



February 7, 2013

FOUNDATION INVESTIGATION REPORT

**CULVERTS - PHASE I
HIGHWAY 69 FOUR-LANING
FROM 0.4 KM NORTH OF HIGHWAY 7182
(SHEBESHEKONG ROAD) NORTHERLY 11 KM
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5403-05-00**

Submitted to:
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REPORT





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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by MMM Group (MMM) on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for twenty-two (2) culverts on Highway 69 Northbound Lane (NBL) and Southbound Lane (SBL) and on Site 9 Road. This project is part of the detail design for the four-laning of Highway 69 from 0.4 km north of Highway 7182 (Shebeshekong Road) northerly for a total distance of 11 km. The general location of this section of the Highway 69 four-laning alignment is shown on the Site Location Plan on Drawing 1.

This report addresses the investigation carried out for the Phase 1 culverts only including eleven water conveyance culverts and eleven Species at Risk (SAR) culverts. A detailed list of the Phase 1 culverts is presented in Table 1. Separate reports will be submitted detailing the foundation investigations for the Phase 2 culverts, as well as for the related swamp and pond crossings and structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the locations of the proposed culvert associated with the new Highway 69 by borehole drilling, rock coring, in situ testing and laboratory testing on selected samples. The culverts were located in the field by Golder relative to centreline stakes installed by MMM referencing plan and section drawings provided by MMM. The investigated areas are shown in plan on Drawing 2. In general, the culverts are typically located within the swamp crossings which were investigated by Golder as reported in:

- Foundation Investigation and Design Report, Swamp and Pond Crossings – Phase 1, Highway 69 Four-Laning from 0.4 km North of Highway 7182 (Shebeshekong Road) Northerly for 11 km, Ministry of Transportation, Ontario, GWP 5403-05-00, dated August 26, 2011.

Preliminary subsurface information for this project is available and was supplied by the MTO, specifically:

- Preliminary Foundation Investigation & Design Report, Swamp Crossings, Highway 69 Route Selection Study, 3.5 km N of Hwy 559 to 3.8 km N of Hwy 522, GWP 5377-02-00, Highway 69, GEOCREs No. 41H-51, dated September 2005, by Trow Associates Inc.

2.0 SITE DESCRIPTION

The section of the new highway being addressed by this report extends from the north side of Shawanaga River to about 8.8 km northerly to the town of Pointe au Baril Station. The future Highway 69 will run generally in a southeast-northwest direction with the project limits spanning from Shawanaga Township at the south end to Harrison Township at the north end. The proposed highway alignment approximately follows the existing alignment of Highway 69 for about 4.4 km northerly from Shawanaga River. About 4.4 km north of Shawanaga River, the proposed alignment will be straightened relative to the existing alignment northerly for about 2 km and will bypass the existing alignment to the east of the town of Pointe Au Baril Station. Re-aligned and/or newly proposed highways and access/service roads associated with the four-laning of the new Highway 69 in this area include Site 9 Road and adjoining ramps for the proposed Highway 529 Interchange.

In general, the topography of the section of the overall project limits consists of rolling terrain, including sparsely treed areas and numerous bedrock outcrops separated by low-lying swamps containing areas of standing water and various vegetation types and surficial organic soils. The ground surface within the investigated areas for the



culverts varies between about Elevation 194.1 m and Elevation 213.1 m, referenced to Geodetic datum, and is gently sloping downward from northeast to southwest towards Georgian Bay. A detailed description of each investigated culvert crossing is presented in Section 4.0.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the investigation associated with the Phase 1 culvert crossings was carried out in several stages, with a total of forty-five (45) boreholes were advanced at or near the culvert locations as follows:

- Fourteen (14) boreholes (C63-1 to C63-5, C76-1 to C76-8 and C76-1a) were advanced from November 3, 2008 to February 2009;
- Ten (10) boreholes (C2-1 and C2-2, C3-1 and C3-2, C4-1 and C4-2, C5-1 and C5-2 and C6-1 and C6-2) were advanced from March 9 to 11, and April 6 to 8, 2010; and
- Twenty-one (21) boreholes (A-1 to A-3, B-1 and B-2, C-1 and C-2, D-1 to D-5, E-1 and E-2, F-1 and F-2, G-1 to G-4 and H-1) were advanced between February 8 and 22, May 4 and 9, July 11 and 27 and August 10, 2011.

In addition, pertinent portions of the field investigation work carried out by Golder for the Phase 1 swamp crossings were utilized to supplement this investigation, and the methods of investigation of this fieldwork are included in the report referenced in Section 1.0 (Golder, December 2009). The locations of the boreholes are summarized in Table 1 and are shown in plan on the drawings in Appendices A to M.

The field investigation was carried out using a variety of drilling equipment due to the varying nature of the terrain within the Phase 1 project limits. The details of the drilling equipment and suppliers are listed below.

Drilling Equipment	Supplied and Operated By
Truck-Mounted CME-55 Track-Mounted CME-55	Landcore Drilling of Sudbury, Ontario
Portable Equipment	OGS Inc. of Almonte, Ontario Landcore Drilling of Sudbury, Ontario Walker Drilling Ltd. of Utopia, Ontario

The boreholes were advanced through the overburden using 108 mm inside diameter (I.D.) hollow stem augers or NW or BW casing. Soil samples were obtained continuously or at intervals of depths 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). Boreholes advanced by portable equipment employed ½ weight hammers lifted manually to the SPT height and the 'N'-values were corrected for the lower energy drive. Samples of the cohesive soils were obtained using a 76 mm O.D. thin walled Shelby tube (ASTM D1587). 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) using MTO Standard 'N' and 'B' size vanes.



Samples of the bedrock were obtained using 'NQ' size rock core barrels. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Reg. 903 (as amended by Ontario Reg. 372).

The boreholes were advanced to depths between 0.8 m and 16.8 m below existing ground surface, generally penetrating 3 m into competent material, which is defined as material that will provide resistance to settlement or instability of the embankments, or to refusal. Most boreholes were terminated on refusal to further auger, casing and/or split-spoon advancement. These depths to refusal do not confirm bedrock surface elevations, but may be inferred to indicate potential proximity to the bedrock surface. In some boreholes, bedrock was cored for depths ranging from about 3.0 m to 3.9 m below the surface of the bedrock.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets in their respective appendices. 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 fieldwork was observed by members of our engineering and technical staff: who located the boreholes; arranged for the clearance of underground services; observed the drilling, sampling and in situ testing operations; logged the boreholes; and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Sudbury geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected representative samples. In addition, one (1) one-dimensional consolidation (oedometer) test was carried out on a select sample of the cohesive deposit. Strength testing (uniaxial compression and point load index) was also carried out on selected specimens of the rock core.

The centreline of the highway and roadway was surveyed and staked in the field by MMM prior to drilling. The as-drilled borehole locations and ground surface elevations were measured/surveyed by members of our technical staff, referenced to the survey stakes. The borehole locations shown on the drawings in Appendices A to N are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The as-drilled borehole locations, ground surface elevations and drilled depths for all the boreholes associated with the culvert investigations in Phase 1 are summarized below.



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Highway Lane/Culvert Location	Borehole/ DCPT	Location (m)		Ground Surface Elevation	Drilled Depth (m)	Appendix
		Northing	Easting			
Highway 69 STA 17+809 NBL and SBL	A-1	5,045,913.4	243,413.3	202.6	6.5	A
	A-2	5,045,923.2	243,431.4	204.8	7.1	
	A-3	5,045,936.4	243,436.5	200.2	5.8	
	S19-1	5,045,893.4	243,407.6	200.8	7.4	
	S19-2	5,045,886.8	243,382.8	198.5	12.5	
Highway 69 STA 19+190 NBL and SBL	D-1	5,046,669.7	242,266.1	208.7	5.9	B
	D-2	5,046,689.2	242,276.7	213.1	11.4	
	D-3	5,046,703.1	242,284.1	209.2	6.7	
	D-4	5,046,718.4	242,292.4	209.5	8.2	
	D-5	5,046,732.1	242,299.8	209.7	6.7	
Highway 69 STA 19+202 SBL	C63-3	5,046,707.2	242,273.9	209.3	9.7	C
	C63-4	5,046,695.9	242,266.4	212.7	13.1	
	C63-5	5,046,678.3	242,253.9	208.2	9.9	
Highway 69 STA 19+253 NBL	C63-1	5,046,775.1	242,243.4	210.3	7.7	C
	C63-2	5,046,736.5	242,237.4	209.6	9.2	
	S15-1	5,046,726.4	242,238.2	209.5	8.8	
	S15-5	5,046,748.9	242,236.2	209.5	7.0	
Highway 69 STA 21+259 NBL and 21+270 SBL	G-1	5,047,664.2	240,433.5	210.3	1.1	D
	G-2	5,047,691.3	240,452.7	212.0	8.1	
	G-3	5,047,702.8	240,471.5	210.4	1.0	
	G-4	5,047,716.5	240,490.2	210.3	1.6	
	S13-4	5,047,689.4	240,461.5	210.6	1.4	
Highway 69 STA 10+259 SBL and 10+270 NBL	C2-1	5,048,051.0	239,890.7	204.8	3.9	E
	C2-2	5,048,079.2	239,695.8	206.6	2.5	
	C3-1	5,048,117.4	239,704.0	204.7	4.5	
	C3-2	5,048,129.9	239,710.9	204.6	2.1	
	S7-2	5,048,109.2	239,693.9	205.3	1.8	
Highway 69 STA 10+530 NBL and 10+558 SBL	C5-1	5,048,220.7	239,418.6	204.6	3.1	F
	C5-2	5,048,227.3	239,435.3	204.6	6.2	
	C6-1	5,048,236.4	239,456.9	204.6	6.0	
	C6-2	5,048,245.4	239,478.5	204.6	5.3	
	S7-12	5,048,257.9	239,490.9	204.6	2.8	
Highway 69 STA 10+974 NBL and 11+019 SBL	C76-1	5,048,486.3	239,117.7	195.3	6.7	G
	C76-1a	5,048,485.9	239,118.3	195.3	8.5	
	C76-2	5,048,471.2	239,096.2	195.3	6.9	
	C76-3	5,048,460.4	239,080.5	195.7	6.8	
	C76-4	5,048,461.7	239,038.9	198.0	16.8	
Site 9 Road STA 12+599	B-1	5,045,944.8	243,442.1	200.5	4.6	A
	B-2	5,045,964.2	243,460.9	200.2	5.0	
Site 9 Road STA 13+165	C-1	5,046,382.2	243,085.9	210.8	1.8	H
	C-2	5,046,397.1	243,107.2	211.5	4.4	
Site 9 Road STA 14+045	E-1	5,046,398.1	242,290.7	207.3	1.8	I
	E-2	5,046,418.2	242,303.8	207.3	6.7	



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Highway Lane/Culvert Location	Borehole/ DCPT	Location (m)		Ground Surface Elevation	Drilled Depth (m)	Appendix
		Northing	Easting			
Site 9 Road STA 14+166	F-1	5,046,457.4	242,198.0	207.1	3.3	J
	F-2	5,046,490.1	242,195.4	207.3	2.6	
Site 9 Road STA 16+323	H-1	5,047,651.3	240,390.0	209.8	5.9	D
	S11-3	5,047,642.6	240,385.1	210.2	2.0	
	S11-4	5,047,629.3	240,392.1	210.2	1.7	
	S11-DC2	5,047,643.9	240,400.1	210.2	3.8	
Site 9 Road STA 17+072	S8-12	5,047,980.6	239,736.6	205.4	5.6	K
	S8-13	5,047,996.2	239,730.8	205.4	1.6	
	S8-14	5,048,011.5	239,724.9	205.4	0.8	
	S8-DC6	5,047,999.8	239,746.8	205.4	5.0	
	DCPSPB-1	5,048,009.0	239,738.0	205.3	4.4	
Site 9 Road STA 17+488	C4-1	5,048,201.7	239,369.1	206.3	4.8	L
	C4-2	5,048,206.7	239,390.6	205.7	3.5	
	S7-31	5,048,193.5	239,352.3	204.9	1.1	
Site 9 Road STA 18+034	C76-6	5,048,487.6	238,925.1	194.2	9.2	M
	C76-7	5,048,478.1	238,900.8	194.1	9.3	
	C76-8	5,048,468.7	238,876.4	194.1	8.0	

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in The Physiography of Southern Ontario (Chapman and Putnam, 1984)¹, this section of Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the Parry Sound and Muskoka areas, then eastward from Muskoka in patches into the area north of the Kawartha Lakes.

This part of the Georgian Bay Fringe physiographic region was never submerged during periods of glacial recession. As a result, the surficial soils in this area consist of very shallow deposits of sand, silt and clay overlying metamorphic bedrock and numerous bare knobs and ridges of bedrock are present throughout the area. Localized low-lying swampy areas, containing peat and/or organic soils overlying soft/loose native soils, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of gneisses of the Britt Domain of the Central Gneiss Belt, a subdivision of the Grenville Structural Province, as described in Geology of Ontario, OGS Special Volume 4². Deposition of Paleozoic strata and later erosion during glaciation exposed these Precambrian rocks.

¹ 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.

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



4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced for this investigation, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole and Drillhole sheets in Appendices A to M. Detailed results of the laboratory testing are provided in Appendices A to M. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of 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 inferred soil stratigraphy as encountered in the boreholes put down at the locations of the proposed Phase 1 culverts is shown on the Drawings in Appendices A to M. It should be noted that the orientation (i.e. north, south, east, west) stated in the text of the report is typically referenced to project north (along the proposed Highway 69 alignment) and therefore may differ from that shown on the drawings which represents magnetic north.

In general, the stratigraphy encountered at the various areas investigated is similar; however, the overburden (soil materials) thickness is variable, ranging from about 0.8 m to about 13.6 m. The stratigraphy generally consists of:

- surficial layers of topsoil, sand to sand and gravel fill and rock fill associated with the existing Highway 69 embankment, peat and organic sand/silt/clayey silt;
- deposits of glacio-lacustrine sand to sandy silt;
- deposits of glacio-lacustrine mixtures of silt and clay interbedded with sand layers in some areas; and
- sand to sand and gravel encountered between the cohesive/cohesionless deposits and the inferred bedrock surface.

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

4.3 Highway 69 NBL – STA 17+809

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+809 in Shawanaga Township are shown on Drawing A1 in Appendix A. The culvert will extend across the proposed Northbound Lane (NBL) Embankment, which is generally within, or in the proximity of, the existing Highway 69 roadway embankment in this area. The proposed embankments will be up to 7.5 m high above existing grade. A total of three boreholes were completed to investigate the subsurface conditions at this culvert location. Two boreholes (Boreholes A-1 and A-3) were advanced near the ends of the culverts and one borehole (Borehole A-2) was advanced through the existing embankment near the midpoint of the culvert. The topography of this section of proposed highway is generally flat and low-lying to either side of the existing Highway 69 embankment.



Fill

Borehole A-2 was advanced through the existing Highway 69 embankment and penetrated a layer of asphalt about 75 mm thick underlain by granular fill. Below the asphalt in Borehole A-2 and from ground surface in Boreholes A-1 and A-3, fill consisting of sand to sand and gravel and/or blast rock was encountered, with a thickness between 0.8 m and 4.0 m between Elevation 204.7 m and 200.2 m.

An SPT 'N'-value recorded within the granular fill is 3 blows per 0.3 m of penetration, indicating a very loose relative density. Recovery of the blast rock drilled with an NQ core barrel ranged between 39 per cent and 67 per cent.

The grain size distribution of one sample of the sand and gravel size rock fill is shown on Figure A1 in Appendix A.

The natural water content measured on samples of the fill range from about 2 per cent to 7 per cent.

Sand to Sand and Silt (Upper Deposit)

A deposit of brown to grey sand, silty sand and/or sand and silt, containing trace to some clay and trace to some gravel was encountered underlying the fill layer in Boreholes A-1 to A-3. The top of this deposit was encountered at 0.8 m to 4.0 m below ground surface, ranging between Elevation 200.8 m and 199.4 m and the thickness of the deposit ranges from 1.5 m to 2.4 m.

SPT 'N'-values recorded within this deposit range between 9 blows and 36 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The grain size distribution of one sample of silty sand from this deposit is shown on Figure A2 in Appendix A.

The natural water content measured on a sample of this deposit is about 27 per cent.

Clayey Silt to Clay

A deposit of brown to grey clayey silt to clay was encountered underlying the silty sand to sand to sand and silt deposit in Boreholes A-1 to A-3. The thickness of the cohesive deposit ranges from 0.9 m to 1.7 m and the top of the deposit was encountered between 2.7 m and 5.5 m below ground surface, ranging between Elevation 199.3 m and 197.5 m.

The SPT 'N'-values measured within this deposit range from 1 blow to 3 blows per 0.3 m of penetration. In situ field vane testing carried out within this stratum measured undrained shear strengths ranging from about 19 kPa to 73 kPa. The SPT 'N'-values together with the in situ field vane tests indicate the deposit has a very soft to stiff consistency.

Atterberg limits testing was carried out on two samples of the silty clay to clay and the test results indicate liquid limits of about 40 per cent and 56 per cent, plastic limits of about 17 per cent and 23 per cent and plasticity indices of about 23 per cent and 33 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure A3 in Appendix A and indicate that the material is classified as a silty clay of medium plasticity to a clay of high plasticity.



The grain size distribution of one sample of the clayey silt deposit is shown on Figure A4 in Appendix A.

Measured water content on samples of this deposit range between about 34 per cent and 74 per cent.

Sandy Silt to Silt (Lower Deposit)

A deposit of grey sandy silt to silt, containing trace to some clay was encountered underlying the clayey silt and clay stratum in Boreholes A-1 and A-2 at depths of 6.3 m and 6.4 m below ground surface, respectively, corresponding to Elevation 196.3 m and 198.4 m, and the thickness of the deposit is 0.2 m and 0.7 m, at the respective boreholes. The bottom of this deposit in both was defined by refusal to further split-spoon advancement.

Gravelly Sand

A deposit of grey gravelly sand containing trace to some silt was encountered below the clayey silt to clay deposit in Borehole A-3. The top of this deposit was encountered at a depth of 4.4 m below ground surface at Elevation 195.8 m, and the thickness of the deposit is 1.4 m. The bottom of this deposit was defined by refusal to further casing advancement.

An SPT 'N'-value measured within this deposit is 32 blows per 0.3 m of penetration, indicating a dense relative density.

Refusal

In Boreholes A-1 to A-3, refusal to further casing or split-spoon advancement was encountered at depths between 5.8 m and 7.1 m below ground surface, corresponding to between Elevation 194.4 m and 197.7 m.

Groundwater Conditions

The unstabilized water level in Boreholes A-1 to A-3 was measured at depths between 0.3 m and 3.7 m below ground surface, corresponding to between Elevations 199.9 m and 201.1 m. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.4 Highway 69 SBL – STA 17+809

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+809 in Shawanaga Township are shown on Drawing A1 in Appendix A. The culvert will extend across the proposed Southbound Lane (SBL) Embankment, which will be up to 8.3 m above existing grade. A total of one borehole was completed to investigate the subsurface conditions at this culvert location, supplemented with two swamp boreholes. Two boreholes (Boreholes A-1 and S19-2) were advanced near the ends of the culvert and one borehole (Borehole S19-1) was advanced near the midpoint of the culvert. The



topography of this section of proposed highway is generally flat and low-lying, with tree cover throughout the swamp limits.

Fill

In Borehole A-1, about 2.2 m of blast rock fill, trace sand and gravel was encountered at ground surface (Elevation 202.6 m). In Borehole S19-1, about 2.1 m of sand to silty sand fill containing trace organics and wood fragments was encountered at ground surface (Elevation 200.8 m).

SPT 'N'-values recorded within the fill range from 5 blows to 44 blows per 0.3 m of penetration, indicating a very loose to dense relative density. Recovery of the blast rock drilled with an NQ core barrel ranged between 57 per cent and 67 per cent.

The grain size distributions of two samples of the fill are shown on Figure A1 in Appendix A.

The natural water content measured on samples of the fill range from about 7 per cent to 17 per cent.

Peat

A deposit of black, fibrous peat was encountered at ground surface in Borehole S19-2. The top of this deposit was encountered at about Elevation 198.5 m and the thickness of the deposit is 2.6 m.

SPT 'N'-values recorded within the peat deposit are 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 is about 331 per cent.

Sand to Silt (Upper Deposit)

A deposit of grey sand, sand and silt or silt with a sand interlayer, containing trace to some clay was encountered underlying the fill in Boreholes A-1 and S19-1 and underlying the peat in Borehole S19-2. The top of this deposit was encountered between 2.1 m and 2.6 m below ground surface, varying between Elevation 200.4 m and 195.9 m and the thickness of the deposit ranges from 1.5 m to 2.4 m.

SPT 'N'-values recorded within this deposit are between 0 blows (weight of hammer) and 36 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The grain size distribution of two samples of the sand and silt to silt deposit is shown on Figure A2 in Appendix A.

The natural water content measured on two samples of this deposit is about 26 per cent and 30 per cent.



Silty Clay to Clay

A deposit of brown to grey silty clay to clay was encountered underlying the sand to silt deposit in Boreholes A-1, S19-1 and S19-2. The top of the deposit was encountered between 4.1 m and 4.6 m below ground surface, varying between Elevation 198.0 m and 194.4 m and the thickness of the deposit ranges from 1.7 m to 4.7 m.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 2 blows per 0.3 m of penetration. In situ field vane testing carried out within this stratum measured undrained shear strengths ranging from about 14 kPa to 31 kPa. The SPT 'N'-values together with the in situ field vane tests indicate the deposit has a soft to firm consistency.

Atterberg limits testing was carried out on three samples of the silty clay to clay deposit and the test results indicate liquid limits ranging from about 37 per cent to 58 per cent, plastic limits ranging from about 17 per cent to 22 per cent and plasticity indices ranging from about 20 per cent to 36 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure A3 in Appendix A and indicate that the material is classified as a silty clay of intermediate plasticity to a clay of high plasticity.

Measured water content on samples of this deposit ranges between about 51 per cent and 64 per cent.

Sandy Silt to Silt (Lower Deposit)

A deposit of grey sandy silt to silt, containing trace to some clay was encountered underlying the silty clay to clay deposit in Boreholes A-1, S19-1 and S19-2. The top of this deposit was encountered between 6.2 m and 8.8 m below ground surface, varying between Elevation 196.3 m and 189.7 m and the thickness of the deposit is between 0.2 m and 2.6 m. The bottom of this deposit was defined by refusal to split-spoon advancement in Borehole A-1.

Two SPT 'N'-values recorded within this deposit are 1 blow and 13 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The grain size distribution of a sample of the sandy silt is shown on Figure A5 in Appendix A.

The natural water content measured on a sample of this deposit is about 26 per cent.

Gravelly Silty Sand to Sand and Gravel

A deposit of grey gravelly silty sand to sand and gravel containing trace clay was encountered underlying the lower sandy silt to silt deposit in Boreholes S19-1 and S19-2. The top of this deposit was encountered at depths of 7.0 m and 11.4 m below ground surface, respectively, corresponding to Elevation 193.8 m and 187.1 m, and the thickness of the deposit is 0.4 m and 1.1 m at the respective boreholes. In Borehole S19-1, the bottom of this deposit was defined by refusal to further split-spoon advancement. Borehole S19-2 was terminated about 1.1 m into this deposit.

SPT 'N'-values measured within this deposit are 107 blows per 0.3 m of penetration and 44 blows per 0.28 m of penetration, indicating a dense to very dense relative density.

The grain size distribution of one sample of this deposit is shown on Figure A6 in Appendix A.



The natural water content measured on samples of this deposit ranges from about 7 per cent to 11 per cent.

Refusal

In Boreholes A-1 and S19-1, refusal to further spoon advancement was encountered at depths of 6.4 m and 7.4 m below ground surface, respectively, corresponding to Elevation 196.1 m and 193.4 m, respectively.

Groundwater Conditions

The unstabilized water level in Boreholes A-1, S19-1 and S19-2 was measured at depths between ground surface and 2.5 m below ground surface, corresponding to Elevations between 198.5 m and 200.1 m. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.5 Highway 69 NBL – STA 19+190 (Site No. 44-582/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 19+190 in Shawanaga Township are shown on Drawing B1 in Appendix B. The culvert will extend across the proposed Highway 69 NBL embankment and the proposed embankment at the proposed culvert location is about 3.7 m high above the existing grade. A total of three boreholes were completed to investigate the subsurface conditions at this culvert location: two boreholes (Boreholes D-3 and D-5) were advanced near the ends of the culvert; and one borehole (Borehole D-4) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with dense tree cover.

Peat

A deposit of wet, black, fibrous peat was encountered at ground surface in Boreholes D-3 to D 5. The thickness of the peat deposit ranges from 0.2 m to 0.8 m and the top of the deposit was encountered between Elevation 209.7 m and 209.2 m.

The SPT 'N'-values measured within the peat deposit are 2 blows per 0.3 m of penetration, suggesting a very soft consistency.

Measured water content on two samples of this deposit is about 83 per cent and 123 per cent.

Sand and Silt to Sand

A deposit of brown to grey, wet silty sand to sand, and/or sand and silt containing trace clay was encountered underlying the peat in Boreholes D-3 to D-5. The top of the deposit was encountered between Elevation 209.5 m and 208.4 m and the thickness of this deposit in Borehole D-3 is 4.8 m where it was fully penetrated. In Boreholes D-4 and D-5, the deposit is at least 7.6 m and 6.5 m thick, respectively.



The SPT 'N'-values measured within this deposit range between 5 blows and 89 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

Grain size distributions of three samples of the deposit are shown on Figure B1 in Appendix B.

The measured water content on samples of this deposit is between about 16 per cent and 26 per cent.

Sand and Gravel

A stratum of grey, wet sand and gravel was encountered underlying the sand to sand and silt deposit in Borehole D-3. The top of the deposit was encountered at a depth of 5.6 m below ground surface, corresponding to Elevation 203.6 m and the deposit is at least 1.1 m but was not fully penetrated.

An SPT 'N'-value measured within this deposit is 74 blows per 0.3 m of penetration, indicating a very dense relative density.

Groundwater Conditions

The unstabilized water level in Boreholes D-3 to D-5 was measured at a depth of 0.2 m below ground surface corresponding to between about Elevations 209.5 m and 209.0 m. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.6 Highway 69 SBL – STA 19+190 (Site No. 44-582/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 19+190 in Shawanaga Township are shown on Drawing B1 in Appendix B. The culvert will extend across the proposed Highway 69 SBL embankment (present Highway 69) and the embankment at the proposed culvert location is about 3.5 m high, requiring a 0.1 m grade raise and widening to the west. A total of three boreholes were completed to investigate the subsurface conditions at this culvert location: two boreholes (Boreholes D-1 and D-3) were advanced near the ends of the culvert; and one borehole (Borehole D-2) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with dense tree cover.

Fill

Borehole D-2 was advanced at the top of the existing embankment and encountered a 130 mm thick layer of asphalt at ground surface, underlain by a 0.7 m thick layer of brown, moist to wet fill comprised of sand and gravel to sand, some silt underlain by a 3.1 m thick layer of blast rock.

A grain size distribution of one sample of the sand fill is shown on Figure B2 in Appendix B.

The measured water content on a sample of this deposit is about 5 per cent.



Peat/Topsoil

In Borehole D-1, a 0.2 m thick deposit of moist, brown topsoil was encountered at the ground surface at Elevation 208.7 m. A 0.8 m thick deposit of wet, black, fibrous peat was encountered at ground surface in Borehole D-3, at Elevation 209.2 m.

One SPT 'N'-value measured within the peat is 2 blows per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on a sample of this deposit is about 83 per cent.

Sand to Sand and Silt

A deposit of brown to grey, wet sand to sand and silt or silty sand, containing trace gravel and trace clay was encountered underlying the topsoil in Borehole D-1, the fill in Borehole D-2 and the peat in Borehole D-3. The top of the deposit was encountered between about 0.2 m and 4.0 m below ground/asphalt surface, between about Elevation 209.1 m and 208.4 m and the thickness of this deposit ranges from 4.8 m to 7.1 m. The upper 0.6 m thick layer of the sand deposit in Borehole D-1 was noted to be slightly organic.

The SPT 'N'-values measured within this deposit range between 3 blows and 85 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

Grain size distributions of three samples of the deposit are shown on Figure B1 in Appendix B.

The measured water content on samples of this deposit is between 19 per cent and 25 per cent, and the sample of slightly organic sand is 39 per cent.

Sand and Gravel

A stratum of grey, wet sand and gravel containing trace silt was encountered underlying the sand to sand and silt/silty sand deposit in Boreholes D-2 and D-3 at depths of 11.1 m and 5.6 m below ground surface, respectively, corresponding to Elevation 202.0 and 203.6 m. The deposit is 0.3 m thick in Borehole D-2 (bottom of the deposit is defined by split-spoon refusal) and was not fully penetrated in Borehole D-3 after drilling 1.1 m into the deposit.

The SPT 'N'-values measured within this deposit are 22 blows and 74 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

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

Refusal

In Boreholes D-1 and D-2, refusal to further casing penetration/advancement was encountered at depths of about 5.9 m and 11.4 m, respectively, below ground surface, corresponding to Elevations 202.8 m and 201.7 m.



Groundwater Conditions

The unstabilized water level in Boreholes D-1 to D-3 was measured at depths between 0.2 m and 3.8 m below ground surface, between Elevation 209.3 m and 208.2 m. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.7 Highway 69 SBL – STA 19+202 (Site No. 44-583/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 19+202 in the Township of Shawanaga are shown on Drawing C1 in Appendix C. The culvert will extend across the existing Highway 69 roadway embankment and the embankment at the proposed culvert location is about 5 m high above the existing grade. A total of three (3) boreholes were completed to investigate the subsurface conditions at this culvert location. Two (2) boreholes (Boreholes C63-3 and C63-5) were advanced at each end of the culvert and one (1) borehole (Borehole C63-4) was advanced through the existing embankment in the east shoulder near the midpoint of the culvert. The topography in the area is generally flat and low-lying with about 1.5 m deep open water encountered on the west side of the existing embankment (in Borehole C63-5).

Embankment Fill

In Borehole C63-4, drilled on the east shoulder of the existing Highway 69 embankment, encountered about 0.2 m of asphalt underlain by 3.9 m of fill comprised of brown sandy gravel to sand to sand and silt. The top of the embankment at this borehole is at Elevation 212.7 m.

The SPT 'N'-values measured within the fill are between 3 blows and 18 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

Grain size analyses were carried out on two (2) samples of this deposit and the results are presented on Figure C1 in Appendix C.

The measured water content on two samples of the fill is about 6 per cent and 12 per cent.

Peat

A deposit of black, fibrous peat was encountered at ground surface in Borehole C63-3. The thickness of the peat deposit is 1.1 m and the top of the deposit was encountered at Elevation 209.3 m.

The SPT 'N'-values measured within the peat are 1 blow per 0.3 m of penetration, indicating a very soft consistency.

A measured water content on one sample of the peat is about 65 per cent.



Sand to Sand and Silt

A deposit of brown to grey sand to silty sand to sand and silt, trace clay and trace gravel, was encountered below the peat deposit in Borehole C63-3, below the embankment fill in Borehole C63-4 and at the bottom of the ponded water in Borehole C63-5. The top of this deposit ranges from Elevation 208.6 m to 206.7 m and the thickness of the deposit ranges from 8.4 m to 9.0 m. In each of the boreholes, the bottom of this deposit was defined by refusal to further auger or casing advancement or split-spoon penetration.

The SPT 'N'-values measured within this deposit range from 9 blows to 89 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The grain size distributions of ten samples of the sand to sand and silt deposit from this culvert location are shown on Figure C2 in Appendix C.

The measured water content on samples of this deposit ranges between about 18 per cent and 27 per cent.

Refusal

Refusal to further auger or casing advancement or split-spoon penetration was encountered at depths ranging between 8.4 m and 13.1 m below ground surface or bottom of the ponded water, corresponding to between Elevations 198.3 m and 199.6 m.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet with free water noted in select sand samples. Water levels were observed in Boreholes C63-3 and C63-4 upon completion of drilling at about Elevation 208.6 m and 208.1 m, respectively, measured at depths between about 0.7 m and 4.6 m below ground surface, respectively. Borehole C63-5 was advanced from the water surface.

4.8 Highway 69 NBL – STA 19+253 (Site No. 44-583/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 19+253 in the Township of Shawanaga are shown on Drawing C2 in Appendix C. The culvert extends across a swamp area and the new embankment at the proposed culvert location is about 3 m high above existing grade. A total of two (2) boreholes were completed to investigate the subsurface conditions at this culvert location and supplemented with two (2) boreholes advanced for the new NBL embankment crossing the swamp in this area. Two (2) boreholes (Boreholes C63-1 and S15-1) were advanced near each end of the culvert and two (2) boreholes (Boreholes C63-2 and S15-5) were advanced along the length of the culvert. The topography of this section of proposed highway is generally flat and low-lying with dense tree cover.

Ice/Snow

Borehole S15-5 was advanced from the ice/snow surface at an Elevation of 209.5 m and penetrated a 0.5 m thick layer of ice/snow.



Fill

A 0.6 m thick layer of fill comprising of brown sand, trace to some silt and trace gravel was encountered at ground surface in Borehole C63-2 at Elevation 209.6 m.

The SPT 'N'-value measured within the fill is 0 blows (weight of hammer) per 0.3 m of penetration, indicating a very loose relative density.

Grain size analyses were carried out on a sample of this deposit and the results are presented on Figure C1 in Appendix C.

The measured water content on a sample of the fill is about 29 per cent.

Peat

A deposit of black, fibrous peat was encountered at ground surface in Borehole S15-1, underlying the fill material in Borehole C63-2 and beneath the ice/snow in Borehole S15-5. The thickness of the peat deposit ranges from 0.1 m to 1.0 m and the top of the deposit was encountered at Elevations 209.5 m and 209.0 m.

The SPT 'N'-values measured within the peat are both 2 blows per 0.3 m of penetration, indicating a very soft consistency.

The measured water content on samples of this deposit ranges between about 126 per cent and 261 per cent.

Sand to Sand and Silt

A deposit of brown to grey sand to silty sand to sand and silt containing trace to some gravel and trace clay was encountered at ground surface in Borehole C63-1 and below the peat in Boreholes C63-2, S15-1 and S15-5. The top of this deposit ranges from Elevation 210.3 m to 208.0 m and the thickness of the deposit ranges from 3.8 m to 8.7 m. In all of the boreholes, the bottom of this deposit was defined by refusal to further split-spoon or casing penetration or coring of the bedrock (in Borehole C63-1).

The SPT 'N'-values measured within this deposit range from 1 blow to 133 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distributions of twelve samples of the sand to sand and silt deposit are shown on Figure C2 in Appendix C.

The measured water content on samples of this deposit ranges between about 19 per cent and 24 per cent.

Bedrock/Refusal

Bedrock was encountered and cored in Borehole C63-1. The bedrock surface was inferred from refusal to further casing or split-spoon advancement in Boreholes S15-1, S15-5 and C63-2. The refusal/bedrock surface ranges from Elevation 206.5 m to 200.4 m at depths ranging from 3.8 m to 9.2 m below ground surface. Bedrock outcrops are present to the northwest of the swamp limit at about STA 19+300.



Based on a review of the rock core sample in Borehole C63-1, the bedrock consists of gneiss and the core samples are described as slightly weathered, fine-grained and grey. The Rock Quality Designation (RQD) measured on the core sample ranges from about 70 per cent to 100 per cent, indicating a rock mass quality ranging from fair to excellent. The Total Core Recovery (TCR) ranges from about 92 per cent to 100 per cent and the Solid Core Recovery (SCR) ranges from about 50 per cent to 90 per cent.

A laboratory UCS test performed on one sample of the bedrock from Borehole C63-1 indicates a UCS result of 71 MPa.

Diametral point load strength index values are shown on the Record of Drillhole sheets. The I_{s50} results range from about 4.3 MPa to 8.2 MPa and the corresponding UCS strengths range between 43 MPa and 82 MPa.

Based on the laboratory UCS test and point load testing results, the estimated intact strength of the bedrock ranges from medium strong (R3, 25 MPa < UCS < 50 MPa) to strong (R4, 50 MPa < UCS < 100 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. Water levels observed in the boreholes upon completion of drilling range from Elevation 208.8 m to 209.8 m, measured at depths ranging from 0.4 m to 0.7 m below the ground surface. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.9 Highway 69 NBL – STA 21+259 (Site No. 44-586/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 21+259 in Shawanaga Township are shown on Drawing D1 in Appendix D. The culvert will extend across the proposed Highway 69 NBL embankment and the embankment at the proposed culvert location is about 3.1 m high above the existing grade. Two boreholes were completed to investigate the subsurface conditions at this culvert location, supplemented with one swamp borehole advanced near the toe of the embankment in the swamp area: two boreholes (Boreholes G-4 and S13-4) were advanced near the ends of the culvert; and one borehole (Borehole G-3) was advanced near the midpoint of the culvert. The topography of this section of the proposed highway is generally flat within a low-lying grassy area with shallow water.

Peat

A deposit of wet, black, fibrous/amorphous peat was encountered at ground surface in Boreholes G-3, G-4 and S13-4. In Boreholes G-3 and G-4, the peat was found to consist of two layers, with the upper layer floating on an approximately 0.4 m and 0.3 m layer of water. The thickness of the peat, excluding the water thickness, ranges from 0.5 m to 0.9 m and the top of the deposit was encountered between Elevation 210.6 m and 210.4 m.

The SPT 'N'-values measured within the peat layers are 1 blow per 0.3 m of penetration and 2 blows per 0.2 m of penetration, suggesting a very soft to soft consistency.



The measured water content on one sample of this deposit is about 60 per cent.

Sand and Silt

A deposit of grey, wet sand and silt containing trace gravel and trace to some clay was encountered underlying the peat in Boreholes G-4 and S13-4. The top of the deposit was encountered at Elevation 209.1 m and 210.1 m and the thickness of the deposit is 0.4 m and 0.9 m in the respective boreholes.

The SPT 'N'-values measured within this deposit are between 5 blows and 11 blows per 0.3 m of penetration, indicating a loose to compact relative density.

A grain size distribution of one sample of the deposit is shown on Figure D1 in Appendix D. An Atterberg limits test on a sample of the sand and silt indicated that the material is non-plastic.

The measured water content on samples of this deposit is about 21 per cent and 28 per cent.

Refusal

In Boreholes G-3, G-4 and S13-4, refusal to further casing advancement was encountered between the depths of 1.0 m and 1.6 m below ground surface, corresponding to between Elevation 209.4 m and 208.7 m.

Groundwater Conditions

The unstabilized water level in Boreholes G-3, G-4 and S13-4 was measured at ground surface, between Elevation 210.6 m and 210.3 m. Water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.10 Highway 69 SBL – STA 21+270 (Site No. 44-586/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 21+270 in Shawanaga Township is shown on Drawing D1 in Appendix D. The culvert will extend across the proposed Highway 69 SBL existing embankment and the embankment at the proposed culvert location is about 2.0 m high above the existing grade, including a grade raise up to 0.2 m high. Two boreholes were completed to investigate the subsurface conditions at this culvert location, supplemented with one swamp borehole advanced near the toe of the embankment in the swamp area. Two boreholes (Boreholes G-1 and S13-4) were advanced near the ends of the culvert and one borehole (Borehole G-2) was advanced near the midpoint of the culvert. The topography of this section of the proposed highway is generally flat within a low-lying grassy area with shallow water.

Fill

Borehole G-2 was advanced through the shoulder of the existing embankment and encountered a 3.5 m thick layer of brown, moist to wet blast rock fill containing sand to sand and gravel. The SPT 'N'-values measured



within the embankment fill are 27 blows and 34 blows per 0.3 m of penetration and 20 blows per 0.15 m of penetration, indicating a compact to dense relative density.

Peat

In Borehole G-1, a 0.7 m thick layer of fill comprised of wet, brown sandy peat was encountered at the ground surface. One SPT 'N'-value measured within the sandy peat fill is 1 blow per 0.3 m of penetration, indicating a very loose relative density. The measured water content on a sample of the sandy peat fill is about 62 per cent.

A 0.5 m thick deposit of moist to wet, black, fibrous/amorphous peat was encountered at ground surface in Borehole S13-4.

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

Silty Clay

A 0.8 m thick layer of grey, wet silty clay containing trace sand and trace gravel was encountered underlying the blast rock fill in Borehole G-2. The top of the deposit was encountered about 3.5 m below ground (top of embankment) surface, at Elevation 208.5 m.

One SPT 'N'-value measured within this deposit is 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very soft consistency.

Sand and Silt

A deposit of grey, wet sand and silt containing trace to some clay was encountered underlying the sandy peat fill in Borehole G-1, below the silty clay in Borehole G-2 and below the peat in Borehole S13-4. The thickness of this deposit ranges from 0.4 m to 0.9 m. The top of the deposit was encountered between about 0.5 m and 4.3 m below ground/top of embankment surface, corresponding to between Elevation 210.1 m and 207.7 m. In each of the boreholes, the bottom of this deposit was defined by refusal to split-spoon advancement or bedrock coring.

The SPT 'N'-values measured within this deposit are 5 blows and 11 blows per 0.3 m of penetration, indicating a loose to compact relative density.

A grain size distribution of a sample of the deposit is shown on Figure D1 in Appendix D.

The measured water content on two samples of this deposit is 21 per cent and 22 per cent.

Bedrock/Refusal

Bedrock was encountered underlying the sand and silt in Borehole G-2 at a depth of 4.7 m below ground surface, corresponding to Elevation 207.3 m and 3.8 m of core was obtained. In Boreholes G-1 and S13-4,



refusal to further split-spoon advancement was encountered at depths of 1.1 m and 1.4 m below ground surface, corresponding to Elevation 209.2 m.

Based on a review of the bedrock core sample, the bedrock generally consists of fine to medium grained, fresh to slightly weathered, grey gneiss.

A core sample was not recovered in the upper 0.3 m of bedrock. The TCR for the three remaining core samples is 100 per cent and the SCR ranges from about 56 per cent to about 86 per cent. RQD values measured on the recovered bedrock core samples range from 70 per cent to 93 per cent, indicating that the rock is of fair to excellent quality according to Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006).

Groundwater Conditions

The unstabilized water level in Boreholes G-1, G-2 and S13-4 was measured at between the ground surface and at 1.8 m below ground surface corresponding to between Elevations 210.6 m and 210.2 m. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.11 Highway 69 SBL – STA 10+259 (Site No. 44-588/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+259 in the Township of Harrison are shown on Drawing E1 in Appendix E. The culvert will extend across the existing Highway 69 roadway embankment, which is generally within or in the proximity of the new SBL embankment in this area. Minimal grade change is proposed for this area except changes for the new alignment. A total of two (2) boreholes were completed to investigate the subsurface conditions at this culvert location and supplemented with one (1) swamp borehole advanced near the median of the new Highway 69 embankments in the culvert area. Two (2) boreholes (Boreholes C2-1 and S7-2) were advanced near each end of the culvert and one (1) borehole (Borehole C2-2) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with sparse tree cover.

Embankment Fill

Borehole C2-2, drilled on the east shoulder of the existing Highway 69 embankment, encountered 0.4 m of sand and gravel fill underlain by a layer of sand fill about 2.1 m thick. The top of the embankment at the borehole location is at Elevation 206.6 m. The bottom of the fill deposit is defined by refusal to further casing advancement at a depth of 2.5 m below ground surface (Elevation 204.1 m).

The SPT 'N'-values measured within the fill range from 10 blows to 32 blows per 0.3 m of penetration, indicating a compact to dense relative density.

A grain size distribution of a sample of the sand fill layer is shown on Figure E1 in Appendix E.

The measured water content on two samples of the fill is 5 per cent and 16 per cent.



Ice

Borehole S7-2 was advanced from the ice surface at Elevation 205.3 m and penetrated a layer of ice 0.6 m thick.

Peat

A deposit of black, fibrous peat containing trace to some clay and trace sand was encountered at ground surface in Borehole C2-1 and below the ice in Borehole S7-2. In Borehole C2-1 and S7-2, the thickness of the peat deposit is 2.0 m and 1.2 m, respectively, and the top of the deposit was encountered at Elevation 204.8 m and 204.7 m, respectively. In Borehole S7-2, the bottom of this deposit is defined by refusal to further split-spoon penetration.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on two samples of this deposit is 197 per cent and 593 per cent.

Clayey Silt

A deposit of grey clayey silt containing trace to some sand was encountered underlying the peat in Borehole C2-1. The top of this deposit was encountered at Elevation 202.8 m and the deposit is 1.0 m thick.

One SPT 'N'-value measured within this deposit is 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very soft consistency.

A grain size distribution of a sample of the clayey silt deposit is shown on Figure E2 in Appendix E.

The measured water content on a sample of the clayey silt is 73 per cent.

Sand and Gravel

A deposit of grey sand and gravel containing some silt and trace clay was encountered underlying the clayey silt in Borehole C2-1. The top of this deposit was encountered at Elevation 201.8 m and the deposit is 0.9 m thick. The bottom of this deposit was defined by refusal to split-spoon and casing advancement.

SPT 'N'-values measured within this deposit are 15 blows per 0.3 m of penetration and 15 blows per 0.1 m of penetration, suggesting a compact relative density.

A grain size distribution of a sample of the deposit is shown on Figure E3 in Appendix E.

The measured water content on one sample is about 9 per cent.

Refusal

In Boreholes C2-1, C2-2 and S7-2, refusal to further split-spoon and/or casing or auger advancement was encountered at depths between 1.8 m and 3.9 m and between Elevation 204.1 m and 200.9 m.



Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. The water level observed in Boreholes C2-1 and S7-2 upon completion of drilling was at ground and ice surface, respectively, at Elevations 204.8 m and 205.3 m, respectively. In Borehole C2-2, the water level was at 2.4 m below ground surface corresponding to Elevation 204.2 m. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.12 Highway 69 NBL – STA 10+270 (Site No. 44-588/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+270 in the Township of Harrison are shown on Drawing E1 in Appendix E. The culvert will extend across the proposed Highway 69 NBL roadway embankment and the top of the embankment at the proposed culvert location is about 2 m above the existing grade. A total of two (2) boreholes were completed to investigate the subsurface conditions at this culvert location and supplemented with one (1) borehole advanced near the median of the new Highway 69 embankments. Two (2) boreholes (Boreholes C3-1 and C3-2) were advanced at the midpoint and near the east end of the culvert and supplemented with one (1) swamp borehole (Borehole S7-2) advanced near the west end of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with sparse tree cover.

Ice/Water

Boreholes C3-1, C3-2 and S7-2 were advanced from the ice surface. The ice surface was at about Elevation 204.7 m and 204.6 m during drilling in March 2010 (Boreholes C3-1 and C3-2) and Elevation 205.3 m during drilling in February 2008 (Borehole S7-2). The ice/water thickness ranges from 0.3 m to 0.6 m.

Peat

A deposit of black, fibrous peat containing trace to some clay and trace sand was encountered underlying the ice and water in Boreholes C3-1, C3-2 and S7-2. The thickness of the peat deposit ranges from 1.2 m to 1.3 m and the top of the deposit was encountered between Elevation 204.7 m and 204.1 m. In Borehole S7-2, the bottom of this deposit is defined by refusal to further split-spoon penetration at a depth of 1.8 m below ground surface (Elevation 203.5 m).

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, suggesting a very soft consistency. An SPT 'N'-value of 50 blows per 0.23 m of penetration was recorded at the contact with the refusal surface.

The measured water content on samples of this deposit ranges between about 197 per cent and 1320 per cent.

Clayey Silt to Silty Clay

A deposit of grey clayey silt to silty clay was encountered underlying the peat in Boreholes C3-1 and C3-2. The top of the deposit was encountered at Elevations 203.2 m and 202.8 m and the thickness of the deposit is 1.2 m



and 0.3 m, respectively, at these two boreholes. In Borehole C3-2, the bottom of this deposit is defined by refusal to further split-spoon and casing advancement.

SPT 'N'-values measured within this cohesive deposit are 0 blows (weight of hammer) per 0.3 m of penetration. One in situ field vane test carried out within this stratum measured an undrained shear strength of about 11 kPa. The result of the in situ field vane test indicates that the deposit has a very soft consistency.

Atterberg limits testing carried out on two samples of the cohesive deposit yielded liquid limits of 22 per cent and 45 per cent, plastic limits of 14 per cent and 20 per cent and plasticity indices of 8 per cent and 25 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure E4 in Appendix E and indicate that the deposit consists of clayey silt of low plasticity to silty clay of intermediate plasticity.

The measured water content on two samples of this deposit is 37 per cent and 78 per cent.

Gravelly Sand

A deposit of grey gravelly sand containing trace to some silt was encountered underlying the silty clay deposit in Borehole C3-1. The top of this deposit was encountered at Elevation 202.0 m and the deposit is 1.8 m thick. The bottom of this deposit was defined by refusal to casing advancement.

The SPT 'N'-values measured within this deposit are 24 blows per 0.3 m of penetration, suggesting a compact relative density.

A grain size distribution of a sample of the deposit is shown on Figure E3 in Appendix E.

The measured water content on a sample of the gravelly sand is 13 per cent.

Refusal

In Boreholes C3-1, C3-2 and S7-2, refusal to further casing and/or split-spoon advancement was encountered at depths between 1.8 m and 4.5 m below ice surface, corresponding to between Elevation 203.5 m and 200.2 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. Water levels observed in the boreholes upon completion of drilling are at the ice surface and range from Elevation 205.3 m (February 2008) to 204.7 m (March 2010). It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.13 Highway 69 NBL – STA 10+530 (Site No. 44-590/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+530 in the Township of Harrison are shown on Drawing F1 in Appendix F. The culvert will extend across the proposed Highway 69 NBL roadway embankment and the top of the embankment at the



proposed culvert location is about 2 m above the existing grade. A total of two (2) boreholes were completed to investigate the subsurface conditions at this culvert location and supplemented with one (1) swamp borehole advanced at the east toe of the NBL embankment. Two (2) boreholes (Boreholes C6-1 and S7-12) were advanced near each end of the culvert and one (1) borehole (Borehole C6-2) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with sparse tree cover.

Ice/Water

Boreholes C6-1 and C6-2 were advanced from the ice surface at Elevation of 204.6 m and penetrated a layer of ice and water about 0.5 m and 0.3 m thick, respectively.

Peat

A deposit of black, fibrous peat was encountered underlying the ice and water in Boreholes C6-1 and C6-2 and at ground surface in Borehole S7-12. The thickness of the peat deposit ranges from 0.2 m to 2.5 m and the top of the deposit was encountered between Elevation 204.6 m and 204.1 m.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on two samples of this deposit is 559 per cent and 1011 per cent.

Clayey Silt

A deposit of grey clayey silt was encountered underlying the peat in Borehole C6-2. The top of this deposit was encountered at Elevation 202.2 m and the deposit is 0.6 m thick.

An SPT 'N'-value measured within the clayey silt is 12 blows per 0.3 m of penetration, suggesting a stiff consistency.

Atterberg limits testing carried out on a sample of the cohesive deposit yielded a liquid limit of 27 per cent, a plastic limit of 16 per cent and a plasticity index of 11 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure F1 in Appendix F and indicate that the deposit consists of clayey silt of low plasticity.

The measured water content on a sample of the clayey silt is about 37 per cent.

Silty Sand to Sand and Gravel

A deposit of grey silty sand, sand, gravelly sand and/or sand and gravel was encountered underlying the peat in Boreholes C6-1 and S7-12 and below the clayey silt deposit in Borehole C6-2. The thickness of the deposit ranges from 2.1 m to 3.0 m and the top of the deposit was encountered between Elevation 204.4 m and 201.6 m. The bottom of this deposit was defined by refusal to casing advancement in Boreholes C6-1 and C6-2.



The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 20 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The grain size distribution of four samples of the deposit is shown on Figure F2 in Appendix F.

An Atterberg limits test on one sample of the silty sand layer indicates that this material is non-plastic.

The measured water content on samples of this deposit ranges between about 13 per cent and 26 per cent.

Sand and Silt

A 0.5 m thick layer of sandy silt was encountered underlying the gravelly sand in Borehole S7-12 at Elevation 202.3 m. The bottom of the layer was defined by refusal to split-spoon penetration.

SPT 'N'-values measured within this deposit are 22 blows per 0.3 m of penetration and 20 blows per 0.12 m of penetration at the refusal surface, indicating a compact relative density.

Refusal

In Boreholes C6-1, C6-2 and S7-12, refusal to further casing advancement or split-spoon penetration was encountered at depths between 2.8 m and 6.0 m below ice/ground surface corresponding to between Elevation 201.8 m and 198.6 m.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet with free water noted in select samples. Water levels observed in the boreholes upon completion of drilling is at the ice surface in Boreholes C6-1 and C6-2 at Elevation 204.6 m and at 0.4 m below ground surface in Borehole S7-12 at Elevation 204.2 m. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.14 Highway 69 SBL – STA 10+558 (Site No. 44-590/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+558 in the Township of Harrison are shown on Drawing F1 in Appendix F. The culvert will extend across the proposed Highway 69 SBL roadway embankment and the top of the embankment at the proposed culvert location is about 2 m above the existing grade. A total of three (3) boreholes were completed to investigate the subsurface conditions at this culvert location. Two (2) boreholes (Boreholes C5-1 and C6-1) were advanced near each end of the culvert and one (1) borehole (Borehole C5-2) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low lying, with sparse tree cover.



Ice/Water

Boreholes C5-1, C5-2 and C6-1 were advanced from the ice surface at Elevation of 204.6 m and penetrated a layer of ice and water ranging in thickness from 0.3 m to 0.8 m.

Peat

A deposit of black, fibrous peat was encountered underlying the ice and water in Boreholes C5-1, C5-2 and C6-1. The thickness of the peat deposit ranges from 0.7 m to 2.6 m and the top of the deposit was encountered between Elevation 204.3 m and 203.8 m.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on samples of this deposit ranges between about 429 per cent and 1011 per cent.

Clayey Silt

A deposit of grey clayey silt was encountered underlying the peat in Boreholes C5-1 and C5-2 at Elevations 203.1 m and 201.7 m, respectively, and its thickness is 0.3 m and 1.4 m, respectively.

SPT 'N'-values measured within the cohesive deposit are 0 blows (weight of hammer) per 0.3 m of penetration. In situ field vane testing carried out in Boreholes C5-1 and C5-2 measured undrained shear strengths of about 14 kPa and 17 kPa, respectively, indicating the deposit has a soft consistency.

A grain size distribution of a sample of the deposit is shown on Figure F3 in Appendix F.

The measured water content on a sample of this deposit is about 49 per cent.

Silty Sand to Sand and Gravel

A deposit of grey silty sand, sand, gravelly sand and/or sand and gravel was encountered underlying the clayey silt in Boreholes C5-1 and C5-2 and below the peat in Borehole C6-1. The thickness of this deposit ranges from 1.3 m to 3.0 m and the top of the deposit was encountered between Elevation 202.8 m and 200.3 m.

SPT 'N'-values measured within this deposit range between 7 blows and 25 blows per 0.3 m of penetration, indicating a loose to compact relative density. An 'N'-value of 0 blows (weight of hammer) was recorded at the contact with the overlying peat and 80 blows per 0.15 m of penetration was recorded at the contact with the refusal surface.

Grain size distributions of three samples of the deposit are shown on Figure F2 in Appendix F.

The measured water content on samples of this deposit is between 13 per cent and 26 per cent.



Refusal

In Boreholes C5-1, C5-2 and C6-1, refusal to further split-spoon or casing advancement was encountered between the depths of 3.1 m and 6.2 m below ground surface, corresponding to between Elevation 201.5 m and 198.4 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. The water level observed in Boreholes C5-1, C5-2 and C6-1 upon completion of drilling was at the ice surface at Elevation 204.6 m. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.15 Highway 69 NBL – STA 10+974 (Site No. 44-592/C1)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+974 in the Township of Harrison are shown on Drawing G1 in Appendix G. The culvert extends along a creek in an area of ponded water and the proposed Highway 69 NBL embankment which will be up to about 10 m above the existing grade. A total of three (3) boreholes were completed to investigate the subsurface conditions at this culvert location. Two (2) boreholes (Boreholes C76-1 and C76-3) were advanced near each end of the culvert and one (1) borehole (Borehole C76-2) was advanced near the centre of the culvert. Borehole C76-1a was advanced adjacent to Borehole C76-1 to allow for coring a minimum of 3 m of bedrock. The topography of this section of proposed highway consists of a low-lying area traversed by a creek flowing westerly between bedrock outcrops. Borehole C76-3, advanced near the west limit of the culvert (i.e. near the centreline median), is generally located near the east toe of the existing Highway 69 embankment.

Water

Boreholes C76-1, C76-1a and C76-2 were advanced from the water surface at Elevation 195.3 m and encountered water to depths of 1.2 m and 1.8 m.

Fill

Borehole C76-3 was advanced near the toe of the existing embankment and encountered fill consisting of a 0.2 m thick layer of topsoil underlain by about a 1 m thick layer of brown to grey sand. Occasional cobbles were encountered within the fill deposit.

The SPT 'N'-value measured within the fill is 25 blows per 0.3 m of penetration, indicating a compact relative density.

The measured water content on a sample of the fill is about 9 per cent.



Peat

A deposit of black, fibrous peat was encountered underlying the water in Boreholes C76-1 and C76-2 and the fill material in Borehole C76-3. The thickness of the organic deposit ranges from 0.2 m to 1.1 m and the top of the deposit was encountered between Elevation 194.5 m and 193.5 m.

An SPT 'N'-value measured within the peat in Borehole C76-3 is 7 blows per 0.3 m of penetration, indicating a firm consistency.

The natural water content on a sample of this deposit is about 153 per cent.

Clayey Silt to Clay

A deposit of brown to grey clayey silt to clay was encountered below the peat in Boreholes C76-2 and C76-3. The top of the deposit was encountered at a depth of about 2.0 m and 2.3 m below ground surface, corresponding to Elevation 193.3 m and 193.4 m in the respective boreholes and is 1.2 m thick.

The SPT 'N'-values measured within this cohesive deposit range from 0 blows (weight of hammer) to 10 blows per 0.3 m of penetration. In situ field vane testing carried out within this stratum measured an undrained shear strength of about 7 kPa. The SPT 'N' values together with the in situ field vane tests indicate the deposit has a very soft to stiff consistency.

Atterberg limits testing carried out on three samples of the cohesive deposit yielded liquid limits ranging from 26 per cent to 55 per cent, plastic limits ranging from 17 per cent to 21 per cent and plasticity indices ranging from 9 per cent to 34 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure G1 in Appendix G and indicate that the deposit consists of clayey silt of low plasticity to clay of high plasticity.

The measured water content on samples of this deposit ranges between about 26 per cent and 70 per cent.

Sand and Silt to Sand

A deposit of grey sand and silt to sand containing trace to some gravel and trace to some clay was encountered below the peat in Borehole C76-1 and below the clay stratum in Borehole C76-3. The top of this deposit was encountered at Elevation 193.9 m to 192.2 m and the thickness of the deposit is 4.2 m to 0.3 m at the respective boreholes. The bottom of this deposit was defined by bedrock coring in the three boreholes.

The SPT 'N'-values measured within this deposit range from 4 blows to 18 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The grain size distributions of six samples of the sand and silt to sand deposit are shown on Figure G2 in Appendix G.

Atterberg limits testing carried out on one sample of the sand and silt from Borehole C76-1 yielded a liquid limit of 16 per cent, a plastic limit of 12 per cent and a plasticity index of 4 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure G3 in Appendix G and indicate that the material is comprised of a silt of low plasticity.



The measured water content on samples of this deposit ranges between about 12 per cent and 30 per cent.

Gravel

A deposit of grey gravel containing some sand was encountered below the clayey silt stratum in Borehole C76-2. The top of this deposit was encountered at Elevation 192.1 m and the thickness of the deposit is 0.2 m.

Bedrock

Bedrock was encountered and cored in the three boreholes. Borehole C76-1a was advanced adjacent to Borehole C76-1 to allow obtaining 3 m of bedrock as only 1.1 m of bedrock was recovered from Borehole C76-1 due to jamming of the core in the core barrel at this location. The bedrock surface ranges from Elevation 191.9 m to 189.7 m and was encountered at depths ranging from 3.4 m to 5.6 m below the ground surface or below the bottom of the ponded water. Bedrock outcrops are exposed on the north and south sides of the creek.

Based on a review of the rock core samples from Boreholes C76-1, C76-1a and C76-2, the bedrock consists of gneiss and the core samples are described as slightly weathered, fine-grained and pinkish grey. In Borehole C76-3, the bedrock consists of meta-quartzite and is described as slightly weathered, fine to medium grained and pink.

The RQD measured on the core samples ranges from about 69 per cent to 100 per cent, indicating a rock mass quality ranging from fair to excellent. The TCR ranges from about 89 per cent to 100 per cent and the SCR ranges from about 58 per cent to 93 per cent.

Laboratory UCS tests were performed on three samples of the bedrock from Borehole C76-1a, C76-2 and C76-3 and the results range from 54 MPa and 69 MPa of the gneiss and to 131 MPa for the meta-quartzite as presented in Table G1 in Appendix G. Diametral point load strength index values are shown on the Record of Drillhole sheets and are presented in Table G2 in Appendix G. The Is_{50} results range from about 2.4 MPa to 8.3 MPa and the corresponding UCS strengths range between 34 MPa and 116 MPa, for the gneiss and 109 MPa to 131 MPa for the meta-quartzite.

Based on the laboratory UCS test and point load testing results, the estimated intact strength of the overall bedrock ranges from medium strong (R3, 25 MPa < UCS < 50 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. Boreholes C76-1, C76-1a and C76-2 were advanced from the water surface at Elevation 195.3 m. The water level observed in Boreholes C76-3 upon completion of drilling was at Elevation 195.4 m, measured at a depth of 0.3 m below the ground surface. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.



4.16 Highway 69 SBL – STA 11+019 (Site No. 44-592/C2)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 11+019 in the Township of Harrison are shown on Drawing G1 in Appendix G. The culvert extends across the southern portion of a swamp and the proposed Highway 69 SBL embankment which will be up to about 8 m above the existing grade. A total of three (3) boreholes were completed to investigate the subsurface conditions at this culvert location. Two (2) boreholes (Boreholes C76-3 and C76-5) were advanced near each end of the culvert and one (1) borehole (Borehole C76-4) was advanced near the midpoint of the culvert on the west shoulder of the existing Highway 69 embankment. Borehole C76-3 was advanced near the east toe of the existing embankment. The topography of this section of proposed highway consists of a low-lying swamp area with bedrock outcrops observed immediately to the south of the proposed culvert. The existing embankment crosses the proposed SBL embankment on a “skew” such that the existing embankment cuts across the west half of the new culvert.

Fill

Borehole C76-3 penetrated fill comprised of a 0.2 m thick layer of topsoil underlain by a 1.0 m thick layer of sand. Borehole C76-4 also encountered fill comprised of a 4.6 m thick layer of gravelly sand to sand and gravel containing blast rock and a 3.0 m thick layer of sand.

The SPT ‘N’-values measured within the fill range from 9 blows to greater than 100 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The grain size distributions of two samples of the fill are shown on Figure G4 in Appendix G.

The measured water content on samples of the fill deposit ranges between about 8 per cent and 28 per cent.

Peat

A deposit of black, fibrous peat was encountered underlying the fill in Boreholes C76-3 and C76-4 and at ground surface in Borehole C76-5. The thickness of the organic deposit is 1.1 m and 1.2 m thick where encountered below the fill and the thickness of the deposit is 3.5 m where encountered below ground surface. The surface of the peat was encountered between Elevations 195.1 m to 190.4 m and in Borehole C76-5 the bottom of this deposit is defined by bedrock.

SPT ‘N’ values measured within the organic deposit range from 0 blows (weight of hammer) to 7 blows per 0.3 m of penetration, indicating a very soft to stiff consistency.

The measured water content on samples of this deposit ranges between about 147 per cent and 613 per cent.

Clay

A deposit of brown and grey clay was encountered below the organic deposit in Borehole C76-3. The top of this deposit was encountered at Elevation 193.4 m and its thickness is 1.2 m.



An SPT 'N'-value measured within this cohesive deposit is 2 blows per 0.3 m of penetration and an in situ field vane testing measured an undrained shear strength of about 7 kPa. The SPT 'N'-value together with the in situ field vane test indicates that the deposit has a very soft consistency.

Atterberg limits testing carried out on a sample of the clay yielded a liquid limit of 55 per cent, a plastic limit of 21 per cent and a plasticity index of 34 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure G1 in Appendix G and indicate that the material is a clay of high plasticity.

The measured water content on a sample of this deposit is about 70 per cent.

Sand to Sand and Silt

A deposit of grey sand to sand and silt was encountered below the clay deposit in Borehole C76-3. The top of this deposit is at Elevation 192.2 m, and the thickness of the deposit is 0.3 m. The bottom of this deposit was defined by refusal to further split-spoon penetration.

A grain size distribution of a sample of the sand and silt deposit from Borehole C76-3 is shown on Figure G2 in Appendix G.

The measured water content on two samples of this deposit is about 12 per cent and 24 per cent.

Sand to Gravelly Sand

A deposit of grey sand to gravelly sand was encountered below the peat in Borehole C76-4. The top of this deposit is at Elevation 189.2 m and the thickness of the deposit is 3.8 m.

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

The grain size distributions of two samples of the sand to gravelly sand are shown on Figure G5 in Appendix G.

The measured water content on samples of this deposit ranges between about 12 per cent and 14 per cent.

Cobbles and Boulders

A deposit of cobbles and boulders was encountered below the gravelly sand in Borehole C76-4 at Elevation 185.4 m and the thickness of the deposit is 1.0 m.

Bedrock

Bedrock was encountered and cored in all of the boreholes. The bedrock surface ranges from Elevation 191.9 m to 184.4 m at corresponding depths ranging from 3.5 m to 13.6 m below ground surface.

Based on a review of the rock core samples, the bedrock at Borehole C76-3 consists of meta-quartzite and is described as slightly weathered, fine to medium grained and pink, whereas the bedrock at Boreholes C76-4 and C76-5 consists of gneiss and is described as slightly to moderately weathered, fine-grained and pinkish grey.



The RQD measured on the core samples typically range from 62 per cent to 100 per cent, indicating a rock mass quality ranging from fair to excellent. The second core sample in Borehole C76-4 over a length of about 0.7 m measured RQD of 0 per cent. The TCR is 100 per cent and the SCR ranges from about 46 per cent to 93 per cent.

Laboratory UCS tests were performed on three samples of the bedrock from Boreholes C76-3, C76-4 and C76-5. The UCS results are 131 MPa for the meta-quartzite core sample and 75 MPa and 94 MPa for the gneiss core samples, as presented in Table G1 in Appendix G.

Diametral point load strength index values are shown on the Record of Drillhole sheets and are presented in Table G2 in Appendix G. The I_{s50} results range from about 6.4 MPa to 7.7 MPa for the meta quartzite core samples and 4.2 MPa to 6.7 MPa for the gneiss core samples. The corresponding UCS strengths range between 109 MPa and 131 MPa for the meta-quartzite and between 59 MPa and 94 MPa for the gneiss.

Based on the laboratory UCS test and point load testing results, the estimated intact strength of the overall bedrock ranges from strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. The water level observed in the boreholes upon completion of drilling range from Elevation 195.4 m to Elevation 193.9 m, with measured depths ranging from 0.3 m to 2.9 m below the ground surface. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.17 Site 9 Road – STA 12+599

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy on Site 9 Road at approximately STA 12+599 in the Township of Shawanaga are shown on Drawing A1 in Appendix A. The culvert will extend across the proposed Site 9 Road roadway embankment and the embankment at the proposed culvert location is about 6.0 m high above the existing grade. A total of two boreholes (Boreholes B-1 and B-2) were advanced at the west and the east ends of the culvert to investigate the subsurface conditions at this culvert location. The topography of this section of proposed highway is generally sloping down to the east, with bedrock exposed beyond the east end of the culvert.

Peat

A 0.7 m thick deposit of moist, black and brown, fibrous sandy peat was encountered in Borehole B-1 at ground surface, at Elevation 200.5 m.

An SPT 'N'-value measured within the peat is 8 blows per 0.3 m of penetration, suggesting a firm consistency.

The measured water content on a sample of the peat is 23 per cent.



Sand to Gravelly Sand

A deposit of brown to grey sand to gravelly sand containing trace to some silt and trace clay was encountered underlying the sandy peat in Borehole B-1 and from ground surface in Borehole B-2. The samples of the sand deposit recovered from Borehole B-2 were noted to be slightly organic. The top of the deposit was encountered at a depth of about 0.7 m and ground surface, corresponding to Elevation 199.8 m and 202.3 m in Boreholes B-1 and B-2, respectively, and the thickness of the deposit is 3.9 m and 1.1 m in the respective boreholes. The bottom of the deposit in Borehole B-1 is defined by refusal to further split-spoon advancement at a depth of 4.6 m below ground surface, corresponding to Elevation 195.9 m.

SPT 'N'-values measured within the granular deposit range between 4 blows and 18 blows per 0.3 m of penetration, indicating a loose to compact relative density.

A grain size distribution of a sample of sand is shown on Figure A7 in Appendix A.

The measured water content on samples of this deposit ranges between 11 per cent and 21 per cent.

A 0.4 m thick silty clay seam was encountered within the granular deposit in Borehole B-1 at a depth of 1.8 m below ground surface (Elevation 198.7 m). An Atterberg limits test carried out on a sample of this seam indicates a liquid limit of about 39 per cent, a plastic limit of about 17 per cent and a plasticity index of about 22 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure A8 in Appendix A and confirm that this seam is a silty clay of intermediate plasticity. The measured water content on a sample of this seam is about 45 per cent.

Cobbles and Boulders

A 1.0 m thick deposit of cobbles and boulders was encountered in Borehole B-2, at a depth of 1.1 m below ground surface, corresponding to Elevation 201.2 m.

Bedrock/Refusal

Bedrock was encountered underlying the cobbles and boulders in Borehole B-2 at a depth of 2.1 m, corresponding to Elevation 200.2 m, and 2.9 m of bedrock core was recovered. Refusal to further split-spoon advancement was encountered in Borehole B-1 at a depth of 4.6 m below ground surface, corresponding to Elevation 195.9 m.

Based on a review of the bedrock core samples, the bedrock generally consists of fine to medium grained, fresh, pinkish grey gneiss.

The TCR is 100 per cent for the core sample. The SCR of the two core runs is about 76 per cent and 81 per cent. The RQD values measured on the recovered bedrock core samples are 80 per cent and 88 per cent, indicating that the rock is of good quality according to Table 3.10 of CFEM (2006).

A UCS test was carried out on a representative sample of the rock core taken from Borehole B-2 and the measured UCS is 140 MPa, indicating that the bedrock is very strong (R5, 100 MPa < UCS < 250 MPa) according to Table 3.5 of CFEM (2006).



Groundwater Conditions

The unstabilized water level in Borehole B-1 was measured at a depth of 2.3 m below ground surface corresponding to Elevation 198.2 m, while Borehole B-2 was dry upon completion of drilling. The groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.18 Site 9 Road – STA 13+165 (Site No. 44-581/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+165 in Shawanaga Township are shown on Drawing H1 in Appendix H. The culvert will extend across the proposed Site 9 Road embankment and the embankment at the proposed culvert location is about 4.0 m high above the existing grade. Two boreholes (Boreholes C-1 and C-2) were advanced near each end of the culvert to investigate the subsurface conditions at this culvert location. The topography of the area in this section of proposed roadway is generally flat and low-lying, with tree cover.

Topsoil

A 0.1 m and 0.2 m thick layer of brown to black, moist topsoil was encountered at the ground surface in Boreholes C-1 and C-2, respectively.

Sand and Silt, Sand to Gravelly Sand

A 1.7 m and 0.6 m thick deposit of moist to wet, brown sand to gravelly sand or sand and silt, containing trace clay was encountered underlying the topsoil in Boreholes C-1 and C-2. The top of the granular deposit was encountered at about 0.1 m and 0.2 m below ground surface in Boreholes C-1 and C-2, corresponding to Elevations 210.7 m and 211.3 m in the respective boreholes. In Borehole C-1, the bottom of this deposit was defined by refusal to split-spoon advancement, while in Borehole C-2 bedrock was cored.

The SPT 'N'-values measured within this deposit range from 6 blows to 85 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

A grain size distribution of a sample of the sand and silt portion of the deposit is shown on Figure H1 in Appendix H.

The measured water content on two samples of this deposit is about 33 per cent and 35 per cent.

Bedrock/Refusal

Refusal to further split-spoon advancement was encountered in Borehole C-1, at a depth of 1.8 m below ground surface, corresponding to Elevation 209.0 m.

Bedrock was encountered underlying the sand to sand and silt in Borehole C-2 at a depth of 0.8 m below ground surface, corresponding to Elevation 210.7 m, and 3.6 m of bedrock core was recovered. Based on a review of



the bedrock core sample, the bedrock consists of fine to coarse grained, slightly weathered to fresh, pink and grey gneiss.

The TCR is 100 per cent for the core samples obtained and the SCR ranges from about 64 per cent to about 95 per cent. RQD values measured on the recovered bedrock core samples range from 56 per cent to 98 per cent, indicating that the rock is of fair to excellent quality according to Table 3.10 of CFEM (2006).

A UCS test was carried out on a sample of the rock core taken from Borehole C-2 and the measured UCS is 60 MPa, indicating that the bedrock is strong (R_4 , $50 \text{ MPa} < \text{UCS} < 100 \text{ MPa}$) according to Table 3.5 of CFEM (2006). The UCS for this test specimen is attributed to failure along a joint as noted by visual examination of the core sample after testing.

Groundwater Conditions

The unstabilized water level in Borehole C-1 was measured at a depth of 1.1 m below ground surface corresponding to Elevation 209.7 m, while Borehole C-2 was dry upon completion of drilling. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.19 Site 9 Road – STA 14+045 (Site No. 44-584/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 14+045 in Shewanaga Township are shown on Drawing I1 in Appendix I. The culvert will extend across the proposed Site 9 Road embankment and the embankment at the proposed culvert location is about 4.3 m high above the existing grade. Two boreholes (Boreholes E-1 and E-2) were advanced near each end of the culvert to investigate the subsurface conditions at this culvert location. The topography of the area in this section of proposed roadway is generally flat and low-lying, with tree cover and exposed bedrock outcrops nearby.

Peat

A 0.2 m and 0.5 m thick deposit of moist to wet, black, fibrous peat was encountered at the ground surface in Boreholes E-1 and E-2.

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

The measured water content on a sample of this deposit is about 95 per cent.

Sand and Silt

A 1.6 m and 6.2 m thick deposit of wet, brown sand and silt, trace clay was encountered in Boreholes E-1 and E-2, underlying the peat at Elevation 207.1 m and 206.8 m in the respective boreholes. In Borehole E-1, the bottom of this deposit was defined by refusal to split-spoon penetration and Borehole E-2 was terminated within this deposit.



The SPT 'N'-values measured within this deposit range between 4 blows and 68 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

Grain size distributions of two samples of the deposit are shown on Figure I1 in Appendix I.

The measured water content on samples of the sand and silt deposit is between about 19 per cent and 27 per cent.

Refusal

In Borehole E-1, refusal to further split-spoon advancement was encountered at a depth of 1.8 m below ground surface, corresponding to Elevation 205.5 m.

Groundwater Conditions

The unstabilized water level in Boreholes E-1 and E-2 was measured at depths of 0.9 m and 0.3 m below ground surface corresponding to Elevations 206.4 m and 207.0 m, respectively. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.20 Site 9 Road – STA 14+166 (Site No. 44-585/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 14+166 in Shawanaga Township are shown on Drawing J1 in Appendix J. The culvert will extend across the proposed Site 9 Road embankment and the embankment at the proposed culvert location is about 3.0 m high above the existing grade. Two boreholes (Boreholes F-1 and F-2) were advanced near each end of the culvert to investigate the subsurface conditions at this culvert location. The topography of the area in this section of proposed roadway is generally flat and low-lying, with tree cover and exposed bedrock.

Peat and Sand (Fill)

A 1.5 m thick deposit of moist to wet, black peat mixed with sand was encountered in Borehole F-2 at the ground surface. Based on site observations, this area appears to have been excavated and backfilled from ditching operations in the area of the borehole.

The SPT 'N'-values measured within the fill are 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on a sample of this deposit is about 50 per cent.

Topsoil

A 0.2 m thick deposit of brown topsoil was encountered in Borehole F-1, at the ground surface.



Sand to Gravelly Sand

A 0.6 m and 1.1 m thick deposit of wet, grey or brown sand or gravelly sand, containing some silt was encountered in Boreholes E-1 and E-2, at 0.2 m and 1.5 m below ground surface, respectively, corresponding to Elevation 206.9 m and 205.8 m. The sand sample in Borehole F-1 was noted to contain trace organics. The bottom of this deposit was defined by refusal to split-spoon penetration in Borehole F-2 and by rock coring in Borehole F-1.

The SPT 'N'-values measured within this deposit range between 1 blow and 40 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

A grain size distribution of a sample of the gravelly sand deposit is shown on Figure J1 in Appendix J.

The measured water content on two samples of this deposit is about 12 per cent and 35 per cent.

Bedrock/Refusal

Refusal to further split-spoon advancement was encountered in Borehole F-2, at a depth of 2.6 m below ground surface, corresponding to Elevation 204.7 m.

Bedrock was encountered underlying the sand in Borehole F-1 at a depth of 0.8 m below ground surface, corresponding to Elevation 206.3 m, and 2.5 m of bedrock core was recovered. Based on a review of the bedrock core samples, the bedrock consists of fine to medium grained, slightly to moderately weathered, grey gneiss.

The TCR is 100 per cent for the core sample and the SCR are about 38 per cent and 58 per cent. RQD values measured on the recovered bedrock core sample are 11 per cent and 44 per cent, indicating that the rock is of very poor to poor quality according to Table 3.10 of CFEM (2006).

A UCS test was carried out on a sample of the rock core taken from Borehole F-1 and the measured UCS is 121 MPa, indicating that the bedrock is very strong ($R5, 100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$) according to Table 3.5 of CFEM (2006).

Groundwater Conditions

The unstabilized water level in Boreholes F-1 and F-2 was measured at depths of 0.8 m and 1.1 m below ground surface, corresponding to Elevation 206.3 m and 206.2 m, respectively. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.21 Site 9 Road – STA 16+323 (Site No. 44-587/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 16+323 in Shawanaga Township are shown on Drawing D1 in Appendix D. The culvert will extend across the proposed Site 9 Road embankment and the embankment at the proposed culvert locations is about 2.3 m high above the existing grade. One borehole (Borehole H-1) was completed at the west end of the culvert to investigate the subsurface conditions at this culvert location, supplemented with two swamp boreholes



(Boreholes S11-3 and S11-4) near the mid-point of the culvert and one swamp DCPT (DCPT S11-DC2) advanced near the east end of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying, with sparse tree cover.

Ice/Water

Boreholes S11-3 and S11-4 were advanced from ice surface at Elevation 210.2 m (drilled in February 2008) and penetrated an ice/water layer 0.2 m and 0.3 m thick.

Peat

A deposit of black, fibrous/amorphous peat was encountered at ground surface in Borehole H-1 and below the ice/water in Boreholes S11-3 and S11-4, and the thickness of the peat deposit ranges from 0.3 m to 1.2 m.

The SPT 'N'-values measured within the peat range between 0 blows (weight of hammer) and 2 blows per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on two samples of this deposit is about 172 per cent and 295 per cent.

Clayey Silt

A 0.4 m thick deposit of brown to grey clayey silt containing trace to some sand was encountered underlying the peat in Borehole S11-4, about 1.1 m below ice surface, corresponding to Elevation 209.1 m.

An in situ field vane test carried out within this stratum measured an undrained shear strength of about 12 kPa, indicating a very soft to soft consistency.

Atterberg limits testing was carried out on one sample of the clayey silt and the test results indicate a liquid limit of about 34 per cent, a plastic limit of about 19 per cent and a plasticity index of about 15 per cent. The results of the Atterberg limits test are shown on the plasticity chart on Figure D2 in Appendix D and indicate that the material is classified as a clayey silt of low plasticity.

A grain size distribution of one sample of the deposit is shown on Figure D3 in Appendix D.

The measured water content on a sample of the clayey silt is 45 per cent.

Silty Sand

A deposit of grey silty sand containing trace to some gravel and trace clay was encountered underlying the clayey silt in Borehole S11-4 and underlying the peat in Boreholes H-1 and S11-3. The top of the deposit was encountered at a depth of between about 0.6 m and 1.5 m below the ice/peat surface, corresponding to Elevation 208.6 m and 209.6 m and the thickness of this deposit ranges from 0.2 m to 1.4 m. The bottom of this deposit was defined by bedrock coring in Borehole H-1 and refusal to split-spoon advancement in Boreholes S11-3 and S11-4.



SPT 'N'-values measured within this deposit range between 11 blows and 18 blows per 0.3 m of penetration, and up to 58 blows per 0.13 m of penetration potentially on bedrock, indicating a compact relative density.

Two Atterberg limits test results indicate that the material is non-plastic.

Grain size distributions of three samples of the deposit are shown on Figure D4 in Appendix D.

The measured water content on three samples of this deposit is between about 13 per cent and 23 per cent.

Bedrock/Refusal

In Boreholes S11-3, S11-4 and DCPT S11-DC2, refusal to further split-spoon or cone advancement was encountered at depths ranging from 1.7 m to 3.8 m (below ice/ground surface), corresponding to between Elevation 208.5 m and 206.4 m.

Bedrock was encountered below the silty sand in Borehole H-1 at a depth of 2.1 m, corresponding to Elevation 207.7 m, and 3.7 m of bedrock core was recovered. Based on a review of the bedrock core sample, the bedrock generally consists of fine grained, fresh, grey gneiss.

The TCR is 100 per cent for the core sample and the SCR ranges from about 93 per cent to about 98 per cent. RQD values measured on the recovered bedrock core samples range from 97 per cent to 100 per cent, indicating that the rock is of excellent quality according to Table 3.10 of CFEM (2006).

A UCS test was carried out on a sample of the rock core taken from Borehole H-1 and the measured UCS is 140 MPa, indicating that the bedrock is very strong ($R_5, 100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$) according to Table 3.5 of CFEM (2006).

Groundwater Conditions

The unstabilized water level in Borehole H-1 was measured at a depth of 0.6 m below ground surface corresponding to Elevation 209.2 m. Boreholes S11-3, S11-4 and DCPT S11-DC2 were advanced from the ice surface at Elevation 210.2 m (February 2008). Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.22 Site 9 Road – STA 17+072 (Site No. 44-589/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+072 in the Township of Harrison are shown on Drawing K1 in Appendix K. The culvert will extend across the proposed Site 9 Road embankment and the embankment at the proposed culvert location is about 2 m above the existing grade. The subsurface conditions at this culvert location are based on the subsurface investigation carried out in the general area of the culvert, consisting of three (3) boreholes and one (1) DCPT advanced during Golder's investigation for the new Site 9 Road embankment crossing the swamp in this area and one (1) DCPT advanced during Trow's preliminary investigation in this area. The culvert alignment is such that the previous swamp investigation boreholes advanced during Golder's investigation in 2008 result in one (1) borehole (Borehole S8-12) being located near the culvert outlet, one (1) borehole (Borehole S8-13) being



located near the midpoint of the culvert and one (1) borehole (Borehole S8-14) being located about 13 m north of the culvert inlet. In addition, one (1) DCPT (S8-DC6) was advanced about 12 m south of the culvert inlet and another DCPT (DCPSPB-1) was advanced near the culvert inlet during Trow's preliminary investigation in 2005 to confirm the depth to refusal.

The topography of the area in this section of proposed roadway is generally flat and low-lying, with sparse tree cover.

Ice/Water

Boreholes S8-12 and S8-13 and DCPT S8-DC6 and DCPSPB-1 were advanced from the ice/water surface at Elevation 205.4 m or 205.3 m and penetrated a layer of ice and/or water about 0.1 m to 0.9 m deep.

Peat

A deposit of black, fibrous/amorphous peat was encountered underlying the water in Boreholes S8-12 to S8-14 and probable peat was encountered underlying the water in DCPT S8-DC6 and DCPSPB-1. The thickness of the peat deposit ranges from 0.2 m to 4.5 m and the top of the deposit was encountered between about Elevation 205.3 m and 203.8 m. In Boreholes S8-13 and S8-14, the bottom of this deposit is defined by refusal to split-spoon penetration.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very soft consistency.

The measured water content on two samples of this deposit is 805 per cent and 1463 per cent.

Sand

A deposit of grey sand was encountered below the peat in Borehole S8-12. The top of this deposit was encountered at Elevation 200.0 m, and the deposit is 0.2 m thick. The bottom of this deposit was defined by refusal to split-spoon penetration.

The measured water content on a sample of the sand deposit is about 12 per cent.

In DCPT S8-DC6 and DCPSPB-1, probable silt was encountered below the peat. The top of this deposit is inferred to be at about Elevation 201.2 m and 200.0 m at the respective DCPTs, and is estimated to be about 1.0 m thick.

Refusal

In Boreholes S8-12 to S8-13 and DCPT S8-DC6 and DCPSPB-1, refusal to further casing or split-spoon advancement or cone penetration was encountered between depths of 0.8 m and 5.6 m corresponding to between Elevation 204.6 m and 199.8 m.



Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. The water level observed in the boreholes upon completion of drilling is at the ground or ice surface and ranges at about Elevation 205.4 m (February 2008) and 205.3 m (February 2005). It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.

4.23 Site 9 Road – STA 17+488 (Site No. 44-591/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 17+488 in the Township of Harrison are shown on Drawing L1 in Appendix L. The existing Highway 69 embankment in the culvert area will be widened to the west for the new alignment of Site 9 Road. The top of the new embankment at the proposed culvert location is about 0.6 m above the existing grade for the existing embankment and up to about 2 m above existing grade in the widened area to the west. A total of two (2) boreholes were completed to investigate the subsurface conditions at this culvert location and supplemented with one (1) borehole advanced for the new Site 9 Road embankment crossing the swamp in this area. Two (2) boreholes (Boreholes S7-31 and C4-2) were advanced near each end of the culvert and one (1) borehole (Borehole C4-1) was advanced near the midpoint of the culvert. The topography of the area in this section of proposed roadway is generally flat and low-lying.

Asphalt/Fill

Borehole C4-1 was drilled in the west paved shoulder and Borehole C4-2 was drilled in the east granular shoulder of the existing Highway 69 embankment. Borehole C4-1 encountered a 0.1 m thick layer of asphalt at ground surface at Elevation 206.3 m underlain by about 0.4 m of crushed granular fill in sand and gravel sizes. At Borehole C4-2, a 0.2 m thick layer of crushed granular fill in sand and gravel sizes was encountered from ground surface. In Boreholes C4-1 and C4-2, a 3.8 m and 2.4 m, respectively, thick layer of sand to gravelly sand fill was encountered underlying the sand and gravel fill.

The SPT 'N'-values measured within the embankment fill range from 3 blows to 44 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The measured water content on two samples of the fill is 11 per cent and 14 per cent.

Peat

A deposit of black, fibrous peat was encountered underlying the fill in Borehole C4-2 and from ground surface (underlying a 0.3 m thick layer of snow) in Borehole S7-31, at Elevation 203.1 m and 204.6 m, respectively. The peat deposit is 0.4 m and 0.3 m thick at the respective boreholes.

Clay

A stratum of grey clay was encountered underlying the peat deposit in Borehole S7-31. The top of this stratum was encountered at Elevation 204.3 m and the stratum is 0.3 m thick.



Sandy Silt

A deposit of grey sandy silt was encountered underlying the fill in Borehole C4-1 at Elevation 202.0 m. The thickness of the deposit is 0.5 m and the bottom of the deposit is defined by refusal to split-spoon and auger advancement.

In Borehole C4-2, and SPT 'N'-value of 24 blows per 0.3 m of penetration was recorded immediately above or across the interface with the overlying sand fill and an 'N'-value of 10 blows per 0.1 m of penetration was recorded immediately above the refusal depth, indicating a compact relative density for this deposit.

A grain size distribution of a sample of the sandy silt is shown on Figure L1 in Appendix L.

The measured water content on one sample of this deposit is 21 per cent.

Silty Sand and Gravelly Sand

A deposit of grey silty sand was encountered underlying the peat deposit in Borehole C4-2 and a deposit of grey gravelly sand was encountered below the clay in Borehole S7-31. The top of the silty sand was encountered at Elevation 202.7 m and the deposit is 0.5 m thick while the top of the gravelly sand was encountered at Elevation 204.0 m and the deposit is 0.2 m thick. The bottom of the deposit in both boreholes was defined by refusal to split-spoon or auger advancement.

The SPT 'N'-values measured within the silty sand are 19 blows per 0.3 m of penetration and 41 blows per 0.2 m of penetration recorded immediately above the refusal surface, indicating a compact relative density.

A grain size distribution of a sample of the silty sand is shown on Figure L1 in Appendix L.

The measured water content on samples of this deposit ranges between about 14 per cent and 21 per cent.

Refusal

In Boreholes C4-1, C4-2 and S7-31, refusal to further split-spoon penetration or auger advancement was encountered between the depths of 1.1 m and 4.8 m below ground surface corresponding to between Elevation 203.8 m and 201.5 m.

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. The water level observed in the boreholes upon completion of drilling ranges from 0.3 m to 2.0 m below ground surface and ranges from Elevation 204.3 m to 204.1 m. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.



4.24 Site 9 Road – STA 18+034 (Site No. 44-593/C)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 18+034 in the Township of Harrison are shown on Drawings M1 in Appendix M. The culvert extends across a swamp and the proposed Site 9 Road embankment which will be up to about 9 m above the existing grade. A total of three (3) boreholes were completed to investigate the subsurface conditions at this culvert location. Two (2) boreholes (Boreholes C76-6 and C76-8) were advanced near each end of the culvert and one (1) borehole (Borehole C76-7) was advanced near the midpoint of the culvert. The topography of this section of proposed roadway consists of a low-lying swamp area with a creek traversing the swamp along the culvert alignment.

Ice/Water

All boreholes were advanced from the ice surface and penetrated an ice/water layer between 0.6 m and 0.8 m thick.

Peat

A deposit of black, fibrous/amorphous peat was encountered underlying the ice/water in all boreholes. The top of the deposit was encountered between Elevation 193.5 m and 193.3 m and the thickness of the peat deposit ranges from 4.0 m to 5.3 m.

SPT 'N'-values measured within the peat deposit are 0 blows (weight of rods or hammer) per 0.3 m of penetration, indicating a very soft consistency.

The measured water content on samples of this deposit ranges between about 295 per cent and 695 per cent.

Clayey Silt to Clay

A deposit of grey clayey silt to clay was encountered below the peat. The top of the deposit was encountered between about Elevation 189.5 m and 188.1 m and the deposit ranges in thickness from 1.5 m to 3.2 m.

The SPT 'N'-values measured within this cohesive deposit are 0 blows (weight of hammer) per 0.3 m of penetration. In situ field vane testing carried out within this stratum measured undrained shear strengths ranging from about 9 kPa to 17 kPa. The SPT 'N' values together with the in situ field vane tests indicate the deposit has a very soft to soft consistency.

Atterberg limits testing carried out on four samples of the cohesive deposit yielded liquid limits ranging from 34 per cent to 57 per cent, plastic limits ranging from 17 per cent to 25 per cent and plasticity indices ranging from 16 per cent to 36 per cent. The results of the Atterberg limits testing are shown on the plasticity chart on Figure M1 in Appendix M and indicate that the material is classified as clayey silt of low plasticity to clay of high plasticity.

The measured water content on samples of this deposit ranges between about 55 per cent and 94 per cent.



One laboratory consolidation test was carried out on a specimen of the silty clay to clay obtained from Borehole C76-7 and the test results are shown on Figure M2 in Appendix M. The preconsolidation pressure was estimated from the Void Ratio versus logarithmic Pressure plots using the Casagrande method as well as from the Total Work versus Pressure plots. The relevant consolidation test results are summarized below.

Borehole / Sample Number	Elevation (m)	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	e_o	C_r	C_c	c_v^* (cm ² /s)
C76-7/8	186.2	23	30	7	1.3	2.60	0.096	0.58	8.4×10^{-4}

Note: *For approximate stress range of $30 \leq \sigma_v' \leq 230$ kPa
 where: σ_{vo}' effective overburden pressure in kPa
 σ_p' preconsolidation pressure in kPa
 OCR overconsolidation ratio
 e_o initial void ratio
 C_c compression index (based on void ratio)
 C_r recompression index (based on void ratio)
 c_v coefficient of consolidation in cm²/s in the normally consolidated range

Sand

A deposit of grey sand was encountered underlying the clayey silt to clay deposit in the three boreholes. The top of this deposit ranges from Elevation 188.0 m to 185.8 m and the thickness of the deposit ranges from 0.8 m to 1.9 m. Refusal to casing advancement was encountered in Borehole C76-8 at a depth of 6.7 m below the bottom of the ponded water (Elevation 187.4 m) and a DCPT was advanced from 6.7 m to refusal at a depth of 8.0 m. The bottom of the sand deposit was defined by refusal to further split-spoon penetration in Boreholes C76-6 and C76-7.

The grain size distributions of three samples of the sand deposit are shown on Figure M3 in Appendix M.

The measured water content on samples of this deposit ranges between about 14 per cent and 18 per cent.

Bedrock/Refusal

Refusal to further split- spoon advancement or dynamic cone penetration was encountered at depths between 7.4 m and 8.5 m below the bottom of the ponded water corresponding to Elevation 186.1 m to 184.8 m. Bedrock outcrops were noted at the south and north limits of the swamp at about STA 17+990 and about STA 18+080.

Groundwater Conditions

In general, the samples taken in the boreholes were wet with free water noted in select samples. As noted above, the boreholes were advanced from the ice/water surface, which was encountered at about Elevation 194.2 m and 194.1 m. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events.



5.0 CLOSURE

The field drilling program was carried out under the supervised of Messrs. Indulis Dumpis and Ed Savard, senior field technicians with Golder, assisted by several field personnel from our Sudbury office, under the overall direction of Mr. André Bom, P.Eng. This report was prepared by Mr. Evan Childerhose, P.Eng., and the technical aspects were reviewed by Mr. André Bom, P.Eng. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and Principal with Golder, also conducted an independent quality control review of the report.

Report Signature Page

GOLDER ASSOCIATES LTD.



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Designated MTO Contact, Principal

EC/AB/JMAC/lb/cl

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n:\active\2007\1190 sudbury\1191\07-1191-0020 mmm hwy 69 twinning\7000 reporting\final\c1 - culverts\07-1191-0020-c1 rpt 13feb7 fdr phase 1 culverts.docx



FOUNDATION REPORT CULVERTS - PHASE 1 - HIGHWAY 69 GWP 5403-05-00

Table 1: Summary of Culvert Details

Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls	Boreholes/DCPTs	Reference Appendix
		East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
Highway 69 NBL STA 17+809	7.5	200.4	199.7	3.0	3.0	34.4	No	3 Boreholes (A-1 that is shared with SBL culvert, A-2 and A-3)	Appendix A
Highway 69 SBL STA 17+809 (Swamp 19)	8.3	199.6	198.8	3.0	3.0	35.2	No	1 Borehole (A-1 that is shared with NBL culvert) 2 Swamp Boreholes (S19-1 and S19-2)	Appendix A
Highway 69 NBL STA 19+190	3.7	209.8	209.1	3.0	2.4	29.7	Yes (East Side)	3 Boreholes (D-3 that is shared with SBL culvert, D-4 and D-5)	Appendix B
Highway 69 SBL STA 19+190	4.6 (<0.2 m grade raise at centre line and on east side; and 4 m widening on the west side)	209.0	208.7	3.0	3.0	35.4	No	3 Boreholes (D-1, D-2 and D-3 that is shared with NBL culvert)	Appendix B
Highway 69 SBL STA 19+202	5.0 (< 0.2 m grade raise at centre line and on east side; and 4 m widening with a 5 m grade raise on the west side)	208.0	207.8	3.0	3.0	37.9	No	3 Boreholes (C63-3 to C63-5)	Appendix C
Highway 69 NBL STA 19+253 (Swamp 15)	3.0	208.6	208.4	3.0	3.0	30.2	Yes (East Side)	2 Boreholes (C63-1 and C63-2) 2 Swamp Boreholes (S15-1 and S15-5)	Appendix C
Highway 69 NBL STA 21+259 (Swamp 13)	3.1	209.9	209.7	3.0	1.8	30.5	No	2 Boreholes (G-3 and G-4) 1 Swamp Borehole (S13-4 that is shared with SBL culvert)	Appendix D
Highway 69 SBL STA 21+270	2.0 (<0.2 m grade raise at centre line and minor widening on east and west sides, i.e. 3 m wide and 1 m high)	209.7	209.6	3.0	1.8	33.9	No	2 Boreholes (G-1 and G-2) 1 Swamp Borehole (S13-4 that is shared with NBL culvert)	Appendix D
Highway 69 SBL STA 10+259 (Swamp 7)	2.0 (< 0.2 m grade cut at the centre of the culvert)	203.9	203.9	3.6	1.5	43.3	No	2 Boreholes (C2-1 and C2-2) 1 Swamp Borehole (Median Borehole S7-2 that is shared with NBL culvert)	Appendix E
Highway 69 NBL STA 10+270 (Swamp 7)	2.0	203.8	203.9	3.6	1.5	32.0	No	2 Boreholes (C3-1 and C3-2) 1 Swamp Borehole (Median Borehole S7-2 that is shared with SBL culvert)	Appendix E



FOUNDATION REPORT CULVERTS - PHASE 1 - HIGHWAY 69 GWP 5403-05-00

Culvert Location (Associated Swamp)	Approximate Proposed Embankment Height (m)	Invert Elevations ¹		Culvert Dimensions ¹			Head Walls	Boreholes/DCPTs	Reference Appendix
		East End of Culvert (m)	West End of Culvert (m)	Width (m)	Height (m)	Length (m)			
Highway 69 NBL STA 10+530 (Swamp 7)	2.0	203.1	203.0	3.6	1.5	38.0	No	2 Boreholes (C6-1 and C6-2 with the median borehole shared with SBL culvert) 1 Swamp Borehole (S7-12)	Appendix F
Highway 69 SBL STA 10+558 (Swamp 7)	2.0	203.0	202.9	3.6	1.5	37.3	No	3 Boreholes (C5-1, C5-2 and C6-1 with the median borehole shared with NBL culvert)	Appendix F
Highway 69 NBL STA 10+974	10.0	194.0	193.9	3.6	3.6	45.4	Yes (Median)	4 Boreholes (includes 1 median borehole that is shared with SBL culvert) (C76-1 to C76-3 and C76-1a)	Appendix G
Highway 69 SBL STA 11+019 (Swamp 6)	8.0	193.9	193.5	3.6	3.6	89.8	Yes (Median)	3 Boreholes (includes 1 median borehole that is shared with NBL culvert) (C76-3 to C76-5)	Appendix G
Site 9 Road STA 12+599	6.0	202.2	200.6	3.0	2.4	26.8	Yes	2 Boreholes (B-1 and B-2)	Appendix A
Site 9 Road STA 13+165	4.0	211.5	210.8	3.0	2.4	25.7	No	2 Boreholes (C-1 and C-2)	Appendix H
Site 9 Road STA 14+045	4.3	207.7	208.3	3.0	2.4	24.8	No	2 Boreholes (E-1 and E-2)	Appendix I
Site 9 Road STA 14+166	3.0	206.2	206.1	3.0	2.1	28.6	No	2 Boreholes (F-1 and F-2)	Appendix J
Site 9 Road STA 16+323 (Swamp 11)	2.3	209.4	209.3	3.0	1.8	28.2	No	1 Borehole (H-1) 2 Swamp Boreholes (S11-3 and S11-4) 1 Swamp DCPT (S11-DC2)	Appendix D
Site 9 Rd STA 17+072 (Swamp 8)	2.0	204.2	204.2	3.6	1.5	25.6	No	3 Swamp Boreholes (S8-12 to S8-14) 2 Swamp Dynamic Cone Penetration Tests (DCPSPB-1 by Trow and S8-DC6)	Appendix K
Site 9 Rd STA 17+488 (Swamp 7)	2.0 (0.6 m grade raise at the centre of the culvert)	202.9	202.8	3.6	1.5	39.6	No	2 Boreholes (C4-1 and C4-2) 1 Swamp Borehole (S7-31)	Appendix L
Site 9 Rd STA 18+034 (Swamp 6)	9.0	193.3	193.1	3.6	3.6	52.6	No	3 Boreholes (C76-6 to C76-8)	Appendix M

Note: ¹ Invert elevations and culvert dimensions as provided by MMM.

Prepared by: EC
Checked by: AB



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

CONT No.
 GWP No. 5403-05-00



HIGHWAY 69
 SITE LOCATION PLAN

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



REFERENCE
 Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Datum : NAD 83 Projection : MTM Zone 10

NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. AB	CHKD. AB	DATE: JAN 2013
DRAWN: JUL	CHKD. AB	APPD. JMAC
		DWG. 1

METRIC

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

CONT No.
WP No. 5403-05-00

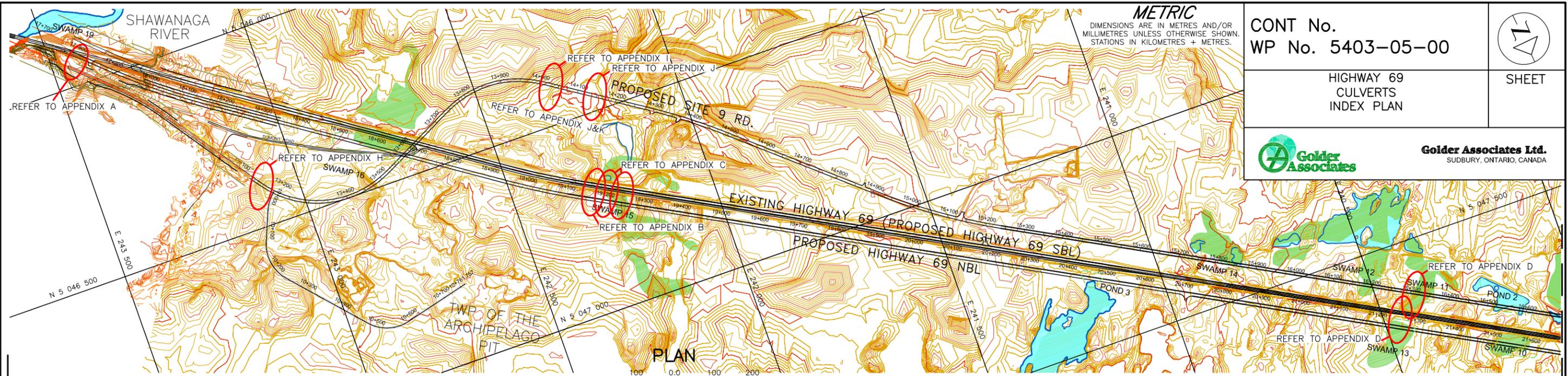


HIGHWAY 69
CULVERTS
INDEX PLAN

SHEET



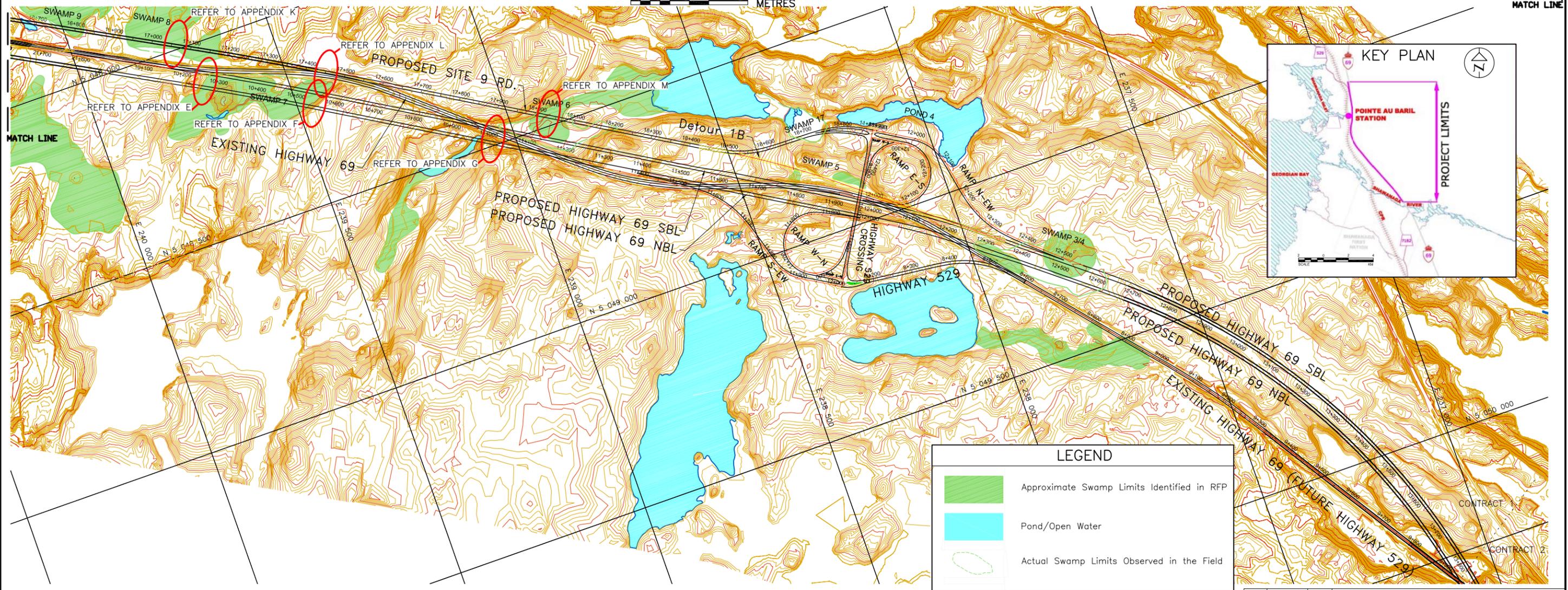
Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



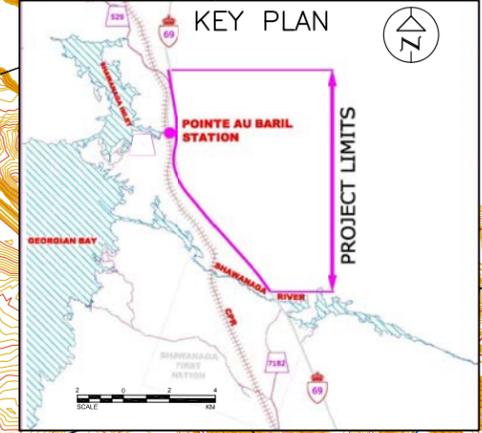
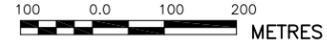
PLAN



MATCH LINE



PLAN



KEY PLAN



LEGEND	
	Approximate Swamp Limits Identified in RFP
	Pond/Open Water
	Actual Swamp Limits Observed in the Field

REFERENCE	
Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 5403-05-00 Design.dwg (received Oct. 2008) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008)	

NO.	DATE	BY	REVISION

Geocres No. 41H-79		PROJECT NO. 07-1191-0020		DIST.	
HWY. 69	CHKD. AB	DATE: JAN 2013	SITE:		
SUBM'D. AB	CHKD.	APPD. JMAC	DWG. 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
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d :

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

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

Piezo-Cone Penetration Test (CPT)

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

V. MINOR SOIL CONSTITUENTS

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

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

(b) Cohesive Soils Consistency

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

IV. SOIL TESTS

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

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



LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

Notes: 1
2

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

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



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.

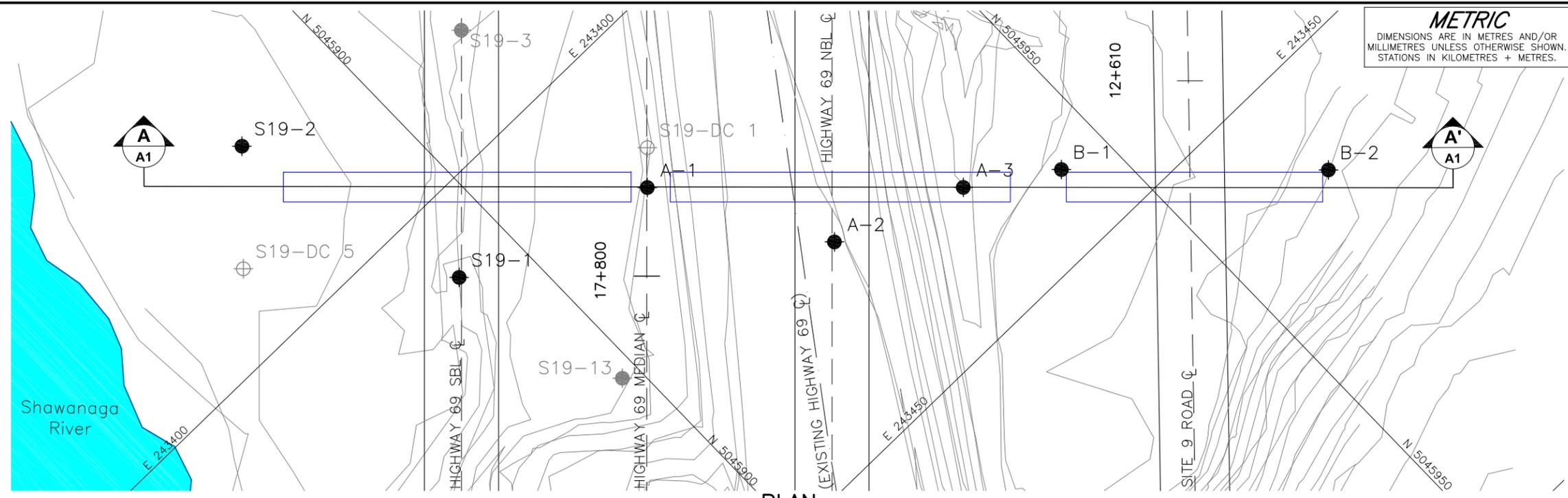
Abbreviations

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	



APPENDIX A

Highway 69 NBL STA 17+809 and SBL STA 17+809 (Swamp 19)
Site 9 Road STA 12+599



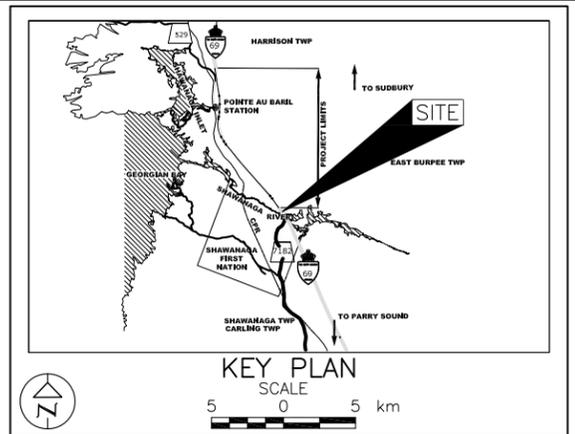
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CONT No.
WP No. 5403-05-00

HIGHWAY 69
CULVERT AT STA. 17+809 (HWY 69)
AND 12+599 (SITE 9 RD.)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

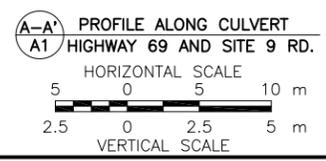
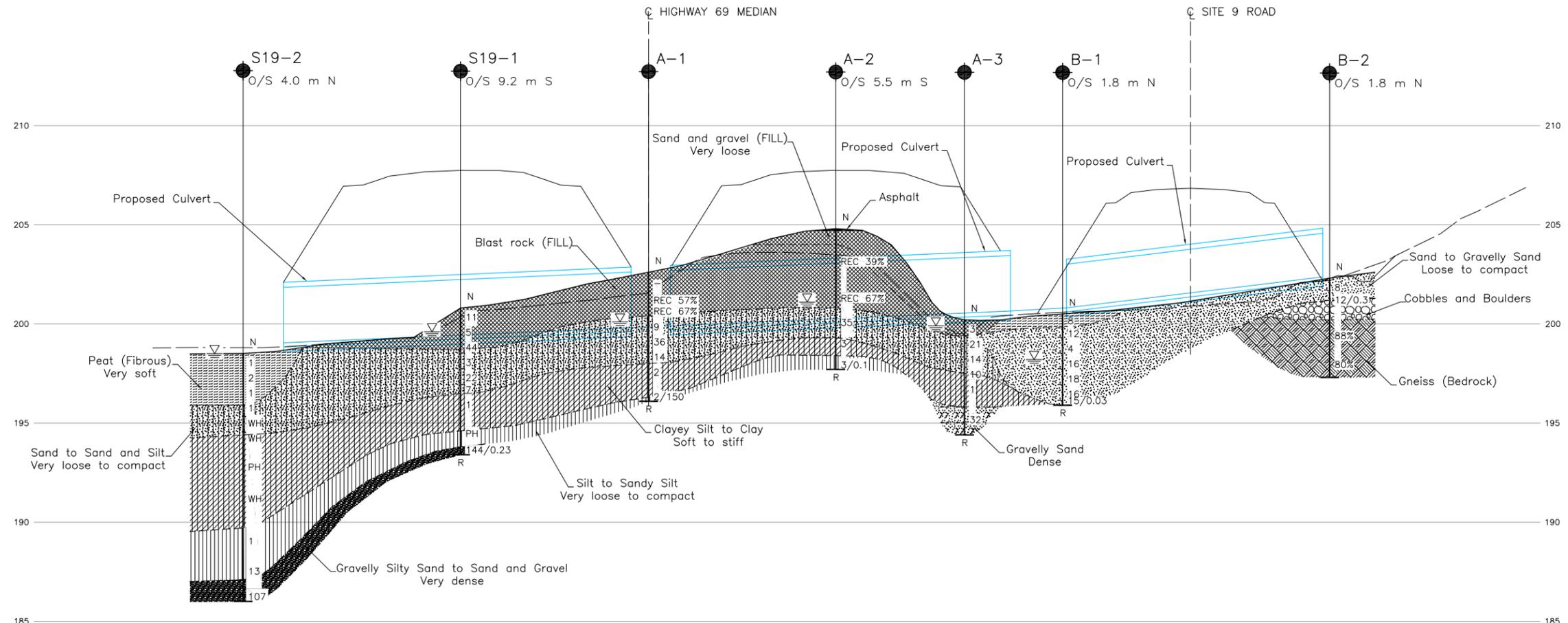


LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
A-1	202.6	5045913.4	243414.3
A-2	204.8	5045923.2	243431.4
A-3	200.2	5045936.4	243436.5
B-1	200.5	5045944.8	243442.1
B-2	202.3	5045964.2	243460.9
S19-1	200.8	5045893.4	243407.6
S19-2	198.5	5045886.8	243382.8



NOTES

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

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

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

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: -
		DWG. A1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No A-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5045913.4; E 243414.3</u>	ORIGINATED BY <u>EHS</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>108mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>May 5 and 6, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	GR	SA
						20	40	60	80	100									
202.6	GROUND SURFACE																		
0.0	Blast rock, trace sand and gravel (FILL)		1	AS	-													30 59 (11)	
200.4																			
2.2	SAND to SAND and SILT, trace to some gravel Loose to dense Brown Wet		2	SS	9														
198.0																			
4.6	SILTY CLAY Soft to firm Brown Wet		5	SS	2														
196.3																			
6.5	SILT, some sand, trace clay Loose Grey Wet END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING) Note: 1. Water level at a depth of 2.5 m below ground surface (Elev. 200.1 m) upon completion of drilling.		6a 6b	SS	2/150														

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No A-3	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5045936.4; E 243436.5</u>	ORIGINATED BY <u>EC</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>July 27, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
200.2	GROUND SURFACE																		
0.0	Sand, trace to some gravel (FILL) Very loose Brown Moist to wet		1	SS	3	▽													
199.4																			
0.8	Silty SAND, trace to some clay Compact Brown and grey Moist to wet		2	SS	21														
			3	SS	14														
			4	SS	10														
197.5	CLAY Firm to stiff Grey Wet		5	SS	1														
2.7																			
195.8	Gravelly SAND, trace to some silt Dense Brown to grey Wet		6	SS	32														
4.4																			
194.4	END OF BOREHOLE NO FURTHER CASING PENETRATION																		
5.8	Note: 1. Water level at a depth of 0.3 m below ground surface (Elev. 199.9 m) upon completion of drilling.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT 07-1191-0020 **RECORD OF BOREHOLE No B-1** 1 OF 1 **METRIC**
 W.P. 5403-05-00 LOCATION N 5045944.8; E 243442.1 ORIGINATED BY EC
 DIST HWY 69 BOREHOLE TYPE 108mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY EC
 DATUM Geodetic DATE May 9, 2011 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60		GR SA SI CL	
200.5	GROUND SURFACE															
0.0	Sandy PEAT (Fibrous) Firm Black and brown Moist		1	SS	8											
199.8																
0.7	SAND to Gravelly SAND, trace to some silt, trace clay Loose to compact Brown to grey Moist		2	SS	12											
	A 0.4 m thick silty clay seam was encountered at 1.8 m depth.		3a	SS	4											
			3b													
			4	SS	16											
			5	SS	18										14 68 15 3	
			6	SS	16											
195.9	END OF BOREHOLE SPOON REFUSAL		7	SS	16/0.03											
4.6	Note: 1. Water level at a depth of 2.3 m below ground surface (Elev. 198.2 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No B-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5045964.2; E 243460.9</u>	ORIGINATED BY <u>EC</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>108mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>May 9, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
202.3	GROUND SURFACE															
0.0	SAND, slightly organic, some gravel Loose to compact Brown Moist		1	SS	8											
201.2			2	SS	12/0.3											
1.1	COBBLES and BOULDERS															
200.2																
2.1	GNEISS (BEDROCK)															
	Bedrock cored from 2.1 m depth to 5.0 m depth. For coring details see Record of Drillhole B-2.		1	RC	REC 100%										RQD = 88%	
			2	RC	REC 100%										RQD = 80%	
197.3																
5.0	END OF BOREHOLE															
	Note: 1. Borehole dry upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: B-2

SHEET 1 OF 1

LOCATION: N 5045964.2 ; E 243460.9

DRILLING DATE: May 9, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION	
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja				Ln
							⊗	⊗			⊗	⊗	⊗	⊗	⊗				⊗
		REFER TO PREVIOUS PAGE		200.2															
3	NW	GNEISS Fine to medium grained Fresh Very strong Pinkish grey		2.1	1														
4	NQ Coring May 9, 2011				2													UCS = 140 MPa	
5		END OF DRILLHOLE		197.3															
5.0																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

DEPTH SCALE

1 : 50



LOGGED: EC

CHECKED: AB

RECORD OF BOREHOLE No S19- 1 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5045893.4; E 243407.6 ORIGINATED BY MR

DIST HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers, HW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE February 9 and 10, 2009 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
											○ UNCONFINED	+				
											● QUICK TRIAXIAL	×				
											WATER CONTENT (%)					
											20	40	60			
200.8	GROUND SURFACE															
0.0	Sand to silty sand, trace gravel, trace organics (FILL) Loose to dense Brown Moist		1	SS	11											
	Wood fragments from 1.7 m depth to 2.1 m depth.		2	SS	5											
198.7			3	SS	44											1 77 (22)
2.1	SILT, some clay, trace sand, trace organics (FILL) Very loose Grey Wet		4	SS	3											
197.8																
3.0	SAND, trace to some silt Compact Grey Wet		5	SS	22											
197.1																
3.7	SILT, some sand, trace to some clay Loose Grey Wet		6	SS	7											0 15 75 10
196.5																
4.3	CLAY Soft Grey Wet		7	SS	1											
194.6																
6.2	SILT, some sand, trace clay Grey Wet		8	TO	PH											
193.8																
193.4	SAND and GRAVEL Very dense Grey Wet		9	SS	144/0.23											
7.4	END OF BOREHOLE SPOON REFUSALE (HAMMER BOUNCING)															
	Note: 1. Water level at a depth of 1.2 m below ground surface (Elev. 199.6 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No S19-2 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5045886.8; E 243382.8 ORIGINATED BY MR

DIST HWY 69 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY AW

DATUM Geodetic DATE February 4, 2009 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
198.5	GROUND SURFACE																		
0.0	PEAT (Fibrous) Very soft Black Moist		1	SS	1														
			2	SS	2														
			3	SS	1														
			4	SS	1														
195.9	SAND and SILT, trace to some clay Very loose Grey Wet		5	SS	WH														
			6	SS	WH														
194.4	SILTY CLAY Soft Grey Wet		7	TO	PH														
			8	SS	WH														
			9	SS	1														
189.7	Sandy SILT, trace to some clay Very loose to compact Grey Wet		10	SS	13														
			11	SS	107														
187.1	Gravelly silty SAND, trace clay Very dense Grey Wet																		
186.0	END OF BOREHOLE																		
12.5	Note: 1. Water level at ground surface (Elev. 198.5 m) upon completion of drilling.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

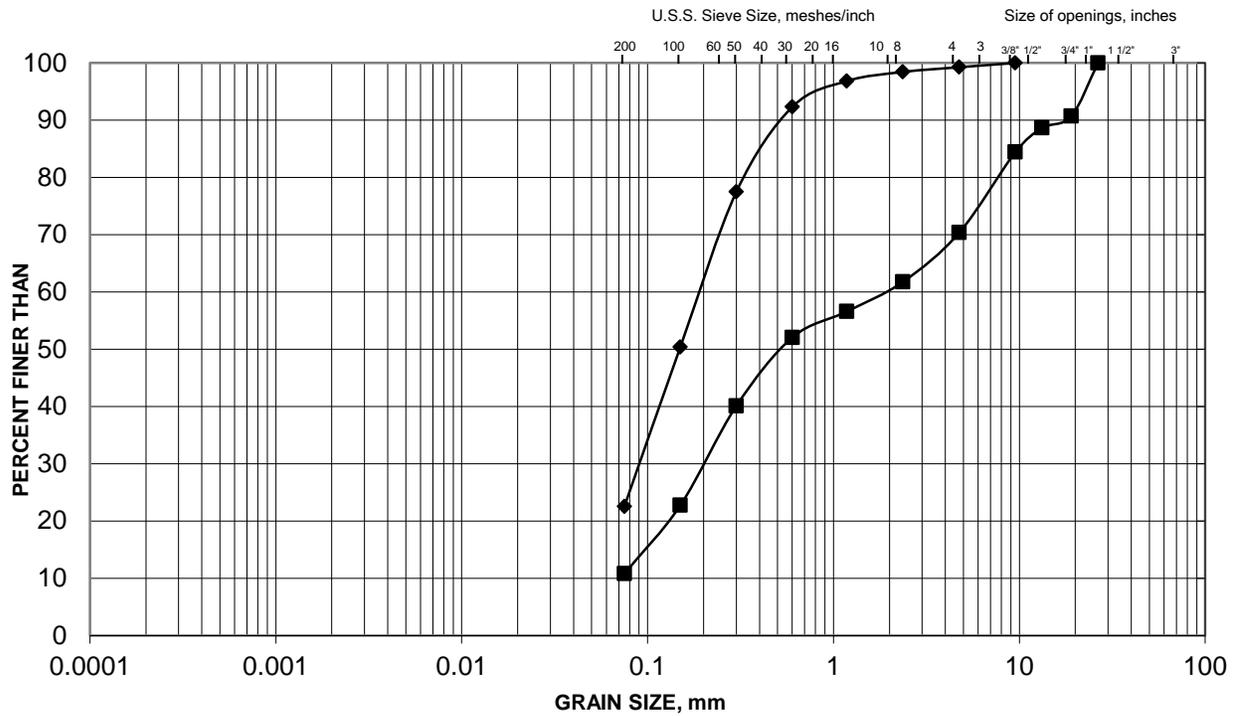
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

**Sand and Gravel (FILL)
Highway 69 NBL and SBL STA 17+809**

FIGURE

A1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	S19-1	3	199.1
■	A-1	1	202.2

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

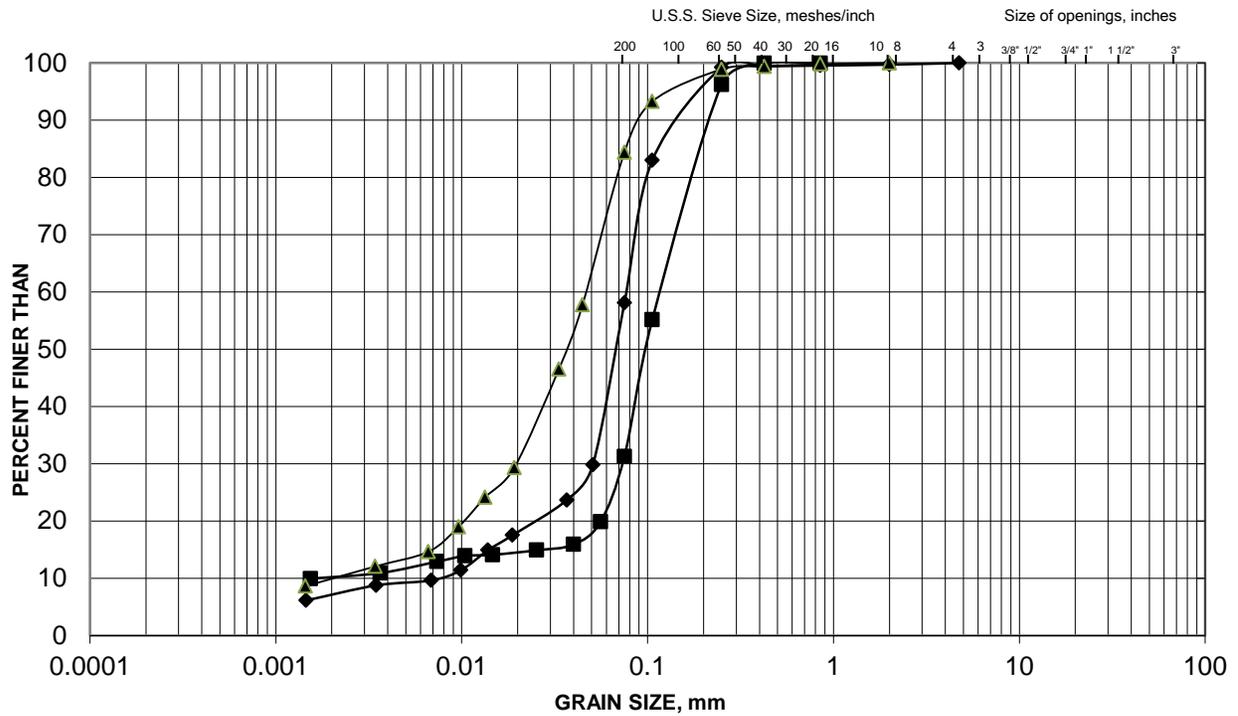
Date: January 2013

GRAIN SIZE DISTRIBUTION

Silty Sand to Silt (Upper)
Highway 69 NBL and SBL STA 17+809

FIGURE

A2



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

LEGEND

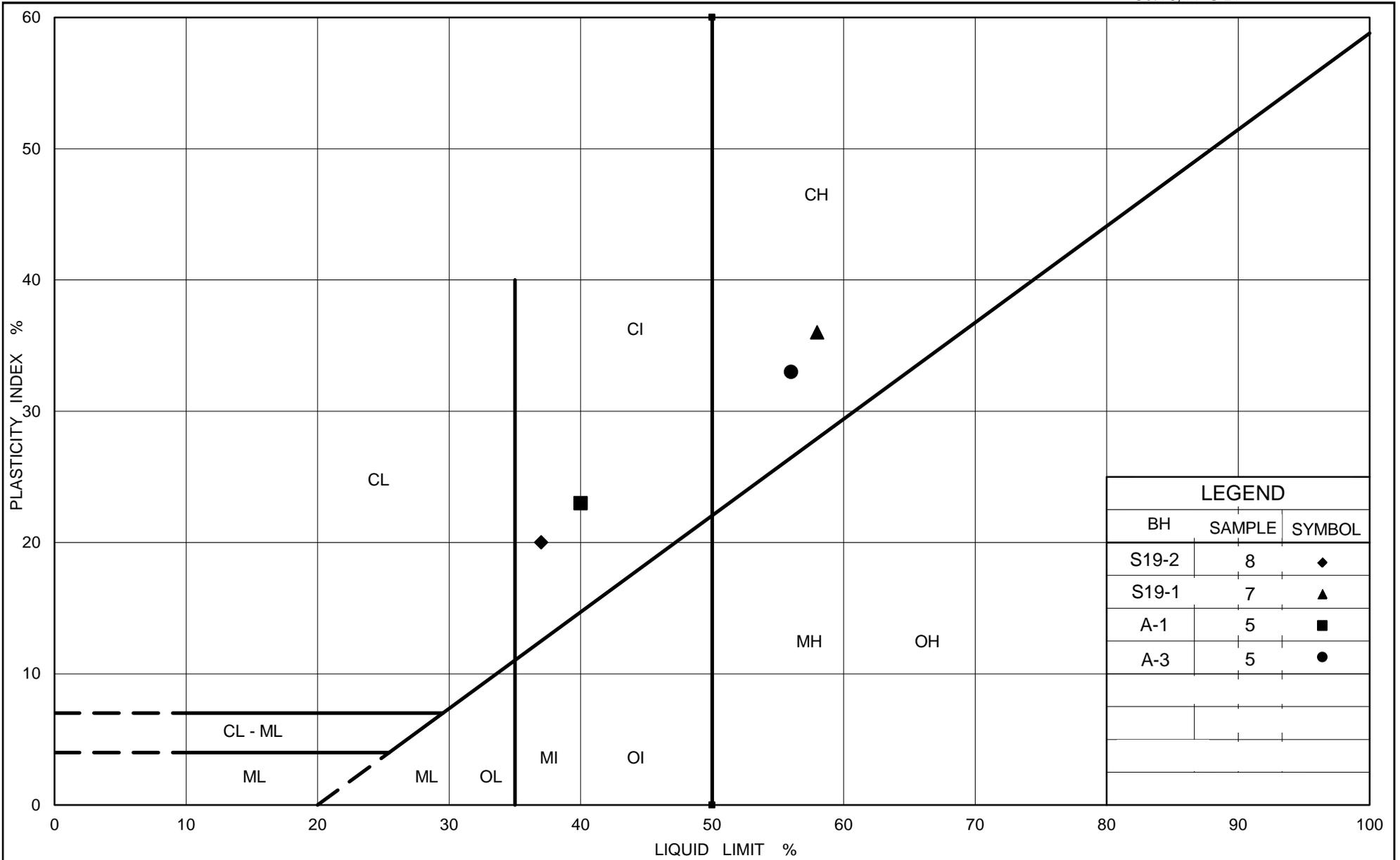
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	S19-2	5	195.1
■	A-3	3	198.4
▲	S19-1	6	196.9

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

Date: January 2013

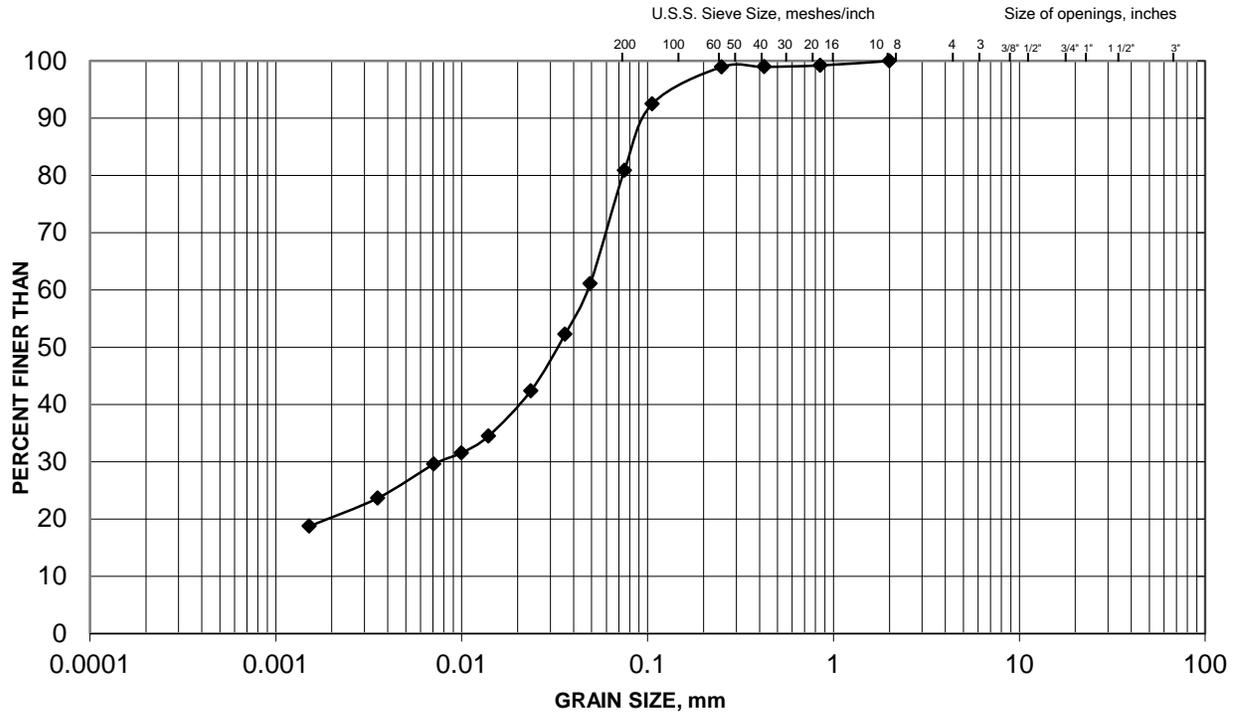


GRAIN SIZE DISTRIBUTION

FIGURE

**Clayey Silt
Highway 69 NBL and SBL STA 17+809**

A4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	A-2	4	199.2

Project Number: 07-1191-0020-C1
Checked By: EC/AB

Golder Associates

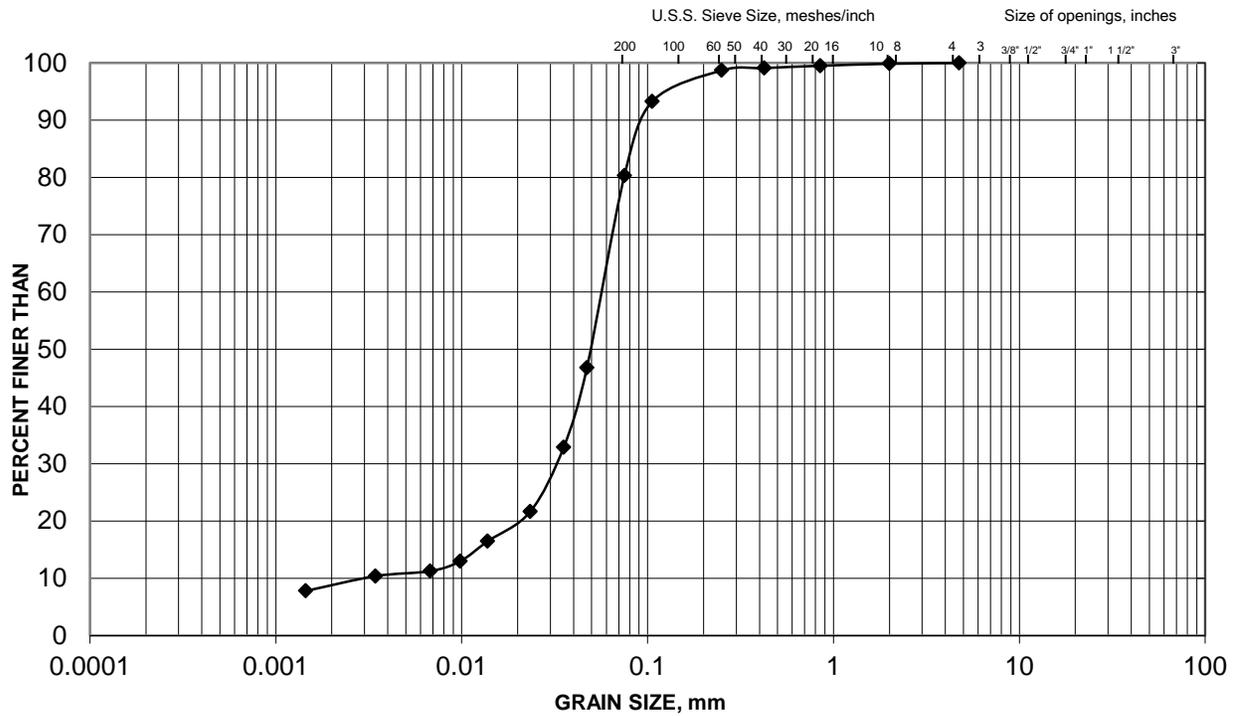
Date: January 2013

GRAIN SIZE DISTRIBUTION

Sandy Silt
Highway 69 NBL and SBL STA 17+809

FIGURE

A5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	S19-2	9	189.2

Project Number: 07-1191-0020-C1
 Checked By: EC/AB

Golder Associates

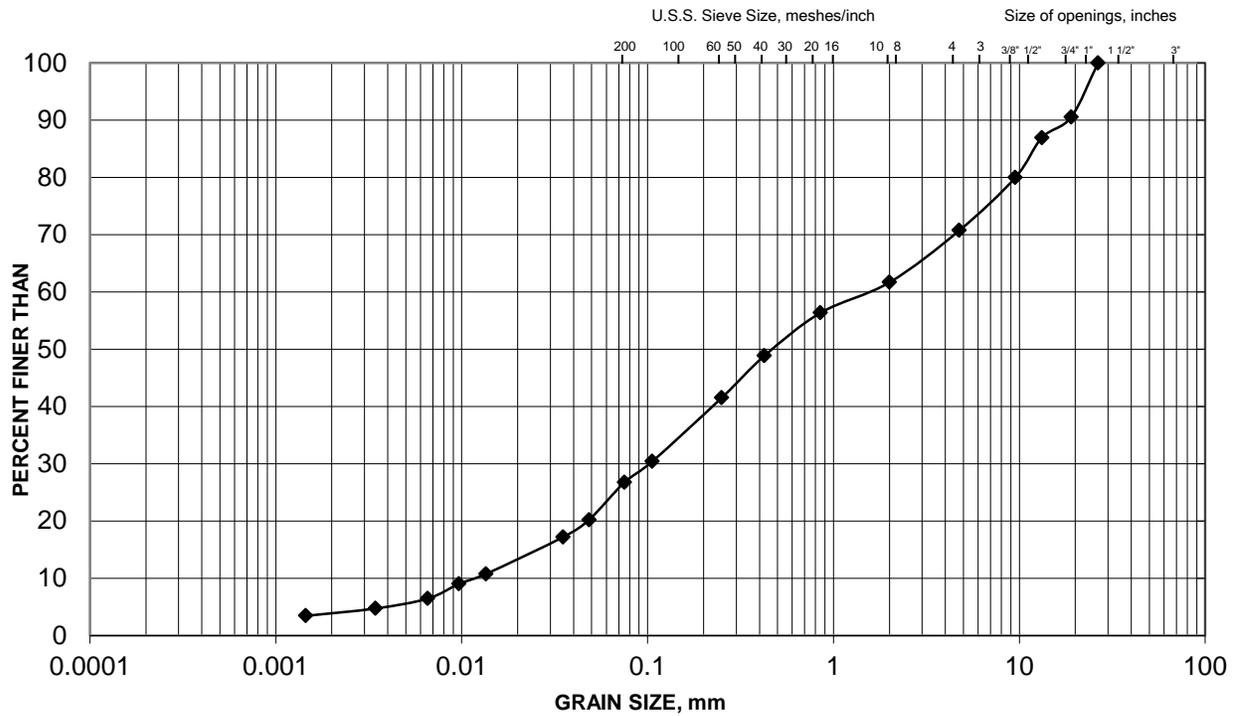
Date: January 2013

GRAIN SIZE DISTRIBUTION

FIGURE

**Gravelly Silty Sand
Highway 69 NBL and SBL STA 17+809**

A6



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	S19-2	11	186.2

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

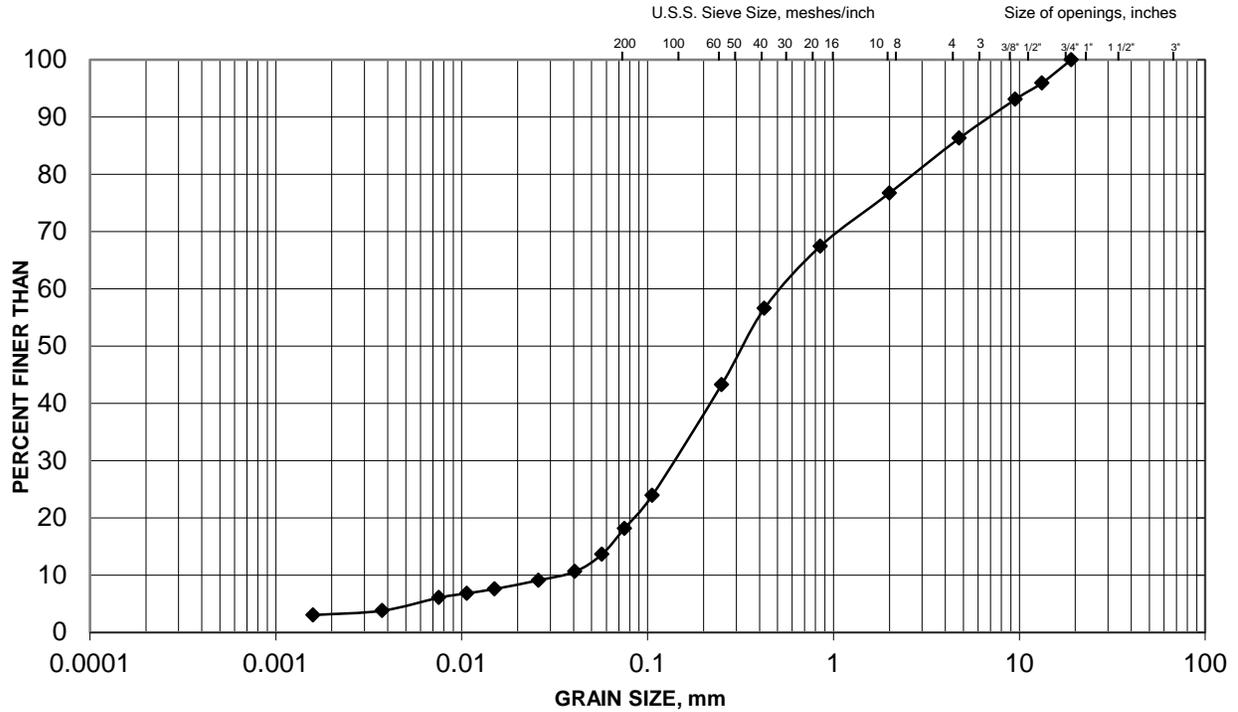
Date: January 2013

GRAIN SIZE DISTRIBUTION

Sand to Gravelly Sand
Site 9 Road STA 12+599

FIGURE

A7



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

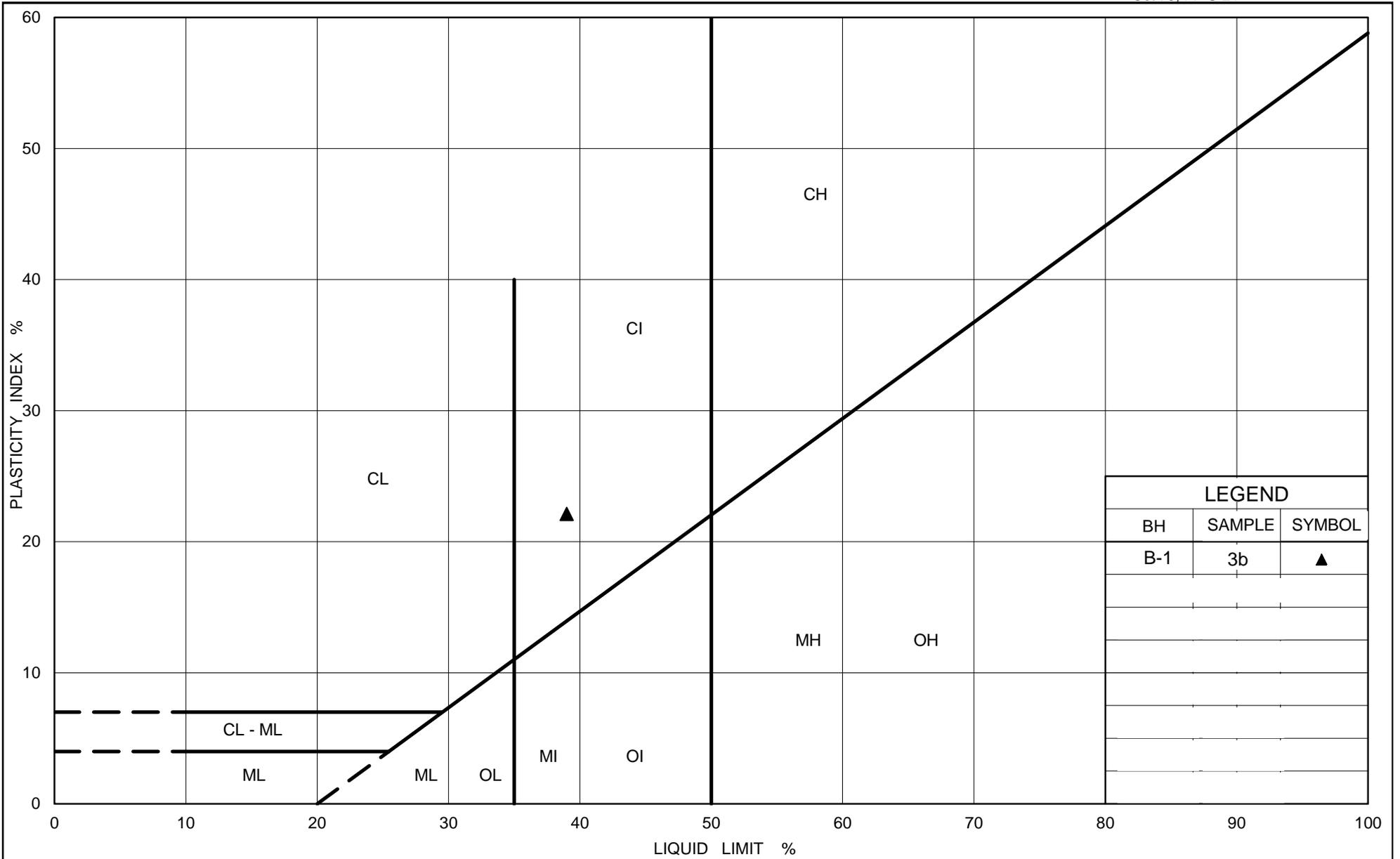
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	B1	5	197.1

Project Number: 07-1191-0020-C1
Checked By: EC/AB

Golder Associates

Date: January 2013





APPENDIX B

Highway 69 NBL and SBL STA 19+190

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

CONT No.
WP No. 5133-12-02 & -03

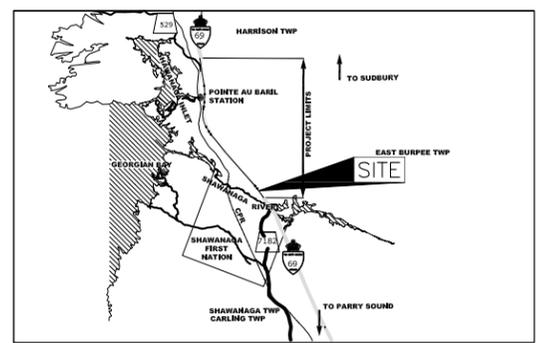


HIGHWAY 69
CULVERT AT STA. 19+190
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



KEY PLAN
SCALE
5 0 5 km

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
D-1	208.7	5046669.7	242266.1
D-2	213.1	5046689.2	242276.7
D-3	209.2	5046703.1	242284.1
D-4	209.5	5046718.4	242292.4
D-5	209.7	5046732.1	242299.8

NOTES

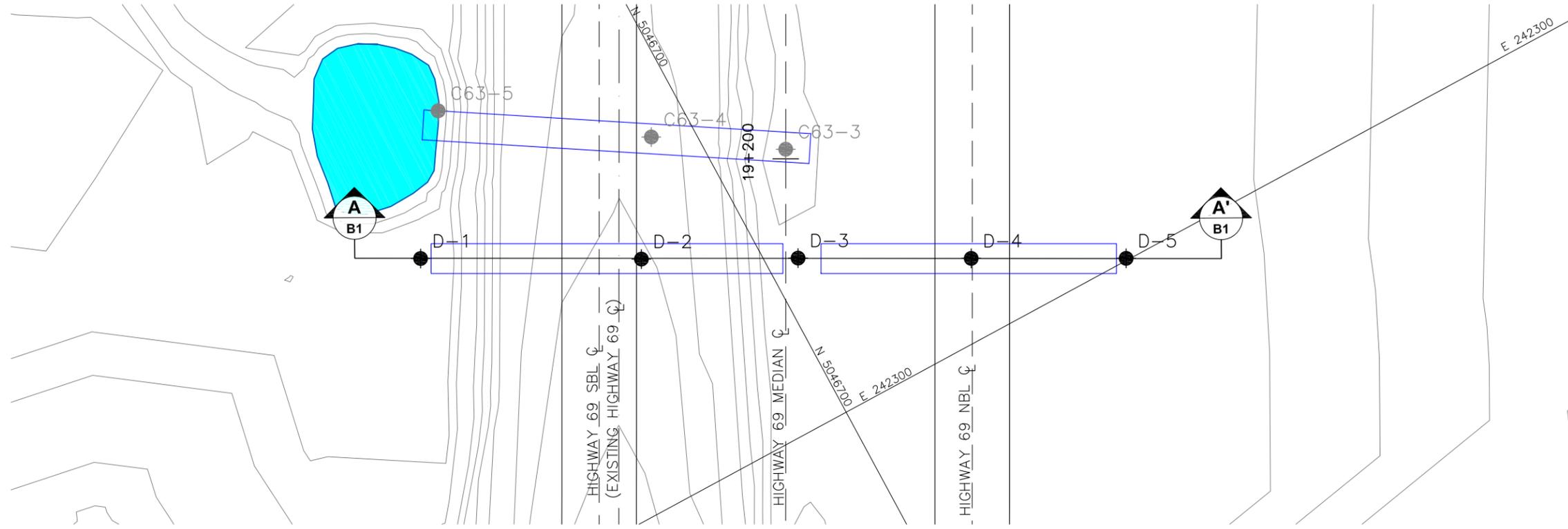
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

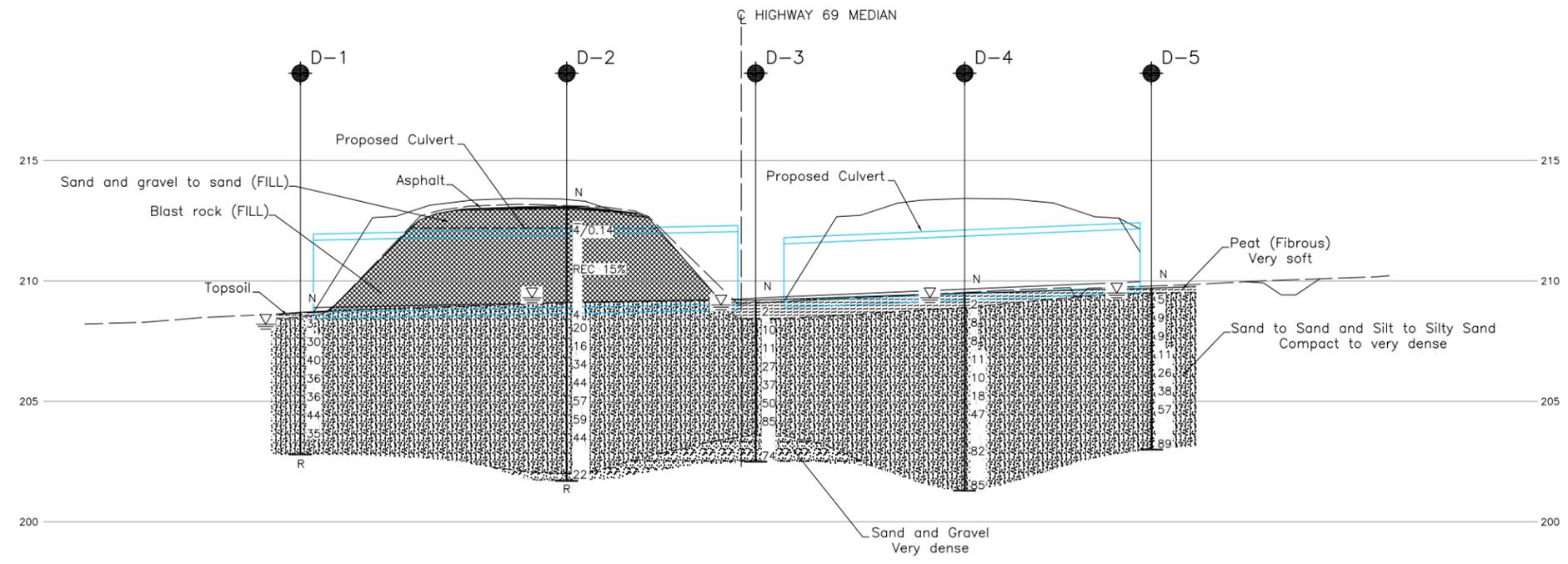
REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)



PLAN

SCALE
5 0 5 10 m



A-A' PROFILE ALONG CULVERT
HIGHWAY 69

HORIZONTAL SCALE
5 0 5 10 m
VERTICAL SCALE
2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: J.J.L.	CHKD.	APPD. JMAC
		SITE: 44-582/C2
		DWG. B1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No D-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046669.7; E 242266.1</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 22, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
208.7	GROUND SURFACE																		
0.0	TOPSOIL Brown Moist		1	SS	3														
0.2	SAND slightly organic Very loose Brown Moist		2	SS	30														
207.9	SAND to SAND and SILT, trace gravel Dense Grey Wet		3	SS	40														
0.8			4	SS	36														
			5	SS	36														
			6	SS	44														
			7	SS	35														
202.8	END OF BOREHOLE CASING REFUSAL																		
5.9	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 208.2 m) upon completion of drilling.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No D-3	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046703.1; E 242284.1</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 17, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
209.2	GROUND SURFACE																		
0.0	PEAT (Fibrous) Very soft Black Wet		1	SS	2														
208.4	Silty SAND to SAND, trace clay Compact to very dense Brown Wet		2	SS	10														0 78 20 2
0.8			3	SS	11														
			4	SS	27														
			5	SS	37														
			6	SS	50														
			7	SS	85														
203.6	SAND and GRAVEL Very dense Grey Wet		8	SS	74														
202.5																			
6.7	END OF BOREHOLE Note: 1. Water level at a depth of 0.2 m below ground surface (Elev. 209.0 m) upon completion of drilling.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No D-5	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046732.1; E 242299.8</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 16, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100	20	40	60		GR	SA	SI	CL
209.7	GROUND SURFACE																	
0.0	PEAT (Fibrous) Black Wet		1	SS	5													
0.2	SAND, trace silt Loose to very dense Brown to grey Wet		2	SS	9													
			3	SS	9													
			4	SS	11													
			5	SS	26													
			6	SS	38													
			7	SS	57													
			8	SS	89													
203.0	END OF BOREHOLE																	
6.7	Note: 1. Water level at a depth of 0.2 m below ground surface (Elev. 209.5 m) upon completion of drilling.																	

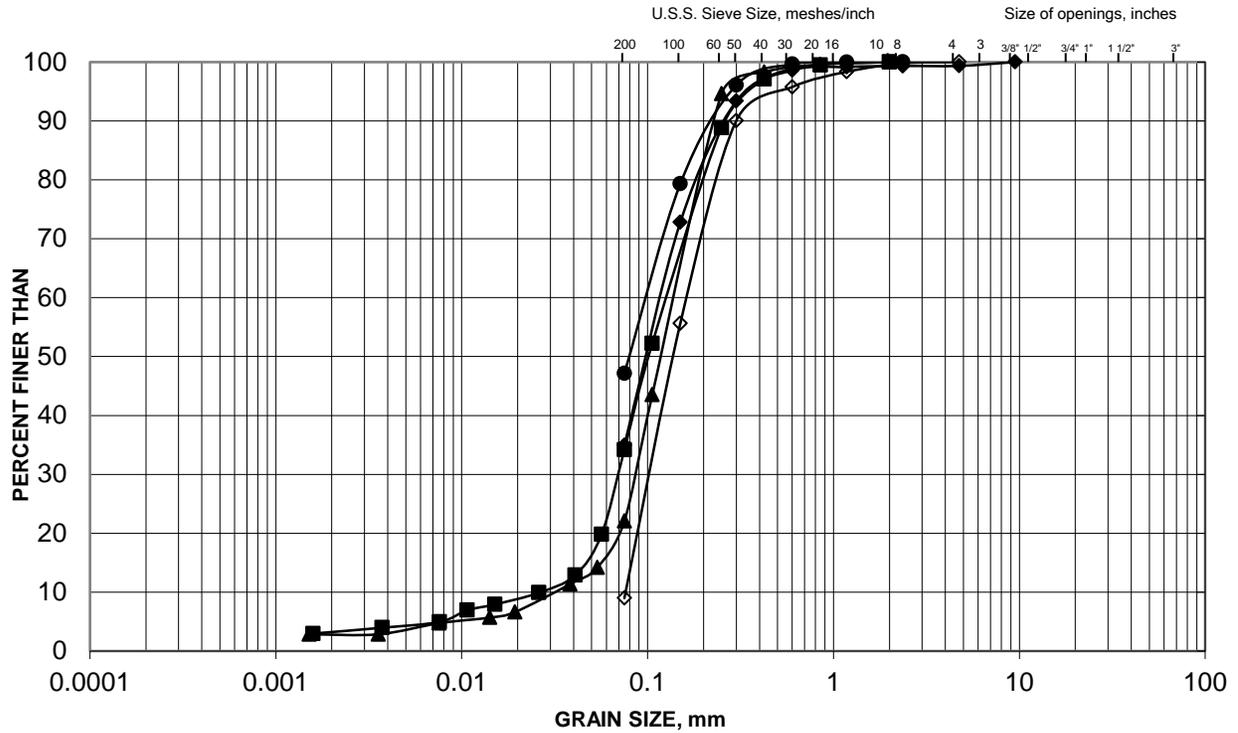
SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION

**Sand to Sand and Silt
Highway 69 NBL and SBL STA 19+190**

FIGURE

B1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	D-1	5	205.3
■	D-2	7	205.9
▲	D-3	2	208.1
●	D-4	4	206.9
◇	D-5	3	207.9

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

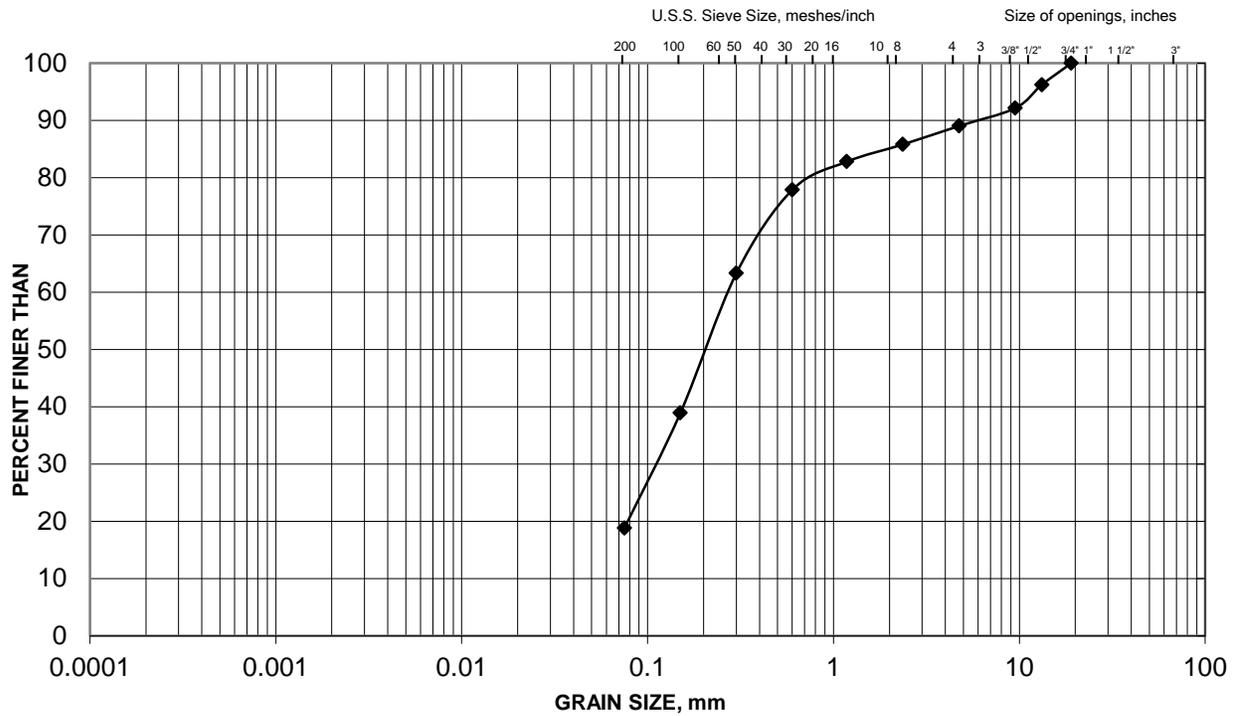
Date: January 2013

GRAIN SIZE DISTRIBUTION

FIGURE

**Sand (Fill)
Highway 69 NBL and SBL STA 19+190**

B2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—◆—	D-2	1	212.6

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

Date: January 2013



APPENDIX C

Highway 69 SBL STA 19+202 and NBL STA 19+253 (Swamp 15)

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

CONT No.
 WP No. 5133-12-05

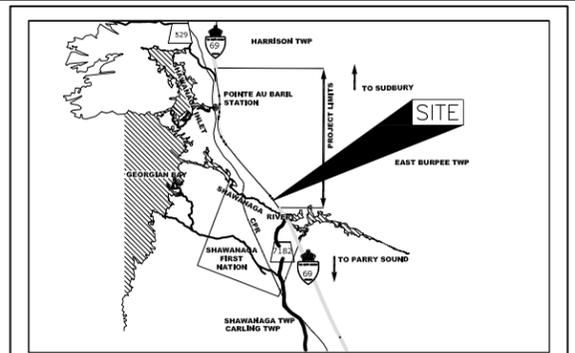


HIGHWAY 69
 CULVERT AT STA. 19+202 (SBL)
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



KEY PLAN
 SCALE 0 5 km

LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C63-3	209.3	5046707.2	242273.9
C63-4	212.7	5046695.9	242266.4
C63-5	208.2	5046678.3	242253.9

NOTES

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

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

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

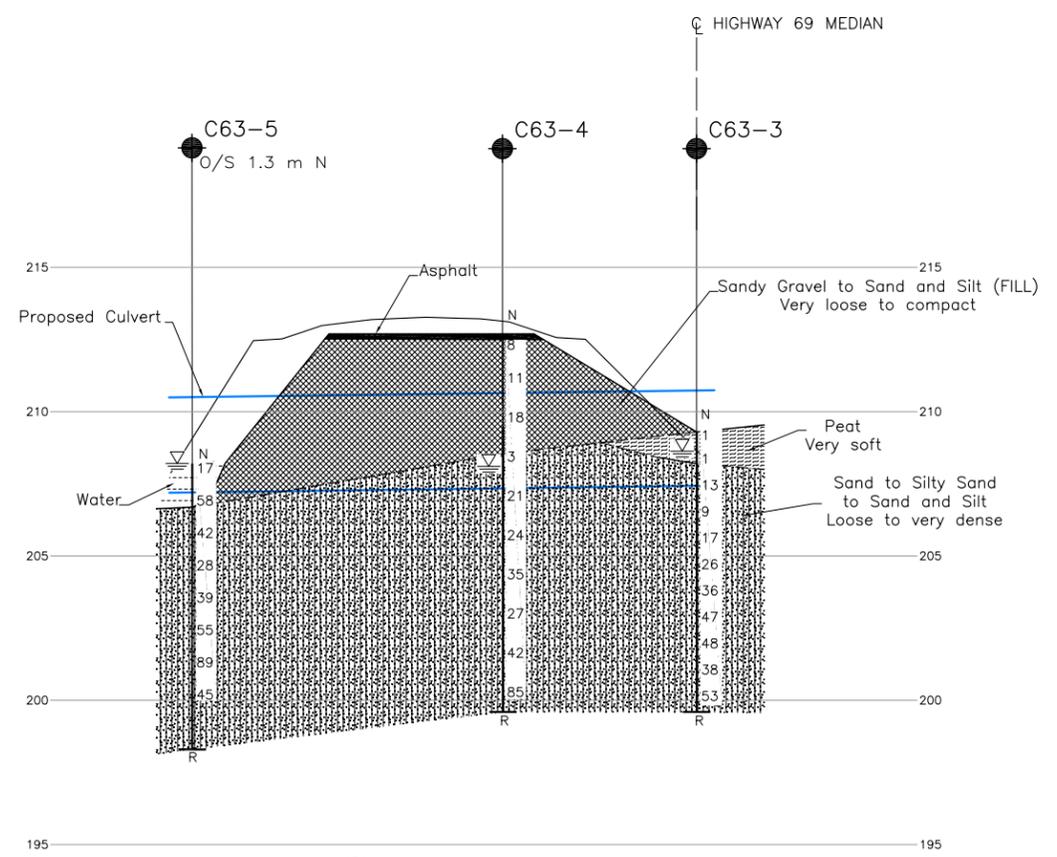
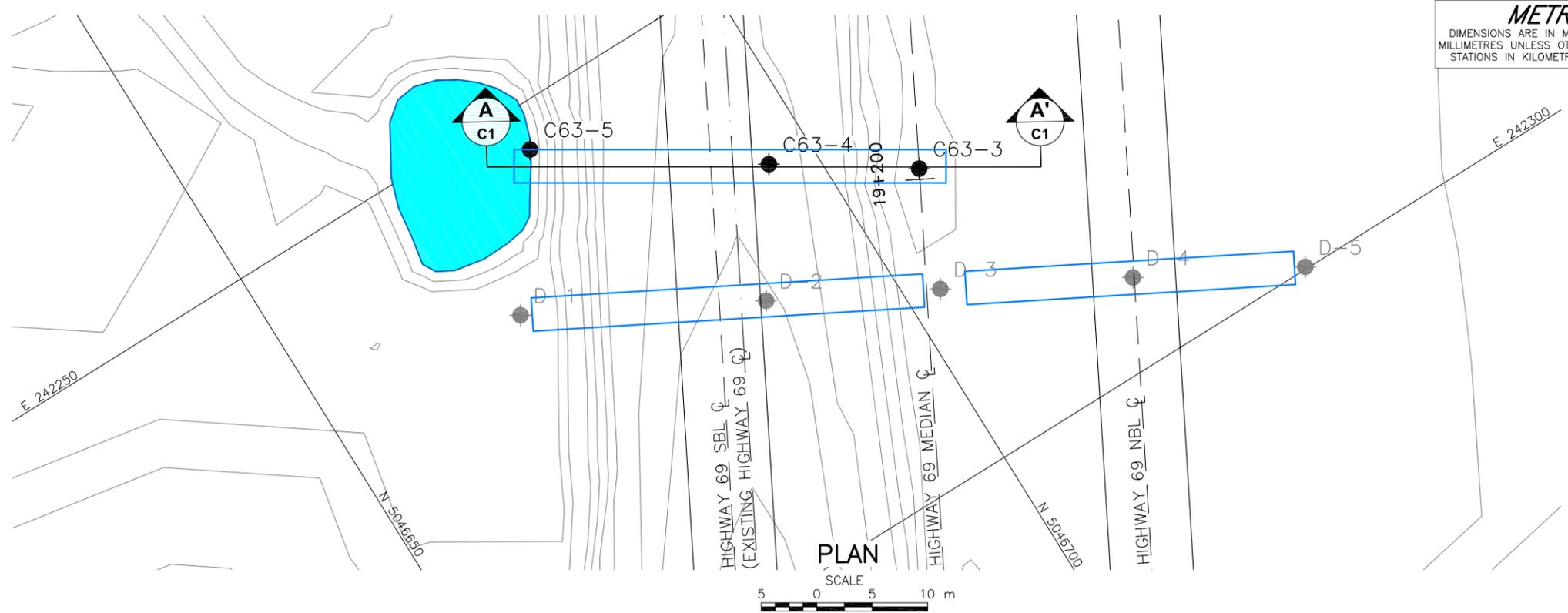
REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. Plan & XS CV 109 & CV 110.dwg (received February 29, 2012)

NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-583/C2
		DWG. C1



PROFILE ALONG CULVERT
 HIGHWAY 69
 HORIZONTAL SCALE 0 5 10 m
 VERTICAL SCALE 0 2.5 5 m



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

CONT No.
WP No. 5133-12-04

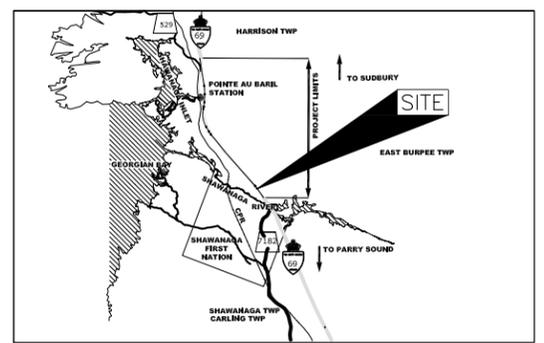


HIGHWAY 69
CULVERT AT STA. 19+253 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

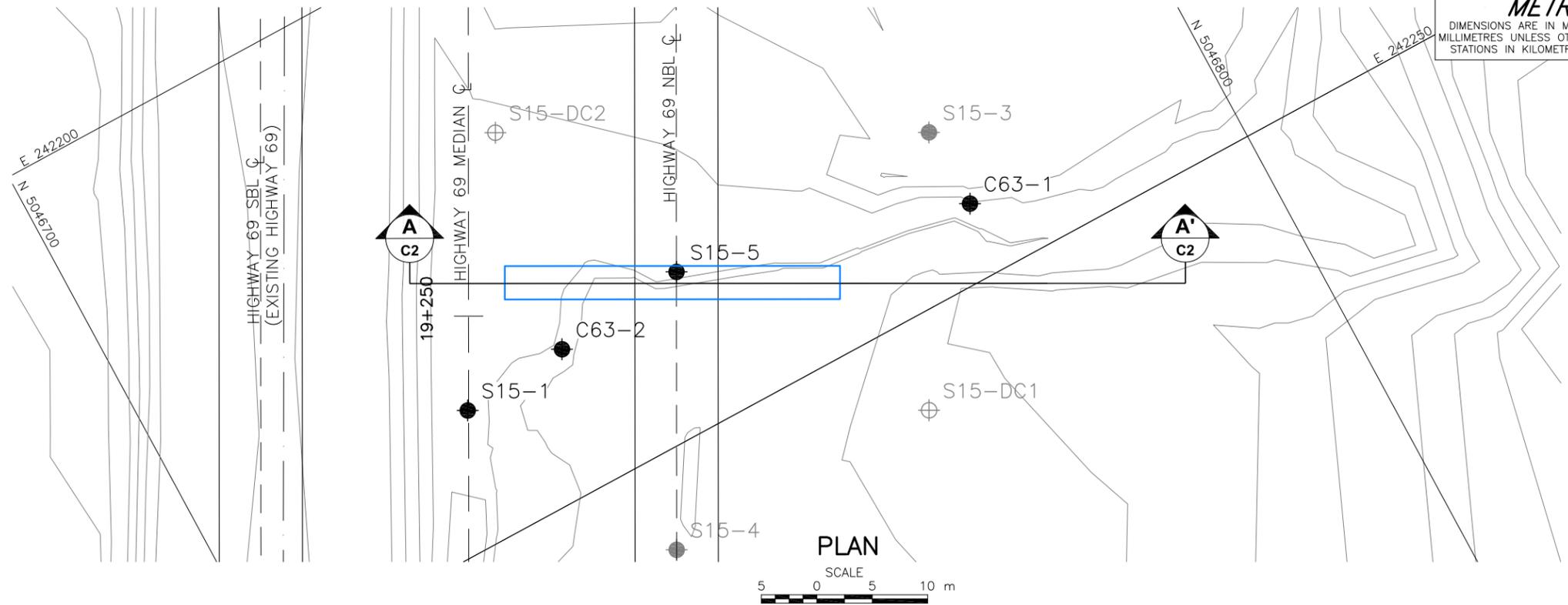
SHEET



Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



KEY PLAN
SCALE 1:50,000
5 0 5 km



LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C63-1	210.3	5046775.1	242243.4
C63-2	209.6	5046736.5	242237.4
S15-1	209.5	5046726.4	242238.2
S15-5	209.5	5046748.9	242236.2

NOTES

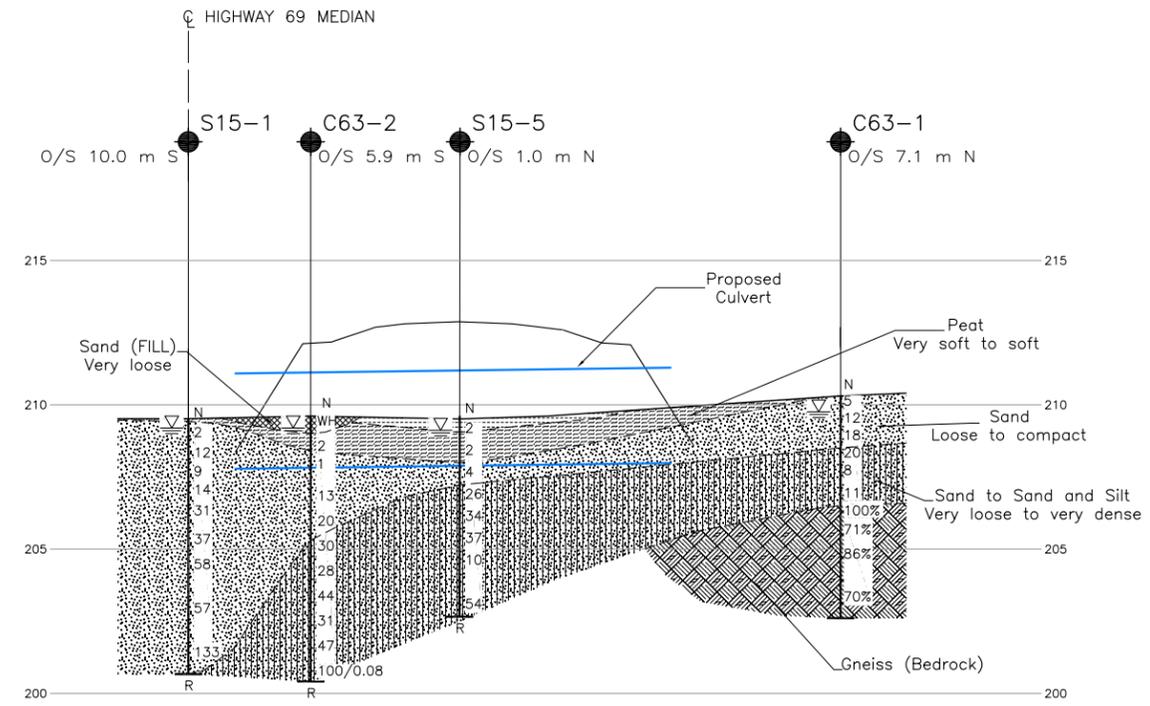
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. Plan & XS CV 109 & CV 110.dwg (received February 29, 2012).



A-A' PROFILE ALONG CULVERT
HIGHWAY 69
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:100



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-583/C1
		DWG. C2

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C63-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046775.1; E 242243.4</u>	ORIGINATED BY <u>TDM</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment NW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 8, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60
210.3 0.0	GROUND SURFACE SAND, trace to some silt Loose to compact Brown to grey Moist to wet		1	SS	5	▽	210												0 92 (8)	
			2	SS	12		209													0 82 18 0
208.5			3	SS	18		208													
206.5 1.8	SAND and SILT, trace to some gravel, trace clay Loose to compact Brown to grey Moist to wet		4	SS	20		207												16 37 46 1	
			5	SS	8		206													
			6	SS	11		205													
206.5 3.8	GNEISS (BEDROCK) Bedrock cored from 3.8 m to 7.7 m depth. For coring details refer to Record of Drillhole C63-1.		1	RC	REC 100%		204												RQD = 100%	
			2	RC	REC 92%		206													RQD = 71%
			3	RC	REC 100%		205													RQD = 86%
			4	RC	REC 100%		204													RQD = 70%
202.6 7.7	END OF BOREHOLE Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 209.8 m) upon completion of drilling.						203													

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C63-1

SHEET 1 OF 1

LOCATION: N 5046775.1 ;E 242243.4

DRILLING DATE: November 8, 2008

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: OGS Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w/EL. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²
							FLUSH	UN			ST	IR	Ir	Ja	Jn	10 ⁰	10 ¹				10 ²		
		Refer to Previous Page		206.5																			
4		GNEISS Fine grained Slightly weathered Strong Grey		3.8	1																		
5					2																		
6					3																		
7					4																		
8		END OF DRILLHOLE		202.6																			
9				7.7																			
10																							
11																							
12																							
13																							

DEPTH SCALE

1 : 50



LOGGED: TDM

CHECKED: AB

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C63-3	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046707.2; E 242273.9</u>	ORIGINATED BY <u>TDM</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment NW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 9, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)			
						20	40	60	80	100	20	40	60		GR	SA	SI	CL		
209.3	GROUND SURFACE																			
0.0	PEAT (Fibrous) Very soft Black Moist to wet		1	SS	1	∇														
208.2			2	SS	1															
1.1	SAND to SAND and SILT, trace clay Loose to very dense Brown to grey Wet		3	SS	13															0 88 12 0
			4	SS	9															0 78 22 0
			5	SS	17															0 67 33 0
			6	SS	26															
			7	SS	36															
			8	SS	47															
			9	SS	48															0 69 30 1
			10	SS	38															
			11	SS	53															
199.6	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)																			
9.7	Note: 1. Water level at a depth of 0.7 m below ground surface (Elev. 208.6 m) upon completion of drilling.																			

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No C63-4 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5046695.9; E 242266.4 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE November 12, 2008 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
212.7	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sandy gravel (FILL) Brown Moist															
211.9																
0.8	Sand to sand and silt, trace clay, trace gravel (FILL) Very loose to compact Brown Moist		1	SS	8						○				3	81 (16)
			2	SS	11											
			3	SS	18										1	64 34 1
			4	SS	3						○					
208.6																
4.1	SAND and SILT to Silty SAND, trace clay Compact to very dense Grey Wet		5	SS	21										0	60 37 3
			6	SS	24						○					
			7	SS	35						○				0	67 32 1
			8	SS	27											
			9	SS	42											
			10	SS	85						○				0	77 23 0
199.6																
13.1	END OF BOREHOLE AUGER REFUSAL															
	Note: 1. Water level at a depth of 4.6 m below ground surface (Elev. 208.1 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-0100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No C63-5 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5046678.3; E 242253.9 ORIGINATED BY TDM

DIST HWY 69 BOREHOLE TYPE Portable Equipment NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE November 11, 2008 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
208.2 0.0	WATER SURFACE WATER	[Strat Plot]				20	40	60	80	100						
206.7 1.5	Silty SAND to SAND, trace gravel, trace clay Compact to very dense Grey Wet	[Strat Plot]	1	SS	17							○			1 72 27 0	
			2	SS	58											
			3	SS	42							○				
			4	SS	28										1 73 25 1	
			5	SS	39							○				
			6	SS	55											
			7	SS	89							○			0 84 16 0	
			8	SS	45											
198.3 9.9	END OF BOREHOLE CASING REFUSAL															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S15-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046726.4; E 242238.2</u>	ORIGINATED BY <u>ID</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment NW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>January 22, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
209.5	GROUND SURFACE																	
0.9	PEAT (Fibrous) Black Wet	1	SS	2	▽	209												
	SAND to Silty SAND Very loose to very dense Brown Wet	2	SS	12		208												0 83 (17)
		3	SS	9		207												NP
		4	SS	14		206												0 78 (22)
	Being grey below 3.0 m depth.	5	SS	31		205												NP
		6	SS	37		204												
		7	SS	58		203												0 84 (16)
		8	SS	57		202												
		9	SS	133		201												
200.7	END OF BOREHOLE CASING REFUSAL																	
8.8	Notes: 1. Area disturbed by excavator, peat thickness estimated to be 0.15 m thick prior to disturbance. 2. Water level at a depth of 0.7 m below ground surface (Elev. 208.8 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S15-5	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046748.9; E 242236.2</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>January 28, 2008</u>	CHECKED BY <u>AB</u>

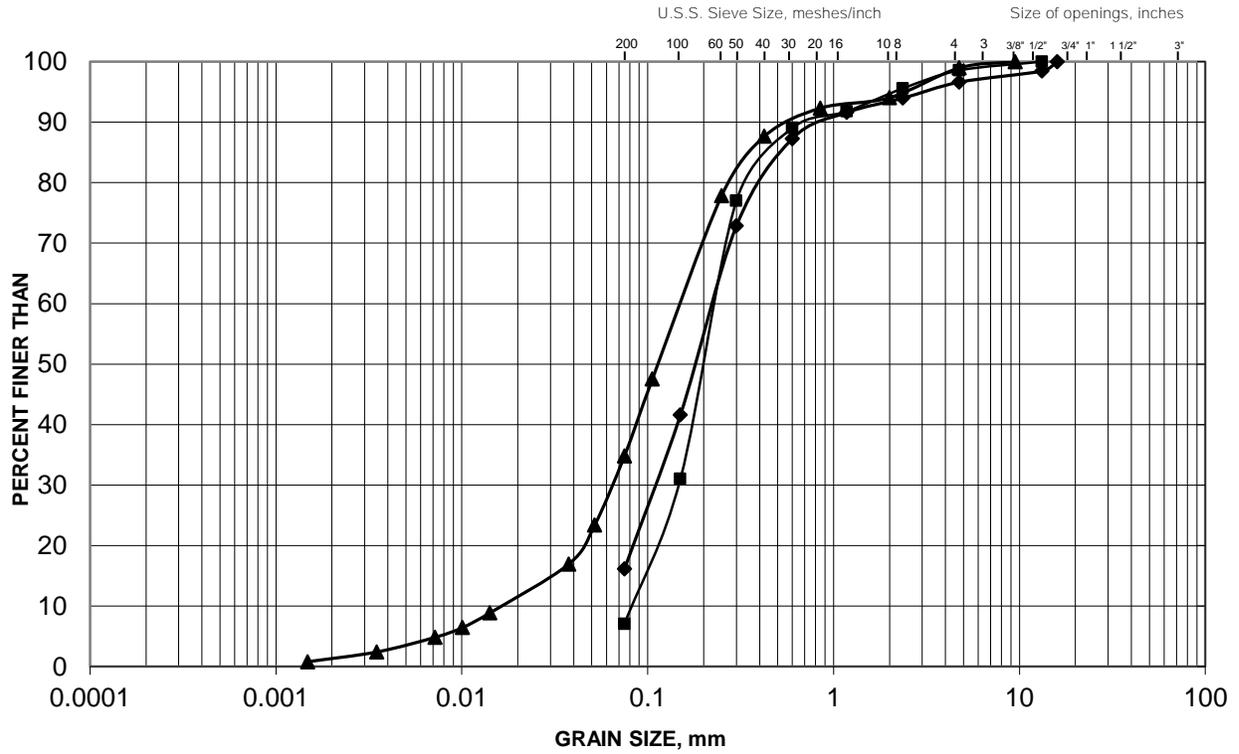
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)				
						20	40	60	80	100	20	40	60		GR	SA	SI	CL			
209.5	ICE SURFACE																				
0.0	SNOW and ICE																				
209.0			1	SS	2																
0.5	PEAT (Fibrous) Very soft Black Wet		2	SS	2	∇															
208.0																					
1.5	SAND, trace gravel, trace silt, trace clay Very loose to loose Grey Wet		3	SS	4													3	93	1	3
207.2																					
2.3	SAND and SILT, trace clay Compact to very dense Grey Wet		4	SS	26																
			5	SS	34																
			6	SS	37																
			7	SS	10																
			8	SS	54																
202.5																					
7.0	END OF BOREHOLE CASING REFUSAL																				
	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 209.0 m) upon completion of drilling.																				

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION

Sand (Fill)
Highway 69 (NBL & SBL) STA 19+202 to 19+253

**FIGURE
C1**



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
■	C63-2	1	209.3
◆	C63-4	1	211.6
▲	C63-4	3	210.1

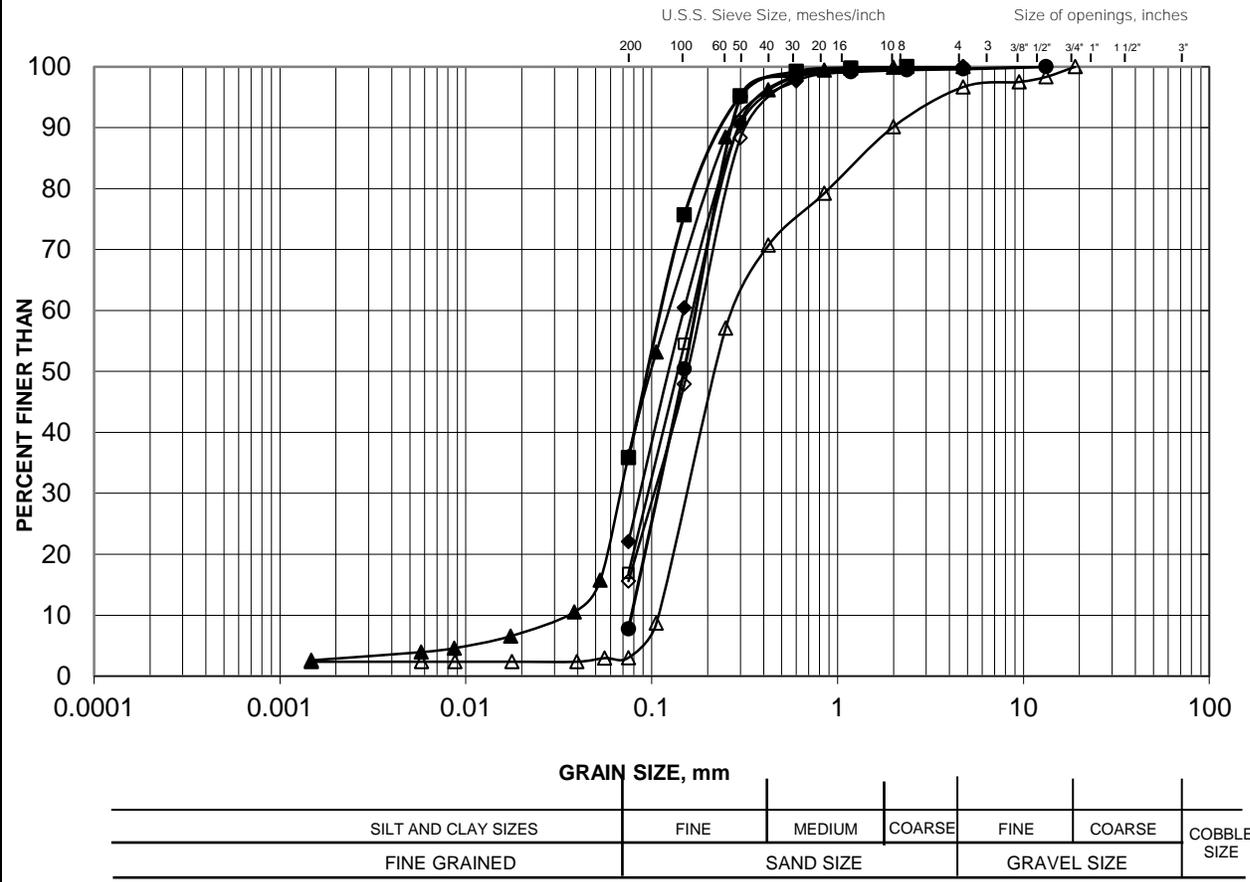
Project Number: 07-1191-0020-C1
 Checked By: AB

Golder Associates

Date: January 2013

GRAIN SIZE DISTRIBUTION
Sand to Sand and Silt
Highway 69 (NBL & SBL) STA 19+202 to 19+253

FIGURE
C2(i)

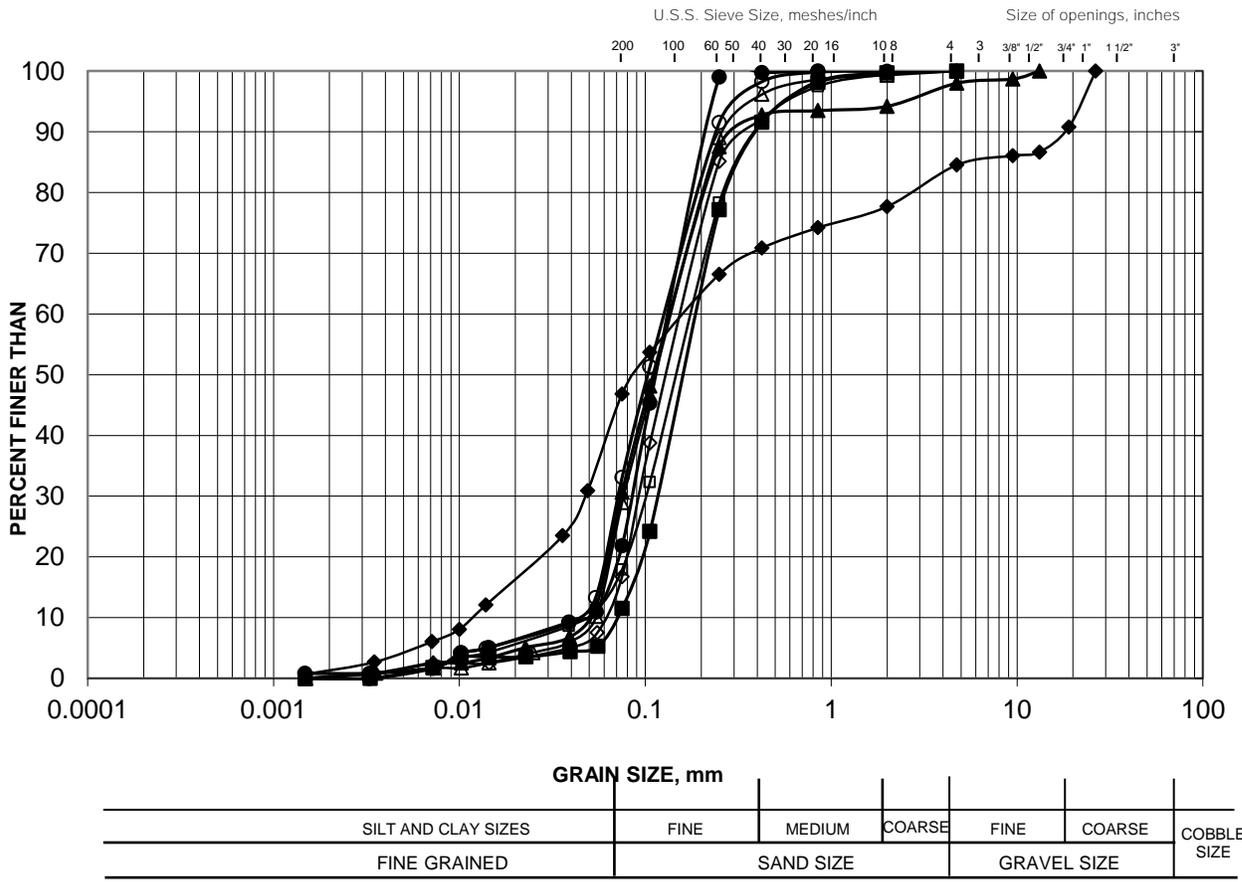


LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
□	S15-1	2	208.4
◆	S15-1	5	206.1
◇	S15-1	8	203.1
△	S15-5	3	207.7
▲	S15-5	4	206.9
■	S15-5	6	205.4
●	C63-1	1	210.0

GRAIN SIZE DISTRIBUTION
Sand to Sand and Silt
Highway 69 (NBL & SBL) STA 19+202 to 19+253

FIGURE
C2(ii)

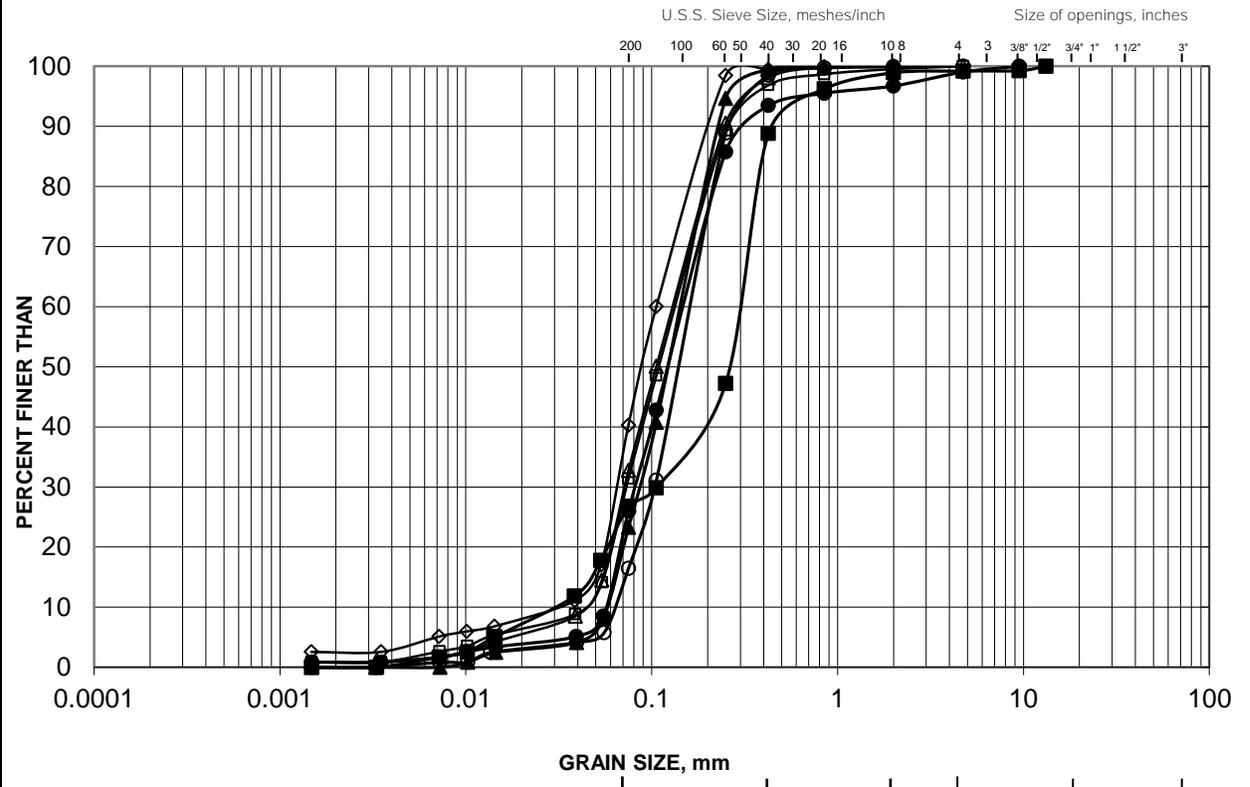


LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
□	C63-1	3	208.8
◆	C63-1	6	206.9
◇	C63-2	4	207.5
△	C63-2	6	206.1
▲	C63-2	8	205.0
■	C63-3	2b	208.2
●	C63-3	3	207.8
○	C63-3	5	206.6

GRAIN SIZE DISTRIBUTION
Sand to Sand and Silt
Highway 69 (NBL & SBL) STA 19+202 to 19+253

FIGURE
C2(iii)



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
□	C63-3	9	202.9
◇	C63-4	5	207.8
△	C63-4	7	204.8
▲	C63-4	10	200.3
■	C63-5	1	206.4
●	C63-5	4	204.1
○	C63-5	7	200.3



APPENDIX D

**Highway 69 NBL STA 21+259 (Swamp 13) and SBL STA 21+270
Site 9 Road STA 16+323 (Swamp 11)**

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

CONT No.
WP No.5133-12-08 to -10

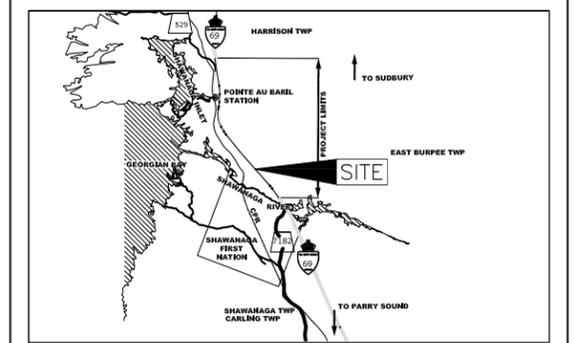
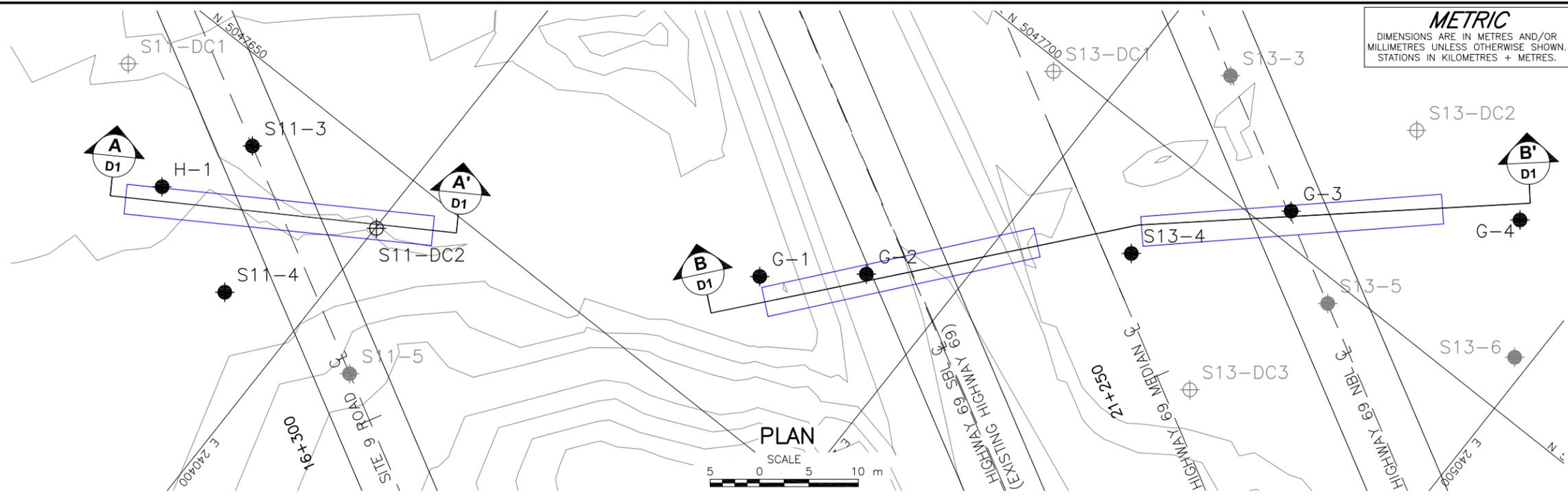


HIGHWAY 69
CULVERT AT STA. 21+259 AND 21+270 (HWY 69) AND 16+323 (SITE 9 RD.)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

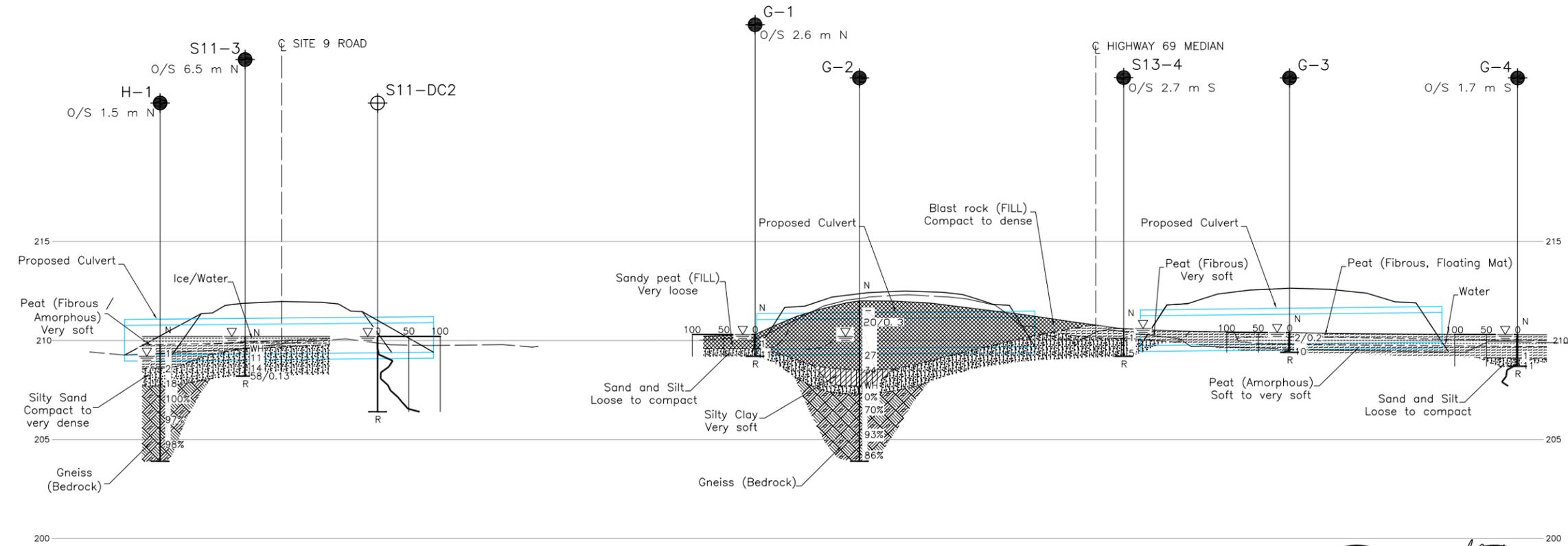


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LEGEND

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



BOREHOLE CO-ORDINATES

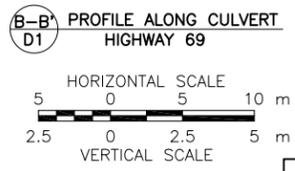
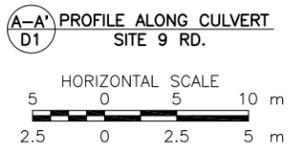
No.	ELEVATION	NORTHING	EASTING
G-1	210.3	5047664.2	240433.5
G-2	212.0	5047671.1	240441.8
G-3	210.4	5047702.8	240471.5
G-4	210.3	5047716.5	240490.2
H-1	209.8	5047633.7	240380.5
S11-3	210.2	5047642.6	240385.1
S11-4	210.2	5047629.3	240392.1
S11-DC2	210.2	5047643.9	240400.1
S13-4	210.6	5047689.4	240461.5

NOTES

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

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

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



REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)

NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		DWG. D1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No G-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047664.2; E 240433.5</u>	ORIGINATED BY <u>LG</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>July 12, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	GR
210.3	GROUND SURFACE																	
0.0	Sandy peat (FILL) Very loose Brown Wet		1	SS	1													
209.6																		
209.2	SAND and SILT, some clay Compact Grey Wet		2	SS	11													0 30 53 17
1.1	END OF BOREHOLE SPOON REFUSAL Note: 1. Water level at ground surface (Elev. 210.3 m) upon completion of drilling. 2. Moved 1.0 m west and advanced DCPT. Refusal at a depth of 0.9 m (Elev. 209.4 m).																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

RECORD OF BOREHOLE No G-2 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5047671.1; E 240441.8 ORIGINATED BY EC

DIST HWY 69 BOREHOLE TYPE 108mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY EC

DATUM Geodetic DATE August 10, 2011 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60		GR SA SI CL	
212.0	GROUND SURFACE															
0.0	Blast rock trace to some sand to sand and gravel (FILL) Compact to dense Brown Moist to wet	▨	1	AS	-											
			2	SS	20/0.15											
			3	SS	27											
208.5			4	SS	34											
3.5	SILTY CLAY, trace sand, trace gravel Very soft Grey Wet	▨														
			5	SS	WH											
207.7																
	SAND and SILT, trace to some clay Loose Grey Wet	▨														
207.3																
4.7	GNEISS (BEDROCK)	▨	1	RC	REC 0%										RQD = 0%	
	Bedrock cored from 4.7 m depth to 8.1 m depth. For coring details see Record of Drillhole G-2.		2	RC	REC 100%										RQD = 70%	
			3	RC	REC 100%										RQD = 93%	
			4	RC	REC 100%										RQD = 86%	
203.9																
8.1	END OF BOREHOLE															
	Note: 1. Water level at a depth of 1.8 m below ground surface (Elev. 210.2 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: G-2

SHEET 1 OF 1

LOCATION: N 5047671.1 ; E 240441.8

DRILLING DATE: August 10, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²
							FLUSH	FLT			BD	PL	PO	BR	NOTE: For additional abbreviations refer to list of abbreviations & symbols.								
		REFER TO PREVIOUS PAGE		207.3																			
5	NQ Coring August 10, 2011	GNEISS Fine to medium grained Fresh to slightly weathered Grey		4.7	1																		
6				2																			
7				3																			
8				4																			
8		END OF DRILLHOLE		203.9																			
9		Note: 1. Did not recover upper 0.3 m of bedrock and broken core from 5.0 m to 5.1 m.		8.1																			

SUD-RCK-07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

DEPTH SCALE

1 : 50



LOGGED: EC

CHECKED: AB

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No G-3	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047702.8; E 240471.5</u>	ORIGINATED BY <u>LG</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>July 11, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
210.4	GROUND SURFACE															
0.0	PEAT (Fibrous, floating mat) Soft Black Wet		1	SS	2/0.2											
209.8																
209.4	WATER		2	SS	10											
1.0	PEAT (Amorphous) Stiff Brown to black Wet															
	END OF BOREHOLE SPOON REFUSAL															
	Note: 1. Water level at ground surface (Elev. 210.4 m) upon completion of drilling. 2. Moved 2.0 m east and advanced DCPT. Refusal at a depth of 1.0 m (Elev. 209.4 m).															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No G-4	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047716.5; E 240490.2</u>	ORIGINATED BY <u>LG</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>July 11, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
210.3	GROUND SURFACE															
210.0	PEAT (Fibrous, floating mat) Black Wet	[Pattern]														
209.7	WATER															
209.1	PEAT (Amorphous) Very soft Black Wet	[Pattern]	1	SS	1											
208.7	SAND and SILT, trace gravel, trace to some clay Compact Grey Wet	[Pattern]	2	SS	11						o				3	59 31 7
208.7	END OF BOREHOLE SPOON REFUSAL															
1.6	Note: 1. Water level at ground surface (Elev. 210.3 m) upon completion of drilling. 2. Moved 2.0 m east and advanced DCPT. Refusal at a depth of 2.6 m (Elev. 207.7 m).															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No H-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047633.7; E 240380.5</u>	ORIGINATED BY <u>EC</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>July 25 and 26, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100				20	40	60		GR SA SI CL
209.8	GROUND SURFACE																	
0.0	PEAT (Fibrous / Amorphous) Very soft Black Moist to wet		1	SS	1												171.8	
208.6			2	SS	2													
1.2	Silty SAND, trace to some gravel Compact Grey Wet																	9 66 (25)
207.7			3	SS	18													
2.1	GNEISS (BEDROCK) Bedrock cored from 2.1 m depth to 5.9 m depth. For coring details see Record of Drillhole H-1.		1	RC	REC 100%													RQD = 100%
			2	RC	REC 100%													RQD = 97%
			3	RC	REC 100%													RQD = 98%
203.9	END OF BOREHOLE																	
5.9	Note: 1. Water level at a depth of 0.6 m below ground surface (Elev. 209.2 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: H-1

SHEET 1 OF 1

LOCATION: N 5047633.7 ; E 240380.5

DRILLING DATE: July 25 and 26, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION					
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				k, cm/s	10 ⁰	10 ¹	10 ²	10 ³
							FLUSH	FLT			BD	PL	PO	BR										
		REFER TO PREVIOUS PAGE		207.7																				
2.1	NW	GNEISS Fine grained Fresh Very strong Grey		2.1																				
3					1																			
4	NQ Coring July 26, 2011				2																			
5					3																			
6		END OF DRILLHOLE		203.9																				
5.9				5.9																				

UCS = 140 MPa

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



RECORD OF BOREHOLE No S11-3 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5047642.6; E 240385.1 ORIGINATED BY TDM

DIST HWY 69 BOREHOLE TYPE Portable Equipment, NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE February 13, 2008 CHECKED BY AB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
210.2	ICE SURFACE																	
0.0	ICE																	
	WATER																	
209.6	PEAT (Fibrous)		1	SS	WH													
0.6	Very soft Black Wet		2	SS	11													
	Silty SAND, some gravel, some clay Compact to very dense Grey Wet		3	SS	14													
208.2			4	SS	58/0.13													18 43 26 13
2.0	END OF BOREHOLE SPOON REFUSAL																	
	Note: 1. Water level at ice surface (Elev. 210.2 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No S11-4 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5047629.3; E 240392.1 ORIGINATED BY TDM

DIST HWY 69 BOREHOLE TYPE Portable Equipment, NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE February 13, 2008 CHECKED BY AB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
210.2	ICE SURFACE																	
0.0	ICE																	
0.2	WATER																	
	PEAT (Fibrous) Very soft to soft Black Wet		1	SS	WH													
209.1	Wet		2	SS	2													
208.7	CLAYEY SILT, trace sand Very soft to soft Brown to grey Wet		3	SS	56/0.15													0 7 58 35
1.7	Silty SAND, trace clay, trace gravel Very dense Grey Wet																	3 63 29 5
	END OF BOREHOLE SPOON REFUSAL																	
	Note: 1. Water level at ice surface (Elev. 210.2 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S13-4	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047689.4; E 240461.5</u>	ORIGINATED BY <u>ID</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Hand Sampling Equipment</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>February 4, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
210.6	GROUND SURFACE															
0.0	PEAT (Fibrous) Very soft		1	SS	1											
210.1	Black Wet															
0.5	SAND and SILT, trace clay Loose		2	SS	5											
209.2	Grey Wet															
1.4	END OF BOREHOLE SPOON AND CASING REFUSAL															
Notes: 1. Bedrock exposed 3.0 m north of borehole. 2. Water level at ground surface (Elev. 210.6 m) upon completion of drilling. 3. Split spoon samples obtained by driving with a 1/2 weight hammer; SPT "N" values shown have been corrected to these corresponding to use of a full weight hammer.																

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

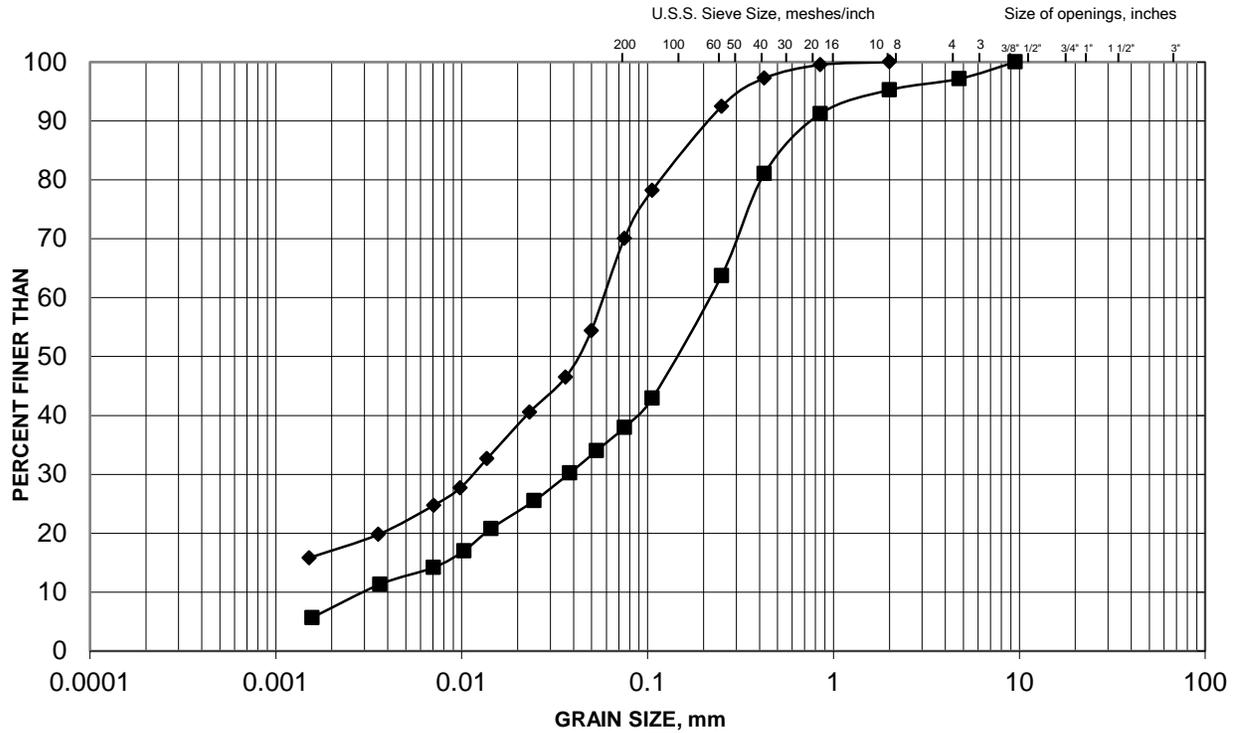
GRAIN SIZE DISTRIBUTION

FIGURE

Sand and Silt

D1

Highway 69 NBL STA 21+259 and SBL STA 21+270



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	G-1	2	209.5
■	G-4	2	208.8

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

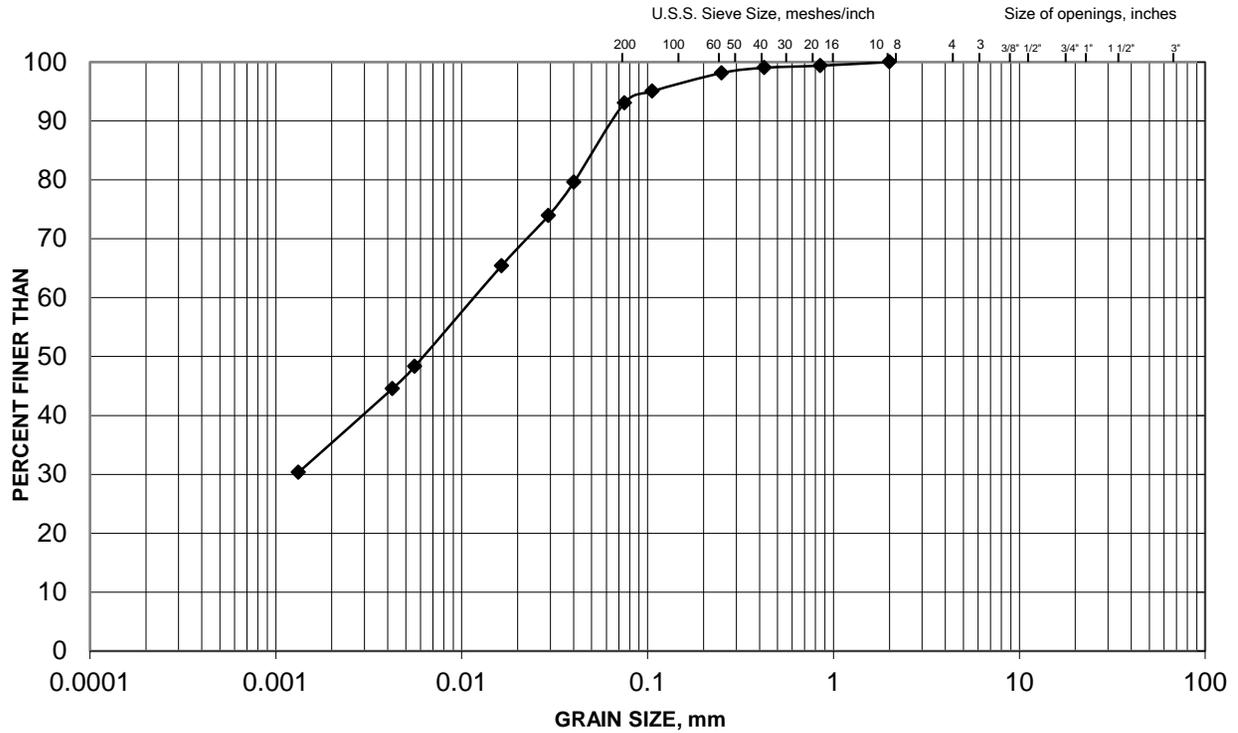
Date: January 2013

GRAIN SIZE DISTRIBUTION

FIGURE

**Clayey Silt
Site 9 Road STA 16+323**

D3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	S11-4	2B	209.0

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

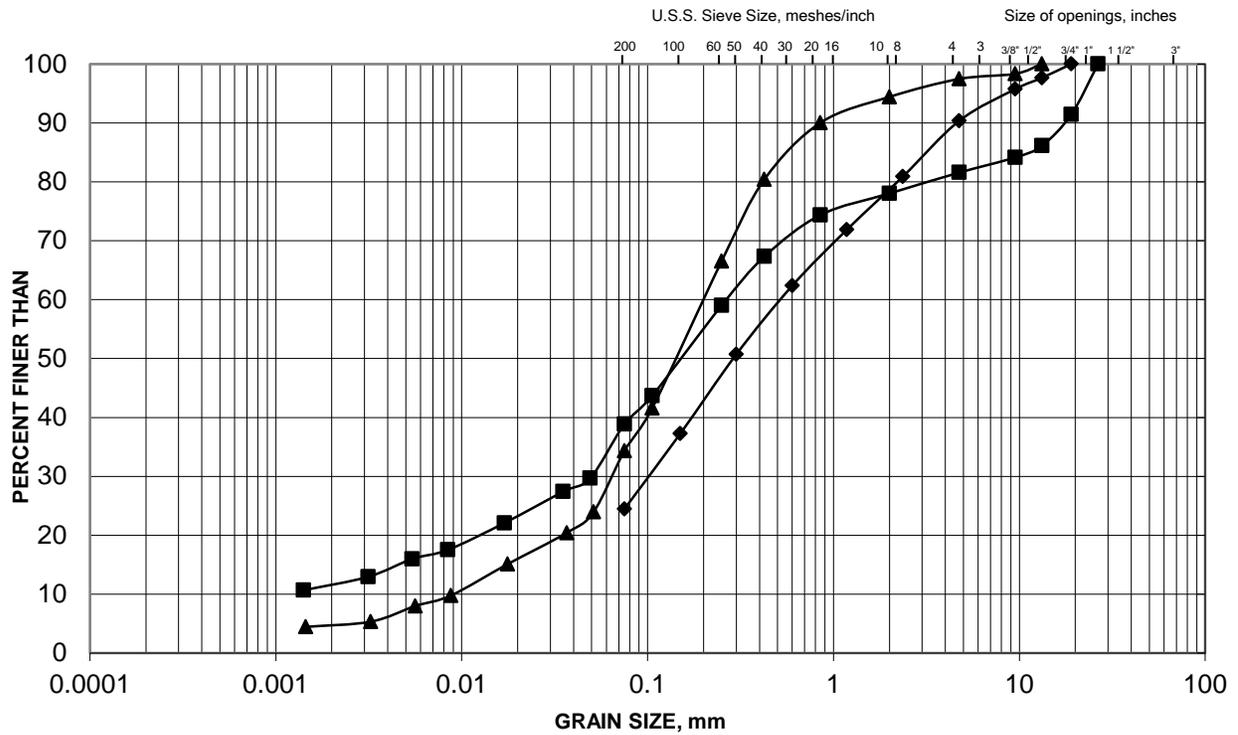
Date: January 2013

GRAIN SIZE DISTRIBUTION

FIGURE

**Silty Sand
Site 9 Road STA 16+323**

D4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	H-1	3	208.0
■	S11-3	3	208.7
▲	S11-4	3	208.6

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

Date: January 2013



APPENDIX E

**Highway 69 SBL STA 10+259 (Swamp 7) and
NBL STA 10+270 (Swamp 7)**

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

CONT No.
 WP No.5133-12-11 & -12

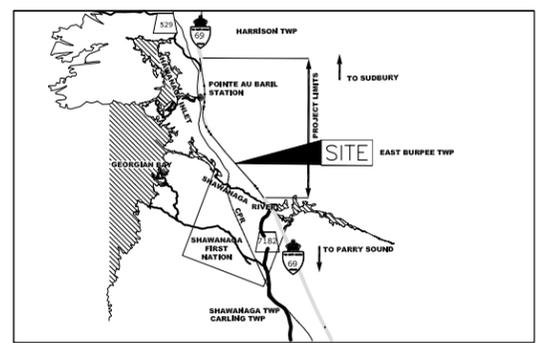
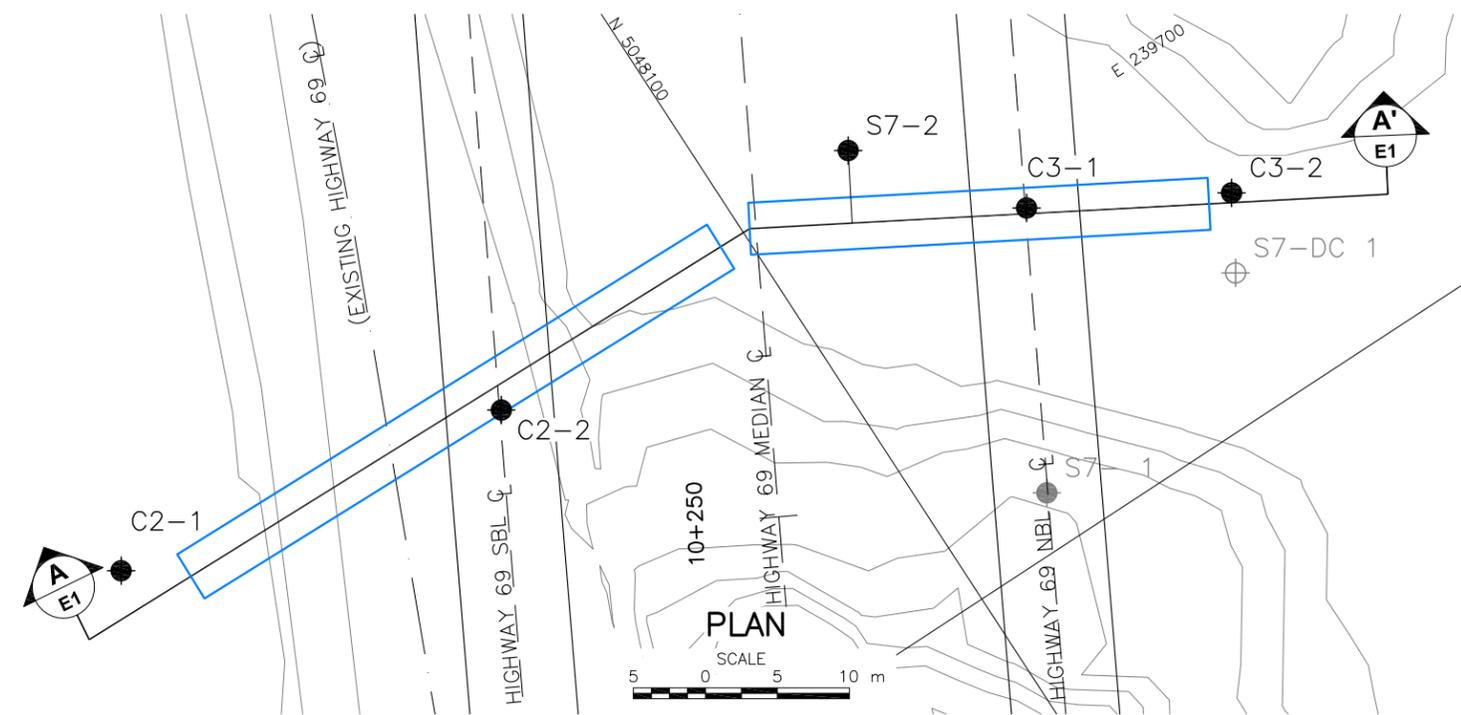


HIGHWAY 69
 CULVERT AT STA. 10+259 (SBL) 10+270 (NBL)
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



KEY PLAN
 SCALE 1:50,000
 5 0 5 km

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C2-1	204.8	5048051.0	239690.7
C2-2	206.6	5048079.2	239695.8
C3-1	204.7	5048117.4	239704.0
C3-2	204.6	5048129.9	239710.9
S7-2	205.3	5048109.2	239693.9

NOTES

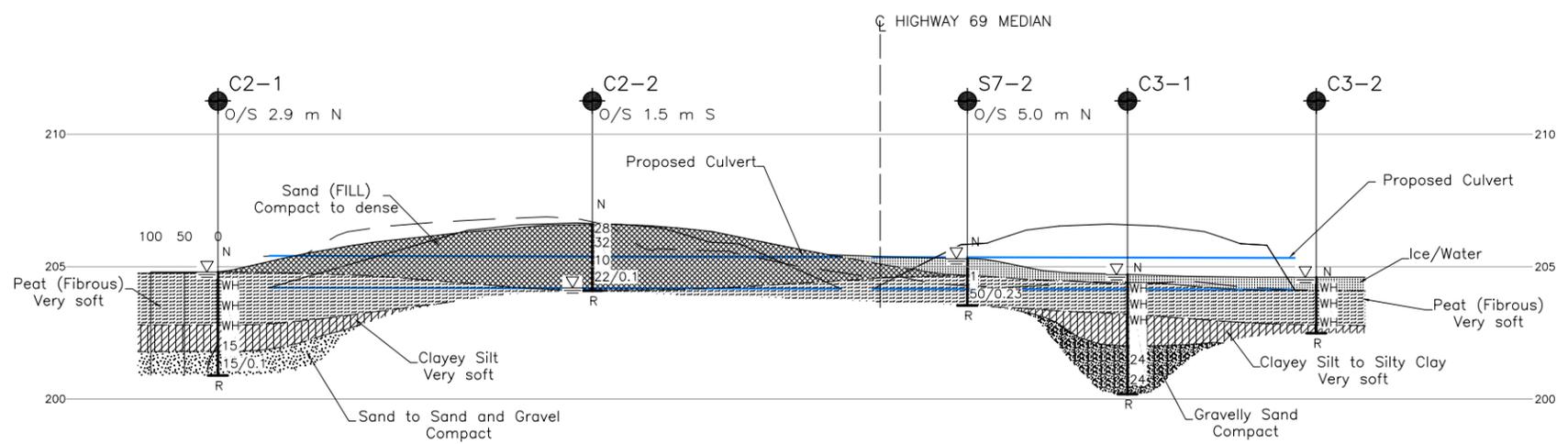
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

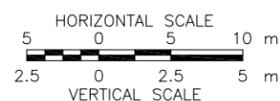
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. PLAN-New location for CV-130A-Site 9 Road-Hwy69 5403-05-00.DWG (received June 3, 2010)



A-A' PROFILE ALONG CULVERT
 E1
 HIGHWAY 69



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJL	CHKD.	APPD. JMAC
		DWG. E1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C2-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048051.0; E 239690.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 10, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
204.8	GROUND SURFACE																	
0.0	PEAT (Fibrous) Very Soft Black Wet		1	SS	WH													
202.8			2	SS	WH													
2.0	CLAYEY SILT with sand layers Very soft Grey Wet		3	SS	WH													0 9 55 36
201.8																		
3.0	SAND and GRAVEL, some silt trace clay Compact Grey Wet		4	SS	15													
200.9			5	SS	15/0.1													33 43 (24)
3.9	END OF BOREHOLE SPOON AND CASING REFUSAL																	
Note: 1. Water level at ground surface (Elev. 204.8 m) upon completion of drilling. 2. Moved 1 m south and advanced DCPT. Refusal at a depth of 4.3 m (Approx. Elev. 200.5 m)																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C2-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048079.2; E 239695.8</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</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>April 6, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
206.6	GROUND SURFACE															
0.0	Sand and gravel (FILL)		1	SS	28											
206.2	Compact Grey Moist															
0.4	Sand, trace gravel, trace to some silt containing trace organics at depth (FILL)		2	SS	32						○					4 84 (12)
	Compact to dense Grey to brown Moist to wet		3	SS	10											
204.1			4	SS	22/0.1						○					
2.5	END OF BOREHOLE SPOON AND CASING REFUSAL															
	Note: 1. Water level at a depth of 2.4 m below ground surface (Elev. 204.2 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C3-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048117.4; E 239704.0</u>	ORIGINATED BY <u>EHS</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 9, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
204.7	ICE SURFACE																	
0.0	ICE																	
204.4																		
0.3	PEAT (Fibrous) Very soft Black Wet		1	SS	WH													
			2	SS	WH													
203.2																		
1.5	SILTY CLAY Very soft Grey Wet		3	SS	WH													
202.0																		
2.7	Gravelly SAND, trace to some silt Compact Grey Wet		4	SS	24													
			5	SS	24													
200.2																		
4.5	END OF BOREHOLE CASING REFUSAL																	
	Note: 1. Water level at ice surface (Elev. 204.7 m) upon completion of drilling. 2. Could not push vane to 2.7 m depth.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C3-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048129.9; E 239710.9</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 9, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
204.6	ICE SURFACE																	
0.0 204.3	ICE																	
	WATER																	
0.5	PEAT (Fibrous) Very soft Black Wet		1	SS	WH													
			2	SS	WH													
202.8																		
202.5 2.1	CLAYEY SILT Very soft Grey Wet		3	SS	WH													
	END OF BOREHOLE SPOON REFUSAL																	
	Note: 1. Water level at ice surface (Elev. 204.6 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

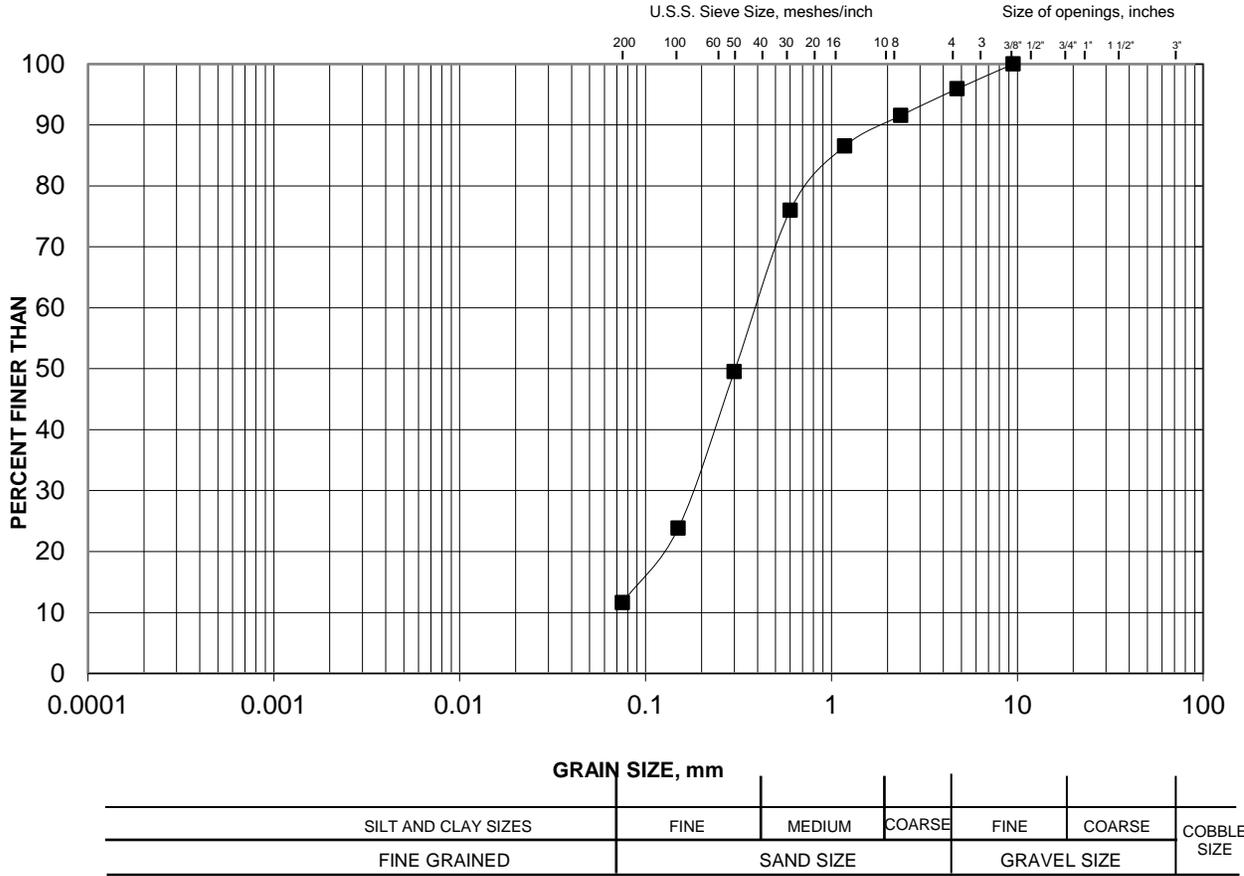
PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S7-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048109.2; E 239693.9</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Hand Auger</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>February 12, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
205.3	ICE SURFACE																	
0.0	ICE																	
204.7	PEAT (Fibrous), trace to some clay, trace sand Very soft Black Wet																	
0.6			1	SS	1													196.7
203.5			2	SS	50/0.23													
1.8	END OF BOREHOLE SPOON REFUSAL																	
	Notes: 1. Water level at ice surface (Elev. 205.3 m) upon completion of drilling. 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a full weight hammer.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION
Sand (Fill)
Highway 69 (SBL) STA 10+259

FIGURE
E1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—■—	C2-2	2	205.5

Project Number: 07-1191-0020-C1

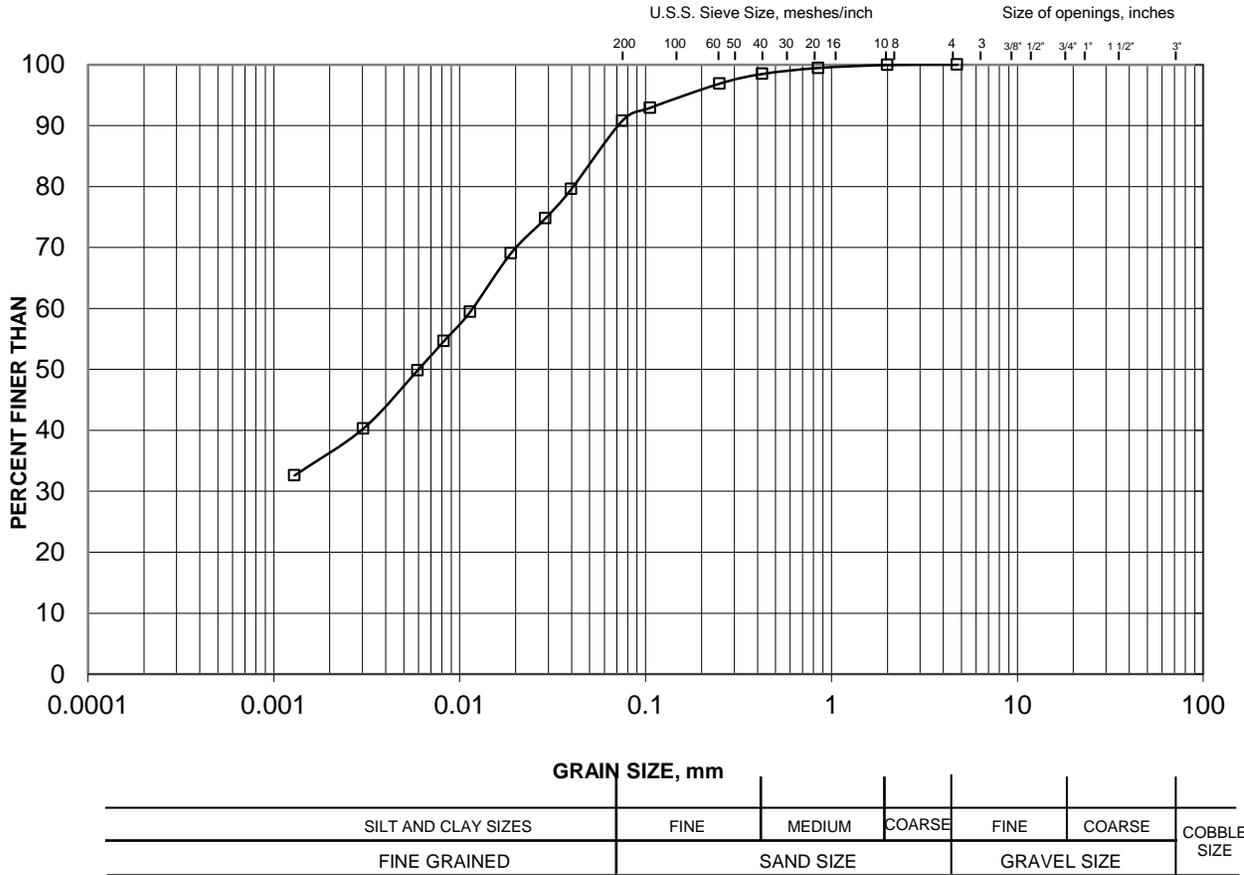
Checked By: AB

Golder Associates

Date: January 2013

GRAIN SIZE DISTRIBUTION
Clayey Silt
Highway 69 (SBL) STA 10+259

FIGURE
E2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—■—	C2-1	3	202.2

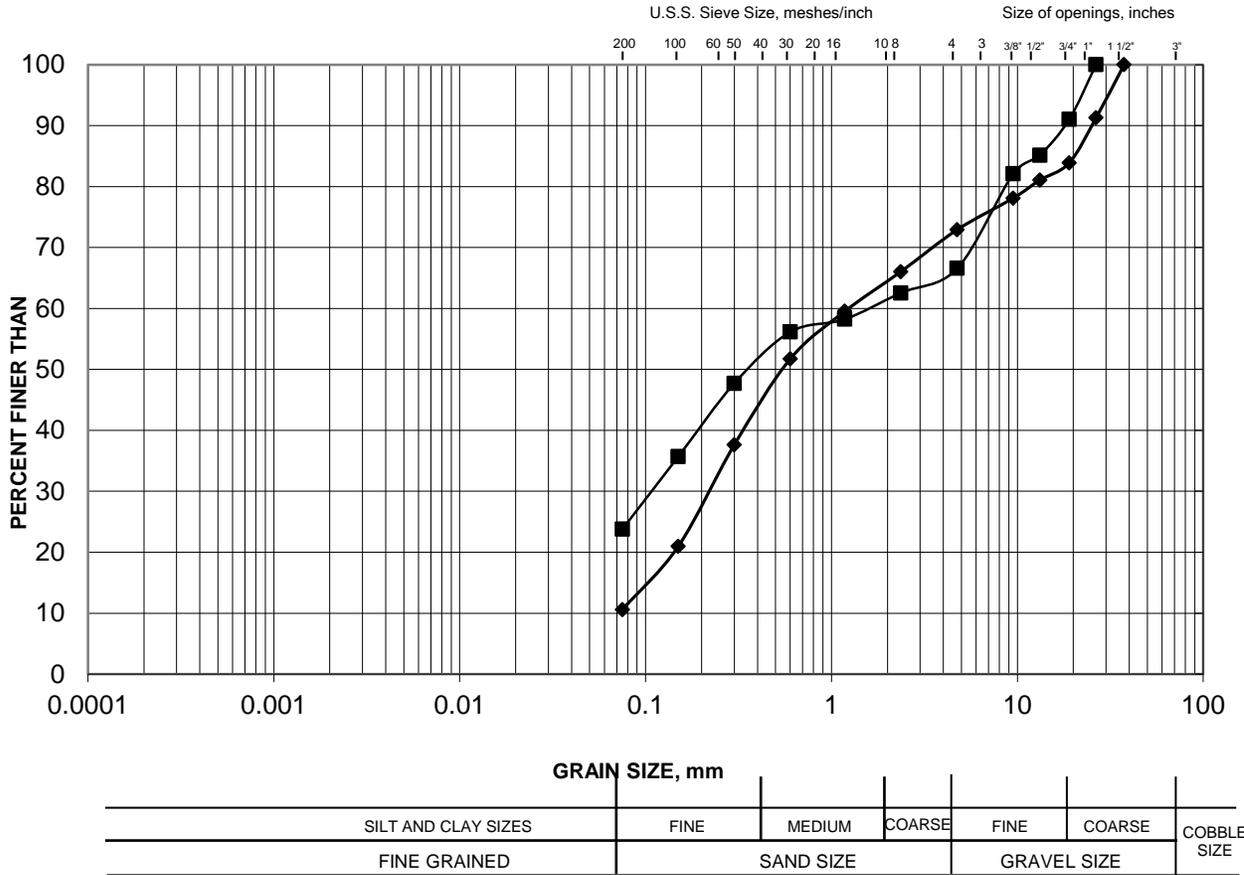
Project Number: 07-1191-0020-C1
 Checked By: AB

Golder Associates

Date: January 2013

GRAIN SIZE DISTRIBUTION
Sand and Gravel to Gravelly Sand
Highway 69 (SBL & NBL) STA 10+259 and 10+270

FIGURE
E3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
■	C2-1	5	200.9
●	C3-1	5	200.6

Project Number: 07-1191-0020-C1

Checked By: AB

Golder Associates

Date: January 2013



APPENDIX F

**Highway 69 NBL STA 10+530 (Swamp 7) and
SBL STA 10+558 (Swamp 7)**

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

CONT No.
WP No.5133-12-14 & -15

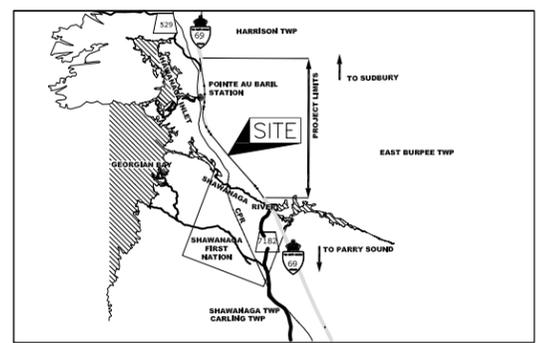


HIGHWAY 69
CULVERT AT STA. 10+530 (NBL) 10+558 (SBL)
BOREHOLE LOCATIONS AND SOIL STRATA

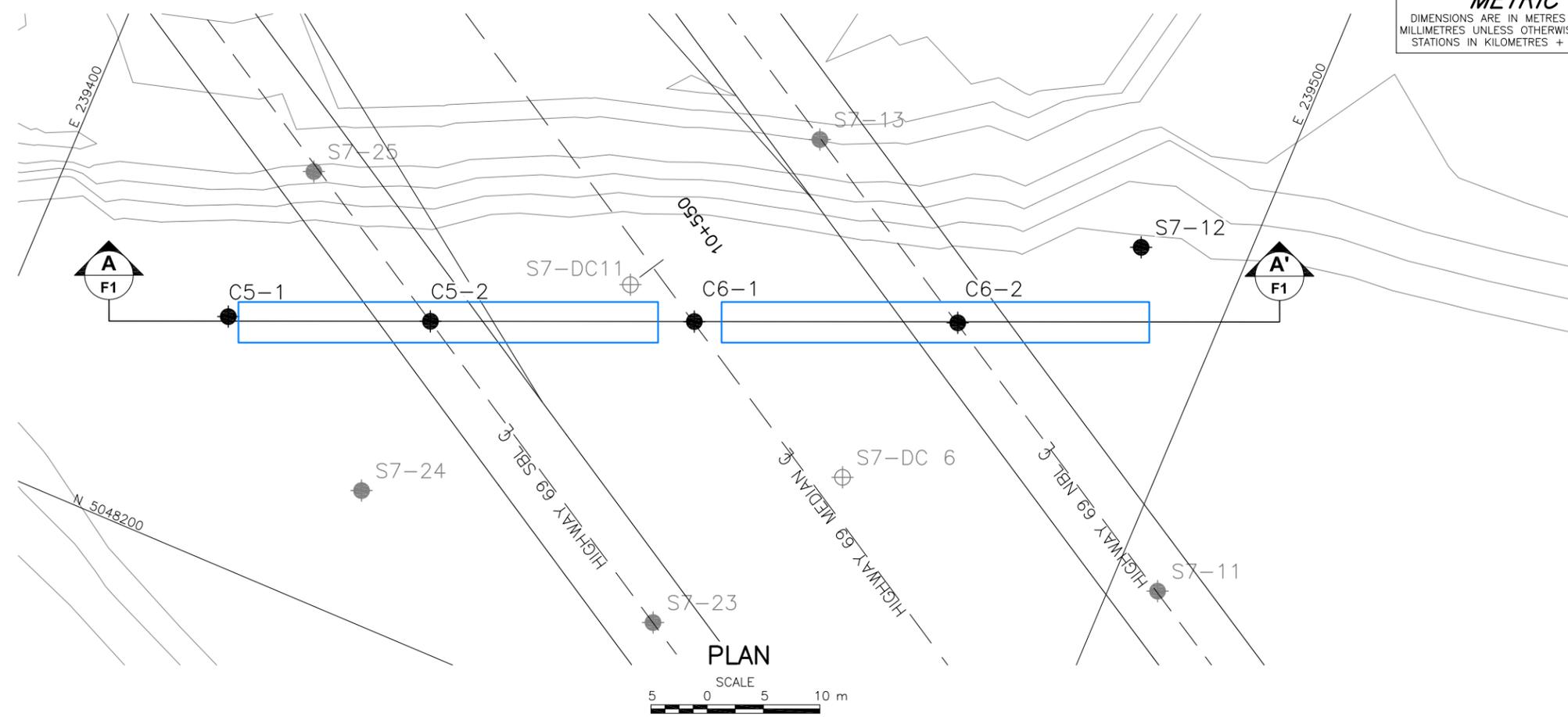
SHEET



Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



KEY PLAN
SCALE 0 5 km



PLAN
SCALE 0 5 10 m

LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C5-1	204.6	5048220.7	239418.6
C5-2	204.6	5048227.3	239435.3
C6-1	204.6	5048236.4	239456.9
C6-2	204.6	5048245.4	239478.5
S7-12	204.6	5048257.9	239490.9

NOTES

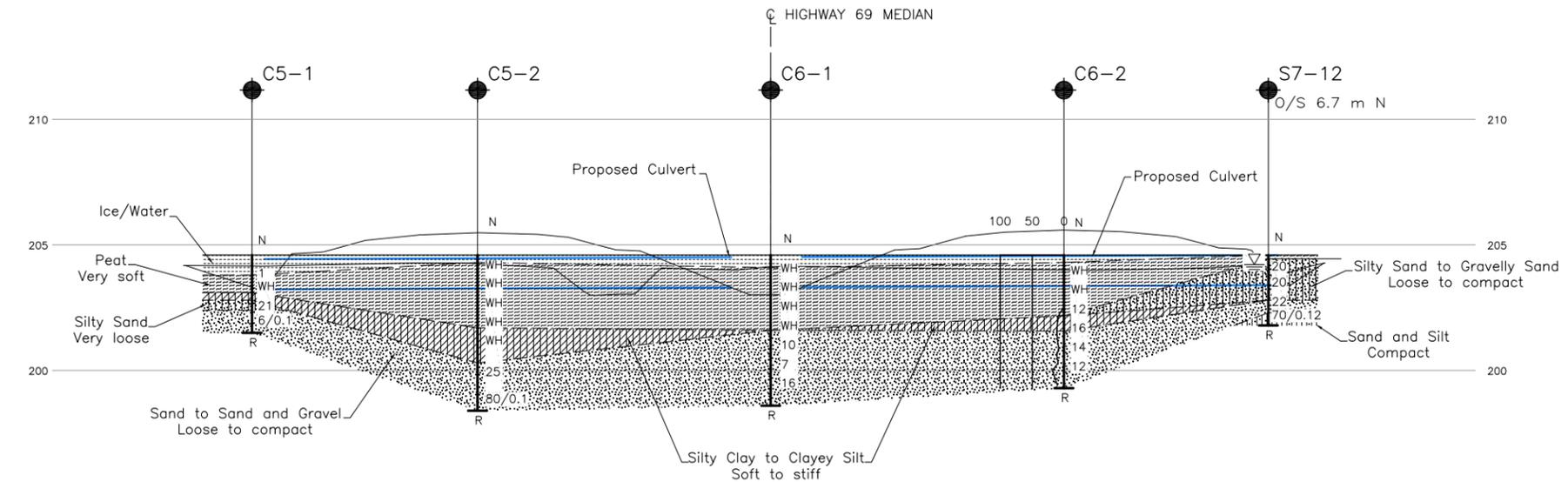
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

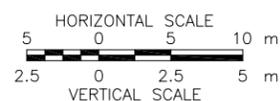
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section 9C 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. PLAN-New location for CV-130A-Site 9 Road-Hwy69 5403-05-00.DWG (received June 3, 2010)



A-A' CULVERT ALONG PROFILE
HIGHWAY 69



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-590/C1/C2
		DWG. F1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C5-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048220.7; E 239418.6</u>	ORIGINATED BY <u>EHS</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 10, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
204.6	ICE SURFACE															
0.0	ICE															
0.2	WATER															
203.8						204										
0.8	PEAT (Fibrous) Very soft Black Wet		1	SS	1									429		
203.1																
202.8	CLAYEY SILT Soft Grey Wet		2A	SS	WH	203	4									
202.4			2B													
2.2	Silty SAND, trace clay, trace to some gravel Very loose Grey Wet		3	SS	21	202										10 58 (32)
201.5																
3.1	Gravelly SAND Compact Grey Wet		4	SS	30/0											
	END OF BOREHOLE SPOON REFUSAL															

Note:

- Water level at ice surface (Elev. 204.6 m) upon completion of drilling.
- Moved 0.5 m east for field vane testing at 1.7 m depth.

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C5-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048227.3; E 239435.3</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 10, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100	20	40	60		GR	SA	SI	CL
204.6	ICE SURFACE																	
0.0	ICE																	
0.3	WATER																	
	PEAT (Fibrous) Very soft Black Wet		1	SS	WH													
			2	SS	WH									461.8				
			3	SS	WH													
201.7			4	SS	WH													
2.9	CLAYEY SILT with sand Soft Grey Wet		5	SS	WH													0 40 36 24
200.3																		
4.3	Gravelly SAND, some silt Compact Grey Wet		6	SS	25													21 60 (19)
198.4																		
6.2	END OF BOREHOLE SPOON REFUSAL		7	SS	80/0/2													
	Note: 1. Water level at ice surface (Elev. 204.6 m) upon completion of drilling. 2. Could not push vane to 4.3 m depth.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C6-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048236.4; E 239456.9</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 11, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
204.6	ICE SURFACE															
0.0 204.3	ICE															
	WATER															
0.5	PEAT (Fibrous) Very soft Black Wet		1	SS	WH											
			2	SS	WH											
			3	SS	WH											
			4	SS	WH											
201.6	SAND to SAND and GRAVEL, trace to some silt Loose to compact Grey Wet		5	SS	10											
3.0			6	SS	7											
			7	SS	16											
198.6	END OF BOREHOLE CASING REFUSAL															
6.0	Note: 1. Water level at ice surface (Elev. 204.6 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C6-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048245.4; E 239478.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>JJL</u>
DATUM <u>Geodetic</u>	DATE <u>March 11, 2010</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
204.6	ICE SURFACE																
0.0	ICE																
0.3	WATER																
	PEAT (Fibrous) Very soft Black Wet	1	SS	WH													
		2	SS	WH													
202.2																	
2.4	CLAYEY SILT, some sand Stiff Grey Wet	3	SS	12													
201.6																	
3.0	Gravelly SAND, trace to some silt Compact Grey Wet	4	SS	16													
		5	SS	14													
		6	SS	12													
199.3																	
5.3	END OF BOREHOLE CASING REFUSAL																
	Note: 1. Water level at ice surface (Elev. 204.6 m) upon completion of drilling. 2. Moved 1 m south and advanced DCPT. Refusal at a depth of 5.2 m (Elev. 199.4 m)																

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

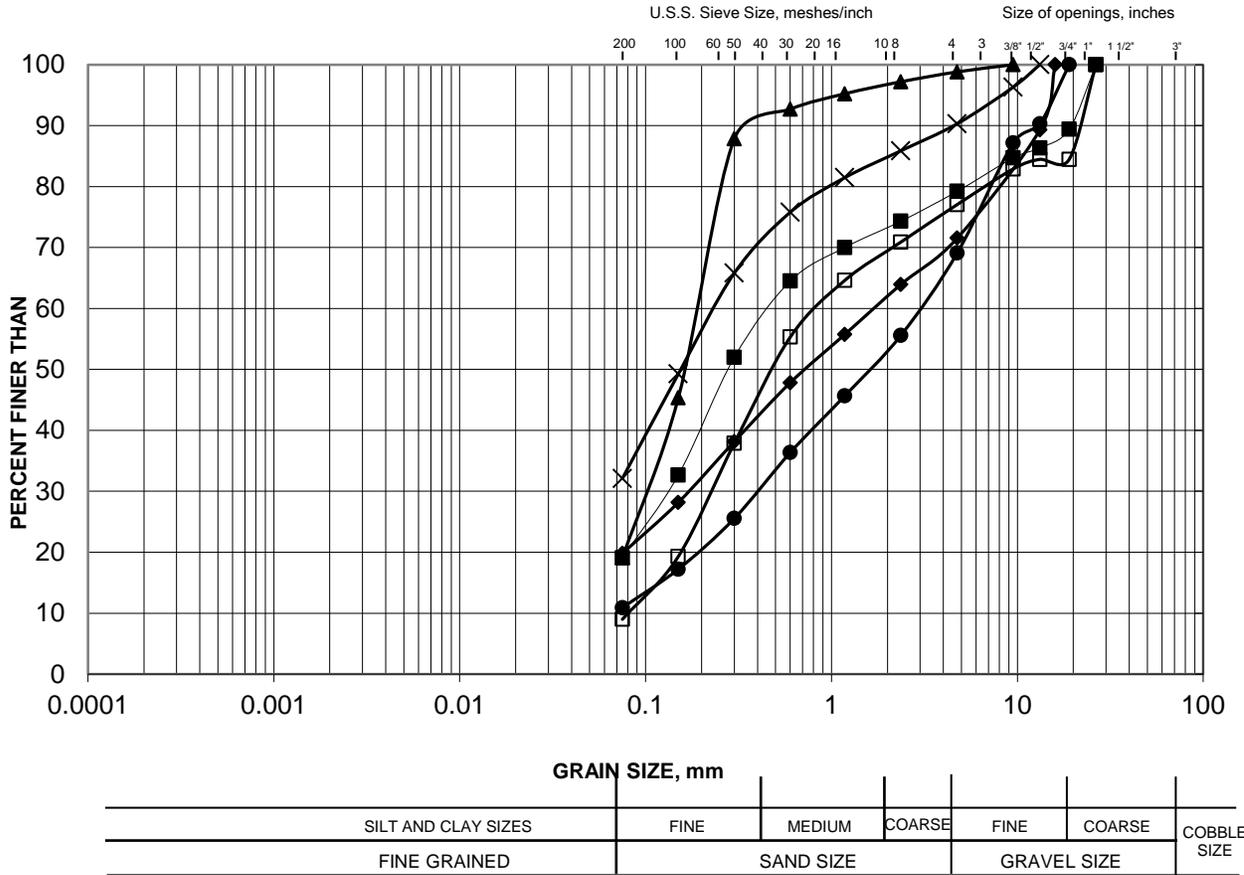
PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S7-12	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048257.9; E 239490.9</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Hand Auger</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>February 4, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)					
							20	40	60	80	100						GR	SA	SI	CL		
204.6	GROUND SURFACE																					
0.0	PEAT		1	SS	6	▽																
0.2	Black Wet Silty SAND, trace to some gravel Loose to compact Grey Wet		2	SS	20		204						○									NP
202.8			3a 3b	SS	20		203						○									28 52 (20)
1.8	Gravelly SAND, some silt, trace clay Compact Brown Wet		4a 4b	SS	22		202						○									
202.3			5	SS	70/0.12																	
2.3	SAND and SILT, trace to some gravel Compact Grey Wet																					
201.8	END OF BOREHOLE SPOON REFUSAL																					
2.8	Notes: 1. Water level at a depth of 0.4 m below ground surface (Elev. 204.2 m) upon completion of drilling. 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a full weight hammer.																					

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION
Silty Sand to Sand and Gravel
Highway 69 (NBL & SBL) STA 10+530 and 10+558

FIGURE
F2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
■	C5-2	6	199.7
◆	S7-12	3b	202.7
▲	C6-1	5	200.8
●	C6-1	7	199.2
◻	C6-2	6	199.7
×	C5-1	2b	202.6

Project Number: 07-1191-0020-C1

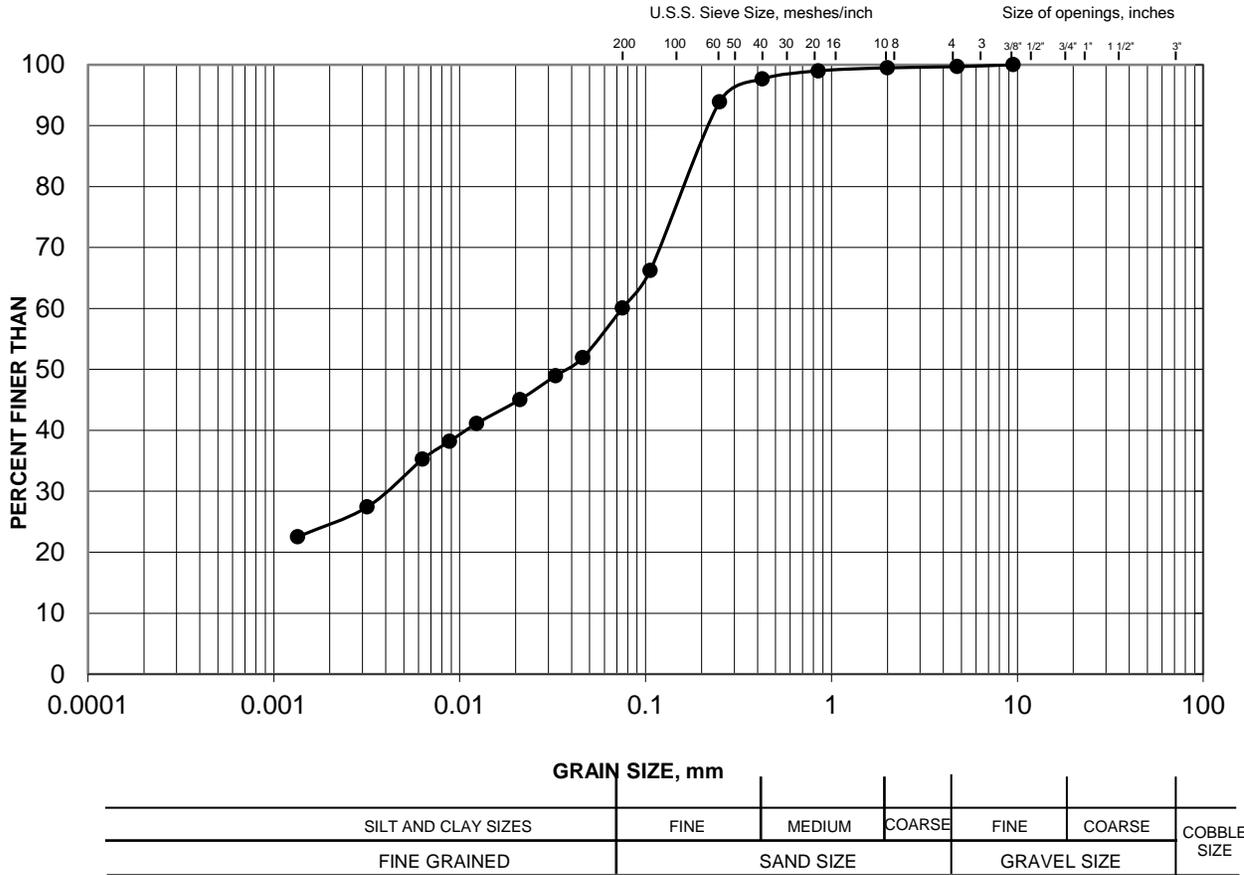
Checked By: AB

Golder Associates

Date: January 2013

GRAIN SIZE DISTRIBUTION
Clayey Silt
Highway 69 (SBL) STA 10+558

FIGURE
F3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—●—	C5-2	5	201.0

Project Number: 07-1191-0020-C1
 Checked By: AB

Golder Associates

Date: January 2013



APPENDIX G

Highway 69 NBL STA 10+974 and SBL STA 11+019 (Swamp 6)

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

CONT No.
WP No.5133-12-17 & -18

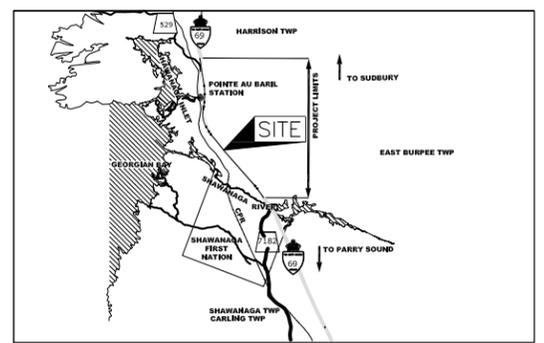


HIGHWAY 69
CULVERT AT STA. 10+974 (NBL) 11+019 (SBL)
BOREHOLE LOCATIONS AND SOIL STRATA

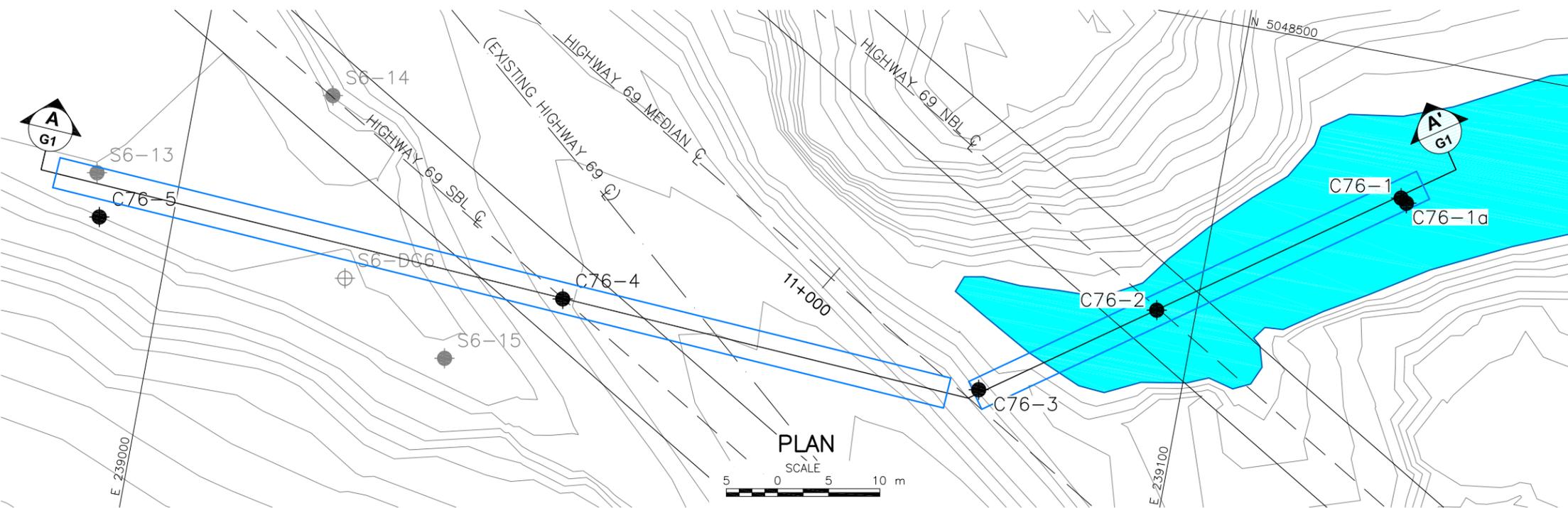
SHEET



Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



KEY PLAN
SCALE
5 0 5 km



PLAN
SCALE
5 0 5 10 m

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C76-1	195.3	5048486.3	239117.7
C76-1a	195.3	5048485.9	239118.3
C76-2	195.3	5048471.2	239096.2
C76-3	195.7	5048460.4	239080.5
C76-4	198.0	5048461.7	239038.9
C76-5	195.1	5048461.3	238992.9

NOTES

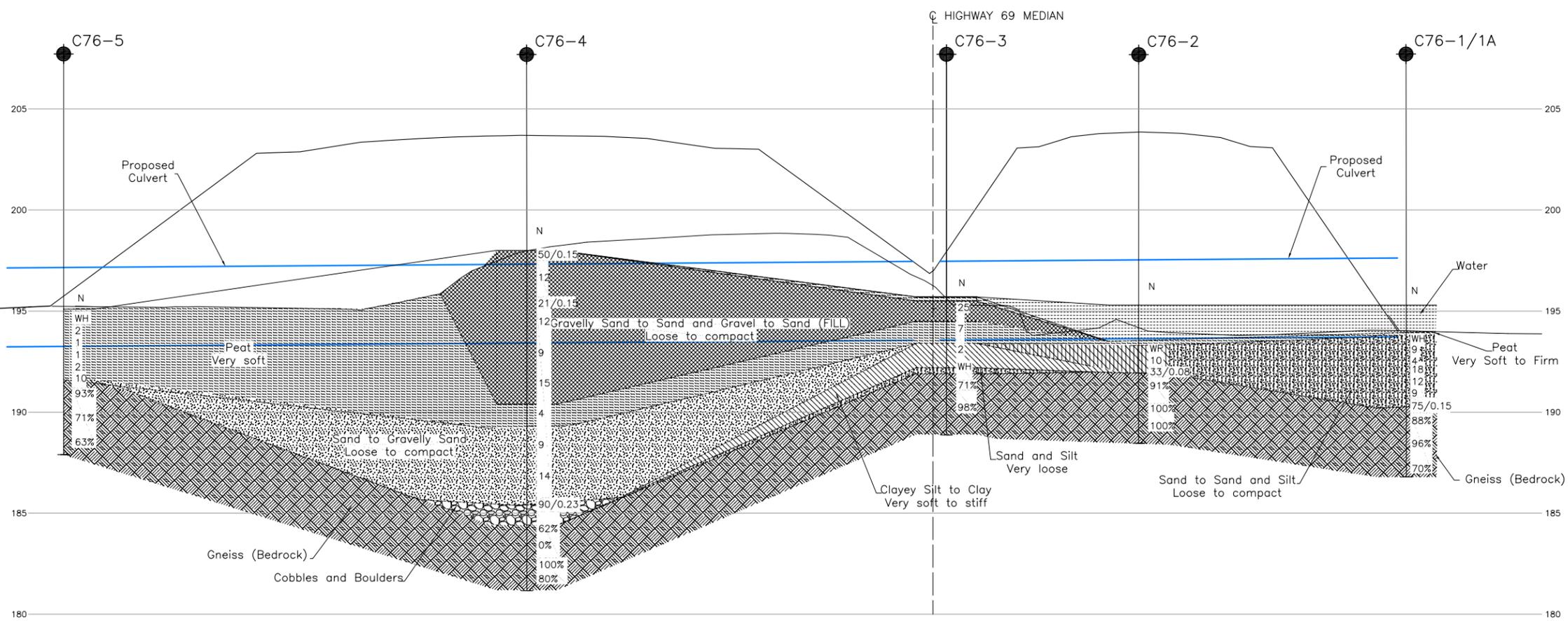
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

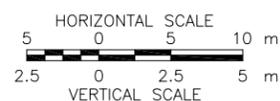
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. Plan & XS CVs 137,138,140.dwg (received February 29, 2012)



A-A' PROFILE ALONG CULVERT
HIGHWAY 69



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		DWG. G1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048486.3; E 239117.7</u>	ORIGINATED BY <u>TDM</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 4 and 5, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
195.3	WATER SURFACE																		
0.0	WATER																		
194.1																			
1.4	PEAT (Fibrous) Very soft Black Wet SAND and SILT to SAND, trace to some gravel, trace clay Loose to compact		1a 1b	SS	WH									155					0 48 37 15
			2a 2b	SS	9														0 56 33 11
			3	SS	4														10 65 (25)
			4	SS	18														
			5	SS	12														17 81 (2)
189.7			7	SS	75/0.15														16 39 (45)
5.6	GNEISS (BEDROCK)		1	RC	REC 97%														RQD = 69%
	Bedrock cored from 5.6 m depth to 6.7 m depth.																		
188.6																			
6.7	END OF BOREHOLE																		
	Note: 1. Rock core jammed in core barrel at 6.7 m depth. Moved 0.5 m north to obtain rock core. Bedrock encountered at 5.0 m depth (Elev. 190.5 m). 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-1a	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048485.9; E 239118.3</u>	ORIGINATED BY <u>TDM</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 5, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)			
195.3	0.0						20	40	60	80	100	20	40	60	GR	SA	SI	CL		
	WATER SURFACE For soil stratigraphy refer to Record of Borehole C76-1.																			
190.3	5.0		1	RC	REC 100%														RQD = 88%	
	GNEISS (BEDROCK) Bedrock cored from 5.0 m depth to 8.5 m depth. For coring details refer to Record of Drillhole C76-1A.		2	RC	REC 100%															RQD = 96%
			3	RC	REC 89%															RQD = 70%
186.8	8.5																			
	END OF BOREHOLE																			

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C76-1a

SHEET 1 OF 1

LOCATION: N 5048485.9 ; E 239118.3

DRILLING DATE: November 5, 2008

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment, BW Casing

DRILLING CONTRACTOR: OGS

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION					
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				k, cm/s	10 ⁰	10 ¹	10 ²	10 ³
							88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888	88888888
5	Refer to Previous Page			190.3																				
	Thin Wall - N Coring November 5, 2008	GNEISS Fine grained Slightly weathered Very strong Pinkish grey		5.0	1																			
6					2													UCS = 69 MPa						
7					3																			
8																								
8		END OF DRILLHOLE		186.8																				
8.5				8.5																				
9																								
10																								
11																								
12																								
13																								
14																								
15																								

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

DEPTH SCALE

1 : 50



LOGGED: TDM

CHECKED: AB

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048471.2; E 239096.2</u>	ORIGINATED BY <u>TDM</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 3 and 4, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20 40 60 80 100	20 40 60 80 100										
195.3	WATER SURFACE																
0.0	WATER																
193.5																	
2.0	PEAT (Fibrous), trace clay Very soft Black Wet		1a 1b	SS	WR												
192.1	CLAYEY SILT Very soft to stiff Grey Wet		2	SS	10												
3.4	GRAVEL, some sand Compact Grey Wet		3	SS	33/0.08												
	GNEISS (BEDROCK)		1	RC	REC 100%											RQD = 91%	
	Bedrock cored from 3.4 m depth to 6.9 m depth. For coring details refer to Record of Drillhole C76-2.		2	RC	REC 100%												RQD = 100%
			3	RC	REC 100%												RQD = 100%
188.4	END OF BOREHOLE																
6.9	Note: 1. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C76-2

SHEET 1 OF 1

LOCATION: N 5048471.2 ; E 239096.2

DRILLING DATE: November 3 and 4, 2008

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment, BW Casing

DRILLING CONTRACTOR: OGS

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²
							FLUSH	FLUSH			FLUSH	FLUSH	FLUSH	FLUSH	FLUSH	FLUSH	FLUSH				FLUSH	FLUSH	FLUSH
		Refer to Previous Page		191.9																			
4	Thin Wall - N Casing November 4, 2008	GNEISS Fine grained Slightly weathered Strong Pinkish grey		3.4	1																		
5				2																			
6				3																			
7		END OF DRILLHOLE		188.4																			
8																							
9																							
10																							
11																							
12																							
13																							

UCS = 54 MPa

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-3	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048460.4; E 239080.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>January 6, 2009</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100	20	40	60		GR SA SI CL
195.7	GROUND SURFACE														
0.0	Topsoil (FILL)														
0.2	Sand, trace to some gravel, trace silt, occasional cobbles (FILL) Compact Brown to grey Wet		1	AS	-										
194.5			2	SS	25										
1.2	PEAT (Fibrous), trace to some sand Firm Black to brown Wet		3	SS	7										
193.4															
2.3	CLAY Very soft Grey and brown Wet		4	SS	2										
192.2															
191.9	SAND and SILT, trace to some clay Very loose Grey Wet		5	SS	WH										0 55 34 11
3.8	META-QUARTZITE (BEDROCK) Bedrock cored from 3.8 m to 6.8 m depth. For coring details refer to Record of Drillhole C76-3.		1	RC	REC 100%										RQD = 71%
			2	RC	REC 100%										RQD = 98%
188.9	END OF BOREHOLE														
6.8	Note: 1. Water level at a depth of 0.3 m below ground surface (Elev. 195.4 m) upon completion of drilling.														

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C76-3

SHEET 1 OF 1

LOCATION: N 5048460.4 ;E 239080.5

DRILLING DATE: January 6, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION				
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²	
							88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888	88888888
		Refer to Previous Page		191.9																				
4	NQ Coring January 6, 2009	META-QUARTZITE Fine to medium grained Slightly Weathered Very strong Pink		3.8																				
				1																				
5																								
				2																				
6																								
7					END OF DRILLHOLE		188.9																	
							6.8																	
8																								
9																								
10																								
11																								
12																								
13																								

UCS = 131 MPa

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



RECORD OF BOREHOLE No C76-4 1 OF 2 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5048461.7; E 239038.9 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE November 6 and 7, 2008 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
198.0	GROUND SURFACE															
0.0	Gravelly sand to sand and gravel, trace to some silt, with rock fill (FILL) Compact Brown Moist		1	SS	50/0.15						○				25	62 (13)
	Difficult augering at 2.1 m depth. Switched to NW Casing.		2	SS	12											
			3	SS	21/0.15											
			4	SS	12											
193.4	Sand, trace gravel, trace to some silt (FILL) Loose to compact Grey Wet		5	SS	9							○			2	90 (8)
			6	SS	15											
190.4	PEAT (Fibrous) Soft to firm Black Wet		7	SS	4									174.8		
189.2	SAND to Gravelly SAND, some silt Loose to compact Grey Wet		8	SS	9						○				17	67 (16)
			9	SS	14											
			10	SS	90/0.23						○				27	58 (15)
185.4	COBBLES and BOULDERS															
184.4	GNEISS (BEDROCK)		1	RC	REC 100%											RQD = 62%
	Bedrock cored from 13.6 m depth to 16.8 m depth.		2	RC	REC 100%											RQD = 0%
	For coring details refer to Record of Drillhole C76-4.		3	RC	REC 100%											RQD = 100%

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

Continued Next Page

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



RECORD OF BOREHOLE No C76-4 2 OF 2 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5048461.7; E 239038.9 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE November 6 and 7, 2008 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20
181.2	GNEISS (BEDROCK)		3	RC	REC 100%													RQD = 100%
	Bedrock cored from 13.6 m depth to 16.8 m depth. For coring details refer to Record of Drillhole C76-4.		4	RC	REC 100%													RQD = 80%
16.8	END OF BOREHOLE																	
	Note: 1. Water level at a depth of 2.9 m below ground surface (Elev. 195.1 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C76-4

SHEET 1 OF 1

LOCATION: N 5048461.7 ;E 239038.9

DRILLING DATE: November 6 and 7, 2008

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Truck Mount CME 55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION					
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				k, cm/s	10 ⁰	10 ¹	10 ²	10 ³
							FLUSH	FLUSH			FLUSH	FLUSH	FLUSH	FLUSH	FLUSH	FLUSH				FLUSH	FLUSH	FLUSH	FLUSH	FLUSH
		Refer to Previous Page		184.4																				
14	NQ Coring November 7, 2008	GNEISS Fine grained Slightly to moderately weathered Strong Pinkish to grey		13.6	1																			
				2																				
15				3																				
16				4																				
17		END OF DRILLHOLE		181.2																				
				16.8																				

UCS = 75 MPa

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: AB

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-5	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048461.3; E 238992.9</u>	ORIGINATED BY <u>TDM</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>November 7, 2008</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
195.1 0.0	GROUND SURFACE PEAT (Amorphous) Soft to stiff Black Moist to wet		1	SS	WH		195								147.1		
			2	SS	2		194								216.5		
			3	SS	1		193								612.7		
			4	SS	1		192								173.4		
			5	SS	2		192										
			6	SS	10		192										
191.6 3.5	GNEISS (BEDROCK) Bedrock cored from 3.5 m depth to 7.2 m depth. For coring details refer to Record of Drillhole C76-5.		1	RC	REC 100%		191									RQD = 93%	
			2	RC	REC 100%		190									RQD = 71%	
			3	RC	REC 100%		189									RQD = 63%	
187.9 7.2	END OF BOREHOLE Note: 1. Water level at a depth of 1.2 m below ground surface (Elev. 193.9 m) upon completion of drilling. 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.						188										

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C76-5

SHEET 1 OF 1

LOCATION: N 5048461.3 ; E 238992.9

DRILLING DATE: November 7, 2008

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment, BW Casing

DRILLING CONTRACTOR: OGS

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION				
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn				k, cm/s	10 ⁰	10 ¹	10 ²
							FLUSH	FLUSH			FLUSH	FLUSH	FLUSH	FLUSH	FLUSH	FLUSH				FLUSH	FLUSH	FLUSH	FLUSH
		Refer to Previous Page		191.6																			
4	NO Coring November 7, 2008	GNEISS Fine grained Slightly weathered Strong Pinkish grey		3.5	1																		
5				2																			
6				3																			
7		END OF DRILLHOLE		187.9																			
8				7.2																			
9																							
10																							
11																							
12																							
13																							

UCS = 94 MPa

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



**TABLE G1
UNIAXIAL COMPRESSION STRENGTH TEST RESULTS
HIGHWAY 69 NBL AND SBL – STA 10+974 & 11+019
GWP 5403-05-00
HIGHWAY 69, POINTE AU BARIL**

Borehole Number	Sample Depth (m)	Sample Elevation (m)	Rock Type	Core Diameter (mm)	Load (kN)	Uniaxial Compressive Strength (MPa)
C76-1A	6.6	188.7	Gneiss	51	139.1	69
C76-2	5.0	190.3	Gneiss	51	108.2	54
C76-3	5.8	189.9	Meta-Quartzite	48	232.6	131
C76-4	14.8	183.2	Gneiss	48	133.5	75
C76-5	5.5	189.6	Gneiss	51	188.4	94

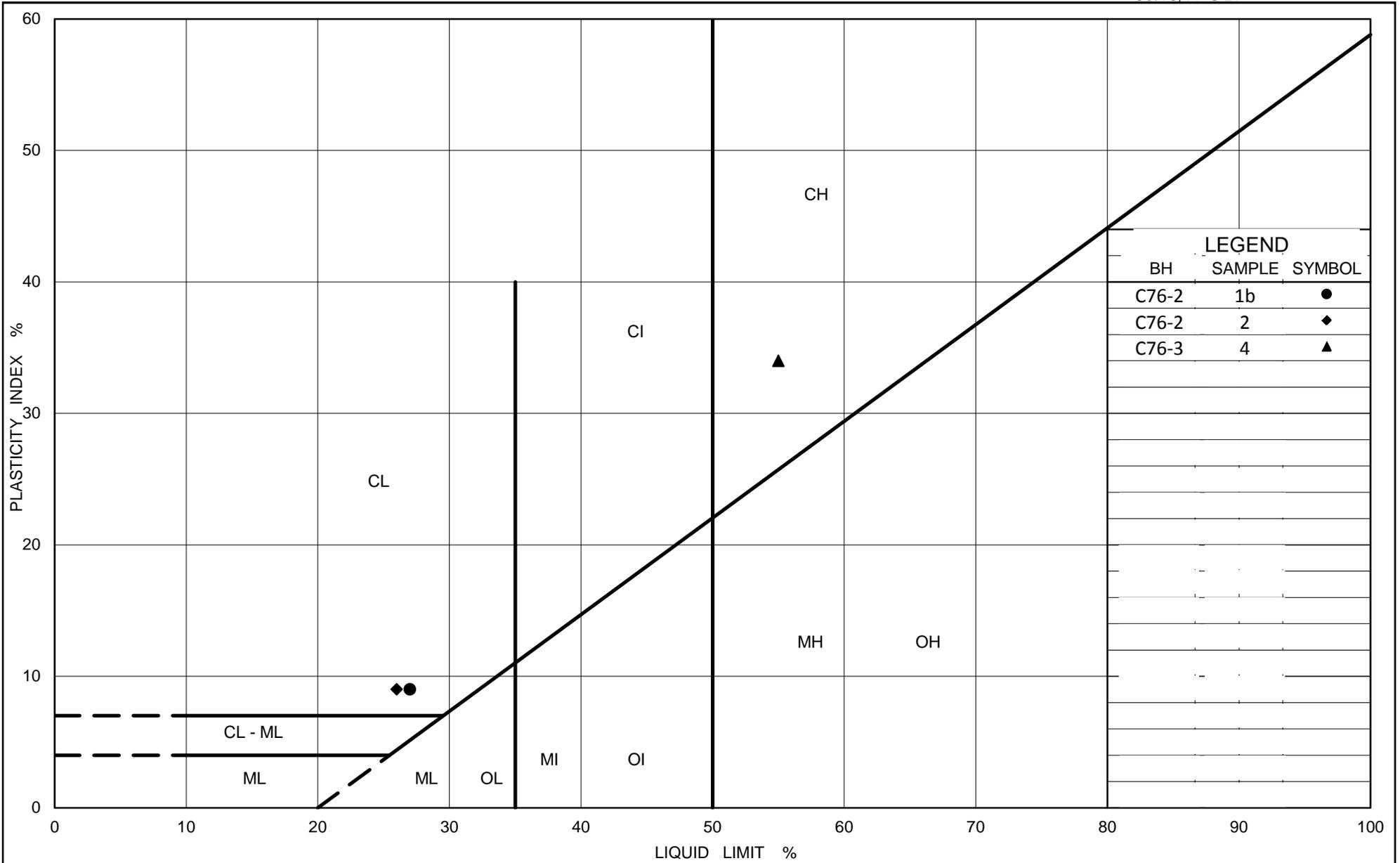
Compiled by: EC
Checked by: AB

TABLE G2
POINT LOAD STRENGTH TEST RESULTS
HIGHWAY 69 NBL AND SBL – STA 10+974 & 11+019
GWP 5403-05-00
HIGHWAY 69, POINTE AU BARIL

Borehole Number	Sample Depth ¹ (m)	Sample Elevation (m)	Rock Type	Test Type ²	Core Diameter (mm)	Ram Pressure (MPa)	Load (kN)	I _s Diametral ² (MPa)	I _s 50 mm ² (MPa)	Approximate UCS ² (MPa)
C76-1A	5.2	190.1	Gneiss	D	51	21.1	0.020	7.9	7.9	110
C76-1A	6.4	188.9	Gneiss	D	51	14.4	0.014	5.3	5.4	76
C76-1A	7.6	187.7	Gneiss	D	51	22.2	0.021	8.3	8.3	116
C76-2	4.0	191.3	Gneiss	D	51	20.3	0.019	7.6	7.6	106
C76-2	5.5	189.8	Gneiss	D	51	20.5	0.019	7.6	7.6	106
C76-2	6.4	188.9	Gneiss	D	51	6.5	0.006	2.4	2.4	34
C76-3	4.0	191.7	Meta-Quartzite	D	48	17.9	0.017	7.5	7.3	124
C76-3	5.0	190.7	Meta-Quartzite	D	48	15.5	0.015	6.5	6.4	109
C76-3	6.2	189.5	Meta-Quartzite	D	48	18.7	0.018	7.9	7.7	131
C76-4	13.9	184.1	Gneiss	D	48	16.3	0.015	6.9	6.7	94
C76-4	14.8	183.2	Gneiss	D	48	13.5	0.013	5.7	5.6	78
C76-4	16.1	181.9	Gneiss	D	48	13.0	0.012	5.5	5.3	74
C76-5	4.3	190.8	Gneiss	D	51	14.9	0.014	5.5	5.5	77
C76-5	5.2	189.9	Gneiss	D	51	11.8	0.011	4.4	4.4	62
C76-5	6.6	188.5	Gneiss	D	51	11.2	0.011	4.2	4.2	59

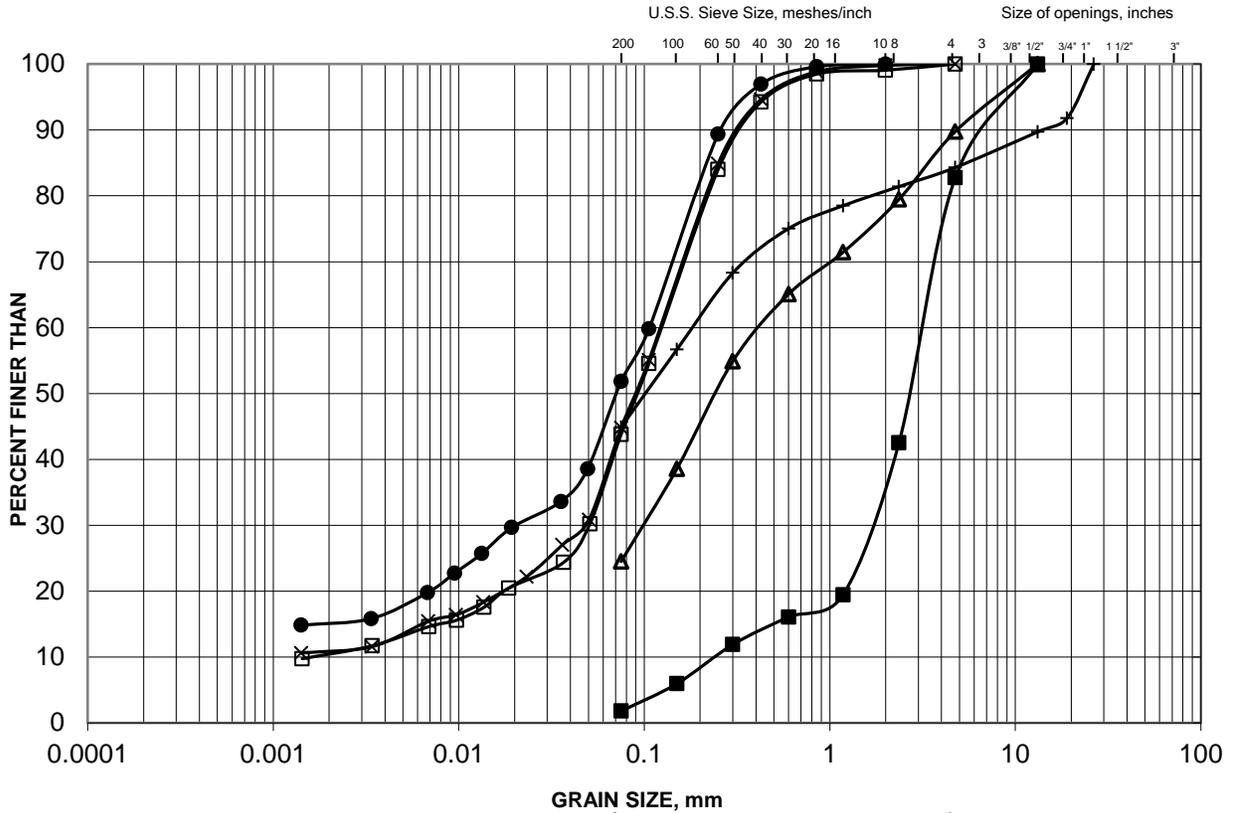
- NOTES:**
1. Depths are given below the ground surface at the borehole location.
 2. Where: D = Diametral test;
I_s Diametral = Uncorrected point load strength;
I_s 50 mm = Corrected point load strength; and
UCS = Uniaxial compressive strength = I_s 50 mm X C. Values of 14 and 17 have been used for the Gneiss and Meta-Quartzite, respectively, based on correlation with UCS for this site ("Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, Int. J. Rock Mech. Sci. and Geomechanical Abst., Vol 22, No. 2, 1985, pp. 53-60.

Compiled by: EC
Checked by: AB



GRAIN SIZE DISTRIBUTION
Sand and Silt to Sand
Highway 69 (NBL & SBL) STA 10+974 & 11+019

FIGURE
G2



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

LEGEND

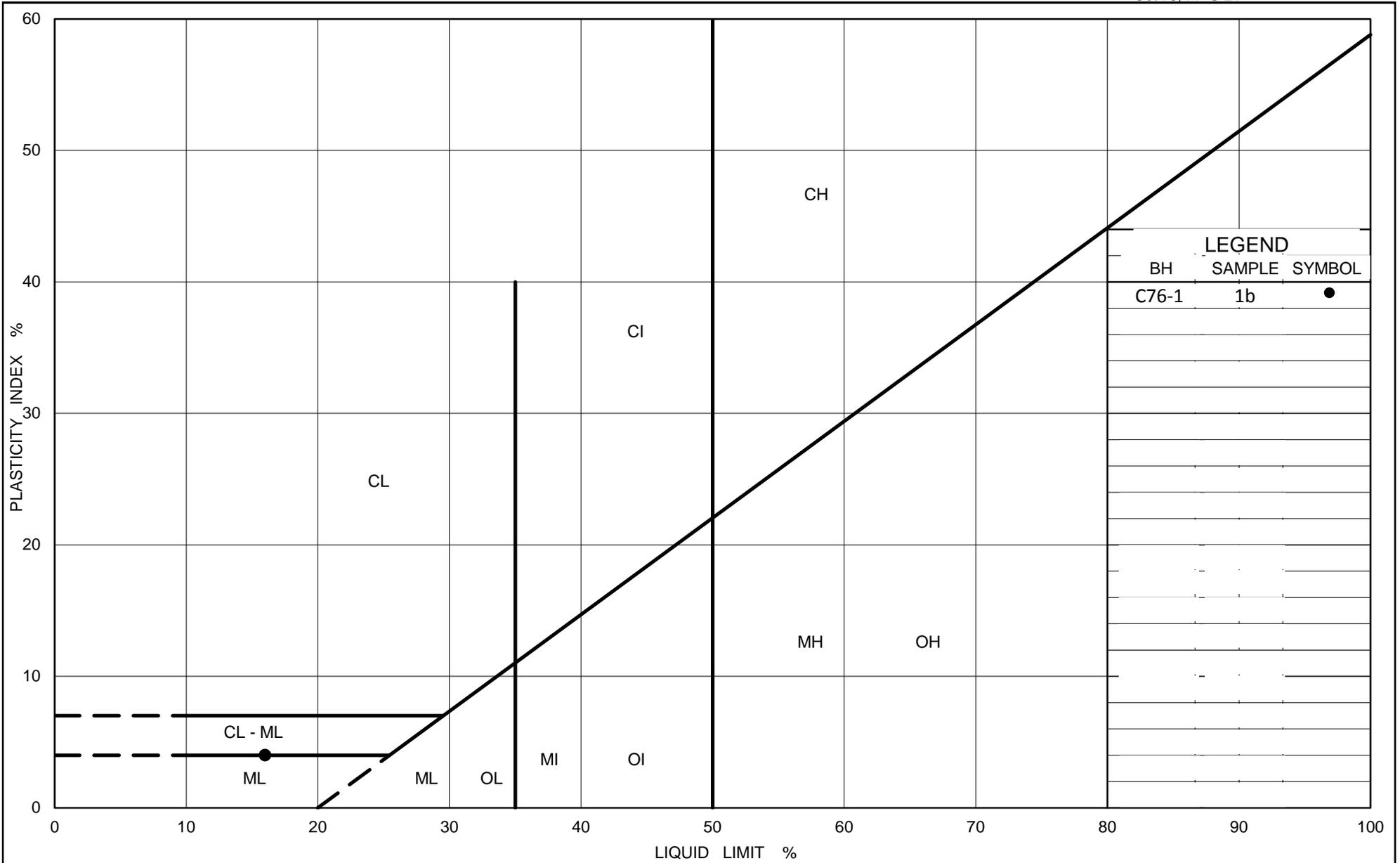
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	C76-1	1b	193.7
□	C76-1	2a	192.9
△	C76-1	3	192.1
■	C76-1	5	190.9
+	C76-1	7	189.8
×	C76-3	5	192.3

Project Number: 07-1191-0020-C1

Checked By: AB

Golder Associates

Date: January 2013



Ministry of Transportation
Ontario

PLASTICITY CHART
Sand and Silt
Hwy 69 (NBL) STA 10+974

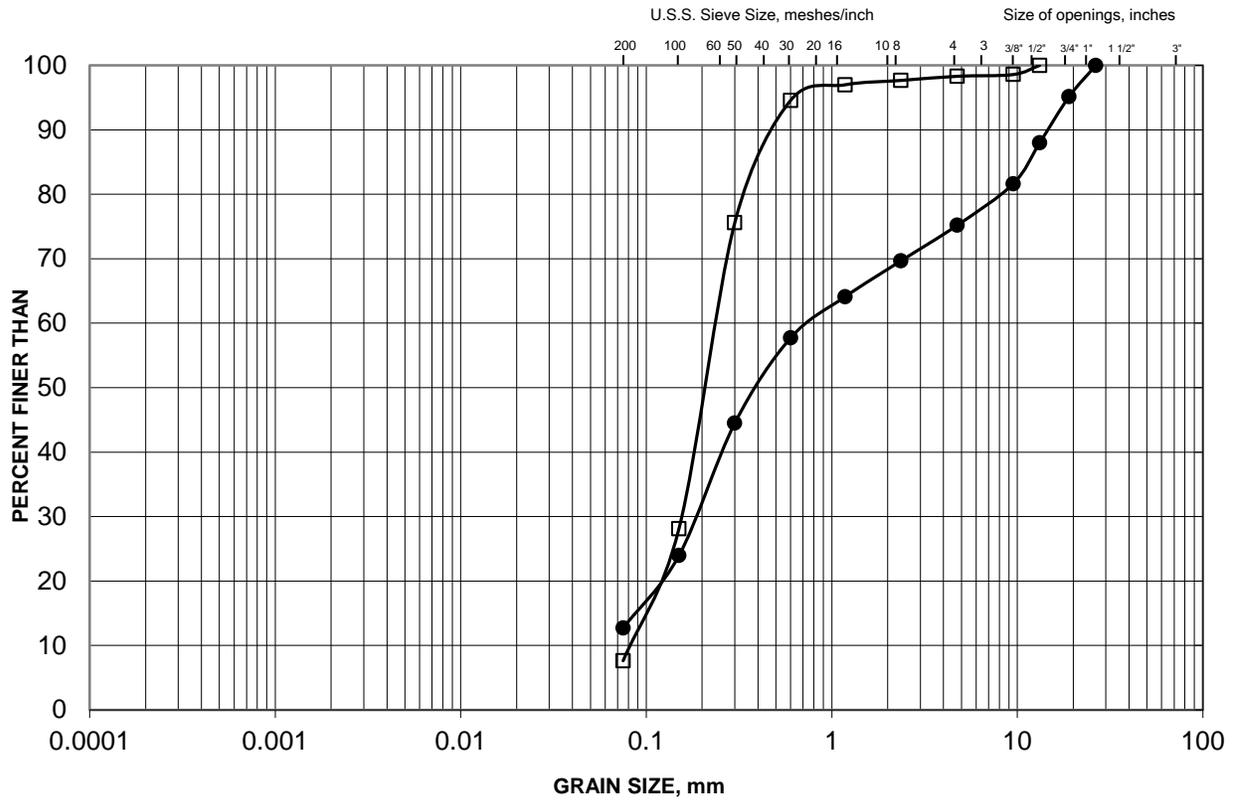
FIG No. G3

Project No. 07-1191-0020-C1

Checked By: AB

GRAIN SIZE DISTRIBUTION
Sand to Gravelly Sand (Fill)
Highway 69 (NBL & SBL) STA 10+974 & 11+019

FIGURE
G4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	C76-4	1	197.1
□	C76-4	5	193.1

Project Number: 07-1191-0020-C1

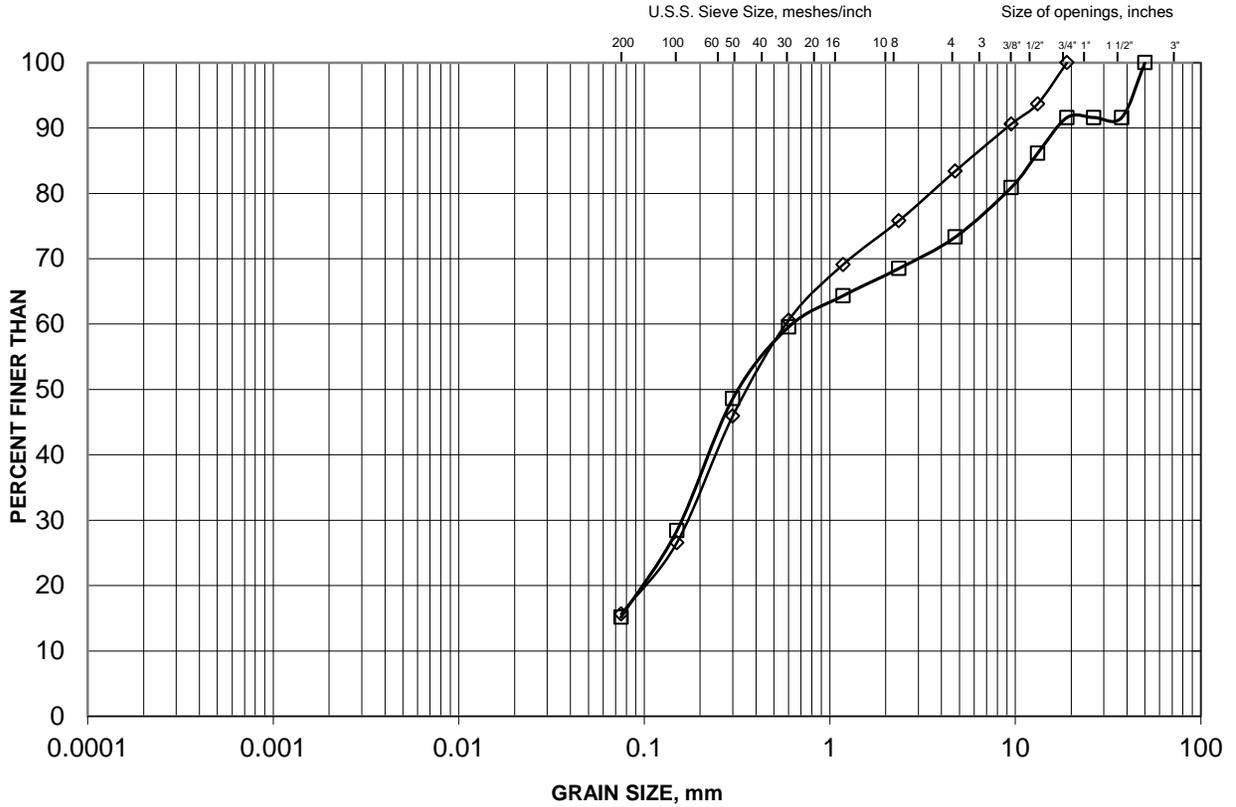
Checked By: AB

Golder Associates

Date: January 2013

GRAIN SIZE DISTRIBUTION
Sand to Gravelly Sand
Highway 69 (NBL & SBL) STA 10+974 & 11+019

FIGURE
G5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—◇—	C76-4	8	188.6
—□—	C76-4	10	185.5

Project Number: 07-1191-0020-C1
Checked By: AB

Golder Associates

Date: January 2013



APPENDIX H

Site 9 Road STA 13+165

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

CONT No.
WP No. 5133-12-01

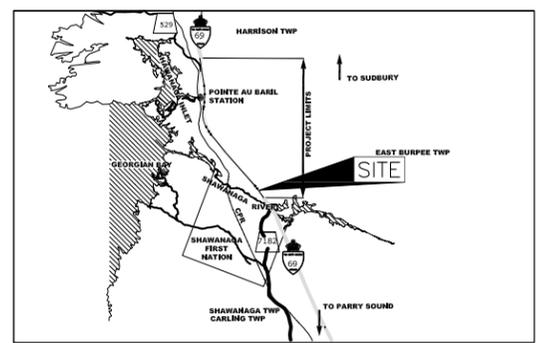


SITE 9 ROAD
CULVERT AT STA. 13+165
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
SUDBURY, ONTARIO, CANADA



KEY PLAN
SCALE 1:50,000
5 0 5 km

LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C-1	210.8	5046382.2	243085.9
C-2	211.5	5046397.1	243107.2

NOTES

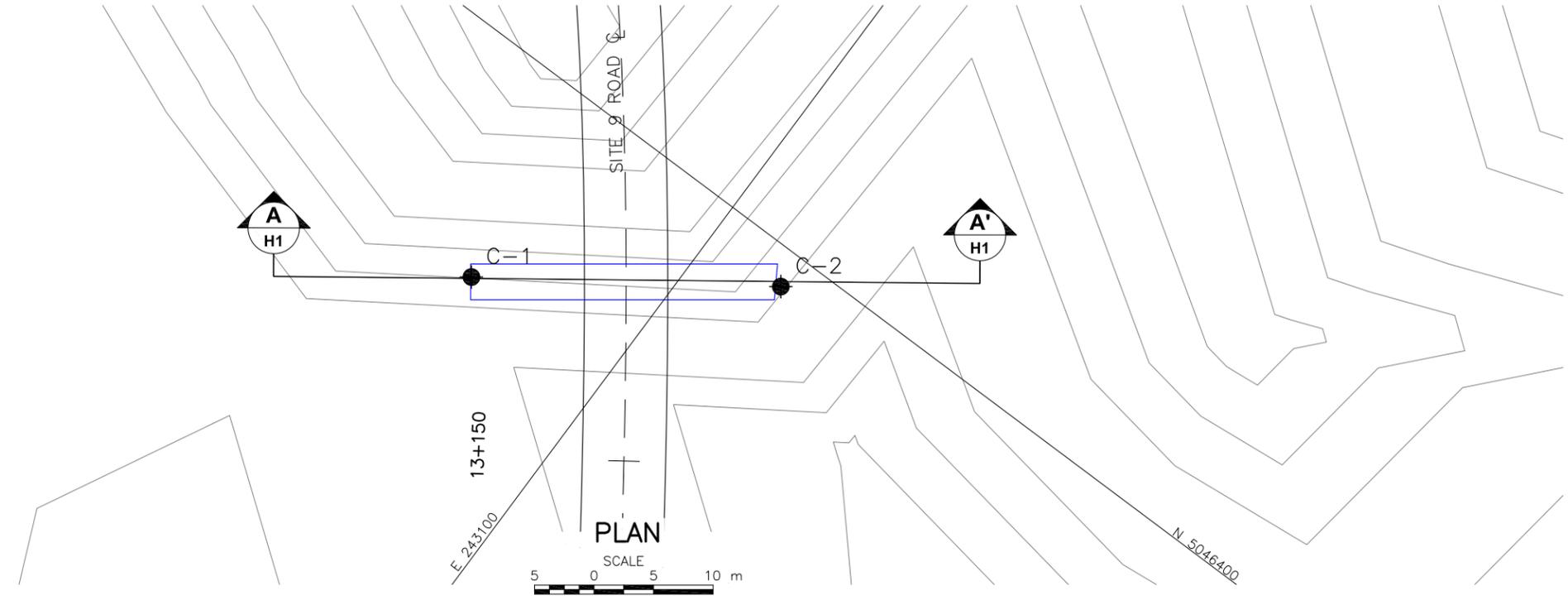
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

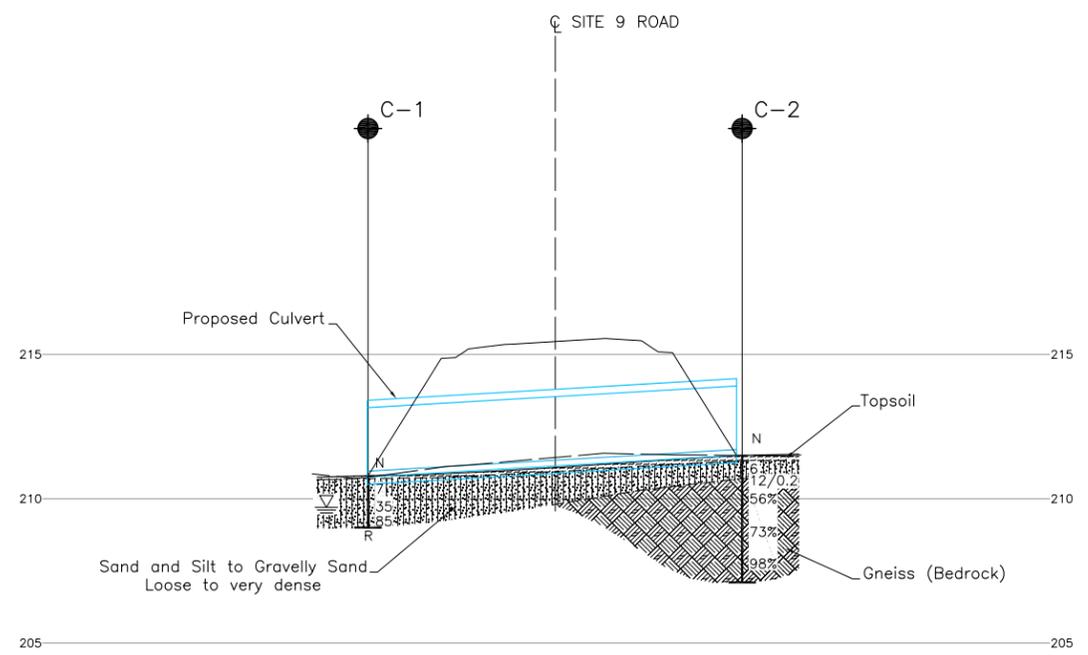
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)



PLAN
SCALE 1:500
5 0 5 10 m



A-A' PROFILE ALONG CULVERT
SITE 9 ROAD

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100
5 0 5 10 m
2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: J.J.L.	CHKD.	APPD. JMAC
		SITE: 44-581/C
		DWG. H1

RECORD OF BOREHOLE No C-1 1 OF 1 **METRIC**

PROJECT 07-1191-0020

W.P. 5403-05-00 LOCATION N 5046382.2; E 243085.9 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment COMPILED BY EC

DATUM Geodetic DATE February 8, 2011 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
210.8	GROUND SURFACE															
0.0	TOPSOIL Brown Moist	1a			7											
	SAND to Gravelly SAND, trace silt Loose to very dense Brown Moist to wet	1b	SS									○				
		2	SS		35											
		3	SS		85											
209.0	END OF BOREHOLE SPOON REFUSAL					209										
1.8	Note: 1. Water level at a depth of 1.1 m below ground surface (Elev. 209.7 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046397.1; E 243107.2</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 8, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
211.5	GROUND SURFACE															
0.0	TOPSOIL Black Moist		1a	SS	6											
0.2	SAND and SILT, trace gravel, trace clay Compact Brown Moist		1b													
210.7			2	SS	12/0.2											
0.8	GNEISS (BEDROCK)		1	RC	REC 100%											RQD = 56%
	Bedrock cored from 0.8 m depth to 4.4 m depth.															
	For coring details see Record of Drillhole C-2.		2	RC	REC 100%											RQD = 73%
			3	RC	REC 100%											RQD = 98%
207.1	END OF BOREHOLE															
4.4	Note: 1. Borehole dry upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: C-2

SHEET 1 OF 1

LOCATION: N 5046397.1 ;E 243107.2

DRILLING DATE: February 8, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diameter Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w/ ZL CORE AXIS	Type and Surface Description	Jr	Ja	Jn	k, cm/s				10 ⁰	10 ¹	10 ²
							80000000	80000000			000000	000000	000000	000000	000000	000000	000000				000000	000000	000000
		REFER TO PREVIOUS PAGE		210.7																			
1	NW	GNEISS Fine to coarse grained Slightly weathered to fresh Strong Pink and grey		0.8	1	Grey 100																	
2	NQ Coring February 9, 2011				2	Grey 100																	
3					3	Grey 100																	
4				207.1														UCS = 60 MPa					
5		END OF DRILLHOLE Note: 1. Joints generally undulating and rough. 2. UCS test core sample broke along healed joint.		4.4																			
6																							
7																							
8																							
9																							
10																							

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

DEPTH SCALE

1 : 50



LOGGED: ID

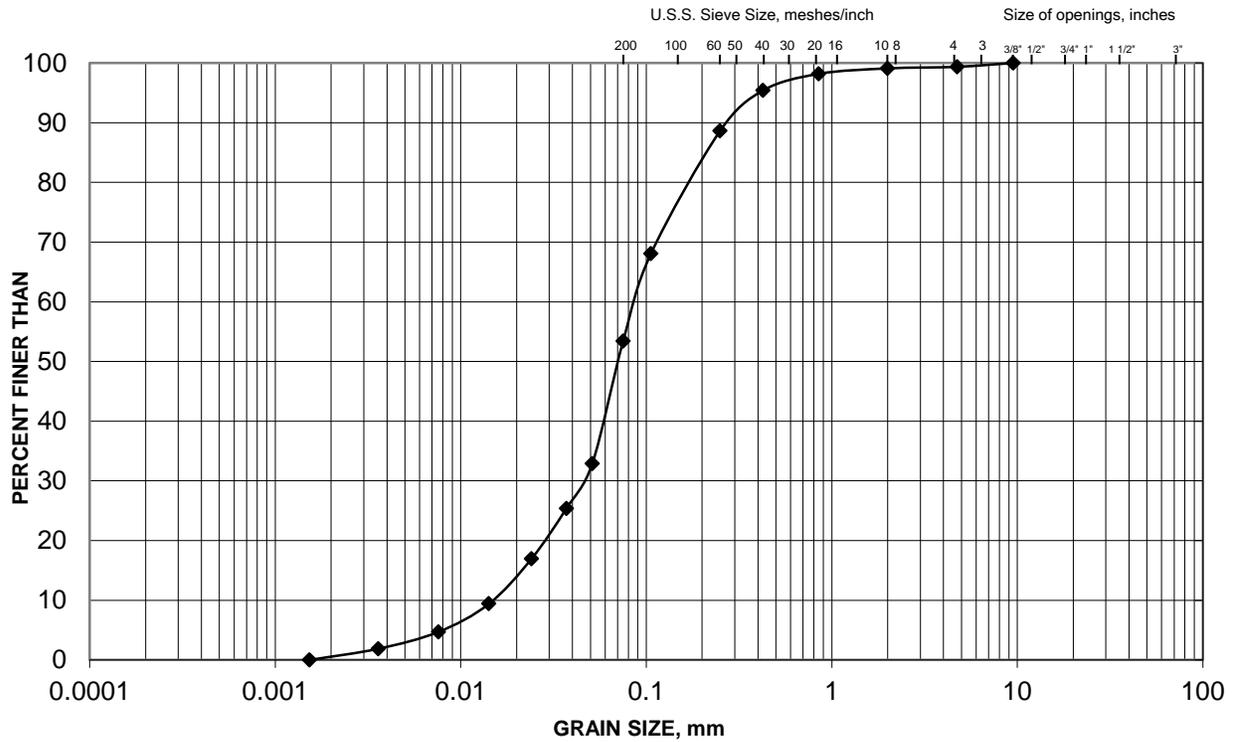
CHECKED: AB

GRAIN SIZE DISTRIBUTION

FIGURE

Sand and Silt
Site 9 Road STA 13+165

H1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (M)
◆	C-2	1B	211.1

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

Date: January 2013



APPENDIX I

Site 9 Road STA 14+045

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

CONT No.
 WP No. 5133-12-06

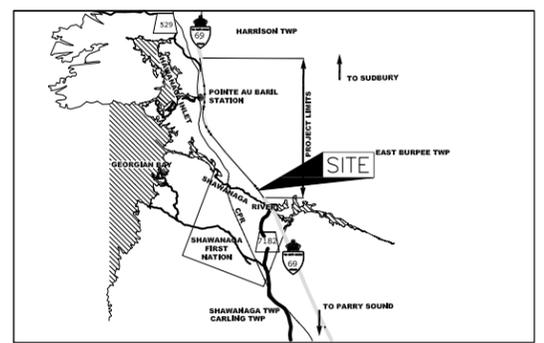


SITE 9 ROAD
 CULVERT AT STA. 14+045
 BOREHOLE LOCATIONS AND SOIL STRATA

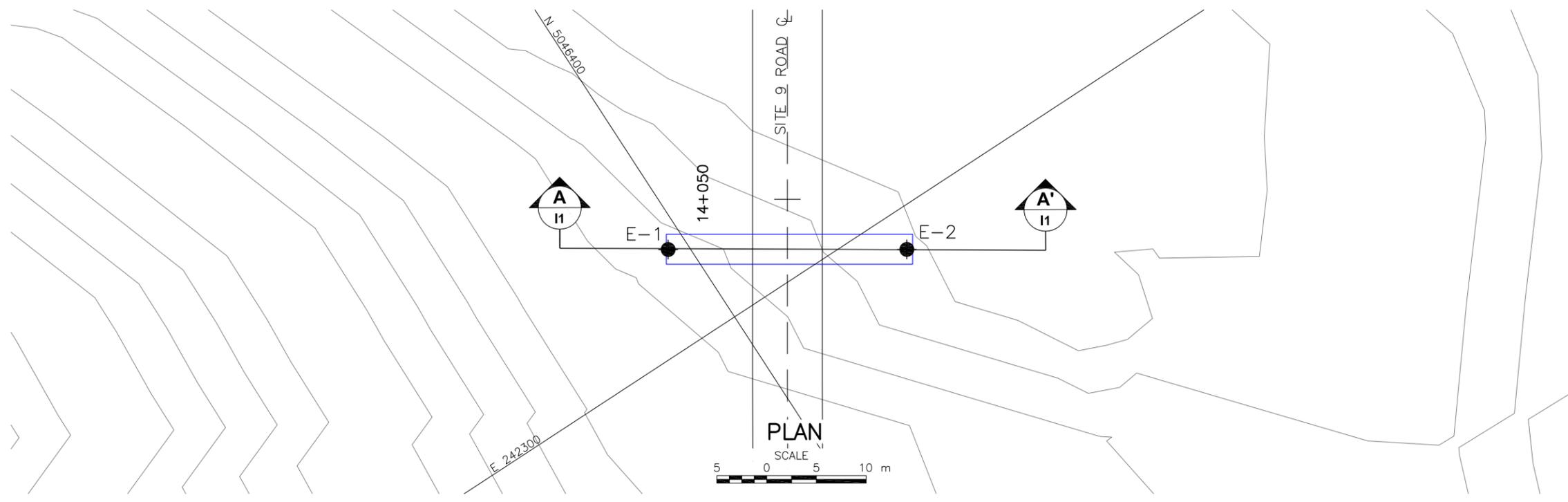
SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



KEY PLAN
 SCALE
 5 0 5 km



PLAN
 SCALE
 5 0 5 10 m

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- R Refusal
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
E-1	207.3	5046398.1	242290.7
E-2	207.3	5046418.2	242303.8

NOTES

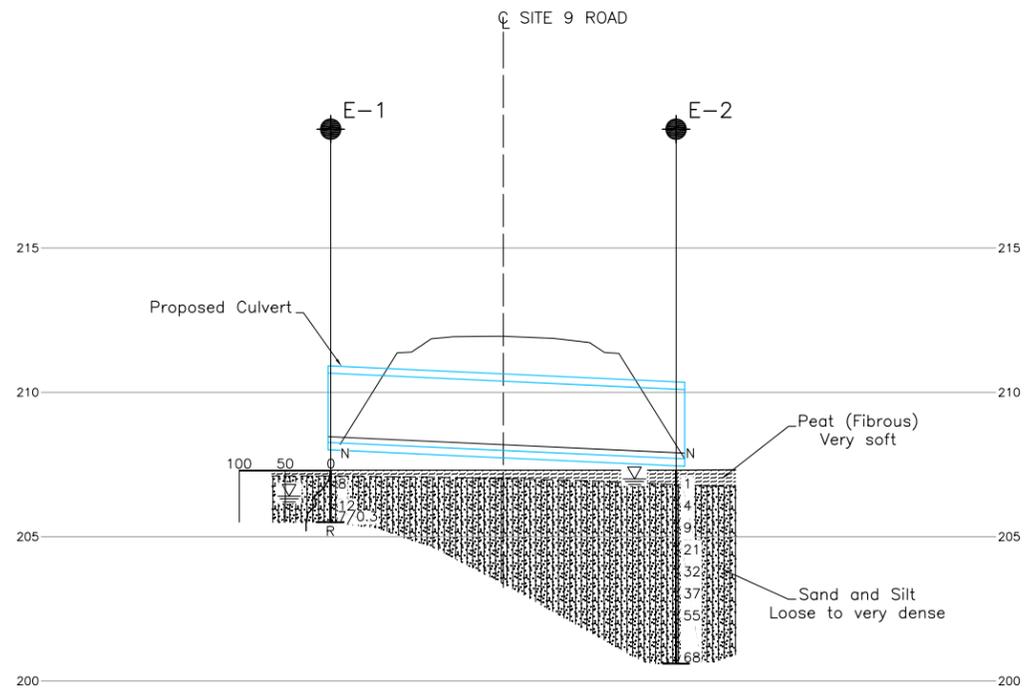
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The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

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 plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)



A-A' PROFILE ALONG CULVERT
 SITE 9 ROAD

HORIZONTAL SCALE
 5 0 5 10 m
 VERTICAL SCALE
 2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-584/C
		DWG. 11

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No E-1	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046398.1; E 242290.7</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 11 and 14, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
207.3	GROUND SURFACE																
0.0	PEAT (Fibrous)		1a														
0.2	Black Moist		1b	SS	8												
	SAND and SILT, trace clay		2	SS	12												
	Compact Brown Wet																
205.5	END OF BOREHOLE SPOON REFUSAL		3	SS	7/0.15												
1.8	Note: 1. Water level at a depth of 0.9 m below ground surface (Elev. 206.4 m) upon completion of drilling. 2. Moved and advanced DCPT 1.5 m north. Refusal at a depth of 2.1 m (Elev. 205.2 m).																

SUD-MTO 001 07-1191-0020-0100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No E-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046418.2; E 242303.8</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 10 and 11, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
							20	40	60	80	100						
207.3	GROUND SURFACE																
0.0	PEAT (Fibrous) Very soft Black Wet		1	SS	1	▽											
206.8	SAND and SILT, trace clay Loose to very dense Brown Wet		2	SS	4												
			3	SS	9												
			4	SS	21												
			5	SS	32												
			6	SS	37												
			7	SS	55												
			8	SS	68												
200.6	END OF BOREHOLE																
6.7	Note: 1. Water level at a depth of 0.3 m below ground surface (Elev. 207.0 m) upon completion of drilling.																

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

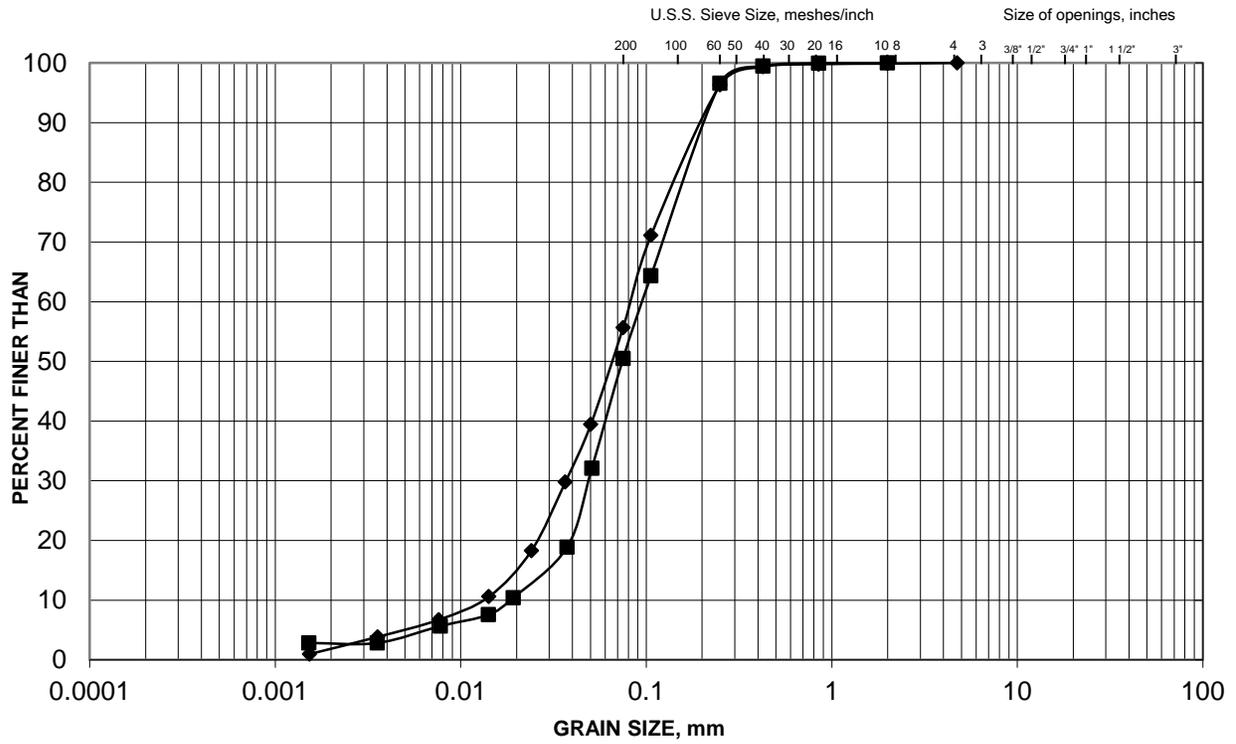
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

FIGURE

Sand and Silt
Site Road 9 STA 14+045

11



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
◆	E-1	2	206.2
■	E-2	3	205.6

Project Number: 07-1191-0020-C1

Checked By: EC/AB

Golder Associates

Date: January 2013



APPENDIX J

Site 9 Road STA 14+166

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

CONT No.
 WP No. 5133-12-07

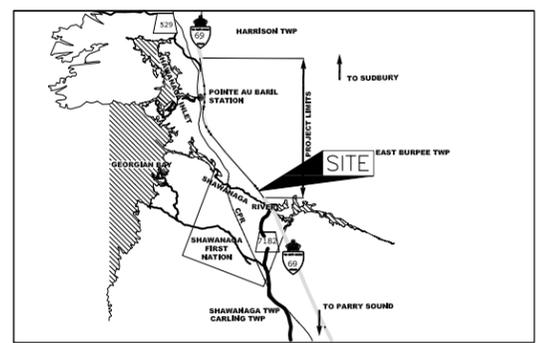


SITE 9 ROAD
 CULVERT AT STA. 14+166
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



KEY PLAN
 SCALE 5 0 5 km

LEGEND

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

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
F-1	207.1	5046457.4	242198.0
F-2	207.3	5046490.1	242195.4

NOTES

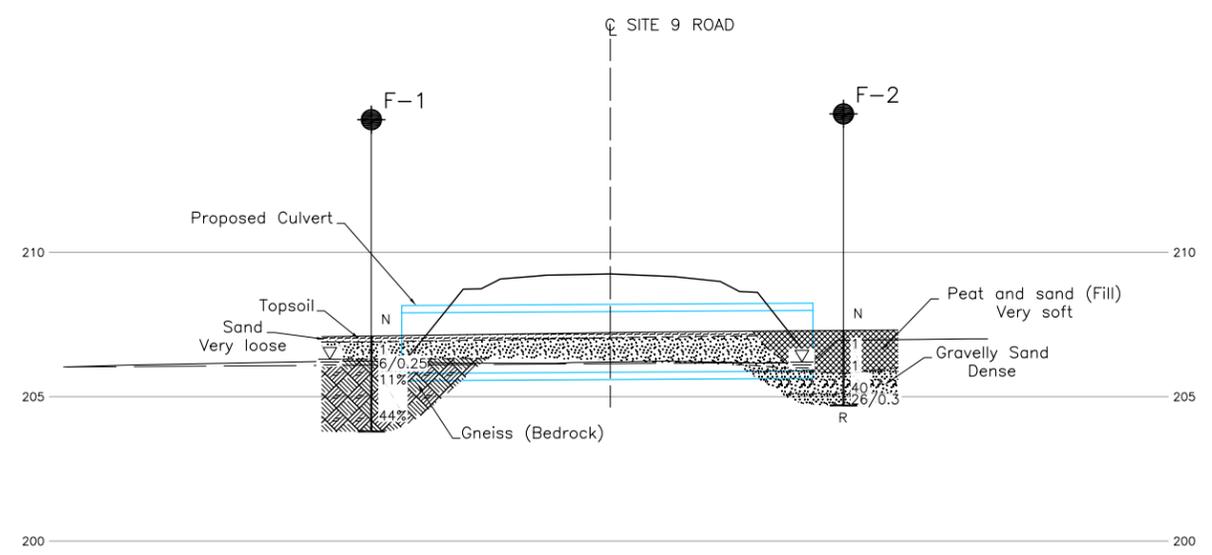
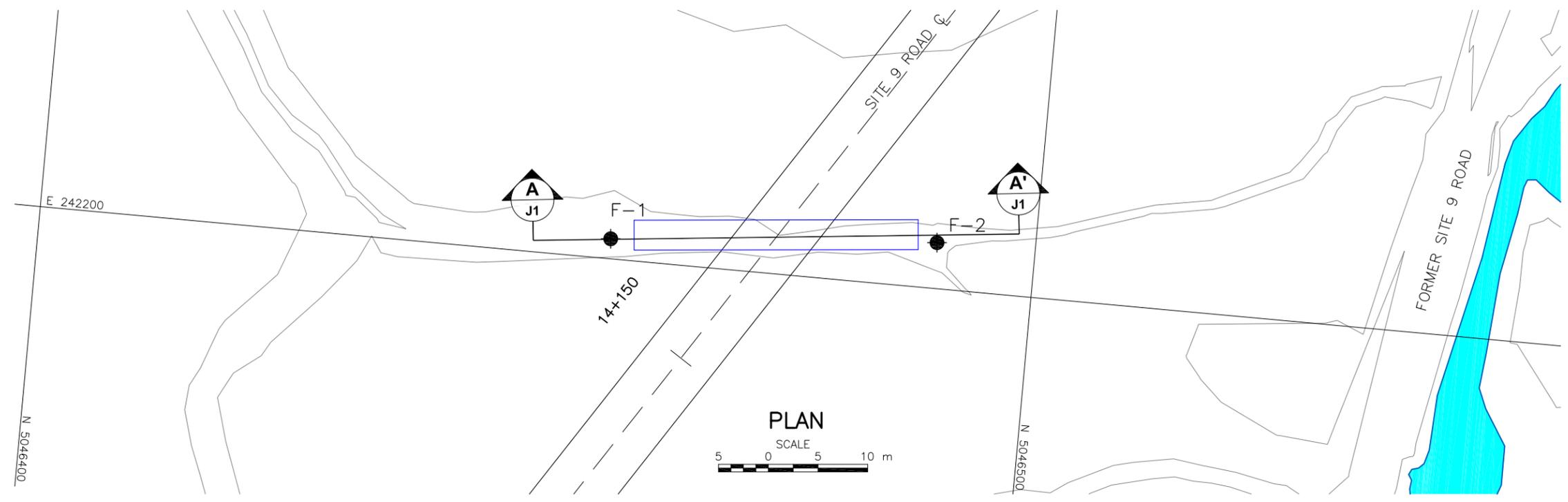
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert location provided by MMM in drawing file no. 5403-05-00 culverts.dwg (received Nov 2010)



**A-A' PROFILE ALONG CULVERT
 SITE 9 ROAD**

HORIZONTAL SCALE
 5 0 5 10 m

VERTICAL SCALE
 2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-585/C
		DWG. J1

RECORD OF BOREHOLE No F-1 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5046457.4; E 242198.0 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE Portable Equipment COMPILED BY EC

DATUM Geodetic DATE February 14, 2011 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
207.1	GROUND SURFACE																	
0.0	TOPSOIL Moist Brown		1	SS	1													
0.2																		
206.3	SAND trace organics Very loose Brown Wet		2	SS	6/0.26													
0.8																		
	GNEISS (BEDROCK)		1	RC	REC 100%													RQD = 11%
	Bedrock cored from 0.8 m depth to 3.3 m depth.																	
	For coring details see Record of Drillhole F-1.																	
			2	RC	REC 100%													RQD = 44%
203.8																		
3.3	END OF BOREHOLE																	
	Note: 1. Water level at a depth of 0.8 m below ground surface (Elev. 206.3m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT: 07-1191-0020

RECORD OF DRILLHOLE: F-1

SHEET 1 OF 1

LOCATION: N 5046457.4 ;E 242198.0

DRILLING DATE: February 14, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Equipment

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION			
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w/EL. AXIS	TYPE AND SURFACE DESCRIPTION	Ur	Ja	Ln	k, cm/s				10 ⁰	10 ¹	10 ²
								88888888	88888888			88888888	88888888	88888888	88888888	88888888	88888888	88888888				88888888	88888888	88888888
		REFER TO PREVIOUS PAGE		206.3																				
1	NQ Coring February 14, 2011	GNEISS Fine to medium grained Slightly to moderately weathered Very strong Grey		0.8	1	Grey	100															UCS = 121 MPa		
2				2	Grey	100																		
3		END OF DRILLHOLE		203.8																				
4		Note: 1. Highly fractured between 1.5 m and 2.1 m and between 2.7 m and 3.3 m depth respectively. 2. Joints generally undulating and rough.		3.3																				
5																								
6																								
7																								
8																								
9																								
10																								

SUD-RCK 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No F-2	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5046490.1; E 242195.4</u>	ORIGINATED BY <u>ID</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>EC</u>
DATUM <u>Geodetic</u>	DATE <u>February 15, 2011</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
207.3	GROUND SURFACE																	
0.0	Peat and sand (FILL) Very soft Black Moist to wet		1	SS	1													
205.8			2	SS	1	▽							○					
1.5	Gravelly SAND, some silt Dense Grey Wet		3	SS	40								○					27 54 (19)
204.7			4	SS	26/0.16													
2.6	END OF BOREHOLE SPOON REFUSAL Note: 1. Water level at a depth of 1.1 m below ground surface (Elev. 206.2 m) upon completion of drilling. 2. Ground surface appeared to be previously disturbed from excavations in area of borehole (i.e. ditching of creek).																	

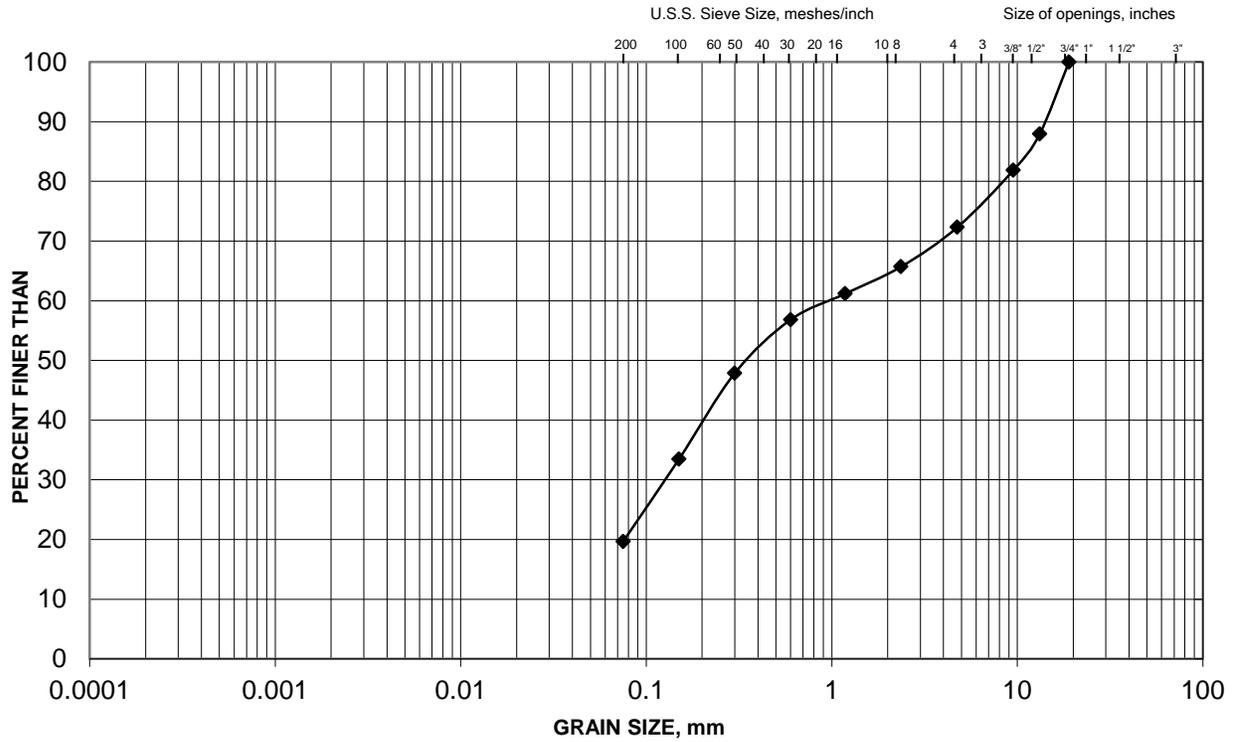
SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION

Gravelly Sand
Site 9 Road STA 14+166

FIGURE

J1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
—◆—	F-2	3	205.5

Project Number: 07-1191-0020-C1
 Checked By: EC/AB

Golder Associates

Date: January 2013



APPENDIX K

Site 9 Road STA 17+072 (Swamp 8)

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

CONT No.
 WP No. 5133-12-13

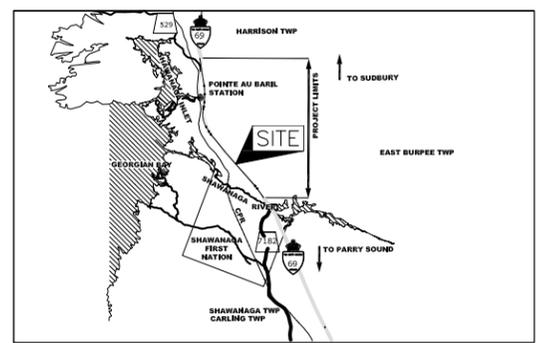
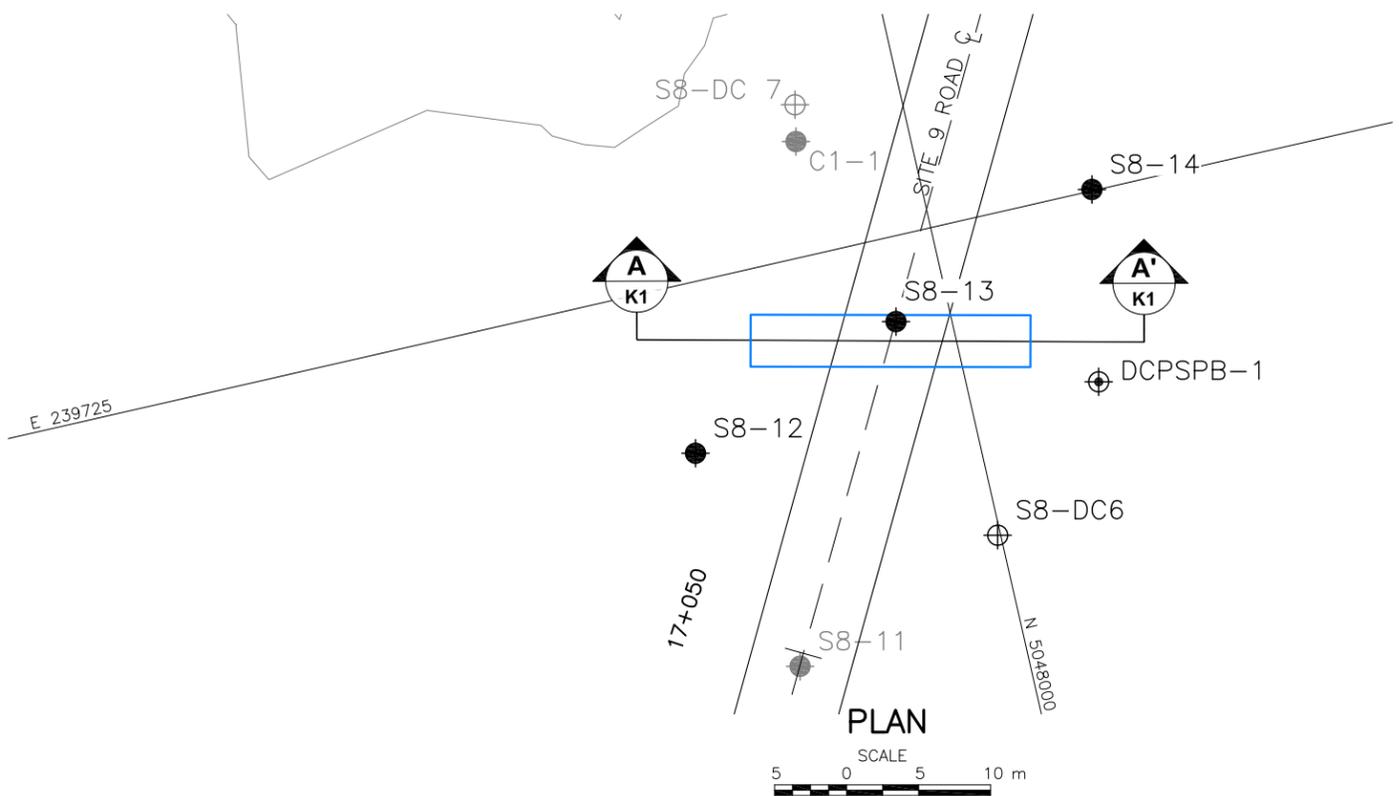


SITE 9 ROAD
 CULVERT AT STA. 17+072
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



KEY PLAN
 SCALE 0 5 km

LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
DCPSPB-1	205.3	5048009.0	239738.0
S8-12	205.4	5047980.6	239736.6
S8-13	205.4	5047996.2	239730.8
S8-14	205.4	5048011.5	239724.9
S8-DC6	205.4	5047999.8	239746.8

NOTES

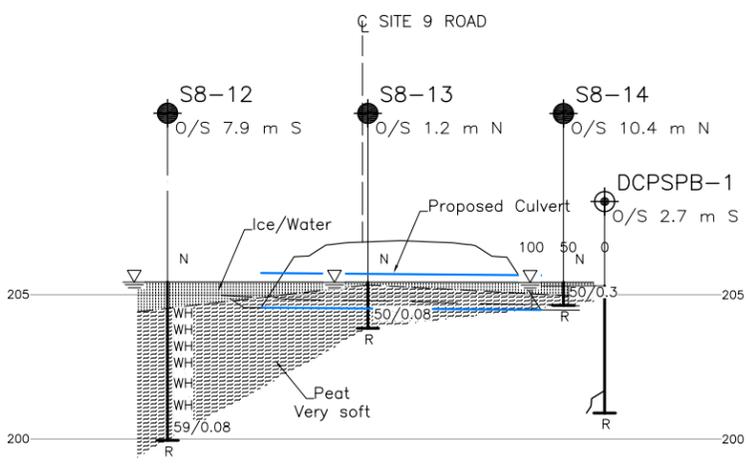
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

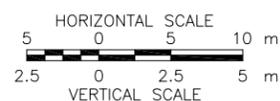
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. PLAN-New location for CV-130A-Site 9 Road-Hwy69 5403-05-00.DWG (received June 3, 2010)



A-A' PROFILE ALONG CULVERT
 K1 SITE 9 ROAD



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-589/C
		DWG. K1

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S8-12	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047980.6; E 239736.6</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Hand Sampling Equipment</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>February 14, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
205.4	ICE SURFACE															
0.9	ICE WATER															
204.5																
0.9	PEAT (Fibrous) Very soft Black Wet		1	SS	WH									805.1		
			2	SS	WH											
203.1																
2.3	PEAT (Amorphous) Very soft Black Wet		3	SS	WH											
			4	SS	WH									1462.8		
			5	SS	WH											
			6	SS	WH											
200.0																
5.6	SAND, trace gravel Grey Wet END OF BOREHOLE SPOON REFUSAL		7	SS	59/0.08											

Notes:

- Water level at ice surface (Elev. 205.4 m) upon completion of drilling.
- Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a full weight hammer.

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No S8-13 1 OF 1 **METRIC**

PROJECT 07-1191-0020

W.P. 5403-05-00 LOCATION N 5047996.2; E 239730.8 ORIGINATED BY MR

DIST HWY 69 BOREHOLE TYPE Portable Equipment, Hand Auger COMPILED BY AW

DATUM Geodetic DATE February 14, 2008 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20	40	60	80	100	W _p	W	W _L			
205.4	ICE SURFACE															
0.9	ICE WATER PEAT (Fibrous) Very soft Black Wet															
203.8	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)		1	SS	WH											
1.6	Notes: 1. Water level at ice surface (Elev. 205.4 m) upon completion of drilling. 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT "N" values have been adjusted to the inferred values that would be obtained using a standard weight hammer.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S8-14	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048011.5; E 239724.9</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, Hand Auger</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>February 14, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20	40
205.4	ICE SURFACE																		
0.0	ICE																		
205.0	WATER																		
204.6	PEAT (Fibrous)		1	SS	WH														
0.8	Very soft Black Wet																		
	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)																		
	Notes: 1. Water level at ice surface (Elev. 205.4 m) upon completion of drilling. 2. Split spoon samples obtained by driving with a 1/3 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																		

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF DCPT No S8-DC 6	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5047999.8; E 239746.8</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Dynamic Cone Penetration Test</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>February 14, 2008</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100						
205.4 0.0	ICE SURFACE START OF DCPT															
						205										
						204										
						203										
						202										
						201										
200.4 5.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (109 Blows/0.15 m)															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

RECORD OF BOREHOLE No DCPSPB-1 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-South Pointe Au Baril-Sta 10+200 65 LT, Co-ords: 5048009N; 239738E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic cone penetration test COMPILED BY C. Roy
 DATUM Geodetic DATE 2005.02.03 CHECKED BY T. Crilly

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
205.3	Water Surface															
0.0	Water															
204.7																
0.6	Probable peat															
202.0																
3.4	probable silt															
200.9																
4.4	End of Dynamic Cone Penetration Test Refusal on Probable Bedrock															

ONTARIO MOT_Hwy 69 SOUTH POINTE_AU BARIL_GPJ_ONTARIO MOT_GDT_05/08/26

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



APPENDIX L

Site 9 Road STA 17+488 (Swamp 7)

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

CONT No.
 WP No. 5133-12-16

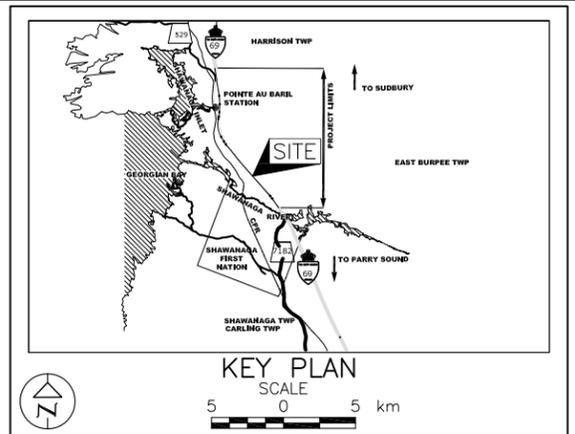
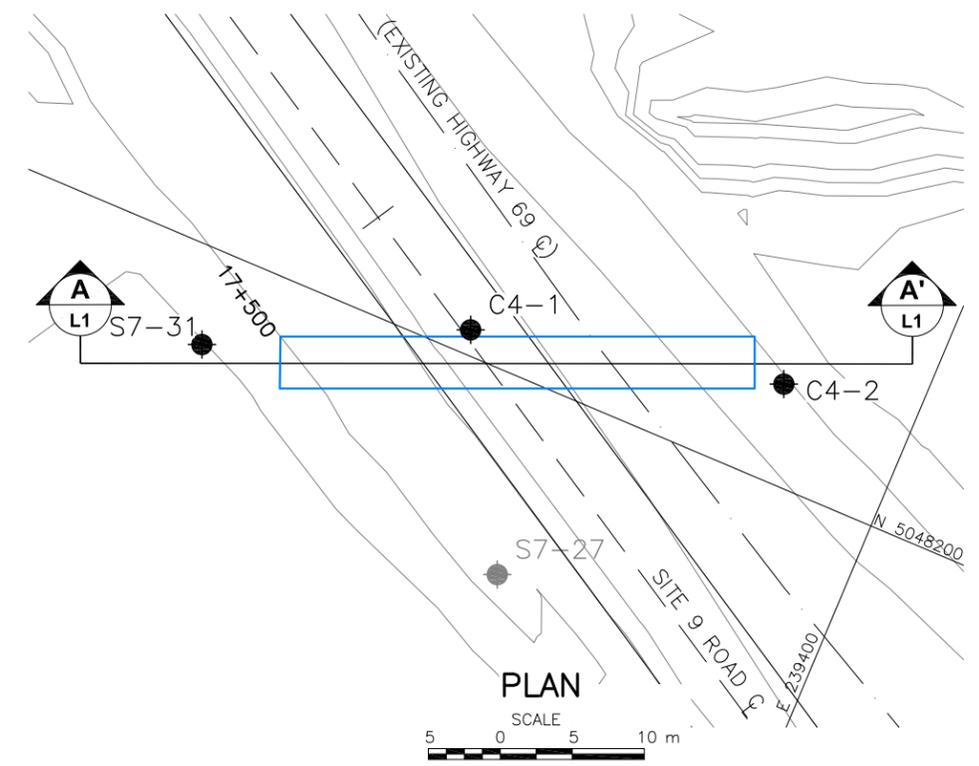


SITE 9 ROAD
 CULVERT AT STA. 17+488
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C4-1	206.3	5048201.7	239369.1
C4-2	205.7	5048206.7	239390.6
S7-31	204.9	5048193.5	239352.3

NOTES

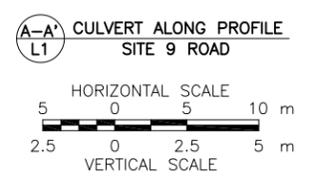
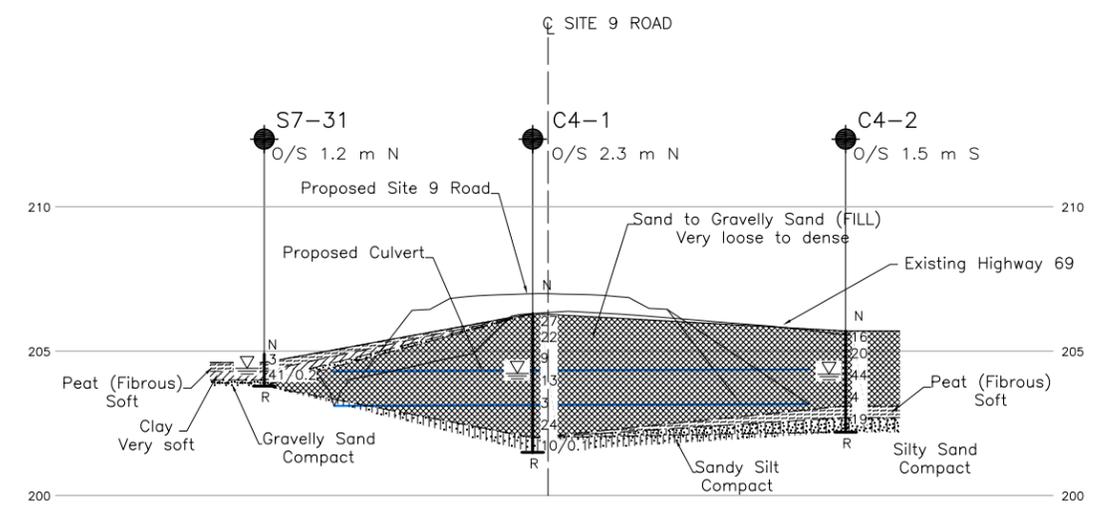
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The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

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REFERENCE

Base plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert locations provided by MMM in drawing file no. PLAN-New location for CV-130A-Site 9 Road-Hwy69 5403-05-00.DWG (received June 3, 2010)



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-591/C
		DWG. L1

RECORD OF BOREHOLE No C4-1 1 OF 1 **METRIC**

PROJECT 07-1191-0020

W.P. 5403-05-00 LOCATION N 5048201.7; E 239369.1 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY JJL

DATUM Geodetic DATE April 6 and 7, 2010 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
206.3	GROUND SURFACE																	
0.0	ASPHALT																	
205.8	Sand and gravel (FILL) Compact Grey Moist		1	SS	27													
0.5	Sand to gravelly sand, trace to some silt (FILL) Very loose to compact Brown Moist to wet		2	SS	22													
			3	SS	9	▽												
			4	SS	13													
			5	SS	3													
202.0			6	SS	24													
4.3	Sandy SILT with silty clay pockets Compact Grey		7	SS	10/0.1													
201.5	Wet																	
4.8	END OF BOREHOLE SPOON AND AUGER REFUSAL																	
	Note: 1. Water level at a depth of 2.0 m below ground surface (Elev. 204.3 m) upon completion of drilling.																	

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

RECORD OF BOREHOLE No C4-2 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5048206.7; E 239390.6 ORIGINATED BY ID

DIST HWY 69 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY JJL

DATUM Geodetic DATE April 6, 2010 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60		GR SA SI CL	
205.7	GROUND SURFACE															
0.0	Sand and gravel (FILL) Grey Moist		1	SS	16											
0.2	Sand to gravelly sand, trace silt (FILL) Compact to dense Brown Moist to wet		2	SS	20							○				
			3	SS	44											
203.1			4	SS	4											
202.7	Peat (Fibrous) Soft Black Wet															
3.0			5	SS	19							○			7 61 28 4	
202.2	Silty SAND, trace to some gravel, trace clay Compact Grey Wet															
3.5	END OF BOREHOLE SPOON AND AUGER REFUSAL															
	Note: 1. Water level at a depth of 1.6 m (Elev. 204.1 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No S7-31	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048193.5; E 239352.3</u>	ORIGINATED BY <u>ID</u>
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>AW</u>
DATUM <u>Geodetic</u>	DATE <u>January 29, 2009</u>	CHECKED BY <u>AB</u>

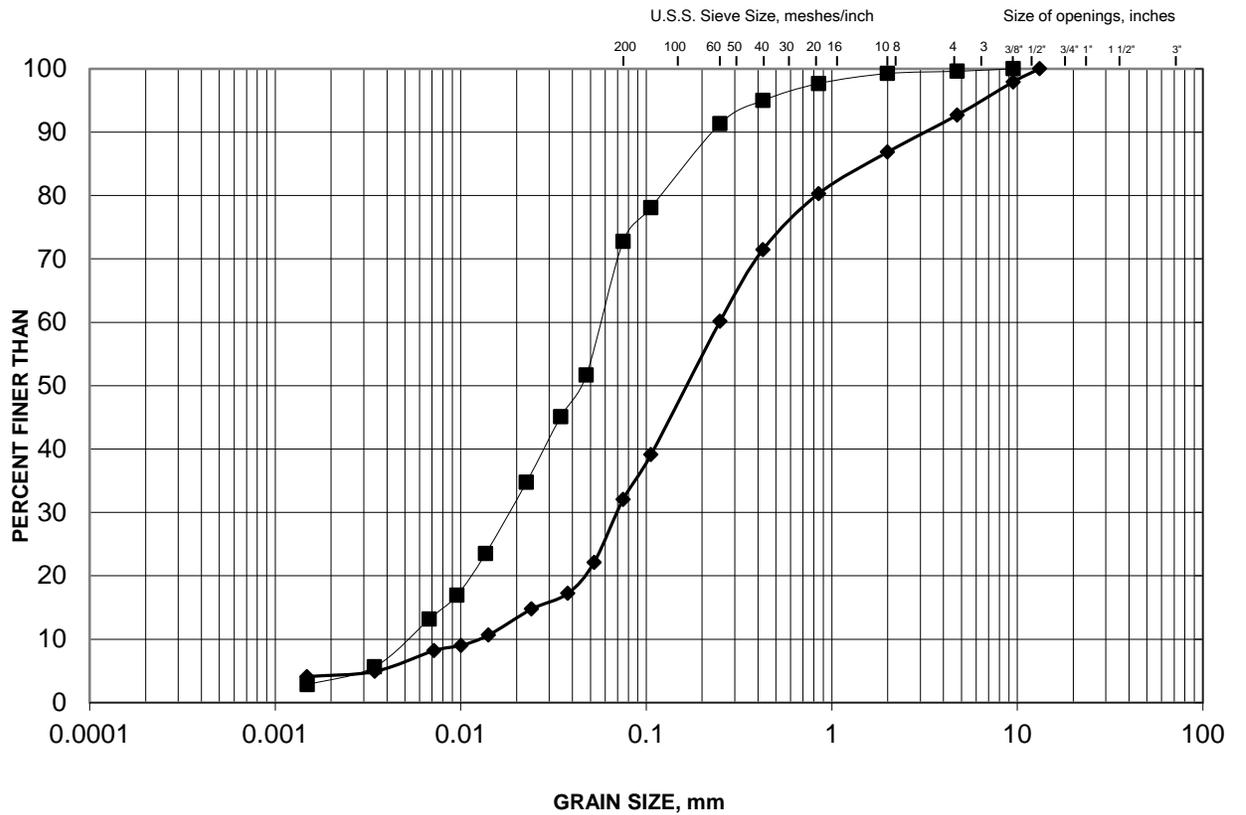
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
							SHEAR STRENGTH kPa					W _p	W	W _L		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	20	40	60	kN/m ³	
204.9	SNOW SURFACE															
0.0	SNOW															
204.6			1	SS	3											
204.3	PEAT (Fibrous) Soft Black Wet					∇										
204.0			2	SS	41/0.2											
1.1	CLAY Grey Wet Gravelly SAND Grey Wet END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING) Note: 1. Water level at a depth of 0.3 m below ground surface (Elev. 204.3 m) upon completion of drilling.															

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

GRAIN SIZE DISTRIBUTION

**Sandy Silt to Silty Sand
Site 9 Road STA 17+488**

**FIGURE
L1**



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
■	C4-1	7	201.6
◆	C4-2	5	202.4

Project Number: 07-1191-0020-C1

Checked By: AB

Golder Associates

Date: January 2013



APPENDIX M

Site 9 Road STA 18+034 (Swamp 6)

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

CONT No.
WP No. 5133-12-19

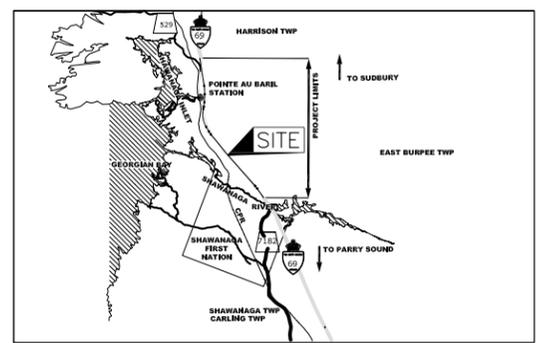


SITE 9 ROAD
CULVERT AT STA. 18+034
BOREHOLE LOCATIONS AND SOIL STRATA

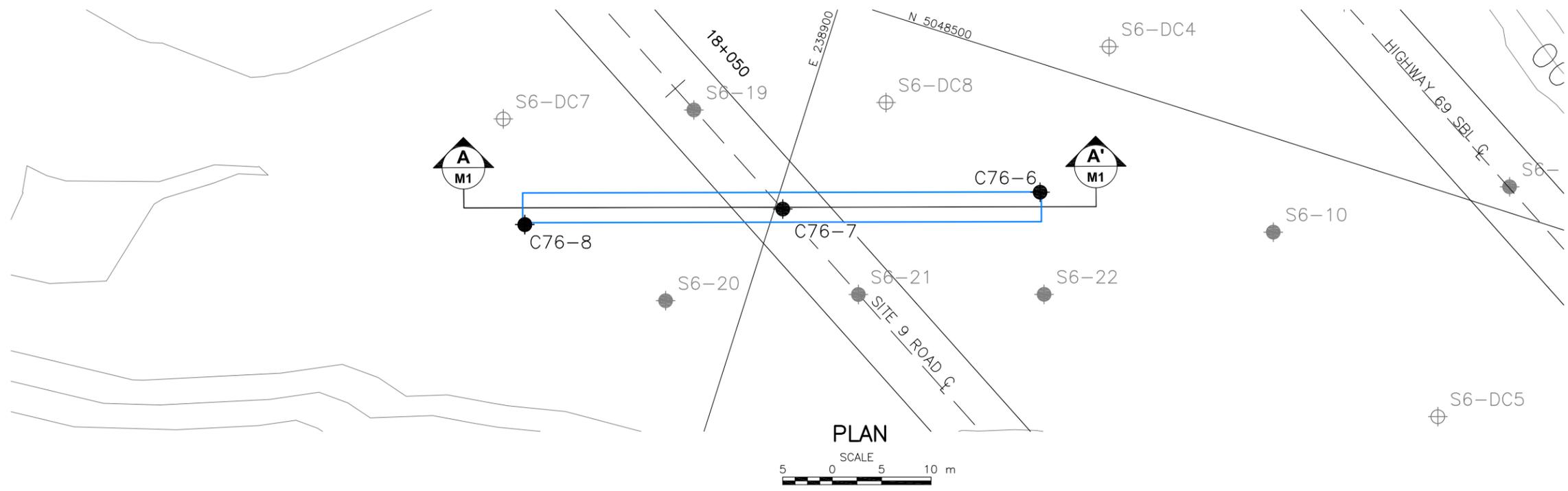
SHEET



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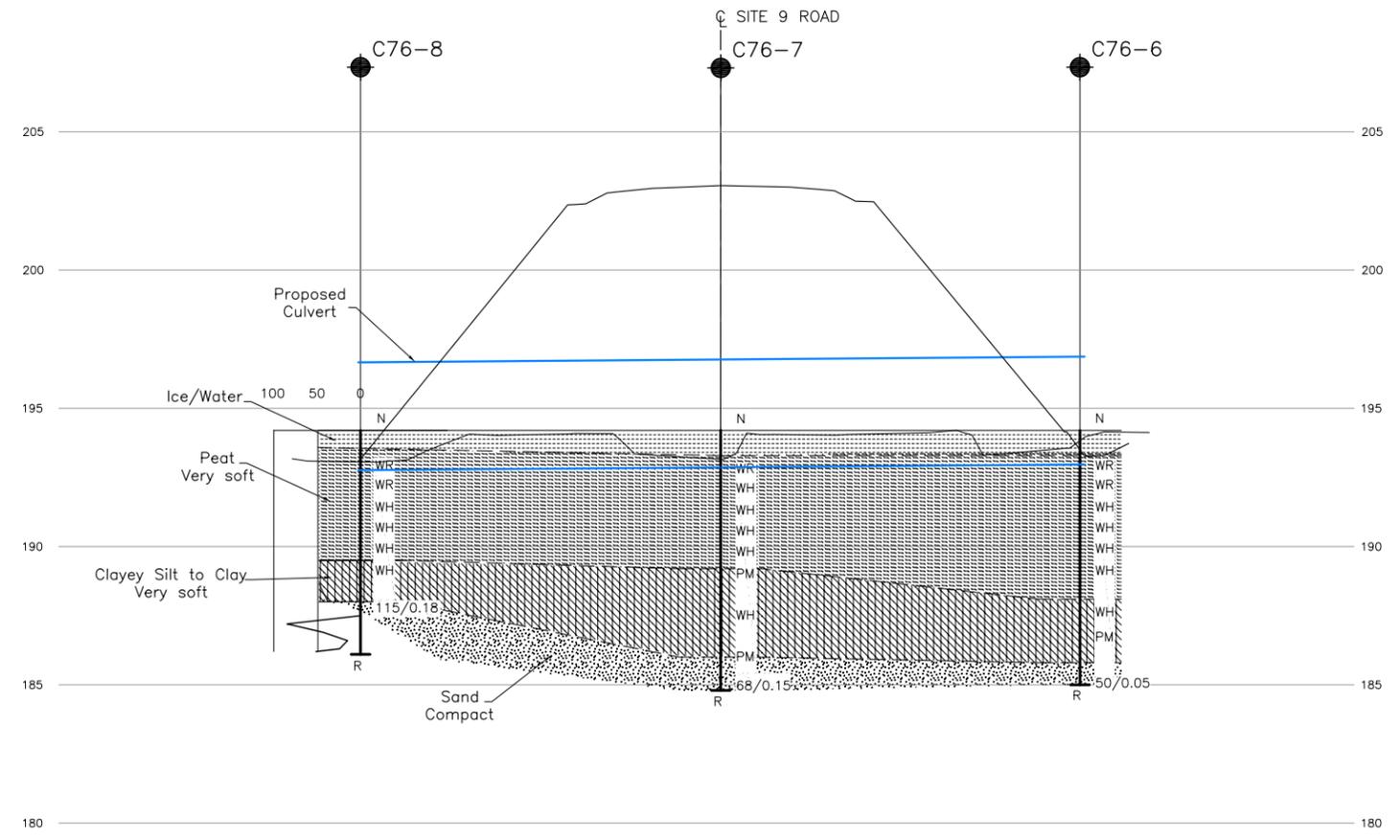


KEY PLAN
SCALE
5 0 5 km



PLAN

SCALE
5 0 5 10 m



A-A' PROFILE ALONG CULVERT
M1
SITE 9 ROAD

HORIZONTAL SCALE
5 0 5 10 m
VERTICAL SCALE
2.5 0 2.5 5 m

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R Refusal
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C76-6	194.2	5048487.6	238925.1
C76-7	194.1	5048478.1	238900.8
C76-8	194.1	5048468.7	238876.4

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 plan provided in digital format by MMM Group, drawing file no. Hwy 69 Design - Rollplan - Golder Foundation.dwg (received Dec. 2007) and key plan, drawing file no. Hwy 69-529-Project key plan (received Apr. 2008). Culvert location provided by MMM in drawing file no. Plan & XS Cvs 137,138,140.dwg (received February 29, 2012).



NO.	DATE	BY	REVISION

Geocres No. 41H-79

HWY. 69	PROJECT NO. 07-1191-0020	DIST.
SUBM'D. EC	CHKD. AB	DATE: JAN 2013
DRAWN: JJJ	CHKD.	APPD. JMAC
		SITE: 44-593/C
		DWG. M1

RECORD OF BOREHOLE No C76-7 1 OF 1 **METRIC**

PROJECT 07-1191-0020 W.P. 5403-05-00 LOCATION N 5048478.1; E 238900.8 ORIGINATED BY TDM

DIST HWY 69 BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring COMPILED BY MM

DATUM Geodetic DATE February 3, 2009 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100	20	40	60		GR SA SI CL		
194.1 0.0	ICE SURFACE ICE and WATER																
193.3 0.8	PEAT (Fibrous) Very soft Black Wet		1	SS	WR									695.3			
			2	SS	WH												
			3	SS	WH											507.8	
191.1 3.0	PEAT (Amorphous) Very soft Black Wet		4	SS	WH												
			5	SS	WH												
189.2 4.9	SILTY CLAY Very soft Grey Wet		6	TO	PM												
			7	SS	WH												
186.0 8.1	SAND, some gravel, trace silt Grey Wet		8	TO	PM												
			9	SS	68/0.15												
184.8 9.3	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)																
	Note: 1. Split spoon samples obtained by driving with a 1/2 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																

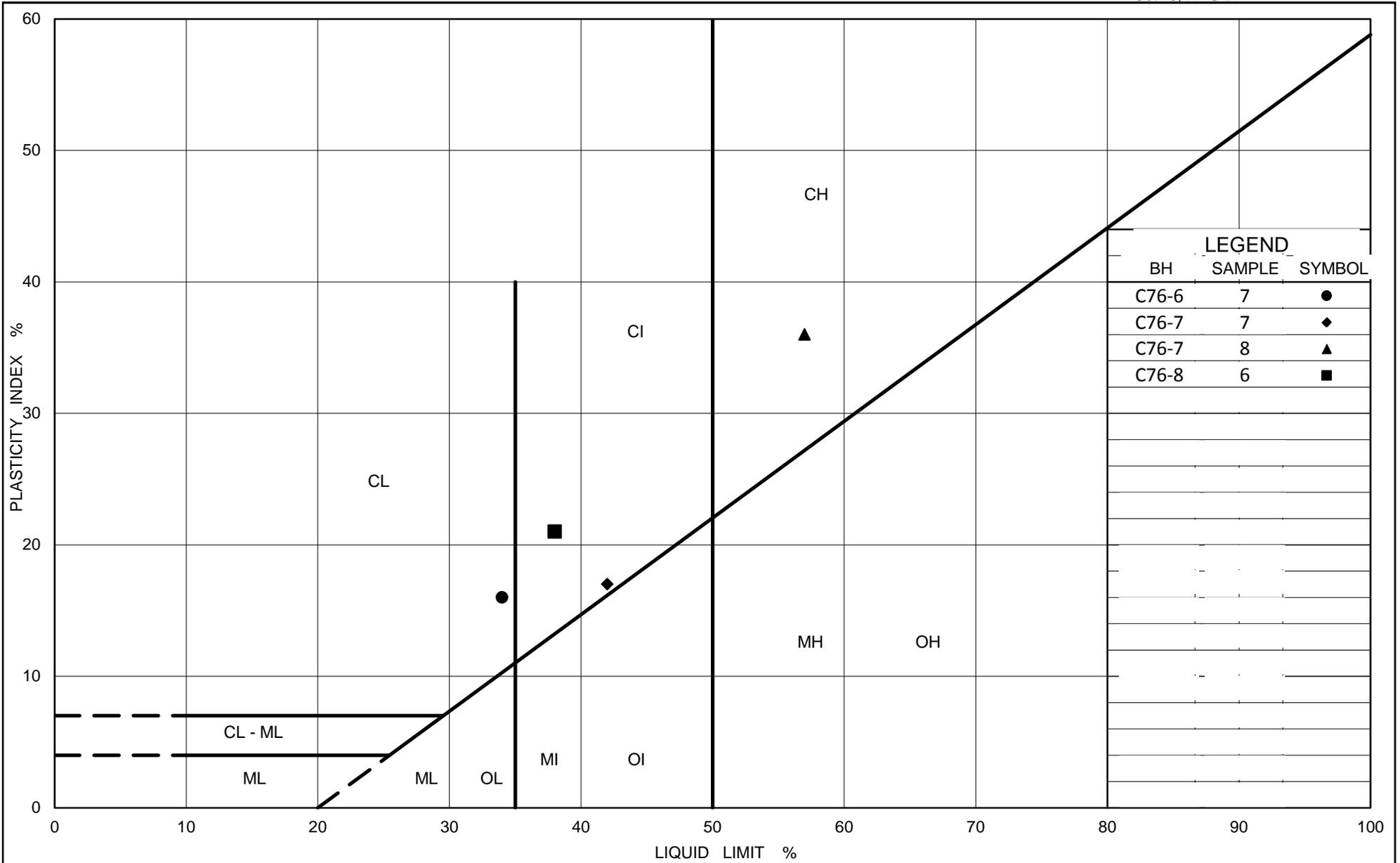
SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:

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

PROJECT <u>07-1191-0020</u>	RECORD OF BOREHOLE No C76-8	1 OF 1 METRIC
W.P. <u>5403-05-00</u>	LOCATION <u>N 5048468.7; E 238876.4</u>	ORIGINATED BY <u>TDM</u>
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing, Wash Boring</u>	COMPILED BY <u>MM</u>
DATUM <u>Geodetic</u>	DATE <u>February 2, 2009</u>	CHECKED BY <u>AB</u>

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
194.1	ICE SURFACE																
0.0	ICE and WATER																
193.5																	
0.6	PEAT (Fibrous) Very soft Black Wet		1	SS	WR												
			2	SS	WR												
			3	SS	WH												
			4	SS	WH												
190.3																	
3.8	PEAT (Amorphous) Very soft Black Wet		5	SS	WH												
189.5																	
4.6	SILTY CLAY Soft Grey Wet		6	SS	WH												
188.0																	
6.1	SAND, trace silt Very dense Grey Wet		7	SS	115/0.18												
187.4																	
6.7	Start of DCPT																
186.1																	
8.0	END OF BOREHOLE REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)																
	Note: 1. Split spoon samples obtained by driving with a 1/2 weight hammer; SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																

SUD-MTO 001 07-1191-0020-9100 CULVERTS BH LOGS.GPJ GAL-MISS.GDT 18/12/12 DATA INPUT:



OEDOMETER CONSOLIDATION SUMMARY

FIGURE M2
Page 1 of 4

SAMPLE IDENTIFICATION

Project Number	07-1191-0020-C1	Borehole, Sample	C76-7, 8
Culvert C76		Sample Depth, (m)	7.9

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	17-Feb-09		
Date Completed	27-Feb-09		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.900	Unit Weight, kN/m ³	14.6
Sample Diameter, cm	5.000	Dry Unit Weight, kN/m ³	7.4
Area, cm ²	19.63	Specific Gravity, assumed	2.7
Volume, cm ³	37.31	Solids Height, cm	0.528
Water Content, %	97.9	Volume of Solids, cm ³	10.36
Wet Mass, g	55.35	Volume of Voids, cm ³	26.95
Dry Mass, g	27.97	Degree of Saturation, %	101.6

TEST COMPUTATIONS

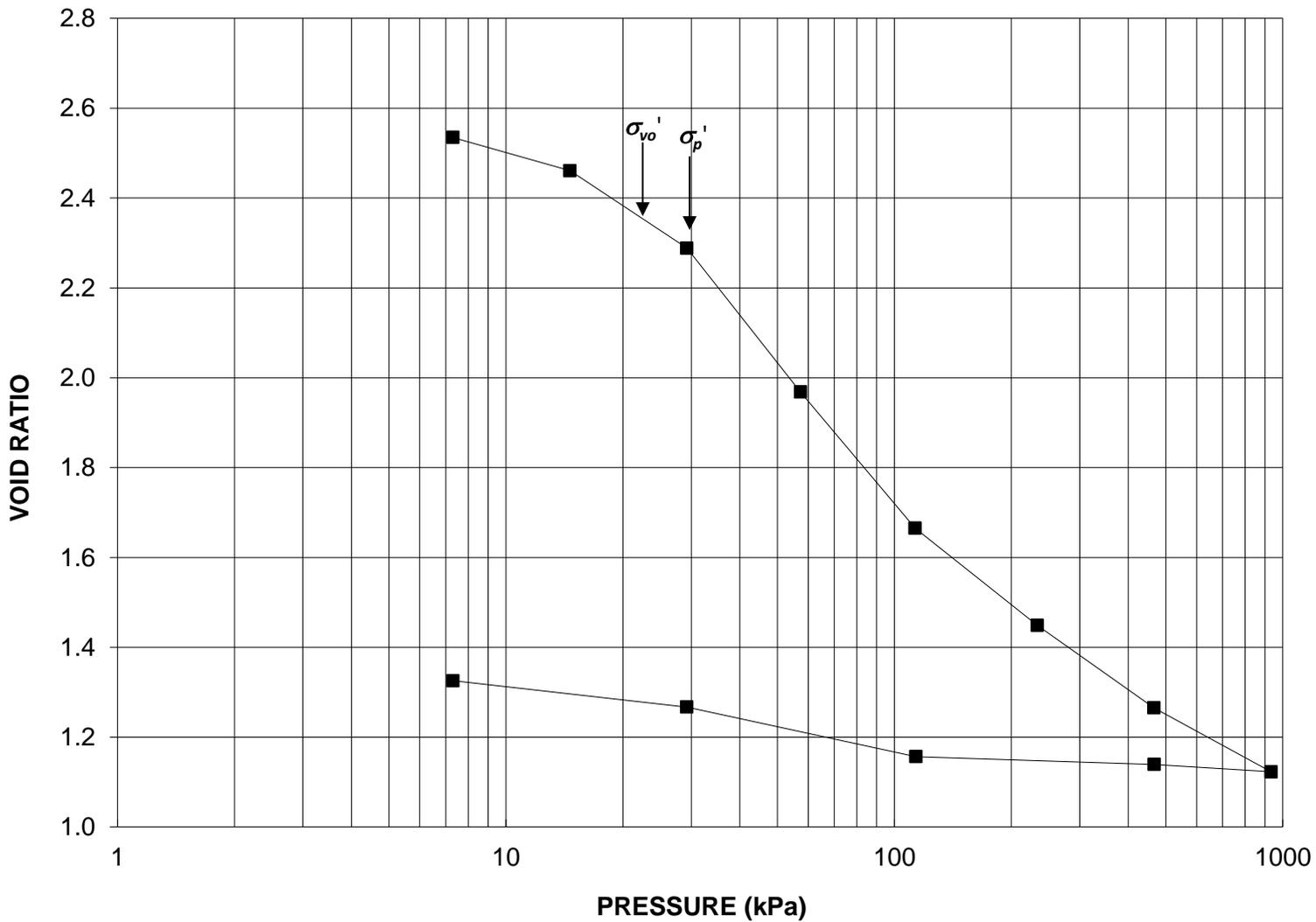
Pressure kPa	Primary	Corr.	Void Ratio	Average	t ₅₀ s	cv. cm ² /s	m _v m ² /MN	k cm/s
	Consolidation mm	Height cm		Height cm				
0	0.00	1.900	2.601	1.9				
7.3	0.35	1.865	2.535	1.883	400	0.00174	2.523	4.299E-07
14.6	0.39	1.826	2.461	1.846	650	0.00103	2.861	2.882E-07
29.2	0.91	1.735	2.289	1.781	700	0.00089	3.409	2.968E-07
57.4	1.69	1.566	1.968	1.651	770	0.00069	3.460	2.354E-07
113.1	1.60	1.406	1.665	1.486	460	0.00094	1.833	1.692E-07
233.3	1.14	1.292	1.449	1.349	310	0.00115	0.675	7.616E-08
466.1	0.97	1.195	1.265	1.244	200	0.00152	0.323	4.795E-08
933.2	0.75	1.120	1.123	1.158	120	0.00219	0.134	2.884E-08
466.5	-0.09	1.129	1.139	1.124				
113.7	-0.09	1.138	1.157	1.133				
29.2	-0.58	1.196	1.267	1.167				
7.3	-0.31	1.227	1.326	1.212				

Notes:
k calculated using cv based on t₅₀ values.

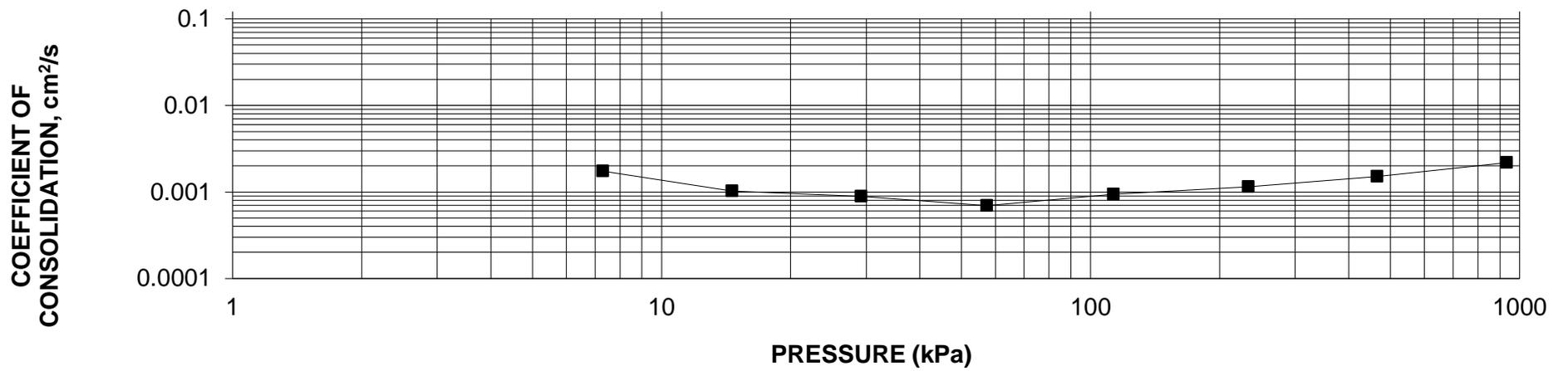
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.227	Unit Weight, kN/m ³	17.2
Sample Diameter, cm	5.000	Dry Unit Weight, kN/m ³	11.4
Area, cm ²	19.63	Specific Gravity, assumed	2.7
Volume, cm ³	24.09	Solids Height, cm	0.528
Water Content, %	50.8	Volume of Solids, cm ³	10.36
Wet Mass, g	42.19	Volume of Voids, cm ³	13.73
Dry Mass, g	27.97	Degree of Saturation, %	103.6

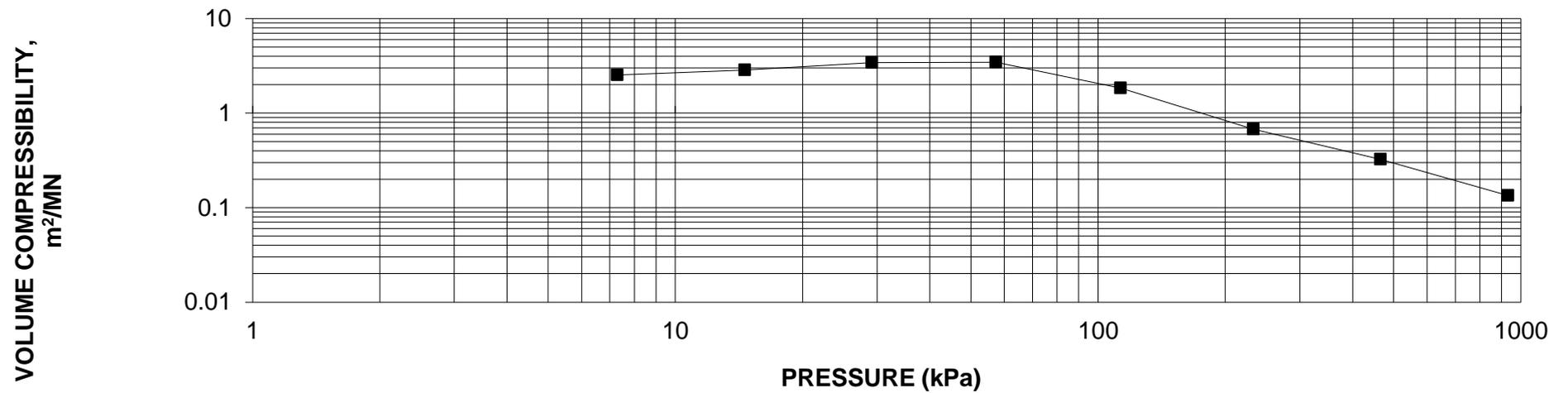
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
C76-7, Sa 8



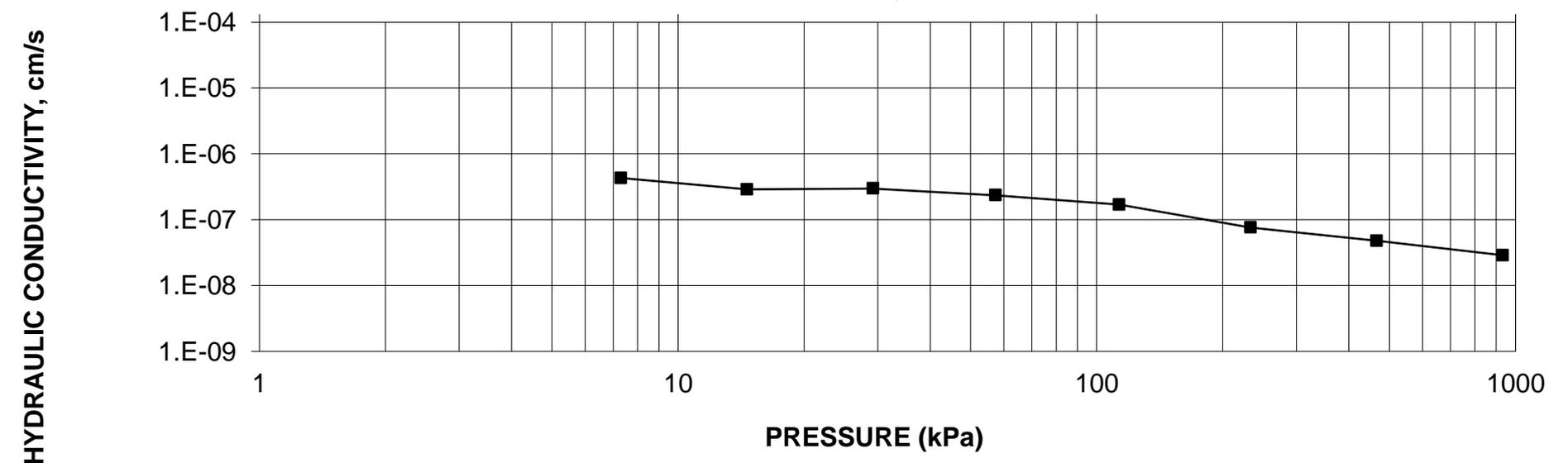
CONSOLIDATION TEST
CV cm²/s VS PRESSURE (kPa)
C76-7, Sa 8



CONSOLIDATION TEST
MV m²/MN
C76-7, Sa 8

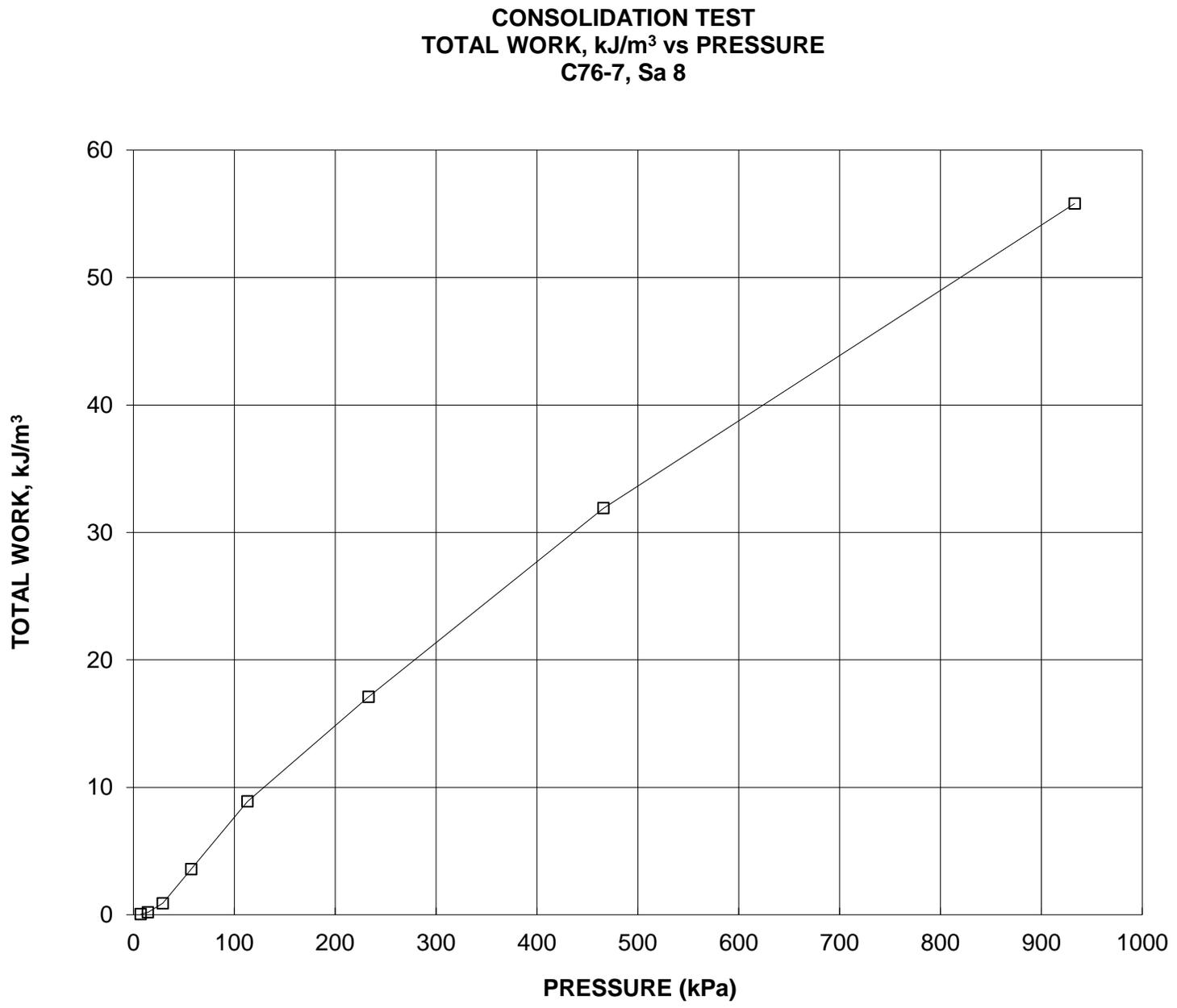


CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
C76-7, Sa 8



**PRIMARY CONSOLIDATION TEST
TOTAL WORK VS. PRESSURE**

**FIGURE M2
Page 4 of 4**



Project No. 07-1191-0020-C1

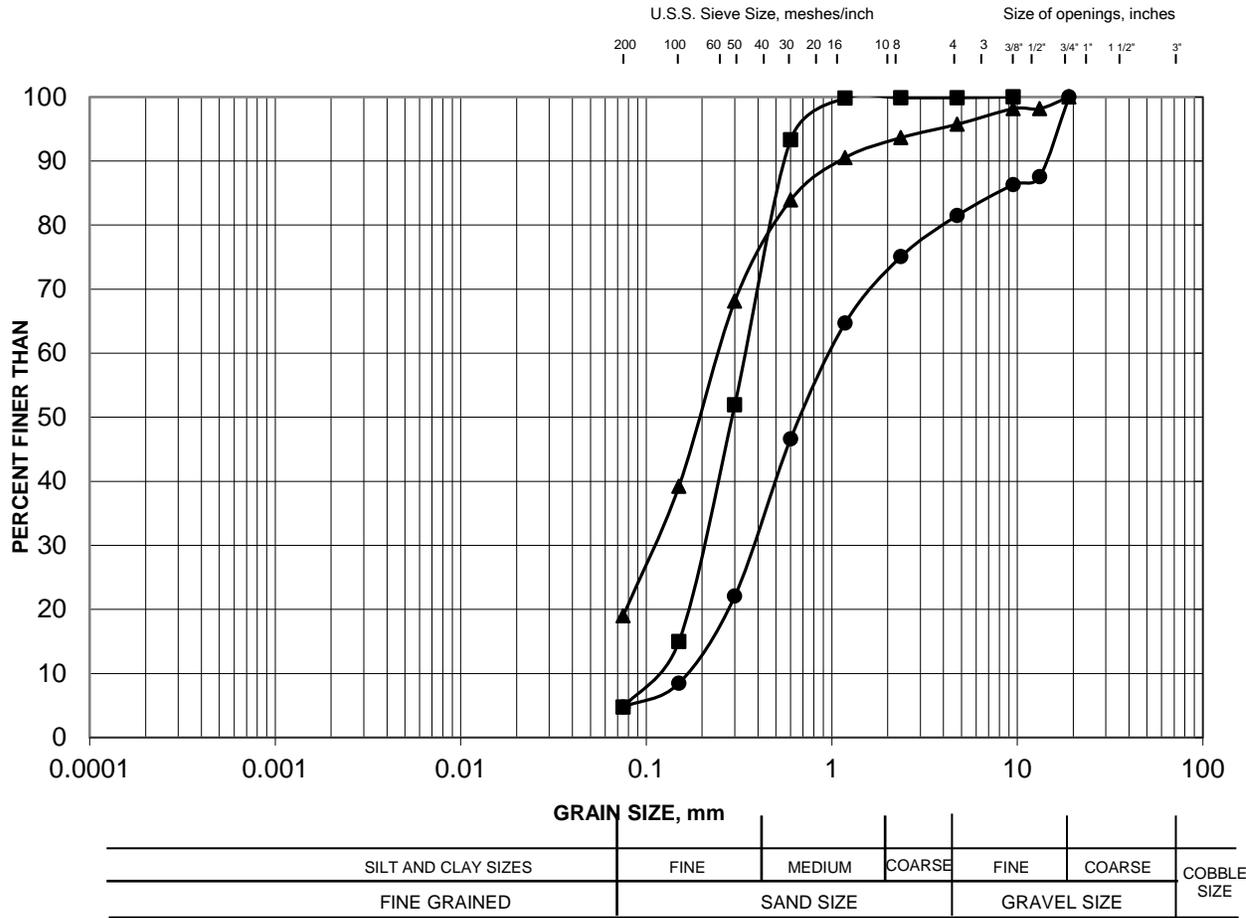
Golder Associates

Prepared by: SL
Checked by: AB

GRAIN SIZE DISTRIBUTION

Sand
Site 9 Road STA 18+034

FIGURE
M3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
▲	C76-6	9	185.0
●	C76-7	9	184.9
■	C76-8	7	187.8

Project Number: 07-1191-0020-C1

Checked By: AB

Golder Associates

Date: January 2013

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