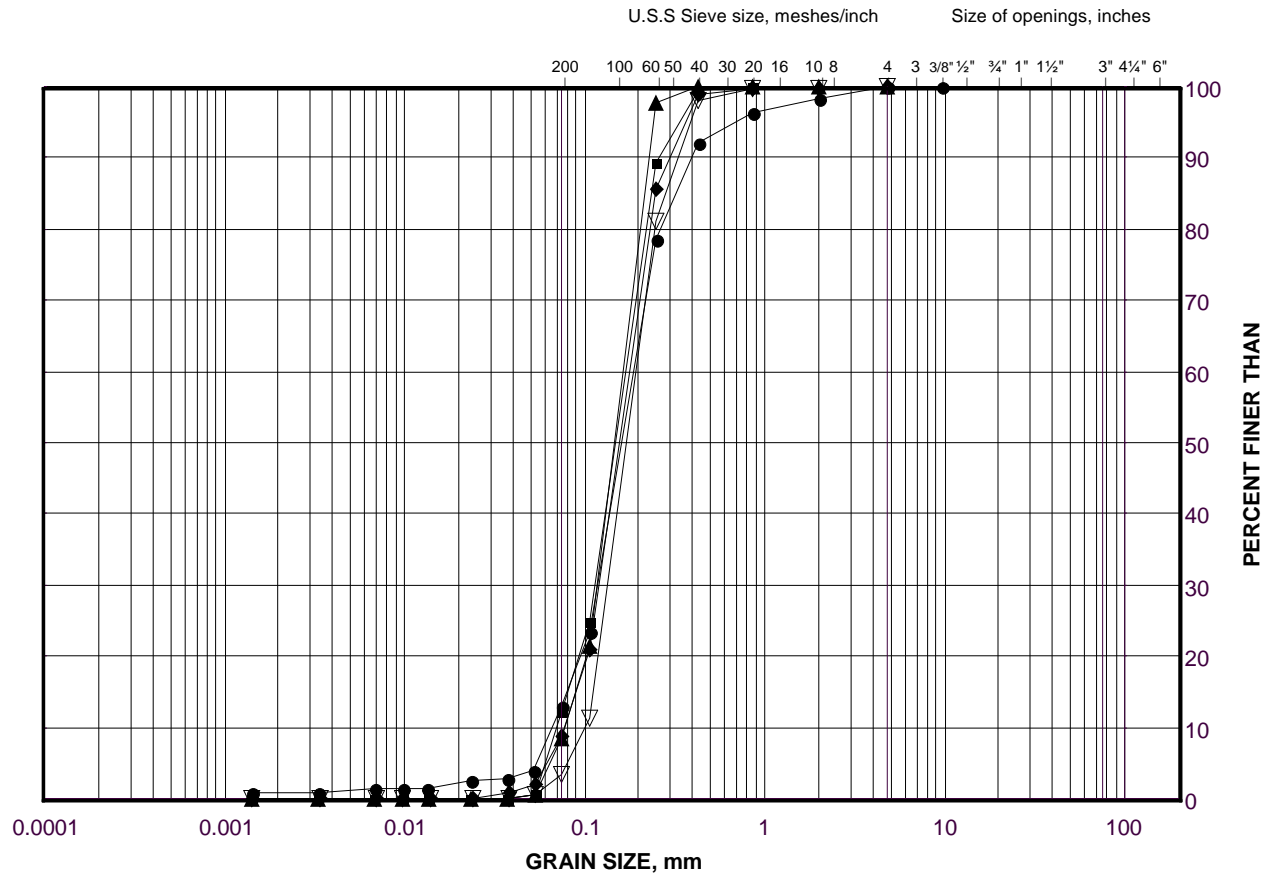
**Golder Associates**

Date: 22-May-15

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sand (Lower Deposit)  
Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-12B



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S25-26	10	190.2
■	S25-25	10	190.5
◆	S25-24	10	192.0
▲	S25-26	7	194.8
▽	S25-23	7	195.0

Project Number: 07-1111-0029

Checked By: CN

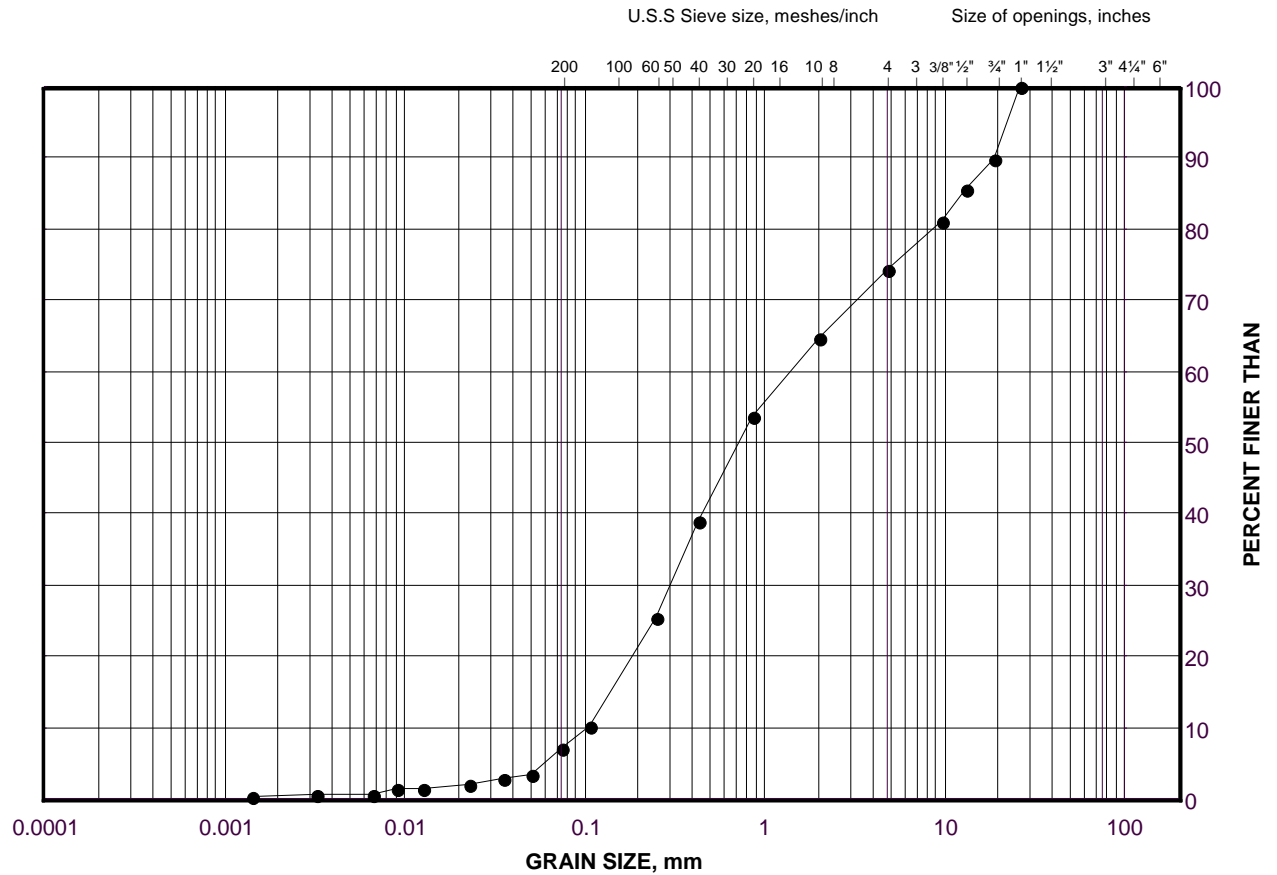
**Golder Associates**

Date: 31-Jul-15

# GRAIN SIZE DISTRIBUTION

Gravelly Sand  
Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-13A



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-12	15	184.9

Project Number: 07-1111-0029

Checked By: CN

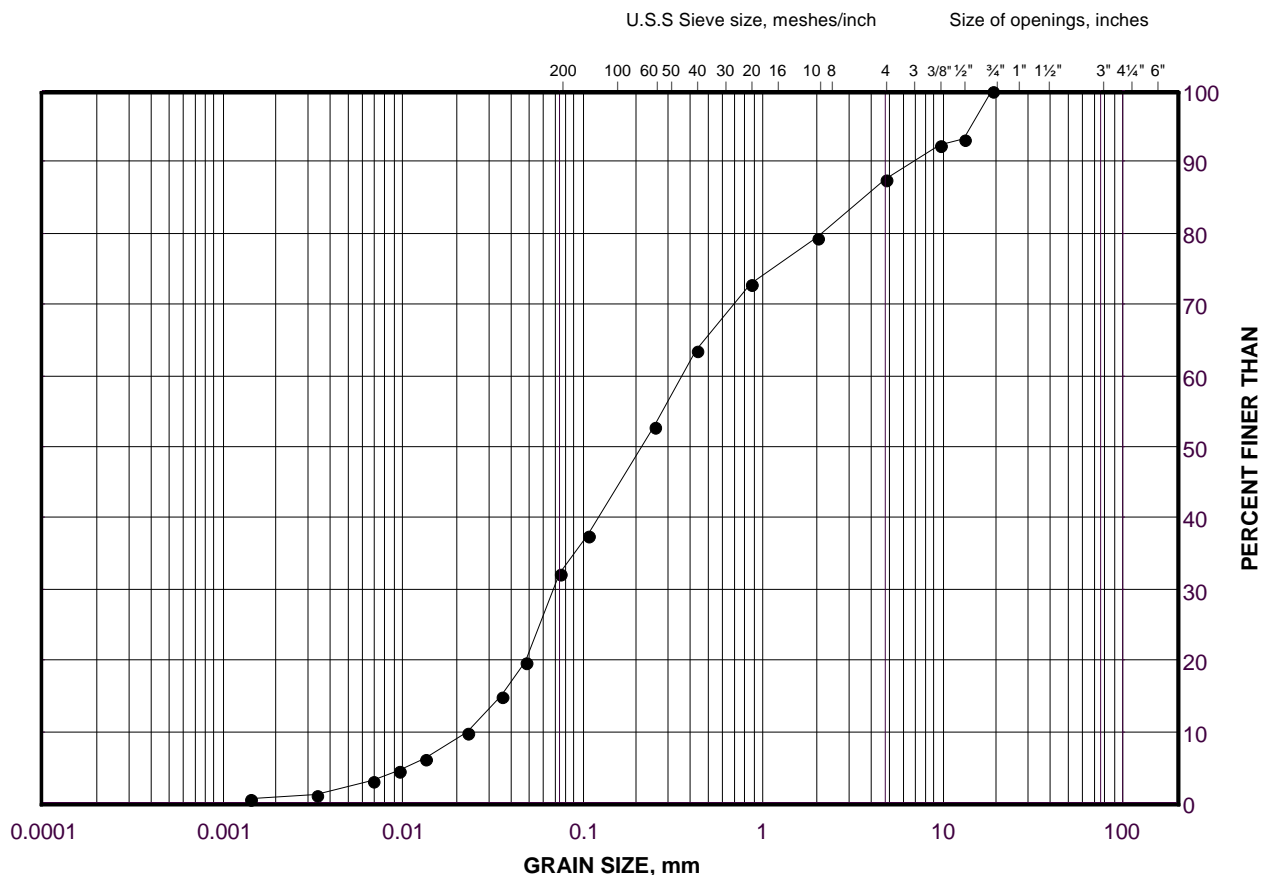
**Golder Associates**

Date: 27-Nov-09

# GRAIN SIZE DISTRIBUTION

Silt and Sand (Pocket)  
Highway 69 (NBL) STA 17+150 to 17+350

FIGURE C.S25-13B



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S25-24	12	189.0

Project Number: 07-1111-0029

Checked By: CN

**Golder Associates**

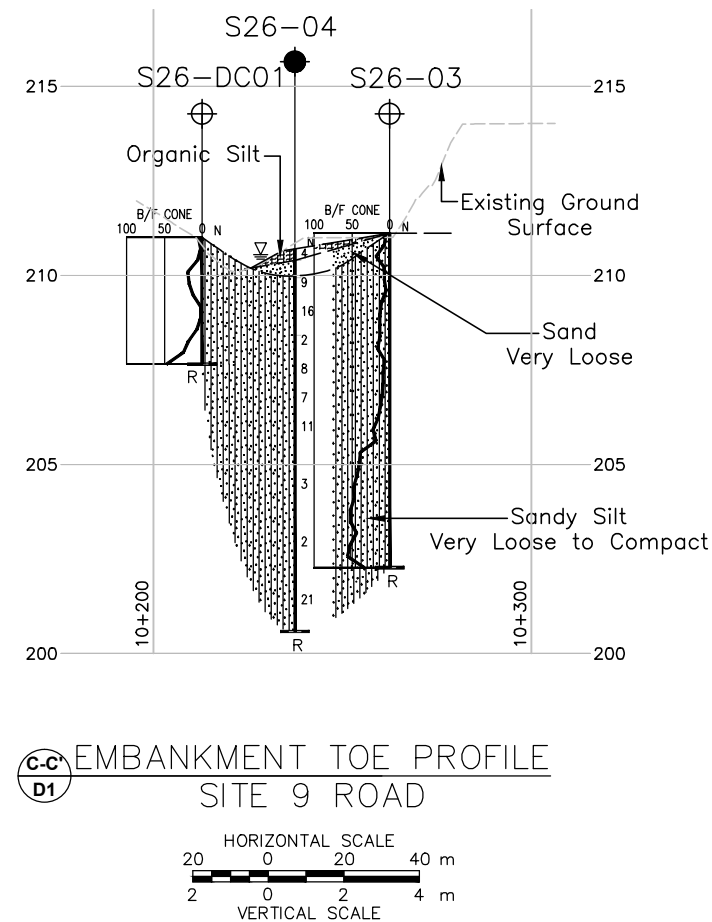
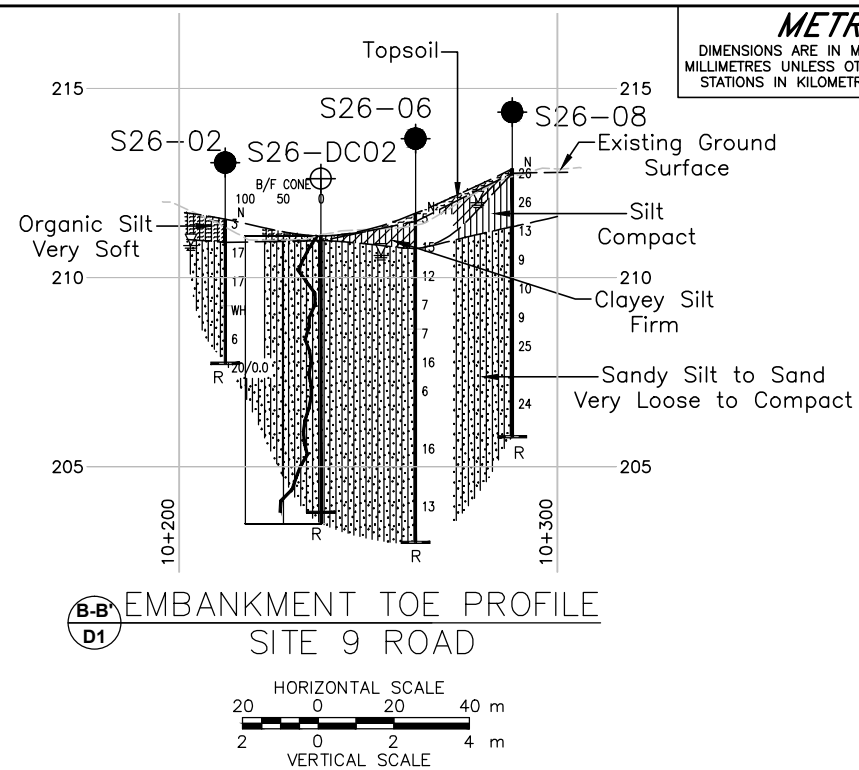
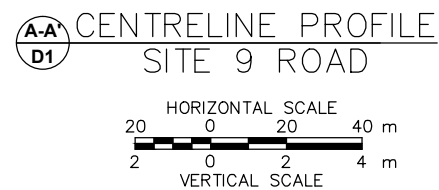
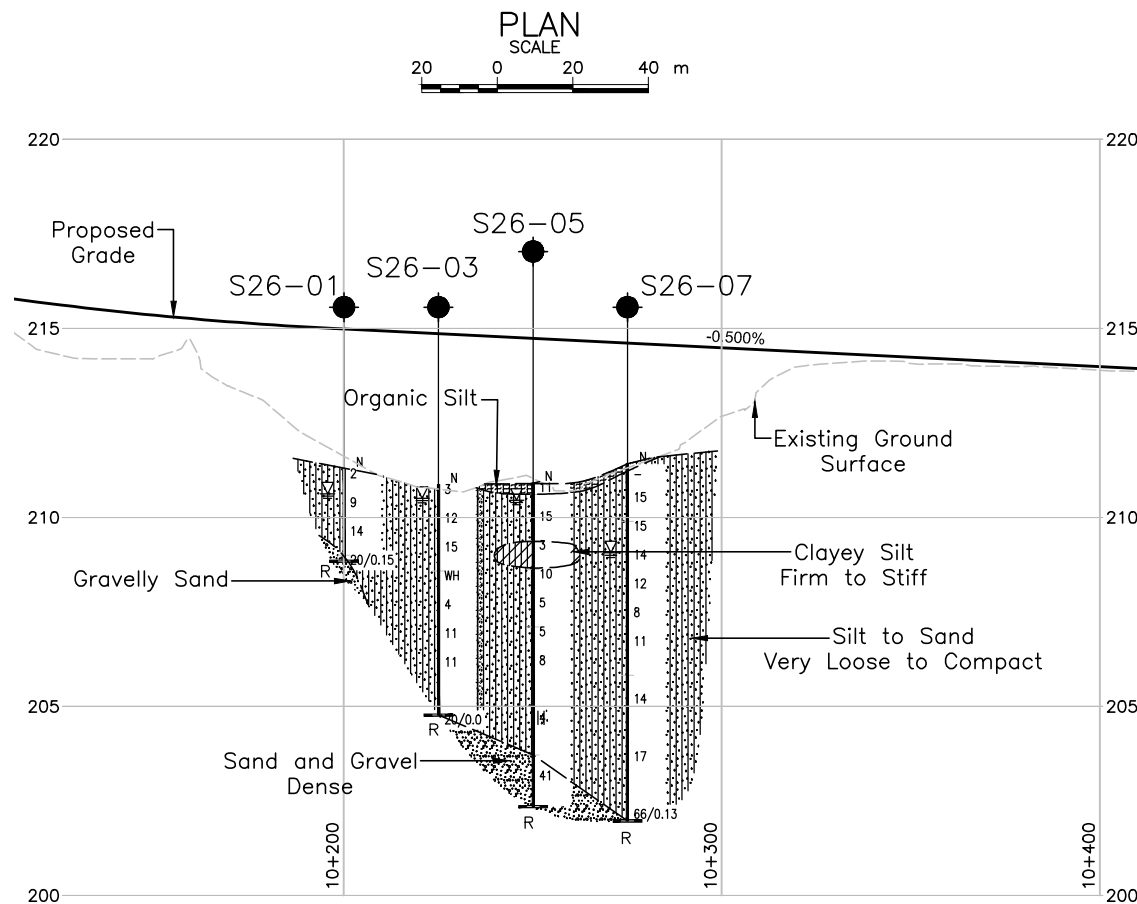
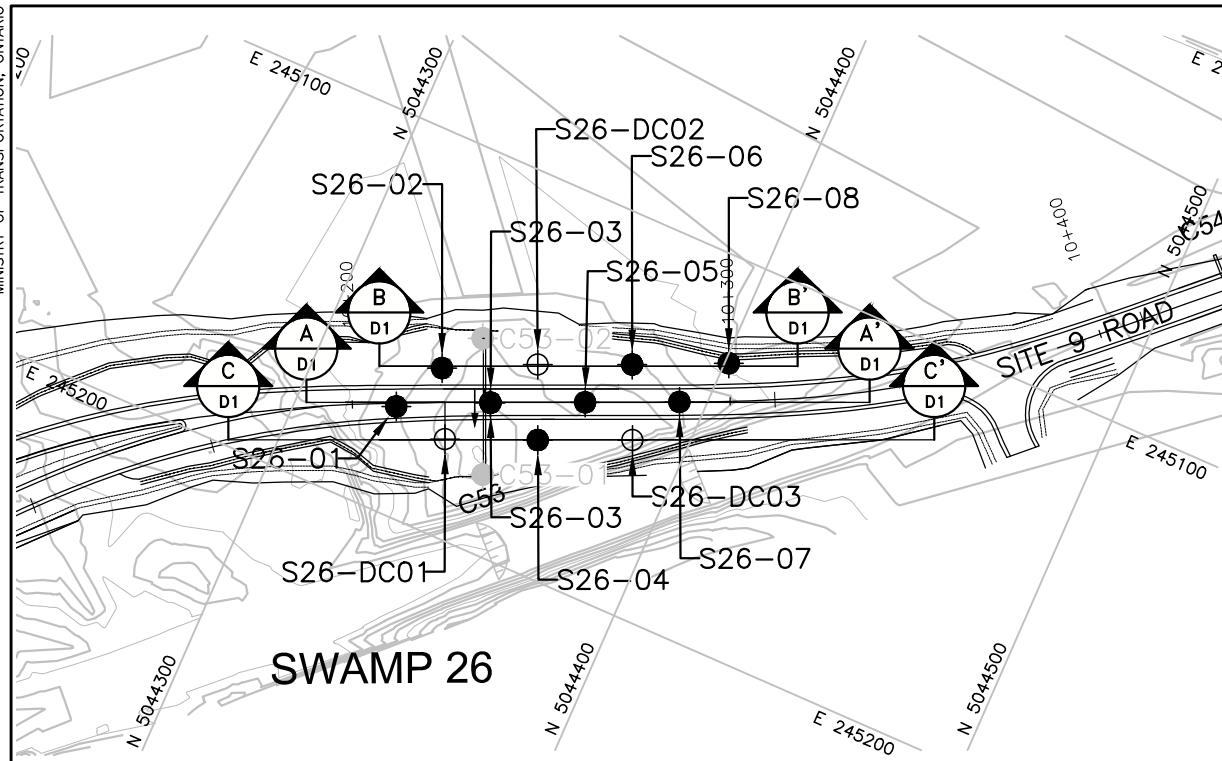
Date: 31-Jul-15





# **APPENDIX D**

**Site 9 Road – STA 10+225 to 10+300 (Swamp 26)**



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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.

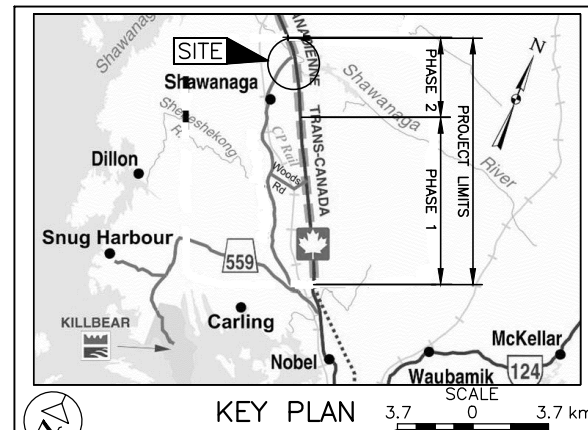
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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






CONT No.  
WP No. 5111-07-00

SITE 9 ROAD STA 10+225 TO 10+300

## BOREHOLE LOCATIONS AND SOIL STRATA



## LEGEND

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

BOREHOLE CO—ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S26—01	211.3	5044325.0	245172.5
S26—02	211.5	5044332.1	245158.3
S26—03	210.9	5044347.5	245161.6
S26—03	211.7	5044347.5	245161.6
S26—04	210.7	5044362.9	245165.6
S26—05	210.9	5044370.4	245151.4
S26—06	211.7	5044377.8	245137.3
S26—07	211.4	5044393.2	245141.3
S26—08	212.9	5044401.1	245126.7
S26—DC01	211.0	5044340.3	245175.2
S26—DC02	211.1	5044354.9	245147.3
S26—DC03	211.1	5044385.9	245155.5

## REFERENCE

Base plans contours and centreline profile provided in digital format by MMM, drawing file nos. S6878-330-001SGA.dwg, dated November 2013, s6878xb02 contours.dwg, h6878\_PHASE2\_XD1 grading.dwg and h6878\_PHASE2\_XN1.dwg, received November 10, 2014, 6878 jh Sheb Tie In at IC Profile-May 14, 2015.dwg received May 14, 2015.

NO.	DATE	BY	REVISION		
Geocres No. 41H-161					
HWY. 69		PROJECT NO. 07-1111-0029		DIST. .	
SUBM'D. AJS		CHKD. CN	DATE: 5/21/2015		SITE:
DRAWN: MR		CHKD. CN	APPD. JPD/JMAC		DWG. D1







PROJECT 07-1111-0029		RECORD OF BOREHOLE No S26-01				SHEET 1 OF 1		METRIC									
W.P. 5111-07-00		LOCATION N 5044325.0 ; E 245172.5				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 29, 2015				CHECKED BY AJS/MCK											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
211.3	GROUND SURFACE							20	40	60	80	100					
0.0	SILT and SAND, some gravel, trace clay, clayey silt seam at 1.5 m depth Very loose to compact Brown to grey Wet		1	SS	2	▽	211										
			2	SS	9		210										
			3	SS	14												
209.0			4	SS	20/0.15		209										
2.4	Gravelly SAND, some silt, trace clay Grey Wet  SPOON AND AUGER REFUSAL END OF BOREHOLE  NOTE:  1. Water level in open borehole measured at a depth of 0.6 m below ground surface (Elev. 210.7 m) upon completion of drilling.																24 52 20 4

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S26-02		SHEET 1 OF 1		METRIC															
W.P. 5111-07-00		LOCATION N 5044332.1 ; E 245158.3		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			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ					
								20 40 60 80 100	20 40 60 80 100	20 40 60	W <sub>p</sub>	W	W <sub>L</sub>								
211.5	GROUND SURFACE																				
0.0	ORGANIC SILT, some sand Very soft Dark brown Wet		1	SS	3		211														OC = 6.1%
210.9																					
0.6	SAND, some silt, trace organics Compact Brown to grey Moist to wet		2	SS	17		210														
			3	SS	17																
209.2																					
2.3	Sandy SILT, trace clay, trace organics, trace wood fragments Very loose to loose Brown to grey Wet		4	SS	WH		209														
			5	SS	6		208														
207.7			6	SS	20/0.0																0 25 71 4 Non-Plastic
3.8	SPOON AND AUGER REFUSAL END OF BOREHOLE																				
	NOTE:  1. Water level in open borehole measured at a depth of 0.7 m below ground surface (Elev. 210.8 m) upon completion of drilling.																				

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S26-03		SHEET 1 OF 1		METRIC											
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			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	20 40 60				
210.9 0.0	GROUND SURFACE Silty SAND, trace clay, trace organics to a depth of 0.8 m Very loose to compact Brown to grey Wet		1	SS	3	▽	210										
			2	SS	12		209										
			3	SS	15												
208.6 2.3	Sandy SILT, trace clay Very loose to compact Brown to grey Wet		4	SS	WH		208										
			5	SS	4		207										
			6	SS	11		206										
			7	SS	11												
204.8 6.1	SPOON AND AUGER REFUSAL END OF BOREHOLE  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.		8	SS	20/0.0		205										

PROJECT		RECORD OF BOREHOLE		No S26-04		SHEET 1 OF 1		METRIC													
W.P.		LOCATION		ORIGINATED BY		ID															
DIST		BOREHOLE TYPE		COMPILED BY		KD/MR															
DATUM		DATE		CHECKED BY		AJS/MCK															
PROJECT 07-1111-0029		N 5044362.9 ; E 245165.6																			
5111-07-00		Continuous Flight 108 mm I.D. Hollow Stem Augers																			
Geodetic		February 2, 2015																			
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20	40	60	80	100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	GR	SA	SI	CL
210.7	0.0	GROUND SURFACE																			
210.4	0.3	ORGANIC SILT		1A	SS	4															
209.9	0.8	SAND, trace organics Very loose Brown Wet		1B																	
		Silty SAND Loose to compact Brown to grey Wet		2	SS	9															
				3	SS	16															
208.4	2.3	Sandy SILT, trace to some gravel, trace clay Very loose to compact Grey Wet		4	SS	2															
				5	SS	8															
				6	SS	7															
				7	SS	11															
				8	SS	3															
				9	SS	2															
				10	SS	21															
200.6	10.1	AUGER REFUSAL END OF BOREHOLE																			
NOTE: 1. Water level in open borehole measured at a depth of 0.2 m below ground surface (Elev. 210.5 m) upon completion of drilling.																					

PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S26-05</b>		SHEET 1 OF 1		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044370.4 ;E 245151.4</u>		ORIGINATED BY <u>ID</u>			
DIST <u>        </u> HWY <u>69</u>		BOREHOLE TYPE <u>Continuous Flight 108 mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>KD/MR</u>			
DATUM <u>Geodetic</u>		DATE <u>February 3, 2015</u>		CHECKED BY <u>AJS/MCK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE   LIQUID LIMIT CONTENT			UNIT WEIGHT  γ  kN/m³	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						
						○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED								GR   SA   SI   CL	
210.9	GROUND SURFACE					▽									
0.0	ORGANIC SILT		1A	SS	11										
210.6			1B												
0.3	Silty SAND, trace organics Compact Brown to grey Moist to wet														OC = 0.8%
			2	SS	15										
209.4															
1.5	CLAYEY SILT, trace sand Firm to stiff Grey Moist		3	SS	3										
208.6															
2.3	SILT and SAND Loose to compact Brown Wet		4	SS	10										
			5	SS	5										
207.1															
3.8	SAND, trace to some gravel, trace silt Loose Brown to grey Wet		6	SS	5									8   88   4   0	
			7	SS	8										
			8	SS	4										
203.7															
7.2	SAND and GRAVEL, trace silt Compact Dense Brown to grey Wet		9	SS	41										
202.3															
8.6	AUGER REFUSAL END OF BOREHOLE														
NOTES:  1. An additional borehole advanced 1.1 m south of Borehole S26-05 to carry out in situ field vanes at depths of 1.7 m and 2.0 m.  2. Water level in open borehole measured at a depth of 0.4 m below ground surface (Elev. 210.5 m) upon completion of drilling.															

PROJECT		RECORD OF BOREHOLE		No S26-06		SHEET 1 OF 1		METRIC					
W.P.		LOCATION		ORIGINATED BY		ID							
DIST		BOREHOLE TYPE		COMPILED BY		KD/MR							
DATUM		DATE		CHECKED BY		AJS/MCK							
PROJECT 07-1111-0029		N 5044377.8 ; E 245137.3											
5111-07-00		Continuous Flight 108 mm I.D. Hollow Stem Augers											
Geodetic		February 4, 2015											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	GR SA SI CL
211.7	GROUND SURFACE												
0.0	TOPSOIL		1A	SS	5		211						
0.2	CLAYEY SILT Firm Brown to grey Moist		1B										
210.8			2A										
0.9	Sandy SILT, trace clay Loose to compact Brown to grey Wet		2B	SS	15								
			3	SS	12		210						0 26 70 4
			4	SS	7		209						
208.7													
3.0	Silty SAND Loose to compact Brown to grey Moist to wet		5	SS	7		208						
			6	SS	16								
			7	SS	6		207						
							206						
			8	SS	16		205						1 76 23 0
			9	SS	13		204						
203.0													
8.7	AUGER REFUSAL END OF BOREHOLE												
NOTE: 1. Water level in open borehole measured at a depth of 1.1 m below ground surface (Elev. 210.6 m) upon completion of drilling.													



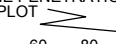
PROJECT <u>07-1111-0029</u>		<b>RECORD OF BOREHOLE No S26-07</b>		SHEET 1 OF 1		<b>METRIC</b>	
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044393.2 ; E 245141.3</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>Continuous Flight 108 mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>KD/MR</u>			
DATUM <u>Geodetic</u>		DATE <u>February 5, 2015</u>		CHECKED BY <u>AJS/MCK</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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
211.4	GROUND SURFACE																
0.0	ORGANIC SILT		1A	AS	-											OC = 24.6%	
0.2	SILT, some sand Compact Brown, becoming grey at a depth of 0.8 m Moist to wet						211										
			2	SS	15												
							210										
209.9																	
1.5	SAND, trace to some silt, trace clay, trace gravel Loose to compact Brown to grey Wet		3	SS	15											0   82   17   1	
			4	SS	14		209										
			5	SS	12		208										
			6	SS	8												
							207										
			7	SS	11											1   98   1   0	
							206										
205.8																	
5.6	Silty SAND, some gravel Compact Brown to grey Wet		8	SS	14		205										
							204										
			9	SS	17												
							203										
202.0			10	SS	66/0.13												
9.4	SPOON AND AUGER REFUSAL END OF BOREHOLE						202										
	NOTE:  1. Water level in open borehole measured at a depth of 2.3 m below ground surface (Elev. 209.1 m) upon completion of drilling.																

PROJECT 07-1111-0029		RECORD OF BOREHOLE No S26-08		SHEET 1 OF 1		METRIC											
W.P. 5111-07-00		LOCATION N 5044401.1 ; E 245126.7		ORIGINATED BY ID													
DIST HWY 69		BOREHOLE TYPE Continuous Flight 108 mm I.D. Hollow Stem Augers		COMPILED BY KD/MR													
DATUM Geodetic		DATE February 5, 2015		CHECKED BY AJS/MCK													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	20 40 60					
212.9	GROUND SURFACE																
0.0	TOPSOIL		1A		26												
0.2	SILT, some sand Compact Light brown with reddish pockets Wet		1B	SS													0 14 82 4
			2	SS	26												
211.4																	
1.5	SAND, some silt, trace gravel Loose to compact Brown to grey Wet		3	SS	13												
			4	SS	9												
			5	SS	10												
			6	SS	9												1 80 19 0
			7	SS	25												
			8	SS	24												
205.8	AUGER REFUSAL END OF BOREHOLE																
7.1	NOTE:  1. Water level in open borehole measured at a depth of 0.9 m below ground surface (Elev. 212.0 m) upon completion of drilling.																

<div style="display: flex; justify-content: space-between;"> <span>PROJECT <u>07-1111-0029</u></span> <span><b>RECORD OF DCPT No S26-DC01</b></span> <span>SHEET 1 OF 1</span> <span><b>METRIC</b></span> </div>																
W.P. <u>5111-07-00</u>		LOCATION <u>N 5044340.3 ; E 245175.2</u>		ORIGINATED BY <u>ID</u>												
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>Dynamic Cone Penetration Test</u>		COMPILED BY <u>KD/MR</u>												
DATUM <u>Geodetic</u>		DATE <u>January 25, 2015</u>		CHECKED BY <u>AJS/MCK</u>												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
211.0	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div>									
0.0	Dynamic Cone Penetration Test (DCPT)						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div>									
207.4	END OF DCPT Refusal to Further Penetration						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div>									
3.6																

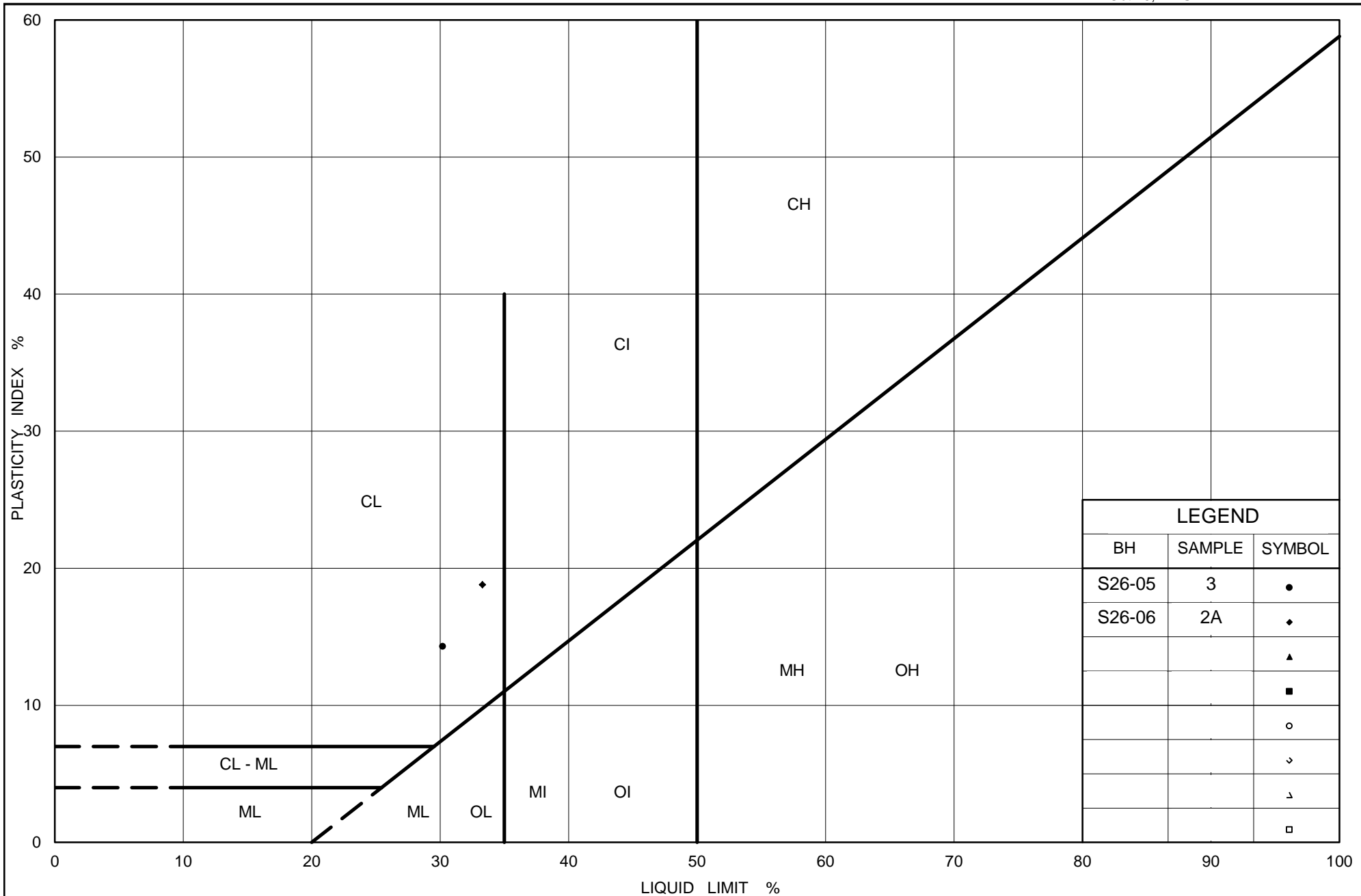
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PROJECT		RECORD OF DCPT No S26-DC02		SHEET 1 OF 1		METRIC				
W.P. 07-1111-0029		LOCATION N 5044354.9 ; E 245147.3		ORIGINATED BY ID						
DIST HWY 69		BOREHOLE TYPE Dynamic Cone Penetration Test		COMPILED BY KD/MR						
DATUM Geodetic		DATE January 29, 2015		CHECKED BY AJS/MCK						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> — W — W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
211.1 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)									
						211 210 209 208 207 206 205 204				
203.5 7.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)									

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PROJECT <u>07-1111-0029</u>				<b>RECORD OF DCPT No S26-DC03</b>				SHEET 1 OF 1				<b>METRIC</b>				
W.P. <u>5111-07-00</u>				LOCATION <u>N 5044385.9 ; E 245155.5</u>				ORIGINATED BY <u>ID</u>								
DIST <u>          </u> HWY <u>69</u>				BOREHOLE TYPE <u>Dynamic Cone Penetration Test</u>				COMPILED BY <u>KD/MR</u>								
DATUM <u>Geodetic</u>				DATE <u>January 29, 2015</u>				CHECKED BY <u>AJS/MCK</u>								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
211.1	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)					211										
						210										
						209										
						208										
						207										
						206										
						205										
						204										
						203										
						202										
201.8	END OF DCPT															
9.3	Refusal to Further Penetration (Hammer Bouncing)															

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



Ministry of Transportation

Ontario

## PLASTICITY CHART

Clayey Silt

Site 9 Road STA 10+225 to 10+300

Figure No. D.S26-1

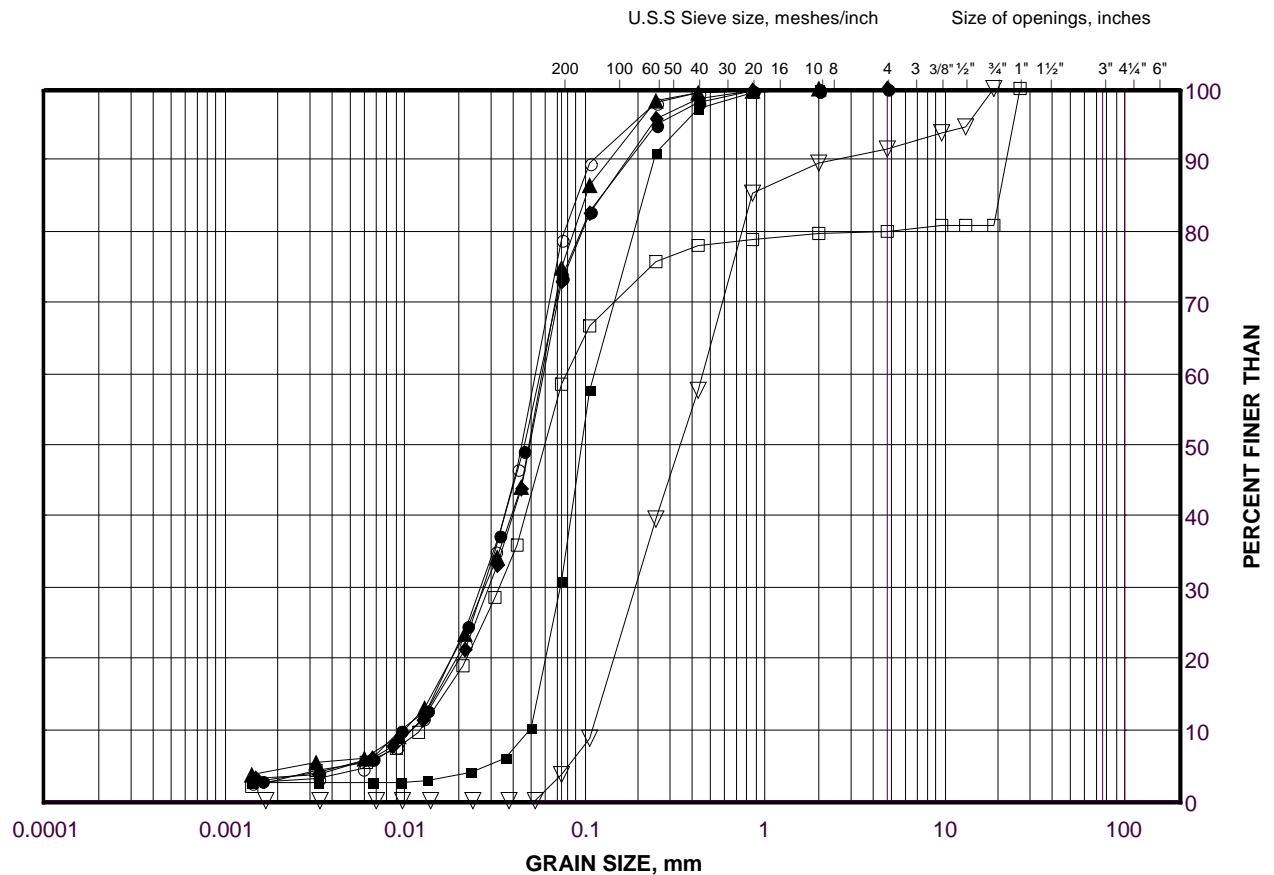
Project No. 07-1111-0029

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# GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand  
Site 9 Road STA 10+225 to 10+300

FIGURE D.S26-2A



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S26-06	3	209.9
■	S26-03	3	209.1
◆	S26-04	4	208.1
▲	S26-02	5	208.2
▽	S26-05	6	206.8
○	S26-03	6	206.8
□	S26-04	7	205.9

Project Number: 07-1111-0029

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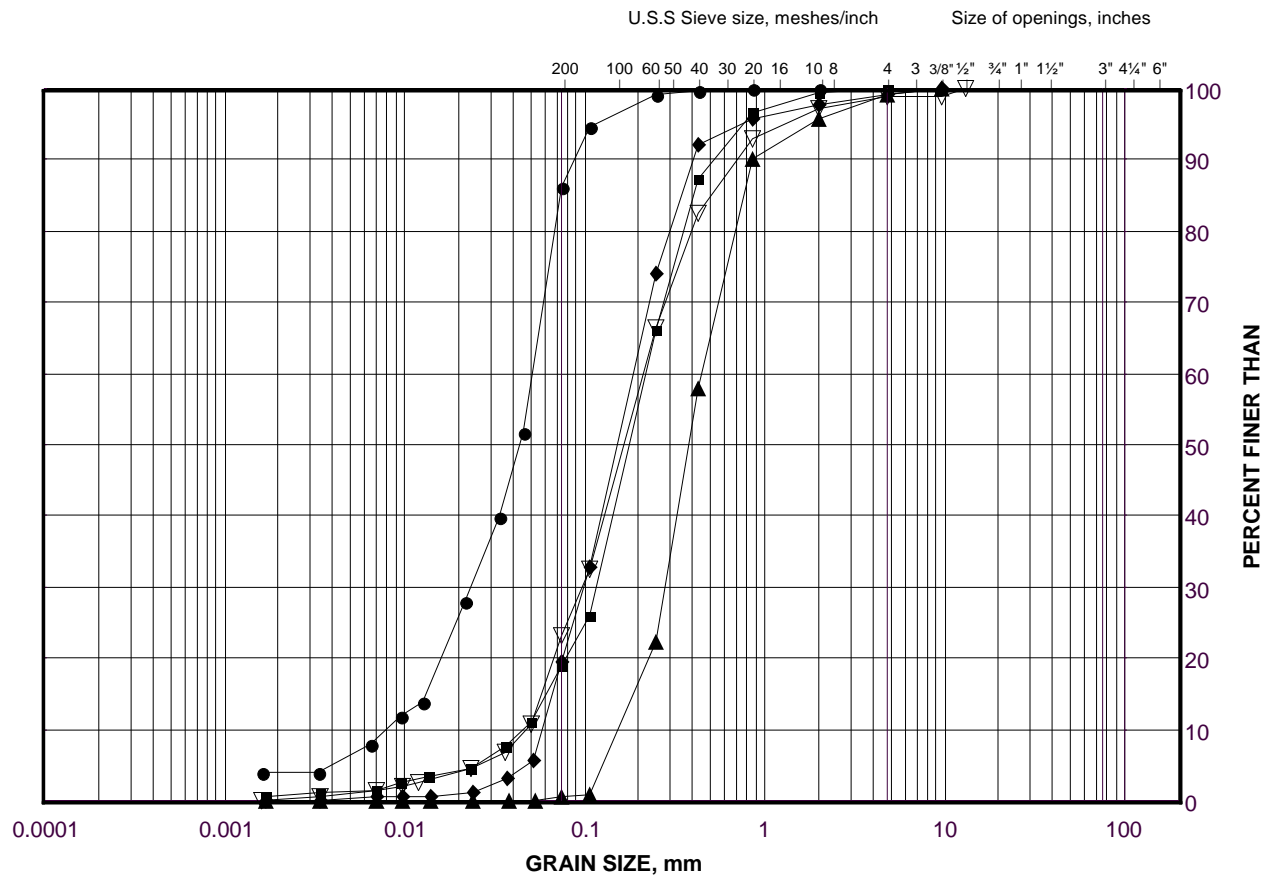
Date: 22-May-15

# GRAIN SIZE DISTRIBUTION

Silt to Sand

Site 9 Road STA 10+225 to 10+300

FIGURE D.S26-2B



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S26-08	1B	212.4
■	S26-07	3	209.6
◆	S26-08	6	208.8
▲	S26-07	7	206.5
▽	S26-06	8	205.3

Project Number: 07-1111-0029

Checked By: CN

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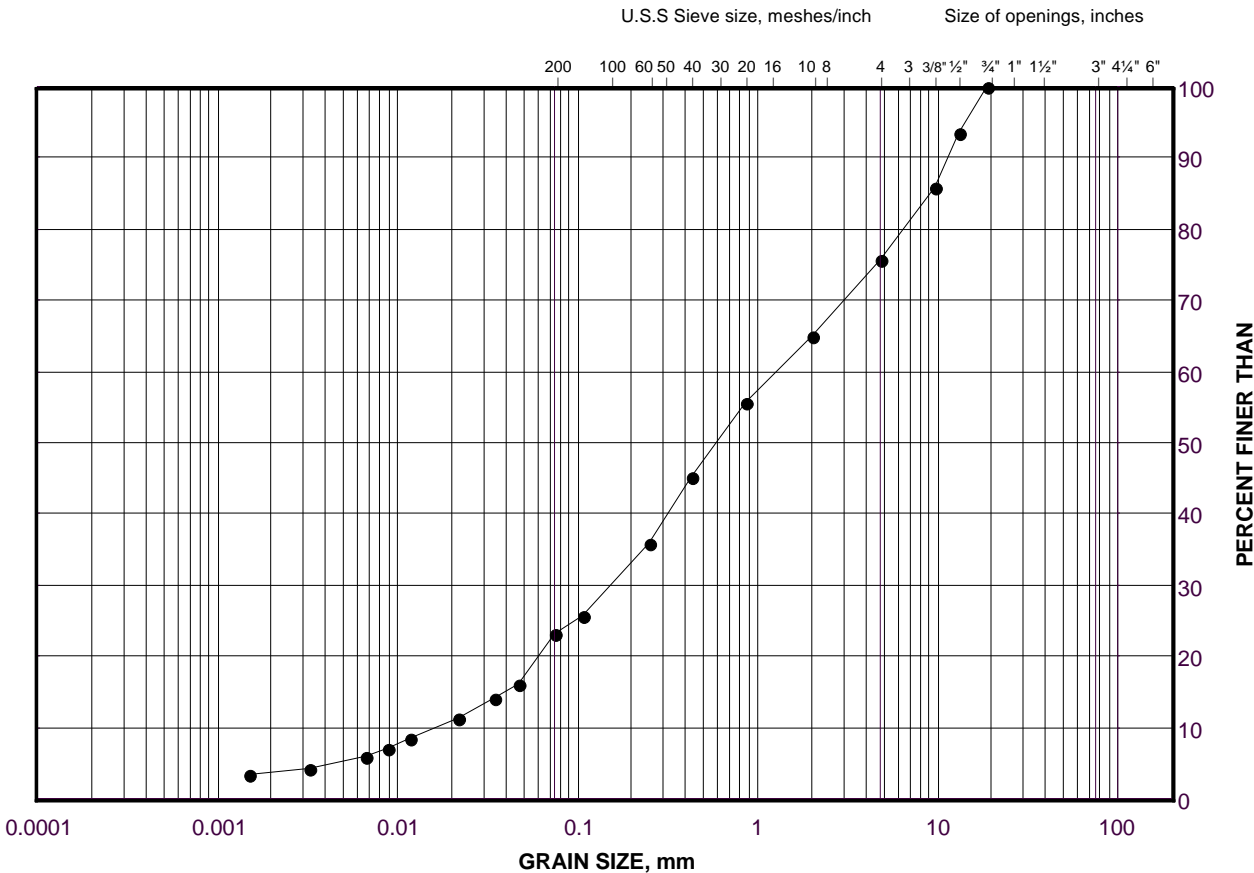
Date: 22-May-15



GRAIN SIZE DISTRIBUTION

Gravelly Sand  
Site 9 Road STA 10+225 to 10+300

FIGURE D.S26-3



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

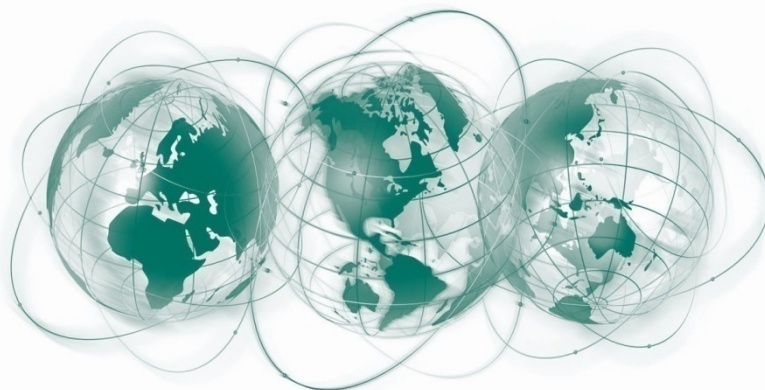
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	S26-01	4	208.9

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

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